

# **GCL SI Manual**





# 1 Numbers

<b>SIGNUM</b> ( <i>number</i> )	Function
Package:LISP	
If NUMBER is zero, returns NUMBER; else returns (/ NUMBER (ABS NUMBER)).	
<b>LOGNOT</b> ( <i>integer</i> )	Function
Package:LISP	
Returns the bit-wise logical NOT of INTEGER.	
<b>MOST-POSITIVE-SHORT-FLOAT</b>	Constant
Package:LISP The short-float closest in value to positive infinity.	
<b>INTEGER-DECODE-FLOAT</b> ( <i>float</i> )	Function
Package:LISP	
Returns, as three values, the integer interpretation of significand F, the exponent E, and the sign S of the given float, so that E FLOAT = S * F * B where B = (FLOAT-RADIX FLOAT)	
F is a non-negative integer, E is an integer, and S is either 1 or -1.	
<b>MINUSP</b> ( <i>number</i> )	Function
Package:LISP	
Returns T if NUMBER < 0; NIL otherwise.	
<b>LOGORC1</b> ( <i>integer1 integer2</i> )	Function
Package:LISP	
Returns the logical OR of (LOGNOT INTEGER1) and INTEGER2.	
<b>MOST-NEGATIVE-SINGLE-FLOAT</b>	Constant
Package:LISP Same as MOST-NEGATIVE-LONG-FLOAT.	
<b>BOOLE-C1</b>	Constant
Package:LISP Makes BOOLE return the complement of INTEGER1.	
<b>LEAST-POSITIVE-SHORT-FLOAT</b>	Constant
Package:LISP The positive short-float closest in value to zero.	
<b>BIT-NAND</b> ( <i>bit-array1 bit-array2 &amp;optional (result-bit-array nil)</i> )	Function
Package:LISP	
Performs a bit-wise logical NAND on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	

<b>INT-CHAR</b> ( <i>integer</i> )	Function
Package:LISP	
Performs the inverse of CHAR-INT. Equivalent to CODE-CHAR in GCL.	
<b>CHAR-INT</b> ( <i>char</i> )	Function
Package:LISP	
Returns the font, bits, and code attributes as a single non-negative integer. Equivalent to CHAR-CODE in GCL.	
<b>LEAST-NEGATIVE-SINGLE-FLOAT</b>	Constant
Package:LISP Same as LEAST-NEGATIVE-LONG-FLOAT.	
<b>/=</b> ( <i>number &amp;rest more-numbers</i> )	Function
Package:LISP	
Returns T if no two of its arguments are numerically equal; NIL otherwise.	
<b>LDB-TEST</b> ( <i>bytespec integer</i> )	Function
Package:LISP	
Returns T if at least one of the bits in the specified bytes of INTEGER is 1; NIL otherwise.	
<b>CHAR-CODE-LIMIT</b>	Constant
Package:LISP The upper exclusive bound on values produced by CHAR-CODE.	
<b>RATIONAL</b> ( <i>number</i> )	Function
Package:LISP	
Converts NUMBER into rational accurately and returns it.	
<b>PI</b>	Constant
Package:LISP The floating-point number that is appropriately equal to the ratio of the circumference of the circle to the diameter.	
<b>SIN</b> ( <i>radians</i> )	Function
Package:LISP	
Returns the sine of RADIANS.	
<b>BOOLE-ORC2</b>	Constant
Package:LISP Makes BOOLE return LOGORC2 of INTEGER1 and INTEGER2.	
<b>NUMERATOR</b> ( <i>rational</i> )	Function
Package:LISP	
Returns as an integer the numerator of the given rational number.	

- MASK-FIELD** (*bytespec integer*) Function  
 Package:LISP  
 Extracts the specified byte from INTEGER.
- INCF** Special Form  
 Package:LISP  
 Syntax:  
     (`incf place [delta]`)  
 Adds the number produced by DELTA (which defaults to 1) to the number in PLACE.
- SINH** (*number*) Function  
 Package:LISP  
 Returns the hyperbolic sine of NUMBER.
- PHASE** (*number*) Function  
 Package:LISP  
 Returns the angle part of the polar representation of a complex number. For non-complex numbers, this is 0.
- BOOLE** (*op integer1 integer2*) Function  
 Package:LISP  
 Returns an integer produced by performing the logical operation specified by OP on the two integers. OP must be the value of one of the following constants: BOOLE-CLR BOOLE-C1 BOOLE-XOR BOOLE-ANDC1 BOOLE-SET BOOLE-C2 BOOLE-EQV BOOLE-ANDC2 BOOLE-1 BOOLE-AND BOOLE-NAND BOOLE-ORC1 BOOLE-2 BOOLE-IOR BOOLE-NOR BOOLE-ORC2 See the variable docs of these constants for their operations.
- SHORT-FLOAT-EPSILON** Constant  
 Package:LISP The smallest positive short-float that satisfies (not (= (float 1 e) (+ (float 1 e) e))).
- LOGORC2** (*integer1 integer2*) Function  
 Package:LISP  
 Returns the logical OR of INTEGER1 and (LOGNOT INTEGER2).
- BOOLE-C2** Constant  
 Package:LISP Makes BOOLE return the complement of INTEGER2.
- REALPART** (*number*) Function  
 Package:LISP  
 Extracts the real part of NUMBER.
- BOOLE-CLR** Constant  
 Package:LISP Makes BOOLE return 0.

<b>BOOLE-IOR</b>	Constant
Package:LISP Makes BOOLE return LOGIOR of INTEGER1 and INTEGER2.	
<b>FTRUNCATE</b> ( <i>number</i> &optional ( <i>divisor</i> 1))	Function
Package:LISP	
Values: (quotient remainder) Same as TRUNCATE, but returns first value as a float.	
<b>EQ</b> ( <i>x y</i> )	Function
Package:LISP	
Returns T if X and Y are EQ, or if they are numbers of the same type with the same value, or if they are character objects that represent the same character. Returns NIL otherwise.	
<b>LOG</b> ( <i>number</i> &optional <i>base</i> )	Function
Package:LISP	
Returns the logarithm of NUMBER in the base BASE. BASE defaults to the base of natural logarithms.	
<b>DOUBLE-FLOAT-NEGATIVE-EPSILON</b>	Constant
Package:LISP Same as LONG-FLOAT-NEGATIVE-EPSILON.	
<b>LOGIOR</b> (&rest <i>integers</i> )	Function
Package:LISP	
Returns the bit-wise INCLUSIVE OR of its arguments.	
<b>MOST-NEGATIVE-DOUBLE-FLOAT</b>	Constant
Package:LISP Same as MOST-NEGATIVE-LONG-FLOAT.	
<b>/</b> ( <i>number</i> &rest <i>more-numbers</i> )	Function
Package:LISP	
Divides the first NUMBER by each of the subsequent NUMBERS. With one arg, returns the reciprocal of the number.	
<b>*RANDOM-STATE*</b>	Variable
Package:LISP The default random-state object used by RANDOM.	
<b>1+</b> ( <i>number</i> )	Function
Package:LISP	
Returns NUMBER + 1.	
<b>LEAST-NEGATIVE-DOUBLE-FLOAT</b>	Constant
Package:LISP Same as LEAST-NEGATIVE-LONG-FLOAT.	

<b>FCEILING</b> ( <i>number</i> &optional ( <i>divisor</i> 1))	Function
Package:LISP	
Same as CEILING, but returns a float as the first value.	
<b>MOST-POSITIVE-FIXNUM</b>	Constant
Package:LISP The fixnum closest in value to positive infinity.	
<b>BIT-ANDC1</b> ( <i>bit-array1 bit-array2</i> &optional ( <i>result-bit-array</i> nil))	Function
Package:LISP	
Performs a bit-wise logical ANDC1 on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	
<b>TAN</b> ( <i>radians</i> )	Function
Package:LISP	
Returns the tangent of RADIANS.	
<b>BOOLE-NAND</b>	Constant
Package:LISP Makes BOOLE return LOGNAND of INTEGER1 and INTEGER2.	
<b>TANH</b> ( <i>number</i> )	Function
Package:LISP	
Returns the hyperbolic tangent of NUMBER.	
<b>ASIN</b> ( <i>number</i> )	Function
Package:LISP	
Returns the arc sine of NUMBER.	
<b>BYTE</b> ( <i>size position</i> )	Function
Package:LISP	
Returns a byte specifier. In GCL, a byte specifier is represented by a dotted pair (<size> . <position>).	
<b>ASINH</b> ( <i>number</i> )	Function
Package:LISP	
Returns the hyperbolic arc sine of NUMBER.	
<b>MOST-POSITIVE-LONG-FLOAT</b>	Constant
Package:LISP The long-float closest in value to positive infinity.	
<b>SHIFTF</b>	Macro
Package:LISP	
Syntax:	
(shiftf {place}+ newvalue)	
Evaluates all PLACES and NEWVALUE in turn, then assigns the value of each form to the PLACE on its left. Returns the original value of the leftmost form.	



<b>LEAST-POSITIVE-LONG-FLOAT</b>	Constant
Package:LISP The positive long-float closest in value to zero.	
<b>DEPOSIT-FIELD</b> ( <i>newbyte bytespec integer</i> )	Function
Package:LISP	
Returns an integer computed by replacing the specified byte of INTEGER with the specified byte of NEWBYTE.	
<b>BIT-AND</b> ( <i>bit-array1 bit-array2 &amp;optional (result-bit-array nil)</i> )	Function
Package:LISP	
Performs a bit-wise logical AND on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	
<b>LOGNAND</b> ( <i>integer1 integer2</i> )	Function
Package:LISP	
Returns the complement of the logical AND of INTEGER1 and INTEGER2.	
<b>BYTE-POSITION</b> ( <i>bytespec</i> )	Function
Package:LISP	
Returns the position part (in GCL, the cdr part) of the byte specifier.	
<b>ROTATEF</b>	Macro
Package:LISP	
Syntax:	
(rotatef {place}*)	
Evaluates PLACES in turn, then assigns to each PLACE the value of the form to its right. The rightmost PLACE gets the value of the leftmost PLACE. Returns NIL always.	
<b>BIT-ANDC2</b> ( <i>bit-array1 bit-array2 &amp;optional (result-bit-array nil)</i> )	Function
Package:LISP	
Performs a bit-wise logical ANDC2 on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	
<b>TRUNCATE</b> ( <i>number &amp;optional (divisor 1)</i> )	Function
Package:LISP	
Values: (quotient remainder) Returns NUMBER/DIVISOR as an integer, rounded toward 0. The second returned value is the remainder.	
<b>BOOLE-EQV</b>	Constant
Package:LISP Makes BOOLE return LOGEQV of INTEGER1 and INTEGER2.	

<b>BOOLE-SET</b>	Constant
Package:LISP Makes BOOLE return -1.	
<b>LDB</b> ( <i>bytespec integer</i> )	Function
Package:LISP	
Extracts and right-justifies the specified byte of INTEGER, and returns the result.	
<b>BYTE-SIZE</b> ( <i>bytespec</i> )	Function
Package:LISP	
Returns the size part (in GCL, the car part) of the byte specifier.	
<b>SHORT-FLOAT-NEGATIVE-EPSILON</b>	Constant
Package:LISP The smallest positive short-float that satisfies (not (= (float 1 e) (- (float 1 e) e))).	
<b>REM</b> ( <i>number divisor</i> )	Function
Package:LISP	
Returns the second value of (TRUNCATE NUMBER DIVISOR).	
<b>MIN</b> ( <i>number &amp;rest more-numbers</i> )	Function
Package:LISP	
Returns the least of its arguments.	
<b>EXP</b> ( <i>number</i> )	Function
Package:LISP	
Calculates e raised to the power NUMBER, where e is the base of natural logarithms.	
<b>DECODE-FLOAT</b> ( <i>float</i> )	Function
Package:LISP	
Returns, as three values, the significand F, the exponent E, and the sign S of the given float, so that $E \text{ FLOAT} = S * F * B$ where $B = (\text{FLOAT-RADIX FLOAT})$	
S and F are floating-point numbers of the same float format as FLOAT, and E is an integer.	
<b>LONG-FLOAT-EPSILON</b>	Constant
Package:LISP The smallest positive long-float that satisfies (not (= (float 1 e) (+ (float 1 e) e))).	
<b>FROUND</b> ( <i>number &amp;optional (divisor 1)</i> )	Function
Package:LISP	
Same as ROUND, but returns first value as a float.	
<b>LOGEQV</b> ( <i>&amp;rest integers</i> )	Function
Package:LISP	
Returns the bit-wise EQUIVALENCE of its arguments.	

<b>MOST-NEGATIVE-SHORT-FLOAT</b>	Constant
Package:LISP The short-float closest in value to negative infinity.	
<b>BIT-NOR</b> ( <i>bit-array1 bit-array2</i> &optional ( <i>result-bit-array nil</i> ))	Function
Package:LISP	
Performs a bit-wise logical NOR on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	
<b>CEILING</b> ( <i>number</i> &optional ( <i>divisor 1</i> ))	Function
Package:LISP	
Returns the smallest integer not less than or NUMBER/DIVISOR. Returns the remainder as the second value.	
<b>LEAST-NEGATIVE-SHORT-FLOAT</b>	Constant
Package:LISP The negative short-float closest in value to zero.	
<b>1-</b> ( <i>number</i> )	Function
Package:LISP	
Returns NUMBER - 1.	
<b>&lt;=</b> ( <i>number</i> &rest <i>more-numbers</i> )	Function
Package:LISP	
Returns T if arguments are in strictly non-decreasing order; NIL otherwise.	
<b>IMAGPART</b> ( <i>number</i> )	Function
Package:LISP	
Extracts the imaginary part of NUMBER.	
<b>INTEGERP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is an integer (fixnum or bignum); NIL otherwise.	
<b>ASH</b> ( <i>integer count</i> )	Function
Package:LISP	
Shifts INTEGER left by COUNT places. Shifts right if COUNT is negative.	
<b>LCM</b> ( <i>integer</i> &rest <i>more-integers</i> )	Function
Package:LISP	
Returns the least common multiple of the arguments.	
<b>COS</b> ( <i>radians</i> )	Function
Package:LISP	
Returns the cosine of RADIANS.	

<b>DECF</b>	Special Form
Package:LISP	
Syntax:	
( <b>decf</b> <i>place</i> [ <i>delta</i> ])	
Subtracts the number produced by DELTA (which defaults to 1) from the number in PLACE.	
<b>ATAN</b> ( <i>x</i> &optional ( <i>y</i> <b>1</b> ))	Function
Package:LISP Returns the arc tangent of X/Y.	
<b>BOOLE-ANDC1</b>	Constant
Package:LISP Makes BOOLE return LOGANDC1 of INTEGER1 and INTEGER2.	
<b>COSH</b> ( <i>number</i> )	Function
Package:LISP Returns the hyperbolic cosine of NUMBER.	
<b>FLOAT-RADIX</b> ( <i>float</i> )	Function
Package:LISP	
Returns the representation radix (or base) of the floating-point number.	
<b>ATANH</b> ( <i>number</i> )	Function
Package:LISP	
Returns the hyperbolic arc tangent of NUMBER.	
<b>EVENP</b> ( <i>integer</i> )	Function
Package:LISP Returns T if INTEGER is even. Returns NIL if INTEGER is odd.	
<b>ZEROP</b> ( <i>number</i> )	Function
Package:LISP Returns T if NUMBER = 0; NIL otherwise.	
<b>FLOATP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is a floating-point number; NIL otherwise.	
<b>SXHASH</b> ( <i>object</i> )	Function
Package:LISP	
Computes a hash code for OBJECT and returns it as an integer.	
<b>BOOLE-1</b>	Constant
Package:LISP Makes BOOLE return INTEGER1.	
<b>MOST-POSITIVE-SINGLE-FLOAT</b>	Constant
Package:LISP Same as MOST-POSITIVE-LONG-FLOAT.	

<b>LOGANDC1</b> ( <i>integer1 integer2</i> )	Function
Package:LISP	
Returns the logical AND of (LOGNOT INTEGER1) and INTEGER2.	
<b>LEAST-POSITIVE-SINGLE-FLOAT</b>	Constant
Package:LISP Same as LEAST-POSITIVE-LONG-FLOAT.	
<b>COMPLEXP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is a complex number; NIL otherwise.	
<b>BOOLE-AND</b>	Constant
Package:LISP Makes BOOLE return LOGAND of INTEGER1 and INTEGER2.	
<b>MAX</b> ( <i>number &amp;rest more-numbers</i> )	Function
Package:LISP	
Returns the greatest of its arguments.	
<b>FLOAT-SIGN</b> ( <i>float1 &amp;optional (float2 (float 1 float1))</i> )	Function
Package:LISP	
Returns a floating-point number with the same sign as FLOAT1 and with the same absolute value as FLOAT2.	
<b>BOOLE-ANDC2</b>	Constant
Package:LISP Makes BOOLE return LOGANDC2 of INTEGER1 and INTEGER2.	
<b>DENOMINATOR</b> ( <i>rational</i> )	Function
Package:LISP	
Returns the denominator of RATIONAL as an integer.	
<b>FLOAT</b> ( <i>number &amp;optional other</i> )	Function
Package:LISP	
Converts a non-complex number to a floating-point number. If NUMBER is already a float, FLOAT simply returns NUMBER. Otherwise, the format of the returned float depends on OTHER; If OTHER is not provided, FLOAT returns a SINGLE-FLOAT. If OTHER is provided, the result is in the same float format as OTHER's.	
<b>ROUND</b> ( <i>number &amp;optional (divisor 1)</i> )	Function
Package:LISP	
Rounds NUMBER/DIVISOR to nearest integer. The second returned value is the remainder.	
<b>LOGAND</b> ( <i>&amp;rest integers</i> )	Function
Package:LISP	
Returns the bit-wise AND of its arguments.	

<b>BOOLE-2</b>	Constant
Package:LISP Makes BOOLE return INTEGER2.	
<b>* (&amp;rest numbers)</b>	Function
Package:LISP	
Returns the product of its arguments. With no args, returns 1.	
<b>&lt; (number &amp;rest more-numbers)</b>	Function
Package:LISP	
Returns T if its arguments are in strictly increasing order; NIL otherwise.	
<b>COMPLEX (realpart &amp;optional (imagpart 0))</b>	Function
Package:LISP	
Returns a complex number with the given real and imaginary parts.	
<b>SINGLE-FLOAT-EPSILON</b>	Constant
Package:LISP Same as LONG-FLOAT-EPSILON.	
<b>LOGANDC2 (integer1 integer2)</b>	Function
Package:LISP	
Returns the logical AND of INTEGER1 and (LOGNOT INTEGER2).	
<b>INTEGER-LENGTH (integer)</b>	Function
Package:LISP	
Returns the number of significant bits in the absolute value of INTEGER.	
<b>MOST-NEGATIVE-FIXNUM</b>	Constant
Package:LISP The fixnum closest in value to negative infinity.	
<b>LONG-FLOAT-NEGATIVE-EPSILON</b>	Constant
Package:LISP The smallest positive long-float that satisfies (not (= (float 1 e) (- (float 1 e) e))).	
<b>&gt;= (number &amp;rest more-numbers)</b>	Function
Package:LISP	
Returns T if arguments are in strictly non-increasing order; NIL otherwise.	
<b>BOOLE-NOR</b>	Constant
Package:LISP Makes BOOLE return LOGNOR of INTEGER1 and INTEGER2.	
<b>ACOS (number)</b>	Function
Package:LISP	
Returns the arc cosine of NUMBER.	

<b>MAKE-RANDOM-STATE</b> ( <i>&amp;optional (state *random-state*)</i> )	Function
Package:LISP	
Creates and returns a copy of the specified random state. If STATE is NIL, then the value of *RANDOM-STATE* is used. If STATE is T, then returns a random state object generated from the universal time.	
<b>EXPT</b> ( <i>base-number power-number</i> )	Function
Package:LISP	
Returns BASE-NUMBER raised to the power POWER-NUMBER.	
<b>SQRT</b> ( <i>number</i> )	Function
Package:LISP	
Returns the principal square root of NUMBER.	
<b>SCALE-FLOAT</b> ( <i>float integer</i> )	Function
Package:LISP	
Returns (* FLOAT (expt (float-radix FLOAT) INTEGER)).	
<b>ACOSH</b> ( <i>number</i> )	Function
Package:LISP	
Returns the hyperbolic arc cosine of NUMBER.	
<b>MOST-NEGATIVE-LONG-FLOAT</b>	Constant
Package:LISP The long-float closest in value to negative infinity.	
<b>LEAST-NEGATIVE-LONG-FLOAT</b>	Constant
Package:LISP The negative long-float closest in value to zero.	
<b>FFLOOR</b> ( <i>number &amp;optional (divisor 1)</i> )	Function
Package:LISP	
Same as FLOOR, but returns a float as the first value.	
<b>LOGNOR</b> ( <i>integer1 integer2</i> )	Function
Package:LISP	
Returns the complement of the logical OR of INTEGER1 and INTEGER2.	
<b>PARSE-INTEGER</b> ( <i>string &amp;key (start 0) (end (length string)) (radix 10) (junk-allowed nil)</i> )	Function
Package:LISP	
Parses STRING for an integer and returns it.	
<b>+</b> ( <i>&amp;rest numbers</i> )	Function
Package:LISP	
Returns the sum of its arguments. With no args, returns 0.	

<b>=</b> ( <i>number</i> &rest <i>more-numbers</i> )	Function
Package:LISP	
Returns T if all of its arguments are numerically equal; NIL otherwise.	
<b>NUMBERP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is any kind of number; NIL otherwise.	
<b>MOST-POSITIVE-DOUBLE-FLOAT</b>	Constant
Package:LISP Same as MOST-POSITIVE-LONG-FLOAT.	
<b>LOGTEST</b> ( <i>integer1 integer2</i> )	Function
Package:LISP	
Returns T if LOGAND of INTEGER1 and INTEGER2 is not zero; NIL otherwise.	
<b>RANDOM-STATE-P</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is a random-state object; NIL otherwise.	
<b>LEAST-POSITIVE-DOUBLE-FLOAT</b>	Constant
Package:LISP Same as LEAST-POSITIVE-LONG-FLOAT.	
<b>FLOAT-PRECISION</b> ( <i>float</i> )	Function
Package:LISP	
Returns the number of significant radix-B digits used to represent the significand F of the floating-point number, where B = (FLOAT-RADIX FLOAT).	
<b>BOOLE-XOR</b>	Constant
Package:LISP Makes BOOLE return LOGXOR of INTEGER1 and INTEGER2.	
<b>DPB</b> ( <i>newbyte bytespec integer</i> )	Function
Package:LISP	
Returns an integer computed by replacing the specified byte of INTEGER with NEW-BYTE.	
<b>ABS</b> ( <i>number</i> )	Function
Package:LISP	
Returns the absolute value of NUMBER.	
<b>CONJUGATE</b> ( <i>number</i> )	Function
Package:LISP	
Returns the complex conjugate of NUMBER.	



