
LispWorks® User Guide and Reference Manual

Version 6.0



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LispWorks User Guide and Reference Manual

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Address

LispWorks Ltd
St. John's Innovation Centre
Cowley Road
Cambridge
CB4 0WS
England

Telephone

From North America: 877 759 8839
(toll-free)
From elsewhere: +44 1223 421860

Fax

From North America: 617 812 8283
From elsewhere: +44 870 2206189

www.lispworks.com

Contents

Preface **xxxv**

1 Starting LispWorks 1

The usual way to start LispWorks	1
Passing arguments to LispWorks	1
Starting the Common LispWorks Graphical IDE	3
Using LispWorks with SLIME	3
Quitting LispWorks	4

2 The Listener 5

First use of the listener	5
Standard listener commands	6
The listener prompt	8

3 The Debugger 9

Entering the REPL debugger	10
Simple use of the REPL debugger	11
The stack in the debugger	12
REPL debugger commands	13
Debugger control variables	22

4 The REPL Inspector 25

Describe	25
Inspect	26

Inspection modes	28
5 The Trace Facility	35
Simple tracing	35
Tracing options	37
Example	44
Tracing methods	45
Trace variables	45
6 The Advice Facility	49
Defining advice	49
Combining the advice	51
Removing advice	53
Advice for macros and methods	53
Examples	56
Advice functions and macros	59
7 Dspecs: Tools for Handling Definitions	61
Dspecs	61
Forms of dspecs	62
Dspec namespaces	63
Types of relations between definitions	66
Details of system dspec classes and aliases	68
Subfunction dspecs	70
Tracking definitions	71
Finding locations	72
Users of location information	73
8 Action Lists	77
Defining and undefining action lists	78
Exception handling variables	80
Other variables	81
Diagnostic utilities	81
Examples	82
Standard Action Lists	84
9 The Compiler	85

Compiling a function	86
Compiling a source file	87
How the compiler works	87
Compiler control	88
Declare, proclaim, and declaim	92
Optimizing your code	94
Compiler parameters affecting LispWorks	100
10 Storage Management	103
Introduction	103
Generations and segments	104
Memory Management in 32-bit LispWorks	104
Memory Management in 64-bit LispWorks	112
Common Memory Management Features	116
Assisting the Garbage Collector	118
11 The Profiler	121
What the profiler does	121
Setting up the profiler	122
Running the profiler	123
Profiler output	125
Interpretation of profiling results	126
Profiling pitfalls	126
Profiling and garbage collection	127
12 Customization of LispWorks	129
Introduction	129
Configuration and initialization files	130
Saving a LispWorks image	131
Saved sessions	133
Load and open your files on startup	136
Customizing the editor	136
Finding source code	138
Controlling redefinition warnings	138
Specifying the initial working directory	139
Using ! for :redo	139
Customizing LispWorks for use with your own code	139

Structure printing	140
Configuring the printer	140
13 LispWorks as a dynamic library	143
Introduction	143
Creating a dynamic library	144
Initialization of the dynamic library	145
Relocation	146
Multiprocessing in a dynamic library	147
Unloading a dynamic library	147
14 The Metaobject Protocol	149
Metaobject features incompatible with AMOP	149
Common problems when using the MOP	152
Implementation of virtual slots	153
15 Multiprocessing	161
Introduction to processes	161
The process programming interface	162
Atomicity and thread safety of the LispWorks implementation	172
Low level atomic operations	175
Aids for implementing modification checks	176
Ensuring order of memory between operations in different threads	177
Locks	179
Process Waiting	182
Synchronization between threads	186
Timers	189
Process properties	189
Native threads and foreign code	190
Example	191
16 Common Defsystem	193
Introduction	193
Defining a system	194
17 The Parser Generator	201
Introduction	201

Grammar rules	201
Functions defined by defparser	203
Error handling	204
Interface to lexical analyzer	204
Example	205
18 Dynamic Data Exchange	209
Introduction	209
Client interface	211
Server interface	214
19 Common SQL	219
Introduction	219
Initialization	223
Functional interface	230
Object oriented interface	238
Symbolic SQL syntax	243
Working with date fields	249
SQL I/O recording	251
Error handling in Common SQL	251
Using MySQL	253
Using Oracle	258
Oracle LOB interface	259
20 User Defined Streams	269
Introduction	269
An illustrative example of user defined streams	269
21 Socket Stream SSL interface	277
Creating a stream with SSL	277
SSL-CTX and SSL objects	278
OpenSSL interface	278
Socket Stream SSL keyword arguments	282
Attaching SSL to an existing socket-stream	285
Using SSL objects directly	285
Initialization	286
Obtaining and installing the OpenSSL library	286

	Errors in SSL	288
22	Internationalization	289
	Introduction	289
	Character and String types	289
	String accessors	292
	String Construction	292
	External Formats	295
	External Formats and File Streams	296
	External Formats and the Foreign Language Interface	299
	Unicode character and string functions	299
23	LispWorks' Operating Environment	301
	The Operating System	301
	Site Name	301
	The Lisp Image	302
	The Command Line	302
	Address Space and Image Size	305
	Startup relocation	306
	Calling external programs	311
	Snapshot debugging of startup errors	311
	System message log	312
	Exit status	312
	Creating a new executable with code preloaded	312
	Universal binaries on Mac OS X	312
	User Preferences	313
	Accessing the Windows registry	314
	The home directory	315
	Special Folders	316
24	64-bit LispWorks	319
	Introduction	319
	Heap size	320
	Architectural constants	320
	Speed	321
	Memory Management	321
	Float types	321

External libraries	321
25 The CLOS Package	323
break-new-instances-on-access	323
break-on-access	324
class-extra-initargs	325
compute-class-potential-initargs	326
compute-discriminating-function	328
funcallable-standard-object	328
process-a-class-option	329
process-a-slot-option	331
set-make-instance-argument-checking	334
slot-boundp-using-class	335
slot-makunbound-using-class	336
slot-value-using-class	336
trace-new-instances-on-access	337
trace-on-access	338
unbreak-new-instances-on-access	341
unbreak-on-access	342
untrace-new-instances-on-access	342
untrace-on-access	343
26 The COMM Package	345
attach-ssl	345
destroy-ssl	347
destroy-ssl-ctx	347
detach-ssl	348
do-rand-seed	349
ensure-ssl	349
get-host-entry	350
get-socket-address	352
get-socket-peer-address	352
get-verification-mode	353
ip-address-string	354
make-ssl-ctx	354
open-tcp-stream	355
openssl-version	358
pem-read	359
read-dhparams	360

set-verification-mode 362
set-ssl-ctx-dh 364
set-ssl-ctx-options 365
set-ssl-ctx-password-callback 366
set-ssl-library-path 367
socket-error 367
socket-stream 368
socket-stream-address 373
socket-stream-ctx 373
socket-stream-peer-address 374
socket-stream-ssl 374
ssl-cipher-pointer 375
ssl-cipher-pointer-stack 375
ssl-closed 376
ssl-condition 376
ssl-ctx-pointer 376
ssl-error 377
ssl-failure 377
ssl-new 377
ssl-pointer 378
ssl-x509-lookup 378
start-up-server 379
start-up-server-and-mp 383
string-ip-address 384
with-noticed-socket-stream 385

27 The COMMON-LISP Package 387

apropos 387
apropos-list 388
base-string 389
close 389
coerce 390
compile 391
compile-file 392
concatenate 397
declaim 397
declare 398
defclass 403
defpackage 407

describe 409
directory 409
disassemble 414
documentation 415
double-float 416
features 416
input-stream-p 419
interactive-stream-p 420
load-logical-pathname-translations 421
long-float 421
long-site-name 422
loop 422
make-array 424
make-hash-table 425
make-instance 428
make-sequence 429
map 429
merge 430
open 431
open-stream-p 433
output-stream-p 433
proclaim 434
restart-case 436
room 436
short-float 440
short-site-name 441
simple-base-string 441
single-float 441
software-type 442
software-version 443
step 444
stream-element-type 447
string 448
time 449
trace 451
truename 458
untrace 459
update-instance-for-different-class 460
update-instance-for-redefined-class 460
with-output-to-string 461

28	The COMPILER Package	463
	deftransform	463
29	The DBG Package	467
	debug-print-length	467
	debug-print-level	468
	executable-log-file	469
	hidden-packages	470
	log-bug-form	471
	logs-directory	473
	output-backtrace	474
	print-binding-frames	475
	print-catch-frames	477
	print-handler-frames	478
	print-open-frames	479
	print-restart-frames	480
	terminal-debugger-block-multiprocessing	481
	with-debugger-wrapper	484
30	The DSPEC Package	489
	active-finders	489
	at-location	490
	canonicalize-dspec	491
	def	492
	define-dspec-alias	493
	define-dspec-class	494
	define-form-parser	497
	dspec-class	501
	dspec-classes	501
	dspec-defined-p	502
	dspec-definition-locations	502
	dspec-equal	503
	dspec-name	504
	dspec-primary-name	504
	dspec-progenitor	505
	dspec-subclass-p	506
	dspec-undefiner	506
	discard-source-info	507

find-dspec-locations	507
find-name-locations	508
get-form-parser	509
local-dspec-p	510
location	511
name-defined-dspecs	511
name-definition-locations	512
name-only-form-parser	513
parse-form-dspec	514
record-definition	514
record-source-files	516
redefinition-action	516
save-tags-database	517
single-form-form-parser	517
single-form-with-options-form-parser	518
traceable-dspec-p	519
tracing-enabled-p	520
tracing-state	521
31 The EXTERNAL-FORMAT Package	523
char-external-code	523
decode-external-string	524
encode-lisp-string	525
external-format-error	526
external-format-foreign-type	526
external-format-type	527
find-external-char	527
valid-external-format-p	528
32 The HCL Package	531
add-special-free-action	531
add-symbol-profiler	532
allocation-in-gen-num	533
analysing-special-variables-usage	534
array-weak-p	537
avoid-gc	538
binds-who	539
block-promotion	539
building-universal-intermediate-p	541

calls-who 541
cd 542
change-directory 543
check-fragmentation 543
clean-down 544
clean-generation-0 546
collect-generation-2 547
collect-highest-generation 547
compiler-break-on-error 548
compile-file-if-needed 549
copy-to-weak-simple-vector 550
create-macos-application-bundle 551
create-universal-binary 553
current-stack-length 555
default-package-use-list 555
default-profiler-collapse 556
default-profiler-cutoff 556
default-profiler-limit 557
default-profiler-sort 557
defglobal-parameter 558
defglobal-variable 558
delete-advice 559
disable-trace 560
do-profiling 561
dump-form 563
dump-forms-to-file 564
enlarge-generation 565
enlarge-static 566
expand-generation-1 567
extend-current-stack 568
extended-time 569
file-string 571
file-writable-p 572
find-object-size 572
finish-heavy-allocation 573
flag-not-special-free-action 574
flag-special-free-action 575
gc-generation 575
gc-if-needed 579
get-default-generation 579

get-gc-parameters 580
get-temp-directory 581
get-working-directory 582
handle-existing-defpackage 582
handle-old-in-package 584
handle-old-in-package-used-as-make-package 584
load-fasl-or-lisp-file 585
mark-and-sweep 586
max-trace-indent 588
modify-hash 589
normal-gc 590
packages-for-warn-on-redefinition 591
parse-float 591
print-profile-list 592
profile 596
profiler-threshold 597
profile-symbol-list 598
profiler-tree-from-function 598
profiler-tree-to-function 599
references-who 600
remove-special-free-action 601
remove-symbol-profiler 601
reset-profiler 602
save-argument-real-p 603
save-current-session 604
save-image 605
save-image-with-bundle 613
save-universal-from-script 615
set-array-single-thread-p 616
set-array-weak 617
set-default-generation 618
set-gc-parameters 619
set-hash-table-weak 621
set-minimum-free-space 623
set-process-profiling 624
set-profiler-threshold 626
set-promotion-count 627
set-system-message-log 628
set-up-profiler 629
sets-who 633

source-debugging-on-p	633
start-profiling	634
stop-profiling	636
sweep-all-objects	637
switch-static-allocation	638
symbol-alloc-gen-num	638
toggle-source-debugging	639
total-allocation	640
traced-arglist	641
traced-results	642
trace-indent-width	643
trace-level	644
trace-print-circle	645
trace-print-length	646
trace-print-level	647
trace-print-pretty	648
trace-verbose	649
try-compact-in-generation	650
try-move-in-generation	651
unwind-protect-blocking-interrupts	653
unwind-protect-blocking-interrupts-in-cleanups	654
who-binds	655
who-calls	656
who-references	657
who-sets	657
with-hash-table-locked	658
with-heavy-allocation	659
with-output-to-fasl-file	659
33 The LINK-LOAD Package	663
break-on-unresolved-functions	663
foreign-symbol-address	664
get-foreign-symbol	665
lisp-name-to-foreign-name	666
read-foreign-modules	667
34 The LISPWORKS Package	669
8-bit-string	669
16-bit-string	670

appendf 670
base-character 670
base-character-p 671
base-char-p 671
base-char-code-limit 672
base-string-p 672
browser-location 673
call-next-advice 673
choose-unicode-string-hash-function 675
compile-system 675
concatenate-system 677
current-pathname 679
defadvice 681
default-action-list-sort-time 684
default-character-element-type 684
define-action 685
define-action-list 687
defsystem 689
defsystem-verbose 694
delete-directory 694
deliver 695
describe-length 696
describe-level 696
describe-print-length 698
describe-print-level 698
dll-quit 699
dotted-list-length 701
dotted-list-p 702
do-nothing 702
enter-debugger-directly 703
environment-variable 703
errno-value 705
example-file 705
example-compile-file 706
example-load-binary-file 707
execute-actions 707
extended-char 709
extended-character 709
extended-character-p 710
extended-char-p 710

external-formats 711
false 712
file-directory-p 712
find-regexp-in-string 713
function-lambda-list 715
get-inspector-values 716
get-unix-error 718
grep-command 718
grep-command-format 719
grep-fixed-args 720
handle-existing-action-in-action-list 720
handle-existing-action-list 721
handle-missing-action-list 721
handle-missing-action-in-action-list 722
handle-warn-on-redefinition 722
hardcopy-system 723
init-file-name 724
inspect-through-gui 724
lisp-image-name 725
lispworks-directory 726
load-all-patches 727
load-system 728
make-unregistered-action-list 730
make-mt-random-state 731
mt-random 732
mt-random-state 733
mt-random-state 733
mt-random-state-p 734
pathname-location 734
precompile-regexp 735
print-actions 736
print-action-lists 736
print-command 737
print-nickname 737
prompt 738
quit 739
rebinding 740
regexp-find-symbols 741
remove-advice 742
removefef 744

require-verbose 744
round-to-single-precision 745
sbchar 746
set-default-character-element-type 746
simple-base-string-p 747
simple-char 748
simple-char-p 748
simple-text-string 749
simple-text-string-p 749
split-sequence 750
split-sequence-if 751
split-sequence-if-not 752
start-tty-listener 753
stchar 753
string-append 754
text-string 755
text-string-p 756
true 756
undefined-action 757
undefined-action-list 757
unicode-alpha-char-p 758
unicode-alphanumeric-p 759
unicode-both-case-p 759
unicode-char-equal 760
unicode-char-greaterp 761
unicode-char-lessp 762
unicode-char-not-equal 763
unicode-char-not-greaterp 763
unicode-char-not-lessp 764
unicode-lower-case-p 765
unicode-string-equal 766
unicode-string-greaterp 767
unicode-string-lessp 768
unicode-string-not-equal 769
unicode-string-not-greaterp 770
unicode-string-not-lessp 771
unicode-upper-case-p 772
user-preference 773
when-let 775
when-let* 776

whitespace-char-p 777
 with-action-item-error-handling 777
 with-action-list-mapping 779
 with-unique-names 780

35 The MP Package 783

 allowing-block-interrupts 783
 barrier-arriver-count 785
 barrier-change-count 785
 barrier-count 786
 barrier-disable 787
 barrier-enable 787
 barrier-name 788
 barrier-pass-through 788
 barrier-unblock 789
 barrier-wait 790
 change-process-priority 793
 condition-variable-broadcast 794
 condition-variable-signal 794
 condition-variable-wait 795
 condition-variable-wait-count 796
 create-simple-process 797
 current-process 799
 current-process-block-interrupts 800
 current-process-in-cleanup-p 801
 current-process-pause 801
 current-process-unblock-interrupts 803
 debug-other-process 804
 default-process-priority 805
 default-simple-process-priority 805
 ensure-process-cleanup 805
 find-process-from-name 806
 general-handle-event 807
 get-current-process 808
 get-process 808
 get-process-private-property 809
 initialize-multiprocessing 810
 initial-processes 811
 last-callback-on-thread 812

list-all-processes 813
lock-locked-p 814
lock-owned-by-current-process-p 815
lock-recursive-p 815
lock-recursively-locked-p 816
lock-name 816
lock-owner 817
mailbox-empty-p 818
mailbox-peek 819
mailbox-read 820
mailbox-reader-process 821
mailbox-send 821
mailbox-wait-for-event 822
main-process 824
make-barrier 824
make-condition-variable 825
make-lock 826
make-mailbox 828
make-named-timer 829
make-semaphore 830
make-timer 831
map-all-processes 832
map-all-processes-backtrace 832
map-process-backtrace 833
map-processes 834
notice-fd 835
process-alive-p 835
process-all-events 836
process-allow-scheduling 836
process-arrest-reasons 837
process-break 838
process-continue 838
process-exclusive-lock 838
process-exclusive-unlock 839
process-idle-time 840
process-initial-bindings 841
process-interrupt 842
process-join 843
process-kill 843
process-lock 844

process-mailbox 845
process-name 846
process-p 846
process-plist 846
process-poke 847
process-priority 848
process-private-property 848
process-property 849
process-reset 850
process-run-function 851
process-run-reasons 853
process-run-time 854
process-send 855
process-sharing-lock 856
process-sharing-unlock 857
process-stop 857
process-stopped-p 858
process-unlock 859
process-unstop 860
process-wait 861
process-wait-for-event 862
process-wait-function 862
process-wait-local 863
process-wait-local-with-periodic-checks 865
process-wait-local-with-timeout 867
process-wait-local-with-timeout-and-periodic-checks 868
process-wait-with-timeout 869
process-whostate 870
pushnew-to-process-private-property 871
pushnew-to-process-property 871
ps 872
remove-from-process-private-property 873
remove-from-process-property 873
remove-process-private-property 874
remove-process-property 875
schedule-timer 876
schedule-timer-milliseconds 878
schedule-timer-relative 879
schedule-timer-relative-milliseconds 881
semaphore-acquire 882

semaphore-count	883
semaphore-name	884
semaphore-release	884
semaphore-wait-count	885
simple-process-p	886
symeval-in-process	886
timer-expired-p	887
timer-name	888
unnotice-fd	890
unschedule-timer	890
wait-processing-events	891
with-exclusive-lock	892
with-interrupts-blocked	893
with-lock	894
with-sharing-lock	895
without-interrupts	896
without-preemption	897
yield	897
36 The PARSERGEN Package	899
defparser	899
37 The SERIAL-PORT Package	901
open-serial-port	901
close-serial-port	903
get-serial-port-state	903
serial-port	904
read-serial-port-char	904
read-serial-port-string	905
serial-port-input-available-p	906
set-serial-port-state	907
wait-serial-port-state	907
write-serial-port-char	908
write-serial-port-string	909
38 The SQL Package	911
add-sql-stream	911
attribute-type	912
cache-table-queries	914

cache-table-queries-default 915
commit 915
connect 916
connect-if-exists 923
connected-databases 923
create-index 924
create-table 925
create-view 926
create-view-from-class 928
database-name 928
default-database 929
default-database-type 929
default-update-objects-max-len 930
def-view-class 930
delete-instance-records 937
delete-records 938
delete-sql-stream 939
disable-sql-reader-syntax 940
disconnect 940
do-query 941
drop-index 942
drop-table 943
drop-view 944
drop-view-from-class 944
enable-sql-reader-syntax 945
execute-command 946
find-database 946
initialize-database-type 947
initialized-database-types 948
insert-records 949
instance-refreshed 950
list-attribute-types 951
list-attributes 952
list-classes 953
list-sql-streams 954
list-tables 955
lob-stream 955
locally-disable-sql-reader-syntax 957
locally-enable-sql-reader-syntax 957
loop 958

map-query 960
mysql-library-directories 961
mysql-library-path 962
ora-lob-append 963
ora-lob-assign 964
ora-lob-char-set-form 964
ora-lob-char-set-id 965
ora-lob-close 966
ora-lob-copy 967
ora-lob-create-empty 968
ora-lob-create-temporary 969
ora-lob-disable-buffering 970
ora-lob-element-type 971
ora-lob-enable-buffering 971
ora-lob-env-handle 972
ora-lob-erase 973
ora-lob-file-close 974
ora-lob-file-close-all 975
ora-lob-file-exists 975
ora-lob-file-get-name 976
ora-lob-file-is-open 977
ora-lob-file-open 978
ora-lob-file-set-name 978
ora-lob-flush-buffer 979
ora-lob-free 980
ora-lob-free-temporary 981
ora-lob-get-buffer 982
ora-lob-get-chunk-size 984
ora-lob-get-length 985
ora-lob-internal-lob-p 985
ora-lob-is-equal 986
ora-lob-is-open 987
ora-lob-is-temporary 987
ora-lob-load-from-file 988
ora-lob-lob-locator 989
ora-lob-locator-is-init 990
ora-lob-open 991
ora-lob-read-buffer 992
ora-lob-read-into-plain-file 994
ora-lob-read-foreign-buffer 995

ora-lob-svc-ctx-handle 996
ora-lob-trim 997
ora-lob-write-buffer 998
ora-lob-write-from-plain-file 999
ora-lob-write-foreign-buffer 1000
p-oci-env 1002
p-oci-file 1002
p-oci-lob-locator 1002
p-oci-lob-or-file 1002
p-oci-svc-ctx 1003
print-query 1003
query 1004
reconnect 1005
restore-sql-reader-syntax-state 1007
rollback 1007
select 1008
simple-do-query 1012
sql 1014
sql-connection-error 1015
sql-database-data-error 1015
sql-database-error 1016
sql-enlarge-static 1017
sql-expression 1017
sql-fatal-error 1018
sql-libraries 1018
sql-loading-verbose 1019
sql-operation 1019
sql-operator 1021
sql-recording-p 1022
sql-stream 1023
sql-temporary-error 1024
sql-timeout-error 1024
sql-user-error 1024
standard-db-object 1025
start-sql-recording 1025
status 1026
stop-sql-recording 1027
table-exists-p 1028
update-instance-from-records 1028
update-objects-joins 1029

update-records 1031
update-records-from-instance 1032
update-record-from-slot 1032
update-slot-from-record 1033
with-transaction 1034

39 The STREAM Package 1037

buffered-stream 1037
fundamental-binary-input-stream 1039
fundamental-binary-output-stream 1040
fundamental-binary-stream 1040
fundamental-character-input-stream 1041
fundamental-character-output-stream 1042
fundamental-character-stream 1043
fundamental-input-stream 1043
fundamental-output-stream 1044
fundamental-stream 1044
stream-advance-to-column 1045
stream-check-eof-no-hang 1046
stream-clear-input 1046
stream-clear-output 1047
stream-file-position 1048
stream-fill-buffer 1048
stream-finish-output 1049
stream-flush-buffer 1050
stream-force-output 1051
stream-fresh-line 1051
stream-line-column 1052
stream-listen 1053
stream-output-width 1054
stream-peek-char 1054
stream-read-buffer 1055
stream-read-byte 1056
stream-read-char 1057
stream-read-char-no-hang 1057
stream-read-line 1058
stream-read-sequence 1059
stream-read-timeout 1060
stream-start-line-p 1060

stream-terpri	1061
stream-unread-char	1062
stream-write-buffer	1062
stream-write-byte	1063
stream-write-char	1064
stream-write-sequence	1064
stream-write-string	1065
with-stream-input-buffer	1066
with-stream-output-buffer	1068
40 The SYSTEM Package	1071
apply-with-allocation-in-gen-num	1071
atomic-decf	1072
atomic-incf	1072
atomic-exchange	1073
atomic-fixnum-decf	1074
atomic-fixnum-incf	1074
atomic-pop	1075
atomic-push	1075
augmented-string	1076
augmented-string-p	1076
call-system	1077
call-system-showing-output	1079
cdr-assoc	1081
check-network-server	1083
coerce-to-gesture-spec	1083
compare-and-swap	1085
copy-preferences-from-older-version	1086
count-gen-num-allocation	1088
debug-initialization-errors-in-snap-shot	1088
default-eol-style	1089
default-stack-group-list-length	1090
define-atomic-modify-macro	1090
define-top-loop-command	1092
detect-eol-style	1094
detect-japanese-encoding-in-file	1095
detect-unicode-bom	1096
directory-link-transparency	1097
ensure-loads-after-loads	1097

ensure-memory-after-store 1098
ensure-stores-after-memory 1099
ensure-stores-after-stores 1099
extended-spaces 1100
file-encoding-detection-algorithm 1101
file-encoding-resolution-error 1102
file-eol-style-detection-algorithm 1102
filename-pattern-encoding-matches 1103
find-encoding-option 1103
find-filename-pattern-encoding-match 1104
gen-num-segments-fragmentation-state 1105
generation-number 1106
gesture-spec-accelerator-bit 1107
gesture-spec-control-bit 1107
gesture-spec-data 1108
gesture-spec-hyper-bit 1108
gesture-spec-meta-bit 1109
gesture-spec-modifiers 1109
gesture-spec-p 1110
gesture-spec-shift-bit 1111
gesture-spec-super-bit 1111
gesture-spec-to-character 1112
get-file-stat 1112
get-folder-path 1114
get-user-profile-directory 1116
guess-external-format 1117
in-static-area 1118
int32 1119
int32* 1120
int32+ 1121
int32- 1122
+int32-0+ 1122
+int32-1+ 1123
int32-1+ 1123
int32-1- 1124
int32/ 1124
int32/= 1125
int32< 1125
int32<< 1126
int32<= 1127

int32= 1127
int32> 1128
int32>= 1129
int32>> 1129
int32-aref 1130
int32-logand 1131
int32-logandc1 1131
int32-logandc2 1132
int32-logbitp 1133
int32-logeqv 1133
int32-logior 1134
int32-lognand 1135
int32-lognor 1135
int32-lognot 1136
int32-logorc1 1137
int32-logorc2 1137
int32-logtest 1138
int32-logxor 1139
int32-minusp 1139
int32-plusp 1140
int32-to-integer 1140
int32-zerop 1141
integer-to-int32 1142
line-arguments-list 1142
load-data-file 1143
locale-file-encoding 1144
low-level-atomic-place-p 1145
make-gesture-spec 1146
make-simple-int32-vector 1151
make-stderr-stream 1152
make-typed-aref-vector 1152
marking-gc 1153
memory-growth-margin 1155
merge-ef-specs 1155
object-address 1156
open-pipe 1157
open-url 1160
pid-exit-status 1161
pointer-from-address 1162
print-pretty-gesture-spec 1163

print-symbols-using-bars	1164
product-registry-path	1165
room-values	1166
run-shell-command	1167
safe-locale-file-encoding	1172
set-automatic-gc-callback	1173
set-blocking-gen-num	1174
set-default-segment-size	1177
set-delay-promotion	1178
set-file-dates	1179
set-gen-num-gc-threshold	1180
set-maximum-memory	1181
set-maximum-segment-size	1183
set-memory-check	1184
set-memory-exhausted-callback	1185
set-signal-handler	1187
set-spare-keeping-policy	1189
setup-atomic-funcall	1190
sg-default-size	1191
simple-augmented-string	1192
simple-augmented-string-p	1192
simple-int32-vector	1193
stack-overflow-behaviour	1193
staticp	1194
storage-exhausted	1194
sweep-gen-num-objects	1195
typed-aref	1196
wait-for-input-streams	1197
wait-for-input-streams-returning-first	1199
with-modification-change	1199
with-modification-check-macro	1200
with-other-threads-disabled	1201
41 Miscellaneous WIN32 symbols	1203
dismiss-splash-screen	1203
latin-1-code-pages	1204
long-namestring	1205
multibyte-code-page-ef	1205
set-application-themed	1206

short-namestring	1207
str	1207
lpcstr	1207
lpstr	1207
tstr	1208
lpctstr	1208
lptstr	1208
wstr	1209
lpcwstr	1209
lpwstr	1209
42 The Windows registry API	1211
close-registry-key	1211
collect-registry-subkeys	1212
collect-registry-values	1213
create-registry-key	1215
delete-registry-key	1216
enum-registry-value	1217
open-registry-key	1219
query-registry-key-info	1220
query-registry-value	1221
registry-key-exists-p	1222
registry-value	1223
set-registry-value	1224
with-registry-key	1225
43 The DDE client interface	1227
dde-advise-start	1227
dde-advise-start*	1230
dde-advise-stop	1231
dde-advise-stop*	1232
dde-client-advise-data	1234
dde-connect	1234
dde-disconnect	1235
dde-execute	1236
dde-execute*	1237
dde-execute-command	1237
dde-execute-command*	1238
dde-execute-string	1240

dde-execute-string*	1241
dde-item	1243
dde-item*	1244
dde-poke	1246
dde-poke*	1248
dde-request	1249
dde-request*	1251
define-dde-client	1253
with-dde-conversation	1254
44 The DDE server interface	1257
dde-server-poke	1257
dde-server-request	1258
dde-server-topic	1259
dde-server-topics	1260
dde-system-topic	1261
dde-topic	1261
dde-topic-items	1262
define-dde-dispatch-topic	1263
define-dde-server	1264
define-dde-server-function	1265
start-dde-server	1269
45 Dynamic library C functions	1271
InitLispWorks	1271
LispWorksDlsym	1274
LispWorksState	1275
SimpleInitLispWorks	1276
QuitLispWorks	1277
Index	1279

Contents

Preface

About this manual

This manual contains a user guide section (previously published separately as the *LispWorks User Guide*) and a reference section (previously the *LispWorks Reference Manual*).

User Guide section

The user guide section of this manual describes the main language-level features and tools available in LispWorks, and how to use them.

These chapters describe the central programming tools and features in LispWorks:

- Chapter 1, “Starting LispWorks” describes how to start LispWorks and supply command line arguments.
- Chapter 2, “The Listener” describes the read-eval-print loop (REPL) listener.
- Chapter 3, “The Debugger” describes the REPL debugger.
- Chapter 4, “The REPL Inspector” describes the REPL inspector.
- Chapter 5, “The Trace Facility” describes the tracer.
- Chapter 6, “The Advice Facility”.

- Chapter 7, “Dspecs: Tools for Handling Definitions” describes the naming system for Lisp definitions, and in particular how to locate these.
- Chapter 8, “Action Lists” describes how you can run code at various hook points.
- Chapter 9, “The Compiler” describes the compiler optimization qualities and some ways to optimize your code.
- Chapter 10, “Storage Management” covers the behavior (and for wizard level users, configuration) of the garbage collector.
- Chapter 11, “The Profiler” describes a tool for identifying bottlenecks impeding performance of your program.

The next chapter, Chapter 12, “Customization of LispWorks”, explains how to perform some commonly required customizations, such as controlling start-up appearance of LispWorks.

The remaining user guide chapters describe features of specialist interest:

- Chapter 13, “LispWorks as a dynamic library” describes how LispWorks operates as a DLL, .dylib or .so.
- Chapter 14, “The Metaobject Protocol” describes how the LispWorks MOP implementation differs from AMOP.
- Chapter 15, “Multiprocessing”, including locks.
- Chapter 16, “Common Defsystem” describes how to use `defsystem` to combine a series of source files into a manageable project.
- Chapter 17, “The Parser Generator”.
- Chapter 18, “Dynamic Data Exchange” describes how to implement DDE functionality in your Microsoft Windows applications.
- Chapter 19, “Common SQL” explains how to use LispWorks to communicate with databases using SQL.
- Chapter 20, “User Defined Streams” provides an illustrative example showing how to define and implement your own streams.
- Chapter 21, “Socket Stream SSL interface” describes the use of Secure Sockets Layer (SSL) with socket streams.

- Chapter 22, “Internationalization” provides an overview of using international characters.
- Chapter 23, “LispWorks’ Operating Environment” explains how to find information about the Operating System and how LispWorks was started.
- Chapter 24, “64-bit LispWorks” outlines differences between 64-bit LispWorks and 32-bit LispWorks.

Please note that documentation for Graphics Ports is in the *LispWorks CAPI User Guide* and *LispWorks CAPI Reference Manual*.

Reference section

Most of the reference section is organized by package: each chapter contains reference material for the exported symbols in a given package. The chapters are organized alphabetically by package name.

Generally one chapter covers each package, but the `WIN32` package symbols are split into four chapters, and the last chapter contains reference material for C functions. Within each chapter, the symbols are organized alphabetically (ignoring non-alphanumeric characters that are common in Lisp symbols, such as *). The chapters are:

- Chapter 25, “The CLOS Package”, describes the LispWorks extensions to CLOS, the Common Lisp Object System.
- Chapter 26, “The COMM Package”, describes the functions providing the TCP/IP interface.
- Chapter 27, “The COMMON-LISP Package”, describes the LispWorks extensions to symbols in the `COMMON-LISP` package. You should refer to the Common Lisp Hyperspec, supplied in HTML format with LispWorks, for full documentation about standard Common Lisp symbols.
- Chapter 28, “The COMPILER Package”, describes symbols available in the `COMPILER` package.
- Chapter 29, “The DBG Package”, describes symbols available in the `DBG` package, used to configure the debugging information produced by LispWorks.

- Chapter 30, “The DSPEC Package”, describes the symbols available in the **DSPEC** package, which are used for naming and locating definitions.
- Chapter 31, “The EXTERNAL-FORMAT Package”, describes symbols available in the **EXTERNAL-FORMAT** package.
- Chapter 32, “The HCL Package”, describes symbols available in the **HCL** package.
- Chapter 33, “The LINK-LOAD Package”, describes symbols available in the **LINK-LOAD** package. It applies to LispWorks for UNIX only (not LispWorks for Linux, FreeBSD, or x86/x64 Solaris).
- Chapter 34, “The LISPWORKS Package”, describes symbols available in the **LISPWORKS** package.
- Chapter 35, “The MP Package”, describes symbols available in the **MP** package, giving you access to the multi-processing capabilities of LispWorks.
- Chapter 36, “The PARSERGEN Package”, describes symbols available in the **PARSERGEN** package, the LispWorks parser generator.
- Chapter 37, “The SERIAL-PORT Package” documents the Serial Port API. This is implemented only in LispWorks for Windows.
- Chapter 38, “The SQL Package” documents symbols used in accessing LispWorks ODBC and SQL functionality.
- Chapter 39, “The STREAM Package” documents the symbols available in the **STREAM** package that provide users with the functionality to define their own streams for use by the standard I/O functions.
- Chapter 40, “The SYSTEM Package”, describes symbols available in the **SYSTEM** package.
- Chapter 41, “Miscellaneous WIN32 symbols”, describes miscellaneous symbols available in the **WIN32** package. It applies only to LispWorks for Windows.
- Chapter 42, “The Windows registry API”, describes the Windows registry API. It applies only to LispWorks for Windows.

- Chapter 43, “The DDE client interface”, describes the Dynamic Data Exchange (DDE) client API. It applies only to LispWorks for Windows.
- Chapter 44, “The DDE server interface”, describes the Dynamic Data Exchange (DDE) server API. It applies only to LispWorks for Windows.
- Chapter 45, “Dynamic library C functions”, describes C functions available in LispWorks dynamic libraries.

Many of these reference chapters should be used in conjunction with corresponding chapters in the user guide section. Reference material for some aspects of LispWorks can be found in other manuals.

The LispWorks manuals

The LispWorks manual set comprises the following books:

- The Common Lisp Hyperspec contains the specification for Common Lisp itself.
- The *LispWorks User Guide and Reference Manual*—this book—describes the main language-level features and tools available in LispWorks, along with an extensive reference of the functions, macros, variables and classes organized by package. Where LispWorks extends the functionality of a Common Lisp symbol, this is mentioned in Chapter 27, “The COMMON-LISP Package”
- The *LispWorks IDE User Guide* describes the LispWorks IDE, the user interface for LispWorks. This is a set of windowing tools that let you develop and test Common Lisp code more easily and quickly.
- The *LispWorks Editor User Guide* describes the keyboard commands and programming interface to the LispWorks IDE editor tool.
- The *LispWorks CAPI User Guide* and the *LispWorks CAPI Reference Manual* describe the CAPI. This is a library of classes, functions, and macros for developing graphical user interfaces for your applications. The *LispWorks CAPI User Guide* is a tutorial guide to the CAPI, and the *LispWorks CAPI Reference Manual* is an in-depth reference text.

- The *LispWorks Foreign Language Interface User Guide and Reference Manual* explains how you can use C source code in applications developed using LispWorks.
- The *LispWorks Delivery User Guide* describes how you can deliver working, standalone versions of your LispWorks applications for distribution to your customers.
- *Developing Component Software with CORBA* describes how LispWorks can interoperate with other CORBA-compliant systems.
- The *LispWorks COM/Automation User Guide and Reference Manual* describes a toolkit for using Microsoft COM and Automation in LispWorks for Windows.
- The *LispWorks Objective-C and Cocoa Interface User Guide and Reference Manual* describes APIs for interfacing to Objective-C and Cocoa in LispWorks for Macintosh.
- The *KnowledgeWorks and Prolog User Guide* describes the LispWorks toolkit for building knowledge-based systems. Common Prolog is a logic programming system written in Common Lisp.
- The *LispWorks Release Notes and Installation Guide* explains how to install LispWorks and start it running. It also contains Release Notes describing the new features in this release and any issues that could not be included in the other manuals.

The LispWorks manuals are all available in Portable Documentation Format (PDF). You can use Adobe Reader to browse the PDF documentation online or to print it. Adobe Reader is available for free download from Adobe's web site at www.adobe.com.

The LispWorks manuals are also available in HTML format. Commands in the **Help** menu of any of the LispWorks IDE tools give you direct access to the HTML documentation, using your web browser. Details of how to use these commands can be found in the *LispWorks IDE User Guide*.

Please let us know if you find any mistakes in the LispWorks documentation, or if you have any suggestions for improvements.

Other documentation

The LispWorks manuals do not attempt to describe Lisp itself. For definitive information on Common Lisp, including CLOS, consult the American National Standard X3.226 for Common Lisp. An HTML version of this document is supplied with LispWorks and can be accessed from the **Help** menu.

For information on CLOS, Sonya E. Keene's book *Object-Oriented Programming in Common Lisp: A Programmers' Guide* is very helpful. This book is published by Addison-Wesley.

For an account of Metaobject protocols as well as a detailed study of an implementation of CLOS see Kiczales, Rivieres and Bobrow, *The Art of the Meta-Object Protocol*, published by MIT Press, often referred to as AMOP. The LispWorks MOP mostly conforms chapters 5 & 6 of AMOP; the differences are mentioned here in Chapter 14, "The Metaobject Protocol".

Notation and conventions

Throughout this manual you will find references such as "... the LispWorks file `foo/bar.lisp`...". This means a file `bar.lisp` in a subdirectory `foo` of the LispWorks library directory. You can obtain the full path of such a file by evaluating this form in your LispWorks image:

```
(sys:lispworks-file "foo/bar.lisp")
```

The LispWorks manuals follow the notation used in *Common Lisp: the Language* (2nd Edition).

Please note that your windows may differ in some respects from the illustrations given in the LispWorks manuals. This is because some details are controlled by the window manager that you are using, not by LispWorks itself.

1

Starting LispWorks

Firstly you need LispWorks installed as described in the Release Notes and Installation Guide.

1.1 The usual way to start LispWorks

On Windows and Mac OS X the simplest way to run LispWorks is that provided in the desktop environment. On Windows you can run LispWorks from the Start menu. On Mac OS X you can run LispWorks by clicking on the ringed "LW" icon in the Dock. On both these platforms you can create a shortcut to LispWorks and place it somewhere that is convenient for you, such as the Quick Start toolbar in Windows XP.

On Linux, FreeBSD and UNIX systems you start LispWorks by entering the name of the LispWorks executable at a shell prompt.

1.2 Passing arguments to LispWorks

Occasionally you may need to start LispWorks with certain arguments. This section describes the most frequent of these occasions.

1.2.1 Saving a new image

Note: If you use the LispWorks IDE, you may a saved session more convenient than saving an image as described in this section. See “Saved sessions” on page 133 for more information.

To save a new image "by hand", create a suitable file `save-config.lisp` as described in the section "Saving and testing the configured image" in the *LispWorks Release Notes and Installation Guide*. Such a file should call `(load-all-patches)` and then load any desired configuration, modules and application code, and lastly call `save-image`.

Then you run LispWorks with a command line which passes your file as an build script.

On Mac OS X, run Terminal.app to get a shell, and enter a line like this at the prompt:

```
% lispworks-6-0-0-macos-universal -build /tmp/save-config.lisp
```

On Windows, run Command Prompt to get a DOS shell, and enter a line like this:

```
C:\Program Files\LispWorks>lispworks-6-0-0-x86-win32.exe -build  
C:\temp\save-config.lisp
```

On Linux, get a shell and enter a line like this:

```
% lispworks-6-0-0-x86-linux -build /tmp/save-config.lisp
```

On UNIX, get a shell and enter a line like this:

```
% lispworks-6-0-0-sparc-solaris -build /tmp/save-config.lisp
```

When the command exits, a new image has been saved. You can run this new image directly from the command line, or create a shortcut or symbolic link to make it convenient to run.

With all the command lines above, if you perform the task frequently, make a script or a shortcut containing the command line, and run that.

1.2.2 Saving a console mode image

To save a LispWorks image which does not start the graphical IDE by default, make a script similar to `save-config.lisp` above, but where you call

```
(save-image "my-console-lispworks" :environment nil)
```

The resulting new image, `my-console-lispworks`, can be made to start the graphical IDE either by calling `env:start-environment` or by passing `-env` or `-environment` on the command line.

1.2.3 Bypassing initialization files

If you do not want to load your personal initialization file, for example to discover if behavior of LispWorks is due to some setting of yours, pass `-init -` on the command line.

To start LispWorks without loading either the personal or site initialization files, start it like this:

```
lispworks -init - -siteinit -
```

1.2.4 Other command line options

Other less commonly-used LispWorks command line arguments are described in “The Command Line” on page 302

1.3 Starting the Common LispWorks Graphical IDE

In LispWorks images shipped on the Windows, Mac OS X, Linux, x86/x64 Solaris and FreeBSD platforms, the IDE starts automatically by default.

If you have an image saved such that the IDE does not start by default, you can start the IDE by calling the function `env:start-environment`. Such an image is shipped for UNIX platforms.

1.4 Using LispWorks with SLIME

To use LispWorks with SLIME you need an image which does not start the LispWorks IDE automatically. Create this image in `~/lw-console` as described in “Saving a non-GUI image with multiprocessing enabled” on page 133.

Download SLIME from <http://common-lisp.net/project/slime/> and configure Emacs to use `"~/lw-console"` as the value of `inferior-lisp-program` as shown in the SLIME README.

Note: Use of LispWorks Personal Edition with SLIME is not supported.

1.5 Quitting LispWorks

To quit LispWorks from the graphical IDE, use one of the following:

- The menu command **File > Exit** all platforms except Mac OS X.
- The menu command **LispWorks > Quit LispWorks** on Mac OS X.
- The key **command+Q** on Mac OS X
- The key sequence **ctrl+x ctrl+c** in an editor-based tool such as the Editor or Listener
- A platform/window-manager-specific exit gesture such as clicking a close button on the Podium window
- Call the function **quit**.

To quit LispWorks when running in console mode or via SLIME, simply call **quit**.

2

The Listener

The listener is another name for the read-eval-print loop (REPL) which allows you to interactively evaluate Lisp forms and see their output and return values. Lisp programmers typically do incremental development and testing in a listener before saving the working code to disk.

This chapter describes the basic use of a LispWorks listener. You might access this in a terminal (Unix shell) or MS-DOS command window. Alternatively the LispWorks IDE contains a graphical Listener tool which runs a REPL and supports all the functionality described in this chapter, as well as its own graphical features. Please refer to the *LispWorks IDE User Guide* for details specific to the graphical Listener tool.

2.1 First use of the listener

LispWorks runs a top-level REPL on startup. The listener by default appears with a prompt. The name of the current package (that is, the value of `cl:*package*`) is printed followed by a positive integer, like this:

```
CL-USER 1 >
```

Enter a Lisp form after the prompt and press `return`:

```
CL-USER 1 > (print 42)
```

```
42
42
```

```
CL-USER 2 >
```

The first ‘42’ printed is the output of the call to `print`. You see it here because output sent to `*standard-output*` is written to the listener.

The second ‘42’ printed is the return value of the call to `print`.

After the return value a new prompt appears. Notice that it contains ‘2’ after the package name: your successive inputs are numbered. You can now proceed to develop and test pieces of your application code:

```
CL-USER 2 > (defstruct animal species name weight)
ANIMAL

CL-USER 3 > (make-animal :species "Hippopotamus" :name "Hilda"
  :weight 42)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)
```

2.2 Standard listener commands

Generally the listener simply evaluates Lisp forms that you enter. However a few keywords, described in the this section, are specially recognized as shortcut for common listener operations.

2.2.1 Standard top-level loop commands

`:redo`

Listener command

`:redo &optional command-identifier`

This option repeats a previous input. The *command-identifier* is either a number in the listener’s history list or a symbol or subform in the input to repeat. If *command-identifier* is not supplied, the last input is repeated.

`:get`

Listener command

`:get name command-identifier`

`:get` retrieves a previously-entered input from the listener's history and places it in the variable *name*. The *command-identifier* is the history list number of the input to be retrieved.

:use*Listener command*

```
:use new old &optional command-identifier
```

`:use` does a variant of a previous input. *old* matches a symbol or subform in the previous input, and is replaced with *new* to construct the new input. If supplied, *command-identifier* is the history list number of the input you want to modify.

:his*Listener command*

```
:his &optional n m
```

`:his` produces a list of the input history. If *n* is supplied it should be a positive integer: the last *n* inputs are shown. If *m* is also supplied it should be a positive integer greater than *n*, when inputs numbered *n* through *m* in the history are shown.

:bug-form*Listener command*

```
:bug-form subject &key filename
```

`:bug-form` prints a template bug report suitable for sending to Lisp Support. Supply a string *subject*. If you also supply *filename*, the report is printed to the file.

:help*Listener command*

```
:help
```

`:help` prints a brief listing of the available listener commands.

:?*Listener command*

```
: ?
```

`:?` is a synonym for `:help`.

2.2.2 Examples

```

CL-USER 4 > :redo
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)

CL-USER 5 > :his

1: (PRINT 42)
2: (DEFSTRUCT ANIMAL SPECIES NAME ...)
3: (MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
4: (MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)

CL-USER 5 > :get make-hilda 3

CL-USER 5 > make-hilda
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)

CL-USER 6 > :use "Henry" "Hilda"
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Henry" :WEIGHT 42)

CL-USER 7 > :bug-form "Too many hippos..." :filename "bug-
report.txt"

```

2.3 The listener prompt

The variable `*prompt*` controls the appearance of the listener prompt. See `*prompt*`, page 738 if you want to alter this.

If the default prompt contains a colon followed by a second positive integer then you are no longer in the top-level loop, but have entered the REPL debugger, as described in “The Debugger” on page 9.

3

The Debugger

The debugger is an interactive tool for examining and manipulating the Lisp environment. Within the debugger you have access to not only the interpreter, but also to a variety of debugging tools. The default behavior when any error occurs is to enter the debugger. Users can then trace backwards through the history of function calls to determine how the error arose. They may inspect and alter local variables of the functions on the execution stack, and possibly continue execution by invoking a pre-defined restart (if available) or by forcing any function invocation on the stack to return user-specified values.

When writing an application it is possible to prevent entry to the debugger when an error occurs, by creating condition handlers to take some appropriate action to recover without user intervention. It is also possible to use restarts to specify some default methods of error recovery. The debugger is entered whenever an error is signalled (via a call to `error` or `cerror`) and not handled by an error handler, or it can be explicitly invoked via a call to `break`.

You can use the debugger in REPL mode (that is, in the listener read-eval-print loop) or using the graphical Debugger tool in the LispWorks IDE. This chapter describes the REPL debugger; please refer to the *LispWorks IDE User Guide* for details about the graphical Debugger tool.

The compiler generates information necessary for the use of the debugger during compilation. You can opt for faster compilation, at the expense of

reducing the information available to the debugger, using `toggle-source-debugging`.

3.1 Entering the REPL debugger

The following is a simple example.

```
CL-USER 1 > (defun make-a-hippo (name weight)
  (if (numberp weight)
      (make-animal 'hippo name weight)
      (error "Argument to make-a-hippo not a number")))
MAKE-A-HIPPO

CL-USER 2 > (make-a-hippo "Hilda" nil)

Error: Argument to make-a-hippo not a number
1 (abort) return to level 0.
2 return to top loop level 0.
3 Destroy process.

Type :c followed by a number to proceed
CL-USER 3 : 1 >
```

The call to `error` causes entry into the debugger. The final prompt in the example contains a 1 to indicate that the top level of the debugger has been entered. The debugger can be entered recursively, and the prompt shows the current level. Once inside the debugger, you may use all the facilities available at the top-level in addition to the debugger commands.

The debugger may also be invoked by using the trace facility to force a break at entry to or exit from a particular function.

The debugger can also be entered by a keyboard interrupt. Keyboard interrupts are generated by the *break gesture*, which varies between the supported systems as follows:

Microsoft Windows

`Ctrl+Break`

GTK and Motif `Meta+Ctrl+C`

`Break` if keyboard has that key. Note that PC keyboards do not have `Break`, only `Ctrl+Break`, which is different. See also `capi:set-interactive-break-gestures`.

Cocoa **Command+Control+,** (comma). This is only supported on Mac OS X 10.4 and newer.

When the break gesture is used, LispWorks attempts to find a busy process to break. If there is no obvious candidate and the LispWorks IDE is running, then it displays the Process Browser tool.

3.2 Simple use of the REPL debugger

Upon entering the debugger as a result of an error, a message describing the error is printed and a number of options to continue (called restarts) are presented. Thus:

```
CL-USER 6 > (/ 3 0)

Error: Division-by-zero caused by / of (3 0)
1 (continue) Return a value to use
2 Supply new arguments to use
3 (abort) return to level 0.
4 return to top loop level 0.
5 Destroy process.

Type :c followed by a number to proceed

CL-USER 7 : 1 >
```

To select one of these restarts, enter **:c** (continue) followed by the number of the restart. So in the above example you could continue as follows:

```
CL-USER 7 : 1 > :c 2

Supply first number: 33

Supply second number: 11
3

CL-USER 8 >
```

There are two special restarts, a continue restart and an abort restart. These are indicated by the bracketed word **continue** or **abort** at their start. The continue restart can be invoked by typing **:c** alone. Similarly, the abort restart can be invoked by entering **:a**. So an alternative continuation of the division example would be:

```
CL-USER 7 : 1 > :c  
Supply a form to be evaluated and used: (+ 4 5)  
9
```

3.3 The stack in the debugger

The debugger allows you to examine the state of the execution stack. This consists of a sequence of frames representing active function invocations, special variable bindings, restarts, active catchers, active handlers and system-related code. In particular the execution stack has a call frame for each active function call (that is for each function that has been entered but from which control has not yet returned). The top of the stack contains the most recently created frames (and so the innermost calls), and the bottom of the stack contains the oldest frames (and so the outermost calls). You can examine a call frame to find the function's name, and the names and values of its arguments.

The function call frames displayed are affected by any `hcl:alias` and `hcl:invisible-frame` declarations. See `declare`, page 398 for the details.

Catch frames are established by using the special form `catch`, and exist to receive throws to the matching tag. Restart frames correspond to restarts that have been set up, and handler frames correspond to the error handlers currently active. Binding frames are formed when special variables are bound. Open frames are established by the system. By default only the catch frames and the call frames are displayed. However the remaining types of frame are displayed if you set the appropriate variables (see Section 3.5 on page 22).

Within the debugger there are commands to examine a stack frame, and to move around the stack. These are explained in the following section. Typing `:help` in the debugger also produces a command listing.

One of the most useful features is that you can access a local variable in the current frame simply by entering its name as shown in the backtrace. See step 7 in “Example debugging session” on page 21.

3.4 REPL debugger commands

This section describes commands specific to the debugger. In the debugger, you can also do anything that you can do in the top-level loop including evaluation of forms and the standard listener commands.

Upon entry to the debugger the implicit current stack frame is set to the top of the execution stack. The debugger commands allow you to move around the stack, to examine the current frame, and to leave the debugger. The commands are all keywords, and as such case-insensitive, but are shown here in lower case for clarity.

You can get brief help listing these commands by entering `:?` at the debugger prompt.

3.4.1 Backtracing

A backtrace is a list of the stack frames starting at the current frame and continuing down the stack. The backtrace thus displays the sequence by which the functions were invoked, starting with the most recent. For instance:

3 The Debugger

```
CL-USER 10 > (defun function-1 (a b c)
                  (function-2 (+ a b) c))
FUNCTION-1

CL-USER 11 > (defun function-2 (a b)
                  (function-3 (+ a b)))
FUNCTION-2

CL-USER 12 > (defun function-3 (a) (/ 3 (- 111 a)))
FUNCTION-3

CL-USER 13 > (function-1 1 10 100)

Error: Division-by-zero caused by / of (3 0)
1 (continue) Return a value to use
2 Supply new arguments to use
3 (abort) return to level 0.
4 return to top loop level 0.
5 Destroy process.

Type :c followed by a number to proceed

CL-USER 14 : 1 > :bq 10

SYSTEM::DIVISION-BY-ZERO-ERROR <- / <- FUNCTION-3
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- FUNCTION-2
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- FUNCTION-1
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- SYSTEM:::%INVOKE <-
SYSTEM::%EVAL

CL-USER 15 : 1 >
```

In the above example the command to show a quick backtrace was used (`:bq`). Instead of showing each stack frame fully, this only shows the function name associated with each of the call frames. The number 10 following `:bq` specifies that only the next ten frames should be displayed rather than continuing to the bottom of the stack.

:b

Debugger command

`:b &optional verbose m`

This is the command to obtain a backtrace from the current frame. It may optionally be followed by `:verbose`, in which case a fuller description of each frame is given that includes the values of the arguments to the

function calls. It may also be followed by a number (*m*), specifying that only that number of frames should be displayed.

:bq

Debugger command

:bq m

This produces a quick backtrace from the current position. Only the call frames are included, and only the names of the associated functions are shown. If the command is followed by a number then only that many frames are displayed.

3.4.2 Moving around the stack

On entry to the debugger the current frame is the one at the top of the execution stack. There are commands to move to the top and bottom of the stack, to move up or down the stack by a certain number of frames, and to move to the frame representing an invocation of a particular function.

:>

Debugger command

This sets the current frame to the one at the bottom of the stack.

:<

Debugger command

This sets the current frame to the one at the top of the stack.

:p

Debugger command

:p [m | fn-name | fn-name-substring]

By default this takes you to the previous frame on the stack. If it is followed by a number then it moves that number of frames up the stack. If it is followed by a function name then it moves to the previous call frame for that function. If it is followed by a string then it moves to the previous call frame whose function name contains that string.

:n *Debugger command*

:n [m | fn-name | fn-name-substring]

Similar to the above, this goes to the next frame down the stack, or *m* frames down the stack, or to the next call frame for the function *fn-name*, or to the next call frame whose function name contains *fn-name-substring*.

3.4.3 Miscellaneous commands

:v *Debugger command*

This displays information about the current stack frame. In the case of a call frame corresponding to a compiled function the names and values of the function's arguments are shown. Closure variables (either from an outer scope or used by an inner scope) and special variables are indicated by {closing} or {special} as in this session:

```

CL-USER 40 > (compile (defun foo (*zero* one two) (declare
(special *zero*)) (divider one *zero*) (list #'(lambda () one)
two)))
FOO
NIL
NIL

CL-USER 41 > (foo 0 1 2)

Error: Division-by-zero caused by / of (1 0).
1 (continue) Return a value to use.
2 Supply new arguments to use.
3 (abort) Return to level 0.
4 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed, or :? for
other options

CL-USER 42 : 1 > :v
Call to FOO (offset 87)
 *ZERO*  {Special} : 0
 ONE      {Closing} : 1
 TWO          : 2

CL-USER 43 : 1 >

```

For an interpreted function the names and values of local variables are also shown.

If the value of an argument is not known (perhaps because the code has been compiled for speed rather than other considerations), then it is printed as the keyword :*dont-know*.

:l

Debugger Command

:l [*m* | *var-name* | *var-name-substring*]

By default this prints a list of the values of all the local variables in the current frame. If the command is followed by a number then it prints the value of the *m*'th local variables (counting from 0, in the order shown by the :v command). If it is followed by a variable name *var-name* then it prints the value of that variable (note that the same effect can be achieved by just entering the name of the variable into the Listener). If it

is followed by a string *var-name-substring* then it prints the value of the first variable whose name contains *var-name-substring*.

In all cases, * is set to the printed value.

:error

Debugger command

This reprints the message which was displayed upon entry to the current level of the debugger. This is typically an error message and includes several continuation options.

:cc

Debugger command

:cc &optional var

This returns the current condition object which caused entry to this level of the debugger. If an optional *var* is supplied then this must be a symbol, whose symbol-value is set to the value of the condition object.

:ed

Debugger command

This allows you to edit the function associated with the current frame. If you are using TAGS, you are prompted for a TAGS file.

:all

Debugger command

:all &optional flag

This option enables you to set the debugger option to show all frames (if *flag* is non-nil), or back to the default (if *flag* is nil). By default, *flag* is t.

:lambda

Debugger command

This returns the lambda expression for an anonymous interpreted frame. If the expression is not known, then it is printed as the keyword :dont-know

:func*Debugger command***:func &optional *disassemble-p***

This returns (and sets `*` to) the function object of the current frame. This is especially useful for the call frame of functions that are not the symbol function of some symbols, for example closures and method functions.

If *disassemble-p* is true, **:func** first disassembles the function, and then returns it and sets `*`. The default value of *disassemble-p* is `nil`.

:func is applicable only in call frames.

:if*Debugger command*

This command prints symbols from other packages corresponding to the symbol that was called, but could not be found, in the current package. Any such symbols are also offered as restarts when you first enter the debugger.

```
NEW 21 > (initialize-graphics-port)

Error: Undefined function INITIALIZE-GRAFICS-PORT called with
arguments ().

 1 (continue) Try invoking INITIALIZE-GRAFICS-PORT again.
 2 Return some values from the call to INITIALIZE-GRAFICS-PORT.
 3 Try invoking GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT with the
same arguments.
 4 Set the symbol-function of INITIALIZE-GRAFICS-PORT to the
symbol-function of GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT.
 5 Try invoking something other than INITIALIZE-GRAFICS-PORT
with the same arguments.
 6 Set the symbol-function of INITIALIZE-GRAFICS-PORT to
another function.
 7 (abort) Return to level 0.
 8 Return to top loop level 0.
```

Type `:c` followed by a number to proceed or type `:?` for other options

```
NEW 22 : 1 > :lf
Possible candidates are (GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT)
GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT
```

```
NEW 23 : 1 >
```

3.4.4 Leaving the debugger

You may leave the debugger either by taking one of the continuation options initially presented, or by explicitly specifying values to return from one of the frames on the stack.

:a *Debugger command*

This selects the `:abort` option from the various continuation options that are displayed when you enter the current level of the debugger.

:c *Debugger command*

`:c &optional m`

If this is followed by a number then it selects the option with that number, otherwise it selects the `:continue` option.

:ret *Debugger command*

`:ret value`

This causes *value* to be returned from the current frame. It is only possible to use this command when the current frame is a call frame. Multiple values may be returned by using the `values` function. So to return the values 1 and 2 from the current call frame, you could type

`:ret (values 1 2)`

:res *Debugger command*

`:res m`

Restarts the current frame. If *m* is `nil`, you are prompted for new arguments which should be entered on one line, separated by whitespace. If *m* is true or is not supplied, the original arguments to the frame are used.

:top *Debugger command*

Aborts to the top level of the debugger. A synonym is `:a :t`.

3.4.5 Example debugging session

This section presents a short interactive debugging session. It starts by defining a routine to calculate Fibonacci Numbers, and then erroneously calls it with a string.

1. First, define the `fibonacci` function shown below in a listener.

```
(defun fibonacci (m)
  (let ((fib-n-1 1)
        (fib-n-2 1)
        (index 2))
    (loop
      (if (= index m) (return fib-n-1))
      (incf index)
      (psetq fib-n-1 (+ fib-n-1 fib-n-2)
            fib-n-2 fib-n-1))))
```

2. Next, call the function as follows.

```
(fibonacci "turtle")
```

The system generates an error, since `=` expects its arguments to be numbers, and displays several continuation options, so that you can try to find out how the problem arose.

3. Type `:bq` at the debugger prompt to perform a quick backtrace. Notice that the problem is in the call to `fibonacci`.

Note that the calls to `*%apply-interpreted-function` in the backtrace occur because `fibonacci` is being interpreted.

You should have passed the length of the string as an argument to `fibonacci`, rather than the string itself.

4. Do this now, by typing the following form at the debugger prompt.

```
(length "turtle")
```

You intended to call `fibonacci` with the length of the string, but typed in `length` incorrectly. This takes you into the second level of the debugger. Note that the continuation options from your entry into the top level of the debugger are still displayed, and are listed after the new options. You can select any of these options.

5. Type `:a` to return to the top level of the debugger.

6. Type `:v` to display variable information about the current stack frame in the debugger.

The following output is displayed:

```
M : "turtle"
INDEX : 2
FIB-N-2 : 1
FIB-N-1 : 1
```

You need to set the value of the variable `m` to be the length of the string “turtle”, rather than the string itself.

7. Type in the form below.

```
(setq m (length "turtle"))
```

In order to get the original computation to resume using the new value of `m`, you still need to handle the original error.

8. Type `:error` to remind yourself of the original error condition you need to handle.

You can handle this error by returning `nil` from the call to `=`, which is the result that would have been obtained if `m` had been correctly set.

9. Type `:c` to invoke the continue restart, which in this case requires you to return a value to use.

10. When prompted for a form to be evaluated, type `nil`.

This causes execution to continue as desired, and you can obtain the final result with no further problems.

3.5 Debugger control variables

common-lisp:`*debug-io*` *Variable*

The value of this variable is the stream which the debugger uses for its input and output.

dbg:*debug-print-length* *Variable*

The value to which `common-lisp:*print-length*` is bound during output from the debugger.

dbg:*debug-print-level* *Variable*

The value to which `common-lisp:*print-level*` is bound during output from the debugger.

dbg:*hidden-packages* *Variable*

This variable should be bound to a list of packages. The debugger suppresses symbols from these packages (so, for example, it does not display call frames for functions in these packages).

dbg:*print-binding-frames* *Variable*

This variable controls whether binding frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `dbg:set-debugger-options` which may be more convenient.

dbg:*print-catch-frames* *Variable*

This variable controls whether catch frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `dbg:set-debugger-options` which may be more convenient.

dbg:*print-handler-frames* *Variable*

This variable controls whether handler frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `dbg:set-debugger-options` which may be more convenient.

dbg:*print-restart-frames* *Variable*

This variable controls whether restart frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `dbg:set-debugger-options` which may be more convenient.

dbg:*print-non-symbol-frames* *Variable*

This variable controls whether non-symbol frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `dbg:set-debugger-options` which may be more convenient.

dbg:set-debugger-options *Function*

`dbg:set-debugger-options &key all bindings catchers hidden non-symbol handler restarts invisible`

A call to `set-debugger-options` allows you to set the debugger printing control variables without having the inconvenience of setting each variable individually with a call to `setq` and without having to remember the names for each of the variables.

The keyword arguments refer to the debugger printing control variables as described below:

- `:all` — affects the state of the `:all` command.
- `:bindings` — `dbg:*print-binding-frames*`
- `:catchers` — `dbg:*print-catch-frames*`
- `:hidden` — `dbg:*hidden-packages*`
- `:non-symbol` — `dbg:*print-non-symbol-frames*`
- `:handler` — `dbg:*print-handler-frames*`
- `:restarts` — `dbg:*print-restart-frames*`
- `:invisible` — `dbg:*print-invisible-frames*`

Note that the call frames are always displayed, so there is no option to control that.

4

The REPL Inspector

LispWorks provides two inspectors. One is for use with the LispWorks IDE, and is described in the *LispWorks IDE User Guide*. The other is the REPL inspector, which uses a stream interface, and can be used on any terminal (in particular within the LispWorks IDE Listener tool). Both inspectors allow you to traverse complex data structures interactively and to destructively modify components of these structures. However, the two inspectors are quite different. No attempt has been made to make their usage compatible and instead each inspector is designed to exploit to the full the particular environment facilities available.

The REPL inspector provides a simple inspector facility which can be used on a stream providing line breaks as the only type of formatting. It is built on top of the `describe` function which is briefly described below and modifies the top level loop in a similar way to the debugger (see Chapter 3, “The Debugger”).

4.1 Describe

The function `describe` displays the slots of composite data structures in a manner dependent on the type of the object. The slots are labeled with a name where appropriate, or otherwise with a number.

The example below shows the result of calling `describe` on a simple list.

```

USER 7 > (setq countries '("Chile" "Peru" "Paraguay"
                           "Brazil"))
("Chile" "Peru" "Paraguay" "Brazil")

USER 8 > (describe countries)
("Chile" "Peru" "Paraguay" "Brazil") is a CONS
[0] : "Chile"

[1] : "Peru"

[2] : "Paraguay"

[3] : "Brazil"

```

`describe` describes slots recursively up to a limit set by the special variable `*describe-level*`. Note that only arrays, structures and conses are printed recursively. The slots of all other object types are only printed when at the top level of `describe`.

`*describe-level*` has an initial value of 1.

The symbols `*describe-print-level*` and `*describe-print-length*` are similar in effect to `*trace-print-level*` and `*trace-print-length*`. They control, respectively, the depth to which nested objects are printed (initial value 10), and the number of components of an object which are printed (initial value 10).

To customize `describe`, define new methods on the generic function `describe-object`.

4.2 Inspect

The function `inspect` is an interactive version of `describe`. It displays objects in a similar way to `describe`. Entering the inspector causes a new level of the top loop to be entered with a special prompt indicating that the inspector has been entered and showing the current inspector level.

In the modified top loop, if you enter a slot name, that slot is inspected and the current object is pushed onto an internal stack of previously inspected objects. The special variables `$`, `$$`, and `$$$` are bound to the top three objects on the inspector stack.

The following keywords are treated specially as commands by the inspector.

Table 4.1 Inspector commands

Command	Meaning
<code>:cv</code>	Display current values of control variables.
<code>:d</code>	Display current object.
<code>:dm</code>	Display more of current object.
<code>:dr</code>	Display rest of current object.
<code>:h</code>	Display help on inspector commands.
<code>:i m</code>	Recursively invoke a new inspector. <i>m</i> is an object to inspect.
<code>:m</code>	Change the inspection mode — see Section 4.3 on page 28.
<code>:q</code>	Quit current inspector.
<code>:s n v</code>	Sets slot <i>n</i> to value <i>v</i> .
<code>:sh</code>	Show inspector stack.
<code>:u int</code>	Undo last inspection. If you supply an optional integer argument, <i>int</i> , then the last <i>int</i> inspections are undone.
<code>:ud</code>	Undo last inspection and redisplay current object.

You can get brief help listing these commands by entering `:?` at the inspector prompt.

The control variables `*inspect-print-level*` and `*inspect-print-length*` are similar to `*describe-print-level*` and `*describe-print-length*` (see above).

`:dm` displays more slots of the current object. If the object has more than `*describe-length*` slots, then the first `*describe-length*` will be printed, followed by an ellipsis and then

`(:dm or :dr for more)`

If you enter the command `:dm` at the prompt it displays the next `*describe-length*` slots, and if you enter `:dr` it displays all the remaining slots. This only

works on the last inspected object, so if you recursively inspect a slot and come back, `:dm` does not do anything useful. Typing `:a` lets you view the object again.

`:ud` is equivalent to typing `:u` followed by `:d`.

4.3 Inspection modes

The `:m` command displays and changes the current inspection mode for an inspected value. The session below demonstrates how it works:

```
CL-USER 128 > (inspect "a
string with
newlines in it")

"a
string with
newlines in it" is a SIMPLE-BASE-STRING
0      #\a
1      #\Newline
2      #\s
3      #\t
4      #\r
5      #\i
6      #\n
7      #\g
8      #\Space
9      #\w
10     #\i
11     #\t
12     #\h
13     #\Newline
14     #\n
15     #\e
16     #\w
17     #\l
18     #\i
19     #\n ..... (:dm or :dr for more)

CL-USER 129 : Inspect 1 > :m
* 1. SIMPLE-STRING
  2. LINES
```

The `:m` produces an enumerated list of inspection modes for this value.

The asterisk next to

```
* 1. SIMPLE-STRING
```

means that SIMPLE-STRING is the current inspection mode.

You can change mode by typing `:m` followed by the name or number of another mode. To change to LINES mode:

```
CL-USER 130 : Inspect 1 > :m 2

" a
string with
newlines in it" is a SIMPLE-BASE-STRING
0      a
1      string with
2      newlines in it
```

4.3.1 Hash table inspection modes

There are five hash table inspection modes. They can be accessed in either the LispWorks IDE Inspector tool or the REPL inspector.

A brief introduction to the representation of hash tables is necessary so that you can fully understand what you gain from the new modes.

Internally, a hash table is a structure containing, among other things,

- a big vector
- size and growth information
- accessing functions.

When keys and values are added to the table, sufficiently similar keys are converted into the same index in the vector. When this happens, the similar keys and values are kept together in a chain that hangs off this place in the vector.

The different inspection modes provide views of different pieces of this structure:

HASH-TABLE

This mode is the “normal” view of a hash table; as a table of keys and values. When you inspect an item you inspect the value of the item.

STRUCTURE This mode provides a raw view of the whole hash table structure. When you inspect an item you are inspecting the value of that slot in the hash table structure.

ENUMERATED-HASH-TABLE

This mode is a variation of the normal view, where a hash table is viewed simply as a list of lists. When you inspect an item you are inspecting a list containing a key and a value.

HASH-TABLE-STATISTICS

This mode shows how long the chains in the hash table are, so that you can tell how efficiently it is being used. For example, if all chains contained fewer than two items the hash table would be being used well.

HASH-TABLE-HISTOGRAM

This mode shows the statistical information from **HASH-TABLE-STATISTICS** as a histogram.

Here is an example of hash table inspection.

```
CL-USER 1 > (defvar *hash* (make-hash-table))
*HASH*

CL-USER 2 > (setf (gethash 'lisp *hash*) 'programming
                    (gethash 'java *hash*) 'programming
                    (gethash 'c *hash*) 'programming
                    (gethash 'c++ *hash*) 'programming
                    (gethash 'english *hash*) 'natural
                    (gethash 'german *hash*) 'natural)
NATURAL

CL-USER 3 > (inspect *hash*)

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE
C++      PROGRAMMING
JAVA     PROGRAMMING
ENGLISH  NATURAL
C        PROGRAMMING
GERMAN   NATURAL
LISP     PROGRAMMING

CL-USER 4 : Inspect 1 > :m
* 1. HASH-TABLE
  2. STRUCTURE
  3. ENUMERATED-HASH-TABLE
  4. HASH-TABLE-STATISTICS
  5. HASH-TABLE-HISTOGRAM
```

STRUCTURE mode displays the raw representation of the hash table:

```

CL-USER 5 : Inspect 1 > :m 2

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE
KIND                  EQL
SIZE                 37
REHASH-SIZE          2.0
REHASH-THRESHOLD    1.0
THRESHOLD            37
COUNTER              525
NUMBER-ENTRIES       6
TABLE                #(#%((LISP . PROGRAMMING) NIL) NIL NIL
NIL NIL ...)
NO-DESTRUCT-REHASH  NIL
POWER2               NIL
HASH-REM              SYSTEM::DIVIDE-GENERAL
HASH-FN               SYSTEM::EQL-HASHFN
GETHASH-FN            SYSTEM::GETHASH-EQL
PUTHASH-FN            SYSTEM::PUTHASH-EQL
REMHASH-FN            SYSTEM::REMHASH-EQL
GET-TLATTER-FN       SYSTEM::GET-TLATTER-EQL
WEAK-KIND             NIL
USER-STUFF            NIL
MODIFICATION-COUNTER 0
FAST-LOCK-SLOT        0

```

In **ENUMERATED-HASH-TABLE** mode you can recursively inspect keys and values by entering the index. This is especially useful in cases where the key or value is unreadable and so cannot be entered into the REPL:

```

CL-USER 6 : Inspect 1 > :m 3

#<EQL Hash Table{6} 21C15D97> is an Enumerated HASH TABLE
0      (C++ PROGRAMMING)
1      (JAVA PROGRAMMING)
2      (ENGLISH NATURAL)
3      (C PROGRAMMING)
4      (GERMAN NATURAL)
5      (LISP PROGRAMMING)

CL-USER 7 : Inspect 1 > 5

(LISP PROGRAMMING) is a LIST
0      LISP
1      PROGRAMMING

CL-USER 8 : Inspect 2 > :u

```

The **HASH-TABLE-STATISTICS** mode shows that *hash* has 31 chains, of which 25 are empty and 6 have one entry::

```
CL-USER 9 : Inspect 1 > :m 4

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE (statistical view)
chain of length 0 :      31
chain of length 1 :      6
```

In **HASH-TABLE-HISTOGRAM** mode the same information is represented as a histogram:

```
CL-USER 10 : Inspect 1 > :m 5

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE (histogram view)
chain of length 0 :      *****
chain of length 1 :      *****

CL-USER 11 : Inspect 1 > :q
#<EQL Hash Table{6} 21C15D97>
```


5

The Trace Facility

The trace facility is a debugging aid enabling you to follow the execution of particular functions. At any time there are a set of functions (and macros and methods) which are being monitored in this way. The normal behavior when a call is made to one of these functions is for the function's name, arguments and results to be printed out by the system. More generally you can specify that particular forms should be executed before or after entering a function, or that certain calls to the function should cause it to enter the main debugger. Tracing of a function continues even if the function is redefined; however the tracing of some structure accessors and so forth may be lost if the compiler is set to optimize the code for efficiency (so that these calls are inlined).

The standard way of getting functions to be traced in this way is to call the macro `trace` with the symbols of the functions (or macros or generic functions) concerned. In addition it is possible to restrict tracing to a particular method (rather than a generic function), by specifying the requisite classes for the arguments in the call to trace. The trace facility handles recursive and nested calls to the functions concerned.

5.1 Simple tracing

This section shows you how to perform simple traces.

1. Type this definition of the factorial function `fac` into the listener:

```
(defun fac (n)
  (if (= n 1) 1
    (* n (fac (- n 1)))))
```

2. Now trace the function by typing the following into the listener.

```
(trace fac)
```

3. Call the function `fac` as follows:

```
(fac 3)
```

The following trace output appears in the listener.

```
0 FAC > (3)
 1 FAC > (2)
   2 FAC > (1)
   2 FAC < (1)
 1 FAC < (2)
0 FAC < (6)
```

Upon entry to each traced function call, `trace` prints the following information:

- The *level* of tracing, that is, the number of recursive entries to `trace` (starting at 0).
- The function name.
- The argument for the current call.

Each call is indented according to the level of tracing for the call.

Upon exit from each call, the same information is produced: The `>` symbol denotes entry to a function, and the `<` symbol denotes exit from it.

Output produced in this way is always sent to a special stream, `*trace-output*`, which is either associated with the listener, or with background output. You can give other expressions to be sent to this stream, in addition to the arguments and results of a function.

Calling `trace` with no arguments produces a list of all the functions currently being traced. In order to cease tracing a function the macro `untrace` should be called with commands. All tracing can be removed by calling `untrace` with no arguments.

```

CL-USER 5 > (untrace fac)
NIL
CL-USER 6 > (fac 4)
24

CL-USER 7 >

```

5.2 Tracing options

There are a number of options available when using the trace facilities, which allow you both to restrict or expand upon the information printed during a trace. For instance, you can restrict tracing of a function to a particular process, or specify additional actions to be taken on function call entry and exit.

Note that the options and values available only apply to a particular traced function. Each traced function has its own, independent, set of options.

This section describes the options that are available. Each option can be set as described above.

5.2.1 Evaluating forms on entry to and exit from a traced function

:before	<i>Trace keyword</i>
----------------	----------------------

:before *list of forms*

If non-nil, the list of forms is evaluated on entry to the function being traced. The forms are evaluated and the results printed after the arguments to the function.

Here is an example of its use. *traced-arglist* is bound to the list of arguments given to the function being traced. In this example, it is used to accumulate a list of all the arguments to `fac` across all iterations.

1. In the listener, initialize the variable `args-in-reverse` as follows:

```
(setq args-in-reverse ())
```

2. For the `fac` function used earlier, set the value of `:before` to the following list:

```
((push (car *traced-arglist*) args-in-reverse))
```

3. In the listener, evaluate the following form:

```
(fac 3)
```

After evaluating this form, `args-in-reverse` has the value `(1 2 3)`, that is, it lists the arguments which `fac` was called with, in the reverse order they were called in.

<code>:after</code>	<i>Trace keyword</i>
---------------------	----------------------

:after *list of forms*

If non-nil, this option evaluates a list of forms upon return from the function to be traced. The forms are evaluated and the results printed after the results of a call to the function.

This option is used in exactly the same way as `:before`. For instance, using the example for `:before` as a basis, create a list called `results-in-reverse`, and set the value of `:after` so that `(car *traced-results*)` is pushed onto this list. After calling `fac`, `results-in-reverse` contains the results returned from `fac`, in reverse order.

Note also that `*traced-arglist*` is still bound.

5.2.2 Evaluating forms without printing results

<code>:eval-before</code>	<i>Trace keyword</i>
---------------------------	----------------------

:eval-before *list-of-forms*

This option allows you to supply a list of forms for evaluation upon entering the traced function. The forms are evaluated after printing out the arguments to the function, but unlike `:before` their results are not printed.

<code>:eval-after</code>	<i>Trace keyword</i>
--------------------------	----------------------

:eval-after *list-of-forms*

This option allows you to supply a list of forms for evaluation upon leaving the traced function. The forms are evaluated after printing out

the results of the function call, but unlike `:after` their results are not printed.

5.2.3 Using the debugger when tracing

`:break`

Trace keyword

`:break form`

If *form* evaluates to non-nil, the debugger is entered directly from `trace`. If it returns `nil`, tracing continues as normal. This option lets you force entry to the debugger by supplying a *form* as simple as `t`.

Upon entry to the traced function, the standard trace information is printed, any supplied `:before` forms are executed, and then *form* is evaluated.

`:break-on-exit`

Trace keyword

`:break-on-exit form`

Like `:break`, this option allows you to enter the debugger from `trace`. It differs in that the debugger is entered *after* the function call is complete.

Upon exit from the traced function, the standard trace information is printed, and then *form* is evaluated. Finally, any supplied `:after` forms are executed.

`:backtrace`

Trace keyword

`:backtrace backtrace`

Generates a backtrace on each call to the traced function. *backtrace* can be any of the following values:

`:quick` Like the `:bq` debugger command.

`t` Like the `:b` debugger command.

`:verbose` Like the `:b :verbose` debugger command.

`:bug-form` Like the `:bug-form` debugger command.

5.2.4 Entering stepping mode

:step *Trace keyword*

:step *form*

When non-nil, this option puts the trace facility into stepper mode, where interpreted code is printed out one step of execution at a time.

5.2.5 Configuring function entry and exit information

:entrycond *Trace keyword*

:entrycond *form*

This option controls the printing of information on entry to a traced function. *form* is evaluated upon entry to the function, and information is printed if and only if *form* evaluates to t. This allows you to turn off printing of function entry information by supplying a *form* of nil, as in the example below.

:exitcond *Trace keyword*

:exitcond *form*

This option controls the printing of information on exit from a traced function. *form* is evaluated upon exit from the function, and, like :entrycond, information is printed if and only if *form* evaluates to t. This allows you to turn off printing of function exit information by supplying a *form* of nil.

An example of using :exitcond and :entrycond is shown below:

1. For the fac function, set the values of :entrycond and :exitcond as follows.

```
:entrycond  => (evenp (car *traced-arglist*))  
:exitcond   => (oddp (car *traced-arglist*))
```

Information is only printed on entry to `fac` if the argument passed to `fac` is even. Conversely, information is only printed on exit from `fac` if the argument passed to `fac` is odd.

2. Type the following call to `fac` in a listener:

```
CL-USER 12 > (fac 10)
```

The tracing information printed is as follows:

```
0 FAC > (10)
2 FAC > (8)
4 FAC > (6)
6 FAC > (4)
8 FAC > (2)
9 FAC < (1)
7 FAC < (6)
5 FAC < (120)
3 FAC < (5040)
1 FAC < (362880)
```

5.2.6 Directing trace output

`:trace-output`

Trace keyword

`:trace-output stream`

This option allows you to direct trace output to a stream other than the listener in which the original function call was made. By using this you can arrange to dispatch traced output from different functions to different places.

Consider the following example:

1. In the listener, create a file stream as follows:

```
CL-USER 129 > (setq str (open "trace.txt" :direction :output))
Warning: Setting unbound variable STR
#<File stream "/u/neald/trace.txt">
```

2. Set the value of the `:trace-output` option for the function `fac` to `str`.
3. Call the `fac` function, and then close the file stream as follows:

```
CL-USER 138 > (fac 8)
40320

CL-USER 139 > (close str)
T
```

Inspect the file `trace.txt` in order to see the trace output for the call of `(fac 8)`.

5.2.7 Restricting tracing

:process *Trace keyword*

:process process

This lets you restrict tracing of a function to a particular process. If *process* evaluates to `t`, then the function is traced from within all processes (this is the default). Otherwise, the function is only traced from within the process that *process* evaluates to.

:when *Trace keyword*

:when form

This lets you invoke the tracing facilities on a traced function selectively. Before each call to the function, *form* is evaluated. If *form* evaluates to `nil`, no tracing is done. The contents of `hcl:*traced-arglist*` can be examined by *form* to find the arguments given to `trace`.

5.2.8 Storing the memory allocation made during a function call

:allocation *Trace keyword*

:allocation form

If *form* is non-`nil`, this prints the memory allocation, in bytes, made during a function call. The symbol that *form* evaluates to is used to accumulate the amount of memory allocated between entering and exiting the traced function.

Note that this symbol continues to be used as an accumulator on subsequent calls to the traced function; the value is compounded, rather than over-written.

Consider the example below:

1. For the `fac` function, set the value of `:allocation` to `$$fac-alloc`.
2. In the listener, call `fac`, and then evaluate `$$fac-alloc`.

```
CL-USER 152 > $$fac-alloc
744
```

5.2.9 Tracing functions from inside other functions

<code>:inside</code>	<i>Trace keyword</i>
----------------------	----------------------

`:inside list-of-functions`

The functions given in the argument to `:inside` should reference the traced function in their implementation. The traced function is then only traced in calls to any function in the list of functions, rather than in direct calls to itself.

For example:

1. Define the function `fac2`, which calls `fac`, as follows:

```
(defun fac2 (x)
  (fac x))
```

2. For the `fac` function, set the value of `:inside` to `fac2`.
3. Call `fac`, and notice that no tracing information is produced.

```
CL-USER 154 > (fac 3)
6
```

4. Call `fac2`, and notice the tracing information.

```
CL-USER 155 > (fac2 3)
0 FAC > (3)
 1 FAC > (2)
   2 FAC > (1)
   2 FAC < (1)
  1 FAC < (2)
0 FAC < (6)
```

5.3 Example

The following example illustrates how `trace` may be used as a debugging tool. Suppose that you have defined a function `f`, and intend its first argument to be a non-negative number. You can trap calls to `f` where this is not true, providing an entry into the main debugger in these cases. It is then possible for you to investigate how the problem arose.

To do this, you specify a `:break` option for `f` using `trace`. If the form following this option evaluates to a non-nil value upon calling the function, then the debugger is entered. In order to inspect the first argument to the function `f`, you have access to the variable `*traced-arglist*`. This variable is bound to a list of the arguments with which the function was called, so the first member of the list corresponds to the first argument of `f` when tracing `f`.

```
CL-USER 12 > (defun f (a1 a2) (+ (sqrt a1) a2))
F

CL-USER 13 > (trace (f :break (< (car *traced-arglist*) 0)))
F

CL-USER 14 > (f 9.0 3)
0 F > (9.0 3)
0 F < (6.0)
6.0

CL-USER 15 > (f -16.0 3)
0 F > (-16.0 3)

Break on entry to F
 1 (continue) return from break.
 2 (abort) return to level 0.
 3 return to top loop level 0.
 4 Destroy process.

Type :c followed by a number to proceed
```

5.4 Tracing methods

You can also trace methods (primary and auxiliary) within a generic function. The following example shows how to specify any qualifiers and specializers.

- Type the following methods into the listener:

```
(defmethod foo (x)
  (print 'there))

(defmethod foo :before ((x integer))
  (print 'hello))
```

- Next, trace only the second of these methods by typing the following definition spec.

```
(trace (method foo :before (integer)))
```

- Test that the trace has worked by calling the methods in the listener:

```
CL-USER 226 > (foo 'x)
```

```
THERE
THERE
```

```
CL-USER 227 > (foo 4)
0 (METHOD FOO :BEFORE (INTEGER)) > (4)
```

```
HELLO
0 (METHOD FOO :BEFORE (INTEGER)) < (HELLO)
```

```
THERE
THERE
```

```
CL-USER 228 >
```

5.5 Trace variables

hcl:*max-trace-indent*

Variable

The maximum indentation used during output from `trace`.

hcl:trace-indent-width* *Variable*

The additional amount by which tracing output is indented upon entering a deeper level of nesting.

hcl:trace-level* *Variable*

The current depth of tracing.

cl:trace-output* *Variable*

The stream to which tracing sends its output by default.

hcl:traced-arglist* *Variable*

The variable that holds the arguments given to the traced function.

hcl:traced-results* *Variable*

The variable that holds the results from the traced function.

The following four variables allow the output produced by tracing to be printed in a style that is controlled separately from normal printing:

hcl:trace-print-circle* *Variable*

The value to which `*print-circle*` is bound during output from `trace`.

hcl:trace-print-length* *Variable*

The value to which `*print-length*` is bound during output from `trace`.

hcl:trace-print-level* *Variable*

The value to which `*print-level*` is bound during output from `trace`.

hcl:*trace-print-pretty* *Variable*

The value to which ***print-pretty*** is bound during output from **trace**.

6

The Advice Facility

The advice facility provides a mechanism for altering the behavior of existing functions. As a simple application of this, you may supplement the original function definition by supplying additional actions to be performed before or after the function is called. Alternatively, you may replace the function with a new piece of code that has access to the original definition, but which is free to ignore it altogether and to process the arguments to the function and return the results from the function in any way you decide. The advice facility allows you to alter the behavior of functions in a very flexible manner, and may be used to engineer anything from a minor addition of a message, to a major modification of the interface to a function, to a complete change in the behavior of a function. This facility can be helpful when debugging, or when experimenting with new versions of functions, or when you wish to locally change some functionality without affecting the original definition.

Note: It can be very dangerous to put advice on system functions.

6.1 Defining advice

Each change that is required should be specified using the `defadvice` macro. This defines a new body of code to be used when the function is called; this piece of code is called a piece of advice. Consider the following example:

```
CL-USER 71 > (defadvice
  (reverse print-advice :before)
  (the-list)
  (format t
    "~%** Calling reverse on ~S **"
    the-list))
NIL

CL-USER 72 > (reverse '(l a m i n a))

** Calling reverse on (L A M I N A) **
(A N I M A L)
```

In the above example you decided to print a message each time `reverse` is called. You called `defadvice` with a description of the function you wanted to alter, a name for the piece of advice, and the keyword `:before` to indicate that you want the code carried out before `reverse` is called. The rest of the call to `defadvice` specifies the additional behavior required, and consists of the lambda list for the new piece of advice and its body (the lambda list may specify keyword parameters and so forth). The advice facility arranges that `print-advice` is invoked whenever `reverse` is called, and that it receives the arguments to `reverse`, and that directly after this the original definition of `reverse` is called.

Pieces of advice may be given to be executed after the call by specifying `:after` instead of `:before` in the call to `defadvice`. So if you wished to add further code to be performed after `reverse` you could continue the session above as follows:

```

CL-USER 73 > (defadvice
  (reverse after-advice :after)
  (the-list)
  (format t
  "~%** After calling reverse on ~S **"
  the-list))
NIL

CL-USER 74 > (reverse '("which" "way" "round"))

** Calling reverse on ("which" "way" "round") **

** After calling reverse on ("which" "way" "round") ** ("round"
"way" "which")

CL-USER 75 >

```

Note that `after-advice` also receives the arguments to `reverse` when it is called.

6.2 Combining the advice

We have already seen how a before and an after piece of advice may be combined, and this section describes the general algorithm. There are three types of advice: *before*, *after* and *around*. These resemble before, after and around methods in CLOS. There may be several pieces of each type of advice present for a particular function.

The first step in working out how the combination is done is to order the pieces of advice. All the around advice comes first, then all the before advice, then the original definition, and lastly the after advice. The order within each of the around, before and after sections defaults to the order in which the pieces of advice were defined (that is most recent first). See `defadvice`, page 681 for details of how to control the ordering of advice within each section.

The remainder of this section discusses what happens when a function that has advice is called.

6.2.1 :before and :after advice

First we deal with the case when there is no around advice present. Here each of the pieces of before advice are called in turn, with the same arguments that

were given to the function, next the original definition is called with these arguments, and finally each of the pieces of after advice is called in reverse order with the same arguments (so that by default the most recently added piece of after advice is invoked last). The results returned by the function call are the values produced by the last piece of after advice to be called (if there is one), or by the original definition (if there is no after advice).

Note that none of these bits of code should destructively modify the arguments that they receive. Adding a piece of before advice thus provides a simple way of specifying some additional action to be performed before the original definition, and before any older bits of before advice. Adding a piece of after advice allows you to specify extra actions to be performed after the original definition, and after any older bits of after advice. The advice facility automatically links together these bits of advice with the original function definition.

6.2.2 :around advice

Next we shall discuss the use of around advice, which provides you with greater control than do before and after advice. Let us suppose that a function that has some around advice is called. The arguments to the function are passed to the code associated with the first piece of around advice in the ordering, and the values returned by that piece of advice are the results of the function. There is no requirement for the advice to invoke any other pieces of advice, nor to call the original definition of the function.

However the code for any piece of around advice has access to the next member of the ordering, which it may invoke any number of times by calling `call-next-advice`. So it is possible for each piece of around advice to call its successor in the ordering if this is desired, and then the bits of around advice are called in turn in a similar fashion to our earlier description for before and after advice. However in the case of around advice the decision whether or not to call the next piece of advice is directly under your control, and you are free to modify the arguments received by the piece of advice, and to choose the arguments to be given to the next piece of advice if it is called.

If the last piece of around advice in the ordering calls `call-next-advice`, then it invokes the combination of before and after advice and the original definition that was discussed earlier. That is, the arguments to the call are given in

the sequence described above to each of the before pieces of advice, then to the original definition and then to the after pieces of advice. The call to `call-next-advice` returns with the values produced by the last of these subsidiary calls, and the around advice may use these values in any way.

6.3 Removing advice

The macro `delete-advice` (or the function `remove-advice`) may be used to remove a named piece of advice. Since several pieces of advice may be attached to a single functional definition, the name must be supplied to indicate which one is to be removed.

```
CL-USER 40 > (delete-advice reverse after-advice)
NIL

CL-USER 41 > (delete-advice reverse print-advice)
NIL
```

6.4 Advice for macros and methods

As well as attaching advice to ordinary functions, it may also be attached to macros and methods.

In the case of a macro, advice is linked to the macro's expansion function, and so any before or after advice receives a copy of the arguments given to this expansion function (normally the macro call form and an environment). A simple example:

```
CL-USER 45 > (defmacro twice (b) `(+ ,b ,b))
TWICE

CL-USER 46 > (defadvice
                 (twice before-twice :before)
                 (call-form env)
                 (format t
                         "~%Twice with environment ~A and call-form ~A"
                         env call-form))
NIL

CL-USER 47 > (twice 3)
Twice with environment NIL and call-form (TWICE 3)
```

Note that the advice is invoked when the macro's expansion function is used. So if the macro is present within a function that is being compiled, then the advice is invoked during compilation of that function (and not when that function is finally used).

In the case of a method, the call to `defadvice` must also specify precisely to which method the advice belongs. A generic function may have several methods, so the call to `defadvice` includes a list of classes. This must correspond exactly to the parameter specializers of one of the methods for that generic function, and it is to that method that the advice is attached. For example:

```

CL-USER 45 > (progn
  (defclass animal ()
    (genus habitat description
    (food-type :accessor eats)
    (happiness :accessor how-happy)
    (eaten :accessor eaten :initform nil)))
  (defclass cat (animal)
    ((food-type :initform 'fish)))
  (defclass elephant (animal)
    (memory (food-type :initform 'hay)))
  (defmethod feed ((animal animal))
    (let ((food (eats animal)))
      (push food (eaten animal))
      (format t "~%Feeding ~A with ~A" animal
             food)))
  (defmethod feed ((animal cat))
    (let ((food (eats animal)))
      (push food (eaten animal))
      (push 'milk (eaten animal))
      (format t "~%Feeding cat ~A with ~A and ~A"
             animal food 'milk)))
  (defvar *cat* (make-instance 'cat))
  (defvar *nellie* (make-instance 'elephant)))
*PELLIE*

CL-USER 46 > (feed *cat*)
Feeding cat #<CAT 6f35d4> with FISH and MILK
NIL

CL-USER 47 > (feed *nellie*)
Feeding #<ELEPHANT 71e7bc> with HAY
NIL

CL-USER 48 > (defadvice
  ((method feed (animal))
   after-feed :after)
  (animal)
  (format t "~%~A has eaten ~A"
         animal (eaten animal)))
NIL

CL-USER 49 > (defadvice
  ((method feed (cat))
   before-feed :before)
  (animal)
  (format t "~%Stroking ~A" animal)
  (setf (how-happy animal) 'high))
NIL

```

```

CL-USER 50 > (feed *cat*)
Stroking #<CAT 6f35d4>
Feeding cat #<CAT 6f35d4> with FISH and MILK
NIL

CL-USER 51 > (feed *nellie*)
Feeding #<ELEPHANT 71eb7c> with HAY
#<ELEPHANT 71eb7c> has eaten (HAY HAY)

```

6.5 Examples

So far you have only seen examples of before and after pieces of advice. This section contains some further examples. Suppose that you define a function `alpha` that squares a number, and then decide that you intended to return the reciprocal of the square instead. You might proceed as follows.

```

CL-USER 30 > (defun alpha (x) (* x x))
ALPHA

CL-USER 31 > (defadvice
                  (alpha reciprocal :around)
                  (num)
                  (/ (call-next-advice num)))
NIL

CL-USER 32 > (alpha -5)
1/25

```

First you change `alpha` to return the reciprocal of the square. Do this by defining an around method to take the reciprocal of the result produced by the next piece of advice (which initially is the original definition). Now suppose that you later decide that you would like `alpha` to return the sum of the squares of the reciprocals in a certain range. You can achieve this by adding an extra layer of around advice. This must iterate over the range required, summing the results obtained by the calls to the next piece of advice (which currently yields the reciprocal of the square of its argument).

```
CL-USER 36 > (defadvice
  (alpha sum-over-range :around)
  (start end)
  (loop for i from start upto end
        summing (call-next-advice i)))
NIL

CL-USER 37 > (alpha 2 5)
1669/3600
```

Note that `alpha` now behaves as a function requiring two arguments; the outer piece of around advice determines the external interface to the function, and uses the inner pieces of advice as it needs - in this case invoking the inner advice a variable number of times depending on the range specified. The use of the words “outer” and “inner” corresponds to earlier and later pieces of around advice in the ordering discussed above, but is more descriptive of their behavior.

You now realize that taking the reciprocal of zero gives an error. You decide that you wish to generate an error if `alpha` is called in such a way as to cause this, but that you want to generate the error yourself. You also decide to add a warning message for negative arguments. As you want these actions to be performed as the last (that is innermost) in the chain of around advice, you specify this in the call to `defadvice` by giving it a `:where` keyword with value `:end`.

```

CL-USER 41 > (defadvice
                  (alpha zero-or-negative
                      :around :where :end)
                  (x)
                  (unless (plusp x)
                      (format t
                          "~%**Warning: alpha is being called with ~A"
                          x))
                  (if (zerop x)
                      (error "Alpha cannot be called with zero")
                      (call-next-advice x)))
NIL

CL-USER 42 > (alpha -5 -2)

**Warning: alpha is being called with -5
**Warning: alpha is being called with -4
**Warning: alpha is being called with -3
**Warning: alpha is being called with -2
1669/3600

CL-USER 43 > (alpha 0 3)

**Warning: alpha is being called with 0
Error: alpha cannot be called with zero
1 (abort) return to level 0.
2 return to top loop level 0

Type :c followed by a number to proceed

CL-USER 44 : 1 > :a

```

Finally you decide to alter `alpha` yet again, this time to produce approximations to π . $\pi^2/6$ is the sum of the reciprocals of the squares of all the positive integers. So you can generate an approximation to π using the sum of the reciprocals of the squares of the integers from one to some limit. (In fact this is not an efficient way of calculating π , but it could be of interest.)

```

CL-USER 51 > (defadvice
                  (alpha pi-approximation :around)
                  (limit)
                  (sqrt
                      (* 6
                          (call-next-advice 1.0 limit))))
NIL

```

Next, try calling the following in turn:

```
(alpha 10.0)
(alpha 100.0)
(alpha 1000.0)
pi
```

Lastly, here is a simple example showing a use of advice with an `&rest` lambda list:

```
(defun foo (a b c)
  (print (list a b c)))

(defadvice (foo and-rest-advice :around) (&rest args)
  (format t "advice called with args ~S" args)
  (apply #'call-next-advice args))
```

6.6 Advice functions and macros

The main functions used for advice are introduced below. See the reference pages for full details.

The main macro used to define new pieces of advice is `defadvice`

Pieces of around advice should use the macro `call-next-advice` to invoke the next piece of advice. As explained earlier this either calls the next piece of around advice (if one exists), or calls the combination of before advice, the original definition, and after advice. It may only be called from within the body of the around advice.

To remove a piece of advice, use the macro `delete-advice` or the function `remove-advice`.

6 The Advice Facility

Dspecs: Tools for Handling Definitions

The dspec system is the machinery underlying the way definitions are named in LispWorks. It supports program development by tracking the locations of definitions, and is also used in tracing and advising functions.

Dspecs are not expected to work in runtimes delivered at a delivery level greater than 0.

This chapter explains the concepts underlying dspecs and their use in tracking locations of definitions. For full details of the programming interface, see Chapter 30, “The DSPEC Package”.

7.1 Dspecs

Definition specifications, or *dspecs*, are a systematic way of naming definitions. The dspec system includes all kinds of definitions provided in LispWorks, and can be extended to include definers that you add.

Most named definitions are global, but local functions can have names, and some of the operations described here can be applied to them as well.

Here are three examples of dspecs:

```
car  
(setf car)
```

```
(defclass standard-object)
```

A dspec is simply a name: you can operate on it even if the thing named does not currently exist.

7.2 Forms of dspecs

A dspec is one of:

- A symbol
- A `setf` function name
- A list starting with a symbol naming the class of definition (`method` or `defstruct` for example).

A symbol which is used as a dspec always names a function or a macro.

`(setf foo)` is a name for a `setf` function.

Note: `nil` is not a legal dspec, because it cannot have a function definition. Therefore when a dspec API returns `nil`, this should be interpreted in the usual way as "not found" or "not applicable".

7.2.1 Canonical dspecs

Internally, dspecs are handled in the canonical form:

```
(dspec-class primary-name . qualifiers)
```

where *dspec-class* is the canonical name of the class, and *qualifiers* is a proper list. *primary-name* is typically a symbol, but can be a list (in the case of a `setf` function) or a string (in the case of a package). The equality for canonical dspecs is `equal`.

As an example the general form of a `defmethod` dspec is:

```
(defmethod name qualifiers (specializer*))
```

name	<code>:= symbol (setf symbol)</code>
qualifiers	<code>:= qualifier (qualifier qualifier*)</code>
qualifier	<code>:= symbol</code>
specializer	<code>:= symbol (eq1 object)</code>

Functions in the dspec API accept non-canonical dspecs. All dspec functions, except `dspec:prettyfy-dspec`, `find-dspec-locations`, `name-definition-locations`, `dspec-definition-locations` and `find-name-locations` return canonical dspecs.

7.3 Dspec namespaces

Dspec classes are the namespaces for dspecs. Class names are often the same as the name of the defining form, though documentation types as defined for `documentation` are also used. See “Details of system dspec classes and aliases” on page 68 for a list of the classes.

7.3.1 Dspec classes

Dspec classes provide a set of handlers, to allow uniform handling of different types of definitions by other parts of the system, such as the editor and various browsers.

The most important handlers are `dspec-defined-p` and `dspec-undefiner` for testing if a dspec is currently defined and for undefining a dspec.

New dspec classes are defined using `define-dspec-class`.

Dspec classes can be subclassed. The top-level classes correspond to distinct global namespaces (such as `variable` for variables and constants and `function` for functions and macros), and at each level, all the subclasses are distinct from each other (but they do not have to form a complete partition of the superclass). See “Details of system dspec classes and aliases” on page 68 for the full hierarchy of system-provided classes.

You are allowed to define new top-level classes and subclass them, but you cannot add new subclasses to a system-provided class. However, see “Dspec aliases” on page 66 for how to add new ways of making existing definitions.

7.3.1.1 Complete example of a top-level dspec class

Define a `saved-value` object which has a name and a value:

```
(defstruct saved-value
  name
  value)
```

The objects are defined using `def-saved-value` and stored on the plist of their name:

```
(defmacro def-saved-value (name value)
  ` (dspec:def (def-saved-value ,name)
    (when (record-definition ` (def-saved-value ,',name)
      (dspec:location))
      (setf (get ',name 'saved-value)
        (make-saved-value :name ',name
          :value ,value)))
    ',name)))
```

Define a function to retrieve the `saved-value` object:

```
(defun find-saved-value (name)
  (get name 'saved-value))
```

Define a macro to access a `saved-value` object:

```
(defmacro saved-value (name)
  ` (saved-value-value (find-saved-value ',name)))
```

Define a dspec class for `def-saved-value` dspecs:

```
(dspec:define-dspec-class def-saved-value nil
  "Defined saved values"
  :definedp
  #'(lambda (name)
    ;; Find any object that def-saved-value recorded
    (not (null (find-saved-value name))))
  :undefinedp
  #'(lambda (dspec)
    ;; Remove what def-saved-value recorded
    `(remprop ,(dspec:dspec-name dspec) 'saved-value))
  :object-dspec
  #'(lambda (obj)
    ;; Given a saved-value object, we can reconstruct its dspec
    (and (saved-value-p obj)
      `(def-saved-value ,(saved-value-name obj)))))
```

For completeness, define a form parser that generates dspecs from forms:

```
(dspec:define-form-parser
  (def-saved-value
    (:parser dspec:single-form-form-parser)))
```

Note: this form parser for `def-saved-value` is not strictly necessary, because the system provides an implicit form parser which recognizes definitions beginning with "def".

7.3.1.2 Example of subclassing

This example is based on that in “Complete example of a top-level dspec class” on page 63.

Define a `computed-saved-value` object has a function to compute the value the first time:

```
(defstruct (computed-saved-value (:include saved-value))
  function)
```

`saved-value` objects are defined using `def-computed-saved-value` and stored on the plist of their name:

```
(defmacro def-computed-saved-value (name function)
  `(dspec:def (def-computed-saved-value ,name)
    (when (record-definition `,(def-computed-saved-value ',name)
      ,(dspec:location))
      (setf (get ',name 'saved-value)
        (make-computed-saved-value :name ',name
          :function ,function)))
    ',name)))
```

Define a function to compute a `computed-saved-value`:

```
(defun ensure-saved-value-computed (name)
  (let ((saved-value (find-saved-value name)))
    (or (saved-value-value saved-value)
        (setf (saved-value-value saved-value)
          (funcall
            (computed-saved-value-function saved-value))))))
```

Define a macro to access a `computed-saved-value`:

```
(defmacro computed-saved-value (name)
  `(ensure-saved-value-computed ',name))
```

Define a dspec class for `def-computed-saved-value` dspecs:

```
(dspec:define-dspec-class def-computed-saved-value def-saved-
value
  "Defined computed saved values"
  :definedp
  #'(lambda (name)
      ;; Find any object that def-computed-saved-value recorded
      (computed-saved-value-p (find-saved-value name)))
  ;; The :undefiner is inherited from the superspace.
  :object-dspec
  #'(lambda (obj)
      ;; Given a computed-saved-value object, we can reconstruct
      its dspec
      (and (computed-saved-value-p obj)
           `(def-computed-saved-value ,(saved-value-name obj)))))
```

For completeness, define a form parser that generates dspecs from forms:

```
(dspec:define-form-parser
  (def-computed-saved-value
    (:parser dspec:single-form-form-parser)))
```

Note: this form parser for `def-computed-saved-value` is not strictly necessary, because the implicit form parser will recognize definitions beginning with "def".

7.3.2 Dspec aliases

You can add new ways of making existing definitions and use the dspec system to track these definitions. This is what happens when your defining form expands into a system-provided form. The macro `define-dspec-alias` is used to inform the dspec system of this.

7.4 Types of relations between definitions

7.4.1 Functionally equivalent definers

When one definition form simply macroexpands into another, or otherwise has an identical effect as far as the dspec system is concerned, the dspec system should consider them variant forms of the same class.

Use `define-dspec-alias` to convert one definer to the other during canonicalization. A pre-defined example of this in LispWorks is `defparameter` and `def-`

`var`. These cannot be distinguished (other than in the source code), so `defparameter` has been defined as a dspec alias for `defvar`. However, `defvar` and `defconstant` are distinct kinds of variable, since we can easily tell which type of definition is in effect by calling the function `constantp`. To define their dspecs, LispWorks creates a dspec class called `variable` and uses it as the superspace argument when defining the `defvar` and `defconstant` dspec classes.

As an explicit example, suppose you have a defining macro

```
(defmacro parameterdef (value name)
  `(defparameter ,name ,value))
```

then

```
(dspec:define-dspec-alias parameterdef (value name)
  `(defparameter ,name))
```

would be a suitable appropriate alias definition. This `define-dspec-alias` form defines the dspec.

`define-dspec-alias` is like `defmacro` for dspecs, so it could be used to describe complicated conversions, as long as it can be done purely statically and totally in terms of existing dspecs. However, nothing more complicated than `defparameter` has been found necessary.

7.4.2 Grouping subdefinitions together

Some definition forms are macros that expand into a group of other definitions, for example `defstruct`. When the form is associated with a dspec class, the subdefinitions can be automatically recorded as being subforms of the new definition, by use of the `def` macro.

This means that the dspec system knows that the subdefinitions were inside the main definition (indeed, inside this particular form). Therefore

- Location queries can retrieve this information.
- The source location commands in the LispWorks IDE, when passed a subdefinition, know to search for the main definition given in the `def`.

Note: to make source location work you will also need a `define-form-parser` definition for the macro that expands into the `def`.

Note: `def` defines a relation between two particular definitions, for example `(defstruct foo)` and `(defun make-foo)`, not between the two dspec classes.

7.4.3 Distributed definitions

Some definitions are additions to another class of definition, for example methods are additions to generic functions. We call these *distributed definitions*, consisting of "parts" and "the aggregate".

The primary name of a part gives the primary name of the aggregate it is a part of, and the qualifiers distinguish it from the other parts of the same aggregate. Only a part dspec may have qualifiers.

7.5 Details of system dspec classes and aliases

This section shows the dspec classes, subclasses and aliases provided by the system. Subclasses are indented. Following the list of dspec classes are notes about some of these classes.

The system-defined dspec classes are:

```

COMPILER-MACRO (alias DEFINE-COMPILER-MACRO)
EDITOR:DEFCOMMAND (alias EDITOR:DEFINE-COMMAND-SYNONYM)
DEFINE-ACTION
DEFINE-ACTION-LIST
WIN32:DEFINE-DDE-CLIENT
WIN32:DEFINE-DDE-DISPATCH-TOPIC
DSPEC:DEFINE-DSPEC-CLASS (aliases DSPEC:DEFINE-SUBCLASS-DSPEC-CLASS,
DSPEC:DEFINE-FUNCTION-DSPEC-CLASS)
DSPEC:DEFINE-DSPEC-ALIAS
EDITOR:DEFINE-EDITOR-VARIABLE (alias EDITOR:DEFINE-EDITOR-MODE-VARIABLE)
FLI:DEFINE-FOREIGN-CALLABLE
FLI:DEFINE-FOREIGN-TYPE (alias FLI:DEFINE-FOREIGN-CONVERTER)
DSPEC:DEFINE-FORM-PARSER
CAPI:DEFINE-MENU
DEFSETF (aliases DEFINE-SETF-EXPANDER, DEFINE-SETF-METHOD)
DEFSYSTEM
FUNCTION
  DEFGENERIC
  DEFMACRO (alias DEFINE-MODIFY-MACRO)
  DEFUN (alias SYSTEM:DEFUN-AND-INLINE)
    FLI:DEFINE-FOREIGN-VARIABLE
    FLI:DEFINE-FOREIGN-FUNCTION (alias FLI:DEFINE-FOREIGN-FUNCALLABLE)
  METHOD (alias DEFMETHOD)
  METHOD-COMBINATION (alias DEFINE-METHOD-COMBINATION)
  PACKAGE (alias DEFPACKAGE)
  STRUCTURE (alias DEFSTRUCT)
TYPE
  DEFCLASS
    CAPI:DEFINE-INTERFACE
    CAPI:DEFINE-LAYOUT
    DEFINE-CONDITION
    STRUCTURE-CLASS
  DEFTYPE
VARIABLE
  DEFINE-SYMBOL-MACRO
  DEFCONSTANT
  DEFVAR (aliases DEFGLOBAL-PARAMETER, DEFGLOBAL-VARIABLE,
  DEFPARAMETER)

```

Further dspec classes are defined by modules such as `com` (on Microsoft Windows), `kw` and `sql`.

The canonical form of a symbol dspec is (`function symbol`) and the canonical form of a setf function name dspec is (`function (setf symbol)`).

7.5.1 CLOS dspec classes

`defgeneric` and `method` can handle `standard-generic-function` and `standard-method`.

7.5.2 Part Classes

`method` is a part class for `defgeneric`.

`compiler-macro` is a part class for `function`.

7.5.3 Foreign callable dspecs

For `fli:define-foreign-callable` the canonical name is the foreign name, with any machine-specific prefixes omitted.

7.6 Subfunction dspecs

For some purposes, we allow dspecs that do not name a global definition, but a local function. These are of the form

`(subfunction name parent)`

where *parent* is another dspec (possibly even a `subfunction` dspec).

name is a symbol, a list, or a number, but it is not used for anything within the dspec system. A `subfunction` dspec can be canonicalized and prettified, and passed as an argument to `dspec-definition-locations` (which will find where *parent* is defined).

Additionally pseudo-dspecs like this are allowed for top-level forms:

`(top-level-form (location <#>))`

location is a basic location and <#> identifies the top-level form within that location. These are used as parent dspecs in `subfunction` dspecs and `:inside` locations. These dspecs can be canonicalized and prettified, and can be returned as dspecs from the location finders.

7.7 Tracking definitions

The dspec system is used to keep track of global definitions in many ways, and global definition macros usually tell the dspec system when the definition changes.

The main purpose of the system is to keep track of where the definition was located, but it also allows fine-tuned control of redefinitions.

7.7.1 Locations

Locations are mainly something the dspec system just stores and retrieves. `:inside` locations are used to describe definitions located as subforms of other definitions.

`:inside` locations are usually not explicitly specified, but arise as a result of having two nested definitions, both of which use the `def` and `location` macros to handle the name and location info.

The types of locations and their meanings are:

A pathname A definition existed in the file named or an editor buffer with that name.

The keyword `:listener`

A definition was executed interactively in the listener or an editor buffer not associated with a file.

The keyword `:unknown`

A definition was found in the image (these are entered when a location query does not find any information already in the database).

The keyword `:implicit`

A definition for a part was recorded, but no information exists for the aggregate.

7.7.2 Recording definitions and redefinition checking

The location information is entered into the database when the definition is executed, by the defining function calling `record-definition`.

`record-definition` performs various checks, and returns true or false depending on whether the definition was allowed or not. In particular, it checks if the same name has already been defined in a different location and if so a warning or error can be signalled. See `record-definition`, page 514 for details.

7.7.2.1 Use of record-definition

You should not usually call `record-definition`, since all the system-provided definers call it.

However, for new classes of definition which you add with `define-dspec-class`, you should call `record-definition` for dspecs in their new classes, as shown in “Complete example of a top-level dspec class” on page 63.

7.8 Finding locations

There are two ways of retrieving location information for definitions in the running LispWorks image:

- query for a dspec using `dspec-definition-locations`, or
- query for a name in a given set of namespaces using `name-definition-locations`

The difference is that name queries will find the locations of all the part definitions as well as the definition named, whereas dspec queries will only find the locations for the definition named (there might be many if it has been redefined).

To provide for sub-definitions hidden in another definition, such as `defstruct` accessors, all location queries produce a list of pairs of dspecs and locations, each pair naming a definition within the corresponding location that contains the definition looked for. So a query for an accessor called `foo-bar` might produce the pair:

```
(defstruct foo) #P"/usr/users/hacker/hacks/hack.lisp")
```

7.9 Users of location information

To find location information for definitions made in the running image or recorded in a tags database or a tags file:

- query for a dspec using `find-dspec-locations`, or
- query for a name in a given set of namespaces using `find-name-locations`

The extent of the search is controlled by the value of the variable `*active-finders*`.

For example, to obtain the locations of the definitions of `foo` across all dspec namespaces, call

```
(dspec:find-name-locations dspec:*dspec-classes* 'foo)
```

Another example of the use of `find-name-locations` is the LispWorks Editor tool's Find Definitions tab.

7.9.1 Finding definitions in the LispWorks editor

Returning to our example definer

```
(defmacro parameterdef (value name)
  `(defparameter ,name ,value))
```

1. Load a file `foo.lisp` containing

```
(parameterdef 42 *foo*)
```
2. Now use **Expression > Find Source** on the symbol `*foo*`. Notice that LispWorks knows which file the definition is in, but cannot find the defining top level form.
3. Also notice that the Definitions tab of the Editor tool does not display the definition of `*foo*`. This is because the Editor does not recognise `parameterdef` as a definer. When the LispWorks editor looks at the definitions in a buffer, it needs to know the dspecs that each defining form will generate when evaluated. You can tell the editor how to parse a defining form to generate the dspec by using `define-form-parser`.

4. Now evaluate these forms to associate a parser with `parameterdef` and inform the dspec system that `parameterdef` is another way of naming a `defparameter` dspec:

```
(dspec:define-form-parser parameterdef (value name)
  `(parameterdef ,name))
```

```
(dspec:define-dspec-alias parameterdef (name)
  `(defparameter ,name))
```

5. Now use **Expression > Find Source** on the symbol `*foo*` again. Notice that the source of the definition of `*foo*` is displayed correctly in the text tab of the Editor tool, and that the Definitions tab displays the definition as

```
(parameterdef *foo*)
```

7.9.2 The editor's implicit form parser

When testing your form parsers bear in mind that the LispWorks editor has an implicit form parser, independent of explicit parsers defined in the dspec system. It tries to parse a dspec from a top level form which is of length 2 or more and whose car has symbol name beginning with "DEF". That is:

```
(defxyz name forms)
```

gets parsed as

```
(defxyz name)
```

which may be a dspec (and thus provides a match for the source location commands). This mechanism operates only when there's no explicit parser defined for `defxyz`.

The editor's implicit form parser is useful because it matches a common simple case. However it does not work for the `parameterdef` example, because that definers symbol name does not begin with "DEF".

7.9.3 Reusing form parsers

The form parser established above was specifically for `parameterdef` forms. However if you have other definers of similar syntax - in this example, defin-

ers for which the name is the second subform - then you can define a form parser which can be associated with each of them, as follows:

```
(dspec:define-form-parser (name-second (:anonymous t))
  (value name)
  `(^,name-second ,name))
```

Note that the *name-second* variable is evaluated in the body of the parser. Supposing you have another defining macro `constantdef`:

```
(defmacro constantdef (value name)
  `(^,defconstant ,name ,value))
```

then you can associate the same parser with both this and `parameterdef`:

```
(dspec:define-form-parser (parameterdef
  (:parser name-second-form-parser)))
(dsdp:define-form-parser (constantdef
  (:parser name-second-form-parser)))
```

7.9.4 Example: defcondition

Suppose you have a macro based on `define-condition`:

```
(defmacro defcondition (&rest args)
  `(^,define-condition ,@args))
```

When the following form is evaluated, the system records the dspec (define-condition foo):

```
(defcondition foo () ())
```

Two setups are needed to allow the editor to locate such a defining form.

Firstly, this tells the system how to parse (defcondition ...) toplevel forms:

```
(dsdp:define-form-parser
  (defcondition
    (:alias define-condition)))
```

So now:

```
(dsdp:parse-form-dspec '(defcondition foo () ()))
=>
(defcondition foo)
```

Secondly, this tells the system that (defcondition foo) is an alias for (define-condition foo).

With this, the editor would report "Cannot find (DEFINE-CONDITION FOO) in ...".

```
(dspec:define-dspec-alias defcondition (name)
  `(define-condition ,name))
```

So now this definition can be located:

```
(defcondition foo () ())
```

just as if it were

```
(define-condition foo () ())
```

8

Action Lists

Action-lists are a unified approach to various different mechanisms for running initializations, or “hook” functions at various points during the life of the system. They provide central gathering points for applications to trigger on system-wide events such as start-up, disk-save, and so on.

An action-list is a tagged list of data, to be executed (in some sense) in sequence whenever the circumstance identified by its tag occurs. It is expected that whatever code detects or causes the circumstance will take care of running the action-list.

An execution-function can be specified for the action-list when it is created. Otherwise, the default behavior is to treat the data of each action as a callable and apply it to any additional arguments specified at execution time. At its simplest, an action-list emulates `(map nil 'funcall)`.

Names of action-lists and action-items are general lisp objects, compared with `equalp`. This allows strings and other objects to be used as unique identifiers.

Actions can be specified to depend on other actions; when defining an action-item, you can say that it must be before or after other action-items using the `:before` and `:after` keywords. Aside from that, actions are assumed to have no dependencies, and no order of execution should be counted on for the actions in a list.

You can (and are encouraged to) specify a documentation string for action-lists or action-items.

In addition you can create action-lists that are not registered globally. This allows applications to have disembodied action lists for their own internal purposes. The other action-list functions allow an action-list to be passed in instead of a name, to accommodate this.

8.1 Defining and undefining action lists

Action lists are defined using the `define-action-list` macro, and are undefined using the `undefine-action-list`. It is also possible to make unnamed, unregistered lists using `make-unregistered-action-list`.

define-action-list *Macro*

```
define-action-list uid &key documentation sort-time dummy-actions  
default-order execution-function
```

The `define-action-list` macro defines an action list.

uid is a unique identifier, and is a general lisp object, to be compared by `equalp`. It names the list in the global registry of lists. See `make-unregistered-action-list` to create unnamed, “unregistered” action-lists. The *uid* may be quoted, but is not required to be. It is possible, but not recommended, to define an action list with unique identifier `nil`. If a registered action-list with the *uid* already exists (that is, one which returns `t` when compared with `equalp`), then notification and subsequent handling is controlled by the value of the `*handle-existing-action-list*` variable.

The *documentation* string allows you to provide documentation for the action list.

sort-time is a keyword specifying when added actions are sorted for the given list — either `:execute` or `:define-action`.

dummy-actions is a list of action-names that specify placeholder actions; they cannot be executed and are constrained to the order specified in this list, for example

```
' (:beginning :middle :end)
```

default-order specifies default ordering constraints for subsequently defined action-items where no explicit ordering constraints are specified. An example is

```
' (:after :beginning :before :end)
```

execution-function specifies a user-defined function accepting arguments of the form:

```
(the-action-list other-args-list &rest keyword-value-pairs)
```

where the two required arguments are the action-list and a list of additional arguments passed to `execute-actions`, respectively. The remaining arguments are any number of keyword-value pairs that may be specified in the call to `execute-actions`. If no execution function is specified, then the default execution function will be used to execute the action-list.

undefine-action-list

Macro

```
undefine-action-list uid
```

The macro `undefine-action-list` flushes the specified list (and all its action-items). If the action-list specified by *uid* does not exist, then handling is controlled by the value of the `*handle-missing-action-list*` variable.

When defining an action-list, the user may provide an associated execution-function. When executing the action-list, this user-defined execution-function is used instead of the default execution-function, to map over and “execute” the action-list’s action-items. The macro `with-action-list-mapping` provides facilities to map over action-items (that is, their corresponding “data”). In addition, the `with-action-list-error-handling` macro provides a simple mechanism to trap errors and print warnings while executing each action-item.

All execution-functions are required to accept arguments of the form:

```
(action-list other-args &rest keyword-value-pairs)
```

where the two required arguments are the action-list and the list of additional arguments passed to `execute-actions` (see above), respectively. The remaining

arguments are any number of keyword-value pairs that may be specified in the call to `execute-actions`. See the LispWorks Reference Manual entries for `with-action-list-mapping` and `with-action-item-error-handling` for examples of execution-functions.

Actions are added to an action list using `define-action`, and are removed using `undefine-action`.

define-action *Macro*

```
define-action name-or-list action-name data &rest specs
```

The macro `define-action` adds a new action to the list specified by `name-or-list`, which will be executed according to the action list's execution function.

undefine-action *Macro*

```
undefine-action name-or-list action-name
```

The macro `undefine-action` removes the action specified by `action-name` from the list specified by `name-or-list`.

8.2 Exception handling variables

The following global variables are used to control the handling of exceptions:

handle-existing-action-list *Variable*

The variable `*handle-existing-action-list*` is a list containing either `:warn` or `:silent`, determining whether to notify the user, and either `:skip` or `:redefine` to determine what to do about an action-list operation when the action-list already exists. The default value is '(:warn :skip). It is used by the `define-action-list` macro.

handle-existing-action-in-action-list *Variable*

The variable `*handle-existing-action-in-action-list*` is a list containing one of `:warn`, or `:silent`, determining whether to notify the user,

and one of `:skip`, or `:redefine`, to determine what to do about an action definition when the action already exists in the given action-list. The default value is '`(:warn :redefine)`'. It is used by `define-action`.

handle-missing-action-list *Variable*

The variable `*handle-missing-action-list*` is a keyword; one of `:warn`, `:error`, or `:ignore`, denoting how to handle an operation on a missing action-list. The default value is `:error`. It is used by `undefined-action-list`, `print-actions`, `execute-actions`, `define-action` and `undefined-action`.

handle-missing-action-in-action-list *Variable*

The variable `*handle-missing-action-in-action-list*` is a keyword; one of `:warn`, `:error` or `:ignore`, denoting how to handle an operation on a missing action. Its default value is `:warn`. It is used by `undefined-action`.

8.3 Other variables

default-action-list-sort-time *Variable*

The variable `*default-action-list-sort-time*` contains a keyword that is either `:execute` or `:define-action`, denoting when actions in action-lists are sorted (see `define-action-list` for an explanation of ordering specifiers). Actions are sorted either at time of definition (`:define-action`) or when their action-list is executed (`:execute`). The default sort time is `:execute`.

8.4 Diagnostic utilities

Two diagnostic functions are provided: `print-actions` which prints out the actions on an action list. and `print-action-lists`, which provides a list of all the defined action lists.

print-actions	<i>Function</i>
----------------------	-----------------

```
print-actions name-or-list &optional stream
```

The function `print-actions` generates a listing of the action items on this action-list, in order. If the action-list specified by *name-or-list* does not exist, then this is handled according to the value of `*handle-missing-action-list*`.

print-action-lists	<i>Function</i>
---------------------------	-----------------

```
print-action-lists &optional stream
```

The function `print-action-lists` generates a listing of all the action lists in the global registry. (The ordering of the action lists here is essentially random.)

8.5 Examples

This example illustrates “typical” use of action lists. The `define-action` forms might be scattered across several files (`mail-utilities.lisp`, `caffeine.lisp`, and so on). Each of the functions, such as `read-mail`, `dont-panic`, and so on, take one argument: `hassled-p`.

```
(in-package "CL-USER")

(define-action-list "On arrival at office"
  :documentation "Things to do in the morning"
  :dummy-actions '("Look busy")
  :default-order '(:before "Look busy"))

(define-action "On arrival at office" "Read mail" 'read-mail)

(define-action "On arrival at office" "Greet co-workers"
  'say-hello)

(define-action "On arrival at office" "Drink much coffee"
  'wake-up:after "Locate coffee machine")

(define-action "On arrival at office" "Locate coffee machine"
  'dont-panic)
```

```
(defun my-morning (hassled-p Monday-p)
  (execute-actions ("On arrival at office"
                    :ignore-errors-p Monday-p)
                  hassled-p)
  <rest of my-morning code goes here>)
```

This example illustrates use of execution-functions and post-processing

```
(in-package "CL-USER")
```

Here are the implementation details, which are hidden from the “user”.

```
(defstruct (thing (:constructor make-thing (name number)))
  name
  number)

(defvar *things*
  (make-unregistered-action-list :sort-time :define-action
    :execution-function 'act-on-things))

(defun do-things (function &optional post-process)
  (execute-actions (*things* :post-process post-process)
    function))

(defun act-on-things (things other-args-list &key post-process)
  (with-action-list-mapping
    (things ignore thing post-process)
    (destructuring-bind
      (function) other-args-list
      (funcall function thing))))
```

The interface is given below. The internals of the mapping mechanism are hidden.

```
(defmacro define-thing (name number)
  (with-unique-names (thing)
    `(let ((,thing (make-thing ,name ,number)))
       (define-action *things* ',name ,thing)))))

(defmacro undefine-thing (name)
  ` (undefine-action *things* ,name))

(defun find-thing (name)
  (do-things #'(lambda (thing)
                 (and (equal name (thing-name thing))
                      thing))
             :or))
```

```
(defun add-things ()  
  (reduce '+ (do-things 'thing-number :collect)))
```

8.6 Standard Action Lists

The following action lists are defined in LispWorks as shipped:

"When starting image" - Actions to be executed upon image startup.

"Confirm when quitting image" - Actions to be executed before the image quits. Every action must return non-nil as its first value, otherwise the quit will be aborted once the actions are complete.

"When quitting image" - Actions to be executed when the image quits, after success of the "Confirm when quitting image" actions.

"Initialize LispWorks Tools" - Things to do when the LispWorks IDE starts on a screen. You may customise your environment startup by defining actions on it.

"Delivery Actions" - Actions to be executed when doing delivery. Actions on this list are executed in a 'normal' environment. See the *Delivery User Guide* for an example action item.

"Save Session Before" - Actions executed before saving a session. See `save-current-session` for details.

"Save Session After" - Actions executed after saving a session and redisplaying all the windows. These actions are executed both in the saving image and in the saved image when restarted. See `save-current-session` for details.

9

The Compiler

The compiler translates Lisp forms and source files into binary code for the host machine. A compiled Lisp function, for instance, is a sequence of machine instructions that directly execute the actions the evaluator would perform in interpreting an application of the original source lambda expression. Where possible the behaviors of compiled and interpreted versions of the same Lisp function are identical. Unfortunately the definition of the Common Lisp language results in certain unavoidable exceptions to this rule. The compiler, for instance, must macroexpand the source before translating it; any side effects of macro-expansion happen only once, at compile time.

By using declarations, you can advise the compiler of the types of variables local to a function or shared across an application. For example, numeric operations on a variable declared as a `single-float` can be compiled as direct floating-point operations, without the need to check the type at execution time. You can also control the relative emphasis the compiler places on efficiency (speed and space), safety (type checking) and support for debugging. By default the compiler produces code that performs all the necessary type checking and includes code to recover from errors. It is especially important that the type declarations be correct when compiling with a safety level less than 3 (see later in this chapter for more details).

When compiling a Lisp source file, the compiler produces its output in a format that is much faster to load than textual Lisp source — the “fasl” or “fast-

load” form. Fasl files contain arbitrary Common Lisp objects in a pre-digested form. They are loaded without needing to use the expensive `read` function. A series of “fasl-loader” routines built into LispWorks interpret the contents of fasl files, building the appropriate objects and structures in such a way that objects that were `eq` before fasl-dumping are created `eq` when fasl-loaded.

Fasl files are given pathname extensions that reflect the target processor they were compiled for; as the fasl files contain processor specific instruction sequences it is essential that the loader be able to distinguish between files compiled for different targets. These pathname extensions always end in “fasl”. See `dump-forms-to-file` for details of all the possible fasl file extensions.

9.1 Compiling a function

The function `compile` takes a symbol as its first argument, and an interpreted function definition (a lambda expression) as its second, optional, argument. It compiles the definition and installs the resultant code as the symbol-function of the symbol (unless the symbol was `nil`). If the definition is omitted then the current symbol-function of the symbol is used. Below are some examples:

```
CL-USER 3 > (compile (defun fred (a b)
                               (dotimes (n a) (funcall b))))
; FRED
FRED
NIL
NIL

CL-USER 4 > (funcall (compile nil '(lambda (n)
                                         (* n n))) 7)
; NIL
49

CL-USER 5 > (compile 'ident-fun '(lambda (x) x))
; IDENT-FUN
IDENT-FUN
NIL
NIL
```

9.2 Compiling a source file

The function `compile-file` takes a pathname as its argument and compiles all the forms in the file, producing a corresponding fasl file (with pathname derived from the source pathname). Any side effects in the source file are only felt once the compiled file is subsequently loaded. Many proclamations, for example, are not visible at compile time. The `eval-when` special form can be used to force such side effects to take effect at the time of compilation, rather than loading.

9.3 How the compiler works

Conceptually the compiler can be viewed as performing a series of separate passes.

- In the first pass the source code is macro expanded in the appropriate macro environment.
- A series of source to source optimizing transformations are performed to simplify the source tree. Type declarations are used to select specialized, efficient versions of low level functions.
- A graph is generated from the source tree. The structure of the graph reflects the flow of control in the tree. The nodes of the graph contain blocks of intermediate code for an abstract machine with byte addressing and an infinite set of registers. Register allocation is performed based on data flow analysis and machine specific rules concerning live ranges across code fragments.
- The blocks of intermediate code are translated into a single linear sequence of target machine code through a process of template matching.
- Finally the relative branch instructions are “fixed up” to point to the correct locations in the code sequence.

The compiler is in fact much more complex than this model might suggest. Machine specific optimizations, for example, can be included in any of the passes. The distinction between passes is also not as simple as that listed above. However, this description is sufficient to allow the programmer to make optimal use of the compiler.

9.4 Compiler control

There are ways to control the nature of compiled code via the `declare` special form and `proclaim` function. See later in this chapter for fuller discussion of these two forms.

In particular there are a set of optimize qualities which take integral values from 0 to 3, in order to control the trade-offs between code size, speed, compilation time, debuggability of the resulting code, and the safety of the code (whether type checks are omitted). For example:

```
(proclaim '(optimize (speed 3) (safety 0) (debug 0)))
```

tells the compiler to concentrate on code speed rather than anything else, and

```
(proclaim '(optimize (safety 3)))
```

ensures that the compiler never takes liberties with Lisp semantics and produces code that checks for every kind of signallable error.

The important declarations to the compiler are type declarations and optimize declarations. To declare that the type of the value of a variable can be relied upon to be unchanging (and hence allow the compiler to omit various checks in the code), say:

```
(declare (type the-type variable *))
```

Optimize declarations have various qualities, and these take values from 0 to 3. The names are `safety`, `fixnum-safety`, `float`, `sys:interruptable`, `debug`, `speed`, `compilation-speed`, and `space`.

Most of the qualities default to 1 (but `safety` and `fixnum-safety` default to 3 and `interruptable` defaults to 0). You can either associate an optimize quality with a new value (with local lexical scope if in `declare`, and global scope if `proclaim`), or just give it by itself, which implies the value 3 (taken to mean “maximum” in some loose sense).

Thus you ensure code is at maximum safety by:

```
(proclaim '(optimize (safety 3)))
```

or

```
(proclaim '(optimize safety))
```

and reduce debugging information to a minimum by

```
(proclaim '(optimize (debug 0)))
```

Normally code is interruptible, but when going for the extreme levels of speed and “undebbugability” this ceases to be the case unless you also ensure it thus:

```
(proclaim '(optimize (debug 0) (safety 0) (speed 3)
                     interruptable))
```

The levels of **safety** have the following implications:

- 0 implies no type checking upon reading or writing from defstructs, arrays and objects in general, nor any checking of array index bounds.
- 1 implies no type checking upon reading from defstructs, arrays and objects in general, nor any checking of array index bounds when reading. However, array index bounds are checked when writing.
- 2 implies type checking when writing, but not when reading. Other than this the compiler generates generally safe code, but allows **type** and **fixnum-safety** declarations to take effect. Array index bounds are checked for both reading and writing.
- 3 (default) implies complete type and bounds checking, and disallows **fixnum-safety** and **type** declarations from taking any effect.

The levels of **fixnum-safety** have the following implications:

- 0 implies no type checking of arguments to numeric operations, which are assumed to be fixnums. Also the result is assumed, without checking, to not overflow - this level means single machine instructions can be generated for most common integer operations, but risks generating values that may confuse the garbage collector.
- 1 implies that numeric operations do not check their argument types (assumed fixnum), but do signal an error if the result would have been out of range.
- 2 implies that numeric operations signal an error if their arguments are non-fixnum, and also check for overflow.

- 3 (default) implies complete conformance to the semantics of Common Lisp numbers, so that types other than integers are handled in compiled code.

Additionally if the level of `float` (really this should be called “float-safety”) is 0 then the compiler reduces allocation during float calculations.

The effects of combining these qualities is summarized below:

Table 9.1 Combining debug and safety levels in the compiler

Keyword settings	Operations
<code>safety=0</code>	Array access optimizations
<code>debug>0</code>	Dumps symbol names for arglist
<code>debug>=2</code>	Ensure debugger knows values of args (and variable when source debugging is on)
<code>debug<1</code>	Does not generate any debug info at all
<code>debug=3</code>	Avoids <code>make-instance</code> and <code>find-class</code> optimizations
<code>debug=3</code>	Avoids <code>gethash</code> and <code>puthash</code> optimizations
<code>debug=3</code>	Avoids <code>ldb</code> and <code>dpb</code> optimizations
<code>debug=3</code>	Avoids an optimization to <code>last</code>
<code>safety>1</code>	Be careful when multiple value counts are wrong
<code>safety<1</code>	Do not check array indices during write
<code>safety<2</code>	Do not check array indices during read
<code>speed>space</code>	Inline map functions (unless <code>debug>2</code>)
<code>debug<=2</code>	Optimize (merge) tail calls
<code>debug<2</code> and <code>safety<2</code>	Self calls
<code>safety>=2</code>	Check get special
<code>safety<2</code>	Do not check types during write
<code>safety<3</code>	Do not check types during read

Table 9.1 Combining debug and safety levels in the compiler

Keyword settings	Operations
<code>safety>=1</code>	Check structure access
<code>safety<=1</code>	Inline structure readers, with no type check
<code>safety=0</code>	Inline structure writers, with no type check
<code>debug>=1</code>	Call count count
<code>safety>1</code>	Check number of args
<code>safety>=1 or interruptible>0</code>	Check stack overflow
<code>safety>1</code>	Ensures the thing being funcalled is a function
<code>safety<3 and fixnum-safety=2</code>	Fixnum-only arithmetic with errors for non fixnum arguments.
<code>safety<3 and fixnum-safety=1</code>	No fixnum overflow checks
<code>safety<3 and fixnum-safety=0</code>	No fixnum arithmetic checks at all
<code>safety>2</code>	<code>char=</code> checks for arguments of type <code>character</code>
<code>safety>=2</code>	Ensures symbols in <code>progv</code>
<code>debug=3</code>	Avoids “ad hoc” predicate type transforms
<code>compilation-speed=3</code>	Reuse virtual registers in very large functions
<code>debug=3 and safety=3</code>	(<code>declare (type foo x)</code>) and (<code>the foo x</code>) ensure a type check
<code>float=0</code>	Optimize floating point calculations

The other optimize qualities are: `speed` — the attention to fast code, `space` — the degree of compactness, `compilation-speed` — speed of compilation, `interruptable` — whether code must be interruptible when unsafe.

Note that if you compile code with a low level of safety, you may get segmentation violations if the code is incorrect (for example, if type checking is turned

off and you supply incorrect types). You can check this by interpreting the code rather than compiling it.

9.4.1 Examples of compiler control

The following function, compiled with safety = 2, does not check the type of its argument because it merely reads:

```
(defun foo (x)
  (declare (optimize (safety 2)))
  (car x))
```

However the following function, also compiled with safety = 2, does check the type of its argument because it writes:

```
(defun set-foo (x y)
  (declare (optimize (safety 2)))
  (setf (car x) y))
```

As another example, interpreted code and code compiled at low safety does not check type declarations. To make LispWorks check declarations, you need to compile your code after doing:

```
(declaim (optimize (safety 3) (debug 3)))
```

9.5 Declare, proclaim, and declare

declare

Special form

```
declare (declaration *)
```

There are two distinct uses of `declare`, one is to declare Lisp variables as “special” (this affects the semantics of the appropriate bindings of the variables), and the other is to provide advice to help the Common Lisp system (in reality the compiler) run your Lisp code faster, or with more sophisticated debugging options.

The special form `declare` behaves computationally as if it is not present (other than to affect the semantics), and is only allowed in certain contexts, such as after the variable list in a `let`, `do`, `defun`, etc.

(Consult the syntax definition of each special form to see if it takes declare forms and/or documentation strings.)

For more detail, including some LispWorks extensions to Common Lisp, in the reference entry for `declare`.

`proclaim`

Function

`proclaim declaration-list`

declaration-list must be a list of declaration forms to be put into immediate and pervasive effect.

Unlike `declare`, `proclaim` is a function that parses the declarations in the list (usually a quoted list, note), and puts their semantics and advice into global effect. This can be useful when compiling a file for speedy execution, since a proclamation such as:

```
(proclaim '(optimize (speed 3) (space 0) (debug 0)))
```

means that the rest of the file is compiled with these optimization levels in effect. (The other way of doing this is to make appropriate declarations in every function in the file).

`proclaim` simply returns `nil`.

`declaim`

Macro

This is a macro equivalent to `proclaim`.

Below are some examples:

```
(proclaim '(special *fred*))  
(proclaim '(type single-float x y z))  
(proclaim '(optimize (safety 0) (speed 3)))
```

As `proclaim` involves parsing a list of lists of symbols and is intended to be used a few times per file, its implementation is not optimized for speed - it makes little sense to use it other than at top level.

Do not forget to quote the argument list if it is a constant list. (`proclaim (special x)`) attempts to call function `special`.

9.5.1 Naming conventions

Exercise caution if you `declare` or `proclaim` variables to be special without regard to the naming convention that surrounds their names with asterisks.

9.6 Optimizing your code

Careful use of the compiler optimize qualities described above or special declarations may significantly improve the performance of your code. However it is not recommended that you simply experiment with the effect of adding declarations. It is more productive to work systematically:

1. Use the Profiler, described in Chapter 11, “The Profiler”, to analyse your application’s performance and identify bottlenecks, then
2. Consider whether re-writing of parts of your source code would improve efficiency at the bottlenecks, and
3. Use `:explain` declarations to make the compiler generate optimization hints, and
4. (In SMP LispWorks) use `analysing-special-variables-usage` to report on symbols proclaimed special, and
5. Consider adding suitable declarations as described in this chapter to improve efficiency at the bottlenecks.

The most important tool for speeding up programs is the Profiler. You use the profiler to find the bottlenecks in the program, and then optimize these bottlenecks by helping the compiler to produce better code.

The remainder of this section describes some specific ways to produce efficient compiled code with LispWorks.

9.6.1 Compiler optimization hints

You can make the compiler print messages which will help you to optimize your code. You add suitable `:explain` declarations, recompile the code, and check the output.

The full syntax of the `:explain` declaration is documented in the reference entry for `declare`.

Various keywords allows you to see information about compiler transformations depending on type information, allocation of floats and bignums, floating point variables, function calls, argument types and so on. Here is a simple example:

```
(defun foo (arg)
  (declare (:explain :variables) (optimize (float 0)))
  (let* ((double-arg (coerce arg 'double-float))
         (next (+ double-arg 1d0))
         (other (* double-arg 1/2)))
    (values next other)))
;;- Variables with non-floating point types:
;;- ARG OTHER
;;- Variables with floating point types:
;;- DOUBLE-ARG NEXT
```

Note: the LispWorks IDE allows you to distinguish compiler optimization hints from the other output of compilation, and also helps you to locate quickly the source of each hint. For more information see the chapter “The Output Browser” in the *LispWorks IDE User Guide*.

9.6.2 Fast 32-bit arithmetic

The INT32 API provides a way to perform optimal raw 32-bit arithmetic. Note that, unlike Lisp integer types, this is modulo 2^{32} like the C int type.

The INT32 symbols are all in the system package.

The Lisp type `int32` reads 32 bits of memory, like `(signed-byte 32)`, but the data is in `int32` format for use with the INT32 API.

9.6.2.1 Optimized and unoptimized INT32 code

When optimized correctly, the intermediate `int32` objects are not constructed.

In unoptimized code, sequences of operations like

```
(sys:int32+ (sys:int32- a b) (sys:int32- c d))
```

will generate intermediate `int32` objects for the results of the subtraction, but the compiler can optimize these away because it knows that the function `int32+` consumes `int32` objects.

Note: the INT32 API is not designed to optimize `sys:int32` objects passed as arguments.

9.6.2.2 The INT32 API

The INT32 API contains the type `int32`, a vector type `simple-int32-vector` and accessor, functions to convert `int32` to and from integer, some constant `int32` values, and a full range of operators for mod 2^{32} arithmetic.

You can find all these by evaluating

```
(apropos "INT32" "SYSTEM" t)
```

For details for each, see the entries starting with `int32` in Chapter 40, “The SYSTEM Package”.

9.6.2.3 INT32 Optimization

The optimization works safely but without boxing when possible. You need

```
(optimize (float 0))
```

to get the optimization. This `float` level affects whether INT32 operations are optimized. This declaration must be placed at the start of a function (not on an inner `let` or `locally` form).

In this example the `safety` level assures a second optimization in `fli:foreign-typed-aref`:

```
(defun incf-signed-byte-32 (ptr index)
  (declare (optimize (safety 0) (float 0))
           (type fixnum index))
  (setf (fli:foreign-typed-aref 'sys:int32 ptr index)
        (sys:int32-1+ (fli:foreign-typed-aref 'sys:int32
                                              ptr index)))
  ;; return ptr, since otherwise the int32 would
  ;; need to be boxed to return it
  ptr)
```

9.6.3 Floating point optimization

The `float` declaration allows generation of more efficient code using float numbers. It reduces allocation during float calculations. It is best used with

safety 0. That is, you declare `(optimize (float 0) (safety 0))` as in this example:

```
(progn
  (setf a
    (make-array 1000
      :initial-element 1D0
      :element-type 'double-float))
  nil ; to avoid printing the large array
)

(compile
  (defun test (a)
    (declare (optimize (speed 3) (safety 0) (float 0)))
    (declare (type (simple-array double-float (1000))
      a))
    (let ((sum 0D0))
      (declare (type double-float sum))
      (dotimes (i 1000)
        (incf sum (the double-float (aref a i)))))
      sum))

  (time (test a))
=>
Timing the evaluation of (TEST A)

user time      =      0.000
system time    =      0.000
Elapsed time   =  0:00:00
Allocation     = 16 bytes standard / 0 bytes conses
0 Page faults
```

Note: calls to `+`, `-` and `*` with more than 4 arguments will not be optimized, even with the declaration described above, so avoid such calls to obtain the best floating point performance

9.6.4 Tail call optimization

In 64-bit LispWorks and on x86 platforms the compiler optimizes tail calls unless

1. The compiler optimize quality `debug` is 3, or

2. There is something with dynamic scope on the stack, such as a special binding, a catch or `dynamic-extent` allocation (so it is not really a tail call)

On all other platforms the compiler optimizes tail calls unless 1.) or 2.) above apply, or

3. The call has more than 4 arguments and this is more than the number of fixed (not `&optional`/`&rest`/`&key`) parameters in the calling function.
4. The call has more than 4 arguments and the calling function has `&rest`/`&key` parameters.

9.6.5 Usage of special variables

In SMP LispWorks access to special variables (excluding constants) is a little slower than in non-SMP LispWorks. It can be speeded up by declarations of the symbol, normally by using `proclaim` or `declare`.

The speedup will be pretty small overall in most cases, because access to specials is usually a small part of a program. However, if the Profiler identifies some piece of code as a bottleneck, you will want to optimize it, and your optimizations may include proclamation of some variable as global or dynamic.

The three declarations described in this section are extensions to Common Lisp. All declare the symbol to be `cl:special`, along with other information. These three declarations are mutually exclusive between themselves and `cl:special`. That is, declaring a symbol with any of these declarations eliminates the other declaration:

- `hcl:special-global` declares that the symbol is never bound.

In SMP LispWorks the compiler signals error if it detects that a symbol declared as `hcl:special-global` is bound, and at runtime it also signals an error.

In non-SMP LispWorks the compiler gives an error, but there is no runtime check. The runtime behavior is the same as `cl:special`, with all accesses to the symbol in low safety.

`hcl:special-global` is very useful, and because of the checks it is reasonably safe. It is useful not only for speed, but also to guard against unintentionally binding variables that should not be bound.

See also `defglobal-parameter`.

- `hcl:special-dynamic` declares that the symbol is never accessed outside the dynamic scope of the binding.

In high safety code accessing the symbol outside the scope of binding signals an error. In low safety code it may result in unpredictable behavior.

In non-SMP LispWorks the only effect of this declaration is to make all access to the variable low safety.

`hcl:special-dynamic` is useful, but because it can lead to unpredictable behavior you need to ensure that you test your program in high safety when you use it.

- `hcl:special-fast-access` declares that a symbol should be "fast access".

The semantics of the declaration is the same as `c1:special`, except that access to the variable is low safety. In addition, the compiler compiles access to the symbol in a way that speeds up the access, but also introduces a tiny reduction in the speed of the whole system. The balance between these effects is not obvious.

It is not obvious where `hcl:special-fast-access` is useful. If you can ensure that the symbol is always bound or never bound then `hcl:special-dynamic` or `hcl:special-global` are certainly better.

9.6.5.1 Finding symbols to declare

The macro `analysing-special-variables-usage` can be used to find symbols that may be proclaimed global, which can improve performance. `analysing-special-variables-usage` also helps to identify inconsistencies in the code.

9.6.6 Stack allocation of objects with dynamic extent

(`declare dynamic-extent`) will optimize these calls so that they allocate in the stack, in all cases:

- `&rest` lists
- `flet` functions and `labels` functions
- `(cons x y)`
- `(list ...)`
- `(list* ...)`
- `(copy-list x)`
- `(make-list x)`
- `(vector ...)`

`(declare dynamic-extent)` will also optimize these specific calls:

- `(make-array n)`
- `(make-array n :initial-element x)` without any other arguments
- `(make-foo ...)` where `make-foo` is an inline structure constructor. The default constructor is declared inline automatically when none of the `defstruct` slot initforms are calls to functions.
- `(make-string n :element-type 'base-char)`

9.6.7 Inlining foreign slot access

Given a structure definition

```
(fli:define-c-struct foo-struct
  (a :int)
  (b :int))
```

you can inline access to a slot by declaring `fli:foreign-slot-value` inline and supplying the *object-type*:

```
(defun foo-a (struct)
  (declare (inline fli:foreign-slot-value))
  (fli:foreign-slot-value struct 'a :object-type 'foo-struct))
```

9.7 Compiler parameters affecting LispWorks

There are six compiler parameters that control the generation of information used by various LispWorks utilities, such as the debugger, and also by various

editor commands, such as `show Paths From`. By default, these parameters are all `t`, which allows you to use all the features of these utilities, at the expense of increasing compilation times.

These variables are initially set to `t` (in the LispWorks file `config/a-dot-lispworks.lisp`). To speed up compilation times, you should set these variables to `nil`. The variables can be controlled as a group by using the function `toggle-source-debugging`.

10

Storage Management

This chapter introduces some basic ideas of storage management, and then discusses the LispWorks storage management system in more detail. The chapter also introduces the functions and macros needed to control storage management. Full details of all the symbols mentioned here are given in Chapter 32, “The HCL Package” and Chapter 40, “The SYSTEM Package”.

10.1 Introduction

Automatic memory management is one of the most significant features of a Lisp system. Whenever an object, such as a cons cell, is required to hold an aggregate of values, the system calls the appropriate function to create a new object and fill it with the intended values. The programmer need not be concerned with the low level allocation and management of memory as the Lisp system provides this functionality automatically.

When an object is no longer required (that is, it has become “garbage”), the system must automatically reclaim (“collect”) the space it occupies and reallocate the space to a new object. Whenever the space for new objects is exhausted, a “garbage collector” is run to determine (by a process of elimination) all the existing objects that are still required by the running program. Any other objects still in the image are necessarily garbage, and the space they occupy can be reclaimed.

For a description of how LispWorks uses the address space of different Operating Systems, and factors affecting the maximum image size, see “Address Space and Image Size” on page 305.

Garbage collection with a naive algorithm is extremely inefficient. The time required to scan an entire image, which may occupy many megabytes of memory, is prohibitive; especially when the collector must perform the scan in a small, fixed, workspace.

10.2 Generations and segments

The LispWorks garbage collector works in unison with the storage allocator to arrange allocated objects in a series of “generations”. Each generation contains objects of a particular age. In practice most Lisp data objects are only required for a very short period of time. That is, they are ephemeral. The LispWorks garbage collector concentrates its efforts on repeatedly scanning the most recent generation. Such a scan requires only a fraction of a second and reclaims most of the space allocated since the last collection. Any object in the most recent generation that survives a number of such collections is promoted to the next youngest generation. Eventually this older generation becomes full, and only then is it collected. The generations are numbered from 0 upwards, so that generation 0 is the youngest.

The remainder of this chapter describes the LispWorks garbage collector in more detail. The implementation and the programmatic interface differ between 32-bit and 64-bit LispWorks.

10.3 Memory Management in 32-bit LispWorks

This section describes the garbage collector (GC) in 32-bit LispWorks 6.0.

In LispWorks for UNIX and LispWorks for Macintosh, the implementation is not significantly different to that in LispWorks 4.x or LispWorks 5.x.

In LispWorks for Windows and LispWorks for Linux, the implementation has changed since LispWorks 4.x and you may notice performance improvements relative to those versions.

10.3.1 Generations

In memory, a generation consists of a chain of segments. Each segment is a contiguous block of memory, beginning with a header and followed by the allocation area.

The first generation normally consists of two segments: the first segment is relatively small, and is where most of the allocation takes place. The second segment is called the big-chunk area, and is used for allocating large objects and when overflow occurs (see below for a discussion of overflow).

The second generation (generation 1) is an intermediate generation, for objects that have been promoted from generation 0 (typically for objects that live for some minutes).

Long-lived objects are eventually promoted to generation 2. Note that generation 2 is not scanned automatically. Therefore these objects will not be reclaimed (even if they are not referenced) until an explicit call to a garbage collector function (for example `mark-and-sweep` on generation 2, or `clean-down`) or when the image is saved. Normally, objects are not promoted from generation 2 to generation 3, except when the image is saved.

Generation 3 normally contains only objects that existed at startup time, that is those were saved in the image. Normally it is not scanned at all, except when an image is saved.

Note that the division between the generations is a result of the promotion mechanism, and is not a property of a piece of code itself. A piece of system software code that is loaded in the system (for example, a patch) is treated the same as any other code. The garbage collection code is explicitly loaded in the static area using the function `switch-static-allocation`.

10.3.2 Allocation of objects

Normal allocation is done from a buffer, called the small objects buffer. The Garbage Collector (GC) maintains a pointer to the beginning and end of the buffer, and allocates from it by moving one of the boundaries. When the buffer becomes too small the GC finds another free block and makes that the buffer.

The minimum and maximum size of free block that the GC uses for the small objects buffer can be set by `set-gc-parameters`, using the keywords

`:minimum-buffer-size` and `:maximum-buffer-size`. If the minimum size is too small, the system allocates buffers more frequently, thus slowing the program. Making the minimum too big causes more fragmentation, because small free blocks are not used. There is no easy way to determine the optimal values for the small objects buffer, except by experiment.

When there is an overflow the small object buffer is allocated in the big-chunk area, and then a bigger buffer is allocated (see below).

10.3.2.1 Allocation of static objects

Objects that cannot be moved are allocated in special segments, called static segments. These can be in any generation, but are in generation 2 by default.

Such objects include:

- Code that must not move during garbage collection, in particular the code and data of the garbage collector itself
- Objects allocated explicitly in the static area, by `in-static-area` or by use of `switch-static-allocation`.
- Foreign code loaded from a non-shared library via `link-load:read-foreign-modules`. This applies to LispWorks for UNIX only (not LispWorks for Linux, x86/x64 Solaris, FreeBSD or Macintosh).
- Objects allocated by `malloc`, `realloc` and `memalign` in foreign code loaded as above.

Because static objects are not allowed to move, the static segments are not allowed to move. This implies that if there is a static segment in a high address the image size cannot be reduced below this size. Applications that use a lot of static area normally allocate additional static segments, and thus grow without being able to shrink again. This can be prevented by enlarging the initial static segment, which is in a low address. Use the function `enlarge-static` to increase the size of the initial static segment. (Use `(room t)` to find its current size.)

10.3.2.2 Allocation in different generations

Objects that are known to have long life can be allocated directly in a higher generation, by using `allocation-in-gen-num` and `set-default-generation`. Note that both these functions have a global effect, i.e. any object allocated after a call to `set-default-generation` or within the body of `allocation-in-gen-num` is allocated in the specified generation, unless it is explicitly allocated in a different generation. Therefore careless use of these functions may lead to allocation of ephemeral garbage in high generations, which is very inefficient. Conversely, if a long-lasting object is allocated to a low generation, it has to survive several garbage collections before being automatically promoted to the next generation.

See also “Allocation of interned symbols and packages” on page 116 and “Allocation of stacks” on page 117.

10.3.3 GC operations

Mark and sweep is the basic operation of reclaiming memory, and it is done in two stages:

<i>Mark</i>	All objects that are alive in the generation being garbage collected and in younger generations are marked as alive. (Alive means pointed to by some other live object.)
<i>Sweep</i>	All unmarked objects in the generations being garbage collected are added to the free blocks, and all marked objects are unmarked.

A mark and sweep operation is always on all the generations from 0 to a specific number.

A mark and sweep operation can be caused explicitly by calling `mark-and-sweep`.

Promotion is the process of moving objects from one generation to the next generation. An object is marked for promotion after surviving a specific number of mark and sweep operations, but may be promoted before that. The number of survivals is specific to each segment.

Promotion does not free objects.

10.3.4 Garbage collection strategy

When the Garbage Collector runs out of memory, it has to find more memory. Normally (that is, when allocating in generation 0) the first operation is a mark and sweep. Before performing the mark and sweep, the GC compares the amount of memory allocated since the previous mark and sweep with the `:minimum-for-sweep` value, which is set by `set-gc-parameters`. If the amount allocated is less than `:minimum-for-sweep` the GC does not do a mark and sweep, but causes an overflow (described below). This prevents an excessive number of mark and sweep operations in periods when the program allocates a large amount of data which stays alive.

Note that the GC monitor window does not indicate a mark-and-sweep of generation 0, as this operation takes a small amount of time (To change the display would take longer than the mark-and-sweep operation itself.).

Note: the GC monitor window appears only in the Motif IDE.

If more than `:minimum-for-sweep` has been allocated, a mark and sweep operation takes place. After this operation the GC checks that the segment it was trying to allocate to has more free space than the minimum free space for this segment. If the remaining free space is less than `minimum-free-space`, the GC tries to create more free space by promoting objects from the segment.

Before promoting, the GC performs two checks. First, it checks that there are enough objects marked for promotion to justify a promotion operation. The minimum free space for a segment is set by `set-minimum-free-space`, and can be shown by `(room t)`.

Second, the GC checks that there is enough free space in the next generation to accommodate the promoted objects. If there is insufficient space, the GC tries to free some, either by a mark and sweep on the next generation, promoting the next generation, or by enlarging the generation.

The minimum amount of space for promotion is the value `minimum-for-promote`, which is set by `set-gc-parameters`.

If there is insufficient space, and there are not enough objects marked for promotion, the GC increases the size of the image, by overflow, as described below.

10.3.5 Overflow

If the amount allocated from the previous mark and sweep operation is less than `:minimum-for-sweep`, the GC does not perform a mark and sweep. Instead it allocates a small-objects buffer in the big-chunk area (the second segment in the first generation). The minimum and maximum sizes of this buffer are specified by `:minimum-overflow` and `:maximum-overflow`, which can be set by `set-gc-parameters`. If the GC fails to find a buffer of this size, it looks for a smaller buffer, and if that fails it enlarges the big-chunk area (and the process size) by the amount needed to allocate a buffer of the size of the currently allocated area in generation 0, up to a maximum amount specified by `:maximum-overflow`.

10.3.6 Behavior of generation 1

When objects are promoted from generation 0 to 1, and there is not enough space in generation 1, the GC tries to free space in generation 1. The first step is to check if sufficient space can be freed by promoting the objects marked for promotion. If this is the case the GC promotes these objects from generation 1 to generation 2. (In practice, this rarely happens.) If this check fails the GC marks and sweeps generation 1. If not enough space is freed by this mark-and-sweep, than either all the objects in generation 1 are promoted, or generation 1 is expanded. This is controlled by `expand-generation-1`, which specifies whether expansion or promotion takes place.

If generation 1 is expanded, the amount it tries to expand by is the value `:new-generation-size` (set by `set-gc-parameters`) in words (i.e. multiples of 4 bytes), or the amount of free space needed, whichever is bigger. If `:new-generation-size` is 0, it is not expanded. In this case part of the objects marked for promotion are not promoted.

10.3.7 Behavior of generation 2

Normally generation 2 is not garbage collected. If the system runs out of space in this generation, it expands it, using the value of `:new-generation-size` multiplied by two. Garbage collection of generation 2 can be caused by calling the function `collect-generation-2` with appropriate argument.

10.3.8 Forcing expansion

If you know that a given generation will need to grow, you can save the GC the work by calling `enlarge-generation` to expand the generation in advance.

10.3.9 Controlling Fragmentation

Some applications periodically free (that is, stop using) a substantial amount of data that lived for long enough to reach generation 2 (use `room` or `room-values` and `generation-number` to follow the behavior of objects). In this case, `mark-and-sweep` should be called on generation 2, to collect these data and reuse the memory. Repeated cycles like this may cause fragmentation, which will slow down promotion into generation 2. This manifests itself in significant pauses, typically of a few seconds. `try-move-in-generation` or `try-compact-in-generation` can be used to reduce the fragmentation, and hence to reduce the pauses. Because these functions themselves take some time, they should be called when such a pause is acceptable.

'Moving' a segment means moving objects out of the segment to another segment, leaving the segment empty. This reduces the fragmentation in the generation, and it is normally much faster than compact. Therefore in almost all cases, `try-move-in-generation` is better than `try-compact-in-generation`.

The actual decision to use these functions will be typically based on the results of `check-fragmentation`. For example, the following function checks if there is more than 10Mb free area in generation 2 in blocks of 4096 bytes or larger (tlb, third return value of `check-fragmentation`). If there is not, and the free area in generation 2 (tf) is more than four times the free area in large blocks, it calls `try-move-in-generation`. Because `try-move-in-generation` gets a *time-threshold* of 0, it returns after moving at most one segment. (It will not move any segments if none of them looks fragmented.)

```
(defun call-memory-functions()
  (mark-and-sweep 2) ; first collect all dead objects
  (multiple-value-bind (tf tsb tlb)
    (check-fragmentation 2) ; check the fragmentation
    (when (and (> 10000000 tlb)
               (> (ash tf -2) tlb))
      (try-move-in-generation 2 0)))))
```

A function such as this can be called at times when a pause of a few seconds is acceptable, and it will keep the memory of generation 2 unfragmented.

It is not possible to give definitive guidance here on how to use `try-move-in-generation` or `try-compact-in-generation`, because it depends on the way the application uses memory. In general, these functions will always improve the behavior of the application. Therefore the main problem is to identify points in the execution of the application where they can be called without causing unacceptably long pauses.

10.3.10 Summary of garbage collection symbols

The remainder of this chapter summarizes which functions are useful in which circumstances. See also “Common Memory Management Features” on page 116. For full details of these functions, see their reference entries.

10.3.10.1 Determining storage usage

To determine storage usage (useful when benchmarking), use the functions `room`, `total-allocation` and `find-object-size`. The function `room-values` is suitable for programmatic use: it returns the values that `room` prints.

In 32-bit LispWorks, `memory-growth-margin` returns the amount by which the Lisp heap can grow, if `set-maximum-memory` has been called.

10.3.10.2 Allocating in specific generations

To control the allocation of objects to generations, use `allocation-in-gen-num`, `get-default-generation`, `set-default-generation` and `*symbol-alloc-gen-num*`.

10.3.10.3 Controlling a specific generation

To control the behavior of a specific generation, use `clean-generation-0`, `collect-generation-2`, `collect-highest-generation`, `expand-generation-1` and `set-minimum-free-space`.

10.3.10.4 Controlling the garbage collector

The functions that are most likely to be useful for controlling the GC are `room`, `check-fragmentation`, `gc-generation` (replacing `mark-and-sweep`) and `try-move-in-generation`.

Other potentially useful functions and macros are `avoid-gc`, `get-gc-parameters`, `gc-if-needed`, `enlarge-generation`, `normal-gc`, `set-gc-parameters`, `with-heavy-allocation` and `try-compact-in-generation`.

10.4 Memory Management in 64-bit LispWorks

This section describes the garbage collector (GC) in 64-bit LispWorks.

10.4.1 General organization of memory

The memory in 64-bit LispWorks is arranged in segments, which belong to generations. Unlike 32-bit LispWorks, segments are sparsely allocated in memory, that is they not contiguous.

Each segment has an allocation type, which defines the type of objects that the segment contains. The system creates and destroys segments as needed. A generation may or may not contain a segment for a specific allocation type, and a generation may contain more than one segment for any particular allocation type. Segments may change in size.

You can see the allocation for each allocation type in the output of:

```
(room t)
```

Additionally you can see the segments of each generation in the output of:

```
(room :full)
```

After the total allocation in each generation, this prints the allocation type for each segment followed by the hexadecimal address range for allocating objects.

10.4.2 Segments and Allocation Types

Some GC interface functions take an allocation type as an argument, which is one of the keywords below. There are two categories of allocation type.

The main allocation types, which can be used as the *what* argument to the function `apply-with-allocation-in-gen-num`, are:

- `:cons` The segment contains only conses.
- `:symbol` The segment contains only symbols (and does not include symbol names or any of the other properties of symbols).
- `:function` The segment contains only function objects.
- `:non-pointer` The segment contains only objects that do not contain pointers (strings, specialized numeric arrays, double-floats).
- `:other` The segment contains other objects, that is any object that contain pointers, and is not a symbol, cons or a function.

The derived allocation types are:

- `:mixed` The segment contains a mixture of `:other`, `:function` and `:symbol`, but not `:cons` or `:non-pointer`.
- `:cons-static` The segment contains cons objects that are static.
- `:non-pointer-static` The segment contains objects that do not contain pointers and are static (currently stacks are also allocated in these segments).
- `:mixed-static` The segment contains a mixture like `:mixed`, but static.
- `:weak` The segment contains weak objects (arrays, and internals of weak hash tables).
- `:other-big` The segment contains a single very large simple vector. The vector is static.
- `:non-pointer-big`

The segment contains a single very large non-pointer object (a string or a specialized numeric array). The vector is static.

Segments of allocation type `:other-big` or `:non-pointer-big` can be as large as required to hold their object.

For all other allocation types, the size of each single segment is restricted. The implementation limit is currently 256MB, and you can specify a smaller limit using `set-maximum-segment-size`.

10.4.3 Garbage Collection Operations

In 64-bit LispWorks there are two methods of garbage collection: *mark and sweep* (also referred to simply as *mark*) and *copy*. The two methods can be mixed within the same garbage collection operation and generation, but a segment is collected using only one of mark or copy in a given operation.

When a segment is collected using the copying method, the objects within it can either be copied to another segment in the same generation or can be copied to a segment in a higher generation. The latter case is called promotion. The automatic garbage collection copies with promotion until the objects reach the blocking generation, which is collected in a specific way as described in “Generation Management” on page 114.

10.4.4 Generation Management

In general, higher generations contain objects that live longer and are therefore much less likely to die. Each garbage collection only collects the generations up to some number, and never reclaims the objects in higher generations.

Objects move between generations by being promoted. For most allocation types, this means that the GC copies the objects from a segment in one generation to a segment in a higher generation. For allocation types `:other-big` and `:non-pointer-big`, the objects are not actually copied when they are promoted; but instead the whole segment is reattached to the higher generation. The automatic garbage collection promotes objects until they reach the blocking generation.

In the default configuration, there are 8 generations, numbered from 0 to 7. Generation 7 is used to keep objects that survived saving the image. Generations 4, 5 and 6 are not used. Generation 3 is the blocking generation, where long-lived objects accumulate. Generations 0, 1, and 2 are ephemeral, and objects that survive a garbage collection in each of these generations are promoted to the next generation.

10.4.5 Tuning the GC

The garbage collector settings are tuned for typical cases, so in general you do not need to change them. If you are considering tuning the GC, contact Lisp Support.

The main tools for seeing how the GC behaves are the macro `extended-time` and periodical calls to `room`.

In the output of `(room t)`, the allocation in each generation is presented according to the allocation type, which may be useful to decide on possible tuning.

`(extended-time forms)` outputs the time spent in garbage collection, whether automatic or called explicitly. The time is shown according to the maximum generation number that was collected and to whether it was a standard garbage collection (automatic and calls to `gc-generation`) or a marking garbage collection (calls to `marking-gc`).

In addition to `room` and `extended-time`, there are also the functions `count-gen-num-allocation`, `gen-num-segments-fragmentation-state`, and `set-automatic-gc-callback`. These function can be used to collect information about automatic garbage collection operations.

The profiler can also help determine whether the settings can be improved for your application. See Chapter 11, “The Profiler” for details of that.

10.4.5.1 Interface for tuning the GC

The main interfaces are those which control the blocking generation.

For generations lower than the blocking generation, objects that survive are promoted, and the system does not automatically promote objects to higher

generations. Thus if the application generates long-lived objects, they will accumulate in the blocking generation.

The behavior when the blocking generation grows is controlled by `set-blocking-gen-num` and `set-gen-num-gc-threshold`. It may also be useful to set the maximum segment size with `set-maximum-segment-size`.

Explicit garbage collection can be done by calling `gc-generation` and `marking-gc`. Since repeated use of `marking-gc` will cause a lot of fragmentation, the arguments `what-to-copy` and `max-size-to-copy` can be used to specify that part of the data should be collected by copying.

`gc-generation` can also be used to promote objects to a higher generation than the blocking generation.

It is normally less important to tune the ephemeral segments, that is the segments below the blocking generation. Functions that may be useful include `set-default-segment-size`, `set-spare-keeping-policy` and `set-delay-promotion`.

10.5 Common Memory Management Features

This section summarises Memory Management functionality common to all LispWorks 6.0 implementations.

10.5.1 Timing the garbage collector

The macro `extended-time` is useful when timing the garbage collector.

10.5.2 Reducing image size

To reduce the size of the whole image, use `clean-down`.

10.5.3 Allocation of interned symbols and packages

Interned symbols (and their symbol names), and packages, are treated in a special way, because they are assumed to have a long life. They are allocated in the generation specified by the variable `*symbol-alloc-gen-num*`, which has the initial value 2 in 32-bit LispWorks and 3 in 64-bit LispWorks.

Symbols created with `make-symbol` or `gensym` start out in generation 0.

Symbols will be garbage collected if they are no longer accessible (regardless of property lists) but note that in 32-bit LispWorks, if the symbols are in generation 2 then you might need to invoke `mark-and-sweep` explicitly to collect them in a timely manner.

10.5.4 Allocation of stacks

Stacks are allocated directly in generation 2 because they are relatively expensive to promote. Therefore creating many processes will cause generation 2 to grow, even if these processes are short-lived.

The variable `*default-stack-group-list-length*` controls the number of stacks that are cached for reuse. Increase its value if your application repeatedly makes and discards more than 10 processes.

10.5.5 Mapping across all objects

To call a function on all objects in the image, use `sweep-all-objects`.

10.5.6 Special actions

You may want to perform special actions when certain types of object are garbage collected, using the functions `add-special-free-action`, `flag-special-free-action`, `flag-not-special-free-action` and `remove-special-free-action`.

For example, when an open file stream is garbage collected, the file descriptor must be closed. This operation is performed as a special action.

10.5.7 Garbage collection of foreign objects

Users of the Foreign Language Interface may want to specify the allocation of static arrays. The recommended way to do this is to call `make-array` with `:allocation :static`. See for example `:lisp-array` in the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

10.5.8 Freeing of objects by the GC

Weak arrays and weak hash tables can be used to allow the GC to free objects.

Relevant functions are `make-hash-table`, `set-hash-table-weak`, `set-array-weak`, `make-array` and `copy-to-weak-simple-vector`.

For a description of weak vectors see `set-array-weak`, page 617.

10.6 Assisting the Garbage Collector

This section describes techniques that may improve the performance of your application by reducing the GC's workload.

10.6.1 Breaking pointers from older objects

This is a technique that can be useful when older objects regularly point to newer objects in a lower generation. In such a case, when the lower generation (only) is collected these newer objects will be promoted even if the older objects are not live. All of these objects will not get collected until the higher generation is collected.

This is a general issue with generational garbage collection and, if it causes poor performance in your application, can be addressed along these lines. It is not necessarily a problem in every case where older objects point to newer objects.

For example, suppose you are popping items from a queue represented as a list of conses (or other structures), then you can set the "next" slot of each popped item to `nil`.

In the code below, if the `queue-head` cons is promoted to generation n , then all the other conses will also be promoted to generation n eventually, until generation n is collected. This happens even after calls to `pop-queue` have removed these conses from the queue.

```
(defstruct queue head tail)

(defun push-queue (item queue)
  (let ((new (cons item nil)))
    (if (queue-head queue)
        (setf (cdr (queue-tail queue)) new)
        (setf (queue-head queue) new))
    (setf (queue-tail queue) new)))

(defun pop-queue (queue)
  (pop (queue-head queue)))
```

The fix is to make `pop-queue` set the "next" slot (in this case the `cdr`) of the discarded `queue-head` cons to `nil`, so that it no longer points from an older object to a newer object. For example:

```
(defun pop-queue (queue)
  (when-let (head (queue-head queue))
    (setf (queue-head queue) (shiftf (cdr head) nil))
    (car head)))
```


11

The Profiler

The LispWorks profiler provides a way of empirically monitoring execution characteristics of Lisp programs. The data obtained can help to improve the efficiency of a Lisp program by highlighting those procedures which are commonly used or particularly slow, and which would therefore benefit from optimization effort.

11.1 What the profiler does

With the profiler running, the Lisp process is interrupted regularly at a specified time interval until the profiler is turned off. Having halted the execution of the process the profiler scans the execution stack and records information about it, including the names of all functions found. A special note is made of which function is at the top of the stack. After profiling stops the profiler can present a report containing a call tree and/or a cumulative columnar report.

The columnar report shows aggregated information about each function as follows:

- The number of times the function was called.
- The number of times the function was found on the stack by the profiler, both in absolute terms and as a percentage of the total number of scans of the stack.

- The number of times the function was found on the top of the stack, both in absolute terms and as a percentage of the total number of scans of the stack.

The call tree shows name of a root function and a "tree" of callee functions below it. To the right of each function's name the number of times it was seen on the stack under a particular caller is shown, along with the percentage this represents of the total number of times the function was seen.

The call tree is more computationally expensive to record than the cumulative data. You can choose whether to record and output the call tree, as described in the next section.

11.2 Setting up the profiler

Before a profiling session can start several parameters must be set, using the function `set-up-profiler`. There are four main areas to consider: the symbols to be profiled, the time interval between samples, the kind of profiling required, and the format of the output.

- It is possible to keep track of every function called during a particular computation, but significant effort is involved in determining which symbols are suitable for profiling and in keeping track of the results. To minimize this effort you need to specify which symbols to profile, either by naming the required symbols, or by naming a package, all of whose symbols are profiled. The profiler first checks that these symbols have indeed got function definitions and are therefore suitable for profiling.
- You might want to specify the time interval between interrupts. The resolution of this value is clearly dependent on the operating system. In most cases the default value, 10ms, is adequate. This number is important, because with these statistical methods of program profiling the accuracy of the results increases with the number of samples taken.
- On Unix/Linux/FreeBSD systems the kind of profiling required may be set. This refers to what kind of time is monitored in order to determine when to interrupt the Lisp process. There are three possibilities for how the time interval is measured:

The time the Lisp process is actually executing plus the time that the system is executing on behalf of the process. This is called *profile time*.

Just the time that the process is actually executing. This is called *virtual time*.

The actual elapsed time, called *real time*.

- The output can be presented as a tree of calls seen and a columnar report (`style :tree`), or just the columnar report (`style :list`). You can restrict the data shown in several ways, helping you to focus on the slowest parts of your program.

Below is an example of setting up the profiler:

```
(set-up-profiler :symbols '(car cdr) :style :list)
```

Here the functions `car` and `cdr` are going to be profiled and the output will be just the columnar report.

The function `set-up-profiler` adds symbols to the `*profile-symbol-list*`. The functions `add-symbol-profiler` and `remove-symbol-profiler` can also be used to change the symbols profiled.

The function `set-profiler-threshold` can be used with `reset-profiler` to control the effects of repeated profiler runs.

11.3 Running the profiler

The profiler has two distinct modes. You can use both in the same session, but not at the same time.

To use either mode, you must first call `set-up-profiler` to load the profiler and set its parameters including the output format.

The macro `profile` simply profiles all processes while a body of code is run, as described in “Using the macro `profile`” on page 124. Start profiling this way if you don’t see a need to use the alternate mode.

Alternatively the functions `start-profiling`, `stop-profiling` and `set-process-profiling` offer programmatic control over when profiling occurs and which processes are profiled. This is described in “Programmatic control of profiling” on page 124.

The function `do-profiling` is a convenience function which allows you to profile multiple threads using `start-profiling` and `stop-profiling`.

11.3.1 Using the macro profile

To profile your Lisp forms enter:

```
(profile <forms>)
```

This evaluates the forms as an implicit `progn` and prints the results, according to the parameters established by `set-up-profiler`.

Note: you cannot use `profile` (or the graphical Profiler tool) after a call to `start-profiling` and before a call to `stop-profiling` with `print t`, because the two profiling modes are incompatible.

11.3.2 Programmatic control of profiling

Your program can control profiling. This is useful when you want to profile only a part of the program.

In your program, call `start-profiling` start collecting profiling information. Call `stop-profiling` with `print nil` to temporarily stop collecting, or call `stop-profiling` with `print t` to stop collecting and print the results. At any point you can call `set-process-profiling` to modify the set of processes for which profiling information is being (or will be) collected.

For example:

```
; ; start profiling, current process only
(start-profiling :processes :current)
(do-interesting-work)
; ; temporarily suspend profiling
(stop-profiling :print nil)
(do-uninteresting-work)
; ; resume profiling
(start-profiling :initialize nil)
(do-more-interesting-work)
; ; now, all processes are interesting
(set-process-profiling :set :all)
(do-some-more-interesting-work)
; ; stop profiling and print the results
(stop-profiling)
```

Note: you cannot call `start-profiling` inside the scope of the macro `profile` or while the graphical Profiler is profiling, because the two profiling modes are incompatible.

11.4 Profiler output

A typical report would be:

```

profile-stacks called 564 times

Call tree
Symbol          seen   (%)
 1: MOD          17 ( 3)
 2: FLOOR        5 ( 1)
 1: EQL          8 ( 1)
 1: >=           7 ( 1)
 2: REALP        2 ( 0)
 1: +            6 ( 1)
 1: LENGTH       4 ( 1)

Cumulative profile summary
Symbol      called  profile   (%)      top   (%)
MOD        1000000    17 ( 3)      8 ( 1)
EQL        2000117     8 ( 1)      8 ( 1)
>=         1000001     7 ( 1)      5 ( 1)
+          1000000     6 ( 1)      6 ( 1)
FLOOR      1000000     5 ( 1)      5 ( 1)
LENGTH     2000086     4 ( 1)      4 ( 1)
REALP      1000001     2 ( 0)      2 ( 0)

Top of stack not monitored 93% of the time

```

The first line means that Lisp was interrupted 564 times by the profiler.

The call tree shows that in 17 of these interrupts (3% of them) the profiler found the function `mod` on the stack, in 5 of these interrupts it found the function `floor` on the stack, and so on. Moreover, `floor` only appears under the `mod` branch of the tree, which means that each of these times `floor` was called by `mod`.

The cumulative profile summary also shows how many times each symbol was found on the stack. Moreover it shows that the function `mod` was called 1000000 times, the function `eq1` was called 2000117 times, and so on. (Note: this information is not collected on Intel-based platforms by default.) In 17 of these interrupts it found the function `mod` on the stack, and on 8 of these occasions `mod` was on the top of the stack. You can deduce that 526 times the function on the top of the stack was none of those reported.

You can control sort order of the cumulative profile summary with `print-profile-list`.

11.5 Interpretation of profiling results

One important figure is the amount of time it was found on top of the stack in the cumulative profile summary. Just because a function is found on the stack does not mean that it uses up much processing time, but if it is found consistently on the top of the stack then it is likely that this function has a significant execution time. Another thing to check is that you expect the functions near to top of the call tree to take significant time.

It must be remembered that the numbers produced are from random samples and thus it is important to be careful in interpreting their meaning. The rate of sampling is always coarse in comparison to the function call rate and so it is possible for strange effects to occur and significant events to be missed. For example, “resonance” may occur when an event always occurs between regular sampling times, though in practice this does not appear to be a problem.

11.6 Profiling pitfalls

Profiling should only be attempted on compiled code. If it is done on interpreted code, the interpreter itself is profiled, and this distorts the results for the actual Lisp program.

Macros cannot be profiled as they are expanded during the compilation process. Similarly some Common Lisp functions may be present in the source code but not in the compiled code as they are transformed by the compiler. For example:

```
(member 'x '(x y z) :test #'eq)
```

is transformed to:

```
(memq 'x '(x y z))
```

by the compiler and therefore the function `member` is never called.

Recursive functions need special attention. A recursive function may well be found on the stack in more than one place during one interrupt. The profiler counts each occurrence of the function. Hence the total number of times a

function is found on the stack may be much greater than the number of times the stack is examined.

Care must be taken when profiling structure accessors. Structure accessors compile down into a call to a closure of which there is one for all structure setters and one for all structure getters. Therefore it is not possible to profile individual structure setters or getters by name.

It must be remembered that even though a function is found on the stack this does not mean that it is active or that it is contributing significantly to the execution time. However the function found on the top of the stack is by definition active, and thus this is the more important value.

It is quite possible that the amount of time the top symbol is monitored is significantly less than 100% despite the profiler being set to profile all the known functions of the application. This is because at the time of the interrupt an internal system function may well be on the top of the stack.

It is possible to profile all the symbols in the system by setting up the profiler as follows:

```
(set-up-profiler :package (list-all-packages))
```

11.7 Profiling and garbage collection

The macro `extended-time` provides useful information on garbage collection activities.

The `gc` argument of `set-up-profiler` controls whether or not the system's memory management functions are profiled.

12

Customization of LispWorks

This chapter gives examples of how to make changes to LispWorks to make it more suitable for use by you and your colleagues.

12.1 Introduction

12.1.1 Pre-loading code

You can save an image with changes pre-loaded. This is suitable for changes you want to share with other users of that image, and for code which takes some time to load. It cannot be used to alter settings which the system makes automatically on startup.

“Saving a LispWorks image” on page 131 describes how to do this.

12.1.2 Loading code at start up

You can also load changes each time you start LispWorks. This is suitable for code which loads quickly. For changes only you want to see, put the code in your personal initialization file. For changes to share with other users at your site, put the code in your site initialization file.

“Initialization files” on page 130 describes these initialization files.

12.1.3 Specific customizations

The remainder of this chapter describes some customizations, all of which can be saved in an image or placed in an initialization file, as needed. You can use both techniques: stable code including patches is saved in the image, whilst experimental or fast-loading code is loaded via the initialization file.

12.2 Configuration and initialization files

There are a number of files that contain configuration and initialization information:

12.2.1 Configuration files

- The LispWorks file `config/configure.lisp` contains many default configuration settings. You can create a customized copy of this file when you install LispWorks, as described in the *LispWorks Release Notes and Installation Guide*.
- The LispWorks file `config/key-binds.lisp` gives the default editor key bindings for Emacs emulation.
- The LispWorks file `config/mac-key-binds.lisp` gives the editor key bindings for Mac OS editor emulation, if supported on your platform.
- The LispWorks file `config/msw-key-binds.lisp` gives the editor key bindings for Microsoft Windows editor emulation, if supported on your platform.

12.2.2 Initialization files

- The LispWorks file `config/siteinit.lisp` is the default site initialization file. The distributed file loads any supplied patches.
- You may also have a personal initialization file which is loaded on startup. By default LispWorks looks for a file called `.lispworks` in your home directory, although you can change its name and location (see “Setting global preferences” in the *LispWorks IDE User Guide*).

The default location of your home directory varies on Unix systems, but it is typically something like `/home`. On Windows, the directory is constructed from the environment variables HOMEDRIVE and HOME- PATH. The directory itself has the same name as your user name, so if you log on as `john`, your home directory might be `/home/john` on Unix systems or something like `C:\Documents and Settings\john` on Windows XP.

A sample personal initialization file, the LispWorks file `config/a-dot-lispworks.lisp`, is supplied. You should create a customized copy of this file when you install LispWorks, as described in the *LispWorks Release Notes and Installation Guide*.

12.3 Saving a LispWorks image

There are two ways to save an image with changes pre-loaded.

- This section describes the traditional method, using a configuration file and `save-image` script.
- “Saved sessions” on page 133 describes how to save a session, which allows restoring your windowing environment as well as your Lisp objects.

12.3.1 The configuration file

First create a file `my-configuration.lisp` containing the settings you want in your saved image. You may want to change some of the pre-configured settings shown in `config/configure.lisp`, add customizations from the rest of this chapter, or load your application code.

12.3.2 The save-image script

Now create a `save-image` script which is a file `save-image.lisp` containing something like:

```
(in-package "CL-USER")
(load-all-patches)
(load #-mswindows "/tmp/my-configuration.lisp"
      #+mswindows "C:/temp/my-configuration.lisp")
#+:cocoa
(compile-file-if-needed
 (sys:example-file
  "configuration/macos-application-bundle")
 :load t)
(save-image #+:cocoa
  (write-macos-application-bundle
   "/Applications/LispWorks 6.0/My LispWorks.app")
 #:-cocoa "my-lispworks")
```

The script shown loads `my-configuration.lisp` from a temporary directory. You may need to modify this.

12.3.3 Save your new image

The simplest way to save your new image is to use the Application Builder tool in the LispWorks IDE. Start the Application Builder as described in the *LispWorks IDE User Guide*, enter the path of your `save-image` script in the **Build script:** pane, and press the **Build the application using the script** button.

Alternatively you can run LispWorks in a command interpreter and pass your `save-image` script in the command line as shown below.

- On Macintosh, run in Terminal.app:

```
mymac$ "/Applications/LispWorks 6.0/LispWorks.app/Contents/MacOS/
lispworks-6-0-0-macos-universal" -build save-image.lisp
```

Your new application bundle is saved in `/Applications/LispWorks 6.0/My LispWorks.app`

- On Microsoft Windows, run in a MS-DOS window:

```
C:\temp\>"C:\Program Files\LispWorks\lispworks-6-0-0-x86-
win32.exe" -build save-image.lisp
```

Your new LispWorks image is saved in `C:\temp\my-lispworks.exe`.

- On Linux, run in a shell:

```
linux:/tmp$ lispworks-6-0-0-x86-linux -build save-image.lisp
```

Your new LispWorks image is saved in `/tmp/my-lispworks`.

For other platforms and for 64-bit LispWorks the image name varies from that shown, but the principle is the same.

12.3.4 Use your new image

Your new LispWorks image contains the settings you specified in `my-configuration.lisp` pre-loaded.

You can add further customizations on start up via the initialization files mentioned in “Initialization files” on page 130.

Note that your newly saved image runs itself, not a saved session.

12.3.5 Saving a non-GUI image with multiprocessing enabled

To create an image which does not start the LispWorks IDE automatically, make a `save-image` script, for example in `/tmp/resave.lisp`, containing:

```
(in-package "CL-USER")
(load-all-patches)
(save-image "~/lw-console"
           :console t
           :multiprocessing t
           :environment nil)
```

Run LispWorks like this to create the new image `~/lw-console`:

```
lispworks-6-0-0-x86-linux -build /tmp/resave.lisp
```

12.4 Saved sessions

You can save a LispWorks session, which can be restarted at a later date. This allows you to resume work after restarting your computer.

Saving sessions is intended for users of the LispWorks IDE. The graphical tools described in *LispWorks IDE User Guide* provide the best way to use and configure session saving. However it is also possible to save a session programmatically, which is described in this section.

When you save a session, LispWorks performs the following three steps:

1. Closing all windows and stopping multiprocessing.

2. Saving an image. On Mac OS X this creates an application bundle.
3. Restarting the LispWorks IDE and all of its windows.

If a saved session is run later, then it will redo the last step above, but see “What is saved and what is not saved” on page 134 for restrictions.

Sessions are stored on disk as LispWorks images, by default within your personal application support folder (the exact directory varies between operating systems).

12.4.1 The default session

There is always a default session, which is used when you run the supplied LispWorks image.

When you run any other image directly, including a saved session or an image you created with `save-image`, it runs itself (not the default session).

Saved sessions are platform and version specific. In particular, a 32-bit LispWorks saved session cannot be the default session for 64-bit LispWorks, or vice-versa.

12.4.2 What is saved and what is not saved

All Lisp code and data that was loaded into the image or was created in it is saved. This includes all editor buffers, the Listener history and the value of `*`, `**` and `***`.

All threads are killed before saving, so any data that is accessible only through a `mp:process`, or by a dynamically bound variable, is not accessible.

All windows are closed, so any data that is accessible only within the windowing system is not accessible after saving a session.

The windows are automatically re-opened after saving the session and all Lisp data within the CAPI panes is retained.

External connections (including open files, sockets, database connections and COM interfaces) become invalid when the saved session is restarted. In the image from which the session was saved, the connections are not explicitly affected but if these connections are thread-specific, they will be affected because the thread is killed. In recreated Shell tools the command history is

recovered but the side effects of those commands are not. Debugger and Stepper windows are not re-opened because they contain the state of threads that have been killed.

12.4.3 Saving a session programmatically

You can save a session by calling `save-current-session`

12.4.3.1 Save Session actions

The first thing that `save-current-session` does is to execute the action-list "Save Session Before".

After redisplaying all the interfaces, the action-list "Save Session After" is executed. That happens both in the saving invocation and the restarting saved image.

12.4.3.2 Non-IDE interfaces

If there are non-IDE interfaces on the screen when `save-current-session` is invoked, these interfaces are destroyed in the first step, and displayed again in the third step. Note that the display will occur in a different thread than the one running the interface before the saving (which was killed in the first step).

If the interface (or any of its children) contains information that is normally destroyed (in some sense) in the `destroy-callback`, this information can be preserved over a call to `save-current-session` by defining methods on the generic functions `capi:interface-preserving-state-p` or `capi:interface-preserve-state`.

12.4.4 Saving a session using the IDE

You can save a session or set up periodic automatic session saving using the configuration tools in the LispWorks IDE. See "Session saving" in the *LispWorks IDE User Guide* for details.

12.5 Load and open your files on startup

Suppose you always compile and load several files after LispWorks starts. You can arrange for this to happen automatically by adding forms like these in your initialization file:

```
(defvar *my-files*
  '("/path/to/fool"
    "/path/to/foo2"
    "/path/to/foo3"))

(dolist (file *my-files*)
  (compile-file file :load t))
```

If you also want to open these files in the Editor tool, then you can add this form in your initialization file, after those above:

```
(define-action "Initialize LispWorks Tools"
  "Open My Files"
  #'(lambda (screen)
      (declare (ignore screen))
      (dolist (file *my-files*)
        (ed file))))
```

12.6 Customizing the editor

This section explains some of the customizations you can make to the Editor tool in the LispWorks IDE.

12.6.1 Controlling appearance of found definitions

The commands `Find Source`, `Find Source for Dspec` and `Find Tag` retrieve the file containing a definition and place it in a buffer with the relevant definition visible. By default, the start of the definition is in the middle of the Editor window and is highlighted.

The variable `editor:*source-found-action*` controls the position and highlighting of the found definition. The value should be a list of length 2.

The first element controls the positioning of the definition, as follows:

t	Show it at the top of the editor window.
---	--

A non-negative fixnum

Position it that many lines from the top.

`nil` Position it at the center of the window.

The second element can be `:highlight`, meaning highlight the definition, or `nil`, meaning don't.

For example, to configure the editor so that found definitions are positioned at the top of the window and are not highlighted, do

```
(setq editor:*source-found-action* '(t nil))
```

This variable is set in the file `a-dot-lispworks.lisp`.

12.6.2 Specifying the number of editor windows

You can specify the maximum number of editor windows that are present at any one time. For example, to set the maximum to 1:

```
(setq editor:*maximum-ordinary-windows* 1)
```

This variable is set in the file `a-dot-lispworks.lisp`.

12.6.3 Binding commands to keystrokes

You can bind existing editor commands to different keystrokes, using `editor:bind-key`.

The LispWorks file `config/key-binds.lisp` is supplied. It shows the standard Emacs key bindings for LispWorks.

The following example shows how to rebind `?` so that it behaves as an ordinary character in the echo area of tools in the LispWorks IDE — this can be useful if your symbol names include question marks.

```
(editor:bind-key "Self Insert" #\? :mode "Echo Area")
```

Since `?` is then no longer available for help, you may wish to rebind help to `Ctrl+?`.

```
(editor:bind-key "Help on Parse" #\C-? :mode "Echo Area")
```

If you use another editor emulation, then see the LispWorks file `config/msw-key-binds.lisp` or `config/mac-key-binds.lisp` for the corresponding `editor:bind-key` forms.

12.7 Finding source code

Note: This section does not apply to LispWorks Personal Edition.

To configure LispWorks so that editor commands such as `Find Source`, the menu command `Find Source`, and the dspec system are able to locate definitions in the supplied editor source code:

1. Load the logical host for the editor source code:

```
(load-logical-pathname-translations "EDITOR-SRC")
```

2. Configure source finding to know about editor source code:

```
(setf dspec:*active-finders*
      (append dspec:*active-finders*
              (list "EDITOR-SRC:editor-tags-db")))
```

3. Now do (for example) `Meta+X Find Command Definition` and enter `Wfind File`.

The definition of the command `wfind File` is displayed in an Editor tool.

See “Controlling appearance of found definitions” on page 136 for information on controlling how the source code is displayed.

12.8 Controlling redefinition warnings

By default most system-provided definers such as `cl:defun`, `cl:defmacro`, `cl:defmethod` and so on signal a warning when they redefine an existing definition. You can bind or set `*redefinition-action*` to eliminate such warnings or make it signal error instead.

Also, the system is configured to protect symbols in implementation packages against definition and redefinition. For example, an error is signalled if you attempt to put a function definition on the symbol `cl:*read-base*`. This behavior is configurable by the variables `*handle-warn-on-redefinition*` and `*packages-for-warn-on-redefinition*`. Bear in mind that the default

configuration protects the stability of the system, so if you need to prevent such errors it is better to bind one or both of these variables around specific defining forms, rather than setting their global values.