<b>CIS</b> ( <i>radians</i> ) Package:LISP Returns e raised to i*RADIANS.	Function
<b>ODDP</b> ( <i>integer</i> ) Package:LISP Returns T if INTEGER is odd; NIL otherwise.	Function
<b>RATIONALIZE</b> ( <i>number</i> ) Package:LISP Converts NUMBER into rational approximately and returns it.	Function
<b>ISQRT</b> ( <i>integer</i> ) Package:LISP Returns the greatest integer less than or equal to the square root of the given non-negative integer.	Function
<b>LOGXOR</b> (&rest <i>integers</i> ) Package:LISP Returns the bit-wise EXCLUSIVE OR of its arguments.	Function
<b>&gt;</b> ( <i>number</i> &rest <i>more-numbers</i> ) Package:LISP Returns T if its arguments are in strictly decreasing order; NIL otherwise.	Function
<b>LOGBITP</b> ( <i>index integer</i> ) Package:LISP Returns T if the INDEX-th bit of INTEGER is 1.	Function
<b>DOUBLE-FLOAT-EPSILON</b> Package:LISP Same as LONG-FLOAT-EPSILON.	Constant
<b>LOGCOUNT</b> ( <i>integer</i> ) Package:LISP If INTEGER is negative, returns the number of 0 bits. Otherwise, returns the number of 1 bits.	Function
<b>GCD</b> (&rest <i>integers</i> ) Package:LISP Returns the greatest common divisor of INTEGERS.	Function
<b>RATIONALP</b> ( <i>x</i> ) Package:LISP Returns T if X is an integer or a ratio; NIL otherwise.	Function

<b>MOD</b> ( <i>number divisor</i> )	Function
Package:LISP	
Returns the second result of (FLOOR NUMBER DIVISOR).	
<b>MODF</b> ( <i>number</i> )	Function
Package:SYSTEM	
Returns the integer and fractional part of a floating point number mod 1.0.	
<b>BOOLE-ORC1</b>	Constant
Package:LISP Makes BOOLE return LOGORC1 of INTEGER1 and INTEGER2.	
<b>SINGLE-FLOAT-NEGATIVE-EPSILON</b>	Constant
Package:LISP Same as LONG-FLOAT-NEGATIVE-EPSILON.	
<b>FLOOR</b> ( <i>number</i> &optional ( <i>divisor 1</i> ))	Function
Package:LISP	
Returns the largest integer not larger than the NUMBER divided by DIVISOR. The second returned value is (- NUMBER (* first-value DIVISOR)).	
<b>PLUSP</b> ( <i>number</i> )	Function
Package:LISP	
Returns T if NUMBER > 0; NIL otherwise.	
<b>FLOAT-DIGITS</b> ( <i>float</i> )	Function
Package:LISP	
Returns the number of radix-B digits used to represent the significand F of the floating-point number, where B = (FLOAT-RADIX FLOAT).	
<b>RANDOM</b> ( <i>number</i> &optional ( <i>state *random-state*</i> ))	Function
Package:LISP	
Generates a uniformly distributed pseudo-random number between zero (inclusive) and NUMBER (exclusive), by using the random state object STATE.	



## 2 Sequences and Arrays and Hash Tables

<b>VECTOR</b> ( <i>&amp;rest objects</i> )	Function
Package:LISP	
Constructs a Simple-Vector from the given objects.	
<b>SUBSEQ</b> ( <i>sequence start</i> &optional ( <i>end (length sequence)</i> ))	Function
Package:LISP	
Returns a copy of a subsequence of SEQUENCE between START (inclusive) and END (exclusive).	
<b>COPY-SEQ</b> ( <i>sequence</i> )	Function
Package:LISP	
Returns a copy of SEQUENCE.	
<b>POSITION</b> ( <i>item sequence</i> &key ( <i>from-end nil</i> ) ( <i>test #'eql</i> ) <i>test-not</i> ( <i>start 0</i> ) ( <i>end (length sequence)</i> ) ( <i>key #'identity</i> ))	Function
Package:LISP	
Returns the index of the first element in SEQUENCE that satisfies TEST with ITEM; NIL if no such element exists.	
<b>ARRAY-RANK</b> ( <i>array</i> )	Function
Package:LISP	
Returns the number of dimensions of ARRAY.	
<b>SBIT</b> ( <i>simple-bit-array</i> &rest <i>subscripts</i> )	Function
Package:LISP	
Returns the bit from SIMPLE-BIT-ARRAY at SUBSCRIPTS.	
<b>STRING-CAPITALIZE</b> ( <i>string</i> &key ( <i>start 0</i> ) ( <i>end (length string)</i> ))	Function
Package:LISP	
Returns a copy of STRING with the first character of each word converted to upper-case, and remaining characters in the word converted to lower case.	
<b>NSUBSTITUTE-IF-NOT</b> ( <i>new test sequence</i> &key ( <i>from-end nil</i> ) ( <i>start 0</i> ) ( <i>end (length sequence)</i> ) ( <i>count most-positive-fixnum</i> ) ( <i>key #'identity</i> ))	Function
Package:LISP	
Returns a sequence of the same kind as SEQUENCE with the same elements except that all elements not satisfying TEST are replaced with NEWITEM. SEQUENCE may be destroyed.	

**FIND-IF** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (key #'identity)*) Function

Package:LISP

Returns the index of the first element in SEQUENCE that satisfies TEST; NIL if no such element exists.

**BIT-EQV** (*bit-array1 bit-array2 &optional (result-bit-array nil)*) Function

Package:LISP

Performs a bit-wise logical EQV on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.

**STRING<** (*string1 string2 &key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))*) Function

Package:LISP

If STRING1 is lexicographically less than STRING2, then returns the longest common prefix of the strings. Otherwise, returns NIL.

**REVERSE** (*sequence*) Function

Package:LISP

Returns a new sequence containing the same elements as SEQUENCE but in reverse order.

**NSTRING-UPCASE** (*string &key (start 0) (end (length string))*) Function

Package:LISP

Returns STRING with all lower case characters converted to uppercase.

**STRING>=** (*string1 string2 &key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))*) Function

Package:LISP

If STRING1 is lexicographically greater than or equal to STRING2, then returns the longest common prefix of the strings. Otherwise, returns NIL.

**ARRAY-ROW-MAJOR-INDEX** (*array &rest subscripts*) Function

Package:LISP

Returns the index into the data vector of ARRAY for the element of ARRAY specified by SUBSCRIPTS.

**ARRAY-DIMENSION** (*array axis-number*) Function

Package:LISP

Returns the length of AXIS-NUMBER of ARRAY.

Returns the first element in SEQUENCE satisfying TEST with ITEM; NIL if no such element exists.

Similar to `STRING=`, but ignores cases.

Returns a copy of `STRING` with the characters in `CHAR-BAG` removed from the right end.

Returns a sequence formed by destructively removing the elements not satisfying TEST from SEQUENCE.

Returns a copy of SEQUENCE with elements not satisfying TEST removed.

Returns T if the two strings are character-wise CHAR=; NIL otherwise.

Returns a sequence of the same kind as SEQUENCE with the same elements except that all elements satisfying TEST are replaced with NEWITEM. SEQUENCE may be destroyed.

otherwise.

**MAKE-STRING** (*size &key (initial-element #\Space)*) Function  
 Package:LISP

Creates and returns a new string of SIZE length whose elements are all INITIAL-ELEMENT.

**NSUBSTITUTE** (*newitem olditem sequence &key (from-end nil) (test #'eql) test-not (start 0) (end (length sequence)) (count most-positive-fixnum) (key #'identity)*) Function  
 Package:LISP

Returns a sequence of the same kind as SEQUENCE with the same elements except that OLDITEMS are replaced with NEWITEM. SEQUENCE may be destroyed.

**STRING-EQUAL** (*string1 string2 &key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))*) Function  
 Package:LISP

Given two strings (string1 and string2), and optional integers start1, start2, end1 and end2, compares characters in string1 to characters in string2 (using char-equal).

**STRING-NOT-GREATERP** (*string1 string2 &key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))*) Function  
 Package:LISP

Similar to STRING<=, but ignores cases.

**STRING>** (*string1 string2 &key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))*) Function  
 Package:LISP

If STRING1 is lexicographically greater than STRING2, then returns the longest common prefix of the strings. Otherwise, returns NIL.

**STRINGP** (*x*) Function  
 Package:LISP

Returns T if X is a string; NIL otherwise.

**DELETE-IF** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (count most-positive-fixnum) (key #'identity)*) Function  
 Package:LISP

Returns a sequence formed by removing the elements satisfying TEST destructively from SEQUENCE.

**SIMPLE-STRING-P** (*x*) Function  
 Package:LISP

Returns T if X is a simple string; NIL otherwise.

- REMOVE-IF** (*test sequence* &key (*from-end* **nil**) (**start 0**) (**end (length sequence)**)) (**count most-positive-fixnum**) (**key #'identity**))      Function  
 Package:LISP  
 Returns a copy of SEQUENCE with elements satisfying TEST removed.
- HASH-TABLE-COUNT** (*hash-table*)      Function  
 Package:LISP  
 Returns the number of entries in the given Hash-Table.
- ARRAY-DIMENSIONS** (*array*)      Function  
 Package:LISP  
 Returns a list whose elements are the dimensions of ARRAY
- SUBSTITUTE-IF-NOT** (*new test sequence* &key (*from-end* **nil**) (**start 0**) (**end (length sequence)**)) (**count most-positive-fixnum**) (**key #'identity**))      Function  
 Package:LISP  
 Returns a sequence of the same kind as SEQUENCE with the same elements except that all elements not satisfying TEST are replaced with NEWITEM.
- ADJUSTABLE-ARRAY-P** (*array*)      Function  
 Package:LISP  
 Returns T if ARRAY is adjustable; NIL otherwise.
- SVREF** (*simple-vector index*)      Function  
 Package:LISP  
 Returns the INDEX-th element of SIMPLE-VECTOR.
- VECTOR-PUSH-EXTEND** (*new-element vector* &optional (*extension (length vector)*))      Function  
 Package:LISP  
 Similar to VECTOR-PUSH except that, if the fill pointer gets too large, extends VECTOR rather than simply returns NIL.
- DELETE** (*item sequence* &key (*from-end* **nil**) (**test #'eql**) **test-not** (**start 0**) (**end (length sequence)**)) (**count most-positive-fixnum**) (**key #'identity**))      Function  
 Package:LISP  
 Returns a sequence formed by removing the specified ITEM destructively from SEQUENCE.
- REMOVE** (*item sequence* &key (*from-end* **nil**) (**test #'eql**) **test-not** (**start 0**) (**end (length sequence)**)) (**count most-positive-fixnum**) (**key #'identity**))      Function  
 Package:LISP  
 Returns a copy of SEQUENCE with ITEM removed.



- STRING** (*x*) Function  
 Package:LISP  
 Coerces X into a string. If X is a string, then returns X itself. If X is a symbol, then returns X's print name. If X is a character, then returns a one element string containing that character. Signals an error if X cannot be coerced into a string.
- STRING-UPCASE** (*string* &key (*start* 0) (*end* (**length** *string*))) Function  
 Package:LISP  
 Returns a copy of STRING with all lower case characters converted to uppercase.
- GETHASH** (*key hash-table* &optional (*default* **nil**)) Function  
 Package:LISP  
 Finds the entry in HASH-TABLE whose key is KEY and returns the associated value and T, as multiple values. Returns DEFAULT and NIL if there is no such entry.
- MAKE-HASH-TABLE** (&key (*test* 'eql) (*size* 1024) (*rehash-size* 1.5) (*rehash-threshold* 0.7)) Function  
 Package:LISP  
 Creates and returns a hash table.
- STRING/=** (*string1 string2* &key (*start1* 0) (*end1* (**length** *string1*)) (*start2* 0) (*end2* (**length** *string2*))) Function  
 Package:LISP  
 Returns NIL if STRING1 and STRING2 are character-wise CHAR=. Otherwise, returns the index to the longest common prefix of the strings.
- STRING-GREATERP** (*string1 string2* &key (*start1* 0) (*end1* (**length** *string1*)) (*start2* 0) (*end2* (**length** *string2*))) Function  
 Package:LISP  
 Similar to STRING>, but ignores cases.
- ELT** (*sequence index*) Function  
 Package:LISP  
 Returns the INDEX-th element of SEQUENCE.
- MAKE-ARRAY** (*dimensions* &key (*element-type* *t*) *initial-element* (*initial-contents* **nil**) (*adjustable* **nil**) (*fill-pointer* **nil**) (*displaced-to* **nil**) (*displaced-index-offset* 0) *static*) Function  
 Package:LISP  
 Creates an array of the specified DIMENSIONS. The default for INITIAL-ELEMENT depends on ELEMENT-TYPE. MAKE-ARRAY will always try to find the 'best' array to accommodate the element-type specified. For example on a SUN element-type (mod 1) -> bit (integer 0 10) -> unsigned-char (integer -3 10) -> signed-char si::best-array-element-type is the function doing this. It is also used by the

compiler, for coercing array element types. If you are going to declare an array you should use the same element type as was used in making it. eg (setq my-array (make-array 4 :element-type '(integer 0 10))) (the (array (integer 0 10)) my-array) When wanting to optimize references to an array you need to declare the array eg: (the (array (integer -3 10)) my-array) if ar were constructed using the (integer -3 10) element-type. You could of course have used signed-char, but since the ranges may be implementation dependent it is better to use -3 10 range. MAKE-ARRAY needs to do some calculation with the element-type if you don't provide a primitive data-type. One way of doing this in a machine independent fashion:

```
(defvar *my-elt-type* #. (array-element-type (make-array 1 :element-type '(integer
-3 10))))
```

Then calls to (make-array n :element-type \*my-elt-type\*) will not have to go through a type inclusion computation. The keyword STATIC (GCL specific) if non nil, will cause the array body to be non relocatable.

**NSTRING-DOWNCASE** (*string* &key (*start* 0) (*end* (*length* *string*))) Function

Package:LISP Returns STRING with all upper case characters converted to lowercase.

**ARRAY-IN-BOUNDS-P** (*array* &rest *subscripts*) Function

Package:LISP Returns T if SUBSCRIPTS are valid subscripts for ARRAY; NIL otherwise.

**SORT** (*sequence predicate* &key (*key* #'identity)) Function

Package:LISP Destructively sorts SEQUENCE. PREDICATE should return non-NIL if its first argument is to precede its second argument.

**HASH-TABLE-P** (*x*) Function

Package:LISP

Returns T if X is a hash table object; NIL otherwise.

**COUNT-IF-NOT** (*test sequence* &key (*from-end* nil) (*start* 0) (*end* (*length* *sequence*)) (*key* #'identity)) Function

Package:LISP

Returns the number of elements in SEQUENCE not satisfying TEST.

**FILL-POINTER** (*vector*) Function

Package:LISP

Returns the fill pointer of VECTOR.

**ARRAYP** (*x*) Function

Package:LISP

Returns T if X is an array; NIL otherwise.

**REPLACE** (*sequence1 sequence2 &key (start1 0) (end1 (length sequence1)) (start2 0) (end2 (length sequence2))*) Function

Package:LISP

Destructively modifies SEQUENCE1 by copying successive elements into it from SEQUENCE2.

**BIT-XOR** (*bit-array1 bit-array2 &optional (result-bit-array nil)*) Function

Package:LISP

Performs a bit-wise logical XOR on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.

**CLRHASH** (*hash-table*) Function

Package:LISP

Removes all entries of HASH-TABLE and returns the hash table itself.

**SUBSTITUTE-IF** (*newitem test sequence &key (from-end nil) (start 0) (end (length sequence)) (count most-positive-fixnum) (key #'identity)*) Function

Package:LISP

Returns a sequence of the same kind as SEQUENCE with the same elements except that all elements satisfying TEST are replaced with NEWITEM.

**MISMATCH** (*sequence1 sequence2 &key (from-end nil) (test #'eql) test-not (start1 0) (start2 0) (end1 (length sequence1)) (end2 (length sequence2)) (key #'identity)*) Function

Package:LISP

The specified subsequences of SEQUENCE1 and SEQUENCE2 are compared element-wise. If they are of equal length and match in every element, the result is NIL. Otherwise, the result is a non-negative integer, the index within SEQUENCE1 of the leftmost position at which they fail to match; or, if one is shorter than and a matching prefix of the other, the index within SEQUENCE1 beyond the last position tested is returned.

**ARRAY-TOTAL-SIZE-LIMIT** Constant

Package:LISP The exclusive upper bound on the total number of elements of an array.

**VECTOR-POP** (*vector*) Function

Package:LISP

Attempts to decrease the fill-pointer of VECTOR by 1 and returns the element pointed to by the new fill pointer. Signals an error if the old value of the fill pointer is 0.

**SUBSTITUTE** (*newitem olditem sequence &key (from-end nil) (test #'eql) test-not (start 0) (end (length sequence)) (count most-positive-fixnum) (key #'identity)*) Function

Package:LISP

Returns a sequence of the same kind as SEQUENCE with the same elements except that OLDITEMs are replaced with NEWITEM.

**ARRAY-HAS-FILL-POINTER-P** (*array*) Function

Package:LISP

Returns T if ARRAY has a fill pointer; NIL otherwise.

**CONCATENATE** (*result-type &rest sequences*) Function

Package:LISP

Returns a new sequence of the specified RESULT-TYPE, consisting of all elements in SEQUENCEs.

**VECTOR-PUSH** (*new-element vector*) Function

Package:LISP

Attempts to set the element of ARRAY designated by its fill pointer to NEW-ELEMENT and increments the fill pointer by one. Returns NIL if the fill pointer is too large. Otherwise, returns the new fill pointer value.

**STRING-TRIM** (*char-bag string*) Function

Package:LISP

Returns a copy of STRING with the characters in CHAR-BAG removed from both ends.

**ARRAY-ELEMENT-TYPE** (*array*) Function

Package:LISP

Returns the type of the elements of ARRAY

**NOTANY** (*predicate sequence &rest more-sequences*) Function

Package:LISP

Returns T if none of the elements in SEQUENCEs satisfies PREDICATE; NIL otherwise.

**BIT-NOT** (*bit-array &optional (result-bit-array nil)*) Function

Package:LISP

Performs a bit-wise logical NOT in the elements of BIT-ARRAY. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.

**BIT-ORC1** (*bit-array1 bit-array2 &optional (result-bit-array nil)*) Function

Package:LISP

Performs a bit-wise logical ORC1 on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.

- COUNT-IF** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns the number of elements in SEQUENCE satisfying TEST.
- MAP** (*result-type function sequence &rest more-sequences*) Function  
 Package:LISP  
 FUNCTION must take as many arguments as there are sequences provided. The result is a sequence such that the i-th element is the result of applying FUNCTION to the i-th elements of the SEQUENCES.
- ARRAY-RANK-LIMIT** Constant  
 Package:LISP The exclusive upper bound on the rank of an array.
- COUNT** (*item sequence &key (from-end nil) (test #'eql) test-not (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns the number of elements in SEQUENCE satisfying TEST with ITEM.
- BIT-VECTOR-P** (*x*) Function  
 Package:LISP  
 Returns T if X is a bit vector; NIL otherwise.
- NSTRING-CAPITALIZE** (*string &key (start 0) (end (length string))*) Function  
 Package:LISP  
 Returns STRING with the first character of each word converted to upper-case, and remaining characters in the word converted to lower case.
- ADJUST-ARRAY** (*array dimensions &key (element-type (array-element-type array)) initial-element (initial-contents nil) (fill-pointer nil) (displaced-to nil) (displaced-index-offset 0)*) Function  
 Package:LISP  
 Adjusts the dimensions of ARRAY to the given DIMENSIONS. The default value of INITIAL-ELEMENT depends on ELEMENT-TYPE.
- SEARCH** (*sequence1 sequence2 &key (from-end nil) (test #'eql) test-not (start1 0) (start2 0) (end1 (length sequence1)) (end2 (length sequence2)) (key #'identity)*) Function  
 Package:LISP  
 A search is conducted for the first subsequence of SEQUENCE2 which element-wise matches SEQUENCE1. If there is such a subsequence in SEQUENCE2, the index of the its leftmost element is returned; otherwise, NIL is returned.

- SIMPLE-BIT-VECTOR-P** (*x*) Function  
 Package:LISP  
 Returns T if X is a simple bit-vector; NIL otherwise.
- MAKE-SEQUENCE** (*type length &key initial-element*) Function  
 Package:LISP  
 Returns a sequence of the given TYPE and LENGTH, with elements initialized to INITIAL-ELEMENT. The default value of INITIAL-ELEMENT depends on TYPE.
- BIT-ORC2** (*bit-array1 bit-array2 &optional (result-bit-array nil)*) Function  
 Package:LISP  
 Performs a bit-wise logical ORC2 on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.
- NREVERSE** (*sequence*) Function  
 Package:LISP  
 Returns a sequence of the same elements as SEQUENCE but in reverse order. SEQUENCE may be destroyed.
- ARRAY-DIMENSION-LIMIT** Constant  
 Package:LISP The exclusive upper bound of the array dimension.
- NOTEVERY** (*predicate sequence &rest more-sequences*) Function  
 Package:LISP  
 Returns T if at least one of the elements in SEQUENCES does not satisfy PREDICATE; NIL otherwise.
- POSITION-IF-NOT** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns the index of the first element in SEQUENCE that does not satisfy TEST; NIL if no such element exists.
- STRING-DOWNCASE** (*string &key (start 0) (end (length string))*) Function  
 Package:LISP  
 Returns a copy of STRING with all upper case characters converted to lowercase.
- BIT** (*bit-array &rest subscripts*) Function  
 Package:LISP  
 Returns the bit from BIT-ARRAY at SUBSCRIPTS.

<b>STRING-NOT-LESSP</b> ( <i>string1 string2 &amp;key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2)))</i> )	Function
Package:LISP	
Similar to STRING>=, but ignores cases.	
<b>CHAR</b> ( <i>string index</i> )	Function
Package:LISP	
Returns the INDEX-th character in STRING.	
<b>AREF</b> ( <i>array &amp;rest subscripts</i> )	Function
Package:LISP	
Returns the element of ARRAY specified by SUBSCRIPTS.	
<b>FILL</b> ( <i>sequence item &amp;key (start 0) (end (length sequence))</i> )	Function
Package:LISP	
Replaces the specified elements of SEQUENCE all with ITEM.	
<b>STABLE-SORT</b> ( <i>sequence predicate &amp;key (key #'identity)</i> )	Function
Package:LISP	
Destructively sorts SEQUENCE. PREDICATE should return non-NIL if its first argument is to precede its second argument.	
<b>BIT-IOR</b> ( <i>bit-array1 bit-array2 &amp;optional (result-bit-array nil)</i> )	Function
Package:LISP	
Performs a bit-wise logical IOR on the elements of BIT-ARRAY1 and BIT-ARRAY2. Puts the results into a new bit array if RESULT-BIT-ARRAY is NIL, into BIT-ARRAY1 if RESULT-BIT-ARRAY is T, or into RESULT-BIT-ARRAY otherwise.	
<b>REMHASH</b> ( <i>key hash-table</i> )	Function
Package:LISP	
Removes any entry for KEY in HASH-TABLE. Returns T if such an entry existed; NIL otherwise.	
<b>VECTORP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is a vector; NIL otherwise.	
<b>STRING&lt;=</b> ( <i>string1 string2 &amp;key (start1 0) (end1 (length string1)) (start2 0) (end2 (length string2))</i> )	Function
Package:LISP	
If STRING1 is lexicographically less than or equal to STRING2, then returns the longest common prefix of the two strings. Otherwise, returns NIL.	