12.9 Specifying the initial working directory

The working directory is set on startup and provides the default location for the **File > Open...** dialog. Call `change-directory` in your initialization file (see “Initialization files” on page 130) to control the initial working directory.

12.10 Using ! for :redo

The default way of redoing the previous command from the command history is via `:redo`. If you want to use `!` (exclamation mark) instead of `:redo`, add the following to your `.lispworks` file:

```
(set-macro-character #\!
  #'(lambda (stream char)
    '!:redo))
```

You may wish during some sessions to reset `!` back to its normal role as a character. To do this, evaluate:

```
(set-syntax-from-char #\! #\@)
```

12.11 Customizing LispWorks for use with your own code

This section contains some information on customizations you can make in order to make developing your own code a little easier.

12.11.1 Preloading selected modules

If you frequently use some code that is normally supplied as separate modules, you can load them at start-up time from your initialization file. This file is called `.lispworks` by default, but can be changed to be any other filename. See “Setting global preferences” in the *LispWorks IDE User Guide* for details.

For example, to load the dynamic-completion code every time you start LispWorks, include the following in your initialization file.

```
(require "dynamic-complete")
```

12.11.2 Creating packages

When writing your own code that uses, for instance, the `capi` package, create a package of your own that uses `capi` — do not work directly in the `capi` package. By doing this you can avoid unexpected name clashes.

12.12 Structure printing

By default `defstruct` generates a method on `print-object`. You can avoid this by binding at macroexpansion time the variable `structure:*defstruct-generates-print-object-method*`.

12.13 Configuring the printer

This section applies only on Unix/Linux/FreeBSD platforms.

You can configure your LispWorks image for your printer, by selecting **File > Printer Setup** from any tool with printing capacities, for example the editor, and choosing **Add Printer**.

When configuring a printer, the CAPI printing library prompts for a *PostScript Printer Description* file (PPD), which defines such things as the paper size and the printable area of the page, in the form of a standard PostScript language header. The printing code splices this file into the PostScript produced from submitting a CAPI printing request.

The library on the LispWorks CD contains a generic PPD file, called `generic.ppd`, that defines these values conservatively to ensure that it should work with most printers. For accurate results, you should use the PPD supplied with your printer.

The PPD files are placed in the `ppd` subdirectory of the `postscript` directory in the `lispworks` library directory. Files added to the `ppd` directory are expected to have the extension ".`ppd`".

12.13.1 PPD file details

A PPD file contains a description of the attributes and capabilities of a given printer, such as paper sizes supported, the printable area of the page, the number and names of input paper trays, optional features such as additional paper

trays or duplex units, and so on, together with the printer-specific PostScript language commands necessary to use the features.

The `generic.ppd` file defines a simple generic printer supporting A4, A3, US letter, and US legal paper sizes, and supporting manual feed. It defines conservative margins (1 inch all round), and the documents generated should be compatible with most PostScript printers. It is suitable for producing PostScript files when the destination printer is unknown, and may also be used if the appropriate PPD for the printer is not available.

However, for the best results, we recommend the use of the appropriate PPD for the printer. This allows you to specify which optional features (if any) have been installed on the printer, and ensures that the Print dialog provides access to appropriate printer capabilities such as multiple input trays and duplex printing. This also ensures that the CAPI uses the correct values for the printable areas of the page.

13

LispWorks as a dynamic library

This chapter describes how to create a dynamic library or DLL from LispWorks and discusses use of the library.

13.1 Introduction

You can use 32-bit LispWorks to build a dynamic library on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD, and 64-bit LispWorks on Windows, Intel Macintosh, Linux and x86/x64 Solaris.

To do this, use `save-image` or `deliver` and supply a list value for *dll-exports*. On platforms other than Windows passing *dll-added-files* also creates a dynamic library.

The result is a library that cannot be executed on its own, but can be dynamically loaded by another process. On Windows this is done with the Windows APIs `LoadLibrary` and then `GetProcAddress`. On other platforms the dynamic library can be loaded by `dlopen` and then `dlsym`.

The dynamic library is usually of file type `dll` on Windows, `dylib` on Macintosh and `so` on Linux, x86/x64 Solaris or FreeBSD. The first implementation of this functionality in LispWorks was on Microsoft Windows only, therefore the terminology that is used is sometimes Windows-like. In particular “DLL” refers to any dynamic library.

13.2 Creating a dynamic library

To deliver a LispWorks runtime as a dynamic library supply a list value for *dll-exports* when calling `deliver`.

To save a LispWorks image as a dynamic library supply a list value for *dll-exports* when calling `save-image`.

Additionally on Linux, x86/x64 Solaris, Macintosh and FreeBSD platforms, you can supply a list value for *dll-added-files* to deliver or save a dynamic library.

Note: a LispWorks dynamic library is licensed in the same way as a LispWorks executable.

13.2.1 C functions provided by the system

When LispWorks is a dynamic library the functions described in Chapter 45, “Dynamic library C functions” are automatically available. They allow the loading process control over relocation and unloading of the library.

13.2.2 C functions provided by the application

dll-exports specifies application-defined exported functions in a LispWorks dynamic library.

Exports can also be provided in the files named in *dll-added-files*, on Linux, x86/x64 Solaris, Macintosh and FreeBSD platforms.

13.2.3 Example

This script saves an image `hello.dll` which is a Windows DLL:

```
----- hello.lisp -----
(in-package "CL-USER")
(load-all-patches)
;; The signature of this function is suitable for use with
;; rundll32.exe.
(fli:define-foreign-callable ("Hello"
                               :calling-convention :stdcall)
  ((hwnd w:hwnd)
   (hinst w:hinstance)
   (string :pointer)
   (cmd-show :int))
  (capi:display-message "Hello world"))

(save-image "hello"
            :dll-exports '("Hello")
            :environment nil)
-----
-----
```

Run the script by

```
lispworks-6-0-0-x86-win32.exe -build hello.lisp
```

on the command line, or use the Application Builder tool.

(See “Saving a LispWorks image” on page 131 for more information about how to save an image.)

You can test the DLL by running

```
rundll32 hello.dll,Hello
```

on the command line.

To see the dialog, you may need to dismiss the LispWorks splashscreen first.

13.3 Initialization of the dynamic library

Each of the exports specified via *dll-exports* ensure first that LispWorks has finished initializing. If initialization has not yet started, they start the initialization process themselves. This is true regardless of the value of *automatic-init* (see below).

A LispWorks dynamic library is initialized automatically on loading, or not, according to the value of *automatic-init* in the call to `deliver` or `save-image`.

13.3.1 Automatic initialization

On Windows when *automatic-init* was true the initialization finishes before the Windows function `LoadLibrary` returns, and if LispWorks fails for some reason then the call to `LoadLibrary` fails too.

On other platforms when *automatic-init* was true, during the automatic initialization `dlopen` just causes the initialization to start and returns immediately. The initialization will finish sometime later. The LispWorks function `LispWorksState` can be used to check whether it finished initializing.

Automatic initialization is useful when the dynamic library is something like a server that does not communicate by function calls. On Windows it also allows `LoadLibrary` to succeed or fail according to whether the LispWorks dynamic library initialized successfully or not.

13.3.2 Initialization via `InitLispWorks`

Not using automatic initialization (that is, creating the dynamic library with *automatic-init nil*) allows using `InitLispWorks` to relocate the image if necessary, and do any other initialization that may be required.

13.4 Relocation

LispWorks normally maps its heap on startup in the same place that it was when it was saved, and when it needs more memory it maps this nearby. This applies when LispWorks is a dynamic library as well as for LispWorks executables.

This mapping can cause memory clashes with other software, which may be avoided by relocating LispWorks. Most of the LispWorks implementations are relocatable though the details vary between platforms and between 32-bit LispWorks and 64-bit LispWorks.

On Microsoft Windows and Macintosh, LispWorks detects and avoids memory clashes automatically. On other platforms, you can relocate a LispWorks dynamic library (for all the relocatable implementations) if necessary by a suitable call to `InitLispWorks` as described in “Startup relocation” on page 306.

13.5 Multiprocessing in a dynamic library

Multiprocessing is started automatically in a LispWorks dynamic library. Therefore you can arrange for Lisp initialization operations by adding process specifications to `*initial-processes*`.

For example, if you have a function like this:

```
(defun my-server ()  
  (let ((s (establish-a-socket)))  
    (loop (accept-connection s))))
```

you need to do something like:

```
(pushnew '("My server" () my-server) mp::*initial-processes*  
        :test 'equalp)
```

before saving or delivering your library.

13.6 Unloading a dynamic library

Before a LispWorks dynamic library is unloaded, LispWorks should be made to ‘quit’ cleanly, allowing it to clean up resources that it uses.

When the LispWorks dynamic library is loaded by a main process which you (the LispWorks programmer) do not control, then use `dll-quit`. If you control the main process, then use `quitLispWorks` instead. For the details, see the respective manual entries for `dll-quit` and `quitLispWorks`.

14

The Metaobject Protocol

LispWorks CLOS essentially supports the metaobject protocol described in chapters 5 & 6 of *The Art of the Metaobject Protocol* (Kiczales, des Rivières & Bobrow, The MIT Press, 1991). Throughout the LispWorks documentation, “AMOP” refers to this book. Users might find it helpful to refer to the relevant chapters online at <http://www.lisp.org/mop/>.

All the LispWorks MOP symbols are in the `clos` package.

There are some discrepancies between LispWorks and AMOP, which are described in this Chapter.

This Chapter also describes some common problems encountered by programmers using the MOP.

14.1 Metaobject features incompatible with AMOP

14.1.1 Instance Structure Protocol

The generic functions implementing slot access are like those described in AMOP, except that each takes a *slot-name* argument rather than a slot definition object, and the primary methods are therefore specialized differently.

For details, see `slot-boundp-using-class`, `slot-value-using-class` and `slot-makunbound-using-class`.

Note: by default, standard slot accessors are optimized to not call `slot-value-using-class`. This can be overridden with the `:optimize-slot-access` class option. See the second definition of `virtual-metaclass` below for an example of the use of this.

`standard-instance-access` is not supported as defined in AMOP. Note that there is an internal function of the same name, but this is not optimal. Also, `funcallable-standard-instance-access` is not supported. An alternative for fast instance access is to use the `:optimize-slot-access` class option.

14.1.2 Method Metaobjects

`standard-reader-method`, `standard-accessor-method` and `standard-writer-method` all have a required `:slot-name` initarg, rather than a `:slot-definition` initarg as specified in AMOP.

Compatibility Note: in LispWorks 4.3 and previous versions, `accessor-method-slot-definition` was not implemented. This is implemented in the current version.

14.1.3 Method Lambdas

LispWorks `make-method-lambda` is not AMOP-compatible. It takes separate `lambda-list` and `body` arguments, and the returned `lambda` form is different to that specified in AMOP (see “Method Functions” on page 150 below).

LispWorks does not support user defined methods for the generic function `make-method-lambda`.

14.1.4 Method Functions

LispWorks method functions take the same arguments as the method itself, whereas in AMOP they take a list of arguments and a list of next methods.

14.1.5 EQL specializers

`eql-specializer`, `eql-specializer-object` and `intern-eql-specializer` are not implemented.

`eql` specializers in LispWorks are lists.

14.1.6 Generic Function Invocation Protocol

`compute-applicable-methods-using-classes` is not implemented.

`compute-discriminating-function` is implemented and returns the discriminator but:

- It does not use `compute-applicable-methods-using-classes` since LispWorks does not have that function.
- It does not call `compute-applicable-methods`.

Moreover `add-method` does not call `compute-discriminating-function` because this would be inefficient when doing multiple calls to `add-method`. Instead, `compute-discriminating-function` is called when the generic function is called.

14.1.7 Method combinations

`method-combination` objects do not contain the arguments, merely the type. There is a single `method-combination` object per type.

Therefore the value returned by `generic-function-method-combination`, and the default value of the `:method-combination` initarg, and the `:method-combination` argument processed by `ensure-generic-function-using-class` are specific only to the type of the method combination.

Also, `find-method-combination` is not implemented.

14.1.8 Compatible metaclasses

The AMOP defines that the standard primary method for `validate-super-class` should return true if the class of one of the arguments is `standard-class` and the class of the other is `funcallable-standard-class`.

In LispWorks, objects of these metaclasses are not completely compatible, so `validate-superclass` will return false in these cases.

Beware that defining a class that mixes `standard-class` and `funcallable-standard-class` can lead to inconsistencies with the predicate `functionp`, the type `function` and the class `function`.

14.1.9 Inheritance Structure of Metaclass Classes

`funcallable-standard-object` is implemented as defined in AMOP, except that its class precedence list has direct superclasses

```
(function standard-object)
```

rather than

```
(standard-object function)
```

so that LispWorks is compliant with the ANSI Common Lisp rules.

For details, see `funcallable-standard-object`, page 328.

14.2 Common problems when using the MOP

14.2.1 Inheritance across metaclasses

Usually an inherited class is of the same metaclass as the parent class.

For other kinds of inheritance, you need to define a method on `validate-superclass` which returns true when called with the respective metaclasses. For example:

```
(defclass mclass-1 (standard-class)
  ())

(defclass mclass-2 (standard-class)
  ())

(defclass a ()
  ()
  (:metaclass mclass-1))

(defmethod validate-superclass
  ((class mclass-2)
   (superclass mclass-1))
  t)

(defclass b (a)
  ()
  (:metaclass mclass-2))
```

Without the `validate-superclass` method, the last form signals an error because `mclass-1` is an invalid superclass of `mclass-2`.

14.2.2 Accessors not using structure instance protocol

By default, `defclass` creates optimized standard accessors which do not call `slot-value-using-class`.

This optimization is controlled by the `defclass` option `:optimize-slot-access`, which defaults to `t`.

There is an illustration of this effect of `:optimize-slot-access` in the example below.

14.2.3 The MOP in delivered images

Issues with MOP code that occur only in delivered LispWorks images are documented in the section “Delivery and the MOP” in the *LispWorks Delivery User Guide*.

14.3 Implementation of virtual slots

This is an implementation of virtual slots with readers, writers and which also allow access by `slot-value`.

```

;; ----- Virtual Slots -----
(in-package "CL-USER")

;; Metaclass of objects that might contain virtual slots.

(defclass virtual-metaclass (standard-class)
  ()
  )

;; Mixin metaclass for virtual slots and methods to make them
;; appear virtual.

(defclass virtual-slot-definition
  (standard-slot-definition)
  ((function :initarg :function
             :accessor virtual-slot-definition-function)))
  )

(defmethod slot-definition-allocation
  ((slotd virtual-slot-definition))
  :virtual)

(defmethod (setf slot-definition-allocation)
  (allocation (slotd virtual-slot-definition))
  (unless (eq allocation :virtual)
    (error "Cannot change the allocation of a ~S"
          'virtual-direct-slot-definition))
  allocation)

;; Class of direct virtual slots and methods to construct them
;; when appropriate.

(defclass virtual-direct-slot-definition
  (standard-direct-slot-definition
   virtual-slot-definition)
  ()
  )

;; Called when the class is being made, to choose the metaclass of
;; a given direct slot. It should return the class of slot
;; definition required.

(defmethod clos:direct-slot-definition-class
  ((class virtual-metaclass) &rest initargs)
  ;; Use virtual-direct-slot-definition if appropriate.
  (if (eq (getf initargs :allocation) :virtual)
      (find-class 'virtual-direct-slot-definition)

```

```

        (call-next-method)))

;; Called when the defclass is expanded, to process a slot option.
;; It should return the new list of slot options, based on
;; already-processed-options.

(defmethod clos:process-a-slot-option
    ((class virtual-metaclass) option value
     already-processed-options slot)
  ;; Handle the :function option by adding it to the
  ;; list of processed options.
  (if (eq option :function)
      (list* :function value already-processed-options)
      (call-next-method)))

;; Class of effective virtual slots and methods to construct
;; them when appropriate.

(defclass virtual-effective-slot-definition
    (standard-effective-slot-definition
     virtual-slot-definition)
  ()
  )

;; Called when the class is being finalized, to choose the
;; metaclass of a given effective slot.  It should return the
;; class of slot definition required.

(defmethod clos:effective-slot-definition-class
    ((class virtual-metaclass) &rest initargs)
  ;; Use virtual-effective-slot-definition if appropriate.
  (let ((slot-initargs (getf initargs :initargs)))
    (if (member :virtual-slot slot-initargs)
        (find-class 'virtual-effective-slot-definition)
        (call-next-method)))

(defmethod clos:compute-effective-slot-definition
    ((class virtual-metaclass)
     name
     direct-slot-definitions)
  ;; Copy the function into the effective slot definition
  ;; if appropriate.
  (let ((effective-slotted (call-next-method)))
    (dolist (slotted direct-slot-definitions)
      (when (typep slotted 'virtual-slot-definition)
        (setf (virtual-slot-definition-function effective-slotted)

```

```

(virtual-slot-definition-function slotd))
  (return)))
effective-slotd))

;; Underlying access methods for invoking
;; virtual-slot-definition-function.

(defmethod clos:slot-value-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :get
                 object)
        (call-next-method)))))

(defmethod (setf clos:slot-value-using-class)
  (value (class virtual-metaclass) object slot-name)
  (format t "~% setf slot : ~A" slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :set
                 object
                 value)
        (call-next-method)))))

(defmethod clos:slot-boundp-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :is-set
                 object)
        (call-next-method)))))

(defmethod clos:slot-makunbound-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :unset
                 object)
        (call-next-method)))))


```

```

          object)
(call-next-method)))))

(defmethod clos:slot-exists-p-using-class
  ((class virtual-metaclass) object slot-name)
(or (call-next-method)
  (and (find slot-name (class-slots class)
             :key 'slot-definition-name)
       t)))

;; Example virtual slot which depends on a real slot.
;; Compile this separately after the virtual-metaclass etc.

(defclass a-virtual-class ()
  ((real-slot :initarg :real-slot :accessor real-slot
              :initform -1)
   (virtual-slot :accessor virtual-slot
                 :initarg :virtual-slot
                 :allocation :virtual
                 :function
                 'a-virtual-class-virtual-slot-function))
  (:metaclass virtual-metaclass))

(defun a-virtual-class-virtual-slot-function
  (key object &optional value)
  (ecase key
    (:get (let ((real-slot (real-slot object)))
            (if (<= 0 real-slot 100)
                (/ real-slot 100.0)
                (slot-unbound (class-of object)
                              object
                              'virtual-slot))))
    (:set (setf (real-slot object) (* value 100))
          value)
    (:is-set (let ((real-slot (real-slot object)))
               (<= real-slot 100)))
    (:unset (setf (real-slot object) -1))))
;; ----- Virtual Slots -----

```

Compile the code above. Then make an object and access the virtual slot:

```

CL-USER 1 > (setf object (make-instance 'a-virtual-class))
#<A-VIRTUAL-CLASS 2067B064>

CL-USER 2 > (setf (virtual-slot object) 0.75)

      setf slot : VIRTUAL-SLOT
0.75

CL-USER 3 > (virtual-slot object)
0.75

CL-USER 4 > (real-slot object)
75.0

```

Note that when you call `(setf real-slot)` there is no output since `(setf clos:slot-value-using-class)` is not called. Compare with `(setf virtual-slot)`.

```

CL-USER 5 > (setf (real-slot object) 42)
42

```

Redefine `a-virtual-class` with `:optimize-slot-access nil`:

```

CL-USER 6 > (defclass a-virtual-class ()
               ((real-slot :initarg :real-slot
                           :accessor real-slot
                           :initform -1)
                (virtual-slot :accessor virtual-slot
                           :initarg :virtual-slot
                           :allocation :virtual
                           :function
                           'a-virtual-class-virtual-slot-function))
               (:metaclass virtual-metaclass)
               (:optimize-slot-access nil))

Warning: (DEFCLASS A-VIRTUAL-CLASS) being redefined in LISTENER
(previously in H:\tmp\vs.lisp).
Warning: (METHOD REAL-SLOT (A-VIRTUAL-CLASS)) being redefined in
LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD (SETF REAL-SLOT) (T A-VIRTUAL-CLASS)) being
redefined in LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD VIRTUAL-SLOT (A-VIRTUAL-CLASS)) being redefined
in LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD (SETF VIRTUAL-SLOT) (T A-VIRTUAL-CLASS)) being
redefined in LISTENER (previously in H:\tmp\vs.lisp).
#<VIRTUAL-METACLASS A-VIRTUAL-CLASS 21AD908C>

```

Now the standard accessors call `slot-value-using-class`, so we see output when calling `(setf real-slot)`

```
CL-USER 7 > (setf (real-slot object) 42)

  setf slot : REAL-SLOT
  42
```


15

Multiprocessing

LispWorks supports “lightweight” processes. The programming environment, for example, makes extensive use of this mechanism to create separate processes for the various tools.

On Microsoft Windows, Mac OS X, Linux, x86/x64 Solaris and FreeBSD, LispWorks multiprocessing uses native threads and supports Symmetric Multiprocessing (SMP). The implementation is referred to as "SMP LispWorks" where relevant.

On other platforms LispWorks uses a single native thread and implements user level threads. The implementation is referred to as "non-SMP LispWorks" where relevant.

15.1 Introduction to processes

A process (sometimes called a thread) is a separate execution context. It has its own call stack and its own dynamic environment.

A process can be in one of three different states: *running*, *waiting*, and *inactive*. When a process is *waiting*, it is still active, but is waiting for the system to wake it up and allow its computation to restart. A process that is *inactive* has stopped, because it has an arrest “reason”.

For a process to be active (that is, running or waiting), it must have at least one run reason and no arrest reasons. If, for example, it was necessary to temporarily stop a process, it could temporarily be given an arrest reason. However the arrest reason mechanism is not commonly used in this manner.

The process that is currently executing is termed “the current process”. The function `get-current-process` gets the current process, and is the preferred way of doing so. The variable `*current-process*` is normally bound to the same process, except inside a wait function when it is called by the scheduler.

The current process continues to be executed until either it becomes a waiting process by calling a Process Wait function as described in “Process Waiting” on page 182, or it allows itself to be interrupted by calling `process-allow-scheduling` (or its current timeslice expires and it involuntarily relinquishes control).

In SMP LispWorks all processes that are not waiting are running as far as LispWorks is concerned, and are scheduled by the operating system to the available CPUs.

In non-SMP LispWorks, the system runs the waiting process with the highest priority. If processes have the same priority then the system treats them equally and fairly. This is called round robin scheduling.

The simplest way to create a process is to use `process-run-function`. This creates a process with the specified name which commences by applying the specified function to arguments. `process-run-function` returns immediately and the newly created process runs concurrently.

15.2 The process programming interface

15.2.1 Creating a process

To create a new process, use `process-run-function`.

15.2.2 Finding out about processes

The system initializes a number of processes on startup. These processes are specified by `*initial-processes*`.

The current process is specified by `*current-process*`. A list of all the current processes is returned by `list-all-processes`. The function `ps` is analogous to the UNIX command `ps`, and returns a list of the processes in the system, ordered by priority.

To find a process when you know its name, use `get-process`. To find the name, when you have the process, use `process-name`. The variable `*process-initial-bindings*` specifies the variables that are initially bound in a process.

15.2.3 Process Priorities

Each process has a priority and can either be runnable, blocked or suspended.

The effect of process priorities is significantly different between SMP LispWorks and non-SMP LispWorks.

15.2.3.1 Process priorities in SMP LispWorks

Process priorities are almost completely ignored in SMP LispWorks.

The main exception is that for processes that wait with `process-wait` for something to happen, a process with higher priority is likely to wake up earlier, but even then it is not guaranteed.

15.2.3.2 Process priorities in non-SMP LispWorks

If there is a runnable process with priority P, then no processes with priority less than P will run. When there are runnable processes with equal priority, they will be scheduled in a round-robin manner.

If a process with priority P is running and a blocked process with priority greater than P becomes runnable, the second process will run when the scheduler is next invoked (either explicitly or at the next preemption tick).

To find the priority of a process, use `process-priority`. This can be changed using `change-process-priority`.

```
(mp:change-process-priority proc-1 10)
```

Another way to specify the priority is to create the process with `process-run-function`, passing the keyword `:priority`:

```
(list
  (mp:process-run-function
    "SORTER-DOT" '(:priority 10) #'sorter #\.)
  (mp:process-run-function
    "SORTER-DASH" () #'sorter #\-))
```

15.2.4 Interrupting a process

To interrupt a running process, use `process-interrupt` OR `process-kill`. To break a process and enter the debugger, use `process-break`.

To suspend a process until a predicate is `t`, use `process-wait`, `process-wait-with-timeout`, `process-wait-local`, `process-wait-local-with-timeout`, `process-wait-local-with-timeout-and-periodic-checks` OR `process-wait-local-with-timeout-and-periodic-checks`. The function `process-wait-function` returns a function that specifies a reason for the process waiting.

Note: The `process-wait*` functions need to be called from the process you want to suspend.

15.2.5 Blocking interrupts

The purpose of blocking interrupts is to prevent a process aborting in the middle of an operation that needs to be completed. A typical example is the cleanup forms of an `unwind-protect`.

Blocking interrupts does not provide atomicity. Other processes may continue to execute.

Blocking interrupts limits the control that LispWorks has over the processes, so interrupts should not be blocked except when necessary. However, apart from blocking interrupts in a process it does not affect the behavior of the system.

The following macros and functions allow control over blocking interrupts: `allowing-block-interrupts`, `with-interrupts-blocked`, `current-process-unblock-interrupts` and `current-process-block-interrupts`.

Additionally the macros `unwind-protect-blocking-interrupts` and `unwind-protect-blocking-interrupts-in-cleanups` allow your program to prevent interrupts from stopping cleanup forms from completing.

Compatibility note: In LispWorks 5.1 and previous versions, `mp:without-preemption` and `mp:without-interrupts` are sometimes used to block interrupts, but they also provide atomicity. In many cases (probably most), they are used to provide atomicity, and in these cases they cannot be replaced by blocking interrupts. To get atomicity in LispWorks 6.0 and later you need to use locks or atomic operations. To get atomicity while debugging, you can also use `with-other-threads-disabled`.

15.2.6 Old interrupt blocking APIs removed

The macros `mp:without-interrupts` and `mp:without-preemption`, which were available in LispWorks 5.1 and earlier, are no longer supported. The semantics of these macros allowed them to be used for several different purposes, which now require specific solutions.

- Atomic operations. This use was designed to make operations atomic with respect to other uses of the same macro or with respect to some other unquantified operations that were expected to be atomic, such as reading or writing a single slot in an object. Code of this kind should be converted to use locks (see “Locks” on page 179) or low level atomic operations (see “Low level atomic operations” on page 175).
- Complete operations. This use was designed to ensure that a set of operations completed without being interrupted by `mp:process-interrupt`, keyboard breaks and so on. See “Blocking interrupts” on page 164 for the new approach.

The following subsections show examples of typical uses of the old interrupt blocking APIs together with their replacements. The examples use `mp:without-interrupts` but the ideas also apply to uses of `mp:without-preemption`.

15.2.6.1 Atomic increment

Old:

```
(without-interrupts
  (incf *global-counter*))
```

New: use low level atomic operations.

```
(sys:atomic-incf *global-counter*)
```

15.2.6.2 Atomic push/pop

Old:

```
(without-interrupts
  (push value *global-list*))
  (without-interrupts
    (pop *global-list*))
```

New: use low level atomic operations.

```
(sys:atomic-push value *global-list*)
(sys:atomic-pop *global-list*)
```

15.2.6.3 Atomic push/delete

Old:

```
(without-interrupts
  (push value *global-list*))
  (without-interrupts
    (setq *global-list* (delete value *global-list*)))
```

New: use a lock, because delete cannot be done atomically since it reads more than one object before modifying one of them.

```
(defvar *global-list-lock* (mp:make-lock :name "Global List"))

(mp:with-lock (*global-list-lock*)
  (push value *global-list*))

(mp:with-lock (*global-list-lock*)
  (setq *global-list* (delete value *global-list*)))
```

15.2.6.4 Atomic plist update

Old:

```
(without-interrupts
  (setf (getf *global-plist* key) value))
  (without-interrupts
    (getf *global-plist* key))
```

New: use a lock, because a plist consists of more than one object so cannot be updated with low level atomic operations.

```
(defvar *global-plist-lock* (mp:make-lock :name "Global Plist"))

(mp:with-lock (*global-plist-lock*)
  (setf (getf *global-plist* key) value))

(mp:with-lock (*global-plist-lock*)
  (getf *global-plist* key))
```

15.2.6.5 Atomic update of a data structure

The example below is a resource object, which maintains a count of free items and also list of them. These two slots must stay synchronized.

Old:

```
(without-interrupts
  (when (plusp (resource-free-item-count resource))
    (decf (resource-free-item-count resource))
    (pop (resource-free-items resource))))
```

New: use a lock, because more than one slot has to be updated, so cannot be updated with low level atomic operations.

```
(mp:with-lock ((resource-lock resource))
  (when (plusp (resource-free-item-count resource))
    (decf (resource-free-item-count resource))
    (pop (resource-free-items resource))))
```

15.2.6.6 Atomic access to a cache in a hash table

Old:

```
(without-interrupts
  (or (gethash value *global-hashtable*)
      (setf (gethash value *global-hashtable*)
            (make-cached-value))))
```

New: use the hash table lock.

```
(hcl:with-hash-table-locked
  *global-hashtable*
  (or (gethash value *global-hashtable*)
      (setf (gethash value *global-hashtable*)
            (make-cached-value))))
```

Alternative new: use the hash table lock only if the value is not already cached. This can be faster than the code above, because it avoids locking the hash table for concurrent reads.

```
(or (gethash value *global-hashtable*); probe without the lock
    (hcl:with-hash-table-locked
      *global-hashtable*
      (or (gethash value *global-hashtable*); reread with the lock
          (setf (gethash value *global-hashtable*)
                (make-cached-value)))))
```

15.2.7 Multiprocessing

To start multiprocessing, use `initialize-multiprocessing`. This function does not return until multiprocessing has terminated.

It is not necessary to use `initialize-multiprocessing` when the LispWorks environment is already running. Note that, on Windows, Mac OS X, Linux, x86/x64 Solaris and FreeBSD, the LispWorks images shipped do start the programming environment. If you create an image which does not start the programming environment, by using the `:environment nil` argument to `save-image`, then multiprocessing can be started in this new image as described below.

15.2.7.1 Starting multiprocessing interactively

You can call `initialize-multiprocessing` from the REPL interface, which generates a default Listener process if no other processes are specified by `*initial-processes*`.

15.2.7.2 Multiprocessing on startup

There are three ways to make a LispWorks executable start multiprocessing on startup.

1. Use the `-multiprocessing` command line argument
2. Save an image which starts multiprocessing by doing

```
(save-image "mp-lispworks"
            :restart-function 'mp:initialize-multiprocessing)
```

3. Use delivery to create the executable and pass the argument `:multiprocessing t` to `deliver`. The delivery function will be called automatically in a new process. See the *LispWorks Delivery User Guide* for more details.

LispWorks dynamic libraries always start multiprocessing on startup. See “Multiprocessing in a dynamic library” on page 147 for more information.

In all cases, `*initial-processes*` can be used to control which processes are created on startup, as described in “Running your own processes on startup” on page 169.

Note: On Windows, Linux, x86/x64 Solaris, FreeBSD and Mac OS X you cannot save a LispWorks image with multiprocessing running.

15.2.7.3 Running your own processes on startup

`*initial-processes*` is a list of lists. Each list is used by the system as a set of arguments to `process-run-function`. During initializing multiprocessing, the system does this:

```
(dolist (x mp:*initial-processes*)
  (apply 'mp:process-run-function x))
```

This script saves a LispWorks image which starts multiprocessing on restart and runs a user-defined process.

```
(load-all-patches)
(load "my-server-code")
(push '("Start Server" () start-my-server)
      mp:*initial-processes*)
(save-image "my-server"
            :remarks "My Server"
            :restart-function 'mp:initialize-multiprocessing
            :environment nil)
```

See `save-image`, page 605 for a description of how to save an image.

15.2.8 Values across processes

This section describes ways to pass or read values in another process.

15.2.8.1 Returning a value from another process

Rather than using global variables to pass values between processes, you can use closures instead. For example:

```
(defun send-with-result (process function)
  (let ((remote-result :none))
    (flet ((resultp ()
            (listp remote-result))
           (run-it ()
             (setq remote-result
                   (multiple-value-list (funcall function))))))
      (mp:process-send process (list #'run-it))
      (mp:process-wait "Waiting for result" #'resultp)
      (values-list remote-result))))
```

15.2.8.2 Accessing symbol values across processes

Use `symeval-in-process` to read the value of a dynamically bound symbol in a given process.

`(setf mp:symeval-in-process)` can set the value of such a symbol.

`symeval-in-process` is mostly intended for debugging. Do not call it while the thread is actually running.

15.2.9 Stopping and unstopping processes

This section describes a typical way of using `process-stop` and `process-unstop`.

Suppose a pool of "worker" processes is managed by a "manager" process. A process in the worker pool marks itself as available for work, and then calls `process-stop`. The manager process later finds a worker process that is marked as available for work, puts the work in a place known to the worker process, and then calls `process-unstop` on the worker process.

For this scheme to work properly, the check of whether the worker is available needs to include a call to `process-stopped-p`. Otherwise, it is possible for the following sequence of events to occur:

1. A worker marks itself as available.
2. The manager process finds the worker and gives it the work.

3. The manager process calls `process-unstop` on the worker.
4. The worker process proceeds and calls `process-stop`, and never wakes up.

To guard against this possibility, then the manager should call `process-stopped-p` when finding the worker in the second step above. Alternatively, it could check the result of `process-unstop`.

15.2.10 Example

The following example allows two (or more) multiplication tables to be printed out simultaneously.

First, the function to print out a multiplication table.

```
(in-package "USER")

(defun print-table (number total stream)
  (do ((i 1 (+ i 1)))
      ((> i total))
    (format stream "~S X ~S = ~S~%" number i (* i number))
    (mp:process-allow-scheduling)))
```

Note the use of `process-allow-scheduling` to allow the process to be interrupted once during each iteration of the do loop.

Now we define the function that calls `print-table` within multiprocessing:

```
(defun process-print-table (name number total)
  (mp:process-run-function name nil
    #'print-table number total *standard-output*))
```

The `nil` argument is used because no keywords are specified.

`process-print-table` can now be called from two separate Listener windows to print out different multiplication tables simultaneously, for example:

```
(process-print-table "t1" 5 50)
```

in one Listener and:

```
(process-print-table "t2" 6 50)
```

in another Listener.

15.3 Atomicity and thread safety of the LispWorks implementation

Access to all Common Lisp objects is thread safe in the sense that it does not cause an error because of threading issues.

15.3.1 Immutable objects

Immutable (or read-only) objects such as numbers, characters, functions, pathnames and restarts can be freely shared between threads.

15.3.2 Mutable objects supporting atomic access

This section outlines for which types of mutable Common Lisp object access is atomic. That is, each value read from the object will correspond to the state at some point in time. Note however, that if several values are read, there is no guarantee about how these values will relate to each other if they are being modified by another thread (see “Issues with order of memory accesses” on page 174).

When one of these mutable atomic objects is modified, readers see either the old or new value (not something else), and it is guaranteed that the Lisp image is not corrupted by the modification even if multiple threads read or write the object simultaneously.

Access to conses, simple arrays, symbols, packages and structures is atomic. Note that this does not apply to non-simple arrays.

Slot access in objects of type `standard-object` is atomic with respect to modification of the slots and and with respect to class redefinition.

`vector-pop`, `vector-push`, `vector-push-extend`, `(setf fill-pointer)` and `adjust-array` are all atomic with respect to each other, and with respect to other access to the array elements.

The Common Lisp functions that access hash tables are atomic with respect to each other. See also `modify-hash` for atomic reading and writing an entry and `with-hash-table-locked`.

Access to packages is atomic.

Note that pathnames cannot be modified, and therefore access to them is always atomic.

Operations on editor buffers (including points) are atomic and thread-safe as long as their arguments are valid. This includes modification to the text. However, buffers and points may become invalid because of execution on another thread. The macros `editor:with-buffer-locked` and `editor:with-point-locked` should be used around editor operations on buffers and points that may be affected by other processes. Note that this is applicable also to operations that do not actually modify the text, because they can behave inconsistently if the buffer they are looking at changes during the operation. See the *LispWorks Editor User Guide* for details of these macros.

15.3.3 Mutable objects not supporting atomic access

This section outlines for which types of mutable Common Lisp object access is not atomic.

Access to arrays with element type of integer of less than 8 bits is not guaranteed to be atomic.

Access to non-simple arrays is not guaranteed to be atomic.

Access to lists (including alists and plists) is not atomic. Lists are made of multiple cons objects, so although access to the individual conses is atomic, the same does not hold for the list as a whole.

Sequence operations which modify multiple elements are not atomic.

Macros that expand to multiple accesses are in general not atomic. In particular, modifying macros like `push` and `incf` are not atomic (but see the atomic versions of some of them in “Low level atomic operations” on page 175).

Making several calls to Common Lisp functions that access hash tables will not be atomic overall. See also `modify-hash` for atomic reading and writing an entry and `with-hash-table-locked`.

Stream operations are in general not atomic. There is an undocumented interface for locking of streams when this is required - contact Lisp Support if you need this.

Operations on CAPI objects are not atomic in general. The same is true for anything in the IDE. These operations need to be invoked from the thread that owns the object, for example by `capi:execute-with-interface` or `capi:apply-in-pane-process`.

15.3.4 Issues with order of memory accesses

When multiple threads access the same memory location, the order of those accesses is not generally guaranteed. You should therefore not attempt to implement "lockless algorithms" which depend on the order of memory accesses.

However, all of the atomic operations and locking operations in this chapter do ensure that all memory accesses that happen before them have finished and that all memory accesses that happen after them start after them. Therefore, normally there is nothing special to consider when using these operations. The modification check macros `with-modification-change` and `with-modification-check-macro` also take care of this.

15.3.5 Single-thread context arrays and hash-tables

Access to hash tables and non-simple arrays can be improved where they are known to be accessed in a single thread context. That is, only thread at the same time accesses them.

The `make-hash-table` argument *single-thread* tells `make-hash-table` that the table is going to be used only in single thread context, and therefore does not need to be thread-safe. Such a table allows faster access.

Similarly the `make-array` argument *single-thread* creates an array that is single threaded. Currently, the main effect of *single-thread* is on the speed of `vector-pop`, `vector-push`, and `vector-push-extend` on non-simple vectors. These operations are much faster on "single threaded" vectors, typically more than twice as fast as "multi-threaded" vectors.

You can also make an array be "single-threaded" with `set-array-single-thread-p`.

The result of parallel access to a "single-threaded" vector is unpredictable.

15.4 Low level atomic operations

Low level atomic operations are defined in all cases for a specific set of places. These places are listed in Table 15.1:

Table 15.1 Places for which low-level atomic operations are defined

Place	Notes
(symbol-value <i>symbol</i>)	When <i>symbol</i> is dynamically bound, this means the dynamically bound value.
(car <i>cons</i>)	
(cdr <i>cons</i>)	
(svref <i>sv index</i>)	Only simple-vector .
Structure accessors	The structure must be defined at compile time, and normally there are only macros for atomic operations on structures.
(slot-value <i>object slot-name</i>)	See below.

Notes about atomic **slot-value** operations:

1. They ignore the MOP **slot-value-using-class** protocol and can only be used for **:instance** and **:class** allocated slots.
2. They are slower than the atomic operations on other types of object because they have to lock the instance. It may be better to have a slot pointing to some other object (for example a structure) and do the atomic operations on that object.

The low level atomic operations implicitly ensure order of memory between operations in different threads.

The low level atomic operations are: **atomic-push**, **atomic-pop**, **atomic-fixnum-incf**, **atomic-fixnum-decf**, **atomic-incf**, **atomic-decf**, **atomic-**

`exchange`, `compare-and-swap`, `define-atomic-modify-macro` and `setup-atomic-funcall`.

You can test whether a place is suitable for use with these operations by the predicate `low-level-atomic-place-p`.

15.5 Aids for implementing modification checks

The macros `with-modification-check-macro` and `with-modification-change` provide a way for a body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code. This is useful in situations when reading some data out of some data structure is more common than modification, and reading the data involves getting some values that need to be consistent. It makes it possible to ensure consistency of the values without a lock.

The checking code should be wrapped by the macro `with-modification-check-macro`, and the modifying code should be wrapped by the macro `with-modification-change`. They are associated by the fact that their `modification-place` argument is the same.

`modification-place` is a place as defined in Common Lisp (it does not need to be one of the places for atomic locking) which can receive a fixnum. It must be initialized to a fixnum. It must not be modified by any code except `with-modification-change`.

`with-modification-check-macro` defines a lexical macro (by `macrolet`) with the name `macro-name` which takes no arguments, and is used to check if there was any change since the entering the body.

Note that these macros do not guard against errors that may occur because of changes to the data structures that are accessed, and do not create any locking between users of these macro. In particular, the modifying code will typically need to lock something too, and the checking code must do only operations that cannot fail because of modification in another thread.

15.5.1 Example modification check

```
(defstruct my-cache
  (modification-count 0)
  a
  b)

;; modifier code
(sys:with-modification-change
 (my-cache-modification-count cache)
 (setf (my-cache-a cache) (calculate-a-value ....)
       (my-cache-b cache) (calculate-b-value ....)))

;; reading code
(loop
 (sys:with-modification-check-macro
  my-cache-did-not-change-p (my-cache-modification-count cache)
  (let ((a (my-cache-a cache))
        (b (my-cache-b cache)))
    (when (my-cache-did-not-change-p)
      (return (values a b))))
```

Provided that all modification to the `a` and `b` slots of a `my-cache` object are done by the modifier code above, the return values of `a` and `b` in the reading code are guaranteed to have been set by the same `setf` invocation in the modifier code.

15.6 Ensuring order of memory between operations in different threads

A set of synchronization functions is provided which ensure order of memory between operations in different threads. These are `ensure-loads-after-loads`, `ensure-memory-after-store`, `ensure-stores-after-memory` and `ensure-stores-after-stores`.

Note: You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs these functions.

The effect of each of these functions is to ensure that all the operations of the first type (the word following the `ensure-`) that are in the program after the call to the function are executed after all the operations of the second type (last word in the function name) that are in the program before the call to the function.

Before or after "in the program" means the order that a programmer interpreting (correctly) the program would expect the operations to be executed. On a modern CPU this is not necessarily the same as the actual execution order. On a single CPU the end result is guaranteed to be the same, but on a computer with multiple CPU cores it is not.

An operation of type *load* is an operation that reads data from an object into a local variable. Typical *load* operations are `car`, `cdr`, `svref`, structure accessors, `slot-value` and getting the value of a symbol. A *store* operation is an operation that modifies data in an object. A *memory* operation is either a *load* or a *store*.

You need these functions when you need to synchronize between threads and you do not want to use the system supplied synchronization objects ("Locks", "mailboxes", "Condition variables", "Counting semaphores", "Synchronization barriers"). In most cases you should try first to use a synchronization object. Using the synchronization functions described in this section is useful if you can identify a serious bottleneck in your code that can be optimized using them.

For simple cases you should consider whether `with-modification-check-macro` and `with-modification-change` gives you the functionality you need.

15.6.1 Example of ensuring order of memory

Suppose you have two code fragments, which may end up executed in parallel, and both of which access a global structure `*gs*`. The first fragment is a setter, and you can be sure that it is not executed in parallel to itself (normally because it actually runs inside a lock):

```
(setf
  (my-structure-value-slot *gs*)      ; store1
  some-value)
(setf
  (my-structure-counter-slot *gs*) ; store2
  counter)
```

The second fragment is the reader. You want to guarantee that it gets a value that was stored after the counter reached some value (the counter value always increases). You may think that this will suffice:

```
(if (>=
      (my-structure-counter-slot *gs*) ; load1
      counter)
    (my-structure-value-slot *gs*) ; load2
  (.. something else ...))
```

Programmatically, if the `>=` is true then `store2` already occurred before `load1`, therefore `store1` also occurred before `load1`, and `load2` which happens after `load1` must happen after `store1`.

On a single CPU that is true. On a computer with multiple CPU cores it can go wrong (that is, `load2` can happen before `store1`) because of two possible reasons:

1. `load2` may happen before `load1`.
2. `store2` may happen before `store1`.

To guarantee that `load2` happens after `store1`, both of these possibilities need to be dealt with. Thus the setter has to be:

```
(setf (my-structure-value-slot *gs*) ; store1
      some-value)
(sys:ensure-stores-after-stores) ; ensure store order
(setf (my-structure-counter-slot *gs*) ; store2
      (incf-counter))
```

and the reader has to be:

```
(if (> (my-structure-counter-slot *gs*) ; load1
        my-counter)
  (progn
    (sys:ensure-loads-after-loads) ; ensure load order
    (my-structure-value-slot *gs*)) ; load2
  (.. something else ...))
```

Note that somehow both threads know about `counter`, and normally will have to synchronize the getting of its value too.

15.7 Locks

Locks can be used to control access to shared data by several processes.

The two main symbols used in locking are the function `make-lock`, to create a lock, and the macro `with-lock`, to execute a body of code while holding the specified lock.

A lock has a name (a string) and several other components. The printed representation of a lock shows the name of the lock and whether it is currently locked. Additionally if the lock is locked it shows the name of the process holding the lock, and how many times that process has locked it. For example:

```
#<MP:LOCK "my-lock" Locked 2 times by "My Process" 2008CAD8>
```

The function `lock-owner` returns the process that locked a given lock.

The function `lock-name` returns the name of a lock.

The function `process-lock` blocks the current process until a given lock is claimed or a timeout passes, and `process-unlock` releases the lock.

The macro `with-lock` executes code with a lock held, and releases the lock on exit, as if by `process-lock` and `process-unlock`.

If you need to avoid blocking on a lock that is held by some other thread, then use `with-lock` with `timeout 0`, like this:

```
(unless (mp:with-lock (lock :timeout 0)
                      (code-to-run-if-locked)
                      t)
      (code-to-run-if-not-locked))
```

The macros `with-sharing-lock` and `with-exclusive-lock` can be used with sharing locks.

15.7.1 Features of lock APIs for SMP

Locks can be marked as recursive or not recursive, and they can be made sharing or exclusive. There are APIs for querying whether a lock can be, or actually is, locked recursively.

There are some guarantees about the lock / unlock functions.

15.7.1.1 Recursive and sharing locks

The keyword argument `recursivep` to `make-lock`, when true, allows the lock to be locked recursively. `recursivep` is true by default. If `recursivep` is false then trying to lock again causes an error. This is useful for debugging code where the lock is not expected to be claimed recursively.

The keyword argument *sharing* to `make-lock`, when true, creates an "sharing" lock object, which supports sharing and exclusive locking. A sharing lock is handled by different functions and methods. See `with-exclusive-lock`, `with-sharing-lock`, `process-exclusive-lock`, `process-exclusive-unlock`, `process-sharing-lock` and `process-sharing-unlock`.

15.7.1.2 Querying locks

See `lock-recursive-p`, `lock-owned-by-current-process-p`, `lock-owner`, `lock-locked-p` and `lock-recursively-locked-p`.

15.7.2 Guarantees and limitations when locking and unlocking

In compiled code `process-lock`, `process-exclusive-lock` and `process-sharing-lock` are guaranteed to return if they locked their argument. In other words there will not be any throw between the time they locked the lock and the time they return. That means that in compiled code the next form will at least start executing, and if it is an `unwind-protect` the cleanup forms will at least start executing. (If the code is evaluated, this is not guaranteed.) "Locking" here also means incrementing the count of a lock that is already held by the current thread.

However these functions may throw before locking. For example, in the following code `process-lock` may throw without locking, for example because something interrupts the process by `process-interrupt`:

```
(unwind-protect
  (progn (mp:process-lock lock)
         (whatever))
  (mp:process-unlock lock))
```

If this call to `process-lock` does throw without locking, then `process-unlock` will be called on a lock that is not locked.

The correct code that guarantees (when compiled) that `process-unlock` is called on exit only when `process-lock` did lock is:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (mp:process-unlock lock))
```

Conversely, `process-unlock`, `process-exclusive-unlock` and `process-sharing-unlock` guarantee to successfully unlock the lock, but are not guaranteed to return.

For example, the following code may fail to call `another-cleanup`:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (mp:process-unlock lock)
  (another-cleanup))
```

If `another-cleanup` is essential to execute in all throws, it needs its own `unwind-protect`:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (unwind-protect
    (mp:process-unlock lock)
    (another-cleanup)))
```

Note: the guarantees described in this section are relevant only in compiled code.

15.8 Process Waiting

Process Waiting means that a process suspends its own execution until some condition is true. The generic Process Wait functions take a `wait-function` argument, which is arbitrary though somewhat restricted Lisp code. A process resumes running when the `wait-function` returns true. The specific Process Wait functions wait for a specific condition.

15.8.1 Specific Process Wait functions

For communication between processes, these are:

`mailbox-read`, `process-wait-for-event` and `mailbox-wait-for-event`.

For synchronization, these are:

`condition-variable-wait` and `barrier-wait`, also `semaphore-acquire` and `semaphore-release`.

For locking these are:

`process-lock`, `process-exclusive-lock` and `process-sharing-lock`.

For sleeping, these are:

`c1:sleep` and `current-process-pause`.

15.8.2 Generic Process Wait functions

The generic Process Wait functions are:

`process-wait` and `process-wait-with-timeout`

`process-wait-local` and `process-wait-local-with-timeout`

`process-wait-local-with-periodic-checks` and `process-wait-local-with-timeout-and-periodic-checks`.

Note: For brevity we sometimes refer to "the `*-periodic-checks` functions" or "the `*-with-timeout` functions".

All the generic Process Wait functions take `wait-reason` and `wait-function` arguments and potentially also arguments to pass to the `wait-function`. The `*-with-timeout` functions mentioned above also take a `timeout` argument. The `*-periodic-checks` functions also take a `period` argument.

The `wait-reason` is used only to mark the process as waiting for something for debugging purposes. It does not affect the behavior of the functions.

The generic Process Wait functions "wake up" (that is, they simply return to the caller) either when the timeout passed (if they take a `timeout` argument), or when the wait function returns true. The three pairs of functions mentioned above differ in the mechanism that calls the wait function.

`process-wait` and `process-wait-with-timeout` arrange that the "scheduler" will call the wait function when it runs. The "scheduler" is invoked at various points, in an indeterminate process. The advantage of this is that the programmer does not need to worry too much about when the wait function is going to be called. In non-SMP LispWorks (that is, LispWorks 5.1 and earlier) the programmer does not need to worry at all: when some process sets up some-

thing that would make the wait function return true, the waiter process could not run anyway until the setting-up process stopped for some reason (including preemption), by which time the scheduler would have called the wait function if it had not done it before. In SMP LispWorks (that is, LispWorks 6.0 and later), these two processes can run simultaneously, so the delay between the setting up and the scheduling is not necessary. It can be avoided by "poking" the waiting process with `process-poke`, if the waiting process is known, or by invoking the scheduler by `process-allow-scheduling`.

Note: All the specific Process Wait functions record that they wait, and the operations that allow them to continue implicitly "poke" the waiting process.

A large disadvantage of `process-wait` and `process-wait-with-timeout` is that their *wait-function* is called by the "scheduler" in an indeterminate process. That means that the wait function does not see the dynamic environment of the calling process (including error handlers), and cannot be debugged properly. It is also called often, and so it needs to be reasonably fast and not allocate much. In addition, having to call the wait function adds overhead to the system. Therefore in general, if you can achieve the required effect by using either any of the specific wait functions or a `process-wait-local*` function, you should do that and avoid `process-wait` and `process-wait-with-timeout`.

`process-wait-local` and `process-wait-local-with-timeout` do not have all the disadvantages listed above, but their *wait-function* is called only when the process is poked (or at the end of the *timeout*). That means that the programmer does need to worry about when they are called. Typically some other process will set up something, and then poke the waiting process to check if it can run.

Note: if the setting up process always knows for sure whether the waiting process can run, then it is normally simpler to use one of the specific Process Wait functions, or maybe even `process-stop` and `process-unstop`.

The `*-periodic-checks` functions give a partial solution to the question of calling the wait function, by ensuring there is a maximum period of time between calls. If having a bounded delay where a bound of more than 0.1 second is not a problem, then the `*-periodic-checks` functions are a simple and efficient way to achieve it.

When the delays need to be bounded by a shorter period, either one of the specific Process Wait functions or explicit calls to `process-poke` need to be used. The latter combined with `process-wait-local` is the most efficient mechanism, but it does require the programmer to ensure that `process-poke` is called in all the right places.

15.8.3 Communication between processes and synchronization

The simplest way to pass a specific event between two processes is to use `process-wait-for-event` on the receiving process, and `process-send` on the sender side. The "event" that is passed is can be any Lisp object.

`process-send` and `process-wait-for-event` use a `mp:mailbox` to pass the object (the `process-mailbox` of the receiver). It is possible to use a `mp:mailbox` object directly, and to communicate between multiple senders and receivers. Use `make-mailbox` to make a mailbox, and `mailbox-send` to put a message in it. The receiver(s) use either `mailbox-wait-for-event` and `mailbox-read`.

`mailbox-wait-for-event` should be used on processes that may make windows (including any process associated with a CAPI interface), but can be used elsewhere. `mailbox-read` is faster, but if it used on a process with a window it may cause hanging.

`process-wait-for-event` and `process-send` and `mp:mailbox` are the primary interface for communication between processes, and should be used unless there is a very good reason to use a different mechanism.

15.8.4 Synchronization

Synchronization can be achieved by the various `process-wait*` functions with the appropriate `wait-function` argument, but for simple cases of synchronization it is better to use the synchronization objects: condition variables or barriers. These synchronization objects are simple, efficient, deal with all thread safety issues, and ensure that the processes that are ready to run will run immediately, rather than the next time that the wait function is called.

Condition variables are used when one or more processes have the knowledge to control when another process(es) runs. The "ignorant" process(es) use `condition-variable-wait` to wait until they can continue. The "knowledgable" process(es) use `condition-variable-signal` and `condition-variable-`

`broadcast` to tell the "ignorant" processes when they can run. Because the communication is via the condition variable, the processes do not need to know explicitly about each other. For more details, see "Condition variables" on page 186.

Barriers are used (mainly) for symmetric synchronization, when a group of processes needs to ensure that none of them goes too far ahead of the rest. The processes call `barrier-wait` when they want to synchronize, and `barrier-wait` waits until the other process arrive too (that is, they call `barrier-wait`). Barriers have additional features that allow more complex synchronization. For more details, see "Synchronization barriers" on page 187.

15.9 Synchronization between threads

In LispWorks 5.1 and previous versions, the main way to synchronize between threads is to use `mp:process-wait` or `mp:process-wait-with-timeout` to supply a predicate to the scheduler. The predicate runs periodically in the background to identify threads that are no longer blocked.

These functions are still available, but there are some alternatives that can be more efficient in many cases by removing the need for the scheduler. The alternatives are:

- Mailboxes (FIFO queues). See `make-mailbox` and `mailbox-send`.
- Condition Variables (used with a lock). See "Condition variables" on page 186.
- Barriers (counting arrivals at a certain point in the code). See "Synchronization barriers" on page 187.
- Counting Semaphores (limiting the number of users of a shared resource). See "Counting semaphores" on page 188

15.9.1 Condition variables

A condition variable allows you to wait for some condition to be satisfied, based on the values stored in shared data that is protected by a lock. The condition is typically something like data becoming available in a queue.

The function `condition-variable-wait` is used to wait for a condition variable to be signalled. It is always called with the lock held, which is automatically released while waiting and reclaimed before continuing. More than one thread can wait for a particular condition variable, so after being notified about the condition changing, you should check the shared data to see if it represents a useful state and call `condition-variable-wait` again if not.

The function `condition-variable-signal` is used to wake exactly one thread that is waiting for the condition variable. If no threads are waiting, then nothing happens.

Alternatively, the function `condition-variable-broadcast` can be used to wake all of the threads that are waiting at the time it is called.

Any threads that wait after the call to `condition-variable-signal` OR `condition-variable-broadcast` will not be woken until the next call.

In most uses of condition variables, the call to `condition-variable-signal` or `condition-variable-broadcast` should be made while holding the lock that waiter used when calling `condition-variable-wait` for this condition variable. This ensures that the signal is not lost if another thread is just about to call `condition-variable-wait`.

The function `condition-variable-wait-count` can be used to determine the current number of threads waiting for a condition variable.

The condition variable implementation in LispWorks aims to comply with the POSIX standard where possible.

15.9.2 Synchronization barriers

Barriers are objects that are used to synchronize multiple threads. A barrier has a count that determines how many "arrivals" (calls to `barrier-wait`) have to occur before these calls return.

The main usage of barriers is to ensure that a group of threads have all finished some stage of an algorithm before any of them proceeds.

The typical way of using a barrier is to make one with a *count* that is the same as the number of threads that are going to work in parallel and then create the threads to do the work. When each thread has done its work, it synchronizes

with the others by calling `barrier-wait`. In most cases `barrier-wait` is the only barrier API that is used.

For example, assume you have a task that be broken into two stages, where each stage can be done in parallel by several threads, but the first stage must be completely finished before any processing of the second stage can start. Then the code will do:

```
(let ((barrier (mp:make-barrier num-of-processes)))
  (dotimes (p num-of-processes)
    (mp:process-run-function (format nil "Task worker ~d" p)
      ()
      #'(lambda (process-number barrier)
          (do-first-stage process-number)
          (mp:barrier-wait barrier)
          (do-second-stage process-number))
      p
      barrier)))
```

It is also possible to use the barrier to block an indefinite number (up to `most-positive-fixnum`) of processes, until another process decides that they can go. For this the barrier is made with count t (or `most-positive-fixnum`). The other process then uses `barrier-disable` to "open" the barrier. If required, the barrier can be enabled again by `barrier-enable`.

15.9.3 Counting semaphores

A counting semaphore is a synchronization object that allows different threads to coordinate their use of a shared resource that contains some number of available units. The meaning of each unit depends on what the semaphore is being used to synchronize.

The three main functions associated with semaphores are: `make-semaphore`, which makes a new semaphore object; `semaphore-acquire`, which acquires units from a semaphore and `semaphore-release`, which releases units back to a semaphore. The current thread will block if it attempts to acquire more units than are current available.

The functions `semaphore-name`, `semaphore-count` and `semaphore-wait-count` can be used to query the name, available unit count and count of waiting units from a semaphore.

15.10 Timers

Use timers to run code after a specified time has passed. You can schedule a timer to run once or repeat at regular intervals, and you can unschedule it before it expires.

For the details, see the reference entries for `make-timer` and `schedule-timer`.

15.10.1 Timers and multiprocessing

Timers run in unpredictable threads, therefore it is not safe to run code that interacts with the user directly. The recommended solution is something like

```
(mp:schedule-timer-relative
  (mp:make-timer 'capi:execute-with-interface
    interface
    'capi:display-message "Time's up")
  5)
```

or

```
(mp:schedule-timer
  (mp:make-timer 'capi:execute-with-interface
    interface
    'capi:display-message "Lunchtime")
  (* 4 60 60))
```

where `interface` is an existing CAPI interface on the screen.

Timers actually run in the process that is current when the scheduled time is reached. This is likely to be The Idle Process in cases where LispWorks is sleeping, but it is inherently unpredictable.

15.10.2 Input and output for timer functions

I/O streams default to the standard input and output of the process, which is initially `*terminal-io*` in the case of The Idle Process.

15.11 Process properties

A "process property" is a pair of an indicator and a value that is associated with it for a process.

LispWorks has two kinds of process properties: general and private. These two kinds of properties are stored separately, and the association of indicator/value in each property kind is independent of any in the other property kind.

General properties are stored in the process plist, and can be modified from other processes.

Private properties can only be modified by the current process. Private properties are faster to modify, because the modification does not need to be thread-safe.

Otherwise there is little difference between general and private properties.

`process-plist` and `(setf process-plist)` are not thread safe. In LispWorks 5.1 and earlier the only interface to process properties is `process-plist`, but this does not work well in SMP LispWorks, and so it is deprecated.

There is no parallel to `process-plist` for the private properties.

The general properties are accessed by: `process-property`, `(setf process-property)`, `remove-process-property`, `pushnew-to-process-property` and `remove-from-process-property`.

The private properties are accessed by: `get-process-private-property` (access from other processes), `process-private-property`, `(setf process-private-property)`, `remove-process-private-property`, `pushnew-to-process-private-property` and `remove-from-process-private-property`.

15.12 Native threads and foreign code

Support for native threads differs between platforms as described in this section.

15.12.1 Native threads on Windows, Mac OS X, Linux, x86/x64 Solaris and FreeBSD

Each Lisp `mp:process` has a separate native thread and in LispWorks 6.0 these threads can run simultaneously.

Note: In LispWorks 5.1 and earlier versions, you can have many runnable `mp:process` objects/native threads, but Lisp code can only run in one thread at a time and a lock is used to enforce this. This can limit performance on a

computer with multiple CPU cores. When a foreign function is called using the FLI, the lock is released until the function returns. This allows other Lisp threads to run, for instance while waiting for a database query to execute.

You can call back into Lisp using `fli:define-foreign-callable` in any thread, without any other setup.

Note: In a LispWorks 5.0 executable on Microsoft Windows you must first call `setup-for-alien-threads` before calling back into Lisp, but in LispWorks 5.1 and later versions this setup is handled automatically (and `setup-for-alien-threads` does not exist).

Threads running Lisp code can be rescheduled preemptively, so if you call into Lisp from more than one thread simultaneously and one request takes a long time then it will not delay the requests in other threads.

15.12.2 Native threads on other platforms

Lisp uses a single native thread and implements user level threads to support `mp:process`.

You can only call back into Lisp from its single native thread.

Note: This section applies to LispWorks for UNIX only (not LispWorks for Linux, FreeBSD, x86/x64 Solaris or Macintosh).

15.12.3 Foreign callbacks on threads not created by Lisp

If a foreign callback occurs on a thread that was not created by LispWorks, then some data is kept on the Lisp side to make the foreign callback entry faster next time. This data is removed when the thread dies, but you force it to be removed sooner by calling `last-callback-on-thread`.

15.13 Example

The following is an informal example of multi-processing with a single process (other than the idle process), namely a top-loop. Once it has started up, try `(mp:ps)`.

```
(in-package "CL-USER")

;; (guarantee-processes) will start up
;; multiprocessing with a top-level loop
;; in this example,
;; use *base-process* to ensure that base
;; process will only be pushed
;; onto *initial-processes* once, no matter how
;; many times guarantee-processes is called

(defvar *base-process*
  '("base-process" nil base-process-function))

;; the base process consists of a top-level
;; loops with restarts which allow control of
;; return in the event of an error -- to see
;; these in action, evaluate (guarantee-processes)
;; and then an unbound variable.

;; Note that starting and stopping multiprocessing is not
;; relevant if the LispWorks IDE is already running. This example
;; is included for illustration only.

(defun base-process-function ()
  (with-simple-restart
    (abort "Return from multiprocessing")
    (loop
      (with-simple-restart
        (abort "Return to top-level-loop")
        (system:%top-level)))
    (mp::stop-multiprocessing)))

;; simple startup of multiprocessing with one
;; process (apart from the idle process)

(defun guarantee-processes ()
  (unless mp::*multiprocessing*
    (pushnew *base-process*
            mp::*initial-processes*)
    (mp:initialize-multiprocessing)))
```

16

Common Defsystem

16.1 Introduction

When an application becomes large, it is usually prudent to divide its source into separate files. This makes the individual parts of the program easier to find and speeds up editing and compiling. When you make a small change to one file, just recompiling that file may be all that is necessary to bring the whole program up to date.

The drawback of this approach is that it is difficult to keep track of many separate files of source code. If you want to load the whole program from scratch, you need to load several files, which is tedious to do manually, as well as prone to error. Similarly, if you wish to recompile the whole program, you must check every file in the program to see if the source file is out of date with respect to the object file, and if so re-compile it.

To make matters more complicated, files often have interdependencies; files containing macros must be loaded before files that use them are compiled. Similarly, compilation of one file may necessitate the compilation of another file even if its object file is not out of date. Furthermore, one application may consist of files of more than one source code language, for example Lisp files and C files. This means that different compilation and loading mechanisms are required.

The Common LispWorks system tools, and the system browser in particular, are designed to take care of these problems, allowing consistent development and maintenance of large programs spread over many files. A system is basically a collection of files that together constitute a program (or a part of a program), plus rules expressing any interdependencies which exist between these files.

You can define a system in your source code using the `defsystem` macro. Once defined, operations such as loading, compiling and printing can be performed on the system as a whole. The system tools ensure that these operations are carried out completely and consistently, without doing unnecessary work.

A system may itself have other systems as members, allowing a program to consist of a hierarchy of systems. Each system is treated independently of the others, and can be used to collect related pieces of code within the overall program. Operations on higher-level systems are invoked recursively on member systems.

16.2 Defining a system

A system is defined with a `defsystem` form in an ordinary Lisp source file. This form must be loaded into the Lisp image in order to define the system in the environment. Once loaded, operations can be carried out on the system by invoking Lisp functions, or, more conveniently, by using the system browser.

For example, the expression:

```
CL-USER 5 > (compile-system 'debug-app :force t)
```

would compile every file in a system called `debug-app`.

Note: When defining a hierarchy of systems, the leaf systems must be defined first — that is, a system must be declared before any systems that include it.

By convention, system definitions are placed in a file called `defsyst.lisp` which usually resides in the same directory as the members of the system.

The full syntax of `defsystem` is given in `defsystem`, page 689. Below is a brief introduction.

16.2.1 DEFSYSTEM syntax

`defsystem`

Macro

```
defsystem system-name options &key members rules
```

system-name A symbol used as the name of the system. If a string is given, it is interned in the current package.

options Any of a number of options that can be specified.

members The members of the system. These may be files of Common Lisp source code, foreign source code, or other systems.

rules A set of rules describing the requirements for and order in which compilation and loading of the system members should take place.

See the following sections for more information about these parameters.

16.2.2 DEFSYSTEM options

Options may be specified to `defsystem` which affect the behavior of the system as a whole. For example, `:package` specifies a default package into which files in the system are compiled and loaded if the file itself does not contain its own package declaration. The `:default-pathname` option tells the system tools where to find files which are not expressed as a full pathname.

16.2.3 DEFSYSTEM members

The `:members` keyword to `defsystem` is used to specify the members of a system. The argument given to `:members` is a list of strings. A system member is either a file or another system, identified by a name. If a full pathname is given then the function `pathname-name` is used to identify the name of the member. Thus, for example, the name of a member expressed as `/u/neald/foo.lisp` is `foo`.

The behavior of any member within a system can be constrained by supplying keyword arguments to the member itself. So, for example, specifying the

`:source-only` keyword ensures that only the source file for that member is ever loaded.

16.2.4 DEFSYSTEM rules

Rules may be defined in a system which modify the default behavior of that system, ensuring, for instance, that certain files are always loaded or compiled before others.

Rules apply to files and subsystems alike as members of their parent system, but are not inherited by subsystems.

When you invoke an action such as compiling a system, the following happens by default:

- Each member of the system is considered in turn, in the order they are given in the system definition.
- If the member is itself a system then the action is performed on that system too, and so on recursively.
- If the member is a file and action-specific constraints are satisfied, the file action is inserted into a *plan*.

For example, in the case of compiling, a “compile this file” event is put into the plan if the source file is newer than the object file.

- After the plan has been assembled, it can be viewed or executed.

This behavior can be modified by describing dependencies between the members using *rules*. These are specified using the `:rules` keyword to `defsystem`.

A rule has three components:

- | | |
|----------------|---|
| The target(s). | The action that is performed if the rule executes successfully. |
|----------------|---|
- This is an action-member description like `:compile "foo"`. The member can be an actual member of the system or `:all` (meaning the rule should apply to each member of the system).

The actions that the target(s) are `:caused-by`.

The actions that cause the rule to execute successfully.

This is a list of action-member descriptions. The member of each of these descriptions should be either a real system member, or `:previous`, which means all members listed before the member of the target in the system description.

If any of these descriptions are already in the current plan (as a result of other rules executing successfully, or as a result of default system behavior), they trigger successful execution of this rule.

The actions that the target(s) `:requires`.

The actions that need to be performed before the rule can execute successfully.

This is a list of action-member descriptions that should be planned for before the action on the target(s). Again, each member should either be a real member of the system, or `:previous`.

The use of the keyword `:previous` means, for example, that you can specify that in order to compile a file in the system, all the members that come before it must be loaded.

When the action and member of a target are matched during the traversal of the list of members, the target is inserted into the plan if either of the following are true:

- any of the action-member descriptions in the `:caused-by` clause is already in the plan, or
- any implicit conditions (such as the source file being newer than the object file) are satisfied.

If the target is put into the plan then other targets are inserted beforehand if the action-member description of any `:requires` clause is not already in the plan.

16.2.5 Examples

Consider an example system, `demo`, defined as follows:

```
(defsystem demo (:package "USER")
  :members ("parent"
            "child1"
            "child2")
  :rules ((:in-order-to :compile ("child1" "child2")
    (:caused-by (:compile "parent")))
    (:requires (:load "parent")))))
```

This system compiles and loads members into the `USER` package if the members themselves do not specify packages. The system contains three members — `parent`, `child1`, and `child2` — which may themselves be either files or other systems. There is only one explicit rule in the example. If `parent` needs to be compiled (for instance, if it has been changed), then this causes `child1` and `child2` to be compiled as well, irrespective of whether they have themselves changed. In order for them to be compiled, `parent` must first be loaded.

Implicitly, it is always the case that if any member changes, it needs to be compiled when you compile the system. The explicit rule above means that if the changed member happens to be `parent`, then every member gets compiled. If the changed member is not `parent`, then `parent` must at least be loaded before compiling takes place.

The next example shows a system consisting of three files:

```
(defsystem my-system
  (:default-pathname "~/junk/")
  :members ("a" "b" "c")
  :rules ((:in-order-to :compile ("c")
    (:requires (:load "a")))
    (:caused-by (:compile "b")))))
```

What plan is produced when all three files have already been compiled, but the file `b.lisp` has since been changed?

First, file `a.lisp` is considered. This file has already been compiled, so no instructions are added to the plan.

Second, file `b.lisp` is considered. Since this file has changed, the instruction `compile b` is added to the plan.

Finally file `c.lisp` is considered. Although this has already been compiled, the clause

```
(:caused-by (:compile "b")))
```

causes the instruction *compile c* to be added to the plan. The compilation of *c.lisp* also requires that *a.lisp* is loaded, so the instruction *load a* is added to the plan first. This gives us the following plan:

1. Compile *b.lisp*.
2. Load *a.lisp*.
3. Compile *c.lisp*.

This last example shows how to make each fasl get loaded immediately after compiling it:

```
(defsystem my-system ()  
  :members ("foo" "bar" "baz" "quux")  
  :rules ((:in-order-to :compile :all  
           (:requires (:load :previous)))))  
  
(compile-system my-system :load t)
```


17

The Parser Generator

17.1 Introduction

The parser generator generates an LALR parser from a specification of a grammar. The parser generator has a simple facility for the static resolution of ambiguity in the grammar and supports an automatic run-time error correction mechanism as well as user-defined error correction. Semantic actions can be included in the rules for the grammar by specifying Lisp forms to be evaluated when reductions are performed.

For further details on LALR parsing, see *Compilers, Principles Techniques and Tools*, by Aho, Sethi and Ullman, publishers Addison Wesley, 1986.

Load the parser generator by (`(require "parsergen")`).

17.2 Grammar rules

The parser generator is accessed by the macro `defparser`, described below:

`defparser` *Macro*

```
defparser name {rules}*
```

<i>name</i>	The name to be used for the parsing function. The remainder of the macro form specifies the reduction rules and semantic actions for the grammar.
<i>rules</i>	The rules specified in a <code>defparser</code> form are of two types, <i>normal rules</i> and <i>error rules</i> , described below.

Each *normal rule* corresponds to one production of the grammar to be parsed:

```
( (non-terminal {grammar-symbol}* ) {form}* )
```

The *non-terminal* is the left-hand side of the grammar production and the list of grammar symbols defines the right-hand side of the production. (The right-hand side may be empty.) The list of forms specifies the semantic action to be taken when the reduction is made by the parser. These forms may contain references to the variables \$1 ... \$n, where n is the length of the right hand side of the production. When the reduction is done, these variables are bound to the semantic values corresponding to the grammar symbols of the rule.

17.2.1 Example

If a grammar contains the production:

```
expression -> expression operator expression
```

with a semantic representation of a list of the individual semantic values, the Lisp grammar would contain the rule:

```
( (expression expression operator expression) (list $1 $2 $3) )
```

Error productions of the form:

```
( (nt :error) (some error behavior) )
```

are explained in the section below.

The first rule of the grammar should be of the form:

```
( (nt nt1) $1)
```

where the non-terminal *nt* has no other productions and *nt1* serves as the main “top-level” non-terminal.

17.2.2 Resolving ambiguities

If the grammar is ambiguous, there is conflict between rules of the grammar: either between reducing with two different rules or between reducing by a rule and shifting an input symbol. Such a conflict is resolved at parser generation time by selecting the highest priority action, where the priority of a reduce action is determined by the closeness of the rule to the beginning of the grammar. A priority is assigned to a shift by associating it with the rule that results in the shift being performed.

For example, if the grammar contains the two rules:

- Rule a: `statement -> :if expression :then statement :else statement`
- Rule b: `statement -> :if expression :then statement`

this results in a conflict in the parser between a shift of `:else`, for rule a, and a reduce by rule b. This conflict may be resolved by listing rule a earlier in the grammar than rule b. This ensures that the shift is always done.

Note that ambiguities cannot always be resolved successfully in this way. In this example, if the ambiguity is resolved the other way around, by listing rule b first, this results in the `if ... then ...` part of an `if ... then ... else ...` statement being reduced, and a syntax error is produced for the `else` part.

During parser generation, any conflicts between rules are reported, together with information about how the conflict was resolved.

17.3 Functions defined by defparser

The form `(defparser name grammar)` defines a number of functions. The main function `name` is defined as the parsing function. For example:

```
(defparser my-parser .. grammar .. )
```

defines the function

```
my-parser lexer &optional symbol-to-string =>
```

`lexer` specifies the lexical analyzer function to be used. The optional argument `symbol-to-string` should be a function mapping grammar symbols to strings for printing purposes. The default value of `symbol-to-string` is the function `c1:identity`.

`defparser` also defines functions corresponding to the individual actions of the parser.

Normal actions are named:

`name-actionindex`

and error actions are named:

`name-error-actionindex`

where `name` here is the name as given to `defparser` and `index` is the number of the rule or error rule in the grammar.

All function names are interned in the current package when `defparser` is called.

17.4 Error handling

The parser supports automatic error correction of its input. The strategy used involves attempting to either push a new token onto the input, replacing an erroneous symbol, or discarding an erroneous symbol. Such action is only taken if it is guaranteed that the parser can continue parsing and read at least one more symbol from its input.

If the correction strategy fails, then error recovery is invoked.

The parser allows the inclusion of grammar productions of the form:

`non-terminal -> :error`

This means that the parser accepts an erroneous string of tokens as constituting an occurrence of the non-terminal. Such productions may be used to skip over portions of input when attempting to recover from an error. The action associated with such an error is specified by a form in the same way as for ordinary actions. The action may perform manipulation of the parser state and input.

17.5 Interface to lexical analyzer

The lexical analyzer function that is passed to the parser is expected to be a function of zero arguments that returns two values each time it is called. The first value is the next token on the input and the second value is the semantic

value corresponding to that token. If there is no more input, then the lexical analyzer may return either the token :`eoi` or `nil`.

For example:

```
(defparser my-parser
  ...)

(defun my-lexer (stream)
  .. read next token from stream ..
  (values token value))
(defun my-symbol-to-string (symbol)
  .. returns a string ..)
(defun my-parse-stream (stream)
  (let ((lexer #'(lambda () (my-lexer stream))))
    (my-parser lexer #'my-symbol-to-string)))
```

Note that during error correction, the parser may push extra tokens onto the input, in which case they are given the semantic value `nil`. The semantic actions should therefore be capable of dealing with this situation. Manipulation of the input (e.g. pushing extra tokens) is done within the parser generator and the lexical analyzer need not concern itself with this.

17.6 Example

The following example shows a simple grammar for a very small subset of English.

```

(defpackage "ENGLISH-PARSER")
(in-package "ENGLISH-PARSER")
(use-package '(parsergen))

;; Define the parser itself.

(defparser english-parser
  ((bs s) $1)
  ((s np vp)
   `($1 ,$2))
  ((bnp :adj bnp)
   `($1 ,$2))
  ((bnp bnp relp)
   `($1 ,$2))
  ((bnp :noun) $1)
  ((relp :rel vp)
   `($1 ,$2))
  ((vp :verb np locp)
   `($1 ,$2 ,$3))
  ((vp :verb locp)
   `($1 ,$2))
  ((vp :verb np)
   `($1 ,$2))
  ((vp :verb)
   $1)
  ((np :art bnp locp)
   `($1 ,$2 ,$3))
  ((np :art bnp)
   `($1 ,$2))
  ((np bnp) $1)
  ((locp :loc np)
   `($1 ,$2)))

;; The lexer function.

;; The basic lexing function

(defvar *input*)
(defun lex-english ()
  (let ((symbol (pop *input*)))
    (if symbol (get-lex-class symbol)
        nil)))

;; Getting syntactic categories.

(defparameter *words*
  '("the" "a" "some" "art" "ate" "verb" "hit"))

```

```

(cat :noun) (rat :noun) (mat :noun) (which :rel) (that :rel)
(who :rel) (man :noun) (big :adj) (small :adj) (brown :adj)
(dog :noun) (on :loc) (with :loc) (behind :loc) (door :noun)
(sat :verb) (floor :noun)))

(defun get-lex-class (word)
  (values
    (or (cadr (assoc word *words*))
        :unknown)
    word))

;;; The main function -- note bindings of globals (these
;;; are exported from the parsergen package).

(defun parse-english (input)
  (let ((*input* input))
    (english-parser #'lex-english)))

```

The following example session shows the parsing of some sentences.

```

ENGLISH-PARSER 34 > (parse-english '(the cat sat on the
                                      mat))
((THE CAT) (SAT (ON (THE MAT)))))

ENGLISH-PARSER 35 > (parse-english '(the big brown dog
                                      behind the door ate the cat
                                      which sat on the floor))
((THE (BIG (BROWN DOG)) (BEHIND (THE DOOR)))
 (ATE (THE (CAT (WHICH (SAT (ON (THE FLOOR))))))))

```


18

Dynamic Data Exchange

18.1 Introduction

Dynamic data exchange (DDE) involves passing data and instructions between applications running under the Microsoft Windows operating system. Typically the data is passed in the form of a string, which is interpreted when it is received. One application acts as a *server* and the other as a *client*.

18.1.1 Types of transaction

The server is normally a passive object, which waits for a client object to tell it what to do. The client can communicate with the server in four ways:

- The client can issue a *request transaction* to the server. This means the client is asking for some information about the server application.
- The client can issue a *poke transaction*. This means the client is passing data to be stored by the server application.
- The client can issue an *execute transaction*. This means the client is asking the server to get the server application to run a command.
- The client can ask the service to set up an *advise loop*, or to close an existing advise loop. An advise loop causes the server to communicate with the client whenever a specified change occurs in the server application.

18.1.2 Conversations, servers, topics, and items

For a transaction to take place between a client and a server, a conversation must be established. A conversation is established when a client makes a request by broadcasting a service name and topic name, and a server responds. Transactions can then take place across the conversation. When no more transactions are to be made, the conversation is terminated.

The following list identifies the elements involved with client/server activity:

conversation	A conversation is established when a server responds to a client.
service name	A service name is a string broadcast by a client hoping to establish a conversation with a server that recognizes the service name. The service name is usually clearly related to the server application name.
topic name	The topic name identifies what the conversation between client and server is to be about. For example, it could be the name of a file that is open in the server application. Each topic is attached to one particular server. A server can have many topics.
item name	The item usually identifies an element of the file identified by the topic which should be read (in the case of a request) or written to (in the case of a poke). For example, it might refer to a cell in a spreadsheet document.

18.1.3 Advise loops

An advise loop instructs the server to inform the client when data in the server's application changes. Advise loops are set up across a conversation, and closing the conversation closes the advise loop.

An advise loop is identified by an item and a key. The key is included to allow any number of uniquely identifiable advise loops to be set up on the same server/topic/item combination.

A successfully established advise loop is also known as a link. When a change occurs to item, the link informs the client by causing it to execute a function.

There are two types of link: the warm link which only informs the client that a change to item has occurred, and the hot link which also sends the new data across.

18.1.4 Execute transactions

When a client issues an execute transaction to a server, the command to be executed is transferred as a string. This involves the marshalling of the command and its arguments into a suitable string format. The standard format of such a string is:

```
[command(arg1,arg2,...)]
```

18.2 Client interface

18.2.1 Opening and closing conversations

A LispWorks client can open a conversation by using `dde-connect`, which takes a service designator and a topic designator as its arguments. If successful, a conversation object is returned which can be used to refer to the conversation. Conversations are closed by the LispWorks client at the end of a transaction by using `dde-disconnect`.

Another method for managing conversations uses `with-dde-conversation` to bind a conversation with a server across a body of code. If no conversation is available for `with-dde-conversation`, then one is automatically opened. The code is executed and the conversation is closed after the body of code exits.

18.2.2 Automatically managed conversations

There is an alternative to manually establishing a conversation and then disconnecting it once all transactions between server and client are concluded: the automatically managed conversation. Client functions that end with a * conduct automatically managed conversations.

A function handling an automatically managed conversation takes a service designator and topic designator as two of its arguments, and either automatically establishes a conversation with a server responding to the service designator/topic designator pair, or uses an existing equivalent conversation. For

the purpose of brevity, functions conducting automatically managed conversations are only briefly mentioned in this chapter. For the details see `dde-advise-start*`, `dde-advise-stop*`, `dde-execute*`, `dde-execute-command*`, `dde-execute-string*`, `dde-item*`, `dde-poke*` and `dde-request*`.

18.2.3 Advise loops

A LispWorks client can set up an advise loop across a conversation using `dde-advise-start`, which takes a *conversation* (or a *service* designator/*topic* designator pair in the case of an automatically managed conversation using `dde-advise-start*`), an *item*, and a *key* as its main arguments. The *key* argument defaults to the conversation name, and can be used to distinguish between multiple advise loops established on the same service/topic/item group.

Whenever the data monitored by the advise loop changes, a function is called to inform the client. By default this function is the generic function `dde-client-advise-data`. You can add methods to `dde-client-advise-data` specialized on the *key* or the client conversation class. Alternatively, you can supply a different function in the call to `dde-advise-start`.

18.2.3.1 Example advise loop

The example shows you how to set up an advise loop. The code assumes that `win32` package symbols are visible.

The first step defines a client conversation class, called `my-conv`.

```
(defclass my-conv (dde-client-conversation)
  ())
```

The function `define-dde-client` can now be used to define a specific instance of the `my-conv` class for referring to a server application that responds to the service name "FOO".

```
(define-dde-client :foo :service "FOO" :class my-conv)
```

The next step defines a method on `dde-client-advise-data` which returns a string stating that the item has changed.

```
(defmethod dde-client-advise-data ((self my-conv) item data &key
  &allow-other-keys)
  (format t "~&Item ~s changed to ~s~%" item data))
```

Finally, the next command starts the advise loop on the server `foo`, with the topic name "`file1`", to monitor the item "`slot1`".

```
(dde-advise-start* :foo "file1" "slot1")
```

When the value of the item specified by "`slot1`" changes, the server calls `dde-client-advise-data` which returns a string, as described above.

The `function` argument of `dde-advise-start` and `dde-advise-start*` specifies the function called by the advise loop when it notices a change to the item it is monitoring. The function is `dde-client-advise-data` by default. A different function can be provided, and should have a lambda list similar to the following:

```
key item data &key conversation &allow-other-keys
```

The arguments `key` and `item` identify the advise loop, or link. The argument `data` contains the new data for hot links; for warm links it is `nil`.

Advise loops are closed using `dde-advise-stop` or `dde-advise-stop*`.

18.2.4 Request and poke transactions

LispWorks clients can issue request and poke transactions across a conversation using `dde-request` and `dde-poke`, which take a `conversation` (or a `service` designator/`topic` designator pair in the case of an automatically managed conversation), and an `item` as their main arguments. In the case of a poke transaction, data to be poked into `item` must also be provided.

In the case of a successful request transaction with `dde-request` or `dde-request*`, the data contained in `item` is returned to the LispWorks client by the server.

In the case of a successful poke transaction with `dde-poke` or `dde-poke*`, the data provided is poked into `item` by the server.

The accessor `dde-item` (or `dde-item*` for automatically managed conversations) can perform request and poke transactions. It performs a request transaction when read, and a poke transaction when set.

18.2.5 Execute transactions

A client can issue an execute transaction across a conversation, or in the case of an automatically established conversation, to a recognized server. There is no need to specify a topic, as an execute transaction instructs the server application to execute a command.

The command and its arguments are issued to the server in the form of a string in a standard format (see “Execute transactions” on page 211). Lisp-Works provides two ways of issuing an execute transaction, namely `dde-execute-string` and `dde-execute-command` (and the corresponding * functions that automatically manage conversations).

The following example shows how `dde-execute-string*` can issue a command to a server designated by `:excel` on the topic `:system`, in order to open a file called `foo.xls`:

```
(dde-execute-string* :excel :system "[open(\"foo.xls\")]")
```

The function `dde-execute-command` takes the command to issue, and its arguments, and marshals these into an appropriate string for you. The following example shows how `dde-execute-command*` can issue the same command as in the previous example:

```
(dde-execute-command* :excel :system 'open '("foo.xls"))
```

18.3 Server interface

18.3.1 Starting a DDE server

To provide a LispWorks application with a DDE server, follow the following three steps.

1. Define a specialized Lisp DDE server class using `define-dde-server`. Here the server class is called `foo-server` and it has the service name "FOO":

```
(define-dde-server foo-server "FOO")
```

2. Provide the server class with the functionality it requires by specializing methods on it and/or using `define-dde-server-function`. Here the server function is `bar`, which takes a string as an argument, and prints this to the standard output. For convenience, the system topic is used, though usually it is better to define your own topic.

```
(define-dde-server-function (bar :topic :system)
  :execute
  ((x string))
  (format t "~&~s~%" x)
  t)
```

3. Start an instance of the server `foo-server` using `start-dde-server`.

```
(start-dde-server 'foo-server)
```

This function returns the server object, which responds to requests for conversations with the service name "foo", and accepts execute transactions for the function `bar` in the "System" topic.

18.3.2 Handling poke and request transactions

Poke and request transactions issued to a server object are handled by defining a method on each of the generic functions `dde-server-poke` and `dde-server-request`.

18.3.3 Topics

DDE servers respond to connection requests containing a service name and a topic name. The service name of a server is the same for any conversation whereas the topic name may vary from conversation to conversation, and identifies the context of the conversation. Typically, valid topics correspond to open documents within the application, so the set of valid topics varies from time to time. In addition, all servers implement a topic called "system", which contains a standard set of items that can be read.

The LispWorks DDE interface supports three types of topics:

1. General topics

A general topic is an instance of a user-defined topic class. The actual set of topics available may vary from time to time as the application is running.

2. Dispatching topics

A dispatching topic has a fixed name, and is available at all times that the server is running. It supports a fixed set of items, and each of these items has Lisp code associated with it to implement these items.

3. The system topic.

The system topic is provided automatically by the LispWorks DDE interface. However, a mechanism is provided to extend the functionality of the system topic by handling additional items.

18.3.3.1 General topics

To use general topics, the LispWorks application must define one or more subclasses of `dde-topic`. If an application supports only a single type of document, it will typically require only one topic class. If several different types of document are supported, it may be convenient to define a different topic class for each type of document.

If the application uses general topics, it should define a method on the `dde-server-topics` generic function, specializing on the application's server class.

18.3.3.2 Dispatching topics

A dispatching topic is a topic which has a fixed name and always exists. Dispatching topics provide dispatching capabilities, whereby appropriate application-supplied code is executed for each supported transaction. Dispatch topics are defined using `define-dde-dispatch-topic`.

18.3.3.3 The system topic

The system topic is implemented as a predefined dispatching topic called `:system`. It is automatically available to all defined DDE servers. Its class is `dde-system-topic`, which is a subclass of `dde-topic`.

The following items are implemented by the system topic:

SZDDESYS_ITEM_TOPICS*Constant*

The constant `SZDDESYS_ITEM_TOPICS` has the value "`Topics`". Referring to this item in the system topic calls `dde-server-topics` to obtain a list of topics implemented by the server. The server should define a method on this generic function to return a list of strings naming the topics supported by the server. If this item is not to be implemented, do not define a method on the function, or define a method that returns `:unknown`.

SZDDESYS_ITEM_SYSITEMS*Constant*

The constant `SZDDESYS_ITEM_SYSITEMS` has the value "`SysItems`". Referring to this item in the system topic calls `dde-topic-items` to obtain a list of items implemented by the system topic. If a server implements additional system topic items it should define a method on the generic function specialized on its server class and `dde-system-topic` returning the complete list of supported topics. The server can return `:unknown` if this item is not to be implemented.

SZDDESYS_ITEM_FORMATS*Constant*

The constant `SZDDESYS_ITEM_FORMATS` has the value "`Formats`", and returns `unicodetext` and `text`. Currently only text formats are supported.

The system topic is a single object which is used by all DDE servers running in the Lisp image. You should therefore not under normal circumstances modify it with `define-dde-server-function` by specifying a value of `:system` for the `topic` argument, as this would make the changes to the system topic visible to all users of DDE within the Lisp image.

Instead, specify `:server my-server :topic :system`, where `my-server` is the name of your DDE server. This makes the additional items available only on the system topic of the specified server.

19

Common SQL

This chapter is applicable to UNIX LispWorks and the Enterprise Edition of LispWorks. It describes Common SQL — the LispWorks interface to SQL. It should be used in conjunction Chapter 38, “The SQL Package”, which contains full reference entries for all the symbols in the SQL package.

For a longer introduction to Common SQL, please see the SQL Tutorial available at www.lispworks.com.

19.1 Introduction

This chapter covers the following areas:

- Initialization and Connection
- The Functional SQL Interface
- The Object-Oriented (CLOS) SQL Interface
- The Symbolic SQL Syntax
- SQL I/O Recording
- SQL Interface Errors

The LispWorks SQL interface uses the following database terminology:

Data Definition Language (DDL)

The language used to specify and interrogate the structure of the database schema.

Data Manipulation Language (DML)

The language used for retrieving and modifying data.
Also known as *query language*.

<i>table</i>	A set of records. Also known as <i>relation</i> .
<i>attribute</i>	A field of information in the table. Also known as <i>column</i> .
<i>record</i>	A complete set of attribute values in the table. Also known as <i>tuple</i> , or <i>row</i> .
<i>view</i>	A display of a table configured to your own needs. Also known as <i>virtual table</i> .

19.1.1 Overview

Common SQL is designed to provide both embedded and transparent access to relational databases from the LispWorks environment. That is, SQL/relational data can be directly manipulated from within Lisp, and also used as necessary when instantiating or accessing particular Lisp objects.

The SQL interface allows the following:

- Direct use of standard SQL statements as strings
- Mixed symbolic SQL and Common Lisp expressions
- Implicit SQL invocation when instantiating or accessing CLOS objects

The SQL interface provides these features through two complementary layers:

- A *functional* SQL interface
- An *object-oriented* SQL interface

The functional interface provides users with Lisp functions which map onto standard SQL DML and DDL commands. Special iteration constructs which utilize these functions are also provided. The object-oriented interface allows users to manipulate database views as CLOS classes via `def-view-class`. The

19.1 Introduction

two interfaces may be flexibly combined in accordance with system requirements and user preference. For example, a *select* query can be used to initialize slots in a CLOS instance; conversely, accessing a CLOS slot may trigger an implicit functional query.

19.1.2 Supported databases

Common SQL supports connections to various databases on the platforms indicated below in Table 19.1. Common SQL may work with other platform/ODBC driver combinations and we would be pleased to hear of your experience with these. The keyword shown in the last column is the corresponding value of the *database-type* argument to `connect`:

Table 19.1 Supported databases

Platform	Database	Driver/Client library	<i>database-type</i>
Windows	ODBC	Microsoft SQL Server	<code>:odbc</code>
Windows	ODBC	Oracle	<code>:odbc</code>
Windows	ODBC	Postgres	<code>:odbc</code>
Linux	ODBC	MySQL	<code>:odbc</code>
Linux	ODBC	Postgres	<code>:odbc</code>
Mac OS X	ODBC	MySQL	<code>:odbc</code>
Mac OS X	ODBC	Postgres	<code>:odbc</code>
Linux	Oracle	Oracle 9i (r2) or 10g	<code>:oracle</code>
Mac OS X/ Intel/32-bit	Oracle	Oracle 10g	<code>:oracle</code>
Mac OS X/ Intel/64-bit	Oracle	Oracle 10g	<code>:oracle</code>
Mac OS X/ PPC/32-bit	Oracle	Oracle 10g	<code>:oracle</code>
Windows	Oracle	Oracle 9i (r2) or 10g	<code>:oracle</code>
Solaris/Intel	Oracle	Oracle 10g	<code>:oracle</code>

Table 19.1 Supported databases

Platform	Database	Driver/Client library	<i>database-type</i>
Solaris/ SPARC	Oracle	Oracle 9i (r2) or 10g	:oracle
HP-UX	Oracle	Oracle 9i (r2) or 10g	:oracle
Linux	Oracle	Oracle	:oracle8
Solaris/ SPARC	Oracle	Oracle	:oracle8
HP-UX	Oracle	Oracle	:oracle8
Linux	PostgreSQL	Postgres	:postgresql
FreeBSD	PostgreSQL	Postgres	:postgresql
Mac OS X	PostgreSQL	Postgres	:postgresql
Windows	PostgreSQL	Postgres	:postgresql
Solaris/Intel	PostgreSQL	Postgres 8.2	:postgresql
Linux	MySQL	MySQL	:mysql
FreeBSD	MySQL	MySQL	:mysql
Mac OS X	MySQL	MySQL	:mysql
Windows	MySQL	MySQL	:mysql
Solaris/Intel	MySQL	MySQL	:mysql
Solaris/ SPARC	MySQL	MySQL	:mysql

Note: MySQL versions prior to 4.1.1 should be run in ANSI mode to work with Common SQL. That is, `mysqld` must be started with `--ansi` or the `ansi` option must appear in the `[mysqld]` section of its configuration file.

Note: To use PostgreSQL on any non-Microsoft Windows platform, LispWorks/Common SQL requires PostgreSQL version $\geq 8.x$ built with `--enable-thread-safety`.

19.2 Initialization

The initialization of Common SQL involves three stages. Firstly the SQL interface loaded. Next, the database type (actually class) to be used is initialized. Finally, Common SQL is used to connect to a database. These stages are explained in more detail in this section.

The Lisp symbols introduced in this chapter are exported from the `sq1` package. Application packages requiring convenient access to these facilities should therefore use the `sq1` package.

The examples in this chapter assume that the `sq1` package is visible.

19.2.1 SQL interface

The SQL interface itself is loaded by issuing the command `(require "odbc")` or `(require "oracle")` or `(require "postgresql")` or `(require "mysql")`. In an application, this step should be performed at build-time.

Not all of these modules are available on every LispWorks platform. See Table 19.1, page 221 for information about which databases are supported per-platform.

19.2.2 Database classes

A connection to a database is represented by a CLOS instance which holds information about the connected database. The special variable `*default-database*` holds the current connection. The database class is subclassed on both vendor and version to provide the right kind of specialized behavior across database facilities: for example, the transaction model or the “brand” of SQL.

19.2.3 Initialization functions and variables

The initialization of the chosen database type is achieved by calling `initialize-database-type` with the appropriate value of *database-type*. In an application, this step should be done at runtime. Where multiple database types are supported, it is possible to initialize more than one database type if needed (by making multiple calls to `initialize-database-type`).

The following functions and variables are relevant to initialization:

`default-database-type` specifies the default type of database. The possible values are shown in the *database-type* column of Table 19.1, page 221.

The function `initialize-database-type` initializes a database type according to the value of its *database-type* argument, which defaults to the value of *`default-database-type`*.

A sample code sequence for initializing Common SQL to work with an ODBC database, using the above functions and variables, is as follows:

```
(require "odbc")
(setf *default-database-type* :odbc)
(initialize-database-type)
```

You can find which database types have been initialized by the value of the variable *`initialized-database-types`*.

19.2.4 Database libraries

Note: This section applies only to Unix/Linux systems.

A database directory environment variable specifies the root of the database directories. This variable is checked by LispWorks when you initialize a database type, and the libraries loaded are dependent on its value. The details of foreign code loading are described in the *LispWorks Foreign Language Interface User Guide and Reference Manual*

Note that most users only need to set the appropriate environment variable for their specific database vendor.

In order to override the default loading of database library code, you may set *`sql-libraries`*. To control messages while loading the libraries, set *`sql-loading-verbose`*.

In LispWorks for UNIX only (not LispWorks for Linux, x86/x64 Solaris, FreeBSD or Macintosh), the list of library modules is added to `link-load:*default-libraries*` and `read-foreign-modules` is called to do the loading. If you need to load a different set of library modules, add your list of library modules to `link-load:*default-libraries*` before loading.

19.2.5 General database connection and disconnection

Once the database type has been initialized a connection can be established by calling `connect` with an appropriate *connection-spec*. A call to `connect` sets `*default-database*` to the database instance which represents the connection. All the other database functions described take a `:database` argument that can be either a database or a database name, and which defaults to the value of `*default-database*`.

Database connections can be named by passing the `:name` argument to `connect`, allowing you to have more than one connection to a given database. If this is omitted, then a unique database name is constructed from *connection-spec* and a counter. Connection names are compared with `equalp`.

To find all the database connection instances, call the function `connected-databases`. To retrieve the `name` for a connection instance, call `database-name`, and to find a connection instance with a given name use `find-database`. To print status information about the existing connections, call `status`.

To close a connection to a database, use `disconnect`.

To reestablish a connection to a database, use `reconnect`.

19.2.5.1 Connection example

The following example assumes that the `:odbc` database type has been initialized as described in “Initialization functions and variables” on page 223. It connects to two databases, `scott` and `personnel`, and then prints out the connected databases.

```
(setf *default-database-type* :odbc)
(connect "scott")
(connect "personnel" :database-type :odbc)
(print *connected-databases*)
```

19.2.6 Connecting to Oracle

For `database-type :oracle`, *connection-spec* conforms to the canonical form described for `connect`. The `connection` part is the string used to establish the connection. When connecting to a local server, it may be the SID, otherwise it is an alias recognized by the names server, or in the `tnsnames.ora` file.

To connect to Oracle via SQL*Net, *connection-spec* is of the form ***username/password@host*** where *host* is an Oracle hostname.

Common SQL uses the Oracle Call Interface internally where this is available. For Oracle version 8, Common SQL automatically uses the same API as in LispWorks 4.4. On some platforms, this can also be obtained by using **database-type :oracle8**. Note that the **:oracle8** database type is restricted because it cannot access or manipulate LOBs and all connections must use the same character set.

19.2.7 Connecting to ODBC

For **database-type :odbc** or **:odbc-driver**, *connection-spec* may take the canonical form described for `connect`, but an additional syntax is also allowed.

`connect` keyword arguments **:encoding**, **:signal-rollback-errors** and **:date-string-format** are all ignored.

19.2.7.1 Connecting to ODBC using a string

connection-spec should have one of the forms:

username/password@dsn The general form.

dsn/username/password For backward compatibility.

The two forms of strings are distinguished by the presence (or absence) of the '@' character. In both forms, *password* can be omitted along with the preceding '/'. Also, *username* can simply be omitted.

Note that this means that "**xyz**" and "@**xyz**" are both interpreted to give the same values (*username* is null, *password* is null, *dsn* is "**xyz**").

19.2.7.2 Connecting to ODBC using a plist

In the plist, the acceptable keywords are **:username**, **:password**, **:dsn** and **:connection**.

:connection is a synonym of **:dsn**.

19.2.8 Connecting to MySQL

For *database-type* :`mysql`, *connection-spec* may be in the canonical form described for `connect`, but it may also have the extensions described in this section.

In both the string and plist forms of *connection-spec* described below, any part that is omitted defaults to the MySQL default:

<i>username</i>	anonymous user
<i>password</i>	No password
<i>dbname</i>	No default database
<i>hostname</i>	localhost
<i>port</i>	3306 (unless using <i>unix-socket</i>).

19.2.8.1 Connecting to MySQL using a string

connection-spec can be a string of the form:

`username/password/dbname@hostname:port`

where *port* is a decimal number specifying the port number to use. *port* can be omitted along with the preceding ':'.

hostname can be omitted. If *port* is omitted too, the '@' can be omitted as well. If *port* is supplied and *hostname* is not supplied, then both the '@' and the ':' are required, for example:

```
me/my-password/my-db@:3307
```

hostname may also specify a unix socket name, which must start with the character '/'.

dbname may be omitted along with the preceding '/'.

password may be omitted. If *dbname* is also omitted, the preceding '/' can be omitted too.

username may be omitted.

19.2.8.2 Connecting to MySQL using a plist

connection-spec can be a plist containing (some of) the keywords `:username`, `:password`, `:dbname`, `:hostname`, `:port`, `:connection`, `:unix-socket`.

Each of these keywords may be omitted.

If `:unix-socket` is specified, then none of `:hostname`, `:port` and `:connection` can be specified. If `:hostname` is specified then `:connection` must not be specified. The value supplied for `:hostname` can be a raw hostname, or a string of the form *hostname*`:`*port*. If `:connection` is specified then it can a string conforming to one of these patterns:

hostname
hostname`:`*port*
`:`*port*
`unix-socket` Must start with '/'

That is, the value *connection* supplied in a plist *connection-spec* is interpreted just like the part of a string *connection-spec* following the '@' character.

19.2.8.3 Locating the MySQL client library

The MySQL interface to initialize, it must find the appropriate MySQL client library. The special variables `*mysql-library-path*` and `*mysql-library-directories*` give you control over this.

19.2.8.4 Special instructions for MySQL on Mac OS X

Download the 32-bit or 64-bit MySQL package to match your LispWorks image.

The downloadable packages from the MySQL web site contain only static client libraries, but LispWorks needs a dynamic library. You need to create the dynamic library, for example by using the following shell command.

To build the 32-bit dynamic library:

```
gcc -dynamiclib -fno-common \
-o /usr/local/mysql/lib/libmysqlclient_r.dylib \
-all_load /usr/local/mysql/lib/libmysqlclient_r.a -lz
```

To build the 64-bit dynamic library:

```
gcc -m64 -dynamiclib -fno-common \
-o /usr/local/mysql/lib/libmysqlclient_r.dylib \
-all_load /usr/local/mysql/lib/libmysqlclient_r.a -lz
```

This command should be executed as the root user, or some other user with write permission to the `/usr/local/mysql/lib` directory and assumes that MySQL was installed in `/usr/local/mysql`, which is the location used by the prepackaged downloads.

An alternate way to create a dynamic library is to build MySQL from its source code with the `--enable-shared` flag.

By default, LispWorks expects to find the library either in `/usr/local/mysql/lib` or on the shared library path. This can be overridden by setting the special variable `*mysql-library-directories*`.

By default, LispWorks expects the library to be called `libmysqlclient.*.dylib` and it searches for a library that matches that pattern, where * is any version number. This search can be avoided by setting `*mysql-library-path*` to something other than the default `("-lmysqlclient")`, for example, it is possible to force LispWorks to look for version 12 by evaluating

```
(setq *mysql-library-path* "libmysqlclient.12")
```

You can also set `*mysql-library-path*` to a full path, which avoids the need to set `*mysql-library-directories*`.

If the environment variable `LW_MYSQL_LIBRARY` is set, then its value is used instead of the value of `*mysql-library-path*`.

19.2.9 Connecting to PostgreSQL

For `database-type :postgresql`, `connection-spec` must be either a string in the format specified by the PostgreSQL libraries or a plist.

19.2.9.1 Connecting to PostgreSQL using a string

If `connection-spec` is a string then it should be in the format specified by

www.postgresql.org/docs/7.4/static/libpq.html#LIBPQ-CONNECT

For example,

```
dbname=test user=scott password=tiger host=scandium
```

19.2.9.2 Connecting to PostgreSQL using a plist

connection-spec can be a plist containing (some of) the keywords `:username` (or `:user`), `:password`, `:dbname`, `:hostname` (or `:host`), `:port`, `:connection`. Each of these keywords may be omitted, but if `:connection` is specified, then `:hostname` and `:port` must not be specified.

The value supplied for `:hostname` can be a raw hostname or a string of the form `hostname:port`. The value supplied for `:port` can be an integer or a string naming a service.

If `:connection` is specified then it can a string conforming to one of these patterns:

`hostname`

`hostname:port`

The values should not be escaped or quoted: LispWorks will escape and quote it as needed before passing it to the PostgreSQL library.

19.3 Functional interface

The functional interface provides a full set of Data Manipulation and Data Definition functions. The interface provides an SQL-compatible means of querying and updating the database from Lisp. In particular, the values returned from the database are Lisp values — thus smoothly integrating user applications with database transactions. An embedded syntax is provided for dynamically constructing sophisticated queries through `select`. Iteration is also provided via a mapping function and an extension to the `loop` macro. If necessary, the basic functions `query` and `execute-command` can be called with SQL statements expressed as strings. It is also possible to update or query the data dictionary.

19.3.1 Functional Data Manipulation Language (FDML)

The functions available for Data Manipulation and Data Definition are described below.

19.3.1.1 Querying

The function `select` returns data from a database matching the constraints specified. The data is returned, by default, as a list of records in which each record is represented as a list of attribute values.

Database identifiers used in `select` are conveniently specified using the symbolic SQL [] syntax. This syntax is enabled by calling `enable-sql-reader-syntax`.

The square bracket syntax assumes that sql symbols are visible. Therefore when using the [] syntax, ensure that the current package either is `sql`, or is a pacakge which has the `sql` package on its package-use-list.

For a description of the symbolic SQL syntax see Section 19.5 on page 243. For example, the following is a potential query and its result:

```
(select [person_id] [person surname] :from [person])
=>
((111 "Brown") (222 "Jones") (333 "Smith"))
("PERSON_ID" "SURNAME")
```

In this example, `[person_id]`, `[person surname]` and `[person]` are database-identifiers and evaluate to literal SQL. The result is a list of lists of attribute values. Conversely, consider

```
(select [surname] :from [person] :flatp t)
=>
("Brown" "Jones" "Smith")
("SURNAME")
```

In this case the result is a simple list of surname values because of the use of the `flatp` keyword. The `flatp` keyword only works when there is one column of data to return.

In this example we use * to match all fields in the table, and then we use the `result-types` keyword to specify the types to return:

```
(select [*] :from [person])
=>
((2 111 "Brown") (3 222 "Jones") (4 333 "Smith"))
("ID" "Person_ID" "Surname")

(select [*] :from [person] :result-types '(:integer :string
:string)
=>
((2 "111" "Brown") (3 "222" "Jones") (4 "333" "Smith"))
("ID" "Person_ID" "Surname")
```

If you want to affect the result type for a specified field, use a type-modified database identifier. As an example:

```
(sql:select [Person_ID :string] [Surname] :from [person])
=>
(("111" "Brown") ("222" "Jones") ("333" "Smith"))
("PERSON_ID" "SURNAME")
```

With *database-type :mysql*, further control over the values returned from queries is possible as described in “Types of values returned from queries” on page 256.

In this final example the `:where` keyword is used to specify a condition for returning selected values from the database.

```
(select [surname] :from [person] :where [= [person_id] 222])
=>
(("Jones"))
("SURNAME")
```

To output the results of a query in a more easily readable tabulated way, use the function `print-query`. For example the following call prints two even columns of names and salaries:

```
(print-query [select [surname] [income] :from [employee]
:titled '("NAME" "SALARY")']

NAME      SALARY
Brown    22000
Jones    45000
Smith    35000
```

19.3.1.2 Modification

Modifications to the database can be done using the following functions; `insert-records`, `delete-records` and `update-records`. The functions `commit`, `rollback` and the macro `with-transaction` are used to control transactions. Although `commit` or `rollback` may be used in isolation it is advisable to do any updates inside a `with-transaction` form instead. This provides consistency across different database transaction models. For example, some database systems do not provide an explicit “start-transaction” command while others do. `with-transaction` allows user code to ignore database-specific transaction models.

The function `insert-records` creates records in a specified table. The values can be either specified directly with the argument `values` or in the argument `av-pairs`, or they can be the result of a query specified in the `query` argument. The attributes can be specified with the argument `attributes` or in the argument `av-pairs`.

If `attributes` is supplied then `values` must be a corresponding list of values for each of the listed attribute names. For example, both:

```
(insert-records :into [person]
  :attributes '(person_id income surname occupation)
  :values '(115 11000 "Johnson" "plumber"))
```

and:

```
(insert-records :into [person]
  :av-pairs `((person_id 115)
    (income 11000)
    (surname "Johnson")
    (occupation "plumber")))
```

are equivalent to the following SQL:

```
INSERT INTO PERSON
  (PERSON_ID, INCOME, SURNAME, OCCUPATION)
VALUES (115, 11000, 'Johnson', 'plumber')
```

If `query` is provided, then neither `values` nor `av-pairs` should be. In this case the attribute names in the query expression must also exist in the insertion table. For example:

```
(insert-records :into [person]
  :query [select [id] [firstname] [surname]
          :from [manager]]
  :attributes '(person_id firstname surname))
```

To delete or alter those records in a table which match some condition, use `delete-records` or `update-records`.

19.3.1.3 Caching of table queries

Operations which add or modify records sometimes need to perform an internal query to obtain type information for the relevant attributes. In principle it is possible for the database schema to change between update operations, and hence this query is run for each update operation. This can be a significant overhead.

For tables which are guaranteed to have a constant schema, you can optimize performance by adding a cache of these internal query results, using the function `cache-table-queries`. This can also be used to reset the cache if the table schema is actually altered. To control the default caching behavior throughout every database connection, you can set the variable `*cache-table-queries-default*`.

19.3.1.4 Transaction handling

A transaction in SQL is defined as *starting from* the `connect`, or from a `commit`, `rollback` or data-dictionary update and *lasting until* a `commit`, `rollback`, data-dictionary update or a `disconnect` command.

The macro `with-transaction` executes a body of code and then does a `commit`, unless the body failed in which case it does a `rollback`. Using this macro allows your code to cope with the fact that transactions may be handled differently in the different vendor implementations. Any differences are transparent if the update is done within a `with-transaction` form.

Note: Common SQL opens an ODBC database in manual commit mode, so that `with-transaction` and `rollback` take effect.

Applications should perform all database update operations in a `with-transaction` form (or follow them with `commit` or `rollback`) in order to safely com-

19.3 Functional interface

mit or discard their changes. This applies to operations that modify either the data or the schema.

The following example shows a series of updates to an employee table within a transaction. This example would commit the changes to the database on exit from `with-transaction`. This example inserts a new record into the `emp` table, then changes those employees whose department number is 40 to 50 and finally removes those employees whose salary is more than 300,000.

```
(connect "personnel")

(with-transaction
  (insert-records :into [emp]
    :attributes '(empno ename job deptno)
    :values '(7100 "ANDERSON" "SALESMAN" 30))
  (update-records [emp]
    :attributes [deptno]
    :values 50
    :where [= [deptno] 40])
  (delete-records :from [emp]
    :where [> [sal] 300000]))
```

To commit or roll back all changes made since the last commit, use the functions `commit` or `rollback`.

19.3.1.5 Iteration

Common SQL has three iteration constructs: a `do` loop, a mapping function, and an extension to the Common Lisp `loop` macro.

The macros `do-query` and `simple-do-query` repeatedly execute a piece of code within the scope of variables bound to the attributes of each record resulting from a query.

The function `map-query` maps a function across the results of a query and returns its result in a sequence of a specified type, like the Common Lisp `map` function.

Common SQL provides an extension to the ANSI Common Lisp macro `loop` which is a clause for iterating over query results. The syntax of the clause is:

```
{for|as} var [type-spec] being
  {the|each}{tuples|tuple}
  {in|of} query-expression
```

The more general word `tuple` is used so that it can also be applied to the object-oriented case. In the functional case, `tuple` is synonymous with `record`.

Each iteration of the loop assigns the next record of the table to the variable `var`. The record is represented in Lisp as a list. Destructuring can be used in `var` to bind variables to specific attributes of the records resulting from *query-expression*. In conjunction with the panoply of existing clauses available from the `loop` macro, the new iteration clause provides an integrated report generation facility.

Suppose the name of everyone in an employee table is required. This simple query is shown below using the different iteration method. The function `map-query` requires `flatp` to be specified; otherwise each name would be wrapped in a list.

```
(do-query ((name) [select [ename] :from [emp]])
          (print name))

(map-query
  nil
  #'(lambda (name) (print name))
  [select [ename] :from [emp] :flatp t])

(loop for (name)
      being each tuple in
      [select [ename] :from [emp]]
      do
    (print name))
```

The following extended `loop` example binds, on each record returned as a result of the query, `name` and `salary`, accumulates the salary, and for salaries greater than 2750 increments a count, and prints the details. Finally, the average salary is printed.

```
(loop for (name salary) being each record in
      [select [ename] [sal] :from [emp]]
      initially (format t "~&~20A~10D" 'name 'salary)
      when (and salary (> salary 2750))
        count salary into salaries
        and sum salary into total
        and do (format t "~&~20A~10D" name salary)
      else
        do (format t "~&~20A~10D" name "N/A")
      finally
    (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

19.3.1.6 Specifying SQL directly

Sometimes it is necessary to execute vendor-specific SQL statements and queries. For these occasions Common SQL provides the functions `query` and `execute-command`. They can also be used when the exact SQL string is known in advance and thus the square bracket syntax is not needed.

The function `query` runs a SQL query on a database and returns a list of values like `select` (see “Querying” on page 231). It also returns a list of the field names selected.

`execute-command` is the basic function which executes any SQL statement other than a query. It can run a stored procedure, as described in `execute-command`, page 946.

19.3.1.7 Building vendor-specific SQL

Common SQL does not provide a general interface to vendor-specific syntax.

There are two approaches you can take with SQL such as this:

```
SELECT B.PARTY_CODE_ALIAS, A.VALUE FROM CODES A, CODE_ALIASES B  
WHERE A.DOMAIN=B.CODE_DOMAIN(+) AND A.VALUE=B.CODE_VALUE(+)  
AND B.PARTY_ID(+)=<party_id>
```

1. Construct the string as above and then call `query` as described in “Specifying SQL directly” on page 237.
2. Use `sql-expression` to construct the vendor-specific pieces of the SQL.
The above expression can be written like this:

```
(sql:select [b party_code_alias] [a value]  
:from '([codes a] [codes_aliases b])  
:where [and [= [a domain]  
          (sql:sql-expression  
           :string "B.CODE_DOMAIN(+)")]  
        [= (sql:sql-expression  
           :string "B.PARTY_ID(+)" PARTY-ID)])
```

19.3.2 Functional Data Definition Language (FDDL)

Functions in the FDDL may be used to change or query the structure of the database.

19.3.2.1 Querying the schema

The functions `list-tables`, `list-attributes`, `attribute-type` and `list-attribute-types` return information about the structure of a database.

19.3.2.2 FDDL Querying example

This example shows you how to query the type of the `ename` attribute of the `emp` table.

```
(attribute-type [ename] [emp]) -> :char
```

19.3.2.3 Modification

You may create or drop (delete) tables using the functions `create-table` and `drop-table`.

Create or drop indexes using the functions `create-index` and `drop-index`.

To create or drop a view (that is, a derived table based on a query) use the functions `create-view` and `drop-view`.

19.4 Object oriented interface

This section describes the object-oriented interface to SQL databases using specialized CLOS classes. These classes have `standard-db-object` as one of their superclasses and have a common metaclass which provides the specialized behavior for mapping subclasses of `standard-db-object` onto records in the database. A class of this kind is created using `def-view-class`.

19.4.1 Object oriented/relational model

In the simple case, a class maps onto a database table, an instance of the class maps onto a record in the table, and a slot in the class maps onto an attribute in the table.

In general, however, a class maps onto a database view, an instance of the class maps onto a collection of records in the view, and a slot in the class is either:

- A *base slot* that maps onto an attribute in the view

19.4 Object oriented interface

- A *join slot* that points to a list of other view-class instances

If an instance maps onto more than one record in the view then for each record, all the key attributes from each table in the view are the same.

19.4.1.1 Inheritance for View Classes

It is not possible to inherit from a class that was defined by `def-view-class`. All of the slots need to be in the same class (and hence also in the same SQL table).

19.4.2 Object-Oriented Data Definition Language (OODDL)

The OODDL lets you define a mapping between the relational and object-oriented worlds to be defined. Through the mapping a CLOS object can effectively denote a collection of records in a database view, and can contain pointers to other view-based CLOS objects. The CLOS object makes explicit an object implicitly described by the flat relational values.

The mapping is defined using the macro `def-view-class`. This extends the syntax of `defclass` to allow special *base slots* to be mapped onto the attributes of database views (presently single tables). When you submit a `select` query that names a View Class (that is, a class defined by `def-view-class`), then the corresponding database view is queried, and the slots in the resulting instances are filled with attribute values from the database.

It is also possible to create *join slots* and *virtual* (ordinary) *slots*.

All the special slots are distinguished by a modified set of class and slot options. The special slots and their options are described in more detail under `def-view-class` in the *LispWorks Reference Manual*.

Note: `def-view-class` defines a Lisp view of an underlying database table. It is a similar concept to that of SQL VIEWS, but does not interact with them.

You can create a table based on a View Class using the function `create-view-from-class` and delete it using the function `drop-view-from-class`.

19.4.2.1 Example View Class definition

The following example shows a View Class corresponding to the traditional employees table, with the employee's department given by a join with the departments table. See `def-view-class`, page 930 for a description of the slot options.

```
(def-view-class employee (standard-db-object)
  ((employee-number :db-kind :key
                    :column empno
                    :type integer)
   (employee-name :db-kind :base
                  :column ename
                  :type (string 20)
                  :accessor employee-name)
   (employee-department :db-kind :base
                        :column deptno
                        :type integer
                        :accessor employee-department)
   (employee-job :db-kind :base
                 :column job
                 :type (string 9))
   (employee-manager :db-kind :base
                     :column mgr
                     :type integer)
   (employee-location :db-kind :join
                      :db-info (:join-class department
                                         :retrieval :deferred
                                         :set nil
                                         :home-key employee-department
                                         :foreign-key department-number
                                         :target-slot department-loc)
                      :accessor employee-location))
   (:base-table emp))
```

The `def-view-class` macro allows elements or lists of elements to follow `:home-key` and `:foreign-key`. The elements can be symbols, `nil`, strings, integers or floats.

This syntax means that an object from the join class is only included in the join slot if the values from `home-key` are `equal` to the values in `foreign-key`, in order. These values are calculated as follows:

- If the element in the list is a symbol it is taken to be a slot name and the value of the slot is used

19.4 Object oriented interface

- Otherwise the element is taken to be the value

Note that some database vendors may have short maximum identifier lengths. The CLOS interface uses constructed alias names for tables in its SQL queries, and long table names or long class names may cause the constructed aliases to exceed the maximum identifier length for a particular vendor.

19.4.3 Object-Oriented Data Manipulation Language (OODML)

The OODML is designed to be powerful and expressive, while remaining familiar to users of the FDML. To achieve this aim, some of the functions and macros in the SQL interface have been *overloaded* — particularly the `select` function and the iteration constructs.

The function `select` is common across the both the functional and object-oriented SQL interfaces. If its first argument, `selections`, refers to a View Class by supplying its symbolic name then the select operation becomes object-oriented and it returns a list of instances instead of a list of attributes.

A subsequent equivalent `select` call will return the same (`eq1`) instances. The `:refresh` argument can be used to ensure that existing instances get updated with any changed data. If such an update requires action by your application, then add methods on the generic function `instance-refreshed`.

In a View Class `select` call, the symbol `slot-value` is a valid SQL operator for use within the `:where` argument.

To find the View Classes for a particular database, use the function `list-classes`.

To manipulate data via a View Class, that is to modify the records corresponding to instances of the View Class, using the generic functions `update-records-from-instance`, and `update-record-from-slot`.

To delete records corresponding to instances of the View Class, use the generic function `delete-instance-records`.

To update existing instances of a View Class when data is known to have changed, use the generic functions `update-slot-from-record` and `update-instance-from-records`.

19.4.3.1 Examples

```
[select 'employee']
-> #<SQL-OBJECT-QUERY (EMPLOYEE)>

(select 'employee'
 :where [= [slot-value 'employee 'employee-job]
 "SALESMAN"])
((#<db-instance EMPLOYEE 8067092>
 (#<db-instance EMPLOYEE 8069536>
 (#<db-instance EMPLOYEE 8069176)))

(list-classes)
(#<db-class EMPLOYEE> #<db-class DEPARTMENT>)
```

19.4.3.2 Iteration

The object-oriented SQL interface has the same three iteration constructs as the functional interface (see Section 19.3.1.5 on page 235): a `do-loop`, a mapping function, and an extension to the Common Lisp `loop` macro. However, in this case, the iteration focus is not a tuple of attributes (that is, a record), but a tuple of instances. For example:

```
(loop for (jones company) being the tuples in
      [select 'person 'organisation
      :where [= [slot-value 'person 'surname] "Jones"]]
      do (format t "~A ~A ~%"
                 (slot-value jones 'forename)
                 (slot-value company 'short-name)))
```

Note: Instances may denote many database records, and hence the effective iteration focus in this case is a tuple of sets of tuples of attributes.

19.4.3.3 Garbage collection of view instances

View instance objects are not released for garbage collection (GC) until the connection is closed. This is because they are referenced by the CLOS object representing the database connection. This is to ensure that they can reliably be compared by `eq`.

19.5 Symbolic SQL syntax

Common SQL supports a symbolic query syntax across both the functional and object-oriented interface layers. It allows SQL and Common Lisp expressions to be mixed together — with as much processing as possible done at compile-time. Symbolic SQL expressions are read as square-bracketed lists to distinguish them from Lisp expressions. However, each can be nested within the other to achieve the desired result.

By default, this reader syntax is turned off. To turn it on see Section 19.5.3 on page 249.

19.5.1 The “[...]" Syntax

The square bracket syntax for the SQL interface is heavily overloaded to provide the most intuitive behavior in all situations. There are three uses of square brackets:

1. To enclose a database identifier
2. To construct an SQL string representing a symbolic expression
3. To enclose literal SQL

Each of these uses is demonstrated below.

19.5.1.1 Enclosing database identifiers

Database identifiers can be enclosed in the square bracket syntax as shown in the following examples.

```
[foo] => #<SQL-IDENT "FOO">
```

This case corresponds to an unqualified SQL identifier
as in: `SELECT FOO FROM BAR.`

```
[foo bar] => #<SQL-IDENT "FOO.BAR">
```

This corresponds to a qualified SQL identifier as in:
`SELECT FOO.BAR FROM FOO`

```
["foo" "bar"] => #<SQL-IDENT "\"foo\".BAR">
```

This corresponds to a qualified SQL identifier with an aliased table name containing special characters as in:
`SELECT "foo".BAR FROM BAZ "foo".`

```
[foo "bar"] => #<SQL-IDENT FOO \"bar\">>
```

This corresponds to an alias definition as in:
`SELECT "bar".* FROM FOO "bar".`

```
[foo :integer] => #<SQL-IDENT "FOO" :INTEGER>
```

As above, but including a type coercion component.

```
[foo bar :integer] -> #<SQL-IDENT "FOO.BAR" :INTEGER>
```

As above, but includes a type coercion component.

```
["foo" bar :integer] -> #<SQL-IDENT "\"foo\".BAR" :INTEGER>
```

As above, but includes a type coercion component.

19.5.1.2 SQL strings representing symbolic expressions

There are some SQL operators which may take a single argument (for example `any`, `some`, `all`, `not`, `union`, `intersect`, `except`, and `minus`). These are read as calls to the appropriate SQL operator. For example:

```
[any '(3 4)] -> #<SQL-VALUE-EXP "(ANY (3,4))">
```

This causes no conflict, however, as it is illegal to use these reserved words as identifiers in SQL. Similarly with two argument operators:

```
[> [baz] [beep]]  
-> #<SQL-RELATIONAL-EXP "(BAZ > BEEP)">
```

The `select` statement itself may be prepared for later query execution using the `[]` syntax. For example:

```
[select [person_id] [surname] :from [person]]
```

This form results in an SQL expression, which could be bound to a Lisp variable and later given to `query` to execute. For example:

19.5 Symbolic SQL syntax

```
[select [foo] [bar *]
       :from '([baz] [bar])
       :where [or [= [foo] 3]
              [> [baz.quux] 10]]]
->
#<SQL-QUERY
  "(SELECT FOO,BAR.* FROM BAZ,BAR
   WHERE ((FOO = 3)
   OR (BAZ.QUUX > 10)))">
```

Strings can be inserted in place of database identifiers within a `select`:

```
[select [foo bar] [baz]
       :from '([foo] [quux])
       :where [or [> [baz] 3]
              [like [foo bar] "SU%"]]]
->
#<SQL-QUERY:
  "(SELECT FOO.BAR,BAZ
   FROM FOO,QUUX
   WHERE ((BAZ > 3)
   OR (FOO.BAR LIKE 'SU%')))">
```

Any non-constant included gets filled in at runtime, for example:

```
[> [foo] x]
```

when macroexpanded reads as

```
(SQL-> #<SQL-IDENT "FOO"> X)
```

which constructs the actual SQL string at runtime.

Any arguments to an SQL operator that are Lisp constants are translated to the matching SQL construct at compile-time, for example:

```
"foo" -> "'foo'"
3 -> "3"
'("this" 5 "that") -> "('this', 5, 'that')"
'xyz -> "XYZ"
```

SQL operators which are supported are `null`, `exists`, `*`, `+`, `/`, `-`, `like`, `substr`, `and`, `or`, `not`, `in`, `all`, `any`, `some`, `| |`, `=`, `<`, `>`, `>=`, `<=`, `<>`, `order-by`, `count`, `max`, `min`, `avg`, `sum`, `minus`, `nvl`, `distinct`, `except`, `intersect`, `union`, `slot-value`, `between` and `userenv`. There are also pseudo operators for calling database functions (see “Calling database functions” on page 247).

The general syntax is: [<operator> <operand> ...], for instance:

```
(select [count [*]] :from [emp])
```

The operand can itself be a SQL expression, as in the following example:

```
(sql:create-table [company]
  '(([name] (varchar 20) not-null)))

(loop for company in '("LispWorks Ltd"
  "Harlequin"
  "Oracle"
  "Rover"
  "Microsoft")
  do
  (sql:insert-records :into [company]
    :av-pairs `(([name] ,company)))

(sql:create-table [person]
  '(([surname] (varchar 20) not-null)
    ([firstname] (varchar 20) not-null))

(loop for person in '(("Joe" "Bloggs")
  ("Fred" "Smith")
  ("Rover" "the Dog")
  ("Fido" "the Dog"))
  do (sql:insert-records :into [person]
    :av-pairs
    `(([firstname] ,(car person))
      ([surname] ,(second person)))))

(sql:select [name]
  :from [company]
  :where [= [name]
    [any [select [surname]
      :from [person]]]])

(sql:select [surname]
  :from [person]
  :set-operation [union [select [firstname]
    :from [person]]])
```

19.5.1.3 Calling database functions

An arbitrary function can be included in the SQL using the pseudo operator `sql-function`. The first argument is the function name and the rest are its arguments, for example:

```
(select [sql-function "COS" [age]] :from [EMPLOYEES])  
  
(insert-records  
  :into [atable]  
  :attributes '(a b)  
  :values  
  (list 1 [sql-function "TO_DATE" "02/06/99" "mm/DD/RR"]))
```

Also you can call SQL infix operators using the pseudo operators `sql-boolean-operator` and `sql-operator`.

19.5.1.4 Enclosing literal SQL

Literal SQL statements can simply be enclosed in the square bracket syntax, as shown below.

```
["SELECT FOO, BAR FROM BAZ"]  
-> #<SQL "SELECT FOO, BAR FROM BAZ">  
  
[select [*] :from [tbl]]  
-> #<SQL-QUERY "(SELECT * FROM TABLE)">  
  
[person surname]  
->#<SQL-IDENT "PERSON.SURNAME">  
  
[> [foo] 37]  
->#<SQL-RELATIONAL-EXP "(FOO > 37)">
```

19.5.2 Programmatic interface

In some cases it is necessary to build SQL-expressions dynamically under program control.

The function `sql-operation` returns the SQL expression for an operator applied to its arguments. It also supports building SQL expressions which contain arbitrary SQL functions using the pseudo operators `sql-function`, `sql-operator` and `sql-boolean-operator`. For examples see `sql-operation`, page 1019.

The function `sql-expression` makes an SQL expression from the given keywords. This is equivalent to the first and third uses of the `[]` syntax as discussed in Section 19.5.1 on page 243.

The function `sql-operator` returns the Lisp symbol for an SQL operator.

The function `sql` makes SQL out of the arguments supplied. Each argument to `sql` is turned into SQL and then the `args` are concatenated with a single space between each pair. A Lisp string maps to the same characters enclosed between single quotes (this corresponds to an SQL string constant). `nil` maps to `"NULL"`, that is, an SQL null value. Symbols and numbers map to strings. A list maps to a parenthesised, comma-separated expression. A vector maps to a comma-separated expression, which allows the easy generation of SQL lists that require no parentheses such as table lists in select statements.

The rules for the conversion are fully specified in `sql`, page 1014.

19.5.2.1 Examples

The following example function, taken from the object-oriented SQL interface layer, makes an SQL query fragment that finds the records corresponding a CLOS object (using the slots as attributes), when built into the `where-clause` of an updating form.

```
(let* ((class (class-of object))
       (key-slots (db-class-keyfields class)))
  (loop
    for key in key-slots
    for slot-name = (slot-definition-name key)
    for slot-type = (db-slot-definition-type key)
    collect
    [= (make-field-name class key)
       (lisp-to-sql-format
         (slot-value object slot-name)
         (if (listp slot-type)
             (car slot-type)
             slot-type))]
    into cols
    finally (apply (sql-operator 'and) cols)))
 ->
 #<SQL-RELATIONAL-EXP "(EMP.EMPNO = 7369)">
```

Here is another example that produces an SQL `select` statement:

19.6 Working with date fields

```
(sql-operation 'select
  (sql-expression :table 'foo
    :attribute 'bar)
  (sql-expression :attribute 'baz)
:from (list
  (sql-expression :table 'foo)
  (sql-expression :table 'quux)))
:where (sql-operation 'or
  (sql-operation '>
    (sql-expression :attribute 'baz)
  3)
  (sql-operation 'like
    (sql-expression :table 'foo
      :attribute 'bar)
    "SU%")))
->
#<SQL-QUERY "SELECT FOO.BAR, BAZ FROM FOO, QUUX
 WHERE ((BAZ > 3) OR (FOO.BAR LIKE 'SU%'))">
```

19.5.3 Utilities

The function `enable-sql-reader-syntax` switches square bracket syntax on and sets the state so that `restore-sql-reader-syntax-state` restores the syntax again if it is subsequently disabled. The function `disable-sql-reader-syntax` switches square bracket syntax off and sets the state so that `restore-sql-reader-syntax-state` disables the syntax again if it is subsequently enabled.

The functions `locally-enable-sql-reader-syntax` and `locally-disable-sql-reader-syntax` switch square bracket syntax on and off, but do not change the state restored by `restore-sql-reader-syntax-state`. The intended use of these is in a file:

```
#. (locally-enable-sql-reader-syntax)
  <code using [...]>
#. (restore-sql-reader-syntax-state)
```

19.6 Working with date fields

This section describes particular issues around using datetime database fields via Common SQL.

See also “Types of values returned from queries” on page 256 for information specifically about returning datetime values from MySQL.

19.6.1 Testing date values

Compare DATE values by formatting the date as a string in a date format that the database can parse. For example:

```
(sql:select * :from [Table] :where [= [Date] "25-Dec-2005"])
```

Note that it is not possible to lookup date values in the database using numeric values. This is because:

1. Common SQL cannot know that the field will be a date field until the results are returned, and
2. the database probably does not know about Common Lisp universal time.

19.6.2 DATE returned as universal time

By default Common SQL converts DATE values to Common Lisp universal times. Therefore code like this returns Common Lisp universal times (that is, integers) where `MyDate` is a DATE field type:

```
(sql:select [MyDate] :from [MyTable] :where [= [id] 1])
```

19.6.2.1 Timezone of returned DATEs

Common SQL creates universal time values from DATE fields assuming that the database contains times in Coordinated Universal Time (UTC). That is, as if by passing `time-zone 0` to `encode-universal-time`. To decode the values consistently with this encoding, pass `time-zone 0` to `decode-universal-time`.

If the database contains times in a different timezone, then the integer `time-zone` needs to be adjusted by adding an appropriate multiple of 3600 before calling `decode-universal-time`.

19.6.3 DATE returned as string

Instead of universal time integers, you can obtain strings formatted by the database by modifying the `myDate` database identifier, adding `:string` like this:

```
(sql:select [MyDate :string] :from [MyTable] :where [= [id] 1])
```

This avoids the overhead of converting DATEs to universal times and so may improve performance of your application.

See `select`, page 1008 for details.

19.6.4 Using universal time format

If the database is only accessed via Common SQL and you want to use the universal time date format, then you might consider using an INTEGER column containing universal time values instead of a DATE column.

19.7 SQL I/O recording

It is sometimes convenient to simply monitor the flow of commands to, and results from, a database. A number of functions are provided for this purpose.

The functions operate on two stream collections (*broadcast streams*) — one each for commands and results. They allow the recording to be started and stopped, checked, or recorded on further individual streams. By default, both commands and results recording is printed only to `*standard-output*`.

For details, see the reference pages for `start-sql-recording`, `stop-sql-recording`, `sql-recording-p`, `list-sql-streams`, `sql-stream`, `add-sql-stream` and `delete-sql-stream`.

19.8 Error handling in Common SQL

All errors generated by Common SQL are of type `sql-user-error` or `sql-database-error`. You can test for these conditions and their subtypes in your error handlers.

19.8.1 SQL condition classes

An `sql-user-error` is an error inside Lisp.

An `sql-database-error` is an error inside the database interface that Lisp uses.

The following are subclasses of `sql-database-error`:

`sql-database-data-error`

An error with the data given. It signifies an error that must be fixed for the code to work.

`sql-timeout-error`

Signifies an error that is a result of other users using the same database. It means the code can work without change, once the other users stop using the database.

`sql-connection-error`

An error with the connection to the RDBMS.

The following are subclasses of `sql-connection-error`:

`sql-timeout-error`

A timeout with some operation.

`sql-fatal-error`

An error which means that the connection is no longer usable.

Note: In general, the documentation for the various supported databases make it difficult to decide which error code should be made into which of the above condition class, and we probably get many of these wrong. If you find errors that seem to be signalled with the wrong condition class, please report them to Lisp Support, including the full printout of the condition, and we will fix it.

19.8.2 Database error accessors

Three functions are provided which access slots of `sql-database-error`, allowing you to discover more about the actual error that occurred.

19.9 Using MySQL

`sql-error-error-id` and `sql-error-secondary-error-id` return primary and secondary error identifiers. If you use these, please read the detailed description in `sql-database-error`, page 1016.

`sql-error-database-message` is a string (maybe `nil`) returned by the foreign code.

19.9 Using MySQL

This section describes particular issues in Common SQL with MySQL databases.

19.9.1 Connection specification

See “Connecting to MySQL” on page 227 for information about MySQL specific extensions for the `connection-spec` passed to `connect`.

19.9.2 Case of table names and database names

MySQL is case sensitive on table names and database names when the server is on a Unix machine. MySQL does not automatically change raw names to uppercase as specified by the SQL standard. However, Common SQL is geared towards uppercasing all names, so this may cause some mismatches. In general, Common SQL uppercases strings, and uses symbol names, which are normally uppercase, as-is.

One solution, possible only if you control the naming of tables and databases, is to make them all have the same case. If this is uppercase, that suffices. If it is lowercase, you need to set the variable `lower_case_table_names` in the configuration of the server.

If you cannot make all the names the same case, you have to get the case right. This can be achieved in several ways:

1. Specify tables names using strings, for example:

```
(sql:select [*] :from ["TableNamewithVARIABLEcase"])
```

Note that this does not work in LispWorks 4.4 and previous versions.

2. Pass the Lisp string directly:

```
(sql:select [*] :from "TableNamewithVARIABLEcase")
```

Note that in this case the table name is passed to the database inside double quotes. That works only when the mode of the Common SQL connection contains `ANSI_QUOTES` (which is the default, see “SQL mode” on page 254 for details).

3. Specify table names as escaped symbols:

```
(sql:select [*] :from [|TableNamewithVARIABLEcase|])
```

4. Construct the whole query string and pass it to `query` rather than using `select`:

```
(sql:query "select * from TableNamewithVARIABLEcase")
```

19.9.3 Encoding (character sets in MySQL).

You can specify the encoding to be used by passing the `:encoding` argument to `connect`. Common SQL supports various encodings for MySQL as documented in `connect`, page 916.

The default is to use the default for the particular MySQL installation.

19.9.4 SQL mode

Because Common SQL is geared towards ANSI SQL, by default it connects in ANSI mode. If another mode is required, it can be set at connection time.

For example, to make MySQL treat quotes as in ANSI without setting other ANSI features, do:

```
(sql:connect "me/mypassword/mydb"
             :sql-mode "ANSI_QUOTES")
```

See the description of the `:sql-mode` argument to `connect`, page 916 for details.

19.9.5 Meaning of the `:owner` argument to `select`

In the Common SQL MySQL interface, the value of the `select` keyword argument `:owner` is interpreted to select a database name.

19.9.6 Special considerations for iteration functions and macros

This section describes particular issues when fetching multiple records using Common SQL with MySQL databases.

19.9.6.1 Fetching multiple records

The function `map-query` and the macros `do-query`, `simple-do-query` and `loop` with `each record` use internally `mysql-use-query`, which means that the underlying MySQL code brings the data from the server one record at a time. With a small number of records, it may be preferable to bring all the data immediately instead. This can be done by passing the argument `get-all`, as follows:

```
(sql:map-query nil 'print
  "select forname,surname from people"
  :get-all t)

(sql:do-query
  ((forname surname) "select forname,surname from people"
   :get-all t)
  body)

(sql:simple-do-query
  (list "select forname,surname from people"
    :get-all t)
  body)

(loop for (forname surname) being each record
  "select forname,surname from people"
  get-all t
  body)
```

19.9.6.2 Aborting queries which fetch many records

In the MySQL interface there is no way to abort a query when part way through it. When any of the iterations above stops before reaching its end, the underlying code retrieves all the records to the end of the query (though without converting them to Lisp objects). If the query found many records, that may be an expensive (that is, time consuming) operation.

It is possible to avoid this inefficiency by passing the argument `not-inside-transaction`. If `not-inside-transaction` is true then when a query is aborted, then

LispWorks closes the database connection and reopens it, rather than retrieving all the remaining records.

```
(sql:map-query nil 'print
  "select forname,surname from people"
  :get-all t
  :not-inside-transaction t)
```

Note that this will lose any state associated with the connection, and so *not-inside-transaction* should only be used with care.

19.9.7 Table types

By default, `create-table` creates tables of the default type. This behavior can be overridden by the `connect` keyword arguments `:default-table-type` and `:default-table-extra-options`, and the `:type` and `:extra-options` keyword arguments to `create-table`.

If `type` is passed to `create-table` or `default-table-type` was passed to `connect`, it is used as the argument to the "keyword" `TYPE` in the SQL statement:

```
create table MyTable (column-specs) TYPE = type-value
```

If `extra-options` is passed to `create-table` or `default-table-extra-options` was passed to `connect`, it is appended in the end of the SQL statement above.

`connect` with `default-table-type` and `create-table` with `type` also accept the keyword argument `:support-transactions`. When `support-transactions` is true, these functions will attempt to make tables that support transactions. It does this by using the type `innodb`.

19.9.8 Rollback errors

The default value of the `connect` keyword argument `:signal-rollback-errors` is determined by the value of the `:default-table-type` argument. If `default-table-type` is `:support-transactions` OR "`innodb`" or "`bdb`", then the default value for `:signal-rollback-errors` is `t`, otherwise the default value is `nil`.

19.9.9 Types of values returned from queries

Common SQL uses the MySQL mechanism that returns values as strings.

19.9 Using MySQL

By default, Common SQL converts these strings to the appropriate Lisp type corresponding to the column type (or more accurately, the type of the field in the query) according to Table 19.2

Table 19.2 MySQL type mapping

MySQL column type	Lisp Type	Meaning
All integer types	<code>integer</code>	
Double	<code>double-float</code>	
Single	<code>single-float</code>	
Decimal	<code>rational</code>	
All String types	<code>string</code>	
All Binary types	<code>(array (unsigned-byte 8) *)</code>	
Date	<code>integer</code>	Universal time
Datetime	<code>integer</code>	Universal time
Timestamp	<code>integer</code>	Universal time
Time	<code>integer</code>	Number of seconds
Year	<code>integer</code>	Number of years

However, if you specify the result type as `:string`, this eliminates the conversion and the return value is simply the string retrieved by MySQL. For information about specifying the result type for a column (or multiple columns) in a query, see “Querying” on page 231.

Each of the five date-like types (that is, Date, Datetime, Timestamp, Time and Year) can have result type `:date`, `:date-string` or `:datetime-string` with the following effects:

`:date`

This result type means a Universal time. This is the default except for Year.

:date-string

A string with the format that MySQL uses for Date columns.

:datetime-string

A string with the format that MySQL uses for Datetime columns.

All the numeric types can have result type `:int`, `:single-float` or `:double-float`, causing the appropriate conversion. No check is made on whether the result is actually useful.

String types can have result type `:binary`, which returns an array.

19.9.10 Autocommit

Common SQL sets `autocommit` to 0 when it opens a MySQL connection.

19.10 Using Oracle

This section describes particular issues in Common SQL with Oracle databases, apart from the LOB interface, which is described in “Oracle LOB interface” on page 259.

19.10.1 Connection specification

See “Connecting to Oracle” on page 225 for information about Oracle-specific interpretation of the *connection-spec* passed to `connect`.

19.10.2 Setting connection parameters

Oracle database connections have prefetch values which you can control via Common SQL. Alternatively you can allow the database default prefetch values to take effect.

You can set the default prefetch values for a connection by passing `:prefetch-rows-number` and `:prefetch-memory` keyword arguments to `connect`. The default value of `prefetch-rows-number` is 100 and the default value of `prefetch-memory` is #x100000 (meaning 1MB of data).

19.11 Oracle LOB interface

You can also pass the value `:default` for either of these arguments. This means that Common SQL does not set the default. This is useful if Oracle itself provides a suitable default.

19.11 Oracle LOB interface

19.11.1 Introduction

The Common SQL Oracle LOB interface allows you to retrieve LOB locators and then perform operations on them. It is also possible to insert new empty LOBs.

19.11.1.1 Retrieving LOB locators

This is done by normal `select` or `query` calls where the *selections* list names one or more columns that are of a LOB type. The LOB types are BLOB, CLOB, NCLOB, BFILE and CFILE.

The returned value is a LOB locator: an opaque Lisp object on which the `ora-lob-*` APIs (that is, those functions with names beginning with "ora-lob-") can be used. This LOB locator contains a pointer to an Oracle descriptor of type OCILobLocator*. Note that there can be multiple LOB locator objects associated with the same LOB in the server, but a LOB locator uniquely identifies a LOB object.

It is possible to specify that the result object should be a stream either for input or output. Then the resulting stream (which will be of type `lob-stream`) can be used as a normal Lisp stream.

19.11.1.2 Operating on LOB locators

This is done using the `ora-lob-*` functions. Most of these functions map directly to the underlying OCILob* functions.

Note that when modifying a LOB locator, the corresponding record must be locked. See “Retrieving Lob Locators” on page 260 for details.

19.11.1.3 Inserting empty LOBs

To add a new LOB object to the database, you must insert an empty LOB. The preferred way of doing this is to use the Oracle SQL functions EMPTY_BLOB and EMPTY_CLOB, which can be called by using the pseudo operator `sql-function`, like this:

```
(sql:insert-records :into [mytable]
:values
(list "name" [sql-function 'empty_blob]))
```

This code inserts a record with "name" and an empty BLOB. It is also possible to make an empty LOB by calling `ora-lob-create-empty`, and passing the empty LOB as a value to `insert-records` or `update-records`.

19.11.2 Retrieving Lob Locators

When the selections list of a query that is used in `select`, `query`, `do-query`, `map-query`, `simple-do-query` or `loop for x being each record` contains a column of a LOB type, the results are LOB locator objects. For example, if the table definition is:

```
create table mytable {
    name varchar(200),
    image blob
}
```

Then doing

```
(sql:select [image] :from [mytable] :flatp t)
```

returns a list of LOB locators.

This example lists the size of the images in the table `mytable`:

```
(dolist (pair (sql:select [name] [image] :from [mytable]))
  (format t "~a has an image of size ~a~%" 
          (first pair) (sql:ora-lob-get-length (second pair)))
  (sql:ora-lob-free (second pair)))
```

or more efficiently

```
(sql:do-query ((name lob-locator)
               [sql:select [name] [image] :from [mytable]])
  (format t "~a has an image of size ~a~%" 
          name (sql:ora-lob-get-length lob-locator)))
```

Note: The lifetime of the LOB locator objects differs between the functions that return a list of objects (`select` and `query`) and the iterative functions and macros (`do-query`, `simple-do-query`, `loop` and `map-query`). The iteration functions and macros free the LOB locators that they retrieve before proceeding to the next iteration. `select` and `query` do not free the LOB locators. Each LOB locator stays alive until the application makes an explicit call to `ora-lob-free`, or until the database is closed by a call to `disconnect`.

19.11.3 Locking

When the LOB or its contents need to modified, the corresponding record must be locked (Oracle enforces this). The best way to lock a record is to pass `:for-update` when calling `select`. See `select`, page 1008 for details. For example, writing a line in the end of the log file of station number 573:

```
create table logfiles (stationid integer, logiles clob)
.. insert records ..

(sql:do-query ((log-stream)
               [select [log :output-stream] :from [logfiles]
                  :where [= [stationid] 573] :for-update t])
               (file-position log-stream :end)
               (write-line "Add this line to the log" log-stream)
               (close log-stream) ; forces the output
            )
(sql:commit)
```

Note that any call to `commit` or `rollback` on the same connection removes the lock. If you want to modify the LOB later, you must lock it again. An efficient way to achieve this is to use the special token `ROWID`, which returns the `ROWID` in the database, because this does not involve searching on the server side. For example:

```

(let ((lobs-list
      (sql:select [lob-field] [rowid] ; get pairs of LOB
                  :from [mytable] ; locators and ROWIDs
                  :where [some-condition])))
  ... do something ...
  ... reach a point when we want to modify one
  ... of the LOBS above and have bound one of the
  ... pairs in the variable pair.
  (sql:select [1]
              :from [mytable] ; retrieve a constant
              :where
              [= [rowid] (second pair)] ; get the right record
              :for-update t) ; lock it
  (sql:ora-lob-write-buffer (car pair) ; modify the lob
                            offset
                            amount
                            buffer)
  (sql:commit) ; also unlock everything
)

```

19.11.4 Retrieving LOB Locators as streams

To retrieve LOB locators as streams, specify the type of retrieved object as `:input-stream` OR `:output-stream` in the query. For example:

```
(sql:select [image :input-stream] :from [mytable] :flatp t)
```

returns a list of streams.

For example, to print the name of all images that start with some "magic number", that is a sequence of 4 specific bytes (#xf5 #x12 #x4e #x23):

```

(let ((array (make-array 4 :element-type '(unsigned-byte 8))))
  (sql:do-query ((name lob-stream)
                 [sql:select [name] [image :input-stream]
                             :from [mytable]])
    (when (and (eq (read-sequence array lob-stream ) 4)
               (eq (aref array 0) #xf5)
               (eq (aref array 0) #x12)
               (eq (aref array 0) #x4e)
               (eq (aref array 0) #x23))
      (print name)))

```

Closing the stream also frees the LOB object.

When using `:output-stream`, it is important to call `force-output` before trying to commit the changes, because the stream is buffered.

19.11.5 Attaching a stream to a LOB locator

It is possible to attach a stream to a LOB locator, passing the LOB locator as a `:lob-locator` argument to `(make-instance 'lob-stream ...)`. The value of the `:direction` argument must be `:input` or `:output`. By default, if the stream is closed the LOB locator is freed, unless the value of the initarg `:free-lob-locator-on-close` is passed as `nil`.

Operations via the stream can be mixed with direct operations on the LOB. However, because of the buffering, accessing the LOB contents will give non-obvious results, as other operations may not see something that was written to the stream because it is still in the stream buffer, or the stream may have already read some contents before they were overwritten. Use `force-output` or `clear-input` before accessing the LOB in other ways to avoid these problems.

It is possible to attach more than one stream to the same LOB locator, in both directions. Apart from the issue of the buffering described above, the streams can be used independently of each other. Note that if you want to close one of the streams and to continue to use the others or the LOB locator itself, you must pass `:free-lob-locator-on-close nil` when you make the stream.

The LOB locator to which a stream is attached can be found by using the reader `lob-stream-lob-locator`.

19.11.6 Interactions with foreign calls

You can define your own foreign calls and use them on the underlying OCI descriptors. For this, you need to access the OCI handles using `ora-lob-lob-locator`, and maybe `ora-lob-env-handle` and `ora-lob-svc-ctx-handle`. These accessors return foreign pointers that can be passed to foreign functions in the usual way.

When the foreign functions deal only with the data, rather than with LOB objects, use the functions `ora-lob-read-foreign-buffer`, `ora-lob-write-foreign-buffer` and `ora-lob-get-buffer`.

For example:

```

;; You have a C function my_lob_processor
;; int my_lob_processor(OCILobLocator *lob,
;;                      OCISvcCtx *Context,
;;                      int other_arg)

(fli:define-foreign-function my-lob-processor
  ((lob sql:p-oci-lob-locator)
   (env sql:p-oci-svc-ctx)
   (other-arg :int))
  :result-type :int)

```

Assuming you have the LOB locator in the variable *lob*, call the foreign function on it:

```
(my-lob-processor (sql:ora-lob-lob lob)
                  (sql:ora-lob-svc-ctx-handle lob)
                  36)
```

There are three handles in the LOB: the LOB descriptor itself, the environment and the context. The pointer types, the reader and the corresponding C type for each handle are shown in Table 19.3 below.

Table 19.3 Handles in the LOB locator

OCI handle	Reader	Pointer type	C type
LOB descriptor	ora-lob-lob-locator	p-oci-lob-locator or p-oci-file	OCILobLocator*
context	ora-lob-svc-ctx-handle	p-oci-svc-ctx	OCISvcCtx*
environment	ora-lob-env-handle	p-oci-env	OCIEnv*

The `p-oci-lob-locator` pointer type is used for internal LOBs (that is, BLOB, CLOB and NCLOB). The `p-oci-file` pointer type is used for file LOBs (CFILE and BFILE). For functions that take both, the type `p-oci-lob-or-file` is defined as the union of these two types

19.11.7 Determining the type of a LOB

The function `ora-lob-internal-lob-p` returns whether it is internal (that is BLOB, CLOB or NCLOB) or not (that is BFILE or CFILE). The function `ora-lob-element-type` returns the LISP element type that best corresponds to the LOB locator. This will be one of `(unsigned-byte 8)` for BLOB and BFILE, or `base-char` or `simple-char` for CLOB, NCLOB and CFILE, depending on the charset of the LOB object.

It is possible to distinguish between CLOB and NCLOB by looking at the result of `ora-lob-char-set-form`. It returns 2 for NCLOB and 1 for CLOB.

19.11.8 Reading and writing from and to LOBs

One way of reading and writing is to use streams as described in the section “Retrieving LOB Locators as streams” on page 262. When large amounts of data are written (read) to (from) the LOB the direct interface may be useful. The direct interface is implemented by `ora-lob-read-foreign-buffer`, `ora-lob-read-buffer`, `ora-lob-write-foreign-buffer`, and `ora-lob-write-buffer`.

All the direct interfaces are more efficient if the buffer that is passed is static. That is always true for the `*-foreign-buffer` functions, but normally not true for Lisp objects. See the documentation for `make-array`, page 424. See also `ora-lob-get-buffer`.

The direct reading and writing methods can be used for "random" access, but they can also be used conveniently for efficient linear access, simply by passing `nil` as the `offset` parameter.

19.11.9 The LOB functions

Most of the LOB functions take an `errorp` argument, which is a boolean controlling what happens if an error occurs inside an OCI function. If `errorp` is true, an error is signaled. If `errorp` is false, the function returns an error object (of type `sql-database-error`).

All the LOB functions signal an error if the `lob-locator` argument given is not a LOB locator object as returned by `select` or `query`.

Many of the functions basically perform a call to the underlying OCI function. When the match is direct, this is mentioned in the function's manual page.

19.11.9.1 Querying functions

You can test whether a LOB locator is initialized, open or temporary with `ora-lob-locator-is-init`, `ora-lob-is-open` or `ora-lob-is-temporary`.

The predicate for internal LOBs is `ora-lob-internal-lob-p`.

`ora-lob-element-type` returns a Lisp element type corresponding to the LOB locator as described "Determining the type of a LOB" on page 265.

`ora-lob-lob-locator`, `ora-lob-env-handle` and `ora-lob-svc-ctx-handle` return foreign pointers to the various handles in the LOB mentioned in "Interactions with foreign calls" on page 263. To determine the best value for the size of a buffer use `ora-lob-get-chunk-size`.

`ora-lob-char-set-form` and `ora-lob-char-set-id` query the charset of a *lob-locator*.

The querying functions specifically for file LOBs are `ora-lob-file-exists`, `ora-lob-file-is-open` and `ora-lob-file-get-name`

You can obtain the current length of the LOB with `ora-lob-get-length`.

You can test two LOB locators for whether they point to the same LOB object with `ora-lob-is-equal`.

19.11.9.2 LOB management functions

You can create a LOB object with `ora-lob-create-empty`.

You can assign a LOB to another LOB locator with `ora-lob-assign`.

You can free a LOB locator with `ora-lob-free`.

19.11.9.3 Modifying LOBs

All the functions mentioned in this section are applicable to internal LOBs only, except `ora-lob-load-from-file`.

19.11 Oracle LOB interface

Before modifying a LOB, the corresponding record must be locked. See the discussion in “Locking” on page 261.

If you make several modifications to a LOB which has functional or domain indexes, it is useful to wrap several calls of modifying functions in a pair of `ora-lob-open` and `ora-lob-close`. That means that the indexes will be updated once (when `ora-lob-close` is called), which saves work. Note that after a call to `ora-lob-open`, `ora-lob-close` must be called before any call to `commit`.

To append the contents of one LOB to another, use `ora-lob-append`.

You can copy all or part of a LOB into another LOB using `ora-lob-copy`.

`ora-lob-load-from-file` loads the data from a file LOB into an (internal) LOB.

You can erase (that is, fill with the 0 byte or with Space character) all or part of a LOB using `ora-lob-erase`.

You can reduce the size of a LOB using `ora-lob-trim`.

If you need to make multiple updates to a LOB you can optionally create a transaction using `ora-lob-open` and `ora-lob-close` call. This may save work on the server side.

19.11.9.4 File operations

These functions are used to modify the properties of file LOBs.

Open and close the file associated with a file LOB using `ora-lob-file-open` and `ora-lob-file-close`.

You can close all the files associated with a file LOB locator that have been opened through the database connection with `ora-lob-file-close-all`.

You can alter the directory and/or the file name for a file LOB locator by calling `ora-lob-file-set-name`.

19.11.9.5 Direct I/O

The direct I/O functions perform input or output directly on the OCI handle, without the intervening layer of a stream. If you move large amounts of data

to or from the LOB, and in particular if you pass the data to or from foreign functions, the direct calls can be more efficient, and in some cases also more convenient to use. Note, however, that if you make many small modifications to the data, the `lob-stream` interface may be more efficient.

Note also that the difference in efficiency between the direct calls and the `lob-stream` interface is likely to be quite small compared to the time spent on network traffic.

If you make many modifications to a LOB, you should also consider wrapping the operations in a transaction created by a pair of calls to `ora-lob-open` and `ora-lob-close`.

You can read data from the LOB locator into a Lisp buffer or foreign buffer using `ora-lob-read-buffer` and `ora-lob-read-foreign-buffer` respectively.

Similarly `ora-lob-write-buffer` and `ora-lob-write-foreign-buffer` can be used to write buffer to a LOB.

You can obtain a buffer suitable for efficient I/O with foreign functions via `ora-lob-get-buffer`.

`ora-lob-read-into-plain-file` writes the contents of a LOB into a file.

`ora-lob-write-from-plain-file` writes the contents of a file into a LOB.

19.11.9.6 Temporary LOBs

You can create a temporary LOB with `ora-lob-create-temporary`.

You can test whether a LOB is temporary with `ora-lob-is-temporary`.

You can free a temporary LOB locator if necessary with `ora-lob-free-temporary`, though temporary LOB locators are freed automatically when the database connection is closed by `disconnect`.

19.11.9.7 Control of buffering

These functions control the internal buffering by the Oracle client: `ora-lob-enable-buffering`, `ora-lob-disable-buffering`, and `ora-lob-flush-buffer`. They have no interaction with any of the other functions above.

20

User Defined Streams

20.1 Introduction

A number of classes and functions are provided in the `stream` package that allow you to define your own input and output streams. You can use the standard Common Lisp I/O functions on these streams, and you can add methods specialized on your stream classes to provide specific implementations of other I/O functions. Note that some changes have been made to the standard I/O functions to allow for this. For example, `stream-element-type` is now a generic function. See Chapter 27, “The COMMON-LISP Package” for alterations to Common Lisp functions, and Chapter 39, “The STREAM Package” for more details on the API for user defined streams.

20.2 An illustrative example of user defined streams

In this chapter an example is provided to illustrate the main features of the `stream` package. In this example a stream class is defined to provide a wrapper for `file-stream` which uses the Unicode Line Separator instead of the usual ASCII CR/LF combination to mark the end of lines in the file. Methods are then defined, specializing on the user defined stream class to ensure that it handles reading from and writing to a file correctly.

20.2.1 Defining a new stream class

Streams can be capable of input or output (or both), and may deal with characters or with binary elements. The `stream` package provides a number of stream classes with different capabilities from which user defined streams can inherit. In our example the stream must be capable of input and output, and must read characters. The following code defines our stream class appropriately:

```
(defclass unicode-ls-stream
  (stream:fundamental-character-input-stream
   stream:fundamental-character-output-stream)
  ((file-stream :initform nil
                :initarg :file-stream
                :accessor ls-stream-file-stream)))
```

The new class, `unicode-ls-stream`, has `fundamental-character-input-stream` and `fundamental-character-output-stream` as its superclasses, which means it inherits the relevant default character I/O methods. We shall be overriding some of these with more relevant and efficient implementations later.

Note that we have also provided a `file-stream` slot. When making an instance of `unicode-ls-stream` we can create an instance of a Common Lisp file stream in this slot. This allows us to use the Common Lisp file stream functionality for reading from and writing to a file.

20.2.2 Recognizing the stream element type

We know that the stream will read from a file using `file-stream` functionality and that the stream element type will be `simple-char`. The following defines a method on `stream-element-type` to return the correct element type.

```
(defmethod stream-element-type ((stream unicode-ls-stream))
  'simple-char)
```

20.2.3 Stream directionality

Streams can be defined for input only, output only, or both. In our example, the `unicode-ls-stream` class needs to be able to read from a file and write to a file, and we therefore defined it to inherit from an input and an output stream class. We could have defined disjoint classes instead, one inheriting from `fun-`

damental-character-input-stream and the other from fundamental-character-output-stream. This would have allowed us to rely on the default methods for the direction predicates.

However, given that we have defined one bi-directional stream class, we must define our own methods for the direction predicates. To allow this, the Common Lisp predicates `input-stream-p` and `output-stream-p` are implemented as generic functions.

```
(defmethod input-stream-p ((stream unicode-ls-stream))
  (input-stream-p (ls-stream-file-stream stream)))

(defmethod output-stream-p ((stream unicode-ls-stream))
  (output-stream-p (ls-stream-file-stream stream)))
```

The above code allows us to “trampoline” the correct direction predicate functionality from `file-stream`, using the `ls-stream-file-stream` accessor we defined previously.

20.2.4 Stream input

The following method for `stream-read-char` reads a character from the stream. If the character read is a #\Line-Separator, then the method returns #\Newline, otherwise the character read is returned. `stream-read-char` returns :eof at the end of the file.

```
(defmethod stream:stream-read-char ((stream unicode-ls-stream))
  (let ((char (read-char (ls-stream-file-stream stream)
                        nil :eof)))
    (if (eq char #\Line-Separator)
        #\Newline
        char)))
```

There is no need to define a new method for `stream-read-line` as the default method uses `stream-read-char` repeatedly to read a line, and our implementation of `stream-read-char` ensures that this will work.

We also need to make sure that if a #\Newline is unread, it is unread as a #\Line-Separator. The following method for `stream-unread-char` uses the Common Lisp file stream function `unread-char` to achieve this.

```
(defmethod stream:stream-unread-char ((stream unicode-ls-stream)
                                       char)
  (unread-char (if (eq char #\Newline) #\Line-Separator char)
               (ls-stream-file-stream stream)))
```

Finally, although the default methods for `stream-listen` and `stream-clear-input` would work for our stream, it is faster to use the functions provided by `file-stream`, again using our accessor `ls-stream-file-stream`.

```
(defmethod stream:stream-listen ((stream unicode-ls-stream))
  (listen (ls-stream-file-stream stream)))

(defmethod stream:stream-clear-input ((stream unicode-ls-stream))
  (clear-input (ls-stream-file-stream stream)))
```

20.2.5 Stream output

The following method for `stream-write-char` uses `write-char` to write a character to the stream. If the character written to `unicode-ls-stream` is a `#\Newline`, then the method writes a `#\Line-Separator` to the file stream.

```
(defmethod stream:stream-write-char ((stream unicode-ls-stream)
                                       char)
  (write-char (if (eq char #\Newline)
                 #\Line-Separator
                 char)
              (ls-stream-file-stream stream)))
```

The default method for `stream-write-string` calls `stream-write-char` repeatedly to write a string to the stream. However, the following is a more efficient implementation for our stream.

```
(defmethod stream:stream-write-string ((stream unicode-ls-stream)
                                         string &optional (start 0)
                                         (end (length string)))
  (loop with i = start
        until (>= i end)
        do (let* ((newline (position #\Newline
                                      string :start i :end end))
                  (this-end (or newline end)))
            (write-string string (ls-stream-file-stream stream)
                         :start i :end this-end)
            (incf i this-end)
            (when newline
              (stream:stream-terpri stream)
              (incf i)))
        finally (return string)))
```

We do not need to define our own method for `stream-terpri`, as the default uses `stream-write-char`, and therefore works appropriately.

To be useful, the `stream-line-column` and `stream-start-line-p` generic functions need to know the number of characters preceding a #\Line-Separator. However, since the LispWorks file stream records line position only by #\Newline characters, this information is not available. Hence we define the two generic functions to return `nil`:

```
(defmethod stream:stream-line-column
  ((stream unicode-ls-stream))
  nil)

(defmethod stream:stream-start-line-p
  ((stream unicode-ls-stream))
  nil)
```

Finally, the methods for `stream-force-output`, `stream-finish-output` and `stream-clear-output` are “trampolined” from the standard `force-output`, `finish-output` and `clear-output` functions.

```
(defmethod stream:stream-force-output ((stream
                                         unicode-ls-stream))
  (force-output (ls-stream-file-stream stream)))

(defmethod stream:stream-finish-output ((stream
                                         unicode-ls-stream))
  (finish-output (ls-stream-file-stream stream)))
```

```
(defmethod stream:stream-clear-output ((stream
                                         unicode-ls-stream))
  (clear-output (ls-stream-file-stream stream)))
```

20.2.6 Instantiating the stream

Now that the stream class has been defined, and all the methods relevant to it have been set up, we can create an instance of our user defined stream to test it. The following function takes a filename and optionally a stream direction as its arguments and makes an instance of `unicode-ls-stream`. It ensures that the `file-stream` slot of the stream contains a Common Lisp `file-stream` capable of reading from or writing to a file given by the filename argument.

```
(defun open-unicode-ls-file (filename &key (direction :input))
  (make-instance 'unicode-ls-stream :file-stream
    (open filename
          :direction direction
          :external-format :unicode
          :element-type 'simple-char)))
```

The following macro uses `open-unicode-ls-stream` in a similar manner to the Common Lisp macro `with-open-file`:

```
(defmacro with-open-unicode-ls-file ((var filename
                                         &key (direction :input))
                                         &body body)
  `(let ((,var (open-unicode-ls-file ,filename
                                      :direction ,direction)))
     (unwind-protect
       (progn ,@body)
       (close ,var)))
```

We now have the required functions and macros to test our user defined stream. The following code uses `config.sys` as a source of input to an instance of our stream, and outputs it to the file `unicode-ls.out`, changing all occurrences of `\Newline` to `\Line-Separator` in the process.

```
(with-open-unicode-ls-file (ss "C:\\unicode-ls.out"
                               :direction :output)
  (write-line "-- Encoding: Unicode; --" ss)
  (with-open-file (ii "C:\\config.sys") ; Don't edit this file!
    (loop with line = nil
          while (setf line (read-line ii nil nil))
          do (write-line line ss))))
```

After running the above code, if you load the file `C:\unicode-ls.out` into an editor (for example, a LispWorks editor), you can see the line separator used instead of CR/LF. Most editors do not yet recognize the Unicode Line Separator character yet. In some editors it appears as a blank glyph, whereas in the LispWorks editor it appears as `<2028>`. In LispWorks you can use `Alt+X What Cursor Position` or `Ctrl+X =` to identify the unprintable characters.

You can also use the follow code to print out the contents of the new file line by line.

```
(with-open-unicode-ls-file (ss "C:\\unicode-ls.out")
  (loop while (when-let (line (read-line ss nil nil))
    (write-line line))))
```


21

Socket Stream SSL interface

The Socket Stream SSL interface allows you to use Secure Socket Layer (SSL) with Lisp objects of type `socket-stream`.

The interface is based on the OpenSSL code, and most of it is simply an FLI interface to OpenSSL functions. The main LispWorks specific code is the way OpenSSL is integrated with `socket-stream`.

Note: to load the Socket Stream SSL interface, evaluate

```
(require "comm")
```

Note: Below we assume that the current package uses the `comm` package. That is, `comm` package symbols may not be qualified explicitly.

21.1 Creating a stream with SSL

There are three ways to make a `socket-stream` with SSL processing:

- Call `(make-instance 'socket-stream :ssl-ctx ...)`
- Call `(open-tcp-stream ... :ssl-ctx ...)`
- Call `attach-ssl` on a `socket-stream`.

For example:

```
(open-tcp-stream some-url 443 :ssl-ctx t)
```

21.2 SSL-CTX and SSL objects

When the value of the `:ssl-ctx` argument is a symbol, LispWorks automatically creates an SSL_CTX object and an SSL object and uses them. If you need to configure these objects, you can access them by the following methods:

- When passing `:ssl-ctx` or when calling `attach-ssl` (as described above) also pass `:ctx-configure-callback` and `:ssl-configure-callback`.
- Use the accessors `socket-stream-ssl` and `socket-stream-ctx`.
- Make your own SSL-CTX or SSL objects and pass them as the `ssl-ctx` argument.

21.3 OpenSSL interface

The configuration interface contains mostly FLI function definitions that map directly to OpenSSL calls. See below for a list of those provided.

There are also some functions to make common cases simpler. These are `read-dhparams`, `pem-read`, `set-ssl-ctx-options`, `set-ssl-ctx-password-callback`, and `set-ssl-ctx-dh`.

21.3.1 OpenSSL constants

The Lisp constants `SSL_FILETYPE_ASN1` and `SSL_FILETYPE_PEM` representing file types are provided.

21.3.2 Naming conventions for direct OpenSSL calls

This section describes the mapping between OpenSSL function names and the corresponding Lisp names.

21.3.2.1 Mapping C names to Lisp names

For functions that map directly to OpenSSL calls, the convention is to create the LISP name from the C name by replacing underscores by hyphens.

21.3.2.2 Mapping Lisp names to C names

To find the C name from the LISP function name:

1. the hyphens need to be replaced by underscores, and
2. the initial SSL or SSL_CTX has to be in uppercase, and
3. the rest has to be lowercase, except that
4. the following phrases are cased specially, like this: "RSAPrivateKey", "DSH", "ASN1", "CA", "PrivateKey"

21.3.3 Direct calls to OpenSSL

The following functions map directly to the OpenSSL functions. Check the OpenSSL documentation for details.

Where an OpenSSL function takes an SSL* or SSL_CTX*, the Lisp function's argument must be a foreign pointer of type `ssl-pointer`, `ssl-ctx-pointer` or `ssl-cipher-pointer`. Where an OpenSSL function takes a `char*` or `int`, the Lisp function's argument must be a string or integer. Where an OpenSSL function takes other kinds of pointers, the Lisp function's argument must be a foreign pointer. The return values are integers or foreign pointers unless stated otherwise.

If an error occurs in one of these functions, an error code is returned. They do not signal any Common Lisp conditions and so you should check the return value carefully.

Table 21.1 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-add-client-ca</code>	
<code>ssl-cipher-get-bits</code>	First value is number of bits the cipher actually uses. Second value is number of bits the algorithm of the cipher can use (which may be higher).

Table 21.1 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-cipher-get-name</code>	string. e.g. "DHE-RSA-AES256-SHA"
<code>ssl-cipher-get-version</code>	string. e.g. "TLSv1/SSLv3"
<code>ssl-clear-num-renegotiations</code>	
<code>ssl-ctrl</code>	
<code>ssl-ctx-add-client-ca</code>	
<code>ssl-ctx-add-extra-chain-cert</code>	
<code>ssl-ctx-ctrl</code>	
<code>ssl-ctx-get-max-cert-list</code>	
<code>ssl-ctx-get-mode</code>	
<code>ssl-ctx-get-options</code>	
<code>ssl-ctx-get-read-ahead</code>	
<code>ssl-ctx-get-verify-mode</code>	integer
<code>ssl-ctx-load-verify-locations</code>	
<code>ssl-ctx-need-tmp-rsa</code>	
<code>ssl-ctx-sess-set-cache-size</code>	
<code>ssl-ctx-sess-get-cache-size</code>	
<code>ssl-ctx-sess-set-cache-mode</code>	
<code>ssl-ctx-sess-get-cache-mode</code>	
<code>ssl-ctx-set-client-ca-list</code>	
<code>ssl-ctx-set-max-cert-list</code>	
<code>ssl-ctx-set-mode</code>	
<code>ssl-ctx-set-options</code>	

Table 21.1 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-ctx-set-read-ahead</code>	
<code>ssl-ctx-set-tmp-rsa</code>	
<code>ssl-ctx-set-tmp-dh</code>	
<code>ssl-ctx-use-certificate-chain-file</code>	
<code>ssl-ctx-use-certificate-file</code>	
<code>ssl-ctx-use-privatekey-file</code>	
<code>ssl-ctx-use-rsaprivatekey-file</code>	
<code>ssl-get-current-cipher</code>	<code>ssl-cipher-pointer</code> Can be a null pointer.
<code>ssl-get-max-cert-list</code>	
<code>ssl-get-mode</code>	
<code>ssl-get-options</code>	
<code>ssl-get-verify-mode</code>	integer
<code>ssl-get-version</code>	string "TLSv1", "SSLv2" or "SSLv3"
<code>ssl-load-client-ca-file</code>	
<code>ssl-need-tmp-rsa</code>	
<code>ssl-num-renegotiations</code>	
<code>ssl-session-reused</code>	
<code>ssl-set-accept-state</code>	None
<code>ssl-set-client-ca-list</code>	
<code>ssl-set-connect-state</code>	None
<code>ssl-set-max-cert-list</code>	
<code>ssl-set-mode</code>	

Table 21.1 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-set-options</code>	
<code>ssl-set-tmp-rsa</code>	
<code>ssl-set-tmp-dh</code>	
<code>ssl-total-renegotiations</code>	
<code>ssl-use-certificate-file</code>	
<code>ssl-use-rsaprivatekey-file</code>	
<code>ssl-use-privatekey-file</code>	

If you need OpenSSL functionality that is not provided here, you can define your own foreign functions via the LispWorks Foreign Language Interface.

If you do this, an important point to note is that on Microsoft Windows, the `:calling-convention` must be `:cdecl` (it defaults to `:stdcall`). If using OpenSSL suddenly causes mysterious crashes, the *calling-convention* in your foreign function definitions is the first thing to check.

21.4 Socket Stream SSL keyword arguments

The keyword arguments `:ssl-ctx`, `:ssl-side`, `:ctx-configure-callback` and `:ssl-configure-callback` can be passed to create and configure socket streams with SSL processing. The various methods for creating and configuring SSL streams accept these keyword arguments as shown in Table 21.2, page 283.

Table 21.2 SSL configuration keywords

	<code>:ssl-ctx</code>	<code>:ssl-side</code>	<code>:ctx-configure-callback</code>	<code>:ssl-configure-callback</code>
<code>socket-stream make-instance</code>	Yes	Yes	Yes	Yes
<code>open-tcp-stream</code>	Yes	No	Yes	Yes
<code>attach-ssl</code>	Yes	Yes	Yes	Yes
<code>make-ssl-ctx</code>	Yes	Yes	No	No

(`make-instance 'socket-stream ...`) and `open-tcp-stream`, when `ssl-ctx` is non-nil, call `attach-ssl` and pass it all the arguments.

`:ssl-ctx` specifies that SSL should be used, and also specifies the SSL_CTX object to use. See the OpenSSL manual entry for `SSL_CTX_new` for details of making a SSL_CTX. The value of `ssl-ctx` can be:

A symbol

Together with `ssl-side`, this symbol specifies which protocol to use. `ssl-ctx` can be one of:

1) `t` or `:default`, meaning use the default. Currently this is the same as `:v23`.

2) One of `:v2`, `:v3`, `:v23` or `:tls-v1`. These are mapped to the `SSLv2_*`, `SSLv3_*`, `SSLv23_*`, `TLSv1_*` methods.

LispWorks makes a new SSL_CTX object and uses it and frees it when the stream is closed. `make-instance`, `attach-ssl` and `open-tcp-stream` also make an SSL object, use it and free it when the stream is closed.

A foreign pointer of type `ssl-ctx-pointer`

This corresponds to the C type `SSL_CTX*`. This is used and is not freed when the stream is closed. `make-instance`, `attach-ssl` and `open-tcp-stream` also make an SSL object, use it and free it when the stream is closed. The foreign pointer maybe a result of a call to `make-ssl-ctx`, but it can also be a result of your code, provided that it points to a valid `SSL_CTX` and has the type `ssl-ctx-pointer`.

A foreign pointer of type `ssl-pointer`

This corresponds to the C type `SSL*`. This specifies the SSL to use in `make-instance`, `attach-ssl` and `open-tcp-stream`. This maybe a result of a call to `ssl-new`, but can also be a result of your code, provided that it points to a valid SSL object and has the type `ssl-pointer`. The SSL is used and is not freed when the stream is closed.

When you pass a `ssl-ctx-pointer` or a `ssl-pointer` foreign pointer, these must have already been set up correctly.

`:ssl-side` specifies which side the stream is. The value `ssl-side` can be one of `:client`, `:server` or `:both`. `open-tcp-stream` does not take this keyword and always uses `:client`. For the other calls this argument defaults to `:server`. The value of `ssl-side` is used in two cases:

When a new `SSL_CTX` object is created, it is used to select the method:

```
:client => *_client_method
:server => *_server_method
:both  => *_method
```

When a new SSL object is created, when `ssl-side` is either `:client` or `:server`, LispWorks calls `ssl-set-connect-state` or `ssl-set-accept-state` respectively.

If the value of `ssl-ctx` is a `ssl-pointer`, `ssl-side` is ignored.

`:ctx-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-ctx-pointer`. This is called immediately after a new

`SSL_CTX` is created. If the value of `ssl-ctx` is not a symbol, `ctx-configure-callback` is ignored.

`:ssl-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-pointer`. This is called immediately after a new SSL is created. If the value of `ssl-ctx` is not a `ssl-pointer`, `ssl-configure-callback` is ignored.

21.5 Attaching SSL to an existing socket-stream

You can attach SSL to an existing `socket-stream` by calling `attach-ssl` on the stream. `attach-ssl` ensures the OpenSSL library is loaded and seeds the Pseudo Random Number Generator (PRNG). The `socket-stream` SSL keyword arguments are processed by `attach-ssl` as described in “Socket Stream SSL keyword arguments” on page 282.

Detach SSL from a `socket-stream` and shut down the SSL with `detach-ssl`.

For full descriptions see `attach-ssl`, page 345 and `detach-ssl`, page 348.

21.6 Using SSL objects directly

The C objects SSL and SSL_CTX are represented in LispWorks by foreign pointers with type `ssl-pointer` and `ssl-ctx-pointer`, which correspond to the C types `SSL*` and `SSL_CTX*`. These foreign types should be used for any foreign function that takes or returns these C types, and must be used when passing a foreign pointer as the value of the `:ssl-ctx` argument.

Making SSL objects is a way of getting access to them to perform configuration, but, especially in the case of the SSL_CTX, it is a useful way to avoid repeated calls to the configuration routines which may be time consuming. For example, if we have defined a function `configure-a-ctx`, and we want to read once every 60 seconds from some URL, we can write:

```
(loop (with-open-stream
      (str (comm:open-tcp-stream some-url 443 :ssl-ctx t
                           :ctx-configure-callback
                           'configure-a-ctx))
        (read-something str))
      (sleep 60))
```

This will cause `configure-a-ctx` to be called each time. If it is expensive, we can call it only once by changing the code to:

```
(let ((ctx (comm:make-ssl-ctx :ssl-side :client)))
  (configure-a-ctx ctx)
  (loop (with-open-stream
          (str (comm:open-tcp-stream some-url 443 :ssl-ctx ctx))
          (read-something str))
        (sleep 60))
    (ssl-ctx-free ctx)))
```

The SSL objects could be made either by `make-ssl-ctx` or `ssl-new` or by user code that calls the C functions `SSL_CTX_new` and `SSL_new`. `destroy-ssl-ctx` frees the `SSL_CTX` object. To free an SSL object you would call `destroy-ssl`. See the manual entries for full descriptions of these functions.

21.7 Initialization

All the functions that make a `SSL_CTX` first call `ensure-ssl`, so normally you do not need to initialize the library. If your code makes a `SSL_CTX` itself (that is, not by calling any of the LispWorks interface functions), it needs to initialize the library first. Normally that should be done by an explicit call to `ensure-ssl`, which loads the SSL library and calls `SSL_library_init` and `SSL_load_error_strings`, and also does some LispWorks specific initializations. If your code must do the initialization, `ensure-ssl` should still be called with the argument `:already-done t`, which tells it that the library is already loaded and initialized.

21.8 Obtaining and installing the OpenSSL library

At the time of writing, OpenSSL is available as shown in Table 21.3:

Table 21.3 OpenSSL availability

Operating System	Availability of OpenSSL
Linux	Installed by default on most 32-bit and 64-bit distributions
Windows	32-bit and 64-bit libraries are available at www.slproweb.com/products/Win32OpenSSL.html

Table 21.3 OpenSSL availability

Operating System	Availability of OpenSSL
Mac OS X	32-bit and 64-bit libraries are installed by default.
FreeBSD	Installed by default
x86/x64 Solaris	Installed by default
SPARC Solaris	Installed by default on Solaris 10. For other verisons, see the freeware from Sun at sunfreeware.com for both 32-bit and 64-bit.

21.8.1 Installing the OpenSSL library on Solaris

After installing (with pkgadd) you need to put the shared libraries `libcrypto.so` and `libssl.so` on the loader path. By default these are installed in `/usr/local/ssl/lib`.

To add the libraries to the loader path, either

- Add `/usr/local/ssl/lib` to the environment variable `LD_LIBRARY_PATH`, or
- Create links from `/usr/lib`.

21.8.2 Loading the OpenSSL libraries

Since OpenSSL is not a standard on all machines yet, the location of the library or libraries varies. By default, `ensure-ssl` loads libraries as shown in Table 21.4, page 287.

Table 21.4 Loading the OpenSSL libraries

Operating System	Libraries
Linux	<code>-lssl</code>
Windows	<code>libeay32.dll libssl32.dll</code>

Table 21.4 Loading the OpenSSL libraries

Operating System	Libraries
Solaris	<code>-lssl</code>
Mac OS X	<code>-lssl</code>
Others	<code>nil</code>

On machines where the path is unknown or is incorrect, you must set the path. Do this by calling `set-ssl-library-path`, or by passing the path as the *library-path* argument to `ensure-ssl`.

21.9 Errors in SSL

If there are errors inside SSL, LispWorks will signal an error of type `ssl-condition`, which is a subclass of `socket-error`.

The condition can be one of the types `ssl-x509-lookup`, `ssl-closed`, `ssl-error` and `ssl-failure`. See the manual pages for details of these condition classes.

22

Internationalization

22.1 Introduction

LispWorks uses Unicode (UCS-2 encoding) internally in its representation of `character` objects. All Unicode characters can be represented in strings, though 8-bit string types are also provided for efficiency when characters beyond the Latin-1 range are not needed. Character and string data can be input and output in various encodings (external formats).

22.2 Character and String types

22.2.1 Character types

The following subtypes of character are defined:

- | | |
|--------------------------|---|
| <code>base-char</code> | simple characters with <code>char-code</code> less than
<code>base-char-code-limit</code> (256). |
| <code>simple-char</code> | simple characters with <code>char-code</code> less than
<code>char-code-limit</code> (65536). |
| <code>character</code> | All characters including non-simple characters (that is,
with non-null bits attributes). |

22.2.2 Character Syntax

All simple characters have names that consist of `u+` followed by the code of the character in hexadecimal, for example `#\U+764F` is (`code-char #x764F`).

Additionally, Latin-1 characters have names derived from the ISO10646 name, for example:

```
(char-name (code-char 190))
=>
"Vulgar-Fraction-Three-Quarters"
```

Names are also provided for space characters:

```
(name-char "Ideographic-Space")
=>
#\Ideographic-Space
```

If required, the bits attributes names can be prepended as usual:

```
#\ctrl-ideographic-space
=>
#\Control-Ideographic-Space
```

22.2.3 String types

String types are supplied which are capable of holding each of the character types mentioned above. The following string types are defined:

<code>base-string</code>	holds any <code>base-char</code>
<code>text-string</code>	holds any <code>simple-char</code>
<code>augmented-string</code>	holds any <code>character</code> .

In particular, `text-string` is the type that can hold all characters used in texts. The types above include non-simple strings - those which are displaced, adjustable or with a fill-pointer.

The Common Lisp type `string` itself is dependent on the value of `*default-character-element-type*` according to the rules for string construction described in “String Construction” on page 292. For example:

```

CL-USER 1 > (set-default-character-element-type 'base-char)
BASE-CHAR

CL-USER 2 > (coerce (list #\Ideographic-Space) 'string)

Error: In a call to SEQ::%SET-ACCESS-ARRAY: #\Ideographic-Space
is not of type BASE-CHAR.
 1 (abort) Return to level 0.
 2 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed, or :? for
other options

CL-USER 3 : 1 > :a

CL-USER 4 > (set-default-character-element-type 'simple-char)
SIMPLE-CHAR

CL-USER 5 > (coerce (list #\Ideographic-Space) 'string)
" "

```

The following types are subtypes of `simple-string`. Note that in the names of the string types, 'simple' refers to the string object and does not mean that the string's elements are `simple-char`s.

<code>simple-base-string</code>	holds any <code>base-char</code>
<code>simple-text-string</code>	holds any <code>simple-char</code>
<code>simple-augmented-string</code>	holds any character.

The Common Lisp type `simple-string` itself is dependent on the value of `*default-character-element-type*` according to the rules for string construction described in "String Construction" on page 292.

22.2.3.1 String types at runtime

The type `string` (and hence `simple-string`) is defined by ANSI Common Lisp to be a union of all the character array types. This makes a call like

```
(coerce s 'simple-string)
```

ambiguous because it needs to select a concrete type (such as `simple-base-string` or `simple-text-string`).

When LispWorks is running with `*default-character-element-type*` set to `base-char`, it expects that you will want strings with element type `base-char`, so functions like `coerce` treat references to `simple-string` as if they were `(simple-array base-char (*))`.

If you call `set-default-character-element-type` with a larger character type, then `simple-string` becomes a union of the array types that are sub-types of that character type.

22.2.3.2 String types at compile time

The compiler always does type inferencing for `simple-string` as if `*default-character-element-type*` was set to `character`.

For example, when you declare something to be of type `simple-string`, the compiler will never treat it as `simple-base-string`. Therefore calls like

```
(schar (the simple-string x) 0)
```

will work whether `x` is a `simple-base-string`, `simple-text-string` or `simple-augmented-string`.

22.3 String accessors

`schar` works on any simple string object. However, for efficient string access when a simple string type is known, the following specialised accessors are provided:

<code>sbchar</code>	for <code>simple-base-string</code> .
<code>stchar</code>	for <code>simple-text-string</code> .

22.4 String Construction

LispWorks constructs strings of a suitable type where sufficient information is available. Failing that, strings are constructed of type according to the value of `*default-character-element-type*`.

22.4.1 Default string construction

If the value of `*default-character-element-type*` is `base-char` then:

```
(make-string 3)
```

returns a `simple-base-string` and

```
(coerce sequence 'simple-string)
```

attempts to construct a `simple-base-string`. This will signal an error if any element of `sequence` is not a `base-char`.

If the value of `*default-character-element-type*` is `simple-char` then

```
(make-string 3)
```

returns a `simple-text-string` and

```
(coerce sequence 'simple-string)
```

attempts to construct a `simple-text-string`. This will signal an error if any element of `sequence` is not a `simple-char`.

Other string constructors also take their default from `*default-character-element-type*`. For instance, the string reader will always construct a string of type determined by this variable, unless it sees a character of a larger type, in which case a suitable string is constructed. Also `with-output-to-string` and `make-string-output-stream` will construct a stream with element type determined by this variable and generate a string of the same element type.

22.4.2 String construction with known type

The variable `*default-character-element-type*` merely provides the default behavior. If enough information is supplied, then a string of suitable type is constructed. For instance, the form:

```
(make-string 3 :initial-element #\Ideographic-Space)
```

constructs a string of a type that can hold its elements, regardless of the value of `*default-character-element-type*`.

22.4.3 Controlling string construction

The initial value of `*default-character-element-type*` is `base-char`, to avoid programs that only require 8-bit strings needlessly creating larger string objects. If your application uses Unicode characters beyond the Latin-1 range (characters of type `extended-char`) then you should consider which of the following two approaches to use:

- Ensure that all strings which may hold `extended-chars` are constructed explicitly with the appropriate type. This is the conservative approach, allowing you to avoid allocation of 16-bit strings where these are not required. Note that you can use the specialised accessors such as `stchar` for strings of type `simple-text-string`.
- Change the default so that by default 16-bit strings are allocated. Do this by:

```
(set-default-character-element-type 'simple-char)
```

Bear in mind that this is a global setting which affects default string construction for the entire system. It could be called from a user interface, depending on whether the user needs to handle `extended-chars`.

Note: Do not attempt to bind or set directly the variable `*default-character-element-type*`.

22.4.4 String construction on Windows systems

When LispWorks for Windows starts up on a OS with a non-Latin-1 code page, it calls

```
(set-default-character-element-type 'simple-char)
```

so that by default, newly constructed strings can contain the data likely to be returned from the OS or user input.

If you know your string only needs to contain 8-bit data, then you can create it explicitly with element type `base-char`.

Conversely if you know that a string may need to contain 16-bit data even on a Latin-1 code page system, then you should create it explicitly with element type `simple-char`.

22.5 External Formats

External formats are two-way translations from Lisp's internal encoding to an external encoding. They can be used in file I/O, and in passing and receiving string data in foreign function calls.

An external format is named in LispWorks by an *external format specification* (*ef-spec*). An ef-spec is a symbol naming the external format, or a list with such a name as its first element followed by parameter/value pairs.

LispWorks has a number of predefined external formats:

`win32:code-page`

The Windows code page with identifier given by the `:id` parameter. Implemented only on Windows.

`:latin-1` ISO8859-1.

`:latin-1-terminal`

As Latin-1, except that if a non-Latin-1 character is output, it is written as <xxxx> where xxxx is the hexadecimal character code and does not signal error.

`:latin-1-safe`

As Latin-1, except that if a non-Latin-1 character is output, it is written as ? and does not signal error.

`:macos-roman`

The Mac OS Roman encoding.

`:ascii` ASCII.

`:unicode` The UCS-2 encoding of Unicode. The parameter `:little-endian` defaults to the endianness of the platform.

`:utf-8` The UTF-8 encoding of Unicode.

`:jis` JIS. The encoding data is read from a file `uni2jis` and is pre-built into LispWorks.

`:euc-jp` EUC-JP. The encoding data is read from a file `uni2jis` and is pre-built into LispWorks.

`:sjis` Shift JIS.

:windows-cp936 Windows code page 936. The encoding data is read from a file `windows-936-2000.ucm` and is pre-built into LispWorks.

:gbk A synonym for `:windows-cp936`.

Note: `windows-936-2000.ucm` is provided by way of documentation in the directory `lib/6-0-0-0/etc/`. It is not read at runtime.

Note: `uni2jis` is provided by way of documentation in the directory `lib/6-0-0-0/etc/`. It is also used at runtime by the function `char-name`.

22.6 External Formats and File Streams

The `:external-format` argument of `open` and related functions should be an ef-spec, where the name can be `:default`. The symbol `:default` is the default value.

If you know the format of the data when doing file I/O, you should definitely specify *external-format* explicitly, in the ef-spec syntax described in this section.

22.6.1 Complete external format ef-specs

An ef-spec is "complete" if and only if the name is not `:default` and the parameters include `:eol-style`.

All external formats have an `:eol-style` parameter. If *eol-style* is not explicit in an ef-spec a default is used. The allowed values are

<code>:lf</code>	This is the default on Unix/Linux/FreeBSD/Mac OS X systems, meaning that lines are terminated by Linefeed.
<code>:crlf</code>	This is the default on Windows, meaning that lines are terminated by Carriage-Return followed by Linefeed.
<code>:cr</code>	Lines are terminated by Carriage-Return.

22.6.2 Using complete external formats

If `open` or `with-open-file` gets a complete `:external-format` argument then, it is used as is. For example, this form opens an ASCII linefeed-terminated stream:

```
(with-open-file (ss "C:/temp/ascii-lf"
                    :direction :output
                    :external-format
                    '(:ascii :eol-style :lf))
  (stream-external-format ss))
=>
(:ASCII :EOL-STYLE :LF)
```

If you know the encoding of a file you are opening, then you should pass the appropriate `:external-format` argument.

22.6.3 Guessing the external format

If `open` or `with-open-file` gets a non-complete `:external-format` argument `ef-spec` then the system decides which external format to use by calling the function `guess-external-format`.

The default behavior of `guess-external-format` is as follows:

1. When `ef-spec`'s name is `:default`, this finds a match based on the file-name; or (if that fails), looks in the Emacs-style (-*) attribute line for an option called ENCODING or EXTERNAL-FORMAT; or (if that fails), chooses from amongst likely encodings by analysing the bytes near the start of the file, or (if that fails) uses a default encoding. Otherwise `ef-spec`'s name is assumed to name an encoding and this encoding is used.
2. When `ef-spec` does not include the `:eol-style` parameter, it then also analyses the start of the file for byte patterns indicating the end-of-line style, and uses a default end-of-line style if no such pattern is found.

The file in this example was written by a Windows program which writes the Byte Order Mark at the start of the file, indicating that it is Unicode (UCS-2) encoded. The routine in step 1 above detects this:

```
(set-default-character-element-type 'simple-char)
=>
SIMPLE-CHAR

(with-open-file (ss "C:/temp/unicode-notepad.txt")
  (stream-external-format ss))
=>
(:UNICODE :LITTLE-ENDIAN T :EOL-STYLE :CRLF)
```

The behavior of `guess-external-format` is configurable via the variables `*file-encoding-detection-algorithm*` and `*file-eol-style-detection-algorithm*`. See the manual pages for details.