- SIMPLE-VECTOR-P** (*x*) Function  
 Package:LISP  
 Returns T if X is a simple vector; NIL otherwise.
- STRING-LEFT-TRIM** (*char-bag string*) Function  
 Package:LISP  
 Returns a copy of STRING with the characters in CHAR-BAG removed from the left end.
- ARRAY-TOTAL-SIZE** (*array*) Function  
 Package:LISP  
 Returns the total number of elements of ARRAY.
- FIND-IF-NOT** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns the index of the first element in SEQUENCE that does not satisfy TEST; NIL if no such element exists.
- DELETE-DUPPLICATES** (*sequence &key (from-end nil) (test #'eql) test-not (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns a sequence formed by removing duplicated elements destructively from SEQUENCE.
- REMOVE-DUPPLICATES** (*sequence &key (from-end nil) (test #'eql) test-not (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 The elements of SEQUENCE are examined, and if any two match, one is discarded. Returns the resulting sequence.
- POSITION-IF** (*test sequence &key (from-end nil) (start 0) (end (length sequence)) (key #'identity)*) Function  
 Package:LISP  
 Returns the index of the first element in SEQUENCE that satisfies TEST; NIL if no such element exists.
- MERGE** (*result-type sequence1 sequence2 predicate &key (key #'identity)*) Function  
 Package:LISP  
 SEQUENCE1 and SEQUENCE2 are destructively merged into a sequence of type RESULT-TYPE using PREDICATE to order the elements.



- EVERY** (*predicate sequence* &rest *more-sequences*) Function  
Package:LISP  
Returns T if every elements of SEQUENCEs satisfy PREDICATE; NIL otherwise.
- REDUCE** (*function sequence* &key (*from-end* **nil**) (**start** 0) (**end** (**length** **sequence**)) **initial-value**) Function  
Package:LISP  
Combines all the elements of SEQUENCE using a binary operation FUNCTION. If INITIAL-VALUE is supplied, it is logically placed before the SEQUENCE.
- STRING-LESSP** (*string1 string2* &key (*start1* 0) (**end1** (**length** **string1**)) (*start2* 0) (**end2** (**length** **string2**))) Function  
Package:LISP  
Similar to STRING<, but ignores cases.

## 3 Characters

- NAME-CHAR** (*name*) Function  
Package:LISP  
Given an argument acceptable to string, Returns a character object whose name is NAME if one exists. Returns NIL otherwise. NAME must be an object that can be coerced to a string.
- CHAR-NAME** (*char*) Function  
Package:LISP  
Returns the name for CHAR as a string; NIL if CHAR has no name. Only #\Backspace, #\Tab, #\Newline (or #\Linefeed), #\Page, #\Return, and #\Rubout have names.
- BOTH-CASE-P** (*char*) Function  
Package:LISP  
Returns T if CHAR is an alphabetic character; NIL otherwise. Equivalent to ALPHA-CHAR-P.
- SCHAR** (*simple-string index*) Function  
Package:LISP  
Returns the character object representing the INDEX-th character in STRING. This is faster than CHAR.
- CHAR-SUPER-BIT** Constant  
Package:LISP The bit that indicates a super character.
- CHAR-FONT-LIMIT** Constant  
Package:LISP The upper exclusive bound on values produced by CHAR-FONT.
- CHAR-DOWNCASE** (*char*) Function  
Package:LISP  
Returns the lower-case equivalent of CHAR, if any. If not, simply returns CHAR.
- STRING-CHAR-P** (*char*) Function  
Package:LISP  
Returns T if CHAR can be stored in a string. In GCL, this function always returns T since any character in GCL can be stored in a string.
- CHAR-NOT-LESSP** (*char &rest more-chars*) Function  
Package:LISP  
Returns T if the codes of CHARs are in strictly non-increasing order; NIL otherwise. For a lower-case character, the code of its upper-case equivalent is used.

<b>DISASSEMBLE</b> ( <i>thing</i> )	Function
Package:LISP	
Compiles the form specified by THING and prints the intermediate C language code for that form. But does NOT install the result of compilation. If THING is a symbol that names a not-yet-compiled function, the function definition is disassembled. If THING is a lambda expression, it is disassembled as a function definition. Otherwise, THING itself is disassembled as a top-level form.	
<b>LOWER-CASE-P</b> ( <i>char</i> )	Function
Package:LISP	
Returns T if CHAR is a lower-case character; NIL otherwise.	
<b>CHAR&lt;=</b> ( <i>char &amp;rest more-chars</i> )	Function
Package:LISP	
Returns T if the codes of CHARs are in strictly non-decreasing order; NIL otherwise.	
<b>CHAR-HYPER-BIT</b>	Constant
Package:LISP The bit that indicates a hyper character.	
<b>CODE-CHAR</b> ( <i>code &amp;optional (bits 0) (font 0)</i> )	Function
Package:LISP	
Returns a character object with the specified code, if any. If not, returns NIL.	
<b>CHAR-CODE</b> ( <i>char</i> )	Function
Package:LISP	
Returns the code attribute of CHAR.	
<b>CHAR-CONTROL-BIT</b>	Constant
Package:LISP The bit that indicates a control character.	
<b>CHAR-LESSP</b> ( <i>char &amp;rest more-chars</i> )	Function
Package:LISP	
Returns T if the codes of CHARs are in strictly increasing order; NIL otherwise. For a lower-case character, the code of its upper-case equivalent is used.	
<b>CHAR-FONT</b> ( <i>char</i> )	Function
Package:LISP	
Returns the font attribute of CHAR.	
<b>CHAR&lt;</b> ( <i>char &amp;rest more-chars</i> )	Function
Package:LISP	
Returns T if the codes of CHARs are in strictly increasing order; NIL otherwise.	

- CHAR>=** (*char* &rest *more-chars*) Function  
 Package:LISP  
 Returns T if the codes of CHARs are in strictly non-increasing order; NIL otherwise.
- CHAR-META-BIT** Constant  
 Package:LISP The bit that indicates a meta character.
- GRAPHIC-CHAR-P** (*char*) Function  
 Package:LISP  
 Returns T if CHAR is a printing character, i.e., #\Space through #\~; NIL otherwise.
- CHAR-NOT-EQUAL** (*char* &rest *more-chars*) Function  
 Package:LISP  
 Returns T if no two of CHARs are the same character; NIL otherwise. Upper case character and its lower case equivalent are regarded the same.
- CHAR-BITS-LIMIT** Constant  
 Package:LISP The upper exclusive bound on values produced by CHAR-BITS.
- CHARACTERP** (*x*) Function  
 Package:LISP  
 Returns T if X is a character; NIL otherwise.
- CHAR=** (*char* &rest *more-chars*) Function  
 Package:LISP  
 Returns T if all CHARs are the same character; NIL otherwise.
- ALPHA-CHAR-P** (*char*) Function  
 Package:LISP  
 Returns T if CHAR is an alphabetic character, A-Z or a-z; NIL otherwise.
- UPPER-CASE-P** (*char*) Function  
 Package:LISP  
 Returns T if CHAR is an upper-case character; NIL otherwise.
- CHAR-BIT** (*char name*) Function  
 Package:LISP  
 Returns T if the named bit is on in the character CHAR; NIL otherwise. In GCL, this function always returns NIL.
- MAKE-CHAR** (*char* &optional (*bits* 0) (*font* 0)) Function  
 Package:LISP  
 Returns a character object with the same code attribute as CHAR and with the specified BITS and FONT attributes.

- CHARACTER** (*x*) Function  
Package:LISP  
Coerces *X* into a character object if possible.
- CHAR-EQUAL** (*char* &rest *more-chars*) Function  
Package:LISP  
Returns T if all of its arguments are the same character; NIL otherwise. Upper case character and its lower case equivalent are regarded the same.
- CHAR-NOT-GREATERP** (*char* &rest *more-chars*) Function  
Package:LISP  
Returns T if the codes of CHARs are in strictly non-decreasing order; NIL otherwise. For a lower-case character, the code of its upper-case equivalent is used.
- CHAR>** (*char* &rest *more-chars*) Function  
Package:LISP  
Returns T if the codes of CHARs are in strictly decreasing order; NIL otherwise.
- STANDARD-CHAR-P** (*char*) Function  
Package:LISP  
Returns T if CHAR is a standard character, i.e., one of the 95 ASCII printing characters #\Space to #\~ and #Newline; NIL otherwise.
- CHAR-UPCASE** (*char*) Function  
Package:LISP  
Returns the upper-case equivalent of CHAR, if any. If not, simply returns CHAR.
- DIGIT-CHAR-P** (*char* &optional (*radix* 10)) Function  
Package:LISP  
If CHAR represents a digit in RADIX, then returns the weight as an integer. Otherwise, returns nil.
- CHAR/=** (*char* &rest *more-chars*) Function  
Package:LISP  
Returns T if no two of CHARs are the same character; NIL otherwise.
- CHAR-GREATERP** (*char* &rest *more-chars*) Function  
Package:LISP  
Returns T if the codes of CHARs are in strictly decreasing order; NIL otherwise. For a lower-case character, the code of its upper-case equivalent is used.
- ALPHANUMERICP** (*char*) Function  
Package:LISP  
Returns T if CHAR is either numeric or alphabetic; NIL otherwise.

- CHAR-BITS** (*char*) Function  
Package:LISP  
Returns the bits attribute (which is always 0 in GCL) of CHAR.
- DIGIT-CHAR** (*digit* &optional (*radix* **10**) (*font* **0**)) Function  
Package:LISP  
Returns a character object that represents the DIGIT in the specified RADIX. Returns NIL if no such character exists.
- SET-CHAR-BIT** (*char name newvalue*) Function  
Package:LISP  
Returns a character just like CHAR except that the named bit is set or cleared, according to whether NEWVALUE is non-NIL or NIL. This function is useless in GCL.



## 4 Lists

<b>NINTERSECTION</b> ( <i>list1 list2</i> &key ( <i>test</i> #' <b>eq</b> ) <b>test-not</b> ( <b>key</b> #' <b>identity</b> )) Package:LISP Returns the intersection of LIST1 and LIST2. LIST1 may be destroyed.	Function
<b>RASSOC-IF</b> ( <i>predicate alist</i> ) Package:LISP Returns the first cons in ALIST whose cdr satisfies PREDICATE.	Function
<b>MAKE-LIST</b> ( <i>size</i> &key ( <i>initial-element</i> <b>nil</b> )) Package:LISP Creates and returns a list containing SIZE elements, each of which is initialized to INITIAL-ELEMENT.	Function
<b>NTH</b> ( <i>n list</i> ) Package:LISP Returns the N-th element of LIST, where the car of LIST is the zeroth element.	Function
<b>CAAR</b> ( <i>x</i> ) Package:LISP Equivalent to (CAR (CAR X)).	Function
<b>NULL</b> ( <i>x</i> ) Package:LISP Returns T if X is NIL; NIL otherwise.	Function
<b>FIFTH</b> ( <i>x</i> ) Package:LISP Equivalent to (CAR (CDDDDR X)).	Function
<b>NCONC</b> (&rest <i>lists</i> ) Package:LISP Concatenates LISTS by destructively modifying them.	Function
<b>TAILP</b> ( <i>sublist list</i> ) Package:LISP Returns T if SUBLIST is one of the conses in LIST; NIL otherwise.	Function
<b>CONSP</b> ( <i>x</i> ) Package:LISP Returns T if X is a cons; NIL otherwise.	Function



<b>TENTH</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CADR (CDDDDR (CDDDDR X))).	
<b>LISTP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is either a cons or NIL; NIL otherwise.	
<b>MAPCAN</b> ( <i>fun list &amp;rest more-lists</i> )	Function
Package:LISP	
Applies FUN to successive cars of LISTS, NCONCs the results, and returns it.	
<b>EIGHTH</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CADDR (CDDDDR X)).	
<b>LENGTH</b> ( <i>sequence</i> )	Function
Package:LISP	
Returns the length of SEQUENCE.	
<b>RASSOC</b> ( <i>item alist &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP	
Returns the first cons in ALIST whose cdr is equal to ITEM.	
<b>NSUBST-IF-NOT</b> ( <i>new test tree &amp;key (key #'identity)</i> )	Function
Package:LISP	
Substitutes NEW for subtrees of TREE that do not satisfy TEST.	
<b>NBUTLAST</b> ( <i>list &amp;optional (n 1)</i> )	Function
Package:LISP	
Changes the cdr of the N+1 th cons from the end of the list LIST to NIL. Returns the whole list.	
<b>CDR</b> ( <i>list</i> )	Function
Package:LISP	
Returns the cdr of LIST. Returns NIL if LIST is NIL.	
<b>MAPC</b> ( <i>fun list &amp;rest more-lists</i> )	Function
Package:LISP	
Applies FUN to successive cars of LISTS. Returns the first LIST.	
<b>MAPL</b> ( <i>fun list &amp;rest more-lists</i> )	Function
Package:LISP	
Applies FUN to successive cdrs of LISTS. Returns the first LIST.	

<b>CONS</b> ( <i>x y</i> )	Function
Package:LISP	
Returns a new cons whose car and cdr are X and Y, respectively.	
<b>LIST</b> (&rest <i>args</i> )	Function
Package:LISP	
Returns a list of its arguments	
<b>THIRD</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CADDR X).	
<b>CDDAAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CDR (CAR (CAR X)))).	
<b>CDADAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CAR (CDR (CAR X)))).	
<b>CDAADR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CAR (CAR (CDR X)))).	
<b>CADDAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CDR (CDR (CAR X)))).	
<b>CADADR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CDR (CAR (CDR X)))).	
<b>CAADDR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CAR (CDR (CDR X)))).	
<b>NTHCDR</b> ( <i>n list</i> )	Function
Package:LISP	
Returns the result of performing the CDR operation N times on LIST.	
<b>PAIRLIS</b> ( <i>keys data &amp;optional (alist nil)</i> )	Function
Package:LISP	
Constructs an association list from KEYS and DATA adding to ALIST.	

<b>SEVENTH</b> ( <i>x</i> ) Package:LISP Equivalent to (CADDR (CDDDDR X)).	Function
<b>SUBSETP</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> ) Package:LISP Returns T if every element of LIST1 appears in LIST2; NIL otherwise.	Function
<b>NSUBST-IF</b> ( <i>new test tree &amp;key (key #'identity)</i> ) Package:LISP Substitutes NEW for subtrees of TREE that satisfy TEST.	Function
<b>COPY-LIST</b> ( <i>list</i> ) Package:LISP Returns a new copy of LIST.	Function
<b>LAST</b> ( <i>list</i> ) Package:LISP Returns the last cons in LIST	Function
<b>CAAAR</b> ( <i>x</i> ) Package:LISP Equivalent to (CAR (CAR (CAR X))).	Function
<b>LIST-LENGTH</b> ( <i>list</i> ) Package:LISP Returns the length of LIST, or NIL if LIST is circular.	Function
<b>CDDDR</b> ( <i>x</i> ) Package:LISP Equivalent to (CDR (CDR (CDR X))).	Function
<b>INTERSECTION</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> ) Package:LISP Returns the intersection of List1 and List2.	Function
<b>NSUBST</b> ( <i>new old tree &amp;key (test #'eql) test-not (key #'identity)</i> ) Package:LISP Substitutes NEW for subtrees in TREE that match OLD.	Function
<b>REVAPPEND</b> ( <i>x y</i> ) Package:LISP Equivalent to (APPEND (REVERSE X) Y)	Function

<b>CDAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CAR X)).	
<b>CADR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CDR X)).	
<b>REST</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR X).	
<b>NSET-EXCLUSIVE-OR</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP	
Returns a list with elements which appear but once in LIST1 and LIST2.	
<b>ACONS</b> ( <i>key datum alist</i> )	Function
Package:LISP	
Constructs a new alist by adding the pair (KEY . DATUM) to ALIST.	
<b>SUBST-IF-NOT</b> ( <i>new test tree &amp;key (key #'identity)</i> )	Function
Package:LISP	
Substitutes NEW for subtrees of TREE that do not satisfy TEST.	
<b>RPLACA</b> ( <i>x y</i> )	Function
Package:LISP	
Replaces the car of X with Y, and returns the modified X.	
<b>SECOND</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CADR X).	
<b>NUNION</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP	
Returns the union of LIST1 and LIST2. LIST1 and/or LIST2 may be destroyed.	
<b>BUTLAST</b> ( <i>list &amp;optional (n 1)</i> )	Function
Package:LISP	
Creates and returns a list with the same elements as LIST but without the last N elements.	
<b>COPY-ALIST</b> ( <i>alist</i> )	Function
Package:LISP Returns a new copy of ALIST.	

<b>SIXTH</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CADR (CDDDDR X)).	
<b>CAAAAR</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CAR (CAR (CAR (CAR X)))).	
<b>CDDDAR</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CDR (CDR (CDR (CAR X)))).	
<b>CDDADR</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CDR (CDR (CAR (CDR X)))).	
<b>CDADDR</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CDR (CAR (CDR (CDR X)))).	
<b>CADDDR</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CAR (CDR (CDR (CDR X)))).	
<b>FOURTH</b> ( <i>x</i> )	Function
Package:LISP Equivalent to (CADDDR X).	
<b>NSUBLIS</b> ( <i>alist tree &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP Substitutes from ALIST for subtrees of TREE.	
<b>SUBST-IF</b> ( <i>new test tree &amp;key (key #'identity)</i> )	Function
Package:LISP Substitutes NEW for subtrees of TREE that satisfy TEST.	
<b>NSET-DIFFERENCE</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP Returns a list of elements of LIST1 that do not appear in LIST2. LIST1 may be destroyed.	
<b>POP</b>	Special Form
Package:LISP Syntax: (pop place)	
Pops one item off the front of the list in PLACE and returns it.	

<b>PUSH</b>	Special Form
Package:LISP	
Syntax:	
(push item place)	
Conses ITEM onto the list in PLACE, and returns the new list.	
<b>CDAAR</b> (x)	Function
Package:LISP	
Equivalent to (CDR (CAR (CAR X))).	
<b>CADAR</b> (x)	Function
Package:LISP	
Equivalent to (CAR (CDR (CAR X))).	
<b>CAADR</b> (x)	Function
Package:LISP	
Equivalent to (CAR (CAR (CDR X))).	
<b>FIRST</b> (x)	Function
Package:LISP	
Equivalent to (CAR X).	
<b>SUBST</b> ( <i>new old tree</i> &key ( <i>test</i> #'eql) <b>test-not</b> (key #'identity))	Function
Package:LISP	
Substitutes NEW for subtrees of TREE that match OLD.	
<b>ADJOIN</b> ( <i>item list</i> &key ( <i>test</i> #'eql) <b>test-not</b> (key #'identity))	Function
Package:LISP	
Adds ITEM to LIST unless ITEM is already a member of LIST.	
<b>MAPCON</b> ( <i>fun list</i> &rest <i>more-lists</i> )	Function
Package:LISP	
Applies FUN to successive cdrs of LISTS, NCONCs the results, and returns it.	
<b>PUSHNEW</b>	Macro
Package:LISP	
Syntax:	
(pushnew item place {keyword value}*)	
If ITEM is already in the list stored in PLACE, does nothing. Else, conses ITEM onto the list. Returns NIL. If no KEYWORDS are supplied, each element in the list is compared with ITEM by EQL, but the comparison can be controlled by supplying keywords :TEST, :TEST-NOT, and/or :KEY.	

<b>SET-EXCLUSIVE-OR</b> ( <i>list1 list2</i> &key ( <i>test</i> #'eql) test-not (key #'identity)) Package:LISP Returns a list of elements appearing exactly once in LIST1 and LIST2.	Function
<b>TREE-EQUAL</b> ( <i>x y</i> &key ( <i>test</i> #'eql) test-not) Package:LISP Returns T if X and Y are isomorphic trees with identical leaves.	Function
<b>CDDR</b> ( <i>x</i> ) Package:LISP Equivalent to (CDR (CDR X)).	Function
<b>GETF</b> ( <i>place indicator</i> &optional ( <i>default</i> nil)) Package:LISP Searches the property list stored in Place for an indicator EQ to Indicator. If one is found, the corresponding value is returned, else the Default is returned.	Function
<b>LDIFF</b> ( <i>list sublist</i> ) Package:LISP Returns a new list, whose elements are those of LIST that appear before SUBLIST. If SUBLIST is not a tail of LIST, a copy of LIST is returned.	Function
<b>UNION</b> ( <i>list1 list2</i> &key ( <i>test</i> #'eql) test-not (key #'identity)) Package:LISP Returns the union of LIST1 and LIST2.	Function
<b>ASSOC-IF-NOT</b> ( <i>test alist</i> ) Package:LISP Returns the first pair in ALIST whose car does not satisfy TEST.	Function
<b>RPLACD</b> ( <i>x y</i> ) Package:LISP Replaces the cdr of X with Y, and returns the modified X.	Function
<b>MEMBER-IF-NOT</b> ( <i>test list</i> &key ( <i>key</i> #'identity)) Package:LISP Returns the tail of LIST beginning with the first element not satisfying TEST.	Function
<b>CAR</b> ( <i>list</i> ) Package:LISP Returns the car of LIST. Returns NIL if LIST is NIL.	Function

<b>ENDP</b> ( <i>x</i> )	Function
Package:LISP	
Returns T if X is NIL. Returns NIL if X is a cons. Otherwise, signals an error.	
<b>LIST*</b> ( <i>arg &amp;rest others</i> )	Function
Package:LISP	
Returns a list of its arguments with the last cons being a dotted pair of the next to the last argument and the last argument.	
<b>NINTH</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CDDDDR (CDDDDR X))).	
<b>CDAAAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CAR (CAR (CAR X)))).	
<b>CADAAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CDR (CAR (CAR X)))).	
<b>CAADAR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CAR (CDR (CAR X)))).	
<b>CAAADR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CAR (CAR (CAR (CDR X)))).	
<b>CDDDDR</b> ( <i>x</i> )	Function
Package:LISP	
Equivalent to (CDR (CDR (CDR (CDR X)))).	
<b>SUBLIS</b> ( <i>alist tree &amp;key (test #'eql) test-not (key #'identity)</i> )	Function
Package:LISP	
Substitutes from ALIST for subtrees of TREE nondestructively.	
<b>RASSOC-IF-NOT</b> ( <i>predicate alist</i> )	Function
Package:LISP	
Returns the first cons in ALIST whose cdr does not satisfy PREDICATE.	
<b>NRECONC</b> ( <i>x y</i> )	Function
Package:LISP	
Equivalent to (NCONC (NREVERSE X) Y).	



<b>MAPLIST</b> ( <i>fun list &amp;rest more-lists</i> ) Package:LISP Applies FUN to successive cdrs of LISTS and returns the results as a list.	Function
<b>SET-DIFFERENCE</b> ( <i>list1 list2 &amp;key (test #'eql) test-not (key #'identity)</i> ) Package:LISP Returns a list of elements of LIST1 that do not appear in LIST2.	Function
<b>ASSOC-IF</b> ( <i>test alist</i> ) Package:LISP Returns the first pair in ALIST whose car satisfies TEST.	Function
<b>GET-PROPERTIES</b> ( <i>place indicator-list</i> ) Package:LISP Looks for the elements of INDICATOR-LIST in the property list stored in PLACE. If found, returns the indicator, the value, and T as multiple-values. If not, returns NILs as its three values.	Function
<b>MEMBER-IF</b> ( <i>test list &amp;key (key #'identity)</i> ) Package:LISP Returns the tail of LIST beginning with the first element satisfying TEST.	Function
<b>COPY-TREE</b> ( <i>object</i> ) Package:LISP Recursively copies conses in OBJECT and returns the result.	Function
<b>ATOM</b> ( <i>x</i> ) Package:LISP Returns T if X is not a cons; NIL otherwise.	Function
<b>CDDAR</b> ( <i>x</i> ) Package:LISP Equivalent to (CDR (CDR (CAR X))).	Function
<b>CDADR</b> ( <i>x</i> ) Package:LISP Equivalent to (CDR (CAR (CDR X))).	Function
<b>CADDR</b> ( <i>x</i> ) Package:LISP Equivalent to (CAR (CDR (CDR X))).	Function

<b>ASSOC</b> ( <i>item alist</i> &key ( <i>test</i> #' <b>eq</b> ) <b>test-not</b> )	Function
Package:LISP	
Returns the first pair in ALIST whose car is equal (in the sense of TEST) to ITEM.	
<b>APPEND</b> (&rest <i>lists</i> )	Function
Package:LISP	
Constructs a new list by concatenating its arguments.	
<b>MEMBER</b> ( <i>item list</i> &key ( <i>test</i> #' <b>eq</b> ) <b>test-not</b> ( <b>key</b> #' <b>identity</b> ))	Function
Package:LISP	
Returns the tail of LIST beginning with the first ITEM.	