22.6.3.1 Example of using UTF-8 by default

To change the default for all file access via `open`, `compile-file` and so on, you can modify the value of `*file-encoding-detection-algorithm*`.

For example given the following definition:

```
(defun utf-8-file-encoding (pathname ef-spec buffer length)
  (declare (ignore pathname buffer length))
  (system:merge-ef-specs ef-spec :utf-8))
```

then this makes it use UTF-8 as a fallback:

```
(setq system:*file-encoding-detection-algorithm*
      (substitute 'utf-8-file-encoding
                  'system:locale-file-encoding
                  system:*file-encoding-detection-algorithm*))
```

and this forces it to always use UTF-8:

```
(setq system:*file-encoding-detection-algorithm*
      '(utf-8-file-encoding))
```

22.6.4 External formats and stream-element-type

The `:element-type` argument in `open` and `with-open-file` defaults to the value of `*default-character-element-type*`.

If `element-type` is not `:default`, checks are made to ensure that the resulting stream's `stream-element-type` is compatible with its external format:

1. If `direction` is `:input` or `:io`, the `element-type` argument must be a supertype of the type of characters produced by the external format.
2. If `direction` is `:output` or `:io`, the `element-type` argument must be a subtype of the type of characters accepted by the external format

If the `element-type` argument doesn't satisfy these requirements, an error is signalled.

If `element-type` is `:default` the system chooses the `stream-element-type` on the basis of the external format.

22.6.5 External formats and the LispWorks Editor

The LispWorks Editor uses `open` with `:element-type :default` to read and write files. On reading a file, the external format is remembered and used when saving the file. On writing a Unicode (UCS-2) file, the Byte Order Mark is written.

It is possible to insert characters in the Editor (for example by pasting clipboard text) which are not supported by the chosen external format. This will lead to errors on attempt to save the buffer. You can handle this by setting the external format appropriately.

See the *LispWorks Editor User Guide* for more details.

22.6.6 Byte Order Mark

The Unicode Byte Order Mark (BOM) is treated as whitespace in the default readtable. This allows the Lisp reader to read a Unicode (UCS-2 encoded, `external-format :unicode`) file regardless of whether the BOM is present.

Some editors including Microsoft Notepad and the LispWorks editor write the BOM when writing a file with Unicode (UCS-2) encoding.

22.7 External Formats and the Foreign Language Interface

External formats can be used to pass and receive string data via the FLI. See the section on string types in the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

22.8 Unicode character and string functions

This section lists functions which compare characters and strings similarly to `cl:char-equal`, `cl:string-greaterp` and so on, but which use Unicode's simple case folding rules.

There are also predicates for properties of characters in Unicode's "general category", corresponding to `cl:alpha-char-p`, `cl:both-case-p` and so on.

22.8.1 Unicode case insensitive character comparision

The functions `lw:unicode-char-equal`, `lw:unicode-char-not-equal`, `lw:unicode-char-lessp`, `lw:unicode-char-not-lessp`, `lw:unicode-char-greaterp` and `lw:unicode-char-not-greaterp` compare characters similarly to `c1:char-equal` etc, but using Unicode's simple case folding rules.

22.8.2 Unicode case insensitive string comparision

The functions `lw:unicode-string-equal`, `lw:unicode-string-not-equal`, `lw:unicode-string-lessp`, `lw:unicode-string-not-lessp`, `lw:unicode-string-greaterp` and `lw:unicode-string-not-greaterp` compare strings similarly to `c1:string-equal` etc, but using Unicode's simple case folding rules.

22.8.3 Unicode character predicates

The predicates `lw:unicode-alphanumericp`, `lw:unicode-alpha-char-p`, `lw:unicode-lower-case-p`, `lw:unicode-upper-case-p` and `lw:unicode-both-case-p` test for properties of a character in Unicode's "general category".

23

LispWorks' Operating Environment

This chapter describes the interfaces which provide information about the environment in which LispWorks is running. This includes the operating system, the physical location of the LispWorks executable, and the arguments it was passed on startup.

23.1 The Operating System

The Common Lisp function `software-type` returns a generic name for the Operating System. The Common Lisp function `software-version` returns information about the version of the Operating System.

In particular `software-type` can be used to distinguish between systems based on Windows 95 and those based on Windows NT. `software-version` allows you to identify variants such as Windows Millennium Edition, Windows 2000, Windows XP, Windows Vista and so on. See the manual pages for details.

23.2 Site Name

The Common Lisp functions `short-site-name` and `long-site-name` can be configured using `setf`:

```
(setf (long-site-name) "LispWorks Ltd"
      (short-site-name) "LW")
```

23.3 The Lisp Image

The function `lisp-image-name` returns the namestring of the full path of the LispWorks executable or dynamic library (DLL). For example, the directory of the image can be found using:

```
(pathname-location (lisp-image-name))
```

To create a new executable or DLL, typically after loading patches, modules and application code, use `save-image` or `deliver`.

Note: Microsoft Windows supports Long and Short forms of paths. You may need to convert a namestring using `long-namestring` or `short-namestring`.

23.4 The Command Line

The command line used to run LispWorks can be found using the variable `*line-arguments-list*`. The value is a list of strings containing the executable name followed by any other command line arguments, in the order they were passed.

For example, if your application needs to behave differently when passed an argument `-foo`, use the following test:

```
(member "-foo" sys:*line-arguments-list* :test 'string=)
```

23.4.1 Command Line Arguments

The following command line options are supported by the system.

`-build build-script`

build-script names a file to be loaded on startup, typically for the purpose of building another image. LispWorks quits after loading the file. If an error is signalled while loading the file, a backtrace is displayed and LispWorks quits.

An image run with `-build` runs itself, and not the default saved session if you created one. See “Saved sessions” on page 133 for information on saved sessions.

Note: `init-file` and `siteinit-file` are not loaded when using `-build`, so your build script file must call `load-all-patches`.

-environment Start the LispWorks IDE development environment automatically, even in an image saved with (`save-image ... :environment nil`)

-eval form Evaluates the Lisp form *form* before loading initialization files.

-env A synonym for `-environment`.

-display display

Sets the X display to use when starting a LispWorks GUI on X Windows.

-IIOPhost host

Controls the host name in placed in IORs. See *Developing Component Software with CORBA* for details.

-IIOPnumeric

IORs contain a host name which is the numeric IP address obtained by reverse lookup of the machine name. See *Developing Component Software with CORBA* for details.

-init init-file

init-file names a file to be loaded on startup after `siteinit-file`. The file is user’s own LispWorks initialization file, containing code that by default is loaded when LispWorks is started. It is useful for loading initializations that should not be done for all users.

Initially the default is to load the file `"~/lispworks"` where `~` expands to the user’s home directory as described in “Configuration and initialization files” on page 130.

Your default initialization file can be set in the Lisp-Works IDE. See “Setting global preferences” in the *Lisp-Works IDE User Guide* for details.

If *init-file* is not found, an error is signalled. To suppress loading of a user initialization file, pass `-init -`.

-load *file* Loads the file *file* before loading initialization files.

-lw-no-redirection

Makes the supplied image run itself, and not the default saved session if you created one. See “Saved sessions” on page 133 for information on saved sessions.

-multiprocessing

Initializes multiprocessing on startup. See Chapter 15, “Multiprocessing”.

-no-restart-function

Suppresses the execution of a restart function on startup. Restart functions can be supplied when saving an image to automatically invoke application code. This argument suppresses that behavior. See `save-image`, page 605.

-ORBport *orbport*

orbport specifies a port number for the LispWorks ORB. The special value 0 allows the system to pick a port.

--relocate-image *BaseAddress*

Causes the image to relocate at *BaseAddress* on supported platforms, as described in “Startup relocation” on page 306. This can be useful on a system where libraries are mapped in address space that LispWorks would otherwise use as it grows. If the image is saved, then on restart without `--relocate-image`, it will locate itself automatically at *BaseAddress*.

Compatibility Note: In LispWorks 5.0 and earlier versions, to be effective, `--relocate-image` must be the first argument on the LispWorks command line. This restriction does not apply in LispWorks 6.0.

--reserve-size *ReserveSize*

Specifies the reserve size on supported platforms, as described in “Startup relocation” on page 306. New in LispWorks 5.1.

-siteinit *siteinit-file*

siteinit-file names a file to be loaded on startup. The file is the LispWorks site initialization file, containing code that by default is loaded when LispWorks is started by any user in that installation. The default is to load the file that is the result of evaluating

`(sys:lispworks-file "config/siteinit.lisp").`

If *siteinit-file* is not found, an error is signalled. To suppress loading of a site initialization file, pass **-siteinit -**.

23.5 Address Space and Image Size

There are two factors that affect the maximum size of the Lisp image: the size of real memory, and the layout of memory. On most platforms you can relocate LispWorks to avoid clashes with other software as described in “Startup relocation” on page 306.

23.5.1 Size of real memory

If LispWorks becomes significantly larger than the size of the real memory, then paging will be the main activity and LispWorks will not function effectively.

23.5.2 Layout of memory

This is Operating System-dependent:

On Solaris, 32-bit LispWorks is mapped at `#x10000000`. In principle it can grow to almost `#x80000000` (the libraries are at higher addresses).

On HP-UX, 32-bit LispWorks is mapped at `#x50000000`, because it cannot use the first quadrant. The libraries are also mapped at the same quadrant, at around `#x7a000000`, so the total size can be a little more than 0.5GB.

For the other platforms and for 64-bit LispWorks, see the discussion in “Startup relocation” on page 306.

23.5.3 Reporting current allocation

The simplest way to see the current Lisp allocation is to call `(room t)`.

To obtain values representing the current total allocation, call `room-values`.

23.6 Startup relocation

On startup, LispWorks normally maps its heap at the address where it was mapped when the image was saved. It maps more memory close to this when needed. This may cause memory clashes with other software, but such clashes may be avoided by relocating LispWorks.

32-bit LispWorks is relocatable on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD. The 32-bit LispWorks implementations on non-x86 platforms are not relocatable. 64-bit LispWorks is relocatable on all supported platforms. The discussion in this section is applicable to all relocatable implementations.

On Microsoft Windows and Macintosh, LispWorks detects memory clashes and avoids them automatically. On these platforms there is no need to explicitly relocate LispWorks. The other relocatable implementations - LispWorks (32-bit) for Linux, LispWorks (64-bit) for Linux, LispWorks (32-bit) for FreeBSD, LispWorks (32-bit) for x86/x64 Solaris, LispWorks (64-bit) for x86/x64 Solaris, and LispWorks (64-bit) for SPARC/Solaris - cannot safely detect memory clashes. Relocation may therefore be useful in these implementations.

23.6.1 How to relocate LispWorks

Relocate LispWorks by passing two parameters: the base address and the reserve amount. Both are optional. The interpretation of these parameters is very different between 64-bit LispWorks and 32-bit LispWorks.

To relocate a LispWorks executable on non-Windows platforms, pass one or both of these command line arguments:

--relocate-image *BaseAddress*

The base address, interpreted as a hexadecimal number
by calling `strtol(BaseAddress, NULL, 16)`)

--reserve-size *ReserveSize*

The reserve size, interpreted as a hexadecimal number
by calling `strtol(ReserveSize, NULL, 16)`)

There is currently no way to control the relocation of a LispWorks for Windows executable.

On all relocatable platforms, a LispWorks dynamic library or Windows DLL can be relocated by calling `InitLispWorks` with second and/or third argument non-zero.

On non-Windows platforms, you can add the appropriate call to `InitLispWorks` in wrappers written in C and added to the dynamic library by passing *dll-added-files* to `save-image` or `deliver`. There is no such option in LispWorks for Windows.

The startup relocation takes some time, normally less than 0.1 seconds on a modern machine. If the relocation address is fixed and known, this startup overhead can be eliminated by relocating the image before calling `save-image` or `deliver`.

23.6.2 Startup relocation of 32-bit LispWorks

32-bit LispWorks on x86 platforms maps its heap in one continuous block, and then grows upwards from the top. When it reaches a region that it cannot use, it can skip it. On Windows and Macintosh this skipping is safe, because LispWorks can safely detect regions of memory that it cannot use. On other x86 platforms, both the initial mapping and the further growing cannot safely detect when they overwrite some other code.

BaseAddress (passed on command line with `--relocate-image` or as the second argument to `InitLispWorks`) tells LispWorks where to map the heap. On Windows and Macintosh, if the address is already used the heap will be mapped elsewhere. On other platforms, the mapping always works, and may destroy what is already mapped at that address.

ReserveSize (passed on command line with `--reserve-size` or as the third argument to `InitLispWorks`) tells LispWorks how much additional memory to reserve. Reservation is properly supported on Windows and Macintosh, though the actual reserved size can be smaller if it fails to reserve as much as was requested. On platforms that do not support reservation (that is, not Windows or Macintosh), the reservation is done by using `mmap` with protection `PROT_NONE`.

23.6.2.1 Linux

On Linux, the default initial heap is mapped at address `#x20000000` (0.5GB). LispWorks then tries to locate the location of dynamic libraries, and marks a region around these libraries that should not be used (by default 64MB from the bottom). In most cases this suffices to avoid clashes.

Problems can arise if the memory at `#x20000000` or above is already used by another part of the software. If that memory gets used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address.

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by supplying *ReserveSize*.

The location of dynamic libraries differs between Linux configurations, and that needs to be taken into account. For most cases, including the cases where the libraries are mapped at `#x40000000` or somewhere above `#x28000000`, the mechanism for detecting libraries works and no action is required.

In principle LispWorks (32-bit) for Linux can grow up to some distance below `#xBF000000` (almost 2.5GB), though this depends on the OS kernel allowing this size.

Note: In LispWorks 5.0 and previous, we told some customers to relocate above the libraries, for example at `#x50000000` or `#x48000000`, but this should not be needed in LispWorks 6.0.

23.6.2.2 FreeBSD

By default, LispWorks is mapped at `#x30000000`.

Problems may arise if something uses memory above #x30000000. If this memory is used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address.

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by using *ReserveSize*.

Normally the dynamic libraries are mapped at #x28000000, and therefore LispWorks can grow without a problem.

In principle LispWorks can grow up to some distance below #xc0000000 (almost 2.25GB), though this depends on the OS kernel allowing this size and how many threads you have running.

23.6.2.3 x86/x64 Solaris

The default initial heap is mapped at address #x10000000 (0.25GB).

LispWorks then tries to locate the location of dynamic libraries, and marks a region around these libraries that should not be used (by default 64MB from the bottom). In most cases this suffices to avoid clashes.

Problems can arise if the memory at #x10000000 or above is already used by another part of the software. If that memory gets used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address.

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by supplying *ReserveSize*.

23.6.2.4 Windows and Macintosh

LispWorks (32-bit) for Windows and LispWorks (32-bit) for Macintosh both map by default at #x20000000. Since these platforms support reservation, normally you will not need to do anything special about this.

Problems may however arise if LispWorks operates in conjunction with non-relocatable software which insists on using addresses at #x20000000 or some distance above, in which case you will need to relocate LispWorks.

LispWorks (32-bit) for Windows can in principle grow up to some distance below #x80000000 (almost 1.5GB) but there is always the possibility that some DLL will be mapped in this region. On startup, it reserves 0.5GB above its location, so that much is guaranteed.

LispWorks (32-bit) for Macintosh can grow to around 2.7GB. You can relocate it only on the Intel architecture.

23.6.3 Startup relocation of 64-bit LispWorks

The size of address space that 64-bit LispWorks can use is limited by the size of internal tables to a "span" of 2^{44} (16TB). The span always starts at 0.

Inside this span LispWorks can use any address. However, to avoid clashes with other software, it uses memory only in some defined range.

Startup relocation means changing this range. *BaseAddress* (passed on command line with `--relocate-image` or as the second argument to `InitLispWorks`, rounded up to 2^{28}) is the start of the range. *ReserveSize* (passed on command line with `--reserve-size` or as the third argument to `InitLispWorks`) is the size of the range. The default of the size of the range is 2^{40} .

If the entire heap is within the new range, nothing else is done. If some part of the heap is outside the new range, the heap is relocated.

The range in each 64-bit LispWorks implementation starts at #x4000000000 (256GB).

23.6.3.1 Linux

In LispWorks (64-bit) for Linux the range is 192GB, ending at #x7000000000, because Linux cannot map above #x8000000000 and puts the dynamic libraries just below that limit (at least in some configurations). Since LispWorks uses the address space sparsely, it will run out of memory with less virtual memory, probably around 150GB to 160GB. If more memory is required, the range can be extended downwards, and possibly some distance upwards too. If other software uses memory in the range from #x4000000000 to #x7000000000, LispWorks should be relocated (potentially just by decreasing the range) to avoid memory clashes.

23.6.3.2 SPARC Solaris

In LispWorks (64-bit) for SPARC Solaris the default range is 768GB, ending at `#x100000000000`. If other software uses memory in this range, the range for LispWorks should be decreased to avoid memory clashes.

23.6.3.3 Windows and Macintosh

In LispWorks (64-bit) for Windows and LispWorks (64-bit) for Macintosh the size of the range is `#x3c0000000000` (3.75TB). Since these platforms properly support reservation, there should not be any reason to change the range. The only time when this is needed is when other software insists on using some address in this range and does not relocate automatically.

23.7 Calling external programs

You can call an external program using `call-system`, `call-system-showing-output` and `open-pipe`.

You can call C programs using the FLI. See the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

On Microsoft Windows a COM/Automation interface is provided. See the *LispWorks COM/Automation User Guide and Reference Manual*. There is also a DDE interface - see Chapter 18, “Dynamic Data Exchange”.

On Mac OS X an Objective-C API is provided. See the *LispWorks Objective-C and Cocoa Interface User Guide and Reference Manual*.

23.8 Snapshot debugging of startup errors

When an error occurs during initialization (for example, because of code in an initialization file) and the image is configured to start the LispWorks IDE, by default it catches the error, starts the IDE and displays the error in a snapshot debugger.

You should note that because this is a snapshot, you cannot actually continue or abort or return from a frame. The snapshot debugger is simply a tool to help debugging the error.

The behavior is controlled by the variable `*debug-initialization-errors-in-snap-shot*`.

23.9 System message log

The system message log is used by the system to produce messages that indicate that something is not as expected, where this is not an error. You can manipulate the log with `set-system-message-log`.

23.10 Exit status

You can return a process exit status to the Operating System when LispWorks or a delivered LispWorks application quits.

Do this by passing a *status* value to the function `quit`. For example:

```
(quit :status 42)
```

23.11 Creating a new executable with code preloaded

There are two ways to create a new executable with your code preloaded.

- To write a copy of the currently running image to disk, use `save-image`, page 605. The saved image requires a development license key to run.
- To create a runtime image, removing unused code to make the image smaller, call `deliver`. For more details see the *LispWorks Delivery User Guide*.

For example of how to use `save-image`, see the section "Saving and testing the configured image" in the *LispWorks Release Notes and Installation Guide*.

See Section 23.12 for information about universal binaries on Mac OS X.

23.12 Universal binaries on Mac OS X

The supplied 32-bit LispWorks for Macintosh images are universal binaries, which run the correct native architecture on PowerPC and Intel-based Macintosh computers by default.

A running Lisp image only supports one architecture, chosen when the image was started. On a PowerPC based Macintosh, this is always the PowerPC architecture. On an Intel-based Macintosh, it can be either the native Intel architecture or the PowerPC architecture (using Rosetta).

Functions such as `save-image` and `deliver` mentioned in Section 23.11 create an image containing only the running architecture and functions that operate on fasl files such as `compile-file` and `load` only support the running architecture.

To build a universal binary application from LispWorks for Macintosh 5.x, you will need to install LispWorks on an Intel-based Macintosh computer.

Building a new universal binary requires three steps:

1. Build the application for PowerPC.
This can be done on your Intel machine using Rosetta
2. Build the application for Intel.
3. Combine the two applications to make a universal binary.

These steps can be automated on a single Intel-based Macintosh by creating a script that compiles and loads the application and then saves the image. Loading this by running LispWorks with the `-build` command line argument would save an image containing a single architecture, but you can use the same script to save a universal binary by calling `save-universal-from-script`, page 615.

Note: You may install LispWorks on multiple machines for use at the same time only if you own multiple LispWorks licenses.

23.13 User Preferences

LispWorks provides an API for setting and querying persistant per-user settings in a platform-dependent registry.

23.13.1 Location of persistant settings

On Microsoft Windows the preferences are stored in the HKEY_CURRENT_USER branch of the Windows registry. (LispWorks also

offers a general Windows registry API, described in “Accessing the Windows registry” on page 314.)

On non-Windows the preferences are stored in subdirectories of the user’s home directory.

To implement preferences for your LispWorks application, you will need to define a registry path using (`setf product-registry-path`) and read it using `product-registry-path`.

23.13.2 Accessing persistant settings

Get and set preferences under the product path at runtime with `user-preference` and (`setf user-preference`).

23.13.3 Example using user preferences

Define a registry path:

```
(setf (sys:product-registry-path :deep-thought)
      '("Software" "My Company" "Deep Thought"))
```

Store a preference for the current user:

```
(setf (user-preference "Answers"
                      "Ultimate Question"
                      :product :deep-thought)
      42)
```

Retrieve a preference for the current user, potentially in a subsequent session:

```
(user-preference "Answers" "Ultimate Question"
                :product :deep-thought)
```

23.14 Accessing the Windows registry

There is an API for accessing the registry on Microsoft Windows. It is available only in LispWorks for Windows. All of its symbols are in the `win32` package.

Create and delete keys with the functions `create-registry-key` and `delete-registry-key`. Open a key for reading and/or writing with `open-registry-key` and close it with `close-registry-key`, or wrap your registry operation inside the macro `with-registry-key`.

Query the registry with `registry-key-exists-p`, `enum-registry-value`, `collect-registry-values`, `collect-registry-subkeys`, `query-registry-key-info`, `query-registry-value`, and `registry-value`. Write to the registry with `set-registry-value` OR `(setf registry-value)`.

For example, this function returns the name, progid and filename for each of the installed ActiveX controls:

```
(defun collect-control-names (&key insertable
                                (max-name-size 256)
                                (max-names most-positive-fixnum))
  (win32:collect-registry-subkeys
   "CLSID"
   :root :root
   :max-name-size max-name-size
   :max-names max-names
   :value-function
   #'(lambda (hKeyClsid ClassidName)
       (win32:with-registry-key
         (hkeyX ClassidName :root hKeyClsid :errorp nil)
         (when (and
                 (win32:registry-key-exists-p "Control"
                                               :root hkeyX)
                 (if insertable
                     (win32:registry-key-exists-p "Insertable"
                                               :root hkeyX)
                     t))
           (when-let
               (progid (win32:query-registry-value "ProgID" nil
                                                 :root hkeyX
                                                 :errorp nil))
               (values
                (list
                 (win32:query-registry-value nil nil
                                              :root hkeyX)
                 progid
                 (win32:query-registry-value "InprocServer32" nil
                                             :root hkeyX
                                             :errorp nil)))
             t))))))
```

23.15 The home directory

This section describes the implementation of the Common Lisp function `user-homedir-pathname`.

On Unix-based systems, the home directory is looked up using the C function `getpwuid`.

On Microsoft Windows systems, `user-homedir-pathname` uses the environment to construct its result. It uses the values of the environment variables HOMEDRIVE and HOMEPATH, if both are defined. If at least one of environment variables HOMEDRIVE and HOMEPATH is not defined, then a pathname `#P"C:/users/login-name"` is returned. These environment variables should be correctly set before LispWorks starts. However it is possible to change the values in Lisp using

```
(setf environment-variable)
```

23.16 Special Folders

On Microsoft Windows and Mac OS X there are various special folders used for application data and user data. Here are some examples of the folder for application data which is shared between all users.

Windows Vista:

```
C:\ProgramData
```

Windows XP:

```
C:\Documents and Settings\All Users.WINDOWS\Application Data
```

Windows 2000:

```
C:\Documents and Settings\All Users\Application Data
```

Mac OS X:

```
/Library/Application Support
```

The locations and folder names can differ between versions of the operating system, therefore it is useful to have a system-independent way to get the path at runtime. The function `get-folder-path` can be used to retrieve the path to special folders. Directory pathnames corresponding to each of the examples above can be obtained by calling:

```
(sys:get-folder-path :common-appdata)
```

Here is another example of differences between operating systems. On Windows Vista:

```
(sys:get-folder-path :my-documents)
=>
#P"C:/Users/dubya/Documents/"
```

On Windows 98 SE:

```
(sys:get-folder-path :my-documents)
=>
#P"C:/My Documents/"
```

On Mac OS X:

```
(sys:get-folder-path :my-documents)
=>
#P"/u/ldisk/dubya/Documents/"
```

See `get-folder-path`, page 1114 for more details.

On Windows NT-based systems there is a profile folder for each user. You can find the profile path for the current user with the function `get-user-profile-directory`, page 1116.

24

64-bit LispWorks

This chapter summarises the technical differences between 64-bit LispWorks and 32-bit LispWorks. Both are ANSI Common Lisp implementations and support the language same extensions and libraries so in many ways they behave the same. However the programmer should be aware of the differences mentioned here.

24.1 Introduction

64-bit LispWorks has a larger address space, subject to physical memory. The maximum heap sizes are shown in Table 24.1.

You can make larger arrays and the `fixnum` type is much larger than in 32-bit LispWorks. The values of various Common Lisp architectural constants reflect this, as shown in Table 24.2.

Other differences in 64-bit LispWorks are noted in the remaining sections of this chapter.

24.2 Heap size

In principle 64-bit LispWorks can grow to almost 16TB but it is intentionally limited to a defined range in order to avoid clashes with other software as shown in Table 24.1.

Table 24.1 Default range for 64-bit LispWorks heap

Platform	Default range	Notes
Intel-based Macintosh	#x4000000000 to #x400000000000 (3.75TB)	
PowerPC Macintosh	#x4000000000 to #x400000000000 (3.75TB)	
Linux	#x4000000000 to #x7000000000 (192GB)	Effective limit around 160GB.
Windows	#x4000000000 to #x400000000000 (3.75TB)	
Solaris	#x4000000000 to #x100000000000 (768GB)	

64-bit LispWorks is relocatable on all supported platforms as described in “Startup relocation of 64-bit LispWorks” on page 310.

In contrast, 32-bit LispWorks has a maximum heap size of 1.5-3.0GB depending on platform and is relocatable on non-Windows platforms only, as described in “Startup relocation of 32-bit LispWorks” on page 307.

24.3 Architectural constants

Common Lisp constants have the values shown in Table 24.2

Table 24.2 Architectural constants

Constant	32-bit LispWorks	64-bit LispWorks
<code>most-positive-fixnum</code>	$2^{29} - 1$	$2^{60} - 1$

Table 24.2 Architectural constants

Constant	32-bit LispWorks	64-bit LispWorks
<code>array-dimension-limit</code>	67108337 (almost 2^{26})	$2^{29} - 1$
<code>array-total-size-limit</code>	2^{26}	$2^{29} - 1$

Note: In 32-bit LispWorks 5.0, `array-total-size-limit` is $2^{29} - 1$, which is wrong.

24.4 Speed

64-bit LispWorks is generally faster than 32-bit LispWorks.

We would be interested to see comparative performance data from your application if it runs on both 32-bit and 64-bit LispWorks.

24.5 Memory Management

Memory layout and the garbage collector (GC) differs significantly between the two implementations.

For the details see “Memory Management in 32-bit LispWorks” on page 104 and “Memory Management in 64-bit LispWorks” on page 112.

24.6 Float types

In 64-bit LispWorks `single-floats` are immediate objects, and `short-float` is the same type as `single-float`.

In 32-bit LispWorks `single-floats` are boxed objects, and `short-float` is disjoint from other float types.

24.7 External libraries

Third party libraries loaded into 64-bit LispWorks must be 64-bit. Availability of a suitable library is therefore a possible issue when porting your LispWorks application to 64-bit.

Third party libraries loaded into 32-bit LispWorks must be 32-bit.

25

The CLOS Package

This chapter describes the LispWorks extensions to CLOS, the Common Lisp Object System.

The LispWorks Meta Object Protocol mostly conforms to chapters 5 & 6 of AMOP. Manual pages for symbols with different functionality from AMOP are in this chapter, and the differences are discussed in Chapter 14, “The Metaobject Protocol”.

	<i>Function</i>
Summary	Breaks to the debugger when a new instance of a class is accessed. Note that this function is deprecated.
Package	<code>clos</code>
Signature	<code>break-new-instances-on-access <i>class-designator</i> &key <i>read</i> <i>write</i> <i>slot-names</i> <i>when</i> <i>process</i> <i>trace-output</i> <i>entrycond</i> <i>eval-before</i> <i>before</i> <i>backtrace</i> => <i>t</i></code>
Arguments	<i>class-designator</i> The class to trap.
Values	Returns <i>t</i> .

Description	Causes a break when new instances of the class given by <i>class-designator</i> are accessed, according to the keyword arguments.
	The keyword arguments control which type of access cause a break and are interpreted as described for <code>trace-on-access</code> .
	Note: this function is deprecated. You should now call <code>trace-new-instances-on-access</code> with <code>:break t</code> instead.
See also	<code>trace-new-instances-on-access</code>

	<i>Function</i>
break-on-access	
Summary	Breaks to the debugger when an instance of a class is accessed. Note that this function is deprecated.
Package	<code>clos</code>
Signature	<code>break-on-access instance &key read write slot-names when process trace-output entrycond eval-before before backtrace => t</code>
Arguments	<code>instance</code> A CLOS instance.
Values	Returns <code>t</code> .
Description	A useful debugging function which causes access to <i>instance</i> to break to the debugger. Accesses include calls to <code>slot-value</code> and also accessor functions defined by the class of <i>instance</i> . Other instances of the same class are unaffected. The keyword arguments control which type of access cause a break and are interpreted as described for <code>trace-on-access</code> . You can remove the break by calling <code>unbreak-on-access</code> . A common use of this function is to find where a slot is being changed in a complex program.

Note: this function is deprecated. You should now call `trace-on-access` with `:break t` instead.

See also `trace-on-access`

class-extra-initargs *Generic Function*

Summary	Extends the valid initialization arguments of a class.	
Package	<code>clos</code>	
Signature	<code>class-extra-initargs prototype => initargs</code>	
Arguments	<code>prototype</code>	A class prototype.
Values	<code>initargs</code>	A list of additional initialization arguments.
Description	The generic function <code>class-extra-initargs</code> lets you extend the set of valid initialization arguments for a class and its subclasses. <code>initargs</code> should be a list of symbols. Each symbol becomes a valid initarg for the class. By default in a non-delivered LispWorks image, <code>make-instance</code> checks that initargs passed to it are valid.	
<p>Note: <code>class-extra-initargs</code> is useful only in complex cases. In most cases other ways of extending the set of valid initargs are simpler and clearer, such as the <code>:extra-initargs</code> class option, described in <code>defclass</code>.</p>		
Example	<p>In this session an illegal initarg <code>:my-keyword</code> is passed, causing <code>make-instance</code> to signal an error.</p> <p>Then <code>:my-keyword</code> is added as an extra initarg, after which <code>make-instance</code> accepts it.</p>	

```

CL-USER 38 > (defclass my-class () ((a :initform nil)))
#<STANDARD-CLASS MY-CLASS 113AAA2F>

CL-USER 39 > (make-instance 'my-class :my-keyword 8)

Error: MAKE-INSTANCE is called with unknown keyword
:MY-KEYWORD among the arguments (MY-CLASS :MY-KEYWORD
8) {no keywords allowed}
1 (continue) Ignore the keyword :MY-KEYWORD
2 (abort) Return to level 0.
3 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 40 : 1 > :a

CL-USER 41 > (defmethod clos:class-extra-initargs
                ((x my-class))
                '(:my-keyword))
#<STANDARD-METHOD CLOS:CLASS-EXTRA-INITARGS (MY-CLASS)
1137C763>

CL-USER 42 > (make-instance 'my-class :my-keyword 8)
#<MY-CLASS 11368963>

```

See also

`compute-class-potential-initargs`
`defclass`
`make-instance`
`set-make-instance-argument-checking`

compute-class-potential-initargs*Generic Function*

Summary Computes the valid initargs of a class.

Package `clos`

Signature `compute-class-potential-initargs class => initargs`

Arguments `class` A class.

Values	<i>initargs</i>	A list of symbols, or <code>t</code> .
Description		<p>The generic function <code>compute-class-potential-initargs</code> is called to compute the initialization arguments of a class. This set of valid initargs is used by <code>make-instance</code> when its arguments are checked.</p> <p><code>class</code> is the class passed to <code>make-instance</code>. That is, <code>compute-class-potential-initargs</code> specializes on the metaclass.</p> <p><i>initargs</i> is either a list of valid initargs, or <code>t</code> meaning that any initialization argument is allowed.</p> <p>There is a supplied method on <code>t</code>, which returns <code>nil</code>.</p> <p>The other supplied method is on <code>standard-class</code>. This consults the Relevant Methods, which are the applicable methods of <code>make-instance</code>, <code>allocate-instance</code>, <code>initialize-instance</code> and <code>shared-initialize</code>. If any of the Relevant Methods have a lambda list containing <code>&allow-other-keys</code> then <i>initargs</i> is <code>t</code>. Otherwise <i>initargs</i> is a list containing:</p> <ul style="list-style-type: none"> • all the <code>&key</code> arguments from Relevant Method lambda lists, and • the initargs of the slots of <code>class</code> and its superclasses, and • any extra initargs specified via the class option <code>:extra-initargs</code> (see <code>defclass</code> for details of this), and • any extra initargs returned by <code>class-extra-initargs</code>. <p>The list <i>initargs</i> contains no duplicates, and the result of <code>compute-class-potential-initargs</code> is cached so that it is not recomputed unless one of the Relevant Methods, the class or its class precedence list is altered.</p>
See also		<p><code>class-extra-initargs</code> <code>make-instance</code> <code>set-make-instance-argument-checking</code></p>

compute-discriminating-function

Generic Function

Summary Returns the discriminating function.

Package `clos`

Signature `compute-discriminating-function gf => result`

Arguments `gf` A generic function.

Values `result` A function.

Description The generic function `compute-discriminating-function` returns the discriminator as specified in AMOP.

However, there are two discrepancies with the AMOP behavior:

- The discriminating function does not `compute-applicable-methods-using-classes`, since this is not implemented.
- `add-method` does not call `compute-discriminating-function`. Instead, it is called when the generic function is called. This is more efficient than calling `compute-discriminating-function` each time `add-method` is called.

funcallable-standard-object

Class

Package `clos`

Superclasses `function`
`standard-object`

Subclasses `generic-function`

Description	The metaclass <code>funcallable-standard-object</code> provides the default <code>:direct-superclasses</code> for instances of <code>funcallable-standard-class</code> and its subclasses. <code>funcallable-standard-object</code> is implemented as described in AMOP except for a different order in the class precedence list. In AMOP the class precedence list is <pre>(funcallable-standard-object standard-object function t)</pre> whereas in LispWorks the class precedence list is <pre>(funcallable-standard-object function standard-object t)</pre> LispWorks is like this to be compliant with the rules in the ANSI Common Lisp Standard. The AMOP class precedence list implies a class precedence for <code>generic-function</code> which violates the last sentence in ANSI Common Lisp 4.2.2 Type Relationships. See www.lisp-works.com/reference/HyperSpec/Body/04_bb.htm .
-------------	--

		<i>Generic Function</i>
Summary		Describes how the value of a class option is parsed.
Package		<code>clos</code>
Signature		<code>process-a-class-option metaclass option value => initargs</code>
Arguments	<code>metaclass</code>	The metaclass of the class being parsed.
	<code>option</code>	The <code>defclass</code> option name.
	<code>value</code>	The tail of the <code>defclass</code> option form.
Values	<code>initargs</code>	A plist of initargs describing the option.

Description	The generic function <code>process-a-class-option</code> describes how the value of a class option is parsed. It is called at <code>defclass</code> macroexpansion time. By default LispWorks parses class options as defined in AMOP, but you need to supply a method if you need class options with different behavior. <code>initargs</code> should be a plist of class initargs and values. These are added to any other initargs for the class.
-------------	---

Example	<pre>(defclass m1 (standard-class) ((title :initarg :title)))</pre> <p>For single-valued, evaluated title option, add a method like this:</p>
---------	---

```
(defmethod clos:process-a-class-option
  ((class m1)
   (name (eql :title))
   value)
  (unless (and value (null (cdr value)))
    (error "m1 :title must have a single value."))
  (list name (car value)))

(defclass my-titled-class ()
  ()
  (:metaclass m1)
  (:title "Initial Title"))
```

If the value is not to be evaluated, the method would look like this:

```
(defmethod clos:process-a-class-option
  ((class m1)
   (name (eql :title))
   value)
  (unless (and value (null (cdr value)))
    (error "m1 :title must have a single value."))
  `(,name ',value))
```

Now suppose we want an option whose value is a list of titles:

```
(defclass m2 (standard-class)
  ((titles-list :initarg :list-of-possible-titles)))
```

If the titles are to be evaluated, add a method like this:

```
(defmethod clos:process-a-class-option
  ((class m2)
   (name (eql :list-of-possible-titles))
   value)
  (list name `@(list ,@value)))
```

Or, if the titles should not be evaluated, add a method like this:

```
(defmethod clos:process-a-class-option
  ((class m2)
   (name (eql :list-of-possible-titles))
   value)
  (list name `',value))

(defclass my-multi-titled-class ()
  ()
  (:metaclass m2)
  (:list-of-possible-titles
   "Initial Title 1"
   "Initial Title 2"))
```

See also [defclass](#)
 [process-a-slot-option](#)

process-a-slot-option

Generic Function

Summary	Describes how a <code>defclass</code> slot option is parsed.	
Package	<code>clos</code>	
Signature	<code>process-a-slot-option metaclass option value already-processed-other-options slot => processed-options</code>	
Arguments	<code>metaclass</code>	The metaclass of the class being parsed.
	<code>option</code>	The slot option name.
	<code>value</code>	The value of the slot option.

	<i>already-processed-other-options</i>
	A plist of initargs for non-standard options that have been processed already.
	<i>slot</i> The whole slot description.
Values	<i>processed-options</i>
	A plist of initargs.
Description	<p>The generic function <code>process-a-slot-option</code> describes how the value of a slot option is parsed. It is called at <code>defclass</code> macroexpansion time. By default LispWorks parses slot options as defined in AMOP, but you need to supply a method if you need slot options with different behavior.</p> <p><i>processed-options</i> should be a plist of slot initargs and values containing those from <i>already-processed-other-options</i> together with initargs for <i>option</i> as required. These are added to any other initargs for the slot.</p>

Example

```
(defclass extended-class (standard-class))

(defmethod clos:process-a-slot-option
  ((class extended-class) option value
   already-processed-options slot)
  (if (eq option :extended-slot)
      (list* :extended-slot
             value
             already-processed-options)
      (call-next-method)))

(defclass extended-direct-slot-definition
  (clos:standard-direct-slot-definition)
  ((extended-slot :initarg :extended-slot :initform
    nil)))

(defmethod clos:direct-slot-definition-class
  ((x extended-class) &rest initargs)
  'extended-direct-slot-definition)

(defclass test ()
  ((regular :initform 3)
   (extended :extended-slot t :initform 4))
  (:metaclass extended-class))
```

To add a slot option `:special-reader` whose value is a non-evaluated symbol naming a reader:

```
(defmethod clos:process-a-slot-option
  ((class my-metaclass) option value
   already-processed-options slot)
  (if (and (eq option :special-reader)
            (symbolp value))
      (list* :special-reader
             `',value already-processed-options)
      (call-next-method)))
```

To allow repeated `:special-reader` options which are combined into a list:

```
(defmethod clos:process-a-slot-option
    ((class my-metaclass) option value
     already-processed-options slot)
  (if (and (eq option :special-reader) (symbolp value))
      (let ((existing (getf
                      already-processed-options
                      :special-reader)))
        (if existing ; this is a quoted list of symbols
            (progn
              (setf (cdr (last (cadr existing))) (list
value)))
              already-processed-options)
            (list* :special-reader
                  `',(value)
                  already-processed-options)))
      (call-next-method)))

```

See also `defclass`
`process-a-class-option`

set-make-instance-argument-checking *Function*

Summary	Switches initarg checking in <code>make-instance</code> on or off.
Package	<code>clos</code>
Signature	<code>set-make-instance-initarg-checking on => on</code>
Arguments	<code>on</code> A boolean.
Description	The function <code>set-make-instance-initarg-checking</code> provides control over whether <code>make-instance</code> checks its initialization arguments. Calling <code>set-make-instance-initarg-checking</code> with <code>on</code> true, causes <code>make-instance</code> to check the initargs. This is the initial state of LispWorks. Initarg checking is switched off globally and dynamically by <code>(set-make-instance-initarg-checking nil)</code> .

Notes	The effect of calling <code>set-make-instance-initarg-checking</code> can be overridden in a runtime by the <code>deliver</code> argument <code>:make-instance-keyword-check</code> . See the <i>LispWorks Delivery User Guide</i> for details.
See also	<code>class-extra-initargs</code> <code>compute-class-potential-initargs</code> <code>make-instance</code>

slot-boundp-using-class *Generic Function*

Summary	Implements <code>slot-boundp</code> .	
Package	<code>clos</code>	
Signature	<code>slot-boundp-using-class class object slot-name => result</code>	
Arguments	<code>class</code>	A class metaobject, the class of <code>object</code> .
	<code>object</code>	An object.
	<code>slot-name</code>	A slot name.
Values	<code>result</code>	A boolean.
Description	<p>The generic function <code>slot-boundp-using-class</code> implements the behavior of the <code>slot-boundp</code> function.</p> <p>The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on <code>t</code> for this argument.</p>	
See also	<code>slot-makunbound-using-class</code> <code>slot-value-using-class</code>	

slot-makunbound-using-class Generic Function

Summary	Implements <code>slot-makunbound</code> .	
Package	<code>clos</code>	
Signature	<code>slot-makunbound-using-class class object slot-name => object</code>	
Arguments	<code>class</code>	A class metaobject, the class of <i>object</i> .
	<code>object</code>	An <i>object</i> .
	<code>slot-name</code>	A slot name.
Values	<code>object</code>	The <i>object</i> argument.
Description	<p>The generic function <code>slot-makunbound-using-class</code> implements the behavior of the <code>slot-makunbound</code> function.</p> <p>The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on <code>t</code> for this argument.</p>	
See also	<code>slot-boundp-using-class</code> <code>slot-value-using-class</code>	

slot-value-using-class Generic Function

Summary	Implements <code>slot-value</code> .	
Package	<code>clos</code>	
Signature	<code>slot-value-using-class class object slot-name => value</code> <code>(setf slot-value-using-class) value class object slot-name => value</code>	
Arguments	<code>class</code>	A class metaobject, the class of <i>object</i> .

	<i>object</i>	An object.
	<i>slot-name</i>	A slot name.
Values	<i>value</i>	The value of the slot named by <i>slot-name</i> .
Description		<p>The generic function <code>slot-value-using-class</code> implements the behavior of the <code>slot-value</code> function.</p> <p>The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on <code>t</code> for this argument.</p> <p>Note: by default, standard slot accessors are optimized to not call <code>slot-value-using-class</code>. This can be overridden with the <code>:optimize-slot-access</code> class option. See <code>defclass</code> for details.</p>
See also		<code>defclass</code> <code>slot-boundp-using-class</code> <code>slot-makunbound-using-class</code>

		<i>Function</i>
Summary		Traces new instances of a given class, based on access modes.
Package		<code>clos</code>
Signature		<code>trace-new-instances-on-access class-designator</code> <code>&key read write slot-names break when process trace-output</code> <code>entrycond eval-before before backtrace => t</code>
Arguments	<i>class-designator</i>	The class to trace.
Values		Returns <code>t</code> .

Description Causes new instances of the class given by *class-designator* to be traced for the access modes given by *read*, *write* and *slot-names*.

The keyword arguments control which type of access are traced, and provide preconditions for tracing, code to run before access, and how to print any trace output. They are interpreted as described for `trace-on-access`.

This function, when used with the `:break` keyword, replaces the deprecated function `break-new-instances-on-access`.

Example

```
(trace-new-instances-on-access 'capi:display-pane
                               :slot-names nil)
```

Suppose you have a bug whereby the slot `bar` of an instance of your class `foo` is incorrectly being set to a negative integer value. You could cause entry into the debugger at the point where the slot is set incorrectly by evaluating this form:

```
(clos:trace-new-instances-on-access
  'foo
  :slot-names '(bar)
  :read nil
  :when '(and (integerp (car *traced-arglist*))
              (< (car *traced-arglist*) 0))
  :break t)
```

and running your program.

See also `break-new-instances-on-access`
`untrace-new-instances-on-access`
`trace-on-access`

trace-on-access

Function

Summary Invokes the trace facilities when an instance of a class is accessed.

Package `clos`

Signature	<code>trace-on-access <i>instance</i> &key <i>read</i> <i>write</i> <i>slot-names</i> <i>break</i> <i>when</i> <i>process</i> <i>trace-output</i> <i>entrycond</i> <i>eval-before</i> <i>before</i> <i>backtrace</i> => <i>t</i></code>	
Arguments	<i>instance</i>	A CLOS instance.
	<i>read</i>	A generalized boolean.
	<i>write</i>	A generalized boolean.
	<i>slot-names</i>	A list of symbols, or <code>t</code> .
	<i>break</i>	A generalized boolean.
	<i>when</i>	A form.
	<i>process</i>	A form.
	<i>trace-output</i>	A form.
	<i>entrycond</i>	A form.
	<i>eval-before</i>	A list of forms.
	<i>before</i>	A list of forms.
	<i>backtrace</i>	A keyword, <code>t</code> or <code>nil</code> .
Values	Returns <code>t</code> .	
Description	<p>A useful debugging function which causes access to <i>instance</i> to invoke the trace facilities. Accesses include calls to <code>slot-value</code> and accessor functions defined by the class of <i>instance</i>.</p> <p>The keyword arguments control which type of access are traced, and provide preconditions for tracing, code to run before access, and how to print any trace output. They are similar to those supported by the <code>trace</code> macro (but note that these CLOS symbols are functions, so the keyword values are evaluated immediately, unlike in <code>trace</code>).</p> <p><i>read</i> controls whether reading slots is traced. The default is <code>t</code>.</p> <p><i>write</i> controls whether writing slots is traced. The default is <code>t</code>.</p>	

slot-names controls which slots to trace access for. It can be a list of symbols which are the slot-names. The default value, `t`, means trace access to all slots.

break controls whether the debugger is entered when a traced slot in *instance* is accessed. When `nil`, the debugger is not invoked and messages are printed to `*trace-output*`. The default value is `nil`.

when is evaluated during slot access to determine whether any tracing should occur. The default value is `t`.

process is evaluated during slot access to determine whether any tracing should occur in the current process. The form should evaluate to either `nil` (meaning trace in all processes), a string naming the process in which tracing should occur (see `process-name`, `find-process-from-name`), or a list of strings naming the processes in which tracing should occur. The default value is `nil`.

trace-output is evaluated during slot access to determine the stream on which to print tracing messages. If this is `nil` then the value of `*trace-output*` is used. The default value is `nil`.

entrycond is evaluated during slot access to determine whether the default tracing messages should be printed.

eval-before is a list of forms which are evaluated during slot access.

before is a list of forms which are evaluated during slot access. The first value returned by each form is printed.

backtrace controls what kind of backtrace to print. If this is `nil` then no backtrace is printed, and this is the default value. Otherwise it can be any of the following values:

- | | |
|-----------------------|---|
| <code>:quick</code> | Like the <code>:bq</code> debugger command. |
| <code>t</code> | Like the <code>:b</code> debugger command. |
| <code>:verbose</code> | Like the <code>:b :verbose</code> debugger command. |

:bug-form Like the **:bug-form** debugger command.

Other instances of the same class are unaffected and you can remove the trace by calling **untrace-on-access**.

The variable ***traced-arglist*** is bound to a list of arguments for the slot access during evaluation of the options above, that is (*instance slot-name*) when reading a slot and (*new-value instance slot-name*) when writing a slot.

A common use of this function is to find where a slot is being changed in a complex program.

This function, when called with **:break t**, replaces the deprecated function **break-on-access**.

See also

untrace-on-access
trace-new-instances-on-access
break-on-access

unbreak-new-instances-on-access *Function*

Summary Removes the trapping installed by **break-new-instances-on-access**. Note that this function is deprecated.

Package **clos**

Signature **unbreak-new-instances-on-access class-designator => t**

Arguments *class-designator* The class whose trap you want to remove.

Values Returns *t*.

Description Removes the trapping installed by **break-new-instances-on-access**. Note that this function is deprecated. You should now use **untrace-new-instances-on-access** instead.

See also **untrace-new-instances-on-access**

		<i>Function</i>
Summary	Removes the trapping installed by <code>break-on-access</code> . Note that this function is deprecated.	
Package	<code>clos</code>	
Signature	<code>unbreak-on-access instance</code>	
Arguments	<code>instance</code>	A class instance
Values	Returns <code>t</code> .	
Description	Removes any break installed on <code>instance</code> by <code>break-on-access</code> . See <code>untrace-on-access</code> for details. Note: this function is deprecated. You should now use <code>untrace-on-access</code> instead.	
See also	<code>untrace-on-access</code>	

		<i>Function</i>
Summary	Removes the tracing installed by <code>trace-new-instances-on-access</code> .	
Package	<code>clos</code>	
Signature	<code>untrace-new-instances-on-access class-designator => t</code>	
Arguments	<code>class-designator</code>	The class whose trap you want to remove.
Values	Returns <code>t</code> .	
Description	Removes the tracing installed by <code>trace-new-instances-on-access</code> .	

See also [trace-new-instances-on-access](#)
[untrace-on-access](#)

untrace-on-access

Function

Summary Removes the tracing installed by `trace-on-access`.

Package **clos**

Signature **untrace-on-access** *instance* => t

Arguments *instance* A class instance

Values Returns t.

Description Removes any trace installed on *instance* by `trace-on-access`.

See also [trace-on-access](#)
[untrace-new-instances](#)

26

The COMM Package

This chapter provides reference entries for the functions in the `comm` package.

The `comm` package provides the TCP/IP interface. TCP/IP sockets can be used to communicate between processes and machines. The TCP/IP mechanism allows LispWorks to connect to or implement a server. It also allows using Secure Sockets Layer (SSL) processing in the socket.

Before the interface can be used the module "`comm`" must be loaded using

```
(require "comm")
```

attach-ssl	<i>Function</i>
Summary	Attaches SSL to a socket stream.
Signature	<code>attach-ssl <i>socket-stream</i> &key <i>ssl-ctx</i> <i>ssl-side</i> <i>ctx-configure-callback</i> <i>ssl-configure-callback</i> => <i>ssl</i></code>
Arguments	<p><code><i>socket-stream</i></code> A <code>socket-stream</code>.</p> <p><code><i>ssl-ctx</i></code> A symbol or a foreign pointer.</p> <p><code><i>ssl-side</i></code> One of the keywords <code>:client</code>, <code>:server</code> or <code>:both</code>.</p>

	<i>ctx-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .
	<i>ssl-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .
Values	<code>ssl</code>	A foreign pointer of type <code>ssl-pointer</code> .
Description	<p>The function <code>attach-ssl</code> attaches SSL to the socket-stream socket-stream.</p> <p>The allowed values and meaning of the keyword arguments are as described for <code>socket-stream</code>.</p> <p>Note that <code>attach-ssl</code> is used by <code>(make-instance 'comm:socket-stream :ssl-ctx ...)</code> and by <code>(comm:open-tcp-stream ... :ssl-ctx ...)</code> but you can also call it explicitly.</p> <p>Before starting to create objects, <code>attach-ssl</code> ensures the SSL library (by calling <code>ensure-ssl</code>) and calls <code>do-rand-seed</code> to seed the Pseudo Random Number Generator (PRNG), so normally you do not need to worry about these.</p> <p>If <code>ssl-ctx</code> is a symbol, it creates the <code>ssl_ctx</code> and calls <code>ctx-configure-callback</code> if this is non-nil. If <code>ssl-ctx</code> is not a <code>ssl-pointer</code>, it creates the <code>ssl</code> object, calls <code>ssl-configure-callback</code> if this is non-nil, and sets the ACCEPT/CONNECT state if the value of <code>ssl-side</code> is not <code>:both</code>. Then it uses <code>ssl_set_fd</code> to attach the <code>ssl</code> to the socket, and records this in the socket stream. It returns the <code>ssl</code>.</p> <p>The default value of <code>ssl-ctx</code> is <code>t</code> and the default value of <code>ssl-side</code> is <code>:server</code>.</p> <p>When a <code>socket-stream</code> is closed, <code>detach-ssl</code> is called with <code>:retry-count nil</code>, which, if the stream is attached to SSL,</p>	

calls `SSL_shutdown` and then frees the object (or objects) that were automatically allocated.

If SSL is already attached to *socket-stream* then `attach-ssl` signals an error.

See also `detach-ssl`

destroy-ssl *Function*

Summary Frees a `SSL`.

Package `comm`

Signature `destroy-ssl ssl-pointer`

Arguments `ssl-pointer` A foreign pointer of type `ssl-pointer`.

Description The function `destroy-ssl` frees the `SSL` pointed to by `ssl-pointer` and also frees any LispWorks cached values associated with it.

See also `ssl-pointer`

destroy-ssl-ctx *Function*

Summary Frees a `SSL_CTX`.

Package `comm`

Signature `destroy-ssl-ctx ssl-ctx-pointer`

Arguments `ssl-ctx-pointer` A foreign pointer of type `ssl-ctx-pointer`.

Description	The function <code>destroy-ssl-ctx</code> frees the <code>ssl_ctx</code> pointed to by <code>ssl-ctx-pointer</code> and also frees any LispWorks cached values associated with it.
See also	<code>ssl-ctx-pointer</code>

detach-ssl	<i>Function</i>
Summary	Detaches the SSL from a socket stream.
Signature	<code>detach-ssl socket-stream &key retry-count retry-timeout</code>
Arguments	<p><code>socket-stream</code> A <code>socket-stream</code>.</p> <p><code>retry-count</code> A non-negative integer.</p> <p><code>retry-timeout</code> A non-negative real.</p>
Description	<p>The function <code>detach-ssl</code> detaches the SSL from the socket-stream <code>socket-stream</code>. If <code>socket-stream</code> is not attached to an SSL, <code>detach-ssl</code> just returns immediately. Otherwise, it detaches the SSL from <code>socket-stream</code>, tries to shut down the SSL cleanly, and then frees the objects that were allocated by <code>attach-ssl</code>.</p> <p><code>retry-count</code> specifies how many additional times to call <code>ssl_shutdown</code> after the second to attempt to get a successful shutdown. The default value of <code>retry-count</code> is 5.</p> <p><code>retry-timeout</code> specifies the time in seconds to wait between each of the calls to <code>ssl_shutdown</code>. If it fails to get a successful shutdown after these attempts, <code>detach-ssl</code> signals an error. The default value of <code>retry-timeout</code> is 0.1.</p> <p>Note that the shutdown calls happen after the SSL has been detached from <code>socket-stream</code> as far as LispWorks is concerned, so if an error occurs at this point and is aborted, <code>socket-stream</code> can be used in <code>attach-ssl</code> again (assuming that the peer can cope with this situation).</p>

If *retry-count* is `nil`, `detach-ssl` does not try to get a successful shutdown call. This value is used when the stream is closed, but should not be used normally.

See also `attach-ssl`

do-rand-seed *Function*

Summary	Calls the SSL function <code>RAND_seed</code> .
Package	<code>comm</code>
Signature	<code>do-rand-seed</code>
Arguments	<code>do-rand-seed</code> takes no arguments.
Values	<code>do-rand-seed</code> returns no values.
Description	The function <code>do-rand-seed</code> calls the SSL function <code>RAND_seed</code> with some suitable value, which is dependent in a non-trivial way on the current time, the history of the current process and the history of the machine it is running on. If the machine that it runs on has the file <code>/dev/urandom</code> , <code>do-rand-seed</code> does nothing.

See also `attach-ssl`

ensure-ssl *Function*

Summary	Initializes SSL.
Signature	<code>ensure-ssl &key library-path already-done</code>
Arguments	<code>library-path</code> A string or a list of strings.

	<i>already-done</i>	A generalized boolean.
Description	The function <code>ensure-ssl</code> initializes SSL. If it was already called in the image, <code>ensure-ssl</code> does nothing. Otherwise it loads the library, calls <code>SSL_library_init</code> , calls <code>SSL_load_error_strings</code> and performs internal initializations. If <i>already-done</i> is true, <code>ensure-ssl</code> does only the internal initializations. The default value of <i>already-done</i> is <code>nil</code> . If <i>library-path</i> is passed, it needs to be either a string, specifying one library, or a list of strings specifying multiple libraries. The default value of <i>library-path</i> is platform-specific. The initial default value is described in “Loading the OpenSSL libraries” on page 287. This default may be changed by calling <code>set-ssl-library-path</code> .	
See also	<code>openssl-version</code> <code>set-ssl-library-path</code>	

		<i>Function</i>
Summary		Returns address or name information about a given host.
Package		<code>comm</code>
Signature		<code>get-host-entry host &key fields => field-values</code>
Arguments	<i>host</i>	A number or a string.
	<i>fields</i>	A list of keywords.
Values	<i>field-values</i>	Values, one for each field.
Description		Using whatever host naming services are configured on the current machine, <code>get-host-entry</code> returns address or name

information about the given host. `nil` is returned if the host is unknown.

The `host` argument can be one of the following:

- a name string, for example "`www.foobar.com`"
- a dotted inet address string, for example "`209.130.14.246`"
- a integer representing the inet address, for example `#xD1820EF6`

The `fields` argument is a list of keywords describing what information to return for the host. If `get-host-entry` succeeds, it returns multiple values, one value for each field specified. The following fields are allowed:

- | | |
|-------------------------|---|
| <code>:address</code> | The primary IP address as an integer. |
| <code>:addresses</code> | A list of all the IP addresses as integers. |
| <code>:name</code> | The primary name as a string. |
| <code>:aliases</code> | The alias names as a list of strings. |

Note: although the results of `get-host-entry` are not cached by LispWorks, the operating System might cache them.

Examples

```
CL-USER 16 > (comm:get-host-entry "www.altavista.com"
                                     :fields '(:address))
3511264349

CL-USER 17 > (comm:get-host-entry 3511264349
                                     :fields '(:name))
"altavista.com"

CL-USER 18 > (comm:get-host-entry "altavista.com"
                                     :fields '(:name
                                               :address
                                               :aliases))
"altavista.com"
3511264349
("www.altavista.com" "www.altavista.com")
```

		<i>Function</i>
Summary		Returns the local address and port number of a given socket.
Package		<code>comm</code>
Signature		<code>get-socket-address socket => address, port</code>
Arguments	<code>socket</code>	A socket handle.
Values	<code>address</code>	The local host address of the socket or <code>nil</code> if not connected.
	<code>port</code>	The local port number of the socket or <code>nil</code> if not connected.
Description		Connected sockets have two addresses, local and remote. The <code>get-socket-address</code> function returns the local address.
See also		<code>get-socket-peer-address</code> <code>socket-stream-address</code>

		<i>Function</i>
Summary		Returns the remote address and port number of a given socket.
Package		<code>comm</code>
Signature		<code>get-socket-peer-address socket => address, port</code>
Arguments	<code>socket</code>	A socket handle.
Values	<code>address</code>	The remote host address of the socket or <code>nil</code> if not connected.

<i>port</i>	The remote port number of the socket or <code>nil</code> if not connected.
Description	Connected sockets have two addresses, local and remote. The <code>get-socket-peer-address</code> function returns the remote address.
See also	<code>get-socket-address</code> <code>socket-stream-peer-address</code>

get-verification-mode *Function*

Summary	Returns the mode of the SSL.	
Package	<code>comm</code>	
Signature	<code>get-verification-mode ssl-or-ssl-ctx => result</code>	
Arguments	<code>ssl-or-ssl-ctx</code>	A foreign pointer of type <code>ssl-pointer</code> or <code>ssl-ctx-pointer</code> .
Values	<code>result</code>	A list of symbols.
Description	<p>The function <code>get-verification-mode</code> returns the mode of the <code>ssl-pointer</code> or <code>ssl-ctx-pointer</code> as a list of symbols.</p> <p><code>result</code> is a list containing zero or more of the symbols <code>:verify-client-once</code>, <code>:verify-peer</code> and <code>:fail-if-no-peer-cert</code>, corresponding to the C constants <code>VERIFY_CLIENT_ONCE</code>, <code>VERIFY_PEER</code> and <code>FAIL_IF_NO_PEER_CERT</code> respectively.</p>	
See also	<code>set-verification-mode</code>	

		<i>Function</i>
Summary	Returns the dotted IP address string from the integer IP address.	
Package	<code>comm</code>	
Signature	<code>ip-address-string ip-address => string-ip-address</code>	
Arguments	<i>ip-address</i>	An integer.
Values	<i>string-ip-address</i>	The dotted string format of the given IP address.
Description		The <code>ip-address-string</code> function converts its argument to a string in the standard dotted IP address notation <code>a.b.c.d</code> .
See also		<code>string-ip-address</code>
make-ssl-ctx		<i>Function</i>
Summary	Makes a <code>ssl_ctx</code> object.	
Package	<code>comm</code>	
Signature	<code>make-ssl-ctx &key ssl-ctx ssl-side => ssl-ctx-ptr</code>	
Arguments	<i>ssl-ctx</i>	A symbol or a foreign pointer.
	<i>ssl-side</i>	One of the keywords <code>:client</code> , <code>:server</code> or <code>:both</code> .
Values	<i>ssl-ctx-ptr</i>	A foreign pointer of type <code>ssl-ctx-pointer</code> .
Description		The function <code>make-ssl-ctx</code> first calls <code>ensure-ssl</code> , and returns a foreign pointer of type <code>ssl-ctx-pointer</code> .

If the value of `ssl-ctx` is `t`, `:default`, `:v2`, `:v3`, `:v23` OR `:tls-v1`, `make-ssl-ctx` creates a `ssl_ctx` object and returns a pointer to it.

The value of `ssl-ctx` can also be a foreign pointer of type `ssl-ctx-pointer`, in which case it is simply returned. If `ssl-ctx` is a foreign pointer of type `ssl-pointer`, then `make-ssl-ctx` signals an error.

The meaning of the keyword arguments `ssl-ctx` and `ssl-side` is as described for `socket-stream`. The default value of `ssl-ctx` is `t` and the default value of `ssl-side` is `:server`.

See also

`ensure-ssl`
`socket-stream`
`ssl-ctx-pointer`

		<i>Function</i>
open-tcp-stream		
Summary		Attempts to connect to a socket on another machine and returns a stream object for the connection.
Package		<code>comm</code>
Signature		<code>open-tcp-stream hostname service &key direction element-type errorp read-timeout write-timeout timeout ssl-ctx ctx-configure- callback ssl-configure-callback local-address local-port nodelay keepalive => stream-object</code>
Arguments	<code>hostname</code>	An integer or string.
	<code>service</code>	A string or a fixnum.
	<code>direction</code>	One of <code>:input</code> , <code>:output</code> OR <code>:io</code> .
	<code>element-type</code>	<code>base-char</code> OR a subtype of <code>integer</code> .
	<code>errorp</code>	A boolean.
	<code>read-timeout</code>	A positive number, or <code>nil</code> .

	<i>write-timeout</i>	A positive number, or <code>nil</code> .
	<i>timeout</i>	A positive number, or <code>nil</code> .
	<i>ssl-ctx</i>	A symbol or a foreign pointer.
	<i>ctx-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .
	<i>ssl-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .
	<i>local-address</i>	<code>nil</code> , an integer or a string.
	<i>local-port</i>	<code>nil</code> , a string or a fixnum.
	<i>nodelay</i>	A generalized boolean.
	<i>keepalive</i>	A generalized boolean.
Values	<i>stream-object</i>	A socket stream.
Description	The <code>open-tcp-stream</code> function attempts to connect to a socket on another machine and returns <i>stream-object</i> for the connection if successful. The server machine to connect to is given by <i>hostname</i> , which can be one of the following:	
	<ul style="list-style-type: none"> • A string naming the host, for example <code>"www.nowhere.com"</code> • A string providing the IP address, for example <code>"204.71.177.75"</code> • An integer IP address in network order, for example <code>#xCC47B14B</code> 	
	The name of the service to provide is given by <i>service</i> . If <i>service</i> is a string, the location of the file specifying the names of the services available varies, but typically on Windows 98 it	

is called `SERVICES` and is stored in the `Windows` directory., and on Windows NT-based systems it is the file

```
%SystemRoot%\system32\drivers\etc\SERVICES
```

The `service` can also be a fixnum representing the port number of the desired connection.

The direction of the connection is given by `direction`. Its default value is `:io`. The element type of the connection is determined from `element-type`, and is `base-char` by default.

If `errorp` is `nil`, failure to connect (possibly after `timeout` seconds) returns `nil`, otherwise an error is signaled.

`timeout` specifies a connection timeout. `open-tcp-stream` waits for at most `timeout` seconds for the TCP connection to be made. If `timeout` is `nil` it waits until the connection attempt succeeds or fails. On failure, `open-tcp-stream` signals an error or returns `nil` according to the value of `errorp`. To provide a timeout for reads after the connection is made, see `read-timeout`. The default value of `timeout` is `nil`.

`read-timeout` specifies the read timeout of the stream. If it is `nil` (the default), the stream does not time out during reads, and these may hang. See `socket-stream` for more details. To provide a connection timeout, see `timeout`.

`write-timeout` is similar to `read-timeout`, but for writes. See `socket-stream` for more details.

`ssl-ctx`, `ctx-configure-callback` and `ssl-configure-callback` are interpreted as described for `socket-stream`. Unlike the other ways of creating a socket stream with SSL processing, `open-tcp-stream` does not take the `ssl-side` argument and always uses the value `:client`.

If `local-address` is `nil` then the operating system chooses the local address of the socket. Otherwise the string or integer value is interpreted as for `hostname` and specifies the local address of the socket. The default value of `local-address` is `nil`.

If *local-port* is `nil` then the operating system chooses the local port of the socket. Otherwise the string or fixnum value is interpreted as for *service* and specifies the local port of the socket. The default value of *local-port* is `nil`.

If *keepalive* is true, `SO_KEEPALIVE` is set on the socket. The default value of *keepalive* is `nil`.

If *nodelay* is true, `TCP_NODELAY` is set on the socket. The default value of *nodelay* is `t`.

Example

The following example opens an HTTP connection to a given host, and retrieves the root page:

```
(with-open-stream (http (comm:open-tcp-stream
                           "www.lispworks.com" 80))
  (format http "GET / HTTP/1.0~C~C~C~C"
          (code-char 13) (code-char 10)
          (code-char 13) (code-char 10))
  (force-output http)
  (write-string "Waiting to reply...")
  (loop for ch = (read-char-no-hang http nil :eof)
        until ch
        do (write-char #\.)
        (sleep 0.25)
        finally (unless (eq ch :eof)
                  (unread-char ch http)))
  (terpri)
  (loop for line = (read-line http nil nil)
        while line
        do (write-line line)))
```

See also

`start-up-server`
`socket-stream`

openssl-version

Function

Summary

Returns the version of the loaded OpenSSL library.

Package

`comm`

Signature	<code>openssl-version &optional what => result</code>	
Arguments	<code>what</code>	One of the keywords <code>:version</code> , <code>:directory</code> , <code>:platform</code> , <code>:cflags</code> and <code>:built-on</code> .
Values	<code>result</code>	A string.
Description	The function <code>openssl-version</code> returns a string specifying the version of the loaded OpenSSL library.	
	The argument <code>what</code> takes these values:	
	<code>:version</code>	<code>result</code> is the version string, which looks like: "OpenSSL 0.9.7i 14 Oct 2005" or "OpenSSL 0.9.8a 11 Oct 2005"
	<code>:built-on</code>	Returns a string specifying when it was built.
	<code>:directory</code>	Returns where OpenSSL thinks it is installed.
	<code>:platform</code>	Returns OpenSSL's idea of which platforms it is.
	<code>:cflags</code>	The compilation command.
	The default value of <code>what</code> is <code>:version</code> .	
See also	<code>ensure-ssl</code>	

	<i>Function</i>
pem-read	
Summary	An interface to the SSL <code>PEM_read_bio_*</code> functions.
Package	<code>comm</code>
Signature	<code>pem-read thing-to-read filename &key pass-phrase callback errorp => result</code>

Arguments	<i>thing-to-read</i>	A string.
	<i>filename</i>	A pathname designator.
	<i>pass-phrase</i>	A string, or <code>nil</code> .
	<i>callback</i>	A function designator, or <code>nil</code> .
	<i>errorp</i>	A generalized boolean.
Values	<i>result</i>	A foreign pointer or <code>nil</code> .
Description	<p>The function <code>pem-read</code> is an interface to the <code>PEM_read_bio_*</code> set of functions. See the manual entry for <code>pem</code> for specifications of these functions.</p> <p><i>thing-to-read</i> defines which function is required. <code>pem-read</code> concatenates <i>thing-to-read</i> with the string " <code>PEM_read_bio_</code>" to form the name of the <code>pem</code> function to call.</p> <p><i>filename</i> specifies the file to load.</p> <p>If <i>pass-phrase</i> is non-<code>nil</code>, it must be a string, which is passed to the <code>pem</code> function. The default value of <i>pass-phrase</i> is <code>nil</code>.</p> <p>If <i>callback</i> is non-<code>nil</code>, it must be a function with signature:</p> <pre>callback maximum-length rwflag => pass-phrase</pre> <p>where <i>maximum-length</i> is an integer, <i>rwflag</i> is a boolean and <i>pass-phrase</i> is the pass-phrase to use. The default value of <i>callback</i> is <code>nil</code>, but you cannot pass non-<code>nil</code> values for both <i>pass-phrase</i> and <i>callback</i>.</p> <p>If it succeeds, <code>pem-read</code> returns a foreign pointer to the structure that was returned by the <code>pem</code> function. If <code>pem-read</code> fails, if <i>errorp</i> is non-<code>nil</code> it signals an error, otherwise it returns <code>nil</code>. The default value of <i>errorp</i> is <code>nil</code>.</p>	

read-dhparams	<i>Function</i>
Summary	Reads or uses cached SSL DH parameters.

Package	<code>comm</code>	
Signature	<code>read-dhparams filename &key pass-phrase callback errorp force => dh-ptr</code>	
Arguments	<code>filename</code>	A pathname designator.
	<code>pass-phrase</code>	A string, or <code>nil</code> .
	<code>callback</code>	A function designator, or <code>nil</code> .
	<code>errorp</code>	A generalized boolean.
	<code>force</code>	A generalized boolean.
Values	<code>dh-ptr</code>	A foreign pointer or <code>nil</code> .
Description	<p>The function <code>read-dhparams</code> reads or uses cached DH parameters.</p> <p><code>filename</code> specifies the file to check.</p> <p>Unless <code>force</code> is true, <code>read-dhparams</code> checks if the file <code>filename</code> has already been loaded, and if it has been loaded, uses the cached value.</p> <p>If <code>force</code> is true, or if there is no cached value for <code>filename</code>, <code>read-dhparams</code> loads the file by calling <code>pem-read</code> with <i>thing-to-read</i> argument "DHparams", <code>pass-phrase</code>, <code>callback</code> and <code>errorp</code>. <code>read-dhparams</code> caches and returns a foreign pointer to the resulting DH structure (that is, a pointer corresponding to the C type <code>DH*</code>).</p> <p>If <code>read-dhparams</code> fails to load the file <code>filename</code>, if <code>errorp</code> is true it signals an error, otherwise it returns <code>nil</code>. The default value of <code>errorp</code> is <code>t</code>.</p>	
See also	<code>pem-read</code>	

		<i>Function</i>
Summary		Sets the verification mode for CTX.
Package		<code>comm</code>
Signature		<code>set-verification-mode ssl-ctx ssl-side mode &optional callback</code>
Arguments	<i>ssl-ctx</i>	A foreign pointer of type <code>ssl-pointer</code> or <code>ssl-ctx-pointer</code> .
	<i>ssl-side</i>	<code>:server</code> or <code>:client</code> .
	<i>mode</i>	An integer, one of the symbols <code>:never</code> , <code>:always</code> , <code>:once</code> , or a list of keywords.
	<i>callback</i>	A foreign function.
Values	<i>result</i>	A list of symbols.
Description		The function <code>set-verification-mode</code> sets the verification mode for CTX according to arguments <i>ssl-side</i> and <i>mode</i> . When <i>ssl-side</i> is <code>:server</code> , <i>mode</i> can be: An integer <i>mode</i> is passed directly to <code>SSL_set_verify</code> or <code>SSL_CTX_set_verify</code> . <code>:never</code> The server will not send a client certificate request to the client, so the client will not send a certificate. <code>:always</code> The server sends a client certificate request to the client. The certificate returned (if any) is checked. If the verification process fails, the TLS/SSL handshake is immediately terminated with an alert message containing the reason for the verification failure.

`:once` Same as `:always` except that the client certificate is checked only on the initial TLS/SSL handshake, and not again in case of renegotiation.

A list The list contains (some of) the keywords `:verify-client-once`, `:verify-peer` and `:fail-if-no-peer-cert`. These keywords map to the corresponding C constants `VERIFY_CLIENT_ONCE`, `VERIFY_PEER` and `FAIL_IF_NO_PEER_CERT` respectively. See the manual entry for `ssl_CTX_set_verify` for the meaning of the constants.

When *ssl-side* is `:client`, *mode* can be:

An integer *mode* is passed directly as for *ssl-side* `:server`.

`:never` If not using an anonymous cipher, the server will send a certificate which will be checked by the client. The handshake will be continued regardless of the verification result.

`:always` The server certificate is verified. If the verification process fails, the TLS/SSL handshake is immediately terminated with an alert message containing the reason for the verification failure. If no server certificate is sent because an anonymous cipher is used, verification is ignored.

A list The list contains keywords as described above for *ssl-side* `:server`.

If non-nil *callback* should be a symbol, function, string or foreign pointer designating a foreign function that is called to perform verification. The default value of *callback* is `nil`.

See also `get-verification-mode`

set-ssl-ctx-dh	<i>Function</i>												
Summary	Sets the DH parameters for a <code>ssl_ctx</code> .												
Package	<code>comm</code>												
Signature	<code>set-ssl-ctx-dh ssl-ctx &key dh filename func filename-list pass-phrase callback => result</code>												
Arguments	<table border="0"> <tr> <td><i>ssl-ctx</i></td><td>A foreign pointer.</td></tr> <tr> <td><i>filename</i></td><td>A pathname designator or <code>nil</code>.</td></tr> <tr> <td><i>func</i></td><td>A function designator or <code>nil</code>.</td></tr> <tr> <td><i>filename-list</i></td><td>An association list.</td></tr> <tr> <td><i>pass-phrase</i></td><td>A string, or <code>nil</code>.</td></tr> <tr> <td><i>callback</i></td><td>A function designator, or <code>nil</code>.</td></tr> </table>	<i>ssl-ctx</i>	A foreign pointer.	<i>filename</i>	A pathname designator or <code>nil</code> .	<i>func</i>	A function designator or <code>nil</code> .	<i>filename-list</i>	An association list.	<i>pass-phrase</i>	A string, or <code>nil</code> .	<i>callback</i>	A function designator, or <code>nil</code> .
<i>ssl-ctx</i>	A foreign pointer.												
<i>filename</i>	A pathname designator or <code>nil</code> .												
<i>func</i>	A function designator or <code>nil</code> .												
<i>filename-list</i>	An association list.												
<i>pass-phrase</i>	A string, or <code>nil</code> .												
<i>callback</i>	A function designator, or <code>nil</code> .												
Values	<i>result</i> A boolean.												
Description	<p>The function <code>set-ssl-ctx-dh</code> sets the DH parameters for a <code>ssl_ctx</code>.</p> <p><i>ssl-ctx</i> can be either a foreign pointer of type <code>ssl-ctx-pointer</code> or a foreign pointer of type <code>ssl-pointer</code>.</p> <p>The value is to use is specified by one of the parameters <i>dh</i>, <i>filename</i>, <i>func</i> or <i>filename-list</i>.</p> <p>If <i>dh</i> is non-nil, it must be a foreign pointer to a DH (corresponding to the C type <code>DH*</code>), and this DH is used as-is. The default value of <i>dh</i> is <code>nil</code>.</p> <p>Otherwise, if <i>filename</i> is non-nil, it must be a pathname designator for a file containing DH parameters, which is loaded (by <code>read-dhparams</code>) and then used. In this case, <i>pass-phrase</i> and <i>callback</i> can be used, and are passed to <code>pem-read</code>.</p> <p>Otherwise, if <i>func</i> is non-nil, it must be a function with signature:</p>												

```
func is-export keylength => dh-ptr
```

where *is-export* is a boolean, *keylength* is an integer, and *dh-ptr* is a pointer to an appropriate DH structure. `set-ssl-ctx-dh` installs *func* as the DH callback.

Otherwise (that is, if each of *dh*, *filename* and *func* are `nil`) then *filename-list* must be a non-nil association list of keylengths and filenames, sorted by the keylengths in ascending order (that is, larger keylengths are towards the end of the list). `set-ssl-ctx-dh` installs a DH callback which when called finds the first keylength which is equal or bigger than the required keylength, loads the associated file (by calling `read-dhparams`), and returns it. It also loads the first file of the list immediately.

result is `t` on success, `nil` otherwise.

See also

`pem-read`
`read-dhparams`
`ssl-ctx-pointer`
`ssl-pointer`

set-ssl-ctx-options

Function

Summary Sets the options in a `SSL_CTX`.

Package `comm`

Signature `set-ssl-ctx-options ssl-ctx &key microsoft_sess_id_bug
netscape_challenge_bug netscape_reuse_cipher_change_bug
sslref2_reuse_cert_type_bug microsoft_big_sslv3_buffer
msie_sslv2_rsa_padding ssleay_080_client_dh_bug tls_d5_bug
tls_block_padding_bug dont_insert_empty_fragments all
no_session_resumption_on_renegotiation single_dh_use ephemeral_rsa
cipher_server_preference tls_rollback_bug no_sslv2 no_sslv3 no_tlsv1
pkcs1_check_1 pkcs1_check_2 netscape_ca_dn_bug
netscape_demo_cipher_change_bug`

Arguments `ssl-ctx` A foreign pointer.

	Each of the keyword arguments is a generalized boolean defaulting to <code>nil</code> .
Description	The function <code>set-ssl-ctx-options</code> sets the options in a <code>SSL_CTX</code> . <code>ssl-ctx</code> can be either a foreign pointer of type <code>ssl-ctx-pointer</code> or a foreign pointer of type <code>ssl-pointer</code> . The option that is set is the <code>logior</code> of all the options that are passed to <code>set-ssl-ctx-options</code> via the keyword arguments. The value used for each non-nil keyword <code>keyword</code> is the value of <code>SSL_OP_</code> <i>keyword</i> . The meaning of the options is specified in the OpenSSL manual page for <code>SSL_set_options</code> .
See also	<code>ssl-ctx-pointer</code> <code>ssl-pointer</code>

	<i>Function</i>						
Summary	Sets the password for a <code>SSL_CTX</code> .						
Package	<code>comm</code>						
Signature	<code>set-ssl-ctx-password-callback ssl-ctx &key callback password</code>						
Arguments	<table> <tr> <td><code>ssl-ctx</code></td><td>A foreign pointer.</td></tr> <tr> <td><code>callback</code></td><td>A function designator, or <code>nil</code>.</td></tr> <tr> <td><code>password</code></td><td>A string, or <code>nil</code>.</td></tr> </table>	<code>ssl-ctx</code>	A foreign pointer.	<code>callback</code>	A function designator, or <code>nil</code> .	<code>password</code>	A string, or <code>nil</code> .
<code>ssl-ctx</code>	A foreign pointer.						
<code>callback</code>	A function designator, or <code>nil</code> .						
<code>password</code>	A string, or <code>nil</code> .						
Description	<p>The function <code>set-ssl-ctx-password-callback</code> sets the password for a <code>SSL_CTX</code>, either to a callback or a password.</p> <p><code>ssl-ctx</code> should be a foreign pointer of type <code>ssl-ctx-pointer</code>.</p> <p>If <code>callback</code> is non-nil, it must be a function with signature:</p> $\text{callback } \text{maximum-length } \text{rwflag} \Rightarrow \text{result}$						

where *maximum-length* is an integer, *rwflag* is a boolean and *result* is a string. The default value of *callback* is `nil`.

If *password* is non-`nil` and *callback* is `nil`, a callback is installed that simply returns *password*. The default value of *password* is `nil`.

If both *callback* and *password* are `nil`, `set-ssl-ctx-password-callback` signals an error.

See also `ssl-ctx-pointer`

`set-ssl-library-path`

Function

Summary Sets the SSL library path.

Package `comm`

Signature `set-ssl-library-path library-path`

Arguments *library-path* A string or a list of strings.

Description The function `set-ssl-library-path` sets the SSL library path.

library-path should a string or a list of strings. Each string specifies a library to load. The libraries are loaded in the order they are in the list.

Note that in contrast to `ensure-ssl`, the effect of `set-ssl-library-path` persists after saving and restarting the image.

See also `ensure-ssl`

`socket-error`

Class

Summary The condition class for socket errors.

Superclasses **simple-error**
 Subclasses **ssl-condition**
 Initargs :**stream** A **socket-stream**.
 Description The condition class for socket errors.

socket-stream *Class*

Summary The socket stream class.
 Superclasses **buffered-stream**
 Initargs :**socket** A socket handle.
 :**direction** One of :**input**, :**output**, or :**io**.
 :**element-type** An element type.
 :**read-timeout** A positive number or **nil**.
 :**write-timeout** A positive number or **nil**.
 :**ssl-ctx** A keyword, **t** or **nil**, or a foreign pointer of
 type **ssl-ctx-pointer** or **ssl-pointer**.
 :**ssl-side** One of the keywords :**client**, :**server** or
 :**both**. The default value is :**server**.
 :**ctx-configure-callback**
 A function designator or **nil**.
 :**ssl-configure-callback**
 A function designator or **nil**.
 Accessors **socket-stream-socket**
 stream:stream-read-timeout
 stream:stream-write-timeout

Description	<p>The <code>socket-stream</code> class implements a buffered stream connected to a socket. The socket handle, specified by <code>:socket</code>, and the direction, specified by <code>:direction</code>, must be passed for a meaningful stream to be constructed. Common Lisp input functions such as <code>read-char</code> will see <code>end-of-file</code> if the other end of the socket is closed.</p> <p>The <code>:element-type</code> keyword determines the expected element type of the stream traffic. However, stream input and output functions for character and binary data generally work in the obvious way on a <code>socket-stream</code> with <code>element-type base-char</code>, <code>(unsigned-byte 8)</code> or <code>(signed-byte 8)</code>. For example, <code>read-sequence</code> can be called with a string buffer and a binary <code>socket-stream</code>: the character data is constructed from the input as if by <code>code-char</code>. Similarly <code>write-sequence</code> can be called with a string buffer and a binary <code>socket-stream</code>: the output is converted from the character data as if by <code>char-code</code>. Also, 8-bit binary data can be read and written to a <code>base-char socket-stream</code>.</p> <p>All standard stream I/O functions except for <code>write-byte</code> and <code>read-byte</code> have this flexibility.</p> <p>The <code>:read-timeout</code> initarg specifies the read timeout in seconds, or is <code>nil</code>, meaning there are no timeouts during reads (this is the default).</p> <p>The <code>read-timeout</code> property is intended for use when a socket connection might hang during a call to any Common Lisp input function. The <code>read-timeout</code> can be set by <code>make-instance</code> or by <code>open-tcp-stream</code>. It can also be modified by <code>(setf stream:stream-read-timeout)</code>. When <code>read-timeout</code> is <code>nil</code>, there is no timeout during reads and the call may hang. When <code>read-timeout</code> is not <code>nil</code>, and there is no input from the socket for more than <code>read-timeout</code> seconds, any reading function returns <code>end-of-file</code>. The <code>read-timeout</code> does not limit the time inside <code>read</code>, but the time between successful extractions of data from the socket. Therefore, if the reading needs several rounds it may take longer than <code>read-timeout</code>.</p>
-------------	---

Using `(setf stream:stream-read-timeout)` on the stream while it is inside a read function has undefined effects. However, the setf function can be used between calls to read functions. The *read-timeout* property of a stream can be read by

```
(stream:stream-read-timeout stream)
```

The `:write-timeout` initarg specifies the write timeout in seconds, or is `nil`, meaning that there are no timeouts during writes (this is the default).

The *write-timeout* property is similar to *read-timeout*, but for write operations. If flushing the stream buffer takes too long then `error` is called.

The keyword arguments `:ssl-ctx`, `:ssl-side`, `:ctx-configure-callback` and `:ssl-configure-callback` can be passed to create and configure socket streams with SSL processing.

`ssl-ctx`, if non-`nil`, specifies that the stream uses SSL and further specifies the `SSL_CTX` object to use. The value of `ssl-ctx` can be a symbol which, together with `ssl-side`, specifies which protocol to use. The value `t` or `:default` means use the default, which is currently the same as `:v23`. The values `:v2`, `:v3`, `:v23` and `:tls-v1` are mapped to the `SSLv2_*`, `SSLv3_*`, `SSLv23_*` and `TLSv1_*` methods respectively. With these symbol values of `ssl-ctx`, LispWorks makes a new `SSL_CTX` object and uses it and frees it when the stream is closed.

The value of `ssl-ctx` can also be a foreign pointer of type `ssl-ctx-pointer` (which corresponds to the C type `SSL_CTX*`). This is used and is not freed when the stream is closed. Also an SSL object is made and used, and this object is freed when the stream is closed. The foreign pointer may be a result of a call to `make-ssl-ctx`, but it can also a result of user code, provided that it points to a valid `SSL_CTX` and has the type `ssl-ctx-pointer`.

The value of `ssl-ctx` can also be a foreign pointer of type `ssl-pointer` (which corresponds to the C type `SSL*`). This speci-

fies the SSL to use. This maybe a result of a call to `ssl-new` but can also be the result of user code, provided that it points to a valid SSL object and has the type `ssl-pointer`. The SSL is used and is not freed when the stream is closed.

When you pass a `ssl-ctx-pointer` or a `ssl-pointer` foreign pointer as the `ssl-ctx` argument, it must have already been set up correctly.

`ssl-side` specifies which side the socket stream is. The value of `ssl-side` is used in two cases:

- When a new `ssl_ctx` object is created, it is used to select the method:

```
:client => *_client_method
:server => *_server_method
:both   => *_method
```
- When a new SSL object is created, when `ssl-side` is either `:client` or `:server`, LispWorks calls `SSL_set_connect_state` or `SSL_set_accept_state` respectively.

If the value of `ssl-ctx` is a `ssl-pointer`, `ssl-side` is ignored.

`ctx-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-ctx-pointer`. This is called immediately after a new `ssl_ctx` is created. If the value of `ssl-ctx` is not a symbol, `ctx-configure-callback` is ignored.

`ssl-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-pointer`. This is called immediately after a new SSL is created. If the value of `ssl-ctx` is not a `ssl-pointer`, `ssl-configure-callback` is ignored.

Example

The following makes a bidirectional stream connected to a socket specified by `handle`.

```
(make-instance 'comm:socket-stream
               :socket handle
               :direction :io
               :element-type 'base-char)
```

This example creates a socket stream with a read-timeout:

```
(make-instance 'comm:socket-stream
               :handle handle
               :direction :input
               :read-timeout 42)
```

The following form illustrates character I/O in a binary socket-stream:

```
(with-open-stream (x
                    (comm:open-tcp-stream
                     "localhost" 80
                     :element-type '(unsigned-byte 8)))
  (write-sequence (format nil "GET / HTTP/1.0~%~%") x)
  (force-output x)
  (let ((res (make-array 20 :element-type 'base-char)))
    (values (read-sequence res x) res)))
```

The following form illustrates binary I/O in a base-char socket-stream:

```
(with-open-stream (x
                    (comm:open-tcp-stream
                     "localhost" 80
                     :element-type 'base-char))
  (write-sequence
   (map #'(simple-array (unsigned-byte 8) 1)
         'char-code
         (format nil "GET / HTTP/1.0~%~%"))
   x)
  (force-output x)
  (let ((res (make-array 20
                        :element-type
                        '(unsigned-byte 8))))
    (values (read-sequence res x)
            (map 'string 'code-char res))))
```

See also

- [open-tcp-stream](#)
- [start-up-server](#)
- [stream-read-timeout](#)
- [wait-for-input-streams](#)

		<i>Function</i>
Summary		Returns the local address and port number of a given socket stream.
Package		<code>comm</code>
Signature		<code>socket-stream-address stream => address, port</code>
Arguments	<i>stream</i>	A socket stream.
Values	<i>address</i>	The local host address of the socket stream or <code>nil</code> if not connected.
	<i>port</i>	The local port number of the socket stream or <code>nil</code> if not connected.
Description		Connected socket streams have two addresses, local and remote. The <code>socket-stream-address</code> function returns the local address.
See also		<code>socket-stream-peer-address</code> <code>get-socket-address</code>

		<i>Function</i>
Summary		Accesses the <code>ssl_ctx</code> attached to a socket stream.
Package		<code>comm</code>
Signature		<code>socket-stream-ctx socket-stream => ssl-ctx-pointer</code>
Arguments	<i>socket-stream</i>	A <code>socket-stream</code> .
Values	<i>ssl-ctx-pointer</i>	A foreign pointer of type <code>ssl-ctx-pointer</code> , or <code>nil</code> .

Description	The function <code>socket-stream-ctx</code> accesses the <code>ssl_ctx</code> that is attached to the <code>socket-stream</code> <code>socket-stream</code> . It returns <code>nil</code> if SSL is not attached.
See also	<code>socket-stream</code> <code>ssl-ctx-pointer</code>

socket-stream-peer-address

Function

Summary	Returns the remote address and port number of a given socket stream.	
Package	<code>comm</code>	
Signature	<code>socket-stream-peer-address stream => address, port</code>	
Arguments	<code>stream</code> A socket stream. Values	
Values	<code>address</code> The remote host address of the socket stream or <code>nil</code> if not connected. <code>port</code> The remote port number of the socket stream or <code>nil</code> if not connected.	
Description	Connected socket streams have two addresses, local and remote. The <code>socket-stream-peer-address</code> function returns the remote address.	
See also	<code>socket-stream-address</code> <code>get-socket-peer-address</code>	

socket-stream-ssl

Function

Summary	Accesses the <code>ssl</code> attached to a socket stream.
---------	--

Package `comm`
 Signature `socket-stream-ssl socket-stream => ssl-pointer`
 Arguments `socket-stream` A `socket-stream`.
 Values `ssl-pointer` A foreign pointer of type `ssl-pointer`, or
`nil`.
 Description The function `socket-stream-ssl` accesses the SSL that is
 attached to the `socket-stream` `socket-stream`.
 It returns `nil` if SSL is not attached.
 See also `socket-stream`
`ssl-pointer`

ssl-cipher-pointer *FLI type descriptor*

Summary An FLI type for use with SSL.
 Package `comm`
 Signature `ssl-cipher-pointer`
 Description The FLI type `ssl-cipher-pointer` corresponds to the C type
`SSL_CIPHER*`.

ssl-cipher-pointer-stack *FLI type descriptor*

Summary An FLI type for use with SSL.
 Package `comm`
 Signature `ssl-cipher-pointer-stack`

Description	The FLI type <code>ssl-cipher-pointer-stack</code> corresponds to the C type <code>STACK_OF(SSL_CIPHER)</code> .
ssl-closed	<i>Class</i>
Summary	The class for SSL errors corresponding to <code>SSL_ERROR_ZERO_RETURN</code> .
Superclasses	<code>ssl-condition</code>
Description	The condition class <code>ssl-closed</code> corresponds to <code>SSL_ERROR_ZERO_RETURN</code> . It means the underlying socket is dead.
ssl-condition	<i>Class</i>
Summary	The condition class for SSL errors.
Superclasses	<code>socket-error</code>
Subclasses	<code>ssl-closed</code> <code>ssl-error</code> <code>ssl-failure</code> <code>ssl-x509-lookup</code>
Description	The condition class for errors inside SSL.
ssl-ctx-pointer	<i>FLI type descriptor</i>
Summary	An FLI type for use with SSL.
Package	<code>comm</code>

Signature	<code>ssl-ctx-pointer</code>
Description	The FLI type <code>ssl-ctx-pointer</code> corresponds to the C type <code>SSL_CTX*</code> .

ssl-error *Class*

Summary	The class for SSL errors corresponding to <code>SSL_ERROR_SYSCALL</code> .
Superclasses	<code>ssl-condition</code>
Description	The condition class <code>ssl-error</code> corresponds to <code>SSL_ERROR_SYSCALL</code> . It means that something got broken.

ssl-failure *Class*

Summary	The class for SSL errors corresponding to <code>SSL_ERROR_SSL</code> .
Superclasses	<code>ssl-condition</code>
Description	The condition class <code>ssl-failure</code> corresponds to <code>SSL_ERROR_SSL</code> . This means a failure in processing the input, typically due to a mismatch between the client and the server. You get this error when trying to use a SSL connection to a non-secure peer.

ssl-new *Function*

Summary	Creates a <code>ssl</code> .
Package	<code>comm</code>
Signature	<code>ssl-new ssl-ctx-pointer => ssl-pointer</code>

Arguments	<code>ssl-ctx-pointer</code>	A foreign pointer of type <code>ssl-ctx-pointer</code> .
Values	<code>ssl-pointer</code>	A foreign pointer of type <code>ssl-pointer</code> .
Description		The function <code>ssl-new</code> creates a <code>ssl</code> by a direct call to the C function <code>SSL_new</code> . It returns a pointer to the new <code>ssl</code> .
See also		<code>ssl-ctx-pointer</code> <code>ssl-pointer</code>

		<i>FLI type descriptor</i>
ssl-pointer		
Summary		An FLI type for use with SSL.
Package		<code>comm</code>
Signature		<code>ssl-pointer</code>
Description		The FLI type <code>ssl-pointer</code> corresponds to the C type <code>SSL*</code> .

		<i>Class</i>
ssl-x509-lookup		
Summary		The class for SSL errors corresponding to <code>SSL_ERROR_WANT_X509_LOOKUP</code> .
Superclasses		<code>ssl-condition</code>
Description		The condition class <code>ssl-x509-lookup</code> corresponds to <code>SSL_ERROR_WANT_X509_LOOKUP</code> . It happens when a certificate is rejected by a user callback.

start-up-server	<i>Function</i>
Summary	Starts a TCP server.
Package	<code>comm</code>
Signature	<code>start-up-server &key function announce service address nodelay keepalive process-name wait error => process, startup-condition</code>
Arguments	<p><i>function</i> A function name.</p> <p><i>announce</i> An output stream, <code>t</code>, <code>nil</code> or a function.</p> <p><i>service</i> An integer, a string or <code>nil</code>.</p> <p><i>address</i> An integer, a string or <code>nil</code>.</p> <p><i>nodelay</i> A generalized boolean.</p> <p><i>keepalive</i> A generalized boolean.</p> <p><i>process-name</i> A symbol or expression.</p> <p><i>wait</i> A boolean.</p> <p><i>error</i> A boolean.</p>
Values	<p><i>process</i> A process, or <code>nil</code>.</p> <p><i>startup-condition</i> A condition object, or <code>nil</code>.</p>
Description	<p>The <code>start-up-server</code> function starts a TCP server. Use <code>process-kill</code> to kill the server, and <code>open-tcp-stream</code> to send messages from another client to the server.</p> <p>The <i>function</i> argument provides the name of the function that processes connections. When a connection is made <i>function</i> is called with the connected socket handle, at which point you can make a stream using <code>make-instance</code> and communicate with the client. The server does not accept more connections until <i>function</i> returns, so normally it should create another light-weight process to handle the connection. However, the operating system typically provides a small queue of</p>

partially accepted connections, which prevents connection failure for new clients until the server is ready to accept more connections. If *function* is not specified the built-in Lisp listener server is used. See the examples section below.

If *announce* is a stream or `t` (denoting `*standard-output*`), a message appears on the stream when the server is started.

If *announce* is a function it is called when the server is started. *announce* should take two arguments: *socket* and *condition*. *socket* is the socket used by the server: *announce* can therefore be used to record this socket. *condition* describes the error if there is one. *announce* can be called with `socket nil` and a condition only if *error* is `nil`. If the process is killed, *announce* is called with `socket nil` and `condition nil`.

The default for *announce* is `nil`, meaning there is no message.

If *service* is a string or positive integer, it specifies the name of the service. The location of the file specifying the names of services available varies, but typically on Windows 98 it is called `SERVICES` and is stored in the `Windows` directory, and on Windows NT-based systems it is the file

```
%SystemRoot%\system32\drivers\etc\SERVICES
```

If *service* is `nil` or 0, then `start-up-server` chooses a free port. The default value for *service* is "lispworks".

If *address* is a string or integer that can be resolved to an IP address, then the server only receives connections for that IP address. This must be one of the addresses associated with the machine and allowed values are a string naming a host, such as "`www.nowhere.com`", a string providing the IP address, such as "`204.71.177.75`", or an integer IP address in network order, such as `#xCC47B14B`.

If *address* is `nil` or 0, then the server will receive connections to all IP addresses on the machine. This is the default.

If *keepalive* is true, `SO_KEEPALIVE` is set on the socket. The default value of *keepalive* is `nil`.

If *nodelay* is true, TCP_NODELAY is set on the socket. The default value of *nodelay* is t.

The *process-name* specifies the process name. The default is constructed from the service name in the following fashion:

```
(format nil "~S server" service)
```

The *wait* argument controls whether `start-up-server` waits for the server to start or returns immediately. When *wait* is non-nil and an error was signalled, *process* is nil and the error is returned in *startup-condition*. Otherwise just one value, the server process, is returned. The default for *wait* is nil.

The *error* argument controls what happens if an error is signalled in the server thread. If *error* is nil then the thread is terminated. If *error* is non-nil then the debugger is entered. The default value for *error* is (not *wait*).

Note: some versions of Microsoft Windows fail to detect the case where more than one server binds a given port, so an error will not be raised in this situation.

Examples The following example uses the built-in Lisp listener server:

```
(comm:start-up-server :service 10243)
```

It makes a Lisp listener server on port 10243 (check with local network managers that this port number is safe to use). When a client connects to this, Lisp calls `read`. The client should send a string using Common Lisp syntax followed by a newline. This string is used to name a new light-weight process that runs a Lisp listener. When this has been created, the server waits for more connections.

The next example illustrates the use of the *function* argument. For each line of input read by the server it writes the line back with a message. The stream generates `eof` if the other end closes the connection.

```
(defvar *talk-port* 10244) ; a free TCP port number
```

```
(defun make-stream-and-talk (handle)
  (let ((stream (make-instance 'comm:socket-stream
                               :socket handle
                               :direction :io
                               :element-type
                               'base-char)))
    (mp:process-run-function (format nil "talk ~D"
                                      handle)
                             '()
                             'talk-on-stream stream)))

(defun talk-on-stream (stream)
  (unwind-protect
      (loop for line = (read-line stream nil nil)
            while line
            do
              (format stream "You sent: '~A'~%" line)
              (force-output stream))
      (close stream)))

(comm:start-up-server :function 'make-stream-and-talk
                      :service *talk-port*)
```

This is a client which uses the talk server:

```
(defun talking-to-myself ()
  (with-open-stream
    (talk (comm:open-tcp-stream "localhost"
                                *talk-port*))
    (dolist (monolog
             '("Hello self."
               "Why don't you say something original?"
               "Talk to you later then. Bye."))
      (write-line monolog talk)
      (force-output talk)
      (format t "I said: \"~A\"~%"
              monolog)
      (format t "Self replied: \"~A\"~%"
              (read-line talk nil nil)))))
```

```

(talking-to-myself)
=>
I said: "Hello self."
Self replied: "You sent: 'Hello self.'"
I said: "Why don't you say something original?"
Self replied: "You sent: 'Why don't you say something
original?'"
I said: "Talk to you later then. Bye."
Self replied: "You sent: 'Talk to you later then.
Bye.'"

```

This example illustrates a server which picks a free port and records the socket. The last form queries the socket for the port used.

```

(defvar *my-socket* nil)

(defun my-announce-function (socket condition)
  (if socket
      (setf *my-socket* socket)
      (my-log-error condition)))

(comm:start-up-server :service nil
                      :error nil
                      :announce 'my-announce-function)

(multiple-value-bind (address port)
  (comm:get-socket-address *my-socket*)
  port)

```

See also [open-tcp-stream](#)
[socket-stream](#)

start-up-server-and-mp

Function

Package `comm`

Signature `start-up-server-and-mp &key function announce service address process-name`

Arguments `function` A function name.

`announce` An output stream, `t`, `nil` or a function.

<i>service</i>	An integer, a string or <code>nil</code> .
<i>address</i>	An integer, a string or <code>nil</code> .
<i>process-name</i>	A symbol or expression.
Description	The <code>start-up-server-and-mp</code> function starts multiprocess-ing if it has not already been started and then calls <code>start-up-server</code> with the supplied <i>function</i> , <i>announce</i> , <i>service</i> , <i>address</i> and <i>process-name</i> arguments. Note: <code>start-up-server-and-mp</code> is implemented only on Unix/Linux/Mac OS X platforms.
See also	<code>start-up-server</code>

string-ip-address		<i>Function</i>
Summary		Returns the integer IP address from the given dotted IP address string.
Package		<code>comm</code>
Signature		<code>string-ip-address ip-address-string => ip-address</code>
Arguments	<i>string-ip-address</i>	A string denoting an IP address in dotted format.
Values	<i>ip-address</i>	An integer IP address.
Description		The <code>string-ip-address</code> function takes a string in the standard dotted IP address notation <code>a.b.c.d</code> and returns the corresponding integer IP address.
See also		<code>ip-address-string</code>

	<i>Macro</i>
Package	<code>comm</code>
Signature	<code>with-noticed-socket-stream (stream) &body body</code>
Arguments	<p><code>stream</code> A stream created using <code>open-tcp-stream</code>.</p> <p><code>body</code> Code to be executed while the stream is “noticed”.</p>
Description	<p>The macro <code>with-noticed-socket-stream</code> evaluates the <code>body</code> forms with the stream <code>stream</code> “noticed” for input. <code>stream</code> becomes unnoticed afterwards.</p> <p>The macro is designed to be used with streams created by <code>open-tcp-stream</code>.</p>
Notes	<ol style="list-style-type: none"> 1. You do not normally need to use this macro, because all of the standard functions that read from socket streams (<code>read-char</code> and so on) will do this automatically when necessary. However, if you call <code>process-wait</code> yourself with a <code>wait-function</code> that detects new input from a socket stream, then this macro is necessary to cause LispWorks to evaluate the <code>wait-function</code> when there is input on the underlying socket. Without that, there might be a delay before the thread responds to the input. 2. <code>with-noticed-socket-stream</code> is not implemented on the Windows platform.
See also	<code>open-tcp-stream</code>

27

The COMMON-LISP Package

This chapter describes the LispWorks extensions to symbols in the `COMMON-LISP` package, which is used by default. This chapter notes only those differences between LispWorks and the ANSI Common Lisp standard. You should refer to this standard (an HTML version, the Common Lisp Hyperspec, is supplied with LispWorks) for full documentation about standard Common Lisp symbols.

		<i>Function</i>
apropos		
Summary		Searches for interned symbols.
Package		<code>common-lisp</code>
Signature		<code>apropos <i>string</i> &optional <i>package external-only</i> => <no values></code>
Arguments	<i>string</i>	A string designator.
	<i>package</i>	A package designator or <code>nil</code> .
	<i>external-only</i>	A generalised boolean.

Description	The function <code>apropos</code> behaves as specified in ANSI Common Lisp. There is an additional optional argument <code>external-only</code> , which if true restricts the search to symbols which are external in the searched package or packages. The default value of <code>external-only</code> is <code>nil</code> .
See also	<code>apropos-list</code> <code>*describe-print-length*</code> <code>*describe-print-level*</code> <code>regexp-find-symbols</code>

	<i>Function</i>						
apropos-list							
Summary	Searches for interned symbols.						
Package	<code>common-lisp</code>						
Signature	<code>apropos-list string &optional package external-only => symbols</code>						
Arguments	<table> <tr> <td><code>string</code></td><td>A string designator.</td></tr> <tr> <td><code>package</code></td><td>A package designator or <code>nil</code>.</td></tr> <tr> <td><code>external-only</code></td><td>A generalised boolean.</td></tr> </table>	<code>string</code>	A string designator.	<code>package</code>	A package designator or <code>nil</code> .	<code>external-only</code>	A generalised boolean.
<code>string</code>	A string designator.						
<code>package</code>	A package designator or <code>nil</code> .						
<code>external-only</code>	A generalised boolean.						
Values	<code>symbols</code> A list of symbols.						
Description	The function <code>apropos-list</code> behaves as specified in ANSI Common Lisp. There is an additional optional argument <code>external-only</code> , which if true restricts the search to symbols which are external in the searched package or packages. The default value of <code>external-only</code> is <code>nil</code> .						
See also	<code>apropos</code>						

		<i>Type</i>
base-string		
Summary	The base string type.	
Package	<code>common-lisp</code>	
Signature	<code>base-string length</code>	
Arguments	<code>length</code>	The length of the string (or *, meaning any).
Description	The type of base strings.	
close		<i>Generic Function</i>
Summary	The <code>close</code> function is implemented as a generic function.	
Package	<code>common-lisp</code>	
Signature	<code>close stream &key abort => result</code>	
Arguments	<code>stream</code>	A stream.
	<code>abort</code>	A generalized boolean.
Values	<code>result</code>	A boolean.
Description	The standard function <code>close</code> is implemented as a generic function. All external resources used by the stream should be freed and true returned when that has been done. The result value for <code>close</code> is as per the Common Lisp ANSI specification.	
	When <code>stream</code> is an instance of a subclass of <code>buffered-stream</code> , if <code>abort</code> is true then any remaining data in the buffer can be discarded. There are two built-in methods on <code>buffered-stream</code> . The primary method specialized on <code>buffered-stream</code> returns t. The other, an :around method specialized	

on `buffered-stream`, flushes the stream buffer if `abort` is `nil`, calls the next method and marks the stream as closed if that method returns true. Thus the only requirement for a primary method specialized on a subclass of `buffered-stream` is that it must close any underlying data source and return true.

The `close` method on the `fundamental-stream` class sets a flag for `open-stream-p`

See also `buffered-stream`
 `fundamental-stream`
 `open-stream-p`

	<i>Function</i>				
coerce					
Summary	Extends the standard <code>coerce</code> function, allowing it to take any Common Lisp type specifier.				
Package	<code>common-lisp</code>				
Signature	<code>coerce object result-type => result</code>				
Arguments	<table border="0"> <tr> <td><i>object</i></td><td>A Lisp object.</td></tr> <tr> <td><i>result-type</i></td><td>A type specifier.</td></tr> </table>	<i>object</i>	A Lisp object.	<i>result-type</i>	A type specifier.
<i>object</i>	A Lisp object.				
<i>result-type</i>	A type specifier.				
Values	<i>result</i> An object of type <i>result-type</i>				
Description	The <code>coerce</code> function still performs those conversions required by the standard, but a larger set of type specifiers is allowed for coercion. A <code>type-error</code> is signalled if <i>result</i> cannot be returned as the <i>result-type</i> specifies.				
See also	<code>concatenate</code>				

compile	<i>Function</i>
Summary	Compiles a lambda expression into a code vector.
Package	<code>common-lisp</code>
Signature	<code>compile name &optional definition -> name, function</code>
Arguments	<p><i>definition</i> If supplied, this is a lambda-expression to be compiled. If not supplied, then the lambda-expression used is the current definition of the name (in this case <i>name</i> must be a non-nil symbol with an uncompiled definition).</p> <p><i>name</i> If not <code>nil</code>, this is the symbol that is to receive the compiled function as its global function definition.</p>
Values	A single value is returned, being the <i>name</i> symbol if supplied, or when <i>name</i> is <code>nil</code> the compiled function definition itself. Such compiled-function objects are not printable (but see <code>disassemble</code>) other than as <code>#<compiled function for SYMBOL></code> .
Description	<p><code>compile</code> calls the compiler to translate a lambda expression into a code vector containing an equivalent sequence of host specific machine code. A compiled function typically runs between 10 and 100 times faster. It is generally worth compiling the most frequently called Lisp functions in a large application during the development phase. The compiler detects a large number of programming errors, and the resulting code runs sufficiently faster to justify the compilation time, even during development.</p> <p>Warning messages are printed to <code>*error-output*</code>. Other messages are printed to <code>*standard-output*</code>.</p>

Compatibility note	In LispWorks 5.1 and previous versions, warning messages are printed to <code>*standard-output*</code> .
Examples	<pre>(defun fn (...) ...) ; interpreted definition for fn (compile 'fn) ; replace with compiled ; definition (compile nil '(lambda (x) (* x x))) ; returns compiled squaring function (compile 'cube '(lambda (x) (* x x x))) ; defun and compile in one</pre>
Notes	See <code>declare</code> for a list of the declarations that alter the behavior of the compiler.
See also	<code>compile-file</code> <code>disassemble</code> <code>declare</code>

compile-file *Function*

Summary	Compiles a Lisp source file into a form that both loads and runs faster.	
Package	<code>common-lisp</code>	
Signature	<code>compile-file input-file &key output-file verbose print external-format load => output-truename, warnings-p, failure-p</code>	
Arguments	<code>input-file</code>	A pathname designator.
	<code>output-file</code>	A pathname designator, or <code>:temp</code> .
	<code>verbose</code>	A generalized boolean.
	<code>print</code>	A generalized boolean.
	<code>external-format</code>	An external format specification.
	<code>load</code>	A generalized boolean.

Values	<i>output-truename</i> A pathname or <code>nil</code> . <i>warnings-p</i> A generalized boolean. <i>failure-p</i> A generalized boolean.
Description	<p>The function <code>compile-file</code> calls the compiler to translate a Lisp source file into a form that both loads and runs faster. A compiled function typically runs more than ten times faster than when interpreted (assuming that it is not spending most of its work calling already compiled functions). A source file with a <code>.lisp</code> or <code>.lsp</code> extension compiles to produce a file with a <code>.*fasl</code> extension (the actual extension depends on the host machine CPU). Subsequent use of <code>load</code> loads the compiled version (which is in LispWorks's FASL or Fast Load format) in preference to the source.</p> <p>In compiling a file the compiler has to both compile each function and top level form in the file, and to produce the appropriate FASL directives so that loading has the desired effect. In particular objects need to have space allocated for them, and top level forms are called as they are loaded.</p> <p><i>output-file</i> specifies the location of the output file. This argument is useful if you are using a non-default file extension for binary files. If you use a non-default file extensions for binary files, you must inform LispWorks of this by pushing the file extension string onto the variable <code>sys::*binary-file-types*</code>. If you fail to do this, LispWorks assumes that these files are text rather than compiled files. See the example below.</p> <p>The special value <i>output-file :temp</i> offers a convenient way to specify that the output file is a temporary file in a location that is likely to be writable.</p> <p><i>verbose</i> controls the printing of messages describing the file being compiled, the current optimization settings, and other information. If <i>verbose</i> is <code>nil</code>, there are no messages. If <i>verbose</i></p>

is 0, only the "Compiling file..." message is printed. For all other true values of *verbose*, messages are also printed about:

- compiler optimization settings before the file is processed, and
- multiple matches when *input-file* does not specify the pathname type, and
- any clean down (garbage collection) that occurs during the compilation.

The default value is the value of `*compile-verbose*`, which defaults to `t`.

print controls the printing of information about the compilation. It can have the following values. If *print* is `nil`, no information is printed. If *print* is a non-positive number, then only warnings are printed. If *print* is a positive number no greater than 1, or if *print* is any non-number object, then the information printed consists of all warning messages and one line of information per function that is compiled. If *print* is a number greater than 1, then full information is printed. The default value of *print* is the value of `*compile-print*`, which has the default value 1.

Warning messages are printed to `*error-output*`. Other messages are printed to `*standard-output*`.

external-format is interpreted as for `open`. The default value is `:default`.

If *load* is true, then the file is loaded after compilation.

output-truename is the `truename` of the output file, or `nil` if that cannot be created.

warnings-p is `nil` if no conditions of type `error` or `warning` were detected during compilation. Otherwise *warnings-p* is a list containing the conditions.

failure-p is `nil` if no conditions of type `error` or `warning` (other than `style-warning`) were detected by the compiler, and `t` otherwise.

Compatibility note In LispWorks 5.1 and previous versions, warning messages are printed to `*standard-output*`.

Examples

```
(compile-file "devel/fred.lisp")
  ;; compile fred.lisp to fred.fasl
(compile-file "devel/fred")
  ;; does the same thing

(compile-file "test" :load t)
  ;; compile test.lisp, then load if successful

(compile-file "program" :output-file "program.abc")
  ;; compile "program.lisp" to "program.abc"

(push "abc" sys::*binary-file-types*)
  ;; tells LispWorks that files with extension
  ;; ".abc" are binaries
```

Notes See `declare` for a list of the declarations that alter the behavior of the compiler.

The act of compiling a file should have no side effects, other than the creation of symbols and packages as the input file is read by the reader.

By default a form is skipped if an error occurs during compilation. If you need to debug an error during compilation by `compile-file`, set `*compiler-break-on-error*`.

During compilation of a file `foo.lisp` (on an Intel Macintosh, for example) a temporary output file named `t_foo.xfasl` is used, so that an unsuccessful compile does not overwrite an existing `foo.xfasl`.

LispWorks uses the following naming conventions for fasl files, and it is recommended that you should use them too, to ensure correct operation of `load` and so on.

Table 27.1 Naming conventions for FASL files

Machine/Implementation	Fasl Extension
x86 Windows/32-bit LispWorks	.fasl
x64 Windows/64-bit LispWorks	.64fasl
x86 Linux/32-bit LispWorks	.ufasl
amd64 Linux/64-bit LispWorks	.64ufasl
x86 FreeBSD/32-bit LispWorks	.ffasl
HP-PA/32-bit LispWorks	.pfasl
SPARC/32-bit LispWorks	.wfasl
SPARC/64-bit LispWorks	.64wfasl
x86 Solaris/32-bit LispWorks	.sfasl
amd64 Solaris/64-bit LispWorks	.64sfasl
Intel Macintosh/32-bit LispWorks	.xfasl
PowerPC Macintosh/32-bit LispWorks	.nfasl
Intel Macintosh/64-bit LispWorks	.64xfasl
PowerPC Macintosh/64-bit LispWorks	.64nfasl

You can find the fasl file extension appropriate for your machine by looking at the variable `system::*binary-file-type*`. The variable `system::*binary-file-types*` contains a list of all the file extensions currently recognized by `load` and `load-data-file`.

Compatibility Note In LispWorks for Windows 4.4 and previous, the fasl file extension is `.fsl`. This changed in LispWorks 5.0.

In LispWorks for Linux 4.4 and previous, the fasl file extension is `.ufs1`. This changed in LispWorks 5.0.

See also

`compile`
`compile-file-if-needed`
`*compiler-break-on-error*`
`disassemble`

concatenate

Function

Summary	Extends the standard <code>concatenate</code> function allowing it to take any Common Lisp type.
Package	<code>common-lisp</code>
Signature	<code>concatenate result-type &rest sequences => result-sequence</code>
Arguments	<code>result-type</code> A type specifier. <code>sequences</code> A sequence.
Values	<code>result-sequence</code> A sequence.
Description	The <code>concatenate</code> function has been extended to take any Common Lisp type. The <code>result-sequence</code> will be of type <code>result-type</code> unless this is not possible, in which case a <code>type-error</code> is signalled.
See also	<code>coerce</code>

declaim

Macro

Summary	Established a specified declarations.
Package	<code>common-lisp</code>

Signature	<code>declare &rest declarations</code>
Arguments	<i>declarations</i> Declaration forms.
Description	The macro <code>declare</code> behaves as specified in the ANSI Common Lisp Standard with one exception: for a top-level call to <code>declare</code> , optimize declarations are omitted from the compiled binary file. This is useful because you are unlikely to want to change these settings outside of that file.
See also	<code>compile-file</code> <code>declare</code> <code>proclaim</code>

declare *Special Form*

Summary	Declares a variable as special, provides advice to the Common Lisp system, or helps the programmer to optimize code.
Package	<code>common-lisp</code>
Signature	<code>declare declaration*</code>
Arguments	<i>declaration</i> A declaration specifier, not evaluated.
Values	<p>The special form <code>declare</code> behaves computationally as if it is not present (other than to affect the semantics), and is only allowed in certain contexts, such as after the variable list in a <code>let</code>, <code>do</code>, <code>defun</code> and so on.</p> <p>(Consult the syntax definition of each special form to see if it takes <code>declare</code> forms and/or documentation strings.)</p>
Description	There are three distinct uses of <code>declare</code> : one is to declare Lisp variables as “special” (this affects the semantics of the appropriate bindings of the variables), the second is to provide

advice to help the Common Lisp system (in reality the compiler) run your Lisp code faster or with more sophisticated debugging options, and the third (using the `:explain` declaration) is to help you optimize your code.

If you use `declare` to specify types (and so eliminate type-checking for the specified symbols) and then supply the wrong type, you may obtain a “Segmentation Violation”. You can check this by interpreting the code (rather than compiling it).

The following are extensions to the Common Lisp definition of `declare`:

- `hcl:special-global` declares that the symbol is never bound.

In SMP LispWorks the compiler signals error if it detects that a symbol declared as `hcl:special-global` is bound, and at runtime it also signals an error.

In non-SMP LispWorks the compiler gives an error, but there is no runtime check. The runtime behavior is the same as `cl:special`, with all accesses to the symbol in low safety.

`hcl:special-global` is very useful, and because of the checks it is reasonably safe. It is useful not only for speed, but also to guard against unintentionally binding variables that should not be bound.

See also `defglobal-parameter`.

- `hcl:special-dynamic` declares that the symbol is never accessed outside the dynamic scope of the binding.

In high safety code accessing the symbol outside the scope of binding signals an error. In low safety code it may result in unpredictable behavior.

In non-SMP LispWorks the only effect of this declaration is to make all access to the variable low safety.

`hcl:special-dynamic` is useful, but because it can lead to unpredictable behavior you need to ensure that you test your program in high safety when you use it.

- `hcl:special-fast-access` declares that a symbol should be "fast access".

The semantics of the declaration is the same as `c1:special`, except that access to the variable is low safety. In addition, the compiler compiles access to the symbol in a way that speeds up the access, but also introduces a tiny reduction in the speed of the whole system. The balance between these effects is not obvious.

It is not obvious where `hcl:special-fast-access` is useful. If you can ensure that the symbol is always bound or never bound then `hcl:special-dynamic` or `hcl:special-global` are certainly better.

- `hcl:lambda-list` specifies the value to be returned when a programmer asks for the arglist of a function.
- `values` specifies the value to be returned when you ask for a description of the results of a function.
- `hcl:invisible-frame` specifies that calls to this function should not appear in a debugger backtrace.
- `hcl:alias` specifies that calls to this function should be displayed as calls to an alternative function in a debugger backtrace.
- `:explain` controls messages printed by the compiler while it is processing forms.

The remainder of this description documents the syntax and use of `:explain` declarations.

declaration ::= `(:explain option*)`

option ::= `optionkey` | `(optionkey optionvalue)`

```
optionkey ::= :none | :variables | :types | :floats |
:non-floats | :all-calls | :all-calls-with-arg-types |
:calls | :boxing | :print-original-form | :print-
expanded-form | :print-length | :print-level
```

The `:explain` declaration controls messages printed by the compiler while it is processing forms. The declaration can be used with `proclaim` or `declare` as a top level form to give it global or file scope. It can also be used at the start of a `#'lambda` form or function body to give it the scope of that function. The declaration has unspecified effect when used in other contexts, for example in the body of a `let` form.

An `:explain` declaration consists of a set of options of the form (*optionkey optionvalue*) which associates *optionvalue* with *optionkey* or *optionkey* which associates `t` with *optionkey*. By default, all of the *optionkeys* have an associated value `nil`. All *optionkeys* not specified by a declaration remain unchanged (except for the special action of the `:none` *optionkey* described below).

The *optionkey* should be one of the following:

- | | |
|--------------------------|--|
| <code>:none</code> | Set value associated with all <i>optionkeys</i> to <code>nil</code> . This turns off all explanations. |
| <code>:variables</code> | If <i>optionvalue</i> is non- <code>nil</code> , list all the variables of each function, specifying whether they are floating point or not. |
| <code>:types</code> | If <i>optionvalue</i> is non- <code>nil</code> , print information about compiler transformations that depend on declared or deduced type information. |
| <code>:floats</code> | If <i>optionvalue</i> is non- <code>nil</code> , print information about calls to functions that may allocate floats. |
| <code>:non-floats</code> | If <i>optionvalue</i> is non- <code>nil</code> , print information about calls to functions that may allocate non-float numbers, for example bignums. |

:all-calls	If <i>optionvalue</i> is non-nil, print information about calls to normal functions.
:all-calls-with-arg-types	If <i>optionvalue</i> is non-nil, print the argument types for calls to normal functions. Must be combined with :all-calls .
:calls	A synonym for :all-calls .
:boxing	If <i>optionvalue</i> is non-nil, print information about calls to functions that may allocate numbers, for example floats or bignums.
:print-original-form	If <i>optionvalue</i> is non-nil, modifies the :all-calls , :floats and :non-floats explanations to include the original source code form that contains the call.
:print-expanded-form	If <i>optionvalue</i> is non-nil, modifies the :all-calls , :floats and :non-floats explanations to include the macroexpanded source code form that contains the call.
:print-length	Use the <i>optionvalue</i> as the value of *print-length* for :all-calls , :floats and :non-floats explanations.
:print-level	Use the <i>optionvalue</i> as the value of *print-level* for :all-calls , :floats and :non-floats explanations.

Example

```
(defun foo (arg)
  (declare
    (:explain :variables)
    (:optimize (float 0)))
  (let* ((double-arg (coerce arg 'double-float))
         (next (+ double-arg 1d0))
         (other (* double-arg 1/2)))
    (values next other)))
;;- Variables with non-floating point types:
;;- ARG OTHER
;;- Variables with floating point types:
;;- DOUBLE-ARG NEXT
```

See also

```
compile
compile-file
proclaim
```

defclass

Macro

Summary

Remains as defined in ANSI Common Lisp, but extra control over parsing of class options and slot options, optimization of slot access, and checking of initargs, is provided.

Package

`common-lisp`

Description

The macro `defclass` is as defined in the ANSI standard with the following extensions.

For extra class options, you may need to define the way these are parsed at `defclass` macroexpansion time. See `process-a-class-option` for details.

For non-standard slot options, you may need to define the way these are parsed at `defclass` macroexpansion time. See `process-a-slot-option` for details.

By default, standard slot accessors are optimized such that they do not call `slot-value-using-class`. This optimization can be switched off using the `:optimize-slot-access nil` class option.

To add valid initialization arguments for the class, use the class option `:extra-initargs`. The argument passed via this option is evaluated, and should return a list of extra initialization arguments for the class. `make-instance` will treat these as valid when checking its arguments.

Compatibility	When a class is redefined, its extra initargs are always reset.
Note	In early versions of LispWorks 4.3, extra initargs were not reset when a class was redefined without specifying extra initargs.
Example	This session illustrates the effects of the <code>:optimize-slot-access</code> class option. When true, slot access is more efficient but note that <code>slot-value-using-class</code> is not called.

```

CL-USER 26 > (compile '(defclass foo ()
                         ((a :type fixnum
                            :initarg :a
                            :reader foo-a))))
NIL

CL-USER 27 > (compile '(defclass bar ()
                         ((a :type fixnum
                            :initarg :a
                            :reader bar-a))
                         (:optimize-slot-access nil)))
NIL

CL-USER 28 > (setf *foo*
                  (make-instance 'foo :a 42)
                  *bar* (make-instance 'bar :a 99))
#<BAR 21D33D4C>

CL-USER 29 > (progn
                 (time (dotimes (i 1000000)
                           (foo-a *foo*)))
                 (time (dotimes (i 1000000)
                           (bar-a *bar*))))
Timing the evaluation of (DOTIMES (I 1000000) (FOO-A
*FOO*))

user time      =      0.328
system time    =      0.015
Elapsed time   =  0:00:00
Allocation     = 2280 bytes standard / 11002882 bytes
conses
0 Page faults
Timing the evaluation of (DOTIMES (I 1000000) (BAR-A
*BAR*))

user time      =      0.406
system time    =      0.015
Elapsed time   =  0:00:00
Allocation     = 4304 bytes standard / 11004521 bytes
conses
0 Page faults
NIL

CL-USER 30 > (trace
                (clos:slot-value-using-class
                  :when
                  (and (member (first *traced-arglist*)

```

```
(list (find-class 'foo)
      (find-class 'bar)))
      (eq (third *traced-arglist*) 'a))))
(CLOS:SLOT-VALUE-USING-CLASS)

CL-USER 31 > (foo-a *foo*)
42

CL-USER 32 > (bar-a *bar*)
0 CLOS:SLOT-VALUE-USING-CLASS > ...
  >> CLASS          : #<STANDARD-CLASS BAR 214897F4>
  >> CLOS::OBJECT    : #<BAR 2148820C>
  >> CLOS::SLOT-NAME : A
0 CLOS:SLOT-VALUE-USING-CLASS < ...
  << VALUE-0 : 99
99
```

This session illustrates the `:extra-initargs` class option:

```

CL-USER 46 > (defclass a () ())
              (:extra-initargs '(:a-initarg)))
#<STANDARD-CLASS A 21C2E4FC>

CL-USER 47 > (defclass b (a) ())
              (:extra-initargs '(:b-initarg)))
#<STANDARD-CLASS B 2068573C>

CL-USER 48 > (defclass c (a) ())
#<STANDARD-CLASS C 22829D44>

CL-USER 49 > (make-instance 'b :a-initarg "A" :b-
initarg "B")
#<B 2068BCE4>

CL-USER 50 > (make-instance 'c :a-initarg "A" :b-
initarg "B")

Error: MAKE-INSTANCE is called with unknown keyword :B-
INITARG among the arguments (C :A-INITARG "A" :B-
INITARG "B") which is not one of (:A-INITARG).
 1 (continue) Ignore the keyword :B-INITARG
 2 (abort) Return to level 0.
 3 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 51 : 1 >

```

See also [process-a-class-option](#)
[process-a-slot-option](#)

defpackage *Macro*

Summary	Remains as defined in Common Lisp, but see <code>*handle-existing-defpackage*</code> for an extension.
Package	<code>common-lisp</code>
Signature	<code>defpackage defined-package-name [[option]] => package</code>

Arguments	<i>defined-package-name</i>
	A string.
<i>option</i>	Keyword options.
<i>add-use-defaults</i>	A keyword
Values	<i>package</i> A package.
Description	<p>The macro <code>defpackage</code> is as defined in the ANSI standard, with the inclusion of the <code>:add-use-defaults</code> keyword. However, the standard explicitly declines to define what <code>defpackage</code> does if <i>defined-package-name</i> already exists and is in a state that differs from that described by the <code>defpackage</code> form. Therefore an extension has been written that allows you to select between alternative behaviors. See <code>*handle-existing-defpackage*</code> for full details.</p> <p>One non-standard <i>option</i> is supported. <code>:add-use-defaults</code>, with a true argument, causes the package <i>defined-package-name</i> to inherit from the following packages (as well as any explicitly specified by the <code>:use</code> option):</p> <ul style="list-style-type: none"> • <code>common-lisp</code> • <code>lispworks</code> • <code>harlequin-common-lisp</code>
Example	<pre>(defpackage "MY-PACKAGE" (:use "CAPI") (:add-use-defaults t)) (package-use-list "MY-PACKAGE") => (#<PACKAGE COMMON-LISP> #<PACKAGE LISPWORKS> #<PACKAGE HARLEQUIN-COMMON-LISP> #<PACKAGE CAPI>)</pre>
See also	<code>*handle-existing-defpackage*</code>

		<i>Function</i>
Summary	Remains as defined in ANSI Common Lisp. Additionally, you can control the depth at which slots inside arrays, structures and conses are described.	
Package	<code>common-lisp</code>	
Signature	<code>describe <i>object</i> &optional <i>stream</i> => <no-values></code>	
Arguments	<p><i>object</i> An object.</p> <p><i>stream</i> An output stream designator.</p>	
Description	<p>The function <code>describe</code> displays information about the object object to the stream indicated by stream, as specified in ANSI Common Lisp.</p> <p>Arrays, structures and conses are described recursively up to the depth given in the value of the variable <code>*describe-level*</code>. Beyond that depth, objects are simply printed.</p>	
See also	<code>*describe-length*</code> <code>*describe-level*</code> <code>*describe-print-length*</code> <code>*describe-print-level*</code>	

		<i>Function</i>
Summary	Determines which files on the system have names matching a given pathname.	
Package	<code>common-lisp</code>	
Signature	<code>directory <i>pathname</i> &key <i>test</i> <i>directories</i> <i>flat-file-namestring</i> <i>link-transparency</i> <i>non-existent-link-destinations</i> => <i>pathnames</i></code>	
Arguments	<i>pathname</i> A pathname, string, or file-stream.	

<i>test</i>	Filtering test (only pathnames matching the test are collected).
<i>directories</i>	A boolean controlling whether non-matching directories are included in the result.
<i>flat-file-namestring</i>	A generalized boolean.
<i>link-transparency</i>	If <code>nil</code> , then symbolic links are not followed. This means that returned names are not necessarily truenames, but has the useful feature that the <code>pathname-directory</code> of each pathname returned is the directory supplied as argument. The default value of <i>link-transparency</i> is given by the special variable, <code>*directory-link-transparency*</code> , which has initial value <code>t</code> on UNIX/Linux/Mac OS X. By setting this variable to <code>nil</code> , you can get the old behavior of <code>directory</code> . On Windows, where the file system does not normally support symbolic links, this variable is initially <code>nil</code> .
<i>non-existent-link-destinations</i>	If this is non-nil, then the pathname pointed to by a symbolic link appears in the output whether or not this file actually exists. If <code>:link-transparency</code> is non-nil and <code>:non-existent-link-destinations</code> is <code>nil</code> (this is the default on UNIX/Linux/Mac OS X), then symbolic links to nonexistent files do not appear. The default value is <code>nil</code> .
Values	<i>pathnames</i> A list of physical pathnames.

Description	<p><code>directory</code> collects all the pathnames matching the given pathname.</p> <p><code>directory</code> returns truenames, conforming to the ANSI specification for Common Lisp. Some programs may depend on the old behavior, however (and <code>directory</code> is slower if it has to find the truename for every file in the directory), and so two keyword arguments are available so that the old behavior can still be used: <i>link-transparency</i> and <i>non-existent-link-destinations</i>.</p> <p>Because truenames are now returned, the entries <code>.</code> and <code>..</code> no longer show up in the output of <code>directory</code>. This means, for instance, that</p> <pre>(directory #P"/usr/users/")</pre> <p>does not include <code>#P"/usr"</code>, which is the truename of <code>#P"/usr/users/.."</code></p> <p>The specification is unclear as to the appropriate behavior of <code>directory</code> in the presence of links to non-existent files or directories. For example, if the directory contains <code>foo</code>, which is a symbolic link to <code>bar</code>, and there is no file named <code>bar</code>, should <code>bar</code> show up in the directory listing? A keyword argument has been added which lets you control this behavior.</p> <p><code>directory</code> returns a single pathname if called with a non-wild (fully-specified) <i>pathname</i>. LispWorks <code>truenames</code> are fully-specified, so this affects recursive calls to <code>directory</code>.</p> <p><code>directories</code>, if non-nil, causes paths of directories that are sub-directories of the directory of the argument <i>pathname</i> to be included in the result, even if they do not match <i>pathname</i> in the name, type or version components. The default value of <code>directories</code> is <code>nil</code>.</p> <p>When <code>flat-file-namestring</code> is non-nil, <code>directory</code> matches the <code>file-namestring</code> of <i>pathname</i> as a flat string, rather than a</p>
-------------	--

pathname name and pathname type. The default value of *flat-file-namestring* is `nil`.

Note: The Search files tool in the LispWorks IDE uses this option when the **Match flat file-namestring** option is selected. See the *LispWorks IDE User Guide* for more information about the Search Files tool.

Note: File names containing the character * cannot be handled by LispWorks. This is because LispWorks uses * as a wildcard, so there can be confusion if a file name containing * is created, for example in the *pathnames* returned by `directory`.

Compatibility The `:check-for-subs` argument, implemented in LispWorks 4.0.1 and previous versions, has been removed. This argument controlled whether directories in the result have null name components. This option is no longer valid since ANSI Common Lisp specifies that `directory` returns truenames.

Note

Example

```
CL-USER 16 > (pprint (directory "*.*"))
(#P"C:/Program Files/LispWorks/readme-4450.txt"
 #P"C:/Program Files/LispWorks/Msvcrt.dll"
 #P"C:/Program Files/LispWorks/LW4450.isu"
 #P"C:/Program Files/LispWorks/lispworks-4450.exe"
 #P"C:/Program Files/LispWorks/license-4450.txt"
 #P"C:/Program Files/LispWorks/lib/")
```

This session illustrates the effect of the *directories* argument:

```

CL-USER 5 > (pprint (directory "/tmp/t*"))

(#P"/tmp/test.lisp" #P"/tmp/test2/" #P"/tmp/test1/")

CL-USER 6 > (pprint (directory "/tmp/t*" :directories
t))

(#P"/tmp/patches/"
 #P"/tmp/test.lisp"
 #P"/tmp/test2/"
 #P"/tmp/opengl/"
 #P"/tmp/test1/"
 #P"/tmp/mnt/")

```

This example illustrates directory returning a single pathname in its result when given a full-specified pathname:

```

CL-USER 1 > (directory
               (make-pathname :host "H"
                             :device :unspecific
                             :directory (list :absolute
                                               "tmp")
                             :name :unspecific
                             :type :unspecific
                             :version :unspecific))
               (#P"H:/tmp/")

```

The next two examples illustrate the effect of *flat-file-namestring*. Suppose the directory *dir* contains files *interp.exe* and *file.lisp*.

This call matches *interp.exe*, where the name *interp* ends with *p*, but does not match *file.lisp*, where the name *file* ends with *e*:

```
(directory "dir/*p")
```

The next call matches *file.lisp*, where the namestring *file.lisp* ends with *p*, but does not match *interp.exe*, where the namestring *interp.exe* ends with *e*:

```
(directory "dir/*p" :flat-file-namestring t)
```

See also

[truename](#)

disassemble	<i>Function</i>
Summary	Prints the machine code of a compiled function.
Package	<code>common-lisp</code>
Signature	<code>disassemble name-or-function => nil</code>
Arguments	<code>name-or-function</code> Either a function object, a lambda expression or a symbol with a function definition.
Description	<p>This function prints the machine code of a compiled function, to <code>*standard-output*</code>.</p> <p>On UNIX and Mac OS X, the number of instructions in the disassembly is also printed, at the end.</p> <p>If the function denoted by <code>name-or-function</code> is not compiled then it is first compiled using the function <code>compile</code>. This happens if <code>name-or-function</code> is a lambda expression or a symbol naming an interpreted function.</p> <p>An error is signalled if <code>name-or-function</code> is not suitable.</p>
Examples	<pre>(disassemble #'(lambda (x) (progn x))) (disassemble 'cons) (disassemble #'map)</pre>
Notes	The output from <code>disassemble</code> lacks useful information such as local and lexical variable names and symbol names. The representation of integers or characters or Lisp objects in general is not easily readable without detailed knowledge of the internals of the Lisp system and the host machine instruction set.
See also	<code>compile</code> <code>compile-file</code>

documentation

Generic Function

Summary	Returns the documentation string if available.
Package	<code>common-lisp</code>
Signature	<code>documentation x doc-type => documentation</code> <code>(setf documentation) new-value x doc-type => new-value</code>
Description	The generic function documentation operates as specified in the ANSI Common Lisp standard. Additional methods with signatures: <code>documentation (dspec t) (doc-type (eql 'dspec:dspec))</code> <code>(setf documentation) new-value (dspec t) (doc-type (eql 'dspec:dspec))</code> are provided. This method allows finding or setting the documentation string when you know the dspec. See Chapter 7, “Dspecs: Tools for Handling Definitions” for information about dspecs. <i>dspec</i> must be a dspec, but it can be non-canonical. This method canonicalizes <i>dspec</i> and then calls <code>documentation</code> with the name as the first argument and the appropriate dspec class name as the second, thereby calling a standard <code>documentation</code> method. If you define your own type of definitions (<code>def-saved-value</code> for example) with <code>define-dspec-class</code> you can add methods on <code>documentation</code> for your dspec class: <code>(documentation (dspec t) (doc-type (eql 'def-saved-value)))</code> This allows LispWorks IDE commands such as Expression > Documentation to display the documentation.

	<i>Type</i>
Summary	A subtype of <code>float</code> .
Package	<code>common-lisp</code>
Signature	<code>double-float</code>
Description	<code>double-float</code> is disjoint from <code>short-float</code> and <code>single-float</code> in all LispWorks implementations in version 5.0 and later.
Compatibility Note	In LispWorks 4.4 and previous on Windows and Linux platforms, all floats are of type <code>double-float</code> . However, there are distinct specialized array types (<code>(array single-float)</code> , with single precision, and <code>(array double-float)</code> , with double precision.
See also	<code>long-float</code> <code>parse-float</code> <code>short-float</code> <code>single-float</code>

	<i>Variable</i>
features	
Summary	The features list.
Package	<code>common-lisp</code>
Initial Value	A list containing <code>:lispworks</code> . The actual value varies depending on the platform.
Description	The following features can be used to distinguish between platforms, or characteristics of the platform or of the Lisp-Works implementation.
	<code>:solaris2</code> Solaris2

:hp-ux	HP-UX
:svr4	System 5 Release 4 machine (for example Solaris2)
:linux	Linux
:darwin	The variant of FreeBSD underlying Mac OS X.
:unix	Unix, including all of the above.
:mswindows	Microsoft Windows, including 32-bit and 64-bit.
:lispworks-64bit	64-bit LispWorks.
:lispworks-32bit	32-bit LispWorks.
:x86	All images that run on the x86 architecture have this feature. This includes Intel Macintosh, FreeBSD, Linux (32-bit), x86/x64 Solaris (32-bit) and Windows (32-bit). Note: 64-bit LispWorks does not have this feature.
:amd64, :x86-64, :x64	Images that run on the amd64/x86_64/x64 architecture have each of these feautures. This includes Linux (64-bit), x86/x64 Solaris (64-bit) and Windows (64-bit).
:sparc	Images that run on SPARC architecture.
:powerpc	Images that run on PowerPC architecture.
:hppa	Images that run in HP PA-RISC architecture.
:little-endian	The compiler targets a little endian machine, for instance x86.

Code can distinguish the fourteen current LispWorks implementations like this:

```
#+(and :mswindows :lispworks-32bit)
"\"LispWorks (32-bit) for Windows"
#+(and :mswindows :lispworks-64bit)
"\"LispWorks (64-bit) for Windows"
#+(and :linux :lispworks-32bit)
"\"LispWorks (32-bit) for Linux"
#+(and :linux :lispworks-64bit)
"\"LispWorks (64-bit) for Linux"
#+freebsd
"\"LispWorks for FreeBSD"
#+(and :darwin :x86)
"\"LispWorks (32-bit) for Macintosh (running on Intel)"
#+(and :darwin :powerpc :lispworks-32bit)
"\"LispWorks (32-bit) for Macintosh (running on PowerPC)"
#+(and :darwin :x86-64 :lispworks-64bit)
"\"LispWorks (64-bit) for Macintosh (running on Intel)"
#+(and :darwin :powerpc :lispworks-64bit)
"\"LispWorks (64-bit) for Macintosh (running on PowerPC)"
#+(and :solaris2 :x86)
"\"LispWorks (32-bit) for Intel/Solaris"
#+(and :solaris2 :x86-64)
"\"LispWorks (64-bit) for Intel/Solaris"
#+(and :sparc :lispworks-32bit)
"\"LispWorks (32-bit) for Solaris"
#+(and :sparc :lispworks-64bit)
"\"LispWorks (64-bit) for Solaris"
#:hppa
"\"LispWorks for HP PA"
```

The following features can be used to distinguish between versions of LispWorks:

- :**lispworks4** All major version 4 releases.
- :**lispworks4.4** Release 4.4.x
- :**lispworks5** All major version 5 releases.
- :**lispworks5.0** Release 5.0.x
- :**lispworks5.1** Release 5.1.x
- :**lispworks6.0** Release 6.0.x

Every LispWorks 5 and LispWorks 6 image has exactly one of the features `:lispworks-32bit` and `:lispworks-64bit`.

For `:sparc`, `:powerpc` and `:mswindows`, there are two LispWorks architectures: 32-bit and 64-bit, which can be distinguished by `:lispworks-32bit` or `:lispworks-64bit`.

The following features are present in LispWorks with the meanings defined for ANSI CL:

```
:ansi-cl  
:common-lisp  
:ieee-floating-point
```

Note that sometimes it is necessary to write code that examines `*features*` at load time or run time. For example this is true when you put platform-dependent code in fasl files that are shared between multiple platforms.

For a LispWorks image with the CAPI loaded, `:capi` will appear on `*features*`.

Note: LispWorks for Macintosh supports the native Mac OS X Cocoa-based GUI and the X11/GTK+ GUI. If you need to test for which of these libraries is loaded, check for the features `:cocoa` and `:gtk`. The X11/Motif GUI is also available by evaluating (`(require "capi-motif")`) in the GTK+ image.

		<i>Generic Function</i>
Summary	A generic function that determines if an object is an input stream.	
Package	<code>common-lisp</code>	
Signature	<code>input-stream-p <i>stream</i> => <i>result</i></code>	
Arguments	<code><i>stream</i></code>	A stream.

Values	<i>result</i>	A generalized boolean.
Description	The predicate <code>input-stream-p</code> is implemented as a generic function. The default method returns <code>t</code> if <i>stream</i> is an input stream. If the user wants to implement a stream with no inherent directionality (and thus does not include <code>fundamental-input-stream</code> or <code>fundamental-output-stream</code>) but for which the directionality depends on the instance, then a method should be provided for <code>input-stream-p</code> .	
There is an example in “Stream directionality” on page 270.		
See also	<code>fundamental-input-stream</code> <code>output-stream-p</code>	

interactive-stream-p *Function*

Summary	A generic function that determines if an object is an interactive stream.	
Package	<code>c1</code>	
Signature	<code>interactive-stream-p <i>stream</i> -> <i>bool</i></code>	
Arguments	<i>stream</i>	A stream.
Values	<i>bool</i>	A generalized boolean.
Description	The predicate <code>interactive-stream-p</code> is implemented as a generic function. The <code>fundamental-stream</code> class provides a default method that returns <code>nil</code> .	
See also	<code>input-stream-p</code> <code>output-stream-p</code>	

		<i>Function</i>
Summary		Searches for and loads the definition of a logical host, if not already defined.
Package		<code>cl</code>
Signature		<code>load-logical-pathname-translations host => just-loaded</code>
Arguments	<code>host</code>	A logical host, expressed as a string.
Values	<code>just-loaded</code>	A generalized boolean
Description		This function loads the translations for <code>host</code> by loading the file <code>host.lisp</code> from the LispWorks directory <code>translations</code> .
Example		<code>(load-logical-pathname-translations "EDITOR-SRC")</code>

		<i>Type</i>
Summary		A subtype of <code>float</code> .
Package		<code>common-lisp</code>
Signature		<code>long-float</code>
Description		<code>long-float</code> is the same type as <code>double-float</code> in LispWorks, on all platforms.
See also		<code>double-float</code> <code>parse-float</code> <code>short-float</code> <code>single-float</code>

long-site-name		<i>Function</i>
-----------------------	--	-----------------

long-site-name		<i>Function</i>
Summary	Identifies the physical location of the computer.	
Package	<code>common-lisp</code>	
Signature	<code>long-site-name => description</code> <code>(setf long-site-name) description => description</code>	
Arguments	<code>description</code>	A string or <code>nil</code> .
Description	<p>The function <code>long-site-name</code> returns a string identifying the physical location of the computer. This should be set using <code>(setf long-site-name)</code> when you configure your Lisp-Works image.</p>	
See also	<code>short-site-name</code>	

loop		<i>Macro</i>
-------------	--	--------------

loop		<i>Macro</i>
Summary	A macro that performs iteration.	
Package	<code>c1</code>	
Signature	<code>loop {for as} var [type-spec]</code> <code> being {the each}{records record}</code> <code>{in of} query-expression => result</code>	
Arguments	<code>var</code>	A variable.
	<code>query-expression</code>	An SQL query-statement
Values	<code>result</code>	An object.
Description	<p>The Common Lisp <code>loop</code> macro has been extended with a clause for iterating over query results. This extension is available only when the SQL interface has been loaded. See Chap-</p>	

ter 38, “The SQL Package”. For a full description of the rest of the Common Lisp `loop` facility, see the Common Lisp Hyperspec.

Each iteration of the loop assigns the next record of the table to the variable `var`. The record is represented in Lisp as a list. Destructuring can be used in `var` to bind variables to specific attributes of the records resulting from *query-expression*. In conjunction with the panoply of existing clauses available from the `loop` macro, the new iteration clause provides an integrated report generation facility.

- Example** This extended `loop` example, on each record returned as a result of the query, binds `name`, finds the salary (if any) from an associated hash-table, and for salaries greater than 20000: increments a count, accumulates the salary, and prints the details. Finally, the average salary is printed.

```
(loop
  for (name) being each record in
    [select [ename] :from [emp]]
    as salary = (gethash name *salary-table*)
    initially (format t "~&~20A~10D" 'name 'salary)
    when (and salary (> salary 20000))
      count salary into salaries
      and sum salary into total
      and do (format t "~&~20A~10D" name salary)
    else
      do (format t "~&~20A~10A" name "N/A")
    finally
      (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

- See also** `do-query`
`map-query`
`query`
`select`

	make-array	<i>Function</i>
Summary	Creates and returns a new array which, in addition to the standard functionality, can be a weak array or statically allocated.	
Package	<code>common-lisp</code>	
Signature		<code>make-array dimensions &key element-type initial-element initial-contents adjustable fill-pointer displaced-to displaced-index-offset weak allocation => new-array</code>
Arguments	<code>weak</code>	A generalized boolean.
	<code>allocation</code>	A fixnum, or one of <code>nil</code> , <code>:new</code> , <code>:static</code> , <code>:old</code> , or <code>:long-lived</code> .
	<code>single-thread</code>	A generalized boolean.
Description	The standard definition of <code>make-array</code> is extended to accept the keyword arguments <code>:weak</code> and <code>:allocation</code> . If <code>weak</code> is non- <code>nil</code> , then <code>displaced-to</code> must be <code>nil</code> and if <code>element-type</code> is supplied it must have <code>upgraded-array-element-type</code> <code>t</code> , otherwise an error is signalled. That is, you cannot make a weak array which is displaced or has <code>array-element-type</code> other than <code>t</code> . When <code>weak</code> is non- <code>nil</code> , it makes <code>new-array</code> weak. If <code>weak</code> is <code>nil</code> , then <code>make-array</code> behaves in the standard way, and <code>new-array</code> is not weak. The value <code>weak</code> defaults to <code>nil</code> . See <code>set-array-weak</code> for a description of weak arrays. The possible values for <code>allocation</code> have the following meanings:	
	<code>:new</code>	Allocate the array normally.
	<code>nil</code>	Same meaning as <code>:new</code> . This is the default value.
	<code>:static</code>	Allocate the array in a static segment.

`:long-lived` Allocate the array assuming it is going to be long-lived.

`:old` Same meaning as `:long-lived`

A fixnum *n* Allocate the array in generation *n*.

Arrays (including strings) that are passed by address to foreign functions must be static, and so must be created with `:allocation :static`.

Allocation with `:old` or `:long-lived` is useful when you know that the array will be long-lived, because your program will avoid the overhead of promoting it to the older generations.

If `single-thread` is true then the system knows that `new-array` will always be accessed in a single thread context. That makes some operations faster, in particular `vector-pop` and `vector-push`. The default value of `single-thread` is `nil`.

See also

`array-weak-p`
`set-array-single-thread-p`
`set-array-weak`

make-hash-table

Function

Summary Creates and returns a new hash table which, in addition to the standard functionality, can have a user-defined test, a user-defined hash function, and be a weak hash table.

Package `common-lisp`

Signature `make-hash-table &key test size rehash-size rehash-threshold
hash-function weak-kind single-thread free-function => hash-table`

Arguments `test` A designator for a function of two arguments, which returns `t` if they should be regarded as the same and `nil` otherwise.

<i>hash-function</i>	A designator for a function of one argument, which returns a hash value.
<i>weak-kind</i>	One of :value, t, :key, :both, :one, :either, nil. The default is nil.
<i>single-thread</i>	A generalized boolean.
<i>free-function</i>	A designator for a function of two arguments.
Description	<p>The standard definition of <code>make-hash-table</code> is extended such that <i>test</i> can be any suitable user-defined function, except that it must not call <code>process-wait</code> or similar <code>mp</code> package functions which suspend the current process. If <i>test</i> is not one of the standard test functions (<code>eq</code>, <code>eql</code>, <code>equal</code> and <code>equalp</code>), and if <i>hash-function</i> is not supplied, then the hash value is the same as would be used if <i>test</i> were <code>equalp</code>.</p> <p><i>hash-function</i> may be supplied only if <i>test</i> is not one of the standard test functions. It takes a hash key as its argument and returns a hash value to use for hashing.</p> <p>If <i>weak-kind</i> is non-nil, it makes <i>hash-table</i> weak. Its semantics are the same as the second argument of <code>set-hash-table-weak</code>, that is:</p> <pre>(make-hash-table :weak-kind <i>weak-kind</i> <other-args>)</pre> <p>is equivalent to</p> <pre>(let ((ht (make-hash-table <other-args>))) (set-hash-table-weak ht <i>weak-kind</i>) ht)</pre> <p><i>single-thread</i>, if true, tells <code>make-hash-table</code> that the table is going to be used only in single thread contexts, and therefore does not need to be thread-safe. Single thread context means that only one thread can access the table at any point in time. That may be because the table is used only in one thread, but it can also be the case if the table is only ever accessed in the scope of a lock. Making a table with <i>single-thread</i> makes</p>

access to this table faster, but not thread-safe. It does not have other effects. The default value of *single-thread* is `nil`.

free-function adds a "free action" for a weak hash table. This has an effect only if `make-hash-table` is called with *weak-kind* non-`nil`. The *free-function* is called after an entry is automatically removed by the Garbage Collector. If *weak-kind* is `nil`, *free-function* is ignored.

free-function, if supplied, must take two arguments: *key* and *value*. When an entry is removed from a weak table *hash-table* because the relevant object is not pointed by any other object, the *key* and the *value* are remembered. Some time later (normally short, but not well-defined) the *free-function* is called with *key* and *value* as its arguments.

free-function needs to be fast, to avoid delays in unexpected places. Otherwise there are no restrictions on what *free-function* does. In particular, it can keep the *key* or *value* alive by storing them somewhere.

When objects are removed from the table by explicit calls (`remhash`, `clrhash`, (`setf gethash`)), *free-function* is not called.

Notes Objects are removed from the table when the GC has identified them as free. For long-lived objects, which normally get promoted to higher generations, that may be quite a long time after the last pointer to them has gone.

free-function can also be specified in a call to `set-hash-table-weak`.

See also `modify-hash`
`set-hash-table-weak`
`with-hash-table-locked`

make-instance		<i>Generic Function</i>
Summary	Creates and returns a new instance of a class.	
Package	<code>common-lisp</code>	
Signature	<code>make-instance class &rest initargs &key &allow-other-keys => instance</code>	
Arguments	<code>class</code>	A class, or a symbol that names a class.
	<code>initargs</code>	An initialization argument list.
Values	<code>instance</code>	A fresh instance of class <code>class</code> .
Description	<p><code>make-instance</code> behaves as specified in ANSI Common Lisp. In particular it checks the initialization arguments as calculated by <code>compute-class-potential-initargs</code>. This check can be suppressed by passing <code>:allow-other-keys t</code>. In addition, LispWorks provides global control over the initarg checking via <code>set-make-instance-argument-checking</code> and per-class control via <code>class-extra-initargs</code>.</p> <p>Note: in a delivered image, <code>make-instance</code> does not check the initialization arguments.</p>	
Compatibility	In LispWorks 4.2 and previous versions, <code>make-instance</code> does not check the initargs. If your code contains invalid initargs, you could use one of the techniques mentioned above to resolve it.	
Note		
See also	<code>class-extra-initargs</code> <code>compute-class-potential-initargs</code> <code>set-make-instance-argument-checking</code>	

make-sequence *Function*

Summary	Extends the standard <code>make-sequence</code> function allowing it to take any type specifier.	
Package	<code>common-lisp</code>	
Signature	<code>make-sequence result-type size &key initial-element => sequence</code>	
Arguments	<p><i>result-type</i> A type specifier. <i>size</i> A non-negative integer. <i>initial-element</i> An object.</p>	
Values	<i>sequence</i>	A sequence.
Description	The <code>make-sequence</code> function has been extended to take any Common Lisp type. The <i>sequence</i> will be of type <i>result-type</i> unless this is not possible, in which case a <code>type-error</code> is signalled.	
See also	<code>concatenate</code> <code>map</code> <code>merge</code>	

map *Function*

Summary	Redefines the standard <code>map</code> function allowing it to take any type specifier.	
Package	<code>common-lisp</code>	
Signature	<code>map result-type function &rest sequences => result</code>	
Arguments	<p><i>result-type</i> A sequence type specifier or <code>nil</code>. <i>function</i> A function designator.</p>	

	<i>sequence</i>	A sequence.
Values	<i>result</i>	A sequence.
Description	The <code>map</code> function has been extended to take any Common Lisp type. The <i>result</i> will be of type <i>result-type</i> unless this is not possible, in which case a <code>type-error</code> is signalled.	
See also	<code>concatenate</code> <code>make-sequence</code> <code>merge</code>	

		<i>Function</i>
	merge	
Summary	Redefines the standard <code>merge</code> function allowing it to take any type specifier.	
Package	<code>common-lisp</code>	
Signature	<code>merge result-type sequence1 sequence2 predicate &key key => sequence</code>	
Arguments	<i>result-type</i>	A type specifier.
	<i>sequence1</i>	A sequence.
	<i>sequence2</i>	A sequence.
	<i>predicate</i>	A designator for a function.
	<i>key</i>	A designator for a function or <code>nil</code> .
Values	<i>sequence</i>	A sequence.
Description	The <code>merge</code> function has been extended to take any Common Lisp type. The <i>sequence</i> will be of type <i>result-type</i> unless this is not possible, in which case a <code>type-error</code> is signalled.	

See also **concatenate**
 make-sequence
 map

open		<i>Function</i>
Summary	Creates, opens, and returns a file stream that is connected to a specified file.	
Package	<code>common-lisp</code>	
Signature	<code>open filespec &key direction element-type external-format if-exists if-does-not-exist => stream</code>	
Arguments	<i>filespec</i>	A file designator.
	<i>direction</i>	If <i>direction</i> is <code>:probe</code> , <i>external-format</i> is ignored. The element type and external format of the returned stream are undefined.
	<i>element-type</i>	By default, the value of <code>*default-character-element-type*</code> (the ANSI standard default is <code>character</code>).
	<i>external-format</i>	An external file format designator. By default, this is <code>:default</code> .
	<i>if-exists</i>	What to do if the file stream already exists. The possible values for this are as in the ANSI standard.
	<i>if-does-not-exist</i>	What to do if the file stream does not already exist. The possible values for this are as in the ANSI standard.
Values	<i>stream</i>	A file stream, or <code>nil</code> .
Description	If <i>external-format</i> has a name which is not <code>:default</code> and the parameters include <code>:eol-style</code> , it is used as is.	

Otherwise, the system decides which external format to use via `guess-external-format`. By default, this finds a match based on the filename; or (if that fails), looks in the EMACS-style (-*) attribute line for an option called `encoding` or `external-format`; or (if that fails), chooses from among likely encodings by analyzing the bytes near the start of the file. By default, it then also analyses the start of the file for byte patterns indicating the end-of-line style, and uses a default end-of-line style if no such pattern is found. This behavior is configurable.

After the external-format has been determined, it is verified using `valid-external-format-p`; and an error is signalled if this check fails.

If `open` gets `:default` as its `element-type` arg, it chooses the type on the basis of the external format. If `open` gets an `element-type` other than `:default` and the direction is `:input` or `:io`, the argument must be a supertype of the type of characters produced by the external format; if the direction is `:output` or `:io`, it must be a subtype of the type of characters accepted by the external format; if it does not satisfy these requirements, an error is signalled.

Standard stream input and output functions for character and binary data generally work in the obvious way on a `file-stream` with `element-type base-char`, `(unsigned-byte 8)` or `(signed-byte 8)`. For example, `read-sequence` can be called with a string buffer and a binary `file-stream`: the character data is constructed from the input as if by `code-char`. Similarly `write-sequence` can be called with a string buffer and a binary `file-stream`: the output is converted from the character data as if by `char-code`. Also, 8-bit binary data can be read from and written to a `base-char file-stream`.

All standard stream I/O functions except for `write-byte` and `read-byte` have this flexibility.

See also ***default-character-element-type***
guess-external-format
set-file-dates
valid-external-format-p

open-stream-p

Generic Function

Summary A generic function that determines if a stream has been closed.

Package common-lisp

Signature `open-stream-p stream => result`

Arguments *stream* A stream.

Values *result* A generalized boolean.

Description The function `open-stream-p` is generic. The default method provided by the class `fundamental-stream` returns `t` if `close` has not been called on the stream.

See also **[close](#)**
 [fundamental-stream](#)

output-stream-p

Generic Function

Summary A generic function that determines if an object is an output stream.

Package common-lisp

Signature `output-stream-p stream => result`

Arguments *stream* A stream.

Values	<i>result</i>	A generalized boolean.
Description	The predicate <code>output-stream-p</code> is implemented as a generic function. The default method returns <code>t</code> if <i>stream</i> is an output stream. If the user wants to implement a stream with no inherent directionality (and thus does not include <code>fundamental-input-stream</code> or <code>fundamental-output-stream</code>) but for which the directionality depends on the instance, then a method should be provided for <code>output-stream-p</code> .	
There is an example in “Stream directionality” on page 270.		
See also	<code>fundamental-output-stream</code> <code>input-stream-p</code>	

proclaim		<i>Function</i>
Summary	Established a specified declaration in the global environment.	
Package	<code>common-lisp</code>	
Signature	<code>proclaim declaration-list => nil</code>	
Arguments	<i>declaration-list</i>	A list of declaration forms to be put into immediate and pervasive effect.
Values	Returns <code>nil</code> .	
Description	Unlike <code>declare</code> , <code>proclaim</code> is a function that parses the declarations in the list (usually a quoted list), and puts their semantics and advice into global effect. This can be useful when compiling a file for speedy execution, since a proclamation such as:	
<pre>(proclaim '(optimize (speed 3) (space 0) (debug 0)))</pre> means the rest of the file is compiled with these optimization levels in effect. Other ways of doing this are:		

- use the `:optimize` option in `defsystem` to establish default optimization qualities for every member of the system, when compiled via `compile-system`.
- add appropriate `declare` declarations in every function in the file.

Note: For a top-level call to `proclaim` or `declare`, optimize declarations are omitted from the compiled binary file. This deviates from the ANSI Common Lisp Standard but is useful because you are unlikely to want to change settings outside of that file. To make the global settings, you can call a function which calls `proclaim` (so it is not a top-level call).

See “Compiler control” on page 88 for a more extended description of the compiler optimize qualities.

Examples

```
(proclaim '(special *fred*))  
(proclaim '(type single-float x y z))  
(proclaim '(optimize (safety 0) (speed 3)))
```

Notes

As `proclaim` involves parsing a list of lists of symbols and is intended to be used a few times per file, its implementation is not optimized for speed — it makes little sense to use it other than at top level.

Remember to quote the argument list if it is a constant list.
`(proclaim (special x))` attempts to call function `special`.

Exercise caution if you declare or proclaim variables to be special without regard to the naming convention that surrounds their names with asterisks.

See also

`compile`
`compile-file`
`declare`
`declare`

restart-case	<i>Macro</i>
Summary	Evaluates a restartable form in a special dynamic environment.
Package	<code>common-lisp</code>
Signature	<code>restart-case restartable-form {clause} => result*</code> <code>clause ::= (case-name lambda-list [[:interactive interactive-expression :report report-expression :test test-expression]] declaration* form*)</code>
Description	<p>The macro <code>restart-case</code> behaves as specified in the ANSI Common Lisp standard.</p> <p>In addition to that specification, <code>report-expression</code> may be a form whose <code>car</code> is <code>list</code>. Such a form is evaluated when the restart is set up and is expected to return a list of a format string and format arguments. When the restart is asked to report, this is done by calling <code>format</code> on the stream, the format string and the format arguments. This is more efficient than specifying an equivalent function, because no function object is created.</p>
room	<i>Function</i>
Summary	Print information about the state of internal storage and its management.
Package	<code>common-lisp</code>
Signature	<code>room &optional x</code>
Arguments	<code>x</code> One of <code>nil</code> , <code>t</code> , or <code>:default</code> .
Values	<code>room</code> returns no values.

Description	<p>This function provides statistics on the current state of the storage, including the amount of space currently allocated, and the amount available for allocation.</p> <p>As outlined in the Common Lisp Hyperspec, the <code>room</code> function takes an optional argument which controls the level of detail it produces.</p> <p>Given an argument of <code>nil</code>, a summary of the total allocation in the entire heap (in kilobytes) is produced. The “allocated” figure only represents the amount of space allocated in heap segments that are writable, as opposed to read-only segments that hold some of the system code such as the garbage collector itself. The free space figure covers all the free space in all segments.</p> <p>When called without an argument, <code>room</code> additionally prints information on the distribution of space between the generations of the heap.</p> <p>When called with argument <code>t</code>, a breakdown of allocation in the individual segments of each generation is produced. Each segment is identified by its start address in memory. For each segment there is a free space threshold (the “minimum free space”)—when the available space in the segment falls below this value, the garbage collector takes action to attempt to free more space in this segment.</p> <p>Two statistics about promotion are also reported on a per-segment basis: the number of sweeps that an object must survive in this generation before becoming eligible for promotion, and the total volume of objects that have survived for that long and are consequently awaiting promotion to the next generation. These statistics are not relevant for static segments, which are indicated as “static”.</p> <p><code>room</code> prints numbers in decimal format, except for the segment start addresses which it prints in hexadecimal format.</p>
-------------	---

Examples

```

CL-USER 23 > (room nil)

Total Size 50752K, Allocated 42868K, Free 7522K

CL-USER 24 > (room)
Generation 0: Total Size 2778K, Allocated 519K, Free
2251K
Generation 1: Total Size 3958K, Allocated 2524K, Free
1413K
Generation 2: Total Size 24324K, Allocated 20730K,
Free 3572K
Generation 3: Total Size 19391K, Allocated 19266K,
Free 112K

Total Size 50752K, Allocated 43040K, Free 7349K

CL-USER 25 > (room t)
Generation 0: Total Size 2778K, Allocated 561K, Free
2208K
Segment 200877D8: Total Size 507K, Allocated
457K, Free 46K
minimum free space 64K,
Awaiting promotion = 1K, sweeps
before promotion =10
Segment 22F58548: Total Size 2270K, Allocated
104K, Free 2162K
minimum free space 0K,
Awaiting promotion = 0K, sweeps
before promotion =2
Generation 1: Total Size 3958K, Allocated 2524K, Free
1413K
Segment 21C08548: Total Size 1472K, Allocated
1423K, Free 44K
minimum free space 0K,
Awaiting promotion = 0K, sweeps
before promotion =4
Segment 22198548: Total Size 1088K, Allocated
778K, Free 305K
minimum free space 0K,
Awaiting promotion = 0K, sweeps
before promotion =4
Segment 20706770: Total Size 68K, Allocated
3K, Free 60K
minimum free space 3K,
Awaiting promotion = 0K, sweeps
before promotion =4
Segment 216D8548: Total Size 1088K, Allocated

```

```
213K, Free 870K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 2004AFA8: Total Size 242K, Allocated
105K, Free 132K
                    minimum free space 0K, static
Generation 2: Total Size 24324K, Allocated 20730K,
Free 3572K
    Segment 222A8548: Total Size 12992K, Allocated
9527K, Free 3460K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 21D78548: Total Size 4224K, Allocated
4110K, Free 109K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 21418548: Total Size 2816K, Allocated
2811K, Free 0K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 217E8548: Total Size 4224K, Allocated
4218K, Free 1K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 20DBDDC8: Total Size 68K, Allocated
63K, Free 0K
                    minimum free space 117K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Generation 3: Total Size 19391K, Allocated 19266K,
Free 112K
    Segment 20106770: Total Size 6144K, Allocated
6139K, Free 0K
                    minimum free space 3K,
                    Awaiting promotion = 0K, sweeps
before promotion =10
    Segment 20DCEE40: Total Size 6437K, Allocated
6321K, Free 112K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =10
    Segment 207177E8: Total Size 6809K, Allocated
```

```

6805K, Free 0K
               minimum free space 0K,
               Awaiting promotion = 0K, sweeps
before promotion =10

Total Size 50752K, Allocated 43083K, Free 7307K

```

See also [find-object-size](#)
[room-values](#)
[total-allocation](#)

	Type
Summary	A subtype of <code>float</code> .
Package	<code>common-lisp</code>
Signature	<code>short-float</code>
Description	<p>A short float is an immediate object.</p> <p><code>short-float</code> is disjoint from <code>double-float</code> in all LispWorks implementations in version 5.0 and later.</p> <p><code>short-float</code> is disjoint from <code>single-float</code> in all 32-bit LispWorks implementations, version 5.0 and later. In 64-bit LispWorks <code>short-float</code> is the same type as <code>single-float</code>.</p>
Compatibility	In LispWorks 4.4 and previous on Windows and Linux platforms, <code>short-float</code> is the same type as <code>double-float</code> .
Note	
See also	<code>double-float</code> <code>long-float</code> <code>parse-float</code> <code>single-float</code>

	<i>Function</i>
Summary	Identifies the physical location of the computer.
Package	<code>common-lisp</code>
Signature	<code>short-site-name => description</code> <code>(setf short-site-name) description => description</code>
Arguments	<code>description</code> A string or <code>nil</code> .
Description	The function <code>short-site-name</code> returns a string briefly identifying the physical location of the computer. This should be set using <code>(setf short-site-name)</code> when you configure your LispWorks image.
See also	<code>long-site-name</code>

	<i>Type</i>
Summary	The simple base string type.
Package	<code>common-lisp</code>
Signature	<code>simple-base-string length</code>
Arguments	<code>length</code> The length of the string (or <code>*</code> , meaning any).
Description	The type of simple base strings.

	<i>Type</i>
Summary	A subtype of <code>float</code> .
Package	<code>common-lisp</code>

Signature	<code>single-float</code>
Description	<p>A <code>single-float</code> is an immediate object in 64-bit LispWorks.</p> <p>A <code>single-float</code> is a boxed object in 32-bit LispWorks.</p> <p><code>single-float</code> is disjoint from <code>double-float</code> in all LispWorks implementations, version 5.0 and later.</p> <p><code>single-float</code> is disjoint from <code>short-float</code> in all 32-bit LispWorks implementations in version 5.0 and later. In 64-bit LispWorks <code>single-float</code> is the same type as <code>short-float</code>.</p>
Compatibility	In LispWorks 4.4 and previous on Windows and Linux platforms, <code>single-float</code> is the same type as <code>double-float</code> .
Note	<p>However, there are distinct specialized array types <code>(array single-float)</code>, with single precision, and <code>(array double-float)</code>, with double precision.</p>
See also	<code>double-float</code> <code>long-float</code> <code>parse-float</code> <code>short-float</code>

software-type	<i>Function</i>
Summary	Identifies the Operating System.
Package	<code>common-lisp</code>
Signature	<code>software-type => description</code>
Values	<code>description</code> A string or <code>nil</code> .
Description	The function <code>software-type</code> returns a string representing a generic name of the Operating System, or <code>nil</code> if this cannot be determined.

On Microsoft Windows 98 and Millennium, `software-type` returns "Windows". On Windows 2000 and Windows XP, `software-type` returns "Windows NT". For more detail, use `software-version`.

See also `software-version`

	<i>Function</i>
software-version	
Summary	Identifies the version of the Operating System.
Package	<code>common-lisp</code>
Signature	<code>software-version => description</code>
Values	<code>description</code> A string or <code>nil</code> .
Description	The function <code>software-version</code> returns a string giving the version of the Operating System, or <code>nil</code> if this cannot be determined. On Microsoft Windows systems, <code>description</code> begins with the specific Operating System. This is "Windows 98", "Windows Millennium", "Windows 2000", "Windows XP", "Windows XP x64 Edition", "Windows 2003", "Windows Vista", "Windows Server \\"Longhorn\\"", or "Some Windows NT derivative". This is followed by the version numbers (Major.Minor), build number and optionally service pack.
Example	<pre>(software-version) => "Windows Vista: 6.0 (build 6000) " (software-version) => "Windows XP: 5.1 (build 2600) Service Pack 2"</pre>

```
(software-version)
=>
"Windows Millennium: 4.90 (build 3000)"
```

See also `software-type`

step *Macro*

Summary Steps through the evaluation of a form.

Package `common-lisp`

Signature `step form => result`

Arguments `form` A form to be stepped and evaluated.

Values `result` The values returned by *form*.

Description `step` evaluates a form and allows you to single-step through it. You can include a call to `step` inside a tricky definition to invoke the stepper every time the definition is used. `step` can also optionally step through macros.

The commands shown below are available. When certain stepper variables (as described below) are set, some of these commands are not relevant and are therefore not available. Use `:help` to get a list of the commands.

- `:s n` Step this form and all of its subforms (optional positive integer argument).
- `:st` Step this form without stepping its sub-forms.
- `:su` Step up out of this form without stepping its subforms.
- `:sr` Return a value to use for this form.
- `:sq` Quit from the current stepper level.

<code>:redo</code>	Redo one of the previous commands.
<code>:get</code>	Get an item from the history list and put it in a variable.
<code>:help</code>	List available commands.
<code>:use</code>	Replace one form with another form in previous command and redo it.
<code>:his</code>	List the commands history.

The optional integer argument *n* for `:s` means do `:s n` times.

Note: `step` is a Listener-based form stepper. LispWorks also offers a graphical source-code Stepper tool. See the *LispWorks IDE User Guide* for details of that.

Examples The following examples illustrate some of these commands.

```

USER 12 > (step (+ 1 (* 2 3) 4))
(+ 1 (* 2 3) 4) -> :s
  1 -> :s
  1
  (* 2 3) -> :su
  6
  4 -> :s
  4
11
11

USER 13 > (defun foo (x y) (+ x y))
FOO

USER 14 > step (foo (+ 1 1) 2)
(FOO (+ 1 1) 2) -> :st
  (+ 1 1) -> :s
    1 -> :s
    1
    1 -> :s
    1
    2
    2 -> :s
    2
4
4

```

```

USER 15 > :redo (STEP (FOO # 2))
(FOO (+ 1 1) 2) -> :s
(+ 1 1) -> :s
  1 -> :s
    1
  2
  2 -> :s
  2
(+ X Y) -> :s
  X -> :s
    2
  Y -> :s
    2
        4
  4
  4

```

You can interact when an evaluated form returns, by setting the variable `*no-step-out*` to `nil`. The prompt changes as shown below:

```

USER 36 > step (cons 1 2)
(CONS 1 2) -> :s
  1 -> :s
  1 = 1 <- :sr 3
  2 -> :s
  2 = 2 <- :sr 4
(CONS 1 2) = (3 . 4) <- :s
(3 . 4)

```

To allow expansion of macros, set the variable `*step-macros*` to `t`.

To step through the function calls in compiled code, set the variable `hcl:*step-compiled*` to `t`.

If required, the stepper can print out the step level: set the variable `*print-step-level*` to `t`, as shown in this session:

```

USER 21 > (setq *print-step-level* t)
T
USER 22 > step (cons 1 2)
[1] (cons 1 2) -> :s
[2]   1 -> :s      1
[2]   2 -> :s
      2
      (1 . 2)
(1 . 2)

```

It is not advisable to try to step certain compiled functions, such as `car` and `format`. The variable `hcl:*step-filter*` contains a list of functions which should not be stepped. If you get deep stack overflows inside the stepper, you may need to add a function name to `hcl:*step-filter*`.

By default, the stepper uses the same printing environment as the rest of LispWorks (the same settings of the `*print-...*` variables). To control the stepper printing environment independently, set the variable `hcl:*step-print-env*` to `t`.

The values of the variables `hcl:*step-print-...*` are then used instead of the variables `*print-...*`.

stream-element-type

Generic Function

Summary Implements `stream-element-type` as a generic function.

Package `common-lisp`

Signature `stream-element-type stream => type`

Arguments `stream` A stream.

Values `type` A type specifier.

Description The function `stream-element-type` is implemented as a generic function. Depending on the stream, a method should

be defined for this generic function that returns the element type of the stream.

Methods must be implemented for all subclasses of `buffered-stream`. Typically for character streams, the implementation can return the `array-element-type` of the buffer.

For the class `fundamental-character-stream` a default method is provided which returns `character`. A method should be defined for stream classes based on the `fundamental-binary-stream` class.

There is an example in “Recognizing the stream element type” on page 270.

See also

`buffered-stream`
`fundamental-binary-stream`
`fundamental-character-stream`

string	<i>Type</i>				
Summary	The string type.				
Package	<code>common-lisp</code>				
Signature	<code>string length element-type</code>				
Arguments	<table border="0"> <tr> <td><code>length</code></td> <td>The length of the string (or <code>*</code>, meaning any).</td> </tr> <tr> <td><code>element-type</code></td> <td>The type of string element. The default is the value of <code>*default-character-element-type*</code> rather than <code>*</code>.</td> </tr> </table>	<code>length</code>	The length of the string (or <code>*</code> , meaning any).	<code>element-type</code>	The type of string element. The default is the value of <code>*default-character-element-type*</code> rather than <code>*</code> .
<code>length</code>	The length of the string (or <code>*</code> , meaning any).				
<code>element-type</code>	The type of string element. The default is the value of <code>*default-character-element-type*</code> rather than <code>*</code> .				
Description	<p>The union of all string types as specified in the standard, but extended with an extra parameter: <code>element-type</code>.</p> <p><code>(string length element-type)</code> means all string types whose element type is a subtype of <code>element-type</code>. That is:</p>				

```

(string * base-char)      = (vector base-char *)
(string * lw:simple-char) = (or (vector base-char *)
                                (vector lw:simple-char *))
(string * character)      = (or (vector base-char *)
                                (vector lw:simple-char *)
                                (vector character *))

```

Example CL-USER 235 > (lw:set-default-character-element-type
 'base-char)
 BASE-CHAR
 CL-USER 236 > (concatenate 'string "f" "o" "o")
 "foo"
 CL-USER 237 > (type-of *)
 SIMPLE-BASE-STRING

See also [*default-character-element-type*](#)
[set-default-character-element-type](#)

	<i>Macro</i>
Summary	Determines the execution time of a form in the current environment.
Package	<code>common-lisp</code>
Signature	<code>time form => result</code>
Arguments	<code>form</code> A form to be evaluated.
Values	<code>result</code> The result of the evaluation of the form.
Description	<code>time</code> can be used to determine execution times. The macro evaluates the form <code>form</code> and returns its value <code>result</code> . <code>time</code> also prints some timing and size data: <i>user time</i> , <i>system time</i> , <i>elapsed time</i> , and the total amount of heap space allocated in executing the form (in bytes).

The *user time* printed is the time used by LispWorks or any code that it calls in a dynamic library.

The *system time* printed is the time used in the operating system kernel when it is doing work on behalf of the LispWorks process.

The *elapsed time* printed is the time you could in principle measure with a stopwatch.

If LispWorks is 100% busy throughout the execution of the code, then *user time* + *system time* = *elapsed time*.

Each of the times is printed as:

- *secs.micros* if less than 60 seconds
- *hours:minutes:secs.micros* if 60 seconds or more.

The timing and size data covers all stack groups, not just the one that invokes `time`.

Notes

1. Note that `time` itself uses a small, constant amount of heap space.
2. `time` measures all threads, so to test accurately for consing in `code` you need to do:
`(sys:with-other-threads-disabled (time code))`
 This is particularly important when using the LispWorks IDE. Do not use `sys:with-unique-names` in your application code.

Examples

```
CL-USER 7 > (time (loop for i below 3000000
                           sum (sqrt i)))
Timing the evaluation of (LOOP FOR I BELOW 3000000 SUM
                           (SQRT I))

User time      =  0:01:04.187
System time   =          0.062
Elapsed time  =  0:01:07.297
Allocation    = 4932022956 bytes
0 Page faults
Calls to %EVAL      72000048
3.4606518E9
```

See also `extended-time`
`with-other-threads-disabled`
`with-unique-names`

	trace	<i>Macro</i>
Summary	Invoke the Common Lisp tracing facility on the named functions.	
Package	<code>common-lisp</code>	
Signature	<pre>trace {function-name tracing-desc}* => trace-result tracing-desc ::= (dspec {keyword form}*) dspec ::= function-name (method generic-function-name [qualifier] (class*)) keyword ::= :after :allocation :before :backtrace :eval-after :eval-before :break :break-on-exit :entrycond :exitcond :inside :process :trace-output :step :when qualifier ::= :after :before :around function-name ::= symbol (setf symbol)</pre>	
Arguments	<p><i>function-name</i> A symbol whose symbol-function is to be traced, or a setf function name. Functions, macros and generic functions may be specified this way.</p> <p><i>dspec</i> Specifies the functional definition which is to be traced. This either has the same form as above, or specifies a method by the name of its generic function and by a list of classes to specialize the arguments to the method. In this latter case the list of classes must correspond exactly to the classes of the special-</p>	

ized parameters of an existing method, and then only this method is traced (as opposed to the corresponding generic function).

tracing-desc Specifies the functional definition which is to be traced and specifies any additional options that are required.

:after is followed by a list of forms; these are evaluated upon returning from the function. The values of these forms are also printed out by the tracer. The forms are evaluated after printing out the results of the function call, and if they modify **hcl:*traced-results*** then the values received by the caller of the function are correspondingly altered (see also **hcl:*traced-results***).

:allocation — if non-nil, the memory allocation made during a function-call is printed upon exit from the function. This allocation is counted in bytes. If it is any other symbol (except **nil**), **trace** uses the symbol to accumulate the amount of allocation made between entering and exiting the function. Upon exit from the function, the symbol contains the number of bytes allocated during the function-call. For example,

```
(trace (print :entrycond nil
              :exitcond nil
              :allocation $$print-allocation))
```

results in **\$\$print-allocation** containing the sum of the allocation made inside **print**.

Note that if the function is called again, **trace** continues to use **\$\$print-allocation** as an accumulator of memory allocation. It adds to the present value rather than re-initializing it each time the function is called.

:backtrace generates a backtrace on each call to the traced function. It is followed by a keyword that can be any of the following values:

:quick	Like the :bq debugger command.
---------------	---------------------------------------

<code>t</code>	Like the <code>:b</code> debugger command.
<code>:verbose</code>	Like the <code>:b :verbose</code> debugger command.
<code>:bug-form</code>	Like the <code>:bug-form</code> debugger command.

`:before` is followed by a list of forms; these are evaluated upon entering the function and their values are printed out by the tracer. The forms are evaluated after printing out the arguments to the function, and if they alter `*traced-arglist*` then the values received by the body of the function are changed accordingly (see also `*traced-arglist*`).

`:eval-after` and `:eval-before` are similar to `:after` and `:before`, without output.

`:break` is followed by a form. This is evaluated after printing the standard information caused by entering the function, and after executing any `:before` forms; if it returns `nil` then tracing continues normally, otherwise `break` is called. This provides a way of entering the debugger through the tracer.

`:break-on-exit` is followed by a form. This is evaluated after printing the standard information caused by returning from the function, and before executing any `:after` forms; if it returns `nil` then tracing continues normally, otherwise `break` is called. This provides a second way of entering the debugger through the tracer.

`:entrycond` controls the printing of the standard entry message (including the function's arguments). If the form following it evaluates to give a non-nil value when the function is entered, then the entry message is printed (but otherwise it is not). If this option is not present then the standard entry message is always printed upon calling the function. See also the `:when` option.

`:exitcond` controls the printing of the standard exit message (including the function's results). If the form following it evaluates to give a non-nil value when the function is exited, then the exit message is printed (but otherwise it is not). If this option is not present then the standard exit message is

always printed upon returning from the function. See also the `:when` option.

`:inside` restricts the tracing to within one of the functions given as an argument. A single symbolic function name is treated as a list of one element, i.e. `:inside format` is equivalent to `:inside (format)`.

`:process` may be used to restrict the tracing to a particular process. If it is followed by a process then the function is only traced when it is invoked from within that process. If it is followed by `t` then it is traced from all processes — this is the default. In any other cases the function is not traced at all.

`:trace-output` should be followed by a stream. All the output from tracing the function is sent to this stream. By default output from the tracer is sent to `*trace-output*`. Use of this argument allows you to dispatch traced output from different functions to different places.

`:step`, when non-nil, invokes the stepper (for evaluated functions).

`:when` overrides all other keywords. It is followed by an expression, and tracing only occurs when that expression evaluates to non-nil. It is useful if you want to combine `:entrycond` and `:exitcond`.

Values	<code>trace-result</code>	If <code>trace</code> is called with no arguments then it returns a list of the names of all the functions currently being traced. When called with one or more arguments, it returns the symbols of the functions specified in those arguments.
Description		<code>trace</code> is the macro used to invoke the tracing facility. This is a useful debugging tool that enables information about selected calls to be generated by the system. The standard way of invoking <code>trace</code> is to call it with the names of the functions, macros and methods that are to be monitored in this

way. Calls to these produce a record of the function that was called, the arguments it received and the results it produced.

The arguments to `trace` each specify a function (or a macro or a method) to be traced. They may also contain further instructions to control how the tracing output is displayed, or to cause particular actions to occur when the functions is called or exited. If `trace` is called with a function that is already being traced, then the new tracing specification for that function replaces the old version.

Note: `trace` works by tracing function names, not function objects. Therefore tracing function objects, for example by

```
(trace #'foo)
```

will not yield any trace output. Also, if the symbol `foo` is traced, then invoking the function `foo` by

```
(funcall (symbol-function 'foo) ...)
```

will not produce any trace output.

Note: for detailed information about the current tracing state, call `tracing-state`.

Example 1

```

USER 1 > (defvar *number-of-calls-to-max* 0)
*NUMBER-OF-CALLS-TO-MAX*

USER 2 > (trace (max :after
                      ((incf *number-of-calls-to-max*))))
(MAX)

USER 3 > (dotimes (i 2) (max i 1))
0 MAX > (0 1)
0 MAX < (1)
1
0 MAX > (1 1)
0 MAX < (1)
2
NIL

USER 4 > *number-of-calls-to-max*
2

USER 5 > (trace (max
                  :entrycond
                  (> (length compiler:*traced-arglist*)
                      2)
                  :exitcond nil))
(MAX)

USER 6 > (max 2 3 (max 4 5))
0 MAX > (2 3 5)
5

```

Example 2

This example illustrates the use of `:inside`.

```

CL-USER 2 > (defun outer ()
               (inner))
OUTER

CL-USER 3 > (defun inner ()
               10)
INNER

CL-USER 4 > (trace (inner :inside outer))
               ;, only trace when inside OUTER
(INNER)

CL-USER 5 > (inner)
               ;, no tracing occurs since we are not inside OUTER
10

CL-USER 6 > (outer)    ;, INNER is traced inside OUTER
0 INNER > NIL
0 INNER < (10)
10

CL-USER 7 >

```

Example 3 To trace a method:

```

(defmethod foo (x) x)

(trace ((method foo (t))))

```

Example 4 To trace a setf function:

```

CL-USER 56 > (defvar *a* 0)
*A*

CL-USER 57 > (defun (setf foo) (x y) (set y x))
(SETF FOO)

CL-USER 58 > (trace (setf foo))
((SETF FOO))

CL-USER 59 > (setf (foo '*a*) 42)
0 (SETF FOO) > (42 *A*)
>> X : 42
>> Y : *A*
0 (SETF FOO) < (42)
42

```

See also ***disable-trace***
max-trace-indent
trace-indent-width
trace-level
trace-new-instances-on-access
trace-on-access
trace-print-circle
trace-print-length
trace-print-level
trace-print-pretty
trace-verbose
traced-arglist
traced-results
tracing-enabled-p
tracing-state
untrace

truename	<i>Function</i>
Summary	Returns the truename of a pathname.
Package	<code>common-lisp</code>
Signature	<code>truename <i>filespec</i> => <i>truename</i></code>
Arguments	<code>filespec</code> A pathname designator.
Values	<code>truename</code> A fully-specified physical pathname.
Description	The function <code>truename</code> behaves as specified in ANSI Common Lisp. The returned value is a fully-specified pathname. Truenames are always fully-specified in LispWorks (this prevents them from ever being corrupted by <code>*default-pathname-defaults*</code>). Note that this means that the paths returned by <code>directory</code> are always fully specified.

See also [directory](#)

untrace *Macro*

Summary	Turns off the Common Lisp tracing facility on the named functions.				
Package	<code>common-lisp</code>				
Signature	<code>untrace {function-name / method-desc}* => untrace-list</code>				
Arguments	<table><tr><td><i>function-name</i></td><td>A symbol whose symbol-function is no longer to be traced.</td></tr><tr><td><i>method-desc</i></td><td>Is a method description, as described in the entry for <code>trace</code>. See <code>trace</code> for more details.</td></tr></table>	<i>function-name</i>	A symbol whose symbol-function is no longer to be traced.	<i>method-desc</i>	Is a method description, as described in the entry for <code>trace</code> . See <code>trace</code> for more details.
<i>function-name</i>	A symbol whose symbol-function is no longer to be traced.				
<i>method-desc</i>	Is a method description, as described in the entry for <code>trace</code> . See <code>trace</code> for more details.				
Values	When called with no arguments, it returns the symbols of all functions currently being traced. When called with one or more functions as arguments, <code>untrace</code> returns a list of the symbols of those functions. Thus, in all situations, <code>untrace</code> returns a list of the symbols of those functions being untraced.				
Description	<code>untrace</code> is used to cease the tracing of functions. If it is called with no arguments then the tracing of all currently traced functions is stopped. If it is called with one or more symbols then the tracing of those functions is stopped. A warning is given if <code>untrace</code> is called with a function that is not being traced.				
Examples	<pre>USER 12 > (progn (untrace) (trace + - / *)) * USER 13 > (+ 2 3) 0 + > (2 3) 0 + < (5) 5</pre>				

```
USER 14 > (untrace + -)
(* |/|)
```

```
USER 15 > (+ 2 3)
5
```

To untrace a method:

```
(untrace (clos:method foo (t)))
```

See also

[trace](#)
[untrace-new-instances-on-access](#)
[untrace-on-access](#)

update-instance-for-different-class

Generic Function

Summary As specified for Common Lisp, and locks the redefined instance.

Package `common-lisp`

Description The generic function `update-instance-for-different-class` behaves as specified for ANSI Common Lisp.

During the operation of updating the instance, including the call to `update-instance-for-different-class`, the redefined instance is locked against access. Any other process that tries to access the instance will hang until the operation finishes. Therefore your methods must avoid doing anything that may wait for another process which may access the instance, as this would cause a deadlock.

See also `update-instance-for-redefined-class`

update-instance-for-redefined-class

Generic Function

Summary As specified for Common Lisp, and locks the redefined instance.

Package	<code>common-lisp</code>
Description	<p>The generic function <code>update-instance-for-redefined-class</code> behaves as specified for ANSI Common Lisp.</p> <p>During the operation of updating the instance, including the call to <code>update-instance-for-redefined-class</code>, the redefined instance is locked against access. Any other process that tries to access the instance will hang until the operation finishes. Therefore your methods must avoid doing anything that may wait for another process which may access the instance, as this would cause a deadlock.</p>
See also	<code>update-instance-for-different-class</code>

with-output-to-string *Macro*

Summary	Creates a character output stream, performs a series of operations that may send results to this stream, and then closes the stream.
Package	<code>common-lisp</code>
Signature	<code>with-output-to-string (var &optional string-form &key element-type) declaration form => result</code>
Description	<p>The macro <code>with-output-to-string</code> behaves as specified in the ANSI Common Lisp Standard with one exception: the default value of <code>element-type</code> is the value of <code>*default-character-element-type*</code>.</p> <p>Therefore for strict compliance you must call <code>set-default-character-element-type</code> to set the default string type to <code>character</code>.</p>
See also	<code>compile-file</code> <code>declare</code>

```
proclaim
*default-character-element-type*
set-default-character-element-type
```

28

The COMPILER Package

This chapter describes symbols available in the `COMPILER` package.

The compiler is discussed in detail in Chapter 9, “The Compiler”.

`deftransform` *Macro*

Summary Defines a function that computes the expansion of a form.

Package `compiler`

Signature `deftransform name transform-name lambda-list &body body => list-of-transforms`

Arguments `name` A symbol naming the function to which the transform is to be applied.

`transform-name` The symbol naming the transformation — it should be unique for the function being transformed — and provides a handle with which to redefine an existing transform.

<i>lambda-list</i>	This must match against the form being expanded before expansion is allowed to take place, in the sense that it must be valid to call a function with such a lambda list using the arguments supplied in the candidate-form for expansion.
<i>body</i>	The body of the expander function, the result of which replaces the original form (unless it evaluates to <code>compiler::%pass%</code> , in which case no transformation is applied).
Values	<i>list-of-transforms</i> A list of the names of transforms defined for the function, including the one just added.
Description	<code>deftransform</code> , like <code>defmacro</code> , defines a function that computes the expansion of a form. Transforms are only used by the compiler and not by the interpreter. <code>deftransform</code> allows you to add to the optimizations performed by the compiler.
Examples	<pre>(compiler:deftransform + +-of-2 (x y) '(system:: +2 ,x ,y)) (compiler:deftransform + +-of-many (x &rest y) '(system:: +2 ,x (+ ,@y))) ;; now an expression like (+ a b c 4 5 7 d e f) ;; compiles to use the binary version ;; of + (inlined by default), ;; rather than the full (slow) version of + (compiler:deftransform list list-of-1 (x) '(cons ,x '())) (compiler:deftransform list list-of-2 (x y) '(cons ,x (cons ,y '()))) ;; save having to call list - ;; cons is inlined by default (compiler:deftransform constant my-trans (x) (cond ((constantp x) x) ((consp x) '(quote ,(eval x))) (t 'compiler::%pass%))) ; give up if not a cons</pre>

```
(compile (defun three-list () (constant (list 1 2 3))))  
;; the function three-list returns the  
;; same list (1 2 3)  
;; every time it is called...
```

The `list-of-2` example returns

```
(LIST-OF-2 LIST-OF-1 COMPILER::LIST-TRANSFORM)
```

as its result, since a similar transform already exists in the compiler, by the name `compiler::list*-transform`.

Notes

`deftransform` differs from `defmacro` in various ways:

The evaluation of the body can return `compiler:%pass%` indicating that the form is not to be expanded (in other words, the transform method has elected to give up trying to improve the code).

The compiler only calls the expander function if the arguments match the lambda list — macros are unconditionally expanded.

There can be several `deftransforms` for the same symbol, each having a different name. (The compiler calls each one in turn until one succeeds. This repeats until they all pass, so that the replacement form may itself be transformed.)

If a transform takes keyword arguments the compiler preserves the correct order of evaluation.

A carelessly written `deftransform` may lead the compiler to transform valid Common Lisp into incorrect code — there is no semantic checking of the transform.

See also

`compile`
`compile-file`

29

The DBG Package

This chapter describes symbols available in the `DBG` package, used to configure the debugging information produced by LispWorks.

The debugger is discussed in detail in Chapter 3, “The Debugger”.

debug-print-length		<i>Variable</i>
Summary	Controls the number of object components printed in debugger output.	
Package	<code>dbg</code>	
Initial Value	<code>40</code>	
Description		This variable is used to control the number of components of an object which are printed during output from the debugger. If its value is a positive integer then the components up to that number are printed. If it is <code>nil</code> then all the parts of an object are shown.
Examples		<code>USER 83 > (setq dbg:*debug-print-length* 3)</code>

```

3
USER 84 > (aref
 '(1 2 3 4 "Jenny" "cottage" "door")
 2)

Error: (1 2 3 4 Jenny cottage door) must be
       an array
1 (abort) return to top loop level 0.

Type :c followed by a number to proceed

USER 85 : 1 > :v
Call to ARRAY-ACCESS :
Arg 0 (ARRAY): (1 2 3 ...)
Arg 1 (SUBSCRIPTS): (2)
Arg 2 (SET-P): NIL Arg 3 (VALUE): NIL

```

Notes ***debug-print-length*** is an extension to Common Lisp.

debug-print-level Variable

Summary Controls the depth to which nested objects are printed in debugger output.

Package **dbg**

Initial Value **4**

Description **dbg: *debug-print-level*** controls the depth to which nested objects are printed during output from the debugger. If its value is a positive integer then components at or above that level are printed. By definition an object to be printed is considered to be at level 0, its components are at level 1, their subcomponents are at level 2, and so on. If **dbg: *debug-print-level*** is **nil** then objects are printed to arbitrary depth.

Example **USER 89 > (setq dbg: *debug-print-level* 2)**

```

2
USER 90 > (subseq 3 '(cat (dog) ((goldfish))
                           (((hamster)))))

Error: Illegal START argument (CAT (DOG)
                               ((GOLDFISH))
                               (((HAMSTER))))
1 (abort) return to top loop level 0.

Type :c followed by a number to proceed

USER 91 : 1 > :v
Call to CHECK-START-AND-END :
Arg 0 (START): (CAT (DOG) (#) (#))
Arg 1 (END): NIL

```

Notes ***debug-print-level*** is an extension to Common Lisp.

executable-log-file

Function

Summary	Returns the default bug form log file.	
Package	dbg	
Signature	executable-log-file => <i>log-file</i>	
Values	<i>log-file</i>	A pathname.
Description	<p>The function executable-log-file returns the default bug form log file for the current executable, which is the default path for *hidden-packages*</p> <p>The path is also user specific.</p>	
See also	*hidden-packages* logs-directory	

hidden-packages		<i>Variable</i>
Summary	A list of packages whose symbols should not be displayed in debugger output.	
Package	<code>dbg</code>	
Initial Value	A list containing the <code>dbg</code> and <code>conditions</code> packages.	
Description	<code>dbg: *hidden-packages*</code> is used by the debugger. It should be bound to a list of package specifiers. If a package is included in the list then any symbols in it are not shown by the debugger. Thus during backtraces the call frames corresponding to functions in these packages are not displayed. This can be useful in restricting the debugger to particular areas.	

Example CL-USER 1 > unbound

```
Error: The variable UNBOUND is unbound.
 1 (continue) Try evaluating UNBOUND again.
 2 Return the value of :UNBOUND instead.
 3 Specify a value to use this time instead of
evaluating UNBOUND.
 4 Specify a value to set UNBOUND to.
 5 (abort) Return to level 0.
 6 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or
?: for other options.
```

CL-USER 2 : 1 > :b 3
Call to ERROR
Call to EVAL
Call to CAPI::CAPI-TOP-LEVEL-FUNCTION

CL-USER 3 : 1 > (push "COMMON-LISP" dbg::*hidden-packages*)
("COMMON-LISP" #<The COMPILER package, 3131/4096
internal, 41/64 external> #<The SYSTEM package,
6258/8192 internal, 1266/2048 external> "DBG"
"CONDITIONS")

CL-USER 4 : 1 > :b 3
Call to CAPI::CAPI-TOP-LEVEL-FUNCTION
Call to CAPI::INTERACTIVE-PANE-TOP-LOOP
Call to MP::PROCESS-SG-FUNCTION

CL-USER 5 : 1 >

Notes *hidden-packages* is an extension to Common Lisp.

log-bug-form	<i>Function</i>
Summary	Writes a log of an error. This is useful in an application's error handlers.
Package	dbg

Signature	<code>log-bug-form</code> <i>description</i> &key <i>log-file</i> <i>message-stream</i> => <i>path</i>	
Arguments	<i>description</i>	A string.
	<i>log-file</i>	A pathname designator.
	<i>message-stream</i>	An output stream, <code>t</code> or <code>nil</code> .
Values	<i>path</i>	A pathname.
Description	<p>The function <code>log-bug-form</code> is a simple interface for writing a log of an error. Your application's error handlers can call it.</p> <p><code>log-bug-form</code> opens the file <i>log-file</i> for output. It writes the current date followed by a bug form. The bug form contains <i>description</i>, and debugging information generated by the system. When it finishes it writes to the stream <i>message-stream</i> a single line reporting that a bug form was written.</p> <p>If <i>log-file</i> is supplied it must be a valid path, and it is used to open the file. The default value of <i>log-file</i> is the value returned by <code>executable-log-file</code>.</p> <p><i>log-bug-form</i> calls <code>ensure-directories-exist</code> before opening the log file, therefore so the directory where the <i>log-file</i> is written does not need to exist before <code>log-bug-form</code> is called.</p> <p>If <i>message-stream</i> is <code>t</code> the message is written to standard output. If <i>message-stream</i> is a stream the message is written to it, and if <i>message-stream</i> is <code>nil</code> then no message is written.</p> <p>If there is an error during the operation, <code>log-bug-form</code> silently fails and returns <code>nil</code>.</p> <p>On success <code>log-bug-form</code> returns the path where the log file was written.</p> <p>See also the section "Reporting bugs" in the <i>LispWorks Release Notes and Installation Guide</i>.</p>	
Notes	<p><code>log-bug-form</code> is invoked automatically if the debugger decides to use the console (the terminal) rather than use the</p>	

LispWorks IDE debugging tools. This means that after such an error the user can always find a bug form in the default log file, which can be found by using `executable-log-file`.

`log-bug-form` always appends, so if it is called frequently the log file grows continuously. You may need to clear it periodically. It may be a good idea to move the file rather than delete it, so a record of errors remains.

When editing the log file it should be noted that each bug-form is preceded by the time it was written, and that the bug forms are in chronological order. That means that the interesting bug form is most often the last one in the file.

See also `executable-log-file`
 `logs-directory`

logs-directory *Function*

Summary Returns the directory in which LispWorks puts log files.

Package `dbg`

Signature `logs-directory => dir`

Values `dir` A directory pathname.

Description The function `logs-directory` returns the directory in which LispWorks puts log files for the current user.

See also `executable-log-file`
 `*hidden-packages*`

	<i>Function</i>
Summary	Prints a backtrace of the current stack. For use in exception handling routines.
Package	<code>dbg</code>
Signature	<code>output-backtrace keyword &key stream printer-bindings</code>
Arguments	<p><i>keyword</i> Defines how verbose the output should be. It can be one of <code>:quick</code>, <code>:brief</code>, <code>:verbose</code> or <code>:bug-form</code>, in increasing order of verbosity.</p> <p><i>stream</i> An output stream designator.</p> <p><i>printer-bindings</i> A list of conses.</p>
Description	<p>The function <code>output-backtrace</code> prints a backtrace of the current stack.</p> <p>The output goes to the stream designated by <i>stream</i>.</p> <p><i>printer-bindings</i>, if supplied, must be a list of conses, where the car of each cons is a symbol. <i>printer-bindings</i> is ignored if <i>keyword</i> is <code>:quick</code>. Otherwise, around the actual printing it binds each symbol to the value in the cdr of the cons. This is intended to override the bindings that are used in the functions that <code>output-backtrace</code> uses.</p> <p><code>output-backtrace</code> should be used by applications in their exception handling routines to log a backtrace whenever an unexpected situation arises. In general, any application that is not intended to be used by Lisp programmers should have error handlers to deal with unexpected situations, and all these handlers should use <code>output-backtrace</code>.</p>
Notes	The symbols that can be bound are not limited to "printer" symbols, so the name <i>printer-bindings</i> is slightly misleading.
See also	

print-binding-frames		<i>Variable</i>
Summary	Controls whether binding frames are printed in debugger output.	
Package	<code>dbg</code>	
Initial Value	<code>nil</code>	
Description		This variable is used by the debugger when it displays the stack frames. Binding frames are formed when special variables are bound, but are normally not shown by the debugger. However if the value of <code>dbg:*print-binding-frames*</code> is true then the binding frames are shown.

Example

```

CL-USER 16 > (defun print-to-length (object length)
    (let ((*print-length* length))
      (prinnt object)))
PRINT-TO-LENGTH

CL-USER 17 > (setf dbg:*print-binding-frames* t)
T

CL-USER 18 > (print-to-length '(x y z) 2)

Error: Undefined operator PRINNT in form (PRINNT
OBJECT) .
  1 (continue) Try invoking PRINNT again.
  2 Return some values from the form (PRINNT OBJECT) .
  3 Try invoking something other than PRINNT with the
same arguments.
  4 Set the symbol-function of PRINNT to another
function.
  5 Set the macro-function of PRINNT to another
function.
  6 (abort) Return to level 0.
  7 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 19 : 1 > :n print-to-length
Interpreted call to PRINT-TO-LENGTH

CL-USER 20 : 1 > :b :verbose 5
Interpreted call to PRINT-TO-LENGTH:
  OBJECT          : (X Y Z)
  LENGTH          : 2
  *PRINT-LENGTH* : 2

  Block environment contour:
  Tag environment contour:
  Function environment contour
  Variable environment contour: ()

  Tag environment contour:
  Block environment contour:
  Function environment contour
  Variable environment contour: ()

Call to EVAL (offset 184)
  EXP : (PRINT-TO-LENGTH (QUOTE (X Y Z)) 2)

```

```

Binding frame:
SYSTEM:::*TOP-LOOP-ACTIVE* : -1
COMPILER:::*IN-COMPILER-HANDLER* : #<Unbound

Marker>
* : NIL
** : NIL
*** : NIL
- : NIL
+ : NIL
++ : NIL
+++ : NIL
/// : NIL
// : NIL
/
SYSTEM:::*TOP-LOOP-HOOK* : NIL
SYSTEM:::*USER-COMMANDS* : NIL
SYSTEM:::*IN-TOP-LEVEL-READ-A-COMMAND* : NIL

```

CL-USER 21 : 1 >

Notes *print-binding-frames* is an extension to Common Lisp.

print-catch-frames

Variable

Summary	Controls whether catch frames are printed in debugger output.
Package	dbg
Initial Value	t
Description	This variable is used by the debugger when it displays the stack frames. Catch frames are created when the special form <code>catch</code> is used. They are set up so that throws to the matching tag can be received. By default the debugger displays these frames, but if <code>*print-catch-frames*</code> is set to <code>nil</code> then the catch frames are no longer shown.

Examples	<pre> USER 17 > (setq dbg:*print-catch-frames* nil) NIL USER 18 > (defun catch-it () (catch 'tag (throw-it) (print "Not caught"))) CATCH-IT USER 19 > (defun throw-it () (throw 'tag (break))) THROW-IT USER 20 > (catch-it) break 1 (continue) return from break. 2 (abort) return to top loop level 0. Type :c followed by a number to proceed USER 21 : 1 > :b 5 Interpreted call to (DEFUN THROW-IT): Call to *%APPLY-INTERPRETED-FUNCTION : Interpreted call to (DEFUN CATCH-IT): Call to *%APPLY-INTERPRETED-FUNCTION : Call to %EVAL : </pre>
Notes	*print-catch-frames* is an extension to Common Lisp.

print-handler-frames		<i>Variable</i>
Summary	Controls whether handler frames are printed in debugger output.	
Package	dbg	
Initial Value	nil	
Description	This variable is used by the debugger when it displays the stack frames. Handler frames are created by error handlers (see “The stack in the debugger” on page 12), and are normally not shown by the debugger. However if *print-han-	

`*print-handler-frames*` is set to `t` then the handler frames are displayed.

Example

```
USER 162 > (setq lw:*print-handler-frames* t)

T
USER 163 > (defun test (n)
  (handler-case (fn-to-use n)
    (type-error () (format t "~%Type error~%") 0)))

TEST
USER 164 > (test #C(1 1))

Error: Undefined function: FN-TO-USE, with args
  (#C(1 1))

1 (continue) Call FN-TO-USE again
  2 (abort) return to top loop level 0.

Type :c followed by a number to proceed

USER 165 : 1 > :b 10
Catch frame: (NIL)
Catch frame: #:|block-catcher-1854|
Call to *%UNDEFINED-FUNCTION-FUNCTION  :
Call to %EVAL  :
Call to RETURN-FROM  :
Call to %EVAL  :
Call to EVAL-AS-PROGN  :
Handler frame: ((TYPE-ERROR %LEXICAL-CLOSURE%
  (LAMBDA
    (CONDITIONS::TEMP)
    (GO #:|lambda-633|))
  ((#:|lambda-632|) (N . #))
  NIL ((#:|lambda-631|) (TEST)))
  ((#:|lambda-633| # #))))
Catch frame: "<* Catch All Object *>"
Call to LET  :
```

Notes

`*print-handler-frames*` is an extension to Common Lisp.

`*print-open-frames*`

Variable

Summary

Controls whether open frames are printed in debugger output.

Package	<code>dbg</code>
Initial Value	<code>nil</code>
Description	This variable is used by the debugger when it displays the stack frames. Open frames are made by the system and are normally not shown by the debugger. However if <code>*print-open-frames*</code> is set to <code>t</code> then the open frames are displayed. It is unlikely that you need to examine open frames: their use is connected with implementation details.
Examples	<pre>USER 52 > (setq dbg:*print-open-frames* t) T USER 53 > (car 2) Error: Cannot take CAR of 2 1 (abort) return to top loop level 0. Type :c followed by a number to proceed USER 54 : 1 > :b 3 Open frame (5) Open frame (5) Call to CAR-FRAME :</pre>
Notes	<code>*print-open-frames*</code> is an extension to Common Lisp.

print-restart-frames <i>Variable</i>	
Summary	Controls whether restart frames are printed in debugger output.
Package	<code>dbg</code>
Initial Value	<code>nil</code>
Description	This variable is used by the debugger when it displays the stack frames. Restart frames are formed when restarts are established (see “The stack in the debugger” on page 12), but

are normally not shown by the debugger. However if `*print-restart-frames*` is set to `t` then the restart frames are shown.

Example

```
USER 43 > (setq dbg:*print-restart-frames* t)
T
USER 44 > (truncate 12.5 0.0)

Error: Division-by-zero caused by TRUNCATE
      of (12.5 0.0)
1 (continue) Return a value to use
2 Supply new arguments to use
3 (abort) return to top loop level 0.

Type :c followed by a number to proceed

USER 45 : 1 > :b 5
Restart frame: (ABORT)
Catch frame: (NIL)
Catch frame: #:|block-catcher-3223|
Call to DIVISION-BY-ZERO-ERROR  :
Call to TRUNCATEANY  :
USER 46 : 1 >
```

Notes `*print-restart-frames*` is an extension to Common Lisp.

terminal-debugger-block-multiprocessing		<i>Variable</i>
Summary	Controls blocking of multiprocessing in the terminal debugger.	
Package	<code>dbg</code>	
Initial Value	<code>t</code>	
Description	When the debugger is entered on the terminal, multiprocessing is blocked if the value of <code>*terminal-debugger-block-multiprocessing*</code> is <code>t</code> . This is the default value.	

If you set this variable to `nil` then other processes, including timers, will continue to run in parallel to the process that entered the terminal debugger (as they did before the debugger was entered). Beware that this will make it more difficult to debug multiprocess activities.

The other allowed value is `:maybe`. This means that multiprocessing is blocked in the terminal debugger unless the debugger was entered from the CAPI environment.

The value of `*terminal-debugger-block-multiprocessing*` affects the behavior of a REPL started by `start-tty-listener`.

Example

This listener session illustrates the effect of `*terminal-debugger-block-multiprocessing*`.

Firstly we see the default behavior whereby a call to `print` in another process is blocked by the debugger.

```
CL-USER 1 > dbg:*terminal-debugger-block-
multiprocessing*
T

CL-USER 2 > unbound

Error: The variable UNBOUND is unbound.
 1 (continue) Try evaluating UNBOUND again.
 2 Specify a value to use this time instead of
evaluating UNBOUND.
 3 Specify a value to set UNBOUND to.
 4 (abort) Return to level 0.
 5 Return to top-level loop.
 6 Return from multiprocessing.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 3 : 1 > (setq *timer* (mp:make-timer 'print
10))
Warning: Setting unbound variable *TIMER*
#<Time Event : PRINT>

CL-USER 4 : 1 > (mp:schedule-timer-relative *timer* 1)
#<Time Event : PRINT>

CL-USER 5 : 1 > :a
```

On leaving the debugger the output 10 from the call to print appears. Then we set *terminal-debugger-block-multiprocessing* to nil and repeat the commands:

```

CL-USER 6 >
10
(setf dbg:*terminal-debugger-block-multiprocessing*
nil)
NIL

CL-USER 7 > unbound

Error: The variable UNBOUND is unbound.
1 (continue) Try evaluating UNBOUND again.
2 Specify a value to use this time instead of
evaluating UNBOUND.
3 Specify a value to set UNBOUND to.
4 (abort) Return to level 0.
5 Return to top-level loop.
6 Return from multiprocessing.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 8 : 1 > (setq *timer* (mp:make-timer 'print
10))
#<Time Event : PRINT>

CL-USER 9 : 1 > (mp:schedule-timer-relative *timer* 1)
#<Time Event : PRINT>

CL-USER 10 : 1 >
10

```

Notice above that the output 10 from the call to `print` appears after 1 second, in the debugger. Multiprocessing was not blocked.

See also `start-tty-listener`

with-debugger-wrapper

Macro

Summary Executes code with a "debugger wrapper" which is called only if the debugger is invoked during the execution.

Package `dbg`

Signature	<code>with-debugger-wrapper <i>wrapper</i> &<i>body</i> <i>body</i> => <i>results</i></code>	
Arguments	<i>wrapper</i>	A function designator.
	<i>body</i>	Forms.
Values	<i>results</i>	Results of <i>body</i> .
Description	<p>The macro <code>with-debugger-wrapper</code> executes forms in <i>body</i> with the function <i>wrapper</i> bound as a "debugger wrapper". This debugger wrapper takes effect only if the code in <i>body</i> tries to invoke the debugger (by a call to <code>invoke-debugger</code>), typically indirectly as a result of an error. Instead of entering the debugger, the debugger wrapper is called with two arguments: a function to call to enter the debugger, and the condition. The wrapper can do whatever is needed. If it wants to enter the debugger, it does it by calling its first argument with the second argument:</p> <pre>(funcall function condition)</pre>	
Example	<p>Suppose that you run many processes in parallel with the same code. If the code is broken then every process will get an error. This example shows how a debugger wrapper can be used to keep a lock around entry to the debugger, so that the processes enter the debugger one by one. It contains firstly the "application code", then the debugger wrapper, and lastly forms which execute the application with or without the debugger wrapper.</p>	

```

;::::::::::::::::::; application code ;::::::::::;
;::::::::::::::::::; (in-package "CL-USER")

(defglobal-parameter *a* 0)

(defun foo (index cons)
  (sys:atomic-push (* index *a*) (cdr cons)))

;; This gets the process function so we can pass
;; the wrapper function instead.
(defun my-run-processes (do-error &optional (process-
function 'foo))
  (setq *a* (if do-error :do-error 7))
  (let ((cons (cons nil nil)))
    (dotimes (x 10)
      (mp:process-run-function
        (format nil "My test process ~d" x)
        ()
        process-function
        x cons))
    (sleep 0.2)
    (print (cdr cons)))))

;::::::::::::::::::; debugger wrapper ;::::::::::;
;::::::::::::::::::; (defglobal-parameter *my-debugger-lock*
;                   (mp:make-lock :name "Debugger Lock"))

(defun my-debugger-wrapper (func condition)
  (mp:with-lock (*my-debugger-lock*)
    (funcall func condition)))

(defun foo-wrapper (index cons)
  (dbg:with-debugger-wrapper 'my-debugger-wrapper
    (foo index cons)))

;; Running the application without the wrapper fills
;; your screen with notifiers
(my-run-processes t)

;; Running with the wrapper raises the notifiers one by
;; one. You can use the Process Browser kill them all.
(my-run-processes t 'foo-wrapper)

```


30

The DSPEC Package

This chapter describes symbols available in the `DSPEC` package.

The `dspec` system is discussed in detail in Chapter 7, “Dspecs: Tools for Handling Definitions”.

active-finders		<i>Variable</i>
Summary	Controls how source finding operates.	
Package	<code>dspec</code>	
Initial Value	<code>(:internal)</code>	
Description	The <code>*active-finders*</code> variable controls how the functions <code>find-name-locations</code> and <code>find-dspec-locations</code> operate. This in turn controls source the finding commands in the LispWorks IDE. You can switch between different sources of location information by setting this variable.	
	The legal values for the elements of <code>*active-finders*</code> are:	

<code>:internal</code>	The internal database of definitions performed in this image.
<code>:tags</code>	Prompt for a tags file, when first used.
<code>pathname</code>	Either a tags file or a tags database. A tags database is a fasl file generated by <code>save-tags-database</code> .
	The order of this list determines the order that the results from the finders are combined in — you would usually want <code>:internal</code> to be the first item on this list, as it contains the up-to-date information about the state of the image. More than one pathname is allowed.

See also `discard-source-info`
 `find-dspec-locations`
 `find-name-locations`
 `save-tags-database`

	<i>Macro</i>				
Summary	Tells the dspec system of the source location.				
Package	<code>dspec</code>				
Signature	<code>at-location (location) &body body => result</code>				
Arguments	<table> <tr> <td><code>location</code></td><td>A pathname or a keyword.</td></tr> <tr> <td><code>body</code></td><td>Forms, including defining forms.</td></tr> </table>	<code>location</code>	A pathname or a keyword.	<code>body</code>	Forms, including defining forms.
<code>location</code>	A pathname or a keyword.				
<code>body</code>	Forms, including defining forms.				
Values	<code>result</code> The result of <code>body</code> .				
Description	The macro <code>at-location</code> informs the dspec system that the source for definitions done during the execution of <code>body</code> are at the location <code>location</code> .				

location is usually a pathname, for definitions occurring in a file or editor buffer with that pathname.

Other locations are reserved for internal use. These are:

An editor buffer Defined in an editor buffer with no pathname.

`:listener` Interactively defined.

`:unknown` Defined without dspec information being recorded.

`:implicit` An aggregate defined by the existence of a part.

`(:inside dspec loc)`

A subform of *dspec* at location *loc*.

canonicalize-dspec

Function

Summary Returns the canonical form for a dspec.

Package `dspec`

Signature `canonicalize-dspec dspec => canonical-dspec`

Arguments `dspec` A dspec.

Values `canonical-dspec` A canonical dspec.

Description The function `canonicalize-dspec` checks that *dspec* is syntactically correct and returns its canonical form if *dspec* is valid. Otherwise `canonicalize-dspec` returns `nil`.

`canonicalize-dspec` expands dspec aliases

Example	<pre>CL-USER 12 > (dspec:canonicalize-dspec 'foo) (FUNCTION FOO) CL-USER 13 > (dspec:canonicalize-dspec '(defmethod bar (list t))) (METHOD BAR (LIST T))</pre>
See also	define-dspec-alias

def *Macro*

Summary	Informs the system of a name for a definition.				
Package	dspec				
Signature	def dspec &body body => result				
Arguments	<table border="0"> <tr> <td style="vertical-align: top;"><i>dspec</i></td> <td>A dspec.</td> </tr> <tr> <td style="vertical-align: top;"><i>body</i></td> <td>Lisp forms, evaluated as an implicit <code>progn</code>.</td> </tr> </table>	<i>dspec</i>	A dspec.	<i>body</i>	Lisp forms, evaluated as an implicit <code>progn</code> .
<i>dspec</i>	A dspec.				
<i>body</i>	Lisp forms, evaluated as an implicit <code>progn</code> .				
Values	<i>result</i> The result of <i>body</i> .				
Description	<p>The macro <code>def</code> informs the system that any definitions within <i>body</i> should be recorded as being within the dspec <i>dspec</i>. This means that when something attempts to locate such a definition, it should look for a definition named <i>dspec</i>.</p> <p>Use <code>def</code> to wrap a group of definitions so that source location for one of the group causes the LispWorks Editor to look for the dspec in the <code>def</code> instead. Typically you will also need a <code>define-form-parser</code> definition for the macro that expands into the <code>def</code>.</p> <p><i>dspec</i> can be non-canonical.</p> <p>You can also use <code>def</code> to provide a dspec for a definition that has its own class that has been defined with <code>define-dspec-</code></p>				

`class`. In this case, you arrange to call `record-definition` with the same dspec as in the example below.

It is also possible to mix these cases, recording a dspec and also grouping inner definitions. For example `defstruct` does this, recording itself and also grouping definitions such as the constructor function.

In all cases, to make source location work in the LispWorks editor you typically also need a `define-form-parser` definition for the macro that expands into the `def`.

Example

```
(defmacro define-wibble (x y)
  `(~(dspec:def (define-wibble ,x)
    (set-wibble-definition ',x ',y (dspec:location)))))

(defun set-wibble-definition (x y loc)
  (when (record-definition `(define-wibble ,x) loc)
    ;; defining code here
    ))
```

See also

`location`

define-dspec-alias

Macro

Summary

Informs the dspec system that a definer expands into another definer.

Package

`dspec`

Signature

`define-dspec-alias name lambda-list &body body`

Arguments

name A symbol naming a definer.

lambda-list A list representing the parameters of a *name* dspec.

body Forms evaluated to yield a dspec.

Description	<p>The macro <code>define-dspec-alias</code> works rather like <code>deftype</code>. Dspecs whose <code>car</code> is <i>name</i> should have parameters that match <i>lambda-list</i>. They will be canonicalized into the dspec returned by <i>body</i>.</p> <p><code>define-dspec-alias</code> is useful when you add a new way of making existing definitions with a new defining form that expands into a system-provided defining form. The dspec system should consider the new and system-provided definers as variant forms of the same dspec class. <code>define-dspec-alias</code> is used to convert one of them to the other during canonicalization by <code>canonicalize-dspec</code>.</p>
Example	<code>defparameter</code> is pre-defined as an alias for <code>defvar</code> .
See also	<code>canonicalize-dspec</code>

define-dspec-class		<i>Macro</i>										
Summary	Defines a dspec class.											
Package	<code>dspec</code>											
Signature	<code>define-dspec-class name superspace documentation &key pretty-name undefiner canonicalize prettify definedp object-dspec defined-parts aggregate-class</code>											
Arguments	<table> <tr> <td><i>name</i></td><td>A symbol naming the dspec class</td></tr> <tr> <td><i>superspace</i></td><td>A symbol naming the superspace</td></tr> <tr> <td><i>documentation</i></td><td>A string describing the dspec class</td></tr> <tr> <td><i>undefiner</i></td><td>A function that generates the undefining form for the class</td></tr> <tr> <td><i>canonicalize</i></td><td>A function to canonicalize a dspec if it belongs to the class</td></tr> </table>		<i>name</i>	A symbol naming the dspec class	<i>superspace</i>	A symbol naming the superspace	<i>documentation</i>	A string describing the dspec class	<i>undefiner</i>	A function that generates the undefining form for the class	<i>canonicalize</i>	A function to canonicalize a dspec if it belongs to the class
<i>name</i>	A symbol naming the dspec class											
<i>superspace</i>	A symbol naming the superspace											
<i>documentation</i>	A string describing the dspec class											
<i>undefiner</i>	A function that generates the undefining form for the class											
<i>canonicalize</i>	A function to canonicalize a dspec if it belongs to the class											

<i>prettyf</i>	A function to return a prettier form of a dspec of the class
<i>definedp</i>	A function to decide if a dspec of the class currently has a definition
<i>object-dspec</i>	A function to return the dspec from an object if it was defined by the class
<i>defined-parts</i>	A function to return all the currently defined parts in the class for a given a primary-name
<i>aggregate-class</i>	The aggregate dspec class for a part dspec
Description	<p>The macro <code>define-dspec-class</code> defines a dspec class, providing handlers for definitions in that dspec class.</p> <p><code>define-dspec-class</code> defines <i>name</i> as a dspec class, inheriting from the dspec class <i>superspace</i>. <i>superspace</i> should be <code>nil</code> to define a new top-level dspec class.</p> <p><i>documentation</i> should be a string documenting the dspec class. For example "<code>My Objects</code>".</p> <p>After evaluating a <code>define-dspec-class</code> form, <i>name</i> can be used by defining forms to record locations of definitions of that dspec class name by calling <code>record-definition</code>.</p> <p>All of the remaining arguments described below can be omitted if not needed. The most important arguments for the LispWorks IDE are <i>definedp</i> and <i>undefiner</i>.</p> <p>If <i>undefiner</i> is given, its value must be a function of one argument. When LispWorks wants to remove a definition, it will call the function with a canonical dspec of class <i>name</i>. The function should returns a form that removes the current definition of that dspec. For example, the undefining form for package dspecs might be <code>delete-package</code>. If <i>undefiner</i> is omitted, then definitions of this class cannot be undefined.</p> <p>If <i>canonicalize</i> is given, its value must be a function of one argument. The function will be called by <code>canonicalize-dspec</code> for a dspec of the given class. The value returned by</p>

the canonicalize function must be a fully canonical dspec of the given class. A typical use for the canonicalize function would be to remove extra options from the dspec which are not required to make the dspec unique. The canonicalize function should return `nil` for malformed dspecs and should take care not to signal an error. The default canonicalize function returns the dspec if it matches the form

`(dspec-class symbol)`

If `prettify` is given, its value must be a function of one argument. When LispWorks wants to print a dspec, for example in an error message, it will call the prettify function for the class of the dspec. The argument will be the canonical dspec and the function should return a dspec which is considered "prettier" for a user to see. The default prettify function returns the dspec unchanged.

If `definedp` is given, its value must be function of one argument. When LispWorks wants to discover if a given dspec is defined, it calls the function with the `dspec-primary-name` of the dspec. The `definedp` function should return true if the primary name is defined in this dspec class and `nil` otherwise. The default `definedp` function always returns `nil`.

If `object-dspec` is given, its value must be a function of one argument. When LispWorks wants to find the dspec that created a given object (for example a package object created by a `defpackage` form), it calls the `object-dspec` functions in all dspec classes. The function should return a dspec for the object if that object was defined by the dspec class or `nil` otherwise. For example, the `object-dspec` function for package dspecs might be:

```
#'(lambda (obj)
  (and (packagep obj)
    ` (package , (package-name obj))))
```

The `object-dspec` function is used by the "Find Source" menu option in the Inspector in the LispWorks IDE to find where the current object was defined.

If *defined-parts* is given, its value must be a function of one argument. When LispWorks wants to find all the definitions that are parts of a given aggregate dspec class, it calls the *defined-parts* functions with the `dspec-primary-name` of the dspec in each class that aggregates with it. The function should return a list of dspecs which are defined parts of the primary name in the class *name*. If this keyword is given, *aggregate-class* must also be given.

If *aggregate-class* is given, its value must be a symbol naming a dspec class that is the aggregate class of the parts defined by *name* dspecs. For example, the aggregate class of `method` is `defgeneric` because methods are the defined parts of a particular generic function. If this keyword is given, the *defined-parts* must also be given.

To make `c1:documentation` work for your dspec class, add a suitable method as described for `documentation`.

Example See “Dspec classes” on page 63.

See also `canonicalize-dspec`
`def`
`dspec-primary-name`
`record-definition`

define-form-parser *Macro*

Summary Establishes a parser for top level forms with the given definier.

Package `dspec`

Signature `define-form-parser definer-and-options &optional parameters &body body => parser`

Arguments *definer-and-options*

		A symbol <i>definer</i> naming a definer of functions, macros, variables and so on, or a list (<i>definer options</i>) where <i>options</i> is a plist of keys and values.
	<i>parameters</i>	<i>nil</i> , or list of parameters <i>params</i> in the top level form, optionally ending with &rest param-getter .
	<i>body</i>	The body of a parser function.
Values	<i>parser</i>	A form parser function.
Description		<p>The macro define-form-parser defines a form parser for forms beginning with <i>definer</i>. <i>options</i> is a property list with the following keys allowed:</p> <ul style="list-style-type: none"> :parser A parser function <i>parser-function</i>. :alias A dspec class or alias <i>alias</i>. :anonymous A boolean. <p>The parser function defined is named by <i>parser-function</i>. If the :parser option is omitted then the name defaults to a symbol in the current package whose symbol name is the symbol name of <i>definer</i> with "-FORM-PARSER" appended.</p> <p>If <i>parameters</i> and <i>body</i> are given, then <i>parser-function</i> is defined as a global function that is expected to return a dspec for the defining form or nil if this is not possible. Within <i>body</i>, <i>definer</i> is bound to the car of the actual form being parsed. In simple cases, this is just <i>definer</i>, but if the form parser is used as in the :alias option of another form parser then the symbol will be bound to the car of that form instead.</p> <p>The <i>params</i> are bound to subsequent subforms of the defining form. If &rest param-getter is supplied, then it is bound to a function of no arguments that returns two values: the next subform if there is one and a boolean to indicate if a subform was found.</p>

If *parameters* and *body* are omitted, then *parser-function* is expected to be a form parser defined by a different `define-form-parser` form, or you can specify as an alias a definer with an existing form parser via the value *alias* of the `:alias` key in *options*.

If the `:anonymous` option is non-nil then *definer* is not associated with the form parser. This is useful in conjunction with *parameters* and *body* for defining generic form parsers that can be used in other `define-form-parser` forms.

LispWorks contains pre-defined form parser functions for the Common Lisp definers `defun`, `defmethod`, `defgeneric`, `defvar`, `defparameter`, `defconstant`, `defstruct`, `defclass`, `defmacro` and `deftype` and for LispWorks definers such as `fli:define-foreign-type` and `dspec:define-form-parser` itself.

When a defining symbol *definer* has an associated form parser, this parser function is used by the source location commands such as **Expression > Find Source** in the LispWorks IDE. Having identified the file where the definition was recorded, LispWorks parses the top level forms in the file looking for the one which matches the definition spec. When found, this match is displayed.

Example

Define a parser for `def-foo` forms which have a single name as the second element in the form:

```
(dspec:define-form-parser def-foo (name)
  `(&,def-foo ,name))
```

Define a parser for `def-other-foo` forms which are like `def-foo` forms:

```
(dspec:define-form-parser
  (def-other-foo (:parser def-foo-form-parser)))
```

Define a parser for `def-bar` forms whose name is made from the second element of the form and any subsequent keywords:

```
(dspec:define-form-parser def-bar (name &rest details)
  `,(def-bar ,(name
    `,@(loop for detail = (funcall details)
      while (keywordp detail)
      collect detail))))
```

Define a parser for forms which have another name as the second element in the form:

```
(dspec:define-form-parser (two-names
  (:anonymous t)) (name1 name2)
  `,(two-names ,name1 ,name2))
```

Define a new way to define CLOS methods, and tell the dspec system to treat them the same. Note the use of `define-dspec-alias` to inform the dspec system that `my-defmethod` is another way of naming `defmethod` dspecs:

```
(defmacro my-defmethod (name args &body body)
  `,(defmethod ,name ,args
    ,@body))

(dspsc:define-dspec-alias my-defmethod
  (name &rest args)
  `,(defmethod ,name ,@args))

(my-defmethod foo ((x number))
  42)

(dspsc:define-form-parser
  (my-defmethod
    (:parser
      #.(dspsc:get-form-parser 'defmethod))))
```

A simpler way to write the last form is:

```
(dspsc:define-form-parser
  (my-defmethod
    (:alias defmethod)))
```

See also

`get-form-parser`
`parse-form-dspec`

dspec-class	<i>Function</i>
Summary	Returns the dspec class of a dspec.
Package	<code>dspec</code>
Signature	<code>dspec-class dspec => class</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>class</code> A dspec class name.
Description	The function <code>dspec-class</code> returns the dspec class name for <i>dspec</i> .
Example	<pre>CL-USER 14 > dspec:dspec-class 'foo FUNCTION CL-USER 15 > dspec:dspec-class '(defmacro foo) DEFMACRO CL-USER 16 > dspec:dspec-class '(defmethod foo) DEFMETHOD</pre>
See also	<code>dspec-name</code>

dspec-classes	<i>Variable</i>
Summary	Lists all the dspec classes.
Package	<code>dspec</code>
Signature	<code>*dspec-classes*</code>
Description	The variable <code>*dspec-classes*</code> contains a list of the names of all the dspec classes.

dspec-defined-p	<i>Function</i>
Summary	The predicate for whether a dspec has a definition.
Package	<code>dspec</code>
Signature	<code>dspec-defined-p dspec => definedp</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>definedp</code> The canonical form of <i>dspec</i> if <i>dspec</i> is defined, or <code>nil</code> otherwise.
Description	<p>The function <code>dspec-defined-p</code> determines whether the dspec <i>dspec</i> has a definition. If so, it returns the canonical form of <i>dspec</i>.</p> <p>If <i>dspec</i> has no definitions, <code>dspec-defined-p</code> returns <code>nil</code>.</p>
Example	<code>CL-USER 23 > (dspec:dspec-defined-p '(function list))</code> <code>(DEFUN LIST)</code>

dspec-definition-locations	<i>Function</i>
Summary	Returns the locations of the known definitions.
Package	<code>dspec</code>
Signature	<code>dspec-definition-locations dspec => locations</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>locations</code> A list of pairs (<i>recorded-dspec location</i>).
Description	The function <code>dspec-definition-locations</code> returns the locations of the definitions recorded for the dspec <i>dspec</i> .

For each known definition *recorded-dspec* names the definition that defined *dspec* in *location*, and *location* is a pathname or keyword as described in [at-location](#).

Note that non-file locations, such as `:unknown`, can occur in the list. The locations in *locations* are all basic locations: that is, there are no `(:inside ...)` locations.

If *dspec* is a local dspec, the parent function is located.

Example `CL-USER 6 > (dspec:dspec-definition-locations
 '(defun foo-bar))
 (((DEFSTRUCT FOO) #P"C:/temp/hack.lisp"))`

See also [name-definition-locations](#)

dspec-equal *Function*

Summary Tests two dspecs for equality as dspecs.

Package `dspec`

Signature `dspec-equal dspec1 dspec2 -> result`

Arguments *dspec1, dspec2* Dspecs.

Values *result* A boolean.

Description The function `dspec-equal` compares *dspec1* and *dspec2* for equality as dspecs.

Both arguments are canonicalized before the comparison.

Dspecs in different subclasses of the same namespace are `dspec-equal` if their names match.

Unknown dspecs are compared simply by `equal`.

Example CL-USER 44 > (dspec:dspec-equal '(deftype foo)
 '(defclass foo))
 T

dspec-name *Function*

Summary	Extracts the name from a canonical dspec.	
Package	dspec	
Signature	dspec-name <i>dspec</i> => <i>name</i>	
Arguments	<i>dspec</i>	A canonical dspec.
Values	<i>name</i>	A dspec name.
Description	<p>The function dspec-name extracts the name from the canonical dspec <i>dspec</i>.</p> <p>Note that for part classes this is a list starting with the primary name.</p> <p>If <i>dspec</i> is not canonicalized, dspec-name signals an error.</p>	
See also	dspec-class	

dspec-primary-name *Function*

Summary	Extracts the primary name from a canonical dspec.	
Package	dspec	
Signature	dspec-primary-name <i>dspec</i> => <i>name</i>	
Arguments	<i>dspec</i>	A canonical dspec.
Values	<i>name</i>	A dspec name.

Description	The function <code>dspec-primary-name</code> extracts the primary name from the canonical dspec <i>dspec</i> . Note that for part classes this is the name of the aggregate definition, for example for methods it returns the name of the generic function.
See also	<code>dspec-class</code>

dspec-progenitor *Function*

Summary	Returns the ultimate parent of a <code>subfunction</code> dspec.	
Signature	<code>dspec-progenitor dspec => result</code>	
Package	<code>dspec</code>	
Arguments	<i>dspec</i>	A dspec.
Values	<i>result</i>	A dspec.
Description	The function <code>dspec-progenitor</code> returns a dspec <i>result</i> which is the ultimate parent of a <code>subfunction</code> dspec argument <i>dspec</i> . If the argument <i>dspec</i> is not a local dspec, it is simply returned. Note that <i>result</i> is not necessarily a canonical dspec.	
Example	<pre>(dspec-progenitor '(subfunction 1 (subfunction (flet a) (defun foo)))) => (defun foo)</pre>	
See also	<code>local-dspec-p</code>	

dspec-subclass-p	<i>Function</i>
Summary	Tests whether one dspec class is a subclass of another.
Package	dspec
Signature	dspec-subclass-p <i>class1 class2</i> => <i>result</i>
Arguments	<i>class1, class2</i> Symbols naming dspec classes.
Values	<i>result</i> A boolean.
Description	The function dspec-subclass-p determines whether the dspec class denoted by <i>class1</i> is a subclass of that denoted by <i>class2</i> .
Example	<pre>CL-USER 55 > (dspec:dspec-subclass-p 'defmacro 'type) NIL CL-USER 56 > (dspec:dspec-subclass-p 'defmacro 'function) T</pre>

dspec-undefiner	<i>Function</i>
Summary	Returns an undefining expression for a dspec.
Package	dspec
Signature	dspec-undefiner <i>dspec</i> => <i>form</i>
Arguments	<i>dspec</i> A dspec.
Values	<i>form</i> A Lisp form.
Description	The function dspec-undefiner returns a form which would undefine dspec, whether or not <i>dspec</i> is currently defined.

If no such form can be constructed, `nil` is returned.

Example	<pre>CL-USER 66 > (dspec:dspec-undefiner '(defun foo)) (PROGN (FMAKUNBOUND (QUOTE FOO)) (SETF (DOCUMENTATION (QUOTE FOO) (QUOTE FUNCTION)) NIL))</pre>
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discard-source-info

Function

Summary	Clears the internal dspec database.
Package	<code>dspec</code>
Signature	<code>discard-source-info => nil</code>
Arguments	None.
Values	Returns <code>nil</code> .
Description	The function <code>discard-source-info</code> removes all source location information from the internal dspec database.
Example	To build <code>my-image</code> which does not contain source locations for the definitions loaded, but retaining a tags database of those definitions: <pre>(load-all-patches) (load "my-code") (dsdp:save-tags-database #P"my-tags-database.ofas1") (dsdp:discard-source-info) (save-image "my-image")</pre>
See also	<code>save-tags-database</code>

find-dspec-locations

Function

Summary	Returns the locations of the definitions of a dspec.
---------	--

Package	<code>dspec</code>
Signature	<code>find-dspec-locations dspec => locations</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>locations</code> A list of pairs (<i>recorded-dspec location</i>).
Description	<p>The function <code>find-dspec-locations</code> returns the locations of the relevant definitions for the dspec <i>dspec</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>dspec</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <code>at-location</code>.</p> <p>If <i>dspec</i> is a local dspec, the parent function is located.</p> <p>The location information is collected from all finders on <code>*active-finders*</code>, that is, the relevant definitions are those known to at least one of these finders.</p> <p>If two or more finders return the same pair (<i>recorded-dspec location</i>), as compared by <code>dspec-equal</code> and location equality, then only the first occurrence of the pair (in the order of <code>*active-finders*</code>) appears in <i>locations</i>.</p>
See also	<code>*active-finders*</code> <code>dspec-definition-locations</code> <code>dspec-equal</code>

	Function
Summary	Returns the locations of the definitions of a name.
Package	<code>dspec</code>
Signature	<code>find-name-locations classes name => locations</code>

Arguments	<i>classes</i>	A list of dspec class names.
	<i>name</i>	A name.
Values	<i>locations</i>	A list of pairs (<i>recorded-dspec location</i>).
Description		<p>The function <code>find-name-locations</code> returns the locations of the relevant definitions for <i>name</i> in the classes listed in <i>classes</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>name</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <code>at-location</code>.</p> <p>The location information is collected from all finders on <code>*active-finders*</code>, that is, the relevant definitions are those known to at least one of these finders.</p> <p>If two or more finders return the same pair (<i>recorded-dspec location</i>), as compared by <code>dspec-equal</code> and location equality, then only the first occurrence of the pair (in the order of <code>*active-finders*</code>) appears in <i>locations</i>.</p>
See also		<code>*active-finders*</code> <code>name-definition-locations</code> <code>dspec-equal</code>

get-form-parser		<i>Function</i>
Summary		Returns the form parser associated with a definer.
Package		<code>dspec</code>
Signature		<code>get-form-parser definer => parser</code>
Arguments	<i>definer</i>	A symbol naming a definer.
Values	<i>parser</i>	A form parser function, or <code>nil</code> .

Description	<p>The function <code>get-form-parser</code> returns a form parser function if there is one associated with <code>definer</code>.</p> <p>This is the case for predefined definers and for those for which you have established a form parser using <code>define-form-parser</code>.</p> <p>If there is no associated form parser, <code>nil</code> is returned.</p>
Example	<pre>CL-USER 1 > dspec:get-form-parser 'defun DSPEC:NAME-ONLY-FORM-PARSER</pre>
See also	<code>define-form-parser</code> <code>parse-form-dspec</code>

	<i>Function</i>
Summary	The predicate for local dspecs.
Package	<code>dspec</code>
Signature	<code>local-dspec-p dspec => localp</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>localp</code> A boolean.
Description	<p>The function <code>local-dspec-p</code> determines whether the dspec <code>dspec</code> is a local dspec.</p> <p>Local dspecs name local definitions, such as local functions.</p> <p>Currently a local dspec is a list whose <code>car</code> is <code>subfunction</code>.</p>
See also	<code>dspec-progenitor</code>

location	<i>Macro</i>
Summary	Returns the source location.
Package	<code>dspec</code>
Signature	<code>location => location</code>
Values	<code>location</code> A pathname or a keyword.
Description	The macro <code>location</code> returns a location suitable for passing to <code>record-definition</code> . This is usually done via a separate defining function. You will need to use <code>location</code> only if you create your own ways of making definitions (and not if your definers call only system-provided definers).
Example	<pre>(defmacro define-wibble (x y) `(~(dspec:def (define-wibble ,x) (set-wibble-definition ',x ',y (dspec:location))))) (defun set-wibble-definition (x y loc) (when (record-definition `(~(define-wibble ,x) loc) ;; defining code here)))</pre>
See also	<code>at-location</code> <code>def</code>

name-defined-dspecs	<i>Function</i>
Summary	Returns defined dspecs matching a name.
Package	<code>dspec</code>
Signature	<code>name-defined-dspecs classes name => dspecs</code>
Arguments	<code>classes</code> A list of dspec class names.

	<i>name</i>	A name.
Values	<i>dspecs</i>	A list of canonical dspecs.
Description		The function <code>name-defined-dspecs</code> looks in each of the dspec classes <i>classes</i> for definitions of <i>name</i> . For each definition found (as if by <code>dspec-defined-p</code>), the result <i>dspecs</i> contains the canonical dspec.
See also		<code>dspec-defined-p</code>

name-definition-locations *Function*

Summary	Returns the locations of the known definitions.	
Package	<code>dspec</code>	
Signature	<code>name-definition-locations classes name => locations</code>	
Arguments	<i>classes</i>	A list of dspec class names.
	<i>name</i>	A name.
Values	<i>locations</i>	A list of pairs (<i>recorded-dspec location</i>).
Description	The function <code>name-definition-locations</code> returns the locations of the definitions recorded for the name <i>name</i> in any of the dspec classes in <i>classes</i> . For each known definition <i>recorded-dspec</i> names the definition that defined <i>name</i> in <i>location</i> , and <i>location</i> is a pathname or keyword as described in <code>at-location</code> .	
Notes	<code>name-definition-locations</code> does not use <code>*active-finders*</code> .	

Example CL-USER 7 > (dspec:name-definition-locations
 '(function) 'foo-bar)
 (((DEFSTRUCT FOO) #P"C:/temp/hack.lisp"))

See also [dspec-definition-locations](#)

name-only-form-parser *Function*

Summary A pre-defined form parser.

Package `dspec`

Signature `name-only-form-parser top-level-form getter => dspec`

Arguments `top-level-form` A top level defining form.

`getter` The subform getter function.

Values `dspec` A dspec.

Description The function `name-only-form-parser` is a predefined form parser for use with `define-form-parser`. The parser consumes one subform and returns it.

`name-only-form-parser` can be used for function definitions where the function name is an abbreviation for the full dspec. It is the predefined parser for `defun`, `defmacro` and `defgeneric` forms.

You can define it to be the parser for your defining forms. using `define-form-parser`.

Example (defmacro my-definer (name &body body)
 ` (defun ,name (x)
 ,@body))

(dspec:define-form-parser
 (my-definer (:parser
 dspec:name-only-form-parser)))

See also [define-form-parser](#)

parse-form-dspec *Function*

Summary Parses the dspec from a defining form.

Package [dspec](#)

Signature `parse-form-dspec form => result`

Arguments *form* A form.

Values *result* A dspec or `nil`.

Description The function `parse-form-dspec` invokes the defined form parser for *form* and returns the resulting dspec.

Example

```
(parse-form-dspec '(def-foo my-foo (arg) (foo-it arg))
=>
(def-foo my-foo))
```

See also [define-form-parser](#)
[get-form-parser](#)

record-definition *Function*

Summary Checks for existing definitions and records a new definition.

Package [dspec](#)

Signature `record-definition dspec location &key check-redefinition-p => result`

Arguments *dspec* A dspec.

location A pathname or keyword.

check-redefinition-p

A boolean.

Values	<i>result</i>	A generalised boolean.
Description	<p>The function <code>record-definition</code> tells the system that <i>dspec</i> is defined at <i>location</i>.</p> <p>The system-provided definer macros call the function <code>record-definition</code> with the current location.</p> <p><i>location</i> should be a pathname or keyword as returned by <code>location</code>.</p> <p>When <i>check-redefinition-p</i> is true, it checks for existing definitions and reports these according to the value of <code>*redefinition-action*</code>. The default value of <i>check-redefinition-p</i> is <code>t</code>.</p> <p>If the definition is made, then <i>result</i> is true. If the definition is not made then <i>result</i> is <code>nil</code>. This can happen if you choose the "Don't redefine ..." restart at a redefinition error.</p> <p>Note: You should not usually call <code>record-definition</code>, since all the system-provided definers call it. However, for new classes of definition which you add with <code>define-dspec-class</code>, you should call <code>record-definition</code> for <i>dspecs</i> in their new classes.</p>	
Compatibility note	<p><code>record-definition</code> was documented in the <code>lispworks</code> package in LispWorks 4.3 and earlier. Although it is currently still available there, this may change in future releases and you should now reference it via the <code>dspec</code> package.</p>	
See also	<code>define-dspec-class</code> <code>*redefinition-action*</code> <code>location</code>	

record-source-files *Variable*

Summary	Controls whether the locations of definitions are recorded.
Package	<code>dspec</code>
Initial value	<code>t</code>
Description	The variable <code>*record-source-files*</code> controls whether locations of definitions are recorded in the internal tags database.
Compatibility note	<code>*record-source-files*</code> was documented in the <code>lispworks</code> package in LispWorks 4.3 and earlier. Although it is currently still available there, this may change in future releases and you should now reference it via the <code>dspec</code> package.
See also	<code>*active-finders*</code>

redefinition-action *Variable*

Summary	Specifies the action on some redefinitions.
Package	<code>dspec</code>
Initial value	<code>:warn</code>
Description	<code>*redefinition-action*</code> controls messages about redefinitions seen by the source location system. If <code>*redefinition-action*</code> is set to <code>:warn</code> then you are warned. If it is set to <code>:quiet</code> or <code>nil</code> , the redefinition is done quietly. If, however, it is set to <code>:error</code> , then LispWorks signals an error. These messages are triggered by defining forms provided, but they could also be from any call to <code>record-definition</code> .

Notes	<code>*redefinition-action*</code> does not affect the behavior of <code>cl:defstruct</code> .
Compatibility note	<code>*redefinition-action*</code> is documented in the <code>lispworks</code> package in LispWorks 4.3 and earlier. It is still currently still available there but this may change in future releases and you should now reference it via the <code>dspec</code> package.
See also	<code>*handle-warn-on-redefinition*</code> <code>record-definition</code>

save-tags-database *Function*

Summary	Saves the current internal dspec database to a given file.	
Package	<code>dspec</code>	
Signature	<code>save-tags-database pathname => pathname</code>	
Arguments	<code>pathname</code>	A filename.
Values	<code>pathname</code>	The filename that was supplied.
Description	The <code>save-tags-database</code> function saves the current internal dspec database into the file given by <code>pathname</code> . The file can then be used in the variable <code>*active-finders*</code> .	
See also	<code>*active-finders*</code>	

single-form-form-parser *Function*

Summary	A pre-defined form parser.
Package	<code>dspec</code>

Signature	<code>single-form-form-parser top-level-form getter => dspec</code>	
Arguments	<code>top-level-form</code>	A top level defining form.
	<code>getter</code>	The subform getter function.
Values	<code>dspec</code>	A dspec.
Description	<p>The function <code>single-form-form-parser</code> is a predefined form parser for use with <code>define-form-parser</code>. The parser consumes one subform and returns a dspec made from the defining form and the subform. This can be used in the common case where a defining form has a name that follows the defining macro and the dspec class is the same as the defining macro, for example <code>defclass</code>.</p> <p><code>single-form-form-parser</code> is the predefined parser for <code>defvar</code>, <code>defparameter</code>, <code>defconstant</code>, <code>define-symbol-macro</code>, <code>define-compiler-macro</code>, <code>deftype</code>, <code>defsetf</code>, <code>define-setf-expander</code>, <code>defpackage</code>, <code>defclass</code>, <code>define-condition</code> and <code>define-method-combination</code> top level forms. It is also the parser for various LispWorks extensions such as <code>defsystem</code>.</p> <p>You can define it to be the parser for your defining forms. using <code>define-form-parser</code>.</p>	
See also	<code>define-form-parser</code>	

single-form-with-options-form-parser		<i>Function</i>
Summary	A pre-defined form parser.	
Package	<code>dspec</code>	
Signature	<code>single-form-with-options-form-parser top-level-form getter => dspec</code>	
Arguments	<code>top-level-form</code>	A top level defining form.

	<i>getter</i>	The subform getter function.
Values	<i>dspec</i>	A dspec.
Description		<p>The function <code>single-form-with-options-form-parser</code> is a predefined form parser for use with <code>define-form-parser</code>. The parser consumes one subform and returns a dspec made from the defining form and either the first element of the subform if it is a cons or the subform itself otherwise. This can be used in the common case where a defining form has a name with options that follows the defining macro and the dspec class is the same as the defining macro, for example <code>defstruct</code>.</p> <p><code>single-form-with-options-form-parser</code> is the predefined parser for <code>defstruct</code>, <code>fli:define-foreign-function</code>, <code>fli:define-foreign-variable</code>, <code>fli:define-c-struct</code>, <code>fli:define-c-union</code>, <code>fli:define-c-enum</code> and <code>fli:define-c-typedef</code> forms.</p> <p>You can define it to be the parser for your defining forms. using <code>define-form-parser</code>.</p>
See also		<code>define-form-parser</code>

traceable-dspec-p		<i>Function</i>
Summary		Tests whether definition can be traced.
Package		<code>dspec</code>
Signature		<code>traceable-dspec-p dspec => result</code>
Arguments	<i>dspec</i>	A dspec.
Values	<i>result</i>	A generalised boolean.

Description	<p>The function <code>traceable-dspec-p</code> determines whether the <i>dspec</i> <i>dspec</i> denotes a definition that can be traced using the Common Lisp macro <code>trace</code>.</p> <p><i>dspec</i> must not be a local <i>dspec</i>, and must be defined, according to <code>dspec-defined-p</code>. The result does not depend on whether <i>dspec</i> is currently traced.</p>
Example	<pre>CL-USER 67 > (dspec:traceable-dspec-p '(subfunction foo bar)) NIL CL-USER 68 > (dspec:traceable-dspec-p '(defun open)) OPEN</pre>

	<i>Function</i>
Summary	Gets and sets the global tracing state..
Package	<code>dspec</code>
Signature	$\text{tracing-enabled-p} \Rightarrow \text{enabledp}$ $(\text{setf tracing-enabled-p}) \text{ enabledp} \Rightarrow \text{enabledp}$
Values	<i>enabledp</i> A generalized boolean.
Description	<p>The function <code>tracing-enabled-p</code> determines whether tracing (by the Common Lisp macro <code>trace</code>) is currently on. This is independent of whether any functions are currently traced.</p> <p>The function <code>(setf tracing-enabled-p)</code> switches tracing on or off according to the value of <i>enabledp</i>. This does not affect the list of functions that are currently traced.</p>
See also	<code>trace</code> <code>tracing-state</code>

	<i>Function</i>
Summary	Gets the current trace details.
Package	<code>dspec</code>
Signature	<code>tracing-state &optional dspec => state</code>
Signature	<code>(setf tracing-state) state &optional dspec => state</code>
Arguments	<code>dspec</code> A <code>dspec</code> .
Values	<code>state</code> A list.
Description	<p>The function <code>tracing-state</code> returns a listing describing the current state of the tracing system. It shows the current tracing state for the <code>dspec</code> <code>dspec</code>, or for all traced definitions if <code>dspec</code> is not supplied.</p> <p>The result <code>state</code> is a list each element of which is a list whose car is a <code>dspec</code> naming the traced definition and whose cdr is the additional trace options. Note that <code>tracing-state</code> returns more information than is returned by <code>trace</code>. It is useful for preserving a complex set of traces.</p> <p>The function <code>(setf tracing-state)</code> sets the state of the tracing system. It changes the current tracing state for the <code>dspec</code> <code>dspec</code>, or for all traced definitions if <code>dspec</code> is not supplied.</p> <p><code>(setf tracing-state)</code> can be used to switch between different sets of traces. Note however that turning tracing on or off is better done using <code>tracing-enabled-p</code>.</p>
See also	<code>trace</code> <code>tracing-enabled-p</code>

31

The EXTERNAL-FORMAT Package

This chapter describes symbols available in the `EXTERNAL-FORMAT` package. Use of these symbols are discussed in Chapter 22, “Internationalization”.

		<i>Function</i>
Summary		Returns the code of a character in the specified character set.
Package		<code>external-format</code>
Signature		<code>char-external-code char set => code</code>
Arguments	<code>char</code>	The character whose code you wish to return.
	<code>set</code>	A character set. Legal values for <code>set</code> are <code>:unicode</code> , <code>:latin-1</code> , <code>:ascii</code> , <code>:macos-roman</code> , <code>:jis-x-208</code> , <code>:jis-x-212</code> , <code>:euc-jp</code> and <code>:sjis</code> . Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier.

Values	<code>code</code>	The code of <i>char</i> in the character set <i>set</i> . An integer.
Description	Returns the code of the character <i>char</i> in the coded character set specified by <i>set</i> , or <code>nil</code> , if there is no encoding. Note that a coded character set is not the same thing as an external format.	
For the <i>set</i> parameter, the <code>:jis-*</code> codes are KUTEN indexes (from the 1990 version of these standards) encoded as		
<code>(+ (* 100 row) column)</code>		
<code>:euc-jp</code> is the complete two-byte format encoded as		
<code>(+ (* 256 first-byte) second-byte)</code>		
<code>:sjis</code> is Shift-JIS encoded in the same way. Strictly speaking, EUC and Shift-JIS are not coded character sets, but encodings of the JIS sets, but the encoding is easily expressed as an integer, so the same interface to it is used.		
See also	<code>find-external-char</code>	

decode-external-string *Function*

Summary	Decodes a binary vector to make a string.	
Package	<code>external-format</code>	
Signature	<code>decode-external-string vector external-format &key start end => string</code>	
Arguments	<code>vector</code>	A binary vector.
	<code>external-format</code>	An external format spec.
	<code>start, end</code>	Bounding index designators of <code>vector</code> .
Values	<code>string</code>	A string.

Description	The function <code>decode-lisp-string</code> decodes the integers in the part of the vector <code>vector</code> bounded by <code>start</code> and <code>end</code> using encoding <code>external-format</code> to make a string <code>string</code> . The element type of <code>vector</code> does not need to match the <code>external-format-foreign-type</code> of <code>external-format</code> .
Compatibility note	This function exists in LispWorks 5.0 but is not documented and does not take the <code>:start</code> and <code>:end</code> arguments. Also, it was inefficient prior to LispWorks 5.0.1.
See also	<code>encode-lisp-string</code>

	<i>Function</i>						
encode-lisp-string	<i>Function</i>						
Summary	Converts a string to an encoded binary vector.						
Package	<code>external-format</code>						
Signature	<code>encode-lisp-string string external-format &key start end => vector</code>						
Arguments	<table> <tr> <td><code>string</code></td> <td>A string.</td> </tr> <tr> <td><code>external-format</code></td> <td>An external format spec.</td> </tr> <tr> <td><code>start, end</code></td> <td>Bounding index designators of <code>string</code>.</td> </tr> </table>	<code>string</code>	A string.	<code>external-format</code>	An external format spec.	<code>start, end</code>	Bounding index designators of <code>string</code> .
<code>string</code>	A string.						
<code>external-format</code>	An external format spec.						
<code>start, end</code>	Bounding index designators of <code>string</code> .						
Values	<code>vector</code> A binary vector.						
Description	<p>The function <code>encode-lisp-string</code> converts the part of <code>string</code> bounded by <code>start</code> and <code>end</code> to a binary vector <code>vector</code> encoded in encoding <code>external-format</code>.</p> <p>The element type of <code>vector</code> matches the <code>external-format-foreign-type</code> of <code>external-format</code>.</p>						

Compatibility note This function exists in LispWorks 5.0 but is not documented and does not take the `:start` and `:end` arguments. Also, it was inefficient prior to LispWorks 5.0.1.

See also `decode-external-string`

external-format-error *Condition*

Summary The condition class `external-format-error` is the superclass of all errors relating to external formats.

Package `external-format`

Superclasses `error`

Initargs `:name` The name of the external format involved.

Description The class `external-format-error` provides a slot for the name of external format involved: this is the fully expanded form of the specification with all the parameters filled in. It is also useful for users who want to set up a handler for encoding errors.

external-format-foreign-type *Function*

Summary Returns a type specifier for the integers handled by a specified external format.

Package `external-format`

Signature `external-format-foreign-type external-format => type-specifier`

Arguments `external-format` An external character format.

Values	<i>type-specifier</i>	A type specifier describing the integer types handled by <i>external-format</i> .
Description		Takes the name of an external format, and returns a Lisp type specifier for the type of integers that the external format handles on the foreign side.
See also		<code>external-format-type</code>

external-format-type *Function*

Summary	Returns a type specifier for the characters handled by a specified external format.	
Package	<code>external-format</code>	
Signature	<code>external-format-type external-format => type-specifier</code>	
Arguments	<i>external-format</i> An external character format.	
Values	<i>type-specifier</i>	A type specifier describing the character types handled by <i>external-format</i> .
Description	Takes the name of an external format, and returns a type specifier for the type of characters that the external format handles on the Lisp side.	
See also	<code>external-format-foreign-type</code>	

find-external-char *Function*

Summary	Returns the character of a given code in a specified character set.	
Package	<code>external-format</code>	

Signature	<code>find-external-char code set => char</code>	
Arguments	<code>code</code>	A character code. This is an integer.
	<code>set</code>	A character set. Legal values for <code>set</code> are <code>:unicode</code> , <code>:latin-1</code> , <code>:ascii</code> , <code>:macos-roman</code> , <code>:jis-x-208</code> , <code>:jis-x-212</code> , <code>:euc-jp</code> and <code>:sjis</code> . Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier.
Values	<code>char</code>	The character represented by <code>code</code> . If <code>code</code> is not a legal code in the specified set, the return value is undefined.
Description	<p>Returns the character that has the code <code>code</code> (an integer) in the coded character set specified by <code>set</code>, or <code>nil</code>, if that character is not represented in the Lisp character set. Note that a coded character set is not the same thing as an external format.</p> <p>For the <code>set</code> parameter, the <code>:jis-*</code> codes are KUTEN indexes (from the 1990 version of these standards) encoded as</p> <pre>(+ (* 100 row) column)</pre> <p><code>:euc-jp</code> is the complete two-byte format encoded as</p> <pre>(+ (* 256 first-byte) second-byte)</pre> <p><code>:sjis</code> is Shift-JIS encoded in the same way. Strictly speaking, EUC and Shift-JIS are not coded character sets, but encodings of the JIS sets, but the encoding is easily expressed as an integer, so the same interface to it is used.</p>	
See also	<code>char-external-code</code>	

	valid-external-format-p	<i>Function</i>
Summary	Tests whether an external format spec is valid.	

Package	<code>external-format</code>	
Signature	<code>valid-external-format-p <i>ef-spec</i> &optional <i>env</i> => <i>bool</i></code>	
Arguments	<i>ef-spec</i>	An external format spec.
	<i>env</i>	An environment across which the spec should apply.
Values	<i>bool</i>	<code>t</code> if <i>ef-spec</i> is a valid spec; <code>nil</code> otherwise.
Description	This predicate tests whether the external format spec given in <i>ef-spec</i> is valid (in the environment <i>env</i>).	
Example	<code>(valid-external-format-p '(:Unicode :eol-style :lf))</code>	

32

The HCL Package

This chapter describes symbols available in the `HCL` package. This package is used by default. Its symbols are visible in the `CL-USER` package.

Various uses of the symbols documented here are discussed throughout this manual.

		<i>Function</i>
Summary	Adds a function to perform a special action during garbage collection.	
Package	<code>hcl</code>	
Signature	<code>add-special-free-action <i>function</i> => <i>function-list</i></code>	
Arguments	<i>function</i>	A symbol naming a function of one argument.
Values	<i>function-list</i>	A list of the functions currently called to perform special actions, including the one just added.

Description	When some objects are garbage collected, you may require a “special action” to be performed as well. <code>add-special-free-action</code> adds the function <i>function</i> to perform the special action. Note that the function is applied to all objects flagged for special-free-action, so the function <i>function</i> should check for the object’s type, so that it only affects relevant objects.
	The functions <code>flag-special-free-action</code> and <code>flag-not-special-free-action</code> flag and unflag objects for action.
Example	<code>(add-special-free-action 'free-my-app)</code>
See also	<code>remove-special-free-action</code> <code>flag-special-free-action</code> <code>flag-not-special-free-action</code>

add-symbol-profiler *Function*

Summary	Adds a symbol to the list of profiled symbols.	
Package	<code>hcl</code>	
Signature	<code>add-symbol-profiler symbol => nil</code>	
Arguments	<code>symbol</code>	A symbol to be added to the <code>*profile-symbol-list*</code> .
Values	Returns <code>nil</code> .	
Description	<code>add-symbol-profiler</code> adds a symbol to <code>*profile-symbol-list*</code> , the list of profiled symbols.	
See also	<code>*profile-symbol-list*</code> <code>remove-symbol-profiler</code>	

		<i>Macro</i>
Summary		Allocates objects from a specified generation within the scope of evaluating a number of forms in 32-bit LispWorks.
Package		<code>hcl</code>
Signature		<code>allocation-in-gen-num <i>gen-num</i> &body <i>body</i> => <i>result</i></code>
Arguments	<i>gen-num</i>	An integer, which if out of range for a valid generation number is rounded either to the youngest or oldest generation. If <i>gen-num</i> is negative, the specified generation is: the highest generation number + 1 - <i>gen-num</i> , so that an argument of -1 specifies the highest generation number.
	<i>body</i>	The forms to be evaluated while the allocation generation has been temporarily set to <i>gen-num</i> .
Values	<i>result</i>	The result of evaluating body.
Description		Allocates objects from a specified generation during the extent of the evaluation of the body forms. Normally objects are allocated from the first (youngest) generation, which assumes that they are short-lived. The storage allocator and garbage collector perform better if allocation of large numbers of non-ephemeral objects is done explicitly into a generation other than the youngest. Note: this macro is implemented only in 32-bit LispWorks. In 64-bit implementations, use <code>apply-with-allocation-in-gen-num</code> or the <code>:allocation</code> argument to <code>make-array</code> instead.

Examples

```
(allocation-in-gen-num
 1
  (setq tab (make-hash-table :size 1200
                               :test 'eq)
        arr (make-array 20)))
```

See also

`apply-with-allocation-in-gen-num`
`make-array`
`set-default-generation`
`get-default-generation`
`*symbol-alloc-gen-num*`

analysing-special-variables-usage*Function*

Summary Prints an analysis of proclaimed symbols seen during compilation, as an aid to improving declarations.

Package `hcl`

Signature `analyzing-special-variables-usage (&key all default maybe-globals maybe-dynamics unused only-bound wrong-global inconsistent stream) &body body => results`

Arguments *all* A boolean.

default A boolean.

maybe-globals A boolean.

maybe-dynamics A boolean.

unused A boolean.

only-bound A boolean.

wrong-global A boolean.

inconsistent A boolean.

stream `t` or an output stream.

body Lisp code that calls the compiler.

Values	<i>results</i>	The results of running <i>body</i> .
Description	<p>The macro <code>analyzing-special-variables-usage</code> executes the code in <i>body</i>, which needs to call the compiler, typically many times (compiling a whole system, for example). When <i>body</i> exits, it prints a simple analysis of symbols that were proclaimed and how they were proclaimed, in a way that is intended to be helpful in improving declarations. For a full explanation of how you might add or alter declarations, see “Usage of special variables” on page 98.</p> <p>The analysis is based solely on what the compiler sees, ignoring what is already in the image. It also ignores inline declarations.</p> <p>Only symbols for which the compiler sees a special proclamation are reported (including <code>c1:defvar</code>, <code>c1:defparameter</code>, <code>defglobal-parameter</code> and <code>defglobal-variable</code>, but not <code>c1:defconstant</code>).</p> <p><i>all</i> and <i>default</i> are convenience arguments to control groups of the other keyword arguments, which are all boolean flags. The default value of <i>all</i> is <code>nil</code>. <i>all</i> provides the default value of <i>maybe-globals</i> and <i>maybe-dynamics</i>. The default value of <i>default</i> is <code>t</code>. <i>default</i> provides the default value of <i>unused</i>, <i>only-bound</i>, <i>wrong-global</i> and <i>inconsistent</i>.</p> <p><i>stream</i> determines where the analysis goes, and is interpreted as if by <code>c1:format</code>. It does not affect any of the I/O in <i>body</i>. The default value of <i>stream</i> is <code>t</code>, meaning standard output.</p> <p><i>inconsistent</i> controls whether to print symbols where the declaration and usage is inconsistent. Inconsistencies include:</p> <ol style="list-style-type: none"> 1. Accessing or binding the symbol before the proclamation. 2. Multiple declarations which are different (for example, change from <code>hcl:special-dynamic</code> to <code>c1:special</code>) <p>The <i>inconsistent</i> messages are the most useful. A well written program should not produce any such message.</p>	

unused controls whether to report symbols that are proclaimed special but are otherwise not used. For this option to be really useful, *body* needs to force compile many source files.

Since such unused variables do not affect the code, *unused* is normally useful only for finding and eliminating dead declarations, but it can also flag situations when the wrong variable is used (if the variable that is supposed to be used is not used elsewhere)

only-bound controls whether to report symbols that have been seen bound, but whose value has not been read. The comments about *unused* also apply to *only-bound*.

wrong-global controls whether to print symbols that are bound but are also proclaimed `hcl:special-global`. If the proclamation preceded the binding, the compiler will signal a `compiler-error`.

maybe-globals controls whether to report symbols that were not seen bound. If these symbols are really never bound, they can be proclaimed global by defining them with `defglobal-parameter` and `defglobal-variable`, or proclaimed `hcl:special-global`, both for speed and also to prevent them getting bound by mistake.

It is quite useful to force compile a program each now and then with *maybe-globals* true, then check through the report and proclaim global all those symbols that can be proclaimed global.

maybe-dynamics controls whether to report symbols that have been seen bound, and are proclaimed special, but not `hcl:special-dynamic` or `hcl:special-global`. Some of these may be proclaimed `hcl:special-dynamic`.

The report that is generated is grouped according to the file in which a proclamation was found. If a variable was proclaimed in multiple files, it will appear multiple times in the output. Within each file the output is grouped according to what is reported.

For the keyword arguments except *inconsistent*, the symbols are simply listed. For the *inconsistent* report, it outputs several lines for each symbol. Each line starts with one of the symbols `c1:special`, `hcl:special-global`, `hcl:special-dynamic`, `hcl:special-fast-access` (these four signify a proclamation), `:bound` or `:accessed` (these two indicate the usage). It is followed by the pathname of the file in which this one found. Only occurrences which give rise to inconsistency are listed.

Notes	The report about <i>inconsistent</i> usage is almost always useful. <i>unused</i> and <i>only-bound</i> are mostly useful when <i>body</i> force compiles many files, though they have limited utility in partial compilation too. <i>maybe-globals</i> and <i>maybe-dynamics</i> need full compilation to be really useful. Of the latter <i>maybe-globals</i> is the more useful.
See also	<code>declare</code> <code>defglobal-parameter</code> <code>defglobal-variable</code>

		<i>Function</i>
Summary		The predicate for whether an object is a weak array.
Package		<code>hcl</code>
Signature		<code>array-weak-p <i>object</i> => <i>result</i></code>
Arguments	<i>object</i>	A Lisp object.
Values	<i>result</i>	A boolean.
Description		The function <code>array-weak-p</code> returns <code>t</code> if its argument <i>object</i> is a weak array, and otherwise returns <code>nil</code> .

See also **`make-array`**
`set-array-weak`

avoid-gc	<i>Function</i>
Summary	Avoids garbage collection if possible in 32-bit LispWorks.
Package	<code>hcl</code>
Signature	<code>avoid-gc => previous-results</code>
Arguments	None.
Values	The function returns the previous settings of <code>minimum-for-sweep</code> , <code>maximum-overflow</code> and <code>minimum-overflow</code> . (see <code>set-gc-parameters</code> for details of these.)
Description	<p><code>avoid-gc</code> sets various internal parameters so that garbage collection is avoided as far as possible.</p> <p>This can be useful with non-interactive programs.</p> <p>If you use <code>avoid-gc</code>, use <code>normal-gc</code> later to reset the parameters to their default settings.</p> <p>Note: <code>avoid-gc</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations. In 64-bit implementations, you can use <code>set-default-segment-size</code> to increase the default size of segments in the lower generations (typically generations 0 and 1). This will lead to less frequent garbage collections.</p>
See also	<code>gc-if-needed</code> <code>normal-gc</code> <code>set-gc-parameters</code> <code>set-default-segment-size</code> <code>without-interrupts</code>

		<i>Function</i>
Summary		Lists special variables bound by a definition.
Package		<code>hcl</code>
Signature		<code>binds-who function => result</code>
Arguments	<i>function</i>	A symbol or a function dspec.
Values	<i>result</i>	A list.
Description		The function <code>binds-who</code> returns a list of the special variables bound by the definition named by <i>function</i> .
		Note: The cross-referencing information used by <code>binds-who</code> is generated when code is compiled with source-level debugging switched on.
See also		<code>toggle-source-debugging</code> <code>who-binds</code>

		<i>Macro</i>
Summary		Prevents promotion of objects into generation 2 during the execution of <i>body</i> .
Package		<code>hcl</code>
Signature		<code>block-promotion &body body => result</code>
Arguments	<i>body</i>	Forms executed as an implicit <code>progn</code> .
Values	<i>result</i>	The result of evaluating the final form in <i>body</i> .

Description	<p>The macro <code>block-promotion</code> executes <i>body</i> and prevents promotion of objects into generation 2 during this execution. After <i>body</i> is executed, generations 0 and 1 are collected.</p> <p>This is useful when a significant number of transient objects actually survive all the garbage collections on generation 1. These would normally then be promoted and, by default, never get collected. In such a situation, (<code>mark-and-sweep 2</code>) will free a large amount of space in generation 2.</p> <p><code>block-promotion</code> can be thought of as doing <code>set-promotion-count</code> on generation 1 with an infinite <i>count</i>, for the duration of <i>body</i>.</p> <p><code>block-promotion</code> is suitable only for use in particular operations that are known to create such relatively long-lived, but transient, objects. In typical uses these are objects that live for a few seconds to several hours. An example usage is LispWorks <code>compile-file</code>, to ensure the transient compile-time data gets collected.</p> <p><code>block-promotion</code> has global scope and hence may not be useful in an application such as a multi-threaded server. During the execution of <i>body</i>, generation 1 grows to accomodate all the allocated data, which may have some negative effects on the behavior of the system, in particular on its interactive response.</p> <p>Note: symbols and process stacks are allocated in generation 2 or 3 (see <code>*symbol-alloc-gen-num*</code>) hence <code>block-promotion</code> cannot prevent these getting into that generation. <code>allocation-in-gen-num</code> can also cause allocation in higher generations.</p> <p>Note: in 64-bit LispWorks, <code>block-promotion</code> is implemented using <code>set-blocking-gen-num</code>.</p>
See also	<p><code>allocation-in-gen-num</code> <code>mark-and-sweep</code> <code>set-promotion-count</code></p>

	<i>Function</i>
Summary	Used in a build script to determine if LispWorks is building an intermediate image when making a universal binary.
Package	<code>hcl</code>
Signature	<code>building-universal-intermediate-p => intermediatep</code>
Arguments	None
Values	<i>intermediatep</i> A boolean.
Description	<p>The function <code>building-universal-intermediate-p</code> can be used in a build script to determine if it is being executed to build one of the architectures of a universal binary.</p> <p>The return value <i>intermediatep</i> is <code>nil</code> in most cases. It will be <code>t</code> only when building an intermediate image for the purpose of building a universal binary, either by <code>save-universal-from-script</code> or the Application Builder (see the <i>LispWorks IDE User Guide</i>).</p> <p>This is useful if there are some configuration that should be done only in a universal binary image but not in a mono-architecture ("thin") image. Whether the intermediate image will be the Intel or the PowerPC part of the universal binary can be determined by checking <code>*features*</code>.</p> <p>On architectures that do not have universal binaries, this function always returns <code>nil</code>.</p>
See also	<code>save-universal-from-script</code> <code>save-argument-real-p</code>

	<i>Function</i>
Summary	Lists functions called by a function.

Package	<code>hcl</code>	
Signature	<code>calls-who dspec => callees</code>	
Arguments	<code>dspec</code>	A <code>dspec</code> .
Values	<code>callees</code>	A list.
Description	<p>The function <code>calls-who</code> returns a list of the <code>dspecs</code> naming the functions called by the function named by <code>dspec</code>.</p> <p>See also the editor commands <code>List Callees</code>, and <code>Show Paths From</code>.</p> <p>Note: The cross-referencing information used by <code>calls-who</code> is generated when code is compiled with source-level debugging switched on.</p>	
Example	<code>(calls-who '(method foo (string)))</code>	
See also	<code>toggle-source-debugging</code> <code>who-calls</code>	

cd		<i>Macro</i>
Summary		Changes the current directory.
Package		<code>hcl</code>
Signature		<code>cd &optional directory => current-dir</code>
Arguments		<code>directory</code> A pathname designator specifying the new directory.
Values		<code>current-dir</code> A physical pathname.

Description The macro `cd` changes the current directory to that specified by *directory*. *directory* may be an absolute or relative pathname, and defaults to the string "`~/`".

See also `change-directory`
 `get-working-directory`

change-directory *Function*

Summary Changes the current directory.

Package `hcl`

Signature `change-directory directory => current-dir`

Arguments *directory* A pathname designator specifying the new directory.

Values *current-dir* A physical pathname.

Description `change-directory` changes the current directory to that specified by *directory*. *directory* may be an absolute or relative pathname.

Use `get-working-directory` to find the current directory.

See also `cd`
 `get-working-directory`

check-fragmentation *Function*

Summary Provides information about the fragmentation in a generation in 32-bit LispWorks.

Package `hcl`

Signature	<code>check-fragmentation gen-num => total-free, total-small-blocks, total-large-blocks</code>	
Arguments	<code>gen-num</code>	0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.
Values	<code>total-free</code>	Total free space in the generation.
	<code>total-small-blocks</code>	Amount of free space in the generation which is available in blocks of 512 bytes or larger.
	<code>total-large-blocks</code>	Amount of free space in the generation which is available in blocks of 4096 bytes or larger.
Description	<p>The latter two values give indication of the level of fragmentation in the generation. This information can be used, for example, to decide whether to call <code>try-move-in-generation</code>.</p> <p>Note: <code>check-fragmentation</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where <code>gen-num-segments-fragmentation-state</code> is available instead.</p>	
See also	<code>try-compact-in-generation</code> <code>try-move-in-generation</code>	

		<i>Function</i>
clean-down		
Summary	Frees memory and reduces the size of the image, if possible.	
Package	<code>hcl</code>	
Signature	<code>clean-down &optional full => new-size</code>	

Arguments	<i>full</i> controls whether to operate on the highest generation. The default is <code>t</code> .
Values	<code>new-size</code> The new size of the image, after reduction.
Description	<p>Tries to free as much memory as possible and then reduce the size of the image as much as possible, and also move all the allocated objects to an old generation.</p> <p>If <i>full</i> is <code>t</code>, <code>clean-down</code> does a mark and sweep on generation 3, promotes all the objects into generation 3, deletes the empty segments and tries to reduce the image size. This is called by default before saving an image.</p> <p>If <i>full</i> is <code>nil</code>, <code>clean-down</code> does a mark and sweep on generation 2, promotes all the objects to generation 2 and tries to reduce the size of all generations up to 2, but does not touch generation 3.</p> <p><code>clean-down</code> may fail to delete empty segments if there are static segments in high address space.</p>
Notes	<p><code>try-move-in-generation</code> uses less CPU than <code>clean-down</code>, though it does not do the mark and sweep.</p> <p>In 64-bit LispWorks, <code>clean-down</code> is implemented as if by</p> <pre>(gc-generation 7 :coalesce t)</pre> <p>though you can use <code>gc-generation</code> directly for better control.</p>
See also	<code>gc-generation</code> <code>save-image</code> <code>try-move-in-generation</code>

clean-generation-0		<i>Function</i>
Summary	Attempts to promote all objects from generation zero into generation one, thereby clearing generation zero, in 32-bit LispWorks.	
Package	<code>hcl</code>	
Signature	<code>clean-generation-0 => 1</code>	
Arguments	None	
Values	Returns the value 1.	
Description	This is useful when passing from a phase of creating long-lived data to a phase of mostly ephemeral data, for example, the end of loading an application and the start of its use.	
	Note: The function may not be very useful, as it may be more efficient to directly allocate the objects in a particular generation in the first place, using <code>allocation-in-gen-num</code> or <code>set-default-generation</code> .	
	Note: <code>clean-generation-0</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where the same effect can be obtained by a call <code>(gc-generation 0)</code> .	
Example	<pre>; allocate lots of non-ephemeral objects ; (clean-generation-0)</pre>	
See also	<code>allocation-in-gen-num</code> <code>collect-generation-2</code> <code>collect-highest-generation</code> <code>expand-generation-1</code> <code>gc-generation</code> <code>set-promotion-count</code>	

collect-generation-2 *Function*

Summary	Controls whether generation 2 is garbage collected in 32-bit LispWorks.	
Package	<code>hcl</code>	
Signature	<code>collect-generation-2 <i>on</i> => <i>size</i></code>	
Arguments	<code>on</code>	If <code>on</code> is <code>nil</code> , generation 2 is not garbage collected. If <code>on</code> is <code>t</code> , the generation is garbage collected.
Values	<code>size</code>	The current size of the image.
Description	Controls whether generation 2 is garbage collected. (Generation 2 normally holds long-lived objects created dynamically.) Note: <code>collect-generation-2</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where you can use <code>set-blocking-gen-num</code> instead.	
See also	<code>clean-generation-0</code> <code>collect-highest-generation</code> <code>expand-generation-1</code> <code>set-blocking-gen-num</code> <code>set-promotion-count</code>	

collect-highest-generation *Function*

Summary	Controls whether the top generation is garbage-collected in 32-bit LispWorks.	
Package	<code>hcl</code>	

Signature	<code>collect-highest-generation flag</code>	
Arguments	<code>flag</code>	If <code>flag</code> is non-nil, the top generation is collected; if <code>flag</code> is any other value, the top generation is not collected. The default is <code>nil</code> .
Values	<code>collect-highest-generation</code> returns no values.	
Description	<p>Note: <code>collect-highest-generation</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.</p>	
See also	<code>avoid-gc</code> <code>clean-generation-0</code> <code>collect-generation-2</code> <code>expand-generation-1</code> <code>normal-gc</code>	

compiler-break-on-error	<i>Variable</i>
Summary	Controls whether <code>compile-file</code> handles compilation errors.
Package	<code>hcl</code>
Initial Value	<code>nil</code>
Description	<p>If an error occurs during compilation of a form by <code>compile-file</code>, an error handler normally causes the compilation of that form to be skipped, and the error is reported later.</p> <p>When <code>*compiler-break-on-error*</code> is non-nil, an error during compilation by <code>compile-file</code> is signaled and the debugger is entered.</p>
See also	<code>compile-file</code>

	<i>Function</i>
Summary	Compiles a Lisp source file if it is newer than the corresponding fasl file.
Package	<code>hcl</code>
Signature	<code>compile-file-if-needed <i>input-pathname</i> &key <i>output-file</i> <i>load</i> & allow-other-keys => <i>output-truename</i>, <i>warnings-p</i>, <i>failure-p</i></code>
Arguments	<p><i>input-pathname</i> A pathname designator.</p> <p><i>output-file</i> A pathname designator.</p> <p><i>load</i> A generalized boolean.</p>
Values	<p><i>output-truename</i> A pathname or <code>nil</code>.</p> <p><i>warnings-p</i> A generalized boolean.</p> <p><i>failure-p</i> A generalized boolean.</p>
Description	<p>The function <code>compile-file-if-needed</code> compares the <code>file-write-date</code> of the source file named by <i>input-pathname</i> with the <code>file-write-date</code> of the appropriate fasl file (as computed by <code>compile-file-pathname</code> from <i>input-pathname</i> and <i>output-file</i>).</p> <p>If the fasl file does not exist or is older than <i>input-pathname</i>, then <code>compile-file</code> is called with <i>input-pathname</i>, <i>output-file</i>, <i>load</i> and any other arguments passed., and the values returned are those returned from <code>compile-file</code>.</p> <p>Otherwise, if <i>load</i> is true <code>compile-file-if-needed</code> loads the fasl file and returns <code>nil</code>, and if <i>load</i> is <code>nil</code> it simply returns <code>nil</code>.</p>

Example

```

CL-USER 19 > (compile-file-if-needed "H:/tmp/foo.lisp"
                                      :output-file
                                      "C:/temp/")
;; Compiling file H:/tmp/foo.lisp ...
;; Safety = 3, Speed = 1, Space = 1, Float = 1,
Interruptible = 0
;; Compilation speed = 1, Debug = 2, Fixnum safety = 3
;; Source level debugging is off
;; Source file recording is on
;; Cross referencing is off
; (TOP-LEVEL-FORM 1)
; (TOP-LEVEL-FORM 2)
; (TOP-LEVEL-FORM 3)
; FOO
; BAR
#P"C:/temp/foo.ofasl"
NIL
NIL

CL-USER 20 > (compile-file-if-needed "H:/tmp/foo.lisp"
                                      :output-file
                                      "C:/temp/"
                                      :load t)
; Loading fasl file C:\temp\foo.ofasl
NIL

```

See also

`compile-file`

copy-to-weak-simple-vector

Function

Summary	Creates a weak vector with the same contents as the supplied vector.	
Package	<code>hcl</code>	
Signature	<code>copy-to-weak-simple-vector vector-t => weak-vector</code>	
Arguments	<code>vector-t</code>	An array of type (<code>vector t</code>).
Values	<code>weak-vector</code>	A weak array of type (<code>vector t</code>).

Description	The function <code>copy-to-weak-simple-vector</code> creates and returns a weak vector with the same contents as the argument <i>vector-t</i> . Apart from the checking of arguments, this is equivalent to:
	<pre>(replace (make-array (length vector-t) :weak t) vector-t)</pre>
See also	<code>make-array</code> <code>set-array-weak</code>

create-macos-application-bundle *Function*

Summary	Creates a Mac OS X application bundle for the running Lisp-Works image.
Package	<code>hcl</code>
Signature	<code>create-macos-application-bundle target-path &key template-bundle bundle-name signature package-type extension application-icns identifier version build version-string help-book-folder help-book-name document-types executable-name => path</code>
Arguments	<p><i>target-path</i> A pathname designator.</p> <p><i>template-bundle</i> A pathname designator.</p> <p><i>bundle-name</i> A string.</p> <p><i>signature</i> A string.</p> <p><i>package-type</i> A string.</p> <p><i>extension</i> A string.</p> <p><i>application-icns</i> A pathname designator.</p> <p><i>identifier</i> A string.</p>

	<i>version</i>	A string.
	<i>build</i>	A string.
	<i>version-string</i>	A string.
	<i>help-book-folder</i>	A string.
	<i>help-book-name</i>	A string.
	<i>document-types</i>	A list or <code>t</code> .
	<i>executable-name</i>	<code>t</code> or <code>nil</code> .
Values	<i>path</i>	A pathname.
Description		<p>The function <code>create-macos-application-bundle</code> creates a Mac OS X application bundle for the running LispWorks image, and returns the pathname <i>path</i> in which an image is expected to be saved. If you are saving an image, it is convenient to use <code>save-image-with-bundle</code>.</p> <p><i>target-path</i> is where the new bundle is created.</p> <p>By default <code>create-macos-application-bundle</code> uses the application bundle of the current image as a template, and modifies it according to its arguments. If you do not supply of any of the keyword arguments, the only modification is to the actual path.</p> <p><i>template-bundle</i> can be supplied to provide a path for an application bundle which will be used as a template. If <i>template-bundle</i> is not supplied, <code>create-macos-application-bundle</code> uses the path of the bundle of the current image. Except when specified, all the other parameters default to their values in the <i>template-bundle</i>.</p> <p><i>bundle-name</i> provides CFBundleName. The default value is the name of the last directory component in <i>target-path</i>.</p> <p><i>signature</i> is the signature in the PkgInfo file.</p>

version is the version value, CFBundleVersion. If *template-bundle* is nil, *version* defaults to the value returned by `cl:lisp-implementation-version`.

executable-name is the filename of the LispWorks image executable, not including the directory. The default value of *executable-name* is the pathname name of the last component of *target-path*.

package-type is the package type, CFBundlePackageType. The default value of *package-type* is "APPL".

extension is the extension to add to the last component of *target-path*. The default value of *extension* is "app", as in "LispWorks.app".

The default value of *document-types* is `t`, which means copy them from *template-bundle*.

`create-macos-application-bundle` is implemented only in LispWorks for Macintosh.

See also `save-image-with-bundle`

create-universal-binary *Function*

Summary Creates a universal binary from two mono-architecture LispWorks images.

Package `hcl`

Signature `create-universal-binary target-image src-image1 src-image2 => target-image`

Arguments *target-image* A pathname designator.

src-image1 A pathname designator.

src-image2 A pathname designator.

Values	<code>target-image</code>	A pathname designator.
Description		<p>This function is intended for advanced use. See the function <code>save-universal-from-script</code> for a simpler way to create a universal binary.</p> <p>The function <code>create-universal-binary</code> writes a universal binary to the file <code>target-image</code> from the saved image files <code>src-image1</code> and <code>src-image2</code>. The value of <code>target-image</code> is returned.</p> <p>The source images <code>src-image1</code> and <code>src-image2</code> must both be LispWorks for Macintosh mono-architecture ("thin") images and one should be for the Intel architecture and the other for the PowerPC architecture (the order is immaterial). For example, they could have been created by <code>save-image</code> or <code>deliver</code>.</p> <p>Note: The function <code>create-universal-binary</code> checks that <code>src-image1</code> and <code>src-image2</code> are LispWorks images of different architectures, but it does not check how they were saved or how similar they are. You need to ensure that both images contain the same functionality.</p> <p>Note: The function <code>create-universal-binary</code> can only be called from a LispWorks for Macintosh image that is itself a universal binary, such as the distributed image.</p>
Example		<p>Suppose that you have saved two images, <code>my-application-intel</code> and <code>my-application-powerpc</code>, which contains the same application code loaded on an Intel Macintosh and a PowerPC Macintosh. The following command will combine them into a universal binary <code>my-application</code> that will run on both kinds of Macintosh:</p> <pre>(create-universal-binary "my-application" "my-application-intel" "my-application-powerpc")</pre>
See also		<p><code>save-image</code> <code>save-universal-from-script</code></p>

	<i>Function</i>
Summary	Returns the size of the current stack.
Package	<code>hcl</code>
Signature	<code>current-stack-length => stack-size</code>
Arguments	None
Values	<p><i>stack-size</i></p> <p>The current size of the stack, in 32 bit words (in 32-bit implementations) or 64-bit words (in 64-bit implementations).</p>
Compatibility note	In LispWorks 4.4 and previous on Windows and Linux platforms, <code>current-stack-length</code> was not implemented. This is fixed in LispWorks 5.0 and later.
Example	<code>(current-stack-length) => 16000</code>
See also	<code>extend-current-stack</code> <code>*sg-default-size*</code>

	<i>Variable</i>
Summary	List of packages that newly created packages use by default.
Package	<code>hcl</code>
Initial Value	<code>("CL" "LW" "HCL")</code>
Description	This variable is the default value of the <code>:use</code> keyword to <code>defpackage</code> , which specifies which existing packages the package being defined inherits from.

default-profiler-collapse *Variable*

Summary Controls collapsing of the profile tree.

Package `hcl`

Initial Value `nil`

Description The variable `*default-profiler-collapse*` is a boolean indicating whether the profile tree should collapse functions with only one child function. The default value is `nil`.

See also `print-profile-list`
`set-up-profiler`

default-profiler-cutoff *Variable*

Summary The minimum percentage that the profiler will display in the output tree.

Package `hcl`

Initial Value `0`

Description The variable `*default-profiler-cutoff*` is the minimum percentage (0 to 100) that the profiler will display in its output tree. Functions below this percentage will not be displayed. The initial value is 0, meaning display everything.

See also `print-profile-list`
`set-up-profiler`

default-profiler-limit *Variable*

Summary	The maximum number of lines of output that are printed during profiling.
Package	<code>hcl</code>
Initial Value	<code>100,000,000</code>
Description	<p><code>*default-profiler-limit*</code> is the maximum number of lines of output in profile results. The default value is large to ensure that you receive all possible output requested.</p> <p><code>*default-profiler-limit*</code> only counts output lines for functions that are actually called during profiling. Therefore, if <code>*default-profiler-limit*</code> is 19, and 20 functions were profiled, you would receive full output if one or more of the functions were not actually called during profiling.</p>
See also	<code>print-profile-list</code> <code>set-up-profiler</code>

default-profiler-sort *Variable*

Summary	The default sorting style for the profiler.
Package	<code>hcl</code>
Initial Value	<code>:profile</code>
Description	<p>The variable <code>*default-profiler-limit*</code> controls which column of the profiler's columnar report is used for sorting.</p> <p>The value can be one of <code>:profile</code>, <code>:call</code> or <code>:top</code>.</p>
See also	<code>print-profile-list</code> <code>set-up-profiler</code>

		<i>Function</i>
Summary	Defines a <code>hcl:special-global</code> parameter.	
Package	<code>hcl</code>	
Signature	<code>defglobal-parameter name initial-value &optional doc => name</code>	
Arguments	<p><i>name</i> A symbol.</p> <p><i>initial-value</i> A Lisp object.</p> <p><i>doc</i> A string.</p>	
Values	<i>name</i> A symbol.	
Description	The macro <code>defglobal-parameter</code> has the same semantics as <code>cl:defparameter</code> , but also declares the name <i>name</i> to be <code>hcl:special-global</code> .	
See also	<code>defglobal-variable</code>	

		<i>Function</i>
Summary	Defines a <code>hcl:special-global</code> variable.	
Package	<code>hcl</code>	
Signature	<code>defglobal-variable name &optional initial-value doc => name</code>	
Arguments	<p><i>name</i> A symbol.</p> <p><i>initial-value</i> A Lisp object.</p> <p><i>doc</i> A string.</p>	
Values	<i>name</i> A symbol.	

Description	The macro <code>defglobal-variable</code> has the same semantics as <code>cl:defvar</code> , but also declares the name <i>name</i> to be <code>hcl:special-global</code> .
See also	<code>defglobal-parameter</code>

delete-advice *Macro*

Summary	Removes a piece of advice.	
Package	<code>hcl</code>	
Signature	<code>delete-advice dspec name => nil</code> <code>dspec ::= fn-name macro-name </code> <code>(clos::method generic-fn-name [(class*)])</code>	
Arguments	<code>dspec</code>	Specifies the functional definition to which the piece of advice belongs. The specification contains the name of the associated function. In the case of a method the list of classes is used to identify from which particular method the advice should come. This list must correspond exactly with the classes corresponding to the specialized parameters for some method belonging to the generic function.
	<code>name</code>	A symbol naming the piece of advice to be removed. Since several pieces of advice may be attached to a single functional definition, the name is necessary to indicate which one is to be removed.
Values	<code>delete-advice</code> returns <code>nil</code> .	

Description	<code>delete-advice</code> is used to remove a piece of advice. Advice is a way of altering the behavior of functions. Pieces of advice are associated with a function using <code>defadvice</code> . They define additional actions to be performed when the function is invoked, or alternative code to be performed instead of the function, which may or may not access the original definition. As well as being attached to ordinary functions, advice may be attached to methods and to macros (in this case it is in fact associated with the macro's expansion function).
	<code>remove-advice</code> is a function, identical in effect to <code>delete-advice</code> , except that you need to quote the arguments.
Notes	<code>delete-advice</code> is an extension to Common Lisp.
See also	<code>defadvice</code> <code>remove-advice</code>

disable-trace		<i>Variable</i>
Summary	Controls tracing.	
Package	<code>hcl</code>	
Initial Value	<code>nil</code>	
Description	<code>*disable-trace*</code> controls tracing without affecting the tracing state. If it is set to <code>t</code> then tracing is switched off, but this does not call <code>untrace</code> . When the value of <code>*disable-trace*</code> is restored to <code>nil</code> , tracing continues as before.	
Notes	<code>*disable-trace*</code> is an extension to Common Lisp.	
See also	<code>trace</code>	

do-profiling	<i>Function</i>																				
Summary	A convenience function for profiling multiple threads, combining <code>start-profiling</code> and <code>stop-profiling</code> .																				
Package	<code>hcl</code>																				
Signature	<code>do-profiling &key initialize processes profile-waiting ignore-in-foreign sleep function arguments func-and-args print stream</code>																				
Arguments	<table> <tr> <td><i>initialize</i></td><td>A boolean.</td></tr> <tr> <td><i>processes</i></td><td>One of <code>:current</code>, <code>:all</code>, a <code>mp:process</code> or a list of <code>mp:process</code> objects.</td></tr> <tr> <td><i>profile-waiting</i></td><td>A boolean.</td></tr> <tr> <td><i>ignore-in-foreign</i></td><td>A boolean.</td></tr> <tr> <td><i>sleep</i></td><td>A non-negative number, or <code>nil</code>.</td></tr> <tr> <td><i>function</i></td><td>A function designator.</td></tr> <tr> <td><i>arguments</i></td><td>Arguments passed to <i>function</i>.</td></tr> <tr> <td><i>func-and-args</i></td><td>A function designator or a list (<i>function-designator</i> . <i>args</i>).</td></tr> <tr> <td><i>print</i></td><td>A generalized boolean.</td></tr> <tr> <td><i>stream</i></td><td>An output stream.</td></tr> </table>	<i>initialize</i>	A boolean.	<i>processes</i>	One of <code>:current</code> , <code>:all</code> , a <code>mp:process</code> or a list of <code>mp:process</code> objects.	<i>profile-waiting</i>	A boolean.	<i>ignore-in-foreign</i>	A boolean.	<i>sleep</i>	A non-negative number, or <code>nil</code> .	<i>function</i>	A function designator.	<i>arguments</i>	Arguments passed to <i>function</i> .	<i>func-and-args</i>	A function designator or a list (<i>function-designator</i> . <i>args</i>).	<i>print</i>	A generalized boolean.	<i>stream</i>	An output stream.
<i>initialize</i>	A boolean.																				
<i>processes</i>	One of <code>:current</code> , <code>:all</code> , a <code>mp:process</code> or a list of <code>mp:process</code> objects.																				
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<i>func-and-args</i>	A function designator or a list (<i>function-designator</i> . <i>args</i>).																				
<i>print</i>	A generalized boolean.																				
<i>stream</i>	An output stream.																				
Description	<p>The function <code>do-profiling</code> is a convenience function for profiling multiple threads, combining <code>start-profiling</code> and <code>stop-profiling</code>.</p> <p>The behavior of <code>do-profiling</code> with no arguments is the same as:</p> <pre>(progn (start-profiling :processes :all) (sleep 6) (stop-profiling))</pre>																				

The arguments *initialize*, *processes*, *profile-waiting* and *ignore-in-foreign* are passed to `start-profiling`. They have the same default values as for `start-profiling`, except *processes* which defaults to `:all`.

The arguments *print* and *stream* are passed to `stop-profiling`. They have the same default values as in `stop-profiling`.

sleep is the time to sleep in seconds. If *sleep* is `nil` or 0 `do-profiling` does not sleep. Also, if *sleep* is supplied and either *function* or *func-and-args* are passed, it does not sleep.

func-and-args, and *function* together with *arguments*, can both be used for calling a function you supply. *func-and-args* is either a list of the form `(function-designator . args)`, in which case *function-designator* is applied to the *args*, or it is a function designator which is called without arguments. *function* is applied to *arguments*.

The order of execution is first *func-and-args* (if this is non-nil), then *function* together with *arguments* if *function* is non-nil, and then sleep if *sleep* was passed explicitly or both *function* and *func-and-args* are `nil`.

Example

To profile whatever happens in the next 6 seconds:

```
(hcl:do-profiling)
```

To profile whatever happens in the next 10 minutes:

```
(hcl:do-profiling :sleep 600)
```

To run 4 processes in parallel with the same function and profile until they all die:

```

(defun check-all-processes-died (processes)
  (dolist (p processes t)
    (when (mp:process-alive-p p)
      (return nil)))

(let ((processes
       (loop for x below 4
             collect
             (mp:process-run-function
              (format nil "my process ~a" x)
              () 'my-function)))
      (hcl:do-profiling
       :func-and-args
       (list 'mp:process-wait
             "Waiting for processes to finish"
             'check-all-process-died
             processes)))

```

See also **[start-profiling](#)**
[stop-profiling](#)

dump-form *Function*

Summary	Dumps selected forms to a stream.					
Package	hcl					
Signature	dump-form form stream => nil					
Arguments	<table> <tr> <td><i>form</i></td> <td>Form to be dumped.</td> </tr> <tr> <td><i>stream</i></td> <td>Stream form is to be dumped to.</td> </tr> </table>		<i>form</i>	Form to be dumped.	<i>stream</i>	Stream form is to be dumped to.
<i>form</i>	Form to be dumped.					
<i>stream</i>	Stream form is to be dumped to.					
Values	Returns nil .					
Description	<p>dump-form is used in conjunction with with-output-to-fasl-file to dump selected forms. A dumped form is evaluated when loaded using load-data-file.</p> <p>See with-output-to-fasl-file for more details.</p>					

See also **dump-forms-to-file**
with-output-to-fasl-file

dump-forms-to-file *Function*

Summary Dumps specified forms to a fasl file.

Package **hcl**

Signature **dump-forms-to-file pathname forms => nil**

Arguments *pathname* Name of the fasl file to be created.
forms Forms to be dumped.

Values Returns **nil**.

Description **dump-forms-to-file** dumps specified forms to a fasl file. Use the Common Lisp functions **make-load-form** and **make-load-form-saving-slots** to control the dumping of forms.

The best way to specify the file type of the output file is to use **compile-file-pathname** as in the example below. The file types currently used by LispWorks for fasl files are listed in **compile-file**.

If the file *pathname* already exists, it is superseded.

A fasl file created using **dump-forms-to-file** must be loaded only by **load-data-file**, and not by **load**.

Example

```
(defclass my-class () ((a :initarg :a :accessor my-a))

(defmethod make-load-form ((self my-class) &optional
environment)
  (declare (ignore environment))
  `(make-instance ',(class-name (class-of self))
    :a ',(my-a self)))

(setq *my-instance* (make-instance 'my-class :a 42))
```

```
(dump-forms-to-file
  (compile-file-pathname "my-instance")
  (list `(setq *my-instance* ,*my-instance*)))
```

In another session, with the same definition of `my-class`, loading the file "my-instance" using `load-data-file` will create an equivalent instance of `my-class`:

```
(sys:load-data-file
  (compile-file-pathname "my-instance"))
```

See also [with-output-to-fasl-file](#)

enlarge-generation *Function*

Summary Enlarges a generation in 32-bit LispWorks.

Package `hcl`

Signature `enlarge-generation gen-num size => result`

Arguments `gen-num` A generation number.

`size` The amount (in bytes) by which the generation is to be enlarged.

Values `result` A boolean.

Description The function `enlarge-generation` enlarges generation `gen-num` by `size` bytes. If possible, an existing segment in generation `gen-num` is enlarged, otherwise a new segment of size `size` is added to the generation.

`result` is `t` on success and `nil` on failure.

This function is useful when it is known that a generation will need to grow. After `enlarge-generation` is called, the Garbage Collector is saved the work of deducing that the generation must grow.

`enlarge-generation` is most useful in non-interactive applications, where relatively long GC delays are not a problem. In this case, enlarging generations 0 and 1 by several Mb may improve the overall performance of the GC.

Note: `enlarge-generation` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations. In 64-bit implementations you can use `set-default-segment-size`.

See also `set-default-segment-size`

`enlarge-static` *Function*

Summary Enlarges the size of the first static segment in 32-bit LispWorks.

Package `hcl`

Signature `enlarge-static size => result`

Arguments `size` A non-negative `fixnum`.

Values `result` A boolean.

Description This function can be used when the system would otherwise allocate additional static segments. Such additional segments would cause the application to grow irreversibly.

`size` is the amount (in bytes) by which the static segment is to be enlarged. It is rounded up to a multiple of 64K.

`result` is `t` if the static segment was successfully enlarged, and `nil` otherwise.

Use `room`, with argument `t`, to find the size of the static segments, and thus the size by which to enlarge the first static segment.

Note: `enlarge-static` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where the irreversible growth problem described above does not exist.

See also `in-static-area`
 `room`
 `set-default-segment-size`
 `switch-static-allocation`

expand-generation-1 *Function*

Summary Controls expansion of generation 1 in 32-bit LispWorks.

Package `hcl`

Signature `expand-generation-1 on`

Arguments `on` `t`, `nil` or `1`.

Description The function `expand-generation-1` controls the subsequent behavior of the garbage collector when insufficient space is freed by a `mark-and-sweep`. When this occurs, either generation 1 is expanded, or the objects in it are promoted.

If `on` is `nil`, generation 1 is never expanded.

If `on` is `t`, generation 1 is always expanded (rather than promotion) when needed.

If `on` is `1`, generation 1 is only expanded if its current size is less than 500000 bytes. This is the initial setting.

Note: `expand-generation-1` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where you can use `set-default-segment-size`.

See also `clean-generation-0`
`collect-generation-2`
`collect-highest-generation`
`mark-and-sweep`
`set-default-segment-size`
`set-gc-parameters`

extend-current-stack *Function*

Summary	Extends the current stack.	
Package	<code>hcl</code>	
Signature	<code>extend-current-stack &optional how-much => size</code>	
Arguments	<code>how-much</code>	What percentage the stack should be extended by. The default is 50.
Values	<code>size</code>	The new size of the stack, after extending.
Description	Extend the current stack by the given percentage.	
Compatibility note	In LispWorks 4.4 and previous on Windows and Linux platforms, <code>extend-current-stack</code> is not implemented. This is fixed in LispWorks 5.0 and later.	
Example	To double the size of the current stack:	
	<pre>(hcl:extend-current-stack 100)</pre>	
See also	<code>current-stack-length</code> <code>*stack-overflow-behaviour*</code>	

extended-time *Macro*

Summary	Prints useful timing information, including information on garbage collection (GC) activity.			
Package	<code>hcl</code>			
Signature	<code>extended-time &body body</code>			
Arguments	<code>body</code>	The forms to be timed.		
Description	<p>The macro <code>extended-time</code> runs the forms in <code>body</code>. It then prints a summary of the time taken followed by a breakdown of time spent in the GC.</p> <p>The three columns of the GC breakdown show, respectively, total time, user time, and system time. The rows of the GC breakdown indicate the type of activity.</p>			
In 32-bit LispWorks these rows begin:				
<code>main promote</code> indicates promotions from generation 0.				
<code>internal promote</code>				
indicates when an attempt to promote from one generation to the next causes promotion of the higher generation, to make room for the objects from the lower generation.				
<code>fixup</code> is a part of the compaction and promotion process.				
In 64-bit LispWorks these rows begin:				
<code>Standard gen-num (n calls)</code>				
indicates <code>n</code> Standard GCs (includes automatic GCs and calls to <code>gc-generation</code>) in which the highest generation collected was <code>gen-num</code> .				
<code>Marking gen-num (n calls)</code>				

indicates *n* Marking GCs (includes calls to `marking-gc`) in which the highest generation collected was *gen-num*.

Thus in the example below

```
Standard 1 (6 calls) ...
```

indicates that there were 6 Standard GCs in which the highest generation collected was 1.

Example

This example illustrates output in 32-bit LispWorks:

```
CL-USER 2 > (extended-time (foo))
Timing the evaluation of (FOO)

User time      =      7.203
System time    =      0.046
Elapsed time   =      7.265
Allocation     = 84011236 bytes
0 Page faults
Calls to %EVAL    23000075

                                total / user / system
total gc activity           =2.125000/ 2.078125/ 0.046875
main promote (9 calls)      =1.640625/ 1.593750/ 0.046875
mark and sweep (12 calls)   =0.484375/ 0.484375/ 0.000000
internal promote (3 calls) =0.437500/ 0.421875/ 0.015625
promote (0 calls)          =0.000000/ 0.000000/ 0.000000
fixup (21 calls)           =0.562500/ 0.562500/ 0.000000
compact (0 calls)          =0.000000/ 0.000000/ 0.000000
537870911
```

This example illustrates output in 64-bit LispWorks:

```

CL-USER 2 > (extended-time (foo))
Timing the evaluation of (FOO)

User time      =        4.468
System time    =        0.208
Elapsed time   =        4.716
Allocation     = 96030696 bytes
0 Page faults

                                total      /  user      /  system
total gc activity      = 1.148826 /  0.959855 /  0.188971
Standard 1 (6 calls) = 0.761885 /  0.632905 /  0.128980
Standard 2 (1 calls) = 0.386941 /  0.326950 /  0.059991
1152921504607846975

```

See also [time](#)

file-string	<i>Function</i>						
Summary	Returns the contents of a file as a string.						
Package	<code>hcl</code>						
Signature	<code>file-string file &key length external-format => string</code>						
Arguments	<table> <tr> <td><i>file</i></td><td>A pathname, string or file-stream, designating a file.</td></tr> <tr> <td><i>length</i></td><td>The number of characters to return in <i>string</i>, or <code>nil</code> (the default).</td></tr> <tr> <td><i>external-format</i></td><td>An external format specification, default value <code>:default</code>.</td></tr> </table>	<i>file</i>	A pathname, string or file-stream, designating a file.	<i>length</i>	The number of characters to return in <i>string</i> , or <code>nil</code> (the default).	<i>external-format</i>	An external format specification, default value <code>:default</code> .
<i>file</i>	A pathname, string or file-stream, designating a file.						
<i>length</i>	The number of characters to return in <i>string</i> , or <code>nil</code> (the default).						
<i>external-format</i>	An external format specification, default value <code>:default</code> .						
Values	<i>string</i> A string containing characters from <i>file</i> .						
Description	Returns the entire contents of <i>file</i> (if <i>length</i> is <code>nil</code>), or the first <i>length</i> characters, as a string.						

Example `CL-USER 26 > file-string "configure.lisp" :length 18
";; -*- Mode: Lisp;"`

See also `guess-external-format`

file-writable-p *Function*

Summary Tests whether a file is writable.

Package `hcl`

Signature `file-writable-p file => result`

Arguments `file` A pathname, string or file-stream, designating a file.

Values `result` `t` or `nil`

Description Checks if *file* is writable. Note that this checks the properties of the file, so trying to write to the file may still fail if the file is non-writable for other reasons, for example if it is opened for writing by another program.

Example `CL-USER 44 > file-writable-p (sys:lispworks-file
"private-patches/load.lisp")
T`

find-object-size *Function*

Summary Returns the size in bytes of the representation of any Lisp object.

Package `hcl`

Signature `find-object-size object => size`

Arguments	<i>object</i>	Any Common Lisp form.
Values		<p>The result is an integer which is the number of bytes of heap storage currently used to represent the object. If the object takes up no heap storage (fixnum or character), then 0 is returned. Such objects are represented by an immediate value held in a single machine “word”.</p> <p>The size of a heap object includes hidden space required to hold type and other information; for instance, a string of 10 characters occupies more than 10 bytes of storage.</p>
Description		Certain Common Lisp objects are not represented by a single heap object; for instance, using <code>find-object-size</code> on a hash-table is misleading as the function returns the size of the hash-table descriptor, rather than the total of the descriptor and the hash-table-array. General vectors and arrays also have this property. All symbols are of the same size, since the print name is not part of a symbol object.
Example		<pre>USER 37 > (hcl:find-object-size (make-string 1000 :initial-element #\A)) 1012</pre>
See also		room total-allocation

finish-heavy-allocation		<i>Function</i>
Summary		Tells the system that allocation of many long-lived objects is over.
Package		<code>hcl</code>
Signature		<code>finish-heavy-allocation</code>

Description	<p>The function <code>finish-heavy-allocation</code> tells the system that the application finished doing 'heavy' allocation, and from that point onwards allocation is 'normal'. The main distinction between heavy and normal allocation is the typical lifetime of objects: normal allocation means most of new objects are ephemeral, while heavy allocation a large proportion of the new objects are long-lived.</p> <p>Heavy allocation normally happens when loading, either the application itself or large amount of data. Operations that do not involve loading will almost always be normal. Hence the time that is useful to call <code>finish-heavy-allocation</code> is after loading something.</p>
See also	<code>with-heavy-allocation</code>

	<i>Function</i>		
Summary	Unflags an object for special action on garbage collection.		
Package	<code>hcl</code>		
Signature	<code>flag-not-special-free-action <i>object</i> => nil</code>		
Arguments	<table> <tr> <td><i>object</i></td> <td>The object on which the special actions are to be removed.</td> </tr> </table>	<i>object</i>	The object on which the special actions are to be removed.
<i>object</i>	The object on which the special actions are to be removed.		
Values	Returns <code>nil</code> .		
Example	<pre>CL-USER 29 : 1 > (make-instance 'capi:title-pane) #<CAPI:TITLE-PANE "" 20F9898C> CL-USER 30 : 1 > (flag-not-special-free-action *) NIL</pre>		
See also	<code>add-special-free-action</code> <code>flag-special-free-action</code> <code>remove-special-free-action</code>		

	<i>Function</i>
Summary	Flags an object for special action on garbage collection.
Package	<code>hcl</code>
Signature	<code>flag-special-free-action <i>object</i> => t</code>
Arguments	<i>object</i> The object on which the special actions are to be performed. This cannot be a symbol.
Values	Returns <code>t</code> .
Description	Note that all the current special-free-action functions are performed on the object. Use <code>flag-not-special-free-action</code> to unflag an object.
Example	<pre>CL-USER 29 > (make-instance 'capi:title-pane) #<CAPI:TITLE-PANE "" 20F9898C> CL-USER 30 > (flag-special-free-action *) T</pre>
See also	<code>add-special-free-action</code> <code>flag-not-special-free-action</code> <code>remove-special-free-action</code>

	<i>Function</i>
Summary	Does a Copying GC.
Package	<code>hcl</code>
Signature	<code>gc-generation <i>gen-num</i> &key coalesce promote <i>block</i> => <i>allocation</i></code>
Arguments	<i>gen-num</i> An integer between 0 and 7 inclusive, or <code>t</code> .

	<i>coalesce</i>	A generalized boolean.
	<i>promote</i>	A generalized boolean.
	<i>block</i>	An integer between 0 and 7, inclusive, or one of the keywords <code>:blocking-gen-num</code> and <code>:all</code> .
Values	<i>allocation</i>	The total allocation in generation <i>gen-num</i> and younger generations.
Description	<p>The function <code>gc-generation</code> does a Garbage Collection of a specific generation. The actual operation is different between 64-bit LispWorks and 32-bit LispWorks.</p> <p><i>gen-num</i> should be a valid generation number, or <code>t</code>. The value <code>t</code> is mapped to the blocking generation number in 64-bit LispWorks, and to <code>2</code> in 32-bit LispWorks. For backwards compatibility the keyword <code>:blocking-gen-num</code> is also accepted, with the same meaning as <code>t</code>.</p> <p>It is especially helpful to GC the blocking generation (or other higher generations) when large, long-lived data structures become garbage. This is because higher generations are rarely collected by default. For the higher generations, the GC takes longer but recovers more space.</p> <p>Another situation which may require <code>gc-generation</code> is when objects are marked for special free action (by <code>flag-special-free-action</code>). If such objects live long enough to be promoted to higher generation, they may not be GCed long after there are no pointers to them. If the free action is important, you may need to periodically GC higher generation (typically the blocking generation, by passing <i>gen-num t</i>).</p>	

Operation in 64-bit LispWorks

By default `gc-generation` operates on the live objects in generation *gen-num* and all lower generations at or above the generation specified by *block* by copying them inside their current generation, and it operates on the live objects in

generations lower than *block* by copying them to the next higher generation.

If *promote* is non-nil, the live objects in generation *gen-num* are also promoted to the next generation. That is the same operation that happens when the GC is invoked automatically. The default value of *promote* is nil.

If *coalesce* is non-nil, all non-static live objects in lower generations are promoted to generation *gen-num*. That is what `clean-down` does (with *gen-num* being the highest generation). It may be useful directly in some cases. The default value of *coalesce* is nil.

block specifies a generation number up to which to promote. An integer value specifies the generation number. If *block* is :blocking-gen-num, then `gc-generation` promotes up to the blocking generation. If *block* is :all, then `gc-generation` promotes nothing. The default value of *block* is :blocking-gen-num.

`gc-generation` is useful when you know points in your application where many objects tend to die, or when you know that that application is less heavily loaded at some time. Typically many objects die in the end (or beginning) of an iteration in a top level loop of the application, and that is normally a useful place to put a call to `gc-generation` of generation 2 or generation 3. If you know a time when the application can spend time GCing, a call to `gc-generation` with a higher value of *gen-num* may be useful. It is probably never really useful to use `gc-generation` on generation 0 or 1.

To decide on which *gen-num* to call `gc-generation`, check which generation gets full by making periodic calls to `room`.

`gc-generation` with *promote* or *coalesce* may also be useful to move objects from the blocking generation to higher generations, which does not happen automatically (except when saving the image). For example, after loading a large amount

of code, and before generating any data that may die shortly, assuming the blocking generation is 3, it may be useful to do:

```
(gc-generation 4 :coalesce t)
```

to move all (non-static) objects to generation 4, where they will not be touched by the GC any more (except following pointers to younger generations).

Operation in 32-bit LispWorks

`gc-generation` marks and sweeps the generation *gen-num* and all generations below, and then does some additional cleanups. *coalesce*, *promote* and *block* are ignored.

Compatibility note In 32-bit LispWorks, `gc-generation` simply calls `mark-and-sweep`. This has a similar effect, but two significant differences must be noted:

1. by default, `gc-generation` promotes the young generations, so repeated calls to `gc-generation` will promote everything to generation *gen-num* or generation *block* (whichever is lower). In contrast `mark-and-sweep` never promotes.
2. In 32-bit LispWorks, generation 2 is the blocking generation. In 64-bit LispWorks, the default blocking generation is generation 3. That is because the 64-bit implementation promotes faster and so needs more generations before the block.

Also note that

```
(gc-generation t)
```

is intended as the replacement of

```
(mark-and-sweep 2)
```

See also

`clean-down`
`mark-and-sweep`
`marking-gc`
`set-blocking-gen-num`

	<i>Function</i>
Summary	Garbage collects if the previous call requires more space than is actually available in 32-bit LispWorks.
Package	<code>hcl</code>
Signature	<code>gc-if-needed => nil</code>
Arguments	None.
Values	Returns <code>nil</code> .
Description	This function checks to see if the amount of allocation from the previous call is more than <code>system:*allocation-interval*</code> , and if it is, performs a mark and sweep and promotion on generation 0. It also tries to reduce the big-chunk area. This is a fairly brief operation, and can be used whenever some operation is finished and may have left some garbage. The system itself uses it after compiling and loading files, when waiting for input, etc.
	Note: This function does nothing in 64-bit LispWorks.
See also	<code>avoid-gc</code> <code>get-gc-parameters</code> <code>mark-and-sweep</code> <code>normal-gc</code> <code>set-gc-parameters</code> <code>without-interrupts</code> <code>with-heavy-allocation</code>

	<i>Function</i>
Summary	Returns the current default generation.
Package	<code>hcl</code>

Signature	<code>get-default-generation => default-gen</code>
Arguments	None.
Values	Returns the current default.
Description	By default, all new objects are allocated to a specific generation. This function returns the current value of this default generation.
	Note: in 64-bit LispWorks, <code>get-default-generation</code> returns 0.
See also	<code>allocation-in-gen-num</code> <code>clean-generation-0</code> <code>collect-generation-2</code> <code>collect-highest-generation</code> <code>expand-generation-1</code> <code>set-default-generation</code> <code>*symbol-alloc-gen-num*</code>

get-gc-parameters *Function*

Summary	Returns the current values of various garbage collector parameters in 32-bit LispWorks.	
Package	<code>hcl</code>	
Signature	<code>get-gc-parameters parameters => values</code>	
Arguments	<code>parameters</code>	A keyword representing a single GC parameter. Any other value means all parameters.
Values	<code>values</code>	If <code>parameters</code> specifies a single GC parameter, the value of that parameter is returned. Otherwise <code>values</code> is an alist containing every GC parameter, together with its current value.

Description	See <code>set-gc-parameters</code> for a full description of these parameters. With keyword argument, of one of the parameters, the corresponding value is returned.
	Note: <code>get-gc-parameters</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.
Example	<pre>CL-USER 1 > (get-gc-parameters :minimum-overflow) 500000 CL-USER 2 > (pprint (get-gc-parameters t)) ((:ENLARGE-BY-SEGMENTS . 10) (:MINIMUM-FOR-PROMOTE . 1000) (:MAXIMUM-OVERFLOW . 1000000) (:MINIMUM-OVERFLOW . 500000) (:MINIMUM-BUFFER-SIZE . 200) (:NEW-GENERATION-SIZE . 262144) (:PROMOTE-MAX-BUFFER . 100000) (:PROMOTE-MIN-BUFFER . 200) (:MAXIMUM-BUFFER-SIZE . 131072) (:MINIMUM-FOR-SWEEP . 8000) (:BIG-OBJECT . 131072))</pre>
See also	<code>set-gc-parameters</code>

		<i>Function</i>
Summary	Returns a directory that can be used for temporary files.	
Package	<code>hcl</code>	
Signature	<code>get-temp-directory => directory</code>	
Values	<code>directory</code>	A pathname

Description The function `get-temp-directory` returns a directory which is likely to be writable and can be used for temporary files.

See also `example-compile-file`

get-working-directory *Function*

Summary Finds the current working directory.

Package `hcl`

Signature `get-working-directory => cwd`

Arguments None.

Values `cwd` The current working directory, as a pathname.

Description This function is used to find the current working directory. It returns a pathname, the directory component of which is the current working directory.

Example `CL-USER 1 > (get-working-directory)
#P"/u/dubya/"`

See also `cd`
`change-directory`

handle-existing-defpackage *Variable*

Summary Controls LispWorks' response when `defpackage` is used on an existing package that is different from the definition given.

Package `hcl`

Initial value	(:warn :modify)
Description	The standard explicitly declines to define what <code>defpackage</code> does if the named package already exists and is in a different state to that described by the <code>defpackage</code> form. The variable <code>*handle-existing-defpackage*</code> is an extension to Common Lisp which allows you to select between alternative behaviors that are known to be useful.

The two alternatives are to modify the package to conform exactly to the definition, removing features if necessary, or to merely add features specified in the `defpackage` but missing from the package. You can also control whether a condition is signalled.

The variable consists of a list of any of the following:

- `:error` Signal an error.
- `:warn` Signal a warning.
- `:add` Add the new symbols to the externals, imports, and so on.
- `:modify` Modify the package to have only these externals.
- `:verbose` The signalled errors or warnings also contain details of the differences.

The options `:error` and `:warn` cannot be specified at the same time. One of `:add` and `:modify` must be specified. Undistinguished internals (that is, internal symbols that are not imported or shadowed), `:intern` options and sizes are ignored when deciding whether to signal.

Note that when you use `:modify` some symbols can be uninterned if `defpackage` imports another symbol with the same name from another package through `:import-from`, `:shadowing-import-from` or `:export`. This happens whether the symbol has a definition as a function, a variable, or nay other Lisp construct, so after making such a change in the package,

you should re-execute the definitions that were (presumably erroneously) attached to the uninterned symbols.

Notes	<code>*handle-existing-defpackage*</code> is an extension to Common Lisp.
See also	<code>defpackage</code>

handle-old-in-package *Variable*

Summary Controls the handling of CLtL1-style `in-package` forms.

Package `hcl`

Initial Value `:warn`

Description The variable `*handle-old-in-package*` controls what happens when a CLtL1-style `in-package` form is processed. This refers to the specification in Common Lisp the Language, first Edition, which preceded ANSI Common Lisp and specified `in-package` as a function with keyword arguments.

The allowed values are as follows:

`:quiet` Quietly use the CLtL1 definition of the `in-package` function.

`:warn` Signal a warning and use the old definition.

`:error` Signal a continuable error.

See also `*handle-old-in-package-used-as-make-package*`

handle-old-in-package-used-as-make-package *Variable*

Summary Controls the handling of CLtL1-style `in-package` forms.

Package	<code>hcl</code>
Initial Value	<code>:quiet</code>
Description	The variable <code>*handle-old-in-package-used-as-make-package*</code> controls what happens when a CLtL1-style <code>in-package</code> form which attempts to create a package is processed. This refers to the specification in Common Lisp the Language, first Edition, which preceded ANSI Common Lisp and specified <code>in-package</code> as a function with keyword arguments.
	The allowed values are as follows:
	<code>:quiet</code> Handle according to the value of <code>*handle-old-in-package*</code> .
	<code>:warn</code> Signal a warning and create the package.
	<code>:error</code> Signal a continuable error.
See also	<code>*handle-old-in-package*</code>

<code>*load-fasl-or-lisp-file*</code>		<i>Variable</i>
Summary	Controls the behavior of <code>load</code> for untyped pathnames.	
Package	<code>hcl</code>	
Description	The variable <code>*load-fasl-or-lisp-file*</code> determines whether <code>(load "foo")</code> should load the binary file <code>(foo.ofasl, foo.ufasl, foo.xfasl</code> etc, depending on platform) or <code>foo.lisp</code> , when both exist. It may take the following values:	
	<code>:load-newer</code> If the fasl is out-of-date, the lisp file is loaded, and a warning message is output in verbose mode.	
	<code>:load-newer-no-warn</code>	

		Like <code>:load-newer</code> , but without the warning.
<code>:load-fasl</code>		Always choose fasl files in preference to lisp files, but when verbose, warn if the lisp file is newer.
<code>:load-fasl-no-warn</code>		Like <code>:load-fasl</code> , but without the warning.
<code>:load-lisp</code>		Always choose lisp files in preference to fasl.
<code>:recompile</code>		If the fasl file is out-of-date or there is none, compile and load the new fasl.
<code>:maybe-recompile</code>		If the fasl is out-of-date, queries whether to load it, recompile and then load it, or load the lisp file.

Initial Value `:load-fasl`

		<i>Function</i>
Summary		Garbage collects a specified generation in 32-bit LispWorks.
Package		<code>hcl</code>
Signature		<code>mark-and-sweep gen-number => bytes</code>
Arguments	<code>gen-number</code>	0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.
Values	<code>bytes</code>	The number of bytes allocated in that generation.
Description		<code>mark-and-sweep</code> is used to garbage-collect a specified generation of storage (and all lower generations). A call to this func-

tion forces the garbage collector to scan the specified generations. This can be of use in obtaining consistent timings of programs that require memory allocation. Alternatively, performance can sometimes be improved by forcing a garbage collection, when it is known that little memory has been allocated since a previous collection, rather than waiting for a later, more extensive collection. For example, the function could be called outside a loop that allocates a small amount of memory.

It is specially helpful to mark and sweep generation 2 when large, long-lived data structures become garbage, because by default it is never marked and swept. The higher the generation number the more time the `mark-and-sweep` takes, but also the more space recovered.

Note: `mark-and-sweep` is implemented only in 32-bit Lisp-Works. It is not relevant to the Memory Management API in 64-bit implementations. In 64-bit implementations you can use `gc-generation` or `marking-gc`.

Examples `(mark-and-sweep 0) ; collect most recent generation`
 `(mark-and-sweep 3) ; collect all generations`

See also `avoid-gc`
 `block-promotion`
 `get-gc-parameters`
 `gc-if-needed`
 `normal-gc`
 `set-array-weak`
 `set-gc-parameters`
 `set-hash-table-weak`
 `without-interrupts`
 `with-heavy-allocation`

max-trace-indent	<i>Variable</i>
Summary	The maximum level of indentation used in trace output.
Package	<code>hcl</code>
Initial value	50
Description	<code>*max-trace-indent*</code> is the maximum indentation that is used during output from tracing. Typically each successive invocation of tracing causes the output to be further indented, making it easier to see how the calls are nested. The value of <code>*max-trace-indent*</code> should be an integer.
Example	<pre>USER 8 > (setq hcl:*max-trace-indent* 4) 4 USER 9 > (defun sum (n res) (if (= n 0) res (+ n (sum (1- n) res)))) SUM USER 10 > (trace sum) SUM USER 11 > (sum 3 0) 0 SUM > (3 0) 1 SUM > (2 0) 2 SUM > (1 0) 3 SUM > (0 0) 3 SUM < (0) 2 SUM < (1) 1 SUM < (3) 0 SUM < (6) 6</pre>
Notes	<code>*max-trace-indent*</code> is an extension to Common Lisp.
See also	<code>trace</code>

modify-hash *Function*

Summary Reads and writes an entry in a hash table atomically.

Package `hcl`

Signature `modify-hash hash-table key function => new-value, key`

Arguments `hash-table` A hash table.

`key` An object.

`function` A function designator.

Values `new-value` An object.

`key` An object.

Description The function `modify-hash` locks the hash table `hash-table`. It then calls the function `function` with three arguments: `key`, the value currently associated with `key` in `hash-table` (if any), and a flag which is true if the key was in the table. (This last argument is needed in case the associated value is `nil`).

`modify-hash` then sets the result of the function `function` as the value for `key` in the table. `modify-hash` returns two values, the `new-value` and the `key`.

The overall effect is like:

```
(with-hash-table-locked
  hash-table
  (multiple-value-bind (value found-p)
    (gethash key hash-table)
    (let ((new-value (funcall function
                               key value found-p)))
      (setf (gethash key hash-table) new-value)
      (values new-value key))))
```

but `modify-hash` should be more efficient.

It is guaranteed that no other thread can modify the value associated with `key` until `modify-hash` returns.

Notes	<i>function</i> is called with <i>hash-table</i> locked, so it should not do anything that may require hanging the modification, or that waits for another process that tries to modify the table.
See also	<code>make-hash-table</code> <code>with-hash-table-locked</code>

normal-gc *Function*

Summary	Returns the image to normal garbage collection activity in 32-bit LispWorks.
Package	<code>hcl</code>
Signature	<code>normal-gc => t</code>
Arguments	None.
Values	The function returns the single result <code>t</code> .
Description	<p><code>normal-gc</code> resets various internal parameters that determine the frequency and extent of garbage collection to their default settings.</p> <p><code>normal-gc</code> is generally used in conjunction with <code>avoid-gc</code>, to cancel the effects of the latter.</p> <p>Note: <code>normal-gc</code> is useful only in 32-bit LispWorks. In 64-bit implementations it does nothing and simply returns nil.</p>

See also	<code>avoid-gc</code> <code>get-gc-parameters</code> <code>gc-if-needed</code> <code>mark-and-sweep</code> <code>set-gc-parameters</code> <code>without-interrupts</code> <code>with-heavy-allocation</code>
----------	--

packages-for-warn-on-redefinition		<i>Variable</i>
Summary	List of packages whose symbols should be checked for definitions.	
Package	<code>hcl</code>	
Initial Value	A list containing "COMMON-LISP" and other package names.	
Description	<p>LispWorks detects attempts to define external symbols in the packages on the list <code>*packages-for-warn-on-redefinition*</code>.</p> <p>LispWorks, as distributed, is configured to protect the COMMON-LISP package and other system packages.</p> <p>In particular, the effect of including "COMMON-LISP" in the list value of <code>*packages-for-warn-on-redefinition*</code> is to make all COMMON-LISP symbols be reserved words in respect of definitions and bindings. LispWorks is configured like this because ANSI Common Lisp states that the consequences of such definitions and bindings are undefined. Therefore they are best avoided.</p> <p>The action taken by LispWorks on such attempted definitions depends on the value of <code>*handle-warn-on-redefinition*</code>.</p>	
See also	<code>*handle-warn-on-redefinition*</code>	

parse-float		<i>Function</i>
Summary	Parses a float from a string and returns it as float.	
Package	<code>hcl</code>	
Signature	<code>parse-float string &key start end default-format -> float</code>	

Arguments	<i>string</i>	A string
	<i>start, end</i>	Bounding index designators for <i>string</i>
	<i>default-format</i>	One of the atomic type specifiers <code>short-float</code> , <code>single-float</code> , <code>double-float</code> , or <code>long-float</code> .
Values	<i>float</i>	A float
Description		<p>The function <code>parse-float</code> parses a float from the substring of <i>string</i> delimited by <i>start</i> and <i>end</i> and returns it as <i>float</i>.</p> <p>If the substring represents an integer or the exponent marker is E or is omitted, then <i>float</i> will be of type <i>default-format</i>, which defaults to the value of <code>*read-default-float-format*</code>. Otherwise, its type will match the exponent marker as specified by 2.3.2.2 "Syntax of a Float" in the Common Lisp standard.</p> <p>If the substring does not represent an integer or a float, then an error of type <code>parse-error</code> is signalled.</p>
Examples		<pre>(parse-float "10") => 10.0f0 (parse-float "10" :default-format 'double-float) => 10.0d0 (parse-float "10d0") => 10.0d0 (parse-float "10.5") => 10.5f0 (parse-float "10.5d0") => 10.5d0</pre>

		<i>Function</i>
Summary		Prints a report of symbols that have been profiled.
Package		<code>hcl</code>
Signature		<code>print-profile-list &key sort limit cutoff collapse => nil</code>

Arguments	<i>sort</i>	:call, :profile or :top
	<i>limit</i>	An integer.
	<i>collapse</i>	A generalized boolean.
	<i>cutoff</i>	A real number.
Values	<code>print-profile-list</code> returns nil.	
Description	<p>The function <code>print-profile-list</code> prints a report of symbols, after profiling using <code>profile</code>, or <code>start-profiling</code> followed by <code>stop-profiling</code>.</p> <p>If the profiler was set up with <code>style :tree</code>, then a tree of calls is printed first, according to <i>limit</i>, <i>cutoff</i> and <i>collapse</i>. Then a columnar report is printed showing how often each function was called, profiled and found on the top of the stack. This report is sorted by the column indicated by the value of <i>sort</i>.</p> <p>If the profiler was set up with <code>style :list</code>, then only the columnar report is printed.</p> <p><i>sort</i> can take these values:</p> <ul style="list-style-type: none"> :call Sort by the number of times the function was called. :profile Sort by the number of times the function was found on the stack. :top Sort by the number of times the function was found at the top of the stack. <p>If <i>sort</i> is not passed then the results are printed as after the profiling run. The default is the value of the variable <code>*default-profiler-sort*</code>.</p> <p><i>limit</i> is the maximum number of lines printed in the columnar report as described for <code>*default-profiler-limit*</code>. The default is the value of the variable <code>*default-profiler-limit*</code>.</p>	

cutoff is the minimum percentage that the profiler will display in the output tree as described for ***default-profiler-cutoff***. The default is the value of the variable ***default-profiler-cutoff***.

collapse controls collapsing of the output tree as described for ***default-profiler-collapse***. The default is the value of the variable ***default-profiler-collapse***.

Example First set up the profiler :

```
CL-USER 1 > (set-up-profiler
                 :symbols
                 '(cadr car eql fixnump + 1+ caaddr caddr))

CL-USER 2 > (profile (dotimes (a 1000000 nil)
                         (+ a a)
                         (car '(foo))))
```

Then call **print-profile-list**:

```
CL-USER 3 > (print-profile-list :sort :call)
```

```
profile-stacks called 327 times
```

```
Cumulative profile summary
```

Symbol	called	profile
(%)	top (%)	
CADR	5000012	13
(4)	13 (4)	
CDDR	3000000	3
(1)	3 (1)	
EQL	2000202	4
(1)	4 (1)	
FIXNUMP	2000003	2
(1)	2 (1)	
CAR	1000000	1
(0)	1 (0)	
+	1000000	3
(1)	3 (1)	
CAADR	1000000	2
(1)	2 (1)	
1+	1000000	2
(1)	2 (1)	

```
Top of stack not monitored 91% of the time
```

```
NIL
```

Notes

You can suppress printing of those symbols that are currently profiled but which were not called in the profiling run by setting `system:*profiler-print-out-all*` to `nil`.

`system:*profiler-print-out-all*` is a variable defined when the profiler is loaded by `set-up-profiler`. Its initial value is `nil`.

See also

- `*default-profiler-collapse*`
- `*default-profiler-cutoff*`
- `*default-profiler-limit*`
- `*default-profiler-sort*`

profile	<i>Macro</i>
Summary	Runs the specified forms, and prints a performance profile.
Package	<code>hcl</code>
Signature	<code>profile &body forms => final</code>
Arguments	<p><i>forms</i> The forms making up the program being profiled.</p>
Values	<i>final</i> The result of evaluating the final form.
Description	<p>This macro starts up the LispWorks program profiler. This tool is useful for determining the time critical elements of a program.</p> <p>At a regular time interval the Lisp process is halted and the execution stack is scanned for the presence of any symbols in the list <code>*profile-symbol-list*</code>. Counters are maintained for the number of calls to each symbol, the total number of times the symbol is found on the stack, and the number of times the profiler finds the symbol on the top of the stack.</p> <p>This information is then presented as absolute numbers and as a percentage of the total number of calls to the profiler. These figures taken together give useful information about which functions the program spends most of its time executing.</p>

Examples

```

USER 22 > (set-up-profiler
             :symbols '(* gethash typep maphash))
NIL
USER 23 > (profile (let ((x 1))
                      (loop for a from 1 to 50 by 1
                            do (setq x (* a x))
                            finally (return x))))
profile-stacks called 12 times
Symbol           called  profile (%)  top
(%)
MAPHASH          1      0      (0)
0 (0)*           50     1      (8)
0 (0)
SYSTEM::DUMMY-STRUCTURE-ACCESSOR 6      0      (0)
0 (0)
SYSTEM::DUMMY-STRUCTURE-SETTER   9      0      (0)
0 (0)
TYPEP            19     1      (8)
0 (0)
GETHASH          78     3      (25)
3 (25)
Top of stack not monitored 75% of the time
3041409320171337804361260816606476884437764156896051200
0000000000

```

See also

- `print-profile-list`
- `*profile-symbol-list*`
- `set-up-profiler`

profiler-threshold *Variable*

Summary	Controls which symbols are profiled on repeated profiling runs.
Package	<code>hcl</code>
Description	<code>*profiler-threshold*</code> is used with repeated profiling runs, to control which symbols are profiled. It is set by <code>set-profiler-threshold</code> .

See also **`set-profiler-threshold`**

profile-symbol-list *Variable*

Summary The list of symbols to be profiled.

Package **hcl**

Description ***profile-symbol-list*** is the list of symbols that are profiled if `profile` is called. Symbols in this list are monitored by the profiler to see if their function objects are on the stack when the profiler interrupts the Lisp process. The length of this list does not affect the speed of the profiling run.

Initial Value **nil**

Notes ***profile-symbol-list*** should normally be set by one of the above functions which check that the symbol is suitable for profiling before adding them to the list.

See also **`add-symbol-profiler`**
`remove-symbol-profiler`
`set-up-profiler`

profiler-tree-from-function *Function*

Summary Prints a call tree of profiled code below a given function.

Package **hcl**

Signature **`profiler-tree-from-function` *function-name* &optional *max-depth***

Arguments *function-name* A symbol naming a function.

max-depth A number or `nil`.

Description	<p>The function <code>profiler-tree-from-function</code> prints a tree with root <i>function-name</i> whose children are the callees of <i>function-name</i> and their callees.</p> <p><code>profiler-tree-from-function</code> uses the data from the previous 'profile session' with style <code>:tree</code>. A profile session ends at the end of <code>profile</code> or when <code>stop-profiling</code> is called, or when the Profiler tool finishes profiling.</p> <p>In both cases the counts of profile calls is the total counts of the calls to <i>function-name</i>. Note that the percentages (the number in parentheses) are percentages from the total number of profile calls, rather than from the numbers of calls to <i>function-name</i>.</p> <p>If <i>max-depth</i> is a number it limits the depth of tree that is printed to that value. The default value of <i>max-depth</i> is <code>nil</code>, meaning no limit on the depth that is printed.</p>
See also	<code>profile</code> <code>start-profiling</code> <code>stop-profiling</code>

profiler-tree-to-function *Function*

Summary	Prints a reversed call tree of profiled code below a given function.	
Package	<code>hcl</code>	
Signature	<code>profiler-tree-to-function <i>function-name</i> &optional <i>max-depth</i></code>	
Arguments	<i>function-name</i>	A symbol naming a function.
	<i>max-depth</i>	A number or <code>nil</code> .
Description	The function <code>profiler-tree-to-function</code> prints a tree with root <i>function-name</i> whose children are the callers of <i>function-name</i> .	

name and their callers. Note that the tree is reversed, that is, callers appear under their callees.

`profiler-tree-to-function` uses the data from the previous 'profile session' with style `:tree`. A profile session ends at the end of `profile` or when `stop-profiling` is called, or when the Profiler tool finishes profiling.

In both cases the counts of profile calls is the total counts of the calls to *function-name*. Note that the percentages (the number in parentheses) are percentages from the total number of profile calls, rather than from the numbers of calls to *function-name*.

max-depth limits the depth of tree that is printed. If *max-depth* is `nil` there is no limit on the depth that is printed. The default value of *max-depth* is 7.

See also

`profile`
`profiler-tree-from-function`
`stop-profiling`

		<i>Function</i>
Summary		Lists special variables referenced by a definition.
Package		<code>hcl</code>
Signature		<code>references-who function => result</code>
Arguments	<i>function</i>	A symbol or a function dspec.
Values	<i>result</i>	A list.
Description		The function <code>references-who</code> returns a list of the special variables referenced by the definition named by <i>function</i> .

Note: The cross-referencing information used by `references-who` is generated when code is compiled with source-level debugging switched on.

See also `toggle-source-debugging`
 `who-references`

remove-special-free-action *Function*

Summary Removes the specified function from the special actions performed when flagged objects are garbage collected.

Package `hcl`

Signature `remove-special-free-action function => function-list`

Arguments `function` The function to be removed.

Values `function-list` A list of the functions currently called to perform special actions, not including the one just removed.

Description Removes the specified function from the special actions performed when flagged objects are garbage-collected. (The special actions are added by `add-special-free-action`.)

See also `add-special-free-action`
 `flag-special-free-action`
 `flag-not-special-free-action`

remove-symbol-profiler *Function*

Summary Removes a symbol from the list of profiled symbols.

Package `hcl`

Signature	<code>remove-symbol-profiler symbol => nil</code>	
Arguments	<code>symbol</code>	A symbol to be removed from the <code>*profile-symbol-list*</code> .
Values	Returns <code>nil</code> .	
Description	<code>remove-symbol-profiler</code> removes a symbol from <code>*profile-symbol-list*</code> , the list of profiled symbols.	
See also	<code>add-symbol-profiler</code> <code>*profile-symbol-list*</code>	

reset-profiler *Function*

Summary	Resets the profiler so that symbols below a given threshold are no longer profiled.	
Package	<code>hcl</code>	
Signature	<code>reset-profiler &key according-to => nil</code>	
Arguments	<code>according-to</code>	One of two values — <code>:profile</code> or <code>:top</code> . This refers to which column of the profiling results <code>reset-profiler</code> uses to determine which symbols to delete from <code>*profile-symbol-list*</code> . The default is <code>:profile</code> .
Values	<code>reset-profiler</code> returns <code>nil</code> .	
Description	This function updates the list of symbols being profiled according to the results of the previous profiling run. <code>reset-profiler</code> runs down the list of symbols being profiled and removes any symbols whose appearance in the previous profiling run falls below the value <code>*profiler-threshold*</code> . In	

this way the number of symbols being considered by the profiler can be reduced to just those which are important.

Example `(reset-profiler :according-to :top)`

Notes Reducing the number of symbols in `profile-symbol-list` does not actually speed up the execution of the form being profiled, but does reduce the setting up time of the profiler and the size of the list of results.

See also `profile`
 `*profiler-threshold*`
 `print-profile-list`
 `set-profiler-threshold`

save-argument-real-p *Function*

Summary Used to determine if a build script knows the real name of the image being saved.

Package `hcl`

Signature `save-argument-real-p => realp`

Arguments None

Values `realp` A boolean.

Description The function `save-argument-real-p` can be used in a build script to determine if the argument passed to a subsequent call to `save-image` or `deliver` is the real filename of the application.

The return value `realp` is `t` in most cases. It is `nil` only when building an intermediate image for the purpose of building a universal binary, either by `save-universal-from-script` or the Application Builder (see the *LispWorks IDE User Guide*).

Operations in a build script that are related to the path of the saved image, such as building an application bundle, should be executed only when this function returns t. When using `save-universal-from-script`, any required application bundle should be created before calling that function (see the `save-macos-application.lisp` example below). When using the Application Builder, any required application bundle should be created in the build script only when `save-argument-real-p` returns t.

On architectures that do not have universal binaries, this function always returns t.

Example `examples/configuration/save-macos-application.lisp`

See also `save-universal-from-script`
`building-universal-intermediate-p`
`deliver`
`save-image`
`save-image-with-bundle`

save-current-session *Function*

Summary Saves the LispWorks session.

Package `hcl`

Signature `save-current-session pathname &rest save-image-args => result`

Arguments `pathname` A pathname designator.
`save-image-args` Arguments.

Values `result` A boolean.

Description The function `save-current-session` closes all windows and stops multiprocessing, saves an image at the location sup-

plied in *pathname*, and restarts multiprocessing and the windows. For more information see “Saved sessions” on page 133.

`save-image-args` are passed to the saving function, which is `save-image` on Windows, GTK and Motif, or `save-image-with-bundle` on Cocoa.

`save-current-session` returns `nil` if the pathname supplied is unacceptable (not writable), otherwise it returns `t`. The actual operation is done asynchronously.

- Notes
1. `save-current-session` is intended for saving the state of a windowing image. Whilst `save-current-session` can be used to save a session in a console image, this achieves nothing more than `save-image`.
 2. The released LispWorks image runs the default session. Therefore after you have used `save-current-session`, starting the supplied image (for example via the Windows start menu or MAc OS X Dock) will run itself only if the default session is "LispWorks Release".

See also
`save-image`
`save-image-with-bundle`

	<i>Function</i>
save-image	
Summary	Saves the image to a new file.
Package	<code>hcl</code>
Signature	<code>save-image filename &key dll-exports dll-added-files automatic-init gc type normal-gc restart-function multiprocessing console environment remarks clean-down image-type split => nil</code>
	The <i>console</i> argument is available only in LispWorks for Windows and LispWorks for Macintosh.

Arguments	<i>filename</i>	A string. It is the name of the file that the image is saved as. This name should not be the same as the original name of the image.
	<i>dll-exports</i>	A list of strings, or the keyword : default .
	<i>dll-added-files</i>	A list of strings.
	<i>automatic-init</i>	A generalized boolean.
	<i>gc</i>	If non-nil, there is a garbage collection before the image is saved. The default value is t.
	<i>type</i>	Determines if some global variables are cleared before the image is saved. You can generally use the default value, which is : user .
	<i>normal-gc</i>	If this is t the function normal-gc is called before the image is saved. The default is t.
	<i>restart-function</i>	A function to be called on restart.
	<i>multiprocessing</i>	Controls whether multiprocessing is enabled on restart.
	<i>console</i>	On Windows <i>console</i> controls whether the new image will be a Console or GUI application and when, if ever, to make a console window in the latter case. On the Macintosh <i>console</i> controls when, if ever, to make a console window. Possible values are discussed below.
	<i>environment</i>	<i>environment</i> controls whether the LispWorks environment is started on restart. Possible values are discussed below.
	<i>remarks</i>	<i>remarks</i> adds a comment to the save history. The value should be a string.
	<i>clean-down</i>	When t, calls (clean-down t).

<i>image-type</i>	One of <code>:exe</code> , <code>:dll</code> or <code>:bundle</code> .
<i>split</i>	A generalized boolean. If non-nil, the Lisp heap and the executable are saved in two separate files.
Values	Returns <code>nil</code> .
Description	<p>The function <code>save-image</code> saves the LispWorks image to a new executable or dynamic library containing any modifications you have made to the supplied image.</p> <p>For information about the sort of changes you might want to save in a new image, see Chapter 12, “Customization of LispWorks”.</p> <p>Do not use <code>save-image</code> when the graphical IDE is running. Instead create a build script and use it with the <code>-build</code> command line argument similar to the examples below, or run LispWorks in a subprocess using the Application Builder tool.</p> <p>You cannot use <code>save-image</code> on Windows, Linux and Mac OS X when multiprocessing is running. It signals an error in this case.</p> <p>On Cocoa you can combine a call to <code>save-image</code> with the creation of an application bundle containing your new LispWorks image, as in the example shown below.</p> <p><i>dll-exports</i> is implemented only on Windows, Linux, x86/x64 Solaris, Macintosh and FreeBSD. It controls whether the image saved is an executable or a dynamic library (DLL). The default value is <code>:default</code> and this value means an executable is saved. The value <code>:com</code> is supported on Microsoft Windows only (see below). Otherwise <i>dll-exports</i> should be list (potentially <code>nil</code>). In this case a dynamic library is saved, and each string in <i>dll-exports</i> names a function which becomes an export of the dynamic library and should be defined as a Lisp function using <code>fli:define-foreign-callable</code>. Each</p>

exported name can be found by `GetProcAddress` (on Windows) or `dlsym` (on other platforms). The exported symbol is actually a stub which ensures that the LispWorks dynamic library has finished initializing, and then enters the Lisp code.

On Microsoft Windows the *dll-exports* list can also contain the keyword `:com`, or *dll-exports* can simply be the keyword `:com`, both of which mean that the DLL is intended to be used as a COM server. See the *LispWorks COM/Automation User Guide and Reference Manual* for details.

On Mac OS X the default behavior is to generate an object of type "Mach-O dynamically linked shared library" with file type `dylib`. See *image-type* below for information about creating another type of library on Mac OS X.

On Linux, Macintosh, x86/x64 Solaris and FreeBSD, to save a dynamic library image the computer needs to have a C compiler installed. This is typically `gcc` (which is available by installing Xcode on the Macintosh).

An image saved as a dynamic library (DLL):

- always runs multiprocessing, and
- may need to be shut down by `QuitLispworks` or by a callback which uses `dll-quit`.

automatic-init specifies whether a LispWorks dynamic library should initialize inside the call to `LoadLibrary` (on Microsoft Windows) or `dlopen` (on other platforms), or wait for further calls. Automatic initialization is useful when the dynamic library does not communicate by function calls. On Microsoft Windows it also allows `LoadLibrary` to succeed or fail according to whether the LispWorks dynamic library initializes successfully or not. Not using automatic initialization allows you to relocate the library if necessary using `InitLispworks`, and do any other initialization that may be required. The default value of *automatic-init* is `t` on Windows, `nil` on other platforms. For more information about auto-

matic initialization in LispWorks dynamic libraries, see Chapter 13, “LispWorks as a dynamic library”.

dll-added-files should be a list of filenames. It is ignored on Microsoft Windows. On other platforms if *dll-added-files* is non-nil then a dynamic library containing each named file is saved. Each file must be of a format that the default C compiler (`(scm:*c-default-compiler*)`) knows about and can incorporate into a shared library. Typically they will be C source files, but can also be assembler or object files. They must not contain exports that clash with names in the LispWorks shared library (see Chapter 45, “Dynamic library C functions” for the predefined exports). The added files are useful to write wrappers around calls into the LispWorks dynamic library. Such wrappers are useful for:

- Calling `InitLispWorks` when required, for example to relocate the LispWorks dynamic library to avoid memory clashes with other software, as described under “Startup relocation” on page 306.
- Calling `QuitLispWorks` when required.
- Changing calls that involve complex C structs or even C++ objects into plain calls, because accessing C structures in Lisp requires defining the structure, while in C it only needs to include the header.
- Creating 'stub' functions that can be called from Lisp, for example for calling a C++ method. The address of the stub function can be passed to Lisp which can call it using a function defined by `fli:define-foreign-funcallable`.
- Adding code that runs automatically inside the call to `dlopen`, by using `__attribute__ ((constructor))`

image-type defaults to `:exe` or `:dll` according to the value of *dll-exports* and therefore you do not normally need to supply *image-type*.

image-type :bundle is used only when saving a dynamic library. On Mac OS X it generates an object of type "Mach-O bundle" and is used for creating shared libraries that will be used by applications that cannot load dylibs (FileMaker for example). It also does not force the filename extension to be `dylib`. On other Unix-like systems *image-type* merely has the effect of not forcing the file type of the saved image, and the format of the saved image is the same as the default. On Microsoft Windows *image-type :bundle* is ignored.

Note: *image-type :bundle* is completely unrelated to the Mac OS X notion of an application bundle.

If *split* is `nil` (the default), then the saved image is written as a single executable file containing the Lisp heap. If *split* is `t`, then the saved Lisp heap is split into a separate file, named by adding `.lheap` to the name of the executable. When the executable runs, it reloads the Lisp heap from this file automatically.

In addition, when saving LispWorks as an application bundle on the Macintosh (for example by using `create-macos-application-bundle`), *split* can be the symbol `:resources`. This places the Lisp heap file in the `Resources` directory of the bundle, rather than in the `Contents/Macos` directory alongside the executable, which allows the heap to be included in the signature of the bundle.

The main use of *split* is to allow third-party code signing to be applied to the executable, which is often not possible when saving an image with the Lisp heap included in a single file.

restart-function, if non-nil, specifies a function (with no arguments) to be called when the image is started. If *multiprocessing* is true, *restart-function* is called in a new process. *restart-function* is called after the initialization file is loaded. The default value of *restart-function* is `nil`.

Note: *restart-function* is not called if the command line argument `-no-restart-function` is present

When *multiprocessing* is `nil`, the executable image will start without multiprocessing enabled. When *multiprocessing* is true or the image is a DLL, the image will start with multiprocessing enabled. The default value of *multiprocessing* is `nil`.

console is implemented only in LispWorks for Windows and LispWorks for Macintosh. The possible values for *console* are as follows:

<code>:default</code>	Unchanged since previous save.
<code>t</code>	On the Macintosh, the value <code>t</code> has the same effect as the value <code>:always</code> . On Windows, a Console application is saved, else a Windows application is saved which creates its own console according to the other possible values.
<code>:input, :output, :io</code>	Whenever input, output or any I/O is attempted on <code>*terminal-io*</code> .
<code>:init</code>	
<code>:init</code>	At startup, if input and output are not redirected
<code>:always</code>	At startup, even if input and output are redirected.

The LispWorks for Windows and LispWorks for Macintosh images shipped have *console* set to `:input`.

The possible values for *environment* are as follows:

<code>:default</code>	Unchanged since previous save.
<code>nil</code>	Start with just the TTY listener.
<code>t</code>	Start the environment automatically, no TTY listener.

:with-tty-listener

Start the environment automatically, but still have a TTY listener.

The LispWorks image shipped is saved with `:environment t` on all platforms except for the Motif images on Mac OS X, Solaris, HP-UX and DEC Tru64 UNIX.

You should not try to save a new image over an existing one. Always save images using a unique image name, and then, if necessary, replace the new image with the old one after the call to `save-image` has returned.

Notes	Do not supply <code>:multiprocessing nil</code> along with a true value of <code>:environment t</code> . Multiprocessing is needed for the GUI environment.
Compatibility note	<p>LispWorks 5.0 and previous versions documented <code>-init</code> as the way to run LispWorks with a build script. This method is deprecated.</p> <p>Note that LispWorks quits automatically after processing a build script via <code>-build</code>, whereas with <code>-init</code> you need to call <code>quit</code> explicitly at the end of the build script.</p> <p>In LispWorks 5.0 and previous versions <code>dll-exports</code> is supported only on Windows.</p> <p><code>dll-added-files</code> and <code>automatic-init</code> are new in LispWorks 5.1.</p>
Example	<p>Here is an example build script. Save this to a file such as <code>c:/build-my-image.lisp</code>:</p> <pre>(load-all-patches) (load "my-code") (save-image "my-image")</pre> <p>Then run LispWorks with the command line argument <code>-build c:/build-my-image.lisp</code> to save the image <code>my-image.exe</code>.</p>

This example shows a portable build script which, on Cocoa, saves your new LispWorks image in a Mac OS X application bundle. This allows your new LispWorks for Macintosh image to be launchable from the Finder or Dock and to have its own icon or other resources:

```
(load-all-patches)
(load "my-code")
#+:cocoa
(compile-file-if-needed
  (example-file
    "configuration/macos-application-bundle")
  :load t)
(save-image
  #+:cocoa
  (write-macos-application-bundle
    "/Applications/LispWorks 6.0/My LispWorks.app")
  #-:cocoa
  "my-lispworks")
```

See also

`deliver`
`dll-quit`
`InitLispWorks`
`LispWorksDlsym`
`load-all-patches`
`quit`
`QuitLispWorks`
`save-current-session`

save-image-with-bundle *Function*

Summary Saves a LispWorks for Macintosh image with an application bundle, thus allowing it to work properly in the Cocoa windowing system.

Package `hcl`

Signature `save-image-with-bundle bundle-path &rest save-image-args &key bundle-arguments bundle-function &allow-other-keys`

Arguments	<p><i>bundle-path</i> A pathname designator.</p> <p><i>save-image-args</i> Arguments passed to <code>save-image</code>.</p> <p><i>bundle-arguments</i> Arguments passed to <i>bundle-function</i>.</p> <p><i>bundle-function</i> A function designator.</p>
Description	<p>The function <code>save-image-with-bundle</code> first creates the application bundle using the function <i>bundle-function</i>, and then saves the LispWorks image in the bundle.</p> <p>The default value of <i>bundle-arguments</i> is <code>nil</code>.</p> <p>The default value of <i>bundle-function</i> is <code>create-macos-application-bundle</code>. You can modify the created bundle by supplying <i>bundle-arguments</i>.</p> <p>With the default values of <i>bundle-function</i> and <i>bundle-arguments</i>, it copies the application bundle of the running image to the bundle path with the minimal necessary modifications, and then saves an image in it. <code>save-image-with-bundle</code> checks <code>save-argument-real-p</code>, so it can be used for saving universals without further checks.</p> <p><code>save-image-with-bundle</code> operates as follows:</p> <ol style="list-style-type: none"> 1. If <code>save-argument-real-p</code> returns true, it calls <i>bundle-function</i> with the <i>bundle-path</i> and <i>bundle-arguments</i>, and then uses the result as the <i>filename</i> for <code>save-image</code>. Otherwise the <i>filename</i> for <code>save-image</code> is <code>nil</code>. 2. It applies <code>save-image</code> to the path derived in the first step and the remaining arguments passed to <code>save-image-with-bundle</code> (other than <i>bundle-arguments</i> and <i>bundle-function</i>). <p><code>save-image-with-bundle</code> is implemented only in LispWorks for Macintosh.</p>
See also	<p><code>create-macos-application-bundle</code></p> <p><code>save-image</code></p>

	<i>Function</i>
Summary	Saves a universal binary LispWorks image using a script designed for saving a mono-architecture image.
Package	<code>hcl</code>
Signature	<code>save-universal-from-script <i>target-image</i> <i>script-name</i> &key output-stream => <i>target-image</i></code>
Arguments	<p><i>target-image</i> A pathname designator.</p> <p><i>script-name</i> A pathname designator.</p> <p><i>output-stream</i> A stream or <code>nil</code>.</p>
Values	<i>target-image</i> A pathname designator.
Description	<p>The function <code>save-universal-from-script</code> provides a convenient way to create a universal binary on an Intel Macintosh, using a script designed for saving a mono-architecture image.</p> <p>The <i>script-name</i> is the name of a Common Lisp build script for saving or delivering an image, as would be used to create a mono-architecture image. It should load the application and then call either <code>deliver</code> or <code>save-image</code> as appropriate.</p> <p>The function <code>save-universal-from-script</code> runs the current LispWorks image in two subprocesses, once for the PowerPC architecture (under Rosetta) and once for the native Intel architecture, passing <code>-build <i>script-name</i></code> on the command line. The script is evaluated as normal, except that the filename that is passed to any call to <code>save-image</code> or <code>deliver</code> is ignored and a temporary filename is used instead. If these two subprocesses are successful, then the temporary images are combined to make a universal binary <i>target-name</i> in the same way as <code>create-universal-binary</code>.</p>

The command line arguments of the images run by the subprocesses will include the command line arguments that were passed to the current image. In addition, various undocumented command line arguments will be prepended, which control how `deliver` or `save-image` work in the script.

Any output generated by the subprocesses is written to *output-stream*. If this is `nil`, then the output is discarded. If this is `t` (the default), then the output is written to the standard output.

Note: The function `save-universal-from-script` can only be called from a LispWorks for Macintosh image that is itself a universal binary, such as the distributed image.

Example Suppose the file `my-build-script.lisp` contains

```
(load-all-patches)
(load "my-application-defsys")
(compile-system 'my-application-system :load t)
(deliver 'my-application-function "my-application" 5)
```

Then, the following call creates a universal binary `my-application` using this script:

```
(save-universal-from-script "my-application"
                            "my-build-script.lisp")
```

See also

`save-image`
`create-universal-binary`
`building-universal-intermediate-p`
`save-argument-real-p`

set-array-single-thread-p

Function

Summary Tells the system whether an array is accessed only in a single thread context, or not.

Package `hcl`

Signature	<code>set-array-single-thread-p array on-p</code>	
Arguments	<code>array</code>	An array.
	<code>on-p</code>	A generalized boolean.
Description	Tells the system whether the array <code>array</code> is accessed only in a single thread context or not, depending on the value of <code>on-p</code> . Arrays that are marked for single thread access are faster for some operations, in particular <code>vector-push</code> and <code>vector-pop</code> .	
See also	<code>make-array</code>	

set-array-weak *Function*

Summary	Sets the weakness state of an array.	
Package	<code>hcl</code>	
Signature	<code>set-array-weak array weakp => weakp</code>	
Arguments	<code>array</code>	A non-displaced array, with <code>array-element-type t</code> .
	<code>weakp</code>	If <code>weakp</code> is non-nil, the array is made weak. If <code>weakp</code> is <code>nil</code> , the array is made non-weak.
Values	Returns <code>weakp</code> .	
Description	<p>By default, arrays are non-weak, and they keep alive all the objects that are stored in them. A weak array may remove a pointer if the object that it points to is not pointed to from somewhere else. When a pointer is removed like this, it is replaced in <code>array</code> with <code>nil</code>.</p> <p>Pointers are replaced by <code>nil</code> after a garbage collector operation that identifies that they can be replaced. This means that if the object that is pointed to has been promoted to a higher</p>	

generation, a garbage collection of the higher generation is required to remove the pointer. Note that by default the system does not automatically GC the blocking generation or higher.

The weakness state of an array can be changed many times.

In all implementations, *array* must not be a displaced array, and the `array-element-type` of *array* must be `t`.

In 64-bit LispWorks, an additional requirement is that *array* must be an adjustable array.

`set-array-weak` can be called at any moment.

Note: An array can be made weak at creation time using the `:weak` argument to `make-array`.

See also

`array-weak-p`
`copy-to-weak-simple-vector`
`set-hash-table-weak`
`make-array`
`mark-and-sweep`

set-default-generation *Function*

Summary	Set the current generation for storage allocation in 32-bit LispWorks.	
Package	<code>hcl</code>	
Signature	<code>set-default-generation num => num</code>	
Arguments	<code>num</code>	The number of the generation from which to do future allocation.
Values	Returns <code>num</code> .	

Description	Set the current generation for storage allocation. By default the system allocates memory from the youngest generation (generation 0).
	Note: <code>set-default-generation</code> is useful only in 32-bit Lisp-Works. In 64-bit implementations it does nothing and returns 0.
Examples	<pre>(set-default-generation 1) ;; allocate from an ;; older generation (set-default-generation 0) ;; return to normal</pre>
See also	allocation-in-gen-num clean-generation-0 collect-generation-2 collect-highest-generation expand-generation-1 get-default-generation set-promotion-count *symbol-alloc-gen-num*

	<i>Function</i>
Summary	Sets the parameters from the garbage collector in 32-bit Lisp-Works.
Package	<code>hcl</code>
Signature	<code>set-gc-parameters &key maximum-buffer-size minimum-buffer-size big-object promote-min-buffer promote-max-buffer new-generation-size minimum-overflow maximum-overflow minimum-for-sweep minimum-for-promote enlarge-by-segments => <no values></code>
Arguments	<p><i>maximum-buffer-size</i> Maximum size of the small objects buffer.</p> <p><i>minimum-buffer-size</i></p>

Minimum size of the small objects buffer.

big-object An object that is bigger than this value is “big”. That is, it is not allocated from the small objects buffer, but from the big-chunk area (if it is allocated in generation 0 in the normal way).

promote-min-buffer

During promotion, a buffer is allocated in the generation being promoted into, and the objects promoted are moved into it. *promote-min-buffer* controls the minimum size of this buffer.

promote-max-buffer

Controls the maximum size of the promotion buffer.

new-generation-size

Controls the minimum enlargement of generation *gen-num*, for *gen-num* > 0. Value 0 means the generation is not expanded. Otherwise, *new-generation-size* must be a fixnum in the exclusive range (10000, 100000000) and the minimum expansion is then *new-generation-size* * *gen-num* words.

new-generation-size has no effect on the enlargement of generation 0.

maximum-overflow

Maximum size of the small-objects buffer in the big-chunk area.

minimum-overflow

Minimum size of the small-objects buffer in the big-chunk area.

minimum-for-promote

Controls the frequency of promotions. Setting *minimum-for-promote* to a high value causes the system to promote less frequently. This may improve performance for programs that allocate a lot of data for a short term and then delete it.

minimum-for-sweep

Controls when a mark-and-sweep takes place. Setting *minimum-for-sweep* to a high value causes the system to mark and sweep less often, which means it has to grow. The CPU time spent in garbage collection is mostly smaller, but the process is bigger and may cause more disk access.

enlarge-by-segments

A minimum for how much the image grows each time a segment is enlarged, as a multiple of 64K. This parameter is ignored when adding a static segment.

Values	None.
Description	This function sets the parameters of the garbage collector, using the keywords described above. Note: <code>set-gc-parameters</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.
See also	<code>get-gc-parameters</code>

set-hash-table-weak

Function

Summary	Sets the weakness state of a hash-table.
---------	--

Package	<code>hcl</code>	
Signature		<code>set-hash-table-weak hash-table weak &optional free-function => weakness-state</code>
Arguments	<code>hash-table</code>	A hash-table.
	<code>weak</code>	Sets the weakness state of <i>hash-table</i> . Value may be:
	<code>:value</code> or <code>t</code>	— An entry is kept if there is a pointer to the value from another object.
	<code>:key</code>	— An entry is kept if there is a pointer to the key from another object.
	<code>:both</code>	— An entry is kept if there are pointers to both the key and the value.
	<code>:one</code> or <code>:either</code>	— An entry is kept if there is a pointer to either the key or the value.
	<code>nil</code>	— Make the hash-table non-weak. All entries are kept.
	<code>free-function</code>	A designator for a function of two arguments.
Values		Returns <code>weak</code> , unless <code>t</code> was passed, when <code>:value</code> is returned.
Description		<p>By default, hash-tables are not weak, which means that they keep alive all the keys and the values in the table.</p> <p>A weak hash-table allows entries to be removed if there are no other pointers to them. The <i>weakness-state</i> tells the system which entries may be removed like this.</p> <p>Entries that can be removed are removed after a garbage collector operation which identifies that they can be removed. This means that if the relevant object(s) (the key or the value) have been promoted to a higher generation, a garbage collection (GC) of the higher generation is required to remove them from the table. Note that by default the</p>

system does not automatically GC the blocking generation or higher.

The *weakness-state* of a hash-table can be changed repeatedly, at any time, at any point using any of the *weak* values listed above. It can also be set by `make-hash-table`.

free-function can be supplied to specify a free function as described for `make-hash-table`. It has no effect if *weak-kind* is `nil`.

See also `make-hash-table`
 `mark-and-sweep`
 `set-array-weak`

		<i>Function</i>
Summary		Sets the minimum free space for a segment of the specified generation in 32-bit LispWorks.
Package		<code>hcl</code>
Signature		<code>set-minimum-free-space gen-num size &optional segment => generation-size</code>
Arguments	<code>gen-num</code>	The generation to be affected.
	<code>size</code>	The size (in bytes) to set the segment to.
	<code>segment</code>	An integer specifying the segment to be affected. The default value is 0, meaning the first segment of the generation.
Values	<code>generation-size</code>	A list showing information for the generation just specified in the call.
Description		Sets the minimum free space for a segment of the specified generation.

By default, affects the first segment — pass *segment* to affect a different segment of the generation.

The minimum free space is shown by `room`.

Note: `set-minimum-free-space` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.

See also

`clean-generation-0`
`collect-generation-2`
`collect-highest-generation`
`expand-generation-1`
`room`
`set-promotion-count`

		<i>Function</i>
Summary	Controls the set of processes that are profiled.	
Package	<code>hcl</code>	
Signature	<code>set-process-profiling flag processes</code>	
Arguments	<code>flag</code> :add, :remove or :set. <code>processes</code> One of :current, :all, a <code>mp:process</code> object, or a list of <code>mp:process</code> objects which may also contain :current.	
Description	<p>The function <code>set-process-profiling</code> modifies the set of processes for which profiling information is (or will be) collected.</p> <p>If <code>set-process-profiling</code> is called while profiling (that is after a call to <code>start-profiling</code> and before the next call to <code>stop-profiling</code> with <i>print</i> non-nil) the system immediately</p>	

starts collecting profile information for the new set of processes.

When `start-profiling` is called without passing `processes`, it sets the processes to profile according to the last call to `set-process-profiling`.

`flag` determines how the set of processes to profile is modified:

<code>:add</code>	The given processes are added to the set.
<code>:remove</code>	The given processes are removed from the set.
<code>:set</code>	The given processes are used as the set.
<code>processes</code>	controls which processes are added to the set, removed from the set or are contained in the set, as follows:
<code>:current</code>	Means the current process. When <code>start-profiling</code> is called it interprets <code>:current</code> to mean the current process at the time it is called. If <code>set-process-profiling</code> is called while profiling, <code>:current</code> is interpreted as the current process when <code>set-process-profiling</code> is called.
<code>:all</code>	Means all processes, including those which are created after profiling started.

A `mp:process` object

Means that process.

A list Means the processes in that list. The list can contain the symbol `:current`, which is interpreted as described above.

`set-process-profiling` can be called whether or not the profiler is collecting information. See `start-profiling` and `stop-profiling`.

Examples

Add `process1` to the set:

```
(set-process-profiling :add process1)
```

Turn off profiling for the current process:

```
(set-process-profiling :remove :current)
```

Turn off all profiling:

```
(set-process-profiling :remove :all)
```

Set all processes for later profiling:

```
(set-process-profiling :set :all)
```

See also

`profile`
`start-profiling`
`stop-profiling`

set-profiler-threshold *Function*

Summary Sets the percentage threshold for symbols to be profiled in a subsequent run.

Package `hcl`

Signature `set-profiler-threshold value => value`

Arguments *value* must be a fixnum between 0 and 100.

Values `set-profiler-threshold` returns *value*.

Description This function sets the value of `*profiler-threshold*` below which symbols are not profiled in a repeated profiling run. After a profiling run, all the symbols being profiled have a percentage value for the amount of time they were on the top of the stack. If `*profiler-threshold*` is set to 40 then by running `reset-profiler` with argument `:top` all symbols which are found on the top of the stack less than forty percent

of the time are removed from the list of those symbols considered for profiling.

Example `(set-profiler-threshold 40)`

See also `reset-profiler`
`profile`
`*profiler-threshold*`

set-promotion-count

Function

Summary Controls when objects can be promoted to the next generation in 32-bit LispWorks. This function is deprecated.

Package `hcl`

Signature `set-promotion-count gen-num count &optional segment => count`

Arguments `gen-num` The generation number affected.

`count` The number of garbage collections survived by objects in that generation, before promotion. If `count` is `nil`, the function returns the current promotion count setting.

`segment` An integer specifying which segment of the generation is to be affected. The default is 0, meaning the lowest segment of the generation.

Values Returns `count`.

Description Controls how many garbage collections an object in a segment must survive before promotion to the next generation.

Notes `set-promotion-count` is deprecated, because experience has shown that it is not useful.

`set-promotion-count` is implemented only in 32-bit Lisp-Works. It is not relevant to the Memory Management API in 64-bit implementations, wherein you may be able to achieve the effect with `set-delay-promotion`.

See also

`block-promotion`
`clean-generation-0`
`collect-generation-2`
`collect-highest-generation`
`expand-generation-1`

		<i>Function</i>
Summary	Manipulates the system message log.	
Package	<code>hcl</code>	
Signature	<code>set-system-message-log &key stream collect get callback => result</code>	
Arguments	<code>stream</code> An output stream designator, or <code>:no-change</code> . <code>collect</code> A boolean, or <code>:no-change</code> . <code>get</code> <code>t</code> or <code>:keep</code> . <code>callback</code> A function designator, or <code>:no-change</code> .	
Values	<code>result</code> A list of strings, or <code>nil</code> .	
Description	The function <code>set-system-message-log</code> manipulates the system message log. This log is used by the system to produce messages that indicate that something is not as expected, but is not an error. For example, putting a bad Break-Gesture in a GTK resource file.	

If *stream* is `t` or a stream, the system message log stream is set, with `t` meaning `*standard-output*`. This stream is used when writing messages.

When *collect* is true but not `:no-change`, messages are collected in an internal list, which can be retrieved by using *get*.

callback can be a designator for a function of one argument, a string. This function is called when a message is generated. The callback must not try to perform GUI operations.

The default value of each of *stream*, *collect* and *callback* is `:no-change`, which does not change the current setting.

When *get* is supplied `set-system-message-log` returns a list of the messages that has been collected. Each message is a single string. If *get* is `t`, the internal list is reset to `nil`. If *get* is `:keep`, the internal list is not reset, so the next call with *get* will get them again.

`set-system-message-log` returns `nil` if *get* is not supplied.

`set-system-message-log` returns the list of collected messages if *get* is supplied.

Notes *stream*, *callback* and *collect* are mutually independent. It is possible to set the system to any combination of these.

The order of operation when a message is generated is first to print, then call the callback, and then collect.

When collecting messages it can accumulate, so it is important to periodically get the message to ensure it does not bloat the memory.

Using *collect* `t` when it is already collecting has no effect, in particular it does not affect the list of collected messages.

set-up-profiler

Function

Summary Declares the parameter values of the profiling function.

Package	<code>hcl</code>
Signature	<code>set-up-profiler &key symbols packages kind interval limit cutoff collapse style gc call-counter show-unknown-frames</code>
Arguments	<p><code>symbols</code> A symbol or a list of symbols.</p> <p><code>packages</code> A valid package name, or a list of package names, or <code>:all</code>.</p> <p><code>kind</code> <code>:profile</code>, <code>:virtual</code> or <code>:real</code>.</p> <p><code>interval</code> An integer greater than or equal to 10000.</p> <p><code>limit</code> An integer or <code>nil</code>.</p> <p><code>cutoff</code> An integer or <code>nil</code>.</p> <p><code>collapse</code> A generalized boolean.</p> <p><code>style</code> <code>:tree</code>, <code>:list</code> or <code>nil</code>.</p> <p><code>gc</code> A generalized boolean.</p> <p><code>call-counter</code> A generalized boolean.</p> <p><code>show-unknown-frames</code> A generalized boolean.</p>
Values	The time interval is returned.
Description	<p><code>set-up-profiler</code> is used to declare the values of the parameters of the profiling function. Three values are required, as follows.</p> <p><code>symbols</code>, if non-nil, specifies which symbols are to be monitored by the profiler. Each symbol in <code>symbols</code> is checked to see if it is suitable for profiling and if so it is added to the list <code>*profile-symbol-list*</code>.</p> <p>If <code>symbols</code> is not passed then <code>packages</code> specifies which symbols are to be monitored. If <code>packages</code> is <code>:all</code>, then all packages are monitored. All the symbols in the packages are checked as</p>

above. If a *symbols* argument is present then *packages* is ignored.

kind specifies the way that the time between samples is measured on Unix-like platforms:

`:profile` Process time only.

`:virtual` Process time and system time for the process.

`:real` Real time.

The default value of *kind* is `:profile`.

Note: *kind* is ignored on Microsoft Windows platforms.

interval specifies the interval in microseconds between profile samples. The minimum value of *interval* is 10000, that is 10 ms. The default value of *interval* is 10000.

limit, when non-nil, sets `*default-profiler-limit*`. This limits the maximum number of lines printed in the profile output (not including the tree). The default value is 100.

cutoff, when non-nil, sets `*default-profiler-cutoff*`. This is the default minimum percentage that the profiler will display in the output tree. Functions below this percentage will not be displayed. The default is `nil`, that is there is no cutoff.

collapse specifies whether functions with only one callee in the profile tree should be collapsed, that is, only the child is printed. When passed, sets `*default-profiler-collapse*`. The default value of *collapse* is `nil`.

style controls the format of output. If *style* is not passed or passed as `nil`, the format does not change. If *style* is passed, it can take these values:

`:list` The profiler will show the functions seen on the stack.

:tree The profiler will generate a tree of calls seen in the profiler, as well as the output shown by **:list**.

The default value of *style* is **:tree**.

gc specifies whether to profile functions inside the memory management code (more accurately, functions that are called on the GC stack) in addition to any other profiling. The default value of **gc** is **nil**.

call-counter whether to add extra code to count calls. The counting is done dynamically. If **call-counter** is **nil**, call counters are not added, and the call counter of all functions is displayed as 0. The default value of **call-counter** is **nil** on Intel-based platforms and **t** on other platforms. This is because the counting significantly affects the performance of applications using Symmetric Multiprocessing (SMP).

Note: Call counting can affect performance significantly on some platforms. To get accurate timing (in scales of a few percentage points), pass **call-counter nil**. However, in most cases the profiler is used to find bottlenecks where the slowdown is hundreds of percentage points and so the effect of call counting is less significant.

Note: **call-counter** is effective only on x86 platforms or in 64-bit LispWorks. On non-x86 platforms 32-bit LispWorks decides whether to do call counting for each function when it is compiled, depending on the debug level, and **call-counter** has no effect.

show-unknown-frames controls whether the profile tree shows nodes where the name of the function is unknown. The default value of **show-unknown-frames** is **nil**.

Example

```
(set-up-profiler :symbols '(car cdr)
                 :interval 50000)
```

On Unix/Linux/Mac OS X:

```
(set-up-profiler :symbols '(car cdr)
                  :kind :profile :interval 50000)
```

See also

- `add-symbol-profiler`
- `*default-profiler-collapse*`
- `*default-profiler-cutoff*`
- `*default-profiler-limit*`
- `profile`
- `*profile-symbol-list*`
- `remove-symbol-profiler`

sets-who *Function*

Summary	Lists special variables set by a definition.	
Package	<code>hcl</code>	
Signature	<code>sets-who function => result</code>	
Arguments	<code>function</code> A symbol or a function dspec.	
Values	<code>result</code> A list.	
Description	The function <code>sets-who</code> returns a list of the special variables set by the definition named by <code>function</code> .	
Note: The cross-referencing information used by <code>sets-who</code> is generated when code is compiled with source-level debugging switched on.		
See also	<code>who-sets</code> <code>toggle-source-debugging</code>	

source-debugging-on-p *Function*

Summary	Tests if source level debugging is on for compiled code.
---------	--

Package	<code>hcl</code>
Signature	<code>source-debugging-on-p => bool</code>
Arguments	None.
Values	<i>bool</i> If <code>t</code> , source level debugging is on.
Description	Returns <code>t</code> if source level debugging is on for compiled code; otherwise returns <code>nil</code> .
See also	<code>toggle-source-debugging</code>

start-profiling *Function*

Summary	Starts collecting profiling information.								
Package	<code>hcl</code>								
Signature	<code>start-profiling &key initialize processes profile-waiting</code>								
Arguments	<table> <tr> <td><i>initialize</i></td> <td>A boolean.</td> </tr> <tr> <td><i>processes</i></td> <td>One of <code>:current</code>, <code>:all</code>, a <code>mp:process</code> or a list of <code>mp:process</code> objects.</td> </tr> <tr> <td><i>profile-waiting</i></td> <td>A boolean.</td> </tr> <tr> <td><i>ignore-in-foreign</i></td> <td>A boolean.</td> </tr> </table>	<i>initialize</i>	A boolean.	<i>processes</i>	One of <code>:current</code> , <code>:all</code> , a <code>mp:process</code> or a list of <code>mp:process</code> objects.	<i>profile-waiting</i>	A boolean.	<i>ignore-in-foreign</i>	A boolean.
<i>initialize</i>	A boolean.								
<i>processes</i>	One of <code>:current</code> , <code>:all</code> , a <code>mp:process</code> or a list of <code>mp:process</code> objects.								
<i>profile-waiting</i>	A boolean.								
<i>ignore-in-foreign</i>	A boolean.								
Description	<p>The function <code>start-profiling</code> starts collecting profiling information.</p> <p>If <code>initialize</code> is non-<code>nil</code> any profiling information collected so far is discarded. The default value of <code>initialize</code> is <code>t</code>.</p> <p>If <code>processes</code> is supplied, the set of processes that will be profiled is set as if by calling:</p> <pre>(set-process-profiling :set :processes processes)</pre>								

Otherwise, the set of processes remains unchanged, so is controlled by any previous calls to `set-process-profiling`.

`profile-waiting` is used only in SMP LispWorks. When `profile-waiting` is true, processes that are marked for profiling are profiled even if they are in a wait state. In non-SMP LispWorks, only processes that are active are profiled.

`ignore-in-foreign` controls whether to ignore processes that are inside foreign calls. The default value of `ignore-in-foreign` is `nil`.

`start-profiling` can be repeatedly called without intervening calls to `stop-profiling`, for example to change the setting of `profile-waiting` or the profiled processes.

`start-profiling` cannot be used while `profile` is used or while the Profiler tool is profiling (on any thread). Between the call to `start-profiling` and the next call to `stop-profiling` with `print t` (or omitted), `profile` and the Profiler tool cannot be used.

Various parameters which are set by `set-up-profiler` control the behavior of the profiler. See the documentation for `set-up-profiler`.

Examples The following sequence of calls to `start-profiling` and `stop-profiling` can be used to profile only interesting work and print the results:

Start profiling the current process:

```
(start-profiling :processes :current)
(do-interesting-work)
```

Temporarily suspend profiling:

```
(stop-profiling :print nil)
(do-uninteresting-work)
```

Resume profiling:

```
(start-profiling :initialize nil)
(do-more-interesting-work)
(stop-profiling)
```

See also

`profile`
`do-profiling`
`set-process-profiling`
`stop-profiling`

stop-profiling

Function

Summary Stops collecting profiling information.

Package `hcl`

Signature `stop-profiling &key print stream`

Arguments `print` A generalized boolean.
 `stream` An output stream.

Description The function `stop-profiling` stops collecting profiling information, and optionally prints the results.

If `print` is non-nil, the information collected so far is printed and the next call to `start-profiling` must pass `initialize t` or omit the `initialize` argument. If `print` is `nil`, then the profiler is put into a suspended state where no profiling information is collected, but can be restarted by calling

```
(start-profiling :initialize nil)
```

The default value of `print` is `t`.

`stream` specifies the stream for output when `print` is non-nil. It is ignored when `print` is `nil`. The default value of `stream` is the value of `*trace-output*`.

Note: parameters set by `set-up-profiler` control the format of the output.

See also

`do-profiling`
`profile`
`set-process-profiling`
`start-profiling`

sweep-all-objects

Function

Summary

Applies a function to all the live objects in the image.

Package

`hcl`

Signature

`sweep-all-objects function &optional gen-0 => nil`

Arguments

`function` A function of one argument, the object.

`gen-0` A generalized boolean, default value `nil`

Values

`sweep-all-objects` returns `nil`.

Description

Applies *function* to all the live objects in the image. Normally it is not useful to sweep objects in generation 0 because they are ephemeral, so by default `sweep-all-objects` does not sweep generation 0. This can be changed by passing a non-nil value as *gen-0*.

function should take one argument, the object. It can allocate, but if it allocates heavily the sweeping becomes unreliable. Small amounts of allocation will normally happen only in generation 0, and so will not affect sweeping of other generations.

To call `sweep-all-objects` reliably, do it inside `with-other-threads-disabled`.

Notes

In 64-bit LispWorks there is a more specific alternative: function `sweep-gen-num-objects` can be used to call a function on all live objects in a particular generation.

See also [`sweep-gen-num-objects`](#)

switch-static-allocation *Function*

Summary	Controls whether objects are allocated in the static area.	
Package	<code>hcl</code>	
Signature	<code>switch-static-allocation flag => previous-flag</code>	
Arguments	<code>flag</code>	If <i>flag</i> is non-nil, subsequent objects are allocated in the static area; if <i>flag</i> has any other value, objects are allocated conventionally.
Values	<code>switch-static-allocation</code> returns the previous setting of <i>flag</i> .	
Description	<p>Objects in the static area are garbage-collected, but not moved.</p> <p>You should avoid using this function.</p>	
See also	<code>enlarge-static</code> <code>in-static-area</code>	

symbol-alloc-gen-num *Variable*

Summary	Specifies the generation in which interned symbols and their symbol names are allocated.	
Package	<code>hcl</code>	
Initial Value	2 in 32-bit LispWorks, 3 in 64-bit LispWorks	

See also `allocation-in-gen-num`
 `get-default-generation`
 `set-default-generation`

toggle-source-debugging *Function*

Summary	Changes compiler settings affecting production of source level debugging information.	
Package	<code>hcl</code>	
Signature	<code>toggle-source-debugging &optional on => bool</code>	
Arguments	<code>on</code>	Flag (<code>t</code> or <code>nil</code>) to control the resulting setting of the variables. The default is <code>t</code> .
Values	<code>bool</code>	The current state of source level debugging: <code>t</code> if source level debugging is on.
Description	<p><code>toggle-source-debugging</code> sets certain compiler parameters, and also turns leaf case optimizations on (when called with <code>nil</code>) or off (when called with <code>t</code>). For all these parameters, the value <code>nil</code> reduces compilation speed.</p> <p><code>toggle-source-debugging</code> is called in the configuration file <code>a-dot-lispworks.lisp</code>, and the initial state of LispWorks such that source level debugging is on.</p> <p>The parameters relate to information required for source level debugging, cross-referencing and finding all changed definitions.</p> <p>The parameters (all in the <code>compiler</code> package) are:</p>	
	<p>*produce-xref-info*</p> <p>When true, the compiler produces information for the Cross Referencer.</p>	

load-xref-info

When true, the cross-referencing information produced by the compiler is loaded when the corresponding file is loaded.

notice-changed-definitions

When true, the Cross Referencer notices when a function is redefined, including an interpreted redefinition..

source-level-debugging

When true, the compiler generates information used by the debugger.

toggle-source-debugging modifies the status of the variables, and then returns the new value. To check whether all the variables are set to true, without modifying them, use **source-debugging-on-p**.

Cross-referencing information is used by the functions **who-calls**, **who-binds**, **who-references**, **who-sets**, and friends.

Compatibility note In LispWorks 4.2 and earlier, **toggle-source-debugging** controlled source file recording information. In LispWorks 4.3 and later, this is controlled independently by ***record-source-files***.

See also **source-debugging-on-p**

	<i>Function</i>
total-allocation	
Summary	Calculate memory consumed since the image was started.
Package	hcl
Signature	total-allocation

Arguments	None.
Values	Returns the amount allocated
Description	This function calculates the total amount of memory consumed since the current image was created. Use at the start and end of a piece of code, to see how much it allocates.
See also	<code>find-object-size</code> <code>room</code>

traced-arglist *Variable*

Summary	The list of arguments given to the function being traced.
Package	<code>hcl</code>
Initial Value	<code>nil</code>
Description	Upon entering a function that is being traced, <code>*traced-arglist*</code> is bound to the list of arguments given to the function. <code>*traced-arglist*</code> is then printed after the function name in the output from tracing. It is accessible in the <code>:before</code> and <code>:after</code> forms to <code>trace</code> . However care should be used when manipulating this variable, since it is the value of <code>*traced-arglist*</code> itself that is used when calling the traced function. Thus if this value is altered by the <code>:before</code> forms then the function receives the altered argument list.

Example

```
USER 14 > (trace (+ :before
                  ((setq *traced-arglist*
                     (mapcar #'1+
                             *traced-arglist*)))))
+
USER 15 > (+ 1 2 3)
```

```
0 + > (1 2 3)
      (2 3 4)
0 + < (9)
9
```

Notes ***traced-arglist*** is an extension to Common Lisp.

See also **trace**

traced-results *Variable*

Summary The list of results from the function being traced.

Package **hcl**

Initial Value **nil**

Description Upon leaving a function that is being traced, ***traced-results*** is bound to the list of results from the function. ***traced-results*** is then printed after the function name in the output from tracing. It is accessible in the **:after** forms to **trace**. However care should be used when manipulating this variable, since it is the value of ***traced-results*** itself that is used when returning from the traced function. Thus if this value is altered by the **:after** forms then the caller of the traced function receives the altered results.

Example

```
USER 5 > (trace (ceiling
                     :after
                     ((setq *traced-results*
                           (mapcar #'1- *traced-results*)))))

CEILING
USER 6 > (multiple-value-call #'+ (ceiling 4 3))

0 CEILING > (4 3)
0 CEILING < (2 -2)
(1 -3)
-2
```

Notes *traced-results* is an extension to Common Lisp.

See also [trace](#)

trace-indent-width

Variable

Summary The amount of extra indentation in the trace output for each level of nesting.

Package hcl

Initial Value 2

Description ***trace-indent-width*** is the extra amount by which the traced output for function calls is indented upon entering a deeper level of nesting (i.e. a traced call from a function that is itself traced). If it is 0 then no indentation occurs.

Example

```

CL-USER 1 > (setq *trace-indent-width* 4
                      *max-trace-indent* 50)
50

CL-USER 2 > (defun quad (a b c) (- (* b b) (* 4 a c)))
QUAD

CL-USER 3 > (trace quad *)
(QUAD *)

CL-USER 4 > (quad 4 3 14)
0 QUAD > ...
  >> A : 4
  >> B : 3
  >> C : 14
    1 * > ...
      >> SYSTEM::ARGS : (3 3)
    1 * < ...
      << VALUE-0 : 9
    1 * > ...
      >> SYSTEM::ARGS : (4 4 14)
    1 * < ...
      << VALUE-0 : 224
0 QUAD < ...
  << VALUE-0 : -215
-215

```

Notes ***trace-indent-width*** is an extension to Common Lisp.

See also **trace**

trace-level *Variable*

Summary The current depth of tracing.

Package **hcl**

Initial Value 0

Description ***trace-level*** is a special variable whose value is the current depth of tracing. The current value of ***trace-level*** is

printed before the function name during the output from tracing.

Example