## 5 Streams and Reading

- MAKE-ECHO-STREAM** (*input-stream output-stream*) Function  
 Package:LISP  
 Returns a bidirectional stream which gets its input from INPUT-STREAM and sends its output to OUTPUT-STREAM. In addition, all input is echoed to OUTPUT-STREAM.
- \*READTABLE\*** Variable  
 Package:LISP The current readtable.
- LOAD** (*filename &key (verbose \*load-verbose\*) (print nil) (if-does-not-exist :error)*) Function  
 Package:LISP  
 Loads the file named by FILENAME into GCL.
- OPEN** (*filename &key (direction :input) (element-type 'string-char) (if-exists :error) (if-does-not-exist :error)*) Function  
 Package:LISP  
 Opens the file specified by FILENAME, which may be a string, a pathname, or a stream. Returns a stream for the open file. DIRECTION is :INPUT, :OUTPUT, :IO or :PROBE. ELEMENT-TYPE is STRING-CHAR, (UNSIGNED-BYTE n), UNSIGNED-BYTE, (SIGNED-BYTE n), SIGNED-BYTE, CHARACTER, BIT, (MOD n), or :DEFAULT. IF-EXISTS is :ERROR, :NEW-VERSION, :RENAME, :RENAME-AND-DELETE, :OVERWRITE, :APPEND, :SUPERSEDE, or NIL. IF-DOES-NOT-EXIST is :ERROR, :CREATE, or NIL.  
 If FILENAME begins with a vertical pipe sign: '|' then the resulting stream is actually a one way pipe. It will be open for reading or writing depending on the direction given. The rest of FILENAME in this case is passed to the /bin/sh command. See the posix description of popen for more details.
- ```
(setq pipe (open "| wc < /tmp/jim"))
(format t "File has ~%d lines" (read pipe))
(close pipe)
```
- \*PRINT-BASE\*** Variable  
 Package:LISP The radix in which the GCL printer prints integers and rationals. The value must be an integer from 2 to 36, inclusive.
- MAKE-STRING-INPUT-STREAM** (*string &optional (start 0) (end (length string))*) Function  
 Package:LISP  
 Returns an input stream which will supply the characters of String between Start and End in order.

- PPRINT** (*object* &optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Pretty-prints OBJECT. Returns OBJECT. Equivalent to (WRITE :STREAM STREAM :PRETTY T) The SI:PRETTY-PRINT-FORMAT property N (which must be a non-negative integer) of a symbol SYMBOL controls the pretty-printing of form (SYMBOL f1 ... fN fN+1 ... fM) in such a way that the subforms fN+1, ..., fM are regarded as the 'body' of the entire form. For instance, the property value of 2 is initially given to the symbol DO.
- \*READ-DEFAULT-FLOAT-FORMAT\*** Variable  
 Package:LISP The floating-point format the GCL reader uses when reading floating-point numbers that have no exponent marker or have e or E for an exponent marker. Must be one of SHORT-FLOAT, SINGLE-FLOAT, DOUBLE-FLOAT, and LONG-FLOAT.
- READ-PRESERVING-WHITESPACE** (&optional (*stream* **\*standard-input\***) (*eof-error-p* t) (*eof-value* nil) (*recursive-p* nil)) Function  
 Package:LISP  
 Reads an object from STREAM, preserving the whitespace that followed the object.
- STREAMP** (x) Function  
 Package:LISP  
 Returns T if X is a stream object; NIL otherwise.
- SET-DISPATCH-MACRO-CHARACTER** (*disp-char* *sub-char* *function* &optional (*readtable* **\*readtable\***)) Function  
 Package:LISP  
 Causes FUNCTION to be called when the DISP-CHAR followed by SUB-CHAR is read.
- WITH-OUTPUT-TO-STRING** Macro  
 Package:LISP  
 Syntax:  
 (with-output-to-string (var [string]) {decl}\* {form}\*)  
 Binds VAR to a string output stream that puts characters into STRING, which defaults to a new string. The stream is automatically closed on exit and the string is returned.
- FILE-LENGTH** (*file-stream*) Function  
 Package:LISP  
 Returns the length of the specified file stream.
- \*PRINT-CASE\*** Variable  
 Package:LISP The case in which the GCL printer should print ordinary symbols. The value must be one of the keywords :UPCASE, :DOWNCASE, and :CAPITALIZE.

- PRINT** (*object* &optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Outputs a newline character, and then prints OBJECT in the mostly readable representation. Returns OBJECT. Equivalent to (PROGN (TERPRI STREAM) (WRITE OBJECT :STREAM STREAM :ESCAPE T)).
- SET-MACRO-CHARACTER** (*char function* &optional (*non-terminating-p* **nil**) (*readtable* **\*readtable\***)) Function  
 Package:LISP  
 Causes CHAR to be a macro character that, when seen by READ, causes FUNCTION to be called.
- FORCE-OUTPUT** (&optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Attempts to force any buffered output to be sent.
- \*PRINT-ARRAY\*** Variable  
 Package:LISP Whether the GCL printer should print array elements.
- STREAM-ELEMENT-TYPE** (*stream*) Function  
 Package:LISP  
 Returns a type specifier for the kind of object returned by STREAM.
- WRITE-BYTE** (*integer stream*) Function  
 Package:LISP  
 Outputs INTEGER to the binary stream STREAM. Returns INTEGER.
- MAKE-CONCATENATED-STREAM** (&rest *streams*) Function  
 Package:LISP  
 Returns a stream which takes its input from each of the STREAMs in turn, going on to the next at end of stream.
- PRIN1** (*object* &optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Prints OBJECT in the mostly readable representation. Returns OBJECT. Equivalent to (WRITE OBJECT :STREAM STREAM :ESCAPE T).
- PRINC** (*object* &optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Prints OBJECT without escape characters. Returns OBJECT. Equivalent to (WRITE OBJECT :STREAM STREAM :ESCAPE NIL).
- CLEAR-OUTPUT** (&optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Clears the output stream STREAM.

- TERPRI** (&optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Outputs a newline character.
- FINISH-OUTPUT** (&optional (*stream* **\*standard-output\***)) Function  
 Package:LISP  
 Attempts to ensure that all output sent to STREAM has reached its destination, and only then returns.
- WITH-OPEN-FILE** Macro  
 Package:LISP  
 Syntax:  

```
(with-open-file (stream filename {options}*) {decl}* {form}*)
```

 Opens the file whose name is FILENAME, using OPTIONS, and binds the variable STREAM to a stream to/from the file. Then evaluates FORMs as a PROGn. The file is automatically closed on exit.
- DO** Special Form  
 Package:LISP  
 Syntax:  

```
(do ({(var [init [step]])*} (endtest {result}*)  

    {decl}* {tag | statement}*))
```

 Creates a NIL block, binds each VAR to the value of the corresponding INIT, and then executes STATEMENTS repeatedly until ENDTEST is satisfied. After each iteration, assigns to each VAR the value of the corresponding STEP. When ENDTEST is satisfied, evaluates RESULTS as a PROGn and returns the value(s) of the last RESULT (or NIL if no RESULTS are supplied). Performs variable bindings and assignments all at once, just like LET and PSETQ do.
- READ-FROM-STRING** (*string* &optional (*eof-error-p* *t*) (*eof-value* *nil*) &key (*start* 0) (*end* (*length* *string*)) (*preserve-whitespace* *nil*)) Function  
 Package:LISP  
 Reads an object from STRING.
- WRITE-STRING** (*string* &optional (*stream* **\*standard-output\***) &key (*start* 0) (*end* (*length* *string*))) Function  
 Package:LISP  
 Outputs STRING and returns it.
- \*PRINT-LEVEL\*** Variable  
 Package:LISP How many levels deep the GCL printer should print. Unlimited if NIL.
- \*PRINT-RADIX\*** Variable  
 Package:LISP Whether the GCL printer should print the radix indicator when printing integers and rationals.

|                                                                                                                                                                                                                                                                                     |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Y-OR-N-P</b> (&optional ( <i>format-string</i> <b>nil</b> ) &rest <b>args</b> )                                                                                                                                                                                                  | Function |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Asks the user a question whose answer is either 'Y' or 'N'. If FORMAT-STRING is non-NIL, then FRESH-LINE operation is performed, a message is printed as if FORMAT-STRING and ARGs were given to FORMAT, and then a prompt "(Y or N)" is printed. Otherwise, no prompt will appear. |          |
| <b>MAKE-BROADCAST-STREAM</b> (&rest <i>streams</i> )                                                                                                                                                                                                                                | Function |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Returns an output stream which sends its output to all of the given streams.                                                                                                                                                                                                        |          |
| <b>READ-CHAR</b> (&optional ( <i>stream</i> <b>*standard-input*</b> ) ( <b>eof-error-p</b> <b>t</b> ) ( <b>eof-value</b> <b>nil</b> ) ( <b>recursive-p</b> <b>nil</b> ))                                                                                                            | Function |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Reads a character from STREAM.                                                                                                                                                                                                                                                      |          |
| <b>PEEK-CHAR</b> (&optional ( <i>peek-type</i> <b>nil</b> ) ( <i>stream</i> <b>*standard-input*</b> ) ( <b>eof-error-p</b> <b>t</b> ) ( <b>eof-value</b> <b>nil</b> ) ( <b>recursive-p</b> <b>nil</b> ))                                                                            | Function |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Peeks at the next character in the input stream STREAM.                                                                                                                                                                                                                             |          |
| <b>OUTPUT-STREAM-P</b> ( <i>stream</i> )                                                                                                                                                                                                                                            | Function |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Returns non-nil if STREAM can handle output operations; NIL otherwise.                                                                                                                                                                                                              |          |
| <b>*QUERY-IO*</b>                                                                                                                                                                                                                                                                   | Variable |
| Package:LISP The query I/O stream.                                                                                                                                                                                                                                                  |          |
| <b>*READ-BASE*</b>                                                                                                                                                                                                                                                                  | Variable |
| Package:LISP The radix that the GCL reader reads numbers in.                                                                                                                                                                                                                        |          |
| <b>WITH-OPEN-STREAM</b>                                                                                                                                                                                                                                                             | Macro    |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Syntax:                                                                                                                                                                                                                                                                             |          |
| (with-open-stream (var <i>stream</i> ) {decl}* {form}*)                                                                                                                                                                                                                             |          |
| Evaluates FORMs as a PROGN with VAR bound to the value of STREAM. The stream is automatically closed on exit.                                                                                                                                                                       |          |
| <b>WITH-INPUT-FROM-STRING</b>                                                                                                                                                                                                                                                       | Macro    |
| Package:LISP                                                                                                                                                                                                                                                                        |          |
| Syntax:                                                                                                                                                                                                                                                                             |          |
| (with-input-from-string (var <i>string</i> {keyword <i>value</i> }*) {decl}* {form}*)                                                                                                                                                                                               |          |
| Binds VAR to an input stream that returns characters from STRING and evaluates the FORMs. The stream is automatically closed on exit. Allowed keywords are :INDEX, :START, and :END.                                                                                                |          |



- CLEAR-INPUT** (&optional (*stream* **\*standard-input\***)) Function  
 Package:LISP Clears the input stream STREAM.
- \*TERMINAL-IO\*** Variable  
 Package:LISP The terminal I/O stream.
- LISTEN** (&optional (*stream* **\*standard-input\***)) Function  
 Package:LISP  
 Returns T if a character is available on STREAM; NIL otherwise. This function does not correctly work in some versions of GCL because of the lack of such mechanism in the underlying operating system.
- MAKE-PATHNAME** (&key (*defaults* (**parse-namestring** ""  
 (**pathname-host** **\*default-pathname-defaults\***))) (**host** (**pathname-host**  
**defaults**)) (**device** (**pathname-device** **defaults**)) (**directory** (**pathname-directory**  
**defaults**)) (**name** (**pathname-name** **defaults**)) (**type** (**pathname-type** **defaults**))  
 (**version** (**pathname-version** **defaults**))) Function  
 Package:LISP  
 Create a pathname from HOST, DEVICE, DIRECTORY, NAME, TYPE and VERSION.
- PATHNAME-TYPE** (*pathname*) Function  
 Package:LISP  
 Returns the type slot of PATHNAME.
- \*PRINT-GENSYM\*** Variable  
 Package:LISP Whether the GCL printer should prefix symbols with no home package with "#:".
- READ-LINE** (&optional (*stream* **\*standard-input\***) (**eof-error-p** t) Function  
 (**eof-value** nil) (**recursive-p** nil))  
 Package:LISP  
 Returns a line of text read from STREAM as a string, discarding the newline character.  
 Note that when using line at a time input under unix, input forms will always be followed by a `#\newline`. Thus if you do  
`>(read-line) "" nil`  
 the empty string will be returned. After lisp reads the (read-line) it then invokes (read-line). This happens before it does anything else and so happens before the newline character immediately following (read-line) has been read. Thus read-line immediately encounters a `#\newline` and so returns the empty string. If there had been other characters before the `#\newline` it would have been different:  
`>(read-line) how are you " how are you" nil`  
 If you want to throw away "" input, you can do that with the following:

```
(sloop::sloop while (equal (setq input (read-line)) ""))
```

You may also want to use character at a time input, but that makes input editing harder. nicolas% stty cbreak nicolas% gcl GCL (GNU Common Lisp) Version(1.1.2)  
Mon Jan 9 12:58:22 MET 1995 Licensed under GNU Public Library License Contains  
Enhancements by W. Schelter

```
>(let ((ifilename nil)) (format t "~%Input file name: ") (setq ifilename (read-line)))
Input file name: /tmp/myfile "/tmp/myfile"
>(bye)Bye.
```

**WRITE-TO-STRING** (*object* &key (*escape* **\*print-escape\***) (*radix* **\*print-radix\***) (*base* **\*print-base\***) (*circle* **\*print-circle\***) (*pretty* **\*print-pretty\***) (*level* **\*print-level\***) (*length* **\*print-length\***) (*case* **\*print-case\***) (*array* **\*print-array\***) (*gensym* **\*print-gensym\***))

Package:LISP

Returns as a string the printed representation of OBJECT in the specified mode. See the variable docs of **\*PRINT-...\*** for the mode.

**PATHNAMEP** (*x*) Function

Package:LISP

Returns T if X is a pathname object; NIL otherwise.

**READTABLEP** (*x*) Function

Package:LISP

Returns T if X is a readtable object; NIL otherwise.

**READ** (&optional (*stream* **\*standard-input\***) (*eof-error-p* *t*) (*eof-value* **nil**) (*recursive-p* **nil**)) Function

Package:LISP

Reads in the next object from STREAM.

**NAMESTRING** (*pathname*) Function

Package:LISP

Returns the full form of PATHNAME as a string.

**UNREAD-CHAR** (*character* &optional (*stream* **\*standard-input\***)) Function

Package:LISP

Puts CHARACTER back on the front of the input stream STREAM.

**CLOSE** (*stream* &key (*abort* **nil**)) Function

Package:LISP

Closes STREAM. A non-NIL value of :ABORT indicates an abnormal termination.

**\*PRINT-LENGTH\*** Variable

Package:LISP How many elements the GCL printer should print at each level of nested data object. Unlimited if NIL.

- SET-SYNTAX-FROM-CHAR** (*to-char from-char* &optional  
(*to-readtable \*readtable\**) (*from-readtable nil*)) Function  
 Package:LISP  
 Makes the syntax of TO-CHAR in TO-READTABLE be the same as the syntax of FROM-CHAR in FROM-READTABLE.
- INPUT-STREAM-P** (*stream*) Function  
 Package:LISP  
 Returns non-NIL if STREAM can handle input operations; NIL otherwise.
- PATHNAME** (*x*) Function  
 Package:LISP  
 Turns X into a pathname. X may be a string, symbol, stream, or pathname.
- FILE-NAMESTRING** (*pathname*) Function  
 Package:LISP  
 Returns the written representation of PATHNAME as a string.
- MAKE-DISPATCH-MACRO-CHARACTER** (*char* &optional  
(*non-terminating-p nil*) (*readtable \*readtable\**)) Function  
 Package:LISP  
 Causes the character CHAR to be a dispatching macro character in READTABLE.
- \*STANDARD-OUTPUT\*** Variable  
 Package:LISP The default output stream used by the GCL printer.
- MAKE-TWO-WAY-STREAM** (*input-stream output-stream*) Function  
 Package:LISP  
 Returns a bidirectional stream which gets its input from INPUT-STREAM and sends its output to OUTPUT-STREAM.
- \*PRINT-ESCAPE\*** Variable  
 Package:LISP Whether the GCL printer should put escape characters whenever appropriate.
- COPY-READTABLE** (&optional (*from-readtable \*readtable\**)  
(*to-readtable nil*)) Function  
 Package:LISP  
 Returns a copy of the readtable FROM-READTABLE. If TO-READTABLE is non-NIL, then copies into TO-READTABLE. Otherwise, creates a new readtable.
- DIRECTORY-NAMESTRING** (*pathname*) Function  
 Package:LISP  
 Returns the directory part of PATHNAME as a string.

- TRUENAME** (*pathname*) Function  
 Package:LISP  
 Returns the pathname for the actual file described by *PATHNAME*.
- \*READ-SUPPRESS\*** Variable  
 Package:LISP When the value of this variable is NIL, the GCL reader operates normally. When it is non-NIL, then the reader parses input characters but much of what is read is not interpreted.
- GET-DISPATCH-MACRO-CHARACTER** (*disp-char sub-char* Function  
*&optional (readtable \*readtable\*)*)  
 Package:LISP  
 Returns the macro-character function for SUB-CHAR under DISP-CHAR.
- PATHNAME-DEVICE** (*pathname*) Function  
 Package:LISP  
 Returns the device slot of *PATHNAME*.
- READ-CHAR-NO-HANG** (*&optional (stream \*standard-input\*)* Function  
*(eof-error-p t) (eof-value nil) (recursive-p nil)*)  
 Package:LISP  
 Returns the next character from *STREAM* if one is available; NIL otherwise.
- FRESH-LINE** (*&optional (stream \*standard-output\*)*) Function  
 Package:LISP  
 Outputs a newline if it is not positioned at the beginning of a line. Returns T if it output a newline; NIL otherwise.
- WRITE-CHAR** (*char &optional (stream \*standard-output\*)*) Function  
 Package:LISP  
 Outputs *CHAR* and returns it.
- PARSE-NAMESTRING** (*thing &optional host (defaults* Function  
*\*default-pathname-defaults\*) &key (start 0) (end (length thing)) (junk-allowed*  
*nil)*)  
 Package:LISP  
 Parses a string representation of a pathname into a pathname. *HOST* is ignored.
- PATHNAME-DIRECTORY** (*pathname*) Function  
 Package:LISP  
 Returns the directory slot of *PATHNAME*.

**GET-MACRO-CHARACTER** (*char* &optional (*readtable* *\*readtable\**)) Function

Package:LISP

Returns the function associated with CHAR and, as a second value, returns the non-terminating-p flag.

**FORMAT** (*destination control-string* &rest *arguments*) Function

Package:LISP

Provides various facilities for formatting output. DESTINATION controls where the result will go. If DESTINATION is T, then the output is sent to the standard output stream. If it is NIL, then the output is returned in a string as the value of the call. Otherwise, DESTINATION must be a stream to which the output will be sent.

CONTROL-STRING is a string to be output, possibly with embedded formatting directives, which are flagged with the escape character "~". Directives generally expand into additional text to be output, usually consuming one or more of ARGUMENTs in the process.

A few useful directives are:

```
~A, ~nA, ~n@A Prints one argument as if by PRINC
~S, ~nS, ~n@S Prints one argument as if by PRIN1
~D, ~B, ~O, ~X Prints one integer in decimal, binary, octal, and hexa
~% Does TERPRI
~& Does FRESH-LINE
```

where n is the minimal width of the field in which the object is printed. ~nA and ~nS put padding spaces on the right; ~n@A and ~n@S put on the left.

~R is for printing numbers in various formats.

```
~nR prints arg in radix n.
~R prints arg as a cardinal english number: two
~:R prints arg as an ordinal english number: third
~@R prints arg as an a Roman Numeral: VII
~:@R prints arg as an old Roman Numeral: IIII
```

~C prints a character.

```
~:C represents non printing characters by their pretty names, eg Space
~@C uses the #\ syntax to allow the reader to read it.
```

~F prints a floating point number arg.

The full form is ~w,d,k,overflowchar,padcharF

w represents the total width of the printed representation (variable if

not present)

d the number of fractional digits to display

(format nil "~,2f" 10010.0314) --> "10010.03"

k arg is multiplied by 10<sup>k</sup> before printing it as a decimal number.

overflowchar width w characters copies of the overflow character will

be printed. eg(format t "X~5,2,,?F<X" 100.034) --> X>?????<X

```

padchar is the character to pad with
(format t "X~10,2,1,'?',bF<X" 100.03417) -->X>bbb1000.34<X
@ makes + sign print if the arg is positive

```

```
~@[print-if-true~]
```

if arg is not nil, then it is retained as an arg for further printing, otherwise it is used up

```

(format nil "~@[x = ~d~]~a" nil 'bil) --> "BIL"
(format nil "~@[x = ~d ~]~a" 8) --> "x = 8 BIL"

```

## **PATHNAME-NAME** (*pathname*)

Function

Package:LISP

Returns the name slot of PATHNAME.

## **MAKE-STRING-OUTPUT-STREAM** ()

Function

Package:LISP

Returns an output stream which will accumulate all output given it for the benefit of the function GET-OUTPUT-STREAM-STRING.

## **MAKE-SYNONYM-STREAM** (*symbol*)

Function

Package:LISP

Returns a stream which performs its operations on the stream which is the value of the dynamic variable named by SYMBOL.

## **\*LOAD-VERBOSE\***

Variable

Package:LISP The default for the VERBOSE argument to LOAD.

## **\*PRINT-CIRCLE\***

Variable

Package:LISP Whether the GCL printer should take care of circular lists.

## **\*PRINT-PRETTY\***

Variable

Package:LISP Whether the GCL printer should pretty-print. See the function doc of PPRINT for more information about pretty-printing.

## **FILE-WRITE-DATE** (*file*)

Function

Package:LISP

Returns the time at which the specified file is written, as an integer in universal time format. FILE may be a string or a stream.

## **PRIN1-TO-STRING** (*object*)

Function

Package:LISP

Returns as a string the printed representation of OBJECT in the mostly readable representation. Equivalent to (WRITE-TO-STRING OBJECT :ESCAPE T).