```
USER 8 > (defun fac (n) (if (<= n 1)
                                1
                                (* n (fac (1- n)))))

FAC
USER 9 > (trace fac)

FAC
USER 10 > (fac 3)

0 FAC > (3)
  1 FAC > (2)
    2 FAC > (1)
      2 FAC < (1)
        1 FAC < (2)
  0 FAC < (6)
6
```

Notes

trace-level is an extension to Common Lisp.

See also

trace

trace-print-circle

Variable

Summary

Controls how circular structures are printed in trace output.

Package

hcl

Initial Value

nil

Description

trace-print-circle controls how circular structures are printed during output from tracing. It allows the printing of circular structures by the tracer to be controlled independently of the usual printing mechanism, which is governed by ***print-circle***. ***print-circle*** is bound to the value of ***trace-print-circle*** while printing tracing information.

Example	<pre> USER 19 > (setq *trace-print-circle* t) T USER 20 > (defun circ (l) (rplacd (last l) 1) l) CIRC USER 21 > (trace second) SECOND USER 22 > (second (circ '(1 2 3 4))) 0 SECOND > (#1=(1 2 3 4 . #1#)) 0 SECOND < (2) 2 </pre>
Notes	* trace-print-circle* is an extension to Common Lisp.
See also	trace

trace-print-length *Variable*

Summary	The number of components of an object that are printed in trace output.
Package	hcl
Initial Value	100
Description	<p>*trace-print-length* controls the number of components of an object which are printed during output from tracing. If its value is a positive integer then the first *trace-print-length* components are printed.</p> <p>*print-length* is bound to the value of *trace-print-length* while printing tracing information. If *trace-print-length* is nil then all the components of the object are printed.</p>
Example	<pre> USER 5 > (trace append) APPEND USER 6 > (setq *trace-print-length* 3) </pre>

```

3
USER 7 > (dotimes (i 10) (setq li (if (zerop i)
                                         nil
                                         (cons i li))))
NIL
USER 8 > (append li '(a b))
0 APPEND > ((9 8 7 ...) (A B))
0 APPEND < ((9 8 7 ...))
(9 8 7 6 5 4 3 2 1 A B)

```

Notes ***trace-print-length*** is an extension to Common Lisp.

See also **trace**

trace-print-level *Variable*

Summary The depth to which nested objects are printed in trace output.

Package **hcl**

Initial value 5

Description ***trace-print-level*** controls the depth to which nested objects are printed during output from tracing. If its value is a positive integer then components at or above that level are suppressed. By definition an object to be printed is considered to be at level 0, its components are at level 1, their sub-components are at level 2, and so on.

print-level is bound to the value of ***trace-print-level*** while printing tracing information. If ***trace-print-level*** is nil then objects are printed without regard to depth.

Examples USER 8 > (**trace append**)

```

APPEND
USER 9 > (dotimes (i 10) (setq li (if (zerop i)
                                              nil
                                              (list i li)))))

NIL
USER 10 > (append li '(a b))
0 APPEND > ((9 (8 (7 (6 #)))) (A B))
0 APPEND < ((9 (8 (7 (6 #))) A B))
(9 (8 (7 (6 (5 (4 (3 (2 (1 NIL))))))) A B)

```

Notes ***trace-print-level*** is an extension to Common Lisp.

See also **trace**

trace-print-pretty *Variable*

Summary Controls the amount of whitespace in trace output.

Package **hcl**

Initial Value **nil**

Description ***trace-print-pretty*** controls the amount of whitespace printed during output from tracing. If it is not **nil** then extra whitespace is inserted to make the output more comprehensible. ***print-pretty*** is bound to the value of ***trace-print-pretty*** while printing tracing information.

Examples USER 6 > (**trace macroexpand-1**)

```

MACROEXPAND-1
USER 7 > (setq *trace-print-pretty* t
                  *print-pretty* nil)
```

```

NIL
USER 8 > (defmacro sum (n)
            `(do ((i 0 (1+ i))
                  (res 0 (+ i res)))
                 ((= i ,n) res)))
```

```

SUM
USER 9 > (macroexpand-1 '(sum 3))

0 MACROEXPAND-1 > ((SUM 3))
0 MACROEXPAND-1 < ((DO ((I 0 (1+ I))
                           (RES 0 (+ I RES)))
                           (= I 3)
                           RES))
                           T)
(DO ((I 0 (1+ I)) (RES 0 (+ I RES))) ((= I 3) RES))
T

```

Notes ***trace-print-pretty*** is an extension to Common Lisp.

See also **trace**

trace-verbose *Variable*

Summary Controls how arguments and values are printed in trace output.

Package **hcl**

Initial Value :**only**

Description ***trace-verbose*** controls the way arguments and values are printed in trace output.

If the value is not **nil** then **trace** attempts to decode the arguments and values, and prints them.

When the value is :**only**, **trace** does not print the lists of arguments and values after the function name.

Notes ***trace-verbose*** is an extension to Common Lisp.

See also **trace**

try-compact-in-generation	<i>Function</i>
Summary	Compacts the most fragmented segment(s) in a generation in 32-bit LispWorks.
Package	hcl
Signature	try-compact-in-generation <i>generation-number time-threshold</i> &optional <i>fraction-threshold</i> => <i>result</i>
Arguments	<p><i>generation-number</i> 0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.</p> <p><i>time-threshold</i> A real number.</p> <p><i>fraction-threshold</i> A real number between 0 and 1, defining the minimum fragmentation to actually compact. The default is 0.25.</p>
Values	<i>result</i> A boolean.
Description	<p>try-compact-in-generation finds the most fragmented segment in the generation specified. If <i>time-threshold</i> is positive, it compacts this segment, and repeats this operation until <i>time-threshold</i> seconds have elapsed. At this point try-compact-in-generation returns, with value t if at least one segment was compacted and value nil otherwise. Because the operation cannot be stopped in the middle, the actual time taken will always be larger than <i>time-threshold</i>.</p> <p>If <i>fraction-threshold</i> is 1, try-compact-in-generation does nothing. If <i>fraction-threshold</i> is 0, try-compact-in-generation will compact all uncompacted segments (unless it runs out of time). With the default (0.25)</p>

`try-compact-in-generation` compacts only moderately fragmented segments.

If *time-threshold* is negative, then `try-compact-in-generation` does not actually compact any segments. *result* is a boolean indicating whether `try-compact-in-generation` would actually try to compact a segment if it were to be called with a positive *time-threshold* and the other arguments unchanged.

This function is typically used after a call to `check-fragmentation`. For more information, see “Controlling Fragmentation” on page 110.

Note: `try-compact-in-generation` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where `marking-gc` with the *what-to-copy* argument offers similar functionality (although `set-blocking-gen-num` is intended to solve the problem of fragmentation automatically).

See also `check-fragmentation`
 `try-move-in-generation`

try-move-in-generation *Function*

Summary	Moves objects out of the most fragmented segment(s) in a generation, leaving them empty in 32-bit LispWorks.
Package	<code>hcl</code>
Signature	<code>try-move-in-generation generation-number time-threshold &optional fraction-threshold => result</code>
Arguments	<i>generation-number</i> 0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.

	<i>time-threshold</i>	A real number.
	<i>fraction-threshold</i>	A real number between 0 and 1, defining the minimum fragmentation to actually move. The default is 0.25.
Values	<i>result</i>	A boolean.
Description		<p><code>try-move-in-generation</code> finds the most fragmented segment in the generation specified. If <i>time-threshold</i> is positive, it moves objects out of this segment, leaving it empty, and repeats this operation until <i>time-threshold</i> seconds have elapsed. At this point <code>try-move-in-generation</code> returns, with value <code>t</code> if at least one segment was moved and value <code>nil</code> otherwise. Because the operation cannot be stopped in the middle, the actual time taken will always be larger than <i>time-threshold</i>.</p> <p>If <i>fraction-threshold</i> is 1, <code>try-move-in-generation</code> does nothing. If <i>fraction-threshold</i> is 0, <code>try-move-in-generation</code> will move all uncompacted segments (unless it runs out of time). With the default (0.25) <code>try-move-in-generation</code> moves only moderately fragmented segments.</p> <p>If <i>time-threshold</i> is negative, then <code>try-move-in-generation</code> does not actually move any segments. <i>result</i> is a boolean indicating whether <code>try-move-in-generation</code> would actually try to move a segment if it were to be called with a positive <i>time-threshold</i> and the other arguments unchanged.</p> <p>This function is typically used after a call to <code>check-fragmentation</code>. For more information, see “Controlling Fragmentation” on page 110.</p> <p>Note: <code>try-move-in-generation</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where <code>marking-gc</code> with the <code>what-to-copy</code> argument offers similar functionality (although</p>

`set-blocking-gen-num` is intended to solve the problem of fragmentation automatically).

See also `check-fragmentation`
`try-compact-in-generation`

unwind-protect-blocking-interrupts *Macro*

Summary	Does <code>unwind-protect</code> blocking interrupts.
Package	<code>hcl</code>
Signature	<code>unwind-protect-blocking-interrupts <i>protected-form</i> &rest cleanups => results</code>
Arguments	<code>protected-form</code> A form. <code>cleanups</code> Forms.
Values	<code>results</code> The values of <code>protected-form</code> .
Description	The macro <code>unwind-protect-blocking-interrupts</code> executes <code>protected-form</code> with interrupts blocked. On exit, whether local or not, the <code>cleanups</code> are executed with interrupts blocked.

In compiled code, the macro is equivalent to

```
(mp:with-interrupts-blocked
  (unwind-protect
    protected-form
    (mp:current-process-block-interrupts)
    cleanup1 cleanup2 ...))
```

However, in interpreted code the macro is expanded to ensure that the call to `(mp:current-process-block-interrupts)` actually happens. If the above form is interpreted and `protected-form` uses `current-process-unblock-interrupts`, the evaluator may throw (if the process is killed, for example) before calling `current-process-unblock-interrupts`.

Notes	<ol style="list-style-type: none"> Both the protected form and the cleanups can block and unblock interrupts using <code>current-process-block-interrupts</code> and <code>current-process-unblock-interrupts</code>. Typically the protected form would set up something and then unblock the interrupts. The cleanups may unblock interrupts if some of the cleanups are essential and others are not. Blocking interrupts causes the process to not respond to interrupts, including killing. You should make sure that forms which are executed with interrupts blocked do not hang.
See also	<code>current-process-block-interrupts</code> <code>current-process-unblock-interrupts</code> <code>unwind-protect-blocking-interrupts-in-cleanups</code>

unwind-protect-blocking-interrupts-in-cleanups *Macro*

Summary	Does <code>unwind-protect</code> blocking interrupts around the cleanups.	
Package	<code>hcl</code>	
Signature	<code>unwind-protect-blocking-interrupts-in-cleanups <i>protected-form</i> &rest <i>cleanups</i> => <i>results</i></code>	
Arguments	<p><i>protected-form</i> A form.</p> <p><i>cleanups</i> Forms.</p>	
Values	<i>results</i> The values of <i>protected-form</i> .	
Description	The macro <code>unwind-protect-blocking-interrupts-in-cleanups</code> executes <i>protected-form</i> . On exit, whether local or not, the <i>cleanups</i> are executed with interrupts blocked. In compiled code, the macro is equivalent to	

```
(unwind-protect
  protected-form
  (mp:with-interrupts-blocked cleanup1 cleanup2 ...)
```

However, in interpreted code the macro is expanded to ensure that the body of `mp:with-interrupts-blocked` actually happens. If the form above is interpreted the evaluator may throw (if the process is killed, for example) before completing macroexpansion of `mp:with-interrupts-blocked` and doing the actual blocking.

- Notes
1. *cleanups* can block and unblock interrupts using `current-process-block-interrupts` and `current-process-unblock-interrupts`. This may be useful if some of the cleanups are essential and others are not.
 2. Blocking interrupts causes the process to not respond to interrupts, including killing. You should make sure that forms which are executed with interrupts blocked do not hang.

See also

`current-process-block-interrupts`
`current-process-unblock-interrupts`
`unwind-protect-blocking-interrupts`
`with-interrupts-blocked`

	<i>Function</i>
Summary	Returns the definitions which bind a special variable.
Package	<code>hcl</code>
Signature	<code>who-binds <i>symbol</i> => <i>result</i></code>
Arguments	<code>symbol</code> A special variable.
Values	<code>result</code> A list.

Description	The function <code>who-binds</code> returns a list of dspecs naming the definitions which bind the special variable <i>symbol</i> . Note: The cross-referencing information used by <code>who-binds</code> is generated when code is compiled with source-level debugging switched on.
See also	<code>binds-who</code> <code>toggle-source-debugging</code>

	<i>Function</i>
Summary	Returns the callers of a function.
Package	<code>hcl</code>
Signature	<code>who-calls dspec => callers</code>
Arguments	<code>dspec</code> A dspec.
Values	<code>callers</code> A list.
Description	The function <code>who-calls</code> returns a list of dspecs naming the definitions which call the function named by <i>dspec</i> . See also the Editor commands <code>List Callers</code> and <code>Show Paths To</code> . Note: The cross-referencing information used by <code>who-calls</code> is generated when code is compiled with source-level debugging switched on.
See also	<code>calls-who</code> <code>toggle-source-debugging</code>

	<i>Function</i>
Summary	Returns the definitions which reference a special variable.
Package	<code>hcl</code>
Signature	<code>who-references symbol => result</code>
Arguments	<i>symbol</i> A special variable.
Values	<i>result</i> A list.
Description	The function <code>who-references</code> returns a list of dspecs naming the definitions which reference the special variable <i>symbol</i> . Note: The cross-referencing information used by <code>who-references</code> is generated when code is compiled with source-level debugging switched on.
See also	<code>references-who</code> <code>toggle-source-debugging</code>

	<i>Function</i>
Summary	Returns the definitions which set a special variable.
Package	<code>hcl</code>
Signature	<code>who-sets symbol => result</code>
Arguments	<i>symbol</i> A special variable.
Values	<i>result</i> A list.
Description	The function <code>who-sets</code> returns a list of dspecs naming the definitions which set the value of the special variable <i>symbol</i> .

Note: The cross-referencing information used by `who-sets` is generated when code is compiled with source-level debugging switched on.

See also

`sets-who`
`toggle-source-debugging`

with-hash-table-locked *Macro*

Summary Evaluates code with a hash-table locked against modification by other threads.

Package `hcl`

Signature `with-hash-table-locked hash-table &body body => results`

Arguments `hash-table` A hash table.

`body` Forms.

Values `results` The results of evaluating `body`.

Description The macro `with-hash-table-locked` evaluates `body` with the hash table `hash-table` locked against modification by other threads. The current thread can modify `hash-table`.

`with-hash-table-locked` is useful not only for multiple accesses to the same table, but also when an access to the table must be consistent with some other operation, avoiding the need to make a separate lock,

See also

`make-hash-table`
`modify-hash`

with-heavy-allocation		<i>Macro</i>
Summary	Slows up garbage collection during the execution of code that allocates a lot of space.	
Package	<code>hcl</code>	
Signature	<code>with-heavy-allocation &rest body => result</code>	
Arguments	<i>body</i>	The forms for which you want the garbage collector to behave differently from normal.
Values	<i>result</i>	The result of executing <i>body</i> .
Description		The macro <code>with-heavy-allocation</code> is for use with code that allocates a lot of space but is not interactive. It ensures that garbage collection (GC) is carried out less frequently while these forms are being executed. However, each GC may take longer.
Compatibility note		In LispWorks 5.0 <code>with-heavy-allocation</code> is implemented only in 32-bit LispWorks. In version 5.1 and later it is implemented in 64-bit LispWorks as well.
See also		<code>avoid-gc</code> <code>gc-if-needed</code> <code>get-gc-parameters</code> <code>mark-and-sweep</code> <code>normal-gc</code> <code>set-gc-parameters</code> <code>finish-heavy-allocation</code> <code>without-interrupts</code>

with-output-to-fasl-file		<i>Function</i>
Summary	Sends output to a fasl file on disk.	

Package	<code>hcl</code>	
Signature	<code>with-output-to-fasl-file (stream pathname &rest options) &body body => nil</code>	
Arguments	<code>stream</code>	Stream to be bound to the fasl file to be created.
	<code>pathname</code>	Name of the fasl file to be created.
	<code>body</code>	Forms, some of which may be dumped.
Values	Returns <code>nil</code> .	
Description	<p><code>with-output-to-fasl-file</code> is used in conjunction with <code>dump-form</code>. The <i>body</i> forms are executed, and during the execution, <code>dump-form</code> may be called to dump selected forms. Dumped forms are evaluated if the file <i>pathname</i> is later loaded by <code>load-data-file</code>.</p> <p>Supply an appropriate fasl extension in <i>pathname</i>. A simple way to achieve this is by calling <code>compile-file-pathname</code>. A complete list of fasl extensions for supported platforms may be found in <code>compile-file</code>.</p> <p>If the file <i>pathname</i> already exists, it is superseded.</p> <p>A fasl file created using <code>with-output-to-fasl-file</code> must be loaded only by <code>load-data-file</code>, and not by <code>load</code>.</p>	
Example	<pre>CL-USER 12 > (with-output-to-fasl-file (s "/tmp/foo.fasl") (dump-form '(print 'hello) s)) NIL CL-USER 13 > (let ((sys:*binary-file-type* "fasl")) (sys:load-data-file "/tmp/foo.fasl")) ; Loading fasl file "/tmp/foo.fasl" HELLO #P"/tmp/foo.fasl"</pre>	

See also

`dump-form`
`dump-forms-to-file`
`load-data-file`

33

The LINK-LOAD Package

This chapter describes the symbols in the `LINK-LOAD` package.

Note: this chapter applies only to LispWorks for UNIX only (not LispWorks for Linux, FreeBSD, or x86/x64 Solaris).

		<i>Function</i>
Package	<code>link-load</code>	
Signature	<code>break-on-unresolved-functions &optional stream</code>	
Arguments	<code>stream</code>	An output stream for message reporting. If set to <code>nil</code> , then no output will be produced. By default this is <code>t</code> .
Description		The <code>break-on-unresolved-functions</code> function produces break-on-entry code for all currently undefined but referenced (that is, unresolved) foreign symbols, so that if an undefined foreign function is called from within the foreign code, a Lisp error will occur. Break-on-entry code will also be

produced for any new unresolved symbols loaded later in your Lisp session.

The special variable `foreign:*break-on-unresolved-functions*` will, when set to non-nil, produce break-on-entry code for all new unresolved symbols that are loaded, but won't do so for symbols already loaded. By default this variable is set to nil.

See also [read-foreign-modules](#)

foreign-symbol-address *Function*

Package [link-load](#)

Signature `foreign-symbol-address name &key errorp functionp => result`

Arguments `name` The name of a foreign symbol.
`errorp` A boolean.
`functionp` A boolean.

Values `result` The address of `name` or `nil`.

Description The `foreign-symbol-address` function is used to find out whether a foreign symbol is defined, by looking for it in the foreign-symbol table. If its associated object code has been loaded into the image, its address is returned. Otherwise `nil` is returned, unless `errorp` is `nil`.

The `errorp` keyword defines the behavior of the function when a symbol has not been defined. If it is non-nil (which is the default value), then an error will be signalled. If it is `nil`, no error will be reported, and the function will return `nil`.

The `functionp` keyword is used to specify the kind of symbol sought. If it is t, `foreign-symbol-address` will assume that

name is the name of a function. If it is `nil` it will assume that *name* is the name of a variable. The default value is `t`.

Example `(foreign-symbol-address 'chmod)`

See also `get-foreign-symbol`

get-foreign-symbol *Function*

Package `link-load`

Signature `get-foreign-symbol name &optional force => result`

Arguments *name* A symbol or string.

force A keyword.

Values *result* A foreign symbol.

Description This function gets a foreign symbol or it may be used to explicitly register an undefined symbol.

name is a symbol or string to look up or to create as a foreign symbol. If it is a symbol, the symbol looked for is that which the function `lisp-name-to-foreign-name` would produce. If *name* is a string, it is taken literally

If supplied and the symbol is not already defined as a foreign symbol, *force* forces it to be an undefined foreign symbol. This provides a reference to the symbol so that a subsequent call to `read-foreign-modules` will attempt to resolve it

Example `(get-foreign-symbol 'my-func-not-yet-loaded t)`

Notes It is not usually necessary to use this function. In order to examine whether a foreign symbol is defined, use `foreign-symbol-address`. The act of defining a foreign function using

`fli:define-foreign-function` makes the symbol undefined, so the use of force is not usually needed.

See also `foreign-symbol-address`
`lisp-name-to-foreign-name`
`read-foreign-modules`

	<i>Function</i>				
lisp-name-to-foreign-name					
Package	<code>link-load</code>				
Signature	<code>lisp-name-to-foreign-name name &key language</code>				
Arguments	<table border="0"> <tr> <td><code>name</code></td><td>A symbol representing a Lisp name. (Strings are passed unchanged through the function.)</td></tr> <tr> <td><code>language</code></td><td>If :c then an equivalent ‘C’ name is produced. :FORTRAN is an alternative.</td></tr> </table>	<code>name</code>	A symbol representing a Lisp name. (Strings are passed unchanged through the function.)	<code>language</code>	If :c then an equivalent ‘C’ name is produced. :FORTRAN is an alternative.
<code>name</code>	A symbol representing a Lisp name. (Strings are passed unchanged through the function.)				
<code>language</code>	If :c then an equivalent ‘C’ name is produced. :FORTRAN is an alternative.				
Description	This function provides an equivalent foreign name for a Lisp name, depending on the keyword language.				
Values	A string is returned which is a foreign equivalent of the Lisp name supplied. If name is a string, the function returns the string unchanged. If language is a symbol, the ‘C’ version replaces occurrences of ‘-’ with ‘_’ and adds a leading underscore. The Fortran version replaces occurrences of ‘-’ with ‘_’ and adds a leading and trailing underscore.				
Example	<code>(lisp-name-to-foreign-name 'lisp-name-with-hyphens) "lisp_name_with_hyphens"</code>				
See also	<code>get-foreign-symbol</code>				

	<i>Function</i>
read-foreign-modules	
Package	link-load
Signature	<code>read-foreign-modules &rest module-names => t</code>
Arguments	<i>module-names</i> A sequence of strings or pathnames.
Values	<i>t</i>
Description	<p>The <code>read-foreign-modules</code> function reads object files of various formats into the Lisp image. Unresolved references are resolved wherever possible and the names of the foreign functions are made available to the Lisp for direct calling from the Lisp if desired. With no argument, <code>read-foreign-modules</code> scans the default libraries looking for definitions of referenced but undefined symbols.</p> <p>The <i>module-names</i> argument is a sequence of items representing object files to be loaded. The items may be of type string or pathname, and will be used to look up a corresponding file in the file system. The only exception is if an item is a string beginning “-l” in which case the rest of the string is used to look up a library file using format strings constructed from the values of the variable <code>*default-library-name-search-paths*</code>, the environment variable <code>LD_LIBRARY_PATH</code> and the variable <code>*default-library-names*</code>. Object files of various formats and library files can be handled by <code>read-foreign-modules</code>.</p>
Example	<pre>(read-foreign-modules "/usr/users/clc/projects/head.o" "~clc/projects/libs.a" "-lw")</pre>
Notes	The <code>read-foreign-modules</code> function actually adds the <i>module-names</i> to the list of modules in the variable <code>*default-libraries*</code> and then tries to resolve any undefined symbols using this list. The function <code>get-foreign-symbol</code> may be

called to explicitly force a symbol onto the undefined list or the act of defining a foreign function (`fli:define-foreign-function`) will do it implicitly.

`read-foreign-modules` may be called at any time during the running of a program and a particular object file may be loaded as often as is necessary.

A warning of any new unresolved references will be printed out after the reading has finished if the flag `*unresolved-messages*` is set to `t` (the default is `nil`). By default messages are printed out about which object modules are being loaded. This may be switched off by setting `*coff-loading-verbose*` to `nil`.

See also `get-foreign-symbol`

34

The LISPWORKS Package

This chapter describes symbols available in the `LISPWORKS` package. This package is used by default. Its symbols are visible in the `CL-USER` package.

Various uses of the symbols documented here are discussed throughout this manual.

8-bit-string	<i>Type</i>
Summary	The 8 bit string type.
Package	<code>lispworks</code>
Signature	<code>8-bit-string <i>length</i></code>
Arguments	<code>length</code> The length of the string (or <code>*</code> , meaning any).
Description	The type of strings that can hold simple chars of codes 0...255. This is the string type that is guaranteed to always take 8 bits per element.

16-bit-string	<i>Type</i>
Summary	The 16 bit string type.
Package	lispworks
Signature	16-bit-string <i>length</i>
Arguments	<i>length</i> The length of the string (or *, meaning any).
Description	The type of strings that can hold simple chars of codes 0...65533. This is the string type that is guaranteed to always take 16 bits per element.
appendf	<i>Macro</i>
Summary	Appends lists to the end of a given list.
Package	lispworks
Signature	appendf <i>place &rest lists</i> => <i>result</i>
Arguments	<i>place</i> A place. <i>lists</i> A set of lists.
Values	<i>result</i> An object.
Description	The modify macro appendf appends the lists given by <i>lists</i> to the end of the list in <i>place</i> . See append for more details.
See also	removef
base-character	<i>Type</i>
Summary	The base character type.

Package	<code>lispworks</code>
Signature	<code>base-character</code>
Description	The type of base characters. <code>base-character</code> is a synonym for the Common Lisp type <code>base-char</code> .
See also	<code>base-char-code-limit</code>

base-character-p *Function*

Summary	Tests if an object is a base character	
Package	<code>lispworks</code>	
Signature	<code>base-character-p object => bool</code>	
Arguments	<code>object</code>	The object to be tested.
Values	<code>bool</code>	<code>t</code> if <code>object</code> is a base character; <code>nil</code> otherwise.
Description	This is the predicate for base characters.	
See also	<code>base-character</code>	

base-char-p *Function*

Summary	Tests if an object is a base character	
Package	<code>lispworks</code>	
Signature	<code>base-char-p object => bool</code>	
Arguments	<code>object</code>	The object to be tested.

Values	<i>bool</i>	<i>t</i> if <i>object</i> is a base character; <i>nil</i> otherwise.
Description	This is also the predicate for base characters, only with standard spelling.	
See also		base-character-p

base-char-code-limit *Constant*

Summary	Upper bound for character codes in base characters.
Package	lispworks
Description	The upper exclusive bound for values of (char-code <i>char</i>) among base characters.

base-string-p *Function*

Summary	Tests if an object is a base string.	
Package	lispworks	
Signature	base-string-p <i>object</i> => <i>bool</i>	
Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	<i>t</i> if <i>object</i> is a base string; <i>nil</i> otherwise.
Description	This is the predicate for base strings.	
See also	base-string	

browser-location		<i>Variable</i>
Signature	<code>*browser-location*</code>	
Package	<code>lispworks</code>	
Initial Value	<code>nil</code>	
Description	<p>Controls how the online documentation interface and the function <code>open-url</code> find a web browser executable (either Netscape, Firefox, Mozilla or Opera) to use. The value should be <code>nil</code> or a string.</p> <p>If the value is <code>nil</code>, LispWorks attempts to find the browser using the value of the environment variable <code>PATH</code>.</p> <p>If the value is a string, it specifies the directory in which the browser is installed. Typical values are <code>"/usr/bin/"</code> and <code>"/usr/local/bin/"</code>.</p> <p>Note: do not omit the trailing slash.</p> <p>Note: <code>*browser-location*</code> is used only in the Motif-based IDE.</p>	
See also	<code>open-url</code>	

call-next-advice		<i>Function</i>
Summary	Calls the next piece of advice associated with a function.	
Package	<code>lispworks</code>	
Signature	<code>call-next-advice args</code>	
Arguments	<code>args</code> are arguments to be given to the next piece of advice to be called. Any number of arguments may be given in this way, including keyword arguments, and there is no require-	

ment for pieces of around advice to receive the same number of arguments as the original definition expected.

Values	<code>call-next-advice</code> returns the values produced by the call to the next piece of advice (or to the combination of before and after advice and the original definition).
Description	<code>call-next-advice</code> is the local function used to invoke the next item in the ordering of pieces of advice associated with a function. It can only be called from within the scope of the around advice. Advice may be attached to a function by <code>defadvice</code> and this allows the behavior of a function to be modified. Extra code to be performed before or after the function may be simply added by creating before or after advice for it. Around advice is more powerful and replaces the original definition. All the advice for a function is ordered with the around advice coming first. The first piece of around advice receives the arguments to the function and may return any values at all. It has access to the rest of the advice, and to the original definition, by means of <code>call-next-advice</code> . A call to this from within the body of the around advice invokes the next piece of around advice with the arguments given to <code>call-next-advice</code> . The last piece of around advice in the ordering invokes the sequence of before advice, the original definition, and after advice if it calls <code>call-next-advice</code> . Around advice may contain any number of calls to <code>call-next-advice</code> , including no calls.
Notes	<code>call-next-advice</code> is an extension to Common Lisp. See Chapter 6, “The Advice Facility” for a broader discussion of advice.
See also	<code>defadvice</code>

		<i>Function</i>
Summary	Returns a hash function suitable for strings, ignoring case using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature		<code>choose-unicode-string-hash-function &key style => hash-function</code>
Arguments	<i>style</i>	A keyword
Values	<i>hash-function</i>	A hash function
Description		The function <code>choose-unicode-string-hash-function</code> return a function which is suitable for use as the <i>hash-function</i> argument to <code>make-hash-table</code> . The function <i>hash-function</i> generates a hash value for a string, ignoring case using specified Unicode comparison rules specified by <i>style</i> . The current implementation only supports one value of <i>style</i> : <code>:simple-case-fold</code> Compares each character of the string using Unicode's simple case folding rules.
See also		<code>make-hash-table</code> <code>unicode-string-equal</code>

		<i>Function</i>
Summary		The function <code>compile-system</code> compiles all the files in a system necessary to make a consistent set of object files.
Package		<code>lispworks</code>
Signature		<code>compile-system system-name &key force simulate load args target-directory</code>

Arguments	<i>system-name</i>	A symbol representing the name of the system. The system must have been defined already using the <code>defsystem</code> macro.
	<i>force</i>	If <code>t</code> then all the files in the system are compiled regardless. (This argument was formerly called <i>force-p</i> . The old name is currently still accepted for compatibility.)
	<i>simulate</i>	If <code>nil</code> or not present then <code>compile-system</code> works silently. Otherwise a plan of the actions which <code>compile-system</code> intends to carry out is printed. What happens next depends on the value of <i>simulate</i> :
		<code>t</code> — do nothing.
		<code>:ask</code> — you are asked if you wish the plan to be carried out using <code>y-or-n-p</code> .
		<code>:each</code> — <code>compile-system</code> displays each action in the plan one at a time, and asks you whether you want to carry out this particular action. The answer <code>c</code> executes the rest of the plan without further prompting, returns from <code>compile-system</code> without further processing, and <code>y</code> and <code>n</code> work as expected.
		<code>:simulate</code> may be abbreviated as <code>:sim</code> .
	<i>load</i>	If <code>t</code> then <code>load-system</code> is called after <code>compile-system</code> has finished. If <code>:no</code> then no files are loaded at all. The default is <code>nil</code> .
	<i>args</i>	Arguments to be passed directly to the compiler.
	<i>target-directory</i>	This must be a string representing a valid directory. It defaults to the <code>:default-pathname</code> option to <code>defsystem</code> . This is the directory where the object files created are put. If the <i>target-directory</i> is given

	then dependency information expressed in the system rules is ignored. <code>:target-directory</code> may be abbreviated as <code>:t-dir</code> .
Values	<code>compile-system</code> returns <code>nil</code> .
Examples	<pre>(compile-system 'blackboard :simulate :ask) (compile-system 'tms :load t) (compile-system 'packages :load :no :target-directory "/usr/users/386i/")</pre>
Notes	If <code>load</code> is <code>t</code> then <code>load-system</code> is called after the system has been compiled.
	C source files, for example <code>foo.c</code> , can be included in a system (see the use of <code>:default-type</code> and <code>:type</code> in <code>defsystem</code>). The corresponding object file name is <code>foo.so</code> on Linux, and on Unix it is <code>foon.o</code> where <code>n</code> is a platform-specific integer. On Mac OS X the object file name is <code>foo.dylib</code> and on Windows the object file name is <code>foo.dll</code> .
See also	<code>concatenate-system</code> <code>defsystem</code> <code>load-system</code>

	<i>Function</i>
concatenate-system	
Summary	Produces a single, concatenated fasl from a <code>defsystem</code> system or systems.
Package	<code>scm</code>
Signature	<code>concatenate-system output system &key force simulate sim source-only args target-directory t-dir script-p => result</code> <code>system ::= system-name*</code>

Arguments	<i>output</i>	The name of the required concatenated fasl.
	<i>system-name</i>	The name of a system defined using <code>defsystem</code> .
	<i>simulate</i>	Verbosity conditions, see Description for more detail.
	<i>sim</i>	Same as <i>simulate</i> .
	<i>force</i>	If <code>t</code> , then all files in the system will be concatenated.
	<i>source-only</i>	If <code>t</code> , the source files of the system are concatenated.
	<i>target-directory</i>	The directory to search for the object files.
	<i>t-dir</i>	Same as <i>target-directory</i> .
Values	<i>result</i>	A list containing the name or names of the concatenated systems.
Description	<p>This function produces a single, concatenated fasl, <i>output-file</i>, from a list of individual systems (named amongst the args).</p> <p>Since concatenated fasl files may be produced in this way, you do not need to be wary of MS filename conventions if developing sources on UNIX for a Microsoft Windows application. This clearly allows more freedom for naming source files. However, <i>output-file</i> must, in such cases, be a MS-Window-compatible filename.</p> <p>If <i>simulate</i> is <code>nil</code> or is not present, <code>concatenate-system</code> will work silently. Otherwise, a plan of the actions which <code>concatenate-system</code> intends to carry out is printed. What happens next depends upon the value of <i>simulate</i>:</p> <ul style="list-style-type: none"> • If it is <code>t</code>, the function does nothing. • If <code>:ask</code>, then the user is asked, using <code>y-or-n-p</code>, if the plan should be carried out. 	

- If it is `:each`, the user is asked at each stage in the plan if the current action should be carried out. The responses `y` and `n` work as normal. If `e` is typed, `concatenate-system` exits without further processing.

If `source-only` is `t`, files will be loaded only if they are sources.

If, when searching `target-directory` for an object file, the file cannot be found, the appropriate source file from the system's default directory will be loaded instead.

See also `compile-system`
`defsystem`
`load-system`

	<i>Function</i>
Summary	Computes a pathname relative to the current path.
Package	<code>lispworks</code>
Signature	<code>current-pathname &optional relative-pathname type => pathname</code>
Arguments	<code>relative-pathname</code> A pathname designator. <code>type</code> A string or <code>nil</code> . The default is <code>nil</code> .
Values	<code>pathname</code> A pathname.
Description	<p>The function <code>current-pathname</code> is useful for loading other files relative to a file.</p> <p><code>current-pathname</code> computes a pathname from the current operation as follows:</p> <p>When loading a file</p> <p style="text-align: center;">Uses <code>*load-pathname*</code>.</p>

When compiling a file

Uses `*compile-file-pathname*`.

When evaluating or compiling an Editor buffer

Uses the pathname of the buffer, if available, otherwise uses the current working directory.

Otherwise

Uses the current working directory.

The pathname computed above is then translated to a physical pathname, and the argument *relative-pathname* is merged with this physical pathname. The `pathname-type` of the result `pathname` is set to *type* if supplied, the `pathname-version` is set to `:newest`, and `pathname` is returned.

A useful value for *type* is `nil`, which can be used to allow `load` to choose between lisp or fasl regardless of the type of the current pathname.

Note: `defsystem` uses `current-pathname` with its `:default-host` argument.

Examples

Suppose you want the file `foo` to load the file `bar`.

While loading the source file `foo.lisp`:

```
(current-pathname "bar")
=>
#P"C:/temp/bar.lisp"
```

While loading the binary file `foo.ofasl`:

```
(current-pathname "bar")
=>
#P"C:/temp/bar.ofasl"
```

To load `bar.lisp` or `bar.ofasl` according to the value of `*load-fasl-or-lisp-file*`, regardless of whether `foo.lisp` or `foo.ofasl` is being loaded, specify *type nil*:

```
(load (current-pathname "bar" nil))
```

See also **defsystem**
 pathname-location

defadvice *Macro*

Summary Defines a new piece of advice.

Package **lispworks**

Signature **defadvice (dspec name advice-type &key where documentation)**
 lambda-list &body body => nil

dspec ::= fn-name |
 macro-name |
 (method generic-fn-name [(class*)])

advice-type ::= :before | :after | :around

Arguments **dspec** Specifies the functional definition to which the piece of advice belongs. There are three forms which this specification may take. The first one above specifies a function by its name; the second one specifies a macro by name; the third specifies a method by the name of its generic function and by a list of classes to specialize the arguments to the method. In the case of a method the list of classes must correspond exactly to the classes of the specialized parameters of an existing method, and the advice is then attached to this method.

When advice is provided for a macro using **defadvice**, then the function with which the advice is associated is the expansion function for that macro. Thus before and after advice for a macro receive the arguments

	given to the macro expansion function, which are normally the macro call form and an environment.
<i>name</i>	A symbol naming the piece of advice being created. It should of course be unique to the advised function, but does not need to be globally unique.
<i>advice-type</i>	A keyword specifying the kind of advice wanted.
<i>where</i>	Specifies where this advice should be placed in the ordering of pieces of advice for the function. By default a piece of advice is placed at the start of the corresponding section. If this argument is present and is :end then the advice is instead placed at the end of its section. The other permissible value for this argument is :start, which places the advice at the start of its section in the ordering (as in the default behavior).
<i>documentation</i>	A string providing documentation on the piece of advice.
<i>lambda-list</i>	A lambda list for the piece of advice. In the case of before and after advice this should be compatible with the lambda list for the original definition, since such advice receives the same arguments as that function.
<i>body</i>	The main body of the advice.
Values	<code>defadvice</code> returns <code>nil</code> .
Description	<code>defadvice</code> is the macro used to define a new piece of advice. Advice provides a way to change the behavior of existing functional definitions in the system. In a simple instance advice might be used to carry out some additional actions

before or after the original definition. More sophisticated uses allow the definition to be replaced by new code that can access the original function repeatedly or as rarely as desired, and that can receive different numbers of arguments and return any values. A function may have any number of pieces of advice attached to it by using `defadvice`.

There are three kinds of advice that may be defined: before, after and around advice. The first two kinds attach auxiliary code to be carried out alongside the original definition (before it for before advice, after it in the case of after advice). Around advice replaces the function altogether; it may define code that never accesses the original definition, that receives different numbers of arguments, and returns different values. All the pieces of advice for a function are ordered. The ordering is important in determining how all the pieces of advice for a function are combined. Around advice always comes first, then before advice, then the original definition, and lastly the after advice.

Conceptually the before advice, the original definition and the after advice are amalgamated into one new construct. If this gets called then each of its components receives the same arguments in turn, and the values returned are those produced by the last piece of after advice to be called in this way (or the original function if there is no after advice). The code associated with before and after advice should not destructively modify its arguments.

If around advice is present then the first piece of around advice is called, instead of the combination involving before and after advice discussed above. It does not have to access any of the other advice, nor the original definition. Its only link to the rest of the advice is by means of a call to `call-next-advice`. It may invoke this as often as it chooses, and by doing so it accesses the next piece of around advice if present, or else it accesses the combination of before and after advice together with the original definition.

Remove advice using `remove-advice` or `delete-advice`.

Notes `defadvice` is an extension to Common Lisp.

See also `call-next-advice`
`delete-advice`
`remove-advice`

default-action-list-sort-time *Variable*

Summary Determines when actions in action lists are sorted.

Package `lispworks`

Signature `*default-action-list-sort-time*`

Initial value `:execute`

Description Contains a keyword that is either `:execute` or `:define-action`, denoting when actions in action-lists are sorted (see `define-action-list` for an explanation of ordering specifiers). Actions are sorted either at time of definition (`:define-action`) or when their action-list is executed (`:execute`). The default sort time is `:execute`.

See also `define-action`

default-character-element-type *Parameter*

Summary Provides defaults for all character type parameters.

Package `lispworks`

Description This variable provides defaults for all character type parameters. The legal values are `base-char`, `lw:simple-char`, and

`character`. Its value must only be set via a call to `lw:set-default-character-element-type`.

This is intended mainly for running old 8-bit applications efficiently. If you write for a fat character implementation you should already be aware of these issues, and make some attempt to provide explicit types.

When the compiler does type inferencing it behaves as if this variable was bound to `character`; if you want assumptions about types to be hard-coded into your program, you must supply explicit declarations and type arguments.

See also

`string`
`open`
`set-default-character-element-type`
`with-output-to-string`

define-action

Macro

Summary	Adds a new action to a specified list.		
Package	<code>lispworks</code>		
Signature	<code>define-action name-or-list action-name data &rest specs =></code>		
Arguments	<code>name-or-list</code>	A list or action list object.	
	<code>action-name</code>	A general lisp object.	
	<code>data</code>	An object.	
	<code>specs</code>	A list.	
Description	The <code>define-action</code> macro adds a new action to the specified list; this action will be executed according to the action-list's execution-function (see <code>execute-actions</code>) when executed. If the action-list specified by <code>name-or-list</code> does not exist, then		

this is handled according to the value of `*handle-missing-action-list*`.

name-or-list is evaluated to give either a list UID (to be looked up in the global registry of lists) or an action list object. *action-name* is a UID (general lisp object, to be compared by `equalp`). It uniquely identifies this action within its list (as opposed to among all lists).

data specifies an object referring to data relevant to the action.

specs is a free-form list of ordering specifiers and extra keywords, used to control more details of how and when this action is executed.

Action-items are normally expected not to be redefined. If an action-item with that action-name already exists in the action-list (that is, one with an identifier `equalp` to the action-name), then the notification and subsequent handling of this attempt is controlled by the values in the list `*handle-existing-action-in-action-list*`. This is to prevent problems due to re-evaluating an action definition inappropriately. Notification and redefine behavior can be overridden by using the `:force` keyword argument. In this case, any required redefinition is performed unconditionally and without notification.

The following keywords are recognized in the *specs* argument:

- | | |
|--|---|
| <code>:after</code> | The following element in <i>specs</i> is a UID.
<code>:after</code> specifies that the action-item being defined must be run after the action-item named. If there is no action-item with a matching name, the restriction is ignored. |
| <code>:before</code> | Like <code>:after</code> , but this action-item must be run before the one specified. |
| <code>:after</code> and <code>:before</code> can be specified as many times as necessary to describe the ordering constraints of this action-item with respect to its neighbors. | |

	:once	Specifies that this action-item should be executed only once; after execution, it is disabled.
	:force	Specifies that this definition should override any previous definition of this action-item, rather than be subject to the value of *handle-existing-action-in-action-list* .
Example		(define-action :network-startup "Reset decnet buffers" ' (decnet::reset-network-buffers *net-buffers*) :after "Reset core network" :once))
See also		undefine-action

define-action-list *Macro*

Summary	Defines a registered action list.
Package	lispworks
Signature	define-action-list <i>uid</i> & key <i>documentation sort-time dummy-actions default-order execution-function -></i>
Arguments	<p><i>uid</i> A Lisp object.</p> <p><i>documentation</i> A string.</p> <p><i>sort-time</i> One of :execute or :define-action.</p> <p><i>dummy-actions</i> A list.</p> <p><i>default-order</i> A list.</p> <p><i>execution-function</i>A function.</p>
Description	The define-action-list macro defines an action list.

uid is a unique identifier, and must be a general Lisp object, to be compared by `equalp`. It names the list in the global registry of lists. See `make-unregistered-action-list` to create unnamed, “unregistered” action-lists. The *uid* may be quoted, but is not required to be. It is possible, but not recommended, to define an action-list with unique identifier `nil`. If a registered action-list with the *uid* already exists (that is, one which returns `t` when compared with `equalp`), then notification and subsequent handling is controlled by the value of the `*handle-existing-action-list*` variable.

The *documentation* string allows you to provide documentation for the action list.

sort-time is a keyword specifying when added actions are sorted for the given list — either `:execute` or `:define-action` (see `*default-action-list-sort-time*`).

dummy-actions is a list of action-names that specify placeholder actions; they cannot be executed and are constrained to the order specified in this list, for example

```
'(:beginning :middle :end)
```

default-order specifies default ordering constraints for subsequently defined action-items where no explicit ordering constraints are specified. An example is

```
'(:after beginning :before :end)
```

execution-function specifies a user-defined function accepting arguments of the form:

```
(the-action-list other-args-list &rest keyword-value-pairs)
```

where the two required arguments are the action-list and a list of additional arguments passed to `execute-actions`, respectively. The remaining arguments are any number of keyword-value pairs that may be specified in the call to `execute-actions`. If no execution function is specified, then the default execution function will be used to execute the action-list.

See also ***default-action-list-sort-time***
 handle-existing-action-list
 undefine-action-list

defsystem *Macro*

Summary	<p><code>defsystem</code> is used to define systems for use with the Lisp-Works system tools. A system is a collection of files and other systems that, together with rules expressing the interdependencies of those files and subsystems, make a complete program. The LispWorks system tools support the development and maintenance of large programs. Find a full description at “Common Defsystem” on page 193.</p>
Package	<code>lispworks</code>
Signature	<code>defsystem system-name options &key members rules => system</code>
Arguments	<p><i>system-name</i> The name of the system to be made. <i>options</i> are expressed as a list of keyword argument pairs. The following keywords are recognized:</p> <p>:package The default package that files are compiled and loaded in. If not specified, this defaults to the value of <code>*package*</code> at macroexpansion time.</p> <p>:default-pathname Used to compute a default pathname in which to find files. <code>defsystem</code> uses <code>current-pathname</code> to compute the pathname. <code>defsystem</code> checks that all the files given as members actually exist.</p>

:default-host	The root pathname of a system is defined to be the :default-host if it is given. Otherwise, it is taken to be the directory containing the defsystem file.
	Absolute pathnames are interpreted literally, and relative pathnames are taken relative to the root pathname.
:default-type	This is the default type of the members of the system. This may be :lisp-file , :lsp-file , :c-file , or :system . The corba module adds :idl-file , :idl-client-definition , :idl-client-definition-only , :idl-server-definition and :idl-server-definition-only .
	The com module adds the type :midl-file and the automation module adds :midl-type-library-file . The default is :lisp-file , which means files with file type (extension) "lisp".
:documentation	This is a string.
:object-pathname	A string or pathname specifying a directory where object files are written. Note: This option will not work if the names in <i>members</i> represent absolute pathnames.
:optimize	A declaration specifying default compilation qualities within the scope of compile-system . These settings override the current global setting. They can be overridden per member by the :optimize option (for subsystems) or proclaim (in files). The :optimize defsystem option accepts the

same optimize qualities as `proclaim` and which are fully described in “Compiler control” on page 88. See below for examples.

`members` is a list defining the members of the system. Each element of the list may be a symbol or a string representing the name of the physical file or system referred to, or a list of format `(name {keyword value}*)` where `name` is once again a symbol or a string referring to the system or physical file, and the possible keywords are:

`:type` The type of this member. Allowed values are as for `:default-type`. If not specified it defaults to the value of `:default-type` given as an *option*.

`:root-module` If `nil` then this member is not loaded unless its loading is specifically requested as a result of a dependency on another module

`:source-only` Only the source file for this member is ever loaded

`:load-only` The member is never compiled by `defsystem`, objects are loaded in preference to source files

`:load-for-compile-only`

The member is only loaded as necessary during compilation and is never loaded independently

`:features` The member is only considered during planning if the feature expression is true.

`:package` A default package for the member.

On Windows, the automation module adds the keyword `:com` for a member with type `:midl-type-library-file`. Then a member of the form

```
("mso97.tlb" :type :midl-type-library-file :com nil)
```

can be specified when you use only Automation client code, reducing the memory used.

rules is a list of rules of the following format :

```
({:in-order-to} action {:all | ({ member-name }* )}
  (:caused-by {(action {:previous |{member-name }* }) }*)
  (:requires {(action {:previous |{ member-name }* }) }*))
```

The keyword :**all** refers to all the members of the system. It provides a shorthand for specifying that a rule should apply to all the system's members. The keyword :**previous** refers to all the members of the system that are before the member in the list of members. This makes it easy, for example, to specify that in order to compile a file in a system, all the members that come before it must be loaded.

There are more details about the rules in “**DEFSYSTEM rules**” on page 196.

Values The name of the system is returned.

Examples

```
(defsystem defsys-macros
  (:default-pathname "/usr/users/james/scm/defsys/"
    :default-type :lisp-file
    :package defsystem)
  :members ("new-macros"
            "scm-timemacros"))
```

```

(defsystem clos-sys
  (:default-pathname "/usr/users/clc/defsys/"
    :default-type :lisp-file
    :package defsystem)
  :members
  (("defsys-macros" :type :system :root-module nil)
   "class"
   "time-methods"
   ("scm-pathname" :source-only t)
   "execute-plan"
   "file-types"
   "make-system"
   "conv-defsys")
  :rules
  ((:in-order-to :compile ("class" "time-methods")
    (:caused-by (:compile "defsys-macros"))
    (:requires
      (:load "defsys-macros")))
   (:in-order-to :compile
     ("time-methods" "execute-plan")
     (:requires (:load "class")))))

(defsystem dataworks-demo
  (:default-type :system)
  :members (
    "db-class"
    "planar"
    "dataworks-dep"
    "dataworks-interface-tk"
    "dataworks-interface-tools"
    "drugs-demo"
    ("gen-demo" :type :lisp-file)
    ("load-icon" :type :lisp-file :source-only t)
  )
  :rules ((:in-order-to :compile :all
    (:requires (:load :previous))))))

```

This last example illustrates the use of `:optimize`.

```

(defsystem foo (:optimize ((speed 3) (space 3)
                           (safety 0)))
  :members ("bar"
             "baz")
  :rules ((:compile :all
    (:requires (:load :previous)))))
```

Notes	Systems that are members of another system must be declared in the system declaration file before the system of which they are a part.
	The ordering of members is important and reflects the order in which operations are carried out on the members of the system.
See also	<code>load-system</code> <code>compile-system</code> <code>concatenate-system</code> <code>current-pathname</code> <code>*defsystem-verbose*</code>

	defsystem-verbose	<i>Variable</i>
Summary	Controls the amount of messages printed by <code>defsystem</code> about system (re)definition.	
Package	<code>lispworks</code>	
Initial value		
Description	The variable <code>*defsystem-verbose*</code> is a generalized boolean controlling the amount of messages printed by <code>defsystem</code> . When the value is true, the system prints messages about system definition and redefinition. The default value is <code>t</code> .	
See also	<code>defsystem</code>	

	delete-directory	<i>Function</i>
Summary	Deletes a directory.	
Package	<code>lispworks</code>	

Signature	<code>delete-directory <i>directory</i> &optional <i>error</i> => <i>result</i></code>	
Arguments	<i>directory</i>	A pathname designator.
	<i>error</i>	<code>nil</code> , <code>:error</code> OR <code>:no-error</code> .
Value	<i>result</i>	<code>t</code> or <code>nil</code> .
Description	<p>The function <code>delete-directory</code> attempts to delete the directory <i>directory</i>. It returns <code>t</code> on success, and on failure either returns <code>nil</code> or signals an error.</p> <p><i>error</i> determines what happens when <code>delete-directory</code> fails. When <i>error</i> is <code>nil</code> (the default), if <i>directory</i> does not exist <code>delete-directory</code> returns <code>nil</code>, otherwise any failure causes an error to be signaled. If <i>error</i> is <code>:no-error</code>, <code>delete-directory</code> returns <code>nil</code> on any failure. If <i>error</i> is <code>:error</code>, any failure causes an error to be signaled.</p> <p>Typical reasons for failures in <code>delete-directory</code> are that <i>directory</i> is not empty, or that the user does not have the right permissions.</p>	

	<i>Function</i>
Summary	The main interface to the Delivery tools.
Package	<code>lispworks</code>
Signature	<code>deliver <i>function file level</i> &rest <i>keywords</i></code>
Description	<p>The function <code>deliver</code> is the main interface to the LispWorks delivery tools. You use it to create LispWorks executable applications and dynamic libraries.</p> <p>For more information about Delivery including a detailed description of <code>deliver</code>, see the <i>LispWorks Delivery User Guide</i>.</p>

For information about invoking `deliver` using the IDE, see "The Application Builder" in the *LispWorks IDE User Guide*.

See also [save-image](#)

describe-length *Variable*

Summary Determines how many attributes of a composite object are described.

Package [lispworks](#)

Initial Value 20

Description The variable `*describe-length*` controls how many attributes of a composite object the function `describe` describes.

This means the number of elements of a sequence, entries in a hash table, slots of a structure instance, and so on.

If `*describe-length*` is `nil` then `describe` describes all of the attributes. Use this value only with care.

Note: the `describe` functionality is load-on-demand in the LispWorks image as shipped. Therefore if you have not done `(require "describe")` or called `describe`, `*describe-length*` may be unbound.

See also [describe](#)

describe-level *Variable*

Summary Controls the depth to which `describe` describes arrays, structures and conses.

Package	<code>lispworks</code>
Initial Value	1
Description	The variable <code>*describe-level*</code> controls the depth to which the function <code>describe</code> describes arrays, structures and conses. Note: the <code>describe</code> functionality is load-on-demand in the LispWorks image as shipped. Therefore if you have not do <code>(require "describe")</code> or called <code>describe</code> , <code>*describe-level*</code> may be unbound.
Example	<pre>CL-USER 23 > (describe 1) [... load output not shown ...] 1 is a BIT DECIMAL 1 HEX 1 OCTAL 1 BINARY 1 CL-USER 24 > *describe-level* 1 CL-USER 25 > (defstruct foo a s d) FOO CL-USER 26 > (defmethod describe-object ((f foo) (s stream)) (format s "FOO ~S~%" f) (describe (foo-a f) s)) #<STANDARD-METHOD DESCRIBE-OBJECT NIL (FOO STREAM) 2068295C> CL-USER 27 > (describe (make-foo :a (vector 1 2 3) :s 42)) FOO #S(FOO A #(1 2 3) S 42 D NIL) #(1 2 3)</pre>

To make `describe` operate on objects inside the structure instance, increase the value of `*describe-level*`:

```

CL-USER 28 > (setf *describe-level* 2)
2

CL-USER 29 > (describe (make-foo :a (vector 1 2 3) :s
42))

FOO #S(FOO A #(1 2 3) S 42 D NIL)
#(1 2 3) is a SIMPLE-VECTOR
      0      1
      1      2
      2      3

```

See also **describe**

describe-print-length *Variable*

Summary Specifies a print length for **describe** and **apropos**.

Package **lispworks**

Initial Value 10

Description If ***print-length*** is **nil**, **describe** and **apropos** bind
print-length to the value of ***describe-print-length***.

See also **describe**

describe-print-level *Variable*

Summary Specifies a print level for **describe** and **apropos**.

Package **lispworks**

Initial Value 10

Description If ***print-level*** is **nil**, **describe** and **apropos** bind
print-level to the value of ***describe-print-level***.

See also **describe**

dll-quit	<i>Function</i>
Summary	Makes a LispWorks dynamic library quit.
Package	lispworks
Signature	dll-quit &key kill-all-processes timeout output force => result, quit-output
Arguments	kill-all-processes A generalized boolean. timeout A positive integer or nil . output An output stream designator. force A generalized boolean.
Values	result t or nil . quit-output A string or nil .
Description	The function dll-quit makes a LispWorks dynamic library (or DLL) quit on returning from the callback in which it was called. It must be called only: <ul style="list-style-type: none">• In an image running as a dynamic library, meaning an image created by save-image with :dll-exports or by deliver with :dll-exports, and• Inside the dynamic scope of a callback into the dynamic library. That is, not in a process that was started by process-run-function. dll-quit sets up the internal state such that just before returning into its caller in the LispWorks dynamic library it causes LispWorks to quit. After quitting the callback returns as normal. The library can be unloaded using FreeLibrary , or you can re-use it (without re-loading).

By default *kill-all-processes* is `nil` which means that, if there are other running processes, `d11-quit` just returns `nil`. If *kill-all-processes* is non-`nil`, `d11-quit` tries to kill all the other processes, and if it succeeds, it quits.

If *kill-all-processes* is true, *timeout* is a maximum time to wait after killing the other processes. It allows *timeout* seconds for all processes to die.

`d11-quit` should be called when no other processes are running, whether they were created by a callback or by `process-run-function`. If such processes exist, by default `d11-quit` does nothing and returns `nil`. If *force* is non-`nil`, `d11-quit` always tries to set LispWorks up for quitting. LispWorks will quit even after a failure to kill all other processes and complete any required shut down operations. A true value of *force* automatically implies *kill-all-processes* true. However, if any of the other processes is stuck in a foreign call, the quitting may fail to finish properly. The default value of *force* is `nil`.

If *output* is supplied, `d11-quit` generates output if it is called when other processes are still running, or a required shut down operation was not completed. *output* can be an output stream, `t` (interpreted as `*standard-output*`) or `nil`. If *output* is `nil`, `d11-quit` collects the output and returns it as second argument *quit-output*. Otherwise it writes the output to the stream and *quit-output* is `nil`.

The output contains a list of the other processes that are still running. If *kill-all-processes* or *force* was supplied, and killing the other processes failed, the output also contains backtraces of the other processes, and possibly other debugging information.

result is `t` on success: the LispWorks dynamic library is set to quit on returning from the callback. *result* is `nil` when other processes are running: the image is not set to quit.

quit-output contains the output which was generated when `output nil` was passed. Otherwise *quit-output* is `nil`.

If `dll-quit` is called inside a recursive foreign callback, the LispWorks dynamic library quits only when the outermost callback returns.

Note: `dll-quit` is intended for use when a LispWorks dynamic library is loaded by a main process which you (the LispWorks programmer) do not control. If you control the main process, then use `QuitLispWorks` instead.

It is expected that the main process will call into the dynamic library with some "shutdown" call, and then calls `FreeLibrary` to free the library. The shutdown call should close and free everything that needs to be closed or freed, call `dll-quit`, and return.

Note: `dll-quit` is supported only where LispWorks can be a dynamic library. Currently this is in 32-bit LispWorks on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD, and in 64-bit LispWorks on Windows, Intel Macintosh, Linux and x86/x64 Solaris.

See also `deliver`
 `save-image`

dotted-list-length

Function

Summary	Similar to <code>list-length</code>	
Package	<code>lispworks</code>	
Signature	<code>dotted-list-length list => result</code>	
Arguments	<code>list</code>	A list.
Value	<code>result</code>	An integer.

Description	The function <code>dotted-list-length</code> performs the same action as <code>list-length</code> , except that if the last <code>cdr</code> is not <code>nil</code> then instead of signalling an error, it returns the number of <code>conses</code> plus 1.
See also	<code>dotted-list-p</code>

dotted-list-p *Function*

Summary	Tests whether a <code>cons</code> is a list ending in a non-nil <code>cdr</code> .	
Package	<code>lispworks</code>	
Signature	<code>dotted-list-p list => bool</code>	
Arguments	<code>list</code>	A list, which must be a <code>cons</code> .
Values	<code>bool</code>	A generalized boolean.
Description	The function <code>dotted-list-p</code> is a predicate which tests whether <code>list</code> (which must be a <code>cons</code>) is a list ending in a non-nil <code>cdr</code> . It returns a true value if this is the case, otherwise it returns <code>nil</code> .	
See also	<code>dotted-list-length</code>	

do-nothing *Function*

Summary	Ignores its arguments and returns an unspecified value.	
Package	<code>lispworks</code>	
Signature	<code>do-nothing &rest ignore => unspecified</code>	
Arguments	<code>ignore</code>	All arguments are ignored.

Values	<i>unspecified</i>	An unspecified value.
Description	The function <code>do-nothing</code> ignores its arguments and returns an unspecified value. It is useful as a function argument.	
See also	<code>false</code> <code>true</code>	

enter-debugger-directly *Variable*

Summary	Controls direct entry into the Debugger tool.
Package	<code>lispworks</code>
Initial value	<code>nil</code>
Description	<p>The variable <code>*enter-debugger-directly*</code> is a generalised boolean which affects the behavior of the LispWorks IDE when an error is signalled outside of the Listener REPL.</p> <p>Value <code>nil</code> causes an error notifier window to be displayed (from which you can abort, report a bug, or raise a Debugger tool).</p> <p>A true value causes the Debugger tool to be displayed immediately, and no error notifier appears.</p> <p>Note: Errors signalled in a Listener Read-Eval-Print loop are handled in the REPL and therefore <code>*enter-debugger-directly*</code> has no effect on the behavior in this case.</p>

environment-variable *Function*

Summary	Reads the value of an environment variable from the environment table of the calling process.
---------	---

Package	<code>lispworks</code>	
Signature	<code>environment-variable name => result</code>	
Arguments	<code>name</code>	A string.
Values	<code>result</code>	A string or <code>nil</code> .
Description	<p>The function <code>environment-variable</code> reads the environment variable specified by <code>name</code> and returns its value, or <code>nil</code> if the variable could not be found.</p> <p>A <code>setf</code> method is also defined, allowing you to set the value of an environment variable:</p>	
	<pre>(setf (environment-variable name) value)</pre> <p>If <code>value</code> is a string, then <code>name</code> is set to be <code>value</code>. If <code>value</code> is <code>nil</code> then <code>name</code> is removed from the environment table.</p>	
Example	<p>In this first example the value of the environment variable <code>PATH</code> is returned:</p> <pre>(environment-variable "PATH")</pre> <p>The result is a string of all the defined paths:</p> <pre>"c:\\hgb\\nt\\x86;c:\\hgb\\nt\\x86\\perl;c:\\hgb\\win32;c:\\usr\\local\\bin;C:\\WINNT35\\system32;C:\\WINNT35;;C:\\MSTOOLS\\bin;C:\\TGS3D\\PROGRAM;c:\\program files\\devstudio\\sharedide\\bin\\ide;c:\\program files\\devstudio\\sharedide\\bin;c:\\program files\\devstudio\\vc\\bin;c:\\msdev\\bin;C:\\WINDOWS;C:\\WINDOWS\\COMMAND;C:\\WIN95\\COMMAND;C:\\MSINPUT\\MOUSE"</pre> <p>In the second example, the variable <code>MYTZONE</code> is found not to be in the environment table:</p> <pre>(environment-variable "MYTZONE")</pre> <pre>NIL</pre>	

It is set to be **GMT** using the **setf** method:

```
(setf (environment-variable "MYTZONE") "GMT")
```

errno-value

Function

Summary Returns the current value of the UNIX variable **errno**.

Package **lispworks**

Signature **errno-value => value**

Arguments None.

Values **value** The current value of **errno**.

Description The function **errno-value** returns the current value of the UNIX variable **errno**.

Note: this is implemented only on UNIX/Linux/Mac OS X.

Example **USER 10 > (errno-value)**
2

```
USER 11 > (get-unix-error 2)  
"no such file or directory"
```

See also **get-unix-error**

example-file

Function

Summary Returns a path in the **examples** folder.

Package **lispworks**

Signature **example-file file => path**

Arguments	<i>file</i>	A pathname designator.
Values	<i>path</i>	A pathname.
Description		The function <code>example-file</code> returns an absolute path to a file <i>file</i> in the <code>examples</code> folder of the LispWorks library. It does not actually test for the existence of the file.
Example		<pre>(example-file "capi/applications/othello.lisp") => #P"C:/Program Files/LispWorks/lib/6-0-0- 0/examples/capi/applications/othello.lisp"</pre>
See also		<code>example-compile-file</code>

example-compile-file *Function*

Summary	Compiles a file in the <code>examples</code> folder to a temporary output file.	
Package	<code>lispworks</code>	
Signature	<code>example-compile-file file &rest args => output-truename, warnings-p, failure-p</code>	
Arguments	<i>file</i>	A pathname designator.
	<i>args</i>	Arguments passed to <code>compile-file</code> .
Values	<i>output-truename</i>	A pathname or <code>nil</code> .
	<i>warnings-p</i>	A generalized boolean.
	<i>failure-p</i>	A generalized boolean.
Description	The function <code>example-compile-file</code> constructs the path to <i>file</i> in the <code>examples</code> folder of the LispWorks library, and a	

path to an output file in a temporary location which is likely to be writable.

It then calls `compile-file` with these paths as the *input-file* and *output-file*, also passing the other *args*, and returns the values returned by `compile-file`.

See also `get-temp-directory`
 `example-file`

example-load-binary-file *Function*

Summary Loads a fasl file compiled by `example-compile-file`.

Package `lispworks`

Signature `example-load-binary-file file => generalized-boolean`

Arguments `file` A pathname designator.

Values *generalized-boolean*
 The value returned by `load`.

Description The function `example-load-binary-file` constructs the path to an output file in a temporary location which would be used as the *output-file* by `example-compile-file`.

It then calls `load` on that path, and returns the values returned by `load`.

See also `example-compile-file`

execute-actions *Macro*

Summary Executes in sequence the actions on a given list.

Package	<code>lispworks</code>
Signature	<code>execute-actions name-or-list &rest keyword-value-pairs &rest other-args =></code>
Arguments	<p><code>name-or-list</code> An action list</p> <p><code>keyword-value-pairs</code> See description.</p> <p><code>other-args</code> A list.</p>
Description	<p>The <code>execute-actions</code> macro executes, in sequence, the actions on the specified list. If the action-list specified by <code>name-or-list</code> does not exist, then this is handled according to the value of <code>*handle-missing-action-list*</code>. Note that <code>name-or-list</code> is evaluated.</p> <p>If a user-defined execution function was specified when the action list was defined, then it should accept the following arguments:</p> <p><code>(action-list other-args &rest keyword-value-pairs)</code></p> <p>Note that <code>other-args</code> is passed as a single list.</p> <p>If a user-defined execution function was not specified when the action list was defined, then the following default mapping occurs. Each action's data is invoked via apply on <code>other-args</code>:</p> <p><code>(apply data other-args)</code></p> <p>This behavior is modified by the keyword-value-pairs, thus:</p> <ul style="list-style-type: none"> • If the keyword parameter <code>:ignore-errors-p</code> is non-nil, any otherwise-unhandled errors signalled inside the execution of that function will be trapped, and a warning issued. Execution continues with the next action-item. If <code>:ignore-errors-p</code> is nil (or not specified), then the error is not trapped.

- If the keyword parameter `:post-process` is non-nil, the first value returned by each action is handled, according to `:post-process`, thus:

<code>:collect</code>	collect values into list
<code>:and</code>	return <code>t</code> only if all values are <code>t</code> . Return <code>nil</code> immediately if any value is <code>nil</code>
<code>:or</code>	return first non-nil value

See also `define-action`
`with-action-list-mapping`

extended-char *Type*

Summary	The extended character type.
Package	<code>lispworks</code>
Signature	<code>extended-char</code>
Description	The type of extended characters. A synonym for <code>extended-character</code> , but with standard spelling.

extended-character *Type*

Summary	The extended character type.
Package	<code>lispworks</code>
Signature	<code>extended-character</code>
Description	The type of extended characters.

		<i>Function</i>
extended-character-p		
Summary	Tests if an object is an extended character.	
Package	lispworks	
Signature	extended-character-p <i>object</i> => <i>bool</i>	
Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	t if <i>object</i> is an extended character; nil otherwise.
Description	This is the predicate for extended characters.	
See also	extended-character	
extended-char-p		
Summary	Tests if an object is an extended character.	
Package	lispworks	
Signature	extended-char-p <i>object</i> => <i>bool</i>	
Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	t if <i>object</i> is an extended character; nil otherwise.
Description	This is also the predicate for extended characters, only with standard spelling.	
See also	extended-char extended-character-p	

external-formats *Variable*

Summary A list of the names of the defined external formats.

Package `lispworks`

Initial value Microsoft Windows platforms:

```
(WIN32 :CODE-PAGE FLI::LATIN-1-WCHAR FLI:ASCII-WCHAR  
:MACOS-ROMAN :UTF-8 :GBK :WINDOWS-CP936 EXTERNAL-  
FORMAT:DOUBLE-BYTE-TABLE-LOOKUP :JIS :EUC-JP :SJIS  
:LATIN-1-TERMINAL :UNICODE :LATIN-1-SAFE :LATIN-1-  
CHECKED :EUC :SHIFT-JIS :NIHONGO-MS :NIHONGO-EUC  
:NIHONGO-JIS CHARACTER EXTERNAL-FORMAT:BYTE-SWAPPED-  
SIMPLE-CHARACTER EXTERNAL-FORMAT:RAW-SIMPLE-CHARACTER  
EXTERNAL-FORMAT:RAW-BASE-CHARACTER :ASCII-TERMINAL  
:ASCII :LATIN-1)
```

On all other platforms:

```
(FLI::LATIN-1-WCHAR FLI:ASCII-WCHAR :MACOS-ROMAN :UTF-8  
:GBK :WINDOWS-CP936 EXTERNAL-FORMAT:DOUBLE-BYTE-TABLE-  
LOOKUP :JIS :EUC-JP :SJIS :LATIN-1-TERMINAL :UNICODE  
:LATIN-1-SAFE :LATIN-1-CHECKED :EUC :SHIFT-JIS  
:NIHONGO-MS :NIHONGO-EUC :NIHONGO-JIS EXTERNAL-  
FORMAT:HOST-PORTABLE EXTERNAL-FORMAT:latin-portable  
CHARACTER EXTERNAL-FORMAT:BYTE-SWAPPED-SIMPLE-  
CHARACTER EXTERNAL-FORMAT:RAW-SIMPLE-CHARACTER  
EXTERNAL-FORMAT:RAW-BASE-CHARACTER :ASCII-TERMINAL  
:ASCII :LATIN-1)
```

Description The variable `*external-formats*` contains a list of the names of the defined external formats.

The platform-specific external format names are:

`code-page`

Uses the encoding in the Microsoft Windows code page specified by the `:id` parameter.

`latin-portable`

Intended for use when communicating with X servers, for example when passing XLFD names. Uses the X Portable Character Set.

host-portableA synonym for **latin-portable**.**false** *Function*Summary Ignores its arguments and returns **nil**.Package **lispworks**Signature **false &rest ignore -> nil**Arguments *ignore* All arguments are ignored.Value **nil**Description The function **false** takes any number of arguments, which it ignores, and returns **nil**. It is useful as a functional argument.See also **do-nothing**
true**file-directory-p** *Function*

Summary Tests for the presence of a directory.

Package **lispworks**Signature **file-directory-p pathname => bool**Arguments *pathname* A pathname, string, or file-stream.Values *bool* If **t**, the pathname represented by pathname exists and is a directory. If **nil**, it either does not exist, or it is not a directory.

Description `file-directory-p` tests whether the pathname represents a directory.

Example

```
CL-USER 70 > (file-directory-p "~")
T
```

```
CL-USER 71 > (file-directory-p ".login")
NIL
```

find-regexp-in-string

Function

Summary Matches a regular expression.

Package `lispworks`

Signature `find-regexp-in-string pattern string &key start end from-end case-sensitive => pos, len`

Arguments `pattern` A string or a precompiled regular expression object.

`string` A string.

`start, end` Bounding index designators of `string`.

`from-end` A generalized boolean.

`case-sensitive` A generalized boolean.

Values `pos` A non-negative integer or `nil`.

`len` A non-negative integer or `nil`.

Description The function `find-regexp-in-string` searches the string `string` for a match for the regular expression `pattern`. The index in `string` of the start of the first match is returned in `pos`, and the length of the match is `len`.

If `from-end` is `nil` (the default value) then the search starts at index `start` and ends at index `end`. `start` defaults to 0 and `end`

defaults to `nil`. If `from-end` is true, then the search direction is reversed.

`pattern` should be a precompiled regular expression object or a string. If `pattern` is a string then `find-regexp-in-string` first makes a precompiled regular expression object. This operation allocates, therefore if you need to repeatedly call `find-regexp-in-string` with the same pattern, it is better to call `precompile-regexp` once and pass its result, a precompiled regular expression object, as `pattern`.

`case-sensitive` controls whether a string `pattern` is precompiled as a case sensitive or case insensitive search. A true value other than `:default` means a case sensitive search. The value `nil` means a case insensitive search. The default value of `case-sensitive` is `:default` which means that a string `pattern` is compiled with case sensitivity according to the value of the Editor variable `DEFAULT-SEARCH-KIND`.

The regular expression syntax used by `find-regexp-in-string` is similar to that used by Emacs, as described in the "Regular expression syntax" section of the *LispWorks Editor User Guide*.

Example

This form allocates several regular expression objects:

```
(loop with pos = 0
      with len = 0
      while pos
        do (multiple-value-setq (pos len)
                               (find-regexp-in-string "[0,2,4,6,8]"
                                         "0123456789"
                                         :start (+ pos len)))
           when pos
           do (format t "~&Match at pos ~D len ~D~%"
```

`pos len))`

This form does the same matching but allocates just one pre-compiled regular expression object:

```

(loop with pattern = (precompile-regexp "[0,2,4,6,8]")
      with pos = 0
      with len = 0
      while pos
      do (multiple-value-setq (pos len)
                               (find-regexp-in-string pattern "0123456789"
                                                       :start (+ pos len)))
      when pos do (format t "~&Match at pos ~D len ~D~%" pos len))

```

See also [precompile-regexp](#)
[regexp-find-symbols](#)

function-lambda-list

Function

Summary	Returns the argument list of the given function.	
Package	<code>lispworks</code>	
Signature	<code>function-lambda-list <i>function</i> &optional <i>error-p</i> => <i>args</i></code>	
Arguments	<i>function</i>	A symbol or a function.
	<i>error-p</i>	A boolean.
Values	<i>args</i>	A list, or the symbol <code>:none</code>
Description	<p><i>function</i> is the function whose arguments are required</p> <p>If <i>error-p</i> is <code>nil</code>, then <code>function-lambda-list</code> returns <code>:none</code> if <i>function</i> is not defined, and does not start the debugger. The default value of <i>error-p</i> is <code>t</code>, meaning that an error is signalled if <i>function</i> is undefined.</p>	
Example	<pre>TEST 2 > (function-lambda-list 'editor:create-buffer-command) (EDITOR::P &OPTIONAL EDITOR:BUFFER-NAME)</pre>	

get-inspector-values		<i>Generic Function</i>
Summary		Customizes the information displayed in the LispWorks IDE Inspector tool.
Package		lispworks
Signature		get-inspector-values <i>object mode</i>
Arguments	<i>object</i>	The object to be inspected.
	<i>mode</i>	Name of a mode, or nil . nil defines the default inspection format for <i>object</i> .
Values		Returns five values: <i>names</i> , <i>values</i> , <i>getter</i> , <i>setter</i> and <i>type</i> . <i>names</i> and <i>values</i> are the two lists displayed in columns in the inspector window. <i>getter</i> is ignored. <i>setter</i> is a function used to updated slot values. <i>type</i> is displayed at the foot of the inspector window.
Description		<p>This generic function allows you to customize the LispWorks IDE Inspector by adding new formats (corresponding to different values of mode) in which instances of a particular class can be inspected. Mode nil is the default mode, which is always present (it can be overwritten).</p> <p>LispWorks includes methods for:</p> <pre>(get-inspector-values (object nil)) (get-inspector-values (standard-object nil)) (get-inspector-values (structured-object nil)) (get-inspector-values (sequence nil)) (get-inspector-values cons nil))</pre> <p>and so on.</p>
Example		This example allows inspection of a CLOS object, displaying only direct slots from a chosen class in its class precedence list. This can be useful when an object inherits many slots from superclasses, and the inherited slots are of no interest.

```

(defmethod lispworks:get-inspector-values
  ((object standard-object)
   (mode (eql 'direct-as)))
  (declare (ignore mode))
  (loop with object-class =
        (class-of object)
        with precedence-list =
        (class-precedence-list object-class)
        with items =
        (loop for super in precedence-list
              collecting (list*
                           (format nil "~a"
                                   (class-name super))
                           super)))
        with class =
        (or (capi:prompt-with-list items
                                    "Direct slots as ...")
            object-class)
            ;; default if no selection
        with slots =
        (class-direct-slots class)
        for slot in slots
        for name =
        (clos::slot-definition-name slot)
        collect name into names
        collect (if (slot-boundp object name)
                   (slot-value object name)
                   :slot-unbound)
        into values
        finally
        (return
         (values
          names
          values
          nil
          #'(lambda
              (x slot-name index new-value)
              (declare (ignore index))
              (setf (slot-value x slot-name)
                    new-value))
          (format nil "~a - direct slots as ~a"
                  (class-name object-class)
                  (class-name class)))))))

```

get-unix-error	<i>Function</i>
Summary	Returns the text associated with a given error.
Package	lispworks
Signature	get-unix-error number => error
Arguments	number The errno value whose text is required.
Values	error The text associated with the error.
Description	The get-unix-error function returns the text associated with the specified value of the UNIX variable errno . Note: this is implemented only on UNIX/Linux/Mac OS X/FreeBSD.
See also	errno-value
grep-command	<i>Variable</i>
Package	lispworks
Summary	Determines the search utility used by Grep searches in the Search Files tool in the LispWorks IDE.
Initial Value	"grep" on Unix/Linux/Mac OS X/FreeBSD platforms. nil on Windows.
Description	If the value is a string, it is the search utility to run in the Search Files tool. If the value is nil , then the value of <code>(sys:lispworks-file "etc/grep")</code>

is expected to be an executable, which is run. On Windows a suitable `grep.exe` is included with LispWorks in this location.

The search utility is passed arguments constructed using
grep-command-format and *grep-fixed-args*.

See the *LispWorks IDE User Guide* for more information about the Search Files tool.

See also *grep-command-format*
grep-fixed-args

grep-command-format *Variable*

Package **lispworks**

Summary The format string used to construct the arguments passed to the Search Files tool to perform a **Grep** search.

Description On Unix/Linux/Mac OS X the first format argument is the current directory.

The remainder of the format arguments are:

- the value of `*grep-command*` or, if this is `nil`, the value of `(sys:lispworks-file "etc/grep")`.
 - the value of `*grep-fixed-args*`.
 - the arguments you specify.

See the *LispWorks IDE User Guide* for more information about the Search Files tool.

See also *grep-command*
grep-fixed-args

grep-fixed-args *Variable*

Package	<code>lispworks</code>
Summary	Arguments added to the command string of a Grep search in the Search Files tool.
Initial Value	<code>" -n"</code>
Description	The variable <code>*grep-fixed-args*</code> provides arguments added to a Grep command string in the Search Files tool. The value should ensure that the line number is output at the start of each match. See the <i>LispWorks IDE User Guide</i> for more information about the Search Files tool.
See also	<code>*grep-command*</code> <code>*grep-command-format*</code>

handle-existing-action-in-action-list *Variable*

Summary	Contains keywords determining behavior on exceptions raised when an action definition already exists in a given action list.
Package	<code>lispworks</code>
Initial value	<code>(:warn :redefine)</code>
Description	A list containing one of <code>:warn</code> , or <code>:silent</code> , determining whether to notify the user, and one of <code>:skip</code> , or <code>:redefine</code> , to determine what to do about an action definition when the action already exists in the given action list. It is used by <code>define-action</code> .

See also [define-action](#)

handle-existing-action-list *Variable*

Summary	Contains keywords determining what to do about a given action list operation when the action list already exists.
Package	lispworks
Initial value	(:warn :skip)
Description	A list containing either <code>:warn</code> or <code>:silent</code> , determining whether to notify the user, and either <code>:skip</code> or <code>:redefine</code> to determine what to do about an action list operation when the action list already exists. The initial value is (:warn :skip). It is used by the <code>define-action-list</code> macro.

See also [define-action-list](#)

handle-missing-action-list *Variable*

Summary	Defines how to handle an operation on a missing action list.
Package	lispworks
Signature	<code>*handle-missing-action-list*</code>
Initial value	<code>:error</code>
Description	A keyword; one of <code>:warn</code> , <code>:error</code> , or <code>:ignore</code> , denoting how to handle an operation on a missing action-list. The default value is <code>:error</code> . It is used by <code>undefined-action-list</code> , <code>print-actions</code> , <code>execute-actions</code> , <code>define-action</code> and <code>undefined-action</code> .

See also [define-action](#)
[execute-actions](#)
[print-actions](#)
[undefine-action](#)
[undefine-action-list](#)

handle-missing-action-in-action-list Variable

Summary Denotes how to handle an operation on a missing action.

Package **lispworks**

Initial value : warn

Description A keyword; one of `:warn`, `:error` or `:ignore`, denoting how to handle an operation on a missing action. Its initial value is `:warn`. It is used by `undefine-action`.

See also [undefined-action](#)

handle-warn-on-redefinition *Variable*

Summary Specifies the action on defining a symbol in certain packages.

Package **lispworks**

Initial value : error

Description *handle-warn-on-redefinition* specifies what action should be taken on defining external symbols in certain packages. It is designed to protect against (re)definition of symbols in implementation packages.

The protected packages are those specified in the variable
`*packages-for-warn-on-redefinition*`.

If `*handle-warn-on-redefinition*` is set to `:warn` then you are warned. If it is set to `:quiet` or `nil`, the definition is done quietly. If, however, it is set to `:error`, then LispWorks signals an error.

See also `*packages-for-warn-on-redefinition*`
 `*redefinition-action*`

hardcopy-system *Function*

Summary	Print each file of a system to a printer.
Package	<code>lispworks</code>
Signature	<code>hardcopy-system system-name &key command simulate => nil</code>
Arguments	<p><code>system-name</code> A symbol representing the name of the system. The system must have been defined using the <code>defsystem</code> macro.</p> <p><code>simulate</code> If <code>nil</code> or not present then <code>hardcopy-system</code> works silently. Otherwise a plan of the actions which <code>hardcopy-system</code> intends to carry out is printed. What happens next depends on the value of <code>simulate</code>:</p> <ul style="list-style-type: none"><code>t</code> — do nothing.<code>:ask</code> — you are asked, using <code>y-or-n-p</code>, if you want the plan to be carried out.<code>:each</code> — <code>hardcopy-system</code> displays each action in the plan one at a time, and asks you if you want to carry out this particular action. The answer executes the rest of the plan without further prompting, <code>e</code> returns from <code>hardcopy-system</code> without further processing, and <code>y</code> and <code>n</code> work as expected.

Values	<code>hardcopy-system</code> returns <code>nil</code> .
Examples	<code>(hardcopy-system 'blackboard)</code> <code>(hardcopy-system 'tms :simulate :ask :command "lpr")</code>
Notes	By default, <code>hardcopy-system</code> uses <code>*print-command*</code> as the command sent to the shell.
See also	<code>defsystem</code> <code>*print-command*</code>

`*init-file-name*` *Variable*

Summary	The default user initialization file.
Package	<code>lispworks</code>
Initial value	<code>"~/lispworks"</code>
Description	The variable <code>*init-file-name*</code> is the name of the default user initialization file. However, if the user initialization file is specified by either:
	<ul style="list-style-type: none"> • the command line argument <code>-init</code>, or • user preferences (as set via the Preferences dialog in the LispWorks IDE)
	then the value of <code>*init-file-name*</code> is not used.

`*inspect-through-gui*` *Variable*

Summary	Controls what <code>inspect</code> does in the development environment.
Package	<code>lispworks</code>

Initial Value	<code>nil</code>
Description	<p>The variable <code>*inspect-through-gui*</code> controls what <code>inspect</code> does in the development environment.</p> <p>When the value is <code>nil</code>, <code>inspect</code> uses a command line interface in the REPL.</p> <p>When the value is true, <code>inspect</code> invokes an Inspector tool in the LispWorks IDE.</p>

`lisp-image-name` *Function*

Summary	Returns the name of the running image.	
Package	<code>lispworks</code>	
Signature	<code>lisp-image-name => name</code>	
Arguments	None.	
Values	<code>name</code>	A string.
Description	<p>The function <code>lisp-image-name</code> returns a string representing the full path to the running LispWorks image. The example below is in typical LispWorks for Windows and LispWorks for Linux installations. In resaved and delivered images (including dynamic libraries such as Windows DLLs), the appropriate path is returned.</p>	

Example On Windows:

```
CL-USER 1 > (lisp-image-name)
"C:\\Program Files\\LispWorks\\lispworks-6-0-0-x86-
win32.exe"
```

On Linux:

```
CL-USER 1 > (lisp-image-name)
"/usr/bin/lispworks-6-0-0-x86-linux"
```

See also ***line-arguments-list***

lispworks-directory *Variable*

Summary	The main LispWorks installation directory.
Package	lispworks
Initial value	<p>The initial value is</p> <p><code>#P"/usr/lib/lispworks/"</code> on Unix.</p> <p><code>#P"/usr/local/lib/LispWorks/"</code> on Linux (for an installation from the tar archive) x86/x64 Solaris or FreeBSD.</p> <p><code>#P"C:\Program Files\LispWorks\"</code> on Microsoft Windows.</p> <p><code>#P"/Applications/LispWorks 6.0/Library/"</code> on Mac OS X.</p> <p>Note however that the value can be set when configuring an image or on startup.</p>
Description	<p>The variable *lispworks-directory* holds the name of the directory where various files important for the running of LispWorks are located.</p> <p>When LispWorks starts in a directory which contains an appropriate numbered subdirectory such as <code>lib/6-0-0-0/</code>, then it assumes this is the LispWorks installation directory and sets *lispworks-directory* accordingly. Additionally, LispWorks for Macintosh running on Cocoa looks for such a subdirectory in the <code>Library</code> folder alongside its application bundle, and if found it sets *lispworks-directory* accordingly.</p>

On non-Windows platforms, LispWorks then consults the Unix environment variable `LISPWORKS_DIRECTORY`. If this is set, then `*lispworks-directory*` is set accordingly.

The `lib/6-0-0-0/` subdirectory of `*lispworks-directory*` should include these subdirectories:

`config`, which contains the configuration files.

`patches`, which contains any public (numbered) patches that are distributed by LispWorks Ltd.

`private-patches`, which is the place to put private (named) patches that are sent to you by Lisp Support.

`postscript`, which contains configuration files for printing using the CAPI printing library. See “Configuring the printer” on page 140 for more information on printer configuration.

`examples`, which contains various files of example code.

Other directories are `etc`, `load-on-demand` and `manual`. There is also `app-defaults` for platforms where Motif is supported.

	<i>Function</i>
Summary	Loads all patch files into the image.
Package	<code>lispworks</code>
Signature	<code>load-all-patches => nil</code>
Arguments	None.
Values	Returns <code>nil</code> .
Description	Loads into the image all appropriate files from the directory <code>patches</code> in the directory determined by

lispworks-directory, and then loads the file **private-patches/load.lisp** where load forms for any private patches may be placed. When the appropriate patches have successfully been loaded, the updated version of the image can be saved using **save-image**.

You should call **load-all-patches** before starting the Lisp-Works IDE. Thus, you normally place the call to this function in your **.lispworks** file.

The system expects all patches to be loaded sequentially. If a patch is missing, there is a warning message. In this situation, it is advisable to contact Lisp Support to obtain a copy of the missing patch.

load-system		<i>Function</i>
Summary		Load each file of a system into the Lisp image if either the file has not been loaded, or the file has been written since it was last loaded.
Package		lispworks
Signature		load-system <i>system-name</i> &key <i>force simulate source-only target-directory</i> => nil
Arguments	system-name	A symbol representing the name of the system. The system must have been defined using the defsystem macro.
	force	If t then all the files in the system are loaded regardless. (This argument was formerly called force-p . The old name is currently still accepted for compatibility.)

<i>simulate</i>	If <code>nil</code> or not present then <code>load-system</code> works silently. Otherwise a plan of the actions which <code>load-system</code> intends to carry out is printed. What happens next depends on the value of <i>simulate</i> :
<code>t</code>	— do nothing.
<code>:ask</code>	— you are asked, using <code>y-or-n-p</code> , if you want to carry out the plan.
<code>:each</code>	— <code>load-system</code> displays each action in the plan one at a time, and asks you if you want to carry out this particular action. The answer executes the rest of the plan without further prompting, <code>e</code> returns from <code>load-system</code> without further processing, and <code>y</code> and <code>n</code> work as expected.
<i>source-only</i>	If <code>t</code> the source files of the system are loaded. This only applies to file types where it makes sense to load a source file.
<i>target-directory</i>	This is the directory to search for the object files. If the object file cannot be found here then the source file from the system's default directory are loaded.

Examples

```
(load-system 'blackboard)

(load-system 'tms :simulate :ask :source-only t)
```

Notes

For Lisp files `load-system` loads the object file (if it exists) into the image, unless over-ridden by the `:source-only` keyword argument. This behavior can be changed so that the newest file (whether source or object) is loaded by setting the variable `*load-source-if-newer*` to `t`.

C source files, for example `foo.c`, can be included in a system (see the use of `:default-type` and `:type` in `defsystem`). The corresponding object file name is `foo.so` on Linux, and on

Unix it is `foon.o` where `n` is a platform-specific integer. On Windows the object file name is `foo.dll`.

See also `defsystem`
`compile-system`
`concatenate-system`

make-unregistered-action-list *Function*

Summary	Makes an unregistered action list.
Package	<code>lispworks</code>
Signature	<code>make-unregistered-action-list &key documentation sort-time dummy-actions default-order execution-function =></code>
Arguments	<p><i>documentation</i> A string.</p> <p><i>sort-time</i> One of <code>:execute</code> or <code>:define-action</code>.</p> <p><i>dummy-actions</i> A list.</p> <p><i>default-order</i> A list.</p> <p><i>execution-function</i> A function.</p>
Description	<p>Return an action-list not registered in the global registry of lists. The keyword arguments are as for <code>define-action-list</code>.</p> <p>The <i>documentation</i> string allows you to provide documentation for the action list.</p> <p><i>sort-time</i> is a keyword specifying when added actions are sorted for the given list — either <code>:execute</code> or <code>:define-action</code> (see <code>*default-action-list-sort-time*</code>).</p> <p><i>dummy-actions</i> is a list of action-names that specify placeholder actions; they cannot be executed and are constrained to the order specified in this list, for example</p>

```
' (:beginning :middle :end)
```

default-order specifies default ordering constraints for subsequently defined action-items where no explicit ordering constraints are specified. An example is

```
' (:after :beginning :before :end)
```

execution-function specifies a user-defined function accepting arguments of the form:

```
(the-action-list other-args-list &rest keyword-value-pairs)
```

where the two required arguments are the action-list and a list of additional arguments passed to `execute-actions`, respectively. The remaining arguments are any number of keyword-value pairs that may be specified in the call to `execute-actions`. If no execution function is specified, then the default execution function will be used to execute the action-list.

See also

`define-action-list`
`*handle-warn-on-redefinition*`

make-**mt-random-state**

Function

Summary	Creates an object of type <code>mt-random-state</code> .	
Package	<code>lispworks</code>	
Signature	<code>make-mt-random-state &optional <i>state</i> => <i>new-state</i></code>	
Arguments	<i>state</i>	<code>nil</code> , <code>t</code> or an object of type <code>mt-random-state</code> . The default is <code>nil</code> .
Values	<i>new-state</i>	A new object of type <code>mt-random-state</code> .

Description	<p>The function <code>make-mt-random-state</code> creates a new object of type <code>mt-random-state</code> which is suitable for use as the value of <code>*mt-random-state*</code>.</p> <p>If <code>state</code> is an object of type <code>mt-random-state</code>, then <code>new-state</code> is a copy of <code>state</code>. If <code>state</code> is <code>nil</code>, then <code>new-state</code> is a copy of the value of <code>*mt-random-state*</code>. If <code>state</code> is <code>t</code> then <code>new-state</code> is an object of type <code>mt-random-state</code> initialized using a call to <code>get-universal-time</code>.</p> <p><code>make-mt-random-state</code> is analogous to <code>cl:make-random-state</code>.</p>
See also	<code>mt-random</code> <code>*mt-random-state*</code> <code>mt-random-state</code>

	<i>Function</i>				
mt-random					
Summary	Returns a pseudo-random number using the Mersenne Twister algorithm.				
Package	<code>lispworks</code>				
Signature	<code>mt-random arg &optional state => random-number</code>				
Arguments	<table> <tr> <td><code>arg</code></td><td>A positive <code>integer</code> or a positive <code>float</code>.</td></tr> <tr> <td><code>state</code></td><td>An object of type <code>mt-random-state</code>. The default is the value of <code>*mt-random-state*</code>.</td></tr> </table>	<code>arg</code>	A positive <code>integer</code> or a positive <code>float</code> .	<code>state</code>	An object of type <code>mt-random-state</code> . The default is the value of <code>*mt-random-state*</code> .
<code>arg</code>	A positive <code>integer</code> or a positive <code>float</code> .				
<code>state</code>	An object of type <code>mt-random-state</code> . The default is the value of <code>*mt-random-state*</code> .				
Values	<code>random-number</code> A non-negative number less than <code>arg</code> and of the same type as <code>arg</code> .				
Description	The function <code>mt-random</code> returns a pseudo-random number which is non-negative, less than <code>arg</code> and is of the same type as <code>arg</code> .				

random-number is generated using the Mersenne Twister algorithm published by Makoto Matsumoto and Takuji Nishimura at

<http://www.math.keio.ac.jp/~matumoto/emt.html>.

We thank the authors for making the algorithm freely available.

`mt-random` is analogous to `cl:random`.

See also

`make-mt-random-state`
`*mt-random-state*`

mt-random-state

Variable

Summary

The default random state used by `mt-random`.

Package

`lispworks`

Description

The variable `*mt-random-state*` contains an object of type `mt-random-state` which is the default state used by `mt-random` if a state is not supplied.

`*mt-random-state*` is analogous to `cl:*random-state*`.

See also

`make-mt-random-state`
`mt-random`
`mt-random-state`

mt-random-state

Type

Summary

The type of objects containing state information used by `mt-random`.

Package

`lispworks`

Description	The Mersenne Twister pseudo-random number generator uses state data contained in a object of type <code>mt-random-state</code> . <code>mt-random-state</code> is analogous to <code>cl:random-state</code> .
See also	<code>*mt-random-state*</code> <code>mt-random</code> <code>mt-random-state-p</code>

mt-random-state-p *Function*

Summary	The predicate for objects of type <code>mt-random-state</code> .	
Package	<code>lispworks</code>	
Signature	<code>mt-random-state-p arg => result</code>	
Arguments	<code>arg</code>	An object.
Values	<code>result</code>	A boolean.
Description	The function <code>mt-random-state-p</code> returns <code>t</code> if <code>arg</code> is an object of type <code>mt-random-state</code> , and <code>nil</code> otherwise. <code>mt-random-state-p</code> is analogous to <code>cl:random-state-p</code> .	
See also	<code>mt-random-state</code>	

pathname-location *Function*

Summary	Returns the location of a file.	
Signature	<code>pathname-location pathname => location</code>	
Arguments	<code>pathname</code>	A pathname designator.

Values	<i>location</i>	A pathname.
Description	The function pathname-location returns a pathname <i>location</i> that represents the directory where the file <i>pathname</i> resides. Each of the name, type and version components of <i>location</i> are nil .	
Example	Due to the ANSI Common Lisp definition of the directory function and the fact that LispWorks returns fully specified truenames, the form	
	<pre>(directory (truename "/tmp/")))</pre>	will always signal an error or return the list (#P"/tmp/"). To obtain the contents of the /tmp directory, use the form
	<pre>(directory (pathname-location (truename "/tmp/"))))</pre>	
See also	current-pathname directory	

precompile-regexp		<i>Function</i>
Summary		Precompiles a regular expression object.
Package		lispworks
Signature		precompile-regexp <i>string</i> => <i>pattern</i>
Arguments	<i>string</i>	A string.
Values	<i>pattern</i>	A precompiled regular expression object.
Description	The function precompile-regexp returns a precompiled regular expression object suitable for passing as <i>pattern</i> to find-regexp-in-string .	
See also	find-regexp-in-string	

print-actions	<i>Function</i>				
Summary	Generates a listing of the action items on a given action list in order.				
Package	<code>lispworks</code>				
Signature	<code>print-actions <i>name-or-list</i> &optional <i>stream</i></code>				
Arguments	<table> <tr> <td><i>name-or-list</i></td> <td>An action list.</td> </tr> <tr> <td><i>stream</i></td> <td>A stream.</td> </tr> </table>	<i>name-or-list</i>	An action list.	<i>stream</i>	A stream.
<i>name-or-list</i>	An action list.				
<i>stream</i>	A stream.				
Description	<p>Generates a listing of the action items on this action-list, in order. If the action-list specified by <i>name-or-list</i> does not exist, then this is handled according to the value of <code>*handle-missing-action-list*</code>.</p> <p><i>stream</i> is an optional argument specifying where to print the output. The default value of <i>stream</i> is the value of <code>*standard-output*</code>.</p>				
See also	<code>print-action-lists</code>				

print-action-lists	<i>Function</i>		
Summary	Prints a list of all the actions lists in the global registry.		
Package	<code>lispworks</code>		
Signature	<code>print-action-lists &optional <i>stream</i></code>		
Arguments	<table> <tr> <td><i>stream</i></td> <td>A stream.</td> </tr> </table>	<i>stream</i>	A stream.
<i>stream</i>	A stream.		
Description	Generates a listing of all the action lists in the global registry. The ordering of the action lists is random.		

stream is an optional argument specifying where to print the output. The default value of *stream* is the value of `*standard-output*`.

See also [print-actions](#)

print-command

Variable

Summary A command used for some printing operations.

Package **lispworks**

Initial Value "print" on Windows.

"lpr" on UNIX/Linux/Mac OS X/FreeBSD systems.

Description This variable is used as the command sent by LispWorks to the shell in `hardcopy-system`.

See also [hardcopy-system](#)

print-nickname

Variable

Summary Controls the package prefix used when a symbol is printed.

Package lispworks

Initial Value nil

Description The variable ***print-nickname*** controls which package prefix is used when a symbol is printed and the symbol's package needs to be output.

If `*print-nickname*` is true and the package has at least one nickname, then the first of the nicknames (that is, the first

nickname in the list returned by `package-nicknames`) is output. Otherwise, the package name is output.

prompt	<i>Variable</i>
Summary	Defines the LispWorks listener prompt.
Package	<code>lispworks</code>
Initial Value	<code>"~%~A ~D~ [~:;~:~* : ~D~] > "</code>
Description	The variable <code>*prompt*</code> defines the LispWorks listener prompt. Its value can be a:
	Function designator A function of zero arguments which should return the prompt as a string.
String	A format string with processing three arguments: the current package name, the next history number, and the debug level.
A form	The form is passed to <code>eval</code> and should return a format string, which is used as for the string case above.
Example	<pre>CL-USER 1 > (defvar *default-prompt* *prompt*) *DEFAULT-PROMPT* CL-USER 2 > (progn (setf *prompt* ' (string-append "~~" (sys:get-user-name) #\Space (subseq *default- prompt* 2))) nil) NIL dubya CL-USER 3 ></pre>

quit	<i>Function</i>								
Summary	Quits LispWorks.								
Package	<code>lispworks</code>								
Signature	<code>quit &key status confirm ignore-errors-p return</code>								
Arguments	<table> <tr> <td><i>status</i></td><td>An integer.</td></tr> <tr> <td><i>confirm</i></td><td>A generalized boolean.</td></tr> <tr> <td><i>ignore-errors-p</i></td><td>A generalised boolean.</td></tr> <tr> <td><i>return</i></td><td>A generalized boolean.</td></tr> </table>	<i>status</i>	An integer.	<i>confirm</i>	A generalized boolean.	<i>ignore-errors-p</i>	A generalised boolean.	<i>return</i>	A generalized boolean.
<i>status</i>	An integer.								
<i>confirm</i>	A generalized boolean.								
<i>ignore-errors-p</i>	A generalised boolean.								
<i>return</i>	A generalized boolean.								
Values	<code>quit</code> does not return, or returns <code>t</code> .								
Description	<p>The function <code>quit</code> exits LispWorks unless the user cancels the operation.</p> <p>There are two stages which may allow the user the chance to cancel.</p> <ol style="list-style-type: none"> First the action items of the action list "<code>Confirm when quitting image</code>" are run. If any action item returns <code>nil</code>, then LispWorks does not exit. Otherwise, if <i>confirm</i> is true (the default value is <code>nil</code>) then a question like <code>"Do you really want to exit LispWorks?"</code> is presented to the user. If the answer No is supplied, then LispWorks does not exit. Otherwise, the action items of the action list "<code>When quitting image</code>" are run, and then LispWorks exits, and the value <i>status</i> is returned to the Operating System as the exit value of the LispWorks process. The default value of <i>status</i> is 0. <p>If <i>ignore-errors-p</i> is true, then any error signalled during the running of the action list items or the confirm prompt is ignored and <code>quit</code> proceeds to exit the image. If <i>ignore-errors-p</i></p>								

is `nil` and an error is signalled during the running of the action list items, then a restart is available allowing the user to choose to continue to exit the image. The default values of `ignore-errors-p` is `nil`.

If `return` is true and LispWorks is going to exit, then `quit` returns `t`. This can be used if you want some other Lisp process to kill the current one later, rather than it self-destructing immediately. This can be useful to allow more precise control over process termination. If `return` is `nil` then `quit` does not return. The default value of `return` is `nil`.

Note: To make a Cocoa application quit cleanly from inside the **Quit** menu command you need to call `capi:destroy` on the application interface instead of calling `quit`. See `capi:default-cocoa-application-interface` in the *CAPI Reference Manual* for more information.

See also `save-image`

		<i>Macro</i>				
rebinding						
Summary	Ensures unique names for all the variables in a groups of forms.					
Package	<code>lispworks</code>					
Signature	<code>rebinding (&rest vars) &body body => form</code>					
Arguments	<table> <tr> <td><code>vars</code></td><td>The variables to be rebound.</td></tr> <tr> <td><code>body</code></td><td>A body of forms, the variables in which should be unique.</td></tr> </table>	<code>vars</code>	The variables to be rebound.	<code>body</code>	A body of forms, the variables in which should be unique.	
<code>vars</code>	The variables to be rebound.					
<code>body</code>	A body of forms, the variables in which should be unique.					
Values	Returns the body wrapped in a form that creates unique names for each variable.					

Description	Returns the <i>body</i> wrapped in a form which creates a unique name for each of the variables (compare with <code>gensym</code>) and binds these names to the values of the variables. This ensures that the body can refer to the variables without name clashes with other variables elsewhere.
Example	After defining
	<pre>(defmacro lister (x y) (rebinding (x y) '(list ,x ,y)))</pre> <p>the form <code>(lister i j)</code> macroexpands to</p> <pre>(LET* ((#:X-77 I) (#:Y-78 J)) (LIST #:X-77 #:Y-78))</pre>

See also [with-unique-names](#)

regexp-find-symbols *Function*

Summary	Returns a list of symbols that match a supplied regular expression.	
Package	<code>lispworks</code>	
Signature	<code>regexp-find-symbols regexp-string &key case-sensitive packages test external-only => symbols</code>	
Arguments	<i>regexp-string</i>	A string.
	<i>case-sensitive</i>	A boolean.
	<i>packages</i>	A list of package designators, a single package designator, or the keyword <code>:all</code> .
	<i>test</i>	A function of one argument returning a boolean result.
	<i>external-only</i>	A generalized boolean.

Values	<i>symbols</i>	A list of symbols.
Description		<p>The function <code>regexp-find-symbols</code> returns a list of symbols that match the regular expression in <i>regexp-string</i>. <i>case-sensitive</i> determines whether the match is case sensitive. The default value of <i>case-sensitive</i> is <code>nil</code>.</p> <p><i>packages</i> specifies in which packages to search. The default value of <i>packages</i> is <code>:all</code>, meaning search in all packages.</p> <p><i>test</i>, if supplied, must be a function of one argument, which returns <code>t</code> if the argument should be returned, and <code>nil</code> otherwise. The function <i>test</i> is applied to each symbol that matches <i>regexp-string</i>, and if it returns <code>nil</code> the symbol is not included in the returned value <i>symbols</i>. If <i>test</i> is <code>nil</code> all matches are returned. The default value of <i>test</i> is <code>nil</code>.</p> <p><i>external-only</i>, if true, specifies that only external symbols should be checked, which makes the search much faster. The default value of <i>external-only</i> is <code>nil</code>.</p> <p>The regular expression syntax used by <code>regexp-find-symbols</code> is similar to that used by Emacs, as described in the "Regular expression syntax" section of the <i>LispWorks Editor User Guide</i>.</p>
Examples		<p>To find all exported symbols that start with DEF:</p> <pre>(lw:regexp-find-symbols "^def" :external-only t)</pre> <p>To find all symbols that contain lower case "slider":</p> <pre>(regexp-find-symbols "slider" :case-sensitive t)</pre>
See also		<p><code>apropos</code> <code>find-regexp-in-string</code></p>

remove-advice *Function*

Summary Remove a piece of advice.

Package	<code>lispworks</code>
Signature	<pre>remove-advice <i>dspec name</i> => <i>nil</i> <i>dspec</i> ::= <i>fn-name</i> <i>macro-name</i> (<i>method generic-fn-name</i> [(<i>class*</i>)])</pre>
Arguments	<p><i>dspec</i> Specifies the functional definition to which the piece of advice belongs. The specification contains the name of the associated function. In the case of a method the list of classes is used to identify from which particular method the advice should come. This list must correspond exactly with the classes corresponding to the specialized parameters for some method belonging to the generic function.</p> <p><i>name</i> A symbol naming the piece of advice to be removed. Since several pieces of advice may be attached to a single functional definition, the name is necessary to indicate which one is to be removed.</p>
Values	<code>remove-advice</code> returns <code>nil</code> .
Description	<p><code>remove-advice</code> is the function used to remove a piece of advice. Advice is a way of altering the behavior of functions. Pieces of advice are associated with a function using <code>defadvice</code>. They define additional actions to be performed when the function is invoked, or alternative code to be performed instead of the function, which may or may not access the original definition. As well as being attached to ordinary functions, advice may be attached to methods and to macros (in this case it is in fact associated with the macro's expansion function).</p> <p><code>hcl:delete-advice</code> is a macro, identical in effect to <code>remove-advice</code>, except that you do not need to quote the arguments.</p>

Notes `remove-advice` is an extension to Common Lisp.

See also `defadvice`
`delete-advice`

removef *Macro*

Summary Removes an item from a sequence.

Package `lispworks`

Signature `removef place item &key test test-not start end key => result`

Arguments `place` A place.

`item` An object.

`test` A test function.

`test-not` A test function.

`start` An integer.

`end` An integer or `nil`.

`key` A key function.

Values `result` A sequence.

Description The modifying macro `removef` removes an item from a sequence using `remove`. See `remove` for more details.

See also `appendf`

require-verbose *Variable*

Summary Controls the output of `require`.

Package	<code>lispworks</code>
Initial value	<code>t</code>
Description	The variable <code>*require-verbose*</code> is a generalized boolean controlling whether <code>require</code> prints the names of the files which are being loaded.

	<i>Function</i>
Summary	Rounds the given float to single-precision format (32 bits) and returns it as a <code>double-float</code> (64 bits).
Package	<code>lispworks</code>
Signature	<code>round-to-single-precision float => double-float</code>
Arguments	<code>float</code> A float
Values	<code>double-float</code> A <code>double-float</code> with <code>single-float</code> precision.
Description	<p>The argument is rounded to single-precision format (32 bits) and returned as a <code>double-float</code> (64 bits). This function allows you to model the rounding behavior of a machine or implementation that performs 32-bit floating point arithmetic.</p> <p>The default size on Windows and Linux is 64 bits as specified by the IEEE standard.</p> <p>LispWorks supports 3 floating point formats, <code>short-float</code>, <code>single-float</code> and <code>double-float</code>. If this function is called with a <code>single-float</code> or a <code>short-float</code>, it returns the equivalent <code>double-float</code>, that is, it is the same as doing</p> <pre>(coerce float 'double-float)</pre>

Compatibility Note LispWorks 4.4 and previous on Windows and Linux platforms supports just one floating point format. In LispWorks 5.0 and later, three floating point formats are supported on all platforms.

Example

```
CL-USER 197 > pi
3.141592653589793D0
```

```
CL-USER 198 > round-to-single-precision pi
3.1415927410125732D0
```

sbchar *Function*

Summary The accessor for simple base strings.

Package `lispworks`

Signature `sbchar string index => value`

Arguments `string` A `simple-base-string`.

`index` An index.

Values `value` The character in `string` at `index`.

Description This is the accessor for simple base strings. `setf` is allowed.

See also `simple-base-string`

set-default-character-element-type *Function*

Summary Configures the value of `lw:*default-character-element-type*`.

Package `lispworks`

Signature	<code>set-default-character-element-type type => type-defaults</code>	
Arguments	type	A character type. This can take any of the values <code>base-char</code> ; <code>lw:simple-char</code> and <code>character</code>
Values	<i>type-defaults</i>	The new value of <code>lw:default-character-element-type</code> .
Description	<p>The function <code>set-default-character-element-type</code> sets the value of <code>lw:default-character-element-type*</code>, ensuring that the system's internal state is also updated accordingly.</p> <p>If you are running an existing 8-bit application you will only need to have this in your site or user configuration file:</p>	
	<pre>(lw:set-default-character-element-type 'base-char)</pre> <p>It would be a mistake to call this function in a loadable package and it is not intended to be called while running code. In particular, it is global, not thread-specific.</p> <p>Hence we consider <code>lw:default-character-element-type*</code> a parameter.</p>	
See also	<code>string</code> <code>open</code> <code>*default-character-element-type*</code> <code>with-output-to-string</code>	

	<i>Function</i>
Summary	Tests if an object is a simple base string.
Package	<code>lispworks</code>
Signature	<code>simple-base-string-p object => bool</code>

Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	<code>t</code> if <i>object</i> is a simple base string; <code>nil</code> otherwise.
Description		This is the predicate for simple base strings.
See also		<code>simple-base-string</code>

simple-char *Type*

Summary	The simple character type.
Package	<code>lispworks</code>
Signature	<code>simple-char</code>
Description	The type of simple characters (standard term for chars with null implementation-defined attributes, that is, no bits).

simple-char-p *Function*

Summary	Tests if an object is a simple character.	
Package	<code>lispworks</code>	
Signature	<code>simple-char-p</code>	<i>object</i> => <i>bool</i>
Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	<code>t</code> if <i>object</i> is a simple character; <code>nil</code> otherwise.
Description	The predicate for simple characters.	

See also [simple-char](#)

simple-text-string *Type*

Summary The simple text string type.

Package [lispworks](#)

Signature `simple-text-string length`

Arguments `length` The length of the string (or *, meaning any).

Description This is the simple version of `text-string`, that is, the string itself is simple. Equivalent to:

```
(simple-vector lw:simple-char length)
```

See also [text-string](#)

simple-text-string-p *Function*

Summary Tests if an object is a simple text string.

Package [lispworks](#)

Signature `simple-text-string-p object => bool`

Arguments `object` The object to be tested.

Values `bool` t if `object` is a simple text string; nil otherwise.

Description This is the predicate for simple text strings.

See also [simple-text-string](#)

split-sequence	<i>Function</i>
Summary	Returns a list of subsequences of a sequence, split at specified separator elements.
Package	lispworks
Signature	split-sequence separator-bag sequence &key start end test key coalesce-separators => sequences
Arguments	<p>separator-bag A sequence.</p> <p>sequence A sequence.</p> <p>start, end Bounding index designators for <i>sequence</i>.</p> <p>test A function designator.</p> <p>key A function designator or <code>nil</code>.</p> <p>coalesce-separators</p> <p style="text-align: right;">A generalized boolean.</p>
Values	<p>sequences A list of sequences.</p>
Description	<p>The function split-sequence returns a list of subsequences of <i>sequence</i> (between start and end), split when an element in the sequence <i>separator-bag</i> is found. The structure of <i>sequence</i> is not changed and the elements matching <i>separator-bag</i> are not included in the resulting sequences.</p> <p>The function <i>test</i>, which defaults to <code>eq1</code>, is used to compare the elements of <i>sequence</i> and the elements of <i>separator-bag</i>.</p> <p>If true, the function <i>key</i>, is applied to the elements of <i>sequence</i> before <i>test</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are removed.</p>
See also	split-sequence-if

	<i>Function</i>
Summary	Returns a list of subsequences of a sequence, split at elements for which a predicate returns true.
Package	<code>lispworks</code>
Signature	<code>split-sequence-if predicate sequence &key start end key coalesce-separators => result</code>
Arguments	<p><i>predicate</i> A function designator.</p> <p><i>sequence</i> A sequence.</p> <p><i>start, end</i> Bounding index designators for <i>sequence</i>.</p> <p><i>key</i> A function designator or <code>nil</code>.</p> <p><i>coalesce-separators</i> A generalized boolean.</p>
Values	<i>result</i> A list of sequences.
Description	<p>The function <code>split-sequence-if</code> returns a list of subsequences of <i>sequence</i> (between <i>start</i> and <i>end</i>), split by where the function <i>predicate</i> returns true for an element. The structure of <i>sequence</i> is not changed and the elements identified by the predicate are not included in the resulting sequences.</p> <p>If non-nil, the function <i>key</i> is applied to the elements of <i>sequence</i> before <i>predicate</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are omitted from <i>result</i>.</p>
See also	<code>split-sequence</code> <code>split-sequence-if-not</code>

	<i>Function</i>
Summary	Returns a list of subsequences of a sequence, split at elements for which a predicate returns false.
Package	<code>lispworks</code>
Signature	<code>split-sequence-if-not predicate sequence &key start end key coalesce-separators => sequences</code>
Arguments	<p><i>predicate</i> A function designator.</p> <p><i>sequence</i> A sequence.</p> <p><i>start, end</i> Bounding index designators for <i>sequence</i>.</p> <p><i>key</i> A function designator or <code>nil</code>.</p> <p><i>coalesce-separators</i></p> <p style="padding-left: 20px;">A generalized boolean.</p>
Values	<i>result</i> A list of sequences.
Description	<p>The function <code>split-sequence-if-not</code> returns a list of subsequences of <i>sequence</i> (between <i>start</i> and <i>end</i>), split by where the function <i>predicate</i> returns false for an element. The structure of <i>sequence</i> is not changed and the elements identified by the predicate are not included in the resulting sequences.</p> <p>If non-nil, the function <i>key</i> is applied to the elements of <i>sequence</i> before <i>predicate</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are omitted from <i>result</i>.</p>
See also	<code>split-sequence</code> <code>split-sequence-if</code>

		<i>Function</i>
Summary	Starts a listener in the startup shell.	
Package	<code>lispworks</code>	
Signature	<code>start-tty-listener force => process</code>	
Arguments	<code>force</code>	A generalized boolean.
Values	<code>process</code>	A listener process, or <code>nil</code> .
Description		<p>The function <code>start-tty-listener</code> returns a process that runs a listener read-eval-print loop connected to <code>*terminal-io*</code>. If <code>force</code> is <code>nil</code>, then <code>start-tty-listener</code> checks if the default listener process is alive or if there is a live process with name "TTY Listener". If such a process exists, <code>start-tty-listener</code> simply returns <code>nil</code> and does not start a new process. If no such process exists, or if <code>force</code> was <code>t</code>, then <code>start-tty-listener</code> starts a new listener process named "TTY Listener", and returns it.</p> <p>If a REPL with I/O through <code>*terminal-io*</code> (such as a REPL started by <code>start-tty-listener</code>) is in the debugger, then by default it blocks multiprocessing. This behavior is controlled by the value of <code>*terminal-debugger-block-multiprocessing*</code>.</p>
See also		<code>*terminal-debugger-block-multiprocessing*</code>

		<i>Function</i>
Summary	The accessor for simple text strings.	
Package	<code>lispworks</code>	

Signature	<code>stchar string index => value</code>	
Arguments	<code>string</code>	A <code>simple-text-string</code> .
	<code>index</code>	An index.
Values	<code>value</code>	The character in <code>string</code> at <code>index</code> .
Description	This is the accessor for simple text strings. <code>setf</code> is allowed.	
See also	<code>simple-text-string</code>	

string-append *Function*

Summary	Constructs a single string from a number of strings.
Package	<code>lispworks</code>
Signature	<code>string-append &rest strings => string</code>
Arguments	<code>strings</code> Any number of strings or string designators.
Values	<code>string</code> A string.
Description	<p>The <code>string-append</code> function takes any number of string designators and constructs a single string from them.</p> <p>A string designator is a string, a symbol or a character object.</p> <p>Each of the elements of the <code>strings</code> argument are first coerced into a string using the <code>string</code> function if they are not already a string.</p> <p><code>string</code> is a string of the "widest" type amongst <code>strings</code>. That is, the constructed string is of the same type as the argument with the largest element type.</p>

Example

```
(readtable-case *readtable*)
=>
:UPCASE
```

```
(string-append "foo" 'bar)
=>
"fooBAR"

(type-of
 (string-append
  (coerce "A" 'simple-base-string)
  (coerce "A" 'simple-text-string)
  )))
=>
SIMPLE-TEXT-STRING
```

	<i>Type</i>
Summary	The text string type.
Package	<code>lispworks</code>
Signature	<code>text-string length</code>
Arguments	<code>length</code> The length of the string (or <code>*</code> , meaning any).
Description	The type of strings that can hold any simple character, that is, <code>(vector lw:simple-char length)</code> . This is the string type that is guaranteed to always hold any character used in writing text (program text or natural language). It will not hold character objects which have non-null attributes. It is equivalent to <code>16-bit-string</code> .
See also	<code>8-bit-string</code> <code>16-bit-string</code>

text-string-p	<i>Function</i>
Summary	Tests if an object is a text string.
Package	lispworks
Signature	text-string-p <i>object</i> => <i>bool</i>
Arguments	<i>object</i> The object to be tested.
Values	<i>bool</i> t if <i>object</i> is a text string; nil otherwise.
Description	This is the predicate for text strings.
See also	text-string
true	<i>Function</i>
Summary	Ignores its arguments and returns t .
Package	lispworks
Signature	true &rest <i>ignore</i> => t
Arguments	<i>ignore</i> All arguments are ignored.
Values	t
Description	The function true ignores all its arguments and returns t . It is useful as a functional argument.
See also	do-nothing false

undefine-action	<i>Macro</i>				
Summary	Removes an action from a specified list.				
Package	<code>lispworks</code>				
Signature	<code>undefine-action <i>name-or-list</i> <i>action-name</i> =></code>				
Arguments	<table> <tr> <td><i>name-or-list</i></td><td>A list or action list object.</td></tr> <tr> <td><i>action-name</i></td><td>A general lisp object.</td></tr> </table>	<i>name-or-list</i>	A list or action list object.	<i>action-name</i>	A general lisp object.
<i>name-or-list</i>	A list or action list object.				
<i>action-name</i>	A general lisp object.				
Description	<p>The <code>undefine-action</code> macro removes the specified action from the specified list. If the action specified by <i>action-name</i> does not exist, then this is handled according to the value of <code>*handle-missing-action-in-action-list*</code>.</p> <p><i>name-or-list</i> is evaluated to give either a list UID (to be looked up in the global registry of lists) or an action list object. <i>action-name</i> is a UID (general lisp object, to be compared by <code>equalp</code>). It uniquely identifies this action within its list (as opposed to among all lists).</p>				
See also	<code>define-action</code>				

undefine-action-list	<i>Macro</i>		
Summary	Removes a given defined action list.		
Package	<code>lispworks</code>		
Signature	<code>undefine-action-list <i>uid</i> =></code>		
Arguments	<table> <tr> <td><i>uid</i></td><td>A lisp object.</td></tr> </table>	<i>uid</i>	A lisp object.
<i>uid</i>	A lisp object.		
Values	None.		

Description	The <code>undefine-action-list</code> flushes the specified list (and all its action-items). If the action-list specified by <i>uid</i> does not exist, then handling is controlled by the value of the <code>*handle-missing-action-list*</code> variable.
See also	<code>define-action-list</code>

unicode-alpha-char-p *Function*

Summary	Returns a value like <code>c1:alpha-char-p</code> , but using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature	<code>unicode-alpha-char-p char &key style => flag</code>	
Arguments	<code>char</code> A character <code>style</code> A keyword	
Values	<code>flag</code> A generalized boolean	
Description	<p>The function <code>unicode-alpha-char-p</code> returns <code>flag</code> as true if <code>char</code> is an alphabetic character according to the Unicode rules specified by <code>style</code>.</p> <p>The current implementation only supports one style:</p> <p><code>:general-category</code></p> <p style="text-align: center;">Use Unicode's "general category" for <code>char</code>.</p>	
See also	<code>unicode-alphanumeric-p</code> <code>unicode-both-case-p</code>	

unicode-alphanumeric-p *Function*

Summary	Returns a value like <code>cl:alphanumericp</code> , but using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature	<code>unicode-alphanumericp char &key style => flag</code>	
Arguments	<code>char</code> A character <code>style</code> A keyword	
Values	<code>flag</code> A generalized boolean	
Description	The function <code>unicode-alphanumericp</code> returns <code>flag</code> as true if <code>char</code> is alphanumeric according to the Unicode rules specified by <code>style</code> . The current implementation only supports one style: <code>:general-category</code> Use Unicode's "general category" for <code>char</code> .	
See also	<code>unicode-alpha-char-p</code> <code>unicode-both-case-p</code>	

unicode-both-case-p *Function*

Summary	Returns a value like <code>cl:both-case-p</code> , but using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature	<code>unicode-both-case-p char &key style => flag</code>	
Arguments	<code>char</code> A character <code>style</code> A keyword	

Values	<i>flag</i>	A generalized boolean
Description	The function <code>unicode-both-case-p</code> returns <i>flag</i> as true if char has case according to the Unicode rules specified by <i>style</i> . The current implementation only supports one style: <code>:general-category</code>	Use Unicode's "general category" for <i>char</i> .
Notes	The name of <code>unicode-both-case-p</code> is slightly confusing, because it matches the ANSI Common Lisp definition "a character with case" whereas there is no guarantee that both cases actually exist. Note also that there are some "alpha" chars which are not lower or upper case.	
See also	 <code>unicode-alpha-char-p</code> <code>unicode-lower-case-p</code> <code>unicode-upper-case-p</code>	

unicode-char-equal		<i>Function</i>
Summary	Compares two characters, ignoring case using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature	<code>unicode-char-equal <i>char1</i> <i>char2</i> &key <i>style</i> => <i>flag</i></code>	
Arguments	 <i>char1</i> <i>char2</i> <i>style</i>	A character A character A keyword
Values	<i>flag</i>	A generalized boolean

Description	The function <code>unicode-char-equal</code> returns true if the characters <i>char1</i> and <i>char2</i> are equal, ignoring case using Unicode rules specified by <i>style</i> . The current implementation only supports one style of comparison: <code>:simple-case-fold</code>
See also	<code>unicode-char-greaterp</code> <code>unicode-char-lessp</code> <code>unicode-char-not-equal</code>

	<i>Function</i>						
<code>unicode-char-greaterp</code>							
Summary	Compares two characters, ignoring case using specified Unicode rules.						
Package	<code>lispworks</code>						
Signature	<code>unicode-char-greaterp char1 char2 &key style => flag</code>						
Arguments	<table> <tr> <td><i>char1</i></td><td>A character</td></tr> <tr> <td><i>char2</i></td><td>A character</td></tr> <tr> <td><i>style</i></td><td>A keyword</td></tr> </table>	<i>char1</i>	A character	<i>char2</i>	A character	<i>style</i>	A keyword
<i>char1</i>	A character						
<i>char2</i>	A character						
<i>style</i>	A keyword						
Values	<i>flag</i> A generalized boolean						
Description	The function <code>unicode-char-greaterp</code> returns true if the character <i>char1</i> is greater than the character <i>char2</i> , similarly to <code>cl:char-greaterp</code> but ignoring case using Unicode rules specified by <i>style</i> . The current implementation only supports one style of comparison:						

`:simple-case-fold`

C.compares characters using Unicode's simple lowercase folding rules.

See also

`unicode-char-equal`
`unicode-char-not-greaterp`

unicode-char-lessp

Function

Summary Compares two characters, ignoring case using specified Unicode rules.

Package `lispworks`

Signature `unicode-char-lessp char1 char2 &key style => flag`

Arguments `char1` A character

`char2` A character

`style` A keyword

Values `flag` A generalized boolean

Description The function `unicode-char-lessp` returns true if the character `char1` is less than the character `char2`, similarly to `cl:char-lessp` but ignoring case using Unicode rules specified by `style`.

The current implementation only supports one style of comparison:

`:simple-case-fold`

C.compares characters using Unicode's simple lowercase folding rules.

See also

`unicode-char-equal`
`unicode-char-not-lessp`

		<i>Function</i>
Summary		Compares two characters, ignoring case using specified Unicode rules.
Package		<code>lispworks</code>
Signature		<code>unicode-char-not-equal char1 char2 &key style => flag</code>
Arguments	<i>char1</i>	A character
	<i>char2</i>	A character
	<i>style</i>	A keyword
Values	<i>flag</i>	A generalized boolean
Description		The function <code>unicode-char-not-equal</code> returns true if the characters <i>char1</i> and <i>char2</i> are not equal, ignoring case using Unicode rules specified by <i>style</i> . The current implementation only supports one style of comparison: <code>:simple-case-fold</code> Compares characters using Unicode's simple case folding rules.
See also		<code>unicode-char-equal</code>

		<i>Function</i>
Summary		Compares two characters, ignoring case using specified Unicode rules.
Package		<code>lispworks</code>
Signature		<code>unicode-char-not-greaterp char1 char2 &key style => flag</code>

Arguments	<i>char1</i>	A character
	<i>char2</i>	A character
	<i>style</i>	A keyword
Values	<i>flag</i>	A generalized boolean
Description	<p>The function <code>unicode-char-not-greaterp</code> returns true if the character <i>char1</i> is not greater than the character <i>char2</i>, similarly to <code>c1:char-not-greaterp</code> but ignoring case using Unicode rules specified by <i>style</i>.</p> <p>The current implementation only supports one style of comparison:</p>	
	<pre>:simple-case-fold</pre> <p>Compares characters using Unicode's simple lowercase folding rules.</p>	
See also	<code>unicode-char-equal</code> <code>unicode-char-greaterp</code>	

unicode-char-not-lessp		<i>Function</i>
Summary		Compares two characters, ignoring case using specified Unicode rules.
Package		<code>lispworks</code>
Signature	<code>unicode-char-not-lessp char1 char2 &key style => flag</code>	
Arguments	<i>char1</i>	A character
	<i>char2</i>	A character
	<i>style</i>	A keyword
Values	<i>flag</i>	A generalized boolean

Description	The function <code>unicode-char-not-lessp</code> returns true if the character <i>char1</i> is not less than the character <i>char2</i> , similarly to <code>cl:char-not-lessp</code> but ignoring case using Unicode rules specified by <i>style</i> . The current implementation only supports one style of comparison: <code>:simple-case-fold</code>
See also	<code>unicode-char-equal</code> <code>unicode-char-lessp</code>

	<i>Function</i>				
Summary	Returns a value like <code>cl:lower-case-p</code> , but using specified Unicode rules.				
Package	<code>lispworks</code>				
Signature	<code>unicode-lower-case-p char &key style => flag</code>				
Arguments	<table> <tr> <td><i>char</i></td><td>A character</td></tr> <tr> <td><i>style</i></td><td>A keyword</td></tr> </table>	<i>char</i>	A character	<i>style</i>	A keyword
<i>char</i>	A character				
<i>style</i>	A keyword				
Values	<i>flag</i> A generalized boolean				
Description	The function <code>unicode-lower-case-p</code> returns <i>flag</i> as true if <i>char</i> is lowercase according to the Unicode rules specified by <i>style</i> . The current implementation only supports one style: <code>:general-category</code>				
	Use Unicode's "general category" for <i>char</i> .				

See also `unicode-both-case-p`
`unicode-upper-case-p`

unicode-string-equal *Function*

Summary Compares two strings, ignoring case using specified Unicode rules.

Package `lispworks`

Signature `unicode-string-equal string1 string2 &key start1 start2 end1 end2 style => flag`

Arguments	<code>string1</code>	A string designator
	<code>string2</code>	A string designator
	<code>start1, end1</code>	Bounding index designators of <code>string1</code>
	<code>start2, end2</code>	Bounding index designators of <code>string2</code>
	<code>style</code>	A keyword

Values `flag` A generalized boolean

Description The function `unicode-string-equal` compares the designated substrings of `string1` and `string2`, ignoring case using Unicode rules specified by `style`. The values of `start1` and `start2` default to 0, while the values of `end1` and `end2` default to `nil`.

The returned value `flag` is true if the strings are equal and false otherwise.

The current implementation only supports one style of comparison:

`:simple-case-fold`

Compares each character of the strings using Unicode's simple case folding rules.

See also `choose-unicode-string-hash-function`
`unicode-string-not-equal`

unicode-string-greaterp *Function*

Summary Compares two strings, ignoring case using specified Unicode rules.

Package `lispworks`

Signature `unicode-string-greaterp string1 string2 &key start1 start2 end1 end2 style => mismatch-index`

Arguments `string1` A string designator
 `string2` A string designator
 `start1, end1` Bounding index designators of `string1`
 `start2, end2` Bounding index designators of `string2`
 `style` A keyword

Values `mismatch-index` A bounding index of `string1` or `nil`

Description The function `unicode-string-greaterp` compares the designated substrings of `string1` and `string2`, similarly to `c1:string-greaterp` but ignoring case using Unicode rules specified by `style`. The values of `start1` and `start2` default to 0, while the values of `end1` and `end2` default to `nil`.

The value of `mismatch-index` is the index where the strings mismatch (as an offset from the beginning of `string1`) if `substring1` is greater than `substring2`, or `nil` otherwise.

The current implementation only supports one style of comparison:

`:simple-case-fold`

C.compares each character of the string using Unicode's simple lowercase folding rules.

See also `unicode-string-equal`
`unicode-string-lessp`

unicode-string-lessp *Function*

Summary	Compares two strings, ignoring case using specified Unicode rules.	
Package	<code>lispworks</code>	
Signature	<code>unicode-string-lessp string1 string2 &key start1 start2 end1 end2 style => mismatch-index</code>	
Arguments	<code>string1</code>	A string designator
	<code>string2</code>	A string designator
	<code>start1, end1</code>	Bounding index designators of <code>string1</code>
	<code>start2, end2</code>	Bounding index designators of <code>string2</code>
	<code>style</code>	A keyword
Values	<code>mismatch-index</code>	A bounding index of <code>string1</code> or <code>nil</code>
Description	<p>The function <code>unicode-string-lessp</code> compares the designated substrings of <code>string1</code> and <code>string2</code>, similarly to <code>c1:string-greaterp</code> but ignoring case using Unicode rules specified by <code>style</code>. The values of <code>start1</code> and <code>start2</code> default to 0, while the values of <code>end1</code> and <code>end2</code> default to <code>nil</code>.</p> <p>The value of <code>mismatch-index</code> is the index where the strings mismatch (as an offset from the beginning of <code>string1</code>) if <code>substring1</code> is less than <code>substring2</code>, or <code>nil</code> otherwise.</p> <p>The current implementation only supports one style of comparison:</p>	

`:simple-case-fold`

Compares each character of the string using Unicode's simple lowercase folding rules.

See also

`unicode-string-equal`
`unicode-string-greaterp`

`unicode-string-not-equal`

Function

Summary Compares two strings, ignoring case using specified Unicode rules.

Package `lispworks`

Signature `unicode-string-not-equal string1 string2 &key start1 start2 end1 end2 style => mismatch-index`

Arguments `string1` A string designator

`string2` A string designator

`start1, end1` Bounding index designators of `string1`

`start2, end2` Bounding index designators of `string2`

`style` A keyword

Values `mismatch-index` A bounding index of `string1` or `nil`

Description The function `unicode-string-not-equal` compares the designated substrings of `string1` and `string2`, ignoring case using Unicode rules specified by `style`. The values of `start1` and `start2` default to 0, while the values of `end1` and `end2` default to `nil`.

The value of `mismatch-index` is the index where the strings mismatch (as an offset from the beginning of `string1`) or `nil` otherwise.

The current implementation only supports one style of comparison:

`:simple-case-fold`

Compares each character of the string using Unicode's simple case folding rules.

See also [unicode-string-equal](#)

unicode-string-not-greaterp *Function*

Summary Compares two strings, ignoring case using specified Unicode rules.

Package [lispworks](#)

Signature `unicode-string-not-greaterp string1 string2 &key start1 start2 end1 end2 style => mismatch-index`

Arguments `string1` A string designator

`string2` A string designator

`start1, end1` Bounding index designators of `string1`

`start2, end2` Bounding index designators of `string2`

`style` A keyword

Values `mismatch-index` A bounding index of `string1` or `nil`

Description The function `unicode-string-not-greaterp` compares the designated substrings of `string1` and `string2`, similarly to `cl:string-not-greaterp` but ignoring case using Unicode rules specified by `style`. The values of `start1` and `start2` default to 0, while the values of `end1` and `end2` default to `nil`.

The value of `mismatch-index` is the index where the strings mismatch (as an offset from the beginning of `string1`) if `substring1` is not greater than `substring2`, or `nil` otherwise.

The current implementation only supports one style of comparison:

`:simple-case-fold`

Compares each character of the string using Unicode's simple lowercase folding rules.

See also `unicode-string-equal`
 `unicode-string-greaterp`

unicode-string-not-lessp *Function*

Summary Compares two strings, ignoring case using specified Unicode rules.

Package `lispworks`

Signature `unicode-string-not-lessp string1 string2 &key start1 start2 end1 end2 style => mismatch-index`

Arguments `string1` A string designator

`string2` A string designator

`start1, end1` Bounding index designators of `string1`

`start2, end2` Bounding index designators of `string2`

`style` A keyword

Values `mismatch-index` A bounding index of `string1` or `nil`

Description The function `unicode-string-not-lessp` compares the designated substrings of `string1` and `string2`, similarly to `cl:string-not-lessp` but ignoring case using Unicode rules specified by `style`. The values of `start1` and `start2` default to 0, while the values of `end1` and `end2` default to `nil`.

The value of *mismatch-index* is the index where the strings mismatch (as an offset from the beginning of *string1*) if *substring1* is not less than *substring2*, or `nil` otherwise.

The current implementation only supports one style of comparison:

`:simple-case-fold`

Compares each character of the string using Unicode's simple lowercase folding rules.

See also [unicode-string-equal](#)
[unicode-string-lessp](#)

unicode-upper-case-p *Function*

Summary Returns a value like `c1:upper-case-p`, but using specified Unicode rules.

Package `lispworks`

Signature `unicode-upper-case-p char &key style => flag`

Arguments `char` A character

`style` A keyword

Values `flag` A generalized boolean

Description The function `unicode-upper-case-p` returns `flag` as true if `char` is uppercase according to the Unicode rules specified by `style`.

The current implementation only supports one style:

`:general-category`

Use Unicode's "general category" for `char`.

See also `unicode-both-case-p`
 `unicode-lower-case-p`

	<i>Function</i>						
user-preference							
Summary	Gets or sets a persistent value in the user's registry.						
Package	<code>lispworks</code>						
Signature	<code>user-preference path value-name &key product => value,</code> <code>valuep</code>						
Signature	<code>(setf user-preference) value path value-name &key product</code> <code>=> value</code>						
Arguments	<table><tr><td><code>path</code></td><td>A string or a list of strings.</td></tr><tr><td><code>value-name</code></td><td>A string.</td></tr><tr><td><code>product</code></td><td>A keyword.</td></tr></table>	<code>path</code>	A string or a list of strings.	<code>value-name</code>	A string.	<code>product</code>	A keyword.
<code>path</code>	A string or a list of strings.						
<code>value-name</code>	A string.						
<code>product</code>	A keyword.						
Values	<table><tr><td><code>value</code></td><td>A Lisp object.</td></tr><tr><td><code>valuep</code></td><td>A boolean.</td></tr></table>	<code>value</code>	A Lisp object.	<code>valuep</code>	A boolean.		
<code>value</code>	A Lisp object.						
<code>valuep</code>	A boolean.						
Description	<p>The function <code>user-preference</code> reads the value of the registry entry <code>value-name</code> under <code>path</code> under the registry path defined for <code>product</code> by <code>(setf product-registry-path)</code>. If the registry entry was found a second value <code>t</code> is returned. If the registry entry was not found, then <code>value</code> is <code>nil</code>.</p> <p>The function <code>(setf user-preference)</code> sets the value of that registry entry to <code>value</code>.</p> <p>If <code>path</code> is a list of strings, then it is interpreted like the directory component of a pathname. If <code>path</code> is a string, then any directory separators should be appropriate for the platform - that is, use backslash on Windows, and forward slash on Unix/Linux/Mac OS X systems.</p>						

Note: when *value* is a string, `user-preference` stores a print-escaped string in the registry and reads it back with `read-from-string`. Therefore it may not work with string values stored by other software.

Note: while *product* can in principle be any Lisp object, values of *product* are compared by `eq`, so you should use keywords.

Note: The CAPI provides a way to store window geometry - see the entry for `capi:top-level-interface-save-geometry-p` in the *LispWorks CAPI Reference Manual*.

Example This example is on Microsoft Windows. Note the use of back-slashes as directory separators in the *path* argument:

```
(setf (user-preference "My Stuff\\FAQ"
                      "Ultimate Answer"
                      :product :deep-thought)
      42)
=>
42
```

This is equivalent to the previous example, and is portable because we avoid the explicit directory separators in the *path* argument:

```
(setf (user-preference (list "My Stuff" "FAQ")
                      "Ultimate Answer"
                      :product :deep-thought)
      42)
=>
42
```

We can retrieve values on Windows like this:

```
(user-preference "My Stuff\\FAQ"
                  "Ultimate Answer"
                  :product :deep-thought)
=>
42
t
```

We can retrieve values on any platform like this:

```
(user-preference (list "My Stuff" "FAQ")
                  "Ultimate Question"
                  :product :deep-thought)
=>
nil
nil
```

See also [copy-preferences-from-older-version](#)
[product-registry-path](#)

when-let

Macro

Summary Executes a body of code if a form evaluates to non-nil, propagating the result of the form through the body of code.

Package [lispworks](#)

Signature `when-let (var form) &body body => result`

Arguments `var` A variable whose value is used in the evaluation of *body*.

`form` A form, which must evaluate to non-nil.

`body` A body of code to be evaluated conditionally on the result of *form*.

Values `result` The result of evaluating *body* using the value *var*.

Description This macro executes the body of code if the form evaluates to a non-nil result. Within the body, the variable *var* is bound to the result of the *form*.

Example The form

```
(when-let (position (search string1 string2))
          (print position))
```

macroexpands to

```
(let ((position (search string1 string2)))
  (when position
    (print position)))
```

See also [when-let*](#)

when-let*		<i>Macro</i>
Summary	Executes a body of code if a series of forms evaluates to non-nil, propagating the results of the forms through the body of code.	
Package	<code>lispworks</code>	
Signature	<code>when-let* <i>bindings</i> &body <i>body</i> => <i>result</i></code> <code><i>bindings</i> ::= ((<i>var</i> <i>form</i>)*)</code>	
Arguments	<p><i>var</i> A variable whose value is used in the evaluation of <i>body</i>.</p> <p><i>form</i> A form, which must evaluate to non-nil.</p> <p><i>body</i> A body of code to be evaluated conditionally on the result of <i>form</i>.</p>	
Values	<i>result</i> The result of evaluating <i>body</i> using the value <i>var</i> .	
Description	The macro <code>when-let*</code> expands into nested <code>when-let</code> forms. The bindings are evaluated in turn as long as each returns non-nil. If the last binding evaluates to non-nil, <i>body</i> is executed. Within the code <i>body</i> , each variable <i>var</i> is bound to the result of the corresponding form <i>form</i> .	

Example

```
(defmacro divisible (n &rest divisors)
  `(when-let* , (loop for div in divisors
                      collect (list (gensym)
                                    (zerop (mod n div)))))
    t))
```

See also

[when-let](#)

whitespace-char-p

Function

Summary

Tests whether a character represents white space.

Package

[lispworks](#)

Signature

`whitespace-char-p char => bool`

Arguments

`char`

A character.

Values

`bool`

`t` if char represents white space; `nil` otherwise.

Description

This predicate recognizes [whitespace1], as described in the standard:

“Space and non-graphic characters that only moved the print position.”

If `sys:*extended-spaces*` is `t`, U+3000 Ideographic Space is also considered whitespace.

See also

[*extended-spaces*](#)

with-action-item-error-handling

Macro

Summary

Executes a body of code across action lists and items, signalling errors and then continuing to the next action item.

Package	<code>lispworks</code>
Signature	<code>with-action-item-error-handling <i>action-list-var</i> <i>action-item-var</i> <i>ignore-errors-p</i> &body <i>body</i></code>
Arguments	<p><i>action-list-var</i> A variable.</p> <p><i>action-item-var</i> A variable.</p> <p><i>ignore-errors-p</i> A boolean.</p> <p><i>body</i> A body of Lisp code.</p>
Description	The <code>with-action-item-error-handling</code> macro executes the <i>body</i> with <i>action-list-var</i> and <i>action-item-var</i> are bound to the action list and item respectively. If <i>ignore-errors-p</i> is set to <code>t</code> then errors are handled. The behavior of the handler is to signal a warning in which the action-list, item and original error are all reported; execution then continues with the next action-item.
Example	<pre>(defun my-execution-function (the-action-list other-args &key ignore-errors-p &allow-other-keys) (with-action-list-mapping (the-action-list an-action-item action-item-data) (with-action-item-error-handling (the-action-list an-action-item ignore-errors-p) (do-something-interesting-first) (apply (car action-item-data) other-args (cdr action-item-data))))</pre> <p>If this function was invoked with the keyword argument <code>:ignore-errors-p t</code>, and an error was signalled while executing the body-form(s) for one of the action-items, then a warning such as:</p> <pre>Warning: Got an error 'The variable *PREV-STATE* is unbound.' while executing action "Initialize State" in list "Startup Inits".</pre>

would be signalled and execution would continue with the next action-item.

See also `*handle-missing-action-in-action-list*`

with-action-list-mapping *Macro*

Summary Maps over an action list's actions with given variables bound to the executing action and its data.

Package `lispworks`

Signature `with-action-list-mapping action-list item-var data-var
&optional post-process &body body)`

Arguments `action-list` An action list.

`item-var` A Lisp symbol.

`data-var` A Lisp symbol.

`post-process` A keyword.

`body` A body of Lisp code.

Description The `with-action-list-mapping` macro maps over an action-list's action-items. During execution, the symbols specified for `item-var` and `data-var` are bound to the executing action-item and its data respectively. See `execute-actions` for more on post-processing.

If this function is invoked with the keyword argument `:post-process :collect`, a list the values returned by each action-item's setf operation are returned.

Examples

```
(defun my-execution-function
  (the-action-list other-args
    &key (post-process nil)
    &allow-other-keys)
  (declare (ignore other-args))
  (with-action-list-mapping (the-action-list
    an-action-item
    action-item-data
    post-process)
    (do-something-interesting-first)
    (setf (symbol-value (car action-item-data))
      (apply (cadr action-item-data)
        (cddr action-item-data)))))
```

See also**execute-actions****with-unique-names***Macro*

Summary Returns a body of code with each specified name bound to a similar name.

Package **lispworks**

Signature **with-unique-names (&rest names) &body body => result**

Arguments **names** The names to be rebound in *body*.

body The body of code within which *names* are rebound.

Values **result** The result of evaluating *body*.

Description Returns the body with each *name* bound to a symbol of a similar name (compare **gensym**).

Example After defining

```
(defmacro lister (p q)
  (with-unique-names (x y)
    `(let ((,x (x-function))
          (,y (y-function)))
      (list ,p ,q ,x ,y))))
```

the form `(lister i j)` macroexpands to

```
(LET* ((#:X-88 (X-FUNCTION))
       (#:Y-89 (Y-FUNCTION)))
  (LIST i j #:X-88 #:Y-89))
```

See also

[rebinding](#)

35

The MP Package

This chapter describes symbols available in the `mp` package, giving you access to the multiprocessing capabilities of LispWorks.

Multiprocessing is discussed in detail in Chapter 15, “Multiprocessing”.

allowing-block-interrupts *Macro*

Summary Allows control over blocking interrupts.

Signature `allowing-block-interrupts start-blocked &body body => results`

Package `mp`

Arguments `start-blocked` A generalized boolean
`body` Code

Values `results` Values returned by evaluating `body`.

Description The macro `allowing-block-interrupts` executes `body` allowing control over blocking interrupts by `current-process-`

`unblock-interrupts` and `current-process-unblock-interrupts`.

Within the dynamic scope of `allowing-block-interrupts`, you can switch the blocking of interrupts on and off. Blocking interrupts prevents any interruption of the current process, including `process-interrupt`, `process-kill`, `process-reset`, `process-break` and `process-stop`. These interrupts are all queued and processed once interrupts become unblocked.

Blocking interrupts also blocks interrupts due to UNIX interrupts. Such interrupts are processed either by another Lisp thread, or once interrupts become unblocked.

If `start-blocked` is true, `allowing-block-interrupts` blocks interrupts on entry. If `start-blocked` is false, the state does not change on entry. If you want to ensure that the initial forms of `allowing-block-interrupts` are interruptible even if it is inside the scope of another `allowing-block-interrupts`, you need to explicitly call `current-process-unblock-interrupts` on entry.

`allowing-block-interrupts` can be used recursively.

In compiled code, `allowing-block-interrupts` with a true value of the `start-blocked` argument is guaranteed not to process interrupts before an explicit change to the blocking state (that includes exiting the scope of `allowing-block-interrupts`). In particular, if the first cleanup form of an `unwind-protect` is a call to `allowing-block-interrupts`, it is guaranteed to execute without interrupts on exit from the protected form. No such guarantee is given in interpreted code.

On exit from `allowing-block-interrupts`, the current state of interrupt blocking and whether there is a surrounding use of `allowing-block-interrupts` or `with-interrupts-blocked` is restored to the state that existed on entry.

`allowing-block-interrupts` returns the results of `body`.

See also `current-process-block-interrupts`
`current-process-unblock-interrupts`
`process-break`
`process-interrupt`
`process-kill`
`process-reset`
`process-stop`
`with-interrupts-blocked`

barrier-arriver-count *Function*

Summary Returns the arriver count of a barrier.

Package `mp`

Signature `barrier-arriver-count barrier => result`

Arguments `barrier` A barrier.

Values `result` A positive fixnum, or `nil`.

Description The function `barrier-arriver-count` returns the arriver count of the barrier `barrier`, or `nil` for a disabled barrier.

Notes For a barrier that is actually in use, the arriver count can change at any time.

See also `make-barrier`

barrier-change-count *Function*

Summary Changes the count of a barrier.

Package `mp`

Signature	<code>barrier-change-count barrier new-count => result</code>	
Arguments	<code>barrier</code>	A barrier.
	<code>new-count</code>	A positive fixnum, or <code>t</code> meaning <code>most-positive-fixnum</code> .
Values	<code>result</code>	A boolean.
Description	<p>The function <code>barrier-change-count</code> changes the count of the barrier <code>barrier</code> to <code>new-count</code>. If the barrier is enabled and the arriver count is less than <code>new-count</code>, this just sets the count of the barrier to the <code>new-count</code> and returns <code>t</code>. Otherwise, it calls</p> <pre>(barrier-unblock barrier :reset-count new-count)</pre> <p>and returns <code>nil</code>.</p>	
See also	<code>barrier-unblock</code>	

barrier-count *iFunction*

Summary	Returns the current count of a barrier.	
Package	<code>mp</code>	
Signature	<code>barrier-count barrier => result</code>	
Arguments	<code>barrier</code>	A barrier.
Values	<code>result</code>	A positive fixnum, or <code>nil</code> .
Description	The function <code>barrier-count</code> returns the current count of the barrier <code>barrier</code> , or <code>nil</code> for a disabled barrier.	

Notes The count value can be changed by `barrier-unblock`, `barrier-enable`, `barrier-disable` OR `barrier-change-count`.

See also `barrier-change-count`
 `barrier-disable`
 `barrier-enable`
 `barrier-unblock`

barrier-disable *Function*

Summary Unblocks and disables a barrier.

Package `mp`

Signature `barrier-disable barrier &optional kill-waiting`

Arguments `barrier` A barrier.
 `kill-waiting` A boolean.

Description The function `barrier-disable` unblocks the barrier `barrier` and then disables it. If `kill-waiting` is true, `barrier-disable` also kills any waiting thread. This is done by calling

```
(barrier-unblock barrier :disable t :kill-waiting kill-waiting)
```

See also `barrier-unblock`

barrier-enable *Function*

Summary Ensures that a barrier is enabled.

Package `mp`

Signature `barrier-enable barrier count &optional kill-waiting`

Arguments	<i>barrier</i>	A barrier.
	<i>count</i>	A positive fixnum, or t meaning <code>most-positive-fixnum</code> .
	<i>kill-waiting</i>	A boolean.
Description	The function <code>barrier-enable</code> ensures that the barrier <i>barrier</i> is enabled after unblocking it if it is already enabled, and sets its count to <i>count</i> . If <i>kill-waiting</i> is true, <code>barrier-enable</code> also kills any waiting threads. This is done by calling <code>(barrier-unblock barrier :reset-count count :kill-waiting kill-waiting)</code>	
See also	<code>barrier-unblock</code>	

		<i>Function</i>
Summary	Returns the name of the barrier	
Package	<code>mp</code>	
Signature	<code>barrier-name barrier => name</code>	
Arguments	<i>barrier</i>	A barrier.
Values	<i>name</i>	A string.
Description	The function <code>barrier-name</code> returns the name of the barrier, as supplied or defaulted in the call to <code>make-barrier</code> .	
See also	<code>make-barrier</code>	

		<i>Function</i>
Summary	Increments the arriver count of a barrier.	

Package	<code>mp</code>	
Signature	<code>barrier-pass-through barrier => result</code>	
Arguments	<code>barrier</code>	A barrier.
Values	<code>result</code>	One of the keyword symbols <code>:unblocked</code> and <code>:passed-through</code> .
Description		The function <code>barrier-pass-through</code> increments the arriver count of the barrier <code>barrier</code> . If the arriver count thereby reaches the count, <code>barrier-pass-through</code> unblocks the barrier and returns <code>:unblocked</code> , otherwise it returns <code>:passed-through</code> . <code>barrier-pass-through</code> is equivalent to calling <code>barrier-wait</code> with <code>pass-through t</code> . See <code>barrier-wait</code> for details.
See also		<code>barrier-wait</code>

		<i>Function</i>
barrier-unblock		
Summary		Unblocks a barrier.
Package	<code>mp</code>	
Signature	<code>barrier-unblock barrier &key disable reset-count kill-waiting</code>	
Arguments	<code>disable</code>	A boolean.
	<code>reset-count</code>	A positive fixnum, <code>t</code> or <code>nil</code> .
	<code>kill-waiting</code>	A boolean.
Description		The function <code>barrier-unblock</code> unblocks the barrier <code>barrier</code> , potentially disabling it, resetting its count or killing the waiting processes.

Without keyword arguments, `barrier-unblock` unblocks the barrier, which means that any thread that is waiting on the barrier wakes and returns from `barrier-wait`, and the arriver count is reset to 0.

If `disable` is true, or if `disable` is not passed and the barrier was made with `disable-on-unblock` true, then `barrier-unblock` also disables the barrier, so any further calls to `barrier-wait` return `nil` immediately.

If `reset-count` is true, it must be valid count (a positive fixnum or t), and `barrier-unblock` sets the count of the barrier to this value.

If `kill-waiting` is true, instead of waking up the waiting threads, `barrier-unblock` kills them (by `process-kill`).

See also

`process-kill`
`barrier-wait`

barrier-wait

Function

Summary	Waits on a barrier until enough threads arrive.	
Package	<code>mp</code>	
Signature	<code>barrier-wait barrier &key timeout callback pass-through discount-on-abort discount-on-timeout disable-on-unblock => result</code>	
Arguments	<code>barrier</code>	A barrier.
	<code>timeout</code>	A non-negative number.
	<code>pass-through</code>	A boolean.
	<code>discount-on-abort</code>	A boolean.
	<code>discount-on-timeout</code>	
		A boolean.
	<code>disable-on-unblock</code>	

		A boolean.
	<i>callback</i>	A function designator.
Values	<i>result</i>	One of the keyword symbols :unblocked, :passed-through, :timeout, nil or t.
Description		<p>The function <code>barrier-wait</code> waits on a barrier until enough threads arrive. When <code>barrier-wait</code> is called it "arrives", and when the number of arrivers reaches the count of the barrier (that is, the <code>count</code> argument to <code>make-barrier</code>), <code>barrier-wait</code> returns. Effectively, the last "arriver" unblocks the barrier and wakes up all the other waiting threads.</p> <p><i>timeout</i> is the maximum time to wait in seconds.</p> <p>If <i>pass-through</i> is true, it does not actually wait.</p> <p><i>discount-on-abort</i> controls whether to change the arrivers count on an abort.</p> <p><i>discount-on-timeout</i> controls whether to change the arrivers count on a timeout.</p> <p><i>disable-on-unblock</i> controls whether to disable the barrier when unblocking.</p> <p><i>callback</i>, if supplied, specifies a callback called before unblocking.</p> <p><code>barrier-wait</code> first checks if the barrier is disabled, and if it is <code>barrier-wait</code> returns nil immediately. It then checks the number of arrivers, which is the number of other calls to <code>barrier-wait</code> on the same barrier since it was last unblocked or created.</p> <p>If the number of arrivers is less than the count minus 1, <code>barrier-wait</code> increases the number of arrivers, and then waits for the barrier to be unblocked (unless <i>pass-through</i> is true). If the number of arrivers is the count minus 1, <code>barrier-wait</code> unblocks the barrier (described below) and returns :unblocked.</p>

discount-on-abort, *discount-on-timeout*, *disable-on-unblock* and *callback* allow you to control the waiting and also the unblocking of the barrier. For each of these, the effective value is either that supplied to `barrier-wait`, or if it was not supplied to `barrier-wait`, the value in the barrier itself (see `make-barrier`).

timeout can be used to limit the time that `barrier-wait` waits. It is either a number of seconds or `nil`, meaning no timeout. If `barrier-wait` times out, it returns `:timeout`. By default it does not change the number of arrivers after a timeout, so the call is still counted as an "arrival", but this can be changed by using *discount-on-timeout*. If *discount-on-timeout* is true then after a timeout `barrier-wait` decrements the arrivers count, so the call has no overall effect on the arrivers count.

If `barrier-wait` is aborted while it waits (for example by `process-kill` or throwing using `process-interrupt`), by default it does not change the arrivers count, so the call still counts as an arrival, but this can be changed by using *discount-on-abort*. If *discount-on-abort* is true, then on aborting `barrier-wait` decrements the arrivers count, so the call has no overall effect on the arrivers count.

If `barrier-wait` would have waited but *pass-through* is true, it returns the symbol `:passed-through` instead of waiting. Hence a call to `barrier-wait` with a true value of *pass-through* has the effect of incrementing the arriver count, and unblocking other waiters if needed, but never itself waiting.

Unblocking the barrier: when the number of arrivers is the count of the barrier minus 1, `barrier-wait` "unblocks the barrier". This involves the following steps:

1. If *callback* is true it is called with the barrier while holding an internal lock on the barrier. See the comment in `make-barrier`. If the callback aborts, nothing has been changed in the barrier (including no change to the arrivers).

2. The barrier is marked as unblocked for the currently waiting threads.
3. The number of arrivers in the barrier is reset to 0. Unless the next step disables the barrier, this means that any subsequent call to `barrier-wait` will wait, as if the barrier had just been created.
4. If `disable-on-unblock` is true, `barrier-wait` then disables the barrier. That means that until it is enabled, any call to `barrier-wait` will return immediately.
5. It wakes up all the waiting threads.
6. It returns the symbol `:unblocked`.

The possible values of *result* occur in these circumstances:

<code>t</code>	The current process waited and some other process unblocked the barrier.
<code>:unblocked</code>	The current process unblocked the barrier.
<code>:timeout</code>	The wait timed out.
<code>:passed-through</code>	Pass through because <i>pass-through</i> was true.
<code>nil</code>	The barrier is disabled.

See also `make-barrier`

change-process-priority

Function

Summary Changes the priority of a process.

Package `mp`

Signature `change-process-priority process new-priority => new-priority`

Arguments `process` A process.

new-priority A fixnum.

Description Changes the priority of *process* to be *new-priority*.

See also `process-priority`

condition-variable-broadcast

Function

Summary Wakes all threads currently waiting on a given condition variable.

Package `mp`

Signature `condition-variable-broadcast condvar => signalledp`

Arguments *condvar* A condition variable

Values *signalledp* A generalized boolean

Description The function `condition-variable-broadcast` wakes all threads currently waiting on the condition variable *condvar*. In most uses of condition variables, the caller should be holding the lock that the waiter used when calling `condition-variable-wait` for this condition variable, but this is not required.

The return value *signalledp* is non-nil if some processes were signalled, or nil if there were no processes waiting.

See also `condition-variable-wait`
`make-condition-variable`

condition-variable-signal

Function

Summary Wakes one thread waiting on a given condition variable.

Package	<code>mp</code>	
Signature	<code>condition-variable-signal condvar => signalledp</code>	
Arguments	<code>condvar</code>	A condition variable
Values	<code>signalledp</code>	A generalized boolean
Description		<p>The function <code>condition-variable-signal</code> wakes exactly one thread waiting on the condition variable <code>condvar</code>. In most uses of condition variables, the caller should be holding the lock that the waiter used when calling <code>condition-variable-wait</code> for this condition variable, but this is not required.</p> <p>The return value <code>signalledp</code> is non-nil if a process was signalled, or <code>nil</code> if there were no processes waiting.</p>
See also		<code>condition-variable-wait</code> <code>make-condition-variable</code>

condition-variable-wait		<i>Function</i>
Summary		Waits for a given condition variable to be signalled.
Package	<code>mp</code>	
Signature	<code>condition-variable-wait condvar lock &key timeout wait-reason => wakep</code>	
Arguments	<code>condvar</code>	A condition variable
	<code>lock</code>	A <code>mp:lock</code>
	<code>timeout</code>	<code>nil</code> or a positive real
	<code>wait-reason</code>	A string
Values	<code>wakep</code>	A generalized boolean

Description	<p>The function <code>condition-variable-wait</code> waits at most <i>timeout</i> seconds for the condition variable <i>condvar</i> to be signalled. The lock <i>lock</i> is released while waiting and claimed again before returning. The caller must be holding the lock <i>lock</i> before calling this function.</p> <p>The return value <i>wakep</i> is non-nil if the signal was received or nil if there was a timeout. If <i>timeout</i> is nil, <code>condition-variable-wait</code> waits indefinitely.</p> <p>If <i>wait-reason</i> is non-nil, it is used as the <i>wait-reason</i> while waiting for the signal.</p>
Notes	<i>timeout</i> controls how long to wait for the signal: before returning, the function waits to claim the lock, possibly indefinitely.
See also	<code>condition-variable-wait-count</code> <code>make-condition-variable</code>

condition-variable-wait-count *Function*

Summary	Returns the current number of threads that are still waiting for the condition variable.	
Package	<code>mp</code>	
Signature	<code>condition-variable-wait-count condvar => wait-count</code>	
Arguments	<i>condvar</i>	A condition variable
Values	<i>wait-count</i>	A non-negative integer
Description	The function <code>condition-variable-wait-count</code> returns the current number of threads that are still waiting for the condition variable. Note that for a condition variable that is actually in use, this number can change at any time.	

See also [condition-variable-wait](#)

create-simple-process *Function*

Summary Creates and returns a simple process, which is a process with no stack of its own.

Signature `create-simple-process name function wait-function &key
function-arguments wait-function-arguments priority => process`

Package `mp`

Arguments `name` A string or symbol

`function` A function

`wait-function` A function

`function-arguments`

A list of arguments for `function`

`wait-function-arguments`

A list of arguments for `wait-function`

`priority` A fixnum

Values `process` A simple process

Description The `create-simple-process` function creates and returns a simple process, which is a process that has no stack of its own.

The `name` argument is a string or symbol that names the process. The `function` argument is a function to be run in the process, and the `wait-function` argument is a wait function that determines when the process function is run. The value of `function-arguments` is a list of arguments to which the process function is applied. The value of `wait-function-arguments` is a list of arguments to which the wait function is applied. The

`:priority` argument is a fixnum that specifies a priority for the process. The default priority is the value of `*default-simple-process-priority*`, and is usually 0.

When the wait function, applied to the `wait-function-arguments`, returns a value other than `nil`, the process function is applied to the function-arguments. The process function is executed inside an `mp:without-preemption` form. If an error occurs in a simple process, that process is stopped and a continuable error is signaled in the process that was running at the time the simple process was started (or the last process to run if the system was idle). Continuing from the error restarts the simple process.

Because a simple process has no stack of its own, it can be executed on an arbitrary stack. However, simple processes have restrictions, the primary one being that they cannot block. The following interfaces cannot be used in a simple process:

- `mp:mailbox-read` (with an empty mailbox)
- `mp:process-allow-scheduling`
- `mp:process-lock`
- `mp:process-wait`
- `mp:process-wait-with-timeout`
- `cl:sleep`
- `mp:sleep-for-time`
- `mp:wait-for-mailbox`
- `mp:wait-processing-events`
- `mp:with-lock`
- CAPI functions that block

Other Common Lisp functions might not work if they attempt to block. This applies in particular to I/O functions on streams such as pipes and to `(setf gethash)` on a hash table that another process is mapping over.

For more information, see Chapter 15, “Multiprocessing”.

Example

The following example creates a simple process that prints the value of `*a*` to the background output when the value is other than `nil`. The process function then sets `*a*` to `nil`. From a listener, the value of `*a*` can be set to trigger the process to run once and then sleep again.

```
(defvar *a* 'i)

*A*

(defun a ()
  (let ((a *a*))
    (setq *a* nil)
    (format mp:*background-standard-output*
           "*a* is ~a~%" a)))

A

(defun b () *a*)

B

(setq r (mp:create-simple-process 'test-proc 'a 'b))

#<MP::SIMPLE-PROCESS Name TEST-PROC Priority 0 State
NIL>
```

See also

`process-run-function`

current-process

Variable

Summary

Contains the object that is the current process.

Package

`mp`

Description This special variable contains the object that is the current process.

See also `get-current-process`

current-process-block-interrupts *Function*

Summary Blocks interrupts in the current process.

Signature `current-process-block-interrupts => t`

Description The function `current-process-block-interrupts` blocks interrupts in the current process.

It signals an error if called outside the dynamic scope of `allowing-block-interrupts` OR `with-interrupts-blocked`.

Blocking interrupts prevents any interruption of the current process, including `process-interrupt`, `process-kill`, `process-reset`, `process-break` and `process-stop`. These interrupts are all queued and processed once interrupts become unblocked.

Blocking interrupts also blocks interrupts due to UNIX interrupts. Such interrupts are processed either by another Lisp thread, or once interrupts become unblocked.

The effect of `current-process-block-interrupts` stays in force until the next call to either `current-process-unblock-interrupts` or `current-process-block-interrupts`, or an exit out of the scope of a surrounding `allowing-block-interrupts` OR `with-interrupts-blocked`. Inside this range bodies of `allowing-block-interrupts` and `with-interrupts-blocked` have their own state, but they restore it on exit.

See also `allowing-block-interrupts`
`current-process-unblock-interrupts`

```
process-break
process-interrupt
process-kill
process-reset
process-stop
with-interrupts-blocked
```

current-process-in-cleanup-p *Function*

Summary	The predicate for whether the current process is cleaning up after being killed.	
Package	<code>mp</code>	
Signature	<code>current-process-in-cleanup-p => result</code>	
Values	<code>result</code>	A boolean.
Description	The function <code>current-process-in-cleanup-p</code> returns true after the current process is killed. In particular, it returns true while the cleanups that were set by <code>ensure-process-cleanup</code> execute.	
See also	<code>ensure-process-cleanup</code>	

current-process-pause *Function*

Summary	Sleeps for a specified time, but can be woken up.	
Package	<code>mp</code>	
Signature	<code>current-process-pause time &optional function &rest args => result</code>	
Arguments	<code>time</code>	A positive number

	<i>function</i>	A function designator.
	<i>args</i>	Arguments passed to <i>function</i> .
Values		The keyword :poked, or nil.
Description		<p>The function <code>current-process-pause</code> sleeps for <i>time</i> seconds, but wakes up if another process did something to wake up the current process (normally this is <code>process-poke</code>, but it can also be <code>process-interrupt</code>, <code>process-stop</code>, <code>process-unstop</code> OR <code>process-kill</code>).</p> <p><code>current-process-pause</code> is quite similar to <code>cl:sleep</code>, but it returns if anything causes the process to wake up even if the time did not pass.</p> <p>If <i>function</i> is passed just before going to sleep, <code>current-process-pause</code> applies <i>function</i> to <i>args</i>, and if this returns a true value <code>current-process-pause</code> returns it immediately. <i>function</i> and <i>args</i> are not used otherwise. If another process calls <code>process-poke</code> on the current process after setting something that causes <i>function</i> to return true, it guarantees that <code>current-process-pause</code> will return immediately without sleeping.</p> <p>If another process woke up the current process, <code>current-process-pause</code> returns the keyword :poked. If it slept the full time, it returns nil.</p>
Notes		<ol style="list-style-type: none"> 1. In contrast to <code>process-wait</code>, the <i>function</i> argument to <code>current-process-pause</code> is applied only once, and within the dynamic scope of <code>current-process-pause</code>. It therefore does not have any of the restrictions that the wait-function in <code>process-wait</code> has. 2) The purpose of <i>function</i> is to guard against the possibility that another process pokes the current process while it is in the process of going to sleep.

3) There is no way to distinguish between the function returning :poked and process being poked in some way.

Example Supposed you want to have a process that each minute does some cleanup, but may also be told by other processes to go and do the cleanup. The process be doing:

```
(loop
  (mp:current-process-pause 60 'check-for-need-cleanup)
  (do-cleanup))
```

Another process which wants to provoke a cleanup will do:

```
(setup-cleanup-flag)

(mp:process-poke *cleanup-process*)
```

Note that `check-for-need-cleanup` is passed to `current-process-pause`, because another process may call `process-poke` after `current-process-pause` was called but before it went to sleep. If `check-for-need-cleanup` was not passed, `current-process-pause` would unnecessarily sleep the whole 60 seconds in this case. The same thing could be implemented by `process-wait-with-timeout`, but the implementation above does not require a wait function that can run in another dynamic scope repeatedly at arbitrary times, and it uses much less system resources. It is also easier to debug.

See also [process-poke](#)

current-process-unblock-interrupts

Function

Summary Unblocks interrupts in the current process.

Signature `current-process-unblock-interrupts => t`

Description The function `current-process-unblock-interrupts` unblocks interrupts in the current process.

It signals an error if called outside the dynamic scope of `allowing-block-interrupts` OR `with-interrupts-blocked`.

The effect of `current-process-unblock-interrupts` stays in force until the next call to either `current-process-unblock-interrupts` OR `current-process-block-interrupts`, or an exit out of the scope of a surrounding `allowing-block-interrupts` OR `with-interrupts-blocked`. Inside this range bodies of `allowing-block-interrupts` and `with-interrupts-blocked` have their own state, but they restore it on exit.

See also	<code>allowing-block-interrupts</code> <code>current-process-block-interrupts</code> <code>with-interrupts-blocked</code>
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	<i>Function</i>
Summary	Debug a thread other than the current process.
Package	<code>mp</code>
Signature	<code>debug-other-process</code> <i>process</i>
Arguments	<i>process</i> A process or a string.
Description	The function <code>mp:debug-other-process</code> causes the debugger to be entered in the given process. If <i>process</i> is a string, the process is found as if by <code>mp:find-process-from-name</code> . The list of process names can be found via <code>mp:ps</code> .
See also	<code>find-process-from-name</code> <code>ps</code>

default-process-priority *Variable*

Summary	The default priority for processes.
Package	<code>mp</code>
Description	The <code>*default-process-priority*</code> variable contains the default priority for processes.
See also	<code>process-run-function</code> <code>create-simple-process</code> <code>*default-simple-process-priority*</code>

default-simple-process-priority *Variable*

Summary	The default priority for simple processes.
Package	<code>mp</code>
Description	The <code>*default-simple-process-priority*</code> variable contains the default priority for simple processes.
See also	<code>create-simple-process</code> <code>*default-process-priority*</code>

ensure-process-cleanup *Function*

Summary	Run forms when a given process terminates.
Package	<code>mp</code>
Signature	<code>ensure-process-cleanup cleanup-form &optional process =></code>
Arguments	<code>cleanup-form</code> Form to run when <code>process</code> terminates.

<i>process</i>	The process to watch for termination. By default, this is the value of <code>*current-process*</code> .
Values	None.
Description	<p>Ensures that the <i>cleanup-form</i> is present for the given process. When the process terminates, its cleanup forms are run. Cleanup forms can be functions of one argument (the process), or lists, in which case the <code>car</code> is applied to the process and the <code>cdr</code> of the list.</p> <p>When adding cleanup forms, this function uses <code>equal</code> to ensure that the form is only added once.</p>
Notes	You can test for whether the current process is executing its cleanups with <code>current-process-in-cleanup-p</code> .
Example	A process calls <code>add-process-dependent</code> each time a dependent object is added to a process. When the process terminates, <code>inform-dependent-of-dead-process</code> is called on all dependent objects.
	<pre>(defun add-process-dependent (dependent) (mp:ensure-process-cleanup ` (delete-process-dependent ,dependent))) (defun delete-process-dependent (process dependent) (inform-dependent-of-dead-process dependent process))</pre>
See also	<code>current-process-in-cleanup-p</code> <code>process-kill</code>

find-process-from-name *Function*

Summary	Finds a process from its name.
Package	<code>mp</code>

Signature	<code>find-process-from-name <i>process-name</i> => <i>result</i></code>	
Arguments	<i>process-name</i>	A string.
Values	<i>result</i>	A <code>mp:process</code> , or <code>nil</code> .
Description	The function <code>find-process-from-name</code> returns the process with the name <i>process-name</i> . If there is no such process, the function returns <code>nil</code> .	
Example	<pre>CL-USER 16 > (mp:find-process-from-name "Listener 1") #<MP:PROCESS Name "Listener 1" Priority 600000 State "Running"></pre>	
See also	<code>get-process</code>	

		<i>Generic function</i>
general-handle-event		
Summary	"handles" an event, depending on the type of the event object.	
Package	<code>mp</code>	
Signature	<code>general-handle-event <i>event-object</i></code>	
Arguments	<i>event-object</i>	A Lisp object.
Description	The generic function <code>general-handle-event</code> "handles" the <i>event-object</i> . What this actually means depends on the type of the object. There are system defined methods for these classes:	
	<code>list</code>	Apply the <code>car</code> to the <code>cdr</code> .
	<code>function</code>	Call it.
	<code>symbol</code>	If fbound call it, otherwise do nothing.
	<code>t</code>	Do nothing.

You can add methods for your own classes.

`general-handle-event` is used by all functions that process events, for example `wait-processing-events` and `process-all-events`, as well as by internal waiting functions.

See also `process-all-events`

get-current-process *Function*

Summary Returns the current Lisp process.

Package `mp`

Signature `get-current-process => result`

Values `result` A `mp:process`, or `nil`.

Description The function `get-current-process` returns the actual process in which it is called. In this respect it differs from `*current-process*`, which can be bound to another process. In particular, when a process A calls the *wait-function* of process B, in the *wait-function* `get-current-process` returns the process A, but `*current-process*` is bound to process B. `result` is `nil` if multiprocessing is off.

See also `*current-process*`

get-process *Function*

Summary Returns a process corresponding to a supplied designator.

Package `mp`

Signature `get-process process-designator => process`

Arguments	<i>process-designator</i>	A <code>mp:process</code> , a string, a stack-group, a function, a symbol or a fixnum.
Values	<code>process</code>	A <code>mp:process</code> .
Description	The function <code>get-process</code> returns a process according to the supplied <i>process-designator</i> , which is interpreted as follows:	
	<code>mp:process</code>	Return it.
	A string	Find the first process (highest priority) with matching name. Process names are compared by <code>string=</code> .
	A stack-group	Return the process of the stack-group.
	A function	Return the first process that has <i>process-designator</i> as its function (that is, the third argument of <code>process-run-function</code>).
	A symbol	First search for a process using the symbol name as a string, and (if that fails) then search using the symbol as a function.
	A fixnum	Find a process for which <i>process-designator</i> is its unique id. The unique id of the current process can be found by <code>(sys:current-thread-unique-id)</code> .
	<i>result</i> is <code>nil</code> if multiprocessing is off.	

See also `find-process-from-name`

get-process-private-property	<i>Function</i>
Summary	Gets the value of a process private property.
Package	<code>mp</code>

Signature	<code>get-process-private-property <i>indicator process &optional default => result</i></code>	
Arguments	<i>indicator</i>	A Lisp object.
	<i>process</i>	A process.
	<i>default</i>	A Lisp object.
Values	<i>result</i>	A property value, or <i>default</i> .
Description	<p>The function <code>get-process-private-property</code> gets the value associated with <i>indicator</i> in the private properties of the process <i>process</i>. If there is no such property, the value <i>default</i> is returned.</p> <p><code>get-process-private-property</code> can be used to read the values of private properties from another process.</p> <p>The default value of <i>default</i> is <code>nil</code>.</p>	
See also	<code>process-private-property</code> <code>remove-process-private-property</code> <code>pushnew-to-process-private-property</code> <code>remove-from-process-private-property</code>	

		<i>Function</i>
Summary	Initializes multiprocessing before use.	
Package	<code>mp</code>	
Signature	<code>initialize-multiprocessing &rest <i>main-process-args => nil</i></code>	
Arguments	<i>main-process-args</i>	A set of arguments for <code>process-run-function</code> .

Values	Returns <code>nil</code> .
Description	<p>The function <code>initialize-multiprocessing</code> initializes multiprocessing, and it does not return until multiprocessing is finished.</p> <p><code>initialize-multiprocessing</code> applies the function <code>process-run-function</code> to each of the entries in <code>*initial-processes*</code> to create the initial processes.</p> <p>When called with <code>main-process-args</code>, it creates an <code>mp:process</code> object for the initial thread using the arguments in that list as if in the call</p> <pre>(apply 'mp:process-run-function main-process-args)</pre> <p>Supplying <code>main-process-args</code> is useful on Mac OS X if you want to run a pure Cocoa application, since the main thread needs to run the Cocoa event loop.</p> <p>It is not necessary to call <code>initialize-multiprocessing</code> when the LispWorks IDE is running (that is, after <code>env:start-environment</code> has been called), as this automatically starts up multiprocessing.</p> <p>Note: On Microsoft Windows, Linux, x86/x64 Solaris, FreeBSD and Mac OS X (using the Cocoa image), the LispWorks IDE starts up by default.</p>
See also	<ul style="list-style-type: none"> <code>*initial-processes*</code> <code>process-run-function</code>

initial-processes		<i>Variable</i>
Summary	A list of the processes the system initializes on startup.	
Package	<code>mp</code>	

Description	<p>The variable <code>*initial-processes*</code> specifies the processes which the system initializes on startup.</p> <p>Each element of the <code>*initial-processes*</code> list is a set of arguments for <code>process-run-function</code>.</p>
Example	To create a listener process as well as your own processes, evaluate this form before saving your image:
See also	<code>process-run-function</code>

last-callback-on-thread *Function*

Summary	Informs LispWorks that there are probably not going to be more callbacks from foreign code on the current thread, allowing it to free some data.
Package	<code>mp</code>
Signature	<code>last-callback-on-thread => result</code>
Values	<code>result</code> <code>t</code> or <code>nil</code> .
Description	<p>The function <code>last-callback-on-thread</code> informs LispWorks that there are probably not going to be more callbacks from foreign code on the current thread (but does not guarantee this).</p> <p><code>last-callback-on-thread</code> must be used in the scope of a call into LispWorks by a foreign callable on a thread that was not created by LispWorks. It informs LispWorks that there are unlikely to be more callbacks into Lisp on the current thread. As a result, LispWorks can cleanup its side.</p> <p>For each thread that was not created by Lisp and on which there was a call into Lisp, LispWorks keeps data on the Lisp</p>

side which it uses to make the entry faster. If the thread goes away, this data is not needed and so LispWorks can free it.

If another callback occurs on the same thread after a callback that called `last-callback-on-thread`, LispWorks will have to recreate its side, which takes a little more time, but otherwise it works in the same way. Thus it is possible to call `last-callback-on-thread` even when it is not guaranteed that there will not be further callbacks on the same thread.

Calling `last-callback-on-thread` on a thread that was created by LispWorks has no effect.

`last-callback-on-thread` returns `t` when called on a thread that was not created by LispWorks, otherwise it returns `nil`.

list-all-processes	<i>Function</i>
---------------------------	-----------------

Summary Lists all the Lisp processes currently in the system.

Package `mp`

Signature `list-all-processes -> process-list`

Arguments None.

Values `process-list` A list of all the currently active Lisp processes.

Description Returns a list of all the active Lisp processes in LispWorks.

Example	<code>CL-USER 71 > (pprint (mp:list-all-processes))</code>
---------	---

```
(#<MP:PROCESS Name "Editor 1" Priority 70000000 State
"Waiting for events">
#<MP:PROCESS Name "Listener 1" Priority 70000000 State
"Running">
#<MP:PROCESS Name "LispWorks 5.1.0" Priority 70000000
State "Waiting for events">
#<MP:PROCESS Name "default listener process" Priority
60000000 State "Waiting for terminal input.">
#<MP:PROCESS Name "CAPI Execution Listener 1" Priority
60000000 State "Running">
#<MP:PROCESS Name "Background execute 2" Priority
50000000 State "Waiting for job to execute">
#<MP:PROCESS Name "Background execute 1" Priority
50000000 State "Waiting for job to execute">
#<MP:PROCESS Name "Editor DDE server" Priority 0 State
"Waiting for an event">
#<MP:PROCESS Name "The idle process" Priority -
536870912 State "Running (preempted)">)
```

	<i>Function</i>
lock-locked-p	
Summary	The predicate for whether a lock is locked.
Package	<code>mp</code>
Signature	<code>lock-locked-p <i>lock</i> => <i>result</i></code>
Arguments	<code>lock</code> A lock.
Values	<code>result</code> A boolean.
Description	<p>The function <code>lock-locked-p</code> is the predicate for whether a lock is locked. Since that can change at any time, the result is reliable only if you know that the state is not going to change.</p> <p>If the lock is a "sharing" lock, this checks for an exclusive lock.</p>
See also	<code>make-lock</code>

lock-owned-by-current-process-p *Function*

Summary	Checks whether a lock is locked by the current thread.	
Package	<code>mp</code>	
Signature	<code>lock-owned-by-current-process-p lock => result</code>	
Arguments	<i>lock</i>	A lock.
Values	<i>result</i>	A boolean.
Description	<p>The function <code>lock-owned-by-current-process-p</code> checks if the lock <i>lock</i> is locked by the current thread. If this returns <code>nil</code>, then the lock is either unlocked or locked by another process.</p> <p>If the lock is a "sharing" lock, this also checks if the current process has an exclusive lock on it. It ignores any shared lock.</p>	
See also	<code>make-lock</code>	

lock-recursive-p *Function*

Summary	The predicate for whether a lock allows recursive locking.	
Package	<code>mp</code>	
Signature	<code>lock-recursive-p lock => result</code>	
Arguments	<i>lock</i>	A lock object.
Values	<i>result</i>	A boolean.
Description	<p>The function <code>lock-recursive-p</code> is the predicate for whether the lock <i>lock</i> allows recursive locking (that is, whether it can be repeatedly locked by the same process).</p>	

See the `make-lock` argument *recursivep*.

Notes	<code>lock-recursive-p</code> does not check whether the lock is currently locked recursively. The function <code>lock-recursively-locked-p</code> does that.
See also	<code>make-lock</code>

lock-recursively-locked-p *Function*

Summary	The predicate for whether a lock is recursively locked.	
Package	<code>mp</code>	
Signature	<code>lock-recursively-locked-p lock => result</code>	
Arguments	<code>lock</code>	A lock.
Values	<code>result</code>	A boolean.
Description	<p>The function <code>lock-recursively-locked-p</code> is the predicate for whether a lock is recursively locked. Since that can change at any time, the result is reliable only if you know that the state is not going to change. For the definition of recursive locking, see the <code>make-lock</code> argument <i>recursivep</i>.</p> <p>If the lock is a "sharing" lock, <code>lock-recursively-locked-p</code> checks for an exclusive lock.</p>	

See also	<code>make-lock</code>
----------	------------------------

lock-name *Function*

Summary	Returns the name of a lock.
---------	-----------------------------

Package	<code>mp</code>
Signature	<code>lock-name lock => name</code>
Arguments	<code>lock</code> A lock object
Values	<code>name</code> A string
Description	The <code>lock-name</code> function takes a lock object as its argument and returns the name of the lock object.
Example	<pre>(let ((lock (mp:make-lock :name "my lock"))) (mp:lock-name lock)) => "my lock"</pre>
See also	<code>make-lock</code> <code>with-lock</code> <code>process-lock</code> <code>process-unlock</code> <code>lock-owner</code>

	<i>Function</i>
Summary	Returns the owner of a lock.
Package	<code>mp</code>
Signature	<code>lock-owner lock => result</code>
Arguments	<code>lock</code> A lock object
Values	<code>result</code> A process, <code>t</code> or <code>:unknown</code>
Description	The <code>lock-owner</code> function returns the process that currently owns the lock, or <code>nil</code> .

If *lock* is a "sharing" lock then `lock-owner` checks for an exclusive lock (see `lock-owned-by-current-process-p`).

If *lock* is locked then *result* is normally the process that locked it. If *lock* was locked while multiprocessing was not running then *result* is `t`. Also, if *lock* was locked by an unknown process (for example, the process is killed whilst holding the lock) then *result* is `:unknown`.

result is `nil` if *lock* is not locked.

Example	<pre>CL-USER 1 > (let ((lock (mp:make-lock :name "my lock"))) (mp:lock-owner lock)) NIL CL-USER 2 > (let ((lock (mp:make-lock :name "my lock"))) (mp:with-lock (lock) (mp:lock-owner lock))) #<MP:PROCESS Name "CAPI Execution Listener 1" Priority 0 State "Running"></pre>
---------	---

See also	<code>lock-owned-by-current-process-p</code> <code>make-lock</code> <code>with-lock</code> <code>process-lock</code> <code>process-unlock</code> <code>lock-name</code> <code>lock-owned-by-current-process-p</code>
----------	--

mailbox-empty-p	<i>Function</i>
Summary	Tests whether a mailbox is empty.
Package	<code>mp</code>
Signature	<code>mailbox-empty-p mailbox => bool</code>

Arguments	<i>mailbox</i>	A mailbox
Values	<i>bool</i>	A generalized boolean
Description		The <code>mailbox-empty-p</code> function returns <code>t</code> if the given <i>mailbox</i> is empty and <code>nil</code> otherwise.
See also		<code>mailbox-send</code> <code>mailbox-peek</code> <code>mailbox-read</code> <code>make-mailbox</code>

mailbox-peek

Function

Summary	Peeks at the first object in a mailbox.	
Package	<code>mp</code>	
Signature	<code>mailbox-peek mailbox => result</code>	
Arguments	<i>mailbox</i>	A mailbox.
Values	<i>result</i>	Any object or <code>nil</code> .
Description		The <code>mailbox-peek</code> function returns the first object in the mailbox without removing it. If the mailbox is empty, <code>nil</code> is returned.
See also		<code>mailbox-empty-p</code> <code>mailbox-send</code> <code>mailbox-read</code> <code>make-mailbox</code>

mailbox-read	Function						
Summary	Reads the next object in a mailbox.						
Package	<code>mp</code>						
Signature	<code>mailbox-read mailbox &optional wait-reason timeout => object, flag</code>						
Arguments	<table> <tr> <td><i>mailbox</i></td><td>A mailbox.</td></tr> <tr> <td><i>wait-reason</i></td><td>A string or <code>nil</code>.</td></tr> <tr> <td><i>timeout</i></td><td>A non-negative number or <code>nil</code>.</td></tr> </table>	<i>mailbox</i>	A mailbox.	<i>wait-reason</i>	A string or <code>nil</code> .	<i>timeout</i>	A non-negative number or <code>nil</code> .
<i>mailbox</i>	A mailbox.						
<i>wait-reason</i>	A string or <code>nil</code> .						
<i>timeout</i>	A non-negative number or <code>nil</code> .						
Values	<table> <tr> <td><i>object</i></td><td>An object.</td></tr> <tr> <td><i>flag</i></td><td>A boolean.</td></tr> </table>	<i>object</i>	An object.	<i>flag</i>	A boolean.		
<i>object</i>	An object.						
<i>flag</i>	A boolean.						
Description	<p>The <code>mailbox-read</code> function returns the next object from the mailbox <i>mailbox</i>, or <code>nil</code>. If <i>mailbox</i> is empty and <i>timeout</i> is <code>nil</code>, then <code>mailbox-read</code> blocks until an object is placed in <i>mailbox</i>. If <i>mailbox</i> is empty and <i>timeout</i> is a number, then <code>mailbox-read</code> blocks until an object is placed in <i>mailbox</i> or <i>timeout</i> seconds have passed. If the timeout occurs, then <code>mailbox-read</code> returns <code>nil</code> as the first value and also <i>flag</i> is <code>nil</code>. If an object is actually read from the mailbox, then <i>flag</i> is <code>t</code>.</p> <p>The <i>wait-reason</i> argument (or the string "<code>Waiting for message</code>" if <i>wait-reason</i> is <code>nil</code>) and the <i>timeout</i> argument are both passed to <code>process-wait-with-timeout</code>.</p> <p>The default value of <i>wait-reason</i> is <code>nil</code> and the default value of <i>timeout</i> is <code>nil</code>.</p>						
See also	<code>mailbox-empty-p</code> <code>mailbox-peek</code> <code>mailbox-send</code> <code>mailbox-wait-for-event</code>						

```
make-mailbox  
process-wait-with-timeout
```

mailbox-reader-process *Function*

Summary	Returns the reader process of the mailbox.	
Package	<code>mp</code>	
Signature	<code>mailbox-reader-process mailbox => process</code>	
Arguments	<code>mailbox</code>	A mailbox
Values	<code>process</code>	A process
Description	The <code>mailbox-reader-process</code> function returns the reader process of <i>mailbox</i> .	

mailbox-send *Function*

Summary	Sends an object to a mailbox.	
Package	<code>mp</code>	
Signature	<code>mailbox-send mailbox object =></code>	
Arguments	<code>mailbox</code>	A mailbox
	<code>object</code>	An object
Description	The <code>mailbox-send</code> sends <i>object</i> to <i>mailbox</i> . The object is queued in the mailbox for retrieval by the reader.	
See also	<code>mailbox-empty-p</code> <code>mailbox-peek</code>	

```
mailbox-read
make-mailbox
```

		<i>Function</i>
mailbox-wait-for-event		
Summary	Waits for an event in a "windowing friendly" way.	
Package	<code>mp</code>	
Signature		<code>mailbox-wait-for-event mailbox &key wait-reason wait-function process-other-messages-p no-hang-p stop-at-user-operation-p => event</code>
Arguments	<code>mailbox</code> A mailbox. <code>wait-reason</code> A string or <code>nil</code> . <code>wait-function</code> A function designator. <code>process-other-messages-p</code> A generalized boolean. <code>no-hang-p</code> A generalized boolean. <code>stop-at-user-operation-p</code> A generalized boolean.	
Values	<code>result</code> An event or <code>nil</code> .	
Description	<p>The function <code>mailbox-wait-for-event</code> waits for an event in a mailbox in a "windowing friendly" way. It reads an event from the mailbox <code>mailbox</code>. If there is no event in the mailbox, it waits for an event (unless <code>no-hang-p</code> is true).</p> <p>The value <code>event</code> is any object that was put in the mailbox, or <code>nil</code> if the mailbox is empty, possibly after waiting.</p> <p><code>mailbox-wait-for-event</code> is the appropriate way to wait for an event in a mailbox in an application with a graphical user interface, because it interacts correctly with the windowing</p>	

system. Most importantly, on Microsoft Windows, when *process-other-messages-p* is true it processes Windows messages while it is waiting. The default value of *process-other-messages-p* is `t`.

wait-function is the wait function to be used, which is called with the mailbox *mailbox* as its argument. If *wait-function* is not supplied, a function that returns `t` when the mailbox is not empty is used internally.

wait-reason is used as the wait reason if it needs to wait. The default value of *wait-reason* is "Waiting for an event".

process-other-messages-p controls processing of other messages. On Microsoft Windows this means Windows messages. On other platforms it has no effect.

no-hang-p controls whether `mailbox-wait-for-event` should really wait. If *no-hang-p* is true and there is no event, it returns immediately except on Microsoft Windows, where it may first process all Windows messages (depending on the value of *process-other-messages-p*). The default value of *no-hang-p* is `nil`.

stop-at-user-operation-p on Microsoft Windows causes `mailbox-wait-for-event` to return if it received a user operation message (meaning keyboard or mouse input). It has no effect on other platforms. The default value of *stop-at-user-operation-p* is `nil`.

If `mailbox-wait-for-event` is called when not Lisp is not multiprocessing, it returns immediately. The return value is an event or `nil`.

See also

`mailbox-read`
`mailbox-send`
`make-mailbox`
`process-wait-for-event`

main-process		<i>Variable</i>
Summary	The process associated with the main thread.	
Package	<code>mp</code>	
Description	This special variable contains the process associated with the main thread of the application. On Mac OS X with the Cocoa GUI, this is the thread that runs the Cocoa event loop. On other platforms, this variable is always <code>nil</code> .	
make-barrier		<i>Function</i>
Summary	Returns a new barrier.	
Package	<code>mp</code>	
Signature	<code>make-barrier count &key discount-on-abort discount-on-timeout callback disable-on-unblock name => barrier</code>	
Arguments	<code>count</code>	A positive fixnum or <code>t</code> .
	<code>name</code>	A string.
Values	<code>barrier</code>	A barrier.
Description	<p>The function <code>make-barrier</code> returns a new barrier with count <code>count</code>. <code>count</code> can be <code>t</code>, which is interpreted as <code>most-positive-fixnum</code>. The barrier has the name <code>name</code>, which is useful for debugging but is not used otherwise. If <code>name</code> is omitted, then a default name is generated that is unique among all such default names. <code>discount-on-timeout</code> and <code>discount-on-abort</code> determine the default behavior when a thread times out or aborts while in</p>	

the function `barrier-wait`. See the documentation for `barrier-wait`.

If `disable-on-unblock` is true, then `barrier-wait` will disable the barrier by default when it unblocks it. See `disable-on-unblock` in the documentation for `barrier-wait`.

`callback` is called by `barrier-wait` just before it unblocks the barrier. It is called with a single argument (the barrier) while holding an internal lock on the barrier that will prevent other operations on the barrier from running. The callback is guaranteed to happen before `barrier-wait` allows any of the other threads to continue.

Notes Because the callback is called inside a lock, you should ensure that it is relatively short to prevent congestion if another thread tries to access the barrier. Allocating a few objects is reasonable. If there is a more expensive operation that has to be done by only one of the threads, it can be done by the thread that returned `:unblocked` from `barrier-wait`. The advantage of using the callback is that it is called before any of the waiting threads pass the barrier.

See also `barrier-wait`

		<i>Function</i>
make-condition-variable		
Summary	Makes a condition variable.	
Package	<code>mp</code>	
Signature		<code>make-condition-variable &key name => condvar</code>
Arguments	<code>name</code>	A string naming the condition variable.
Values	<code>condvar</code>	A condition variable.

Description	<p>The function <code>make-condition-variable</code> makes a condition variable for use with <code>condition-variable-wait</code>, <code>condition-variable-signal</code> and <code>condition-variable-broadcast</code>.</p> <p><i>name</i> is used when printing the condition variable, and is useful for debugging. If <i>name</i> is omitted, then a default name is generated that is unique among all such default names.</p>
See also	<code>condition-variable-wait</code> <code>condition-variable-signal</code> <code>condition-variable-broadcast</code>

	<i>Function</i>										
make-lock											
Summary	Makes a lock.										
Package	<code>mp</code>										
Signature	<code>make-lock &key name important-p safep recursivep sharing => lock</code>										
Arguments	<table> <tr> <td><i>name</i></td><td>A string.</td></tr> <tr> <td><i>important-p</i></td><td>A generalized boolean.</td></tr> <tr> <td><i>safep</i></td><td>A generalized boolean.</td></tr> <tr> <td><i>recursivep</i></td><td>A generalized boolean.</td></tr> <tr> <td><i>sharing</i></td><td>A generalized boolean.</td></tr> </table>	<i>name</i>	A string.	<i>important-p</i>	A generalized boolean.	<i>safep</i>	A generalized boolean.	<i>recursivep</i>	A generalized boolean.	<i>sharing</i>	A generalized boolean.
<i>name</i>	A string.										
<i>important-p</i>	A generalized boolean.										
<i>safep</i>	A generalized boolean.										
<i>recursivep</i>	A generalized boolean.										
<i>sharing</i>	A generalized boolean.										
Values	<i>lock</i> The lock object.										
Description	<p><code>make-lock</code> creates a lock object. See “Locks” on page 179 for a general description of locks.</p> <p><i>name</i> names the lock and can be queried with <code>mp:lock-name</code>. The default value of <i>name</i> is "Anon".</p>										

important-p controls whether the lock is automatically freed when the holder process finishes. When *important-p* is true, the system notes that this lock is important, and automatically frees it when the holder process finishes. *important-p* should be `ni1` for locks which are managed completely by the application, as it is wasteful to record all locks in a global list if there is no need to free them automatically. This might be appropriate when two processes sharing a lock must both be running for the system to be consistent. If one process dies, then the other one kills itself. Thus the system does not need to worry about freeing the lock because no process could be waiting on it forever after the first process dies. The default value of *important-p* is `ni1`.

safep controls whether the lock is safe. A safe lock gives an error if `process-unlock` is called on it when it is not locked by the current process, and potentially in other 'dangerous' circumstances. An unsafe lock does not signal these errors. The default value of *safep* is `t`.

recursivep, when true, allows the lock to be locked recursively. Trying to lock a lock that is already locked by the current thread just increments its lock count. If the lock is created with *recursivep* `ni1` then trying to lock again causes an error. This is useful for debugging code where the lock is never expected to be claimed recursively. The default value of *recursivep* is `t`.

sharing, when true, causes *lock* to be a "sharing" lock object, which supports sharing and exclusive locking. At any given time, an sharing lock may be free, or it may be locked for sharing by any number of threads or locked for exclusive use by a single thread. Sharing locks are handled by different functions and methods from non-sharing locks.

Example	<pre> CL-USER 3 > (setq *my-lock* (mp:make-lock :name "my-lock")) #<MP:LOCK "my-lock" Unlocked 2008CAC7> CL-USER 4 > (mp:process-lock *my-lock*) T CL-USER 5 > *my-lock* #<MP:LOCK "my-lock" Locked once by "CAPI Execution Listener 1" 2008CAC7> CL-USER 6 > (mp:process-lock *my-lock*) T CL-USER 7 > *my-lock* #<MP:LOCK "my-lock" Locked 2 times by "CAPI Execution Listener 1" 2008CAC7> </pre>
See also	create-simple-process lock-recursive-p process-lock process-unlock schedule-timer with-lock

make-mailbox

Function

Summary Make a new mailbox for the current process.

Package `mp`

Signature `make-mailbox &key size => mailbox`

Arguments `size` An integer

Values `mailbox` A mailbox

Description The function `make-mailbox` returns a new mailbox.

size specifies the initial size of the mailbox.

The reader process is set to the current process.

See also

`mailbox-empty-p`
`mailbox-peek`
`mailbox-read`
`mailbox-send`

make-named-timer

Function

Summary Creates and returns a named timer.

Package `mp`

Signature `make-named-timer name function &rest arguments => timer`

Arguments *name* A string or symbol

function A function

arguments A set of arguments to *function*

Values *timer* A timer

Description The `make-named-timer` function creates and returns a named timer. The first argument is a string or symbol naming the timer. The second argument is a function to be applied to the remaining arguments when the timer expires. Use the function `schedule-timer` or `schedule-timer-relative` to set an expiration time.

In comparison, the function `make-timer` creates an unnamed timer.

Example

```
(setq timer (mp:make-named-timer 'timer-1 'print 10  
*standard-output*))  
  
#<Time Event TIMER-1 : PRINT>
```

See also

`make-timer`
`schedule-timer`
`schedule-timer-milliseconds`
`schedule-timer-relative`
`schedule-timer-relative-milliseconds`
`timer-expired-p`
`timer-name`
`unschedule-timer`

make-semaphore*Function*

Summary Makes a semaphore.

Package `mp`

Signature `make-semaphore &key name count => sem`

Arguments `name` An object.
`count` A non-negative fixnum.

Values `sem` A semaphore.

Description The function `make-semaphore` returns a new semaphore for use with `semaphore-acquire` and `semaphore-release`. The unit count is initialized to `count`, which defaults to 1. If `name` is supplied, the semaphore will have that name. If `name` is not supplied, the semaphore will be given a unique anonymous name.

See also `semaphore-acquire`
`semaphore-count`
`semaphore-name`
`semaphore-release`
`semaphore-wait-count`

make-timer	<i>Function</i>				
Summary	Creates and returns an unnamed timer.				
Signature	<code>make-timer <i>function</i> &rest <i>arguments</i> => <i>timer</i></code>				
Package	<code>mp</code>				
Arguments	<table> <tr> <td><i>function</i></td><td>A function</td></tr> <tr> <td><i>arguments</i></td><td>A set of arguments to <i>function</i></td></tr> </table>	<i>function</i>	A function	<i>arguments</i>	A set of arguments to <i>function</i>
<i>function</i>	A function				
<i>arguments</i>	A set of arguments to <i>function</i>				
Values	<i>timer</i> A timer				
Description	<p>The <code>make-timer</code> function creates and returns an unnamed timer. The <i>function</i> argument is a function to be applied to the remaining arguments when the timer expires. Use the function <code>schedule-timer</code> or <code>schedule-timer-relative</code> to set an expiration time.</p> <p>Note that the function <code>make-named-timer</code> creates a named timer.</p>				
Example	<pre>(setq timer (mp:make-timer 'print 10 *standard-output*)) => #<Time Event : PRINT></pre>				
See also	<code>make-named-timer</code> <code>make-timer</code> <code>schedule-timer</code> <code>schedule-timer-milliseconds</code> <code>schedule-timer-relative</code> <code>schedule-timer-relative-milliseconds</code> <code>timer-expired-p</code> <code>timer-name</code> <code>unschedule-timer</code>				

	map-all-processes	<i>Function</i>
Summary	Calls a predicate function on processes in turn until a true value is returned.	
Package	<code>mp</code>	
Signature	<code>map-all-processes function =></code>	
Arguments	<i>function</i>	A function taking one argument
Values	None.	
Description	<p>The function <code>map-all-processes</code> calls <i>function</i> on processes in the image, including simple processes.</p> <p><i>function</i> is passed each process in turn as its single argument.</p> <p>If <i>function</i> returns false, <code>map-all-processes</code> calls <i>function</i> on the next process.</p> <p>If <i>function</i> returns true, <code>map-all-processes</code> returns immediately, so <i>function</i> may not get called on all processes.</p>	
See also	<code>map-processes</code>	

	map-all-processes-backtrace	<i>Function</i>
Summary	Produces a backtrace for every known process.	
Package	<code>mp</code>	
Signature	<code>map-all-processes-backtrace &optional function</code>	
Arguments	<i>function</i>	A function taking one argument
Values	None.	

Description The `map-all-processes-backtrace` function calls *function*, which defaults to `print`, for every known process and each line of its backtrace.

See also `map-process-backtrace`

map-process-backtrace *Function*

Summary Produces a backtrace for a process

Package `mp`

Signature `map-process-backtrace process function`

Arguments *process* A process

function A function taking one argument

Values None.

Description The `map-process-backtrace` function collects a backtrace for the process specified by *process*, and the function *function* is called on each line of the backtrace in turn.

Example	<pre>CL-USER 1 > (mp:map-process-backtrace mp:*current- process* 'print) DBG:::GET-CALL-FRAME MP:MAP-PROCESS-BACKTRACE SYSTEM::%INVOKE SYSTEM::%EVAL EVAL SYSTEM::DO-EVALUATION SYSTEM::%TOP-LEVEL-INTERNAL SYSTEM::%TOP-LEVEL SYSTEM::LISTENER-TOP-LEVEL CAPI::CAPI-TOP-LEVEL-FUNCTION CAPI::INTERACTIVE-PANE-TOP-LOOP (SUBFUNCTION MP::PROCESS-SG-FUNCTION MP::INITIALIZE- PROCESS-STACK) SYSTEM::%%FIRST-CALL-TO-STACK NIL</pre>
See also	map-all-processes-backtrace

map-processes *Function*

Summary	Calls the function for all non-simple processes.	
Package	<code>mp</code>	
Signature	<code>map-processes function</code>	
Arguments	<code>function</code>	A function taking one argument
Values	None.	
Description	<p>The function <code>map-processes</code> calls <i>function</i> for every non-simple process.</p> <p><i>function</i> is passed each such process as its single argument.</p>	
See also	map-all-processes	

notice-fd *Function*

Summary	Add a file descriptor to the set of interesting input file descriptors.	
Package	<code>mp</code>	
Signature	<code>notice-fd fd</code>	
Arguments	<code>fd</code>	A UNIX file descriptor
Values	None.	
Description	<p>The <code>notice-fd</code> function adds the given <i>fd</i> to the set of fds that cause LispWorks to wake up when they contain input.</p> <p>This function is not implemented on Microsoft Windows.</p>	
See also	<code>unnotice-fd</code>	

process-alive-p *Function*

Summary	Determines if a process is alive.	
Package	<code>mp</code>	
Signature	<code>process-alive-p process => bool</code>	
Arguments	<code>process</code>	A process
Values	<code>bool</code>	A boolean
Description	<p>The <code>process-alive-p</code> function returns <code>t</code> if <i>process</i> is alive, that is, if <code>mp:process-kill</code> has not been called on the process.</p>	
Example	<code>(mp:process-alive-p mp:*current-process*)</code>	

```
=> T

(let ((process (mp:process-run-function
                 "test" nil 'identity nil)))
  (sleep 2)
  (mp:process-alive-p process))

=> NIL
```

process-all-events *Function*

Summary	Processes the events in the mailbox of the current process.
Package	<code>mp</code>
Signature	<code>process-all-events => processedp</code>
Values	<code>processedp</code> A boolean.
Description	<p>The function <code>process-all-events</code> processes all the events in the mailbox of the current process, by calling <code>general-handle-event</code> on each one of them.</p> <p><code>process-all-events</code> returns a boolean indicating whether it processed any event.</p>
See also	<code>general-handle-event</code> <code>process-mailbox</code> <code>process-send</code>

process-allow-scheduling *Function*

Summary	Allows scheduling within a process, so that the process is interruptible.
Package	<code>mp</code>
Signature	<code>process-allow-scheduling =></code>

Arguments	None.
Values	None.
Description	This gives other Lisp processes a chance to run.

process-arrest-reasons		<i>Function</i>
Summary	Returns a list of the reasons why a Lisp process has stopped.	
Package	<code>mp</code>	
Signature	<code>process-arrest-reasons process => reasons</code>	
Arguments	<i>process</i>	A process.
Values	<i>reasons</i>	A list of reasons.
Description	Returns a list of the reasons why a Lisp process has stopped. A process is inactive if it has any arrest reasons. Use of <code>(setf mp:process-arrest-reasons)</code> is deprecated. You should use <code>process-stop</code> instead. If you set the arrest reasons of the current process, this causes the current process to stop immediately, before returning from <code>mp:process-</code> <code>arrest-reasons</code> (like <code>process-stop</code>).	
Compatibility note	The immediate stopping behavior of <code>(setf mp:process-arrest-reasons)</code> is different from LispWorks 5.0 and previous versions.	
See also	<code>process-run-reasons</code> <code>process-stop</code>	

process-break	<i>Function</i>
Summary	Breaks a Lisp process and enters the debugger.
Package	<code>mp</code>
Signature	<code>process-break process =></code>
Arguments	<code>process</code> A process.
Values	None.
Description	The function <code>process-break</code> forces the process <i>process</i> to break and enter the debugger.
process-continue	<i>Function</i>
Summary	Wakes up a process.
Package	<code>mp</code>
Signature	<code>process-continue process => nil</code>
Arguments	<code>process</code> A <code>mp:process</code> object.
Description	The function <code>process-continue</code> wakes up the process <i>process</i> , regardless of whether it is sleeping, stopped or waiting. <code>process-continue</code> returns <code>nil</code> .
process-exclusive-lock	<i>Function</i>
Summary	Like <code>process-lock</code> , but on a "sharing" lock.
Package	<code>mp</code>

Signature	<code>process-exclusive-lock <i>sharing-lock</i> &optional <i>whostate</i> <i>timeout</i></code>	
Arguments	<i>sharing-lock</i>	A sharing lock.
	<i>whostate</i>	The status of the process while the lock is locked, as seen in the Process Browser.
	<i>timeout</i>	A timeout interval, in seconds.
Description	<p>The function <code>process-exclusive-lock</code> is the same as <code>process-lock</code>, but on a "sharing" lock. It waits until the lock is free before locking in exclusive mode.</p> <p>Calls to <code>process-exclusive-lock</code> should be paired with <code>process-exclusive-unlock</code> calls. In most cases the macro <code>with-exclusive-lock</code> the best way to achieve this.</p>	
Notes	<p>It is not possible to use exclusive lock in the scope of a sharing lock on the same lock, and trying to do this will cause the process to hang. Whether it is possible to use an exclusive lock inside an exclusive lock of the same lock is determined by the <code>recursivep</code> argument in <code>make-lock</code>.</p> <p><code>process-exclusive-lock</code> is guaranteed to return if it locked process, but may throw before locking, as described in "Guarantees and limitations when locking and unlocking" on page 181.</p>	
See also	<code>make-lock</code> <code>process-lock</code> <code>with-exclusive-lock</code>	

process-exclusive-unlock *Function*

Summary	Like <code>process-unlock</code> , but on a "sharing" lock.
Package	<code>mp</code>

Signature	<code>process-exclusive-unlock <i>sharing-lock</i></code>
Arguments	<i>sharing-lock</i> A sharing lock.
Description	<p>The function <code>process-exclusive-unlock</code> is the same as <code>process-unlock</code> but for a "sharing" lock.</p> <p>Calls to <code>process-exclusive-unlock</code> should be paired with <code>process-exclusive-lock</code> calls. In most cases the macro <code>with-exclusive-lock</code> the best way to achieve this.</p>
Notes	<code>process-exclusive-unlock</code> is guaranteed to successfully unlock the lock, but is not guaranteed to return, as described in "Guarantees and limitations when locking and unlocking" on page 181.
See also	<code>process-exclusive-lock</code> <code>process-unlock</code> <code>with-exclusive-lock</code>

	<i>Function</i>
Summary	Returns the time for which a process has been idle.
Package	<code>mp</code>
Signature	<code>process-idle-time <i>process</i> => <i>time</i></code>
Arguments	<i>process</i> A process.
Values	<i>time</i> A non-negative integer.
Description	The function <code>process-idle-time</code> returns the length of time in internal time units that <i>process</i> has been idle. If the process is running (for example the current process) then the return value is 0.

See also [process-run-time](#)

process-initial-bindings *Variable*

Summary Specifies the variables initially bound in a new process.

Package [mp](#)

Description This specifies the variables that are initially bound in a Lisp process when that process is created. This variable is an association list of symbols and initial value forms. The initial value forms are processed by a simple evaluation that handles symbols and function call forms, but not special operators. As a special case, if the value form is the same as the symbol and that symbol is unbound, then the symbol will be unbound in the new process.

Examples This example shows a typical use with a bound symbol:

```
(defvar *binding-1* 10)

(let ((mp:*process-initial-bindings*
       (cons '(*binding-1* . 20)
             mp:*process-initial-bindings*)))
  (mp:process-run-function
   "binding-1"
   '()
   #'(lambda (stream)
        (format stream "~&Binding 1 is ~S.~%" *binding-1*))
   *standard-output*)
  (sleep 1))
=>
Binding 1 is 20.
```

This example shows the special case with an unbound symbol:

```
(defvar *binding-2*)
```

```

(let ((mp:*process-initial-bindings*
      (cons '(*binding-2* . *binding-2*)
            mp:*process-initial-bindings*)))
  (flet ((check-binding-2 ()
          (mp:process-run-function
           "binding-2"
           '()
           #'(lambda (stream)
               (if (boundp '*binding-2*)
                   (format stream "~&Binding 2 is ~S.~%" 
*binding-2*)
                   (format stream "~&Binding 2 is
unbound.~%")))
               *standard-output*)
           (sleep 1)))
        (check-binding-2)
        (let ((*binding-2* 123))
          (check-binding-2))))
  =>
Binding 2 is unbound.
Binding 2 is 123.

```

process-interrupt *Function*

Summary	Interrupts a process.	
Package	<code>mp</code>	
Signature	<code>process-interrupt <i>process function &rest arguments</i> =></code>	
Arguments	<p><i>process</i> A process.</p> <p><i>function</i> A function to apply on resuming <i>process</i>.</p> <p><i>arguments</i> Arguments to supply to <i>function</i>.</p>	
Values	None.	
Description	Causes the Lisp process <i>process</i> to apply <i>function</i> to <i>arguments</i> when it is next resumed. Afterwards the process resumes its normal execution. A waiting process is temporarily woken up.	

process-join *Function*

Summary	Waits until a specified process dies, or a <i>timeout</i> is reached.	
Package	<code>mp</code>	
Signature	<code>process-join <i>process</i> &key <i>timeout</i> => <i>flag</i></code>	
Arguments	<i>process</i>	A process.
	<i>timeout</i>	A non-negative number.
Values	<i>flag</i>	A boolean.
Description	<p>The function <code>process-join</code> waits until the process <i>process</i> dies, or <i>timeout</i> seconds passed.</p> <p>If the process dies then <code>process-join</code> returns <code>t</code>. If the timeout passed it returns <code>nil</code>.</p> <p><code>process-join</code> can be used on dead processes, and in this case returns <code>t</code> immediately.</p> <p>The effect of <code>process-join</code> is similar to</p> <pre>(mp:process-wait-with-timeout "Waiting for process to die" <i>timeout</i> #'(lambda (x) (not (mp:process-alive-p x))) <i>process</i>)</pre> <p>but the call above may not return until the next time the scheduler runs, possibly causing a delay. In contrast <code>process-join</code> returns immediately when the process dies.</p>	
See also	<code>process-wait-with-timeout</code>	

process-kill *Function*

Summary	Kills the specified Lisp process.
---------	-----------------------------------

Package	<code>mp</code>
Signature	<code>process-kill process =></code>
Arguments	<code>process</code> A process.
Values	None.
Description	The function <code>process-kill</code> kills the specified Lisp process.
See also	<code>ensure-process-cleanup</code>

process-lock *Function*

Summary	Claims the lock for the current process.						
Package	<code>mp</code>						
Signature	<code>process-lock lock &optional whostate timeout => result</code>						
Arguments	<table> <tr> <td><code>lock</code></td> <td>A lock object (see <code>make-lock</code>).</td> </tr> <tr> <td><code>whostate</code></td> <td>The status of the current Lisp process, before <code>process-lock</code> returns, that is, the status while the current process is waiting to time-out. This can be seen in the Process Browser.</td> </tr> <tr> <td><code>timeout</code></td> <td>A timeout interval, in seconds. If this is not given, <code>process-lock</code> waits until the lock can be set by the current Lisp process. A process can set a lock more than once.</td> </tr> </table>	<code>lock</code>	A lock object (see <code>make-lock</code>).	<code>whostate</code>	The status of the current Lisp process, before <code>process-lock</code> returns, that is, the status while the current process is waiting to time-out. This can be seen in the Process Browser.	<code>timeout</code>	A timeout interval, in seconds. If this is not given, <code>process-lock</code> waits until the lock can be set by the current Lisp process. A process can set a lock more than once.
<code>lock</code>	A lock object (see <code>make-lock</code>).						
<code>whostate</code>	The status of the current Lisp process, before <code>process-lock</code> returns, that is, the status while the current process is waiting to time-out. This can be seen in the Process Browser.						
<code>timeout</code>	A timeout interval, in seconds. If this is not given, <code>process-lock</code> waits until the lock can be set by the current Lisp process. A process can set a lock more than once.						
Values	<code>result</code> A boolean.						
Description	<code>process-lock</code> attempts to lock <code>lock</code> and returns <code>t</code> if successful, or <code>nil</code> if timed out. If <code>lock</code> is already locked and the owner of the lock is the value of <code>*current-process*</code> , then <code>lock</code>						

remains locked and an internal count is incremented. The Lisp process sleeps until the lock is claimed or the timeout period expires.

result is `t` if *lock* was successfully locked, and `nil` otherwise.

Notes	<code>process-lock</code> is guaranteed to return if it locked process, but may throw before locking, as described in “Guarantees and limitations when locking and unlocking” on page 181.
Example	<code>(process-lock *my-lock* "waiting to lock" 10)</code>
See also	<code>make-lock</code> <code>process-exclusive-lock</code> <code>process-unlock</code> <code>with-lock</code>

process-mailbox

Function

Summary	Accesses the mailbox associated with a process.	
Package	<code>mp</code>	
Signature	<code>process-mailbox process => result</code> <code>(setf process-mailbox) result process => result</code>	
Arguments	<code>process</code>	A process.
Values	<code>result</code>	A mailbox object, or <code>nil</code> .
Description	<code>process-mailbox</code> is an accessor function which returns or sets the mailbox associated with <i>process</i> .	
Example	<code>(setf (mp:process-mailbox mp:*current-process*) (mp:make-mailbox))</code>	

process-name	<i>Function</i>	
Summary	Returns the name of a specified process.	
Package	<code>mp</code>	
Signature	<code>process-name process => name</code>	
Arguments	<code>process</code>	A process.
Values	<code>name</code>	The name of the process specified by <code>process</code> .
Description	Returns the name of the specified Lisp process.	
process-p	<i>Function</i>	
Summary	A predicate to indentify non-simple processes	
Package	<code>mp</code>	
Signature	<code>process-p object => bool</code>	
Arguments	<code>object</code>	Any object
Values	<code>bool</code>	A generalized boolean.
Description	The <code>process-p</code> function returns <code>t</code> if <code>object</code> is a non-simple process, and <code>nil</code> otherwise.	
process-plist	<i>Function</i>	
Summary	Returns the plist associated with a process. This function is deprecated.	
Package	<code>mp</code>	

Signature	<code>process-plist process => plist</code>	
Arguments	<code>process</code>	A process
Values	<code>plist</code>	A plist
Description	The <code>process-plist</code> function returns the plist associated with <code>process</code> .	
Notes	It is not possible to manipulate the plist in a thread-safe manner, and <code>process-plist</code> may interact badly with other users of the plist, hence <code>process-plist</code> is deprecated. Use instead <code>process-property</code> and <code>get-process-private-property</code> etc.	

process-poke *Function*

Summary	Makes a waiting process call its wait function.	
Package	<code>mp</code>	
Signature	<code>process-poke process => result</code>	
Arguments	<code>process</code>	A process.
Values	<code>result</code>	A boolean.
Description	If the process <code>process</code> is waiting, <code>process-poke</code> causes it to run its <i>wait-function</i> as soon as possible, and if the wait function returns true, the process returns from <code>process-wait</code> . This has an effect only in SMP LispWorks, where the running of the <i>wait-function</i> can happen asynchronously. <code>process-poke</code> can be used to avoid delays that happen because the next execution of the <i>wait-function</i> does not happen immediately. Without the call to <code>process-poke</code> , the process may wake up after some delay.	

`process-poke` returns `t` if it actually poked the process or `nil` otherwise (when the process is not waiting or is stopped).

Example (`my-queue-an-event-for-the-workers`)

```
(dolist (process *my-worker-processes*)
  (when (mp:process-poke process) (return)))
```

See also

process-priority

Function

Summary Returns the numerical priority of the Lisp process.

Package `mp`

Signature `process-priority process => priority`

Arguments `process` A process.

Values `priority` A fixnum, the priority of `process`.

Description Returns the numerical priority of the Lisp process. This can be modified by calling `mp:change-process-priority`.

Example CL-USER 17 > (mp:process-priority mp:*current-process*)
 600000

See also `change-process-priority`

process-private-property

Function

Summary Gets or sets the value of a private property of the current process.

Package `mp`

Signature	<pre><code>process-private-property <i>indicator</i> &optional <i>default</i> => <i>result</i></code></pre> <code>(setf mp:process-private-property) <i>value indicator</i> &optional <i>default</i> => <i>result</i></code>	
Arguments	<i>indicator</i>	A Lisp object.
	<i>default</i>	A Lisp object.
Values	<i>result</i>	<i>value or default</i>
Description	<p>The function <code>process-private-property</code> gets or sets the value that is associated with <i>indicator</i> in the private properties of the current process (that is, the result of calling <code>get-current-process</code>).</p> <p>If <i>indicator</i> is not associated with a value in the private properties, <code>process-private-property</code> returns <i>default</i>.</p> <p><code>(setf process-private-property)</code> overwrites any existing value for <i>indicator</i>.</p> <p>The default value of <i>default</i> is <code>nil</code>.</p>	
See also	<code>remove-process-private-property</code> <code>pushnew-to-process-private-property</code> <code>remove-from-process-private-property</code> <code>get-process-private-property</code>	

	<i>Function</i>
Summary	Gets and sets a general property for a process.
Package	<code>mp</code>
Signature	<pre><code>process-property <i>indicator</i> &optional <i>process default</i> => <i>result</i></code></pre> <code>(setf process-property) <i>value indicator</i> &optional <i>process default</i> => <i>result</i></code>

Arguments	<i>indicator</i>	A Lisp object.
	<i>process</i>	A process.
	<i>default</i>	A Lisp object.
Values	<i>result</i>	A property value, or default.
Description		<p>The function <code>process-property</code> gets the value that is associated with <i>indicator</i> for the process <i>process</i>, and <code>(setf process-property)</code> sets this value.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p>
Example		<pre>(process-property 'foo (get-current-process) 'bar) => BAR (setf (process-property 'foo) 'foo-value) => FOO-VALUE (process-property 'foo) => FOO-VALUE</pre>
See also		remove-process-property remove-from-process-property pushnew-to-process-property

process-reset Function

Summary	Resets a process by discarding its current state.	
Package	<code>mp</code>	
Signature	<code>process-reset <i>process</i> =></code>	
Arguments	<i>process</i>	A process.

Values	None.
Description	<p><code>process-reset</code> interrupts the execution of process and “throws away” its current state. Upon resuming execution, the process calls its function with its initial argument and priority.</p> <p><code>process-reset</code> modifies the dynamic execution state of <i>process</i>. It performs a non-local exit from the currently running function, to cause the process’s main function to return. <code>unwind-protect</code> forms will be run.</p> <p><code>process-reset</code> does not modify any of the attributes of the process, in particular its priority, items on the plist, or accumulated run-time.</p>
Notes	Since <code>process-reset</code> causes an asynchronous non-local exit, it is possible that it can occur within an <code>unwind-protect</code> cleanup form or before data used by an <code>unwind-protect</code> cleanup form has been initialized. In some cases, not all cleanups within that form will be run.

process-run-function *Function*

Summary	Create a new process, passing it a function to run.	
Package	<code>mp</code>	
Signature	<code>process-run-function name keywords function &rest arguments</code> <code>=> process</code>	
Arguments	<i>name</i>	A name for the new process.
	<i>keywords</i>	Keywords specifying properties of the new process.
	<i>function</i>	A function to apply.
	<i>arguments</i>	Arguments to pass to <i>function</i> .

Values	<i>process</i>	The newly created process.
Description		This function creates a new Lisp process with name <i>name</i> . Other properties of <i>process</i> may be specified in key-word/value pairs in <i>keywords</i> :
	:priority	A fixnum representing the priority for the process. If :priority is not supplied, the process priority becomes the value of the variable *default-process-priority* .
	:mailbox	A mailbox object, a string, t or nil, used to initialize the process-mailbox of <i>process</i> . True values specify that <i>process</i> should have a mailbox. A mailbox object is used as-is; a string is used as the name of a new mailbox; and t causes it to create a mailbox with the same name as <i>process</i> , that is, <i>name</i> . Note that both process-send and process-wait-for-event force the relevant process to have a mailbox.
		The new process is preset to apply <i>function</i> to <i>arguments</i> and runs in parallel, while process-run-function returns immediately.

Example

```
CL-USER 253 > (defvar *stream* *standard-output*)
*STREAM*

CL-USER 254 > (mp:process-run-function
                  "My process"
                  '(:priority 42)
                  #'(lambda (x)
                      (loop for i below x
                            do (and (print i *stream*)
                                     (sleep 1)))
                     finally
                     (print (mp:process-priority
                             mp:*current-process*)
                           *stream*)))
3)
#<MP:PROCESS Name "My process" Priority 850000 State
"Running">

0
1
2
42
CL-USER 255 >
```

See also

default-process-priority

process-run-reasons

Function

Summary

Returns the reasons that a specified process is running.

Package

mp

Signature

`process-run-reasons process => reasons`

`(setf process-run-reasons) process reasons => reasons`

Arguments

process

A process.

Values

reasons

A list of run reasons.

Description	The function <code>process-run-reasons</code> returns a list of reasons for the specified Lisp process running. These can be changed using <code>setf</code> . A process is only active if it has at least one run reason and no arrest reasons.
See also	<code>process-arrest-reasons</code> <code>process-run-function</code> <code>process-whostate</code>

process-run-time *Function*

Summary	Returns the current run time for a process.	
Package	<code>mp</code>	
Signature	<code>process-run-time process => time</code>	
Arguments	<code>process</code>	A process.
Values	<code>time</code>	A positive integer or <code>nil</code> .
Description	The function <code>process-run-time</code> returns the current run time for <code>process</code> in internal time units. If the value cannot be determined (currently this is only on FreeBSD), then the return value is <code>nil</code> . Note: The value returned by <code>get-internal-run-time</code> is similar, but on some operating systems it is the total time for all Lisp processes in the image.	
See also	<code>process-idle-time</code>	

process-send	<i>Function</i>						
Summary	Sends an object to the mailbox of a given process.						
Package	<code>mp</code>						
Signature	<code>process-send process object &key change-priority =></code>						
Arguments	<table> <tr> <td><i>process</i></td><td>A process</td></tr> <tr> <td><i>object</i></td><td>An object</td></tr> <tr> <td><i>change-priority</i></td><td>A fixnum, <code>nil</code>, <code>t</code>, or <code>:default</code></td></tr> </table>	<i>process</i>	A process	<i>object</i>	An object	<i>change-priority</i>	A fixnum, <code>nil</code> , <code>t</code> , or <code>:default</code>
<i>process</i>	A process						
<i>object</i>	An object						
<i>change-priority</i>	A fixnum, <code>nil</code> , <code>t</code> , or <code>:default</code>						
Values	None.						
Description	<p>The <code>process-send</code> function queues <i>object</i> in the mailbox of the given process.</p> <p><i>object</i> can any kind of Lisp object, and it is up to the receiving process to interpret it.</p> <p><code>process-send</code> only sends the event: it is the responsibility of the receiving process to actually read the event and then interpret it. Reading is typically done by calling <code>process-wait-for-event</code>. Interpreting the event is up the caller of <code>process-wait-for-event</code>.</p> <p><code>process-send</code> actually uses the <code>process-mailbox</code> of <i>process</i>, creating a mailbox for <i>process</i> if it does not already have one. In principle <i>object</i> can be read by another process, by calling <code>mailbox-read</code> (or <code>process-wait-for-event</code>) on the mailbox.</p> <p>If <i>change-priority</i>, which has a default value of <code>:default</code>, is non-nil, it controls how the priority of that process is calculated as follows:</p> <ul style="list-style-type: none"> • <code>fixnum</code> — use the value of <i>change-priority</i> as the new priority. • <code>t</code> — set the priority to the interactive priority. 						

- `:default` — set the priority to the normal running priority.

See also `mailbox-send`
`process-wait-for-event`

	<i>Function</i>						
process-sharing-lock							
Summary	Like <code>process-lock</code> , but on a "sharing" lock.						
Package	<code>mp</code>						
Signature	<code>process-sharing-lock sharing-lock &optional whostate timeout</code>						
Arguments	<table border="0"> <tr> <td><i>sharing-lock</i></td><td>A sharing lock.</td></tr> <tr> <td><i>whostate</i></td><td>The status of the process while the lock is locked, as seen in the Process Browser.</td></tr> <tr> <td><i>timeout</i></td><td>A timeout period, in seconds.</td></tr> </table>	<i>sharing-lock</i>	A sharing lock.	<i>whostate</i>	The status of the process while the lock is locked, as seen in the Process Browser.	<i>timeout</i>	A timeout period, in seconds.
<i>sharing-lock</i>	A sharing lock.						
<i>whostate</i>	The status of the process while the lock is locked, as seen in the Process Browser.						
<i>timeout</i>	A timeout period, in seconds.						
Description	<p>This is like <code>process-lock</code>, but the lock must be "sharing" and the lock will be locked in shared mode. That means that other threads can also lock it in shared mode.</p> <p>Before locking this waits for the lock to be free of any exclusive lock, but it does not check for other shared mode use of the same lock.</p> <p>Calls to <code>process-sharing-lock</code> should be matched by calls to <code>process-sharing-unlock</code>. Normally <code>with-sharing-lock</code> is the best way to achieve this.</p>						
Notes	<p>It is possible to lock for sharing inside the scope of sharing lock and inside the scope of exclusive lock.</p> <p><code>process-sharing-lock</code> is guaranteed to return if it locked process, but may throw before locking, as described in</p>						

“Guarantees and limitations when locking and unlocking”
on page 181.

See also **process-lock**
 process-sharing-unlock
 with-sharing-lock

process-sharing-unlock *Function*

Summary Removes a sharing lock.

Package **mp**

Signature **process-sharing-unlock *sharing-lock***

Arguments ***sharing-lock*** A sharing lock.

Description The function **process-sharing-unlock** is the same as **process-unlock** but for a "sharing" lock.
Calls to **process-sharing-unlock** should be matched by calls to **process-sharing-lock**. Normally **with-sharing-lock** is the best way to achieve this.

Notes **process-sharing-unlock** is guaranteed to successfully unlock the lock, but is not guaranteed to return, as described in “Guarantees and limitations when locking and unlocking” on page 181.

See also **process-unlock**
 with-sharing-lock

process-stop *Function*

Summary Stops a process.

Package	<code>mp</code>
Signature	<code>process-stop process</code>
Arguments	<code>process</code> A <code>mp:process</code> object.
Description	<p>The function <code>process-stop</code> stops the process <code>process</code>. <code>process</code> must be a full process (that is, not one created by <code>create-simple-process</code>).</p> <p><code>process-stop</code> causes <code>process</code> to stop until some other process explicitly wakes it up. If it is called on the current process, the current process stops during the call, and returns from <code>process-stop</code> after the process gets woken up.</p> <p>In SMP LispWorks, if <code>process</code> is not the current process, <code>process-stop</code> returns immediately and the execution of <code>process</code> stops at some point, possibly after <code>process-stop</code> returned. In non-SMP LispWorks if <code>process</code> is not the current process, <code>process</code> stops before <code>process-stop</code> returns.</p> <p>You can wake up a stopped process (that is, make it runnable) by calling <code>process-kill</code>, <code>process-unstop</code> or <code>process-continue</code>.</p> <p><code>process-interrupt</code> does not wake up a stopped process.</p> <p>There is a discussion of a typical use of <code>process-stop</code> in the section “Stopping and unstopping processes” on page 170.</p> <p><code>process-stop</code> does not return any useful value.</p>
See also	<code>process-arrest-reasons</code> <code>process-stopped-p</code> <code>process-unstop</code>

process-stopped-p *Function*

Summary The predicate for stopped processes.

Package	<code>mp</code>	
Signature	<code>process-stopped-p process => result</code>	
Arguments	<code>process</code>	A <code>mp:process</code> object.
Values	<code>result</code>	A boolean.
Description		The function <code>process-stopped-p</code> queries whether the process <code>process</code> is stopped or not. If <code>process</code> stopped because it called <code>process-stop</code> on itself, then <code>process-stopped-p</code> <code>result</code> is <code>t</code> only if <code>process-stop</code> really stopped it (that is, a later call to <code>process-unstop</code> will unstopp the process).
See also		<code>process-stop</code> <code>process-unstop</code>

process-unlock *Function*

Summary	Relinquishes a lock held by the current process.	
Package	<code>mp</code>	
Signature	<code>process-unlock lock &optional errorp => result</code>	
Arguments	<code>lock</code>	The lock to be relinquished.
	<code>errorp</code>	When this is <code>t</code> , an error is signalled if <code>*current-process*</code> is not the owner of the lock. The default is <code>t</code> .
Values	<code>result</code>	A boolean.
Description	Attempts to release a lock. If the lock is owned by <code>*current-process*</code> , <code>process-unlock</code> decrements an internal count. If	

this lock count is then zero, the lock is released. Note that `process-unlock` relates only on Lisp processes.

result is `t` if the lock was released, and `nil` otherwise.

Notes	<code>process-sharing-unlock</code> is guaranteed to successfully unlock the lock, but is not guaranteed to return, as described in “Guarantees and limitations when locking and unlocking” on page 181.
See also	<code>make-lock</code> <code>process-exclusive-unlock</code> <code>process-lock</code> <code>with-lock</code>

process-unstop *Function*

Summary	Unstops a process.	
Package	<code>mp</code>	
Signature	<code>process-unstop process => result</code>	
Arguments	<code>process</code>	A <code>mp:process</code> object.
Values	<code>result</code>	A boolean.
Description	<p>The function <code>process-unstop</code> unstops the process <code>process</code> if it is stopped.</p> <p><code>process</code> must be a full process (that is, not one created by <code>create-simple-process</code>).</p> <p>If <code>process</code> was stopped (by <code>process-stop</code>), it is unstopped and resumes execution.</p> <p><i>result</i> is <code>t</code> if <code>process</code> was stopped, and <code>nil</code> otherwise.</p>	

There is a discussion of a typical use of `process-unstop` in the section “Stopping and unstopping processes” on page 170.

See also

`process-stop`
`process-stopped-p`

process-wait *Function*

Summary Suspends the current process until a condition is true.

Package `mp`

Signature `process-wait wait-reason wait-function &rest wait-arguments =>`

Arguments `wait-reason` A string describing the reason that the process is waiting.

`wait-function` A function designator.

`wait-arguments` The arguments that `wait-function` is applied to.

Values None.

Description The function `process-wait` suspends the current Lisp process until the predicate `wait-function` applied to `wait-arguments` returns `t`. This is tested periodically.

`wait-function` must not do a non-local exit. `wait-function` should not have side effects and, since it is called frequently, it should be efficient.

`wait-reason` allows you to find out why a process is waiting via the function `process-whostate`.

See also

`process-wait-with-timeout`
`process-whostate`

process-wait-for-event		<i>Function</i>
Summary	Waits for an event in a "windowing friendly" way.	
Package	<code>mp</code>	
Signature		<code>process-wait-for-event &key wait-reason wait-function process-other-messages-p no-hang-p stop-at-user-operation-p => event</code>
Arguments	<i>wait-reason</i>	A string or <code>nil</code> .
	<i>wait-function</i>	A function designator.
	<i>process-other-messages-p</i>	
		A generalized boolean.
	<i>no-hang-p</i>	A generalized boolean.
	<i>stop-at-user-operation-p</i>	
		A generalized boolean.
Values	<i>result</i>	An event or <code>nil</code> .
Description		The function <code>process-wait-for-event</code> calls <code>mailbox-wait-for-event</code> on the mailbox of the current process, after ensuring that the current process has a mailbox. The arguments and value are interpreted as for <code>mailbox-wait-for-event</code> .
See also		<code>mailbox-wait-for-event</code>

process-wait-function		<i>Function</i>
Summary	Returns a function that determines whether a process should continue to wait.	
Package	<code>mp</code>	

Signature	<code>process-wait-function process => wait-function</code>	
Arguments	<code>process</code>	A process.
Values	<code>wait-function</code>	A function designator.
Description	<p>The function <code>process-wait-function</code> returns the function that determines whether the Lisp process waits. The system periodically calls <code>wait-function</code> to decide whether to wake the process up.</p> <p><code>wait-function</code> is applied to <code>wait-arguments</code>, where both <code>wait-function</code> and <code>wait-arguments</code> were passed to <code>process-wait</code>.</p>	
See also	<code>process-wait</code>	

		<i>Function</i>
Summary	Has the same semantics as <code>process-wait</code> , but does not interact with the scheduler.	
Package	<code>mp</code>	
Signature	<code>process-wait-local wait-reason function &rest args => t</code>	
Arguments	<code>wait-reason</code>	A string.
	<code>function</code>	A function designator.
	<code>args</code>	Arguments passed to function.
Description	The function <code>process-wait-local</code> has same semantics as <code>process-wait</code> , but is "local", which here means that it does not interact with the scheduler. The scheduler does not call the wait function and hence never wakes the waiting process	

The wait function is called only by the calling process, before going to sleep, and whenever it is "poked". A process is typically "poked" by calling `process-poke`, but all the other process managing functions (`process-unstop`, `process-interrupt`, `process-kill`) also "poke" the process. Returning from any of the generic Process Waiting functions (see "Generic Process Wait functions" on page 183) or `c1:sleep` also implicitly pokes the process. A process may be also poked internally.

Because the wait function is checked only when the process is poked, it is the responsibility of the application to poke the process when it should check the wait function. This is the disadvantage of `process-wait-local` and `process-wait-local-with-timeout`.

Note: See `process-wait-local-with-periodic-checks` and `process-wait-local-with-timeout-and-periodic-checks` for functions that periodically check the wait functions.

One advantage of using the "local" waiters is that the wait function is called only by the waiting process. This means that the wait function does not have any of the restrictions that the wait function of `process-wait` has. In particular:

1. It does not matter if the wait function is not very fast.
Note however, that it may be called several times, and not always in a predictable way, so it is better not to make it too slow or allocate much. You also cannot rely on any side effect that is cumulative inside the wait function, except in the call that returns `t` (because this happens at most once).
2. If there is an unhandled error in the wait function it enters the debugger like normal Lisp code, so it is easier to debug.

3. The wait function is in the dynamic scope of the calling process, and so it sees all the dynamic bindings and can throw to all the catchers. That also means that all the handlers and restarts of the calling process are applicable in the wait function.
4. The wait function can itself call Process Waiting functions or `c1:sleep`, with a small caveat: since these functions may implicitly "poke" the process, if the wait function calls any of them and then returns `nil`, it may be immediately called again (if it returns `t` then `process-wait-local` itself returns). Normally this is not a problem, because it is still waiting, but it does mean that the wait function is called more times than expected.
5. The wait function, because it can call Process Waiting functions, can use locks without causing errors. Note, however, that if the lock is held, it will cause an internal call to a Process Waiting function, which will "poke" the process and hence cause another call of the wait function (unless it returns `t`).
6. The wait function is visible in the output of the profiler.

Another advantage of the "local" functions is that they do not interact with the scheduler and so they reduce the overhead of the scheduler.

`process-wait-local` always returns `t`.

See also

`process-wait-local-with-periodic-checks`
`process-wait-local-with-timeout`

process-wait-local-with-periodic-checks

Function

Summary

Like `process-wait-local`, but also calls the wait function periodically.

Package

`mp`

Signature	<code>process-wait-local-with-periodic-checks</code> <i>wait-reason period function &rest args</i>	
Arguments	<i>wait-reason</i>	A string.
	<i>period</i>	A positive real number.
	<i>function</i>	A function designator.
	<i>args</i>	Arguments passed to <i>function</i> .
Description	<p>The function <code>process-wait-local-with-periodic-checks</code> is like <code>process-wait-local</code>, but also calls the wait function periodically.</p> <p>The <i>period</i> is in seconds.</p> <p>After each call to the function <i>wait-function</i>, the process sleeps at most <i>period</i> seconds, and then checks the wait function. If the process is poked while sleeping, it wakes up, checks the wait function, and then (if the wait function returns <code>nil</code>), sleeps again for at most <i>period</i> seconds.</p>	
Notes	<p>The resolution of the period is dependent on the underlying operating system. Many systems give time-slices of few milliseconds, so the actual period may be out by a few milliseconds. In general, periods of 0.1 seconds or more are reasonably reliable, though not exact. Shorter periods become less and less reliable.</p> <p>If the period is short, the wait function is called frequently, and hence there is more overhead for the system. With a reasonable wait function and a period of 0.1 or more, this overhead is probably insignificant. If you use shorter periods, or an expensive wait function, you may want to check what the overhead is. The easiest way to check is to make sure your system is such that the wait function returns <code>nil</code>, then run</p>	

```
(ignore-errors ; just in case
  (sys:with-other-threads-disabled
    (time (mp:process-wait-local-with-timeout-and-
periodic-checks
      "Timing" 5 period function args))))
```

When this form returns, compare the user and system times (which is what it actually used) to the elapsed time (which should be approximately 5 seconds). That will tell you what fraction of a "CPU" is used by the call. If the user and system time are less than 0.01 seconds, you may want to increase the time to get a more accurate number.

Warning: inside the scope of `with-other-threads-disabled`, the rest of the threads are disabled. So if your wait function ends up waiting for something that has to happen on another thread, your system will be deadlocked.

See also

`process-wait-local`
`process-wait-local-with-timeout-and-periodic-checks`

process-wait-local-with-timeout *Function*

Summary Has the same semantics as `process-wait-with-timeout`, but does not interact with the scheduler.

Package

`mp`

Signature

`process-wait-local-with-timeout wait-reason timeout function&rest args => result`

Arguments

<code>wait-reason</code>	A string.
<code>timeout</code>	A non-negative number.
<code>function</code>	A function designator.
<code>args</code>	Arguments passed to function.

Values

<code>result</code>	A boolean.
---------------------	------------

Description	<p>The function <code>process-wait-local-with-timeout</code> has same semantics as <code>process-wait-with-timeout</code>, but is "local", which here means that it does not interact with the scheduler. The scheduler does not call the wait function and hence never wakes the waiting process.</p> <p>The <i>timeout</i> is in seconds.</p> <p>The circumstances in which the function <i>wait-function</i> is called, and the restrictions on it, are as documented for <code>process-wait-local</code> except that the wait function can additionally be called when it times out.</p> <p><code>process-wait-local-with-timeout</code> returns <code>t</code> if a call to the wait function returns true. It returns <code>nil</code> if it times out.</p>
See also	<code>process-wait-local</code>

`process-wait-local-with-timeout-and-periodic-checks` *iFunction*

Summary	Like <code>process-wait-local-with-timeout</code> , but also calls the wait function periodically.										
Package	<code>mp</code>										
Signature	<code>process-wait-local-with-timeout-and-periodic-checks wait-reason timeout period function &rest args</code>										
Arguments	<table> <tr> <td><i>wait-reason</i></td> <td>A string.</td> </tr> <tr> <td><i>timeout</i></td> <td>A non-negative number.</td> </tr> <tr> <td><i>period</i></td> <td>A positive real number.</td> </tr> <tr> <td><i>function</i></td> <td>A function designator.</td> </tr> <tr> <td><i>args</i></td> <td>Arguments passed to <i>function</i>.</td> </tr> </table>	<i>wait-reason</i>	A string.	<i>timeout</i>	A non-negative number.	<i>period</i>	A positive real number.	<i>function</i>	A function designator.	<i>args</i>	Arguments passed to <i>function</i> .
<i>wait-reason</i>	A string.										
<i>timeout</i>	A non-negative number.										
<i>period</i>	A positive real number.										
<i>function</i>	A function designator.										
<i>args</i>	Arguments passed to <i>function</i> .										

Description	The function <code>process-wait-local-with-timeout-and-periodic-checks</code> is like <code>process-wait-local-with-timeout</code> , but also calls the <code>wait</code> function periodically. The <code>timeout</code> and <code>period</code> are both in seconds. For information about the periodic calls, see <code>process-wait-local-with-periodic-checks</code> .
See also	<code>process-wait-local-with-periodic-checks</code> <code>process-wait-local-with-timeout</code>

		<i>Function</i>
Summary	Suspend the current process until certain conditions are true, or until a timeout expires.	
Package	<code>mp</code>	
Signature	<code>process-wait-with-timeout <i>wait-reason</i> <i>timeout</i> &optional <i>wait-function</i> &rest <i>wait-arguments</i> => <i>bool</i></code>	
Arguments	<p><i>wait-reason</i> A string describing the reason that the process is waiting.</p> <p><i>timeout</i> A timeout, in seconds.</p> <p><i>wait-function</i> A function to test.</p> <p><i>wait-arguments</i> The arguments to apply to <i>wait-function</i>.</p>	
Values	<i>bool</i>	A boolean.
Description	This function uses <code>process-wait</code> to suspend the current Lisp process until the predicate <code>wait-function</code> applied to <code>wait-arguments</code> returns <code>t</code> , or until <code>timeout</code> seconds have passed. <i>bool</i> is <code>nil</code> if the timeout occurred before <code>wait-function</code> returned true. <i>bool</i> is true otherwise.	

See also `process-join`
`process-wait`

process-whostate *Function*

Summary Returns the state of a process.

Signature `process-whostate process => result`

Package `mp`

Arguments `process` A process.

Values `reason` A string.

Description The function `process-whostate` returns a string describing the state of the process.

Depending on the state of `process`, `reason` can be:

- `"Dead"`
- `"Stopped"`,
- `"Sleeping"`
- `"Running"`
- `"Running (preempted)"`

`reason` can also be the *wait-reason* of the process, as passed to `wait-processing-events`, `process-wait` and so on.

`reason` can also be a string containing the *run-reasons*, as set by `(setf process-run-reasons)`.

See also `wait-processing-events`
`process-wait`
`process-run-reasons`

		<i>Function</i>
Summary	Pushes a new value to a private property of the current process.	
Package	<code>mp</code>	
Signature		<code>pushnew-to-process-private-property <i>indicator</i> <i>value</i> &key test => <i>result</i></code>
Arguments	<i>indicator</i>	A Lisp object.
	<i>value</i>	A Lisp object.
	<i>test</i>	A function designator for a function of two arguments.
Values	<i>result</i>	A list.
Description		The function <code>pushnew-to-process-private-property</code> pushes <i>value</i> to the value of the private property associated with <i>indicator</i> for the current process. It behaves just like <code>pushnew-to-process-property</code> .
See also		<code>process-private-property</code> <code>pushnew-to-process-property</code> <code>remove-process-private-property</code> <code>get-process-private-property</code>

	<i>Function</i>
Summary	Pushes a new value to a general property of a process.
Package	<code>mp</code>
Signature	

`pushnew-to-process-property indicator value &key process test
=> result`

Arguments	<i>indicator</i>	A Lisp object.
	<i>value</i>	A Lisp object.
	<i>process</i>	A process, or <code>nil</code> .
	<i>test</i>	A function designator for a function of two arguments.
Values	<i>result</i>	A list.
Description		<p>The function <code>pushnew-to-process-property</code> pushes <i>value</i> to the value of the property associated with <i>indicator</i> for the process <i>process</i>. It uses the function <i>test</i> to compare existing property values of <i>process</i> with <i>value</i> and does not push if one matches, in the same way as <code>cl:pushnew</code>.</p> <p>The default value of <i>test</i> is <code>#'eql</code>.</p> <p>If there is a property associated with <i>indicator</i>, the value of the property must be a list.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> <p><i>result</i> is the new value of the process property.</p> <p>The modification is done in a thread-safe way.</p>
See also		<code>process-property</code> <code>remove-process-property</code>

ps		<i>Function</i>
Summary		Prints the processes in the system
Package		<code>mp</code>
Signature		<code>ps =></code>
Arguments		None.

Values	None.
Description	Prints a list of the processes in the system, ordered by priority. (This function is analogous to the UNIX command <code>ps</code> .)

remove-from-process-private-property *Function*

Summary Removes a value from a private property of the current process.

Package `mp`

Signature `remove-from-process-private-property indicator value &key test => result`

Arguments *indicator* A Lisp object.

value A Lisp object.

Values *result* A list.

Description The function `remove-from-process-private-property` removes *value* from the value of the private property associated with *indicator* for the current process.

It behaves just like `remove-from-process-property`.

See also `process-private-property`
`remove-from-process-property`
`remove-process-private-property`
`get-process-private-property`

remove-from-process-property *Function*

Summary Removes a value from a general property of a process.

Package	<code>mp</code>	
Signature		<code>remove-from-process-property <i>indicator value</i> &key <i>process test</i> => <i>result</i></code>
Arguments	<i>indicator</i>	A Lisp object.
	<i>value</i>	A Lisp object.
	<i>process</i>	A process, or <code>nil</code> .
	<i>test</i>	A function designator for a function of two arguments.
Values	<i>result</i>	A list.
Description		<p>The function <code>remove-from-process-property</code> removes <i>value</i> from the value of the property associated with <i>indicator</i> for the process <i>process</i>. It uses the function <i>test</i> to compare <i>value</i> with existing values, in the same way as <code>cl:remove</code>.</p> <p>The default value of <i>test</i> is <code>#'eql</code>.</p> <p>If there is a property associated with <i>indicator</i>, the value of the property must be a list.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> <p><i>result</i> is the new value of the process property.</p> <p>The modification is done in a thread-safe way.</p>
See also		<code>process-property</code> <code>remove-process-property</code>

	remove-process-private-property	<i>Function</i>
Summary	Removes a property from the private properties of the current process.	

Package	<code>mp</code>	
Signature	<code>remove-process-private-property <i>indicator</i> -> removedp</code>	
Arguments	<i>indicator</i>	A Lisp object.
Values	<i>removedp</i>	A generalized boolean.
Description		The function <code>remove-process-private-property</code> removes the property associated with <i>indicator</i> from the private properties of the current process. Note that removing a property is different from setting its value to <code>nil</code> , because when <code>process-private-property</code> is called with a <i>default</i> for a property that was removed, it returns the <i>default</i> , but for a property that was set to <code>nil</code> it returns <code>nil</code> .
See also		<code>process-private-property</code> <code>pushnew-to-process-private-property</code> <code>remove-from-process-private-property</code> <code>get-process-private-property</code>

remove-process-property		<i>Function</i>
Summary		Removes a general property from a process.
Package	<code>mp</code>	
Signature	<code>remove-process-property <i>indicator</i> &optional <i>process</i> -> removedp</code>	
Arguments	<i>indicator</i>	A Lisp object.
	<i>process</i>	A process.
Values	<i>removedp</i>	A generalized boolean.

Description	<p>The function <code>remove-process-property</code> removes the general property associated with <i>indicator</i> from the process <i>process</i>. If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> <p>Note that removing a property is different from setting its value to <code>nil</code>, because when <code>process-property</code> is called with a default for a property that was removed, it returns the default, but for a property that was set to <code>nil</code> it returns <code>nil</code>.</p> <p><i>removedp</i> is true if the property was removed.</p>
See also	<p><code>pushnew-to-process-property</code> <code>remove-from-process-property</code> <code>process-property</code></p>

	<i>Function</i>						
Summary	Schedules a timer to expire at a given time after the start of the program.						
Signature	<code>schedule-timer timer absolute-expiration-time &optional repeat-time => timer</code>						
Package	<code>mp</code>						
Arguments	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"><i>timer</i></td> <td style="width: 70%;">A timer</td> </tr> <tr> <td><i>absolute-expiration-time</i></td> <td>A non-negative real</td> </tr> <tr> <td><i>repeat-time</i></td> <td>A non-negative real</td> </tr> </table>	<i>timer</i>	A timer	<i>absolute-expiration-time</i>	A non-negative real	<i>repeat-time</i>	A non-negative real
<i>timer</i>	A timer						
<i>absolute-expiration-time</i>	A non-negative real						
<i>repeat-time</i>	A non-negative real						
Values	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"><i>timer</i></td> <td style="width: 70%;">A timer</td> </tr> </table>	<i>timer</i>	A timer				
<i>timer</i>	A timer						
Description	The <code>schedule-timer</code> function schedules a timer to expire at a given time after the start of the program. The <i>timer</i> argument is a timer, returned by <code>make-timer</code> or <code>make-named-timer</code> . The						

absolute-expiration-time argument is a non-negative real number of seconds since the start of the program at which the timer is to expire. If *repeat-time* is specified, it is a non-negative real number of seconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.

If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the *absolute-expiration-time* argument. If that argument is `nil`, the timer is not rescheduled, but the repeat interval is set to the interval specified by the *repeat-time* argument.

The function `schedule-timer-relative` schedules a timer to expire at a time relative to the call to that function.

Example The following example schedules a timer to expire 15 minutes after the start of the program and every 5 minutes thereafter.

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer timer 900 300)

#<Time Event : PRINT>
```

See also `make-named-timer`
`make-timer`
`schedule-timer-milliseconds`
`schedule-timer-relative`
`schedule-timer-relative-milliseconds`
`timer-expired-p`
`timer-name`
`unschedule-timer`

	Function						
Summary	Schedules a timer to expire after a given amount of time.						
Signature	<code>schedule-timer-milliseconds timer absolute-expiration-time &optional repeat-time => timer</code>						
Package	<code>mp</code>						
Arguments	<table> <tr> <td><i>timer</i></td><td>A timer</td></tr> <tr> <td><i>absolute-expiration-time</i></td><td>A non-negative real</td></tr> <tr> <td><i>repeat-time</i></td><td>A non-negative real</td></tr> </table>	<i>timer</i>	A timer	<i>absolute-expiration-time</i>	A non-negative real	<i>repeat-time</i>	A non-negative real
<i>timer</i>	A timer						
<i>absolute-expiration-time</i>	A non-negative real						
<i>repeat-time</i>	A non-negative real						
Values	<i>timer</i> A timer						
Description	<p>The <code>schedule-timer-milliseconds</code> function schedules a timer to expire at a given time after the start of the program. The <i>timer</i> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. The <i>absolute-expiration-time</i> argument is a non-negative real number of milliseconds since the start of the program at which the timer is to expire. If <i>repeat-time</i> is specified, it is a non-negative real number of milliseconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <i>absolute-expiration-time</i> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <i>repeat-time</i> argument.</p> <p>The function <code>schedule-timer-relative-milliseconds</code> schedules a timer to expire at a time relative to the call to that function.</p>						

Example The following example schedules a timer to expire 15 minutes after the start of the program and every 5 minutes thereafter.

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer-milliseconds timer 900000 300000)

#<Time Event : PRINT>
```

See also

- [make-named-timer](#)
- [make-timer](#)
- [schedule-timer](#)
- [schedule-timer-relative](#)
- [schedule-timer-relative-milliseconds](#)
- [timer-expired-p](#)
- [timer-name](#)
- [unschedule-timer](#)

schedule-timer-relative *Function*

Summary Schedules a timer to expire at a given time after this function is called.

Signature `schedule-timer-relative timer relative-expiration-time
&optional repeat-time => timer`

Package `mp`

Arguments `timer` A timer
`relative-expiration-time` A non-negative real
`repeat-time` A non-negative real

Values `timer` A timer

Description	<p>The <code>schedule-timer-relative</code> function schedules a timer to expire at a given time after the call to the function. The <code>timer</code> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. The <code>relative-expiration-time</code> argument is a non-negative real number of seconds after the call to the function at which the timer is to expire. If <code>repeat-time</code> is specified, it is a non-negative real number of seconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <code>relative-expiration-time</code> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <code>repeat-time</code> argument.</p> <p>The function <code>schedule-timer</code> schedules a timer to expire at a time relative to the start of the program.</p>
Example	<p>The following example schedules a timer to expire 5 seconds after the call to <code>schedule-timer-relative</code> and every 5 seconds thereafter.</p> <pre>(setq timer (mp:make-timer 'print 10 *standard-output*)) #<Time Event : PRINT> (mp:schedule-timer-relative timer 5 5) #<Time Event : PRINT></pre>

See also

[make-named-timer](#)
[make-timer](#)
[schedule-timer](#)
[schedule-timer-milliseconds](#)
[schedule-timer-relative-milliseconds](#)
[timer-expired-p](#)
[timer-name](#)
[unschedule-timer](#)

		<i>Function</i>
Summary	Schedules a timer to expire at a given time after this function is called.	
Signature		<code>schedule-timer-relative-milliseconds <i>timer</i> relative-expiration-time &optional repeat-time => <i>timer</i></code>
Package		<code>mp</code>
Arguments	<i>timer</i>	A timer
	<i>relative-expiration-time</i>	A non-negative real
	<i>repeat-time</i>	A non-negative real
Values	<i>timer</i>	A timer
Description	<p>The <code>schedule-timer-relative-milliseconds</code> function schedules a timer to expire at a given time after the call to the function. The <i>timer</i> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. The <i>relative-expiration-time</i> argument is a non-negative real number of milliseconds after the call to the function at which the timer is to expire. If <i>repeat-time</i> is specified, it is a non-negative real number of milliseconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <i>relative-expiration-time</i> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <i>repeat-time</i> argument.</p> <p>The function <code>schedule-timer-milliseconds</code> schedules a timer to expire at a time relative to the start of the program.</p>	

Example The following example schedules a timer to expire 5 seconds after the call to `schedule-timer-relative-milliseconds` and every 5 seconds thereafter.

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer-relative-milliseconds timer 5000
  5000)

#<Time Event : PRINT>
```

See also

- `make-named-timer`
- `make-timer`
- `schedule-timer`
- `schedule-timer-milliseconds`
- `schedule-timer-relative`
- `timer-expired-p`
- `timer-name`
- `unschedule-timer`

semaphore-acquire *Function*

Summary Acquires units from a semaphore.

Package `mp`

Signature `semaphore-acquire sem &key timeout wait-reason count => flag`

Arguments

<code><i>sem</i></code>	A semaphore.
<code><i>timeout</i></code>	An integer or <code>nil</code> .
<code><i>wait-reason</i></code>	A string or <code>nil</code> .
<code><i>count</i></code>	A non-negative fixnum.

Values `flag` A generalized boolean.

Description	<p>The function <code>semaphore-acquire</code> acquires <i>count</i> units from the semaphore <i>sem</i>.</p> <p>It attempts to atomically decrement the semaphore's unit count by <i>count</i> (which defaults to 1) and returns true if this would give a non negative unit count.</p> <p>If decrementing the semaphore's unit count would result in a negative number, then <code>semaphore-acquire</code> waits until the semaphore's unit count is larger than <i>count</i> and tries again. If <i>wait-reason</i> is true, then it is used as the thread's <i>wait-reason</i> when waiting for the semaphore.</p> <p>If <i>timeout</i> is <code>nil</code>, <code>semaphore-acquire</code> can wait forever. If <i>timeout</i> is true, it should be an integer. If the semaphore count cannot be decremented within <i>timeout</i> seconds, then <code>semaphore-acquire</code> returns false and the semaphore is unaffected. Pass <i>timeout</i> 0 if you do not want to wait at all.</p>
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See also	<code>make-semaphore</code> <code>semaphore-count</code> <code>semaphore-release</code> <code>semaphore-wait-count</code>
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		<i>Function</i>
Summary	Gets the current unit count of a semaphore.	
Package	<code>mp</code>	
Signature	<code>semaphore-count <i>sem</i> => <i>count</i></code>	
Arguments	<code>sem</code>	A semaphore.
Values	<code>count</code>	A non negative fixnum.

Description	The function <i>semaphore-count</i> returns the current unit count of the semaphore <i>sem</i> . The value is 0 if the semaphore has no unit remaining.
Notes	The current unit count value can change in the semaphore after calling <i>semaphore-count</i> .
See also	<i>make-semaphore</i> <i>semaphore-acquire</i> <i>semaphore-release</i> <i>semaphore-wait-count</i>

semaphore-name *Function*

Summary	Gets the name of a semaphore.	
Package	<i>mp</i>	
Signature	<i>semaphore-name sem => name</i>	
Arguments	<i>sem</i>	A semaphore.
Values	<i>name</i>	An object.
Description	The function <i>semaphore-name</i> returns the name that semaphore <i>sem</i> was given when it was created.	
See also	<i>make-semaphore</i>	

semaphore-release *Function*

Summary	Releases units back to a semaphore.
Package	<i>mp</i>

Signature	<code>semaphore-release sem &key count => flag</code>	
Arguments	<i>sem</i>	A semaphore.
	<i>count</i>	A non negative fixnum.
Values	<i>flag</i>	A generalized boolean.
Description	<p>The function <code>semaphore-release</code> releases count units back to the semaphore <i>sem</i>.</p> <p>It atomically increments the semaphore's unit count by <i>count</i> (which defaults to 1).</p> <p>The returned <i>flag</i> is true if any other thread was waiting for the semaphore and false otherwise</p>	
See also	make-semaphore semaphore-acquire semaphore-count semaphore-wait-count	

		<i>Function</i>
Summary	Get the current wait count of a semaphore.	
Package	<code>mp</code>	
Signature	<code>semaphore-wait-count sem => wait-count</code>	
Arguments	<i>sem</i>	A semaphore.
Values	<i>wait-count</i>	A non negative fixnum.
Description	<p>The function <code>semaphore-wait-count</code> returns the current number of units that other threads are waiting for from the semaphore <i>sem</i>. The value <i>wait-count</i> is 0 if the semaphore has no thread waiting for it.</p>	

Notes	The value can change in the semaphore after calling <code>semaphore-wait-count</code> .
See also	<code>make-semaphore</code> <code>semaphore-acquire</code> <code>semaphore-count</code> <code>semaphore-release</code>

simple-process-p

Function

Summary	A predicate identifying simple processes.	
Package	<code>mp</code>	
Signature	<code>simple-process-p object=> bool</code>	
Arguments	<code>object</code>	An object
Values	<code>bool</code>	A generalized boolean
Description	The <code>simple-process-p</code> function returns <code>t</code> if <code>object</code> is a simple process and <code>nil</code> otherwise.	
See also	<code>create-simple-process</code>	

symeval-in-process

Function

Summary	Reads the value of symbol which is dynamically bound in a given process.	
Package	<code>mp</code>	
Signature	<code>symeval-in-process symbol process => value, flag</code> <code>(setf symeval-in-process) value symbol process => value</code>	

Arguments	<i>symbol</i>	A symbol
	<i>process</i>	A process
Values	<i>value</i>	A Lisp object
	<i>flag</i>	One of <code>t</code> , <code>nil</code> or the keyword <code>:unbound</code>
Description		<p>The function <code>symeval-in-process</code> reads the value of the symbol <i>symbol</i> in the process <i>process</i> if it is bound dynamically. The global value of <i>symbol</i> is never returned.</p> <p>If <i>symbol</i> is not bound in <i>process</i>, then <i>value</i> and <i>flag</i> are both <code>nil</code>. If <i>symbol</i> is bound in <i>process</i> but <code>makunbound</code> has been called within the dynamic scope of the binding, <i>value</i> is <code>nil</code> and <i>flag</i> is <code>:unbound</code>. Otherwise, <i>value</i> is the value of <i>symbol</i> and <i>flag</i> is <code>t</code>.</p>
		In addition, the form
		<pre>(setf (symeval-in-process <i>symbol</i> <i>process</i>) <i>value</i>)</pre>
		sets the value of <i>symbol</i> to <i>value</i> in <i>process</i> . It is an error if <i>process</i> has no binding for <i>symbol</i> . This <code>setf</code> form returns <i>value</i> as specified by Common Lisp.
Notes		<code>symeval-in-process</code> is mostly intended for debugging. It is OK to call it on a thread known to be idle, or in <code>process-wait</code> or <code>process-stop</code> , but it should not be called while the thread is running.

		<i>Function</i>
Summary	Returns <code>t</code> if a given timer has expired or is about to expire.	
Signature		<code>timer-expired-p <i>timer</i> &optional <i>delta</i> => <i>bool</i></code>
Package		<code>mp</code>

Arguments	<i>timer</i>	A timer
	<i>delta</i>	A non-negative real
Values	<i>bool</i>	A boolean
Description		<p>The <code>timer-expired-p</code> function returns <code>t</code> if the specified timer is not scheduled to expire or is scheduled to expire within the number of seconds specified by the <i>delta</i> argument after the call to <code>timer-expired-p</code>. Otherwise, the function returns <code>nil</code>.</p> <p>The <i>timer</i> argument is a timer, returned by <code>make-timer</code> or <code>make-named-timer</code>. The <i>delta</i> argument, if supplied, is a non-negative real number of seconds.</p>
Example		<pre>(setq timer (mp:make-timer 'print 10 *standard-output*)) #<Time Event : PRINT> (mp:schedule-timer-relative timer 5) #<Time Event : PRINT> (mp:timer-expired-p timer) NIL</pre>
See also		<code>make-named-timer</code> <code>make-timer</code> <code>schedule-timer</code> <code>schedule-timer-milliseconds</code> <code>schedule-timer-relative</code> <code>timer-name</code> <code>unschedule-timer</code>

	Function
Summary	Returns the name of a specified timer.
Signature	<code>timer-name <i>timer</i> => <i>name</i></code>

Signature	<code>(setf timer-name) name timer => name</code>	
Package	<code>mp</code>	
Arguments	<code>timer</code>	A timer
Values	<code>name</code>	A string
Description	<p>The <code>timer-name</code> function returns the name of the specified <i>timer</i>. The <i>timer</i> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. If the timer has no name, <code>timer-name</code> returns <code>nil</code>.</p> <p>The name of a timer created by either <code>make-timer</code> or <code>make-named-timer</code> can be set by means of the following syntax:</p> <pre>(setf (mp:timer-name timer) name)</pre>	
Example	<pre>(setq timer (mp:make-timer 'print 10 *standard-output*)) #<Time Event : PRINT> (mp:timer-name timer) NIL (setf (mp:timer-name timer) 'timer-1) TIMER-1 (mp:timer-name timer) TIMER-1</pre>	
See also	<code>make-named-timer</code> <code>make-timer</code> <code>schedule-timer</code> <code>schedule-timer-milliseconds</code> <code>schedule-timer-relative</code> <code>timer-expired-p</code> <code>unschedule-timer</code>	

unnotice-fd	<i>Function</i>
Summary	Removes a file descriptor from the set of interesting input file descriptors.
Package	<code>mp</code>
Signature	<code>unnotice-fd fd</code>
Arguments	<i>fd</i> A file descriptor
Values	None.
Description	<p>The <code>unnotice-fd</code> function removes <i>fd</i> from the set of fds that cause LispWorks to wake up when they contain input.</p> <p>This function is not implemented on Microsoft Windows.</p>
See also	<code>notice-fd</code>

unschedule-timer	<i>Function</i>
Summary	Unschedules a scheduled timer
Signature	<code>unschedule-timer timer => result</code>
Package	<code>mp</code>
Arguments	<i>timer</i> A timer
Values	<i>result</i> A timer or <code>nil</code>
Description	If the specified timer has been scheduled to expire at a time after the call to <code>unschedule-timer</code> , this function unschedules the timer and returns the timer. Otherwise, the function returns <code>nil</code> .

The argument is a timer, returned by `make-timer` or `make-named-timer`.

Example

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer-relative timer 60)

#<Time Event : PRINT>

(mp:unschedule-timer timer)

#<Time Event : PRINT>

(mp:timer-expired-p timer)

T
```

See also

`make-named-timer`
`make-timer`
`schedule-timer`
`schedule-timer-milliseconds`
`schedule-timer-relative`
`timer-expired-p`
`timer-name`

wait-processing-events

Function

Summary Waits processing events.

Signature `wait-processing-events timeout &key wait-reason wait-function
 wait-args => result`

Package `mp`

Arguments `timeout` A number.
`wait-reason` A string.
`wait-function` A function designator.

	<code>wait-args</code>	A list.
Values	<code>result</code>	<code>t</code> or <code>nil</code>
Description	<p>The function <code>wait-processing-events</code> does not return until one of two conditions is met:</p> <ul style="list-style-type: none"> • <i>timeout</i> seconds have passed. In this case, <code>result</code> is <code>nil</code>. • <code>wait-function</code> returns a true value. In this case, <code>result</code> is <code>t</code>. <p><code>wait-reason</code> provides the value returned by <code>process-whostate</code> when called on the current process.</p> <p><code>wait-function</code> is called periodically with arguments <code>wait-args</code>. <code>wait-function</code> may be called many times and in several places. Therefore <code>wait-function</code> should be fast and make no assumptions about its dynamic context.</p> <p><code>wait-processing-events</code> processes all events sent to the current process, including system events such as window messages on Microsoft Windows, and objects sent by other processes via <code>process-send</code>. In the latter case, the objects must be lists of the form <code>(function . arguments)</code>, which cause <code>function</code> to be applied to <code>arguments</code> (the values are discarded).</p> <p><code>wait-processing-events</code> is a useful alternative to <code>sleep</code> in a situation where you want to process events to see window updates and so on.</p>	
See also	<code>process-send</code> <code>process-whostate</code>	

with-exclusive-lock		<i>Macro</i>
Summary	Holds a sharing lock in exclusive mode while evaluating its body, and then unlocks the lock.	
Package	<code>mp</code>	

Signature	<code>with-exclusive-lock (<i>sharing-lock</i> &optional <i>whostate timeout</i>) &body <i>body</i> => <i>results</i></code>	
Arguments	<i>sharing-lock</i>	A sharing lock.
	<i>whostate</i>	The status of the process while the lock is locked, as seen in the Process Browser.
	<i>timeout</i>	A timeout period, in seconds.
	<i>body</i>	The forms to execute
Values	<i>results</i>	The values returned from evaluating body.
Description	The macro <code>with-exclusive-lock</code> is the same as <code>with-lock</code> , except that the lock must be "sharing", that is, created with the argument <code>sharing</code> true in <code>make-lock</code> . It waits until <code>sharing-lock</code> is completely free, that is, the lock is not locked in a sharing mode and is not locked in exclusive mode by another thread. It then locks the lock <code>sharing-lock</code> in exclusive mode, evaluates <code>body</code> and unlocks the lock.	
Notes	It is not possible to use an exclusive lock in the scope of a sharing-lock on the same lock, and trying to do it will cause the process to hang. Whether it is possible to use exclusive-lock inside exclusive-lock of the same lock is determined by the <code>recursivep</code> argument in <code>make-lock</code> .	
See also	<code>make-lock</code> <code>with-lock</code>	

with-interrupts-blocked *Macro*

Summary	Evaluates code with interrupts blocked.
Package	<code>mp</code>
Signature	<code>with-interrupts-blocked &body <i>body</i> => <i>results</i></code>

Arguments	<i>body</i>	Code
Values	<i>results</i>	Values returned by evaluating <i>body</i> .
Description	Evaluates <i>body</i> with interrupts blocked. This actually expands to <code>(mp:allowing-block-interrupts t ,@body)</code>	which means it also allows you to change the blocking of interrupts. See the entry for <code>allowing-block-interrupts</code> for full details.
See also	<code>allowing-block-interrupts</code>	

with-lock		<i>Macro</i>
Summary	Executes a body of code while holding a lock.	
Package	<code>mp</code>	
Signature	<code>with-lock (lock &optional whostate timeout) &body body => result</code>	
Arguments	<i>lock</i>	The lock.
	<i>whostate</i>	The status of the process while the lock is locked, as seen in the Process Browser.
	<i>timeout</i>	A timeout period, in seconds.
	<i>body</i>	The forms to execute.
Values	<i>result</i>	The result of executing <i>body</i> .
Description	<code>with-lock</code> executes <i>body</i> while holding the lock, and unlocks the lock when <i>body</i> exits. This is the recommended way of using locks. The value of <i>body</i> is returned normally. <i>body</i> is	

not executed if the lock could not be claimed, in which case, `with-lock` returns `nil`.

See also

`make-lock`
`process-lock`
`process-unlock`
`with-exclusive-lock`
`with-sharing-lock`

with-sharing-lock

Macro

Summary	Holds a lock in shared mode while executing a body of code.	
Package	<code>mp</code>	
Signature	<code>with-sharing-lock (sharing-lock &optional whostate timeout) &body body => results</code>	
Arguments	<code>sharing-lock</code>	A sharing lock.
	<code>whostate</code>	The status of the process while the lock is locked, as seen in the Process Browser.
	<code>timeout</code>	A timeout period, in seconds.
	<code>body</code>	The forms to execute
Values	<code>results</code>	The values returned from evaluating body.
Description	<p>The macro <code>with-sharing-lock</code> is like <code>with-lock</code>, but the lock must be "sharing" and the lock will be locked in shared mode. That means that other threads can also lock it in shared mode.</p> <p>Before locking this waits for the lock to be free of any exclusive lock, but it does not check for other shared mode use of the same lock.</p>	

Notes	It is possible to lock for sharing inside the scope of sharing lock and inside the scope of an exclusive lock.
See also	<code>make-lock</code> <code>with-lock</code>

without-interrupts Macro

Summary	Causes any interrupts that occur during the execution of a body of code to be queued.	
Package	<code>mp</code>	
Signature	<code>without-interrupts &rest body => result</code>	
Arguments	<code>body</code>	The forms to execute while interrupts are queued.
Values	<code>result</code>	The result of executing <code>body</code> .
Description	While <code>body</code> is executing, all interrupts (for example, preemption, keyboard break etc.) are queued. They are executed when <code>body</code> exits.	
Example	To ensure that the seconds and milliseconds slots are always consistent, you can use <code>mp:without-interrupts</code> within the function which sets them.	
	<pre>(defstruct elapsed-time seconds milliseconds) (defun update-elapsed-time-atomically (elapsed-time seconds milliseconds) (mp:without-interrupts (setf (elapsed-time-seconds elapsed-time) seconds (elapsed-time-milliseconds elapsed-time) milliseconds)))</pre>	

See also [without-preemption](#)

without-preemption *Macro*

Summary	Identifies forms which should not be preempted during execution.
Package	<code>mp</code>
Signature	<code>without-preemption &rest body => result</code>
Arguments	<code>body</code> The forms to be evaluated atomically.
Values	<code>result</code> The result of executing <code>body</code> .
Description	Identifies forms which should not be preempted during execution.

yield *Function*

Summary	Allows preemption to happen in low safety code.
Package	<code>mp</code>
Signature	<code>yield</code>
Arguments	None.
Values	None.
Description	Normally code compiled at safety 0 cannot be preempted because the necessary checks are omitted. This can be overcome by calling <code>yield</code> at regular intervals. Usually there is no need to call this if you use functions from the <code>common-lisp</code> package because these are not compiled at safety 0, but for

example if you find that preemption is not working in a loop with no function calls, `yield` can be useful. Note that `process-allow-scheduling` also allows preemption, but also checks the wait functions of other processes.

See also `process-allow-scheduling`

36

The PARSERGEN Package

This chapter describes symbols available in the `PARSERGEN` package, the Lisp-Works parser generator.

This functionality is discussed in detail in Chapter 17, “The Parser Generator”.

<code>defparser</code>	<i>Macro</i>
Summary	Creates a parsing function of the given name for the grammar defined.
Package	<code>parsergen</code>
Signature	<pre>defparser name {rule}* => parsing-function rule ::= normal-rule error-rule normal-rule ::= ((non-terminal {grammar-symbol}*) {form}*) error-rule ::= ((non-terminal :error) {form}*)</pre>
Arguments	<code>name</code> The name of the parser.

The rules define the productions of the grammar and the associated forms define the semantic actions for the rules.

Values *parsing-function* The symbol name of the parsing function.

Description `defparser` creates a parsing function of the given name for the grammar defined. The parsing function is defined as if by:

```
(defun <name> (&optional (symbol-to-string  
 #'identify)))
```

The *lexer* parameter is a function of no arguments that returns two values: the next grammar token on the input and the associated semantic value.

The optional symbol-to-string function can be used to define a printed representation of the grammar tokens. The function should take a grammar symbol as its single argument and returns an object to be used as a print representation for the grammar token.

For a full description and examples, see Chapter 17, “The Parser Generator”.

37

The SERIAL-PORT Package

This chapter describes the symbols available in the **SERIAL-PORT** package.

The Serial Port functionality is loaded into LispWorks by evaluating

```
(require "serial-port")
```

Note: this chapter applies only to LispWorks for Windows, and not the UNIX, Linux or Mac OS X platforms.

		<i>Function</i>
Summary		Attempts to open the named serial port and return a serial-port object.
Package		serial-port
Signature		open-serial-port <i>name</i> &rest <i>args</i> &key <i>baud-rate data-bits stop-bits parity cts-flow-p dsr-flow-p dtr rts read-interval-timeout read-total-base-timeout read-total-byte-timeout write-total-base-timeout write-total-byte-timeout</i> => serial-port
Arguments	<i>name</i>	A string naming a serial port.

	args	See in the Description below for details of the remaining arguments.
Values	serial-port	A serial-port object.
Description	The function <code>open-serial-port</code> attempts to open the serial port <i>name</i> and return a serial-port object. <i>name</i> is passed directly to <code>Createfile()</code> . For ports COM <i>n</i> where <i>n</i> > 9, you must take care to pass the real port name expected by Windows. At the time of writing this issue is documented at http://support.microsoft.com/kb/115831 . If any of <i>baud-rate</i> , <i>data-bits</i> , <i>stop-bits</i> and <i>parity</i> are supplied then the corresponding serial port settings are changed. The values of <i>baud-rate</i> and <i>data-bits</i> should each be an appropriate integer. The value of <i>stop-bits</i> should be 1, 1.5 or 2. The value of <i>parity</i> should be one of the keywords <code>:even</code> , <code>:mark</code> , <code>:none</code> , <code>:odd</code> OR <code>:space</code> . The arguments <i>cts-flow-p</i> and <i>dsr-flow-p</i> control whether write operations respond to CTS and DSR flow control. A non-nil value means that the corresponding flow control is used. The arguments <i>dtr</i> and <i>rts</i> control whether read operations generate DTR or RTS flow control. If the value is <code>:handshake</code> then the corresponding flow control signal is generated automatically. If the value is <code>nil</code> or <code>t</code> then the initial state of the flow control signal is set and automatic flow control is not used. See <code>set-serial-port-state</code> for manual flow control. The argument <i>read-interval-timeout</i> can be used to control the maximum time to wait between each input character. The value <code>:none</code> means that reading will not wait for characters at all, only returning whatever is already in the input buffer The arguments <i>read-total-base-timeout</i> and <i>read-total-byte-timeout</i> can be used to control the maximum time to wait for a sequence of characters. The arguments <i>write-total-base-timeout</i> and <i>write-total-byte-timeout</i> can be used to control the maxi-	

mum time to wait when transmitting a sequence of characters. For both reading and writing the timeout is given by the expression:

```
base_timeout + nchars * byte_timeout
```

The default value of each of *read-total-base-timeout*, *read-total-byte-timeout*, *write-total-base-timeout* and *write-total-byte-timeout* is `nil` and this means that the corresponding parameter in the OS is left unchanged and there is zero timeout. Otherwise the value should be a non-negative real number specifying a timeout in seconds.

See also

`close-serial-port`
`set-serial-port-state`

close-serial-port

Function

Summary

Closes a serial port

Package

`serial-port`

Signature

`close-serial-port serial-port`

Arguments

`serial-port` A `serial-port` object.

Description

The function `close-serial-port` closes the serial port associated with the given `serial-port` object.

If `serial-port` is already closed, an error is signalled.

See also

`open-serial-port`

get-serial-port-state

Function

Summary

Queries various aspects of the state of a serial port.

Package	<code>serial-port</code>	
Signature	<code>get-serial-port-state serial-port keys => state</code>	
Arguments	<code>serial-port</code>	A <code>serial-port</code> object.
	<code>keys</code>	A list of keywords.
Values	<code>state</code>	A list.
Description	The function <code>get-serial-port-state</code> queries various aspects of the state of the serial port associated with <code>serial-port</code> . The argument <code>keys</code> should be a list of one or more of the keywords <code>:dsr</code> and <code>:cts</code> . These cause <code>get-serial-port-state</code> to check the DSR and CTS lines respectively. The result <code>state</code> is a list giving the state of each line in the same order as they appear in the argument <code>keys</code> .	

serial-port	<i>Class</i>
Summary	The class of objects representing serial ports.
Package	<code>serial-port</code>
Description	The class <code>serial-port</code> is the class of objects representing serial ports. These are constructed by <code>open-serial-port</code> - do not create them directly.
See also	<code>open-serial-port</code>

read-serial-port-char	<i>Function</i>
Summary	Reads a character from a serial port.
Package	<code>serial-port</code>

This chapter applies only to LispWorks for Windows

Signature	<code>read-serial-port-char serial-port &optional timeout-error-p timeout-char => char</code>	
Arguments	<code>serial-port</code>	A <code>serial-port</code> object.
	<code>timeout-error-p</code>	A boolean.
	<code>timeout-char</code>	A character.
Values	<code>char</code>	A character.
Description	<p>The function <code>read-serial-port-char</code> reads and returns a character from the serial port associated with <code>serial-port</code>. A timeout will occur if the character is not available before the read timeout (as specified by values given when the serial port was opened by <code>open-serial-port</code>). When a timeout occurs, if <code>timeout-error-p</code> is non-nil, then an error of type <code>serial-port-timeout</code> is signalled, otherwise <code>timeout-char</code> is returned. The default value of <code>timeout-error-p</code> is t.</p>	
See also	<code>read-serial-port-string</code>	

read-serial-port-string

Function

Summary	Reads a string from a serial port.	
Package	<code>serial-port</code>	
Signature	<code>read-serial-port-string string serial-port &optional timeout-error-p &key start end => nread</code>	
Arguments	<code>string</code>	A string.
	<code>serial-port</code>	A <code>serial-port</code> object.
	<code>timeout-error-p</code>	A boolean.
	<code>start, end</code>	Bounding index designators for <code>string</code> .

Values	<i>nread</i>	An integer.
Description	The function <code>read-serial-port-string</code> reads characters from the serial port associated with <i>serial-port</i> and places them in <i>string</i> , bounded by <i>start</i> and <i>end</i> . The default values of <i>start</i> and <i>end</i> are 0 and <code>nil</code> (interpreted as the length of <i>string</i>) respectively. The number of characters requested is the difference between <i>end</i> and <i>start</i> . If the number of characters actually read, <i>nread</i> , is less than the number requested, then if <i>timeout-error-p</i> is non- <code>nil</code> an error of type <code>serial-port-timeout</code> is signalled. If <i>nread</i> is the number of characters requested, or if <i>timeout-error-p</i> is <code>nil</code> , <i>nread</i> is returned. The default value of <i>timeout-error-p</i> is <code>t</code> .	
See also		<code>read-serial-port-char</code>

		<i>Function</i>
Summary		Checks whether a character is available on a serial port.
Package		<code>serial-port</code>
Signature		<code>serial-port-input-available-p serial-port => result</code>
Arguments	<i>serial-port</i>	A <code>serial-port</code> object.
Values	<i>result</i>	A boolean.
Description		The function <code>serial-port-input-available-p</code> checks the serial port associated with <i>serial-port</i> to see if a character is available. <i>result</i> is <code>t</code> if input is available, and <code>nil</code> otherwise.

		<i>Function</i>
set-serial-port-state		
Summary	Changes various aspects of the state of a serial port.	
Package	<code>serial-port</code>	
Signature	<code>set-serial-port-state serial-port &key dtr rts break</code>	
Arguments	<i>serial-port</i>	A <code>serial-port</code> object.
	<i>dtr</i>	A boolean.
	<i>rts</i>	A boolean.
	<i>break</i>	A boolean.
Description	The function <code>set-serial-port-state</code> changes various aspects of the state of the serial port associated with <i>serial-port</i> . The argument <i>dtr</i> , if supplied, controls the DTR line. A true value means set and <code>nil</code> means clear. If <i>dtr</i> is not supplied, the state is unchanged. The argument <i>rts</i> controls the RTS line in the same way. The argument <i>break</i> controls the break state of the data line in the same way.	

		<i>Function</i>
wait-serial-port-state		
Summary	Waits for some aspect of the state of a serial port to change.	
Package	<code>serial-port</code>	
Signature	<code>wait-serial-port-state serial-port keys &key timeout => result</code>	
Arguments	<i>serial-port</i>	A <code>serial-port</code> object.
	<i>keys</i>	A list of keywords.
	<i>timeout</i>	A number.

Values	<i>result</i>	A list.
Description	<p>The function <code>wait-serial-port-state</code> waits for some state in the serial port associated with <i>serial-port</i> to change.</p> <p>The argument <i>keys</i> should be a list of one or more of the keywords <code>:cts</code>, <code>:dsr</code>, <code>:err</code>, <code>:ring</code>, <code>:rlsd</code> and <code>:break</code>.</p> <p><i>result</i> is a list giving the keys for which the state has changed.</p> <p>If <i>timeout</i> is non-nil then the function will return <code>nil</code> after that many seconds even if the state has not changed.</p>	

write-serial-port-char		<i>Function</i>
Summary	Writes a character to a serial port.	
Package	<code>serial-port</code>	
Signature	<code>write-serial-port-char char serial-port &optional timeout-error-p => char</code>	
Arguments	<p><i>char</i></p> <p><i>serial-port</i></p> <p><i>timeout-error-p</i></p>	<p>A character.</p> <p>A <code>serial-port</code> object.</p> <p>A boolean.</p>
Values	<i>char</i>	
Description	<p>The function <code>write-serial-port-char</code> writes the character <i>char</i> to the serial port associated with <i>serial-port</i>, and returns <i>char</i>.</p> <p>A timeout will occur if the character cannot be written before the write timeout (as specified by values given when the serial port was opened by <code>open-serial-port</code>).</p>	

When a timeout occurs, if *timeout-error-p* is non-nil, then an error of type **serial-port-timeout** is signalled, otherwise **nil** is returned. The default value of *timeout-error-p* is **t**.

See also

	<i>Function</i>
write-serial-port-string	
Summary	Writes a string to a serial port.
Package	serial-port
Signature	write-serial-port-string <i>string</i> <i>serial-port</i> &optional <i>timeout-error-p</i> &key <i>start end</i> => <i>nwritten</i>
Arguments	<i>string</i> A string. <i>serial-port</i> A serial-port object. <i>timeout-error-p</i> A boolean. <i>start, end</i> Bounding index designators for <i>string</i> .
Values	<i>result</i> The string <i>string</i> or nil .
Description	The function write-serial-port-string writes characters from the subsequence of <i>string</i> bounded by <i>start</i> and <i>end</i> to the serial port associated with <i>serial-port</i> . The default values of <i>start</i> and <i>end</i> are 0 and nil (interpreted as the length of <i>string</i>) respectively. If the characters are successfully written then <i>string</i> is returned. A timeout will occur if the characters cannot be written before the write timeout (as specified by values given when the serial port was opened by open-serial-port).

When a timeout occurs, if *timeout-error-p* is non-nil, then an error of type `serial-port-timeout` is signalled, otherwise `nil` is returned. The default value of *timeout-error-p* is `t`.

See also

`write-serial-port-char`

38

The SQL Package

This chapter describes the symbols available in the `sql` package which implements Common SQL. You should use this chapter in conjunction with Chapter 19, “Common SQL”. In particular that chapter contains more information about the Oracle LOB interface (that is, those functions with names beginning `sql:ora-lob-`).

On Microsoft Windows, Linux, x86/x64 Solaris, FreeBSD and Mac OS X, Common SQL is included only in LispWorks Enterprise Edition.

add-sql-stream		<i>Function</i>
Summary		Adds a stream to the broadcast list for SQL commands or results traffic.
Package		<code>sql</code>
Signature		<code>add-sql-stream stream &key type database -> added-stream</code>
Arguments	<code>stream</code>	A stream, or <code>t</code> .
	<code>type</code>	A keyword.

	database	A database.
Values	added-stream	The argument <i>stream</i> .
Description		<p>The <code>add-sql-stream</code> function adds the stream <i>stream</i> to the list of streams which receive SQL commands traffic or results traffic.</p> <p>To add <code>*standard-output*</code> to the list, pass <i>stream</i> <code>t</code>.</p> <p>The argument <i>type</i> is one of <code>:commands</code>, <code>:results</code> or <code>:both</code>, and determines whether a stream for commands traffic, results traffic, or both is added.</p> <p>The argument <i>type</i> has a default value of <code>:commands</code>. The <i>database</i> is the value of <code>*default-database*</code> by default.</p>
See also		<code>*default-database*</code> <code>delete-sql-stream</code> <code>list-sql-streams</code> <code>sql-recording-p</code> <code>sql-stream</code> <code>start-sql-recording</code> <code>stop-sql-recording</code>

		<i>Function</i>
Summary		Returns the type of an attribute.
Package		<code>sql</code>
Signature		<code>attribute-type attribute table &key database owner -> datatype</code>
Arguments	table	A table.
	attribute	An attribute from <i>table</i> .
	database	A database.

This chapter applies to the Enterprise Edition only

	<i>owner</i>	<code>nil</code> , <code>:all</code> or a string.
Values	<i>datatype</i>	A keyword or list denoting a vendor-specific type.
Description		<p>The function <code>attribute-type</code> returns the type of the attribute specified by <i>attribute</i> in the table given by <i>table</i>. The database, in which <i>table</i> is found, has a default value of <code>*default-database*</code>.</p> <p>If <i>owner</i> is <code>nil</code>, only user-owned attributes are considered. This is the default.</p> <p>If <i>owner</i> is <code>:all</code>, all attributes are considered.</p> <p>If <i>owner</i> is a string, this denotes a username and only attributes owned by <i>owner</i> are considered.</p> <p><i>datatype</i> demotes a vendor-specific type. Examples in a MS Access database are <code>:integer</code>, <code>:longchar</code> and <code>:datetime</code>. When <i>datatype</i> is a list, the second element is the length of the type, for example <code>(:varchar 255)</code>.</p>
Example		To print the type of every attribute in the database, do
		<pre>(loop for tab in (sql:list-tables) do (loop for att in (sql:list-attributes tab) do (format t "~&Table ~S Attribute ~S Type ~S" tab att (sql:attribute-type att tab))))</pre>
See also		<code>*default-database*</code> <code>list-attribute-types</code> <code>list-attributes</code>

cache-table-queries	Function						
Summary	Controls the caching of attribute type information.						
Package	<code>sql</code>						
Signature	<code>cache-table-queries table &key database action</code>						
Arguments	<table border="0"> <tr> <td><code>table</code></td><td>A string naming a table, <code>:default</code> or <code>t</code>.</td></tr> <tr> <td><code>database</code></td><td>A database.</td></tr> <tr> <td><code>action</code></td><td><code>t, nil</code> or <code>:flush</code>.</td></tr> </table>	<code>table</code>	A string naming a table, <code>:default</code> or <code>t</code> .	<code>database</code>	A database.	<code>action</code>	<code>t, nil</code> or <code>:flush</code> .
<code>table</code>	A string naming a table, <code>:default</code> or <code>t</code> .						
<code>database</code>	A database.						
<code>action</code>	<code>t, nil</code> or <code>:flush</code> .						
Description	<p>The function <code>cache-table-queries</code> provides per-table control on the caching in a particular database connection of attribute type information using during update operations.</p> <p>If <code>table</code> is a string, it is the name of the table for which caching is to be altered. If <code>table</code> is <code>t</code>, then the <code>action</code> applies to all tables. If <code>table</code> is <code>:default</code>, then the default caching action is set for those tables which do not have an explicit setting.</p> <p><code>database</code> specifies the database connection, its default value is the value of <code>*default-database*</code>.</p> <p><code>action</code> specifies the caching action. The value <code>t</code> means cache the attribute type information. The value <code>nil</code> means do not cache the attribute type information. If <code>table</code> is <code>:default</code>, the setting applies to all tables which do not have an explicit setup.</p> <p>The value <code>:flush</code> means remove any existing cache for <code>table</code> in <code>database</code>, but continue to cache.</p> <p><code>cache-table-queries</code> should be called with <code>action :flush</code> when the attribute specifications in <code>table</code> have changed.</p>						
See also	<code>*cache-table-queries-default*</code> <code>*default-database*</code>						

This chapter applies to the Enterprise Edition only

cache-table-queries-default		<i>Variable</i>
Package	<code>sql</code>	
Initial Value	<code>nil</code>	
Description	The variable <code>*cache-table-queries-default*</code> provides the default attribute type caching behavior. It allowed values are as described for the <i>action</i> argument of <code>cache-table-queries</code> .	
See also	<code>cache-table-queries</code>	

commit		<i>Function</i>
Summary	Commits changes made to a database.	
Package	<code>sql</code>	
Signature	<code>commit &key database => nil</code>	
Arguments	<code>database</code>	A database.
Values	<code>nil</code>	
Description	The <code>commit</code> function commits changes made to the database specified by <i>database</i> , which is <code>*default-database*</code> by default.	
Example	This example changes records in a database, and uses <code>commit</code> to make those changes permanent.	

```
(insert-records :into [emp]
                      :attributes '(x y z)
                      :values '(a b c))
(update-records [emp]
                :attributes [dept]
                :values 50
                :where [= [dept] 40])
(delete-records :from [emp]
                 :where [> [salary] 300000])
(commit)
```

See also

default-database
rollback
with-transaction

connect	<i>Function</i>
Summary	Opens a connection to a database.
Package	sql
Signature	connect <i>connection-spec</i> & key <i>if-exists</i> <i>database-type</i> <i>interface</i> <i>name</i> <i>encoding</i> <i>signal-rollback-errors</i> <i>default-table-type</i> <i>default-table</i> - <i>extra-options</i> <i>date-string-format</i> <i>sql-mode</i> <i>prefetch-rows-number</i> <i>prefetch-memory</i> => <i>database</i>
Arguments	<p><i>connection-spec</i> The connection specifications.</p> <p><i>if-exists</i> A keyword.</p> <p><i>database-type</i> A database type.</p> <p><i>interface</i> A displayed CAPI element, or nil.</p> <p><i>name</i> A Lisp object.</p> <p><i>encoding</i> A keyword naming an encoding.</p> <p><i>signal-rollback-errors</i> nil, the keyword :default, or a function designator.</p>

This chapter applies to the Enterprise Edition only

	<i>default-table-type</i>	A string, the keyword <code>:support-transactions</code> , or <code>nil</code> .
	<i>default-table-extra-options</i>	A string or <code>nil</code> .
	<i>date-string-format</i>	A string, or the keyword <code>:standard</code> , or <code>nil</code> .
	<i>sql-mode</i>	A string or <code>nil</code> .
	<i>prefetch-rows-number</i>	An integer or the keyword <code>:default</code> .
	<i>prefetch-memory</i>	An integer or the keyword <code>:default</code> .
Values	<i>database</i>	A database.
Description	The <code>connect</code> function opens a connection to a database of type <i>database-type</i> . The allowed values for <i>database-type</i> are <code>:odbc</code> , <code>:odbc-driver</code> , <code>:mysql</code> , <code>:postgresql</code> , <code>:oracle8</code> and <code>:oracle</code> , though not all of these are supported on some platforms. See “Supported databases” on page 221 for details of per-platform database support. The default for <i>database-type</i> is the value of <code>*default-database-type*</code> . <code>connect</code> sets the variable <code>*default-database*</code> to an instance of the database opened, and returns that instance. If <i>connection-spec</i> is a list it is interpreted as a plist of keywords and values. Some of the keywords are <i>database-type</i> specific, see the documentation for each database. General keywords are:	<code>:username</code> User name <code>:password</code> Password

:connection A specification of the connection. In general, this is supposed to be sufficient information (other than the username and password) to open a connection. The precise meaning varies according to the *database-type*.

If *connection-spec* is a string, it is interpreted canonically as:

username/password@connection

where *connection* can be omitted along with the '@' in cases when there is a default connection, *password* can be omitted along with the preceding '/', and *username* can be omitted if there is a default user. For example, if you have an Oracle user matching the current Unix username and that does not need a password to connect, you can call

```
(connect "/")
```

Specific *database-types* may allow more elaborate syntax, but conforming to the pattern above. See the section “Initialization” on page 223 for details.

Additionally for *database-types* :**odbc** and :**odbc-driver**, if *connection-spec* does not include the '@' character then the string is interpreted in a special way, for backward compatibility with LispWorks 4.4 and earlier versions. See the section “Connecting to ODBC” on page 226 for details.

The argument *if-exists* modifies the behavior of **connect** as follows:

:new Makes a new connection even if connections to the same database already exist.

:warn-new Makes a new connection but warns about existing connections.

:error Makes a new connection but signals an error for existing connections.

:warn-old Selects old connection if one exists (and warns) or makes a new one.

This chapter applies to the Enterprise Edition only

:old Selects old connection if one exists or makes a new one.

The default value of *if-exists* is the value of ***connect-if-exists***.

interface is used if **connect** needs to display a dialog to ask the user for username and password. If *interface* is a CAPI element, this is used. If *interface* is any other value (the default value is **ni1**), and **connect** is called in a process which is associated with a CAPI interface, then this CAPI interface is used. *interface* has been added because dialogs asking for passwords can fail otherwise. This depends on the driver that the datasource uses: the problem has only been observed using MS SQL on Microsoft Windows.

name can be passed to explicitly specify the name of the connection. If *name* is supplied then it is used as-is for the connection name. Therefore it can be found by another call to **connect** and calls to **find-database**. Connection names are compared with **equalp**. If *name* is not supplied, then a unique database name is constructed from *connection-spec* and a counter.

Note: all the Common SQL functions that accept the keyword argument **:database** use **find-database** to find the database if the given value is not a database. Therefore these functions can now find only databases that were opened with an explicit *name*:

```
(connect ... :name name ...)
```

encoding specifies the encoding to use in the connection. The value should be a keyword naming an acceptable encoding, or **ni1** (the default). The value **:unicode** is accepted for all *database-types*, and this will try to make a connection that can support sending and retrieving double-byte string values. Other values are *database-type* specific:

<code>:mysql</code>	If <i>encoding</i> is <code>nil</code> or <code>:default</code> then the encoding is chosen according to the default character set of the connection (if available) and if that fails the encoding <code>:utf-8</code> is used. The other recognised values of <i>encoding</i> are <code>:unicode</code> , <code>:utf-8</code> , <code>:ascii</code> , <code>:latin-1</code> , <code>:euc</code> and <code>:sjis</code> . <code>:unicode</code> uses <code>:utf-8</code> internally.
<code>:postgresql</code>	<i>encoding</i> is ignored.
<code>:oracle</code>	The only recognised values of <i>encoding</i> are <code>nil</code> and <code>:unicode</code> .
<code>:oracle8</code>	<i>encoding</i> is ignored.
<code>:odbc</code>	<i>encoding</i> is ignored.
<code>:odbc-driver</code>	<i>encoding</i> is ignored.

signal-rollback-errors controls what happens when an attempted `rollback` causes an error, for databases that do not support rollback properly (for example MySQL with the default settings). For *database-types* other than `:mysql` *signal-rollback-errors* is ignored and such an error is always signalled. For *database-type* `:mysql` *signal-rollback-errors* is interpreted as follows:

<code>nil</code>	Ignore the error.
<code>:default</code>	If <i>default-table-type</i> is <code>:support-transactions</code> , "innodb" or "bdb", then rollback errors are signalled. Otherwise rollback errors are not signalled.

Function designator

The function *signal-rollback-errors* should take two arguments: the database object and a string (for an error message). The function is called when a rollback signalled an error.

The default value of *signal-rollback-errors* is `:default`.

default-table-type specifies the default value of the `:type` argument to `create-table`. See `create-table` for details. The default value of *default-table-type* is `nil`.

default-table-extra-options specifies the default value of the `:extra-options` argument to `create-table`. See `create-table` for details. The default value of *default-table-extra-options* is `nil`.

date-string-format specifies which format to use to represent dates. If the value is a string, it should be appropriate for the *database-type*. The value `:standard` means that the standard SQL date format is used. If the value is `nil` (the default), then the date format is not changed. Currently only *database-type* `:oracle` uses the value of *date-string-format*, and in this case it must be a valid date format string for Oracle.

sql-mode specifies the mode of the SQL connection for *database-type* `:mysql`. By default (that is, when *sql-mode* is not supplied) `connect` sets the mode of the connection to ANSI, by executing this statement:

```
"set sql_mode='ansi'"
```

sql-mode can be supplied as `nil`, in which case no statement is executed. Otherwise it should be a string which is a valid setting for `sql_mode`, and then `connect` executes the statement:

```
set sql_mode='sql-mode'
```

When *database-type* is not `:mysql`, *sql-mode* is ignored.

prefetch-rows-number and *prefetch-memory* are used when *database-type* is `:oracle`, and specify the amount of data to prefetch when performing queries. *prefetch-rows-number* is the number of rows to prefetch, with default value 100. *prefetch-memory* is the maximum number of bytes to prefetch, with default value #x100000. *prefetch-rows-number* and *prefetch-memory* can both also have the value `:default`, which allows the database to choose the amount to prefetch.

Compatibility Note	LispWorks 4.4 (and previous versions) use <i>connection-spec</i> passed to <code>connect</code> as the database name. <code>connect</code> checks if a connection with this name already exists (according to the value of <i>if-exists</i>). <code>find-database</code> can be used to find a database using this name. LispWorks 5.0 (and later versions) does not use <i>connection-spec</i> as the name. Instead, by default it generates a name from the <i>connection-spec</i> . The name is intended to be unique (by including a counter). Thus normally <code>connect</code> will not find an existing connection even if it is called again with identical value of <i>connection-spec</i> .
Example	The following example connects LispWorks to the <code>info</code> database. <code>(connect "info")</code> The next example connects to the ODBC database <code>personnel</code> using the username "admin" and the password "secret". <code>(connect "personnel/admin/secret" :database-type :odbc)</code> The next example opens a connection to MySQL which treats quotes as in ANSI but does not set other ANSI features: <code>(sql:connect "me/mypassword/mydb" :sql-mode "ANSI_QUOTES")</code>
See also	<code>*default-database*</code> <code>*default-database-type*</code> <code>connected-databases</code> <code>*connect-if-exists*</code> <code>database-name</code> <code>disconnect</code> <code>find-database</code> <code>reconnect</code> <code>status</code>

This chapter applies to the Enterprise Edition only

connect-if-exists		<i>Variable</i>
Summary	The default value for the <i>if-exists</i> keyword of the <code>connect</code> function.	
Package	<code>sql</code>	
Initial Value	<code>:error</code>	
Description	The variable <code>*connect-if-exists*</code> is the default value for the <i>if-exists</i> keyword of the <code>connect</code> function. It can take the following values:	
<code>:new</code>	Instructs <code>connect</code> to make a new connection even if connections to the same database already exist.	
<code>:warn-new</code>	Instructs <code>connect</code> to make a new connection but warn about existing connections.	
<code>:error</code>	Instructs <code>connect</code> to make a new connection but signal an error for existing connections.	
<code>:warn-old</code>	Instructs <code>connect</code> to select an old connection if one exists (and warns) or make a new one.	
<code>:old</code>	Instructs <code>connect</code> to select an old connection if one exists or make a new one.	
See also	<code>connect</code>	

connected-databases		<i>Function</i>
Summary	Returns a list of connected databases.	
Package	<code>sql</code>	
Signature	<code>connected-databases => database-list</code>	

Arguments	None.
Values	<code>database-list</code> A list of connected databases.
Description	The function <code>connected-databases</code> returns a list of the databases LispWorks is connected to.
See also	<code>connect</code> <code>disconnect</code> <code>status</code> <code>find-database</code> <code>database-name</code>

create-index *Function*

Summary	Creates an index for a table.										
Package	<code>sql</code>										
Signature	<code>create-index name &key on unique attributes database =></code>										
Arguments	<table> <tr> <td><code>name</code></td> <td>The name of the index.</td> </tr> <tr> <td><code>on</code></td> <td>The name of a table.</td> </tr> <tr> <td><code>unique</code></td> <td>A boolean.</td> </tr> <tr> <td><code>attributes</code></td> <td>A list of attributes.</td> </tr> <tr> <td><code>database</code></td> <td>A database.</td> </tr> </table>	<code>name</code>	The name of the index.	<code>on</code>	The name of a table.	<code>unique</code>	A boolean.	<code>attributes</code>	A list of attributes.	<code>database</code>	A database.
<code>name</code>	The name of the index.										
<code>on</code>	The name of a table.										
<code>unique</code>	A boolean.										
<code>attributes</code>	A list of attributes.										
<code>database</code>	A database.										
Values	None.										
Description	The function <code>create-index</code> creates an index called <code>name</code> on the table specified by <code>on</code> . The attributes of the table to index are given by <code>attributes</code> . Setting <code>unique</code> to <code>t</code> includes <code>UNIQUE</code> in the SQL index command, specifying that the columns indexed must contain unique values.										

This chapter applies to the Enterprise Edition only

The default value of *unique* is `nil`. The default value of *database* is `*default-database*`.

Example `(create-index [manager]
 :on [emp] :unique t :attributes '([ename] [sal]))`

See also `*default-database*`
`drop-index`
`create-table`

create-table

Function

Summary Creates a table.

Package `sql`

Signature `create-table name description &key database type extra-options`

Arguments `name` The name of the table.

`description` The table properties.

`database` A database.

`type` A string or the keyword
`:support-transactions`, or `nil`.

`extra-options` A string or `nil`.

Values None.

Description The function `create-table` creates a table called *name* and defines its columns and other properties with *description*. The argument *description* is a list containing lists of attribute-name and type information pairs.

The default value of *database* is `*default-database*`.

type and *extra-options* are treated in a *database-type* specific way. Currently only *database-type* :mysql uses these options, as follows.

If *type* is not supplied, it defaults to the value (if any) of *default-table-type* that was supplied to `connect`. If *extra-options* is not supplied, it defaults to the value (if any) of *default-table-extra-options* that was supplied to `connect`.

type, if non-nil, is used as argument to TYPE in the SQL statement:

```
create table MyTable (column-specs) TYPE = type
```

except that if *type* is :support-transactions then `createtable` will attempt to make tables that support transactions, by using the type innodb.

extra-options (if non-nil) is appended in the end of this SQL statement.

When *database-type* is not :mysql, *type* and *extra-options* are ignored.

Example

The following code:

```
(create-table [manager]
  '(([id] (char 10) not-null)
    ([salary] (number 8 2))))
```

is equivalent to the following SQL:

```
CREATE TABLE MANAGER
  (ID CHAR(10) NOT NULL, SALARY NUMBER(8,2))
```

See also

```
connect
*default-database*
drop-table
```

create-view

Function

Summary

Creates a view using a specified query.

This chapter applies to the Enterprise Edition only

Package	<code>sql</code>						
Signature	<code>create-view name &key as column-list with-check-option database =></code>						
Arguments	<table><tr><td><code>name</code></td><td>The view to be created.</td></tr><tr><td><code>as</code></td><td>An SQL query statement.</td></tr><tr><td><code>column-list</code></td><td>A list.</td></tr></table>	<code>name</code>	The view to be created.	<code>as</code>	An SQL query statement.	<code>column-list</code>	A list.
<code>name</code>	The view to be created.						
<code>as</code>	An SQL query statement.						
<code>column-list</code>	A list.						
	<i>with-check-option</i>						
	A boolean.						
	<code>database</code>						
	A database.						
Values	None.						
Description	<p>The <code>create-view</code> function creates a view called <code>name</code> using the <code>as</code> query and the optional <code>column-list</code> and <code>with-check-option</code>. The <code>column-list</code> argument is a list of columns to add to the view. The <code>with-check-option</code> adds <code>WITH CHECK OPTION</code> to the resulting SQL.</p> <p>The default value of <code>with-check-option</code> is <code>nil</code>. The default value of <code>database</code> is <code>*default-database*</code>.</p>						
Example	This example creates the view <code>manager</code> with the records in the employee table whose department is 50.						
	<pre>(create-view [manager] :as [select [*] :from [emp] :where [= [dept] 50]])</pre>						
See also	<code>create-index</code> <code>create-table</code> <code>*default-database*</code> <code>drop-view</code>						

		<i>Function</i>
Summary		Creates a view in a database based on a class that defines the view.
Package		<code>sql</code>
Signature		<code>create-view-from-class class &key database =></code>
Arguments	<i>class</i>	A class.
	<i>database</i>	A database.
Values		None.
Description		The function <code>create-view-from-class</code> creates a view in <i>database</i> based on <i>class</i> which defines the view. The argument <i>database</i> has a default value of <code>*default-database*</code> .
See also		<code>*default-database*</code> <code>drop-view-from-class</code> <code>create-view</code>

		<i>Function</i>
Summary		Returns the name of a database.
Package		<code>sql</code>
Signature		<code>database-name database => connection</code>
Arguments	<i>database</i>	A database.
Values	<i>connection</i>	A string.
Description		The function <code>database-name</code> returns the name of the database specified by <i>database</i> .

This chapter applies to the Enterprise Edition only

See also

`connect`
`disconnect`
`connected-databases`
`find-database`
`status`

default-database

Variable

Summary The default database in database operations.

Package `sql`

Initial Value `nil`

Description The variable `*default-database*` is set by `connect` and specifies the default database to be used for database operations.

See also `connect`

default-database-type

Variable

Summary Specifies the default type of database.

Package `sql`

Initial Value `nil`

Description The variable `*default-database-type*` specifies the default type of database. You can set this or it is initialized by the `initialize-database-type` function.

LispWorks supports the values shown in “Supported databases” on page 221.

See also [initialize-database-type](#)

default-update-objects-max-len *Variable*

Summary	The default maximum number of objects supplying data for a query when updating remote joins.
Package	<code>sql</code>
Initial Value	<code>nil</code>
Description	The variable <code>*default-update-objects-max-len*</code> provides the default value of the <i>max-len</i> argument in the function <code>update-objects-joins</code> .
See also	<code>update-objects-joins</code>

def-view-class *Macro*

Summary	Extends the syntax of <code>defclass</code> to allow specified slots to be mapped onto the attributes of database views.								
Package	<code>sql</code>								
Signature	<code>def-view-class name superclasses slots &rest class-options => class</code>								
Arguments	<table><tr><td><i>name</i></td><td>A class name.</td></tr><tr><td><i>superclasses</i></td><td>The superclasses of the class to be created.</td></tr><tr><td><i>slots</i></td><td>The slot definitions of the new class.</td></tr><tr><td><i>class-options</i></td><td>The class options of the new class.</td></tr></table>	<i>name</i>	A class name.	<i>superclasses</i>	The superclasses of the class to be created.	<i>slots</i>	The slot definitions of the new class.	<i>class-options</i>	The class options of the new class.
<i>name</i>	A class name.								
<i>superclasses</i>	The superclasses of the class to be created.								
<i>slots</i>	The slot definitions of the new class.								
<i>class-options</i>	The class options of the new class.								
Values	<table><tr><td><i>class</i></td><td>The defined class.</td></tr></table>	<i>class</i>	The defined class.						
<i>class</i>	The defined class.								

Slot Options	The slot options for <code>def-view-class</code> are <code>:db-kind</code> and <code>:db-info</code> . In addition the slot option <code>:type</code> is treated specially for View Classes. <code>:db-kind</code> may be one of <code>:base</code> , <code>:key</code> , <code>:join</code> , or <code>:virtual</code> . The default is <code>:base</code> . Each value is described below:
<code>:base</code>	This indicates that this slot corresponds to an ordinary attribute of the database view. You can name the database attribute by using the keyword <code>:column</code> . By default, the database attribute is named by the slot.
<code>:key</code>	This indicates that this slot corresponds to part of the unique key for this view. A <code>:key</code> slot is also a <code>:base</code> slot. All View Classes must have <code>:key</code> fields that uniquely distinguish the instances, to maintain object identity.
<code>:join</code>	To specify a key which spans multiple slots, each of the slots should have <code>:db-kind :key</code> . The underlying requirement is that tuples of the form (key1 ... keyN) are unique. The <code>:db-kind :key</code> slots do not need to be keys in the table.
<code>:virtual</code>	This indicates that this slot corresponds to a join. A slot of this type will contain View Class objects.

A join is defined by the slot option `:db-info`, which takes a list. Items in the list may be:

`:join-class class-name`

This is the class to join on.

:home-key slot-name

This is the slot of the defining class to be a subject for the join. The argument *slot-name* may be an element or a list of elements, where elements can be symbols, `nil`, strings, integers or floats.

:foreign-key slot-name

This is the name of the slot of the `:join-class` to be a subject for the join. The *slot-name* may be an element or a list of elements, where elements can be symbols, `nil`, strings, integers or floats.

:target-slot target-slot

This is the name of a `:join` slot in `:join-class`. This is optional and is only specified if you want the defining slot to contain instances of this target slot as opposed to those of `:join-class`. The actual behavior depends on the value of *set*. An example of its usage is when the `:join-class` is an intermediate class and you are really only interested in it as a route to the `:target-slot`.

:retrieval retrieval-time

retrieval-time can be `:deferred`, which defers filling this slot from the database until the slot itself is accessed. This is the default value.

retrieval-time can alternatively be `:immediate` which generates the join SQL for this slot whenever a query is generated on the class. In other words, this is an intermediate class only, which is present for the

purpose of joining two entities of other classes together. When *retrieval-time* is `:immediate`, then *set* is `nil`.

`:set set`

When *set* is `t` and *target-slot* is defined, the slot will contain a list of pairs (*target-value join-instance*) where *target-value* is the value of the target slot and *join-instance* is the corresponding instance of the join class.

When *set* is `t` and *target-slot* is undefined, the slot will contain a list of instances of the join class.

When *set* is `nil` the slot will contain a single instance.

The default value of *set* is `t`.

The syntax for `:home-key` and `:foreign-key` means that an object from a join class will only be included in the join slot if the values from *home-key* are *equal* to the values in *foreign-key*, in order. These values are calculated as follows: if the element in the list is a symbol it is taken to be a slot name and the value of the slot is used, otherwise the element is taken to be the value. See the second example below.

The `:type` slot option is treated specially for View Classes. There is a need for stringent type-checking in View Classes because of the translation into database data, and therefore `:type` is mandatory for slots with `:db-kind :base` or `:key`. Some methods are provided for type checking and type conversion. For example, a `:type` specifier of `(string 10)` in SQL terms means allow a character type value with length of less than or equal to 10. The following Lisp types are accepted for *type*, and correspond to the SQL type shown:

<code>(string n)</code>	CHAR(n)
<code>integer</code>	INTEGER
<code>(integer n)</code>	INTEGER(n)

<code>float</code>	<code>FLOAT</code>
<code>(float n)</code>	<code>FLOAT(n)</code>
<code>sql:universal-time</code>	<code>TIMESTAMP</code>

Class Options `def-view-class` recognizes the following class options in addition to the standard class options defined for `defclass`:

`(:base-table table-name)`

The slots of the class *name* will be read from the table *table-name*. If you do not specify the `:base-table` option, then *table-name* defaults to the name of the class.

Description The macro `def-view-class` creates a class called *name* which maps onto a database view. Such a class is called a View Class.

The macro `def-view-class` extends the syntax of `defclass` to allow special *base slots* to be mapped onto the attributes of database views (presently single tables). When a `select` query that names a View Class is submitted, then the corresponding database view is queried, and the slots in the resulting View Class instances are filled with attribute values from the database.

If *superclasses* is `nil` then `standard-db-object` automatically becomes the superclass of the newly-defined View Class. If *superclasses* is `nil`, it must include `standard-db-object`.

Examples The following example shows a class corresponding to the traditional employees table, with the employee's department given by a join with the departments table.

This chapter applies to the Enterprise Edition only

```
(def-view-class employee (standard-db-object)
  ((employee-number :db-kind :key
                    :column empno
                    :type integer)
   (employee-name :db-kind :base
                  :column ename
                  :type (string 20)
                  :accessor employee-name)
   (employee-department :db-kind :base
                         :column deptno
                         :type integer
                         :accessor employee-department)
   (employee-job :db-kind :base
                 :column job
                 :type (string 9))
   (employee-manager :db-kind :base
                     :column mgr
                     :type integer)
   (employee-location :db-kind :join
                       :db-info (:join-class department
                                         :retrieval :deferred
                                         :set nil
                                         :home-key
                                         employee-department
                                         :foreign-key
                                         department-number
                                         :target-slot
                                         department-loc)
                       :accessor employee-location))
  (:base-table emp))
```

The following example illustrates how elements or lists of elements can follow :**home-key** and :**foreign-key** in the :**db-info** slot option.

```
(def-view-class flex-schema ()
  ((name      :type (string 8) :db-kind :key)
   (description :type (string 256))
   (classes :db-kind :join
             :db-info (:home-key name
                               :foreign-key schema-name
                               :join-class flex-class
                               :retrieval :deferred)))
  (:base-table flex_schema))
```

```

(def-view-class flex-class ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (name       :type (string 32) :db-kind :key)
   (base-name  :type (string 64) :column base_name)
   (super-classes :db-kind :join
     :db-info (:home-key
               (schema-name name)
               :foreign-key
               (schema-name class-name)
               :join-class
               flex-superclass
               :retrieval :deferred))
   (schema :db-kind :join
     :db-info (:home-key schema-name
                           :foreign-key name
                           :join-class flex-schema
                           :set nil))
   (properties :db-kind :join
     :db-info (:home-key (schema-name name ""))
               :foreign-key
               (schema-name class-name slot-name)
               :join-class flex-property
               :retrieval :deferred)))
  (:base-table flex_class))

(def-view-class flex-slot ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (class-name :type (string 32) :db-kind :key
     :column class_name)
   (name       :type (string 32) :db-kind :key)
   (class :db-kind :join
     :db-info (:home-key (schema-name class-name)
                           :foreign-key (schema-name name)
                           :join-class flex-class
                           :set nil))
   (properties :db-kind :join
     :db-info (:home-key
               (schema-name class-name name)
               :foreign-key
               (schema-name class-name slot-name)
               :join-class flex-property
               :retrieval :deferred)))
  (:base-table flex_slot))

```

This chapter applies to the Enterprise Edition only

```
(def-view-class flex-property ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (class-name :type (string 32) :db-kind :key
     :column class_name)
   (slot-name :type (string 32) :db-kind :key
     :column slot_name)
   (property :type (string 32) :db-kind :key)
   (values :db-kind :join
     :db-info (:home-key
       (schema-name class-name
         slot-name property)
       :foreign-key
       (schema-name class-name
         slot-name property)
       :join-class flex-property-value
       :retrieval :deferred)))
  (:base-table flex_property))

(def-view-class flex-property-value ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (class-name :type (string 32) :db-kind :key
     :column class_name)
   (slot-name :type (string 32) :column slot_name)
   (property :type (string 32) :db-kind :key)
   (order :type integer)
   (value :type (string 128)))
  (:base-table flex_property_value))
```

See also

[create-view-from-class](#)
[delete-instance-records](#)
[drop-view-from-class](#)
[standard-db-object](#)
[update-record-from-slot](#)
[update-records-from-instance](#)

delete-instance-records

Generic Function

Summary Deletes records corresponding to View Class instances.

Package `sql`

Signature	<code>delete-instance-records <i>instance</i> =></code>
Arguments	<code><i>instance</i></code> An instance of a View Class.
Values	None.
Description	The <code>delete-instance-records</code> function deletes the records represented by <i>instance</i> from the database associated with it. If <i>instance</i> has no associated database, <code>delete-instance-records</code> signals an error.
See also	<code>update-records</code> <code>update-records-from-instance</code>

delete-records		<i>Function</i>
Summary	Deletes rows from a database table.	
Package	<code>sql</code>	
Signature	<code>delete-records &key <i>from where database</i> =></code>	
Arguments	<code><i>from</i></code>	A database table.
	<code><i>where</i></code>	An SQL conditional statement.
	<code><i>database</i></code>	A database.
Values	None.	
Description	The <code>delete-records</code> function deletes rows from a table specified by <i>from</i> in which the <i>where</i> condition is true. The argument <i>database</i> specifies a database from which the records are to be removed, and defaults to <code>*default-database*</code> .	

This chapter applies to the Enterprise Edition only

See also *default-database*
 insert-records
 update-records

delete-sql-stream		Function
Summary	Deletes a stream from the broadcast list for SQL commands or results traffic.	
Package	<code>sql</code>	
Signature	<code>delete-sql-stream stream &key type database => deleted-stream</code>	
Arguments	<code>stream</code>	A stream or <code>t</code> .
	<code>type</code>	A keyword.
	<code>database</code>	A database.
Values	<code>deleted-stream</code>	The argument <code>stream</code> .
Description	<p>The function <code>delete-sql-stream</code> deletes the stream <code>stream</code> from the list of streams which receive SQL commands or results traffic.</p> <p>To remove <code>*standard-output*</code> from the list, pass <code>stream t</code>.</p> <p>The keyword <code>type</code> is <code>:commands</code>, <code>:results</code> or <code>:both</code>. It determines whether a stream for SQL commands traffic, results traffic, or both is deleted.</p> <p>The default value of <code>type</code> is <code>:commands</code>. The default value for <code>database</code> is the value of <code>*default-database*</code>.</p>	
See also	<code>add-sql-stream</code> <code>*default-database*</code> <code>list-sql-streams</code> <code>sql-recording-p</code> <code>sql-stream</code>	

```
start-sql-recording
stop-sql-recording
```

disable-sql-reader-syntax Function

Summary	Turns off square bracket syntax.
Package	<code>sql</code>
Signature	<code>disable-sql-reader-syntax =></code>
Arguments	None.
Values	None.
Description	The function <code>disable-sql-reader-syntax</code> turns off square bracket syntax and sets state so that <code>restore-sql-reader-syntax-state</code> will make the syntax disabled if it is consequently enabled.
See also	<code>enable-sql-reader-syntax</code> <code>locally-disable-sql-reader-syntax</code> <code>locally-enable-sql-reader-syntax</code> <code>restore-sql-reader-syntax-state</code>

disconnect Function

Summary	Closes a connection to a database.				
Package	<code>sql</code>				
Signature	<code>disconnect &key database error => success</code>				
Arguments	<table> <tr> <td><code>database</code></td> <td>A database.</td> </tr> <tr> <td><code>error</code></td> <td>A boolean.</td> </tr> </table>	<code>database</code>	A database.	<code>error</code>	A boolean.
<code>database</code>	A database.				
<code>error</code>	A boolean.				

This chapter applies to the Enterprise Edition only

Values	<code>success</code>	A boolean.
Description		<p>The function <code>disconnect</code> closes a connection to a database specified by <i>database</i>. If successful, <i>success</i> is <code>t</code> and if only one other connection exists, <code>*default-database*</code> is reset.</p> <p>The default value for <i>database</i> is <code>*default-database*</code>. If <i>database</i> is a database object, then it is used directly. Otherwise, the list of connected databases is searched to find one with <i>database</i> as its connection specifications (see <code>connect</code>). If no such database is found, then if <i>error</i> and <i>database</i> are both non-nil an error is signaled, otherwise <code>disconnect</code> returns <code>nil</code>.</p>
Example		<code>(disconnect :database "test")</code>
See also		<code>connect</code> <code>connected-databases</code> <code>database-name</code> <code>*default-database*</code> <code>find-database</code> <code>reconnect</code> <code>status</code>

		<i>Macro</i>
do-query		
Summary		Repeatedly binds a set of variables to the results of a query, and executes a body of code using the bound variables.
Package		<code>sql</code>
Signature		<code>do-query ((&rest args) query &key database not-inside-transaction get-all) &body body =></code>
Arguments	<code>args</code>	A set of variables.
	<code>query</code>	A database query.

	<i>database</i>	A database.
	<i>not-inside-transaction</i>	A generalized boolean.
	<i>get-all</i>	A generalized boolean.
	<i>body</i>	A Lisp code body.
Values		None.
Description		<p>The macro <code>do-query</code> repeatedly executes <code>body</code> within a binding of <code>args</code> on the attributes of each record resulting from <code>query</code>. <code>do-query</code> returns no values.</p> <p>The default value of <code>database</code> is <code>*default-database*</code>.</p> <p><i>not-inside-transaction</i> and <code>get-all</code> may be useful when fetching many records through a connection with <code>database-type :mysql</code>. Both of these arguments have default value <code>nil</code>. See the section “Special considerations for iteration functions and macros” on page 255 for details.</p>
Example		<p>The following code repeatedly binds the result of selecting an entry in <code>ename</code> from the table <code>emp</code> to the variable <code>name</code>, and then prints <code>name</code> using the Lisp function <code>print</code>.</p> <pre>(do-query ((name) [select [ename] :from [emp]]) (print name))</pre>
See also		<p><code>loop</code> <code>map-query</code> <code>query</code> <code>select</code> <code>simple-do-query</code></p>
drop-index		<i>Function</i>
Summary		Deletes an index from a database.

This chapter applies to the Enterprise Edition only

Package	<code>sql</code>				
Signature	<code>drop-index index &key database =></code>				
Arguments	<table><tr><td><code>index</code></td><td>The name of an index.</td></tr><tr><td><code>database</code></td><td>A database.</td></tr></table>	<code>index</code>	The name of an index.	<code>database</code>	A database.
<code>index</code>	The name of an index.				
<code>database</code>	A database.				
Values	None.				
Description	<p>The function <code>drop-index</code> deletes <i>index</i> from <i>database</i>. The default value of <i>database</i> is <code>*default-database*</code>.</p>				
See also	<code>create-index</code> <code>drop-table</code>				

drop-table *Function*

Summary	Deletes a table from a database.				
Package	<code>sql</code>				
Signature	<code>drop-table table &key database =></code>				
Arguments	<table><tr><td><code>table</code></td><td>The name of a table.</td></tr><tr><td><code>database</code></td><td>A database.</td></tr></table>	<code>table</code>	The name of a table.	<code>database</code>	A database.
<code>table</code>	The name of a table.				
<code>database</code>	A database.				
Values	None.				
Description	<p>The function <code>drop-table</code> deletes <i>table</i> from a <i>database</i>. The default value of <i>database</i> is <code>*default-database*</code>.</p>				
See also	<code>create-table</code> <code>*default-database*</code>				

		<i>Function</i>
drop-view		
Summary	Deletes a view from a database.	
Package	<code>sql</code>	
Signature	<code>drop-view view &key database =></code>	
Arguments	<code>view</code> A view. <code>database</code> A database.	
Values	None.	
Description	<p>The function <code>drop-view</code> deletes <code>view</code> from <code>database</code>.</p> <p>The default value of <code>database</code> is <code>*default-database*</code>.</p> <p>Note: <code>DROP VIEW</code> is not implemented in MS Access SQL, so <code>drop-view</code> does not work with that database. Use <code>drop-table</code> instead.</p>	
See also	<code>create-view</code> <code>*default-database*</code> <code>drop-index</code> <code>drop-table</code>	

		<i>Function</i>
drop-view-from-class		
Summary	Deletes a view from a database based on a class defining the view.	
Package	<code>sql</code>	
Signature	<code>drop-view-from-class class &key database =></code>	
Arguments	<code>class</code> A class. <code>database</code> A database.	

This chapter applies to the Enterprise Edition only

Values	None.
Description	The function <code>drop-view-from-class</code> deletes a view or base table from <i>database</i> based on <i>class</i> which defines that view. The argument <i>database</i> has a default value of <code>*default-database*</code> .
See also	<code>create-view-from-class</code> <code>*default-database*</code> <code>drop-view</code>

	<i>Function</i>
enable-sql-reader-syntax	
Summary	Turns on square bracket SQL syntax.
Package	<code>sql</code>
Signature	<code>enable-sql-reader-syntax =></code>
Arguments	None.
Values	None.
Description	The function <code>enable-sql-reader-syntax</code> turns on square bracket syntax and sets the state so that <code>restore-sql-reader-syntax-state</code> will make the syntax enabled if it is subsequently disabled.
See also	<code>disable-sql-reader-syntax</code> <code>locally-disable-sql-reader-syntax</code> <code>locally-enable-sql-reader-syntax</code> <code>restore-sql-reader-syntax-state</code>

		<i>Function</i>
	execute-command	
Summary		Executes an SQL expression.
Package		<code>sql</code>
Signature		<code>execute-command sql-exp &key database =></code>
Arguments	<code>sql-exp</code> <code>database</code>	Any SQL statement other than a query. A database.
Values		None.
Description		<p>The function <code>execute-command</code> executes the SQL command specified by <code>sql-exp</code> for the database specified by <code>database</code>, which has a default value of <code>*default-database*</code>. The argument <code>sql-exp</code> may be any SQL statement other than a query.</p> <p>To run a stored procedure, pass an appropriate string. The call to the procedure needs to be wrapped in a PL/SQL <code>BEGIN</code> <code>END</code> pair, for example:</p> <pre>(sql:execute-command "BEGIN my_procedure(1, 'foo'); END;")</pre>
See also		<code>*default-database*</code> <code>query</code>

		<i>Function</i>
	find-database	
Summary		Returns a database, given a database or database name.
Package		<code>sql</code>
Signature		<code>find-database database &optional errorp => database, count</code>
Arguments	<code>database</code>	A string or a database.

This chapter applies to the Enterprise Edition only

	<i>errorp</i>	A boolean. Default value: t.
Values	<i>database</i>	A database.
	<i>count</i>	An integer.
Description		The function <code>find-database</code> , given a string <i>database</i> , searches amongst the connected databases for one matching the name <i>database</i> . If there is exactly one such database, it is returned and the second return value <i>count</i> is 1. If more than one databases match and <i>errorp</i> is nil, then the most recently connected of the matching databases is returned and <i>count</i> is the number of matches. If no matching database is found and <i>errorp</i> is nil, then nil is returned. If none, or more than one, matching databases are found and <i>errorp</i> is true, then an error is signalled. If the argument <i>database</i> is a database, it is simply returned.
See also		<code>connect</code> <code>connected-databases</code> <code>database-name</code> <code>disconnect</code> <code>status</code>

		<i>Function</i>
Summary		Initializes a database type.
Package		<code>sql</code>
Signature		<code>initialize-database-type &key database-type => type</code>
Arguments	<i>database-type</i>	A database type.
Values	<i>type</i>	A database type.

Description	The function <code>initialize-database-type</code> initializes a database type by loading code and appropriate database libraries according to the value of <code>database-type</code> . If <code>*default-database-type*</code> is not initialized, this function initializes it. It adds <code>database-type</code> to the list of initialized types. The initialized database type is returned.
Example	The following example shows how to use <code>initialize-database-type</code> to initialize the <code>:odbc</code> database type.
	<pre>(require "odbc") (in-package sql) (setf *default-database-type* :odbc) (initialize-database-type) (print *initialized-database-types*)</pre>

The ODBC database type is now initialized, and connections can be made to ODBC databases.

See also	<code>database-name</code> <code>*initialized-database-types*</code> <code>*default-database-type*</code>
----------	---

initialized-database-types *Variable*

Summary	A list of initialized database types.
Package	<code>sql</code>
Initial Value	<code>nil</code>
Description	The variable <code>*initialized-database-types*</code> contains a list of database types that have been initialized by calls to <code>initialize-database-type</code> .
See also	<code>initialize-database-type</code>

insert-records	<i>Function</i>												
Summary	Inserts a set of values into a table.												
Package	<code>sql</code>												
Signature	<code>insert-records &key into attributes values av-pairs query database</code>												
Arguments	<table><tr><td><code>into</code></td><td>A database table.</td></tr><tr><td><code>values</code></td><td>A list of values, or <code>nil</code></td></tr><tr><td><code>attributes</code></td><td>A list of attributes, or <code>nil</code></td></tr><tr><td><code>av-pairs</code></td><td>A list of two-element lists, or <code>nil</code>.</td></tr><tr><td><code>query</code></td><td>A query expression, or <code>nil</code>.</td></tr><tr><td><code>database</code></td><td>A database.</td></tr></table>	<code>into</code>	A database table.	<code>values</code>	A list of values, or <code>nil</code>	<code>attributes</code>	A list of attributes, or <code>nil</code>	<code>av-pairs</code>	A list of two-element lists, or <code>nil</code> .	<code>query</code>	A query expression, or <code>nil</code> .	<code>database</code>	A database.
<code>into</code>	A database table.												
<code>values</code>	A list of values, or <code>nil</code>												
<code>attributes</code>	A list of attributes, or <code>nil</code>												
<code>av-pairs</code>	A list of two-element lists, or <code>nil</code> .												
<code>query</code>	A query expression, or <code>nil</code> .												
<code>database</code>	A database.												
Values	None.												
Description	<p>The function <code>insert-records</code> inserts records into the table <i>into</i>. The records created contain <i>values</i> for <i>attributes</i> (or <i>av-pairs</i>). The argument <i>values</i> is a list of values. If <i>attributes</i> is supplied then <i>values</i> must be a corresponding list of values for each of the listed attribute names. If <i>av-pairs</i> is non-nil, then both <i>attributes</i> and <i>values</i> must be <code>nil</code>. If <i>query</i> is non-nil, then neither <i>values</i> nor <i>av-pairs</i> should be. <i>query</i> should be a query expression, and the attribute names in it must also exist in the table <i>into</i>. The default value of <i>database</i> is <code>*default-database*</code>.</p>												
Example	In the first example, the Lisp expression												

```
(insert-records :into [person]
  :values '("abc" "Joe" "Bloggs" 10000 3000 nil
           "plumber"))
```

is equivalent to the following SQL:

```
INSERT INTO PERSON
  VALUES ('abc','Joe',
          'Bloggs',10000,3000,NULL,'plumber')
```

In the second example, the LispWorks expression

```
(insert-records :into [person]
  :attributes '(person_id income surname occupation)
  :values '("aaa" 10 "jim" "plumb"))
```

is equivalent to the following SQL:

```
INSERT INTO PERSON
  (PERSON_ID,INCOME,SURNAME,OCCUPATION)
  VALUES ('aaa',10,'jim','plumb')
```

The following example demonstrates how to use :av-pairs.

```
(insert-records :into [person] :av-pairs
  '((person_id "bbb") (surname "Jones")))
```

See also

- *default-database*
- delete-records
- update-records

instance-refreshed

Generic Function

Summary	Provides a hook for user code on View Class instance updates.
---------	---

Package	sql
---------	-----

Signature	<code>instance-refreshed <i>instance</i></code>
-----------	---

Arguments	<code><i>instance</i></code>	An instance of a View Class.
-----------	------------------------------	------------------------------

This chapter applies to the Enterprise Edition only

Values	None.
Description	<p>The function <code>instance-refreshed</code> is called inside <code>select</code> when its <code>refresh</code> argument is true and the instance <code>instance</code> has just been updated.</p> <p>The supplied method on <code>standard-db-object</code> does nothing. If your application needs to take action when a View Class instance has been updated by</p> <pre>(select ... :refresh t)</pre> <p>then add an <code>instance-refresh</code> method specializing on your subclass of <code>standard-db-object</code>.</p>
See also	<code>def-view-class</code> <code>select</code>

list-attribute-types *Function*

Summary	Returns type information for a table's attributes.	
Package	<code>sql</code>	
Signature	<code>list-attribute-types table &key database owner => result</code>	
Arguments	<code>table</code>	A table.
	<code>database</code>	A database.
	<code>owner</code>	<code>nil</code> , <code>:all</code> or a string.
Values	<code>result</code>	A list.
Description	<p>The function <code>list-attribute-types</code> returns type information for the attributes in the table given by <code>table</code>. <code>database</code> has a default value of <code>*default-database*</code>.</p>	

If *owner* is `nil`, only user-owned attributes are considered.
This is the default.

If *owner* is `:all`, all attributes are considered.

If *owner* is a string, this denotes a username and only attributes owned by *owner* are considered.

result is a list in which each element is a list (*attribute datatype precision scale nullable*). *attribute* is a string denoting the attribute name. *datatype* is the vendor-specific type as described in `attribute-type`. *nullable* is 1 if the attribute accepts the value `NULL`, and 0 otherwise.

Example

To print the type of every attribute in the database, do

```
(loop for tab in
      (sql:list-tables)
      do
        (loop for type-info in
              (sql:list-attribute-types tab)
              do
                (format t "~&Table ~S Attribute ~S Type ~S"
                        tab
                        (first type-info)
                        (second type-info))))
```

See also

`attribute-type`
`list-attributes`

list-attributes

Function

Summary Returns a list of attributes from a table in a database.

Package `sql`

Signature `list-attributes table &key database owner => result`

Arguments `table` A table in the database.

`database` A database.

This chapter applies to the Enterprise Edition only

	<i>owner</i>	<code>nil</code> , <code>:all</code> or a string.
Values	<i>result</i>	A list of attributes.
Description		The function <code>list-attributes</code> returns a list of attributes from <i>table</i> in <i>database</i> , which has a default value of <code>*default-database*</code> . If <i>owner</i> is <code>nil</code> , only user-owned attributes are considered. This is the default. If <i>owner</i> is <code>:all</code> , all attributes are considered. If <i>owner</i> is a string, this denotes a username and only attributes owned by <i>owner</i> are considered.
See also		<code>attribute-type</code> <code>list-attribute-types</code> <code>list-tables</code>

		<i>Function</i>
Summary		Returns a list of View Classes connected to a given database.
Package		<code>sql</code>
Signature		<code>list-classes &key database root-class test => result-list</code>
Arguments	<i>database</i>	A database.
	<i>root-class</i>	A class.
	<i>test</i>	A test function.
Values	<i>result-list</i>	A list of class objects.
Description		The function <code>list-classes</code> collects all the classes below <i>root-class</i> (which defaults to <code>standard-db-object</code>) that are connected to the given database specified by <i>database</i> , and which

satisfy the *test* function. The default for the *test* argument is `cl:identity`.

By default, `list-classes` returns a list of all the classes connected to the default database, `*default-database*`.

	<i>Function</i>				
Summary	Returns the broadcast list of streams recording SQL commands or results traffic.				
Package	<code>sql</code>				
Signature	<code>list-sql-streams &key type database => streams</code>				
Arguments	<table> <tr> <td><i>type</i></td><td>A keyword.</td></tr> <tr> <td><i>database</i></td><td>A database.</td></tr> </table>	<i>type</i>	A keyword.	<i>database</i>	A database.
<i>type</i>	A keyword.				
<i>database</i>	A database.				
Values	<i>streams</i> A list.				
Description	<p>The function <code>list-sql-streams</code> returns the broadcast list of streams recording SQL commands or results traffic.</p> <p>Each element of <i>streams</i> is a stream or the symbol <code>t</code>, denoting <code>*standard-output*</code>.</p> <p>The keyword <i>type</i> is one of <code>:commands</code> or <code>:results</code>, and determines whether to return a list of streams for SQL commands or results traffic.</p> <p>The default value of <i>type</i> is <code>:commands</code>. The default value for <i>database</i> is the value of <code>*default-database*</code>.</p>				
See also	<code>add-sql-stream</code> <code>delete-sql-stream</code> <code>sql-recording-p</code> <code>sql-stream</code>				

This chapter applies to the Enterprise Edition only

```
start-sql-recording  
stop-sql-recording
```

		<i>Function</i>
list-tables		
Summary		Returns a list of the table names in a database.
Package		<code>sql</code>
Signature		<code>list-tables &key database owner => table-list</code>
Arguments	<code>database</code>	A database.
	<code>owner</code>	<code>nil</code> , <code>:all</code> or a string.
Values	<code>table-list</code>	A list of table names.
Description		The function <code>list-tables</code> returns the list of table names in <code>database</code> , which has a default value of <code>*default-database*</code> . If <code>owner</code> is <code>nil</code> , only user-owned tables are considered. This is the default. If <code>owner</code> is <code>:all</code> , all tables are considered. If <code>owner</code> is a string, this denotes a username and only tables owned by <code>owner</code> are considered.
See also		<code>create-table</code> <code>drop-table</code> <code>list-attributes</code> <code>table-exists-p</code>
lob-stream		<i>Class</i>
Summary		The LOB stream class.

Superclasses	<code>buffered-stream</code>
Initargs	<code>:lob-locator</code> A LOB locator. <code>:direction</code> One of <code>:input</code> or <code>:output</code> . <code>:free-lob-locator-on-close</code> A generalized boolean.
Accessors	<code>lob-stream-lob-locator</code>
Description	<p>The <code>lob-stream</code> class implements LOB streams in the Oracle LOB interface.</p> <p>A <code>lob-stream</code> for input can be returned from <code>select</code> or <code>query</code> by specifying <code>:input-stream</code> as the type to return for the LOB column.</p> <p>A <code>lob-stream</code> for output can be returned from <code>select</code> or <code>query</code> by specifying <code>:output-stream</code> as the type to return for the LOB column.</p> <p>A <code>lob-stream</code> can be attached to an existing LOB locator by creating the stream explicitly.</p> <p><i>direction</i> specifies whether the stream is for input or output. The default value of <i>direction</i> is <code>:input</code>.</p> <p>By default, if the stream is closed the LOB locator is freed, unless <code>free-lob-locator-on-close</code> is passed as <code>nil</code>. The default value of <code>free-lob-locator-on-close</code> is <code>t</code>.</p>
Example	<p>This creates an input stream connected to the LOB locator <i>lob-locator</i>.</p> <pre>(make-instance 'lob-stream :lob-locator <i>lob-locator</i>)</pre>
See also	<code>query</code> <code>select</code>

This chapter applies to the Enterprise Edition only

locally-disable-sql-reader-syntax		<i>Function</i>
Summary	Turns off square bracket syntax and does not change syntax state.	
Package	<code>sql</code>	
Signature	<code>locally-disable-sql-reader-syntax =></code>	
Arguments	None.	
Values	None.	
Description	The function <code>locally-disable-sql-reader-syntax</code> turns off square bracket syntax and does not change syntax state. This ensures that <code>restore-sql-reader-syntax-state</code> restores the current enable/disable state.	
Example	The intended use of <code>locally-disable-sql-reader-syntax</code> is in a file:	
	<pre>#.(locally-disable-sql-reader-syntax) <Lisp code not using [...] syntax> #.(restore-sql-reader-syntax-state)</pre>	
See also	<code>disable-sql-reader-syntax</code> <code>enable-sql-reader-syntax</code> <code>locally-enable-sql-reader-syntax</code> <code>restore-sql-reader-syntax-state</code>	

locally-enable-sql-reader-syntax		<i>Function</i>
Summary	Turns on square bracket syntax and does not change syntax state.	
Package	<code>sql</code>	

Signature	<code>locally-enable-sql-reader-syntax</code>
Arguments	None.
Values	None.
Description	The function <code>locally-enable-sql-reader-syntax</code> turns on square bracket syntax and does not change the syntax state. This ensures that <code>restore-sql-reader-syntax-state</code> restores the current enable/disable state.
Example	The intended use of <code>locally-enable-sql-reader-syntax</code> is in a file:
	<pre>#.(locally-enable-sql-reader-syntax) <code using [...] syntax> #. (restore-sql-reader-syntax-state)</pre>
See also	<code>disable-sql-reader-syntax</code> <code>enable-sql-reader-syntax</code> <code>locally-disable-sql-reader-syntax</code> <code>restore-sql-reader-syntax-state</code>

	loop	<i>Macro</i>				
Summary	Extends <code>loop</code> to provide a clause for iterating over query results.					
Package	<code>common-lisp</code>					
Signature	<code>loop {for as} var [type-spec] being {the each} {records record} {in of} query-expression [not-inside-transaction <i>not-inside-transaction</i>] [get-all get-all] => result</code>					
Arguments	<table> <tr> <td><code>var</code></td> <td>A variable.</td> </tr> <tr> <td><code>query-expression</code></td> <td>An SQL query statement.</td> </tr> </table>	<code>var</code>	A variable.	<code>query-expression</code>	An SQL query statement.	
<code>var</code>	A variable.					
<code>query-expression</code>	An SQL query statement.					

	<i>not-inside-transaction</i>	A generalised boolean.
	<i>get-all</i>	A generalised boolean.
Values	<i>result</i>	A <code>loop</code> return value.
Description		<p>The Common Lisp <code>loop</code> macro has been extended with a clause for iterating over query results. This extension is available only when Common SQL has been loaded. For a full description of the rest of the Common Lisp <code>loop</code> facility, including the possible return values, see the ANSI Common Lisp specification.</p> <p>Each iteration of the loop assigns the next record of the table to the variable <code>var</code>. The record is represented in Lisp as a list. Destructuring can be used in <code>var</code> to bind variables to specific attributes of the records resulting from <i>query-expression</i>. In conjunction with the panoply of existing clauses available from the <code>loop</code> macro, the new iteration clause provides an integrated report generation facility.</p> <p>The additional loop keywords <code>not-inside-transaction</code> and <code>get-all</code> may be useful when fetching many records through a connection with <code>database-type :mysql</code>. See the section “Special considerations for iteration functions and macros” on page 255 for details.</p>
Example		<p>This extended <code>loop</code> example performs the following on each record returned as a result of a query: bind <code>name</code> to the query result, find the salary (if any) from an associated hash-table, increment a count for salaries greater than 20000, accumulate the salary, and print the details. Finally, it prints the average salary.</p>

```
(loop
    for (name) being each record in
        [select [ename] :from [emp]]
        as salary = (gethash name *salary-table*)
        initially (format t "~&~20A~10D" 'name 'salary)
        when (and salary (> salary 20000))
            count salary into salaries
            and sum salary into total
            and do (format t "~&~20A~10D" name salary)
        else
            do (format t "~&~20A~10A" name "N/A")
        finally
            (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

See also

[do-query](#)
[map-query](#)
[query](#)
[select](#)
[simple-do-query](#)

map-query*Function*

Summary Returns the results of mapping a function across an SQL query statement.

Package `sql`

Signature `map-query output-type-spec function query-exp &key database not-inside-transaction get-all => result`

Arguments `output-type-spec` The output type specification.

`result-type` The result sequence type.

`function` A function.

`query-exp` An SQL query.

`database` A database.

`not-inside-transaction`

A generalized boolean.

This chapter applies to the Enterprise Edition only

	<code>get-all</code>	A generalized boolean.
Values	<code>result</code>	A sequence of type <i>output-type-spec</i> containing the results of the map function.
Description		The function <code>map-query</code> returns the result of mapping <i>function</i> across the results of <i>query-exp</i> . The <i>output-type-spec</i> argument specifies the type of the result sequence as per the Common Lisp <code>map</code> function. The default value of <i>database</i> is <code>*default-database*</code> . <i>not-inside-transaction</i> and <code>get-all</code> may be useful when fetching many records through a connection with <i>database-type</i> <code>:mysql</code> . Both of these arguments have default value <code>nil</code> . See the section “Special considerations for iteration functions and macros” on page 255 for details.
Example		This example binds <code>name</code> to each name in the employee table and prints it.
		<pre>(map-query nil #'(lambda (name) (print name)) [select [ename] :from [emp] :flatp t])</pre>
See also		<code>do-query</code> <code>loop</code> <code>print-query</code> <code>query</code> <code>select</code> <code>simple-do-query</code>

mysql-library-directories

Variable

Package	<code>sql</code>
Initial Value	<code>"C:\\Program Files\\MySQL\\MySQL*\\bin"</code>

Description	The variable *mysql-library-directories* helps Lisp-Works for Windows to locate the MySQL library for use with <i>database-type :mysql</i> . It specifies a directory or a list of directories in which to search for the MySQL library. If the value is a directory pathname specifier then it is passed to directory . If the value is a list of directory pathname specifiers then each item is passed to directory . The collected results are the list of directories to search in. The default value matches the default MySQL installation. Note that this default will match any MySQL release, so if you need to be sure to match a specific MySQL release, you need to change the value of *mysql-library-directories* such that it matches only that particular release.
See also	*mysql-library-path*

mysql-library-path *Variable*

Package	sql
Initial Value	On Microsoft Windows: <code>"libmysql.dll"</code> On other platforms with pthreads: <code>"-lmysqlclient_r"</code> On other platforms without pthreads: <code>"-lmysqlclient"</code>
Description	The variable *mysql-library-path* helps the system to locate the MySQL library for use with <i>database-type :mysql</i> . It specifies the library name, and can also be set to a full path. If it is not a name, the system searches the standard library locations.

This chapter applies to the Enterprise Edition only

You can override the value of *mysql-library-path* by setting the environment variable `LW_MYSQL_LIBRARY`.

See also `*mysql-library-directories*`

ora-lob-append	<i>Function</i>
-----------------------	-----------------

Summary Appends two internal LOBs together.

Package `sql`

Signature `ora-lob-append src-lob-locator dest-lob-locator &key errorp`

Arguments `src-lob-locator` A LOB locator.

`dest-lob-locator` A LOB locator.

`errorp` A generalized boolean.

Description The function `ora-lob-append` appends the contents of the LOB pointed to by `src-lob-locator` to the end of LOB pointed by `dest-lob-locator`. The source and destination LOBs must be of the same internal LOB type, that is, either both BLOB or both CLOB/NCLOB.

If an error occurs and `errorp` is true, an error is signaled. If `errorp` is false, the function returns an object of type `sql-database-error`. The default value of `errorp` is `nil`.

`ora-lob-append` is applicable to internal LOBs only.

Note: This is a direct call OCILobAppend.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

ora-lob-assign	<i>Function</i>
Summary	Assigns a LOB to another LOB locator.
Package	sql
Signature	ora-lob-assign src-lob-locator &key dest-lob-locator errorp => lob-locator
Arguments	<p><i>src-lob-locator</i> A LOB locator.</p> <p><i>dest-lob-locator</i> A LOB locator.</p> <p><i>errorp</i> A generalized boolean.</p>
Values	<p><i>lob-locator</i> A LOB locator.</p>
Description	<p>The function ora-lob-assign assigns the underlying LOB for <i>src-lob-locator</i> to another LOB locator.</p> <p>If <i>dest-lob-locator</i> is nil then a new LOB locator is created and returned. Otherwise <i>dest-lob-locator</i> should be an existing LOB locator which is modified and returned. The default value of <i>dest-lob-locator</i> is nil.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type sql-database-error. The default value of <i>errorp</i> is nil.</p> <p>Note: This is a direct call to OCILobAssign.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>

ora-lob-char-set-form	<i>Function</i>
Summary	Returns the character set form of a LOB.
Package	sql

This chapter applies to the Enterprise Edition only

Signature	<code>ora-lob-char-set-form lob-locator &key errorp => charset</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>charset</i>	A non-negative integer.
Description	<p>The function <code>ora-lob-char-set-form</code> returns the char set form of the LOB underlying <i>lob-locator</i>.</p> <p><i>charset</i> is 0 for a binary LOB (BLOB or BFILE), SQLCS_IMPLICIT (1) for a character LOB (CFILE or CLOB) and SQLCS_NCHAR (2) for a NCLOB.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobCharSetForm</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>	

		<i>Function</i>
Summary	Returns the database character set identifier of a LOB.	
Package	<code>sql</code>	
Signature	<code>ora-lob-char-set-id lob-locator &key errorp => db-charset-id</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>db-charset-id</i>	A non-negative number.

Description	<p>The function <code>ora-lob-char-set-id</code> returns the database character set identifier of the LOB underlying <i>lob-locator</i>. <i>db-charset-id</i> is 0 for a binary LOB.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to OCILobCharSetID.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
-------------	---

ora-lob-close	<i>Function</i>						
Summary	Closes an opened LOB.						
Package	<code>sql</code>						
Signature	<code>ora-lob-close lob-locator &key errorp</code>						
Arguments	<table border="0"> <tr> <td style="vertical-align: top;">Arguments</td> <td style="vertical-align: top;"><i>lob-locator</i></td> <td>A LOB locator.</td> </tr> <tr> <td></td> <td style="vertical-align: top;"><i>errorp</i></td> <td>A generalized boolean.</td> </tr> </table>	Arguments	<i>lob-locator</i>	A LOB locator.		<i>errorp</i>	A generalized boolean.
Arguments	<i>lob-locator</i>	A LOB locator.					
	<i>errorp</i>	A generalized boolean.					
Description	<p>The function <code>ora-lob-close</code> closes a LOB which has been opened by <code>ora-lob-open</code>.</p> <p>For more information see <code>ora-lob-open</code>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to OCILobClose.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>						

This chapter applies to the Enterprise Edition only

See also [ora-lob-open](#)

ora-lob-copy *Function*

Summary Copies part of an internal LOB.

Package `sql`

Signature `ora-lob-copy dest-lob-locator src-lob-locator amount &key dest-offset src-offset errorp`

Arguments *dest-lob-locator* A LOB locator.

src-lob-locator A LOB locator.

amount A non-negative integer.

dest-offset A non-negative integer.

src-offset A non-negative integer.

errorp A generalized boolean.

Description The function `ora-lob-copy` copies part of the LOB pointed to by *src-lob-locator* into the LOB pointed to by *dest-lob-locator*.

The details of the operation are determined by *amount*, *src-offset* and *dest-offset*. These numbers are in characters for CLOB/NCLOB and bytes for BLOB, and the offsets start from 1. The part of the source LOB from offset *src-offset* of length *amount* is copied into the destination LOB at offset *dest-offset*. The default value of *dest-offset* is 1 and the default value of *src-offset* is 1.

The destination LOB is extended if needed. If the *dest-offset* is beyond the end of the destination LOB, the gap between the end and *dest-offset* is erased, that is, filled with 0 for BLOBs or spaces for CLOBs.

Both LOBs must be internal LOBs, and they must be of the same type, that is, either both BLOB or both CLOB/NCLOB.

`ora-lob-append` is applicable to internal LOBs only.

If an error occurs and `errorp` is true, an error is signaled. If `errorp` is false, the function returns an object of type `sql-database-error`. The default value of `errorp` is `nil`.

Note: This is a direct call OCILobCopy.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

See also `ora-lob-load-from-file`

ora-lob-create-empty *Function*

Summary Creates an empty LOB.

Package `sql`

Signature `ora-lob-create-empty &key db type => lob--locator`

Arguments `db` A database.

`type` A Lisp object.

Values `lob-locator` A LOB locator.

Description The function `ora-lob-create-empty` creates an empty LOB object and returns a LOB locator for it.

If `type` is `:lob` then `ora-lob-create-empty` creates a LOB of type BLOB/CLOB. If `type` is any other value, it creates a file LOB. The default value of `type` is `:lob`.

Empty LOBs can be put in the database by passing them to `insert-records` or `update-records`. However, the preferred approach is to use the Oracle SQL function `EMPTY_BLOB` as described in the section "Inserting empty LOBs" on page 260.

This chapter applies to the Enterprise Edition only

The default value of *db* is the value of ***default-database***.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

	<i>Function</i>
ora-lob-create-temporary	
Summary	Creates a temporary LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-create-temporary db-or-lob-locator &key errorp cache session-duration clob-p => lob-locator</code>
Arguments	<i>db-or-lob-locator</i> A database or a LOB locator. <i>errorp</i> A generalized boolean. <i>cache</i> A generalized boolean. <i>session-duration</i> A generalized boolean. <i>clob-p</i> A generalized boolean.
Values	<i>lob-locator</i> A LOB locator.
Description	The function <code>ora-lob-create-temporary</code> creates a temporary LOB. <i>db-or-lob-locator</i> specifies the database to associate the new LOB with. If it is a LOB locator the database from which the LOB locator came is used. If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> . <i>cache</i> specifies whether to use a cache or not. The default value of <i>cache</i> is <code>nil</code> .

session-duration specifies the lifetime: if it is true then it uses OCI_DURATION_SESSION, otherwise it uses OCI_DURATION_CALL. The default value of *session-duration* is `t`.

If *clob-p* is true then the new LOB is a CLOB, otherwise it is a BLOB. The default value of *clob-p* is `nil`.

The new temporary LOB locator is returned.

Note: This is a direct call to OCILobCreateTemporary.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

See also `ora-lob-free-temporary`
 `ora-lob-is-temporary`

ora-lob-disable-buffering

Function

Summary	Disables the buffering of the Oracle client.	
Package	<code>sql</code>	
Signature	<code>ora-lob-disable-buffering lob-locator &key errorp</code>	
Arguments	<code>lob-locator</code>	A LOB locator.
	<code>errorp</code>	A generalized boolean.
Description	<p>The function <code>ora-lob-disable-buffering</code> disables the buffering of the Oracle client. This function does not flush the buffers.</p> <p>This function is applicable to internal LOBs only.</p> <p>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <code>errorp</code> is <code>nil</code>.</p>	

This chapter applies to the Enterprise Edition only

Note: This is a direct call to OCILobDisableBuffering.

Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.

See also [ora-lob-enable-buffering](#)
[ora-lob-flush-buffer](#)

ora-lob-element-type *Function*

Summary	Returns the Lisp element type corresponding to that of a LOB locator.
Package	<code>sql</code>
Signature	<code>ora-lob-element-type lob-locator => type</code>
Arguments	<i>lob-locator</i> A LOB locator.
Values	<i>type</i> A Lisp type descriptor.
Description	The function <code>ora-lob-element-type</code> returns the Lisp element type that best corresponds to the charset of the LOB locator <i>lob-locator</i> . For BLOB and BFILE <i>type</i> is <code>(unsigned-byte 8)</code> . For CLOB, NCLOB and CFILE <i>type</i> is either <code>base-char</code> or <code>simple-char</code> , depending on the charset. Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

ora-lob-enable-buffering *Function*

Summary Enables the buffering of the Oracle client.

Package	<code>sql</code>				
Signature	<code>ora-lob-enable-buffering lob-locator &key errorp</code>				
Arguments	<table border="0"> <tr> <td><i>lob-locator</i></td><td>A LOB locator.</td></tr> <tr> <td><i>errorp</i></td><td>A generalized boolean.</td></tr> </table>	<i>lob-locator</i>	A LOB locator.	<i>errorp</i>	A generalized boolean.
<i>lob-locator</i>	A LOB locator.				
<i>errorp</i>	A generalized boolean.				
Description	<p>The function <code>ora-lob-enable-buffering</code> enables the buffering of the Oracle client. This function does not flush the buffers.</p> <p>This function is applicable to internal LOBs only.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobEnableBuffering</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>				
See also	<code>ora-lob-disable-buffering</code> <code>ora-lob-flush-buffer</code>				

	<i>Function</i>		
Summary	Returns a foreign pointer to the environment handle of a LOB.		
Package	<code>sql</code>		
Signature	<code>ora-lob-env-handle lob-locator => pointer</code>		
Arguments	<table border="0"> <tr> <td><i>lob-locator</i></td><td>A LOB locator.</td></tr> </table>	<i>lob-locator</i>	A LOB locator.
<i>lob-locator</i>	A LOB locator.		
Values	<table border="0"> <tr> <td><i>pointer</i></td><td>A foreign pointer of type <code>sql:p-oci-env</code>.</td></tr> </table>	<i>pointer</i>	A foreign pointer of type <code>sql:p-oci-env</code> .
<i>pointer</i>	A foreign pointer of type <code>sql:p-oci-env</code> .		

This chapter applies to the Enterprise Edition only

Description	The function <code>ora-lob-env-handle</code> returns a foreign pointer to the environment handle of the LOB underlying <i>lob-locator</i> . Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.
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ora-lob-erase *Function*

Summary	Erases part of an internal LOB.	
Package	<code>sql</code>	
Signature	<code>ora-lob-erase lob-locator offset amount &key errorp => erased</code>	
Arguments	<code>lob-locator</code>	A LOB locator.
	<code>offset</code>	A non-negative integer.
	<code>amount</code>	A non-negative integer.
	<code>errorp</code>	A generalized boolean.
Values	<code>erased</code>	A non-negative integer.
Description	<p>The function <code>ora-lob-erase</code> erases part of the LOB pointed to by <i>lob-locator</i>. That is, it fills part of the LOB with 0 for BLOBs or spaces for CLOBs.</p> <p>The operation starts from offset <i>offset</i> into the LOB and erases <i>amount</i> of data in the LOB, or to the end of the LOB. Note that the offset starts from 1, and that <i>offset</i> and <i>amount</i> are in characters for CLOBs and bytes for BLOB.</p> <p>Erasing does not extend beyond the end of the LOB. The return value <i>erased</i> is the number of characters or bytes erased. <i>erased</i> will be smaller than <i>amount</i> if the sum of <i>offset</i> and <i>amount</i> is greater than the length of the LOB.</p> <p><code>ora-lob-erase</code> is applicable to internal LOBs only.</p>	

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type `sql-database-error`. The default value of *errorp* is `nil`.

Note: This is a direct call to `OCILobErase`.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

	<i>Function</i>
Summary	Closes a file LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-file-close file-lob-locator &key errorp</code>
Arguments	<p><i>file-lob-locator</i> A file LOB locator.</p> <p><i>errorp</i> A generalized boolean.</p>
Description	<p>The function <code>ora-lob-file-close</code> closes the file that <i>file-lob-locator</i> is associated with.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobFileClose</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
See also	<code>ora-lob-file-open</code>

This chapter applies to the Enterprise Edition only

ora-lob-file-close-all	<i>Function</i>				
Summary	Closes all the file LOBs.				
Package	<code>sql</code>				
Signature	<code>ora-lob-file-close-all &key db errorp</code>				
Arguments	<table><tr><td><i>db</i></td><td>A database.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>	<i>db</i>	A database.	<i>errorp</i>	A generalized boolean.
<i>db</i>	A database.				
<i>errorp</i>	A generalized boolean.				
Description	<p>The function <code>ora-lob-file-close</code> closes the files that are associated with all the file LOB locators that are opened through the database connection specified by <i>database</i>.</p> <p>The default value of <i>db</i> is the value of <code>*default-database*</code>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobFileCloseAll</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>				
See also	<code>ora-lob-file-close</code>				

ora-lob-file-exists	<i>Function</i>		
Summary	The predicate for whether a LOB file exists.		
Package	<code>sql</code>		
Signature	<code>ora-lob-file-exists lob-locator &key errorp => result</code>		
Arguments	<table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr></table>	<i>lob-locator</i>	A LOB locator.
<i>lob-locator</i>	A LOB locator.		

	<i>errorp</i>	A generalized boolean.
Values	<i>result</i>	A boolean.
Description	<p>The function <code>ora-lob-file-exists</code> returns <code>t</code> if the file associated with the LOB exists. This function is applicable only to file LOBs (CFILE or BFILE).</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobFileExists</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>	

		<i>Function</i>
Summary	Returns the directory and name for the file associated with a file LOB.	
Package	<code>sql</code>	
Signature	<code>ora-lob-file-get-name lob-locator &key errorp -> dir, filename</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>dir</i>	A string of length no greater than 30.
	<i>filename</i>	A string of length no greater than 255.
Description	<p>The function <code>ora-lob-file-get-name</code> returns as multiple values the directory alias <i>dir</i> and the filename <i>filename</i> associated with the LOB denoted by <i>lob-locator</i>. The function is applicable only to file LOBs (CFILE or BFILE).</p>	

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type `sql-database-error`. The default value of *errorp* is `nil`.

Note: This is a direct call to `OCILobFileGetName`.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

<code>ora-lob-file-is-open</code>	<i>Function</i>
-----------------------------------	-----------------

Summary	The predicate for whether a LOB file is open.	
Package	<code>sql</code>	
Signature	<code>ora-lob-file-is-open lob-locator &key errorp => result</code>	
Arguments	<code>lob-locator</code>	A LOB locator.
	<code>errorp</code>	A generalized boolean.
Values	<code>result</code>	A boolean.
Description	The function <code>ora-lob-file-is-open</code> returns <code>t</code> if the file associated with the LOB is open. This function is applicable only to file LOBs (CFILE or BFILE). If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> .	
	Note: This is a direct call to <code>OCILobFileIsOpen</code> .	
	Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.	

	<i>Function</i>
Summary	Opens a file LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-file-open file-lob-locator &key errorp</code>
Arguments	<p><code>file-lob-locator</code> A file LOB locator.</p> <p><code>errorp</code> A generalized boolean.</p>
Description	<p>The function <code>ora-lob-file-open</code> opens the file that <code>file-lob-locator</code> is associated with.</p> <p>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <code>errorp</code> is <code>nil</code>.</p> <p>Note: This is a direct call to <code>OCILobFileOpen</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
See also	<code>ora-lob-file-close</code>

	<i>Function</i>
Summary	Sets the name of a file LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-file-set-name file-lob-locator dir-alias name &key errorp</code>
Arguments	<p><code>file-lob-locator</code> A file LOB locator.</p> <p><code>dir-alias</code> A string or <code>nil</code>.</p>

This chapter applies to the Enterprise Edition only

<i>name</i>	A string or <code>nil</code> .
<i>errorp</i>	A generalized boolean.
Description	The function <code>ora-lob-file-set-name</code> sets the directory alias and the name of the file LOB pointed to by <i>file-lob-locator</i> . If <i>dir-alias</i> is a string it should be of length no greater than 30. If it is <code>nil</code> then the directory alias of the file LOB is not changed. If <i>name</i> is a string it should be of length no greater than 255. If it is <code>nil</code> then the name of the file LOB is not changed. If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> .
Note:	This is a direct call to <code>OCILobFileSetAlias</code> .
Note:	this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

	<i>Function</i>
Summary	Flushes the buffer of the Oracle client.
Package	<code>sql</code>
Signature	<code>ora-lob-flush-buffer lob-locator &key free-buffer errorp</code>
Arguments	<i>lob-locator</i> A LOB locator. <i>free-buffer</i> A generalized boolean. <i>errorp</i> A generalized boolean.
Description	The function <code>ora-lob-flush-buffer</code> flushes the buffer that is used by the Oracle client.

If *free-buffer* is true, it also frees the buffer. The default value of *free-buffer* is `nil`.

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type `sql-database-error`. The default value of *errorp* is `nil`.

Note: This is a direct call to `OCILobFlushBuffer`.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

See also `ora-lob-enable-buffering`

ora-lob-free	<i>Function</i>
Summary	Frees a LOB locator.
Package	<code>sql</code>
Signature	<code>ora-lob-free lob-locator</code>
Arguments	<i>lob-locator</i> A LOB locator.
Description	<p>The function <code>ora-lob-free</code> frees the LOB locator <i>lob-locator</i>. If <i>lob-locator</i> was retrieved inside an iteration macro or function (that is, one of <code>map-query</code>, <code>do-query</code>, <code>simple-do-query</code> and <code>loop</code>), it is freed before the next record is fetched, or when terminating the iteration for the last record.</p> <p>LOB locators which were retrieved by <code>select</code> or <code>query</code>, or were created by the user by <code>ora-lob-assign</code> or <code>ora-lob-create-empty</code> are freed automatically when the database connection is closed by a call to <code>disconnect</code>.</p>

If you create many LOB locators without closing the connection, it is useful to free them by calling `ora-lob-free`, to free the resources that are associated with them.

Freeing a LOB locator does not affect the underlying LOB. In particular, after modifications to the LOB there is no `roll-back` even if there was not yet a `commit`.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

ora-lob-free-temporary	<i>Function</i>
Summary	Frees a temporary LOB locator.
Package	<code>sql</code>
Signature	<code>ora-lob-free-temporary temp-lob-locator &key errorp</code>
Arguments	<code>temp-lob-locator</code> A temporary LOB locator. <code>errorp</code> A generalized boolean.
Description	The function <code>ora-lob-free-temporary</code> frees a temporary LOB locator. <code>temp-lob-locator</code> should be a temporary LOB locator as created by <code>ora-lob-create-temporary</code> . If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <code>errorp</code> is <code>nil</code> . Note: temporary LOB locators are freed automatically when the database connection is closed by <code>disconnect</code> . Note: This is a direct call to <code>OCILobFreeTemporary</code> .

Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.

See also **ora-lob-create-temporary**
ora-lob-is-temporary

ora-lob-get-buffer *Function*

Summary Gets a buffer for efficient I/O with foreign functions.

Package **sql**

Signature **ora-lob-get-buffer lob-locator &key for-writing offset => amount/size, foreign-buffer, eof-or-error-p**

Arguments **lob-locator** A LOB locator.

for-writing A generalized boolean.

offset A non-negative integer or **nil**.

Values **amount/size** A non-negative integer.

foreign-buffer A FLI pointer.

eof-or-error-p A boolean or an error object.

Description The function **ora-lob-get-buffer** gets a buffer for efficient I/O with foreign functions.

If **for-writing** is **nil**, then **ora-lob-get-buffer** fills an internal buffer and returns three values: **amount/size** is how much it filled, **foreign-buffer** points to the actual buffer, and **eof-or-error-p** is the return value from the call to **ora-lob-read-foreign-buffer**. The offset **offset** is passed directly **ora-lob-read-foreign-buffer**.

If **for-writing** is true, then **ora-lob-get-buffer** returns two values: **amount/size** is the size of the foreign buffer and **foreign-**

buffer points to the actual buffer, which then can be passed to `ora-lob-write-foreign-buffer`.

The default value of *for-writing* is `nil`.

The buffer that is used by `ora-lob-get-buffer` is always the same for the LOB locator, it is used by `ora-lob-read-buffer` and `ora-lob-write-buffer`, and is freed automatically when the LOB locator is freed. Thus until you finish with the buffer, you cannot use `ora-lob-read-buffer` OR `ora-lob-write-buffer` or call `ora-lob-get-buffer` again or free the LOB locator.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

Example

This first example illustrates reading using the buffer obtained by `ora-lob-get-buffer`. You have a foreign function:

```
my_chunk_processor(char *data, int size)
```

with this FLI definition:

```
(fli:define-foreign-function my_chunk_processor
  ((data :pointer)
   (size :int)))
```

You can pass all the data from the LOB locator to this function. Assuming no other function reads from it, it will start from the beginning.

```
(loop
  (multiple-value-bind (amount buffer eof-or-error-p)
    (ora-lob-get-buffer lob)
    (when (zerop amount) (return))
    (my_chunk_processor buffer amount)))
```

This second example illustrates writing with the buffer obtained by `ora-lob-get-buffer`. You have a foreign function that fills a buffer with data, and you want to write it to a

LOB. First you should lock the record, and if required trim the LOB locator.

```
(multiple-value-bind (size buffer)
  (ora-lob-get-buffer lob-locator
    :for-writing t
    ;; start at the beginning
    :offset 1)
  (loop (let ((amount (my-fill-buffer buffer size)))
    (when (zerop amount) (return))
    (ora-lob-write-foreign-buffer
      lob-locator nil
      amount buffer size))))
```

See also **ora-lob-read-buffer**
ora-lob-read-foreign-buffer
ora-lob-write-buffer
ora-lob-write-foreign-buffer

ora-lob-get-chunk-size *Function*

Summary Returns the chunk size of a LOB.

Package **sql**

Signature **ora-lob-get-chunk-size** *lob-locator* &**key** *errorp* => *size*

Arguments *lob-locator* A LOB locator.

errorp A generalized boolean.

Values *size* A non-negative integer.

Description The function **ora-lob-get-chunk-size** returns the chunk size of the LOB locator *lob-locator*, which is the best value for the size of a buffer.

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type **sql-database-error**. The default value of *errorp* is **nil**.

This chapter applies to the Enterprise Edition only

Note: This is a direct call to OCILobGetChunkSize.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

ora-lob-get-length *Function*

Summary	Returns the length of a LOB.	
Package	<code>sql</code>	
Signature	<code>ora-lob-get-length lob-locator &key errorp => length</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>length</i>	A non-negative integer.
Description	The function <code>ora-lob-get-length</code> returns the current length of the LOB underlying <i>lob-locator</i> . If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> .	
	Note: This is a direct call to OCILobGetLength.	
	Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.	

ora-lob-internal-lob-p *Function*

Summary	The predicate for internal LOBs.
Package	<code>sql</code>

Signature	<code>ora-lob-internal-lob-p <i>lob-locator</i> => <i>result</i></code>	
Arguments	<i>lob-locator</i>	A LOB locator.
Values	<i>result</i>	A boolean.
Description	The function <code>ora-lob-internal-lob-p</code> returns <code>t</code> if <i>lob-locator</i> is internal (BLOB, CLOB, or NCLOB). Otherwise it returns <code>nil</code> .	
<p>Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.</p>		

		<i>Function</i>
Summary	The comparison function for LOB locators.	
Package	<code>sql</code>	
Signature	<code>ora-lob-is-equal <i>lob-locator1</i> <i>lob-locator2</i> => <i>result</i></code>	
Arguments	<i>lob-locator1</i>	A LOB locator.
	<i>lob-locator2</i>	A LOB locator.
Values	<i>result</i>	A boolean.
Description	The function <code>ora-lob-is-equal</code> returns <code>t</code> if <i>lob-locator1</i> and <i>lob-locator2</i> point to the same LOB object.	
<p>Note: This is a direct call to <code>OCILobIsEqual</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.</p>		

This chapter applies to the Enterprise Edition only

		<i>Function</i>
ora-lob-is-open		
Summary	The predicate for whether a LOB locator is opened.	
Package	<code>sql</code>	
Signature	<code>ora-lob-is-open lob-locator &key errorp => result</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>result</i>	A boolean.
Description	The function <code>ora-lob-is-open</code> returns <code>t</code> if the LOB pointed to by <i>lob-locator</i> is opened (by <code>ora-lob-open</code>). <code>ora-lob-is-open</code> is applicable to internal LOBs only. If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> .	
		Note: This is a direct call to <code>OCILobIsOpen</code> .
		Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.
See also	<code>ora-lob-open</code>	

		<i>Function</i>
ora-lob-is-temporary		
Summary	The predicate for whether a LOB is temporary.	
Package	<code>sql</code>	
Signature	<code>ora-lob-is-temporary lob-locator &key errorp => result</code>	

Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>result</i>	A boolean.
Description		<p>The function <code>ora-lob-is-temporary</code> returns <code>t</code> if the LOB underlying <i>lob-locator</i> is temporary, that is, it was created by <code>ora-lob-create-temporary</code>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to OCILobIsTemporary.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
See also		<code>ora-lob-create-temporary</code>

		<i>Function</i>
Summary		Loads data from a file LOB into a LOB.
Package		<code>sql</code>
Signature		<code>ora-lob-load-from-file dest-lob-locator src-lob-file amount &key src-offset dest-offset errorp</code>
Arguments	<i>dest-lob-locator</i>	An internal LOB locator.
	<i>src-lob-file</i>	A file LOB locator.
	<i>amount</i>	A non-negative integer.
	<i>src-offset</i>	A non-negative integer.
	<i>dest-offset</i>	A non-negative integer.

This chapter applies to the Enterprise Edition only

	<i>errorp</i>	A generalized boolean.
Description	The function <code>ora-lob-load-from-file</code> loads the data from the <i>src-lob-file</i> into the destination LOB pointed to by <i>dest-lob-locator</i> . The source LOB must be a BFILE and the destination must be an internal LOB. The details of the operation are determined by <i>amount</i> , <i>src-offset</i> and <i>dest-offset</i> . <i>amount</i> and <i>dest-offset</i> are in characters for CLOB/NCLOB and are in bytes for BLOB. <i>src-offset</i> is in bytes. The offsets start from 1. The default value of <i>dest-offset</i> is 1 and the default value of <i>src-offset</i> is 1. No conversion is performed by <code>ora-lob-load-from-file</code> , so if the destination is a CLOB/NCLOB, the source must already be in the right format. If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> .	
	Note: This is a direct call to OCILobReadFromFile. The Oracle documentation is ambiguous on whether it is mandatory to open the source LOB before calling this function.	
	Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.	
See also	<code>ora-lob-copy</code>	

	Function
Summary	Returns a foreign pointer to the underlying LOB locator.
Package	<code>sql</code>

Signature	<code>ora-lob-lob-locator lob-locator => pointer</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
Values	<i>pointer</i>	A foreign pointer.
Description	<p>The function <code>ora-lob-lob-locator</code> returns a foreign pointer to the OCI LOB locator underlying <i>lob-locator</i>.</p> <p><i>pointer</i> is of type <code>sql:p-oci-lob-locator</code> or <code>sql:p-oci-file</code>.</p>	
<p>Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.</p>		

		<i>Function</i>
Summary	The predicate for whether a LOB is initialized.	
Package	<code>sql</code>	
Signature	<code>ora-lob-locator-is-init lob-locator &key errorp => result</code>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>errorp</i>	A generalized boolean.
Values	<i>result</i>	A boolean.
Description	<p>The function <code>ora-lob-locator-is-init</code> returns <code>t</code> if the LOB locator <i>lob-locator</i> is initialized.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p>	
<p>Note: This is a direct call to <code>OCILobIsInit</code>.</p>		

This chapter applies to the Enterprise Edition only

Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.

ora-lob-open	<i>Function</i>				
Summary	Opens a LOB.				
Package	<code>sql</code>				
Signature	<code>ora-lob-open lob-locator &key errorp</code>				
Arguments	<table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>	<i>lob-locator</i>	A LOB locator.	<i>errorp</i>	A generalized boolean.
<i>lob-locator</i>	A LOB locator.				
<i>errorp</i>	A generalized boolean.				
Description	<p>The function <code>ora-lob-open</code> opens the LOB pointed to by <i>lob-locator</i>, which can be an internal LOB or a file LOB.</p> <p>Opening the LOB creates a transaction, so any updates associated with modifying the LOB are delayed until the <code>ora-lob-close</code> call. This saves round-trips and avoids extra work on the server side. However it is not mandatory to use <code>ora-lob-open</code>.</p> <p>Calls to <code>ora-lob-open</code> must be strictly paired to calls to <code>ora-lob-close</code>, and the latter must be called before a call to <code>commit</code>. It is also an error to call <code>ora-lob-open</code> on a server LOB object that is already open, even if it has been opened via a different LOB locator.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to OCILobOpen.</p>				

Note: this function is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 259 for more information.

See also

`ora-lob-close`
`ora-lob-is-open`

		<i>Function</i>
Summary	Reads from a LOB into a buffer.	
Package	<code>sql</code>	
Signature		<code>ora-lob-read-buffer lob-locator offset amount buffer &key buffer-offset csid => amount-read, eof-or-error-p</code>
Arguments	<p><i>lob-locator</i> A LOB locator.</p> <p><i>offset</i> A non-negative integer or <code>nil</code>.</p> <p><i>amount</i> A non-negative integer.</p> <p><i>buffer</i> A string, or a vector of element type <code>(unsigned-byte 8)</code>.</p> <p><i>buffer-offset</i> A non-negative integer.</p> <p><i>csid</i> A Character Set ID</p>	
Values	<p><i>amount-read</i> A non-negative integer.</p> <p><i>eof-or-error-p</i> A boolean or an error object.</p>	
Description	<p>The function <code>ora-lob-read-buffer</code> reads into <i>buffer</i> from the LOB pointed to by <i>lob-locator</i>.</p> <p><i>offset</i> specifies the offset to start reading from. It starts with 1, and specifies characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE. If <i>offset</i> is <code>nil</code> then the offset after the end of the previous read operation is used (write operations are</p>	

ignored). This is especially useful for reading linearly from the LOB.

amount is the amount to read, in characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE.

The element type of *buffer* should match the element type of the LOB locator (see `ora-lob-element-type`). For this comparison (`unsigned-byte 8`) and `base-char` are considered as the same.

If the buffer *buffer* is not static, there is some additional overhead. For small amounts of data, this is probably insignificant.

buffer-offset specifies where to put the data. It is an offset in bytes from the beginning of the buffer. The default value of *buffer-offset* is 0.

csid specifies what Character Set ID the data in the target buffer should be. It defaults to the CSID of the LOB pointed to by *lob-locator*.

The return value *amount-read* is the number of elements (characters or bytes) that were read.

If the return value *eof-or-error-p* is `nil` then there is still more to read. If *eof-or-error-p* is `t` then it read to the end of the LOB. If an error occurred then *eof-or-error-p* is an error object.

Note: This is a direct call to OCILobRead, without callback.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

Example

This example sequentially reads the LOB data into a string, starting from offset 10000. It calls a processing function on each chunk of data and then reads in the next chunk starting from where the previous read ended.

```
(let ((my-buffer (make-string 1000
                             :element-type 'base-char))
      (offset 10000))
  (loop
    (let ((nread
           (ora-lob-read-buffer lob-locator
                                 offset
                                 1000
                                 my-buffer)))
      (when (zerop nread) ; end of the LOB
        (return))
      (my-processing-function my-buffer nread))
    (setq offset nil))) ; so next time it continues
                         ; from where it finished
```

See also **ora-lob-element-type**
 ora-lob-read-foreign-buffer

ora-lob-read-into-plain-file *Function*

Summary	Writes the contents of a LOB into a file.	
Package	sql	
Signature	ora-lob-read-into-plain-file <i>lob-locator</i> <i>file-name</i> & <i>key</i> <i>offset</i> <i>file-offset</i> <i>if-exists</i>	
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>file-name</i>	A pathname designator.
	<i>offset</i>	A non-negative integer, or <i>nil</i> .
	<i>file-offset</i>	A non-negative integer, or <i>nil</i> .
	<i>if-exists</i>	A keyword or <i>nil</i> .
Description	<p>The function ora-lob-read-into-plain-file writes the contents of a LOB into a file.</p> <p><i>file-name</i> specifies the file to write, which should be a standard file. The file is always opened in a binary mode, so if the</p>	

This chapter applies to the Enterprise Edition only

LOB is a CLOB, the file will be generated in the right format when reading it from the LOB.

offset is the offset into the LOB from where to start reading. It starts from 1, counts characters in a CLOB, and if it is `nil` then the operation starts from the end of the previous read operation. The default value of *offset* is `nil`.

file-offset specifies the offset into the file to start the operation from. If *file-offset* is `nil` then it starts writing at the start of the file. The default value of *file-offset* is `nil`.

if-exists is passed to `open` when opening the file, with the standard Common Lisp meaning. The default value of *if-exists* is `:error`.

Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.

See also

`ora-lob-write-from-plain-file`

		<i>Function</i>
	<code>ora-lob-read-foreign-buffer</code>	
Summary		Reads from a LOB into a foreign buffer.
Package		<code>sql</code>
Signature		<code>ora-lob-read-foreign-buffer lob-locator offset amount foreign-buffer buffer-length &key buffer-offset csid => amount-read, eof-or-error-p</code>
Arguments	<i>lob-locator</i>	A LOB locator.
	<i>offset</i>	A non-negative integer or <code>nil</code> .
	<i>amount</i>	A non-negative integer.
	<i>foreign-buffer</i>	A FLI pointer.
	<i>buffer-length</i>	A non-negative integer.

<i>buffer-offset</i>	A non-negative integer.
<i>csid</i>	A.Character Set ID
Values	<p><i>amount-read</i> A non-negative integer.</p> <p><i>eof-or-error-p</i> A boolean or an error object.</p>
Description	<p>The function <code>ora-lob-read-foreign-buffer</code> reads from the LOB pointed to by <i>lob-locator</i> into the foreign buffer <i>foreign-buffer</i>.</p> <p>This is just like <code>ora-lob-read-buffer</code> except that it reads from the LOB locator into a foreign buffer.</p> <p><i>foreign-buffer</i> is a FLI pointer to a buffer, which must be of size at least <i>buffer-length</i>.</p> <p>Note: This is a direct call to OCILobRead, without callback.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
See also	<p>ora-lob-get-buffer</p> <p>ora-lob-read-buffer</p>

ora-lob-svc-ctx-handle	Function
------------------------	----------

Summary	Returns a foreign pointer to the context handle of a LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-svc-ctx-handle lob-locator => pointer</code>
Arguments	<i>lob-locator</i> A LOB locator.
Values	<i>pointer</i> A foreign pointer of type <code>sql:p-oci-svc-ctx</code> .

This chapter applies to the Enterprise Edition only

Description	The function <code>ora-lob-svc-ctx-handle</code> returns a foreign pointer to the context handle of the LOB underlying <i>lob-locator</i> . Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.
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	<i>Function</i>						
ora-lob-trim							
Summary	Trims an internal LOB.						
Package	<code>sql</code>						
Signature	<code>ora-lob-trim lob-locator new-size &key errorp</code>						
Arguments	<table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>new-size</i></td><td>A non-negative integer.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>	<i>lob-locator</i>	A LOB locator.	<i>new-size</i>	A non-negative integer.	<i>errorp</i>	A generalized boolean.
<i>lob-locator</i>	A LOB locator.						
<i>new-size</i>	A non-negative integer.						
<i>errorp</i>	A generalized boolean.						
Description	<p>The function <code>ora-lob-trim</code> trims the LOB pointed to by <i>lob-locator</i> to a new size <i>new-size</i>, which must be smaller than its current size.</p> <p>Note that <i>new-size</i> is in characters for CLOBs and bytes for BLOBs.</p> <p><code>ora-lob-trim</code> is applicable to internal LOBs only.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> <p>Note: This is a direct call to OCILobTrim.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>						

ora-lob-write-buffer	Function
Summary	Writes a buffer to a LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-write-buffer lob-locator offset amount buffer &key buffer-offset csid => amount-written, eof-or-error-p</code>
Arguments	<p><i>lob-locator</i> A LOB locator.</p> <p><i>offset</i> A non-negative integer or <code>nil</code>.</p> <p><i>amount</i> A non-negative integer.</p> <p><i>buffer</i> A string, or a vector of element type <code>(unsigned-byte 8)</code>.</p> <p><i>buffer-offset</i> A non-negative integer.</p> <p><i>csid</i> A Character Set ID</p>
Values	<p><i>amount-written</i> A non-negative integer.</p> <p><i>eof-or-error-p</i> A boolean or an error object.</p>
Description	<p>The function <code>ora-lob-write-buffer</code> writes to the LOB pointed to by <i>lob-locator</i> from <i>buffer</i>.</p> <p><i>offset</i> specifies the offset to start writing to. It starts with 1, and specifies characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE. If <i>offset</i> is <code>nil</code> then the offset after the end of the previous write operation is used (read operations are ignored). This is especially useful for writing linearly to the LOB.</p> <p><i>amount</i> is the amount to write, in characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE.</p> <p>The element type of <i>buffer</i> should match the element type of the LOB locator (see <code>ora-lob-element-type</code>). For this comparison <code>(unsigned-byte 8)</code> and <code>base-char</code> are considered as the same.</p>

If the buffer *buffer* is not static, there is some additional overhead. For small amounts of data, this is probably insignificant.

buffer-offset specifies where in the buffer to start writing data from. It is an offset in bytes from the beginning of the buffer. The default value of *buffer-offset* is 0.

csid specifies what Character Set ID the data in the source buffer should be. It defaults to the CSID of the LOB pointed to by *lob-locator*.

The return value *amount-written* is the number of elements (characters or bytes) that were written

The LOB is extended as required.

If the return value *eof-or-error-p* is `nil` then there is still more to write. If *eof-or-error-p* is `t` then it wrote to the end of the LOB. If an error occurred then *eof-or-error-p* is an error object.

Note: The record from which the LOB came must be locked. See the section “Locking” on page 261.

Note: This is a direct call to OCILobWrite, without callback.

Note: this function is available only when the “oracle” module is loaded. See the section “Oracle LOB interface” on page 259 for more information.

See also	<code>ora-lob-element-type</code> <code>ora-lob-write-foreign-buffer</code>
----------	--

	<i>Function</i>
Summary	Writes the contents of a file into a LOB.
Package	<code>sql</code>
Signature	<code>ora-lob-write-from-plain-file lob-locator file-name &key offset file-offset if-does-not-exist</code>

Arguments	<i>lob-locator</i>	A LOB locator.
	<i>file-name</i>	A pathname designator.
	<i>offset</i>	A non-negative integer, or <code>nil</code> .
	<i>file-offset</i>	A non-negative integer, or <code>nil</code> .
	<i>if-does-not-exist</i>	A keyword or <code>nil</code> .
Description		<p>The function <code>ora-lob-write-from-plain-file</code> writes the contents of a file into a LOB.</p> <p><i>file-name</i> specifies the file to read, which should be a standard file. The file is always opened in a binary mode, so if the LOB is a CLOB, the file must be in the right format when writing it into the LOB.</p> <p><i>offset</i> is the offset into the LOB from where to start writing. It starts from 1, counts characters in a CLOB, and if it is <code>nil</code> then the operation starts from the end of the previous write operation. The default value of <i>offset</i> is <code>nil</code>.</p> <p><i>file-offset</i> specifies the offset into the file to start the operation from. If <i>file-offset</i> is <code>nil</code> then it starts reading at the start of the file. The default value of <i>file-offset</i> is <code>nil</code>.</p> <p><i>if-does-not-exist</i> is passed to <code>open</code> when opening the file, with the standard Common Lisp meaning. The default value of <i>if-does-not-exist</i> is <code>:error</code>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>
See also		<code>ora-lob-read-into-plain-file</code>

		<i>Function</i>
Summary	Writes a foreign buffer to a LOB.	