- MERGE-PATHNAMES** (*pathname* &optional (*defaults* **\*default-pathname-defaults\***) **default-version**) Function  
 Package:LISP  
 Fills in unspecified slots of *PATHNAME* from *DEFAULTS*. *DEFAULT-VERSION* is ignored in GCL.
- READ-BYTE** (*stream* &optional (*eof-error-p* **t**) (*eof-value* **nil**)) Function  
 Package:LISP  
 Reads the next byte from *STREAM*.
- PRINC-TO-STRING** (*object*) Function  
 Package:LISP  
 Returns as a string the printed representation of *OBJECT* without escape characters. Equivalent to (WRITE-TO-STRING *OBJECT* :ESCAPE NIL).
- \*STANDARD-INPUT\*** Variable  
 Package:LISP The default input stream used by the GCL reader.
- PROBE-FILE** (*file*) Function  
 Package:LISP  
 Returns the truename of *file* if the file exists. Returns NIL otherwise.
- PATHNAME-VERSION** (*pathname*) Function  
 Package:LISP  
 Returns the version slot of *PATHNAME*.
- WRITE-LINE** (*string* &optional (*stream* **\*standard-output\***) &key (**start 0**) (**end (length string)**)) Function  
 Package:LISP  
 Outputs *STRING* and then outputs a newline character. Returns *STRING*.
- WRITE** (*object* &key (*stream* **\*standard-output\***) (*escape* **\*print-escape\***) (*radix* **\*print-radix\***) (*base* **\*print-base\***) (*circle* **\*print-circle\***) (*pretty* **\*print-pretty\***) (*level* **\*print-level\***) (*length* **\*print-length\***) (*case* **\*print-case\***) (*array* **\*print-array\***) (*gensym* **\*print-gensym\***)) Function  
 Package:LISP  
 Prints *OBJECT* in the specified mode. See the variable docs of *\*PRINT-...\** for the mode.
- GET-OUTPUT-STREAM-STRING** (*stream*) Function  
 Package:LISP  
 Returns a string of all the characters sent to *STREAM* made by MAKE-STRING-OUTPUT-STREAM since the last call to this function.

**READ-DELIMITED-LIST** (*char* &optional (*stream* **\*standard-input\***) (**recursive-p** **nil**)) Function

Package:LISP

Reads objects from STREAM until the next character after an object's representation is CHAR. Returns a list of the objects read.

**READLINE-ON** () Function

Package:SI

Begins readline command editing mode when possible. In addition to the basic readline editing features, command word completion is implemented according to the following scheme:

[[pkg]::]txt

pkg – an optional package specifier. Defaults to the current package. The symbols in this package and those in the packages in this package's use list will be searched.

:[] – an optional internal/external specifier. Defaults to external. The keyword package is denoted by a single colon at the beginning of the token. Only symbols of this type will be searched for completion.

txt – a string. Symbol names beginning with this string are completed. The comparison is case insensitive.

**READLINE-OFF** () Function

Package:SI

Disables readline command editing mode.

**\*READLINE-PREFIX\*** Variable

Package:SI

A string implicitly prepended to input text for use in readline command completion. If this string contains one or more colons, it is used to specify the default package and internal/external setting for searched symbols in the case that the supplied text itself contains no explicit package specification. If this string contains characters after the colon(s), or contains no colons at all, it is treated as a symbol name prefix. In this case, the prefix is matched first, then the supplied text, and the completion returned is relative to the supplied text itself, i.e. contains no prefix. For example, the setting "maxima::\$" will complete input text "int" according to the internal symbols in the maxima package of the form "maxima::\$int...", and return suggestions to the user of the form "int...".





## 6 Special Forms and Functions

### LAMBDA-LIST-KEYWORDS

Constant

Package:LISP List of all the lambda-list keywords used in GCL.

### GET-SETF-METHOD (*form*)

Function

Package:LISP

Returns the five values (or five 'gangs') constituting the SETF method for FORM. See the doc of DEFINE-SETF-METHOD for the meanings of the gangs. It is an error if the third value (i.e., the list of store variables) is not a one-element list. See the doc of GET-SETF-METHOD-MULTIPLE-VALUE for comparison.

### THE

Special Form

Package:LISP

Syntax:

`(the value-type form)`

Declares that the value of FORM must be of VALUE-TYPE. Signals an error if this is not the case.

### SETF

Special Form

Package:LISP

Syntax:

`(setf {place newvalue}*)`

Replaces the value in PLACE with the value of NEWVALUE, from left to right. Returns the value of the last NEWVALUE. Each PLACE may be any one of the following:

A symbol that names a variable.

A function call form whose first element is the name of the following functions:

```
nth elt subseq rest first ... tenth
c?r c??r c???r c????r
aref svref char schar bit sbit fill-poiter
get getf documentation symbol-value symbol-function
symbol-plist macro-function gethash
char-bit ldb mask-field
apply
```

where '?' stands for either 'a' or 'd'.

the form (THE type place) with PLACE being a place recognized by SETF.

a macro call which expands to a place recognized by SETF.

any form for which a DEFSETF or DEFINE-SETF-METHOD declaration has been made.

**WHEN**

Special Form

Package:LISP

Syntax:

`(when test {form}*)`

If TEST evaluates to non-NIL, then evaluates FORMs as a PROGN. If not, simply returns NIL.

**CCASE**

Macro

Package:LISP

Syntax:

`(ccase keyplace {{key | ({key}*)} {form}*)*)`

Evaluates KEYPLACE and tries to find the KEY that is EQL to the value of KEY-PLACE. If one is found, then evaluates FORMs that follow the KEY and returns the value(s) of the last FORM. If not, signals a correctable error.

**MACROEXPAND** (*form* &optional (*env* nil))

Function

Package:LISP

If FORM is a macro form, then expands it repeatedly until it is not a macro any more. Returns two values: the expanded form and a T-or-NIL flag indicating whether the original form was a macro.

**MULTIPLE-VALUE-CALL**

Special Form

Package:LISP

Syntax:

`(multiple-value-call function {form}*)`

Calls FUNCTION with all the values of FORMs as arguments.

**DEFSETF**

Macro

Package:LISP

Syntax:

```
(defsetf access-fun {update-fun [doc] |
                        lambda-list (store-var) {decl | doc}*
  {form}*)
```

Defines how to SETF a generalized-variable reference of the form (ACCESS-FUN ...). The doc-string DOC, if supplied, is saved as a SETF doc and can be retrieved by (documentation 'NAME 'setf).

```
(defsetf access-fun update-fun) defines an expansion from
(setf (ACCESS-FUN arg1 ... argn) value) to (UPDATE-FUN arg1 ... argn value).
```

```
(defsetf access-fun lambda-list (store-var) . body) defines a macro which
expands
```

```
(setf (ACCESS-FUN arg1 ... argn) value) into the form
(let* ((temp1 ARG1) ... (tempn ARGn) (temp0 value)) rest)
```

where REST is the value of BODY with parameters in LAMBDA-LIST bound to the symbols TEMP1 ... TEMPn and with STORE-VAR bound to the symbol TEMP0.

**TAGBODY**

Special Form

Package:LISP

Syntax:

`(tagbody {tag | statement}*)`

Executes STATEMENTS and returns NIL if it falls off the end.

**ETYPECASE**

Macro

Package:LISP

Syntax:

`(etypecase keyform {(type {form}*)}*)`

Evaluates KEYFORM and tries to find the TYPE in which the value of KEYFORM belongs. If one is found, then evaluates FORMs that follow the KEY and returns the value(s) of the last FORM. If not, signals an error.

**LET\***

Special Form

Package:LISP

Syntax:

`(let* ({var | (var [value])}*) {decl}* {form}*)`

Initializes VARs, binding them to the values of VALUEs (which defaults to NIL) from left to right, then evaluates FORMs as a PROGN.

**PROG1**

Special Form

Package:LISP

Syntax:

`(prog1 first {form}*)`

Evaluates FIRST and FORMs in order, and returns the (single) value of FIRST.

**DEFUN**

Special Form

Package:LISP

Syntax:

`(defun name lambda-list {decl | doc}* {form}*)`Defines a function as the global function definition of the symbol NAME. The complete syntax of a lambda-list is: `({var}* [&optional {var | (var [initform [svar]])}]* [&rest var] [&key {var | ({var | (keyword var)} [initform [svar]])}]* [&allow-other-keys] [&aux {var | (var [initform])}]*)` The doc-string DOC, if supplied, is saved as a FUNCTION doc and can be retrieved by `(documentation 'NAME 'function)`.**MULTIPLE-VALUE-BIND**

Special Form

Package:LISP

Syntax:

`(multiple-value-bind ({var}*) values-form {decl}* {form}*)`

Binds the VARIABLES to the results of VALUES-FORM, in order (defaulting to NIL) and evaluates FORMs in order.

**DECLARE**

Special Form

Package:LISP

Syntax:

`(declare {decl-spec}*)`

Gives a declaration. Possible DECL-SPECs are: (SPECIAL {var}\*) (TYPE type {var}\*) where 'TYPE' is one of the following symbols

```
array fixnum package simple-bit-vector
atom float pathname simple-string
bignum function random-state simple-vector
bit hash-table ratio single-float
bit-vector integer rational standard-char
character keyword readable stream
common list sequence string
compiled-function long-float short-float string-char
complex nil signed-byte symbol
cons null unsigned-byte t
double-float number simple-array vector
```

'TYPE' may also be a list containing one of the above symbols as its first element and more specific information later in the list. For example

```
(vector long-float 80) ; vector of 80 long-floats.
(array long-float *)   ; array of long-floats
(array fixnum)         ; array of fixnums
(array * 30)           ; an array of length 30 but unspecified type
```

A list of 1 element may be replaced by the symbol alone, and a list ending in '\*\*' may drop the the final '\*\*'.

```
(OBJECT {var}*)
(FTYPE type {function-name}*)
  eg: ;; function of two required args and optional args and one value:
      (ftype (function (t t *) t) sort reduce)
      ;; function with 1 arg of general type returning 1 fixnum as value.
      (ftype (function (t) fixnum) length)
(FUNCTION function-name ({arg-type}*) {return-type}*)
(INLINE {function-name}*)
(NOTINLINE {function-name}*)
(IGNORE {var}*)
(OPTIMIZE {(SPEED | SPACE | SAFETY | COMPILATION-SPEED) {0 | 1 | 2 | 3}}*)
(DECLARATION {non-standard-decl-name}*)
(:DYNAMIC-EXTENT {var}*) ;GCL-specific.
```

**DEFMACRO**

Special Form

Package:LISP

Syntax:

`(defmacro name defmacro-lambda-list {decl | doc}* {form}*)`

Defines a macro as the global macro definition of the symbol NAME. The complete syntax of a defmacro-lambda-list is:

```
( [&whole var] [&environment var] {pseudo-var}* [&optional {var | (pseudo-var [init-
form [pseudo-var]])}*] {[{&rest | &body} pseudo-var] [&key {var | ({var | (keyword
pseudo-var)} [initform [pseudo-var]])}* [&allow-other-keys]] [&aux {var | (pseudo-var
[initform])}*] | . var})
```

where pseudo-var is either a symbol or a list of the following form:

```
( {pseudo-var}* [&optional {var | (pseudo-var [initform [pseudo-var]])}*] {[{&rest |
&body} pseudo-var] [&key {var | ({var | (keyword pseudo-var)} [initform [pseudo-
var]])}* [ &allow-other-keys ] ] [&aux {var | (pseudo-var [initform])}*] | . var})
```

As a special case, a non-NIL symbol is accepted as a defmacro-lambda-list: (DEFMACRO <name> <symbol> ...) is equivalent to (DEFMACRO <name> (&REST <symbol>) ...). The doc-string DOC, if supplied, is saved as a FUNCTION doc and can be retrieved by (documentation 'NAME 'function). See the type doc of LIST for the backquote macro useful for defining macros. Also, see the function doc of PPRINT for the output-formatting.

### **\*EVALHOOK\***

Variable

Package:LISP If \*EVALHOOK\* is not NIL, its value must be a function that can receive two arguments: a form to evaluate and an environment. This function does the evaluation instead of EVAL.

### **FUNCTIONP** (x)

Function

Package:LISP

Returns T if X is a function, suitable for use by FUNCALL or APPLY. Returns NIL otherwise.

### **LAMBDA-PARAMETERS-LIMIT**

Constant

Package:LISP The exclusive upper bound on the number of distinct parameter names that may appear in a single lambda-list. Actually, however, there is no such upper bound in GCL.

### **FLET**

Special Form

Package:LISP

Syntax:

```
(flet ({(name lambda-list {decl | doc}* {form}*)}* ) . body)
```

Evaluates BODY as a PROGN, with local function definitions in effect. BODY is the scope of each local function definition. Since the scope does not include the function definitions themselves, the local function can reference externally defined functions of the same name. See the doc of DEFUN for the complete syntax of a lambda-list. Doc-strings for local functions are simply ignored.

### **ECASE**

Macro

Package:LISP

Syntax:

```
(ecase keyform ({key | ({key}*)} {form}*))
```

Evaluates KEYFORM and tries to find the KEY that is EQL to the value of KEY-FORM. If one is found, then evaluates FORMs that follow the KEY and returns the value(s) of the last FORM. If not, signals an error.

## PROG2

Special Form

Package:LISP

Syntax:

```
(prog2 first second {forms}*)
```

Evaluates FIRST, SECOND, and FORMs in order, and returns the (single) value of SECOND.

## PROGV

Special Form

Package:LISP

Syntax:

```
(progv symbols values {form}*)
```

SYMBOLS must evaluate to a list of variables. VALUES must evaluate to a list of initial values. Evaluates FORMs as a PROGn, with each variable bound (as special) to the corresponding value.

## QUOTE

Special Form

Package:LISP

Syntax:

```
(quote x)
```

or 'x Simply returns X without evaluating it.

## DOTIMES

Special Form

Package:LISP

Syntax:

```
(dotimes (var countform [result]) {decl}* {tag | statement}*)
```

Executes STATEMENTs, with VAR bound to each number between 0 (inclusive) and the value of COUNTFORM (exclusive). Then returns the value(s) of RESULT (which defaults to NIL).

## SPECIAL-FORM-P (*symbol*)

Function

Package:LISP

Returns T if SYMBOL globally names a special form; NIL otherwise. The special forms defined in Steele's manual are:

```
block if progv
catch labels quote
compiler-let let return-from
declare let* setq
eval-when macrolet tagbody
```

```
flet multiple-value-call the
function multiple-value-prog1 throw
go progn unwind-protect
```

In addition, GCL implements the following macros as special forms, though of course macro-expanding functions such as `MACROEXPAND` work correctly for these macros.

```
and incf prog1
case locally prog2
cond loop psetq
decf multiple-value-bind push
defmacro multiple-value-list return
defun multiple-value-set setf
do or unless
do* pop when
dolist prog
dotimes prog*
```

## FUNCTION

Special Form

Package:LISP

Syntax:

```
(function x)
```

or `#'x` If `X` is a lambda expression, creates and returns a lexical closure of `X` in the current lexical environment. If `X` is a symbol that names a function, returns that function.

## MULTIPLE-VALUES-LIMIT

Constant

Package:LISP The exclusive upper bound on the number of values that may be returned from a function. Actually, however, there is no such upper bound in GCL.

## APPLYHOOK (*function args evalhookfn applyhookfn* &optional (*env nil*))

Function

Package:LISP

Applies `FUNCTION` to `ARGS`, with `*EVALHOOK*` bound to `EVALHOOKFN` and with `*APPLYHOOK*` bound to `APPLYHOOKFN`. Ignores the hook function once, for the top-level application of `FUNCTION` to `ARGS`.

## \*MACROEXPAND-HOOK\*

Variable

Package:LISP Holds a function that can take two arguments (a macro expansion function and the macro form to be expanded) and returns the expanded form. This function is whenever a macro-expansion takes place. Initially this is set to `#'FUN-CALL`.

## PROG\*

Special Form

Package:LISP

Syntax:

```
(prog* ({var | (var [init])}*) {decl}* {tag | statement}*)
```

Creates a `NIL` block, binds `VARs` sequentially, and then executes `STATEMENTS`.



**BLOCK**

Special Form

Package:LISP

Syntax:

`(block name {form}*)`

The FORMs are evaluated in order, but it is possible to exit the block using (RETURN-FROM name value). The RETURN-FROM must be lexically contained within the block.

**PROGN**

Special Form

Package:LISP

Syntax:

`(progn {form}*)`

Evaluates FORMs in order, and returns whatever the last FORM returns.

**APPLY** (*function arg &rest more-args*)

Function

Package:LISP

Applies FUNCTION. The arguments to the function consist of all ARGs except for the last, and all elements of the last ARG.

**LABELS**

Special Form

Package:LISP

Syntax:

`(labels ({(name lambda-list {decl | doc}* {form}*)}*) . body)`

Evaluates BODY as a PROGN, with the local function definitions in effect. The scope of the locally defined functions include the function definitions themselves, so their definitions may include recursive references. See the doc of DEFUN for the complete syntax of a lambda-list. Doc-strings for local functions are simply ignored.

**RETURN**

Special Form

Package:LISP

Syntax:

`(return [result])`

Returns from the lexically surrounding NIL block. The value of RESULT, which defaults to NIL, is returned as the value of the block.

**TYPECASE**

Macro

Package:LISP

Syntax:

`(typecase keyform {(type {form}*)}*)`

Evaluates KEYFORM and tries to find the TYPE in which the value of KEYFORM belongs. If one is found, then evaluates FORMs that follow the KEY and returns the value of the last FORM. If not, simply returns NIL.

**AND**

Special Form

Package:LISP

Syntax:

`(and {form}*)`

Evaluates FORMs in order from left to right. If any FORM evaluates to NIL, returns immediately with the value NIL. Else, returns the value(s) of the last FORM.

**LET**

Special Form

Package:LISP

Syntax:

`(let ({var | (var [value])}* {decl}* {form}*)`

Initializes VARs, binding them to the values of VALUEs (which defaults to NIL) all at once, then evaluates FORMs as a PROGN.

**COND**

Special Form

Package:LISP

Syntax:

`(cond {(test {form}*)}*)`

Evaluates each TEST in order until one evaluates to a non-NIL value. Then evaluates the associated FORMs in order and returns the value(s) of the last FORM. If no forms follow the TEST, then returns the value of the TEST. Returns NIL, if all TESTs evaluate to NIL.

**GET-SETF-METHOD-MULTIPLE-VALUE** (*form*)

Function

Package:LISP Returns the five values (or five 'gangs') constituting the SETF method for FORM. See the doc of DEFINE-SETF-METHOD for the meanings of the gangs. The third value (i.e., the list of store variables) may consist of any number of elements. See the doc of GET-SETF-METHOD for comparison.

**CATCH**

Special Form

Package:LISP

Syntax:

`(catch tag {form}*)`

Sets up a catcher with that value TAG. Then evaluates FORMs as a PROGN, but may possibly abort the evaluation by a THROW form that specifies the value EQ to the catcher tag.

**DEFINE-MODIFY-MACRO**

Macro

Package:LISP

Syntax:

`(define-modify-macro name lambda-list fun [doc])`

Defines a read-modify-write macro, like PUSH and INCF. The defined macro will expand a form (NAME place val1 ... valn) into a form that in effect SETFs the

value of the call (FUN PLACE arg1 ... argm) into PLACE, where arg1 ... argm are parameters in LAMBDA-LIST which are bound to the forms VAL1 ... VALn. The doc-string DOC, if supplied, is saved as a FUNCTION doc and can be retrieved by (documentation 'NAME 'function).

### **MACROEXPAND-1** (*form* &optional (*env* nil))

Function

Package:LISP

If FORM is a macro form, then expands it once. Returns two values: the expanded form and a T-or-NIL flag indicating whether the original form was a macro.

### **FUNCALL** (*function* &rest *arguments*)

Function

Package:LISP

Applies FUNCTION to the ARGUMENTs

### **CALL-ARGUMENTS-LIMIT**

Constant

Package:LISP The upper exclusive bound on the number of arguments that may be passed to a function. Actually, however, there is no such upper bound in GCL.

### **CASE**

Special Form

Package:LISP

Syntax:

```
(case keyform {{(key | (key*))} {form}*})
```

Evaluates KEYFORM and tries to find the KEY that is EQL to the value of KEY-FORM. If one is found, then evaluates FORMs that follow the KEY and returns the value(s) of the last FORM. If not, simply returns NIL.

### **DEFINE-SETF-METHOD**

Macro

Package:LISP

Syntax:

```
(define-setf-method access-fun defmacro-lambda-list {decl | doc}*  
  {form}*)
```

Defines how to SETF a generalized-variable reference of the form (ACCESS-FUN ...). When a form (setf (ACCESS-FUN arg1 ... argn) value) is being evaluated, the FORMs are first evaluated as a PROGN with the parameters in DEFMACRO-LAMBDA-LIST bound to ARG1 ... ARGn. Assuming that the last FORM returns five values (temp-var-1 ... temp-var-k) (value-from-1 ... value-form-k) (store-var) storing-form access-form in order, the whole SETF is then expanded into (let\* ((temp-var-1 value-from-1) ... (temp-k value-form-k) (store-var VALUE)) storing-from) Incidentally, the five values are called the five gangs of a SETF method. The doc-string DOC, if supplied, is saved as a SETF doc and can be retrieved by (documentation 'NAME 'setf).

### **COMPILER-LET**

Special Form

Package:LISP

Syntax:

```
(compiler-let ({var | (var [value])}*) {form}*)
```

When interpreted, this form works just like a LET form with all VARs declared special. When compiled, FORMs are processed with the VARs bound at compile time, but no bindings occur when the compiled code is executed.

## **VALUES** (&rest args)

Function

Package:LISP

Returns ARGs in order, as values.

## **MULTIPLE-VALUE-LIST**

Special Form

Package:LISP

Syntax:

```
(multiple-value-list form)
```

Evaluates FORM, and returns a list of multiple values it returned.

## **MULTIPLE-VALUE-PROG1**

Special Form

Package:LISP

Syntax:

```
(multiple-value-prog1 form {form}*)
```

Evaluates the first FORM, saves all the values produced, then evaluates the other FORMs. Returns the saved values.

## **MACROLET**

Special Form

Package:LISP

Syntax:

```
(macrolet ({(name defmacro-lambda-list {decl | doc}* . body)}*)
  {form}*)
```

Evaluates FORMs as a PROGN, with the local macro definitions in effect. See the doc of DEFMACRO for the complete syntax of a defmacro-lambda-list. Doc-strings for local macros are simply ignored.

## **GO**

Special Form

Package:LISP

Syntax:

```
(go tag)
```

Jumps to the specified TAG established by a lexically surrounding TAGBODY.

## **PROG**

Special Form

Package:LISP

Syntax:

```
(prog ({var | (var [init])}*) {decl}* {tag | statement}*)
```

Creates a NIL block, binds VARs in parallel, and then executes STATEMENTS.

|                                                                                                                                                                                                                                                                                                                 |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>*APPLYHOOK*</b>                                                                                                                                                                                                                                                                                              | Variable     |
| Package:LISP Used to substitute another function for the implicit APPLY normally done within EVAL. If *APPLYHOOK* is not NIL, its value must be a function which takes three arguments: a function to be applied, a list of arguments, and an environment. This function does the application instead of APPLY. |              |
| <b>RETURN-FROM</b>                                                                                                                                                                                                                                                                                              | Special Form |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Syntax:                                                                                                                                                                                                                                                                                                         |              |
| <code>(return-from name [result])</code>                                                                                                                                                                                                                                                                        |              |
| Returns from the lexically surrounding block whose name is NAME. The value of RESULT, which defaults to NIL, is returned as the value of the block.                                                                                                                                                             |              |
| <b>UNLESS</b>                                                                                                                                                                                                                                                                                                   | Special Form |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Syntax:                                                                                                                                                                                                                                                                                                         |              |
| <code>(unless test {form}*)</code>                                                                                                                                                                                                                                                                              |              |
| If TEST evaluates to NIL, then evaluates FORMs as a PROGN. If not, simply returns NIL.                                                                                                                                                                                                                          |              |
| <b>MULTIPLE-VALUE-SETQ</b>                                                                                                                                                                                                                                                                                      | Special Form |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Syntax:                                                                                                                                                                                                                                                                                                         |              |
| <code>(multiple-value-setq variables form)</code>                                                                                                                                                                                                                                                               |              |
| Sets each variable in the list VARIABLES to the corresponding value of FORM. Returns the value assigned to the first variable.                                                                                                                                                                                  |              |
| <b>LOCALLY</b>                                                                                                                                                                                                                                                                                                  | Special Form |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Syntax:                                                                                                                                                                                                                                                                                                         |              |
| <code>(locally {decl}* {form}*)</code>                                                                                                                                                                                                                                                                          |              |
| Gives local pervasive declarations.                                                                                                                                                                                                                                                                             |              |
| <b>IDENTITY</b> (x)                                                                                                                                                                                                                                                                                             | Function     |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Simply returns X.                                                                                                                                                                                                                                                                                               |              |
| <b>NOT</b> (x)                                                                                                                                                                                                                                                                                                  | Function     |
| Package:LISP                                                                                                                                                                                                                                                                                                    |              |
| Returns T if X is NIL; NIL otherwise.                                                                                                                                                                                                                                                                           |              |

**DEFCONSTANT**

Macro

Package:LISP

Syntax:

```
(defconstant name initial-value [doc])
```

Declares that the variable NAME is a constant whose value is the value of INITIAL-VALUE. The doc-string DOC, if supplied, is saved as a VARIABLE doc and can be retrieved by (documentation 'NAME 'variable).