This chapter applies to the Enterprise Edition only

Package	sql														
Signature	<code>ora-lob-write-foreign-buffer lob-locator offset amount foreign-buffer buffer-length &key buffer-offset csid => amount- written, eof-or-error-p</code>														
Arguments	<table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>offset</i></td><td>A non-negative integer or <code>nil</code>.</td></tr><tr><td><i>amount</i></td><td>A non-negative integer.</td></tr><tr><td><i>foreign-buffer</i></td><td>A FLI pointer.</td></tr><tr><td><i>buffer-length</i></td><td>A non-negative integer.</td></tr><tr><td><i>buffer-offset</i></td><td>A non-negative integer.</td></tr><tr><td><i>csid</i></td><td>A Character Set ID</td></tr></table>	<i>lob-locator</i>	A LOB locator.	<i>offset</i>	A non-negative integer or <code>nil</code> .	<i>amount</i>	A non-negative integer.	<i>foreign-buffer</i>	A FLI pointer.	<i>buffer-length</i>	A non-negative integer.	<i>buffer-offset</i>	A non-negative integer.	<i>csid</i>	A Character Set ID
<i>lob-locator</i>	A LOB locator.														
<i>offset</i>	A non-negative integer or <code>nil</code> .														
<i>amount</i>	A non-negative integer.														
<i>foreign-buffer</i>	A FLI pointer.														
<i>buffer-length</i>	A non-negative integer.														
<i>buffer-offset</i>	A non-negative integer.														
<i>csid</i>	A Character Set ID														
Values	<table><tr><td><i>amount-written</i></td><td>A non-negative integer.</td></tr><tr><td><i>eof-or-error-p</i></td><td>A boolean or an error object.</td></tr></table>	<i>amount-written</i>	A non-negative integer.	<i>eof-or-error-p</i>	A boolean or an error object.										
<i>amount-written</i>	A non-negative integer.														
<i>eof-or-error-p</i>	A boolean or an error object.														
Description	<p>The function <code>ora-lob-write-foreign-buffer</code> writes to the LOB pointed to by <i>lob-locator</i> from <i>buffer</i>. This is just like <code>ora-lob-write-buffer</code> except that it writes the LOB locator from a foreign buffer. <i>foreign-buffer</i> is a FLI pointer to a buffer, which must be of size at least <i>buffer-length</i>.</p> <p>Note: this function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 259 for more information.</p>														
See also	<code>ora-lob-get-buffer</code> <code>ora-lob-write-buffer</code>														

p-oci-env	<i>FLI type descriptor</i>
Summary	A foreign type representing objects in the Oracle interface.
Package	<code>sql</code>
Description	See “Interactions with foreign calls” on page 263 for details.
p-oci-file	<i>FLI type descriptor</i>
Summary	A foreign type representing objects in the Oracle interface.
Package	<code>sql</code>
Description	See “Interactions with foreign calls” on page 263 for details.
p-oci-lob-locator	<i>FLI type descriptor</i>
Summary	A foreign type representing objects in the Oracle interface.
Package	<code>sql</code>
Description	See “Interactions with foreign calls” on page 263 for details.
p-oci-lob-or-file	<i>FLI type descriptor</i>
Summary	A foreign type representing objects in the Oracle interface.
Package	<code>sql</code>
Description	See “Interactions with foreign calls” on page 263 for details.

This chapter applies to the Enterprise Edition only

p-oci-svc-ctx	<i>FLI type descriptor</i>
Summary	A foreign type representing objects in the Oracle interface.
Package	<code>sql</code>
Description	See “Interactions with foreign calls” on page 263 for details.
print-query	<i>Function</i>
Summary	Prints a tabulated version of records resulting from a query.
Package	<code>sql</code>
Signature	<code>print-query query-exp &key titles formats sizes stream database =></code>
Arguments	<code>query-exp</code> An SQL query expression. <code>titles</code> A list of strings. <code>formats</code> A list of strings. <code>sizes</code> A list. <code>stream</code> An output stream. <code>database</code> A database.
Values	None.
Description	The <code>print-query</code> function takes a symbolic SQL query expression and formatting information and prints onto <code>stream</code> a table containing the results of the query. A list of strings to use as column headings is given by <code>titles</code> , which has a default value of <code>nil</code> .

The *formats* argument is a list of format strings used to print each attribute, and has a default value of `t`, which means that `~A` or `~va` are used if sizes are provided or computed.

The field sizes are given by *sizes*. It has a default value of `t`, which specifies that minimum sizes are computed.

The output stream is given by *stream*, which has a default value of `t`. This specifies that `*standard-output*` is used.

Examples The following call prints out two even columns of names and salaries:

```
(print-query [select [surname] [income] :from [person]
             :titles '("NAME" "SALARY")')
```

See also `map-query`
`print-query`
`select`

query	<i>Function</i>								
Summary	Queries a database and returns a list of values.								
Package	<code>sql</code>								
Signature	<code>query sql-exp &key database result-types flatp => result-list, field-names</code>								
Arguments	<table border="0"> <tr> <td><i>sql-exp</i></td> <td>An SQL query statement to be performed.</td> </tr> <tr> <td><i>database</i></td> <td>A database.</td> </tr> <tr> <td><i>result-types</i></td> <td>A list of symbols.</td> </tr> <tr> <td><i>flatp</i></td> <td>A boolean.</td> </tr> </table>	<i>sql-exp</i>	An SQL query statement to be performed.	<i>database</i>	A database.	<i>result-types</i>	A list of symbols.	<i>flatp</i>	A boolean.
<i>sql-exp</i>	An SQL query statement to be performed.								
<i>database</i>	A database.								
<i>result-types</i>	A list of symbols.								
<i>flatp</i>	A boolean.								
Values	<table border="0"> <tr> <td><i>result-list</i></td> <td>A list of values.</td> </tr> <tr> <td><i>field-names</i></td> <td>A list of strings.</td> </tr> </table>	<i>result-list</i>	A list of values.	<i>field-names</i>	A list of strings.				
<i>result-list</i>	A list of values.								
<i>field-names</i>	A list of strings.								

This chapter applies to the Enterprise Edition only

Description	The function <code>query</code> is the basic SQL query function. It queries the database specified by <code>database</code> with an SQL query statement given by <code>sql-exp</code> . The argument <code>database</code> defaults to <code>*default-database*</code> . <code>result-types</code> is a list of symbols such as <code>:string</code> and <code>:integer</code> , one for each field in the query, which are used to specify the types to return. <code>flatp</code> is used as in <code>select</code> . <code>result-list</code> is a list of values as per <code>select</code> , and <code>field-names</code> is a list of field names selected in <code>sql-exp</code> .
Example	The following two queries, on a table whose second column contains dates that we want to return as strings, are equivalent: <pre>(sql:query "select * from some_table" :result-types '(nil :string)) (sql:query [select [*] :from [some_table] :result-types '(nil :string)])</pre>
See also	<code>do-query</code> <code>execute-command</code> <code>lob-stream</code> <code>loop</code> <code>map-query</code> <code>select</code> <code>simple-do-query</code>

reconnect	<i>Function</i>
Summary	Reconnects a database to its underlying RDBMS.
Package	<code>sql</code>

Signature	<code>reconnect &key database error force => success</code>	
Arguments	<code>database</code>	The database to be reconnected.
	<code>error</code>	A boolean.
	<code>force</code>	A boolean.
Values	<code>success</code>	A boolean.
Description	<p>The <code>reconnect</code> function reconnects <code>database</code> to its underlying RDBMS. If successful, <code>success</code> is <code>t</code> and the variable <code>*default-database*</code> is set to the newly reconnected database.</p> <p>The default value for <code>database</code> is <code>*default-database*</code>. If <code>database</code> is a database object, then it is used directly. Otherwise, the list of connected databases is searched to find one with <code>database</code> as its connection specifications (see <code>connect</code>). If no such database is found, then if <code>error</code> and <code>database</code> are both non-nil an error is signaled, otherwise <code>reconnect</code> returns <code>nil</code>.</p> <p><code>force</code> controls whether an error should be signaled if the existing database connection cannot be closed. When non-nil (this is the default value) the connection is closed without error checking. When <code>force</code> is <code>nil</code>, an error is signaled if the database connection has been lost.</p> <p>Note: <code>force</code> non-nil might result in a memory leak if the database driver fails to release its memory (some drivers do not allow the connection to be closed if the underlying RDBMS is not responding).</p>	
See also	<code>connect</code> <code>connected-databases</code> <code>*default-database*</code>	

This chapter applies to the Enterprise Edition only

		<i>Function</i>
	restore-sql-reader-syntax-state	
Summary		Sets the enable/disable square bracket syntax state to reflect the last call to either <code>disable-sql-reader-syntax</code> or <code>enable-sql-reader-syntax</code> .
Package		<code>sql</code>
Signature		<code>restore-sql-reader-syntax-state</code>
Arguments		None.
Values		None.
Description		The function <code>restore-sql-reader-syntax-state</code> sets the enable/disable state of the square bracket syntax to reflect the last call to either <code>enable-sql-reader-syntax</code> or <code>disable-sql-reader-syntax</code> . The default state of the square bracket syntax is disabled.
See also		<code>disable-sql-reader-syntax</code> <code>enable-sql-reader-syntax</code> <code>locally-disable-sql-reader-syntax</code> <code>locally-enable-sql-reader-syntax</code>
	rollback	
Summary		Rolls back changes made to a database since the last commit.
Package		<code>sql</code>
Signature		<code>rollback &key database => nil</code>
Arguments	<code>database</code>	A database.
Values		<code>nil</code>

Description	The function <code>rollback</code> rolls back changes made in <i>database</i> since the last commit, that is, changes made since the last commit are not recorded. The argument <i>database</i> defaults to <code>*default-database*</code> .
See also	<code>commit</code> <code>with-transaction</code>

	<i>Function</i>																								
select	<i>Function</i>																								
Summary	Selects data from a database given a number of specified constraints.																								
Package	<code>sql</code>																								
Signature	<code>select &rest selections &key all set-operation distinct from result-types flatp where group-by having database order-by refresh for-update => result-list</code>																								
Arguments	<table> <tr> <td><i>selections</i></td><td>A set of database identifiers or strings.</td></tr> <tr> <td><i>all</i></td><td>A boolean.</td></tr> <tr> <td><i>set-operation</i></td><td>An SQL operation.</td></tr> <tr> <td><i>distinct</i></td><td>A boolean.</td></tr> <tr> <td><i>from</i></td><td>An SQL table.</td></tr> <tr> <td><i>result-types</i></td><td>A list of symbols.</td></tr> <tr> <td><i>flatp</i></td><td>A boolean.</td></tr> <tr> <td><i>where</i></td><td>An SQL condition.</td></tr> <tr> <td><i>group-by</i></td><td>An SQL condition.</td></tr> <tr> <td><i>having</i></td><td>An SQL condition.</td></tr> <tr> <td><i>database</i></td><td>A database.</td></tr> <tr> <td><i>order-by</i></td><td>An SQL condition.</td></tr> </table>	<i>selections</i>	A set of database identifiers or strings.	<i>all</i>	A boolean.	<i>set-operation</i>	An SQL operation.	<i>distinct</i>	A boolean.	<i>from</i>	An SQL table.	<i>result-types</i>	A list of symbols.	<i>flatp</i>	A boolean.	<i>where</i>	An SQL condition.	<i>group-by</i>	An SQL condition.	<i>having</i>	An SQL condition.	<i>database</i>	A database.	<i>order-by</i>	An SQL condition.
<i>selections</i>	A set of database identifiers or strings.																								
<i>all</i>	A boolean.																								
<i>set-operation</i>	An SQL operation.																								
<i>distinct</i>	A boolean.																								
<i>from</i>	An SQL table.																								
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<i>flatp</i>	A boolean.																								
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<i>group-by</i>	An SQL condition.																								
<i>having</i>	An SQL condition.																								
<i>database</i>	A database.																								
<i>order-by</i>	An SQL condition.																								

This chapter applies to the Enterprise Edition only

	<i>refresh</i>	A boolean.
	<i>for-update</i>	<code>t</code> , <code>:nowait</code> , a string or a list.
Values	<i>result-list</i>	A list of selections.
Description	The function <code>select</code> selects data from <i>database</i> , which has a default value of <code>*default-database*</code> , given the constraints specified by the rest of the arguments. It returns a list of objects as specified by <i>selections</i> . By default, the objects will each be represented as lists of attribute values. The argument <i>selections</i> consists either of database identifiers, type-modified database identifiers or literal strings. A type-modified database identifier is an expression such as <code>[foo :string]</code> which means that the values in column <code>foo</code> are returned as Lisp strings. This syntax can be used to force values in time/date fields to be returned as strings (see below for an example). It can also be used to affect the value returned from MySQL, using the keywords mentioned in the section “Using MySQL” on page 253. It can also be used to return <code>lob-stream</code> objects for queries on Oracle LOB columns, using an expression like <code>[foo :input-stream]</code> or <code>[foo :output-stream]</code>	
	<i>result-types</i> is used when <i>selections</i> is <code>*</code> or <code>[*]</code> . It should be a list of symbols such as <code>:string</code> and <code>:integer</code> , one for each field in the table being selected in order to specify the types to return. Note that, for specific selections, the result type can be specified by using a type-modified identifier as described above. However, you cannot use <i>result-types</i> to modify the type returned from a time/date field. The <code>flatp</code> argument, which has a default value of <code>nil</code> , specifies if full bracketed results should be returned for each matched entry. If <code>flatp</code> is <code>nil</code> , the results are returned as a list of lists. If <code>flatp</code> is <code>t</code> , the results are returned as elements of a list, only if there is only one result per row. See the examples section for an example of the use of <code>flatp</code> .	

The arguments *all*, *set-operation*, *distinct*, *from*, *where*, *group-by*, *having* and *order-by* have the same function as the equivalent SQL expression.

for-update is used to specify the FOR UPDATE clause in a select statement which is used by Oracle to lock the selected records. If *for-update* is *t* then a plain "FOR UPDATE" clause is generated. This locks all retrieved records, waiting for the locks to become available. If *for-update* is *:nowait* then a "FOR UPDATE NOWAIT" clause is generated. This locks all the retrieved records, or otherwise returns with error ora-00054 which causes Lisp to signal a `sql-temporary-error`. If *for-update* is a string then it should specify a column to be locked and a clause "FOR UPDATE OF *for-update*" is generated. If *for-update* is a list then the elements of the list should be strings each specifying a column to be locked, except that the last element of the list may be *:nowait*. A clause locking multiple columns is generated, waiting for the locks according to whether *:nowait* was supplied. For an example see the section "Locking" on page 261.

The `select` function is common across both the functional and object-oriented SQL interfaces. If *selections* refers to View Classes then the select operation becomes object-oriented. This means that `select` returns a list of View Class instances, and `slot-value` becomes a valid SQL operator for use within the *where* clause.

In the View Class case, a second equivalent `select` call will return the same View Class instance objects. If *refresh* is true, then existing instances are updated if necessary, and in this case you might need to extend the hook `instance-refreshed`. Any join slots defined using `retrieval :deferred` will be recomputed the next time they are accessed. The default value of *refresh* is `nil`.

SQL expressions used in the `select` function are specified using the square bracket syntax, once this syntax has been enabled using `enable-sql-reader-syntax`.

Examples

The following is a potential query and result:

```
(select [person_id] [surname] :from [person])  
=> ((111 "Brown") (112 "Jones") (113 "Smith"))
```

In the next example, the *flatp* argument is set to *t*, and the result is a simple list of surname values:

```
(select [surname] :from [person] :flatp t)  
=> ("Brown" "Jones" "Smith")
```

In this example data in the attribute *largenum*, which is of a vendor-specific large numeric type, is returned to Lisp as strings:

```
(sql:select [largenum :string] :from [my-table])
```

In this example the second column of *some_table* is a date that we want to return as a string:

```
(sql:select [*]  
          :from [some_table]  
          :result-types '(nil :string))
```

In this example we see that a time/date field value is returned as an integer. We then use Common Lisp to decode that universal time, and finally query the database again, forcing the return value to be a string formatted by the database:

```

CL-USER 219 > (sql:select [MyDate]
                           :from [MyTable]
                           :flatp t)
(3313785600)
("MYDATE")

CL-USER 220 > (decode-universal-time (car *))
0
0
0
4
1
2005
1
NIL
0

CL-USER 221 > (sql:select [MyDate :string]
                           :from [MyTable]
                           :flatp t)
("2005-01-04 00:00:00")
("MYDATE")

```

Finally this code gets the first 1KB of data from the first LOB returned by a query on an Oracle table containing a column of type LOB:

```

(let* ((array
        (make-array 1024
                   :element-type '(unsigned-byte 8)))
       (lobs (sql:select [my-lob-column :input-stream]
                         :from [mytable] :flatp t)))
  (read-sequence array (car lobs)))

```

See also [instance-refreshed](#)
[lob-stream](#)
[print-query](#)

simple-do-query *Macro*

Summary Repeatedly binds a variable to the results of a query, optionally binds another variable to the column names, and executes a body of code within the scope of these bindings.

This chapter applies to the Enterprise Edition only

Package	<code>sql</code>	
Signature	<code>simple-do-query (values-list query &key names-list database not-inside-transaction get-all) &body body =></code>	
Arguments	<code>values-list</code>	A variable.
	<code>query</code>	A database query.
	<code>names-list</code>	A variable, or <code>nil</code> .
	<code>database</code>	A database.
	<code>not-inside-transaction</code>	A generalized boolean.
	<code>get-all</code>	A generalized boolean.
	<code>body</code>	A Lisp code body.
Values	None.	
Description	<p>The macro <code>simple-do-query</code> repeatedly executes <code>body</code> within a binding of <code>values-list</code> to the attributes of each record resulting from <code>query</code>.</p> <p>If a variable <code>names-list</code> is supplied, then it is bound to a list of the column names for the query during the execution of <code>body</code>. The default value of <code>names-list</code> is <code>nil</code>.</p> <p><code>simple-do-query</code> returns no values.</p> <p>The default value of <code>database</code> is <code>*default-database*</code>.</p> <p><code>not-inside-transaction</code> and <code>get-all</code> may be useful when fetching many records through a connection with <code>database-type :mysql</code>. Both of these arguments have default value <code>nil</code>. See the section “Special considerations for iteration functions and macros” on page 255 for details.</p>	

Example	<pre>(sql:simple-do-query (person-details [select [Surname] [ID] :from [person]] :names-list xx) (format t "~&~A: ~A, ~A: ~A~%" (first xx) (first person-details) (second xx) (second person-details))) => SURNAME: Brown, ID: 2 SURNAME: Jones, ID: 3 SURNAME: Smith, ID: 4</pre>
See also	do-query loop map-query query select

sql	<i>Function</i>
Summary	Generates SQL from a set of expressions.
Package	<code>sql</code>
Signature	<code>sql &rest args => sql-expression</code>
Arguments	args A set of expressions.
Values	<code>sql-expression</code> An SQL expression.
Description	The function <code>sql</code> generates SQL from a set of expressions given by <code>args</code> . Each argument to <code>sql</code> is translated into SQL and then the <code>args</code> are concatenated with a single space between each pair. The rules for translation into SQL, based on the type of each individual argument <code>x</code> , are as follows:

```
string => (format nil "'~A'" x)
nil => "NULL"
```

This chapter applies to the Enterprise Edition only

```
symbol => (symbol-name x)
number => (princ-to-string x)
list => (format nil "~{~A~^,~}") (mapcar #'sql x))
vector => (format nil "~{~A~^,~}" (map 'list #'sql x))
sql-expression => x
Any other symbol => error
```

See also [sql-expression](#)
[sql-operation](#)
[sql-operator](#)

sql-connection-error *Condition*

Package [sql](#)
Superclasses [sql-database-error](#)
Subclasses [sql-fatal-error](#)
 [sql-timeout-error](#)
Description The condition class **sql-connection-error** is used to signal an error with the connection to the database.

sql-database-data-error *Condition*

Package [sql](#)
Superclasses [sql-database-error](#)
Description The condition class **sql-database-data-error** is used to signal an error with the data given. This means either a syntax error or things like accessing a non-existent table.
It signifies an error that must be fixed for the code to work.

sql-database-error	<i>Condition</i>
Package sql	
Superclasses simple-error	
Subclasses sql-connection-error sql-database-data-error sql-temporary-error	
Accessors sql-error-error-id sql-error-secondary-error-id sql-error-database-message	
Description The condition class sql-database-error is used to signal errors in the database interface that Common SQL uses. sql-error-error-id returns the primary error identifier. On ODBC the value is a string. On Oracle it is some number, the "v2 return code" in the Cursor Data Area. sql-error-secondary-error-id returns the secondary error identifier. On ODBC this is the error code from the underlying database. On Oracle that is the "v4 return code" (also known as "return code") in the Cursor Data Area, which is the useful code. sql-error-database-message is a string (maybe nil) that came back from the foreign code. Note: ODBC drivers for Oracle return the "v4 return code" as the underlying database code. Therefore in the event of an error on connection to an Oracle database, sql-error-secondary-error-id always returns the "v4 return code" whether the connection is through ODBC.	
See also sql-user-error	

This chapter applies to the Enterprise Edition only

sql-enlarge-static		<i>Variable</i>
Package	<code>sql</code>	
Initial Value	<code>100000</code>	
Description	The amount to enlarge static memory by before loading database code. This is an optimization of static memory fragmentation, useful for some databases. It is ignored when loading Oracle.	
Note: applicable in LispWorks for UNIX only (not LispWorks for Linux, FreeBSD, or x86/x64 Solaris).		

sql-expression		<i>Function</i>
Summary	Generates an SQL expression from the given keywords.	
Package	<code>sql</code>	
Signature	<code>sql-expression &key string table alias attribute type => sql-result</code>	
Arguments	<code>string</code>	A string.
	<code>table</code>	A table in a database.
	<code>alias</code>	A table alias.
	<code>attribute</code>	An attribute.
	<code>type</code>	A type.
Values	<code>sql-result</code>	An SQL expression.
Description	The function <code>sql-expression</code> generates an SQL expression from the given keywords. Valid combinations of the arguments are:	

- *string*
- *table*
- *table* and *alias*
- *table* and *attribute*
- *table*, *attribute*, and *type*
- *table* or *alias*, and *attribute*
- *table* or *alias*, and *attribute* and *type*
- *attribute*
- *attribute* and *type*

See also

`sql`
`sql-operation`
`sql-operator`

sql-fatal-error*Condition*

Package `sql`

Superclasses `sql-connection-error`

Description The condition class `sql-fatal-error` is used to signal errors that mean the connection can no longer be used.

sql-libraries*Variable*

Package `sql`

Initial Value `nil`

This chapter applies to the Enterprise Edition only

Description	Holds a pathname or list of libraries to override default database library loading. The value should be a pathname or a list. If its value is a pathname, it is prepended to a list of relative pathnames in the same manner that the supplied environment variable (for example <code>ORACLE_HOME</code>) would be. If its value is a list, then it is assumed to be a complete list of full library names which are loaded verbatim.
Note:	applicable only on Unix/Linux.

sql-loading-verbose		<i>Variable</i>
Package	<code>sql</code>	
Initial Value	<code>nil</code>	
Description	The variable <code>*sql-loading-verbose*</code> controls the verbosity of messages while loading the database libraries.	
Note:	applicable only on Unix.	

sql-operation		<i>Function</i>
Summary	Generates an SQL statement from an operator and arguments.	
Package	<code>sql</code>	
Signature	<code>sql-operation op &rest args => sql-result</code> <code>sql-operation sql-function name &rest args => sql-result</code> <code>sql-operation sql-operator inop1 left &rest rights => sql-result</code> <code>sql-operation sql-boolean-operator inop2 left &rest rights => sql-result</code>	

Arguments	<i>op</i>	An operator.
	<i>args</i>	A set of arguments for <i>op</i> .
	<i>name</i>	An arbitrary function.
	<i>args</i>	A set of arguments for <i>name</i> .
	<i>inop1</i>	An infix operator with non-boolean result.
	<i>inop2</i>	An infix operator that returns a boolean.
	<i>left</i>	Argument to be placed on the left of an infix operator.
	<i>rights</i>	Arguments to be placed on the right of an infix operator.
Values	<i>sql-result</i>	An SQL expression.
Description	<p>The function <code>sql-operation</code> takes an operator and its arguments, and returns an SQL expression.</p> <p><code>(sql-operation op args)</code></p> <p>is shorthand for</p> <p><code>(apply (sql-operator op) args).</code></p> <p>The pseudo operator <code>sql-function</code> allows an arbitrary function <i>name</i> to be passed. In this case, <i>name</i> is put in the SQL expression using <code>princ</code>, and <i>args</i> are given as arguments.</p> <p>The pseudo operators <code>sql-boolean-operator</code> and <code>sql-operator</code> generate SQL that calls an infix operator with <i>left</i> on the left and <i>rights</i> on the right separated by spaces. Use <code>sql-boolean-operator</code> for SQL infix operators that return a boolean and use <code>sql-operator</code> for any other SQL infix operator.</p> <p>Note: the pseudo operator <code>sql-operator</code> should not be confused with the Common SQL function <code>sql-operator</code>.</p>	

This chapter applies to the Enterprise Edition only

Example The following code, uses **sql-operation** to produce an SQL expression.

```
(sql-operation 'select
    (sql-expression :table 'foo :attribute 'bar)
    (sql-expression :attribute 'baz)
    :from (list
        (sql-expression :table 'foo)
        (sql-expression :table 'quux))
    :where
        (sql-operation 'or
            (sql-operation '>
                (sql-expression :attribute 'baz)
                3)
            (sql-operation 'like
                (sql-expression :table 'foo :attribute 'bar)
                "SU%")))
```

The following SQL expression is produced.

```
#<SQL-QUERY: "(SELECT FOO.BAR,BAZ FROM FOO,QUUX
    WHERE ((BAZ > 3) OR (FOO.BAR LIKE 'SU%')))">
```

The following code illustrates use of the pseudo operator **sql-function**:

```
(sql-operation 'sql-function "TO_DATE" "03/06/99"
    "mm/DD/RR")
```

The following SQL expression is produced.

```
#<SQL-VALUE-EXP "TO_DATE('03/06/99','mm/DD/RR')">
```

See also **sql**
 sql-expression
 sql-operator

sql-operator

Function

Summary Returns the symbol for a SQL operator.

Package **sql**

Signature	<code>sql-operator symbol => sql-symbol</code>	
Arguments	<code>symbol</code>	A symbol naming an SQL operator.
Values	<code>sql-symbol</code>	A symbol.
Description	The function <code>sql-operator</code> takes an operator as an argument and returns the Lisp symbol for the operator.	
See also	sql sql-expression sql-operation	

	<i>Function</i>				
sql-recording-p					
Summary	A predicate for determining if SQL commands or results traffic is being recorded.				
Package	<code>sql</code>				
Signature	<code>sql-recording-p &key type database => recording-p</code>				
Arguments	<table> <tr> <td><code>type</code></td> <td>One of <code>:commands</code> or <code>:results</code>.</td> </tr> <tr> <td><code>database</code></td> <td>A database.</td> </tr> </table>	<code>type</code>	One of <code>:commands</code> or <code>:results</code> .	<code>database</code>	A database.
<code>type</code>	One of <code>:commands</code> or <code>:results</code> .				
<code>database</code>	A database.				
Values	<code>recording-p</code> A boolean.				
Description	<p>The function <code>sql-recording-p</code> returns <code>t</code> if <code>type</code> is <code>:commands</code> and SQL commands traffic is being recorded, or if <code>type</code> is <code>:results</code> and SQL results traffic is being recorded. Otherwise it returns <code>nil</code>.</p> <p>The default value of <code>type</code> is <code>:commands</code>. The default value of <code>database</code> is the value of <code>*default-database*</code>.</p>				

This chapter applies to the Enterprise Edition only

See also [add-sql-stream](#)
[delete-sql-stream](#)
[list-sql-streams](#)
[sql-stream](#)
[start-sql-recording](#)
[stop-sql-recording](#)

	<i>Function</i>
sql-stream	
Summary	Returns the broadcast stream used for recording SQL commands or results traffic
Package	<code>sql</code>
Signature	<code>sql-stream &key type database => stream</code>
Arguments	<code>type</code> One of <code>:commands</code> or <code>:results</code> . <code>database</code> A database.
Values	<code>stream</code> A broadcast stream.
Description	The function <code>sql-stream</code> returns the broadcast stream used for recording SQL commands or results traffic. <code>type</code> can be either <code>:commands</code> or <code>:results</code> , and specifies whether to return the broadcast stream for commands or results traffic. The default value of <code>type</code> is <code>:commands</code> . The default value of <code>database</code> is the value of <code>*default-database*</code> . Note that SQL traffic can appear on <code>*standard-output*</code> as well as on <code>stream</code> . See <code>add-sql-stream</code> for details.
See also	add-sql-stream delete-sql-stream list-sql-streams

```
sql-recording-p  
start-sql-recording  
stop-sql-recording
```

sql-temporary-error *Condition*

Package **sql**

Superclasses **sql-database-error**

Description The condition class **sql-temporary-error** is used to signal an error that results from other users using the same database. This can be a table lock, but also running out of various resources.

It means the code can work without change, once the other users stop using the database.

sql-timeout-error *Condition*

Package **sql**

Superclasses **sql-connection-error**

Description The condition class **sql-timeout-error** is used to signal an error due to the time out of some operation.

sql-user-error *Condition*

Package **sql**

Superclasses **simple-error**

This chapter applies to the Enterprise Edition only

Description The condition class `sql-user-error` is used to signal errors in Lisp code.

See also `sql-database-error`

standard-db-object *Class*

Package `sql`

Superclasses `standard-object`

Description The class `standard-db-object` implements View Classes.

See also `def-view-class`

start-sql-recording *Function*

Summary Starts recording SQL commands or results traffic.

Package `sql`

Signature `start-sql-recording &key type database =>`

Arguments `type` A keyword.

`database` A database.

Values None.

Description The function `start-sql-recording` starts recording SQL traffic, potentially to multiple streams. The traffic recorded can be the commands, the results, or both commands and results.

By default the output appears only *standard-output*. You can modify the broadcast list of recording streams using `add-sql-stream` and `delete-sql-stream`.

`type` is one of `:commands`, `:results` or `:both`. It determines whether SQL commands traffic, results traffic or both is recorded.

The default value of `type` is `:commands`. The default value for `database` is the value of *default-database*.

See also

`add-sql-stream`
`delete-sql-stream`
`list-sql-streams`
`sql-stream`
`sql-recording-p`
`stop-sql-recording`

	<i>Function</i>
status	
Summary	Returns status information for the connected databases and initialized database types.
Package	<code>sql</code>
Signature	<code>status &optional full =></code>
Arguments	<code>full</code> A boolean.
Values	None.
Description	The function <code>status</code> prints status information to the standard output, for the connected databases and initialized database types. If <code>full</code> is <code>t</code> , detailed status information is printed. The default value of <code>full</code> is <code>nil</code> .

This chapter applies to the Enterprise Edition only

See also

connect
connected-databases
database-name
disconnect
find-database

stop-sql-recording

Function

Summary	Stops recording SQL commands or results traffic.	
Package	sql	
Signature	stop-sql-recording &key type database =>	
Arguments	type A keyword. database A database.	
Values	None.	
Description	The function stop-sql-recording stops recording SQL commands or results traffic. type is one of :commands , :results or :both . It determines whether the recording of SQL commands traffic, results traffic or both is stopped. The default value of type is :commands . The default value for database is *default-database* .	
See also	add-sql-stream delete-sql-stream list-sql-streams sql-recording-p sql-stream start-sql-recording	

		<i>Function</i>
table-exists-p		
Summary	A predicate for the existence of a table.	
Package	<code>sql</code>	
Signature	<code>table-exists-p <i>table</i> &key <i>database owner</i> => <i>result</i></code>	
Arguments	<p><i>table</i> A potential table name.</p> <p><i>database</i> A database.</p> <p><i>owner</i> <code>nil</code>, <code>:all</code> or a string.</p>	
Values	<i>result</i> A boolean.	
Description	<p>The function <code>table-exists-p</code> determines whether there is a table named <i>table</i> in database <i>database</i>.</p> <p>If <i>owner</i> is <code>nil</code>, only user-owned tables are considered. This is the default.</p> <p>If <i>owner</i> is <code>:all</code>, all tables are considered.</p> <p>If <i>owner</i> is a string, this denotes a username and only tables owned by <i>owner</i> are considered.</p> <p>The default value of <i>database</i> is <code>*default-database*</code>.</p>	
See also	<code>list-tables</code>	

		<i>Generic Function</i>
update-instance-from-records		
Summary	Updates a View Class instance.	
Package	<code>sql</code>	
Signature	<code>update-instance-from-records <i>instance</i> &key <i>database</i> => <i>instance</i></code>	

This chapter applies to the Enterprise Edition only

Arguments	<i>instance</i>	An instance of a View Class.
	<i>database</i>	A database.
Values	<i>instance</i>	The updated View Class instance.
Description	The generic function <code>update-instance-from-records</code> updates the values in the slots of the View Class instance <i>instance</i> using the data in the database <i>database</i> .	
	<i>database</i> defaults to the database that <i>instance</i> is associated with, or the value of <code>*default-database*</code> . If <i>instance</i> is associated with a database, then <i>database</i> must be that same database.	
	The argument <i>slot</i> is the CLOS slot name; the corresponding column names are derived from the View Class definition.	
	The update is not recursive on joins. Join slots (that is, slots with <code>:db-kind :join</code>) are updated, but the joined objects are not updated.	
See also	<code>def-view-class</code> <code>update-slot-from-record</code>	

update-objects-joins

Function

Summary	Updates the remote join slots.	
Signature	<code>update-objects-joins objects &key slots force-p class-name max-len</code>	
Arguments	<i>objects</i>	A list of database objects.
	<i>slots</i>	A list of slot names, or <code>t</code> .
	<i>force-p</i>	A boolean.
	<i>class-name</i>	The class of the objects, or <code>nil</code> .
	<i>max-len</i>	A non-negative integer, or <code>nil</code> .

Description	The function <code>update-objects-joins</code> updates the remote join slots, that is those slots defined without <code>:retrieval :immediate</code> . This is an optimization function which can improve the efficiency of an application by reducing the number of queries of the database. For each slot, it queries the database using the data from all the objects, and then assigns the appropriate value to each object. <i>objects</i> is a list of database objects. If <i>class-name</i> is non-nil, then all the database objects are of this class. If <i>class-name</i> is <code>nil</code> , then all the database objects are of the class of the first database object in the list <i>objects</i> . If <i>objects</i> is <code>nil</code> , then <code>update-objects-joins</code> does nothing. <i>class-name</i> specifies a class containing all the database objects in the list <i>objects</i> . If <i>class-name</i> is <code>nil</code> (the default) then the class of the first database object is used. <i>slots</i> provides a list of the names of slots to update. Each of these slots should be a remote join slot (as defined above). <i>slots</i> can also be <code>t</code> , meaning update all the remote join slots. The default value of <i>slots</i> is <code>t</code> . <i>force-p</i> controls whether to force the update of all values in the objects. If <i>force-p</i> is <code>nil</code> , then slots which are already are not updated. The default value of <i>force-p</i> is <code>t</code> . <i>max-len</i> , if non-nil, is a maximum number of objects from which to use data in a single query. If the length of the list <i>objects</i> is greater than <i>max-len</i> then <code>update-objects-joins</code> performs multiple queries using the data from no more than <i>max-len</i> objects in each query. This is useful if the DBMS may reject large queries, but it will increase the number of queries and hence reduce overall performance to some extent. The default value of <i>max-len</i> is the value of the variable <code>*default-update-objects-max-len*</code> .
-------------	---

This chapter applies to the Enterprise Edition only

See also

```
*default-update-objects-max-len*
def-view-class
```

update-records

Function

Summary Changes the values of fields in a table.

Package sq1

Signature **update-records** *table* &key *attributes* *values* *av-pairs* where
 database =>

Arguments *table* A database table.

attributes A set of columns.

values A set of values.

<i>av-pairs</i>	An association list alternative to <i>attributes</i> and <i>values</i> .
-----------------	--

where A condition.

database A database.

Values None

Description The function `update-records` changes the values of existing fields in *table* with columns specified by *attributes* and *values* (or *av-pairs*) where the *where* condition is true.

See also [delete-instance-records](#)

```
delete-records  
insert-records  
update-records-from-instance
```

update-records-from-instance *Generic Function*

Summary	Updates a set of specified records in a database.				
Package	<code>sql</code>				
Signature	<code>update-records-from-instance instance &key database =></code>				
Arguments	<table border="0"> <tr> <td><code>instance</code></td><td>An instance of a View Class.</td></tr> <tr> <td><code>database</code></td><td>A database.</td></tr> </table>	<code>instance</code>	An instance of a View Class.	<code>database</code>	A database.
<code>instance</code>	An instance of a View Class.				
<code>database</code>	A database.				
Values	None.				
Description	<p>The generic function <code>update-records-from-instance</code> updates the records in <i>database</i> represented by <i>instance</i>. If the instance is already associated with a database, that database is used, and <i>database</i> is ignored. If <i>instance</i> is not yet associated with a database, a record is created for <i>instance</i> in the appropriate table of <i>database</i> and the instance becomes associated with that database.</p> <p><code>update-records-from-instance</code> only updates the records from the base slots of <i>instance</i> - it doesn't look at the join slots.</p>				
See also	<code>def-view-class</code> <code>delete-instance-records</code> <code>update-records</code>				

update-record-from-slot *Generic Function*

Summary	Updates an individual data item from a slot.
Package	<code>sql</code>
Signature	<code>update-record-from-slot instance slot &key database</code>

This chapter applies to the Enterprise Edition only

Arguments	<i>instance</i>	An instance of a View Class.
	<i>slot</i>	A slot.
	<i>database</i>	A database.
Values	None.	
Description	The generic function <code>update-record-from-slot</code> updates an individual data item in the column represented by <i>slot</i> . The <i>database</i> is only used if <i>instance</i> is not yet associated with any database, in which case a record is created in <i>database</i> . Only <i>slot</i> is initialized in this case; other columns in the underlying database receive default values. The argument <i>slot</i> is the CLOS slot name; the corresponding column names are derived from the View Class definition.	
See also	<code>def-view-class</code> <code>update-records-from-instance</code>	

update-slot-from-record *Generic Function*

Summary	Updates a slot in a View Class instance.	
Package	<code>sql</code>	
Signature	<code>update-slot-from-record</code> <i>instance slot</i> => <i>instance</i>	
Arguments	<i>instance</i>	An instance of a View Class.
	<i>slot</i>	A slot name.
Values	<i>instance</i>	The updated View Class instance.
Description	The generic function <code>update-slot-from-record</code> updates the value in the slot <i>slot</i> of the View Class instance <i>instance</i> using the records in the database.	

instance must be associated with a database.

The argument *slot* is the CLOS slot name; the corresponding column names are derived from the View Class definition.

The update is not recursive on joins. Join slots (that is, slots with `:db-kind :join`) are updated, but the joined objects are not updated.

See also

`def-view-class`
`update-instance-from-records`

with-transaction Macro

Summary Performs a body of code within a transaction for a database.

Package `sql`

Signature `with-transaction &key database &body body => results`

Arguments `database` A database.

`body` A set of Lisp expressions.

Values `results` The values returned by *body*.

Description The macro `with-transaction` executes *body* within a transaction for *database* (which defaults to `*default-database*`). The transaction is committed if the body finishes successfully (without aborting or throwing), otherwise the database is rolled back.

`with-transaction` returns the value or multiple values returned from *body*.

Example

The following example shows how to use `with-transaction` to insert a new record, updates the department number of employes from 40 to 50, and removes employees whose sal-

This chapter applies to the Enterprise Edition only

ary is higher than 300,000. If an error occurs anywhere in the body and an **abort** or **throw** is executed, none of the updates are committed.

```
(with-transaction
  (insert-record :into [emp]
                  :attributes '(x y z)
                  :values '(a b c))
  (update-records [emp]
                  :attributes [dept]
                  :values 50
                  :where [= [dept] 40])
  (delete-records :from [emp]
                  :where [> [salary] 300000]))
```

See also

commit
rollback

39

The STREAM Package

This chapter describes the symbols available in the `stream` package that provide users with the functionality to define their own streams for use by the standard I/O functions.

This is discussed in detail in Chapter 20, “User Defined Streams”.

buffered-stream	<i>Class</i>
Summary	A stream class giving access to stream buffers.
Package	<code>stream</code>
Superclasses	<code>fundamental-stream</code>
Subclasses	<code>lob-stream</code> <code>string-stream</code> <code>socket-stream</code>
Initargs	<code>:direction</code> One of <code>:input</code> , <code>:output</code> or <code>:io</code> . This argument is required.

`:element-type` One of `base-char`, `simple-char` or `character`.

Description	<p>The class <code>buffered-stream</code> provides default methods for the majority of the functions in the User Defined Streams protocol. The default methods implement buffered I/O, requiring the user to define only the methods <code>stream-read-buffer</code>, <code>stream-write-buffer</code> and <code>stream-element-type</code> for each subclass of <code>buffered-stream</code>. You are at liberty to redefine other methods in subclasses as long as they obey the rules outlined here. For example it is usually desirable to implement methods on <code>stream-listen</code>, <code>stream-check-eof-no-hang</code> and <code>close</code> as well.</p> <p>The initargs are handled by the method <code>(method initialize-instance :after (buffered-stream))</code> as follows:</p> <p>Input and/or output buffers are created based on the value <code>direction</code>. There is no default value, and you must supply a value.</p> <p><code>element-type</code> determines the <code>stream-element-type</code> of the stream. The default is <code>base-char</code>. For binary streams, use <code>base-char</code>.</p> <p>All the methods in the User Defined Streams protocol are defined for <code>buffered-stream</code> as follows:</p> <ul style="list-style-type: none"> • The methods on <code>stream-read-char</code>, <code>stream-read-line</code>, <code>stream-read-sequence</code>, <code>stream-unread-char</code>, <code>stream-read-char-no-hang</code>, <code>stream-clear-input</code> handle input from the buffer. They each call <code>stream-fill-buffer</code> to fill the empty buffer as required. • The methods on <code>stream-write-char</code>, <code>stream-write-string</code>, <code>stream-write-sequence</code>, <code>stream-clear-output</code>, <code>stream-finish-output</code>, <code>stream-force-output</code> and <code>stream-line-column</code> handle output to the buffer. They each call <code>stream-flush-buffer</code> to make the buffer empty as required.
-------------	--

- There are `:around` methods on `stream-listen` and `close` which handle the buffer.
- The methods on `input-stream-p`, `output-stream-p` return the appropriate values based on the value of the `:direction` initarg.
- The `open-stream-p` method returns true if `close` has not been called.

Example See the extended example in `examples/streams/buffered-stream.lisp`

See also `close`
`stream-flush-buffer`
`stream-fill-buffer`
`stream-listen`
`stream-read-buffer`
`stream-write-buffer`
`with-stream-input-buffer`

fundamental-binary-input-stream *Class*

Summary A stream class for binary input.

Package `stream`

Superclasses `fundamental-binary-stream`
`fundamental-input-stream`

Subclasses None.

Description The class `fundamental-binary-input-stream` provides a class for generating customized binary input stream classes. A method for `stream-read-byte` should be provided when using this class.

See also **fundamental-binary-stream**
fundamental-input-stream
stream-read-byte

fundamental-binary-output-stream *Class*

Summary A stream class for binary output.

Package **stream**

Superclasses **fundamental-binary-stream**
fundamental-output-stream

Description The class **fundamental-binary-output-stream** provides a class for generating customized binary output stream classes. A method for **stream-write-byte** should be provided.

See also **fundamental-binary-stream**
fundamental-output-stream
stream-write-byte

fundamental-binary-stream *Class*

Summary A class for binary streams.

Package **stream**

Superclasses **fundamental-stream**

Subclasses **fundamental-binary-input-stream**
fundamental-binary-output-stream

Description The class **fundamental-binary-stream** is the superclass of the binary input and output stream classes. A method for **stream-element-type** should be provided for instantiable subclasses of this class.

See also **`fundamental-binary-input-stream`**
`fundamental-binary-output-stream`
`fundamental-stream`
`stream-element-type`

fundamental-character-input-stream *Class*

Summary A class that should be included in stream classes for character input.

Package **`stream`**

Superclasses **`fundamental-character-stream`**
`fundamental-input-stream`

Subclasses None.

Description The class **`fundamental-character-input-stream`** provides default methods for generic functions used for character input, and should therefore be included by stream classes concerned with character input. The user can provide methods for these generic functions specialized on the user-defined class. Methods for other generic functions must be provided by the user.

There is an example in “Defining a new stream class” on page 270.

See also **`fundamental-character-stream`**
`fundamental-input-stream`
`stream-clear-input`
`stream-listen`
`stream-peek-char`
`stream-read-char`
`stream-read-char-no-hang`
`stream-read-line`

```
stream-read-sequence  
stream-unread-char
```

fundamental-character-output-stream *Class*

Summary	A class that should be included in stream classes for character output.
Package	stream
Superclasses	fundamental-character-stream fundamental-output-stream
Subclasses	None.
Description	The class fundamental-character-output-stream provides default methods for generic functions used for character output, and should therefore be included by stream classes concerned with character output. The user can provide methods for these generic functions specialized on the user-defined class. Methods for other generic functions must be provided by the user. There is an example in “Defining a new stream class” on page 270.
See also	fundamental-character-stream fundamental-input-stream stream-clear-output stream-finish-output stream-force-output stream-start-line-p stream-terpri stream-line-column stream-write-char stream-write-sequence stream-write-string

fundamental-character-stream *Class*

Summary	A class whose inclusion provides a method for <code>stream-element-type</code> that returns <code>character</code> .
Package	<code>stream</code>
Superclasses	<code>fundamental-stream</code>
Subclasses	<code>fundamental-character-input-stream</code> <code>fundamental-character-output-stream</code>
Description	The class <code>fundamental-character-stream</code> is a superclass for character streams. Its inclusion provides a method for the generic function <code>stream-element-type</code> that returns the symbol <code>character</code> .
See also	<code>fundamental-character-input-stream</code> <code>fundamental-character-output-stream</code> <code>fundamental-stream</code> <code>stream-element-type</code>

fundamental-input-stream *Class*

Summary	A class whose inclusion causes <code>input-stream-p</code> to return <code>t</code> .
Package	<code>stream</code>
Superclasses	<code>fundamental-stream</code>
Subclasses	<code>fundamental-binary-input-stream</code> <code>fundamental-character-input-stream</code>
Description	The <code>fundamental-input-stream</code> class is a superclass to the binary and character input classes. Its inclusion causes the generic function <code>input-stream-p</code> to return <code>t</code> .

See also **fundamental-binary-input-stream**
fundamental-character-input-stream
fundamental-stream
input-stream-p

fundamental-output-stream *Class*

Summary A class whose inclusion causes **output-stream-p** to return t.

Package **stream**

Superclasses **fundamental-stream**

Subclasses **fundamental-binary-output-stream**
fundamental-character-output-stream

Description The **fundamental-output-stream** class is a superclass to the binary and character output classes. Its inclusion causes the generic function **output-stream-p** to return t.

See also **fundamental-binary-output-stream**
fundamental-character-output-stream
fundamental-stream
input-stream-p

fundamental-stream *Class*

Summary A class whose inclusion causes **stream-p** to return t.

Package **stream**

Superclasses **standard-object**
stream

Subclasses	<code>fundamental-binary-stream</code> <code>fundamental-character-stream</code> <code>fundamental-input-stream</code> <code>fundamental-output-stream</code>
Description	The class <code>fundamental-stream</code> is a superclass to the fundamental input, output, character and binary streams. Its inclusion causes <code>streamp</code> to return <code>t</code> .
See also	<code>close</code> <code>fundamental-binary-stream</code> <code>fundamental-character-stream</code> <code>fundamental-input-stream</code> <code>fundamental-output-stream</code> <code>open-stream-p</code>

stream-advance-to-column

Generic Function

Summary	Writes the required number of blank spaces to ensure that the next character will be written in a given column.	
Package	<code>stream</code>	
Signature	<code>stream-advance-to-column stream column => result</code>	
Arguments	<code>stream</code>	A stream.
	<code>column</code>	An integer.
Values	<code>result</code>	A boolean.
Description	The generic function <code>stream-advance-to-column</code> writes enough blank spaces to <code>stream</code> to ensure that the next character is written at <code>column</code> . The generic function returns <code>t</code> if the operation is successful, or <code>nil</code> if it is not supported for this stream.	

This function is intended for use by `print` and `format ~t`. The default method uses `stream-line-column` and repeated calls to `stream-write-char` with a `#\Space` character, and returns `nil` if `stream-line-column` returns `nil`.

See also [stream-line-column](#)

stream-check-eof-no-hang

Generic Function

Summary Determines whether a stream is at end of file.

Package stream

Signature `stream-check-eof-no-hang stream => result`

Arguments *stream* An input stream.

Values *result* nil or :eof.

Description The generic function `stream-check-eof-no-hang` determines if the data source of the stream is at end of file, without hanging.

stream should be an instance of a subclass of `buffered-stream`.

result is :eof if *stream* is at end of file and nil otherwise.

There is a built-in method specialized on `buffered-stream` which returns `:eof` in all cases.

See also [buffered-stream](#)

stream-clear-input

Generic Function

Summary **Implements** `clear-input`.

Package	<code>stream</code>
Signature	<code>stream-clear-input stream => nil</code>
Arguments	<code>stream</code> A stream.
Values	<code>nil</code>
Description	The generic function <code>stream-clear-input</code> implements <code>clear-input</code> . The default method is defined on <code>fundamental-input-stream</code> and does nothing.
See also	<code>fundamental-input-stream</code>

stream-clear-output

Generic Function

Summary	Implements <code>clear-output</code> .
Package	<code>stream</code>
Signature	<code>stream-clear-output stream => nil</code>
Arguments	<code>stream</code> A stream.
Values	<code>nil</code>
Description	The generic function <code>stream-clear-output</code> implements <code>clear-output</code> . The default method is on <code>fundamental-output-stream</code> and does nothing.
	There is an example in “Stream output” on page 272.
See also	<code>fundamental-output-stream</code>

stream-file-position	<i>Generic Function</i>				
Summary	Returns or changes the current position within a stream.				
Package	stream				
Signature	stream-file-position stream => position				
Signature	(setf stream-file-position) position-spec stream => success-p				
Arguments	<table border="0"> <tr> <td>stream</td> <td>A stream.</td> </tr> <tr> <td>position-spec</td> <td>A file position designator.</td> </tr> </table>	stream	A stream.	position-spec	A file position designator.
stream	A stream.				
position-spec	A file position designator.				
Values	<table border="0"> <tr> <td>position</td> <td>A file position or nil.</td> </tr> <tr> <td>success-p</td> <td>A generalized boolean.</td> </tr> </table>	position	A file position or nil .	success-p	A generalized boolean.
position	A file position or nil .				
success-p	A generalized boolean.				
Description	<p>The generic function stream-file-position implements file-position. stream-file-position is called when file-position is called with one argument. (setf stream:stream-file-position) is called when file-position is called with two arguments.</p> <p>The return value is returned by file-position. For the setf function, this is a slight anomaly because setf functions normally return the new value. However in this case it should return the success-p value mandated by the ANSI Common Lisp standard.</p> <p>The default methods specialized on stream return nil.</p>				

stream-fill-buffer	<i>Generic Function</i>
Summary	Fills the stream buffer.
Package	stream

Signature	<code>stream-fill-buffer stream => result</code>	
Arguments	<code>stream</code>	An input stream.
Values	<code>result</code>	A generalized boolean.
Description	<p>The generic function <code>stream-fill-buffer</code> is called by the reading functions to fill an empty stream buffer from the underlying data source.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p><code>stream-fill-buffer</code> should block until some data is available or return false at end of file. If data is available, it should place it in a buffer, set the stream's input buffer, index and limit appropriately and return a true value. The existing stream buffer can be reused if desired but the index and limit must be updated. The buffer must be of type <code>simple-string</code>, whose element type matches that given when the stream was constructed.</p> <p>There is a built-in method specialized on <code>buffered-stream</code> which usually suffices. It calls <code>stream-read-buffer</code> with the whole buffer and returns false if this call returns 0. If not, the input index is set to 0 and the input limit is set to the value returned by <code>stream-read-buffer</code>.</p>	
See also	<code>buffered-stream</code> <code>stream-read-buffer</code>	

	<i>Generic Function</i>
Summary	Implements <code>finish-output</code> .
Package	<code>stream</code>
Signature	<code>stream-finish-output stream => nil</code>

Arguments	<i>stream</i>	A stream.
Values	<code>nil</code>	
Description		The generic function <code>stream-finish-output</code> implements <code>finish-output</code> . The default method is on <code>fundamental-output-stream</code> and does nothing. There is an example in “Stream output” on page 272.
See also		<code>fundamental-output-stream</code>

stream-flush-buffer

Generic Function

Summary	Flushes a stream's buffer.	
Package	<code>stream</code>	
Signature	<code>stream-flush-buffer stream => result</code>	
Arguments	<i>stream</i>	An output stream.
Values	<i>result</i>	A generalized boolean.
Description	<p>The generic function <code>stream-flush-buffer</code> is called by the writing functions to flush a stream buffer to the underlying data sink.</p> <p><i>stream</i> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Before returning, <code>stream-flush-buffer</code> must set the output index of <i>stream</i> so that more characters can be written to the buffer. If desired, the output buffer and limit can be set too.</p> <p>There is a built-in method specialized on <code>buffered-stream</code> which usually suffices. It calls <code>stream-write-buffer</code> with the</p>	

currently active part of the stream's output buffer and sets the output index to 0.

result is true if the buffer was flushed.

See also **buffered-stream**
 stream-write-buffer

stream-force-output

Generic Function

Summary Implements **force-output**.

Package **stream**

Signature **stream-force-output stream => nil**

Arguments **stream** A stream.

Values **nil**

Description The generic function **stream-force-output** implements **force-output**. The default method is on **fundamental-output-stream** and does nothing.

There is an example in “Stream output” on page 272.

See also **fundamental-output-stream**

stream-fresh-line

Generic Function

Summary Used by **fresh-line** to start a new line on a given stream.

Package **stream**

Signature **stream-fresh-line stream => bool**

Arguments	<i>stream</i>	A stream.
Values	<i>bool</i>	A generalized boolean.
Description		The generic function <code>stream-fresh-line</code> is used by <code>fresh-line</code> to start a new line on a stream. The default method uses <code>stream-start-line-p</code> and <code>stream-terpri</code> . The result value is <code>t</code> if a new line is output successfully.
See also		<code>stream-start-line-p</code> <code>stream-terpri</code>

stream-line-column

Generic Function

Summary	Returns the column number where the next character will be written.	
Package	<code>stream</code>	
Signature	<code>stream-line-column stream => column</code>	
Arguments	<i>stream</i>	A stream.
Values	<i>column</i>	An integer.
Description		The generic function <code>stream-line-column</code> returns the column number where the next character will be written from <code>stream</code> , or <code>nil</code> if this is not meaningful for the stream. This function is used in the implementation of <code>print</code> and the <code>format ~t</code> directive. A method for this function must be defined for every character output stream class that is defined, although at its simplest it may be defined to always return <code>nil</code> .
See also	<code>fundamental-character-output-stream</code> <code>stream-start-line-p</code>	

stream-listen

Generic Function

Summary	A function used by <code>listen</code> that returns <code>t</code> if there is input available.	
Package	<code>stream</code>	
Signature	<code>stream-listen stream => result</code>	
Arguments	<code>stream</code>	A stream.
Values	<code>result</code>	A generalized boolean.
Description	<p>The generic function <code>stream-listen</code> is called to determine if there is data immediately available on the stream <code>stream</code>, without hanging.</p> <p><code>result</code> should be true if there is input, and <code>nil</code> otherwise (including at end of file).</p> <p>This method must be implemented for subclasses of <code>buffered-stream</code> that handle input.</p> <p>There is a built-in primary method specialized on <code>buffered-stream</code> which returns <code>nil</code>. There is a built-in <code>:around</code> method specialized on <code>buffered-stream</code> which checks for input in the buffer and calls the next method if the buffer is empty. Thus a primary method specialized on a subclass of <code>buffered-stream</code> need only check the underlying data source.</p> <p>The built-in method on <code>fundamental-input-stream</code> uses <code>stream-read-char-no-hang</code> and <code>stream-unread-char</code>. Most streams should define their own method as this is usually trivial and more efficient than the method provided.</p>	
See also	<code>buffered-stream</code> <code>stream-read-char-no-hang</code> <code>stream-unread-char</code>	

stream-output-width		<i>Generic Function</i>
Summary		Used by the pretty printer to determine the output width when <code>*print-right-margin*</code> is <code>nil</code> .
Package	<code>stream</code>	
Signature		<code>stream-output-width stream => result</code>
Arguments	<code>stream</code>	A stream.
Values	<code>result</code>	An integer or <code>nil</code> .
Description		The generic function <code>stream-output-width</code> is used by the pretty printer to determine the output width when <code>*print-right-margin*</code> is <code>nil</code> . It returns <code>result</code> , the integer width of <code>stream</code> in units of ems, or <code>nil</code> if the width is not known. The default method provided by <code>fundamental-stream</code> returns <code>nil</code> .
See also		<code>fundamental-stream</code>

stream-peek-char		<i>Generic Function</i>
Summary		A generic function used by <code>peek-char</code> that returns a character on a given stream without removing it from the stream buffer.
Package	<code>stream</code>	
Signature		<code>stream-peek-char stream => result</code>
Arguments	<code>stream</code>	A stream.
Values	<code>result</code>	A character or <code>:eof</code> symbol.

Description	The generic function <code>stream-peek-char</code> is used to implement <code>peek-char</code> , and corresponds to a peek-type of <code>nil</code> . The default method reads a character from the stream without removing it from the stream buffer, by using <code>stream-read-char</code> and <code>stream-unread-char</code> .
See also	<code>stream-listen</code> <code>stream-read-char</code> <code>stream-unread-char</code>

stream-read-buffer

Generic Function

Summary	Reads data into the stream buffer.	
Package	<code>stream</code>	
Signature	<code>stream-read-buffer stream buffer start end => result</code>	
Arguments	<code>stream</code>	An input stream.
	<code>buffer</code>	A stream buffer.
	<code>start, end</code>	Bounding indexes for a subsequence of <code>buffer</code> .
Values	<code>result</code>	A non-negative integer.
Description	<p>The generic function <code>stream-read-buffer</code> is called by <code>stream-fill-buffer</code> to place characters into the region of the buffer <code>buffer</code> bounded by <code>start</code> and <code>end</code>.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p><code>stream-read-buffer</code> should block until some data is available. <code>result</code> should be the number of characters actually placed in the buffer (0 if at end of file). This method must be</p>	

implemented for subclasses of `buffered-stream` that handle input.

See also [buffered-stream](#)
[stream-fill-buffer](#)

stream-read-byte *Generic Function*

Summary A generic function used by `read-byte` to read an integer or `:eof` symbol from a binary stream.

Package stream

Signature **stream-read-byte** *stream* => *result*

Arguments *stream* An input stream.

Values *result* An integer or :eof.

Description The generic function `stream-read-byte` is used by `read-byte`, and returns either an integer read from the binary stream specified by `stream`, or the keyword :`eof`.

A method must be implemented for all binary subclasses of `buffered-stream` that handle input. A typical implementation will call `stream-read-char` and convert the character to an integer using `char-code`.

A method should be defined for a subclass of `fundamental-binary-input-stream`.

See also [buffered-stream](#)
[fundamental-binary-input-stream](#)
[fundamental-binary-stream](#)
[stream-read-char](#)

stream-read-char

Generic Function

Summary	Read one character from a stream.	
Package	stream	
Signature	stream-read-char <i>stream</i> => <i>character</i>	
Arguments	<i>stream</i>	An input stream.
Values	<i>character</i>	A character or the :eof symbol.
Description	The generic function stream-read-char reads one item from <i>stream</i> . The item read is either a character or the end of file symbol :eof if the stream is at the end of a file. Every subclass of fundamental-character-input-stream must define a method for this function.	
See also	fundamental-character-input-stream stream-unread-char	

stream-read-char-no-hang

Generic Function

Summary	Returns either a character from the stream, an :eof if the end-of-file is reached, or nil if no input is currently available.	
Package	stream	
Signature	stream-read-char-no-hang <i>stream</i> => <i>result</i>	
Arguments	<i>stream</i>	An input stream.
Values	<i>result</i>	Either a character, an :eof symbol, or nil.
Description	The generic function stream-read-char-no-hang implements read-char-no-hang . It returns either a character read	

from the stream, or `:eof` if end-of-file is reached, or `nil` if no input is available. The default method provided by `fundamental-character-input-stream` simply calls `stream-read-char` which is sufficient for file streams, but interactive streams should define their own method.

See also `fundamental-character-input-stream`
`stream-read-char`

	<i>Generic Function</i>
stream-read-line	
Summary	Returns a string read from a stream.
Package	<code>stream</code>
Signature	<code>stream-read-line stream => result terminated</code>
Arguments	<code>stream</code> An input stream.
Values	<code>result</code> A string or <code>:eof</code> . <code>terminated</code> A boolean.
Description	The generic function <code>stream-read-line</code> reads a line of characters from <code>stream</code> and returns this line as a string. If the string is terminated by an end-of-file instead of a newline then <code>terminated</code> is <code>t</code> . The default method uses repeated calls to <code>stream-read-char</code> , and uses <code>stream-element-type</code> to determine the element-type of its result.
See also	<code>fundamental-character-input-stream</code> <code>stream-element-type</code> <code>stream-read-char</code>

stream-read-sequence

Generic Function

Summary Reads a number of items from a stream into a sequence.

Package `stream`

Signature `stream-read-sequence stream sequence start end => index`

Arguments `stream` A stream.

`sequence` A sequence.

`start` An integer.

`end` An integer.

Values `index` An integer.

Description The generic function `stream-read-sequence` reads from `stream` into `sequence`. Elements from the `start` of `sequence` are replaced by elements from `stream` until `end` in `sequence` or the end-of-file in `stream` is reached. The index of the first element in `sequence` that is not replaced is returned.

A default method is provided by `fundamental-character-input-stream` which makes repeated calls to `stream-read-char` and uses `(setf elt)` to insert characters into `sequence`. A default method is provided by `fundamental-binary-input-stream` that makes repeated calls to `stream-read-byte` and also uses `(setf elt)` to insert bytes into `sequence`. Note that this may lead to error if the sequence is of inappropriate type.

See also `fundamental-binary-input-stream`
 `fundamental-character-input-stream`
 `stream-read-byte`
 `stream-read-char`

stream-read-timeout *Generic Function*

Summary	Accesses the read-timeout property of a socket stream.	
Package	stream	
Signature	stream-read-timeout <i>stream</i> => <i>timeout</i>	
Arguments	<i>stream</i>	A socket stream.
Values	<i>timeout</i>	A positive number or nil .
Description	<p>The generic function stream-read-timeout reads the current <i>read-timeout</i> of an instance of comm:socket-stream.</p> <p>(setf stream-read-timeout) sets the read-timeout of an instance of comm:socket-stream.</p>	
See also	socket-stream open-tcp-stream	

stream-start-line-p *Generic Function*

Summary	A generic function that returns t if the stream is positioned at the beginning of a line.	
Package	stream	
Signature	stream-start-line-p <i>stream</i> => <i>result</i>	
Arguments	<i>stream</i>	A stream.
Values	<i>result</i>	A boolean.
Description	The generic function stream-start-line-p returns t if <i>stream</i> is positioned at the beginning of a line, and nil other-	

wise. It is permissible to define a method that always returns `nil`.

Note that although a value of `0` from `stream-line-column` also indicates the beginning of a line, there are cases where `stream-start-line-p` can be meaningfully implemented and `stream-line-column` cannot. For example, for a window using variable-width characters the column number is not very meaningful, whereas the beginning of a line has a clear meaning.

The default method for `stream-start-line-p` on class `fundamental-character-output-stream` uses `stream-line-column`. Therefore, if this is defined to return `nil`, a method should be provided for either `stream-start-line-p` or `stream-fresh-line`.

See also `fundamental-character-output-stream`
 `stream-fresh-line`
 `stream-line-column`

stream-terpri *Generic Function*

Summary	Writes an end of line to a stream.	
Package	<code>stream</code>	
Signature	<code>stream-terpri stream => nil</code>	
Arguments	<code>stream</code>	A stream.
Values	<code>nil</code>	
Description	The generic function <code>stream-terpri</code> writes an end of line to <code>stream</code> , as for <code>terpri</code> . The default method for <code>stream-terpri</code> is (<code>(stream-write-char stream #\newline)</code>).	

See also [stream-write-char](#)

stream-unread-char

Generic Function

Summary Undoes the last call to `stream-read-char`.

Package stream

Signature `stream-unread-char stream character => nil`

Arguments *stream* A stream.

character A character.

Values nil

Description	The generic function <code>stream-unread-char</code> undoes the last call to <code>stream-read-char</code> , as in <code>unread-char</code> . Every subclass of <code>fundamental-character-input-stream</code> must define a method for this function.
-------------	---

See also [fundamental-character-input-stream](#)

stream-write-buffer

Generic Function

Summary Writes a part of stream's buffer.

Package stream

Signature stream-write-buffer *stream buffer start end*

Arguments *stream* An output stream.

buffer A stream buffer

start, end Bounding indexes for a subsequence of *buffer*.

Description	<p>The generic function <code>stream-write-buffer</code> is called by <code>stream-flush-buffer</code> to write the region of the buffer bounded by <code>start</code> and <code>end</code> to the stream's underlying data sink.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>This method must be implemented for subclasses of <code>buffered-stream</code> that handle output.</p>
See also	<p><code>buffered-stream</code></p> <p><code>stream-flush-buffer</code></p>

stream-write-byte *Generic Function*

Summary	A generic function used by <code>write-byte</code> to write an integer to a binary stream.	
Package	<code>stream</code>	
Signature	<code>stream-write-byte stream integer => result</code>	
Arguments	<code>stream</code>	A stream.
	<code>integer</code>	An integer.
Values	<code>result</code>	An integer.
Description	<p>The generic function <code>stream-write-byte</code> is used by <code>write-byte</code>, and writes the integer <code>integer</code> to the binary stream specified by <code>stream</code>.</p> <p>A method must be implemented for all binary subclasses of <code>buffered-stream</code> that handle output. A typical implementation will convert the integer to a character using <code>code-char</code> and call <code>stream-write-char</code>.</p>	

A method should be defined for all subclasses of `fundamental-binary-output-stream`.

See also `buffered-stream`
`fundamental-binary-output-stream`
`fundamental-binary-stream`
`stream-write-char`

stream-write-char *Generic Function*

Summary Writes a character to a specified stream.

Package `stream`

Signature `stream-write-char stream character => character`

Arguments `stream` A stream.
`character` A character.

Values `character` A character.

Description The generic function `stream-write-char` writes *character* to *stream*. Every subclass of `fundamental-character-output-stream` must have a method defined for this function.
There is an example in “Stream output” on page 272.

See also `fundamental-character-output-stream`

stream-write-sequence *Generic Function*

Summary Writes a subsequence of a sequence to a stream.

Package `stream`

Signature	<code>stream-write-sequence <i>stream sequence start end => result</i></code>	
Arguments	<i>stream</i>	A stream.
	<i>sequence</i>	A sequence.
	<i>start</i>	An integer.
	<i>end</i>	An integer.
Values	<i>result</i>	A sequence.
Description	<p>The generic function <code>stream-write-sequence</code> is used by <code>write-sequence</code> to write a subsequence of <code>sequence</code> delimited by <code>start</code> and <code>end</code> to <code>stream</code>.</p> <p>A default method is provided by <code>fundamental-character-output-stream</code> that tests each element of <code>sequence</code> in turn, and then uses <code>stream-write-char</code> or produces an error. A default method is provided by <code>fundamental-binary-output-stream</code> that tests each element of <code>sequence</code> in turn, and then uses <code>stream-write-byte</code> or produces an error.</p>	
See also	<code>fundamental-binary-output-stream</code> <code>fundamental-character-output-stream</code> <code>stream-read-sequence</code> <code>stream-write-byte</code> <code>stream-write-char</code>	

stream-write-string		<i>Generic Function</i>
Summary	Used by <code>write-string</code> to write a string to a character output stream.	
Package	<code>stream</code>	
Signature	<code>stream-write-string <i>stream string &optional start end => result</i></code>	

Arguments	<i>stream</i>	A stream.
	<i>string</i>	A string.
	<i>start</i>	An integer.
	<i>end</i>	An integer.
Values	<i>result</i>	A string.
Description	<p>The generic function <code>stream-write-string</code> is used by <code>write-string</code> to write <i>string</i> to <i>stream</i>. The string can, optionally, be delimited by <i>start</i> and <i>end</i>.</p> <p>The default method provided by <code>fundamental-character-output-stream</code> uses repeated calls to <code>stream-write-char</code>.</p> <p>There is an example in “Stream output” on page 272.</p>	
See also	<code>fundamental-character-output-stream</code> <code>stream-write-char</code>	

with-stream-input-buffer *Macro*

Summary	Allows access to the input buffer.	
Package	<code>stream</code>	
Signature	<code>with-stream-input-buffer (buffer index limit) stream &body body => result</code>	
Arguments	<i>buffer, index, limit</i>	Variables.
	<i>stream</i>	An input stream.
	<i>body</i>	Code.
Values	<i>result</i>	The value returned by <i>body</i> .

Description	<p>The macro <code>with-stream-input-buffer</code> allows access to the state of the input buffer for the given buffered stream.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Within the code <code>body</code>, the variables <code>buffer</code>, <code>index</code> and <code>limit</code> are bound to the buffer of <code>stream</code>, its current index and the limit of the buffer. Setting <code>buffer</code>, <code>index</code> or <code>limit</code> will change the values in the stream <code>stream</code> but note that other changes to these values (for example, by calling other stream functions) will not affect the values bound within the macro. See the example for a typical use which shows how this restriction can be handled.</p> <p>The buffer is always of type <code>simple-string</code>. The <code>stream-element-type</code> of <code>stream</code> depends on how it was constructed.</p> <p>The index is the position of the next element to be read from the buffer and the limit is the position of the element after the end of the buffer. Therefore there is no data in the buffer when <code>index</code> is greater than or equal to <code>length</code>.</p>
Example	This example function returns a string with exactly four characters read from a buffered stream. If <code>end-of-file</code> is reached before four characters have been read, it returns <code>nil</code> .

```
(defun read-4-chars (stream)
  (declare (type stream:buffered-stream stream))
  (let ((res (make-string 4))
        (elt 0))
    ;; Outer loop handles buffer filling.
    (loop
      ;; Inner loop handles buffer scanning.
      (loop (stream:with-stream-input-buffer (buf ind
lim) stream
        (when (>= ind lim)
          ;; End of buffer: try to refill.
          (return))
        (setf (schar res elt) (schar buf ind))
        (incf elt)
        (incf ind)
        (when (= elt 4)
          (return-from read-4-chars res))))
      (unless (stream:stream-fill-buffer stream)
        (return-from read-4-chars nil)))))
```

See also **buffered-stream**
with-stream-output-buffer

with-stream-output-buffer

Macro

Summary Allows access to the output buffer.

Package **stream**

Signature **with-stream-output-buffer** (*buffer index limit*) **stream &body**
body => *result*

Arguments *buffer, index, limit*

Variables

stream An output stream

body Code

Values *result* The value returned by body.

Description	<p>The macro <code>with-stream-output-buffer</code> allows access to the state of the output buffer for the given buffered stream. <code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Within the code <i>body</i>, the variable names <i>buffer</i>, <i>index</i> and <i>limit</i> are bound to the buffer of <i>stream</i>, its current index and the limit of the buffer. Setting <i>buffer</i>, <i>index</i> or <i>limit</i> will change the values in the stream <i>stream</i> but note that other changes to these values (for example, by calling other stream functions) will not affect the values bound within the macro. See the example for a typical use which shows how this restriction can be handled.</p> <p>The buffers are always of type <code>simple-string</code>. The <code>stream-element-type</code> of <i>stream</i> depends on how the stream was constructed.</p> <p>The index is the position of the next free element in the buffer and the limit is the position of the element after the end of the buffer. Therefore the buffer is full when <i>index</i> is greater than or equal to <i>length</i>.</p>
Example	This example function writes a four character string to a buffered stream.

```
(defun write-4-chars (stream string)
  (declare (type stream:buffered-stream stream))
  (let ((elt 0))
    ;; Outer loop handles buffer flushing.
    (loop
      ;; Inner loop handles buffer updating.
      (loop (stream:with-stream-output-buffer (buf ind
lim) stream
        (when (>= ind lim)
          ;; Buffer full: try to flush.
          (return))
        (setf (schar buf ind) (schar string elt))
        (incf elt)
        (incf ind)
        (when (= elt 4)
          (return-from write-4-chars))))
      (stream:stream-flush-buffer stream))))
```

See also

buffered-stream
with-stream-input-buffer

40

The SYSTEM Package

This chapter describes symbols available in the `SYSTEM` package.

Various uses of the symbols documented here are discussed throughout this manual.

		<i>Function</i>
Summary	Allows control over which generation objects are allocated in, in 64-bit LispWorks.	
Package	<code>system</code>	
Signature	<code>apply-with-allocation-in-gen-num what gen-num func &rest args => results</code>	
Arguments	<i>what</i>	One of <code>:cons</code> , <code>:symbol</code> , <code>:function</code> , <code>:non-pointer</code> and <code>:other</code> .
	<i>gen-num</i>	An integer in the inclusive range [0,7], or <code>nil</code> .
	<i>func</i>	A function designator.

	args	The arguments passed to <i>func</i> .
Values	results	The values returned from the call to <i>func</i> with <i>args</i> .
Description		<p>The function <code>apply-with-allocation-in-gen-num</code> applies the function <i>func</i> to <i>args</i> such that objects of allocation type <i>what</i> are allocated in generation <i>gen-num</i>, in 64-bit LispWorks.</p> <p>See also the keyword <code>:allocation</code> to <code>make-array</code>, which catches the most common cases.</p> <p>It is probably quite rare that it is useful to use this function, unless the function allocates a lot, and you are certain that every object that is allocated of the allocation type is long-lived, which is normally difficult to tell.</p> <p>Note that allocation of interned symbols is controlled separately by <code>*symbol-alloc-gen-num*</code>.</p> <p>Note: In 32-bit LispWorks the argument <i>what</i> is ignored and the effect is like that of the macro <code>allocation-in-gen-num</code>.</p>
See also		allocation-in-gen-num make-array *symbol-alloc-gen-num*

atomic-decf**atomic-incf***Macros*

Summary	Like <code>incf</code> and <code>decf</code> , but does the operation atomically.
Package	<code>system</code>
Signature	<code>atomic-decf place &optional delta => new-value</code> <code>atomic-incf place &optional delta => new-value</code>

Arguments	<i>place</i>	One of the specific set of places defined for low level atomic operations.
	<i>delta</i>	A number, default value 1.
Values	<i>new-value</i>	A number
Description		The macro <code>atomic-decf</code> is like <code>decf</code> and <code>atomic-incf</code> is like <code>incf</code> , except that they are guaranteed atomic for a suitable place. <i>place</i> must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.
Notes		Unlike <code>atomic-fixnum-decf</code> and <code>atomic-fixnum-incf</code> , these macros can deal with any number.
See also		<code>atomic-fixnum-decf</code> <code>atomic-fixnum-incf</code> <code>low-level-atomic-place-p</code>

atomic-exchange		<i>Macro</i>
Summary		Atomically exchange a place value with a new value, returning the old value.
Package		<code>system</code>
Signature		<code>atomic-exchange place new-value => old-value</code>
Arguments	<i>place</i>	One of the specific set of places defined for low level atomic operations.
	<i>new-value</i>	An object.
Values	<i>old-value</i>	An object.

Description	<p>The macro <code>atomic-exchange</code> exchanges the value in <i>place</i> with <i>new-value</i>, returning the <i>old-value</i>. The operation is guaranteed to be atomic.</p> <p><i>place</i> must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.</p>
See also	<code>compare-and-swap</code> <code>low-level-atomic-place-p</code>

atomic-fixnum-decf**atomic-fixnum-incf***Macros*

Summary	Like <code>decf</code> and <code>incf</code> , but does the operation atomically.	
Package	<code>system</code>	
Signature	<code>atomic-fixnum-decf place &optional fixnum-delta => new-value</code> <code>atomic-fixnum-incf place &optional fixnum-delta => new-value</code>	
Arguments	<code>place</code> <code>fixnum-delta</code>	One of the specific set of places defined for low level atomic operations. A fixnum, default value 1
Values	<code>new-value</code>	A fixnum.
Description	The macro <code>atomic-fixnum-decf</code> is like <code>decf</code> (for fixnums only) and <code>atomic-fixnum-incf</code> is like <code>incf</code> (for fixnums only), except that they are guaranteed atomic for a suitable place.	
	<i>place</i> must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.	
	Both the value in the <i>place</i> and <i>fixnum-delta</i> must be fixnums. The arithmetic is done without checking for overflow.	

See also **atomic-decf**
 atomic-incf
 low-level-atomic-place-p

atomic-pop *Macro*

Summary Like **pop**, but does the operation atomically.

Package **system**

Signature **atomic-pop** *place* => *element*

Arguments *place* One of the specific set of places defined for low level atomic operations.

Values *element* An object.

Description The macro **atomic-pop** is the same as **c1:pop**, but is guaranteed atomic for a suitable place.

place must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.

See also **atomic-push**
 low-level-atomic-place-p

atomic-push *Macro*

Summary Like **push**, but does the operation atomically.

Package **system**

Signature **atomic-push** *new-value* *place* => *new-place-value*

Arguments *new-value* An object.

	<i>place</i>	One of the specific set of places defined for low level atomic operations.
Values	<i>new-place-value</i>	A list (the new value of place).
Description		The macro <code>atomic-push</code> is the same as <code>c1:push</code> , but is guaranteed atomic for a suitable place. <i>place</i> must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.
Notes		In many cases the natural inverse of <code>push</code> is <code>delete</code> , but there is no way to do <code>delete</code> atomically, except by using a separate lock, which must also be held while doing the <code>push</code> .
See also		<code>atomic-pop</code> <code>low-level-atomic-place-p</code>

augmented-string		<i>Type</i>
Summary		The augmented string type.
Package		<code>system</code>
Signature		<code>augmented-string length</code>
Arguments	<i>length</i>	The length of the string (or *, meaning any).
Description		This is the string type that can hold any character. Equivalent to: <code>(vector character length)</code>

augmented-string-p		<i>Function</i>
Summary		Tests if an object is an augmented string.

Package	<code>system</code>	
Signature	<code>augmented-string-p object => bool</code>	
Arguments	<i>object</i>	The object to be tested.
Values	<i>bool</i>	<code>t</code> if <i>object</i> is an augmented string; <code>nil</code> otherwise.
Description		This is the predicate for augmented strings.
See also		<code>augmented-string</code>

call-system *Function*

Package	<code>system</code>	
Signature	<code>call-system command &key current-directory wait shell-type => status</code>	
Arguments	<i>command</i>	A string, a list of strings, a simple-vector of strings, or <code>nil</code> .
	<i>current-directory</i>	A string. Implemented only on Microsoft Windows.
	<i>wait</i>	A boolean.
	<i>shell-type</i>	A string or <code>nil</code> .
Values	<i>status</i>	The exit status of the invoked shell or process.
Description		<code>call-system</code> allows executables and DOS or Unix shell commands to be called from Lisp code. The output goes to standard output, as the operating system sees it. (This normally means <code>*terminal-io*</code> in LispWorks.)

If *command* is a string then it is passed to the shell as the command to run without any other arguments. The type of shell to run is determined by *shell-type* as described below.

If *command* is a list then it becomes the argv of a command to run directly, without invoking a shell. The first element is the command to run directly and the other elements are passed as arguments on the command line (that is, element 0 has its name in argv[0] in C, and so on).

If *command* is a simple vector of strings, the element at index 0 is the command to run and the other elements are the complete set of arguments seen by the command (that is, element 1 becomes argv[0] in C, and so on).

If *command* is `nil`, then the shell is run.

On Microsoft Windows *current-directory* is the *lpCurrentDirectory* argument passed to `createProcess`. If this is not supplied, the `pathname-location` of the `current-pathname` is passed.

If *wait* is true, `call-system` does not return until the process has exited. The default for *wait* is `t`.

On Unix/Linux/Mac OS X/FreeBSD, if *shell-type* is a string it specifies the shell. If *shell-type* is `nil` (the default) then the Bourne shell, `/bin/sh`, is used. The C shell may be obtained by passing `"./bin/csh"`.

On Microsoft Windows if *shell-type* is `nil` then `cmd.exe` is used on Windows Vista, Windows XP and Windows 2000 and `command.com` on Windows 98 and Windows ME.

`call-system` returns the exit status of the shell invoked to execute the command on Unix/Linux/Mac OS X, or the process created on Microsoft Windows.

Compatibility Note	The <code>:shell-type</code> argument is not implemented in LispWorks for Windows 4.4 and earlier, and <code>cmd.exe</code> is not used implicitly.
--------------------	---

LispWorks for Windows 5.0 and later use *shell-type cmd.exe* (or *command.com*) by default when *command* is a string. The user may see a DOS command window in this case. To call your command directly *command* should be a list, as in the last example below.

Example

On Unix:

```
(call-system (format nil "adb ~a < ~a > ~a"
                      (namestring a)
                      (namestring b)
                      (namestring c)))
```

On Microsoft Windows:

```
(sys:call-system "sleep 3" :wait t)

(sys:call-system '("notepad" "myfile.txt"))
```

See also

[open-pipe](#)
[call-system-showing-output](#)
[run-shell-command](#)

call-system-showing-output

Function

Package

`system`

Signature

```
call-system-showing-output command &key current-directory
prefix show-cmd output-stream wait shell-type kill-process-on-abort
=> status
```

Arguments

command A string, a list of strings, a simple-vector of strings, or `nil`.

current-directory A string. Supported only on Microsoft Windows.

prefix A string.

show-cmd A boolean.

output-stream A symbol.

	<i>wait</i>	A boolean.
	<i>shell-type</i>	A string. Supported only on Unix/Linux/Mac OS X.
	<i>kill-process-on-abort</i>	A generalized boolean.
Values	<i>status</i>	The exit status of the invoked shell or process.
Description	<p><code>call-system-showing-output</code> is an extension to <code>call-system</code> which allows output to be redirected. On Unix/Linux/Mac OS X this means it can be redirected to places other than the shell process from which the LispWorks image was invoked. <code>call-system-showing-output</code> therefore allows the user to, for example, invoke a shell command and redirect the output to the current Listener window.</p> <p>The argument <i>command</i> is interpreted as by <code>call-system</code>. <i>prefix</i> is a prefix to be printed at the start of any output line. The default value is " ; ".</p> <p><i>show-cmd</i> specifies whether or not the <i>cmd</i> invoked will be printed as well as the output for that command. If <i>t</i> then <i>cmd</i> will be printed. The default value for <i>show-cmd</i> is <i>t</i>.</p> <p><i>output-stream</i> specifies where the output will be sent to. The default value is <code>*standard-output*</code>.</p> <p>If <i>wait</i> is true, <code>call-system-showing-output</code> does not return until the process has exited. If <i>nil</i>, <code>call-system-showing-output</code> returns immediately and no output is shown. The default for <i>wait</i> is <i>t</i>.</p> <p><i>shell-type</i> is a string naming a UNIX shell. The default is <code>"/bin/sh"</code>.</p> <p>If <i>kill-process-on-abort</i> is true, then when <code>call-system-showing-output</code> is aborted the process is killed. The default value of <i>kill-process-on-abort</i> is <i>nil</i>.</p>	

`call-system-showing-output` returns the exit status of the shell invoked to execute the command on Unix/Linux/Mac OS X/FreeBSD, or the process created on Microsoft Windows.

Examples

On Linux:

```
CL-USER 1 > (sys:call-system-showing-output "pwd"
:prefix "***")
***pwd
***/amd/xanfs1-cam/u/ldisk/sp/lispsrc/v42/builds
0
```

```
CL-USER 2 > (sys:call-system-showing-output "pwd"
:&&prefix "" :show-cmd nil)
&&&/amd/xanfs1-cam/u/ldisk/sp/lispsrc/v42/builds
0
```

On Microsoft Windows:

```
CL-USER 223 > (sys:call-system-showing-output
                 "cmd /c type hello.txt"
                 :prefix "***")
***cmd /c type hello.txt
***Hi there
0
```

```
CL-USER 224 > (sys:call-system-showing-output
                 "cmd /c type hello.txt"
                 :prefix "&&&"
                 :show-cmd nil)
&&&Hi there
0
```

See also

`call-system`
`openpipe`
`run-shell-command`

cdr-assoc

Function

Summary

A generalized reference for alist elements.

Package	<code>system</code>	
Signature	<code>cdr-assoc item alist &key test test-not key => result</code> <code>(setf cdr-assoc) value item alist => value</code>	
Arguments	<i>item</i>	An object.
	<i>alist</i>	An association list.
	<i>test</i>	A function designator.
	<i>test-not</i>	A function designator.
	<i>key</i>	A function designator.
	<i>value</i>	An object.
Values	<i>result</i>	An object (from <i>alist</i>) or <code>nil</code> .
Description	<p>The functions <code>cdr-assoc</code> and <code>(setf cdr-assoc)</code> provide a generalized reference for elements in an association list. The arguments are all as specified for the Common Lisp function <code>assoc</code>. <code>cdr-assoc</code> and <code>(setf cdr-assoc)</code> read and write the <code>cdr</code> of an element in a manner consistent with the Common Lisp notion of places.</p> <p><code>cdr-assoc</code> returns the <code>cdr</code> of the first cons in the alist <i>alist</i> that satisfies the test, or <code>nil</code> if no element of <i>alist</i> matches.</p> <p><code>(setf cdr-assoc)</code> modifies the first cons in <i>alist</i> that satisfies the test, setting its <code>cdr</code> to <i>value</i>. If no element of <i>alist</i> matches, then <code>(setf cdr-assoc)</code> constructs a new cons (<code>(cons item value)</code>) and inserts it in the head of <i>alist</i>.</p>	

Example

```
CL-USER 1 > (defvar *my-alist*
              (list (cons :foo 1)
                    (cons :bar 2)))
*MY-ALIST*

CL-USER 2 > (setf (sys:cdr-assoc :bar
                                      *my-alist*) 3)
3

CL-USER 3 > *my-alist*
((:FOO . 1) (:BAR . 3))
```

check-network-server**Variable****Summary**

Indicates the presence of a network license.

Note: LispWorks for UNIX only.

Package

`system`

Description

This should always be set to `t` for a site (that is, network) license — the licensing mechanism does not work in any other circumstances. Do not set the variable otherwise, as it overrides any useful diagnostics which may accompany keyfile errors. Not applicable to LispWorks for Linux, Windows, x86/x64 Solaris, FreeBSD or Macintosh.

coerce-to-gesture-spec**Function****Summary**

Returns a Gesture Spec object.

Package

`system`

Signature

`coerce-to-gesture-spec object &optional errorp => gspec`

Arguments

`object`

A character, keyword, Gesture Spec or string.

	<i>errorp</i>	A boolean.
Values	<i>gspec</i>	A Gesture Spec object
Description	<p>The function <code>coerce-to-gesture-spec</code> returns a Gesture Spec object <i>gspec</i> which can be used to represent the key-stroke indicated by <i>object</i>.</p> <p>If <i>object</i> is a Lisp character, then <i>gspec</i>'s data is one of the known Gesture Spec keywords, or its <code>char-code</code>, and <i>gspec</i>'s modifiers contains its <code>char-bits</code> attribute mapped onto the values <code>gesture-spec-control-bit</code> etc.</p> <p>If <i>object</i> is a keyword, then it must be one of the known Gesture Spec keywords and becomes <i>gspec</i>'s data. <i>gspec</i>'s modifiers is 0.</p> <p>If <i>object</i> is a string, then <code>coerce-to-gesture-spec</code> expects it to be a sequence of modifier key names separated by the - character, followed by a single character or a character name as returned by <code>name-char</code> or the name of one of the known Gesture Spec keywords. Then <i>gspec</i> contains the corresponding Gesture Spec keyword or <code>char-code</code> in its <i>data</i>, and the modifier keys are represented in its <i>modifiers</i>.</p> <p>If <i>object</i> is a Gesture Spec object, it is simply returned.</p> <p><code>coerce-to-gesture-spec</code> does not create wild gesture specs.</p>	

Examples

```
(sys:coerce-to-gesture-spec #\Control-C)
=>
#S(SYSTEM::GESTURE-SPEC :DATA 67 :MODIFIERS 2)

CL-USER 8 > (sys:coerce-to-gesture-spec #\Control-\c)
=>
#S(SYSTEM::GESTURE-SPEC :DATA 99 :MODIFIERS 2)

(sys:coerce-to-gesture-spec :F10)
=>
#S(SYSTEM::GESTURE-SPEC :DATA :F10 :MODIFIERS 0)

(sys:coerce-to-gesture-spec "Ctrl-C")
=>
#S(SYSTEM::GESTURE-SPEC :DATA 67 :MODIFIERS 2)

(sys:coerce-to-gesture-spec "Shift-F10")
=>
#S(SYSTEM::GESTURE-SPEC :DATA :F10 :MODIFIERS 1)
```

See also

- `gesture-spec-control-bit`
- `gesture-spec-data`
- `gesture-spec-modifiers`
- `gesture-spec-p`
- `gesture-spec-to-character`
- `make-gesture-spec`
- `print-pretty-gesture-spec`

compare-and-swap

Macro

Summary	Performs a conditional store, atomically.				
Package	<code>system</code>				
Signature	<code>compare-and-swap place compare new-value => result</code>				
Arguments	<table border="0"> <tr> <td><i>place</i></td> <td>One of the specific set of places defined for low level atomic operations.</td> </tr> <tr> <td><i>compare</i></td> <td>An object.</td> </tr> </table>	<i>place</i>	One of the specific set of places defined for low level atomic operations.	<i>compare</i>	An object.
<i>place</i>	One of the specific set of places defined for low level atomic operations.				
<i>compare</i>	An object.				

	<i>new-value</i>	An object.
Values	<i>result</i>	A boolean.
Description		<p>The macro <code>compare-and-swap</code> compares the value in <i>place</i> with <i>compare</i>, and if they are the same (by <code>eq</code>), stores the <i>new-value</i> in <i>place</i>.</p> <p><code>compare-and-swap</code> returns non-nil if the store occurred, or <code>nil</code> if the store did not occur.</p> <p><i>place</i> must be one of the places described in “Low level atomic operations” on page 175, or expand to one of them.</p> <p>The operation is guaranteed to be atomic.</p>
See also		<code>atomic-exchange</code> <code>low-level-atomic-place-p</code>

copy-preferences-from-older-version		<i>Function</i>
Summary	Copies uses preferences.	
Package	<code>system</code>	
Signature		<code>copy-preferences-from-older-version <i>old-path</i> <i>new-path</i></code> <code>&optional <i>flag-name</i></code>
Arguments	<code>old-path</code> <code>new-path</code> <code>flag-name</code>	A preference path. A preference path. A string.
Description		<p>The function <code>copy-preferences-from-older-version</code> copies uses preferences from one part of the registry to another.</p> <p><i>old-path</i> and <i>new-path</i> are the paths of preferences for the old and the new version, corresponding to the paths that were passed to <code>(setf product-registry-path)</code>.</p>

flag-name is a name of the flag to use to record in the registry that the copy is already done. *flag-name* must be a valid registry value name on Microsoft Windows, and a valid filename on all other platforms. The default value of *flag-name* is the string "copied-old-preferences".

`copy-preferences-from-older-version` performs several checks:

1. It checks if it already copied to *new-path* in the current session, and if so does nothing.
2. It checks if the *flag-name* entry exists, and if so it does nothing.
3. It checks if another call to `copy-preferences-from-older-version` is already executing (in another thread), and if so it just waits for the other call to finish.

Then if all the checks above indicate that copying is still needed, `copy-preferences-from-older-version` copies the values from the tree below *old-path* to a tree below *new-path*. It traverses the entire tree below *old-path*, and checks each key to see if it has any values.

For a key that has values, it checks if the key exists under *new-path*, and if the key exists it does not copy any of the values for this key, though it still traverses and maybe copies its subkeys. If the key does not exist under *new-path*, it creates the key and copies the values.

Because it makes checks before doing any work, `copy-preferences-from-older-version` is an inexpensive call that can be used freely.

See also

`product-registry-path`
`user-preference`

count-gen-num-allocation		<i>Function</i>
Summary	Returns the amount of allocated data in a generation in 64-bit LispWorks.	
Package	<code>system</code>	
Signature	<code>count-gen-num-allocation <i>gen-num</i> &optional <i>include-lower-generations</i></code>	
Arguments	<i>gen-num</i> An integer between 0 and 7, inclusive. <i>include-lower-generations</i> A generalized boolean.	
Values	<i>allocation</i> An integer.	
Description	The function <code>count-gen-num-allocation</code> returns the amount of allocated data in generation <i>gen-num</i> . If <i>include-lower-generations</i> is non-nil, the returned value <i>allocation</i> also includes the data in the younger generations. Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations, where you can use <code>room-values</code> instead.	
See also	<code>room-values</code>	

debug-initialization-errors-in-snap-shot		<i>Variable</i>
Summary	Controls use of the snapshot debugger.	
Package	<code>system</code>	
Initial value	<code>t</code>	

Description	The variable <code>*debug-initialization-errors-in-snapshot*</code> controls whether, in an image which is configured to start the LispWorks IDE automatically, an error during initialization is handled and displayed in a snapshot debugger after the IDE starts.
	If the value of <code>*debug-initialization-errors-in-snapshot*</code> is <code>nil</code> LispWorks behaves like LispWorks 5.0 and previous versions. That is, it attempts to enter the command line debugger.

	<i>Function</i>								
default-eol-style									
Summary	Provides a default end of line style for a file.								
Package	<code>system</code>								
Signature	<code>default-eol-style pathname ef-spec buffer length => new-ef-spec</code>								
Arguments	<table> <tr> <td><i>pathname</i></td><td>Pathname identifying location of <i>buffer</i>.</td></tr> <tr> <td><i>ef-spec</i></td><td>An external format spec.</td></tr> <tr> <td><i>buffer</i></td><td>A buffer whose contents are examined.</td></tr> <tr> <td><i>length</i></td><td>Length (an integer) up to which <i>buffer</i> should be examined.</td></tr> </table>	<i>pathname</i>	Pathname identifying location of <i>buffer</i> .	<i>ef-spec</i>	An external format spec.	<i>buffer</i>	A buffer whose contents are examined.	<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.
<i>pathname</i>	Pathname identifying location of <i>buffer</i> .								
<i>ef-spec</i>	An external format spec.								
<i>buffer</i>	A buffer whose contents are examined.								
<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.								
Values	<i>new-ef-spec</i> A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.								
Description	Merge <i>ef-spec</i> with <code>(:default :eol-style :crlf)</code> on Microsoft Windows, <code>(:default :eol-style :lf)</code> on UNIX/Linux/Mac OS X. This is usually used as the last function on its list.								
See also	<code>*file-eol-style-detection-algorithm*</code>								

default-stack-group-list-length Variable

Summary The size of the stack cache.

Package **system**

Initial Value 10

Description This variable determines the maximum size of the stack cache.

Process stacks are cached and reused. When a process dies, its stack is put in the stack cache for future reuse if there are currently less than ***default-stack-group-list-length*** stacks in the cache. Therefore if your application repeatedly creates and discards more than 10 processes you should consider increasing the value of this variable.

Note that stacks are allocated in generation 2, hence a program with a high turnover of processes may need to call **(mark-and-sweep 2)** periodically unless all the stacks of dead processes are reused.

The default stack size is 64KB on all 32-bit LispWorks x86 platforms.

See also **mark-and-sweep**

define-atomic-modify-macro Macro

Summary An atomic version of **define-modify-macro**.

Package **system**

Signature **define-atomic-modify-macro name lambda-list function &optional doc-string => name**

Arguments **name** A symbol.

	<i>lambda-list</i>	A <code>define-modify-macro</code> lambda list.
	<i>function</i>	A symbol.
	<i>doc-string</i>	A string, not evaluated.
Values	<i>name</i>	A symbol.
Description		<p>The macro <code>define-atomic-modify-macro</code> has the same syntax as <code>cl:define-modify-macro</code>, and performs a similar operation.</p> <p>The resulting macro <i>name</i> can be used only on one of the specific set of places defined for low level atomic operations. It reads the value of the <i>place</i>, calls the function <i>function</i>, and then writes the result of the function call if the value in <i>place</i> has not changed since it was first read. If that value did change, the operation is repeated until it succeeds.</p>
		<p>Note that this means:</p> <ol style="list-style-type: none"> 1. The function <i>function</i> may be called more than once for each invocation of the defined macro. Therefore <i>function</i> should not have any side effects. 2. <i>function</i> must be thread-safe, because it may run concurrently in several threads if the defined macro <i>name</i> is used from several threads simultaneously. 3. It is possible in principle for the value to change more than once between reading the <i>place</i> and writing the new value. This may end up resetting the value in <i>place</i> to its original value, and hence the operation will succeed. This is equivalent to the code being invoked after the last change, unless <i>function</i> itself looks at <i>place</i>, which may cause inconsistent results.
See also		<code>low-level-atomic-place-p</code>

define-top-loop-command		<i>Macro</i>
Summary	Defines a top level loop command.	
Package	system	
Signature	$\text{define-top-loop-command } \textit{name-and-options} \textit{lambda-list} \textit{form}^*$ $\textit{name-and-options} ::= \textit{name}$ $ (\textit{name} \textit{option}^*)$ $\textit{option} ::= (:aliases \textit{alias}^*)$ $ (:result-type \textit{result-type})$	
Arguments	<p><i>name</i> A keyword naming the command.</p> <p><i>alias</i> A keyword naming an alias for the command.</p> <p><i>lambda-list</i> A destructuring lambda list.</p> <p><i>result-type</i> One of the symbols values, eval and nil.</p>	
Description	<p>The macro define-top-loop-command defines a top level loop command called <i>name</i> which takes the parameters specified by <i>lambda-list</i>. If &whole is used in <i>lambda-list</i> then the variable will be bound to a list containing the whole command line, including the command name, but the command name is not included in <i>lambda-list</i> otherwise.</p> <p>If any aliases are specified in <i>option</i>, these keywords will also invoke the command.</p> <p>When the command is used, each form is evaluated in sequence with the variables from <i>lambda-list</i> bound to the subsequent forms on the command line.</p> <p>If <i>result-type</i> is values (the default), then the values of the last form will be returned to the top level loop.</p>	

If *result-type* is `eval`, then the value of the last form should be a form and is evaluated by the top level loop as if it had been entered at the prompt.

If *result-type* is `nil`, then the last form should return two values. If the second value is `nil` then the first value is treated as a list of values to returned to the top level loop. If the second value is non-nil then the first value should be a form and is evaluated by the top level loop as if it had been entered at the prompt.

Note: for details of pre-defined top level loop commands, enter `:?` at the Listener prompt.

Example

Given this definition:

```
(define-top-loop-command (:lave
                           (:result-type eval)) (form)
                           (reverse form))
```

then the command line

```
:lave (1 2 list)
```

will evaluate the form `(list 2 1)`.

Here are definitions for two commands both of which will run `apropos`:

```
(define-top-loop-command (:apropos-eval
                           (:result-type eval))
                           (&rest args)
                           ` (apropos ,@args))

(define-top-loop-command :apropos-noeval (&rest args)
                           (apply 'apropos args))
```

The first one will evaluate the arguments before calling `apropos` whereas the second one will just pass the forms, so

```
:apropos-noeval foo
```

will find all the symbols containing the string `foo`, whereas

```
(setq foo "bar")
```

```
:apropos-eval foo
```

will find all the symbols containing the string `bar`.

detect-eol-style	<i>Function</i>								
Summary	Detects the end of line style of a file.								
Package	<code>system</code>								
Signature	<code>detect-eol-style pathname ef-spec buffer length => new-ef-spec</code>								
Arguments	<table border="0"> <tr> <td><i>pathname</i></td><td>Pathname identifying location of <i>buffer</i>.</td></tr> <tr> <td><i>ef-spec</i></td><td>An external format spec.</td></tr> <tr> <td><i>buffer</i></td><td>A buffer whose contents are examined.</td></tr> <tr> <td><i>length</i></td><td>Length (an integer) up to which <i>buffer</i> should be examined.</td></tr> </table>	<i>pathname</i>	Pathname identifying location of <i>buffer</i> .	<i>ef-spec</i>	An external format spec.	<i>buffer</i>	A buffer whose contents are examined.	<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.
<i>pathname</i>	Pathname identifying location of <i>buffer</i> .								
<i>ef-spec</i>	An external format spec.								
<i>buffer</i>	A buffer whose contents are examined.								
<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.								
Values	<table border="0"> <tr> <td><i>new-ef-spec</i></td><td>A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.</td></tr> </table>	<i>new-ef-spec</i>	A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.						
<i>new-ef-spec</i>	A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.								
Description	<p>When the encoding in <i>ef-spec</i> has foreign type (<code>unsigned-byte 8</code>), search <i>buffer</i> up to <i>length</i> for the first occurrence of the byte (<code>10</code>). If found, and it is preceded in <i>buffer</i> by (<code>13</code>), merge <i>ef-spec</i> with</p> <pre>(:default :eol-style :crlf)</pre> <p>If found and is not preceded by (<code>13</code>), merge <i>ef-spec</i> with</p> <pre>(:default :eol-style :lf)</pre> <p>Thus a complete external format spec is constructed. Otherwise, return <i>ef-spec</i>.</p>								

When the encoding in *ef-spec* has foreign type (`unsigned-byte 16`), search *buffer* up to *length* for the first occurrence of the byte sequence (13 0 10). If found, merge *ef-spec* with

```
(:default :eol-style :crlf)
```

If (13 0 10) is not found, search *buffer* up to *length* for (10 0) or (0 10). If found, merge *ef-spec* with

```
(:default :eol-style :lf)
```

Thus a complete external format spec is constructed. Otherwise, return *ef-spec*.

See also ***file-eol-style-detection-algorithm***

detect-japanese-encoding-in-file *Function*

Summary	Determines which type of Japanese encoding is used in a buffer.	
Package	<code>system</code>	
Signature	<code>detect-japanese-encoding-in-file pathname ef-spec buffer length => new-ef-spec</code>	
Arguments	<code>pathname</code>	Pathname identifying location of <i>buffer</i> .
	<code>ef-spec</code>	An external format spec.
	<code>buffer</code>	A buffer whose contents are examined.
	<code>length</code>	Length (an integer) up to which <i>buffer</i> should be examined.
Values	<code>new-ef-spec</code>	A new external format spec created by merging <i>ef-spec</i> with the Japanese encoding that was found.

Description	Assume the encoding is one of <code>:jis</code> , <code>:sjis</code> , <code>:euc</code> , <code>:unicode</code> and <code>:ascii</code> , and try to determine which of these it is, by looking for distinctive byte sequences in <i>buffer</i> up to <i>length</i> . If found, merge <i>ef-spec</i> with that encoding.
See also	<code>*file-encoding-detection-algorithm*</code>

	<i>Function</i>								
detect-unicode-bom									
Summary	Looks for the Unicode Byte Order Mark, which if found is assumed to indicate a Unicode UCS-2 encoded file.								
Package	<code>system</code>								
Signature	<code>detect-unicode-bom pathname ef-spec buffer length => new-ef-spec</code>								
Arguments	<table> <tr> <td><i>pathname</i></td><td>Pathname identifying location of <i>buffer</i>.</td></tr> <tr> <td><i>ef-spec</i></td><td>An external format spec.</td></tr> <tr> <td><i>buffer</i></td><td>A buffer whose contents are examined.</td></tr> <tr> <td><i>length</i></td><td>Length (an integer) up to which <i>buffer</i> should be examined.</td></tr> </table>	<i>pathname</i>	Pathname identifying location of <i>buffer</i> .	<i>ef-spec</i>	An external format spec.	<i>buffer</i>	A buffer whose contents are examined.	<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.
<i>pathname</i>	Pathname identifying location of <i>buffer</i> .								
<i>ef-spec</i>	An external format spec.								
<i>buffer</i>	A buffer whose contents are examined.								
<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.								
Values	<table> <tr> <td><i>new-ef-spec</i></td><td>A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.</td></tr> </table>	<i>new-ef-spec</i>	A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.						
<i>new-ef-spec</i>	A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.								
Description	<p>When called as part of <code>open</code>'s encoding detection routine, if byte pair FE FF is found at the start of the file, it is assumed to be UTF16-BE encoded. This encoding is represented by the <i>ef-spec</i> (<code>:unicode :little-endian nil</code>).</p> <p>If byte pair FF FE is found at the start of the file, it is assumed to be UTF16-LE encoded. This encoding is represented by the <i>ef-spec</i> (<code>:unicode :little-endian t</code>).</p>								

See also ***file-encoding-detection-algorithm***

directory-link-transparency *Variable*

Summary Controls whether `directory` returns truenames on Unix-like systems.

Package `system`

Initial Value `t` on Unix-like systems, `nil` on Microsoft Windows.

Description In line with the ANSI Common Lisp standard, `directory` returns truenames by default.

Setting `*directory-link-transparency*` to `nil` allows you to get the old behavior of `directory`, whereby soft links are not resolved in the pathnames returned.

`*directory-link-transparency*` is the default value of the *link-transparency* argument to `directory`.

See also `directory`

ensure-loads-after-loads *Function*

Summary Ensures all following loads in the program are executed after all prior loads.

Package `system`

Signature `ensure-loads-after-loads => nil`

Description `ensure-loads-after-loads` is a synchronization function which ensures order of memory between operations in different threads.

See “Ensuring order of memory between operations in different threads” on page 177 for a full description and example.

Notes	You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.
See also	<code>ensure-memory-after-store</code> <code>ensure-stores-after-memory</code> <code>ensure-stores-after-stores</code>

`ensure-memory-after-store` *Function*

Summary	Ensures all following stores and loads in the program are executed after all prior stores.
Package	<code>system</code>
Signature	<code>ensure-memory-after-store => nil</code>
Description	<code>ensure-memory-after-store</code> is a synchronization function which ensures order of memory between operations in different threads. See “Ensuring order of memory between operations in different threads” on page 177 for a full description and example.
Notes	You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.
See also	<code>ensure-loads-after-loads</code> <code>ensure-stores-after-memory</code> <code>ensure-stores-after-stores</code>

	<i>Function</i>
Summary	Ensures all following stores in the program are executed after all prior stores and loads.
Package	<code>system</code>
Signature	<code>ensure-stores-after-memory => nil</code>
Description	<code>ensure-stores-after-memory</code> is a synchronization function which ensures order of memory between operations in different threads. See “Ensuring order of memory between operations in different threads” on page 177 for a full description and example.
Notes	You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.
See also	<code>ensure-loads-after-loads</code> <code>ensure-memory-after-store</code> <code>ensure-stores-after-stores</code>

	<i>Function</i>
Summary	Ensures all following stores in the program are executed after all prior stores.
Package	<code>system</code>
Signature	<code>ensure-loads-after-loads => nil</code>
Description	<code>ensure-loads-after-loads</code> is a synchronization function which ensures order of memory between operations in different threads.

See “Ensuring order of memory between operations in different threads” on page 177 for a full description and example.

Notes	You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.
See also	<code>ensure-loads-after-loads</code> <code>ensure-memory-after-store</code> <code>ensure-stores-after-memory</code>

extended-spaces

Variable

Summary	Extends the notion of space to include more than just the space character.
Package	<code>system</code>
Initial value	<code>nil</code>
Description	<p>When this variable is true, the concept of “space” is extended from just <code>#\space</code> to include other appropriate characters. The default is <code>nil</code>, for ANS compliance, but we recommend that you set it to <code>t</code>.</p> <p>This variable controls how the format directives <code>~:c</code> and <code>~:@c</code> output graphic characters which have an empty glyph. When this variable is <code>t</code>, all such characters are output using the name:</p> <pre>(format nil "~:C" #\No-break-space) -> "No-Break-Space" (format nil "~:C" (code-char #x3000)) -> "Ideographic-Space"</pre> <p>When false, only one such character is output using the name:</p>

```
(format nil "~:C" #\Space)           -> "Space"  
(format nil "~:C" #\No-break-space)    -> " "  
(format nil "~:C" (code-char #x3000)) -> " "
```

It also affects `whitespace-char-p`.

See also [extended-character-p](#)

file-encoding-detection-algorithm

Variable

Summary List of functions to call to work out an encoding.

Package `system`

Initial value
`(find-filename-pattern-encoding-match
 find-encoding-option
 detect-unicode-bom
 locale-file-encoding)`

Description Functions on this list take four arguments—the pathname of the file; an external format spec; a vector of element-type `(unsigned-byte 8)` which contains the first bytes of the file; and a non-negative integer which is the maximum extent of buffer to be searched. This length argument is 0 in the case that the file does not exist, or the direction is `:output`. They return an external format spec, which normally is either `ef-spec` unmodified, or the result of merging `ef-spec` with another external format spec via `merge-ef-specs`.

Example If you want `open` and so on, when opening a file for input, to inspect the attribute line and then fall back to a default if no attribute line is found, then set the variable to this value:

```
(find-encoding-option locale-file-encoding)
```

There are further examples in “Guessing the external format” on page 297.

See also

`find-filename-pattern-encoding-match`
`find-encoding-option`
`detect-unicode-bom`
`detect-japanese-encoding-in-file`
`guess-external-format`
`locale-file-encoding`

file-encoding-resolution-error*Condition*

Summary An error type to signal when an external file format cannot be deduced.

Package `system`

Superclasses `error`

Initargs `:ef-spec` An external format specification.

Description An error type signalled when `open`, `load` or `compile-file` fail to detect an external format to use.

The `ef-spec` slot contains the incomplete external format specification argument constructed by `guess-external-format`.

See also `guess-external-format`

file-eol-style-detection-algorithm*Variable*

Summary List of functions for determining the end of line style of a file.

Package `system`

Description Functions on this list satisfy the same specifications as for those in ***file-encoding-detection-algorithm***. However

they will only be passed an external format spec with the name already determined.

Initial value `(detect-eol-style default-eol-style)`

See also `detect-eol-style`
`default-eol-style`
`guess-external-format`

filename-pattern-encoding-matches *Variable*

Summary An association of filename patterns to external format specs.

Package `system`

Initial value `((\"TAGS\" . (:latin-1 :eol-style :lf)))`

Description An alist of filename patterns to external format specs.

See also `*file-encoding-detection-algorithm*`

find-encoding-option *Function*

Summary Examines a buffer for an encoding option.

Package `system`

Signature `find-encoding-option pathname ef-spec buffer length => result`

Arguments `pathname` Pathname identifying location of `buffer`.
`ef-spec` An external format spec.
`buffer` A buffer whose contents are examined.
`length` Length (an integer) up to which `buffer` should be examined.

Values	<i>result</i>	The result of reading the value returned from the <code>encoding</code> or <code>external-format</code> option as a Lisp expression in the <code>keyword</code> package.
Description	<p>Looks in the file options (EMACS-style <code>-*</code> line) for an option called <code>encoding</code> or <code>external-format</code>, with value <code>value</code>. If found, it reads <code>value</code> as a Lisp expression in the <code>keyword</code> package and merges <code>ef-spec</code> with <code>value</code> and returns the result as <code>result</code>. Thus it does not override a supplied <code>ef-spec</code>.</p>	
See also	<code>*file-encoding-detection-algorithm*</code>	

find-filename-pattern-encoding-match *Function*

Summary	Finds the encoding of a file based on the filename.		
Package	<code>system</code>		
Signature	<code>find-filename-pattern-encoding-match pathname ef-spec buffer length => new-ef-spec</code>		
Arguments	<i>pathname</i>	Pathname identifying location of <i>buffer</i> .	
	<i>ef-spec</i>	An external format spec.	
	<i>buffer</i>	A buffer whose contents are examined.	
	<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.	
Values	<i>new-ef-spec</i>	An external format spec.	
Description	Compares <i>pathname</i> (using <code>pathname-match-p</code>) with elements of <code>*filename-pattern-encoding-matches*</code> .		

If a match is found, merges *ef-spec* with the corresponding external format spec and returns the result as *new-ef-spec*. Thus it does not override a supplied *ef-spec*.

See also ***file-encoding-detection-algorithm***
 filename-pattern-encoding-matches

	gen-num-segments-fragmentation-state	<i>Function</i>
Summary		Shows the fragmentation state in a generation in 64-bit LispWorks.
Package		system
Signature		gen-num-segments-fragmentation-state <i>gen-num</i> &optional statics-too => <i>fragmentation-state</i>
Arguments	<i>gen-num</i>	A number.
	<i>statics-too</i>	A generalized boolean?
Values	<i>fragmentation-state</i>	A list in which each element is a list of length 3.
Description		The function gen-num-segments-fragmentation-state shows the fragmentation state in a generation in 64-bit LispWorks. gen-num-segments-fragmentation-state returns a list, where each element is a sub-list showing the fragmentation state in a segment. The sub-list is of the form (allocation-type allocated free) where <i>allocation-type</i> is the allocation type of the segment, <i>allocated</i> is the amount of allocated data in the segment, and <i>free</i> is the total size of free areas in the segment that cannot be easily used.

The ratio **free/allocated** is the ratio that is compared to the fragmentation threshold to decide whether to copy a segment when doing a marking GC with copying (see `set-blocking-gen-num` and `marking-gc`).

Allocation types `:cons-static`, `:non-pointer-static`, `:mixed-static`, `:other-big` and `:non-pointer-big` are included in the result only if `statics-too` is non-nil. The default value of `statics-too` is nil.

Note: The implementation of `set-blocking-gen-num` is intended to solve any fragmentation issues automatically.

Note: `gen-num-segments-fragmentation-state` is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations, where `check-fragmentation` is available instead.

See also	<code>check-fragmentation</code> <code>marking-gc</code> <code>set-blocking-gen-num</code>
----------	--

		<i>Function</i>
Summary	Returns the current generation number for an object.	
Package	<code>system</code>	
Signature	<code>generation-number object => integer</code>	
Arguments	<code>object</code>	A Lisp object.
Values	<code>integer</code>	An integer.
Description		The function <code>generation-number</code> returns the generation number in which the Lisp object <code>object</code> currently is. See the discussion in Chapter 10, “Storage Management”.

If *object* is an immediate object then `generation-number` returns -1. immediates are objects which are not allocated, including fixnums, characters and short floats, and single floats in 64-bit LispWorks.

gesture-spec-accelerator-bit

Constant

Summary	Used in the representation of a keystroke with the accelerator key.
Package	<code>system</code>
Description	The constant <code>gesture-spec-accelerator-bit</code> is used to represent the accelerator key in a Gesture Spec object. See the entry for <code>capi:output-pane</code> in the <i>LispWorks CAPI Reference Manual</i> for more information about the use of Gesture Specs.
See also	<code>coerce-to-gesture-spec</code> <code>gesture-spec-modifiers</code> <code>make-gesture-spec</code>

gesture-spec-control-bit

Constant

Summary	Used in the representation of a keystroke with the <code>control</code> key.
Package	<code>system</code>
Description	The constant <code>gesture-spec-control-bit</code> is used to represent the <code>control</code> modifier key in a Gesture Spec object. See the entry for <code>capi:output-pane</code> in the <i>LispWorks CAPI Reference Manual</i> for more information about the use of Gesture Specs.

See also `coerce-to-gesture-spec`
`gesture-spec-modifiers`
`make-gesture-spec`

gesture-spec-data

Function

Summary Returns the key in a Gesture Spec object.

Package `system`

Signature `gesture-spec-data gspec => data`

Arguments `gspec` A Gesture Spec object

Values `data` A non-negative integer or a keyword.

Description The function `gesture-spec-data` returns an integer or keyword representing the key in the Gesture Spec object `gspec`.
When `data` is an integer, it is a non-negative integer less than `char-code-limit`, and `gspec` represents a keystroke with the key indicated by the character which is the value of `(code-char data)`.
`data` can also be a keyword such as `:f6`, when `gspec` represents a keystroke with `f6` pressed.

See also `gesture-spec-modifiers`
`make-gesture-spec`

gesture-spec-hyper-bit

Constant

Summary Used in the representation of a keystroke with the `hyper` key.

Package `system`

Description	The constant <code>gesture-spec-hyper-bit</code> is used to represent the <code>Hyper</code> modifier key in a Gesture Spec object.
	See the entry for <code>capi:output-pane</code> in the <i>LispWorks CAPI Reference Manual</i> for more information about the use of Gesture Specs.
See also	<code>coerce-to-gesture-spec</code> <code>gesture-spec-modifiers</code> <code>make-gesture-spec</code>

gesture-spec-meta-bit *Constant*

Summary	Used in the representation of a keystroke with the <code>Meta</code> key.
Package	<code>system</code>
Description	The constant <code>gesture-spec-meta-bit</code> is used to represent the <code>Meta</code> modifier key in a Gesture Spec object.
	See the entry for <code>capi:output-pane</code> in the <i>LispWorks CAPI Reference Manual</i> for more information about the use of Gesture Specs.
See also	<code>coerce-to-gesture-spec</code> <code>gesture-spec-modifiers</code> <code>make-gesture-spec</code>

gesture-spec-modifiers *Function*

Summary	Returns the modifiers in a Gesture Spec object.
Package	<code>system</code>
Signature	<code>gesture-spec-modifiers gspec => mods</code>

Arguments	<i>gspec</i>	A Gesture Spec object
Values	<i>mods</i>	An integer.
Description	<p>The function <code>gesture-spec-modifiers</code> returns an integer representing the modifiers in the Gesture Spec object <i>gspec</i>. The value <i>mods</i> contains some (or none) of the constants <code>gesture-spec-accelerator-bit</code>, <code>gesture-spec-control-bit</code>, <code>gesture-spec-meta-bit</code>, <code>gesture-spec-hyper-bit</code>, <code>gesture-spec-shift-bit</code> and <code>gesture-spec-super-bit</code>, combined as if by <code>logior</code>.</p>	
See also	<code>gesture-spec-accelerator-bit</code> <code>gesture-spec-control-bit</code> <code>gesture-spec-data</code> <code>gesture-spec-meta-bit</code> <code>gesture-spec-hyper-bit</code> <code>gesture-spec-shift-bit</code> <code>gesture-spec-super-bit</code> <code>make-gesture-spec</code>	

gesture-spec-p		<i>Function</i>
Summary	The predicate for Gesture Spec objects.	
Package	<code>system</code>	
Signature	<code>gesture-spec-p object => result</code>	
Arguments	<i>object</i>	A Lisp object
Values	<i>result</i>	A boolean.
Description	The function <code>gesture-spec-p</code> is the predicate for whether the object <i>object</i> is a Gesture Spec object.	

See also [coerce-to-gesture-spec](#)
[make-gesture-spec](#)

gesture-spec-shift-bit

Constant

Summary	Used in the representation of a keystroke with the <code>shift</code> key.
Package	<code>system</code>
Description	<p>The constant <code>gesture-spec-shift-bit</code> is used to represent the <code>shift</code> modifier key in a Gesture Spec object.</p> <p>Note that you may not construct a Gesture Spec with a <code>both-case-p</code> character represented in the <code>data</code> and with <code>modifiers</code> equal to <code>gesture-spec-shift-bit</code>. See <code>make-gesture-spec</code> for details and examples.</p> <p>See the entry for <code>capi:output-pane</code> in the <i>LispWorks CAPI Reference Manual</i> for more information about the use of Gesture Specs.</p>
See also	<code>coerce-to-gesture-spec</code> <code>gesture-spec-modifiers</code> <code>make-gesture-spec</code>

gesture-spec-super-bit

Constant

Summary	Used in the representation of a keystroke with the <code>super</code> key.
Package	<code>system</code>
Description	The constant <code>gesture-spec-super-bit</code> is used to represent the <code>Super</code> modifier key in a Gesture Spec object.

See the entry for `capi:output-pane` in the *LispWorks CAPI Reference Manual* for more information about the use of Gesture Specs.

See also [coerce-to-gesture-spec](#)
[gesture-spec-modifiers](#)
[make-gesture-spec](#)

gesture-spec-to-character *Function*

Summary	Returns the character corresponding to a Gesture Spec object.	
Package	<code>system</code>	
Signature	<code>gesture-spec-to-character gspec => char</code>	
Arguments	<code>gspec</code>	A Gesture Spec object
Values	<code>char</code>	A Lisp character.
Description	The function <code>gesture-spec-to-character</code> returns the Lisp <code>character</code> object corresponding to the Gesture Spec object <code>gspec</code> . Modifier bits in <code>gspec</code> are mapped to Lisp character bits attributes where possible. <code>gesture-spec-accelerator-bit</code> is ignored.	
See also	coerce-to-gesture-spec make-gesture-spec	

get-file-stat *Function*

Summary	Provides read access to the C stat structure which describes files.
---------	---

Note: not applicable on Microsoft Windows.

Package	<code>system</code>	
Signature	<code>get-file-stat filename-or-fd => file-stat (errno)</code>	
Arguments	<code>filename-or-fd</code> A string denoting a file, or a file descriptor.	
Values	<code>file-stat</code>	On success, an object representing the stat values. On failure, <code>nil</code> is returned together with a second value.
	<code>errno</code>	Indicates the errno value returned by the system call. This second value is returned only in the case of failure.
Description	<p><code>file-stat</code> is an object representing the stat values, as would be returned by the system call <code>stat</code> (for a filename) or the system call <code>fstat</code> (for an fd).</p> <p>The values in <code>file-stat</code> are the raw data, and it is the responsibility of the user to interpret them when needed. See the UNIX manual entry for <code>stat</code> for details.</p> <p>The values can be read from <code>file-stat</code> by these readers:</p>	
	<p><code>sys:file-stat-inode</code> The inode of the file.</p>	
	<p><code>sys:file-stat-device</code> The id of the device where the file is.</p>	
	<p><code>sys:file-stat-owner-id</code> The user id of the owner of the file.</p>	
	<p><code>sys:file-stat-group-id</code> The group id of the file's group.</p>	

sys:file-stat-size

The size of the file in bytes.

sys:file-stat-blocks

The number of 512-bytes blocks used by the file.

sys:file-stat-mode

The protection value of the file.

sys:file-stat-last-access

The time of the last access to the file in seconds from 1 January 1970.

sys:file-stat-last-change

The time of the last change in the data of the file in seconds from 1 January 1970.

sys:file-stat-last-modify

The time of the last modification of the file status in seconds from 1 January 1970.

sys:file-stat-links

The number of hard links to the file.

sys:file-stat-device-type

The device type (sometimes called Rdev).

get-folder-path	<i>Function</i>
------------------------	-----------------

Summary	Gets the path of a special folder on a Microsoft Windows or Mac OS X machine.
---------	---

Package	system
---------	---------------

Signature	<code>get-folder-path <i>what</i> &key <i>create</i> => <i>result</i></code>	
Arguments	<i>what</i>	A keyword.
	<i>create</i>	A boolean.
Values	<i>result</i>	A directory pathname naming the path, or <code>nil</code> .
Description	<p>The function <code>get-folder-path</code> obtains the current value for various special folders often used by applications. It is useful because these paths may differ between versions of the operating system. <code>get-folder-path</code> is implemented only on Microsoft Windows and Mac OS X.</p> <p><i>what</i> indicates the purpose of the special folder. For instance, <code>:common-appdata</code> means the folder containing application data for all users.</p> <p>The following values are recognized on Microsoft Windows and Mac OS X:</p> <ul style="list-style-type: none"> <code>:appdata</code>, <code>:documents</code>, <code>:my-documents</code>, <code>:common-appdata</code>, <code>:common-documents</code> and <code>:local-appdata</code>. <code>:documents</code> is an alias for <code>:my-documents</code>. <p>The following values are recognized on Mac OS X only:</p> <ul style="list-style-type: none"> <code>:my-library</code>, <code>:my-appsupport</code>, <code>:my-preferences</code>, <code>:my-caches</code>, <code>:my-logs</code>, <code>:common-library</code>, <code>:common-appsupport</code>, <code>:common-preferences</code>, <code>:common-caches</code>, <code>:common-logs</code>, <code>:system-library</code>. <p>On Mac OS X, <code>:appdata</code> is an alias for <code>:my-appsupport</code>, <code>:common-appdata</code> is an alias for <code>:common-appsupport</code>, and <code>:local-appdata</code> is an alias for <code>:common-appsupport</code>.</p> <p>If the folder does not exist and <i>create</i> is true, the folder is created. The default value of <i>create</i> is <code>nil</code>.</p> <p>If the folder does exist, <i>result</i> is <code>nil</code>.</p>	

Compatibility note In LispWorks 5.0 and previous versions, `get-folder-path` returns a string.

Example This form constructs a pathname to a file `foo.lisp` in the user's documents directory:

```
(make-pathname
  :name "foo"
  :type "lisp"
  :defaults
  (sys:get-folder-path :my-documents))
```

See also `get-user-profile-directory`

get-user-profile-directory

Function

Summary Gets the root of the user's profile on a Windows NT-based system.

Package `system`

Signature `get-user-profile-directory => result`

Values `result` A directory pathname naming the path, or `nil`.

Description The function `get-user-profile-directory` obtains the path to the current user's profile folder on a Windows NT-based system (including Windows 2000, Windows XP and Windows Vista). `get-user-profile-directory` is implemented only on Microsoft Windows.

`result` names the root of the profile directory.

Note that the default path for each user's profile may differ between versions of the operating system.

Compatibility note	In LispWorks 5.0 and previous versions, <code>get-user-profile-directory</code> returns a string.
Example	On Windows XP: <pre>(sys:get-user-profile-directory) => #P"C:/Documents and Settings/fred/"</pre>
	On Windows 98 SE: <pre>(sys:get-user-profile-directory) => nil</pre>
See also	<code>get-folder-path</code>

guess-external-format *Function*

Summary	Tries to work out the external format		
Package	<code>system</code>		
Signature	<code>guess-external-format pathname ef-spec buffer length => ef-spec</code>		
Arguments	<i>pathname</i>	Pathname identifying location of <i>buffer</i> .	
	<i>ef-spec</i>	An external format spec.	
	<i>buffer</i>	A buffer whose contents are examined.	
	<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.	
Values	<i>ef-spec</i>	An external format spec.	
Description	If <i>ef-spec</i> is complete, then it is returned. Otherwise <code>guess-external-format</code> calls, in turn, functions on the list <code>*file-encoding-detection-algorithm*</code> . If a complete external format spec is returned it is used, otherwise the return value is		

passed to the next function. If the name of the external format spec returned by the last function on this list is `:default`, an error of type `file-encoding-resolution-error` is signalled. The caller offers a restart for trying again with respecified `external-format` and/or `element-type` arguments. Otherwise `guess-external-format` proceeds to guess the `eol-style`.

To guess the `eol-style`, functions on the list `*file-eol-style-detection-algorithm*` are called in turn. If a complete external format spec is returned it is used, otherwise the return value is passed to the next function. If the external format spec returned by the last function on this list does not contain `:eol-style`, an error of type `file-encoding-resolution-error` is signalled.

See also

`*file-encoding-detection-algorithm*`
`*file-eol-style-detection-algorithm*`
`file-encoding-resolution-error`

	<i>Macro</i>
Summary	Allocates the objects produced by the specified forms to the static area.
Package	<code>system</code>
Signature	<code>in-static-area &rest body => result</code>
Arguments	<code>body</code> The forms for which you want the garbage collector to allocate space in the static area.
Values	<code>result</code> The result of executing <code>body</code> .
Description	Allocates the objects produced by the specified forms to the static area. Objects in the static area are not moved, though they are garbage collected when there is no longer a pointer to the object.

Note: the macro `in-static-area` is deprecated. Use `make-array` with `:allocation :static` where possible instead.

Example `(system:in-static-area (make-string 10))`

See also `enlarge-static`
`make-array`
`staticcp`

int32 *Type*

Summary A type used to generate optimal 32-bit arithmetic code.

Package `system`

Signature `int32`

Description The type `int32` is used to generate optimal 32-bit arithmetic code.

Objects of type `int32` are generated and can be manipulated using the functions in the INT32 API but the compiler can optimize such source code by eliminating the intermediate `int32` objects to produce efficient raw 32-bit code.

See the section “Fast 32-bit arithmetic” on page 95 for more information.

See also `int32*`
`int32+`
`int32-`
`+int32-0+`
`+int32-1+`
`int32-1+`
`int32-1-`
`int32/`
`int32/=`

```

int32<
int32<=
int32=
int32>
int32>=
int32-aref
int32-logand
int32-logandc1
int32-logandc2
int32-logeqv
int32-logior
int32-lognand
int32-lognor
int32-lognot
int32-logorc1
int32-logorc2
int32-logxor
int32-minusp
int32-plusp
int32-to-integer
int32-zerop
integer-to-int32
make-simple-int32-vector
simple-int32-vector

```

int32*	<i>Function</i>		
Summary	The multiply operator for <code>int32</code> objects.		
Package	<code>system</code>		
Signature	<code>int32* x y => int32</code>		
Arguments	<table> <tr> <td><code>x</code></td> <td>An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</td> </tr> </table>	<code>x</code>	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
<code>x</code>	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).		

	<i>y</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32*</code> is the multiply operator for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32+		<i>Function</i>
Summary		The add operator for <code>int32</code> objects.
Package		<code>system</code>
Signature		<code>int32+ x y => int32</code>
Arguments	<i>x</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<i>y</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32+</code> is the add operator for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32-	<i>Function</i>
Summary	The subtract operator for <code>int32</code> objects.
Package	<code>system</code>
Signature	<code>int32- x y => int32</code>
Arguments	<p><code>x</code> An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code>.</p> <p><code>y</code> An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code>.</p>
Values	<code>int32</code> An <code>int32</code> object.
Description	<p>The function <code>int32-</code> is the subtract operator for <code>int32</code> objects.</p> <p>See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.</p>
See also	<code>int32</code>

+int32-0+	<i>Symbol Macro</i>
Summary	Shorthand for <code>(sys:integer-to-int32 0)</code> .
Package	<code>system</code>
Description	The symbol macro <code>+int32-0+</code> expands to <code>(sys:integer-to-int32 0)</code> .
See also	<code>integer-to-int32</code>

+int32-1+ *Symbol Macro*

Summary	Shorthand for <code>(sys:integer-to-int32 1)</code> .
Package	<code>system</code>
Description	The symbol macro <code>+int32-1+</code> expands to <code>(sys:integer-to-int32 1)</code> .
See also	<code>integer-to-int32</code>

int32-1+ *Function*

Summary	The operator for <code>int32</code> objects corresponding to the function <code>1+</code> .	
Package	<code>system</code>	
Signature	<code>int32-1+ x => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-1+</code> is the operator for <code>int32</code> objects that corresponds to the function <code>1+</code> . See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

		<i>Function</i>
int32-1-		
Summary		The operator for <code>int32</code> objects corresponding to the function <code>1-</code> .
Package	<code>system</code>	
Signature	<code>int32-1- x => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description		<p>The function <code>int32-1-</code> is the operator for <code>int32</code> objects that corresponds to the function <code>1-</code>.</p> <p>See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.</p>
See also	<code>int32</code>	

		<i>Function</i>
int32/		
Summary		The divide operator for <code>int32</code> objects.
Package	<code>system</code>	
Signature	<code>int32/ x y => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
	<code>y</code>	An <code>int32</code> object that does not correspond to 0, or a non-zero integer of type (<code>signed-byte 32</code>).

Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32/</code> is the divide operator for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32/= *Function*

Summary	The <code>/=</code> comparison for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32/= x y => result</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .

Values	<code>result</code>	A boolean.
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Description	The function <code>int32/=</code> is the not equal comparison for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>

int32< *Function*

Summary	The <code><</code> comparison for <code>int32</code> objects.
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Package	<code>system</code>	
Signature	<code>int32< x y => result</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>result</code>	A boolean.
Description	The function <code>int32<</code> is the less than comparison for <code>int32</code> objects.	See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>	

int32<<		<i>Function</i>
Summary	A shift left operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32<< x y => result</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>result</code>	An <code>int32</code> object.
Description	The function <code>int32<<</code> is a shift left operator for <code>int32</code> objects.	

See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.

See also [int32](#)

int32<= *Function*

Summary The `<=` comparison for `int32` objects.

Package `system`

Signature `int32<= x y => result`

Arguments `x` An `int32` object or an integer of type `(signed-byte 32)`.

`y` An `int32` object or an integer of type `(signed-byte 32)`.

Values `result` A boolean.

Description The function `int32<=` is the less than or equal comparison for `int32` objects.

See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.

See also [int32](#)

int32= *Function*

Summary The `=` comparison for `int32` objects.

Package `system`

Signature `int32= x y => result`

Arguments	<i>x</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<i>y</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<i>result</i>	A boolean.
Description	The function <code>int32=</code> is the equal comparison for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

		<i>Function</i>
Summary	The <code>></code> comparison for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32> <i>x</i> <i>y</i> => <i>result</i></code>	
Arguments	<i>x</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<i>y</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<i>result</i>	A boolean.
Description	The function <code>int32></code> is the greater than comparison for <code>int32</code> objects. See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	

See also [int32](#)

int32>= *Function*

Summary The `>=` comparison for `int32` objects.

Package `system`

Signature `int32>= x y => result`

Arguments `x` An `int32` object or an integer of type
`(signed-byte 32)`.

`y` An `int32` object or an integer of type
`(signed-byte 32)`.

Values `result` A boolean.

Description The function `int32>=` is the greater than or equal comparison for `int32` objects.

See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.

See also [int32](#)

int32>> *Function*

Summary A shift right operator for `int32` objects.

Package `system`

Signature `int32>> x y => result`

Arguments `x` An `int32` object or an integer of type
`(signed-byte 32)`.

	<i>y</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<i>result</i>	An <code>int32</code> object.
Description	The function <code>int32>></code> is a shift right operator for <code>int32</code> objects.	See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>	

int32-aref *Function*

Summary	The accessor for a <code>simple-int32-vector</code> .	
Package	<code>system</code>	
Signature	<code>int32-aref vector index => int32</code> <code>(setf int32-aref) x vector index => int32</code>	
Arguments	<code>vector</code>	An <code>simple-int32-vector</code> .
	<code>index</code>	A non-negative fixnum.
	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-aref</code> is the accessor for a <code>simple-int32-vector</code> . The reader returns an <code>int32</code> object for the value at index <code>index</code> in <code>vector</code> . The writer sets the value at index <code>index</code> in <code>vector</code> to the <code>int32</code> object or integer <code>x</code> supplied.	
	See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.	

See also [int32](#)
[simple-int32-vector](#)

int32-logand

Function

Summary The logand operator for int32 objects.

Package system

Signature **int32-logand** *x y* => *int32*

Arguments *x* An `int32` object or an integer of type `(signed-byte 32)`.

y An `int32` object or an integer of type
`(signed-byte 32)`.

Values *int32* An *int32* object.

Description The function `int32-and` is the bitwise logical 'and' operator for `int32` objects.

See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.

See also [int32](#)

int32-logandc1

Function

Summary The `logandc1` operator for `int32` objects.

Package system

Signature `int32-logandc1 x y => int32`

Arguments	x	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
	y	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-logandc1</code> is the bitwise logical operator for <code>int32</code> objects which 'ands' the complement of <i>x</i> with <i>y</i> . See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32-logandc2 *Function*

Summary	The <code>logandc2</code> operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32-logandc2 x y => int32</code>	
Arguments	x	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
	y	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-logandc2</code> is the bitwise logical operator for <code>int32</code> objects which 'ands' <i>x</i> with the complement of <i>y</i> . See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	

See also [int32](#)

int32-logbitp *Function*

Summary The `logbitp` operator for `int32` objects.

Package `system`

Signature `int32-logbitp index x => result`

Arguments `index` An `int32` object or an integer of type
`(signed-byte 32)`.

`x` An `int32` object or an integer of type
`(signed-byte 32)`.

Values `result` An boolean.

Description The function `int32-logbitp` is the test for `int32` objects
which returns `t` if if the bit at index `index` in `x` is 1, and `nil` if it
is 0.

See the section “Fast 32-bit arithmetic” on page 95 for more
information about the INT32 API.

See also [int32](#)

int32-logeqv *Function*

Summary The `logeqv` operator for `int32` objects.

Package `system`

Signature `int32-logeqv x y => int32`

Arguments	x	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
	y	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description		The function <code>int32-logeqv</code> is the bitwise logical operator for <code>int32</code> objects which returns the complement of the 'exclusive or' of <i>x</i> and <i>y</i> . See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.
See also		<code>int32</code>

		<i>Function</i>
Summary		The <code>logior</code> operator for <code>int32</code> objects.
Package		<code>system</code>
Signature		<code>int32-logior x y => int32</code>
Arguments	x	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
	y	An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description		The function <code>int32-logior</code> is the bitwise logical 'inclusive or' operator for <code>int32</code> objects. See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.

See also [int32](#)

int32-lognand *Function*

Summary The `lognand` operator for `int32` objects.

Package `system`

Signature `int32-lognand x y => int32`

Arguments `x` An `int32` object or an integer of type
`(signed-byte 32)`.

`y` An `int32` object or an integer of type
`(signed-byte 32)`.

Values `int32` An `int32` object.

Description The function `int32-lognand` is the bitwise logical operator
for `int32` objects which returns the complement of the 'and'
of `x` and `y`.

See the section "Fast 32-bit arithmetic" on page 95 for more
information about the INT32 API.

See also [int32](#)

int32-lognor *Function*

Summary The `lognor` operator for `int32` objects.

Package `system`

Signature `int32-lognor x y => int32`

Arguments	x	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	y	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description		<p>The function <code>int32-lognor</code> is the bitwise logical operator for <code>int32</code> objects which returns the complement of the 'inclusive or' of <i>x</i> and <i>y</i>.</p> <p>See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.</p>
See also		<code>int32</code>

int32-lognot		<i>Function</i>
Summary		The <code>lognot</code> operator for an <code>int32</code> object.
Package		<code>system</code>
Signature		<code>int32-lognot x => int32</code>
Arguments	x	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description		<p>The function <code>int32-lognot</code> is the bitwise logical operator for <code>int32</code> objects which returns the complement of its argument <i>x</i>.</p> <p>See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.</p>
See also		<code>int32</code>

int32-logorc1 *Function*

Summary	The <code>logorc1</code> operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32-logorc1 x y => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-logorc1</code> is the bitwise logical operator for <code>int32</code> objects which 'inclusive ors' the complement of <code>x</code> with <code>y</code> . See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32-logorc2 *Function*

Summary	The <code>logorc2</code> operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32-logorc2 x y => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .

Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-logorc2</code> is the bitwise logical operator for <code>int32</code> objects which 'inclusive ors' <code>x</code> with the complement of <code>y</code> . See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

int32-logtest		<i>Function</i>
Summary	The <code>logtest</code> operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32-logtest x y => result</code>	
Arguments	<p><code>x</code> An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</p> <p><code>y</code> An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</p>	
Values	<code>result</code>	An boolean.
Description	The function <code>int32-logtest</code> is the bitwise test for <code>int32</code> objects which returns <code>t</code> if any of the bits designated by 1 in <code>x</code> is 1 in <code>y</code> , and returns <code>nil</code> otherwise. See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

		<i>Function</i>
Summary	The <code>logxor</code> operator for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>int32-logxor x y => int32</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
	<code>y</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>int32-logxor</code> is the bitwise logical 'exclusive or' operator for <code>int32</code> objects. See the section "Fast 32-bit arithmetic" on page 95 for more information about the INT32 API.	
See also	<code>int32</code>	

		<i>Function</i>
Summary	The <code>minusp</code> test for an <code>int32</code> object.	
Package	<code>system</code>	
Signature	<code>int32-minusp x => result</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>result</code>	A boolean.

Description	The function <code>int32-minusp</code> tests whether its argument <code>x</code> is <code>int32<</code> than the value of <code>+int32-0+</code> .
	See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>

int32-plusp

Function

Summary	The <code>plusp</code> test for an <code>int32</code> object.	
Package	<code>system</code>	
Signature	<code>int32-plusp x => result</code>	
Arguments	<code>x</code>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<code>result</code>	A boolean.
Description	The function <code>int32-plusp</code> tests whether its argument <code>x</code> is <code>int32></code> than the value of <code>+int32-0+</code> .	See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>	

int32-to-integer

Function

Summary	The destructor converting an <code>int32</code> object to an integer.	
Package	<code>system</code>	
Signature	<code>int32-to-integer int32 => integer</code>	

Arguments	<i>int32</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<i>integer</i>	An integer of type <code>(signed-byte 32)</code> .
Description		The function <code>int32-to-integer</code> returns an integer <i>integer</i> of type <code>(signed-byte 32)</code> corresponding to the <code>int32</code> object <i>int32</i> . The argument <i>int32</i> can also be an integer of type <code>(signed-byte 32)</code> , in which case it is simply returned. An error is signalled if <i>int32</i> is not of type <code>int32</code> or <code>(signed-byte 32)</code> . See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also		<code>int32</code>

int32-zerop		<i>Function</i>
Summary		The <code>zerop</code> test for an <code>int32</code> object.
Package		<code>system</code>
Signature		<code>int32-zerop x => result</code>
Arguments	<i>x</i>	An <code>int32</code> object or an integer of type <code>(signed-byte 32)</code> .
Values	<i>result</i>	A boolean.
Description		The function <code>int32-zerop</code> tests whether its argument <i>x</i> is <code>int32=</code> to the value of <code>+int32-0+</code> . See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also		<code>int32</code>

integer-to-int32		<i>Function</i>
Summary	The constructor for <code>int32</code> objects.	
Package	<code>system</code>	
Signature	<code>integer-to-int32 integer => int32</code>	
Arguments	<code>integer</code>	An integer of type (<code>signed-byte 32</code>).
Values	<code>int32</code>	An <code>int32</code> object.
Description	The function <code>integer-to-int32</code> constructs an <code>int32</code> object from an integer. An error is signalled if <code>integer</code> is not of type (<code>signed-byte 32</code>).	
		See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.
See also	<code>int32</code>	

line-arguments-list		<i>Variable</i>
Summary	List of the command line arguments used when LispWorks was invoked.	
Package	<code>system</code>	
Initial Value	<code>nil</code>	
Description	This variable contains a list of strings. These are the arguments with which LispWorks was called, in the same order. The first element is the executable itself.	
	You can implement command line processing in your application by testing elements in <code>*line-arguments-list*</code> . Use a	

string comparison function such as `string=` to compare them.

For a description of the command line arguments processed by LispWorks, see “The Command Line” on page 302.

See also `lisp-image-name`

load-data-file	<i>Function</i>
-----------------------	-----------------

Summary	Loads a fasl file created by <code>dump-forms-to-file</code> or <code>with-output-to-fasl-file</code> .
---------	---

Package	<code>system</code>
---------	---------------------

Signature	<code>load-data-file file &rest args => result</code>
-----------	--

Arguments	<code>file</code> A pathname designator. <code>args</code> Arguments passed to <code>load</code> .
-----------	---

Values	<code>result</code> A generalized boolean.
--------	--

Description	The function <code>load-data-file</code> loads a fasl file created by <code>dump-forms-to-file</code> OR <code>with-output-to-fasl-file</code> .
-------------	--

`load-data-file` has the same semantics as `load`, but treats fasl files differently:

- it cannot load a fasl generated by `compile-file`.
- it allows loading of fasls generated by `dump-forms-to-file` OR `with-output-to-fasl-file`, including those generated by a previous version of LispWorks.

`load-data-file` is intended to work with data files generated in a previous version of LispWorks. In particular you can load data files generated by LispWorks 4.3, LispWorks 4.4 and LispWorks 5.0 into LispWorks 5.1.

Fasl files generated by `dump-forms-to-file` or `with-output-to-fasl-file` must only be loaded using `load-data-file`.

The pathname specified by *file* must be recognized as a fasl file type, otherwise `load-data-file` will load it as a text file.

Compatibility Note The default fasl file type in LispWorks 5.0 and later differs to LispWorks 4.x on Windows and Linux, as described in `compile-file`. Therefore you may need to do something like this to ensure your LispWorks 4.x data file is recognized as a fasl file when loading it in this version of LispWorks:

```
(let ((sys::*binary-file-types*
      (cons "fsl" sys::*binary-file-types*)))
  (sys:load-data-file "C:/temp/data.fsl"))
```

Compatibility Note The `fixnum` type in LispWorks 5.0 and later is larger than in LispWorks 4.x on Windows and Linux. A `bignum` dumped in a LispWorks 4.x data file will be loaded as a `fixnum` in LispWorks 5.0 and later if its value is within the `fixnum` range.

See also `dump-forms-to-file`
`with-output-to-fasl-file`

locale-file-encoding *Function*

Summary Provides an encoding corresponding to the current code page on Microsoft Windows, and the locale on Unix.

Package `system`

Signature `locale-file-encoding pathname ef-spec buffer length -> new-ef-spec`

Arguments	pathname	Pathname identifying location of <i>buffer</i> .
	ef-spec	An external format spec.
	buffer	A buffer whose contents are examined.

<i>length</i>	Length (an integer) up to which <i>buffer</i> should be examined.
Values	<i>new-ef-spec</i> Default external format spec created by merging <i>ef-spec</i> with the encoding that was found.
Description	<p>The function <code>locale-file-encoding</code> consults the ANSI code page on Microsoft Windows. If the code page identifier is in <code>win32:*latin-1-code-pages*</code>, <code>locale-file-encoding</code> merges <i>ef-spec</i> with <code>:latin-1</code>. This external format writes Latin-1 on output, giving an error for any non-Latin-1 characters that are written. If the code page identifier is not in <code>win32:*latin-1-code-pages*</code> then <code>locale-file-encoding</code> merges <i>ef-spec</i> with an encoding corresponding to the current code page that gives an error for characters that cannot be encoded.</p> <p><code>locale-file-encoding</code> merges <i>ef-spec</i> with <code>:latin-1</code> on Unix.</p>
See also	<ul style="list-style-type: none"> <code>*file-encoding-detection-algorithm*</code> <code>*latin-1-code-pages*</code> <code>*multibyte-code-page-ef*</code> <code>safe-locale-file-encoding</code>

	Function				
Summary	The predicate for whether a place is suitable for use with the low-level atomic operators.				
Signature	<code>low-level-atomic-place-p place &optional environment => result</code>				
Arguments	<table> <tr> <td><i>place</i></td> <td>A place</td> </tr> <tr> <td><i>environment</i></td> <td>An environment object</td> </tr> </table>	<i>place</i>	A place	<i>environment</i>	An environment object
<i>place</i>	A place				
<i>environment</i>	An environment object				

Values	<i>result</i>	A boolean
Description	The function <code>low-level-atomic-place-p</code> is the predicate for whether the place <i>place</i> is one of the places for which low-level atomic operations are defined, and is therefore suitable for use with those operators.	These places are described in “Low level atomic operations” on page 175.
See also	<code>atomic-decf</code> <code>atomic-exchange</code> <code>atomic-fixnum-decf</code> <code>atomic-pop</code> <code>atomic-push</code> <code>compare-and-swap</code> <code>define-atomic-modify-macro</code>	

make-gesture-spec		<i>Function</i>
Summary	Create a Gesture Spec object.	
Package	<code>system</code>	
Signature	<code>make-gesture-spec <i>data</i> <i>modifiers</i> &optional <i>can-shift-both-case-p</i> => <i>gspec</i></code>	
Arguments	<i>data</i>	A non-negative integer less than <code>char-code-limit</code> , or a Gesture Spec keyword, or <code>nil</code> .
	<i>modifiers</i>	A non-negative integer less than 64, or <code>nil</code> .
	<i>can-shift-both-case-p</i>	A generalized boolean.
Values	<i>gspec</i>	A Gesture Spec object

Description	The function <code>make-gesture-spec</code> returns a new Gesture Spec object <i>gspec</i> . This can be used to represent a keystroke consisting of the key indicated by <i>data</i> , modified by the modifier keys indicated by <i>modifiers</i> . If <i>data</i> is an integer, it represents the key (<code>code-char data</code>). If <i>data</i> is a keyword, it must be one of the known Gesture Spec keywords and represents the key with the same name. If <i>data</i> is <code>nil</code> , then <i>gspec</i> has a wild data component.
-------------	---

These are the Gesture Spec keywords:

```
:f1  
:f2  
:f3  
:f4  
:f5  
:f6  
:f7  
:f8  
:f9  
:f10  
:f11  
:f12  
:f13  
:f14  
:f15  
:f16  
:f17  
:f18  
:f19  
:f20  
:f21  
:f22  
:f23
```

```
:f24
:f25
:f26
:f27
:f28
:f29
:f30
:f31
:f32
:f33
:f34
:f35
:help
:left
:right
:up
:down
:home
:prior
:next
:end
:begin
:select
:print
:execute
:insert
:undo
:redo
:menu
:find
:cancel
:break
```

```
:clear
:pause
:kp-f1
:kp-f2
:kp-f3
:kp-f4
:kp-enter
:applications-menu
:print-screen
:scroll-lock
:sys-req
:reset
:stop
:user
:system
:clear-line
:clear-display
:insert-line
:delete-line
:insert-char
:delete-char
:prev-item
:next-item
```

Not all of these Gesture Spec keywords will be generated by all platforms and/or keyboards.

If *modifiers* is an integer, it represents modifier keys according to the values `gesture-spec-accelerator-bit`, `gesture-spec-control-bit`, `gesture-spec-hyper-bit`, `gesture-spec-meta-bit`, `gesture-spec-shift-bit`, and `gesture-spec-super-bit`. If *modifiers* is `nil`, then *gspec* has a wild modifiers component.

The gesture `shift+x` could potentially be represented by the unmodified uppercase character `x`, or lowercase `x` with the `Shift` modifier. In order to ensure a consistent representation the latter form is not supported by Gesture Specs by default. That is, a `both-case-p` character may not be combined with the single modifier `shift` in the accelerator argument. This can be overridden by passing a true value for `can-shift-both-case-p`.

A `both-case-p` character is allowed with `shift` if there are other modifiers. See the below for examples.

Wild Gesture Specs can be useful when specifying an input model for a `capi:output-pane`.

Example

```
(sys:make-gesture-spec
  97
  (logior sys:gesture-spec-control-bit
          sys:gesture-spec-meta-bit))
```

A `both-case-p` character may not be combined with the single modifier `shift` in the accelerator argument, so code like this signals an error:

```
(sys:make-gesture-spec
  (char-code #\x)
  sys:gesture-spec-shift-bit)
```

Instead you should use:

```
(sys:make-gesture-spec (char-code #\X) 0)
```

A `both-case-p` character is allowed with `shift` if there are other modifiers:

```
(sys:make-gesture-spec
  (char-code #\x)
  (logior sys:gesture-spec-shift-bit
          sys:gesture-spec-meta-bit))
```

See also

`gesture-spec-accelerator-bit`
`gesture-spec-control-bit`
`gesture-spec-data`

```
gesture-spec-hyper-bit  
gesture-spec-meta-bit  
gesture-spec-modifiers  
gesture-spec-p  
gesture-spec-shift-bit  
gesture-spec-super-bit  
print-pretty-gesture-spec
```

make-simple-int32-vector *Function*

Summary	The constructor for <code>simple-int32-vector</code> objects.	
Package	<code>system</code>	
Signature	<code>make-simple-int32-vector length &key initial-contents initial-element => vector</code>	
Arguments	<code>length</code>	A non-negative fixnum.
	<code>initial-contents</code>	A sequence of integers of type (<code>signed-byte 32</code>), or <code>nil</code> .
	<code>initial-element</code>	An integer of type (<code>signed-byte 32</code>).
Values	<code>vector</code>	A <code>simple-int32-vector</code> .
Description	<p>The function <code>make-simple-int32-vector</code> is the constructor for <code>simple-int32-vector</code> objects.</p> <p>The argument <code>initial-contents</code>, if supplied, should be a sequence of length <code>length</code>. It specifies the contents of <code>vector</code>.</p> <p>The argument <code>initial-element</code>, if supplied, specifies the contents of <code>vector</code>.</p> <p>An error is signalled if both <code>initial-contents</code> and <code>initial-element</code> are supplied.</p> <p>See the section “Fast 32-bit arithmetic” on page 95 for more information about the INT32 API.</p>	

See also `int32`
`simple-int32-vector`

make-stderr-stream *Function*

Summary	Returns an output stream connected to stderr.	
Package	<code>system</code>	
Signature	<code>make-stderr-stream => stream</code>	
Arguments	None.	
Values	<code>stream</code>	An output stream.
Description	<p>The function <code>make-stderr-stream</code> returns an output stream connected to stderr.</p> <p>On Microsoft Windows, you should take care to not close this stream or make multiple stderr streams.</p>	

make-typed-aref-vector *Function*

Summary	Makes a vector that can be accessed efficiently.	
Package	<code>system</code>	
Signature	<code>make-typed-aref-vector byte-length => vector</code>	
Arguments	<code>byte-length</code>	A non-negative fixnum.
Values	<code>vector</code>	A vector.

Description	The function <code>make-typed-aref-vector</code> returns a vector which is suitable for efficient access at compiler optimization level safety = 0. Use <code>typed-aref</code> to access <code>vector</code> efficiently.
See also	<code>typed-aref</code>

marking-gc *Function*

Summary	Performs a Marking GC in 64-bit LispWorks.
Package	<code>system</code>
Signature	<code>marking-gc gen-num &key what-to-copy max-size max-size-to-copy fragmentation-threshold</code>
Arguments	<p><i>gen-num</i> An integer in the inclusive range [0,7].</p> <p><i>what-to-copy</i> One of the keywords <code>:cons</code>, <code>:symbol</code>, <code>:function</code>, <code>:non-pointer</code>, <code>:other</code>, <code>:weak</code>, <code>:all</code> or <code>:default</code>.</p> <p><i>max-size-to-copy</i> A positive number or <code>nil</code>.</p> <p><i>max-size</i> A synonym for <i>max-size-to-copy</i></p> <p><i>fragmentation-threshold</i> A number in the inclusive range [0, 10].</p>
Description	<p>The function <code>marking-gc</code> garbage collects (GCs) the generation specified by <i>gen-num</i>, and all younger generations. It uses mark and sweep, rather than copy.</p> <p>Mark and sweep garbage collection uses less virtual memory during its operation, but leaves the memory fragmented, which has a detrimental effect on the performance of the system afterwards. It is therefore not used automatically by the system, except to garbage collect static objects.</p>

`marking-gc` is useful when you want to GC a generation which contains large amount (gigabytes) of data, to make sure there are no spurious pointers from this generation to a younger generation, and you do not expect many objects in the large generation to be collected. In this scenario, a Copying GC would use virtual memory which is almost double the size of the large generation during its operation, and so would possibly cause heavy paging.

Marking GC causes fragmentation. You can reduce the amount of fragmentation by supplying either (or both) of the arguments `what-to-copy` and `max-size-to-copy`. These specify that part of the data should be collected by copying instead. Using some copying GC rather than mark and sweep will reduce the amount of fragmentation.

`what-to-copy` specifies the allocation type to copy. It can be one of the main allocation types or `:weak`, meaning copy only objects in segments of that type. `what-to-copy` can also be `:all`, meaning copy objects in all segments. If `what-to-copy` is `:default` then each call to `marking-gc` chooses one of the main allocation types or `:weak` to copy, and successive calls with `:default` cycle through these allocation types.

`max-size-to-copy` can be used to limit the amount that is copied, and thus limit the virtual memory that the operation needs. If `max-size-to-copy` is non-nil, it specifies the limit, in gigabytes, of memory that can be used for copying. If there is more than `max-size-to-copy` gigabytes of data of the type `what-to-copy`, the rest of this data is garbage collected by marking. The default value of `max-size-to-copy` is `nil`, which means there is no limit on the amount that is copied.

`fragmentation-threshold` should be a number between 0 and 10. It specifies a minimum ratio between the free area in a segment that cannot be easily used for more allocation and the allocated area in this segment. Segments that are below this threshold are not copied. The default value of `fragmentation-threshold` is 1.

Note: this function is implemented only in 64-bit LispWorks.
It is not relevant to the Memory Management API in 32-bit
implementations.

See also

`gc-generation`
`set-blocking-gen-num`

memory-growth-margin *Function*

Summary Returns the difference between the top of the Lisp heap and a maximum memory limit in 32-bit LispWorks.

Package `system`

Signature `memory-growth-margin => result`

Values `result` An integer address, or `nil`.

Description If a limit on the maximum memory has been set by `set-maximum-memory`, then `memory-growth-margin` returns the difference between the current top of the Lisp heap and that limit. That is, the amount by which the heap can grow.

Otherwise `memory-growth-margin` returns `nil`. This is the default behavior.

Note: `memory-growth-margin` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.

See also

`set-maximum-memory`

merge-ef-specs *Function*

Summary Creates a new external format spec from two other external format specs.

Package	<code>system</code>
Signature	<code>merge-ef-specs ef-spec1 ef-spec2 => ef-spec</code>
Arguments	<p><code>ef-spec1</code> An external format spec.</p> <p><code>ef-spec2</code> An external format spec.</p>
Values	<p><code>ef-spec</code> The resultant external format spec created from information in <code>ef-spec1</code> and <code>ef-spec2</code>.</p>
Description	<p>The function <code>merge-ef-specs</code> returns an external format spec constructed by adding information not supplied in <code>ef-spec1</code> from <code>ef-spec2</code>.</p> <p>Each external format spec argument is either a symbol or a list.</p> <p>If <code>ef-spec1</code> and <code>ef-spec2</code> have the same value for their name component (whether they are lists or symbols), return <code>ef-spec1</code> combined with any parameters from <code>ef-spec2</code> that are not specified in <code>ef-spec1</code>.</p> <p>Otherwise, if <code>ef-spec1</code> is <code>:default</code> or a list beginning with <code>:default</code>, return <code>ef-spec2</code> with parameters modified to be a union of the parameters from <code>ef-spec1</code> and <code>ef-spec2</code>, with those from <code>ef-spec1</code> taking priority.</p> <p>Otherwise, return <code>ef-spec1</code> with any <code>:eol-style</code> parameter from <code>ef-spec2</code> if <code>ef-spec1</code> does not specify <code>:eol-style</code>.</p>

object-address	<i>Function</i>
Summary	Returns the address of the given <i>object</i> as an integer.
Package	<code>system</code>
Signature	<code>object-address object => address</code>

Arguments	<i>object</i>	The object whose address should be returned.
Values	<i>address</i>	The address of <i>object</i> . An integer.
Description		Returns the address of the given <i>object</i> as an integer. Note that the address is likely to change during garbage collection so this integer should be used for debugging purposes only.
Example		This shows that the address returned by <code>sys:object-address</code> is the same as the one printed by the <code>print-object</code> method for <code>generic-function</code> .
		<pre>CL-USER 1 > (let ((gf #'initialize-instance)) (format t "address = ~X~%gf = ~S" (sys:object-address gf) gf)) address = 1cff778 gf = #<STANDARD-GENERIC-FUNCTION INITIALIZE-INSTANCE 1cff778> NIL CL-USER 2 ></pre>
See also		<code>pointer-from-address</code>

openpipe		<i>Function</i>
Summary		Runs a command in a subshell.
Package		<code>system</code>
Signature		<code>openpipe command &key direction element-type interrupt-off shell-type => stream</code>
Arguments	<i>command</i>	A string, a list of strings, a simple-vector of strings, or <code>nil</code> .
	<i>direction</i>	<code>:input</code> , <code>:output</code> or <code>:io</code> .
	<i>element-type</i>	A type specifier.

	<i>interrupt-off</i>	A boolean. Not implemented on Microsoft Windows.
	<i>shell-type</i>	A shell type.
Values	<i>stream</i>	A pipe stream.
Description		<p>On Unix/Linux/Mac OS X the behavior of <code>open-pipe</code> is analogous to that of <code>popen</code> in the UNIX library. It creates a pipe to/from a subprocess and returns a stream. The stream can be read from or written to as appropriate.</p> <p>On Microsoft Windows <code>open-pipe</code> calls <code>CreateProcess</code> and <code>CreatePipe</code> and returns a bidirectional stream.</p> <p>If <i>command</i> is a string then it is passed to the shell as the command to run without any arguments. If <i>command</i> is a list, then its first element is the command to run directly and the other elements are passed as arguments on the command line (that is, element 0 has its name in <code>argv[0]</code> in C, and so on). If <i>command</i> is a simple-vector of strings, the element at index 0 is the command to run and the other elements are the complete set of arguments seen by the command (that is, element 1 becomes <code>argv[0]</code> in C, and so on). If <i>command</i> is <code>nil</code>, then the shell is run.</p> <p><i>direction</i> is a keyword for the stream direction. The default value is <code>:input</code>. Bidirectional (I/O) pipes may be created by passing <code>:io</code>. See the example below. This argument is ignored on Microsoft Windows.</p> <p><i>element-type</i> specifies the type of the stream as with <code>open</code>. The default value is <code>base-char</code>. This argument is ignored on Microsoft Windows.</p> <p><i>interrupt-off</i>, if <code>t</code>, ensures that <code>ctrl+c</code> (SIGINT) to the Lisp-Works image is ignored by the subprocess. This argument is not implemented on Microsoft Windows.</p> <p><i>shell-type</i> specifies the type of shell to run. On Unix/Linux/Mac OS X/FreeBSD the default value is</p>

`"/bin/sh"`. On Microsoft Windows the default value is `"cmd"`. Note that on Windows ME/98/95 you will need to pass `"command"`.

stream supports mixed character and binary I/O in the same way as file streams constructed by `open`.

Examples

Example on Unix:

```
CL-USER 1 > (setf *ls* (sys:open-pipe "ls"))
Warning: Setting unbound variable *LS*
#<SYSTEM::PIPE-STREAM "ls">

CL-USER 2 > (loop while
                (print (read-line *ls* nil nil)))

"hello"
"othello"
NIL
NIL

CL-USER 3 > (close *ls*)
T
```

The following example shows you how to use bidirectional pipes.

```
CL-USER 1 > (with-open-stream
                  (s (sys:open-pipe "/bin/csh"
                                    :direction :io))
                  (write-line "whereis ls" s)
                  (force-output s)
                  (read-line s))
"ls: /sbin/ls /usr/bin/ls /usr/share/man/man1.Z/ls.1"
NIL
```

Example on Microsoft Windows

```

CL-USER 40 > (setf *ls* (sys:open-pipe "dir"))
#<WIN32::TWO-WAY-PIPE-STREAM 205F03F4>

CL-USER 41 > (loop while
                  (print (read-line *ls* nil nil)))

" Volume in drive Z is lispsrc"
" Volume Serial Number is 82E3-1342"
"""
" Directory of Z:\\v42\\delivery-tests"
"""
"20/02/02  11:57a      <DIR>          .
"20/02/02  11:57a      <DIR>          ..
"14/02/02  07:04p        6,815,772 othello.exe"
"14/02/02  07:07p        6,553,628 hello.exe"
"                           4 File(s)     13,369,400 bytes"
"                           3,974,103,040 bytes free"
NIL
NIL

CL-USER 42 > (close *ls*)
T

```

See also

[call-system](#)
[call-system-showing-output](#)

open-url*Function*

Summary Displays a HTML page in a web browser.

Package **system**

Signature **open-url *url***

Arguments *url* A string.

Description The function **open-url** displays the page at the URL *url* in a web browser.

Supported browsers are Netscape, Firefox, Mozilla, Opera on all platforms, Microsoft Internet Explorer on Microsoft Windows and Mac OS X, plus Safari on Mac OS X.

`open-url` is defined in the "hqn-web" module.

Compatibility Note	If your code uses the unsupported function <code>hqn-web:browse</code> please change to use <code>open-url</code> in LispWorks 5.0 and later.
Examples	(<code>sys:open-url "www.lispworks.com"</code>)
See also	<code>*browser-location*</code>

pid-exit-status *Function*

Summary	Returns the exit status of a process executed with <code>run-shell-command</code> .	
Package	<code>system</code>	
Signature	<code>pid-exit-status pid &key wait name => exit-status</code>	
Arguments	<code>pid</code>	A process ID.
	<code>wait</code>	A boolean, default value <code>t</code> .
	<code>name</code>	A Lisp object, default value <code>pid</code> .
Values	<code>exit-status</code>	An integer, or <code>nil</code> .
Description	<p>The function <code>pid-exit-status</code> returns the exit status of a process executed by <code>run-shell-command</code> with argument <code>save-exit-status</code> passed a non-nil value.</p> <p>If <code>wait</code> is true then <code>pid-exit-status</code> waits until the process exits, using <code>name</code> in the wait message. If <code>wait</code> is <code>nil</code> and the process has not terminated, then <code>pid-exit-status</code> returns <code>nil</code> immediately.</p>	

Note: `pid-exit-status` is implemented only for Unix/Linux/Mac OS X.

See also `run-shell-command`

pointer-from-address *Function*

Summary Returns the object into which the given address is pointing.

Package `system`

Signature `pointer-from-address address => object`

Arguments `address` An integer giving the address of the object.

Values `object` The object pointed to by `address`.

Description The function `pointer-from-address` returns the object into which the given integer `address` is pointing. Note that this address may not be pointing into this object after a garbage collection, unless the object is static and is still referenced by another Lisp variable or object.

Example

```
CL-USER 8 > (setq static-string
                      (make-array 3
                                :element-type 'base-char
                                :allocation :static))
Warning: Setting unbound variable STATIC-STRING
"") ?"

CL-USER 9 > (sys:object-address static-string)
537166552

CL-USER 10 > (sys:pointer-from-address *)
"") ?"

CL-USER 11 > (eq * static-string)
T
```

See also

`object-address`

		<i>Function</i>
print-pretty-gesture-spec		
Summary		Prints a Gesture Spec object as a keystroke.
Package		<code>system</code>
Signature		<code>print-pretty-gesture-spec gspec stream &key force-meta-to-alt force-shift-for-upcase => gspec</code>
Arguments	<i>gspec</i>	A Gesture Spec object.
	<i>stream</i>	An output stream.
	<i>force-meta-to-alt</i>	A boolean.
	<i>force-shift-for-upcase</i>	A boolean.
Values	<i>gspec</i>	The Gesture Spec objec that was passed.
Description		<p>The function <code>print-pretty-gesture-spec</code> prints the key-stroke represented by the Gesture Spec object <i>gspec</i> to the stream <i>stream</i>.</p> <p>If <i>force-meta-to-alt</i> is true, then <code>gesture-spec-meta-bit</code> is represented as <code>Alt</code> in the output; otherwise it is represented as <code>Meta</code>. <i>force-meta-to-alt</i> defaults to <code>nil</code>.</p> <p>If <i>force-shift-for-upcase</i> is true and <i>gspec</i> represents uppercase input such as <code>A</code>, then the <code>Shift</code> modifier is printed, indicating that <code>Shift</code> is pressed to obtain the <code>A</code> character. <i>force-shift-for-upcase</i> defaults to <code>t</code>.</p> <p>If <i>gspec</i> has a wild modifiers or data component (that is, <code>gesture-spec-modifiers</code> and/or <code>gesture-spec-data</code> return <code>nil</code>) then <code><wild></code> appears in the output.</p>

See also [gesture-spec-data](#)
[gesture-spec-meta-bit](#)
[gesture-spec-modifiers](#)
[make-gesture-spec](#)

print-symbols-using-bars Variable

Summary Controls how escaping is done when symbols are printed.

Package system

Initial Value nil

Description The variable `*print-symbols-using-bars*` controls how escaping is done when symbols are printed.

When the value is true, printing symbols that must be escaped (for example, those with names containing the colon character :) is done using the bar character | instead of the backslash character \ in cases when the readable case and ***print-case*** are both :upcase or both :downcase.

```
Example CL-USER 1 > readable-case *readable*
:UPCASE

CL-USER 2 > (let ((sys:*print-symbols-using-bars* t)
                     (*print-case* :upcase))
               (print (intern "FOO:BAR"))
               (values))

| FOO:BAR |

CL-USER 3 > (let ((sys:*print-symbols-using-bars* t)
                     (*print-case* :downcase))
               (print (intern "FOO:BAR"))
               (values))

foo\:bar
```

product-registry-path	<i>Function</i>
Summary	Gets or sets a registry path for use with your software.
Package	<code>system</code>
Signature	<code>product-registry-path <i>product</i> => <i>path-string</i></code>
Signature	<code>(setf product-registry-path) <i>path</i> <i>product</i> => <i>path</i></code>
Arguments	<p><i>product</i> A Lisp object.</p>
Values	<p><i>path</i> The path as a string or a list of strings.</p> <p><i>path-string</i> The path as a string.</p>
Description	<p>The function <code>product-registry-path</code> returns the registry subpath defined for the product denoted by <i>product</i>, as a string.</p> <p>The function <code>(setf product-registry-path)</code> sets the registry subpath for the product denoted by <i>product</i>.</p> <p>If <i>path</i> is a string it can contain backslash \ or forward slash / as directory separators - these are translated internally to the separator appropriate for the system. Note that any backslash will need escaping (with another backslash) if you input the string value via the Lisp reader.</p> <p>If <i>path</i> is a list of strings, then it is interpreted like the directory component of a pathname.</p> <p>This registry subpath is used when reading and storing user preferences with <code>user-preference</code>.</p> <p>Note that while <i>product</i> can be any Lisp object, values of <i>product</i> are compared by <code>eq</code>, so you should use keywords.</p> <p>Note: to store CAPI window geometries under the registry path for your product, see the entry for <code>capi:top-level-</code></p>

`interface-geometry-key`. in the *LispWorks CAPI Reference Manual*.

Example

```
(setf (sys:product-registry-path :deep-thought)
      (list "Deep Thought" "1.0"))
```

Then, on Unix/Linux/Mac OS X systems:

```
(sys:product-registry-path :deep-thought)
=>
"Deep Thought/1.0"
```

And on Microsoft Windows:

```
(sys:product-registry-path :deep-thought)
=>
"Deep Thought\\1.0"
```

See also

`copy-preferences-from-older-version`
`user-preference`

room-values *Function*

Summary Returns information about the state of internal storage.

Package `system`

Signature `room-values => result`

Values `result` A plist
`(:total-size size`
`:total-allocated allocated`
`:total-free free)`

Description `room-values` returns a plist containing information about the state of internal storage. This information is the same as would be printed by `(room)`.

Note: In 64-bit LispWorks you can also use `count-gen-num-allocation` and `gen-num-segments-fragmentation-state`.

See also `count-gen-num-allocation`
`room`

		<i>Function</i>
Package	<code>system</code>	
Signature		<code>run-shell-command command &key input output error-output separate-streams wait if-input-does-not-exist if-output-exists if-error- output-exists show-window environment element-type save-exit- status => result</code>
Signature		<code>run-shell-command command &key input output error-output separate-streams wait if-input-does-not-exist if-output-exists if-error- output-exists show-window environment element-type save-exit- status => stream, error-stream, process</code>
Arguments	<i>command</i>	A string, a list of strings, a simple-vector of strings, or <code>nil</code> .
	<i>input</i>	<code>nil, :stream</code> or a file designator. Default value <code>nil</code> .
	<i>output</i>	<code>nil, :stream</code> or a file designator. Default value <code>nil</code> .
	<i>error-output</i>	<code>nil, :stream, :output</code> or a file designator. Default value <code>nil</code> .
	<i>separate-streams</i>	A boolean. True value not currently supported.
	<i>wait</i>	A boolean, default value <code>t</code> .
	<i>if-input-does-not-exist</i>	<code>:error, :create</code> or <code>nil</code> . Default value <code>:error</code> .
	<i>if-output-exists</i>	<code>:error, :overwrite, :append, :supersede</code> or <code>nil</code> . Default value <code>:error</code> .
	<i>if-error-output-exists</i>	

		:error, :overwrite, :append, :supersede or nil. Default value :error.
	<i>show-window</i>	A boolean. True value not currently supported.
	<i>environment</i>	An alist of strings naming environment variables and values. Default value nil.
	<i>element-type</i>	Default value base-char.
	<i>save-exit-status</i>	A boolean, default value nil.
Values	<i>result</i>	The exit status of the process running command, or a process ID
	<i>stream</i>	A stream, or nil.
	<i>error-stream</i>	A stream, or nil.
	<i>process</i>	A process ID.
Description		<p>The function <code>run-shell-command</code> allows Unix shell commands to be called from Lisp code with redirection of the std-out, std-in and std-err to Lisp streams. It creates a subprocess which executes the command <i>command</i>.</p> <p>The argument <i>command</i> is interpreted as by <code>call-system</code>. In the cases where a shell is run, the shell to use is determined by the environment variable SHELL, or defaults to /bin/csh or /bin/sh if that does not exist.</p> <p>If <i>wait</i> is true, then <code>run-shell-command</code> executes <i>command</i> and does not return until the process has exited. In this case none of <i>input</i>, <i>output</i> or <i>error-output</i> may have the value :stream, and the single value <i>result</i> is the exit status of the process that ran <i>command</i>.</p> <p>If <i>wait</i> is nil and none of <i>input</i>, <i>output</i> or <i>error-output</i> have the value :stream then <code>run-shell-command</code> executes <i>command</i> and returns a single value <i>result</i> which is the process ID of the process running <i>command</i>.</p>

If *wait* is `nil` and either of *input* or *output* have the value `:stream` then `run-shell-command` executes *command* and returns three values: *stream* is a Lisp stream which acts as the stdout of the process if *output* is `:stream`, and is the stdin of the process if *input* is `:stream`. *error-stream* is determined by the argument *error-output* as described below. *process* is the process ID of the process.

If *wait* is `nil` and neither of *input* or *output* have the value `:stream` then the first return value, *stream*, is `nil`.

If *wait* is `nil` and *error-output* has the value `:stream` then `run-shell-command` executes *command* and returns three values. *stream* is determined by the arguments *input* and *output* as described above. *error-stream* is a Lisp stream which acts as the stderr of the process. *process* is the process ID of the process.

If *wait* is `nil` and *error-output* is not `:stream` then the second return value, *error-stream*, is `nil`. If *error-output* is `:output`, then stderr goes to the same place as stdout.

If *input* is a pathname or string, then `open` is called with `:if-does-not-exist` *if-input-does-not-exist*. The resulting `file-stream` acts as the stdin of the process.

If *output* is a pathname or string, then `open` is called with `:if-exists` *if-output-exists*. The resulting `file-stream` acts as the stdout of the process.

If *error-output* is a pathname or string, then `open` is called with `:if-exists` *if-error-output-exists*. The resulting `file-stream` acts as the stderr of the process.

This table describes the streams created, for each combination of stream arguments:

Table 40.1 The streams created by `run-shell-command`

Arguments	<i>stream</i>	<i>error-stream</i>
<i>input</i> is : stream <i>output</i> is : stream <i>error-output</i> is : stream	An I/O stream connected to stdin and stdout	An input stream connected to stderr
<i>input</i> is not : stream <i>output</i> is : stream <i>error-output</i> is : stream	An input stream connected to stdout	An input stream connected to stderr
<i>input</i> is : stream <i>output</i> is not : stream <i>error-output</i> is : stream	An output stream connected to stdin	An input stream connected to stderr
<i>input</i> is not : stream <i>output</i> is not : stream <i>error-output</i> is : stream	nil	An input stream connected to stderr
<i>input</i> is : stream <i>output</i> is : stream <i>error-output</i> is : output	An I/O stream connected to stdin, stdout and stderr	nil
<i>input</i> is not : stream <i>output</i> is : stream <i>error-output</i> is : output	An input stream connected to stdout and stderr	nil
<i>input</i> is : stream <i>output</i> is not : stream <i>error-output</i> is : output	An output stream connected to stdin	nil
<i>input</i> is not : stream <i>output</i> is not : stream <i>error-output</i> is : output	nil	nil
<i>input</i> is : stream <i>output</i> is : stream <i>error-output</i> is not : stream OR : output	An I/O stream connected to stdin and stdout	nil

Table 40.1 The streams created by `run-shell-command`

Arguments	<i>stream</i>	<i>error-stream</i>
<i>input</i> is not <code>:stream</code> <i>output</i> is <code>:stream</code> <i>error-output</i> is not <code>:stream</code> OR <code>:output</code>	An input stream connected to stdout	<code>nil</code>
<i>input</i> is <code>:stream</code> <i>output</i> is not <code>:stream</code> <i>error-output</i> is not <code>:stream</code> OR <code>:output</code>	An output stream connected to stdin	<code>nil</code>
<i>input</i> is not <code>:stream</code> <i>output</i> is not <code>:stream</code> <i>error-output</i> is not <code>:stream</code> OR <code>:output</code>	<code>nil</code>	<code>nil</code>

If any of *input*, *output* or *error-output* are streams, then they must be `file-streams` or `socket-streams` capable of acting as the stdin, stdout or stderr of the process.

environment should be an alist of strings naming environment variables and their values. The process runs in an environment inherited from the Lisp process, augmented by *environment*.

If *save-exit-status* is true, then the system stores the exit status of the process, so that it can be recovered by calling `pid-exit-status`.

Note: `run-shell-command` is implemented only for Unix/Linux/Mac OS X.

Example	<pre>(multiple-value-bind (out err pid) (sys:run-shell-command "sh -c 'echo foo >&2; echo bar'"' :wait nil :output :stream :error-output :stream) (with-open-stream (out out) (with-open-stream (err err) (values (read-line out) (read-line err))))) => "bar", "foo"</pre>
See also	<p><code>call-system</code> <code>call-system-showing-output</code> <code>openpipe</code></p>

safe-locale-file-encoding

Function

Summary	Provides a safe encoding which corresponds to the current code page on Microsoft Windows, and the locale on Unix.
Package	<code>system</code>
Signature	<code>safe-locale-file-encoding pathname ef-spec buffer length => new-ef-spec</code>
Description	<p>The function <code>safe-locale-file-encoding</code> is similar to <code>locale-file-encoding</code> except that it always returns a safe external format. That is, the external format does not signal error on writing characters not in the encoding.</p> <p>On Microsoft Windows, <code>safe-locale-file-encoding</code> consults the ANSI code page. If the code page identifier <i>id</i> is in <code>win32:*latin-1-code-pages*</code>, it merges <i>ef-spec</i> with <code>:latin-1-safe</code>. This external format writes Latin-1 on output, using 63 (ASCII '?') to replace any non-Latin-1 characters that are written. If the code page identifier <i>id</i> is not in <code>win32:*latin-1-code-pages*</code> then <code>safe-locale-file-encoding</code> merges <i>ef-spec</i> with an encoding corresponding to the current code page</p>

that uses the code page's replacement code for characters that cannot be encoded.

`safe-locale-file-encoding` merges `ef-spec` with `:latin-1-safe` on Unix.

See also `*file-encoding-detection-algorithm*`
`*latin-1-code-pages*`
`locale-file-encoding`

set-automatic-gc-callback *Function*

Summary Sets a function or functions to call after an automatic GC in 64-bit LispWorks.

Package `system`

Signature `set-automatic-gc-callback blocking-gen-num-func &optional other-func => other-func`

Arguments `blocking-gen-num-func`
 A function designator for a function of two arguments, or `nil`.

`other-func` A function designator for a function of one argument, or `nil`.

Values `other-func` A function designator for a function of one argument, or `nil`.

Description The function `set-automatic-gc-callback` sets a function or functions to call after an automatic garbage collection (GC).
If `blocking-gen-num-func` is a function designator it should take two arguments: the generation number and, if `do-gc` in the last call to `set-blocking-gen-num` was a number, the number of copied segments. It is called whenever the block-

ing generation is GCed automatically. If *blocking-gen-num-func* is `nil`, then this callback is switched off.

If *other-func* is a function designator it should take one argument, the generation number that was GCed. It is called whenever an automatic GC occurred and *blocking-gen-num-func* was not called, either because the blocking generation was not GCed, or because *blocking-gen-num-func* was passed as `nil`. If *other-func* is `nil` (the default) then this callback is switched off.

The calls occur after the GC has finished and there is no restriction on what they can do. If the call ends up allocating enough to trigger another automatic GC, they enter again recursively.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also [set-blocking-gen-num](#)

set-blocking-gen-num *Function*

Summary Sets the blocking generation in 64-bit LispWorks.

Package `system`

Signature `set-blocking-gen-num gen-num &key do-gc max-size max-size-to-copy gc-threshold => old-blocking-gen-num, do-gc, max-size-to-copy, old-gc-threshold`

Arguments `gen-num` An integer between 0 and 7, inclusive.

`do-gc` One of `t`, `nil` and `:mark`, or a real number between 0 and 10, inclusive.

`max-size-to-copy` A positive real number, or `nil`.

`max-size` A synonym for `max-size-to-copy`.

	<i>gc-threshold</i>	An integer greater than 12800, or a real in the inclusive range [0 100], or <code>nil</code> .
Values	<i>old-blocking-gen-num</i>	An integer between 0 and 7, inclusive.
	<i>do-gc</i>	One of <code>t</code> , <code>nil</code> and <code>:mark</code> , or a real number between 0 and 10, inclusive.
	<i>max-size-to-copy</i>	A positive real number.
	<i>old-gc-threshold</i>	A number.
Description		<p>The function <code>set-blocking-gen-num</code> sets <i>gen-num</i> as the generation that blocks. That is, no object is automatically promoted out of generation <i>gen-num</i> to a higher generation.</p> <p>If <i>do-gc</i> is non-<code>nil</code>, then generation <i>gen-num</i> is automatically collected when needed, as defined by <i>gc-threshold</i> (see <code>set-gen-num-gc-threshold</code>).</p> <p>The actual value of <i>do-gc</i> specifies how to GC the blocking generation when required. The possible values of <i>do-gc</i> are interpreted as follows:</p> <ul style="list-style-type: none"> <code>t</code> Use Copying GC. <code>:mark</code> Use Marking GC. A number in the inclusive range [0, 10] Use Marking GC with copying of fragmented segments. The value specifies the <i>fragmentation-threshold</i> (the same as the argument to <code>marking-gc</code>). This is the ratio between the amount of free space that cannot be easily used and the amount of allocated space inside a segment. Only segments with fragmentation higher than the threshold are copied.
		The default value of <i>do-gc</i> is <code>t</code> .

max-size-to-copy is meaningful only if *do-gc* is a number. It specifies the maximum size in Gigabytes to try to copy. If the fragmented segments contain more data than this value, only some of them are copied in each GC.

If *gc-threshold* is non-nil, it is used to set the threshold for automatic GC using `set-gen-num-gc-threshold`.

The initial setup is as if this call has been made:

```
(sys:set-blocking-gen-num 3)
```

That is, the system will GC automatically according to the default *gc-threshold* using Copying GC.

Setting the blocking generation *gen-num* to a lower number is useful into two situations:

1. When you have an operation that allocates a significant amount of data, and almost of it goes when the operation finishes, it is useful to reduce the blocking *gen-num* during the operation. The macro `block-promotion` is a convenient way of doing that.
2. If you have a good idea of how your application behaves, it may be useful to block at a lower generation (2 or 1), and then periodically call `gc-generation` explicitly to promote long living objects to a higher generation. The advantage of doing this is that you can call `gc-generation` in places where you know there are not many short-lived objects alive.

Passing a *do-gc* value other than `t` is useful when the blocking generation can be large enough that copying it all may cause very serious paging. Passing *do-gc :mark* will stop the system from copying the blocking generation, but may cause fragmentation if a significant number of long-lived objects die after a while, and there are not explicit calls to `gc-generation` or `marking-gc`.

`set-blocking-gen-num` returns four values: the old blocking generation number, the old value of *do-gc*, the *max-size-to-*

copy, and the old value of *gc-threshold*. It can be called with *gen-num nil* to query the values without changing any of them.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also [block-promotion](#)

[gc-generation](#)

[marking-gc](#)

[set-automatic-gc-callback](#)

[set-gen-num-gc-threshold](#)

set-default-segment-size *Function*

Summary Sets the default initial size of a segment in 64-bit LispWorks.

Package [system](#)

Signature `set-default-segment-size gen-num allocation-type size-in-mb
=> segment-size`

Arguments *gen-num* An integer between 0 and 3, inclusive.

allocation-type One of :cons, :symbol, :function, :non-pointer, :other, :mixed, :cons-static, :non-pointer-static, :mixed-static, :weak, :other-big, and :non-pointer-big.

size-in-mb A number, or *nil*.

Values *segment-size* A number.

Description The function `set-default-segment-size` sets the default initial size of a segment for a specific generation and allocation type.

The default initial size is also used as the default size for enlargement of the segment.

allocation-type can be any of the allocation types. However, if *allocation-type* is `:other-big` or `:non-pointer-big`, this function has no effect.

If *size-in-mb* is a number, it specifies the size in megabytes. If *size-in-mb* is `nil` then `set-default-segment-size` returns the default initial segment size without altering it.

The returned value, *segment-size*, is the previous default initial segment size.

During automatic garbage collections (GCs) the system collects an ephemeral generation when any of its segments for the main allocation types is full. Thus the size of the segments defines the frequency of GCs in these generations.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations, where `enlarge-generation` is available.

See also	<code>avoid-gc</code> <code>enlarge-generation</code> <code>set-maximum-segment-size</code>
----------	---

set-delay-promotion *Function*

Summary	Delays promotion for a specified generation in 64-bit Lisp-Works.	
Package	<code>system</code>	
Signature	<code>set-delay-promotion gen-num on => on</code>	
Arguments	<code>gen-num</code>	An integer between 0 and 7, inclusive.
	<code>on</code>	A generalized boolean.

Values	<i>on</i>	A generalized boolean.
Description	The function <code>set-delay-promotion</code> delays promotion for generation <i>gen-num</i> , which means that objects are promoted to the next generation in the second garbage collection (GC) that they survive in generation <i>gen-num</i> . By default, objects are promoted in the first GC.	It is not obvious under what circumstances delayed promotion is more useful than the default behavior. If you find this function useful, please let us know at Lisp Support.
Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.		
See also	<code>set-blocking-gen-num</code>	

		<i>Function</i>
Summary	Sets the modification and access times of a file.	
Package	<code>system</code>	
Signature	<code>set-file-dates file &key creation modification access</code>	
Arguments	<i>file</i>	A pathname designator.
	<i>creation</i>	A non-negative integer, or <code>nil</code> .
	<i>modification</i>	A non-negative integer, or <code>nil</code> .
	<i>access</i>	A non-negative integer, or <code>nil</code> .
Description	The function <code>set-file-dates</code> sets the modification and access times of the file <i>file</i> for each of <i>modification</i> and <i>access</i> that is non- <i>nil</i> .	

On Microsoft Windows, if *creation* is non-nil, the creation time of the file is also set. *creation* is ignored on other platforms.

Each keyword argument is interpreted as a universal time representing the time to set, unless it is `nil` in which case the corresponding time for *file* is not changed. Each keyword argument has default value `nil`.

An error of type `file-error` is signalled on failure.

See also [open](#)

set-gen-num-gc-threshold *Function*

Summary Sets the additional allocation threshold that triggers a GC in the blocking generation in 64-bit LispWorks.

Package `system`

Signature `set-gen-num-gc-threshold gen-num threshold => old-threshold`

Arguments `gen-num` An integer between 0 and 7, inclusive.
 `threshold` An integer greater than 12800, or a real in the inclusive range [0 100], or `nil`.

Values `old-threshold` A number.

Description The function `set-gen-num-gc-threshold` sets the threshold for additional allocation that triggers a garbage collection (GC) in generation *gen-num* when this is the blocking generation (as set by `set-blocking-gen-num`). A GC is triggered when the allocation in generation *gen-num* grows more than *threshold* over the allocation after the last GC of this generation (or a GC of a higher generation).

To set the threshold, *threshold* can be an integer greater than 12800, which is interpreted as the absolute value. Alternatively *threshold* can be a real number in the inclusive range [0 100], which is multiplied by the allocation since the previous GC to get the actual threshold to set.

The default threshold for all generations is 1. That is, for all generations *gen-num*, when generation *gen-num* is the blocking generation and allocation in it has doubled since the previous GC, generation *gen-num* is collected automatically.

`set-gen-num-gc-threshold` can be called when the generation *gen-num* is not the blocking generation, and will set the value for that *gen-num*. Such a call will not take effect until the generation *gen-num* becomes the blocking generation, as set by a call to `set-blocking-gen-num` (with `:do-gc non-nil`).

Increasing the threshold reduces the number of GC calls, but may increase the virtual memory usage.

`set-gen-num-gc-threshold` returns the old threshold for the generation *gen-num*. It can be called with *threshold nil* to return the threshold value without changing it.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also

`set-blocking-gen-num`

set-maximum-memory

Function

Summary	Sets or removes a limit for the top of the Lisp heap in 32-bit LispWorks.
Package	<code>system</code>
Signature	<code>set-maximum-memory address</code>

Arguments	<code>address</code>	An integer address, or <code>nil</code> .
Description	<code>set-maximum-memory</code> sets or removes a limit for the maximum address that the Lisp heap can grow to. If <code>address</code> is an integer, this becomes the maximum address. If <code>address</code> is <code>nil</code> , any limit set by <code>set-maximum-memory</code> is removed.	In 32-bit implementations on platforms other than Linux and Macintosh, by default the maximum memory is not set. LispWorks (32-bit) for Linux and LispWorks (32-bit) for Macintosh both set the maximum memory on startup. In all cases the system is constrained by the size of the physical memory.
		When the maximum memory is reached (either that set by <code>set-maximum-memory</code> or the physical memory limit) the system will become unstable. Therefore this situation should be avoided. The benefit of having the maximum memory set is that a useful error is signaled if the limit is reached.
		An application which is likely to grow to the maximum memory should test the amount of available memory using <code>memory-growth-margin</code> or <code>room-values</code> at suitable times, and take action to reclaim memory. Do not rely on handling the error signaled when the maximum memory is reached, since the system is already unstable at this point.
		Note: <code>set-maximum-memory</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.
See also		<code>check-fragmentation</code> <code>mark-and-sweep</code> <code>memory-growth-margin</code> <code>room-values</code>

set-maximum-segment-size	<i>Function</i>
Summary	Defines the maximum segment size for a generation and allocation type in 64-bit LispWorks.
Package	<code>system</code>
Signature	<code>set-maximum-segment-size gen-num allocation-type size-in-mb</code>
Arguments	<p><i>gen-num</i> An integer between 0 and 7, inclusive.</p> <p><i>allocation-type</i> One of :cons, :symbol, :function, :non-pointer, :other, :mixed, :cons-static, :non-pointer-static, :mixed-static, :weak, :other-big, and :non-pointer-big.</p> <p><i>size-in-mb</i> An integer between 1 and 256 inclusive, or <code>nil</code>.</p>
Values	<p><i>max-segment-size</i> A number.</p>
Description	<p>The function <code>set-maximum-segment-size</code> sets the maximum segment size for a generation and allocation type in 64-bit LispWorks.</p> <p><i>allocation-type</i> can be any of the allocation types. However, if <i>allocation-type</i> is :other-big or :non-pointer-big, this function has no effect.</p> <p><i>size-in-mb</i> is the size in megabytes.</p> <p>For the non-ephemeral generations (that is, the blocking generation and above), if the system needs more memory of some allocation type in some generation, its normal operation is to enlarge one of the existing segments in this generation of this allocation type. If it does not find a segment that it can enlarge, it allocates a new segment of the same allocation type in the same generation. Therefore the maximum segment size affects the number of segments that will be used.</p>

There is an overhead to using more segments, so normally having the largest segment size which the implementation allows (256MB) is the best. Reducing the size may be useful when using `marking-gc` with *what-to-copy* non-nil or `set-blocking-gen-num` with *do-gc* a number to prevent fragmentation in the blocking generation. In this situation, reducing the size of each segment makes it easier for the system to find segments to copy, even if the *max-size-to-copy* parameter is set to a low number to avoid using too much virtual memory.

The returned value, *max-segment-size*, is the previous maximum segment size.

If *size-in-mb* is a number, it specifies the size in megabytes. If *size-in-mb* is `nil` then `set-maximum-segment-size` returns the maximum segment size without altering it.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also	<code>marking-gc</code> <code>set-blocking-gen-num</code> <code>set-default-segment-size</code>
----------	---

set-memory-check *Function*

Summary	Sets a memory check in 64-bit LispWorks.	
Package	<code>system</code>	
Signature	<code>set-memory-check size function</code>	
Arguments	<code>size</code>	An integer.
	<code>function</code>	A function designator.
Description	The function <code>set-memory-check</code> sets a memory check.	

size must be an integer. It specifies the total size in bytes of the mapped areas of Lisp at which the check is triggered.

function is a function of no arguments.

After each automatic garbage collection (GC) the system checks whether the mapped area (excluding stacks) is larger than *size*. If it is larger, *function* is called with no arguments.

Inside the dynamic scope of the call, the check is disabled. There are no restrictions or special considerations on what the function *function* does.

The current mapped area can be found by the `:total-size` value returned by `room-values`.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also **`set-memory-exhausted-callback`**

`set-memory-exhausted-callback` *Function*

Summary Sets a callback that is called when memory is exhausted in 64-bit LispWorks.

Package `system`

Signature `set-memory-exhausted-callback function &optional where => callbacks`

Arguments *function* A function designator, the keyword `:reset`, or `nil`.

where `:first`, `:last` or `nil`.