**VALUES-LIST** (*list*)

Function

Package:LISP

Returns all of the elements of LIST in order, as values.

**ERROR** (*control-string* &rest *args*)

Function

Package:LISP

Signals a fatal error.

**IF**

Special Form

Package:LISP

Syntax:

```
(if test then [else])
```

If TEST evaluates to non-NIL, then evaluates THEN and returns the result. If not, evaluates ELSE (which defaults to NIL) and returns the result.

**UNWIND-PROTECT**

Special Form

Package:LISP

Syntax:

```
(unwind-protect protected-form {cleanup-form}*)
```

Evaluates PROTECTED-FORM and returns whatever it returned. Guarantees that CLEANUP-FORMS be always evaluated before exiting from the UNWIND-PROTECT form.

**EVALHOOK** (*form evalhookfn applyhookfn* &optional (*env nil*))

Function

Package:LISP

Evaluates FORM with \*EVALHOOK\* bound to EVALHOOKFN and \*APPLY-HOOK\* bound to APPLYHOOKFN. Ignores these hooks once, for the top-level evaluation of FORM.

**OR**

Special Form

Package:LISP

Syntax:

```
(or {form}*)
```

Evaluates FORMs in order from left to right. If any FORM evaluates to non-NIL, quits and returns that (single) value. If the last FORM is reached, returns whatever values it returns.

**CTYPECASE**

Macro

Package:LISP

Syntax:

```
(ctypecase keyplace {(type {form}*)}*)
```

Evaluates KEYPLACE and tries to find the TYPE in which the value of KEYPLACE belongs. If one is found, then evaluates FORMs that follow the KEY and returns the value(s) of the last FORM. If not, signals a correctable error.

**EVAL** (*exp*)

Function

Package:LISP

Evaluates EXP and returns the result(s).

**PSETF**

Macro

Package:LISP

Syntax:

```
(psetf {place newvalue}*)
```

Similar to SETF, but evaluates all NEWVALUES first, and then replaces the value in each PLACE with the value of the corresponding NEWVALUE. Returns NIL always.

**THROW**

Special Form

Package:LISP

Syntax:

```
(throw tag result)
```

Evaluates TAG and aborts the execution of the most recent CATCH form that sets up a catcher with the same tag value. The CATCH form returns whatever RESULT returned.

**DEFPARAMETER**

Macro

Package:LISP

Syntax:

```
(defparameter name initial-value [doc])
```

Declares the variable NAME as a special variable and initializes the value. The doc-string DOC, if supplied, is saved as a VARIABLE doc and can be retrieved by (documentation 'NAME 'variable).

**DEFVAR**

Macro

Package:LISP

Syntax:

```
(defvar name [initial-value [doc]])
```

Declares the variable NAME as a special variable and, optionally, initializes it. The doc-string DOC, if supplied, is saved as a VARIABLE doc and can be retrieved by (documentation 'NAME 'variable).

## 7 Compilation

**COMPILE** (*name* &optional (*definition* **nil**))

Function

Package:LISP

If DEFINITION is NIL, NAME must be the name of a not-yet-compiled function. In this case, COMPILE compiles the function, installs the compiled function as the global function definition of NAME, and returns NAME. If DEFINITION is non-NIL, it must be a lambda expression and NAME must be a symbol. COMPILE compiles the lambda expression, installs the compiled function as the function definition of NAME, and returns NAME. There is only one exception for this: If NAME is NIL, then the compiled function is not installed but is simply returned as the value of COMPILE. In any case, COMPILE creates temporary files whose filenames are "gazonk\*\*\*". By default, i.e. if :LEAVE-GAZONK is not supplied or is NIL, these files are automatically deleted after compilation.

**LINK** (*files image* &optional *post extra-libs* (*run-user-init* **t**) &aux **raw init**)

Function

Package:LISP

On systems where dlopen is used for relocations, one cannot make custom images containing loaded binary object files simply by loading the files and executing save-system. This function is provided for such cases.

After compiling source files into objects, LINK can be called with a list of binary and source FILES which would otherwise normally be loaded in sequence before saving the image to IMAGE. LINK will use the system C linker to link the binary files thus supplied with GCL's objects, using EXTRA-LIBS as well if provided, and producing a raw IMAGE executable. This executable is then run to initialize first GCL's objects, followed by the supplied files, in order, if RUN-USER-INIT is set. In such a case, source files are loaded at their position in the sequence. Any optional code which should be run after file initialization can be supplied in the POST variable. The image is then saved using save-system to IMAGE.

This method of creating lisp images may also have the advantage that all new object files are kept out of the lisp core and placed instead in the final image's .text section. This should in principle reduce the core size, speed up garbage collection, and forego any performance penalty induced by data cache flushing on some machines.

In both the RAW and SAVED image, any calls to LOAD binary object files which have been specified in this list will bypass the normal load procedure, and simply initialize the already linked in module. One can rely on this feature by disabling RUN-USER-INIT, and instead passing the normal build commands in POST. In the course of executing this code, binary modules previously linked into the .text section of the executable will be initialized at the same point at which they would have normally been loaded into the lisp core, in the executable's .data section. In this way, the user can choose to take advantage of the aforementioned possible benefits of this linking method in a relatively transparent way.

All binary objects specified in FILES must have been compiled with :SYSTEM-P set to T.



**EVAL-WHEN**

Special Form

Package:LISP

Syntax:

`(eval-when ({situation}*) {form}*)`

A situation must be either COMPILE, LOAD, or EVAL. The interpreter evaluates only when EVAL is specified. If COMPILE is specified, FORMs are evaluated at compile time. If LOAD is specified, the compiler arranges so that FORMs be evaluated when the compiled code is loaded.

**COMPILE-FILE** (*input-pathname &key output-file (load nil)*)

Function

(*message-file nil*) ;GCL specific keywords: *system-p c-debug c-file h-file data-file*)

Package:LISP

Compiles the file specified by INPUT-PATHNAME and generates a fasl file specified by OUTPUT-FILE. If the filetype is not specified in INPUT-PATHNAME, then ".lsp" is used as the default file type for the source file. :LOAD specifies whether to load the generated fasl file after compilation. :MESSAGE-FILE specifies the log file for the compiler messages. It defaults to the value of the variable COMPILER:\*DEFAULT-MESSAGE-FILE\*. A non-NIL value of COMPILER::\*COMPILE-PRINT\* forces the compiler to indicate the form currently being compiled. More keyword parameters are accepted, depending on the version. Most versions of GCL can receive :O-FILE, :C-FILE, :H-FILE, and :DATA-FILE keyword parameters, with which you can control the intermediate files generated by the GCL compiler. Also :C-DEBUG will pass the -g flag to the C compiler.

By top level forms in a file, we mean the value of \*top-level-forms\* after doing (TF form) for each form read from a file. We define TF as follows:

```
(defun TF (x) (when (consp x) (setq x (macroexpand x)) (when (consp x) (cond
((member (car x) '(progn eval-when)) (mapcar 'tf (cdr x))) (t (push x *top-level-forms*))))))
```

Among the common lisp special forms only DEFUN and DEFMACRO will cause actual native machine code to be generated. The rest will be specially treated in an init section of the .data file. This is done so that things like putprop,setq, and many other forms would use up space which could not be usefully freed, if we were to compile to native machine code. If you have other 'ordinary' top level forms which you need to have compiled fully to machine code you may either set compiler::\*COMPILE-ORDINARIES\* to t, or put them inside a

```
(PROGN 'COMPILE ...forms-which-need-to-be-compiled)
```

The compiler will take each of them and make a temporary function which will be compiled and invoked once. It is permissible to wrap a (PROGN 'COMPILE ..) around the whole file. Currently this construction binds the compiler::\*COMPILE-ORDINARIES\* flag to t. Setting this flag globally to a non nil value to cause all top level forms to generate machine code. This might be useful in a system such as PCL, where a number of top level lambda expressions are given. Note that most common lisps will simply ignore the top level atom 'compile, since it has no side effects.

Defentry, clines, and defcfun also result in machine code being generated.

## subsection Evaluation at Compile time

In GCL the eval-when behaviour was changed in order to allow more efficient init code, and also to bring it into line with the resolution passed by the X3J13 committee. Evaluation at compile time is controlled by placing eval-when special forms in the code, or by the value of the variable `compiler::*eval-when-defaults*` [default value `:defaults`]. If that variable has value `:defaults`, then the following hold:

Eval at Compile Type of Top Level Form

Partial:     `defstructs`, `defvar`, `defparameter`

Full:        `defmacro`, `defconstant`, `defsetf`, `define-setf-method`, `deftype`, `package ops`, `proclaim`

None:        `defun`, others

By ‘partial’ we mean (see the X3J13 Common Lisp document (`doc/compile-file-handling-of-top-level-forms`) for more detail), that functions will not be defined, values will not be set, but other miscellaneous compiler properties will be set: eg properties to inline expand `defstruct` accessors and testers, `defstruct` properties allowing subsequent `defstructs` to include this one, any type hierarchy information, special variable information will be set up.

Example:

```
(defun foo () 3)
(defstruct jo a b)
```

As a side effect of compiling these two forms, `foo` would not have its function cell changed. Neither would `jo-a`, although it would gain a property which allows it to expand inline to a structure access. Thus if it had a previous definition (as commonly happens from previously loading the file), this previous definition would not be touched, and could well be inconsistent with the compiler properties. Unfortunately this is what the CL standard says to do, and I am just trying to follow it.

If you prefer a more intuitive scheme, of evaling all forms in the file, so that there are no inconsistencies, (previous behaviour of AKCL) you may set `compiler::*eval-when-defaults*` to `'(compile eval load)`.

The variable `compiler::*FASD-DATA*` [default `t`] controls whether an ascii output is used for the data section of the object file. The data section will be in ascii if `*fasd-data*` is `nil` or if the `system-p` keyword is supplied to `compile-file` and `*fasd-data*` is not eq to `:system-p`.

The old GCL variable `*compile-time-too*` has disappeared.

See `OPTIMIZE` on how to enable warnings of slow constructs.

### **PROCLAIM** (*decl-spec*)

Function

Package:LISP

Puts the declaration given by `DECL-SPEC` into effect globally. See the doc of `DECL-CLARE` for possible `DECL-SPECs`.

- PROVIDE** (*module-name*) Function  
 Package:LISP  
 Adds the specified module to the list of modules maintained in \*MODULES\*.
- COMPILED-FUNCTION-P** (*x*) Function  
 Package:LISP  
 Returns T if X is a compiled function; NIL otherwise.
- GPROF-START** () Function  
 Package:SYSTEM  
 GCL now has preliminary support for profiling with gprof, an externally supplied profiling tool at the C level which typically accompanies gcc. Support must be enabled at compile time with `-enable-gprof`. This function starts the profiling timers and counters.
- GPROF-QUIT** () Function  
 Package:SYSTEM  
 GCL now has preliminary support for profiling with gprof, an externally supplied profiling tool at the C level which typically accompanies gcc. Support must be enabled at compile time with `-enable-gprof`. This function reports the profiling results in the form of a call graph to standard output, and clears the profiling arrays. Please note that lisp functions are not (yet) displayed with their lisp names. Please see also the PROFILE function.
- GPROF-SET** (*begin end*) Function  
 Package:SYSTEM  
 GCL now has preliminary support for profiling with gprof, an externally supplied profiling tool at the C level which typically accompanies gcc. Support must be enabled at compile time with `-enable-gprof`. This function sets the address range used by GPROF-START in specifying the section of the running program which is to be profiled. All subsequent calls to GPROF-START will use this new address range. By default, the range is set to begin at the starting address of the .text section, and to end at the current end of the running core. These default values can be restored by calling GPROF-SET with both arguments set to 0.
- \*DEFAULT-SYSTEM-P\*** Variable  
 Package:COMPILER Specifies the default setting of :SYSTEM-P used by COMPILE.  
 Defaults to NIL.
- \*DEFAULT-C-FILE\*** Variable  
 Package:COMPILER Specifies the default setting of :C-FILE used by COMPILE.  
 Defaults to NIL.
- \*DEFAULT-H-FILE\*** Variable  
 Package:COMPILER Specifies the default setting of :H-FILE used by COMPILE.  
 Defaults to NIL.

**\*DEFAULT-DATA-FILE\***

Variable

Package:COMPILER Specifies the default setting of :DATA-FILE used by COM-PILE. Defaults to NIL.

**\*FEATURES\***

Variable

Package:LISP List of symbols that name features of the current version of GCL. These features are used to decide the read-time conditionalization facility provided by '#+' and '#-' read macros. When the GCL reader encounters

`#+ feature-description form`

it reads FORM in the usual manner if FEATURE-DESCRIPTION is true. Otherwise, the reader just skips FORM.

`#- feature-description form`

is equivalent to

`#- (not feature-description) form`

A feature-description may be a symbol, which is true only when it is an element of \*FEATURES\*. Or else, it must be one of the following:

`(and feature-description-1 ... feature-description-n)`

`(or feature-description-1 ... feature-description-n)`

`(not feature-description)`

The AND description is true only when all of its sub-descriptions are true. The OR description is true only when at least one of its sub-descriptions is true. The NOT description is true only when its sub-description is false.



## 8 Symbols

- GENSYM** (&optional (*x nil*)) Function  
 Package:LISP  
 Creates and returns a new uninterned symbol whose name is a prefix string (defaults to "G"), followed by a decimal number. The number is incremented by each call to GENSYM. X, if an integer, resets the counter. If X is a string, it becomes the new prefix.
- KEYWORDP** (*x*) Function  
 Package:LISP  
 Returns T if X is a symbol and it belongs to the KEYWORD package; NIL otherwise.
- REMPROP** (*symbol indicator*) Function  
 Package:LISP  
 Look on property list of SYMBOL for property with specified INDICATOR. If found, splice this indicator and its value out of the plist, and return T. If not found, returns NIL with no side effects.
- SYMBOL-PACKAGE** (*symbol*) Function  
 Package:LISP  
 Returns the contents of the package cell of the symbol SYMBOL.
- \*PACKAGE\*** Variable  
 Package:LISP The current package.
- SHADOWING-IMPORT** (*symbols* &optional (*package \*package\**)) Function  
 Package:LISP  
 Imports SYMBOLS into PACKAGE, disregarding any name conflict. If a symbol of the same name is already present, then it is uninterned. SYMBOLS must be a list of symbols or a symbol.
- REMF** Macro  
 Package:LISP  
 Syntax:  
 (remf *place indicator*)  
 PLACE may be any place expression acceptable to SETF, and is expected to hold a property list or NIL. This list is destructively altered to remove the property specified by INDICATOR. Returns T if such a property was present; NIL otherwise.
- MAKUNBOUND** (*symbol*) Function  
 Package:LISP  
 Makes empty the value slot of SYMBOL. Returns SYMBOL.

- USE-PACKAGE** (*packages-to-use* &optional (*package* **\*package\***)) Function  
 Package:LISP  
 Adds all packages in PACKAGE-TO-USE list to the use list for PACKAGE so that the external symbols of the used packages are available as internal symbols in PACKAGE.
- MAKE-SYMBOL** (*string*) Function  
 Package:LISP  
 Creates and returns a new uninterned symbol whose print name is STRING.
- PSETQ** Special Form  
 Package:LISP  
 Syntax:  
 (psetq {var form}\*)  
 Similar to SETQ, but evaluates all FORMs first, and then assigns each value to the corresponding VAR. Returns NIL always.
- PACKAGE-USED-BY-LIST** (*package*) Function  
 Package:LISP  
 Returns the list of packages that use PACKAGE.
- SYMBOLP** (*x*) Function  
 Package:LISP  
 Returns T if X is a symbol; NIL otherwise.
- NIL** Constant  
 Package:LISP Holds NIL.
- SET** (*symbol value*) Function  
 Package:LISP  
 Assigns the value of VALUE to the dynamic variable named by SYMBOL, and returns the value assigned.
- SETQ** Special Form  
 Package:LISP  
 Syntax:  
 (setq {var form}\*)  
 VARs are not evaluated and must be symbols. Assigns the value of the first FORM to the first VAR, then assigns the value of the second FORM to the second VAR, and so on. Returns the last value assigned.
- UNUSE-PACKAGE** (*packages-to-unuse* &optional (*package* **\*package\***)) Function  
 Package:LISP  
 Removes PACKAGES-TO-UNUSE from the use list for PACKAGE.

|                                                                                                                                                                                                                                                                 |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>T</b>                                                                                                                                                                                                                                                        | Constant |
| Package:LISP Holds T.                                                                                                                                                                                                                                           |          |
| <b>PACKAGE-USE-LIST</b> ( <i>package</i> )                                                                                                                                                                                                                      | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns the list of packages used by PACKAGE.                                                                                                                                                                                                                   |          |
| <b>LIST-ALL-PACKAGES</b> ()                                                                                                                                                                                                                                     | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns a list of all existing packages.                                                                                                                                                                                                                        |          |
| <b>COPY-SYMBOL</b> ( <i>symbol</i> &optional ( <i>copy-props</i> <b>nil</b> ))                                                                                                                                                                                  | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns a new uninterned symbol with the same print name as SYMBOL. If COPY-PROPS is NIL, the function, the variable, and the property slots of the new symbol have no value. Otherwise, these slots are given the values of the corresponding slots of SYMBOL. |          |
| <b>SYMBOL-PLIST</b> ( <i>symbol</i> )                                                                                                                                                                                                                           | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns the property list of SYMBOL.                                                                                                                                                                                                                            |          |
| <b>SYMBOL-NAME</b> ( <i>symbol</i> )                                                                                                                                                                                                                            | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns the print name of the symbol SYMBOL.                                                                                                                                                                                                                    |          |
| <b>FIND-SYMBOL</b> ( <i>name</i> &optional ( <i>package</i> <b>*package*</b> ))                                                                                                                                                                                 | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns the symbol named NAME in PACKAGE. If such a symbol is found, then the second value is :INTERN, :EXTERNAL, or :INHERITED to indicate how the symbol is accessible. If no symbol is found then both values are NIL.                                       |          |
| <b>SHADOW</b> ( <i>symbols</i> &optional ( <i>package</i> <b>*package*</b> ))                                                                                                                                                                                   | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Creates an internal symbol in PACKAGE with the same name as each of the specified SYMBOLS. SYMBOLS must be a list of symbols or a symbol.                                                                                                                       |          |
| <b>FBOUNDP</b> ( <i>symbol</i> )                                                                                                                                                                                                                                | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| Returns T if SYMBOL has a global function definition or if SYMBOL names a special form or a macro; NIL otherwise.                                                                                                                                               |          |
| <b>MACRO-FUNCTION</b> ( <i>symbol</i> )                                                                                                                                                                                                                         | Function |
| Package:LISP                                                                                                                                                                                                                                                    |          |
| If SYMBOL globally names a macro, then returns the expansion function. Returns NIL otherwise.                                                                                                                                                                   |          |



- IN-PACKAGE** (*package-name* &key (*nicknames* **nil**) (**use** **'(lisp)**)) Function  
 Package:LISP  
 Sets \*PACKAGE\* to the package with PACKAGE-NAME, creating the package if it does not exist. If the package already exists then it is modified to agree with USE and NICKNAMES arguments. Any new nicknames are added without removing any old ones not specified. If any package in the USE list is not currently used, then it is added to the use list.
- MAKE-PACKAGE** (*package-name* &key (*nicknames* **nil**) (**use** **'(lisp)**)) Function  
 Package:LISP  
 Makes a new package having the specified PACKAGE-NAME and NICKNAMES. The package will inherit all external symbols from each package in the USE list.
- PACKAGE-SHADOWING-SYMBOLS** (*package*) Function  
 Package:LISP  
 Returns the list of symbols that have been declared as shadowing symbols in PACKAGE.
- INTERN** (*name* &optional (*package* **\*package\***)) Function  
 Package:LISP  
 Returns a symbol having the specified name, creating it if necessary. Returns as the second value one of the symbols :INTERNAL, :EXTERNAL, :INHERITED, and NIL.
- EXPORT** (*symbols* &optional (*package* **\*package\***)) Function  
 Package:LISP  
 Makes SYMBOLS external symbols of PACKAGE. SYMBOLS must be a list of symbols or a symbol.
- PACKAGEP** (*x*) Function  
 Package:LISP  
 Returns T if X is a package; NIL otherwise.
- SYMBOL-FUNCTION** (*symbol*) Function  
 Package:LISP  
 Returns the current global function definition named by SYMBOL.
- SYMBOL-VALUE** (*symbol*) Function  
 Package:LISP  
 Returns the current value of the dynamic (special) variable named by SYMBOL.
- BOUNDP** (*symbol*) Function  
 Package:LISP  
 Returns T if the global variable named by SYMBOL has a value; NIL otherwise.

- DOCUMENTATION** (*symbol doc-type*) Function  
 Package:LISP  
 Returns the doc-string of DOC-TYPE for SYMBOL; NIL if none exists. Possible doc-types are: FUNCTION (special forms, macros, and functions) VARIABLE (dynamic variables, including constants) TYPE (types defined by DEFTYPE) STRUCTURE (structures defined by DEFSTRUCT) SETF (SETF methods defined by DEFSETF, DEFINE-SETF-METHOD, and DEFINE-MODIFY-MACRO) All built-in special forms, macros, functions, and variables have their doc-strings.
- GENTEMP** (&optional (*prefix "t"*) (**package \*package\***)) Function  
 Package:LISP  
 Creates a new symbol interned in the package PACKAGE with the given PREFIX.
- RENAME-PACKAGE** (*package new-name* &optional (*new-nicknames nil*)) Function  
 Package:LISP  
 Replaces the old name and nicknames of PACKAGE with NEW-NAME and NEW-NICKNAMES.
- UNINTERN** (*symbol* &optional (*package \*package\**)) Function  
 Package:LISP  
 Makes SYMBOL no longer present in PACKAGE. Returns T if SYMBOL was present; NIL otherwise. If PACKAGE is the home package of SYMBOL, then makes SYMBOL uninterned.
- UNEXPORT** (*symbols* &optional (*package \*package\**)) Function  
 Package:LISP  
 Makes SYMBOLS no longer accessible as external symbols in PACKAGE. SYMBOLS must be a list of symbols or a symbol.
- PACKAGE-NICKNAMES** (*package*) Function  
 Package:LISP  
 Returns as a list the nickname strings for the specified PACKAGE.
- IMPORT** (*symbols* &optional (*package \*package\**)) Function  
 Package:LISP  
 Makes SYMBOLS internal symbols of PACKAGE. SYMBOLS must be a list of symbols or a symbol.
- GET** (*symbol indicator* &optional (*default nil*)) Function  
 Package:LISP  
 Looks on the property list of SYMBOL for the specified INDICATOR. If this is found, returns the associated value. Otherwise, returns DEFAULT.

- FIND-ALL-SYMBOLS** (*string-or-symbol*) Function  
Package:LISP  
Returns a list of all symbols that have the specified name.
- FMAKUNBOUND** (*symbol*) Function  
Package:LISP  
Discards the global function definition named by SYMBOL. Returns SYMBOL.
- PACKAGE-NAME** (*package*) Function  
Package:LISP  
Returns the string that names the specified PACKAGE.
- FIND-PACKAGE** (*name*) Function  
Package:LISP  
Returns the specified package if it already exists; NIL otherwise. NAME may be a string that is the name or nickname of the package. NAME may also be a symbol, in which case the symbol's print name is used.
- APROPOS-LIST** (*string* &optional (*package* **nil**)) Function  
Package:LISP  
Returns, as a list, all symbols whose print-names contain STRING as substring. If PACKAGE is non-NIL, then only the specified package is searched.

## 9 Operating System

### 9.1 Command Line

The variable `si::*command-args*` is set to the list of strings passed in when `gcl` is invoked. Various flags are understood.

- `-eval`      Call read and then eval on the command argument following `-eval`
- `-load`      Load the file whose pathname is specified after `-load`.
- `-f`          Replace `si::*command-args*` by the the list starting after `-f`. Open the file following `-f` for input, skip the first line, and then read and eval the rest of the forms in the file. This can be used as with the shells to write small shell programs:

```
#!/usr/local/bin/gcl.exe -f
(format t "hello world ~a%" (nth 1 si::*command-args*))
```

The value `si::*command-args*` will have the appropriate value. Thus if the above 2 line file is made executable and called ‘foo’ then

```
tutorial% foo billy
hello world billy
```

NOTE: On many systems (eg SunOs) the first line of an executable script file such as:

```
#!/usr/local/bin/gcl.exe -f
```

only reads the first 32 characters! So if your pathname where the executable together with the ‘-f’ amount to more than 32 characters the file will not be recognized. Also the executable must be the actual large binary file, [or a link to it], and not just a `/bin/sh` script. In latter case the `/bin/sh` interpreter would get invoked on the file.

Alternately one could invoke the file ‘foo’ without making it executable:

```
tutorial% gcl -f foo "from bill"
hello world from bill
```

Finally perhaps the best way (why do we save the best for last.. I guess because we only figure it out after all the others..) The following file ‘myhello’ has 4 lines:

```
#!/bin/sh
#| Lisp will skip the next 2 lines on reading
exec gcl -f "$0" $ |#
(format t "hello world ~a%" (nth 1 si::*command-args*))
marie% chmod a+x myhello
marie% myhello bill
hello world bill
```

The advantage of this method is that ‘gcl’ can itself be a shell script, which sets up environment and so on. Also the normal path will be searched to find ‘gcl’ The disadvantage is that this would cause 2 invocations of ‘sh’ and one

invocation of `'gcl'`. The plan using `'gcl.exe'` bypasses the `'sh'` entirely. Indeed invoking `'gcl.exe'` to print `'hello world'` is faster on most systems than a similar `'csh'` or `'bash'` script, but slightly slower than the old `'sh'`.

- batch** Do not enter the command print loop. Useful if the other command line arguments do something. Do not print the License and acknowledgement information. Note if your program does print any License information, it must print the GCL header information also.
- dir** Directory where the executable binary that is running is located. Needed by `save` and `friends`. This gets set as `si::*system-directory*`
- libdir**
  - `-libdir '/d/wfs/gcl-2.0/'`
  - would mean that the files like `gcl-tk/tk.o` would be found by concatting the path to the libdir path, ie in
  - `'/d/wfs/gcl-2.0/gcl-tk/tk.o'`
- compile** Invoke the compiler on the filename following `-compile`. Other flags affect compilation.
- o-file** If nil follows `-o-file` then do not produce an `.o` file.
- c-file** If `-c-file` is specified, leave the intermediate `.c` file there.
- h-file** If `-h-file` is specified, leave the intermediate `.h` file there.
- data-file**
  - If `-data-file` is specified, leave the intermediate `.data` file there.
- system-p**
  - If `-system-p` is specified then invoke `compile-file` with the `:system-p t` keyword argument, meaning that the C init function will bear a name based on the name of the file, so that it may be invoked by name by C code.

## 9.2 Operating System Definitions

- |                                                                                                                                                                    |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>GET-DECODED-TIME</b> ()                                                                                                                                         | Function |
| Package:LISP                                                                                                                                                       |          |
| Returns the current time in decoded time format. Returns nine values: second, minute, hour, date, month, year, day-of-week, daylight-saving-time-p, and time-zone. |          |
| <b>HOST-NAMESTRING</b> ( <i>pathname</i> )                                                                                                                         | Function |
| Package:LISP                                                                                                                                                       |          |
| Returns the host part of <code>PATHNAME</code> as a string.                                                                                                        |          |
| <b>RENAME-FILE</b> ( <i>file new-name</i> )                                                                                                                        | Function |
| Package:LISP                                                                                                                                                       |          |
| Renames the file <code>FILE</code> to <code>NEW-NAME</code> . <code>FILE</code> may be a string, a pathname, or a stream.                                          |          |

- FILE-AUTHOR** (*file*) Function  
 Package:LISP  
 Returns the author name of the specified file, as a string. FILE may be a string or a stream
- PATHNAME-HOST** (*pathname*) Function  
 Package:LISP  
 Returns the host slot of PATHNAME.
- FILE-POSITION** (*file-stream* &optional *position*) Function  
 Package:LISP  
 Sets the file pointer of the specified file to POSITION, if POSITION is given. Otherwise, returns the current file position of the specified file.
- DECODE-UNIVERSAL-TIME** (*universal-time* &optional *timezone* **-9**) Function  
 Package:LISP  
 Converts UNIVERSAL-TIME into a decoded time at the TIMEZONE. Returns nine values: second, minute, hour, date, month (1 - 12), year, day-of-week (0 - 6), daylight-saving-time-p, and time-zone. TIMEZONE in GCL defaults to 6, the time zone of Austin, Texas.
- USER-HOMEDIR-PATHNAME** (&optional *host*) Function  
 Package:LISP  
 Returns the home directory of the logged in user as a pathname. HOST is ignored.
- \*MODULES\*** Variable  
 Package:LISP A list of names of the modules that have been loaded into GCL.
- SHORT-SITE-NAME** () Function  
 Package:LISP  
 Returns a string that identifies the physical location of the current GCL.
- DIRECTORY** (*name*) Function  
 Package:LISP  
 Returns a list of files that match NAME. NAME may be a string, a pathname, or a file stream.
- SOFTWARE-VERSION** () Function  
 Package:LISP  
 Returns a string that identifies the software version of the software under which GCL is currently running.
- INTERNAL-TIME-UNITS-PER-SECOND** Constant  
 Package:LISP The number of internal time units that fit into a second.

**ENOUGH-NAMESTRING** (*pathname* &optional (*defaults* \*default-pathname-defaults\*)) Function

Package:LISP

Returns a string which uniquely identifies *PATHNAME* with respect to *DEFAULTS*.

**REQUIRE** (*module-name* &optional (*pathname*)) Function

Package:LISP

If the specified module is not present, then loads the appropriate file(s). *PATHNAME* may be a single pathname or it may be a list of pathnames.

**ENCODE-UNIVERSAL-TIME** (*second minute hour date month* *year* &optional (*timezone* )) Function

Package:LISP

Does the inverse operation of *DECODE-UNIVERSAL-TIME*.

**LISP-IMPLEMENTATION-VERSION** () Function

Package:LISP

Returns a string that tells you when the current GCL implementation is brought up.

**MACHINE-INSTANCE** () Function

Package:LISP

Returns a string that identifies the machine instance of the machine on which GCL is currently running.

**ROOM** (&optional (*x t*)) Function

Package:LISP

Displays information about storage allocation in the following format.

for each type class

the number of pages so-far allocated for the type class

the maximum number of pages for the type class

the percentage of used cells to cells so-far allocated

the number of times the garbage collector has been called to collect cells of the type class

the implementation types that belongs to the type class

the number of pages actually allocated for contiguous blocks

the maximum number of pages for contiguous blocks

the number of times the garbage collector has been called to collect contiguous blocks

the number of pages in the hole

the maximum number of pages for relocatable blocks

the number of times the garbage collector has been called to collect relocatable blocks

the total number of pages allocated for cells

the total number of pages allocated

the number of available pages

the number of pages GCL can use.

The number of times the garbage collector has been called is not shown, if the number is zero. The optional X is ignored.

## **GET-UNIVERSAL-TIME ()**

Function

Package:LISP

Returns the current time as a single integer in universal time format.

## **GET-INTERNAL-RUN-TIME ()**

Function

Package:LISP

Returns the run time in the internal time format. This is useful for finding CPU usage. If the operating system allows, a second value containing CPU usage of child processes is returned.

## **\*DEFAULT-PATHNAME-DEFAULTS\***

Variable

Package:LISP The default pathname-defaults pathname.

## **LONG-SITE-NAME ()**

Function

Package:LISP

Returns a string that identifies the physical location of the current GCL.

## **DELETE-FILE (*file*)**

Function

Package:LISP Deletes FILE.

## **GET-INTERNAL-REAL-TIME ()**

Function

Package:LISP

Returns the real time in the internal time format. This is useful for finding elapsed time.

## **MACHINE-TYPE ()**

Function

Package:LISP

Returns a string that identifies the machine type of the machine on which GCL is currently running.

## **TIME**

Macro

Package:LISP

Syntax:

(**time** *form*)

Evaluates FORM and outputs timing statistics on \*TRACE-OUTPUT\*.



**SOFTWARE-TYPE ()**

Function

Package:LISP

Returns a string that identifies the software type of the software under which GCL is currently running.

**LISP-IMPLEMENTATION-TYPE ()**

Function

Package:LISP

Returns a string that tells you that you are using a version of GCL.

**SLEEP (*n*)**

Function

Package:LISP

This function causes execution to be suspended for N seconds. N may be any non-negative, non-complex number.

## 10 Structures

### DEFSTRUCT

Macro

Package:LISP

Syntax:

```
(defstruct
  {name | (name {(:conc-name | (:conc-name prefix-string) |
                  :constructor | (:constructor symbol [lambda-list]) |
                  :copier | (:copier symbol) |
                  :predicate | (:predicate symbol) |
                  (:include symbol) |
                  (:print-function function) |
                  (:type {vector | (vector type) | list}) |
                  :named | (:static { nil | t})
                  (:initial-offset number))*})}
  [doc]
  {slot-name |
   (slot-name [default-value-form] {(:type type | :read-only flag}*) }*)
  )
```

Defines a structure. The doc-string DOC, if supplied, is saved as a STRUCTURE doc and can be retrieved by (documentation 'NAME 'structure). STATIC is gcl specific and makes the body non relocatable.

See the files misc/rusage.lsp misc/cstruct.lsp, for examples of making a lisp structure correspond to a C structure.

### HELP (&optional symbol)

Function

Package:LISP

GCL specific: Prints the documentation associated with SYMBOL. With no argument, this function prints the greeting message to GCL beginners.



## 11 Iteration and Tests

### DO-EXTERNAL-SYMBOLS

Macro

Package:LISP

Syntax:

```
(do-external-symbols (var [package [result-form]])
  {decl}* {tag | statement}*)
```

Executes STATEMENTS once for each external symbol in the PACKAGE (which defaults to the current package), with VAR bound to the current symbol. Then evaluates RESULT-FORM (which defaults to NIL) and returns the value(s).

### DO\*

Special Form

Package:LISP

Syntax:

```
(do* ({(var [init [step]])}*) (endtest {result}*)
  {decl}* {tag | statement}*)
```

Just like DO, but performs variable bindings and assignments in serial, just like LET\* and SETQ do.

### DO-ALL-SYMBOLS

Macro

Package:LISP

Syntax:

```
(do-all-symbols (var [result-form]) {decl}* {tag | statement}*)
```

Executes STATEMENTS once for each symbol in each package, with VAR bound to the current symbol. Then evaluates RESULT-FORM (which defaults to NIL) and returns the value(s).

### YES-OR-NO-P (&optional (*format-string* **nil**) &rest **args**)

Function

Package:LISP

Asks the user a question whose answer is either 'YES' or 'NO'. If FORMAT-STRING is non-NIL, then FRESH-LINE operation is performed, a message is printed as if FORMAT-STRING and ARGS were given to FORMAT, and then a prompt "(Yes or No)" is printed. Otherwise, no prompt will appear.

### MAPHASH #'hash-table

Function

Package:LISP

For each entry in HASH-TABLE, calls FUNCTION on the key and value of the entry; returns NIL.

### MAPCAR (*fun list* &rest *more-lists*)

Function

Package:LISP

Applies FUN to successive cars of LISTS and returns the results as a list.

**DOLIST**

Special Form

Package:LISP

Syntax:

```
(dolist (var listform [result]) {decl}* {tag | statement}*)
```

Executes STATEMENTS, with VAR bound to each member of the list value of LIST-FORM. Then returns the value(s) of RESULT (which defaults to NIL).

**EQ** (x y)

Function

Package:LISP

Returns T if X and Y are the same identical object; NIL otherwise.

**EQUALP** (x y)

Function

Package:LISP

Returns T if X and Y are EQUAL, if they are characters and satisfy CHAR-EQUAL, if they are numbers and have the same numerical value, or if they have components that are all EQUALP. Returns NIL otherwise.

**EQUAL** (x y)

Function

Package:LISP

Returns T if X and Y are EQL or if they are of the same type and corresponding components are EQUAL. Returns NIL otherwise. Strings and bit-vectors are EQUAL if they are the same length and have identical components. Other arrays must be EQ to be EQUAL.

**DO-SYMBOLS**

Macro

Package:LISP

Syntax:

```
(do-symbols (var [package [result-form]]) {decl}* {tag |  
statement}*)
```

Executes STATEMENTS once for each symbol in the PACKAGE (which defaults to the current package), with VAR bound to the current symbol. Then evaluates RESULT-FORM (which defaults to NIL) and returns the value(s).

**LOOP**

Special Form

Package:LISP

Syntax:

```
(loop {form}*)
```

Executes FORMs repeatedly until exited by a THROW or RETURN. The FORMs are surrounded by an implicit NIL block.

## 12 User Interface

- Special Variable  
 Package:LISP Holds the top-level form that GCL is currently evaluating.
  
- *(number &rest more-numbers)* Function  
 Package:LISP  
 Subtracts the second and all subsequent NUMBERS from the first NUMBER. With one arg, negates it.
  
- UNTRACE** Macro  
 Package:LISP  
 Syntax:  
     (untrace {function-name}\*)  
 Removes tracing from the specified functions. With no FUNCTION-NAMES, un-traces all functions.
  
- \*\*\*** Variable  
 Package:LISP Gets the previous value of \*\* when GCL evaluates a top-level form.
  
- MAKE-STRING-INPUT-STREAM** *(string &optional (start 0) (end (length string)))* Function  
 Package:LISP  
 Returns an input stream which will supply the characters of String between Start and End in order.
  
- STEP** Macro  
 Package:LISP  
 Syntax:  
     (step form)  
 Evaluates FORM in the single-step mode and returns the value.
  
- \*BREAK-ENABLE\*** Variable  
 Package:LISP GCL specific: When an error occurs, control enters to the break loop only if the value of this variable is non-NIL.
  
- /** Special Variable  
 Package:LISP Holds a list of the values of the last top-level form.
  
- DESCRIBE** *(x)* Function  
 Package:LISP  
 Prints a description of the object X.

|                                                                                                                                |                  |
|--------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>ED</b> (&optional x)                                                                                                        | Function         |
| Package:LISP                                                                                                                   |                  |
| Invokes the editor. The action depends on the version of GCL.                                                                  |                  |
| <b>*DEBUG-IO*</b>                                                                                                              | Variable         |
| Package:LISP Holds the I/O stream used by the GCL debugger.                                                                    |                  |
| <b>*BREAK-ON-WARNINGS*</b>                                                                                                     | Variable         |
| Package:LISP When the function WARN is called, control enters to the break loop only if the value of this variable is non-NIL. |                  |
| <b>CERROR</b> ( <i>continue-format-string error-format-string &amp;rest args</i> )                                             | Function         |
| Package:LISP                                                                                                                   |                  |
| Signals a correctable error.                                                                                                   |                  |
| <b>**</b>                                                                                                                      | Variable         |
| Package:LISP Gets the previous value of * when GCL evaluates a top-level form.                                                 |                  |
| <b>+++</b>                                                                                                                     | Special Variable |
| Package:LISP Gets the previous value of ++ when GCL evaluates a top-level form.                                                |                  |
| <b>INSPECT</b> (x)                                                                                                             | Function         |
| Package:LISP                                                                                                                   |                  |
| Shows the information about the object X in an interactive manner                                                              |                  |
| <b>//</b>                                                                                                                      | Special Variable |
| Package:LISP Gets the previous value of / when GCL evaluates a top-level form.                                                 |                  |
| <b>*TRACE-OUTPUT*</b>                                                                                                          | Variable         |
| Package:LISP The trace output stream.                                                                                          |                  |
| <b>++</b>                                                                                                                      | Special Variable |
| Package:LISP Gets the previous value of + when GCL evaluates a top-level form.                                                 |                  |
| <b>*ERROR-OUTPUT*</b>                                                                                                          | Variable         |
| Package:LISP Holds the output stream for error messages.                                                                       |                  |
| <b>DRIBBLE</b> (&optional <i>pathname</i> )                                                                                    | Function         |
| Package:LISP                                                                                                                   |                  |
| If PATHNAME is given, begins to record the interaction to the specified file. If PATHNAME is not given, ends the recording.    |                  |
| <b>*</b>                                                                                                                       | Variable         |
| Package:LISP Holds the value of the last top-level form.                                                                       |                  |

**///** Special Variable  
 Package:LISP Gets the previous value of `//` when GCL evaluates a top-level form.

**WARN** (*format-string* &rest *args*) Function  
 Package:LISP  
 Formats `FORMAT-STRING` and `ARGS` to `*ERROR-OUTPUT*` as a warning message.

**BREAK** (&optional (*format-string* **nil**) &rest **args**) Function  
 Package:LISP  
 Enters a break loop. If `FORMAT-STRING` is non-NIL, formats `FORMAT-STRING` and `ARGS` to `*ERROR-OUTPUT*` before entering a break loop. Typing `:HELP` at the break loop will list the break-loop commands.

**+** Special Variable  
 Package:LISP Holds the last top-level form.

**TRACE** Macro  
 Package:LISP  
 Syntax:

```
(trace {function-name}*)
```

Traces the specified functions. With no `FUNCTION-NAMES`, returns a list of functions currently being traced.

Additional Keywords are allowed in GCL with the syntax `(trace {fn | (fn {kw form}*)}*)`

For each `FN` naming a function, traces that function. Each `:KW` should be one of the ones listed below, and `FORM` should have the corresponding form. No `:KW` may be given more than once for the same `FN`. Returns a list of all `FNs` now traced which weren't already traced.

EXAMPLE (Try this with your favorite factorial function `FACT`):

```
;; print entry args and exit values
```

```
(trace FACT)
```

```
;; Break coming out of FACT if the value is bigger than 1000.
```

```
(trace (fact :exit
  (progn
    (if (> (car values) 1000)(break "big result"))
    (car values))))
```

```
;; Hairy example:
```

```
;;make arglist available without the si:: prefix
(import 'si::arglist)
```



```
(trace (fact
:DECLARATIONS
((in-string "Here comes input: ")
(out-string "Here comes output: ")
all-values
(silly (+ 3 4)))
:COND
(equal (rem (car arglist) 2) 0)
:ENTRY
(progn
(cond
((equal (car arglist) 8)
(princ "Entering FACT on input 8!! ")
(setq out-string "Here comes output from inside (FACT 8): "))
(t
(princ in-string)))
(car arglist))
:EXIT
(progn
(setq all-values (cons (car values) all-values))
(princ out-string)
(when (equal (car arglist) 8)
;; reset out-string
(setq out-string "Here comes output: "))
(cons 'fact values))
:ENTRYCOND
(not (= (car arglist) 6))
:EXITCOND
(not (= (car values) (* 6 (car arglist))))
:DEPTH
5))
```

Syntax is `:keyword form1 :keyword form2 ...`

`:declarations`

DEFAULT: NIL

FORM is `((var1 form1 )(var2 form2 )...)`, where the `var.i` are symbols distinct from each other and from all symbols which are similarly declared for currently traced functions. Each form is evaluated immediately. Upon any invocation of a traced function when not already inside a traced function call, each `var` is bound to that value of form .

`:COND`

DEFAULT: T

Here, FORM is any Lisp form to be evaluated (by EVAL) upon entering a call of FN, in the environment where `si::ARGLIST` is bound to the current list of arguments of FN. Note that even if the evaluation of FORM changes the value of `SI::ARGLIST` (e.g. by evaluation of `(SETQ si::ARGLIST ...)`), the list of arguments passed to FN is unchanged. Users may alter

args passed by destructively modifying the list structure of `SI::ARGLIST` however. The call is traced (thus invoking the `:ENTRYCOND` and `:EXITCOND` forms, at least) if and only if `FORM` does not evaluate to `NIL`.

`:ENTRYCOND`

DEFAULT: T

This is evaluated (by `EVAL`) if the `:COND` form evaluates to non-`NIL`, both in an environment where `SI::ARGLIST` is bound to the current list of arguments of `FN`. If non-`NIL`, the `:ENTRY` form is then evaluated and printed with the trace "prompt".

`:ENTRY`

DEFAULT: (CONS (QUOTE x) SI::ARGLIST),

where `x` is the symbol we call `FN` if the `:COND` and `:ENTRYCOND` forms evaluate to non-`NIL`, then the trace "prompt" is printed and then this `FORM` is evaluated (by `EVAL`) in an environment where `SI::ARGLIST` is bound to the current list of arguments of `FN`. The result is then printed.

`:EXITCOND`

DEFAULT: T

This is evaluated (by `EVAL`) in the environment described below for the `:EXIT` form. The `:EXIT` form is then evaluated and printed with the "prompt" if and only if the result here is non-`NIL`.

`:EXIT`

DEFAULT: (CONS (QUOTE x) VALUES),

where `x` is the symbol we call `FN` Upon exit from tracing a given call, this `FORM` is evaluated (after the appropriate trace "prompt" is printed), using `EVAL` in an environment where `SI::ARGLIST` is bound to the current list of arguments of `FN` and `VALUES` is bound to the list of values returned by `FN` (recalling that Common Lisp functions may return multiple values).

`:DEPTH`

DEFAULT: No depth limit

`FORM` is simply a positive integer specifying the maximum nesting of traced calls of `FN`, i.e. of calls of `FN` in which the `:COND` form evaluated to non-`NIL`. For calls of `FN` in which this limit is exceeded, even the `:COND` form is not evaluated, and the call is not traced.



## 13 Doc

**APROPOS** (*string* &optional (*package* **nil**))

Function

Package:LISP

Prints those symbols whose print-names contain *STRING* as substring. If *PACKAGE* is non-NIL, then only the specified package is searched.