Values *callbacks* A list of function designators.

Description The function `set-memory-exhausted-callback` adds a callback that is called when memory is exhausted. That is, when the system fails to map memory.

Note: `set-memory-check` is a more robust way to protect against memory exhaustion problems.

If *function* is a function designator then it should be a function with signature

```
function gen-num size type-name static
```

function is expected to report what the system was trying to allocate when it failed to map memory. Its arguments are:

gen-num The number of the generation in which it was trying to allocate.

size The size in bytes which it was trying to allocate.

type-name A string naming the allocation type it was trying to allocate.

static A boolean, true if it was trying to allocate a static object, and false otherwise.

function can also have the special value `:reset`, which resets the callback list to `nil`.

function can also be `nil`, which means do nothing but simply return the current list of callbacks.

where defines the position in the list that the callback *function* is placed. Its allowed values are:

`:first` *function* is placed first in the callbacks list.

`:last` *function* is placed last in the callbacks list.

`nil` *function* is removed from the callbacks list.

`set-memory-exhausted-callback` always first removes *function* from the callbacks list, and then adds it according to

where. The default value of *where* is `:first`. Functions in the list are compared with `equalp`.

`set-memory-exhausted-callback` returns the callback list.

When a callback is called, Lisp already failed to map memory. This means that you must not rely on the callback to do real work. It should therefore attempt only a minimal amount of work such as clean-ups and generating debug information. It should not try to do real work.

After all the callbacks are called, the system signals an error of type `storage-exhausted`. The condition can be accessed using the accessors described for `storage-exhausted`.

Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also

`set-memory-check`
`storage-exhausted`

		<i>Function</i>
Summary		Installs or removes a handler for a Unix signal.
		Note: applicable only on UNIX/Linux/Mac OS X.
Package		<code>system</code>
Signature		<code>set-signal-handler <i>signum</i> <i>handler</i></code>
Arguments	<i>signum</i>	A Unix signal number.
	<i>handler</i>	A function or <code>nil</code> .
Description		<code>set-signal-handler</code> with a function <i>handler</i> configures Lisp-Works such that <i>handler</i> is called when the Unix signal <i>signum</i> occurs.

If *handler* is `nil`, any handler for *signum* is removed.

handler should be defined to take an `&rest` argument, and ignore it. There are no restrictions on *handler* other than those applying to any asynchronous function call, and that it may be called in any thread. In particular there is no need to handle the signal immediately.

The configuration established by `set-signal-handler` is not persistent over image saving (or application delivery), so it should be called each time the image (or application) is started.

Notes	<p>The currently defined signal handlers are shown in the output of the bug report template which can generated via the <code>:bug-form</code> listener command. For example, there is a <code>SIGINT</code> handler which calls <code>break</code>. You should consult Lisp Support before overwriting existing signal handlers.</p> <p>LispWorks initially has no <code>SIGHUP</code> handler. <code>SIGHUP</code> will kill a LispWorks process which does not have a <code>SIGHUP</code> handler installed. When the LispWorks IDE starts up, a <code>SIGHUP</code> handler (which attempts to release locks in the environment) is installed. However if you need a <code>SIGHUP</code> handler in a server application, for example, you should install one using <code>set-signal-handler</code>.</p>
Example	<pre>(defun my-hup-handler (&rest x) (declare (ignorable x)) (cerror "Continue" "Got a HUP signal")) (sys:set-signal-handler 1 'my-hup-handler)</pre>

Note that the LispWorks IDE overwrites a `SIGHUP` handler, so you would need to reinstall it after GUI startup.

	<i>Function</i>
Summary	Controls the behavior of the system when a segment is emptied in 64-bit LispWorks.
Package	<code>system</code>
Signature	<code>set-spare-keeping-policy gen-num policy => old-policy</code>
Arguments	<p><i>gen-num</i> An integer in the inclusive range [0,7].</p> <p><i>policy</i> A generalized boolean.</p>
Values	<i>old-policy</i> A generalized boolean.
Description	<p>The function <code>set-spare-keeping-policy</code> controls the behavior of the system when a segment is emptied in 64-bit LispWorks.</p> <p>If <i>policy</i> is non-nil, then when a segment in generation <i>gen-num</i> is emptied by copying all the objects out from it, it may be kept as a spare segment to be used in the future. This increases the use of virtual memory, but reduces the number of calls to <code>mmap</code> and <code>munmap</code>. It may be useful in applications that allocate at a very high rate.</p> <p>If timing an application reveals a lot (more than 5%) of time in the "System Time", and especially if this shows up in the GC times produced by <code>extended-time</code>, it may be useful to set the policy to non-nil in generation 1, 2 and maybe in generation 3.</p> <p>The default policy is <code>nil</code> for all generations, meaning that empty segments are discarded.</p> <p>The returned value <i>old-policy</i> is the previous policy for the generation <i>gen-num</i>.</p> <p>Note: this function is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.</p>

See also [extended-time](#)

setup-atomic-funcall *Function*

Summary Sets up mutually atomic funcalls in SMP LispWorks.

Package [system](#)

Signature `setup-atomic-funcall &rest function-and-arguments`

Arguments *function-and-arguments* A list.

Description The function `setup-atomic-funcall` sets up a funcall which will be executed atomically with respect to any other calls which were also set up by `setup-atomic-funcall`.

The call causes the execution of the form

```
(apply (car function-and-arguments)
      (cdr function-and-arguments))
```

some time after the entry to `setup-atomic-funcall`. The call may happen before `setup-atomic-funcall` returns, and it is expected that normally this is what will happen. However, it may be delayed for an indefinite period, but normally this period is short (milliseconds). The execution occurs atomically with respect to other calls that were set up by `setup-atomic-funcall`.

The call should be short, because otherwise it will delay all the other calls. If an error occurs during the call, the atomicity is no longer guaranteed.

`setup-atomic-funcall` is useful when a process needs to atomically tell another process to do something, but does not need to wait for it to finish.

`setup-atomic-funcall` causes less congestion than using a lock, and so is more efficient for locks that may cause conges-

tion. `compare-and-swap` and `atomic-exchange` operations will be faster.

See also [atomic-exchange](#)
[compare-and-swap](#)

sg-default-size

Variable

Summary Default initial size of a stack group.

Package system

Initial Value In LispWorks (64-bit) for Solaris:

20000

In all other implementations:

16000

Description

The value of the variable `*sg-default-size*` is the initial size of a stack group, in 32 bit words (in 32-bit implementations) or in 64 bit words (in 64-bit implementations).

sg-default-size can be bound around a call to a process creation function. Note that setting the global value of this variable affects the size of all system processes too, so this is not recommended.

Example To create a process with a stack of 32000 words:

```
(let ((sys:*sg-default-size* 32000))
  (mp:process-run-function "Larger stack" '()
    #'(lambda ()
        (print (hcl:current-stack-length))))
```

See also [current-stack-length](#)
[*stack-overflow-behaviour*](#)

simple-augmented-string		<i>Type</i>
Summary	The simple augmented string type.	
Package	<code>system</code>	
Signature	<code>simple-augmented-string length</code>	
Arguments	<code>length</code>	The length of the string (or *, meaning any).
Description	This is the simple version of <code>augmented-string</code> , that is, the string itself is simple. Equivalent to:	
		<code>(simple-vector character length)</code>
See also	<code>augmented-string</code>	

simple-augmented-string-p		<i>Function</i>
Summary	Tests if an object is a simple augmented string.	
Package	<code>system</code>	
Signature	<code>simple-augmented-string-p object => bool</code>	
Arguments	<code>object</code>	The object to be tested.
Values	<code>bool</code>	<code>t</code> if <code>object</code> is a simple augmented string; <code>nil</code> otherwise.
Description	This is the predicate for simple augmented strings.	
See also	<code>simple-augmented-string</code>	

simple-int32-vector *Type*

Summary	A type for simple vectors of <code>int32</code> objects.
Package	<code>system</code>
Signature	<code>simple-int32-vector</code>
Description	<p>The type <code>simple-int32-vector</code> provides simple vectors of <code>int32</code> objects and can be used to generate optimal 32-bit arithmetic code. Create a <code>simple-int32-vector</code> by calling <code>make-simple-int32-vector</code>.</p> <p>See the section “Fast 32-bit arithmetic” on page 95 for more information.</p>
See also	<code>int32</code> <code>int32-aref</code> <code>make-simple-int32-vector</code>

stack-overflow-behaviour *Variable*

Summary	Controls behavior when stack overflow occurs.
Package	<code>system</code>
Initial Value	<code>:error</code>
Description	<p>The variable <code>*stack-overflow-behaviour*</code> controls behavior when stack overflow occurs.</p> <p>When <code>*stack-overflow-behaviour*</code> is set to <code>:error</code>, LispWorks signals an error.</p> <p>When it is set to <code>:warn</code>, LispWorks increases the stack size automatically to accommodate the overflow, but prints a warning message to signal that this has happened.</p> <p>When it is set to <code>nil</code>, LispWorks increases stack size silently.</p>

Compatibility In LispWorks 4.4 and previous on Windows and Linux platforms, automatic stack extension is not implemented. This has been fixed in LispWorks 5.0 and later.

See also ***sg-default-size***

staticp *Function*

Summary Specifies whether a given object has been allocated in static memory.

Package **system**

Signature **staticp obj => bool**

Arguments **obj** An object.

Values **bool** **t** if the object is allocated in static memory;
nil otherwise.

Description This predicate can be used on an object to find out whether it is allocated in static memory.

Foreign instantiations made by Lisp — for example in a Foreign Language Interface program — are made in static memory. The Lisp representations of these alien objects are not, however. Therefore **staticp** applied to an alien returns **nil** even though the alien instance itself is really allocated in static memory. To establish this, you can check the pointer to the alien instance within its Lisp representation (a structure).

storage-exhausted *Class*

Summary A condition class for failures to map memory.

Superclasses	<code>storage-condition</code>	
Initargs	<code>:gen-num</code>	The number of the generation in which the system was trying to allocate.
	<code>:size</code>	The size in bytes which the system was trying to allocate.
	<code>:type</code>	A string naming the allocation type the system was trying to allocate.
	<code>:static</code>	A boolean, true if the system was trying to allocate a static object, and false otherwise.
Accessors	<code>storage-exhausted-gen-num</code> <code>storage-exhausted-size</code> <code>storage-exhausted-static</code> <code>storage-exhausted-type</code>	
Description	<p>The class <code>storage-condition</code> is a condition class used for reporting failures to map memory.</p> <p>Allocation types are as described in <code>set-maximum-segment-size</code>.</p>	
See also	<code>set-memory-exhausted-callback</code>	

sweep-gen-num-objects		<i>Function</i>
Summary	Applies a function to all the live objects in a generation in 64-bit LispWorks.	
Package	<code>system</code>	
Signature	<code>sweep-gen-num-objects gen-num function</code>	
Arguments	<code>gen-num</code>	An integer in the inclusive range [0,7].
	<code>function</code>	A designator for a function of one argument, the object.

Values	<code>sweep-gen-num-objects</code> returns <code>nil</code> .
Description	The function <code>sweep-gen-num-objects</code> applies <i>function</i> to all the live objects in the generation <i>gen-num</i> . <i>function</i> should take one argument, the object. It can allocate, but if it allocates heavily the sweeping becomes unreliable. Small amounts of allocation will normally happen only in generation 0, and so will not affect sweeping of other generations.
Note: <code>sweep-gen-num-objects</code> is not implemented in 32-bit LispWorks, where you can use <code>sweep-all-objects</code> instead.	
See also	<code>sweep-all-objects</code>

	<i>Function</i>						
typed-aref							
Summary	Accesses a typed aref vector efficiently.						
Package	<code>system</code>						
Signature	<code>typed-aref type vector byte-index => value</code> <code>(setf typed-aref) value type vector byte-index => value</code>						
Arguments	<table> <tr> <td><code>type</code></td><td>A type specifier.</td></tr> <tr> <td><code>vector</code></td><td>A vector created by <code>make-typed-aref-vector</code>.</td></tr> <tr> <td><code>byte-index</code></td><td>A non-negative fixnum.</td></tr> </table>	<code>type</code>	A type specifier.	<code>vector</code>	A vector created by <code>make-typed-aref-vector</code> .	<code>byte-index</code>	A non-negative fixnum.
<code>type</code>	A type specifier.						
<code>vector</code>	A vector created by <code>make-typed-aref-vector</code> .						
<code>byte-index</code>	A non-negative fixnum.						
Values	<code>value</code> An object of type <i>type</i> .						
Description	The function <code>typed-aref</code> allows efficient access to a typed aref vector. <i>type</i> must evaluate to one of: <code>double-float</code> , <code>float</code> , <code>single-float</code> , <code>sys:int32</code> , <code>(unsigned-byte 32)</code> , <code>(signed-byte 32)</code> ,						

(`unsigned-byte 16`), (`signed-byte 16`), (`unsigned-byte 8`) OR (`signed-byte 8`).

`vector` must be an object returned by `make-typed-aref-vector`.

`byte-index` specifies the index in bytes from the start of the data in the vector. It must be a non-negative fixnum which is less than the `byte-length` argument passed to `make-typed-aref-vector`.

`typed-aref` and `(setf typed-aref)` will be inlined to code which is as efficient as possible when compiled with `(optimize (safety 0))` and a constant type. As usual, you need to add `(optimize (float 0))` to remove boxing for the float types.

Note: Efficient access to foreign arrays is also available. See `fli:foreign-typed-aref` in the *LispWorks Foreign Language Interface User Guide and Reference Manual*

Example

```
(defun double-float-typed-aref-incf (x y z)
  (declare (optimize (float 0) (safety 0)))
  (incf (sys:typed-aref 'double-float x y)
        (the double-float z))
  x)
```

See also

`make-typed-aref-vector`

wait-for-input-streams

Function

Summary

Waits for input on a list of socket streams, returning those that are ready.

Package

`system`

Signature

```
wait-for-input-streams streams &key wait-function wait-reason
                      timeout => result
```

Arguments	<i>streams</i>	A list, each member of which is a <code>socket-stream</code> .
	<i>wait-function</i>	A function of no arguments.
	<i>wait-reason</i>	A string.
	<i>timeout</i>	A real number or <code>nil</code> .
Values	<i>result</i>	A list of <code>socket-streams</code> or <code>nil</code> .
Description	<p>The function <code>wait-for-input-streams</code> waits for any of the streams in the argument <i>streams</i> to be ready for input. "Ready for input" typically means that some input is available from the stream, but can also mean that the peer closed the connection or there is an attempt to connect to the socket. Note that this function first checks the buffer for buffered streams.</p> <p>When any of the streams is ready for input, <code>wait-for-input-streams</code> returns a list of all the streams that are ready, in the same order that they appear in <i>streams</i>.</p> <p>If <i>timeout</i> is non-<code>nil</code> it must be a real number, specifying a timeout in seconds. If <i>timeout</i> seconds pass and none of the streams is ready, <code>wait-for-input-streams</code> returns <code>nil</code>.</p> <p>If <i>timeout</i> is 0, <code>wait-for-input-streams</code> returns all of the streams that are ready immediately, without waiting at all. That is, it behaves like <code>listen</code> on many streams.</p> <p>If <i>wait-function</i> is supplied, it is called periodically with no arguments, and if it returns non-<code>nil</code> then <code>wait-for-input-streams</code> returns <code>nil</code>. Note that, like the <i>wait-function</i> of <code>process-wait</code>, <i>wait-function</i> is called often and on other threads, so need to be an inexpensive call and independent of dynamic context.</p> <p>If <i>wait-reason</i> is supplied it is used as the <i>wait-reason</i> for the Lisp process that calls <code>wait-for-input-streams</code> while it is waiting.</p>	

Notes	<code>wait-for-input-streams</code> may return the list <i>streams</i> that was passed to it as is, if all the streams are ready.
See also	<code>wait-for-input-streams-returning-first</code>

wait-for-input-streams-returning-first *Function*

Summary	Waits for input on a list of socket streams, returning the first stream that is ready.		
Package	<code>system</code>		
Signature	<code>wait-for-input-streams-returning-first streams &key wait-function wait-reason timeout => result</code>		
Arguments	<i>streams</i>	A list, each member of which is a <code>socket-stream</code> .	
	<i>wait-function</i>	A function of no arguments.	
	<i>wait-reason</i>	A string.	
	<i>timeout</i>	A real number or <code>nil</code> .	
Values	<i>result</i>	A <code>socket-stream</code> or <code>nil</code> .	
Description	The function <code>wait-for-input-streams-returning-first</code> behaves just like <code>wait-for-input-streams</code> except that it returns the first stream in the list <i>streams</i> that is ready for input.		
See also	<code>wait-for-input-streams</code>		

with-modification-change *Macro*

Summary	Provides a way to check whether there was any "modification" during execution of a body of code.
---------	--

Package	<code>system</code>
Signature	<code>with-modification-change <i>modification-place</i> &body <i>body</i></code>
Arguments	<p><i>modification-place</i>A place as defined in Common Lisp which can receive a fixnum.</p>
	<p><i>body</i> Lisp code</p>
Description	<p>The macro <code>with-modification-change</code>, together with the macro <code>with-modification-check-macro</code>, provides a way for a body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code.</p> <p>See "Aids for implementing modification checks" on page 176 for the full description and an example.</p>
Notes	<i>modification-place</i> does not need to be one of the places defined for low level atomic operations.
See also	<code>with-modification-check-macro</code>

with-modification-check-macro		<i>Macro</i>
Summary	Provides a way to check whether there was any "modification" during execution of a body of code.	
Package	<code>system</code>	
Signature	<code>with-modification-check-macro <i>macro-name</i> <i>modification-place</i> &body <i>body</i></code>	
Arguments	<i>modification-place</i> A place as defined in Common Lisp which can receive a fixnum.	
Description	The macro <code>with-modification-check-macro</code> , together with the macro <code>with-modification-change</code> , provides a way for a	

body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code.

`with-modification-check-macro` defines a lexical macro (by macrolet) with the name *macro-name* which takes no arguments, and is used to check if there was any change since entering the body.

modification-place must be initialized to a fixnum. It must not be modified by any code except `with-modification-change`.

See "Aids for implementing modification checks" on page 176 for the full description and an example.

Notes *modification-place* does not need to be one of the places defined for low level atomic operations.

See also `with-modification-change`

with-other-threads-disabled *Macro*

Summary A debugging macro which executes code with all other threads temporarily disabled.

Package `system`

Signature `with-other-threads-disabled &body body => results`

Arguments *body* Code.

Values *results* The results of evaluating *body*.

Description The macro `with-other-threads-disabled` disables all the other threads (that is, the `mp:process` objects), executes *body* and then enables the other threads. Thus it guarantees "single-thread execution" for the forms in *body*.

The point at which each of the other threads is stopped is not well-defined. It is always a GC safe point, but it can be inside manipulating some data structure or inside a lock. As a result, if the code in *body* accesses a data structure or tries to lock a lock, it may see an inconsistent structure or get an error about calling `process-wait` when scheduling not is allowed.

As a result, `with-other-threads-disabled` is safe only if the code in *body* does not do anything that accesses trees of pointers and expects them to be in a consistent state and does not use locks. Any other code may, rarely but not never, get some unexpected error.

`with-other-threads-disabled` is useful for:

- the most accurate timing possible of specific operations
- running `sweep-all-objects` reliably
- "freezing" the program when something unexpected occurs and you want to debug it in the terminal.

Notes

`with-other-threads-disabled` cannot be guaranteed to be 100% safe in all cases, and therefore must not be used in end-user applications. It is useful for debugging purposes.

The LispWorks IDE relies on multithreading and will not work while the code in *body* executes.

See also

`sweep-all-objects`
`time`

41

Miscellaneous WIN32 symbols

This chapter describes miscellaneous symbols available in the `WIN32` package.

The `WIN32` package also includes functions for accessing the Microsoft Windows registry API, the DDE client interface, and the DDE server interface. These are documented in separate chapters in this manual.

Note: This chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD or Mac OS X platforms.

Note: the `WIN32` package is not a supported implementation of the Win32 API. Define your own interfaces to Windows functions as you need - see the *LispWorks Foreign Language Interface User Guide and Reference Manual* for details.

		<i>Function</i>
Summary		Makes a startup screen disappear.
Package		<code>win32</code>
Signature		<code>dismiss-splash-screen &optional forcep</code>
Arguments	<code>forcep</code>	A generalized boolean.

Description	<p>The function <code>dismiss-splash-screen</code> makes a startup screen (as specified via the <code>:startup-bitmap-file</code> delivery keyword) disappear.</p> <p>If <code>forcep</code> is <code>nil</code> then the startup screen is displayed for a minimum of 5 seconds before disappearing. If <code>forcep</code> is true then the startup screen disappears when <code>dismiss-splash-screen</code> is called. The default value of <code>forcep</code> is <code>nil</code>.</p> <p>If <code>dismiss-splash-screen</code> is not called, the startup screen appears for 30 seconds.</p> <p>Note: the user can dismiss the startup screen by clicking on it.</p> <p>For more information about specifying a startup screen in your application, see the entry for <code>:startup-bitmap-file</code> in the <i>LispWorks Delivery User Guide</i>.</p>
-------------	--

latin-1-code-pages		<i>Variable</i>
Summary	Windows Code Pages for which Latin-1 encoded files are used.	
Package	<code>win32</code>	
Initial Value	<code>(1252 28591)</code>	
Description	<p>The value of <code>*latin-1-code-pages*</code> is a list of integers, which must be Windows code page identifiers. When the current Code Page is on this list, the default file encoding detection algorithm will cause <code>(:latin-1 :encoding-error-action 63)</code> to be used for file I/O. Files will be written as Latin-1 with '?' replacing any non-Latin-1 character. This is faster than converting to the code page.</p> <p>If <code>safe-locale-file-encoding</code> is used for file encoding detection, then the <code>:latin-1-safe</code> external format will be used.</p>	

Note: the LispWorks editor binds `*latin-1-code-pages*` to `nil` when reading and writing files, in order to ensure that code page characters outside of Latin-1 are handled regardless of the configuration of `open`.

See also **`*file-encoding-detection-algorithm*`**

long-namestring *Function*

Summary Returns the long form of a namestring.

Package `win32`

Signature `long-namestring pathname => result`

Arguments `pathname` A pathname designator.

Values `result` A string or `nil`.

Description The function `long-namestring` first obtains the full namestring as if by `cl:namestring`, and then converts this namestring to the long form (in the Microsoft Windows meaning of "Long" paths).

If the translation succeeds then `result` is a string in the Long form.

The translation may fail, in which case `nil` is returned.

See also **`short-namestring`**

multibyte-code-page-ef *Variable*

Summary Holds the external format corresponding to the current Windows multi-byte code page.

Package	<code>win32</code>
Description	This variable holds the external format corresponding to the current Windows multi-byte code page. It is automatically initialized to the right value, when the image is started. If you change the code page (using <code>_setmbcp</code>), you need to set this variable, too.
See also	<code>locale-file-encoding</code>

set-application-themed *Function*

Summary	Controls whether LispWorks should be themed.	
Package	<code>win32</code>	
Signature	<code>set-application-themed on/off</code>	
Arguments	<code>on/off</code>	A generalized boolean.
Description	<p>The function <code>set-application-themed</code> controls whether a LispWorks application should be themed.</p> <p>On Windows XP, LispWorks is "themed", that is it uses the current theme of the desktop. You can switch this off by calling</p> <pre>(win32:set-application-themed nil)</pre> <p>On non-XP systems, or when the application does not have Common Controls 6, this call has no effect.</p> <p><code>set-application-themed</code> affects only windows that are created after it was called. Normally, it should be called before any window is created, so all LispWorks windows will appear with the same theme. However, <code>set-application-themed</code> can be called multiple times in the same run.</p>	

short-namestring	<i>Function</i>
Summary	Returns the short form of a namestring.
Package	<code>win32</code>
Signature	<code>short-namestring pathname => result</code>
Arguments	<code>pathname</code> A pathname designator.
Values	<code>result</code> A string or <code>nil</code> .
Description	The function <code>short-namestring</code> first obtains the full namestring as if by <code>c1:namestring</code> , and then converts this namestring to the short form (in the Microsoft Windows meaning of "Short" paths). If the translation succeeds then <code>result</code> is a string in the short form. The translation may fail, in which case <code>nil</code> is returned.
See also	<code>long-namestring</code>

str	
lpcstr	
lpstr	<i>FLI type descriptors</i>
Summary	Types converting to ANSI strings.
Package	<code>win32</code>
Signature	<code>str &key length</code> <code>lpcstr &key max-length</code> <code>lpstr &key max-length</code>

Description	str is an ANSI string. lpcstr is a reference-pass pointer to an ANSI string. lptr is a reference (in/out) pointer to an ANSI string.
See also	tstr

tstr**lpctstr****lptstr***FLI type descriptors*

Summary	Types which automatically switch between ANSI and Unicode strings.
Package	win32
Signature	tstr &key length lpctstr &key max-length lptstr &key max-length
Description	tstr is an ANSI/Unicode string. lpctstr is a reference-pass pointer to ANSI/Unicode string. lptstr is a reference (in/out) pointer to an ANSI/Unicode string. Each of these three types automatically switch between ANSI and Unicode, which makes them ideal for use with the :dbcS <i>encoding</i> option in fli:define-foreign-function .

Example This calls `GetDriveTypeA` on Windows ME, and `GetDriveTypeW` on Windows XP/Vista/7.

The argument is passed as ANSI or Unicode respectively:

```
(fli:define-foreign-function (%get-drive-type
  "GetDriveType" :dbcbs)
  ((lpRootPathName W:LPCTSTR))
  :result-type (:unsigned :int))

(defconstant +drive-types+
  #(:unknown :none :removable :fixed :remote :cdrom
  :ramdisk))

(defun get-drive-information (drive)
  (the drive-type (svref +drive-types+ (%get-drive-type
  drive)))))
```

`wstr`

`lpcwstr`

`lpwstr`

FLI type descriptors

Summary Types converting to Unicode strings.

Package `win32`

Signature `wstr &key length`

`lpcwstr &key max-length`

`lpwstr &key max-length`

Description `wstr` is an Unicode string.

`lpcwstr` is a reference-pass pointer to an Unicode string.

`lpwstr` is a reference (in/out) pointer to an Unicode string.

These three types are Unicode only. You are unlikely to need these unless you know your application only needs to run on Windows XP/Vista/7, or if you are interfacing to some of the few 'W' functions that are available on Windows ME. In that

case you need to pass the correct function name, something like `FooBarW` with the `w` suffix, to `fli:define-foreign-function`.

See also [tstr](#)

42

The Windows registry API

This chapter describes the Microsoft Windows registry API, which is available in the `WIN32` package

The `WIN32` package also includes functions for accessing miscellaneous Windows functionality, the DDE client interface, and the DDE server interface. These are documented in separate chapters in this manual.

Note: this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD or Mac OS X platforms.

close-registry-key		<i>Function</i>
Summary		Closes a handle to an open registry key.
Signature		<code>close-registry-key handle &key errorp => successp, error-code</code>
Arguments	<i>handle</i>	A handle to an open registry key.
Values	<i>successp</i>	A boolean.
	<i>error-code</i>	An integer error code or <code>nil</code> .

Description	The function <code>close-registry-key</code> closes <i>handle</i> , which should be an open registry key handle. The return value on success is <code>t</code> . If an error occurs and <i>errorp</i> is true then an error is signalled. Otherwise, the return values are <code>nil</code> and the Windows <i>error-code</i> . The default value of <i>errorp</i> is <code>t</code> .
See also	<code>create-registry-key</code> <code>open-registry-key</code>

collect-registry-subkeys <i>Function</i>													
Summary	Returns names of the subkeys of a registry key.												
Signature	<code>collect-registry-subkeys <i>subkey</i> &key <i>root</i> <i>max-name-size</i> <i>max-names</i> <i>errorp</i> <i>value-function</i> => <i>subsubkeys</i></code>												
Arguments	<table> <tr> <td><i>subkey</i></td><td>A string specifying the name of the key.</td></tr> <tr> <td><i>root</i></td><td>A keyword or handle.</td></tr> <tr> <td><i>max-name-size</i></td><td>An integer.</td></tr> <tr> <td><i>max-names</i></td><td>An integer.</td></tr> <tr> <td><i>errorp</i></td><td>A boolean.</td></tr> <tr> <td><i>value-function</i></td><td>A function designator or <code>nil</code>.</td></tr> </table>	<i>subkey</i>	A string specifying the name of the key.	<i>root</i>	A keyword or handle.	<i>max-name-size</i>	An integer.	<i>max-names</i>	An integer.	<i>errorp</i>	A boolean.	<i>value-function</i>	A function designator or <code>nil</code> .
<i>subkey</i>	A string specifying the name of the key.												
<i>root</i>	A keyword or handle.												
<i>max-name-size</i>	An integer.												
<i>max-names</i>	An integer.												
<i>errorp</i>	A boolean.												
<i>value-function</i>	A function designator or <code>nil</code> .												
Values	<i>subsubkeys</i> A list.												
Description	The function <code>collect-registry-subkeys</code> returns a list of names which are subsubkeys of <i>subkey</i> under the key <i>root</i> . <i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code> . The default value of <i>root</i> is <code>:user</code> .												

max-name-size specifies the maximum length of the returned name. If the name is longer than this, an error is signalled. The default value of *max-name-size* is 256.

max-names specifies the maximum number of names returned. Names after this number are ignored. The default value of *max-names* is `most-positive-fixnum`.

If *value-function* is non-nil, it should be a function with signature

`value-function handle subsubkey-name => name, collectp`

value-function is funcalled for each subsubkey with the handle of *subkey* and the name of the subsubkey. If *collectp* is non-nil then *name* is collected into the list *subsubkeys* to return from `collect-registry-subkeys`. Otherwise it is ignored.

If *value-function* is `nil`, then the returned *subsubkeys* is a list of strings naming all (subject to *max-names*) of the subsubkeys. The default value of *value-function* is `nil`.

If an error occurs opening *subkey* and *errorp* is true then an error is signalled. Otherwise, *subsubkeys* is returned as `nil` if *subkey* could not be opened. The default value of *errorp* is `t`.

See also `collect-registry-values`
 `create-registry-key`

		<i>Function</i>
Summary		Returns the values of a registry key.
Signature		<code>collect-registry-values subkey &key root max-name-size max-buffer-size expected-type errorp value-function => values-alist</code>
Arguments	<i>subkey</i>	A string specifying the name of the key.
	<i>root</i>	A keyword or handle.
	<i>max-name-size</i>	An integer.

	<i>max-buffer-size</i>	An integer.
	<i>expected-type</i>	A keyword or <code>t</code> .
	<i>errorp</i>	A boolean.
	<i>value-function</i>	A function or symbol.
Values	<i>values-alist</i>	An alist.
Description		<p>The function <code>collect-registry-values</code> returns an alist of all of the values of <i>subkey</i> under the key <i>root</i>.</p> <p><i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. The default value of <i>root</i> is <code>:user</code>.</p> <p><i>max-name-size</i> specifies the maximum length of the returned name. If the name is longer than this, an error is signalled. The default value of <i>max-name-size</i> is 256.</p> <p><i>max-buffer-size</i> specifies the maximum length in bytes of the data. If the data is longer than this, an error is signalled. The default value of <i>max-buffer-size</i> is 1024.</p> <p>If <i>value-function</i> is <code>nil</code>, the returned <i>values-alist</i> is an association list containing pairs <code>(name . data)</code> consisting of the names and data of the values of <i>subkey</i>. <i>expected-type</i> controls how certain types are converted to Lisp objects as described for <code>enum-registry-value</code>. The default value of <i>expected-type</i> is <code>t</code>.</p> <p>If <i>value-function</i> is non-nil, it should be a function with signature</p> <pre>value-function handle subsubkey-name-and-value => name-and-value, collectp</pre> <p><i>value-function</i> is funcalled for each subsubkey with the handle of <i>subkey</i> and a cons of the name and value of the subsubkey. If <i>collectp</i> is non-nil then <i>name-and-value</i> is collected into the alist <i>values-alist</i> to return from <code>collect-registry-values</code>. Otherwise <i>name-and-value</i> is ignored.</p>

If an error occurs and *errorp* is true, then an error is signalled. Otherwise, *values-alist* is returned as *nil* if *subkey* could not be opened at all or contains *nil* for the data of any particular pair that cannot be read. The default value of *errorp* is *t*.

See also **collect-registry-subkeys**
 create-registry-key
 enum-registry-value

create-registry-key *Function*

Summary	Creates a new registry key.	
Signature	create-registry-key <i>subkey</i> & <i>key class root access errorp => handle, disposition, error-code</i>	
Arguments	<i>subkey</i>	A string specifying the name of the key.
	<i>class</i>	A string.
	<i>root</i>	A keyword or handle.
	<i>access</i>	A keyword or an integer.
	<i>errorp</i>	A generalized boolean.
Values	<i>handle</i>	The handle of the new key.
	<i>disposition</i>	A keyword, either :created-new-key or :opened-existing-key .
	<i>error-code</i>	An integer error code or <i>nil</i> .
Description	<p>The function create-registry-key creates a new registry key named <i>subkey</i> under the parent key <i>root</i>. If the key already exists, it is opened and returned.</p> <p><i>subkey</i> is a string specifying a path from a root. Each component of the path is separated by a backslash. Use "" to denote the null path (that is, the root).</p>	

class can be used to specify the class of the key if it is created.

root should be a handle to an open registry key (for example a key returned by `create-registry-key` or `open-registry-key` or one of the keywords `:classes`, `:user`, `:local-machine` or `:users` which represent the standard top level roots in the registry. The default value of *root* is `:user`.

If *access* is `:read`, then the key is created with `KEY_READ` permissions. If *access* is `:write`, then the key is created with `KEY_WRITE` permissions. If *access* is an integer, then the value *access* specifies the desired Win32 access rights. The default value of *access* is `:read`.

The return values on success are the handle of the new key and a keyword `:created-new-key` or `:opened-existing-key` indicating whether a new key was created or opened.

If an error occurs and *errorp* is true then an error is signalled. Otherwise, the return values are `nil`, `nil` and the Windows *error-code*. The default value of *errorp* is `t`.

See also `delete-registry-key`
 `open-registry-key`

delete-registry-key *Function*

Summary Deletes a registry key.

Signature `delete-registry-key subkey &key root errorp => successp, error-code`

Arguments `subkey` A string specifying the name of the key.
`root` A keyword or handle.
`errorp` A generalized boolean.

Values `successp` A boolean.

	<i>error-code</i>	An integer error code or <code>nil</code> .
Description	The function <code>delete-registry-key</code> deletes the registry key named <i>subkey</i> under the parent key <i>root</i> . <i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code> . The default value of <i>root</i> is <code>:user</code> . The value <code>t</code> is returned if the key is deleted successfully. If an error occurs and <i>errorp</i> is true then an error is signalled. Otherwise, the return values are <code>nil</code> and the Windows <i>error-code</i> . The default value of <i>errorp</i> is <code>t</code> .	
See also	<code>create-registry-key</code>	

enum-registry-value *Function*

Summary	Enumerates the values of a registry key.	
Signature	<code>enum-registry-value subkey index &key root max-name-size max-buffer-size expected-type errorp => name, data-type, data, error-code</code>	
Arguments	<i>subkey</i>	A string specifying the name of the key.
	<i>index</i>	An integer.
	<i>root</i>	A keyword or handle.
	<i>max-name-size</i>	An integer.
	<i>max-buffer-size</i>	An integer.
	<i>expected-type</i>	A keyword or <code>t</code> .
	<i>errorp</i>	A boolean.
Values	<i>name</i>	A string.
	<i>data-type</i>	A keyword.
	<i>data</i>	A lisp object.

	<i>error-code</i>	An integer error code or <code>nil</code> .
Description	<p>The function <code>enum-registry-value</code> allows the values of subkey under the key <i>root</i> to be enumerated.</p> <p><i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. The default value of <i>root</i> is <code>:user</code>.</p> <p><i>index</i> specifies which value to return, with 0 being the first item.</p> <p><i>max-name-size</i> specifies the maximum length of the returned name. If the name is longer than this, an error is signalled. The default value of <i>max-name-size</i> is 256.</p> <p><i>max-buffer-size</i> specifies the maximum length in bytes of the value. The value is longer than this, an error is signalled. The default value of <i>max-buffer-size</i> is 1024.</p> <p>If the value exists (that is, <i>index</i> is not too large), then the return values are the name, data type and data associated with the value in the registry. The argument <i>expected-type</i> controls how certain data types are converted to Lisp objects as follows:</p>	

Table 42.1 Conversion of registry values to Lisp objects

<i>data-type</i>	<i>expected-type</i>	Description of converted data
<code>:string</code>	<code>:lisp-object</code>	String made with <code>read-from-string</code>
<code>:string</code>	Not supplied	String, exactly as in the registry
<code>:environment-string</code>	<code>:string</code>	String, exactly as in the registry
<code>:environment-string</code>	Not supplied	String, environment variables expanded
<code>:integer</code>	Not supplied	Integer

Table 42.1 Conversion of registry values to Lisp objects

<i>data-type</i>	<i>expected-type</i>	Description of converted data
<code>:little-endian-integer</code>	Not supplied	Integer
<code>:binary</code>	Not supplied	A newly allocated foreign object
<code>:binary</code>	<code>:lisp-object</code>	Vector, element type (<code>unsigned-byte 8</code>)

The default value of *expected-type* is `t`.

If an error occurs and *errorp* is true, then an error is signalled. Otherwise, the return values are `nil`, `nil`, `nil` and the Windows *error-code*. The default value of *errorp* is `t`.

See also [create-registry-key](#)

open-registry-key		<i>Function</i>
Summary	Opens a registry key.	
Signature		<code>open-registry-key subkey &key root access errorp => handle, error-code</code>
Arguments	<code>subkey</code> <code>root</code> <code>access</code> <code>errorp</code>	A string specifying the name of the key. A keyword or handle. An integer or keyword. A generalized boolean.
Values	<code>handle</code> <code>error-code</code>	The handle of the key. An integer error code or <code>nil</code> .

Description	<p>The function <code>open-registry-key</code> opens a registry key named <i>subkey</i> under the parent key <i>root</i>.</p> <p><i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. If <i>subkey</i> is an empty string, then the <i>root</i> key is returned. The default value of <i>root</i> is <code>:user</code>.</p> <p>If <i>access</i> is <code>:read</code>, then it opens the key with <code>KEY_READ</code> permissions. If <i>access</i> is <code>:write</code>, then it opens the key with <code>KEY_WRITE</code> permissions. If <i>access</i> is an integer, then the value <i>access</i> specifies the desired Win32 access rights. If <i>access</i> is omitted and <i>root</i> is <code>:user</code>, then <code>open-registry-key</code> uses <code>KEY_ALL_ACCESS</code>. Otherwise it uses <code>KEY_READ</code>.</p> <p>The return value on success is the <i>handle</i> of the opened key.</p> <p>If an error occurs and <i>errorp</i> is true, then an error is signalled. Otherwise, the return values are <code>nil</code> and the Windows <i>error-code</i>. The default value of <i>errorp</i> is <code>t</code>.</p>
See also	<code>create-registry-key</code>

	<i>Function</i>				
Summary	Returns information about an open registry key handle.				
Signature	<code>query-registry-key-info key => info, error-code</code>				
Arguments	<table> <tr> <td><i>key</i></td> <td>A handle.</td> </tr> </table>	<i>key</i>	A handle.		
<i>key</i>	A handle.				
Values	<table> <tr> <td><i>info</i></td> <td>A property list.</td> </tr> <tr> <td><i>error-code</i></td> <td>An integer error code or <code>nil</code>.</td> </tr> </table>	<i>info</i>	A property list.	<i>error-code</i>	An integer error code or <code>nil</code> .
<i>info</i>	A property list.				
<i>error-code</i>	An integer error code or <code>nil</code> .				
Description	<p>The function <code>query-registry-key-info</code> returns a plist of information about the open registry key handle <i>key</i>. The elements of the plist <i>info</i> are:</p> <table> <tr> <td><code>:class</code></td> <td>A string naming the class of the key, if any.</td> </tr> </table>	<code>:class</code>	A string naming the class of the key, if any.		
<code>:class</code>	A string naming the class of the key, if any.				

:subkeys-count An integer giving the number of subkeys.

:subkey-max-len
An integer giving the length of the longest subkey name.

:class-name-max-len
An integer giving the length of the longest class name.

:values-count An integer giving the number of values.

:value-max-len An integer giving the length of the longest value name.

:max-data-len An integer giving the length of the longest value data.

:security-len An integer giving the length of the security descriptor.

query-registry-value *Function*

Summary	Returns a value stored in the registry.	
Signature	<code>query-registry-value <i>subkey name &key root expected-type</i> <i>errorp => data, successp, error-code</i></code>	
Arguments	<i>subkey</i>	A string specifying the name of the key.
	<i>name</i>	A string specifying the name of the value.
	<i>root</i>	A keyword or handle.
	<i>expected-type</i>	A keyword or <code>t</code> .
	<i>errorp</i>	A boolean.
Values	<i>data</i>	A Lisp object.
	<i>successp</i>	A boolean.
	<i>error-code</i>	An integer error code or <code>nil</code> .

Description	<p>The function <code>query-registry-value</code> returns the value associated with <code>name</code> in <code>subkey</code> under the key <code>root</code>.</p> <p><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. If <code>subkey</code> is an empty string, then the <code>root</code> key is returned. The default value of <code>root</code> is <code>:user</code>.</p> <p>If the value exists, then the return values are the data and true. <code>expected-type</code> controls how certain types are converted to the Lisp object <code>data</code> as described for <code>enum-registry-value</code>. The default value of <code>expected-type</code> is t.</p> <p>If an error occurs and <code>errorp</code> is true then an error is signalled. Otherwise, the return values are <code>nil</code>, <code>nil</code> and the Windows <code>error-code</code>. The default value of <code>errorp</code> is t.</p>
See also	<code>create-registry-key</code> <code>enum-registry-value</code>

registry-key-exists-p Function

Summary	The predicate for whether a registry key can be opened.	
Signature	<code>registry-key-exists-p subkey &key root access => existsp</code>	
Arguments	<code>subkey</code>	A string specifying the name of the key.
	<code>root</code>	A keyword or handle.
	<code>access</code>	An integer or keyword.
Values	<code>existsp</code>	A boolean.
Description	<p>The function <code>registry-key-exists-p</code> checks whether the registry key named <code>subkey</code> can be opened under the parent key <code>root</code> with the supplied <code>access</code> permissions.</p> <p><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. The default value of <code>root</code> is <code>:user</code>.</p>	

If *access* is :**read**, then it opens the key with **KEY_READ** permissions. If *access* is :**write**, then it opens the key with **KEY_WRITE** permissions. If *access* is an integer, then the value *access* specifies the desired Win32 access rights. If *access* is omitted and *root* is :**user**, then **registry-key-exists-p** uses **KEY_ALL_ACCESS**. Otherwise it uses **KEY_READ**.

registry-key-exists-p closes the key before returning, but the return value is **t** if the key could actually be opened and **nil** otherwise.

See also [create-registry-key](#)

registry-value *Accessor*

Summary Gets or sets a value in the registry.

Signature **registry-value** *subkey name &key root expected-type errorp => data, successp, error-code*

 (**setf registry-value**) *value subkey name &key root expected-type errorp => value*

Arguments *subkey* A string specifying the name of the key.

name A string specifying the name of the value.

root A keyword or handle.

expected-type A keyword or **t**.

errorp A boolean.

Values *data* A Lisp object.

successp A boolean.

error-code An integer error code or **nil**.

Description The function **registry-value** returns the value associated with *name* in *subkey* under the key *root*.

subkey and *root* are interpreted as described for `create-registry-key`. The default value of *root* is `:user`.

If the value exists, then the return values are the data and true. *expected-type* controls how certain types are converted to Lisp objects as described for `enum-registry-value`. The default value of *expected-type* is t.

If an error occurs and *errorp* is true then an error is signalled. Otherwise, the return values are `nil`, `nil` and the Windows *error-code*. The default value of *errorp* is t.

The function `(setf registry-value)` sets the value associated with *name* in *subkey* under the key *root*, creating the subkey if necessary. The default value of *root* is `:user`.

See also `set-registry-value`

set-registry-value *Function*

Summary Stores a value in the registry.

Signature `set-registry-value data subkey name &key root expected-type
errorp => error-code`

Arguments *data* A Lisp object.

subkey A string specifying the name of the key.

name A string specifying the name of the value.

root A keyword or handle.

expected-type A keyword or t.

errorp A boolean.

Values *error-code* An integer error code or `nil`.

Description The function `set-registry-value` sets the value associated with *name* in *subkey* under the key *root*.

`subkey` and `root` are interpreted as described for `create-registry-key`. The default value of `root` is `:user`.

The stored value is derived from *data*, converted according to *expected-type* as follows:

Table 42.2 Conversion of Lisp objects to registry values

Lisp data	<i>expected-type</i>	Registry type
A string	<code>:string</code>	<code>REG_SZ</code> exactly as in <i>data</i>
Lisp value	<code>:lisp-object</code>	<code>REG_SZ</code> made with <code>prin1-to-string</code> of <i>data</i>
An integer	<code>:integer</code>	<code>REG_DWORD</code> containing <i>data</i>
A foreign pointer	<code>:binary</code>	<code>REG_BINARY</code> containing bytes of one element at the pointer
An array	<code>:binary</code>	<code>REG_BINARY</code> containing bytes from the array

The default value of `expected-type` is `t`.

If an error occurs and `errorp` is true then an error is signalled.
The default value of `errorp` is t.

See also [create-registry-key](#)
[registry-value](#)

with-registry-key

Macro

Summary Runs code with an open registry key handle.

Signature	<code>with-registry-key (handle subkey &key root access errorp) &body body => values</code>	
Arguments	<code>handle</code>	A variable name.
	<code>subkey</code>	A string specifying the name of the key.
	<code>root</code>	A keyword or handle.
	<code>access</code>	An integer or keyword.
	<code>errorp</code>	A boolean.
Values	<code>values</code>	The values returned by <i>body</i> .
Description	The macro <code>with-registry-key</code> evaluates <i>body</i> with the variable <code>handle</code> bound to the registry key handle opened as if by calling <code>(open-registry-key subkey :root root :access access :errorp errorp)</code>	
	<i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code> .	
	If <i>errorp</i> is <code>nil</code> and <i>subkey</i> cannot be opened then <i>body</i> is not evaluated.	
See also	<code>create-registry-key</code>	

43

The DDE client interface

This chapter describes the Dynamic Data Exchange (DDE) client interface which is available in the `win32` package. You should use this chapter in conjunction with Chapter 18, “Dynamic Data Exchange”.

The `win32` package also includes functions for accessing miscellaneous Microsoft Windows functionality, the registry API, and the DDE server interface. These are documented in separate chapters in this manual.

Note: this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD or Mac OS X platforms.

	<i>Function</i>
Summary	Sets up an advise loop on a specified data item for a conversation.
Package	<code>win32</code>
Signature	<code>dde-advise-start conversation item &key key function format datap type errorp => result</code>
Arguments	<code>conversation</code> A conversation object.

	<i>item</i>	A string or symbol.
	<i>key</i>	An object.
	<i>function</i>	A function name.
	<i>format</i>	A clipboard format specifier.
	<i>datap</i>	A boolean.
	<i>type</i>	A keyword.
	<i>errorp</i>	A boolean.
Values	<i>result</i>	A boolean.
Description	<p>The <code>dde-advise-start</code> function sets up an advise loop for the data item specified by <i>item</i> on the specified <i>conversation</i>. The argument <i>format</i> should be one of the following:</p> <ul style="list-style-type: none"> • A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format. • A string containing either the name of a standard clipboard format (without the <code>CF_</code> prefix), or the name of a registered clipboard format. • A symbol, in which case its print name is taken to specify the clipboard format. • The keyword <code>:text</code> – the default value of <i>format</i>. The keyword <code>:text</code> is treated specially. If supported by the server it uses the <code>CF_UNICODETEXT</code> clipboard format, otherwise it used the <code>CF_TEXT</code> format. <p>The argument <i>type</i> specifies how the response data should be converted to a Lisp object. For text formats, the default value indicates that a Lisp string should be created. The value <code>:string-list</code> may be specified to indicate that the return value should be taken as a tab-separated list of strings; in this case the Lisp return value is a list of strings. The default conversation class only supports text formats, unless <i>type</i> is specified as <code>:foreign</code>, which can be used with any clipboard</p>	

format. It returns a `clipboard-item` structure, containing a foreign pointer to the data, the data length, and the format identifier.

If `datap` is `t` (the default value), a hot link is established, where the new data is supplied whenever it changes. If `datap` is `nil`, a warm link is established, where the data is not passed, and must be explicitly requested using `dde-request`.

The argument `key` is used to identify this link. If specified as `nil` (the default value), it defaults to the conversation. Multiple links are permitted on a conversation with the same `item` and `format` values, as long as their `key` values differ.

If the link is established, the return value `result` is `t`. If the link could not be established, the behavior depends on the value of `errorp`. If `errorp` is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

If the link is established, the function `function` is called whenever the data changes. If `function` is `nil` (the default value), then the generic function `dde-client-advise-data` will be called.

The function specified by `function` should have a lambda list similar to the following:

`key item data &key conversation &allow-other-keys`

The arguments `key` and `item` identify the link. The argument `data` contains the new data for hot links; for warm links it is `nil`.

See also

`dde-advise-start*`
`dde-advise-stop`
`dde-client-advise-data`

		<i>Function</i>
Summary	Sets up an advise loop for a specified data item for an automatically managed conversation.	
Package	<code>win32</code>	
Signature		<code>dde-advise-start* service topic item &key key function format datap type errorp connect-error-p new-conversation-p => result</code>
Arguments	<p><i>service</i> A string or symbol.</p> <p><i>topic</i> A string or symbol.</p> <p><i>item</i> A string or symbol.</p> <p><i>key</i> An object.</p> <p><i>function</i> A function name.</p> <p><i>format</i> A clipboard format specifier.</p> <p><i>datap</i> A boolean.</p> <p><i>type</i> A keyword.</p> <p><i>errorp</i> A boolean.</p> <p><i>connect-error-p</i> A boolean.</p> <p><i>new-conversation-p</i></p> <p> A boolean.</p>	
Values	<i>result</i> A boolean.	
Description	The <code>dde-advise-start*</code> function is similar to the <code>dde-advise-start</code> , and sets up an advise loop for the data item specified by <i>item</i> on a conversation recognizing the <i>service/topic</i> pair.	
	See <code>dde-advise-start</code> for information on the <i>format</i> , <i>type</i> , and <i>datap</i> arguments.	

The argument *key* is used to identify this link. If specified as `nil` (the default value), it defaults to the conversation. Multiple links are permitted on a conversation with the same *item* and *format* values, as long as their *key* values differ.

If the link is established, the return value *result* is `t`. If the link could not be established, the behavior depends on the value of *errorp*. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

If the link is established, the function *function* will be called whenever the data changes. If *function* is `nil` (the default value), the generic function `dde-client-advise-data` will be called.

The function specified by *function* should have a lambda list similar to the following:

`key item data &key conversation &allow-other-keys`

The arguments *key* and *item* identify the link. The argument *data* contains the new data for hot links; for warm links it is `nil`.

See also

`dde-advise-start`
`dde-advise-stop`
`dde-advise-stop*`
`dde-client-advise-data`

dde-advise-stop

Function

Summary Removes a link from a conversation specified by a given item and key.

Package `win32`

Signature **`dde-advise-stop conversation item &key key format errorp disconnectp no-advise-ok => result`**

Arguments	<i>conversation</i>	A conversation object.
	<i>item</i>	A string or symbol.
	<i>key</i>	An object.
	<i>format</i>	A clipboard format specifier.
	<i>errorp</i>	A boolean.
	<i>disconnectp</i>	A boolean.
	<i>no-advise-ok</i>	A boolean.
Values	<i>result</i>	A boolean.
Description	<p>The function <code>dde-advise-stop</code> removes a particular link from <i>conversation</i> specified by <i>item</i>, <i>format</i> and <i>key</i>. If <i>key</i> is the last key for the <i>item/format</i> pair, the advise loop for the pair is terminated.</p> <p>If <i>disconnectp</i> is <code>t</code>, and the last advise loop for the conversation is terminated, the conversation is disconnected.</p> <p>Attempting to remove a link that does not exist raises an error, unless <i>no-advise-ok</i> is <code>t</code>.</p> <p>If this function succeeds, it returns <code>t</code>. If it fails, the behavior depends on the value of <i>errorp</i>. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If <i>errorp</i> is <code>nil</code>, the function returns <code>nil</code> to indicate failure.</p>	
See also	dde-advise-start dde-advise-start* dde-advise-stop* dde-client-advise-data	

dde-advise-stop* *Function*

Summary	Removes a link from an automatically managed conversation specified by a given item and key.
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Package	<code>win32</code>	
Signature	<code>dde-advise-stop* service topic item &key key format errorp disconnectp => result</code>	
Arguments	<code>service</code>	A string or symbol.
	<code>topic</code>	A string or symbol.
	<code>item</code>	A string or symbol.
	<code>key</code>	An object.
	<code>format</code>	A clipboard format specifier.
	<code>errorp</code>	A boolean.
	<code>disconnectp</code>	A boolean.
Values	<code>result</code>	A boolean.
Description	<p>The function <code>dde-advise-stop*</code> is similar to the function <code>dde-advise-stop</code>, and removes a particular link from a conversation specified by the <code>service/topic</code> pair indicated by <code>item</code>, <code>format</code> and <code>key</code>. If <code>key</code> is the last key for the <code>item/format</code> pair, the advise loop for the pair is terminated.</p> <p>If <code>disconnectp</code> is <code>t</code> (the default value), and the last advise loop for the conversation is terminated, the conversation is disconnected.</p> <p>If this function succeeds, it returns <code>t</code>. If it fails, the behavior depends on the value of <code>errorp</code>. If <code>errorp</code> is <code>t</code> (the default value), LispWorks signals an error. If <code>errorp</code> is <code>nil</code>, the function returns <code>nil</code> to indicate failure.</p>	
See also	<code>dde-advise-start</code> <code>dde-advise-start*</code> <code>dde-advise-stop</code>	

dde-client-advise-data Generic Function

Summary	Called when data changes in an advise loop.	
Package	<code>win32</code>	
Signature	<code>dde-client-advise-data key item data &key &allow-other-keys</code>	
Arguments	<code>key</code>	An object.
	<code>item</code>	A string or symbol.
	<code>data</code>	A string.
Values	None.	
Description	The generic function <code>dde-client-advise-data</code> is the default function called when an advise loop informs a client that the data monitored by the loop has changed. By default it does nothing, but it may be specialized on the object used as the key in <code>dde-advise-start</code> or <code>dde-advise-start*</code> , or on a client conversation class if the default <code>key</code> is used.	
See also	<code>dde-advise-start</code> <code>dde-advise-stop</code>	

dde-connect Function

Summary	Attempts to create a conversation with a specified DDE server.	
Package	<code>win32</code>	
Signature	<code>dde-connect service topic &key class errorp -> object</code>	
Arguments	<code>service</code>	A symbol or string.

	<i>topic</i>	A symbol or string.
	<i>class</i>	The class of the conversation object to create.
	<i>errorp</i>	A boolean.
Values	<i>object</i>	A conversation object.
Description		<p>The function <code>dde-connect</code> attempts to create a conversation with a DDE server. If <code>server</code> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <code>server</code> is any other symbol, the print name of the symbol is used as the DDE service name. If <code>server</code> is a string, that string is used as the DDE service name.</p> <p>The <code>topic</code> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>The <code>class</code> argument specifies the class of the conversation object to create. It must be a subclass of <code>dde-client-conversation</code>, or <code>nil</code>. If it is <code>nil</code> (the default value), then a conversation of class <code>dde-client-conversation</code> is created, unless <code>server</code> names a client service registered with <code>define-dde-client</code>, in which case the registered class (if any) is used.</p> <p>On executing successfully, this function returns a conversation object. If unsuccessful, the behavior depends on the value of <code>errorp</code>. If <code>errorp</code> is <code>t</code> (the default value), then an error is raised. If <code>errorp</code> is false, the function returns <code>nil</code>.</p> <p>Note that conversation objects may only be used within the thread (lightweight process) in which they were created.</p>

See also [`dde-disconnect`](#)

dde-disconnect *Function*

Summary Disconnects a conversation object.

Package	<code>win32</code>	
Signature	<code>dde-disconnect conversation => result</code>	
Arguments	<code>conversation</code>	A conversation object.
Values	<code>result</code>	A boolean.
Description	The function <code>dde-disconnect</code> disconnects the conversation object. The conversation may no longer be used. If the conversation disconnects successfully, <code>t</code> is returned.	
See also	<code>dde-connect</code>	

		<i>Function</i>
<code>dde-execute</code>		
Summary	An alternative syntax for <code>dde-execute-command</code> .	
Package	<code>win32</code>	
Signature	<code>dde-execute conversation command &rest {args}* => result</code>	
Arguments	<code>conversation</code>	A conversation object.
	<code>command</code>	A string or symbol.
	<code>args</code>	An argument.
Values	<code>result</code>	A boolean.
Description	The function <code>dde-execute</code> provides an alternative syntax for <code>dde-execute-command</code> . Unlike <code>dde-execute-command</code> , <code>dde-execute</code> takes the arguments for <code>command</code> as a sequence of <code>args</code> following <code>&rest</code> , and does not have an argument for specifying how to handle an error.	

This chapter applies only to LispWorks for Windows

See also

dde-execute*
dde-execute-command*
dde-execute-string

dde-execute*

Function

Summary An alternative syntax for `dde-execute-command*`.

Package win32

Signature **dde-execute*** *service topic command &rest {args}* => result*

Arguments *service* A string or symbol.

topic A string symbol.

command A string or symbol.

args An argument.

o *o*

Values *result* A boolean.

Description The function `dde-execute*` provides an alternative syntax for `dde-execute-command*`. Unlike `dde-execute-command*`, `dde-execute*` takes the arguments for `command` as a sequence of `args` following `&rest`, and does not have any arguments for specifying how to handle errors.

See also

dde-execute
dde-execute-command
dde-execute-string

dde-execute-command

Function

Summary Sends a command string to a specified conversation.

Package	<code>win32</code>	
Signature		<code>dde-execute-command <i>conversation command arg-list &key errorp => result</i></code>
Arguments	<i>conversation</i>	A conversation object.
	<i>command</i>	A string or symbol.
	<i>arg-list</i>	A list of strings, integers, and floats.
	<i>errorp</i>	A boolean.
Values	<i>result</i>	A boolean.
Description		The function <code>dde-execute-command</code> sends a command string to the conversation specified by <i>conversation</i> . The command string consists of <i>command</i> and <i>arg-list</i> , which are combined using the appropriate argument-marshalling conventions. By default, the syntax is [<i>command</i> (<i>arg1</i> , <i>arg2</i> ,...)] On success, this function returns a result of <code>t</code> . On failure, the behavior depends on the value of the <i>errorp</i> argument. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If it is <code>nil</code> , the function returns <code>nil</code> to indicate failure.
See also		<code>dde-execute</code> <code>dde-execute-string</code>

	dde-execute-command*	<i>Function</i>
Summary	Sends a command string to a specified service on a given topic.	
Package	<code>win32</code>	

Signature	<code>dde-execute-command* service topic command arg-list &key errorp connect-error-p new-conversation-p => result</code>	
Arguments	<i>service</i>	A string or symbol.
	<i>topic</i>	A string or symbol.
	<i>command</i>	A string or symbol.
	<i>arg-list</i>	A list of strings, integers, and floats.
	<i>errorp</i>	A boolean.
	<i>connect-error-p</i>	A boolean.
	<i>new-conversation-p</i>	A boolean.
Values	<i>result</i>	A boolean.
Description	The function <code>dde-execute-command*</code> is similar to <code>dde-execute-command</code> , and sends a command string to the server specified by <i>service</i> on a topic given by <i>topic</i> . The command string consists of <i>command</i> and <i>arg-list</i> , which are combined using the appropriate argument-marshalling conventions. By default, the syntax is <code>[command(arg1,arg2,...)]</code>	
	If <i>server</i> names a client service registered with <code>define-dde-client</code> , the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.	
	The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.	
	If necessary, the function <code>dde-execute-command*</code> creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed	

over that conversation. Hence, if several transactions will be made with the same *service* and *topic*, placing them inside a `with-dde-conversation` prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value) and a conversation cannot be established, then LispWorks signals an error. If it is `nil`, `dde-execute-command*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

Upon success, this function returns a result of `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also	<code>dde-execute</code> <code>dde-execute-string</code> <code>dde-execute-command</code>
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	<i>Function</i>						
Summary	Issues an execute transaction consisting of a specified string.						
Package	<code>win32</code>						
Signature	<code>dde-execute-string <i>conversation command</i> &key <i>errorp</i> => <i>result</i></code>						
Arguments	<table><tr><td><i>conversation</i></td><td>A conversation object.</td></tr><tr><td><i>command</i></td><td>A string or symbol.</td></tr><tr><td><i>errorp</i></td><td>A boolean.</td></tr></table>	<i>conversation</i>	A conversation object.	<i>command</i>	A string or symbol.	<i>errorp</i>	A boolean.
<i>conversation</i>	A conversation object.						
<i>command</i>	A string or symbol.						
<i>errorp</i>	A boolean.						

Values	<i>result</i>	A boolean.
Description	The function <code>dde-execute-string</code> issues an execute transaction consisting of the string <i>command</i> . This string should be an appropriately formatted as described in “Execute transactions” on page 211. No processing of the string is performed.	On success, this function returns <code>t</code> . On failure, the behavior depends on the value of the <i>errorp</i> argument. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If it is <code>nil</code> , the function returns <code>nil</code> to indicate failure.
See also	<code>dde-execute</code> <code>dde-execute-command</code> <code>dde-execute-string*</code>	

dde-execute-string*		<i>Function</i>
Summary	Issues an execute transaction consisting of a specified string on an automatically managed conversation.	
Package	<code>win32</code>	
Signature	<code>dde-execute-string* service topic command &key errorp connect-error-p new-conversation-p => result</code>	
Arguments	<i>service</i>	A symbol or string.
	<i>topic</i>	A symbol or string.
	<i>command</i>	A string or symbol.
	<i>errorp</i>	A boolean.
	<i>connect-error-p</i>	A boolean.
	<i>new-conversation-p</i>	A boolean.

Values	<code>result</code>	A boolean.
Description		<p>The function <code>dde-execute-string*</code> is similar to <code>dde-execute-string</code>, in that it issues an execute transaction consisting of the string <i>command</i>. However, the conversation across which <i>command</i> is issued is managed automatically. No processing of the string is performed.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> <p>The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>If necessary, the function <code>dde-execute-string*</code> will create a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction will be executed over that conversation. Hence, if several transactions will be made with the same <i>service</i> and <i>topic</i>, placing them inside a <code>with-dde-conversation</code> prevents a new conversation being established for each transaction.</p> <p>If <i>new-conversation-p</i> is set to <code>t</code> a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.</p> <p>If <i>connect-error-p</i> is <code>t</code> (the default value), then LispWorks signals an error if a conversation cannot be established. If it is <code>nil</code>, <code>dde-execute-string*</code> returns <code>nil</code> if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.</p> <p>Upon success, the function returns <code>t</code>. On failure, the behavior depends on the value of the <i>errorp</i> argument. If <i>errorp</i> is <code>t</code> (the</p>

default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-execute`
`dde-execute-command`
`dde-execute-string`

dde-item

Accessor

Summary

An accessor which can perform a request transaction or a poke transaction.

Package

`win32`

Signature

`dde-item conversation item &key format type errorp => result`

Arguments

conversation A conversation object.

item A string or symbol.

format A clipboard format specifier.

type A keyword.

errorp A boolean.

Values

result A boolean.

Description

The accessor `dde-item` performs a request transaction when read. It performs a poke transaction when set.

To illustrate, the following `dde-request` command

```
(dde-request conversation item :format format :type type  
:errorp errorp)
```

can also be issued using `dde-item` as follows:

```
(dde-item conversation item :FORMAT format :TYPE type  
:ERRORP errorp)
```

Similarly, the following `dde-poke` command

```
(dde-poke conversation item data :format format :type type  
:errorp errorp)
```

can be issued using `dde-item` as follows:

```
(setf (dde-item conversation item :format format :type type  
:errorp errorp) data)
```

except that the *format* always returns *data*.

Upon success, this function returns a *result* of `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-item*`
`dde-poke`
`dde-request`

dde-item*		<i>Accessor</i>
Summary	An accessor which can perform a request transaction or a poke transaction on an automatically managed conversation.	
Package	<code>win32</code>	
Signature		<code>dde-item* service topic item &key format type errorp connect-error-p new-conversation-p => result</code>
Arguments	<code>service</code>	A string or symbol.
	<code>topic</code>	A string or symbol.
	<code>item</code>	A string or symbol.
	<code>format</code>	A clipboard format specifier.
	<code>type</code>	A keyword.
	<code>errorp</code>	A boolean.

connect-error-p A boolean.

new-conversation-p

A boolean.

Values *result* A boolean.

Description The accessor `dde-item*` is similar to `dde-item`, and performs a request transaction when read. It performs a poke transaction when set.

To illustrate, the following `dde-request*` command

```
(dde-request* service topic item :format format :type type  
:errorp errorp connect-error-p new-conversation-p)
```

can also be issued using `dde-item*` as follows:

```
(dde-item* service topic item :FORMAT format :TYPE type  
:ERRORP errorp connect-error-p new-conversation-p)
```

Similarly, the following `dde-poke*` command

```
(dde-poke* conversation item data :format format :type type  
:errorp errorp connect-error-p new-conversation-p)
```

can be issued using `dde-item*` as follows:

```
(setf (dde-item* conversation item :format format :type type  
:errorp errorp connect-error-p new-conversation-p) data)
```

except that the *format* always returns *data*.

If necessary, the accessor `dde-item*` creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed over that conversation. If you need to make several transactions with the same *service* and *topic*, placing them inside a `with-dde-conversation` prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is

always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value), then LispWorks signals an error if a conversation cannot be established. If it is `nil`, `dde-item*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

On success, the function returns `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-item`
`dde-poke`
`dde-request`

		<i>Function</i>
dde-poke		
Summary		Issues a poke transaction on a conversation, to set the value of a specified item.
Package		<code>win32</code>
Signature		<code>dde-poke conversation item data &key format type errorp => result</code>
Arguments	<i>conversation</i>	A conversation object.
	<i>item</i>	A string or symbol.
	<i>data</i>	A string.
	<i>format</i>	A clipboard format specifier.
	<i>type</i>	A keyword.
	<i>errorp</i>	A boolean.

Values	<i>result</i>	A boolean.		
Description	The function <code>dde-poke</code> issues a poke transaction on <i>conversation</i> to set the value of the item specified by <i>item</i> to the value specified by <i>data</i> . The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.			
The argument <i>format</i> should be one of the following:				
<ul style="list-style-type: none">• A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format.• A string containing either the name of a standard clipboard format (without the <code>CF_</code> prefix), or the name of a registered clipboard format.• A symbol, in which case its print name is taken to specify the clipboard format.• The keyword <code>:text</code>. This is the default value.				
The keyword <code>:text</code> is treated specially. If supported by the server it uses the <code>CF_UNICODETEXT</code> clipboard format, otherwise it used the <code>CF_TEXT</code> format.				
For text transactions, the default value of <i>type</i> indicates that <i>data</i> is a Lisp string to be used. If <i>type</i> is <code>:string-list</code> , then <i>data</i> is taken to be a list of strings, and is sent as a tab-separated string.				
Alternatively, <i>data</i> can be a <code>clipboard-item</code> structure, containing a foreign pointer to the data to send and the length of the data. In this case the <i>type</i> argument is ignored.				
On success, this function returns <code>t</code> . On failure, the behavior depends on the value of the <i>errorp</i> argument. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If it is <code>nil</code> , the function returns <code>nil</code> to indicate failure.				
See also	<code>dde-item</code> <code>dde-request</code>			

	<i>Function</i>																				
dde-poke*																					
Summary	Issues a poke transaction on an automatically managed conversation, to set the value of a specified item.																				
Package	<code>win32</code>																				
Signature	<code>dde-poke* service topic item data &key format type errorp connect-error-p new-conversation-p => result</code>																				
Arguments	<table> <tr> <td><i>service</i></td><td>A symbol or string.</td></tr> <tr> <td><i>topic</i></td><td>A symbol or string.</td></tr> <tr> <td><i>item</i></td><td>A string or symbol.</td></tr> <tr> <td><i>data</i></td><td>A string.</td></tr> <tr> <td><i>format</i></td><td>A clipboard format specifier.</td></tr> <tr> <td><i>type</i></td><td>A keyword.</td></tr> <tr> <td><i>errorp</i></td><td>A boolean.</td></tr> <tr> <td><i>connect-error-p</i></td><td>A boolean.</td></tr> <tr> <td> <i>new-conversation-p</i></td><td></td></tr> <tr> <td></td><td>A boolean.</td></tr> </table>	<i>service</i>	A symbol or string.	<i>topic</i>	A symbol or string.	<i>item</i>	A string or symbol.	<i>data</i>	A string.	<i>format</i>	A clipboard format specifier.	<i>type</i>	A keyword.	<i>errorp</i>	A boolean.	<i>connect-error-p</i>	A boolean.	 <i>new-conversation-p</i>			A boolean.
<i>service</i>	A symbol or string.																				
<i>topic</i>	A symbol or string.																				
<i>item</i>	A string or symbol.																				
<i>data</i>	A string.																				
<i>format</i>	A clipboard format specifier.																				
<i>type</i>	A keyword.																				
<i>errorp</i>	A boolean.																				
<i>connect-error-p</i>	A boolean.																				
 <i>new-conversation-p</i>																					
	A boolean.																				
Values	<i>result</i> A boolean.																				
Description	<p>The function <code>dde-poke*</code> is the same as <code>dde-poke</code>, except that conversations are managed automatically. The function issues a poke transaction to set the value of the item specified by <i>item</i> to the value specified by <i>data</i>. The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the</p>																				

symbol is used as the DDE service name. If *server* is a string, that string is used as the DDE service name.

The *topic* argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.

For information on the *format*, *type*, and *errorp* arguments, see [dde-poke](#).

If necessary, the function [dde-poke*](#) creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed over that conversation. Hence, if several transactions are made with the same *service* and *topic*, placing them inside a [with-dde-conversation](#) prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value), LispWorks signals an error if a conversation cannot be established. If it is `nil`, [dde-poke*](#) returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

See also

[dde-item](#)

[dde-request](#)

dde-request

Function

Summary

Issues a request transaction on a conversation for a specified item.

Package

`win32`

Signature	<code>dde-request conversation item &key format type errorp => result successp</code>
Arguments	<p><i>conversation</i> A conversation object.</p> <p><i>item</i> A string or symbol.</p> <p><i>format</i> A clipboard format specifier.</p> <p><i>type</i> A keyword.</p> <p><i>errorp</i> A boolean.</p>
Values	<p><i>result</i> The return value of the transaction.</p> <p><i>successp</i> A boolean.</p>
Description	<p>The function <code>dde-request</code> issues a request transaction on <i>conversation</i> for the specified <i>item</i>. The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.</p> <p>The argument <i>format</i> should be one of the following:</p> <ul style="list-style-type: none"> • A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format. • A string containing either the name of a standard clipboard format (without the <code>CF_</code> prefix), or the name of a registered clipboard format. • A symbol, in which case its print name is taken to specify the clipboard format. • The keyword <code>:text</code>. This is the default value. <p>The keyword <code>:text</code> is treated specially. If supported by the server it uses the <code>CF_UNICODETEXT</code> clipboard format, otherwise it used the <code>CF_TEXT</code> format.</p> <p>The default conversation class only supports text formats, unless <i>type</i> is specified as <code>:foreign</code>. The argument <i>type</i> specifies how the response data should be converted to a Lisp object. For text formats, the default value indicates that a Lisp</p>

string should be created. The value `:string-list` may be specified for `type` to indicate that the return value should be taken as a tab-separated list of strings; in this case the Lisp return value is a list of strings. The value `:foreign` can be used with any clipboard format. It returns a `clipboard-item` structure, containing a foreign pointer to the data, the data length, and the format identifier.

This function returns two values, `result` and `successp`. If successful, `result` is the return value of the transaction (which may be `nil` in the case of `:string-list`), and `successp` is true to indicate success.

On failure, the result of the function depends on the `errorp` argument. If `errorp` is `t` (the default), the function signals an error. If `errorp` is `nil`, the function returns `(values nil nil)`.

See also

`dde-item`
`dde-poke`
`dde-request*`

dde-request*		<i>Function</i>
Summary		Issues a request transaction on an automatically managed conversation for a specified item.
Package		<code>win32</code>
Signature		<code>dde-request* service topic item &key format type errorp connect-error-p new-conversation-p => result successp</code>
Arguments	<code>service</code>	A symbol or string.
	<code>topic</code>	A symbol or string.
	<code>item</code>	A string or symbol.
	<code>format</code>	A clipboard format specifier.
	<code>type</code>	A keyword.

	<i>errorp</i>	A boolean.
	<i>connect-error-p</i>	A boolean.
	<i>new-conversation-p</i>	A boolean.
Values	<i>result</i>	The return value of the transaction.
Description		<p>The function <code>dde-request*</code> is similar to <code>dde-request</code>, except that conversations are managed automatically. The function issues a request transaction for the specified <i>item</i>. The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> <p>The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>For information on the <i>format</i>, <i>type</i>, and <i>errorp</i> arguments see dde-request.</p> <p>If necessary, the function <code>dde-request*</code> will create a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction will be executed over that conversation. Hence, if several transactions will be made with the same <i>service</i> and <i>topic</i>, placing them inside a <code>with-dde-conversation</code> prevents a new conversation being established for each transaction.</p> <p>If <i>new-conversation-p</i> is set to <code>t</code> a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.</p>

If `connect-error-p` is `t` (the default value), then LispWorks signals an error if a conversation cannot be established. If it is `nil`, `dde-request*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

See also

`dde-item`
`dde-poke`
`dde-request`

`define-dde-client`

Macro

Summary Registers a client service.

Package `win32`

Signature `define-dde-client name &key service class => name`

Arguments `name` A symbol.

`service` A string.

`class` A subclass of `dde-client-conversation`.

Values `name` A symbol.

Description The macro `define-dde-client` defines a mapping from the symbol `name` to the DDE service name with which to establish a conversation, and the conversation class to use for this conversation. The argument `service` is a string which names the DDE service. It defaults to the print-name of `name`. The argument `class` is a subclass of `dde-client-conversation` which is used for all conversations with this service. It defaults to `dde-client-conversation`. Specifying a subclass allows various aspects of the behavior of the conversation to be specialized.

Note that it is generally not necessary to register client services unless a specialized conversation type is required.

However, it is sometimes convenient to register a client service in order to allow the service name to be changed in the future.

If the macro executes successfully, the *name* of the DDE service is returned.

See also	<code>dde-connect</code> <code>dde-disconnect</code> <code>with-dde-conversation</code>
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with-dde-conversation *Macro*

Summary	Dynamically binds a conversation to a server across a given body of code.	
Package	<code>win32</code>	
Signature	<code>with-dde-conversation (conv service topic &key errorp new-conversation-p) &body body => result</code>	
Arguments	<code>conv</code>	A conversation object.
	<code>service</code>	A symbol or string.
	<code>topic</code>	A symbol or string.
	<code>errorp</code>	A boolean.
	<code>new-conversation-p</code>	A boolean.
	<code>body</code>	A list of Lisp forms.
Values	<code>result</code>	A boolean.

Description	<p>The macro <code>with-dde-conversation</code> dynamically binds a conversation with a server across the scope of a body of code specified by <i>body</i>. The argument <i>conv</i> is bound to a conversation with the server specified by <i>service</i>, and the topic specified by <i>topic</i>.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> <p>The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>An existing conversation may be used, if available, unless <i>new-conversation-p</i> is true, in which case a new conversation is always created.</p> <p>If a new conversation is created, it is disconnected after <i>body</i> has executed as an implicit program.</p> <p>If a conversation cannot be established, the result returned by the function depends on the value of <i>errorp</i>. If <i>errorp</i> is <code>t</code> (the default value), then LispWorks signals an error. If <i>errorp</i> is <code>nil</code>, the body is not executed, and <code>nil</code> is returned.</p>
See also	<code>define-dde-client</code>

44

The DDE server interface

This chapter describes the Dynamic Data Exchange (DDE) server interface which is available in the `win32` package. You should use this chapter in conjunction with Chapter 18, “Dynamic Data Exchange”.

The `win32` package also includes functions for accessing miscellaneous Microsoft Windows functionality, the registry API, and the DDE client interface. These are documented in separate chapters in this manual.

Note: this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD or Mac OS X platforms.

		<i>Generic Function</i>
Summary		Called when a poke transaction is received.
Package		<code>win32</code>
Signature		<code>dde-server-poke server topic item data &key format &allow-other-keys => successp</code>
Arguments	<code>server</code>	A server object.
	<code>topic</code>	A topic object.

	<i>item</i>	A string.
	<i>data</i>	A string.
	<i>format</i>	A keyword.
Values	<i>successp</i>	A boolean.
Description		<p>The generic function <code>dde-server-poke</code> is called in response to a poke transaction. A method specializing on the classes of <i>server</i> and <i>topic</i> should poke the data given by <i>data</i> into the item specified by <i>item</i>.</p> <p>The keyword <i>format</i> indicates the format in which the item is being requested. By default, only text transfers are supported (and the <i>format</i> argument will have the value <code>:text</code>).</p> <p>The set of supported formats may be extended in future releases, so applications should always check the value of the <i>format</i> parameter and reject transactions which use formats not supported by the application.</p> <p>If the poke transaction is successful, <code>non-nil</code> should be returned, and <code>nil</code> should be returned for failure.</p>
See also		<p><code>dde-poke</code></p> <p><code>dde-request</code></p> <p><code>dde-server-request</code></p>

dde-server-request**Generic Function**

Summary	Called when a request transaction is received.		
Package	<code>win32</code>		
Signature	<code>dde-server-request server topic item &key format &allow-other-keys => data</code>		
Arguments	<table> <tr> <td><i>server</i></td> <td>A server object.</td> </tr> </table>	<i>server</i>	A server object.
<i>server</i>	A server object.		

	<i>topic</i>	A topic object.
	<i>item</i>	A string.
	<i>format</i>	A keyword.
Values	<i>data</i>	The returned data.
Description		<p>The generic function <code>dde-server-request</code> is called in response to a request transaction. A method specializing on the classes of <i>server</i> and <i>topic</i> should return the data in <i>item</i>. The expected format of the data is given by <i>format</i>, which defaults to <code>:text</code>. The set of supported formats may be extended in future releases, so applications should always check the value of the format parameter and reject transactions which use formats not supported by the application.</p> <p>If the request fails, <code>nil</code> should be returned.</p>
See also		<code>dde-poke</code> <code>dde-request</code> <code>dde-server-poke</code>

		<i>Generic Function</i>
Summary		Called whenever a client attempts to connect to a server with a given topic.
Package		<code>win32</code>
Signature		<code>dde-server-topic server topic-name => topic</code>
Arguments	<i>server</i>	A server.
	<i>topic-name</i>	A string.
Values	<i>topic</i>	A topic.

Description	The generic function <code>dde-server-topic</code> is called whenever a client attempts to make a connection to the server. The argument <i>topic-name</i> is a string identifying a topic. If the server recognizes the topic, a method specializing on the server should return an instance of one of the server's topic classes. If the server does not recognize the topic, the method should return <code>nil</code> .
See also	<code>dde-server-topics</code> <code>dde-topic-items</code>

dde-server-topics	<i>Generic Function</i>
--------------------------	-------------------------

Summary	Returns a list of the available general topics on a given server.	
Package	<code>win32</code>	
Signature	<code>dde-server-topics server => topic-list</code>	
Arguments	<code>server</code> A server object.	
Values	<code>topic-list</code> A list of strings.	
Description	<p>The generic function <code>dde-server-topics</code> returns a list of the available general topics on a given server. A suitable method specializing on the server class should be defined. Dispatching topics (see <code>define-dde-dispatch-topic</code>) should not be returned, as they are handled automatically by LispWorks. If you do not provide a <code>dde-server-topics</code> method, the default method returns <code>:unknown</code>, which prevents the DDE server from responding to the topics request.</p> <p>Generally only one canonical name should be returned for each topic, even though the server may recognize several alternative forms of name for a topic. For example, if an application implements a topic for each open file, the topics <code>foo</code>, <code>foo.doc</code> and <code>c:\foo.doc</code> may all be acceptable strings</p>	

This chapter applies only to LispWorks for Windows

for referring to the same topic; however `dde-server-topics` should return each topic once only.

The application must also provide a method on the `dde-server-topic` generic function.

See also `dde-server-topic`
 `dde-topic-items`

dde-system-topic *Class*

Summary A built-in topic class for the `:system` topic.

Package `win32`

Superclasses `dde-topic`

Description The class `dde-system-topic` is a built-in topic class for the `:system` topic.
See “The system topic” on page 216 for details of the items implemented by this topic.

See also `dde-topic`

dde-topic *Class*

Summary The ancestor of all topic classes.

Package `win32`

Superclasses `standard-object`

Subclasses `dde-system-topic`

Description	The class <code>dde-topic</code> is the superclass of all topic objects. You can define subclasses using <code>defclass</code> and return instances of them by defining a method for the <code>dde-server-topic</code> generic function. This allows you to create topics with arbitrary internal state that can be accessed via DDE.
Examples	See <code>examples\dde\server-dispatching.lisp</code>
See also	<code>dde-server-topic</code> <code>dde-system-topic</code>

	<i>Generic Function</i>
<code>dde-topic-items</code>	
Summary	Returns the valid items in a topic.
Package	<code>win32</code>
Signature	<code>dde-topic-items server topic => item-strings</code>
Arguments	<code>server</code> A server object. <code>topic</code> A topic object.
Values	<code>item-strings</code> A list of strings.
Description	The generic function <code>dde-topic-items</code> returns a list of strings corresponding to the valid items in the topic. A method specializing on a server and topic should be defined. If it is not practical to return a list of the items (for example, if the list is potentially infinite), the generic function returns <code>:unknown</code> .
See also	<code>dde-server-topic</code> <code>dde-server-topics</code>

define-dde-dispatch-topic	Macro						
Summary	Defines a dispatch topic.						
Package	<code>win32</code>						
Signature	<code>define-dde-dispatch-topic name &key server topic-name => name</code>						
Arguments	<table><tr><td><code>name</code></td><td>A symbol.</td></tr><tr><td><code>server</code></td><td>A server class.</td></tr><tr><td><code>topic-name</code></td><td>A string.</td></tr></table>	<code>name</code>	A symbol.	<code>server</code>	A server class.	<code>topic-name</code>	A string.
<code>name</code>	A symbol.						
<code>server</code>	A server class.						
<code>topic-name</code>	A string.						
Values	<code>name</code> A symbol.						
Description	<p>The macro <code>define-dde-dispatch-topic</code> defines a dispatching topic. A dispatching topic is a topic which has a fixed name and always exists. Dispatching topics provide dispatching capabilities, whereby appropriate application-supplied code is executed for each supported transaction. Note that the server implementation also provides some dispatching capabilities.</p> <p>The name of the dispatching topic object is specified by <code>name</code>.</p> <p>The topic is identified by the string <code>topic-name</code>.</p> <p>The class of the server to attach the topic to is given by <code>server</code>.</p> <p>The macro <code>define-dde-dispatch-topic</code> returns the name of the dispatching topic, <code>name</code>.</p> <p>Use <code>define-dde-server-function</code> with the <code>:topic</code> option to define items for a dispatch topic.</p>						
Example	<pre>(define-dde-dispatch-topic topic1 :server demo-server) (define-dde-server-function (item1 :topic topic1) :request () ..handle topic1.item1 request..)</pre>						

See also [**dde-server-topic**](#)
[**dde-server-topics**](#)
[**define-dde-server-function**](#)

define-dde-server *Macro*

Summary Defines a class for a Lisp DDE server.

Package `win32`

Signature `define-dde-server class-name service-name => class-name`
`define-dde-server class-name superclasses slot-specs options => class-name`

Arguments `class-name` A class name.

`service-name` A string.

`superclasses` A list of superclasses.

`slot-specs` The specifications for the class' slots.

`options` A keyword option.

Values `class-name` A class name.

Description The macro `define-dde-server` defines a class for a Lisp DDE server. The class inherits from `dde-server`.

The long form of the macro is similar to `defclass`, but with one extra option, `:service`, which is used to specify the service name string to which this server will respond.

The short form is provided to handle the common simple case; `class-name` is the name of the Lisp class to be defined, and `service-name` is the service name string to which this server will respond.

Example The first example uses the short version of `define-dde-server` to define a class, called `lisp-server`, which has the service name “LISP”.

```
(define-dde-server lisp-server "LISP")
```

The second example shows how to use the long form of the macro to define the same class, and illustrates the use of the *superclasses* and *options* arguments.

```
(define-dde-server lisp-server (dde-server)
  ())
  (:service "LISP"))
```

See also `dde-server-topic`
`dde-server-topics`
`dde-topic-items`

define-dde-server-function *Macro*

Summary Defines a server function that is called when a specific transaction occurs.

Package `win32`

Signature

```
define-dde-server-function name-and-options transaction
  (binding*) form* => name

name-and-options ::= name | (name [[option]])  

transaction ::= :request | :poke | :execute  

option ::= :server server | :topic-class topic-class | :topic
topic | :item item | :format format | :command command |
:iresult-type result-type | :advisep advisep  

binding ::= var-binding | execute-arg-binding  

var-binding ::= (var :server) | (var :topic) | (var :data
[i data-type]) | (var :format)  

execute-arg-binding ::= var | (var type-spec)
```

Arguments	<i>name</i>	A symbol.
	<i>transaction</i>	A keyword.
	<i>server</i>	A server object.
	<i>topic-class</i>	A topic class.
	<i>topic</i>	A symbol naming a dispatch topic.
	<i>item</i>	A string.
	<i>format</i>	A keyword.
	<i>command</i>	A string.
	<i>result-type</i>	A data type.
	<i>advisep</i>	A boolean.
	<i>var</i>	A variable.
	<i>data-type</i>	A data type.
	<i>type-spec</i>	A data type.
	<i>form</i>	A Lisp form.
Values	<i>name</i>	A symbol.
Description	<p>The macro <code>define-dde-server-function</code> is used to define a server function, called <i>name</i>, which is called when a specific transaction occurs. The defined function may either be attached to a server class (using the dispatching capabilities built into the server implementation) or to a named dispatch topic.</p> <ul style="list-style-type: none"> • To attach the definition to a server, <code>:server</code> should be used to specify the server class. <code>:topic-class</code> may be used to specify the topic-class for which this definition should be used. It can be a symbol which names a <code>topic-class</code>, or <code>t</code> (meaning All topics, this is the default for execute transactions), or <code>:system</code> (The System topic), or <code>:non-system</code> (any topic except the System topic). In the case of execute transactions only, <code>:topic-class</code> defaults 	

to `t`; in all other cases, it must be specified. Typically, execute transactions ignore the topic of the conversation.

Alternatively, you may choose to only support execute transactions in the system topic.

- A server function may instead be attached to a particular instance of `dde-dispatch-topic`, previously defined by `define-dde-dispatch-topic`. This is the main use of dispatching topics. In this case `:topic` should be provided with a symbol that names a dispatching topic. The function is installed on that topic, and only applies to that topic.

In the case of a request or poke transaction, `item` is a string defining the item name for which this definition should be invoked. It defaults to the capitalized print-name of `name`, with hyphens removed.

For request transactions, the `:format` option is used to specify the format understood. It defaults to `:text`. It can be specified as `:all`, in which case the `:format` binding may be used to determine the actual format requested (see below).

In the case of an execute transaction, `command` is a string specifying the name of the command for which this definition should be invoked. It defaults to the capitalized print-name of `name`, with hyphens removed.

The `execute-arg-bindings` are only used with execute transactions. They specify the arguments expected. `type-spec` should be one of `t`, `string`, `number`, `integer` or `float`. If not specified, `t` is assumed.

The `var-bindings` may appear anywhere in the binding list, and in any order. Binding variables to `:server` and `:topic` is useful with all transaction types. A `:server` binding causes the variable to be bound to the server object, whereas a `:topic` binding causes the variable to be bound to the topic object. This allows the server and/or the topic to be referred to in the body of the function.

A `:format` binding can only be used with request and poke transactions, where an *option* of `:format :all` has been specified. It causes the variable specified by `var` to be bound to the format of data requested or supplied. The body of the defined function should fail the transaction if it does not support the requested format.

A `:data` binding can only be used with poke transactions. It binds a variable to the data to be poked. For text transfers, the data variable is normally bound to a string. However, if `datatype` is specified as `:string-list`, the data in the transaction is interpreted as a tab-separated list of strings, and the data variable is bound to a list of strings.

For execute and poke transactions, the body of the defined function is expected to return `t` for success and `nil` for failure.

For request transactions, the body of the defined function is normally expected to return a result value, or `nil` for failure.

The `result-type` option may only be specified for request transactions. If it is specified as `:string-list`, then for text requests the body is expected to return a list of strings, which are used to create a tab-separated list to be returned to the client.

Sometimes, it may be necessary to support returning `nil` to mean the empty list, rather than failure. In this case, the `result-type` can be specified as `(:string-list t)`. The body is then expected to return two values: a list of strings, and a flag indicating success.

In the case of execute transactions, the command name and arguments are unmarshalled by the default argument unmarshalling. This is compatible with the default argument unmarshalling described under `dde-execute-command`. The execute string is expected to be of the following syntax:

```
[command1(arg1,arg2,...)] [command2(arg1,arg2,...)] ...]
```

Note that multiple commands may be packed into a single execute transaction. However, `dde-execute-command` does not currently generate such strings.

See also

`dde-execute-command`
`define-dde-client`
`define-dde-dispatch-topic`
`define-dde-server`

start-dde-server	<i>Function</i>
-------------------------	-----------------

Summary Creates and starts an instance of a DDE server.

Package `win32`

Signature `start-dde-server name => server`

Arguments `name` A DDE server class

Values `server` A server object

Description The function `start-dde-server` creates an instance of a server of the class specified by `name` which then starts accepting transactions. If successful the function returns the server, otherwise `nil` is returned.

You need to call `start-dde-server` in a thread that will process Windows messages. This can either be done by using `capi:execute-with-interface` to run it in the thread of an application's main window (if there is one) or by running it in a dedicated thread as in the example. DDE callbacks will happen in this thread.

Example

```
(mp:process-run-function
  "DDE Server"
  ()
  #'(lambda ()
      (win32:start-dde-server 'lispworks-dde-server)
      (loop
        (mp:wait-processing-events
         nil
         :wait-reason "DDE Request Loop"))))
```

See also**define-dde-server**

45

Dynamic library C functions

This chapter describes the C functions available in a LispWorks dynamic library, that is a library created by passing *dll-exports* or *dll-added-files* to `save-image` or `deliver`.

For an overview of this functionality with examples of use, see Chapter 13, “LispWorks as a dynamic library”.

Note: this chapter applies only to 32-bit LispWorks on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD, and 64-bit LispWorks on Windows, Intel Macintosh, Linux and x86/x64 Solaris.

InitLispWorks	C function
Summary	Provides control over the initialization of a LispWorks dynamic library.
Signature	On Windows: <code>int __stdcall InitLispWorks (int MilliTimeOut, void *BaseAddress, size_t ReserveSize)</code> On Linux, Macintosh, x86/x64 Solaris and FreeBSD:

```
int InitLispWorks (int MilliTimeOut, void *BaseAddress,
size_t ReserveSize)
```

Description The C function `InitLispWorks` allows you to relocate a LispWorks dynamic library if this is necessary, and offers control of the initialization process.

A LispWorks dynamic library is automatically initialized by any call to its exported symbols, so in most cases there is no need to call `InitLispWorks`. It is however necessary when you need to relocate LispWorks or when you need finer control over the initialization process.

For more information about relocating a LispWorks dynamic library, see “Startup relocation” on page 306)

MilliTimeOut specifies the time in milliseconds to wait for LispWorks to finish initializing before returning. `InitLispWorks` checks whether the library was initialized and if not initiates initialization. It then waits at most *MilliTimeOut* milliseconds before returning.

BaseAddress specifies the base address for relocation. Can be 0.

ReserveSize specifies the reserve size for relocation. Can be 0.

BaseAddress and *ReserveSize* are interpreted as described in “Startup relocation” on page 306.

Non-negative return values indicate success:

1 LispWorks was already initialized or in the process of initializing, and finished initializing by the time `InitLispWorks` returned.

0 `InitLispWorks` initialized LispWorks and the initialization finished successfully.

Values in the inclusive range [-1, -99] indicate a timeout:

-1 `InitLispWorks` started initialization and timed out before LispWorks finished mapping itself from the file.

- 2 LispWorks already started initialization, and `InitLispWorks` timed out before LispWorks finished mapping itself from the file.
- 3 `InitLispWorks` started initialization and timed out after LispWorks mapped itself from the file, but before the initialization was complete.
- 4 LispWorks already started initialization, and `InitLispWorks` timed out before after LispWorks mapped itself from the file, but before the initialization was complete.

After `InitLispWorks` times out, the state of LispWorks can be queried by `LispWorksState`.

Lower values indicate failure, as follows:

- 1000 Failure to start a thread to do the initialization.
- 1401 The file seems to be corrupted.
- 1402 Failure to map into memory.
- 1403 Failure to read the LispWorks header from the file.
- 1406 Bad base address.

Additionally, a value *value* in the inclusive range [-1400, -1001] on Linux, Macintosh, FreeBSD and x86/x64 Solaris platforms indicates an error in a system call. Calculate the errno number by -1001 - *value*.

Note: If LispWorks is already initialized or in the process of being initialized, `InitLispWorks` does not initiate the process of initialization. Therefore the arguments to `InitLispWorks` have no effect if LispWorks was already initialized when it is called. On Microsoft Windows, the default behavior is to initialize a LispWorks dynamic library automatically during loading, so this needs to be disabled to use `InitLispWorks`

effectively. Disable automatic initialization of a library as described for `deliver` and `save-image`.

Note: Once `QuitLispWorks` has returned 0, LispWorks can be initialized again. It is possible to quit and restart LispWorks several times, at the same address or at a different address.

Note: On Linux, Macintosh, FreeBSD and x86/x64 Solaris you can create wrappers to the C functions described in this chapter from your application by writing them in C and adding them to the dynamic library using `dll-added-files` in `deliver` and `save-image`. Such wrappers can be used to add calls to `InitLispWorks` before actually calling into Lisp.

`InitLispWorks` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 13, “*LispWorks as a dynamic library*”.

See also

`deliver`
`LispWorksState`
`save-image`
`QuitLispWorks`

LispWorksDlsym

C function

Summary Returns the address of a foreign callable.

Signature On Windows:

```
void __stdcall *LispWorksDlsym (const char * name)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
void *LispWorksDlsym (const char * name)
```

Description	<p>The C function <code>LispWorksD1sym</code> returns the address of a foreign callable <i>name</i> which is defined in Lisp using <code>fli:define-foreign-callable</code>.</p> <p><code>LispWorkD1sym</code> first checks if the LispWorks dynamic library finished initializing, and if not uses <code>InitLispWorks</code> to initialize it (with <i>MilliTimeOut</i> 200). If this fails <code>LispWorkD1sym</code> returns NULL. When the LispWorks dynamic library is initialized, <code>LispWorksD1sym</code> returns the address of <i>name</i>, or NULL if it is not defined.</p> <p><code>LispWorksD1sym</code> is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see <code>deliver</code> and <code>save-image</code>. For an overview of LispWorks as a dynamic library, see Chapter 13, “LispWorks as a dynamic library”.</p>
See also	<code>InitLispWorks</code>

LispWorksState		<i>C function</i>
Summary	Returns the state of a LispWorks dynamic library.	
Signature	On Windows:	
	<code>int __stdcall LispWorksState (int MilliTimeOut)</code>	
	On Linux, Macintosh, FreeBSD and x86/x64 Solaris:	
	<code>int LispWorksState (int MilliTimeOut)</code>	
Description	<p>The C function <code>LispWorksState</code> returns the state of a LispWorks dynamic library.</p> <p><i>MilliTimeOut</i> specifies the time to wait in milliseconds if LispWorks is in the process of initialization.</p> <p>If LispWorks has not been initialized, or has been quit by <code>QuitLispWorks</code>, <code>LispWorksState</code> returns -100. Otherwise, it returns the same values as <code>InitLispWorks</code>. In particular, if</p>	

LispWorks is already properly initialized it returns 1, and if LispWorks is still in the process of initialization it returns -2 or -4. Otherwise it returns a more negative number indicating an error.

`LispWorksState` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 13, “LispWorks as a dynamic library”.

See also [InitLispWorks](#)
[QuitLispWorks](#)

SimpleInitLispWorks *C function*

Summary Initializes a LispWorks dynamic library.

Signature On Windows:

```
int __stdcall SimpleInitLispWorks (void)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
int SimpleInitLispWorks (void)
```

Description The C function `SimpleInitLispWorks` calls `InitLispWorks(0,0,0)` and returns the value of that call. `SimpleInitLispWorks` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 13, “LispWorks as a dynamic library”.

See also [InitLispWorks](#)

QuitLispWorks

C function

Summary Allows a LispWorks dynamic library to be unloaded.

Signature On Windows:

```
int __stdcall QuitLispWorks(int Force, int MilliTimeOut)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
int QuitLispWorks(int Force, int MilliTimeOut)
```

Description The C function `quitLispWorks` allows a LispWorks dynamic library to be unloaded. You should make a LispWorks dynamic library 'quit' by calling `quitLispWorks` before unloading the library. This call causes LispWorks to cleanup everything it uses, in particular the memory and threads.

In general, `quitLispWorks` should be called only when the LispWorks dynamic library is idle. That is, when there is no callback into the library that has not returned, and there are no processes that has started by a callback. All callbacks should return, and any processes should be killed before calling `quitLispWorks`.

Force should be 0 or 1. It specifies whether to force quitting even if LispWorks is still executing something.

MilliTimeOut specifies how long to wait for LispWorks to complete the cleanup.

If LispWorks is idle, `quitLispWorks` signals it to quit, and waits *MilliTimeOut* milliseconds for it to finish the cleanup. If LispWorks finished cleanup, `quitLispWorks` return 0 (SUCCESS). If the cleanup is not finished it returns -2 (TIMEOUT).

If LispWorks is not idle, that is there are still some active callbacks or there are processes that have started by a callback (even if they are inside `process-wait`), `quitLispWorks` checks the value of *Force*. If *Force* is 0, `quitLispWorks` returns -1 (NOT_IDLE). If *Force* is 1, `quitLispWorks` signals it to quit and behaves as if LispWorks is idle, described above.

`QuitLispWorks` can be called repeatedly to check if LispWorks finished the cleanup.

When `QuitLispWorks` returns NOT_IDLE, it has done nothing, and the LispWorks dynamic library can be used for further callbacks. Once `QuitLispWorks` returns any other value, callbacks into the dynamic library will result in undefined behavior.

Once `QuitLispWorks` returns SUCCESS, it is safe to unload the dynamic library. Unloading it before `QuitLispWorks` returns SUCCESS gives undefined results.

Once `QuitLispWorks` returns SUCCESS, LispWorks can be initialized again. Calling any exported function (supplied to `save-image` or `deliver` in `dll-exports`) or any of `InitLispWorks`, `SimpleInitLispWorks` and `LispWorksDlSym` will cause LispWorks to initialize again.

Note: On Linux, Macintosh, FreeBSD and x86/x64 Solaris it is possible to add calls to `QuitLispWorks` at the right places via *dll-added-files*.

Note: A possible reason for failure to finish the cleanup is that a LispWorks process is stuck inside a foreign call. Dynamic library applications that need to be unloaded should be careful to ensure that they do not get stuck in a foreign function call.

`QuitLispWorks` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 13, “LispWorks as a dynamic library”.

See also

`deliver`
`dll-quit`
`save-image`

Index

Symbols

`!` 139
`:<` debugger command 15
`$`(dollar) variable 26
`$$` variable 26
`$$$` variable 26
`(setf fill-pointer)` function 172
`:>` debugger command 15
`>`, SQL operator 244
`:?` listener command 7
`[...]` syntax in Common SQL 243

Numerics

`16-bit-string` type 670
`8-bit-string` type 669

A

`:a` debugger command 20
abort restart 11
`accessor-method-slot-definition`
generic function 150
accessors
 `dde-item` 1243
 `dde-item*` 1244
 `lob-stream-lob-locator` 956
 `socket-stream-socket` 368
`sql-database-data-error` 1016
`sql-error-database-message` 1016
`sql-error-secondary-error-id` 1016
`storage-exhausted-gen-num` 1195

`storage-exhausted-size` 1195
`storage-exhausted-static` 1195
`storage-exhausted-type` 1195
`stream-read-timeout` 368
`stream-write-timeout` 368
action lists 77
 defining 78
 examples 82
 undefining 78
`*active-finders*` variable 489
adding actions to action lists 80
`add-method` generic function 151
address space 319
`add-special-free-action` function 117, 531
`add-sql-stream` function 251, 911
`add-symbol-profiler` function 123, 532
`adjust-array` function 172
advice
 after 51
 around 51
 before 51
 example of use 56
 facility 49
 for macros 53
 for methods 53
 main chapter 49, 61
 removing 53
after advice 51
`:after` keyword 38
`:all` debugger command 18
`:all` keyword 196
`all`, SQL operator 244
`:allocation` keyword 42
allocation of stacks 117, 1090
`allocation-in-gen-num` macro 107, 111,

533
allowing-block-interrupts macro 164, 783
analysing-special-variables-usage macro 534
ANSI
 Common Lisp 152, 235
 SQL mode 222, 254
ANSI_QUOTES
 SQL mode 254
any, SQL operator 244
appendf macro 670
apply-in-pane-process function 174
apply-with-allocation-in-gen function 113
apply-with-allocation-in-gen-num function 1071
apropos function 387
apropos-list function 388
 argument list 715
 arguments
 command line 302
 lisp function 715
 around advice 51
array-dimension-limit constant 321
array-total-size-limit constant 321
array-weak-p function 537
 ASCII 295
at-location macro 490
atomic-decf macro 1072
atomic-exchange macro 1073
atomic-fixnum-decf macro 1074
atomic-fixnum-incf macro 1074
atomic-incf macro 1072
 atomicity and thread safety
 in CAPI 174
 in the editor 173
 in the LispWorks implementation 172
atomic-pop macro 1075
atomic-push macro 1075
attach-ssl function 277
attach-ssl function 283, 345
attribute-type function 238, 912
augmented-string type 290, 1076
augmented-string-p function 1076
avoid-gc function 112, 538

B

:b debugger command 14
 backtrace 13
 quick backtrace 14
 verbose backtrace 14

:backtrace keyword 39
barrier-arriver-count function 785
barrier-change-count function 785
barrier-count function 786
barrier-disable function 188, 787
barrier-enable function 188, 787
barrier-name function 788
barrier-pass-through function 788
barrier-unblock function 789
barrier-wait function 187, 790
 base slot 238
base-char type 289, 671
base-character type 670
base-character-p function 671
base-char-code-limit constant 672
base-char-p function 671
base-string type 290, 389
base-string-p function 672
:base-table class option 934
 before advice 51
:before keyword 37
binary-file-type variable 396
binary-file-types variable 393, 396
:bindings keyword 24
binds-who function 539
block-promotion macro 539
 BOM 297, 299
 Bordeaux threads
 APIs needed for 843
:bq debugger command 15
:break keyword 39
break-new-instances-on-access function 323
break-on-access function 324
:break-on-exit keyword 39
break-on-unresolved-functions function 663
 browser 673
browser-location variable 673
 browsing documentation 673
buffered-stream class 1037
:bug-form listener command 7
building-universal-intermediate-p function 541
 Byte Order Mark 297, 299

C

:c debugger command 20
 C functions
 dlopen 143
 dlsym 143
 GetProcAddress 143

InitLispWorks 146, 307, 1271
LispWorksDlsym 1274
LispWorksState 146, 1275
LoadLibrary 143
malloc 106
memalign 106
QuitLispWorks 147, 1277
realloc 106
SimpleInitLispWorks 1276
cache-table-queries function 234, 914
cache-table-queries-default
 variable 915
call Unix functions from Lisp 311
calling AppleScript 1078
call-next-advice function 52, 673
call-next-advice macro 59
calls-who function 541
call-system function 1077
call-system-showing-output
 function 1079
canonicalize-dspec function 491
catch frame, examining 12
:catchers keyword 24
:caused-by keyword 196
:cc debugger command 18
cd macro 542
cdr-assoc function 1081
change-directory function 139, 543
change-process-priority function 163,
 793
character type 289
character types 289
char-external-code function 523
check-fragmentation function 110, 112,
 543
check-network-server variable 1083
choose-unicode-string-hash-function
 function 675
class options
 parsing of 330
:base-table 934
:extra-initargs 325, 327, 404
:optimize-slot-access 150, 153, 337,
 403
classes
 buffered-stream 1037
 dde-system-topic 1261
 dde-topic 1261
 eql-specializer 151
 funcallable-standard-object 328
 fundamental-binary-input-
 stream 1039
fundamental-binary-output-
 stream 1040
fundamental-binary-stream 1040
fundamental-character-input-
 stream 1041
fundamental-character-output-
 stream 1042
fundamental-character-stream 1043
fundamental-input-stream 1043
fundamental-output-stream 1044
fundamental-stream 1044
lob-stream 259, 263, 268, 955
method-combination 151
socket-error 367
socket-stream 277, 283, 368
ssl-closed 288, 376
ssl-condition 288, 376
ssl-error 288, 377
ssl-failure 288, 377
ssl-x509-lookup 288, 378
standard-accessor-method 150
standard-db-object 238, 1025
standard-reader-method 150
standard-writer-method 150
storage-exhausted 1194
class-extra-initargs generic
 function 325
clean-down function 105, 116, 544
clean-generation-0 function 111, 546
close generic function 389
close-registry-key function 314, 1211
close-serial-port function 903
Cocoa application 811
Cocoa application bundle
 saving 131
Cocoa event loop 811
code signing
 in saved image 610
coerce function 390
coerce-to-gesture-spec function 1083
coff-loading-verbose 668
collect-generation-2 function 109, 111,
 547
collect-highest-generation
 function 111, 547
collect-registry-subkeys function 315,
 1212
collect-registry-values function 315,
 1213
command line 302
command line arguments 1142
 -build 302

-display 303
-env 303
-environment 303
-eval 303
-IIOPhost 303
-IIOPnumeric 303
-init 303
-load 304
-lw-no-redirection 304
-multiprocessing 304
-no-restart-function 304
-ORBport 304
--relocate-image 304
--reserve-size 305
-siteinit 305
command line processing 1142
commands
 listener 1092
 top level 1092
commit function 233, 235, 261, 915
Common Lisp
 systems. See system
Common SQL
 `[...]` syntax 243
 case of names 253
 database classes 223
 database connection 225
 database encoding 254
 date fields 249, 257
 encoding 226
 errors 251
 Functional DDL 237
 Functional DML 231
 functional interface 230
 I/O recording 251
 initialization 223
 iteration 242
 main chapter 219
 Object Oriented DDL 239
 Object Oriented DML 241
 object-oriented interface 238
 ODBC compliance 221
 programmatic interface 247
 result types 231, 232, 256
 supported databases 221
 symbolic syntax 243
 transaction handling 226, 234, 256
 utilities 249
Common SQL errors
 sql-connection-error 252
 sql-database-data-error 252
 sql-database-error 251
sql-fatal-error 252
sql-temporary-error 252
sql-timeout-error 252
sql-user-error 251
compare-and-swap macro 1085
compilation-speed 88
compile function 391
compile-file function 392
compile-file-if-needed function 549
compiler
 comparison with interpreter 85
 control 88
 levels of safety 89
 main chapter 85
 optimization of 88–92
 workings of 87
compiler explanations 94, 398
compiler help 94, 398
compiler-break-on-error
 variable 548
compile-system function 194, 675
compute-applicable-methods-using-classes generic function 151
compute-class-potential-initargs
 generic function 326
compute-discriminating-function
 generic function 151, 328
concatenate function 397
concatenate-system function 677
Condition variables 186
conditions
 external-format-error 526
 file-encoding-resolution-error 1102
 sql-connection-error 1015
 sql-database-data-error 1015
 sql-database-error 1016
 sql-fatal-error 1018
 sql-temporary-error 1024
 sql-timeout-error 1024
 sql-user-error 1024
condition-variable-broadcast
 function 187, 794
condition-variable-signal
 function 187, 794
condition-variable-wait function 187,
 795
condition-variable-wait-count
 function 187, 796
configuring the printer 140
connect function 221, 225, 226, 227, 253,
 916

connected-databases function 225, 923
connect-if-exists variable 923
 connecting to a database
 MySQL 227
 ODBC 226
 Oracle 225
 PostgreSQL 229
console 606
console application 606
constants
 array-dimension-limit 321
 array-total-size-limit 321
 base-char-code-limit 672
 most-positive-fixnum 320
continue restart 11
copy-preferences-from-older-version
 function 1086
copy-to-weak-simple-vector
 function 118, 550
count-gen-num-allocation function 115,
 1088
Counting semaphores 188
create-index function 238, 924
create-macos-application-bundle
 function 551
create-registry-key function 314, 315,
 1215
create-simple-process function 797
create-table function 238, 925
create-universal-binary function 553
create-view function 238, 926
create-view-from-class function 239,
 928
creation of process 162
:ctx-configure-callback initarg 368
current frame 15
current process 162
current-pathname function 679
current-process variable 162, 163, 799
current-process-block-interrupts
 function 164, 800
current-process-in-cleanup-p
 function 801
current-process-pause function 801
current-process-unblock-interrupts
 function 164, 803
current-stack-length function 555
customization
 main chapter 130
 of editor 136
:cv inspector command 27

D
:d inspector command 27
database
 classes in Common SQL 223
 connection in Common SQL 225
 encoding in Common SQL 254
 table names 253
database-name function 225, 928
databases
 supported 221
dates
 in Common SQL 249, 257
dde-advise-client-data generic
 function 212
dde-advise-start function 212, 1227
dde-advise-start* function 212, 1230
dde-advise-stop function 213, 1231
dde-advise-stop* function 213, 1232
dde-client-advise-data generic
 function 1234
dde-connect function 211
dde-connect macro 1234
dde-disconnect function 211
dde-disconnect macro 1235
dde-execute function 1236
dde-execute* function 1237
dde-execute-command* function 214
dde-execute-command function 214, 1237
dde-execute-command* function 1238
dde-execute-string function 214, 1240
dde-execute-string* function 214, 1241
dde-item accessor 1243
dde-item* accessor 1244
dde-item function 213
dde-poke function 213, 1246
dde-poke* function 1248
dde-request function 213, 1249
dde-request* function 1251
dde-server-poke generic function 215,
 1257
dde-server-request generic
 function 215, 1258
dde-server-topic generic function 1259
dde-server-topics generic function 216,
 1260
dde-system-topic class 1261
dde-topic class 1261
dde-topic-items generic function 1262
DDL 237, 239
debug 88
debugger
 commands 13

control variables 22
 invoking from the tracer 39
 main chapter 9
 debugger commands
 :
 :< 15
 :> 15
 :a 20
 :all 18
 :b 14
 :bq 15
 :c 20
 :cc 18
 :ed 18
 :error 18
 :func 19
 :l 17
 :lambda 18
 :lf 19
 :n 16
 :p 15
 :res 20
 :ret 20
 :top 20
 :v 16
 *debug-initialization-errors-in-
 snap-shot* variable 1088
 debug-io variable 22
 debug-other-process function 804
 debug-print-length variable 23, 467
 debug-print-level variable 23, 468
 declaim macro 93, 397
 declaration
 alias 398
 :explain 398
 invisible-frame 398
 lambda-list 398
 special-dynamic 98, 398
 special-fast-access 98, 398
 special-global 98, 398
 values 398
 declare :explain 94, 398
 declare special form 88, 92, 398
 decode-external-string function 524
 def macro 492
 defadvice macro 50, 54, 59, 681
 default directory 582
 default file directory 582
 default-action-list-sort-time
 variable 684, 81
 default-character-element-type
 parameter 684
 default-character-element-type
 variable 290, 292, 293, 294, 298
 default-database variable 223, 225,
 929
 default-database-type variable 224,
 929
 default-eol-style function 1089
 default-libraries variable 667
 default-package-use-list
 variable 555
 :default-pathname keyword 195
 default-process-priority
 variable 805
 default-profiler-collapse
 variable 556
 default-profiler-cutoff
 variable 556
 default-profiler-limit variable 557
 default-profiler-sort variable 557
 default-simple-process-priority
 variable 805
 default-stack-group-list-length
 variable 117, 1090
 default-update-objects-max-len
 variable 930
 defclass macro 403
 defglobal-parameter macro 558
 defglobal-variable macro 558
 define-action macro 80, 685
 define-action-list macro 78, 687
 define-atomic-modify-macro
 macro 1090
 define-dde-client function 212
 define-dde-client macro 1253
 define-dde-dispatch-topic macro 216,
 1263
 define-dde-server macro 214, 1264
 define-dde-server-function
 macro 215, 1265
 define-dspec-alias macro 493
 define-dspec-class macro 494
 define-foreign-callable macro 191
 define-form-parser macro 73, 497
 define-top-loop-command macro 1092
 definition specs 45
 defpackage macro 407
 defparameter macro 558
 defparser
 error handling with 204
 defparser macro 201, 899
 functions defined by 203
 defstruct macro 140
 *defstruct-generates-print-object-

method* variable 140
defsystem macro 195, 195–199, 689
 examples of use 197
defsystem-verbose variable 694
deftransform macro 463
defvar macro 559
def-view-class macro 220, 238, 239, 930
delete-advice macro 53, 59, 559
delete-directory function 694
delete-instance-records generic
 function 241, 937, 950
delete-records function 233, 234, 938
delete-registry-key function 314, 1216
delete-sql-stream function 251, 939
deliver function 143, 302, 307, 695
deliverable
 filename 302, 725
 pathname 302, 725
delivering a DLL 143
delivering a dynamic library 143
describe function 25, 409
describe-length variable 696, 27
describe-level variable 696
describe-level special variable 26
describe-object generic function 26
describe-print-length variable 698,
 26
describe-print-level variable 698, 26
destroy-ssl function 286, 347
destroy-ssl-ctx function 286, 347
detach-ssl function 285, 348
detect-eol-style function 1094
detect-japanese-encoding-in-file
 function 1095
detect-unicode-bom function 1096
diagnostic utilities
 for action lists 81
:direction initarg 368, 956, 1037
directory function 409
directory-link-transparency special
 variable 410
directory-link-transparency
 variable 1097
disable-sql-reader-syntax
 function 249, 940
disable-trace variable 560
disassemble function 414
discard-source-info function 507
disconnect function 225, 940
dismiss-splash-screen function 1203
DLL 143
 filename 302, 725

 pathname 302, 725
dll-quit function 147, 699
dlopen C function 143
dlsym C function 143
:dm inspector command 27
DML 231, 241
DNS 350
documentation generic function 415
\$(\$) variable 26
\$\$ variable 26
\$\$\$ variable 26
domain 350
do-nothing function 702
:dont-know keyword 17
do-profiling function 123, 561
do-query macro 235, 260, 941
do-rand-seed function 349
DOS command
 call-system 1077
 call-system-showing-output 1079
 open-pipe 1158
dotted-list-length function 701
dotted-list-p function 702
double-float type 416
:dr inspector command 27
drop-index function 238, 942
drop-table function 238, 943
drop-view function 238, 944
drop-view-from-class function 239, 944
dspec-class function 501
dspec-classes variable 501
dspec-defined-p function 502
dspec-definition-locations
 function 502
dspec-equal function 503
dspec-name function 504
dspec-primary-name function 504
dspec-progenitor function 505
dspecs
 aggregate 68
 canonical 62
 displaying definitions 73
 examples 61
 finding definitions 72
 grouping definitions 67
 new defining forms 66
 parts 68
 recording definitions 71
dspec-subclass-p function 506
dspec-undefiner function 506
dump-form function 563
dump-forms-to-file function 564

dylib 143
 dynamic libraries 143, 306
 dynamic library 143
 memory clash 146
 relocation 146

E

:ed debugger command 18
 editor
 customizing 136
 editor source code 138
 ef-spec 295
 :ef-spec initarg 1102
 :element-type initarg 368, 1038
 Emacs 3
 enable-sql-reader-syntax function 231,
 249, 945
 encode-lisp-string function 525
 encoding
 changing default for files 298
 enlarge-generation function 110, 112,
 565
 enlarge-static function 566
 ensure-loads-after-loads
 function 1097
 ensure-memory-after-store
 function 1098
 ensure-process-cleanup function 805
 ensure-ssl function 286
 ensure-ssl function 349
 ensure-stores-after-memory
 function 1099
 ensure-stores-after-stores
 function 1099
 enter-debugger-directly
 variable 703
 :entrycond keyword 40
 enum-registry-value function 315, 1217
 environment-variable function 703
 eql-specializer class 151
 eql-specializer-object function 151
 errno-value function 705
 :error debugger command 18
 error handlers
 in applications 474
 error handling
 in parser generator 204
 error output 1152
 errors in Common SQL 251
 EUC-JP 295
 :eval-after keyword 38
 :eval-before keyword 38

evaluating
 forms during tracing 37-39
 example-compile-file function 706
 example-file function 705
 example-load-binary-file function 707
 except, SQL operator 244
 exception handlers
 in applications 474
 exception handling
 for action lists 80
 exceptions
 handling 474
 executable 302
 filename 302, 725
 pathname 302, 725
 executable-log-file function 469
 execute-actions macro 707
 execute-command function 237, 946
 execute-with-interface function 174
 execution functions 77
 execution profiling 121
 execution stack
 examining 12
 :exitcond keyword 40
 expand-generation-1 function 111, 567
 extend-current-stack function 568
 extended-char type 709
 extended-character type 709
 extended-character-p function 710
 extended-char-p function 710
 extended-spaces variable 777, 1100
 extended-time function 569
 extended-time macro 115, 116, 127
 external format
 changing default for files 298
 external format specification 295
 External formats 295
 external programs
 calling from Lisp 311
 external-format-error condition 526
 external-format-foreign-type
 function 526
 external-formats variable 711
 external-format-type function 527
 :extra-initargs class option 325, 327,
 404

F

false function 712
 fasl (fast load)
 description 85
 FDDL 237

FDML 241
features variable 416
file-directory-p function 712
file-encoding-detection-algorithm
 variable 298, 1101
file-encoding-resolution-error
 condition 1102
***file-eol-style-detection-algo-**
 rithm* variable 298, 1102
filename of deliverable 302, 725
filename of DLL 302, 725
filename of dynamic library 725
filename of executable 302, 725
filename of lisp image 302, 725
filename-pattern-encoding-matches
 variable 1103
files
 load-on-demand 139
file-stat-blocks function 1114
file-stat-device function 1113
file-stat-device-type function 1114
file-stat-group-id function 1113
file-stat-inode function 1113
file-stat-last-access function 1114
file-stat-last-change function 1114
file-stat-last-modify function 1114
file-stat-links function 1114
file-stat-mode function 1114
file-stat-owner-id function 1113
file-stat-size function 1114
file-string function 571
file-writable-p function 572
find-database function 225, 946
find-dspec-locations function 507
find-encoding-option function 1103
find-external-char function 527
find-filename-pattern-encoding-
 match function 1104
find-name-locations function 508
find-object-size function 111, 572
find-process-from-name function 806
find-regexp-in-string function 713
finish-heavy-allocation function 573
fixnum type 319
fixnum-safety 88
flag-not-special-free-action
 function 117, 574
flag-special-free-action function 117,
 575
FLI types
 lpcstr 1207
 lpctstr 1208
 lpcwstr 1209
 lpstr 1207
 lptstr 1208
 lpwstr 1209
 p-oci-env 1002
 p-oci-file 1002
 p-oci-lob-locator 1002
 p-oci-lob-or-file 1002
 p-oci-svc-ctx 1003
 ssl-cipher-pointer 375
 ssl-cipher-pointer-stack 375
 ssl-ctx-pointer 376
 ssl-pointer 378
 str 1207
 tstr 1208
 wstr 1209
float 88
float calculations, optimizing 96
foreign callbacks 191
foreign types
 p-oci-env 264, 972
 p-oci-file 264, 990
 p-oci-lob-locator 264, 990
 p-oci-svc-ctx 264, 996
 ssl-cipher-pointer 279
 ssl-ctx-pointer 279
 ssl-pointer 279
foreign-slot-value function 100
foreign-symbol-address function 664
forms
 evaluating when tracing 37-39
frame, examining 12
:free-lob-locator-on-close initarg 956
:func debugger command 19
funcallable-standard-class class 151
funcallable-standard-instance-
 access function 150
funcallable-standard-object class 152,
 328
function, altering with advice 49
Functional DDL 237
Functional DML 231
functional interface in Common SQL 230
function-lambda-list function 715
functions
 add-special-free-action 117, 531
 add-sql-stream 251, 911
 add-symbol-profiler 123, 532
 apply-with-allocation-in-gen 113
 apply-with-allocation-in-gen-
 num 1071
 apropos 387

apropos-list 388
 arguments for traced 37
 array-weak-p 537
 attach-ssl 277, 283, 345
 attribute-type 238, 912
 augmented-string-p 1076
 avoid-gc 112, 538
 barrier-arriver-count 785
 barrier-change-count 785
 barrier-count 786
 barrier-disable 188, 787
 barrier-enable 188, 787
 barrier-name 788
 barrier-pass-through 788
 barrier-unblock 789
 barrier-wait 187, 790
 base-character-p 671
 base-char-p 671
 base-string-p 672
 binds-who 539
 break-new-instances-on-access 323
 break-on-access 324
 break-on-unresolved 663
 building-universal-intermediate-p 541
 cache-table-queries 234, 914
 call-next-advice 52, 673
 calls-who 541
 call-system 1077
 call-system-showing-output 1079
 canonicalize-dspec 491
 cdr-assoc 1081
 change-directory 139, 543
 change-process-priority 163, 793
 char-external-code 523
 check-fragmentation 110, 112, 543
 choose-unicode-string-hash-function 675
 clean-down 105, 116, 544
 clean-generation-0 111, 546
 close-registry-key 314, 1211
 close-serial-port 903
 coerce 390
 coerce-to-gesture-spec 1083
 collect-generation-2 109, 111, 547
 collect-highest-generation 111, 547
 collect-registry-subkeys 315, 1212
 collect-registry-values 315, 1213
 commit 233, 235, 261, 915
 compile 391
 compile-file 392
 compile-file-if-needed 549
 compile-system 194, 675
 concatenate 397
 concatenate-system 677
 condition-variable-broadcast 187, 794
 condition-variable-signal 187, 794
 condition-variable-wait 187, 795
 condition-variable-wait-count 187, 796
 connect 225, 226, 227, 253, 916
 connected-databases 225, 923
 copy-preferences-from-older-version 1086
 copy-to-weak-simple-vector 118, 550
 count-gen-num-allocation 115, 1088
 create-index 238, 924
 create-macos-application-bundle 551
 create-registry-key 314, 315, 1215
 create-simple-process 797
 create-table 238, 925
 create-universal-binary 553
 create-view 238, 926
 create-view-from-class 239, 928
 current-pathname 679
 current-process-block-interrupts 164, 800
 current-process-in-cleanup-p 801
 current-process-pause 801
 current-process-unblock-interrupts 164, 803
 current-stack-length 555
 database-name 225, 928
 dde-advise-start 1227
 dde-advise-start* 1230
 dde-advise-stop 1231
 dde-advise-stop* 1232
 dde-execute 1236
 dde-execute* 1237
 dde-execute-command 1237
 dde-execute-command* 1238
 dde-execute-string 1240
 dde-execute-string* 1241
 dde-poke 1246
 dde-poke* 1248
 dde-request 1249
 dde-request* 1251
 debug-other-process 804
 decode-external-string 524
 default-eol-style 1089
 delete-directory 694
 delete-records 233, 234, 938

delete-registry-key 314, 1216
 delete-sql-stream 251, 939
 deliver 143, 302, 307, 695
 describe 25, 409
 destroy-ssl 286, 347
 destroy-ssl-ctx 286, 347
 detach-ssl 285, 348
 detect-eol-style 1094
 detect-japanese-encoding-in-file 1095
 detect-unicode-bom 1096
 directory 409
 disable-sql-reader-syntax 249, 940
 disassemble 414
 discard-source-info 507
 disconnect 225, 940
 dismiss-splash-screen 1203
 dll-quit 147, 699
 do-nothing 702
 do-profiling 123, 561
 do-rand-seed 349
 dotted-list-length 701
 dotted-list-p 702
 drop-index 238, 942
 drop-table 238, 943
 drop-view 238, 944
 drop-view-from-class 239, 944
 dspec-class 501
 dspec-defined-p 502
 dspec-definition-locations 502
 dspec-equal 503
 dspec-name 504
 dspec-primary-name 504
 dspec-progenitor 505
 dspec-subclass-p 506
 dspec-undefiner 506
 dump-form 563
 dump-forms-to-file 564
 enable-sql-reader-syntax 231, 249, 945
 encode-lisp-string 525
 enlarge-generation 110, 112, 565
 enlarge-static 566
 ensure-loads-after-loads 1097
 ensure-memory-after-store 1098
 ensure-process-cleanup 805
 ensure-ssl 286, 349
 ensure-stores-after-memory 1099
 ensure-stores-after-stores 1099
 enum-registry-value 315, 1217
 environment-variable 703
 eql-specializer-object 151
 errno-value 705
 example-compile-file 706
 example-file 705
 example-load-binary-file 707
 executable-log-file 469
 execute-command 237, 946
 expand-generation-1 111, 567
 extend-current-stack 568
 extended-character-p 710
 extended-char-p 710
 extended-time 569
 external-format-foreign-type 526
 external-format-type 527
 false 712
 file-directory-p 712
 file-stat-blocks 1114
 file-stat-device 1113
 file-stat-device-type 1114
 file-stat-group-id 1113
 file-stat-inode 1113
 file-stat-last-access 1114
 file-stat-last-change 1114
 file-stat-last-modify 1114
 file-stat-links 1114
 file-stat-mode 1114
 file-stat-owner-id 1113
 file-stat-size 1114
 file-string 571
 file-writable-p 572
 find-database 225, 946
 find-dspec-locations 507
 find-encoding-option 1103
 find-external-char 527
 find-filename-pattern-encoding-match 1104
 find-name-locations 508
 find-object-size 111, 572
 find-process-from-name 806
 find-regexp-in-string 713
 finish-heavy-allocation 573
 flag-not-special-free-action 117, 574
 flag-special-free-action 117, 575
 foreign-slot-value 100
 foreign-symbol-address 664
 funcallable-standard-instance-access 150
 function-lambda-list 715
 gc-generation 112, 115, 116, 575
 gc-if-needed 112, 579
 generation-number 110, 1106
 gen-num-segments-fragmentation-

state 115, 1105
 gensym 116
 gesture-spec-data 1108
 gesture-spec-modifiers 1109
 gesture-spec-p 1110
 gesture-spec-to-character 1112
 get-current-process 162, 808
 get-default-generation 111, 579
 get-file-stat 1112
 get-folder-path 316, 1114
 get-foreign-symbol 665
 get-form-parser 509
 get-gc-parameters 112, 580
 get-host-entry 350
 get-process 163, 808
 get-process-private-property 809
 get-serial-port-state 903
 get-socket-address 352
 get-socket-peer-address 352
 get-temp-directory 581
 get-unix-error 718
 get-user-profile-directory 317,
 1116
 get-verification-mode 353
 get-working-directory 582
 guess-external-format 297, 1117
 hardcopy-system 723
 initialize-database-type 223, 947
 initialize-multiprocessing 168, 810
 insert-records 233, 260, 949
 inspect 26
 int32* 1120
 int32+ 95, 1121
 int32- 95, 1122
 int32/ 1124
 int32/= 1125
 int32< 1125
 int32<< 1126
 int32<= 1127
 int32= 1127
 int32> 1128
 int32>= 1129
 int32>> 1129
 int32-1+ 1123
 int32-1- 1124
 int32-aref 1130
 int32-logand 1131
 int32-logandc1 1131
 int32-logandc2 1132
 int32-logbitp 1133
 int32-logeqv 1133
 int32-logior 1134
 int32-logrand 1135
 int32-lognor 1135
 int32-lognot 1136
 int32-logorc1 1137
 int32-logorc2 1137
 int32-logtest 1138
 int32-logxor 1139
 int32-minusp 1139
 int32-plusp 1140
 int32-to-integer 1140
 int32-zerop 1141
 integer-to-int32 1142
 interactive-stream-p 420
 intern-eql-specializer 151
 ip-address-string 354
 last-callback-on-thread 812
 lisp-image-name 302, 725
 lisp-name-to-foreign-name 666
 list-all-processes 163, 813
 list-attributes 238, 952
 list-attribute-types 238, 951
 list-classes 241, 953
 list-sql-streams 251, 954
 list-tables 238, 955
 load-all-patches 727
 load-data-file 1143
 load-logical-pathname-
 translations 421
 load-system 728
 lob-stream-lob-locator 263
 local-dspec-p 510
 locale-file-encoding 1144
 locally-disable-sql-reader-
 syntax 249, 957
 locally-enable-sql-reader-
 syntax 249, 957
 lock-locked-p 814
 lock-name 180, 816
 lock-owned-by-current-process-
 p 815
 lock-owner 180, 817
 lock-recursively-locked-p 816
 lock-recursive-p 815
 log-bug-form 471
 logs-directory 473
 long-namestring 302, 1205, 1207
 long-site-name 301, 422
 low-level-atomic-place-p 1145
 mailbox-empty-p 818
 mailbox-peek 819
 mailbox-read 820
 mailbox-reader-process 821

mailbox-send 821
 mailbox-wait-for-event 822
 make-array 118, 174, 424
 make-barrier 188, 824
 make-condition-variable 825
 make-gesture-spec 1146
 make-hash-table 118, 174, 425
 make-lock 826
 make-mailbox 828
 make-mt-random-state 731
 make-named-timer 829
 make-semaphore 188, 830
 make-sequence 429
 make-simple-int32-vector 1151
 make-ssl-ctx 283, 284, 354
 make-stderr-stream 1152
 make-symbol 116
 make-timer 189, 831
 make-typed-aref-vector 1152
 make-unregistered-action-list 730
 map 429
 map-all-processes 832
 map-all-processes-backtrace 832
 map-process-backtrace 833
 map-processes 834
 map-query 235, 260, 960
 mark-and-sweep 105, 112, 586
 marking-gc 115, 116, 1153
 memory-growth-margin 111, 1155
 merge 430
 merge-ef-specs 1155
 modify-hash 589
 mt-random 732
 mt-random-state-p 734
 name-defined-dspecs 511
 name-definition-locations 512
 name-only-form-parser 513
 normal-gc 112, 590
 notice-fd 835
 object-address 1156
 open 431
 open-pipe 1157
 open-registry-key 314, 1219
 open-serial-port 901
 openssl-version 358
 open-tcp-stream 277, 283, 355
 open-url 1160
 ora-lob-append 267, 963
 ora-lob-assign 266, 964
 ora-lob-char-set-form 265, 964
 ora-lob-char-set-id 965
 ora-lob-close 267, 966
 ora-lob-copy 267, 967
 ora-lob-create-empty 260, 266, 968
 ora-lob-create-temporary 268, 969
 ora-lob-disable-buffering 268, 970
 ora-lob-element-type 265, 971
 ora-lob-enable-buffering 268, 971
 ora-lob-env-handle 263, 972
 ora-lob-erase 267, 973
 ora-lob-file-close 267, 974
 ora-lob-file-close-all 267, 975
 ora-lob-file-exists 975
 ora-lob-file-get-name 976
 ora-lob-file-is-open 977
 ora-lob-file-open 267, 978
 ora-lob-file-set-name 267, 978
 ora-lob-flush-buffer 268, 979
 ora-lob-free 266, 980
 ora-lob-free-temporary 268, 981
 ora-lob-get-buffer 263, 268, 982
 ora-lob-get-chunk-size 266, 984
 ora-lob-get-length 266, 985
 ora-lob-internal-lob-p 265, 266, 985
 ora-lob-is-equal 266, 986
 ora-lob-is-open 266, 987
 ora-lob-is-temporary 266, 268, 987
 ora-lob-load-from-file 267, 988
 ora-lob-lob-locator 263, 989
 ora-lob-locator-is-init 266, 990
 ora-lob-open 267, 991
 ora-lob-read-buffer 265, 268, 992
 ora-lob-read-foreign-buffer 263,
 265, 268, 995
 ora-lob-read-into-plain-file 268,
 994
 ora-lob-svc-ctx-handle 263, 996
 ora-lob-trim 267, 997
 ora-lob-write-buffer 265, 268, 998,
 1000
 ora-lob-write-foreign-buffer 263,
 265, 268
 ora-lob-write-from-plain-file 268,
 999
 output-backtrace 474
 parse-float 591
 parse-form-dspec 514
 pathname-location 734
 pem-read 278, 359
 pid-exit-status 1161
 pointer-from-address 1162
 precompile-regexp 735
 print-action-lists 736
 print-actions 82, 736

print-pretty-gesture-spec 1163
print-profile-list 126, 592
print-query 232, 1003
process-alive-p 835
process-all-events 836
process-allow-scheduling 162, 836
process-arrest-reasons 837
process-break 164, 838
process-continue 838
process-exclusive-lock 838
process-exclusive-unlock 839
process-idle-time 840
process-interrupt 164, 165, 842
process-join 843
process-kill 164, 843
process-lock 180, 844
process-mailbox 845
process-name 163, 846
process-p 846
process-plist 190, 846
process-poke 847
process-priority 163, 848
process-private-property 848
process-property 190, 849
process-reset 850
process-run-function 162, 851
process-run-reasons 853
process-run-time 854
process-send 855
process-sharing-lock 856
process-sharing-unlock 857
process-stop 170, 857
process-stopped 170
process-stopped-p 858
process-unlock 859
process-unstop 170, 860
process-wait 164, 186, 861
process-wait-for-event 862
process-wait-function 164, 862
process-wait-local 164, 863
process-wait-local-with-periodic-checks 865
process-wait-local-with-timeout 867
process-wait-local-with-timeout-and-periodic-checks 868
process-wait-with-timeout 164, 183, 186, 869
process-whostate 870
proclaim 88, 93, 434
product-registry-path 314, 1165
profiler-tree-from-function 598
profiler-tree-to-function 599
ps 163, 872
pushnew-to-process-private-property 190, 871
pushnew-to-process-property 190, 871
query 237, 259, 1004
query-registry-key-info 315, 1220
query-registry-value 315, 1221
quit 4, 312, 739
read-dhparams 360
read-dhparms 278
read-foreign-modules 667
read-serial-port-char 904
read-serial-port-string 905
reconnect 225, 1005
record-definition 514
references-who 600
regexp-find-symbols 741
registry-key-exists-p 315, 1222
registry-value 315, 1223
remove-advice 53, 59, 742
remove-from-process-private-property 190, 873
remove-from-process-property 190, 873
remove-process-private-property 190, 874
remove-process-property 190, 875
remove-special-free-action 117, 601
remove-symbol-profiler 123, 601
reset-profiler 123, 602
restore-sql-reader-syntax-state 249, 1007
results for traced 38
rollback 233, 235, 261, 1007
room 111, 112, 115, 306, 436
room-values 306, 1166
round-to-single-precision 745
run-shell-command 1167
safe-locale-file-encoding 1172
save-argument-real-p 603
save-current-session 604
save-image 131, 143, 302, 307, 312, 605
save-image-with-bundle 613
save-tags-database 517
save-universal-from-script 313, 615
sbchar 746
schedule-timer 189, 876
schedule-timer-milliseconds 878
schedule-timer-relative 879
schedule-timer-relative-

milliseconds 881
 select 231, 241, 1008
 semaphore-acquire 188, 882
 semaphore-count 188, 883
 semaphore-name 188, 884
 semaphore-release 188, 884
 semaphore-wait-count 188, 885
 serial-port 904
 serial-port-input-available-p 906
 set-application-themed 1206
 set-array-single-thread-p 616
 set-array-weak 118, 617
 set-automatic-gc-callback 115, 1173
 set-blocking-gen-num 116, 1174
 set-debugger-options 24
 set-default-character-element-type 746
 set-default-generation 107, 111, 618
 set-default-segment-size 116, 1177
 set-delay-promotion 116, 1178
 setf cdr-assoc 1081
 setf timer-name 886
 set-file-dates 1179
 set-gc-parameters 105, 108, 112, 619
 set-gen-num-gc-threshold 116, 1180
 set-hash-table-weak 118, 621
 set-make-instance-argument-checking 334
 set-maximum-memory 111, 1181
 set-maximum-segment-size 114, 116, 1183
 set-memory-check 1184
 set-memory-exhausted-callback 1185
 set-minimum-free-space 108, 111, 623
 set-process-profiling 123, 124, 624
 set-profiler-threshold 123, 626
 set-promotion-count 627
 set-registry-value 315, 1224
 set-serial-port-state 907
 set-signal-handler 1187
 set-spare-keeping-policy 116, 1189
 set-ssl-ctx-dh 278, 364
 set-ssl-ctx-options 278, 365
 set-ssl-ctx-password-callback 278, 366
 set-ssl-library-path 288, 367
 sets-who 633
 set-system-message-log 628
 setup-atomic-funcall 1190
 setup-for-alien-threads 191
 set-up-profiler 122, 629
 set-verification-mode 362
 short-namestring 302
 short-site-name 301, 441
 simple-augmented-string-p 1192
 simple-base-string-p 747
 simple-char-p 748
 simple-process-p 886
 simple-text-string-p 749
 single-form-form-parser 517
 single-form-with-options-form-parser 518
 socket-stream-address 373
 socket-stream-ctx 278, 373
 socket-stream-peer-address 374
 socket-stream-ssl 278, 374
 software-type 301, 442
 software-version 301, 443
 source-debugging-on-p 633
 split-sequence 750
 split-sequence-if 751
 split-sequence-if-not 752
 sql 248, 1014
 sql-expression 248, 1017
 sql-operation 247, 1019
 sql-operator 248, 1021
 sql-recording-p 251, 1022
 sql-stream 251, 1023
 ssl-add-client-ca 279
 ssl-cipher-get-bits 279
 ssl-cipher-get-name 280
 ssl-cipher-get-version 280
 ssl-clear-num-renegotiations 280
 ssl-ctrl 280
 ssl-ctx-add-client-ca 280
 ssl-ctx-add-extra-chain-cert 280
 ssl-ctx-ctrl 280
 ssl-ctx-get-max-cert-list 280
 ssl-ctx-get-mode 280
 ssl-ctx-get-options 280
 ssl-ctx-get-read-ahead 280
 ssl-ctx-get-verify-mode 280
 ssl-ctx-load-verify-locations 280
 ssl-ctx-need-tmp-rsa 280
 ssl-ctx-sess-get-cache-mode 280
 ssl-ctx-sess-get-cache-size 280
 ssl-ctx-sess-set-cache-mode 280
 ssl-ctx-sess-set-cache-size 280
 ssl-ctx-set-client-ca-list 280
 ssl-ctx-set-max-cert-list 280
 ssl-ctx-set-mode 280
 ssl-ctx-set-options 280
 ssl-ctx-set-read-ahead 281
 ssl-ctx-set-tmp-dh 281

ssl-ctx-set-tmp-rsa 281
 ssl-ctx-use-certificate-chain-file 281
 ssl-ctx-use-certificate-file 281
 ssl-ctx-use-privatekey-file 281
 ssl-ctx-use-rsaprivatekey-file 281
 ssl-get-current-cipher 281
 ssl-get-max-cert-list 281
 ssl-get-mode 281
 ssl-get-options 281
 ssl-get-verify-mode 281
 ssl-get-version 281
 ssl-load-client-ca-file 281
 ssl-need-tmp-rsa 281
 ssl-new 286, 377
 ssl-num-renegotiations 281
 ssl-session-reused 281
 ssl-set-accept-state 281, 284
 ssl-set-client-ca-list 281
 ssl-set-connect-state 281, 284
 ssl-set-max-cert-list 281
 ssl-set-mode 281
 ssl-set-options 282
 ssl-set-tmp-dh 282
 ssl-set-tmp-rsa 282
 ssl-total-renegotiations 282
 ssl-use-certificate-file 282
 ssl-use-privatekey-file 282
 ssl-use-rsaprivatekey-file 282
 standard-instance-access 150
 start-dde-server 1269
 start-profiling 123, 124, 634
 start-sql-recording 251, 1025
 start-tty-listener 753
 start-up-server 379
 start-up-server-and-mp 383
 staticcp 1194
 status 225, 1026
 stchar 753
 stop-profiling 123, 124, 636
 stop-sql-recording 251, 1027
 string-append 754
 string-ip-address 384
 sweep-all-objects 117, 637
 sweep-gen-num-objects 1195
 switch-static-allocation 105, 106,
 638
 symeval-in-process 170, 886
 table-exists-p 1028
 text-string-p 756
 timer-expired-p 887
 timer-name 888
 toggle-source-debugging 101, 639
 total-allocation 111, 640
 traceable-dspec-p 519
 trace-new-instances-on-access 337
 trace-on-access 338
 tracing inside 43
 tracing-enabled-p 520
 tracing-state 521
 true 756
 truename 458
 try-compact-in-generation 110, 112,
 650
 try-move-in-generation 110, 112, 651
 typed-aref 1196
 unbreak-new-instances-on-access 341
 unbreak-on-access 342
 unicode-alpha-char-p 300, 758
 unicode-alphanumericp 300, 759
 unicode-both-case-p 300, 759
 unicode-char-equal 300, 760
 unicode-char-greaterp 300, 761
 unicode-char-lessp 300, 762
 unicode-char-not-equal 300, 763
 unicode-char-not-greaterp 300, 763
 unicode-char-not-lessp 300, 764
 unicode-lower-case-p 300, 765
 unicode-string-equal 300, 766
 unicode-string-greaterp 300, 767
 unicode-string-lessp 300, 768
 unicode-string-not-equal 300, 769
 unicode-string-not-greaterp 300,
 770
 unicode-string-not-lessp 300, 771
 unicode-upper-case-p 300, 772
 unnotice-fd 890
 unschedule-timer 890
 untrace-new-instances-on-access 342
 untrace-on-access 343
 update-instance-for-different-class 460
 update-instance-for-redefined-class 460
 update-objects-joins 1029
 update-records 233, 234, 260, 1031
 user-homedir-pathname 315
 user-preference 314, 773
 valid-external-format-p 528
 vector-pop 174
 vector-push 174
 vector-push-extend 174

```

wait-for-input-streams 1197
wait-for-input-streams-returning-
    first 1199
wait-processing-events 891
wait-serial-port-state 907
whitespace-char-p 777
who-binds 655
who-calls 656
who-references 657
who-sets 657
without-preemption 165
with-output-to-fasl-file 659
write-serial-port-char 908
write-serial-port-string 909
yield 897
fundamental-binary-input-stream
    class 1039
fundamental-binary-output-stream
    class 1040
fundamental-binary-stream class 1040
fundamental-character-input-stream
    class 270, 1041
fundamental-character-output-stream
    class 270, 1042
fundamental-input-stream class 1043
fundamental-output-stream class 1044
fundamental-stream class 1044

G
garbage collection, see also storage man-
    agement
    main chapter 103
GBK 296
gc-generation function 112, 115, 116, 575
gc-if-needed function 112, 579
general-handle-event generic
    function 807
generation
    definition 104
generation 2 109
generation-number function 110, 1106
generic functions
    accessor-method-slot-
        definition 150
    add-method 151
    class-extra-initargs 325
    close 389
    compute-applicable-methods-using-
        classes 151
    compute-class-potential-
        initargs 326
    compute-discriminating-
        function 151, 328
dde-client-advise-data 1234
dde-server-poke 1257
dde-server-request 1258
dde-server-topic 1259
dde-server-topics 1260
dde-topic-items 1262
delete-instance-records 241, 937,
    950
describe-object 26
documentation 415
general-handle-event 807
get-inspector-values 716
input-stream-p 419
instance-refreshed 241
make-instance 428
make-method-lambda 150
open-stream-p 433
output-stream-p 433
print-object 140
process-a-class-option 329
process-a-slot-option 331
slot-boundp-using-class 150, 335
slot-makunbound-using-class 150,
    336
slot-value-using-class 150, 336
stream-advance-to-column 1045
stream-check-eof-no-hang 1046
stream-clear-input 272, 1046
stream-clear-output 273, 1047
stream-element-type 270, 447
stream-file-position 1048
stream-fill-buffer 1048
stream-finish-output 273, 1049
stream-flush-buffer 1050
stream-force-output 273, 1051
stream-fresh-line 1051
stream-line-column 273, 1052
stream-listen 272, 1053
stream-output-width 1054
stream-peek-char 1054
stream-read-buffer 1055
stream-read-byte 1056
stream-read-char 271, 1057
stream-read-char-no-hang 1057
stream-read-line 1058
stream-read-sequence 1059
stream-read-timeout 1060
stream-start-line-p 273, 1060
stream-terpri 1061
stream-unread-char 271, 1062
stream-write-buffer 1062

```

```

stream-write-byte 1063
stream-write-char 272, 1064
stream-write-sequence 1064
stream-write-string 1065
update-instance-from-records 241,
    1028
update-record-from-instance 1032
update-record-from-slot 241, 1032
update-records-from-instance 241
update-slot-from-record 241, 1033
:gen-num-initarg 1195
gen-num-segments-fragmentation-
    state function 115, 1105
gensym function 116
gesture-spec-accelerator-bit
    variable 1107
gesture-spec-control-bit
    variable 1107
gesture-spec-data function 1108
gesture-spec-hyper-bit variable 1108
gesture-spec-meta-bit variable 1109
gesture-spec-modifiers function 1109
gesture-spec-p function 1110
gesture-spec-shift-bit variable 1111
gesture-spec-super-bit variable 1111
gesture-spec-to-character
    function 1112
:get listener command 6
get-current-process function 162, 808
get-default-generation function 111,
    579
get-file-stat function 1112
get-folder-path function 316, 1114
get-foreign-symbol function 665
get-form-parser function 509
get-gc-parameters function 112, 580
get-host-entry function 350
get-inspector-values generic
    function 716
GetProcAddress C function 143
get-process function 163, 808
get-process-private-propertye
    function 809
get-serial-port-state function 903
get-socket-address function 352
get-socket-peer-address function 352
get-temp-directory function 581
get-unix-error function 718
get-user-profile-directory
    function 317, 1116
get-verification-mode function 353
get-working-directory function 582

grammar
    non-terminal 202
    resolving ambiguities 203
graphics ports xxxvii
>, SQL operator 244
*grep-command* variable 718
*grep-command-format* variable 719
*grep-fixed-args* variable 720
guess-external-format function 297,
    1117
GUI application 606

H
:h inspector command 27
*handle-existing-action-in-action-
    list* variable 720, 80
*handle-existing-action-list*
    variable 721, 80
*handle-existing-defpackage*
    variable 582
*handle-missing-action-in-action-
    list* variable 722
*handle-missing-action-in-action-
    list* variable 81
*handle-missing-action-list*
    variable 721, 81
*handle-old-in-package* variable 584
*handle-old-in-package-used-as-
    make-package* variable 584
handler frame, examining 12
:handler keyword 24
*handle-warn-on-redefinition*
    variable 138, 722
hardcopy-system function 723
hash tables
    weak 425
heap size 319
:help listener command 7
:hidden keyword 24
*hidden-packages* variable 23, 470
:his listener command 7
hook functions 77
host 350
host name 350
hostname 350

I
:i inspector command 27
i18n 289
image
    saving 131

```

image size 304
`incf` macro 173
 init file 724
`*init-file-name*` variable 724
 initialization
 of Common SQL 223
 initialization file 724
`initialize-database-type`
 function 223
`initialize-database-type` function 947
`*initialized-database-types*`
 variable 224, 948
`initialize-multiprocessing`
 function 168, 810
`*initial-processes*` variable 147, 162,
 168, 811
`InitLispWorks` C function 146, 307, 1271
`input-stream-p` generic function 419
`insert-records` function 233, 260, 949
`:inside` keyword 43
`inspect` function 26
 inspector
 main chapter 25
 REPL 25
 teletype 25
 inspector commands
 `:cv` 27
 `:d` 27
 `:dm` 27
 `:dr` 27
 `:h` 27
 `:i` 27
 `:m` 27, 28
 `:q` 27
 `:s` 27
 `:sh` 27
 `:u` 27
 `:ud` 27, 28
`*inspect-print-length*` variable 27
`*inspect-print-level*` variable 27
`*inspect-through-gui*` variable 724
`instance-refreshed` generic function 241
`in-static-area` macro 106, 1118
`int32*` function 1120
`int32+` function 95, 1121
`int32-` function 95, 1122
`int32` type 95, 1119
`int32/` function 1124
`int32/=` function 1125
`int32<` function 1125
`int32<<` function 1126
`int32<=` function 1127
`int32=` function 1127
`int32>` function 1128
`int32>=` function 1129
`int32>>` function 1129
`+int32-0+` symbol macro 1122
`int32-1+` function 1123
`int32-1-` function 1124
`+int32-1+` symbol macro 1123
`int32-aref` function 1130
`int32-logand` function 1131
`int32-logandc1` function 1131
`int32-logandc2` function 1132
`int32-logbitp` function 1133
`int32-logeqv` function 1133
`int32-logior` function 1134
`int32-lognand` function 1135
`int32-lognor` function 1135
`int32-lognot` function 1136
`int32-logorc1` function 1137
`int32-logorc2` function 1137
`int32-logtest` function 1138
`int32-logxor` function 1139
`int32-minusp` function 1139
`int32-plusp` function 1140
`int32-to-integer` function 1140
`int32-zerop` function 1141
`integer-to-int32` function 1142
`interactive-stream-p` function 420
 interface
 between parser generator and lexical
 analyser 204
 Common SQL initialization 223
 Internationalization 289
`intern-eql-specializer` function 151
 interpreter
 differences from compiler 85
`interruptable` 88
`intersect`, SQL operator 244
`invalid superclass` 153
`:invisible` keyword 24
`IP Address` 350
`ip-address-string` function 354
`ISO8859-1` 295

J

`JIS` 295
 join slot 239

K

keywords
 `:after` 38

```

:all 196
:allocation 42
:backtrace 39
:before 37
:bindings 24
:break 39
:break-on-exit 39
:catchers 24
:caused-by 196
:default-pathname 195
:dont-know 17
:entrycond 40
:eval-after 38
:eval-before 38
:exitcond 40
:handler 24
:hidden 24
:inside 43
:invisible 24
:maximum-buffer-size 106
:maximum-overflow 109
:members 195
:minimum-buffer-size 106
:minimum-for-sweep 108, 109
:minimum-overflow 109
:new-generation-size 109
:non-symbol 24
:package 195
:previous 197
:process 42
:requires 197
:restarts 24
:rules 196
:source-only 196
:step 40
:trace-output 41
:when 42

L
:1 debugger command 17
:lambda debugger command 18
last-callback-on-thread function 812
Latin-1 295
*latin-1-code-pages* variable 1204
levels of safety, see compiler
:if debugger command 19
library formats 667
lightweight processes 161
*line-arguments-list* variable 302,
    1142
lisp image
filename 302, 725
pathname 302, 725
lisp-image-name function 302, 725
lisp-name-to-foreign-name
function 666
LispWorks
customizing 130
lightweight processes in 161
processes 161
quitting 4, 84
saving 2
starting 1, 84
LispWorks as a DLL 143
LispWorks as a dynamic library 143
LispWorks as a shared library 143
*lispworks-directory* variable 726
LispWorksDlsym C function 1274
LispWorksState C function 146, 1275
list-all-processes function 163, 813
list-attributes function 238, 952
list-attribute-types function 238, 951
list-classes function 241, 953
listener 753
main chapter 5
top level commands 1092
listener commands
: ? 7
:bug-form 7
:get 6
:help 7
:his 7
:redo 6
:use 7
listener process 812
listener prompt 738
list-sql-streams function 251, 954
list-tables function 238, 955
load-all-patches function 727
load-data-file function 1143
*load-fasl-or-lisp-file* variable 585
LoadLibrary C function 143
load-logical-pathname-translations
function 421
load-on-demand 139
*load-source-if-newer* 729
load-system function 728
:lob-locator initarg 956
lob-stream class 259, 263, 268, 955
lob-stream-lob-locator accessor 956
lob-stream-lob-locator function 263
local-dspec-p function 510
locale-file-encoding function 1144
locally-disable-sql-reader-syntax

```

```

        function 249, 957
locally-enable-sql-reader-syntax
        function 249, 957
location macro 511
lock-locked-p function 814
lock-name function 180, 816
lock-owned-by-current-process-p
        function 815
lock-owner function 180, 817
lock-recursively-locked-p
        function 816
lock-recursive-p function 815
locks 179
log-bug-form function 471
logs-directory function 473
long-float type 421
long-namestring function 302, 1205, 1207
long-site-name function 301, 422
loop macro 230, 235, 422, 958
        extensions in Common SQL 242
loop, extensions in Common SQL 236
Low level atomic operations 175
low-level-atomic-place-p
        function 1145
lpcstr FLI type 1207
lpctstr FLI type 1208
lpewstr FLI type 1209
lpstr FLI type 1207
lptstr FLI type 1208
lpwstr FLI type 1209

M
:m inspector command 27, 28
Mach-O bundle 610
Mach-O dynamically linked shared
    library 608
macros
    advice 53
    allocation-in-gen-num 107, 111, 533
    allowing-block-interrupts 164, 783
    analysing-special-variables-
        usage 534
    appendf 670
    at-location 490
    atomic-decf 1072
    atomic-exchange 1073
    atomic-fixnum-decf 1074
    atomic-fixnum-incf 1074
    atomic-incf 1072
    atomic-pop 1075
    atomic-push 1075
    block-promotion 539
call-next-advice 59
cd 542
compare-and-swap 1085
dde-connect 1234
dde-disconnect 1235
claim 93, 397
def 492
defadvice 50, 54, 59, 681
defclass 403
defglobal-parameter 558
defglobal-variable 558
define-action 80, 685
define-action-list 78, 687
define-atomic-modify-macro 1090
define-dde-client 1253
define-dde-dispatch-topic 1263
define-dde-server 1264
define-dde-server-function 1265
define-dspec-alias 493
define-dspec-class 494
define-foreign-callable 191
define-form-parser 497
define-top-loop-command 1092
defpackage 407
defparameter 558
defparser 201, 203, 899
defstruct 140
defsystem 195, 195–199, 689
deftransform 463
defvar 559
def-view-class 238, 239, 930
delete-advice 53, 59, 559
do-query 235, 260, 941
execute-actions 707
extended-time 115, 116, 127
in-static-area 106, 1118
location 511
loop 422, 958
profile 123, 596
rebinding 740
removef 744
restart-case 436
simple-do-query 235, 260, 1012
step 444
time 449
trace 451
undefined-action 80, 757
undefined-action-list 79, 757
untrace 459
unwind-protect-blocking-
        interrupts 164, 653
unwind-protect-blocking-inter-

```

rupts-in-cleanups 164, 654
when-let 775
when-let* 776
with-action-item-error-handling 777
with-action-list-mapping 779
with-dde-conversation 1254
with-debugger-wrapper 484
with-exclusive-lock 180, 892
with-hash-table-locked 658
with-heavy-allocation 112, 659
with-interrupts-blocked 164, 893
with-lock 180, 894
with-modification-change 1199
with-modification-check-macro 1200
with-noticed-socket-stream 385
with-other-threads-disabled 165, 1201
without-interrupts 165, 896
without-preemption 165, 897
with-output-to-string 461
with-registry-key 314, 1225
with-sharing-lock 180, 895
with-stream-input-buffer 1066
with-stream-output-buffer 1068
with-transaction 233, 234, 1034
with-unique-names 780
mailbox-empty-p function 818
mailbox-peek function 819
mailbox-read function 820
mailbox-reader-process function 821
mailbox-send function 821
mailbox-wait-for-event function 822
main-process variable 824
make-array function 118, 174, 424
make-barrier function 188, 824
make-condition-variable function 825
make-gesture-spec function 1146
make-hash-table function 118, 174, 425
make-instance generic function 428
make-lock function 826
make-mailbox function 828
make-method-lambda generic function 150
make-mt-random-state function 731
make-named-timer function 829
make-semaphore function 188, 830
make-sequence function 429
make-simple-int32-vector
 function 1151
make-ssl-ctx function 283, 284, 354
make-stderr-stream function 1152
make-symbol function 116
make-timer function 189, 831
make-typed-aref-vector function 1152
make-unregistered-action-list
 function 730
malloc C function 106
map function 429
map-all-processes function 832
map-all-processes-backtrace
 function 832
map-process-backtrace function 833
map-processes function 834
map-query function 235, 260, 960
mark
 and sweep 107
mark-and-sweep function 105, 112, 586
marking-gc function 115, 116, 1153
:maximum-buffer-size keyword 106
maximum-ordinary-windows
 variable 137
:maximum-overflow keyword 109
max-trace-indent variable 45, 588
memalign C function 106
:members keyword 195
memory allocation during tracing 42
memory clashes 146
 avoiding 306
memory management 304
 garbage collection strategy 108
 image reduction 116
 mark and sweep 107
 overflow 109
 timing in 115, 116
memory-growth-margin function 111, 1155
merge function 430
merge-ef-specs function 1155
Mersenne Twister 732
Metaobject Protocol 149
metaobject protocol
 class options 330
 slot options 332
method
 advice 53
method-combination class 151
methods
 tracing 45
:minimum-buffer-size keyword 106
:minimum-for-sweep keyword 108, 109
:minimum-overflow keyword 109
minus, SQL operator 244
mod 2^{32} arithmetic 95
modify-hash function 172, 173, 589
modifying a database 233

MOP
AMOP compatibility 149
class options 330
slot options 332
most-positive-fixnum constant 320
mt-random function 732
mt-random-state type 733
mt-random-state variable 733
mt-random-state-p function 734
multibyte-code-page-ef
variable 1205
multi-processing
locks 179
MySQL
connecting 227
MySQL client library 228
Mac OS X 228
mysql-library-directories
variable 228, 229, 961
mysql-library-path variable 228, 229,
962

N

:n debugger command 16
name-defined-dspecs function 511
name-definition-locations
function 512
name-only-form-parser function 513
New in LispWorks 6.0
allowing-block-interrupts 783
analysing-special-variables-
usage 534
array-weak-p 537
atomic-decf 1072
atomic-exchange 1073
atomic-fixnum-decf 1074
atomic-fixnum-incf 1074
atomic-incf 1072
atomic-pop 1075
atomic-push 1075
barrier-arriver-count 785
barrier-change-count 785
barrier-count 786
barrier-disable 787
barrier-enable 787
barrier-name 788
barrier-pass-through 788
barrier-unblock 789
barrier-wait 790
Blocking interrupts 164
choose-unicode-string-hash-
function 675

compare-and-swap 1085
condition-variable-broadcast 794
condition-variable-signal 794
condition-variable-wait 795
condition-variable-wait-count 796
create-macos-application-
bundle 551
current-process-block-
interrupts 800
current-process-in-cleanup-p 801
current-process-pause 801
current-process-unblock-
interrupts 803
defglobal-parameter 558
defglobal-variable 558
define-atomic-modify-macro 1090
do-profiling 561
ensure-loads-after-loads 1097
ensure-memory-after-store 1098
ensure-stores-after-memory 1099
ensure-stores-after-stores 1099
executable-log-file 469
:func 19
generation-number 1106
get-process-private-property 809
get-temp-directory 581
last-callback-on-thread 812
lock-locked-p 814
lock-owned-by-current-process-
p 815
lock-recursively-locked-p 816
lock-recursive-p 815
log-bug-form 471
logs-directory 473
low-level-atomic-place-p 1145
make-barrier 824
make-semaphore 830
modify-hash 589
new-function 825
process-all-events 836
process-exclusive-lock 838
process-exclusive-unlock 839
process-poke 847
process-private-property 848
process-property 849
process-sharing-lock 856
process-sharing-unlock 857
process-wait-local 863
process-wait-local-with-periodic-
checks 865
process-wait-local-with-
timeout 867

process-wait-local-with-timeout-and-periodic-checks 868
pushnew-to-process-private-property 871
pushnew-to-process-property 871
 recursive locks 826
remove-from-process-private-property 873
remove-from-process-property 873
remove-process-private-property 874
remove-process-property 875
save-current-session 604
save-image-with-bundle 613
semaphore-acquire 882
semaphore-count 883
semaphore-name 884
semaphore-release 884
semaphore-wait-count 885
set-array-single-thread-p 616
set-system-message-log 628
setup-atomic-funcall 1190
 sharing locks 826
short-namestring 1205, 1207
split-sequence 750
split-sequence-if 751
split-sequence-if-not 752
unicode-alpha-char-p 300, 758
unicode-alphanumericp 300, 759
unicode-both-case-p 300, 759
unicode-char-equal 300, 760
unicode-char-greaterp 300, 761
unicode-char-lessp 300, 762
unicode-char-not-equal 300, 763
unicode-char-not-greaterp 300, 763
unicode-char-not-lessp 300, 764
unicode-lower-case-p 300, 765
unicode-string-equal 300, 766
unicode-string-greaterp 300, 767
unicode-string-lessp 300, 768
unicode-string-not-equal 300, 769
unicode-string-not-greaterp 300,
 770
unicode-string-not-lessp 300, 771
unicode-upper-case-p 300, 772
unwind-protect-blocking-interrupts
 interrupts 653
unwind-protect-blocking-interrupts-in-cleanups 654
with-exclusive-lock 892
with-hash-table-locked 658
with-interrupts-blocked 893
with-modification-change 1199
with-modification-check-macro 1200
with-other-threads-disabled 1201
with-sharing-lock 895
:new-generation-size keyword 109
:non-symbol keyword 24
 non-terminal in grammar 202
normal-gc function 112, 590
not, SQL operator 244
notice-fd function 835

O

object
 object-oriented interface in Common SQL 238
static 106
object finalization 117
Object Oriented DDL in Common SQL 239
Object Oriented DML in Common SQL 241
object-address function 1156
ODBC
 connecting 226
OODDL 239
OODML 241
open function 431
 opening a URL 1160
open-pipe function 1157
open-registry-key function 314, 1219
open-serial-port function 901
OpenSSL 277
openssl-version function 358
open-stream-p generic function 433
open-tcp-stream function 277, 283, 355
open-url function 1160
 operating system 301
optimization
 fast 32-bit arithmetic 95
 floating point 96
 foreign slot access 100
 of compiler 88
 tail call 97
optimization declarations 88
optimization hints 94, 398
optimize 88
optimize qualities 89–91
:optimize-slot-access class option 150,
 153, 337, 403
Oracle
 connecting 225
Oracle Call Interface
 in Common SQL 226
ora-lob-append function 267, 963

ora-lob-assign function 266, 964
ora-lob-char-set-form function 265,
 964
ora-lob-char-set-id function 965
ora-lob-close function 267, 966
ora-lob-copy function 267, 967
ora-lob-create-empty function 260, 266,
 968
ora-lob-create-temporary function 268,
 969
ora-lob-disable-buffering
 function 268, 970
ora-lob-element-type function 265, 971
ora-lob-enable-buffering function 268,
 971
ora-lob-env-handle function 263, 972
ora-lob-erase function 267, 973
ora-lob-file-close function 267, 974
ora-lob-file-close-all function 267,
 975
ora-lob-file-exists function 975
ora-lob-file-get-name function 976
ora-lob-file-is-open function 977
ora-lob-file-open function 267, 978
ora-lob-file-set-name function 267,
 978
ora-lob-flush-buffer function 268, 979
ora-lob-free function 266, 980
ora-lob-free-temporary function 268,
 981
ora-lob-get-buffer function 263, 268,
 982
ora-lob-get-chunk-size function 266,
 984
ora-lob-get-length function 266, 985
ora-lob-internal-lob-p function 265,
 266, 985
ora-lob-is-equal function 266, 986
ora-lob-is-open function 266, 987
ora-lob-is-temporary function 266, 268,
 987
ora-lob-load-from-file function 267,
 988
ora-lob-lob-locator function 263, 989
ora-lob-locator-is-init function 266,
 990
ora-lob-open function 267, 991
ora-lob-read-buffer function 265, 268,
 992
ora-lob-read-foreign-buffer
 function 263, 265, 268, 995
ora-lob-read-into-plain-file
 function 268, 994
ora-lob-svc-ctx-handle function 263,
 996
ora-lob-trim function 267, 997
ora-lob-write-buffer function 265, 268,
 998, 1000
ora-lob-write-foreign-buffer
 function 263, 265, 268
ora-lob-write-from-plain-file
 function 268
ora-lob-write-from-plain-file
 function 999
output
 trace 41
output-backtrace function 474
output-stream-p generic function 433

P

:p debugger command 15
package
 hiding 23
:package keyword 195
packages
 allocation of 116
packages-for-warn-on-redefinition
 variable 138, 591
parameters
 command line 302
 default-character-element-type 684
parse-float function 591
parse-form-dspec function 514
parser generator main chapter 201
parser, error handling 204
passing runtime parameters 302
patches
 saving an image with 4
path
 long form on Windows 302
 short form on Windows 302
pathname of deliverable 302, 725
pathname of DLL 302, 725
pathname of dynamic library 725
pathname of executable 302, 725
pathname of lisp image 302, 725
pathname-location function 734
pem-read function 278
pem-read function 359
pid-exit-status function 1161
pipe
 open 1158
PL/SQL 946

platform 301
 features 416
 software-type 442
 software-version 443
 p-oci-env FLI type 1002
 p-oci-env foreign type 264, 972
 p-oci-file FLI type 1002
 p-oci-file foreign type 264, 990
 p-oci-lob-locator FLI type 1002
 p-oci-lob-locator foreign type 264, 990
 p-oci-lob-or-file FLI type 1002
 p-oci-svc-ctx FLI type 1003
 p-oci-svc-ctx foreign type 264, 996
 pointer-from-address function 1162
 pointers
 weak 617
 PostgreSQL
 connecting 229
 PostScript Printer Description files 140
 PPD files 140–141
 precompile-regexp function 735
 :previous keyword 197
 print-action-lists function 736
 print-actions function 82, 736
 print-binding-frames variable 23, 475
 print-catch-frames variable 23, 477
 print-command variable 737
 printer
 configuring 140
 print-handler-frames variable 23, 478
 print-nickname variable 737
 print-non-symbol-frames variable 24
 print-object generic function 140
 print-open-frames variable 479
 print-pretty-gesture-spec
 function 1163
 print-profile-list function 126, 592
 print-query function 232, 1003
 print-restart-frames variable 24, 480
 print-symbols-using-bars
 variable 1164
 process
 creation 162
 current 162
 in LispWorks 161
 scheduling 163
 process exit status 312
 :process keyword 42
 process plist 189
 Process properties 189
 process waiting 182
 process-a-class-option generic
 function 329
 process-alive-p function 835
 process-all-events function 836
 process-allow-scheduling function 162,
 836
 process-arrest-reasons function 837
 process-a-slot-option generic
 function 331
 process-break function 164, 838
 process-continue function 838
 processes
 allocation of 117
 process-exclusive-lock function 838
 process-exclusive-unlock function 839
 process-idle-time function 840
 process-initial-bindings
 variable 163, 841
 process-interrupt function 164, 165, 842
 process-join function 843
 process-kill function 164, 843
 process-lock function 180, 844
 process-mailbox function 845
 process-name function 163, 846
 process-p function 846
 process-plist function 190, 846
 process-poke function 847
 process-priority function 163, 848
 process-private-property function 848
 process-property function 190, 849
 process-reset function 850
 process-run-function function 162, 851
 process-run-reasons function 853
 process-run-time function 854
 process-send function 855
 process-sharing-lock function 856
 process-sharing-unlock function 857
 process-stop function 170, 857
 process-stopped function 170
 process-stopped-p function 858
 process-unlock function 859
 process-unstop function 170, 860
 process-wait function 164, 186, 861
 process-wait-for-event function 862
 process-wait-function function 164,
 862
 process-wait-local function 164, 863
 process-wait-local-with-periodic-
 checks function 865
 process-wait-local-with-timeout
 function 867
 process-wait-local-with-timeout-
 and-periodic-checks

function 868
process-wait-with-timeout
 function 164, 183, 186, 869
process-whostate function 870
proclaim function 88, 93, 434
product-registry-path function 314,
 1165
profile macro 123, 596
profile time 122
profiler
 interpretation of results 126
 main chapter 121
 pitfalls 126
 setting up 122
profiler-print-out-all variable 595
profiler-threshold variable 597
profiler-tree-from-function
 function 598
profiler-tree-to-function
 function 599
profile-symbol-list variable 123, 598
profiling
 execution 121
 program 121
program profiling 121
promotion 107
prompt variable 738
prompt
 in listener 738
prompt variable 8
ps function 163, 872
pseudo operators
 sql-boolean-operator 247
 sql-function 247
 sql-operator 247
push macro 173
pushnew-to-process-private-property
 function 190, 871
pushnew-to-process-property
 function 190, 871

Q

:q inspector command 27
query function 237, 259, 1004
query-registry-key-info function 315,
 1220
query-registry-value function 315, 1221
quick backtrace 14
quit function 4, 312, 739
quitLispWorks C function 147, 1277
quitting LispWorks 4, 84

R

raw 32-bit arithmetic 95
read-dhparams function 360
read-dhparms function 278
read-eval-print loop 5, 753
read-foreign-modules function 667
read-serial-port-char function 904
read-serial-port-string function 905
:read-timeout initarg 368
real time 123
realloc C function 106
rebinding macro 740
reconnect function 225, 1005
record-definition function 514
record-source-files variable 516
redefinition-action variable 138, 516
redo 139
:redo listener command 6
references-who function 600
regexp 713, 741
regexp-find-symbols function 741
registry
 API on Windows 314, 1211
registry-key-exists-p function 315,
 1222
registry-value function 315, 1223
regular expression 713, 741
regular expression matching 695, 713, 741
relocating 306
relocation 304
remove-advice function 53, 59, 742
removef macro 744
remove-from-process-private-property
 function 190, 873
remove-from-process-property
 function 190, 873
remove-process-private-property
 function 190, 874
remove-process-property function 190,
 875
remove-special-free-action
 function 117, 601
remove-symbol-profiler function 123,
 601
removing actions from action lists 80
REPL 5, 753
REPL inspector 25
:requires keyword 197
require-verbose variable 744
:res debugger command 20
reserved words 591
reset-profiler function 123, 602

restart 11
restart frame, examining 12
restart-case macro 436
:restarts keyword 24
restore-sql-reader-syntax-state
 function 249, 1007
:ret debugger command 20
rollback function 233, 235, 261, 1007
room function 111, 112, 115, 306, 436
room-values function 306, 1166
round-to-single-precision
 function 745
:rules keyword 196
run-shell-command function 1167
runtime parameters 302

S

:s inspector command 27
safe-locale-file-encoding
 function 1172
safety 88
save-argument-real-p function 603
save-current-session function 604
save-image function 131, 143, 302, 307,
 312, 605
save-image-with-bundle function 613
save-tags-database function 517
save-universal-from-script
 function 313, 615
saving images 131
sbchar accessor 292
sbchar function 746
schar accessor 292
schedule-timer function 189, 876
schedule-timer-milliseconds
 function 878
schedule-timer-relative function 879
schedule-timer-relative-millisecon
 ds function 881
scheduling of processes 163
segmentation violation in compiled
 code 91
select function 231, 241, 1008
select, SQL operator 244
semaphore-acquire function 188, 882
semaphore-count function 188, 883
semaphore-name function 188, 884
semaphore-release function 188, 884
semaphore-wait-count function 188, 885
serial-port function 904
serial-port-available-p
 function 906

set-application-themed function 1206
set-array-single-thread-p
 function 616
set-array-weak function 118, 617
set-automatic-gc-callback
 function 115, 1173
set-blocking-gen-num function 116, 1174
set-debugger-options function 24
set-default-character-element-type
 function 746
set-default-generation function 107,
 111, 618
set-default-segment-size function 116,
 1177
set-delay-promotion function 116, 1178
setf cdr-assoc function 1081
setf timer-name function 886
set-file-dates function 1179
set-gc-parameters function 105, 108,
 112, 619
set-gen-num-gc-threshold function 116,
 1180
set-hash-table-weak function 118, 621
set-make-instance-argument-checking
 function 334
set-maximum-memory function 111, 1181
set-maximum-segment-size function 114,
 116, 1183
set-memory-check function 1184
set-memory-exhausted-callback
 function 1185
set-minimum-free-space function 108,
 111, 623
set-process-profiling function 123,
 124, 624
set-profiler-threshold function 123,
 626
set-promotion-count function 627
set-registry-value function 315, 1224
set-serial-port-state function 907
set-signal-handler function 1187
set-spare-keeping-policy function 116,
 1189
set-ssl-ctx-dh function 278
set-ssl-ctx-dh function 364
set-ssl-ctx-options function 278
set-ssl-ctx-options function 365
set-ssl-ctx-password-callback
 function 278
set-ssl-ctx-password-callback
 function 366
set-ssl-library-path function 288, 367

sets-who function 633
set-system-message-log function 628
setup-atomic-funcall function 1190
setup-for-alien-threads function 191
set-up-profiler function 122, 629
set-verification-mode function 362
sg-default-size variable 1191
:sh inspector command 27
shared libraries 143, 306
shared library 143
shared object file 143
Shift JIS 295
short-float type 321, 440
short-namestring function 302
short-site-name function 301, 441
Show Paths From Editor command 101
shutdown 84
simple-augmented-string type 291, 1192
simple-augmented-string-p
 function 1192
simple-base-string type 291, 292, 441
simple-base-string-p function 747
simple-char type 289, 748
simple-char-p function 748
simple-do-query macro 235, 260, 1012
SimpleInitLispWorks C function 1276
simple-int32-vector type 96, 1193
simple-process-p function 886
simple-string type 291, 292
simple-text-string type 291, 292, 749
simple-text-string-p function 749
single-float type 321, 441
single-form-form-parser function 517
single-form-with-options-form-
 parser function 518
single-threaded
 arrays 174
 hash tables 174
:size initarg 1195
SLIME 3
slot-boundp-using-class generic
 function 150, 335
slot-makunbound-using-class generic
 function 150, 336
slot-value
 atomic operations 175
slot-value-using-class generic
 function 150, 336
:socket initarg 368
socket-error class 367
socket-stream class 277
socket-stream class 283, 368
socket-stream-address function 373
socket-stream-ctx function 278
socket-stream-ctx function 373
socket-stream-peer-address
 function 374
socket-stream-socket accessor 368
socket-stream-ssl function 278
socket-stream-ssl function 374
software-type function 301, 442
software-version function 301, 443
some, SQL operator 244
source-debugging-on-p function 633
source-found-action variable 136
:source-only keyword 196
space 88
special actions 117
special forms
 declare 88, 92, 398
special variables
 describe-level 26
 directory-link-transparency 410
speed 88
splash screen 1203
split-sequence function 750
split-sequence-if function 751
split-sequence-if-not function 752
SQL
 database functions 247
 database operators 247
 direct specification 237
 mode 254
 stored procedure 237, 946
sql function 248, 1014
SQL pseudo operators
 sql-boolean-operator 247, 1019
 sql-function 247, 1019
 sql-operator 247, 1019
 sql-boolean-operator pseudo
 operator 247
 sql-boolean-operator SQL pseudo
 operator 247, 1019
sql-connection-error condition 1015
sql-connection-error error 252
sql-database-data-error accessor 1016
sql-database-data-error
 condition 1015
sql-database-data-error error 252
sql-database-error condition 1016
sql-database-error error 251
sql-enlarge-static variable 1017
sql-error-database-message
 accessor 1016

sql-error-secondary-error-id
 accessor 1016
sql-expression function 248, 1017
sql-fatal-error condition 1018
sql-fatal-error error 252
sql-function pseudo operator 247
sql-function SQL pseudo operator 247, 1019
sql-libraries variable 224, 1018
sql-loading-verbose variable 224, 234, 1019
sql-operation function 247, 1019
sql-operator function 248, 1021
sql-operator pseudo operator 247
sql-operator SQL pseudo operator 247, 1019
sql-recording-p function 251, 1022
sql-stream function 251, 1023
sql-temporary-error condition 1024
sql-temporary-error error 252
sql-timeout-error condition 1024
sql-timeout-error error 252
sql-user-error condition 1024
sql-user-error error 251
square bracket syntax 243
ssl-add-client-ca function 279
ssl-cipher-get-bits function 279
ssl-cipher-get-name function 280
ssl-cipher-get-version function 280
ssl-cipher-pointer FLI type 375
ssl-cipher-pointer foreign type 279
ssl-cipher-pointer-stack FLI type 375
ssl-clear-num-renegotiations
 function 280
ssl-closed class 288, 376
ssl-condition class 288, 376
:ssl-configure-callback initarg 368
ssl-ctrl function 280
:ssl-ctx initarg 368
ssl-ctx-add-client-ca function 280
ssl-ctx-add-extra-chain-cert
 function 280
ssl-ctx-ctrl function 280
ssl-ctx-get-max-cert-list
 function 280
ssl-ctx-get-mode function 280
ssl-ctx-get-options function 280
ssl-ctx-get-read-ahead function 280
ssl-ctx-get-verify-mode function 280
ssl-ctx-load-verify-locations
 function 280
ssl-ctx-need-tmp-rsa function 280
ssl-ctx-pointer FLI type 376
ssl-ctx-pointer foreign type 279
ssl-session-reused function 281
ssl-set-accept-state function 281, 284
ssl-set-client-ca-list function 281
ssl-set-connect-state function 281, 284
ssl-set-max-cert-list function 281
ssl-set-mode function 281
ssl-set-options function 282
ssl-set-tmp-dh function 282
ssl-set-tmp-rsa function 282
:ssl-side initarg 368

ssl-total-renegotiations function 282
ssl-use-certificate-file function 282
ssl-use-privatekey-file function 282
ssl-use-rsaprivatekey-file
 function 282
ssl-x509-lookup class 288, 378
stack
 examining 12
 extension 568
 size 555, 1191
stack size 117, 1090
stack-overflow-behaviour
 variable 1193
stacks
 allocation of 117
standard-accessor-method class 150
standard-class class 151
standard-db-object class 238, 1025
standard-instance-access function 150
standard-object class 172
standard-reader-method class 150
standard-writer-method class 150
start 84
start LispWorks 1
start-dde-server function 215, 1269
Starting LispWorks 1, 84
start-profiling function 123, 124, 634
start-sql-recording function 251, 1025
start-tty-listener function 753
startup 84
startup image 1203
startup relocation 306
startup screen 1203
startup window 1203
start-up-server function 379
start-up-server-and-mp function 383
:static initarg 1195
static object
 allocation in memory management 106
staticp function 1194
status function 225, 1026
stchar accessor 292
stchar function 753
stderr 1152
:step keyword 40
step macro 444
step-compiled variable 446
step-filter variable 447
stepper, entering when tracing 40
step-print-env variable 447
stop-profiling function 123, 124, 636
stop-sql-recording function 251, 1027
storage management
 main chapter 103
storage-exhausted class 1194
storage-exhausted-gen-num
 accessor 1195
storage-exhausted-size accessor 1195
storage-exhausted-static
 accessor 1195
storage-exhausted-type accessor 1195
str FLI type 1207
:stream initarg 368
stream-advance-to-column generic
 function 1045
stream-check-eof-no-hang generic
 function 1046
stream-clear-input generic
 function 272, 1046
stream-clear-output generic
 function 273, 1047
stream-element-type generic
 function 270, 447
stream-file-position generic
 function 1048
stream-fill-buffer generic
 function 1048
stream-finish-output generic
 function 273, 1049
stream-flush-buffer generic
 function 1050
stream-force-output generic
 function 273, 1051
stream-fresh-line generic function 1051
stream-line-column generic
 function 273, 1052
stream-listen generic function 272, 1053
stream-output-width generic
 function 1054
stream-peek-char generic function 1054
stream-read-buffer generic
 function 1055
stream-read-byte generic function 1056
stream-read-char generic function 271,
 1057
stream-read-char-no-hang generic
 function 1057
stream-read-line generic function 1058
stream-read-sequence generic
 function 1059
stream-read-timeout accessor 368
stream-read-timeout generic
 function 1060
streams

defining new 270
directionality 270
example 270–275
input 271
instantiating 274
output 272
user defined 269
stream-start-line-p generic
 function 273, 1060
stream-terpri generic function 1061
stream-unread-char generic
 function 271, 1062
stream-write-buffer generic
 function 1062
stream-write-byte generic function 1063
stream-write-char generic function 272,
 1064
stream-write-sequence generic
 function 1064
stream-write-string generic
 function 1065
stream-write-timeout accessor 368
string construction 292
string type 290, 291, 448
string types 290
string-append function 754
string-ip-address function 384
superclass
 invalid 153
sweep 107
sweep-all-objects function 117, 637
sweep-gen-num-objects function 1195
switch-static-allocation function 105,
 106, 638
symbol macros
 +int32-0+ 1122
 +int32-1+ 1123
symbol-alloc-gen-num variable 111,
 116, 638
symbolic query syntax 243
symbolic syntax in Common SQL 243
symbols
 allocation of 116
symeval-in-process function 170, 886
Synchronization barriers 187
syntax, in Common SQL 243
system
 compile 675
 defining 194–199
 introduction to 193–194
 load 728
 members of 195
plan 196
print 723
rules 196–197
system commands
 running directly 1078
 running via a shell 1078

T

table-exists-p function 1028
tail call 97
tail call merging 97
tail call optimization 97
tail merge 97
tail recursion 97
tail-call 97
teletype inspector 25
***terminal-debugger-block-multipro-**
 cessing* variable 481
text-string type 290, 755
text-string-p function 756
threads
 allocation of 117
time macro 449
timer-expired-p function 887
timer-name function 888
timers 189
 I/O 189
 input and output 189
 multiprocessing 189
 process 189
 threading issues 189
toggle-source-debugging function 101,
 639
tools
 inspector 25
:top debugger command 20
top-level loop 5
total-allocation function 111, 640
trace
 main chapter 35
trace macro 451
traceable-dspec-p function 519
traced-arglist variable 37, 38, 40, 46,
 641
traced-results variable 38, 46, 452,
 642
trace-indent-width variable 46, 643
trace-level variable 46, 644
trace-new-instances-on-access
 function 337
trace-on-access function 338
:trace-output keyword 41

```

*trace-output* variable 46
*trace-print-circle* variable 46, 645
*trace-print-length* variable 26, 46,
  646
*trace-print-level* variable 26, 46, 647
*trace-print-pretty* variable 47, 648
tracer
  :after option 38
  :allocation option 42
  :before option 37
  :break option 39
  :break-on-exit option 39
  commands available 37–44
  definition specs 45
  directing output 41
  entering the stepper 40
  :entrycond option 40
  :eval-after option 38
  :eval-before option 38
  evaluating forms 37–39
  example of use 35
  :exitcond option 40
  functions, tracing inside 43
  information displayed 36
  :inside option 43
  invoking the debugger 39
  memory allocation 42
  methods, tracing 45
  :process option 42
  restricting to a process 42
  :step option 40
  traced function, arguments for 37
  traced functions, results for 38
  :trace-output option 41
*trace-verbose* variable 649
tracing-enabled-p function 520
tracing-state function 521
transaction handling
  in Common SQL 226, 234, 256
true function 756
truetype function 458
try-compact-in-generation
  function 110, 112, 650
try-move-in-generation function 110,
  112, 651
tstr FLI type 1208
tty 606
:type initarg 1195
typed-aref function 1196
types
  16-bit-string 670
  8-bit-string 669
augmented-string 290, 1076
base-char 289, 671
base-character 670
base-string 290, 389
character 289
double-float 416
extended-char 709
extended-character 709
fixnum 319
int32 95, 1119
long-float 421
mt-random-state 733
short-float 321, 440
simple-augmented-string 291, 1192
simple-base-string 291, 292, 441
simple-char 289, 748
simple-int32-vector 96, 1193
simple-string 291, 292
simple-text-string 291, 292, 749
single-float 321, 441
string 290, 291, 448
text-string 290, 755

```

U

```

:u inspector command 27
UCS-2 295
:ud inspector command 27, 28
unbreak-new-instances-on-access
  function 341
unbreak-on-access function 342
undefine-action macro 80, 757
undefine-action-list macro 79, 757
Unicode 289
unicode-alpha-char-p function 300, 758
unicode-alphanumericp function 300,
  759
unicode-both-case-p function 300, 759
unicode-char-equal function 300, 760
unicode-char-greaterp function 300,
  761
unicode-char-lessp function 300, 762
unicode-char-not-equal function 300,
  763
unicode-char-not-greaterp
  function 300, 763
unicode-char-not-lessp function 300,
  764
unicode-lower-case-p function 300, 765
unicode-string-equal function 300, 766
unicode-string-greaterp function 300,
  767
unicode-string-lessp function 300, 768

```

unicode-string-not-equal function 300, 769
unicode-string-not-greaterp function 300, 770
unicode-string-not-lessp function 300, 771
unicode-upper-case-p function 300, 772
union, SQL operator 244
universal binaries 312
 helper functions 541, 603
 saving
 advanced 553
 simply 615
UNIX command
 call-system 1077
 call-system-showing-output 1079
 open-pipe 1158
 run-shell-command 1168
Unix commands
 calling from Lisp 311
Unix functions
 calling from Lisp 311
unnotice-fd function 890
unresolved-messages 668
unschedule-timer function 890
untrace macro 459
untrace-new-instances-on-access function 342
untrace-on-access function 343
unwind-protect-blocking-interrupts macro 164, 653
unwind-protect-blocking-interrupts-
 in-cleanups macro 164, 654
update-instance-for-different-class function 460
update-instance-for-redefined-class function 460
update-instance-from-records generic function 241, 1028
update-objects-joins function 1029
update-record-from-slot generic function 241, 1032
update-records function 233, 234, 260, 1031
update-records-from-instance generic function 241, 1032
update-slot-from-record generic function 241, 1033
URL
 opening 1160
:use listener command 7
user defined stream 269
user-homedir-pathname function 315
user-preference function 314, 773
UTF-8 295, 298
utilities in Common SQL 249

V

:v debugger command 16
validate-superclass generic function 151, 152
valid-external-format-p function 528
variables
 \$ (dollar) 26
 \$\$ 26
 \$\$\$ 26
 active-finders 489
 binary-file-type 396
 binary-file-types 393, 396
 browser-location 673
 cache-table-queries-default 915
 check-network-server 1083
 compiler-break-on-error 548
 connect-if-exists 923
 current-process 162, 163, 799
 *debug-initialization-errors-in-
 snap-shot* 1088
 debug-io 22
 debug-print-length 23, 467
 debug-print-level 23, 468
 *default-action-list-sort-
 time* 81, 684
 *default-character-element-
 type* 290, 292, 293, 294, 298
 default-database 223, 225, 929
 default-database-type 224, 929
 default-libraries 667
 default-package-use-list 555
 default-process-priority 805
 default-profiler-collapse 556
 default-profiler-cutoff 556
 default-profiler-limit 557
 default-profiler-sort 557
 *default-simple-process-
 priority* 805
 *default-stack-group-list-
 length* 117, 1090
 *default-update-objects-max-
 len* 930
 *defstruct-generates-print-
 object-method* 140
 defsystem-verbose 694
 describe-length 27, 696
 describe-level 696

describe-print-length 26, 698
 describe-print-level 26, 698
 directory-link-transparency 1097
 disable-trace 560
 dspec-classes 501
 enter-debugger-directly 703
 extended-spaces 777, 1100
 external-formats 711
 features 416
 file-encoding-detection-algorithm 298, 1101
 file-eol-style-detection-algorithm 298, 1102
 filename-pattern-encoding-matches 1103
 gesture-spec-accelerator-bit 1107
 gesture-spec-control-bit 1107
 gesture-spec-hyper-bit 1108
 gesture-spec-meta-bit 1109
 gesture-spec-shift-bit 1111
 gesture-spec-super-bit 1111
 grep-command 718
 grep-command-format 719
 grep-fixed-args 720
 handle-existing-action-in-action-list 80, 720
 handle-existing-action-list 80, 721
 handle-existing-defpackage 582
 handle-missing-action-in-action-list 81, 722
 handle-missing-action-list 81, 721
 handle-old-in-package 584
 handle-old-in-package-used-as-make-package 584
 handle-warn-on-redefinition 138, 722
 hidden-packages 23, 470
 init-file-name 724
 initialized-database-types 224, 948
 initial-processes 147, 162, 168, 811
 inspect-print-length 27
 inspect-print-level 27
 inspect-through-gui 724
 latin-1-code-pages 1204
 line-arguments-list 302, 1142
 lispworks-directory 726
 load-fasl-or-lisp-file 585
 main-process 824
 maximum-ordinary-windows 137
 max-trace-indent 45, 588
 mt-random-state 733
 multibyte-code-page-ef 1205
 mysql-library-directories 228, 229, 961
 mysql-library-path 228, 229, 962
 packages-for-warn-on-redefinition 138, 591
 print-binding-frames 23, 475
 print-catch-frames 23, 477
 print-command 737
 print-handler-frames 23, 478
 print-nickname 737
 print-non-symbol-frames 24
 print-open-frames 479
 print-restart-frames 24, 480
 print-symbols-using-bars 1164
 process-initial-bindings 163, 841
 profiler-print-out-all 595
 profiler-threshold 597
 profile-symbol-list 123, 598
 prompt 8, 738
 record-source-files 516
 redefinition-action 138, 516
 require-verbose 744
 sg-default-size 1191
 source-found-action 136
 sql-enlarge-static 1017
 sql-libraries 224, 1018
 sql-loading-verbose 224, 234, 1019
 stack-overflow-behaviour 1193
 step-compiled 446
 step-filter 447
 step-print-env 447
 symbol-alloc-gen-num 111, 116, 638
 terminal-debugger-block-multiprocessing 481
 traced-arglist 37, 38, 40, 46, 641
 traced-results 38, 46, 452, 642
 trace-indent-width 46, 643
 trace-level 46, 644
 trace-output 46
 trace-print-circle 46, 645
 trace-print-length 26, 46, 646
 trace-print-level 26, 46, 647
 trace-print-pretty 47, 648
 trace-verbose 649
 vector-pop function 172, 174
 vector-push function 172, 174
 vector-push-extend function 172, 174
 verbose backtrace 14
 virtual (ordinary) slots 239

virtual time 123

W

`wait-for-input-streams` function 1197
`wait-for-input-streams-returning-first` function 1199
`wait-processing-events` function 891
`wait-serial-port-state` function 907
weak
 arrays 617
 hash tables 425
weak hash tables 425
weak pointers 617
web browser 1160
`:when` keyword 42
`when-let` macro 775
`when-let*` macro 776
`whitespace-char-p` function 777
`who-binds` function 655
`who-calls` function 656
`who-references` function 657
`who-sets` function 657
Windows code page 936 296
Windows registry
 API 314, 1211
Windows XP themes 1206
windows-cp936 296
`with-action-item-error-handling`
 macro 777
`with-action-list-mapping` macro 779
`with-dde-conversation` macro 211, 1254
`with-debugger-wrapper` macro 484
`with-exclusive-lock` macro 180, 892
`with-hash-table-locked` 658
`with-hash-table-locked` macro 172, 173
`with-heavy-allocation` macro 112, 659
`with-interrupts-blocked` macro 164,
 893
`with-lock` macro 180, 894
`with-modification-change` macro 174,
 1199
`with-modification-check-macro`
 macro 174, 1200
`with-noticed-socket-stream` macro 385
`with-other-threads-disabled`
 macro 165, 1201
`without-interrupts` macro 165, 896
`without-preemption` function 165
`without-preemption` macro 165, 897
`with-output-to-fasl-file` function 659
`with-output-to-string` macro 461
`with-registry-key` macro 314, 1225

`with-sharing-lock` macro 180, 895
`with-stream-input-buffer` macro 1066
`with-stream-output-buffer` macro 1068
`with-transaction` macro 233, 234, 1034
`with-unique-names` macro 780
`write-serial-port-char` function 908
`write-serial-port-string` function 909
`:write-timeout` initarg 368
`wstr` FLI type 1209

Y

yellow pages 350
`yield` function 897