**INFO** (*string* &optional (*list-of-info-files* **\*default-info-files\***))

Function

PACKAGE:SI

Find all documentation about *STRING* in *LIST-OF-INFO-FILES*. The search is done for *STRING* as a substring of a node name, or for *STRING* in the indexed entries in the first index for each info file. Typically that should be a variable and function definition index, if the info file is about a programming language. If the windowing system is connected, then a choice box is offered and double clicking on an item brings up its documentation.

Otherwise a list of choices is offered and the user may select some of these choices.

*list-of-info-files* is of the form

```
("gcl-si.info" "gcl-tk.info" "gcl.info")
```

The above list is the default value of *\*default-info-files\**, a variable in the SI package. To find these files in the file system, the search path *\*info-paths\** is consulted as is the master info directory *'dir'*.

see *\*Index \*default-info-files\*::* and *\*Index \*info-paths\*::*. For example

```
(info "defun")
```

```
0: DEFUN :(gcl-si.info)Special Forms and Functions.
```

```
1: (gcl.info)defun.
```

```
Enter n, all, none, or multiple choices eg 1 3 : 1
```

```
Info from file /home/wfs/gcl-doc/gcl.info:
```

```
defun
```

[Macro]■

```
-----■
'Defun'  function-name lambda-list [[{declaration}* | documentation]]■
```

```
...
```

would list the node *(gcl.info)defun*. That is the node entitled **defun** from the info file *gcl.info*. That documentation is based on the ANSI common lisp standard. The choice

```
DEFUN :(gcl-si.info)Special Forms and Functions.
```

refers to the documentation on DEFUN from the info file *gcl-si.info* in the node *Special Forms And Functions*. This is an index reference and only the part of the node which refers to **defun** will be printed.

```
(info "factor" '("maxima.info"))
```

would search the maxima info files index and nodes for **factor**.

**\*info-paths\***

Variable

Package SI:

A list of strings such as

```
'( " " /usr/info/" /usr/local/lib/info/" /usr/local/info/"
  "/usr/local/gnu/info/" )
```

saying where to look for the info files. It is used implicitly by `info`, see `*Index info::`.

Looking for `maxima.info` would look for the file `maxima.info` in all the directories listed in `*info-paths*`. If not found then it would look for `'dir'` in the `*info-paths*` directories, and if it were found it would look in the `'dir'` for a menu item such as

```
* maxima: (/home/wfs/maxima-5.0/info/maxima.info).
```

If such an entry exists then the directory there would be used for the purpose of finding `maxima.info`

## 14 Type

|                                                                                                                                                             |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>COERCE</b> ( <i>x type</i> )                                                                                                                             | Function |
| Package:LISP                                                                                                                                                |          |
| Coerces X to an object of the type TYPE.                                                                                                                    |          |
| <b>TYPE-OF</b> ( <i>x</i> )                                                                                                                                 | Function |
| Package:LISP                                                                                                                                                |          |
| Returns the type of X.                                                                                                                                      |          |
| <b>CONSTANTP</b> ( <i>symbol</i> )                                                                                                                          | Function |
| Package:LISP                                                                                                                                                |          |
| Returns T if the variable named by SYMBOL is a constant; NIL otherwise.                                                                                     |          |
| <b>TYPEP</b> ( <i>x type</i> )                                                                                                                              | Function |
| Package:LISP                                                                                                                                                |          |
| Returns T if X is of the type TYPE; NIL otherwise.                                                                                                          |          |
| <b>COMMONP</b> ( <i>x</i> )                                                                                                                                 | Function |
| Package:LISP                                                                                                                                                |          |
| Returns T if X is a Common Lisp object; NIL otherwise.                                                                                                      |          |
| <b>SUBTYPEP</b> ( <i>type1 type2</i> )                                                                                                                      | Function |
| Package:LISP                                                                                                                                                |          |
| Returns T if TYPE1 is a subtype of TYPE2; NIL otherwise. If it could not determine, then returns NIL as the second value. Otherwise, the second value is T. |          |
| <b>CHECK-TYPE</b>                                                                                                                                           | Macro    |
| Package:LISP                                                                                                                                                |          |
| Syntax:                                                                                                                                                     |          |
| <code>(check-type place typespec [string])</code>                                                                                                           |          |
| Signals an error, if the contents of PLACE are not of the specified type.                                                                                   |          |
| <b>ASSERT</b>                                                                                                                                               | Macro    |
| Package:LISP                                                                                                                                                |          |
| Syntax:                                                                                                                                                     |          |
| <code>(assert test-form [(<i>{place}</i>*) [<i>{string {arg}*</i>]])</code>                                                                                 |          |
| Signals an error if the value of TEST-FORM is NIL. STRING is an format string used as the error message. ARGS are arguments to the format string.           |          |

**DEFTYPE**

Macro

Package:LISP

Syntax:

```
(deftype name lambda-list {decl | doc}* {form}*)
```

Defines a new type-specifier abbreviation in terms of an 'expansion' function (lambda lambda-list1 {decl}\* {form}\*) where lambda-list1 is identical to LAMBDA-LIST except that all optional parameters with no default value specified in LAMBDA-LIST defaults to the symbol '\*', but not to NIL. When the type system of GCL encounters a type specifier (NAME arg1 ... argn), it calls the expansion function with the arguments arg1 ... argn, and uses the returned value instead of the original type specifier. When the symbol NAME is used as a type specifier, the expansion function is called with no argument. The doc-string DOC, if supplied, is saved as the TYPE doc of NAME, and is retrieved by (documentation 'NAME 'type).

**DYNAMIC-EXTENT**

Declaration

Package:LISP Declaration to allow locals to be cons'd on the C stack. For example (defun foo (&rest l) (declare (:dynamic-extent l)) ...) will cause l to be a list formed on the C stack of the foo function frame. Of course passing L out as a value of foo will cause havoc. (setq x (make-list n)) (setq x (cons a b)) (setq x (list a b c ..)) also are handled on the stack, for dynamic-extent x.

## 15 GCL Specific

- SYSTEM** (*string*) Function  
 Package:LISP  
 GCL specific: Executes a Shell command as if STRING is an input to the Shell. Not all versions of GCL support this function. At least on POSIX systems, this call should return two integers representing the exit status and any possible terminating signal respectively.
- \*TMP-DIR\*** Variable  
 Package:COMPILER GCL specific: Directory in which temporary “gazonk” files used by the compiler are to be created.
- \*IGNORE-MAXIMUM-PAGES\*** Variable  
 Package:SI GCL specific: Tells the GCL memory manager whether (non-NIL) or not (NIL) it should expand memory whenever the maximum allocatable pages have been used up.
- \*OPTIMIZE-MAXIMUM-PAGES\*** Variable  
 Package:SI  
 GCL specific: Tells the GCL memory manager whether to attempt to adjust the maximum allowable pages for each type to approximately optimize the garbage collection load in the current process. Defaults to T. Set to NIL if you care more about memory usage than runtime.
- MACHINE-VERSION** () Function  
 Package:LISP  
 Returns a string that identifies the machine version of the machine on which GCL is currently running.
- BY** () Function  
 Package:LISP  
 GCL specific: Exits from GCL.
- DEFCFUN** Macro  
 Package:LISP  
 Syntax:  
 (defcfun header n {element}\*)  
 GCL specific: Defines a C-language function which calls Lisp functions and/or handles Lisp objects. HEADER gives the header of the C function as a string. Non-negative-integer is the number of the main stack entries used by the C function, primarily for protecting Lisp objects from being garbage-collected. Each ELEMENT may give a C code fragment as a string, or it may be a list ((symbol {arg}\*) {place}\*) which, when executed, calls the Lisp function named by SYMBOL with the specified arguments



and saves the value(s) to the specified places. The DEF CFUN form has the above meanings only after compiled; The GCL interpreter simply ignores this form.

An example which defines a C function list2 of two arguments, but which calls the 'lisp' function CONS by name, and refers to the constant 'NIL. Note to be loaded by load the function should be static.

```
(defCfun "static object list2(x,y) object x,y;" 0 "object z;" ('NIL z) ((CONS y z) z)
((CONS x z) z) "return(z);" )
```

In lisp the operations in the body would be (setq z 'nil) (setq z (cons y z)) (setq z (cons x z))

Syntax:

```
(defCfun header non-negative-integer
  { string
    | ( function-symbol { value }* )
    | (( function-symbol { value }* ) { place }* ) })

value:
place:
    { C-expr | ( C-type C-expr ) }

C-function-name:
C-expr:
    { string | symbol }

C-type:
    { object | int | char | float | double }
```

## CLINES

Macro

Package:LISP

Syntax:

```
(clines {string}*)
```

GCL specific: The GCL compiler embeds STRINGS into the intermediate C language code. The interpreter ignores this form.

## ALLOCATE (*type number* &optional (*really-allocate* **nil**))

Function

Package:LISP

GCL specific: Sets the maximum number of pages for the type class of the GCL implementation type TYPE to NUMBER. If REALLY-ALLOCATE is given a non-NIL value, then the specified number of pages will be allocated immediately.

## GBC (*x*)

Function

Package:LISP

GCL specific: Invokes the garbage collector (GC) with the collection level specified by X. NIL as the argument causes GC to collect cells only. T as the argument causes GC to collect everything.

**SAVE** (*pathname*) Function  
 Package:LISP

GCL specific: Saves the current GCL core image into a program file specified by *PATHNAME*. This function depends on the version of GCL. The function `si::save-system` is to be preferred in almost all circumstances. Unlike `save`, it makes the relocatable section permanent, and causes no future gc of currently loaded .o files.

**HELP\*** (*string* &optional (*package* 'lisp)) Function  
 Package:LISP

GCL specific: Prints the documentation associated with those symbols in the specified package whose print names contain *STRING* as substring. *STRING* may be a symbol, in which case the print-name of that symbol is used. If *PACKAGE* is `NIL`, then all packages are searched.

**DEFLA** Macro  
 Package:LISP

Syntax:

```
(defla name lambda-list {decl | doc}* {form}*)
```

GCL specific: Used to `DEFine` Lisp Alternative. For the interpreter, `DEFLA` is equivalent to `DEFUN`, but the compiler ignores this form.

**PROCLAMATION** (*decl-spec*) Function  
 Package:LISP

GCL specific: Returns `T` if the specified declaration is globally in effect; `NIL` otherwise. See the doc of `DECLARE` for possible `DECL-SPECs`.

**DEFENTRY** Macro  
 Package:LISP

Syntax:

```
(defentry name arg-types c-function)
```

GCL specific: The compiler defines a Lisp function whose body consists of a calling sequence to the C language function specified by *C-FUNCTION*. The interpreter ignores this form. The *ARG-TYPES* specifies the C types of the arguments which *C-FUNCTION* requires. The list of allowed types is (object char int float double string). Code will be produced to coerce from a lisp object to the appropriate type before passing the argument to the *C-FUNCTION*. The *c-function* should be of the form (c-result-type c-fname) where *c-result-type* is a member of (void object char int float double string). *c-fname* may be a symbol (in which case it will be downcased) or a string. If *c-function* is not a list, then (object *c-function*) is assumed. In order for C code to be loaded in by `load` you should declare any variables and functions to be static. If you will link them in at build time, of course you are allowed to define new externals.

```

    Sample usage:
--File begin-----
;; JOE takes X a lisp string and Y a fixnum and returns a character.■
(clines "#include \"foo.ch\"")
(defentry joe (string int) (char "our_c_fun"))
---File end-----
---File foo.ch---
/* C function for extracting the i'th element of a string */
static char our_c_fun(p,i)
char *p;
int i;
{
return p[i];
}
-----File end---

```

One must be careful of storage allocation issues when passing a string. If the C code invokes storage allocation (either by calling `malloc` or `make_cons` etc), then there is a possibility of a garbage collection, so that if the string passed was not constructed with `:static t` when its array was constructed, then it could move. If the C function may allocate storage, then you should pass a copy:

```

(defun safe-c-string (x)
  (let* ((n (length x))
        (a (make-array (+ n 1) :element-type 'string-char
                        :static t :fill-pointer n)))
    (si::copy-array-portion x y 0 0 n)
    (setf (aref a n) (code-char 0)))
  a)

```

## **COPY-ARRAY-PORITION** (*x,y,i1,i2,n1*)

Function

Package:SI Copy elements from X to Y starting at X[i1] to Y[i2] and doing N1 elements if N1 is supplied otherwise, doing the length of X - I1 elements. If the types of the arrays are not the same, this has implementation dependent results.

## **BYE** ( &optional (*exit-status 0*))

Function

Package:LISP

GCL specific: Exits from GCL with exit-status.

## **USE-FAST-LINKS** (*turn-on*)

Function

Package:LISP

GCL specific: If TURN-ON is not nil, the fast link mechanism is enabled, so that ordinary function calls will not appear in the invocation stack, and calls will be much faster. This is the default. If you anticipate needing to see a stack trace in the debugger, then you should turn this off.

## 15.1 Bignums

A directory `mp` was added to hold the new multi precision arithmetic code. The layout and a fair amount of code in the `mp` directory is an enhanced version of `gpari` version 34. The `gpari.c` code was rewritten to be more efficient, and `gcc` assembler macros were added to allow inlining of operations not possible to do in C. On a 68K machine, this allows the C version to be as efficient as the very carefully written assembler in the `gpari` distribution. For the main machines, an assembler file (produced by `gcc`) based on this new method, is included. This is for sites which do not have `gcc`, or do not wish to compile the whole system with `gcc`.

Bignum arithmetic is much faster now. Many changes were made to `cmpnew` also, to add 'integer' as a new type. It differs from variables of other types, in that storage is associated to each such variable, and assignments mean copying the storage. This allows a function which does a good deal of bignum arithmetic, to do very little consing in the heap. An example is the computation of `PI-INV` in `scratchpad`, which calculates the inverse of `pi` to a prescribed number of bits accuracy. That function is now about 20 times faster, and no longer causes garbage collection. In versions of GCL where `HAVE_ALLOCA` is defined, the temporary storage growth is on the C stack, although this often not so critical (for example it makes virtually no difference in the `PI-INV` example, since in spite of the many operations, only one storage allocation takes place.

Below is the actual code for `PI-INV`

On a sun3/280 (cli.com)

Here is the comparison of `lucid` and `gcl` before and after on that `pi-inv`. Times are in seconds with multiples of the `gcl/akcl` time in parentheses.

On a sun3/280 (cli.com)

| pi-inv | akcl-566 | franz       | lucid       | old kcl/akcl   |
|--------|----------|-------------|-------------|----------------|
| -----  | -----    | -----       | -----       | -----          |
| 10000  | 3.3      | 9.2(2.8 X)  | 15.3 (4.6X) | 92.7 (29.5 X)  |
| 20000  | 12.7     | 31.0(2.4 X) | 62.2 (4.9X) | 580.0 (45.5 X) |

```
(defun pi-inv (bits &aux (m 0))
  (declare (integer bits m))
  (let* ((n (+ bits (integer-length bits) 11))
        (tt (truncate (ash 1 n) 882))
        (d (* 4 882 882))
        (s 0))
    (declare (integer s d tt n))
    (do ((i 2 (+ i 2))
        (j 1123 (+ j 21460)))
      ((zerop tt) (cons s (- (+ n 2))))
      (declare (integer i j))
      (setq s (+ s (* j tt))
            m (- (* (- i 1) (- (* 2 i) 1) (- (* 2 i) 3)))
            tt (truncate (* m tt) (* d (the integer (expt i 3)))))))
```



## 16 C Interface

### 16.1 Available Symbols

When GCL is built, those symbols in the system libraries which are referenced by functions linked in in the list of objects given in ‘`unixport/makefile`’, become available for reference by GCL code.

On some systems it is possible with `faslink` to load ‘.o’ files which reference other libraries, but in general this practice is not portable.



## 17 System Definitions

- ALLOCATE-CONTIGUOUS-PAGES** (*number* &optional (*really-allocate* **nil**)) Function  
 Package:SI  
 GCL specific: Sets the maximum number of pages for contiguous blocks to **NUMBER**. If **REALLY-ALLOCATE** is non-NIL, then the specified number of pages will be allocated immediately.
- FREEZE-DEFSTRUCT** (*name*) Function  
 Package:SI  
 The inline defstruct type checker will be made more efficient, in that it will only check for types which currently include **NAME**. After calling this the defstruct should not be altered.
- MAXIMUM-ALLOCATABLE-PAGES** (*type*) Function  
 Package:SI  
 GCL specific: Returns the current maximum number of pages for the type class of the GCL implementation type **TYPE**.
- ALLOCATED-RELOCATABLE-PAGES** () Function  
 Package:SI  
 GCL specific: Returns the number of pages currently allocated for relocatable blocks.
- PUTPROP** (*symbol* *value* *indicator*) Function  
 Package:SI  
 Give **SYMBOL** the **VALUE** on **INDICATOR** property.
- ALLOCATED-PAGES** (*type*) Function  
 Package:SI  
 GCL specific: Returns the number of pages currently allocated for the type class of the GCL implementation type **TYPE**.
- ALLOCATE-RELOCATABLE-PAGES** (*number*) Function  
 Package:SI  
 GCL specific: Sets the maximum number of pages for relocatable blocks to **NUMBER**.
- ALLOCATED-CONTIGUOUS-PAGES** () Function  
 Package:SI  
 GCL specific: Returns the number of pages currently allocated for contiguous blocks.
- MAXIMUM-CONTIGUOUS-PAGES** () Function  
 Package:SI  
 GCL specific: Returns the current maximum number of pages for contiguous blocks.



|                                                                                                                                                                                                                                                                                                                                                                                                |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>GET-HOLE-SIZE</b> ()                                                                                                                                                                                                                                                                                                                                                                        | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns as a fixnum the size of the memory hole (in pages).                                                                                                                                                                                                                                                                                                                      |          |
| <b>SPECIALP</b> ( <i>symbol</i> )                                                                                                                                                                                                                                                                                                                                                              | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns T if the SYMBOL is a globally special variable; NIL otherwise.                                                                                                                                                                                                                                                                                                           |          |
| <b>OUTPUT-STREAM-STRING</b> ( <i>string-output-stream</i> )                                                                                                                                                                                                                                                                                                                                    | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the string corresponding to the STRING-OUTPUT-STREAM.                                                                                                                                                                                                                                                                                                                    |          |
| <b>GET-STRING-INPUT-STREAM-INDEX</b> ( <i>string-input-stream</i> )                                                                                                                                                                                                                                                                                                                            | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the current index of the STRING-INPUT-STREAM.                                                                                                                                                                                                                                                                                                                            |          |
| <b>STRING-CONCATENATE</b> (&rest <i>strings</i> )                                                                                                                                                                                                                                                                                                                                              | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the result of concatenating the given STRINGS.                                                                                                                                                                                                                                                                                                                           |          |
| <b>BDS-VAR</b> ( <i>i</i> )                                                                                                                                                                                                                                                                                                                                                                    | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the symbol of the i-th entity in the bind stack.                                                                                                                                                                                                                                                                                                                         |          |
| <b>ERROR-SET</b> ( <i>form</i> )                                                                                                                                                                                                                                                                                                                                                               | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Evaluates the FORM in the null environment. If the evaluation of the FORM has successfully completed, SI:ERROR-SET returns NIL as the first value and the result of the evaluation as the rest of the values. If, in the course of the evaluation, a non-local jump from the FORM is attempted, SI:ERROR-SET traps the jump and returns the corresponding jump tag as its value. |          |
| <b>COMPILED-FUNCTION-NAME</b> ( <i>compiled-function-object</i> )                                                                                                                                                                                                                                                                                                                              | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the name of the COMPILED-FUNCTION-OBJECT.                                                                                                                                                                                                                                                                                                                                |          |
| <b>STRUCTUREP</b> ( <i>object</i> )                                                                                                                                                                                                                                                                                                                                                            | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns T if the OBJECT is a structure; NIL otherwise.                                                                                                                                                                                                                                                                                                                           |          |
| <b>IHS-VS</b> ( <i>i</i> )                                                                                                                                                                                                                                                                                                                                                                     | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                     |          |
| GCL specific: Returns the value stack index of the i-th entity in the invocation history stack.                                                                                                                                                                                                                                                                                                |          |

- UNIVERSAL-ERROR-HANDLER** (*error-name correctable  
function-name continue-format-string error-format-string &rest args*) Function  
 Package:SI  
 GCL specific: Starts the error handler of GCL. When an error is detected, GCL calls SI:UNIVERSAL-ERROR-HANDLER with the specified arguments. ERROR-NAME is the name of the error. CORRECTABLE is T for a correctable error and NIL for a fatal error. FUNCTION-NAME is the name of the function that caused the error. CONTINUE-FORMAT-STRING and ERROR-FORMAT-STRING are the format strings of the error message. ARGS are the arguments to the format strings. To change the error handler of GCL, redefine SI:UNIVERSAL-ERROR-HANDLER.
- \*INTERRUPT-ENABLE\*** Variable  
 Package:SI GCL specific: If the value of SI:\*INTERRUPT-ENABLE\* is non-NIL, GCL signals an error on the terminal interrupt (this is the default case). If it is NIL, GCL ignores the interrupt and assigns T to SI:\*INTERRUPT-ENABLE\*.
- CHDIR** (*pathname*) Function  
 Package:SI  
 GCL/UNIX specific: Changes the current working directory to the specified path-name.
- COPY-STREAM** (*in-stream out-stream*) Function  
 Package:SI  
 GCL specific: Copies IN-STREAM to OUT-STREAM until the end-of-file on IN-STREAM.
- INIT-SYSTEM** () Function  
 Package:SI  
 GCL specific: Initializes the library and the compiler of GCL. Since they have already been initialized in the standard image of GCL, calling SI:INIT-SYSTEM will cause an error.
- \*INDENT-FORMATTED-OUTPUT\*** Variable  
 Package:SI GCL specific: The FORMAT directive ~% indents the next line if the value of this variable is non-NIL. If NIL, ~% simply does Newline.
- SET-HOLE-SIZE** (*fixnum*) Function  
 Package:SI  
 GCL specific: Sets the size of the memory hole (in pages).
- FRS-BDS** (*i*) Function  
 Package:SI  
 GCL specific: Returns the bind stack index of the i-th entity in the frame stack.

|                                                                                                                                                                                                                                                                                                                                                                                                             |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>IHS-FUN</b> ( <i>i</i> )                                                                                                                                                                                                                                                                                                                                                                                 | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Returns the function value of the i-th entity in the invocation history stack.                                                                                                                                                                                                                                                                                                                |          |
| <b>*MAKE-CONSTANT</b> ( <i>symbol value</i> )                                                                                                                                                                                                                                                                                                                                                               | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Makes the SYMBOL a constant with the specified VALUE.                                                                                                                                                                                                                                                                                                                                         |          |
| <b>FIXNUMP</b> ( <i>object</i> )                                                                                                                                                                                                                                                                                                                                                                            | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Returns T if the OBJECT is a fixnum; NIL otherwise.                                                                                                                                                                                                                                                                                                                                           |          |
| <b>BDS-VAL</b> ( <i>i</i> )                                                                                                                                                                                                                                                                                                                                                                                 | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Returns the value of the i-th entity in the bind stack.                                                                                                                                                                                                                                                                                                                                       |          |
| <b>STRING-TO-OBJECT</b> ( <i>string</i> )                                                                                                                                                                                                                                                                                                                                                                   | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: (SI:STRING-TO-OBJECT STRING) is equivalent to (READ-FROM-STRING STRING), but much faster.                                                                                                                                                                                                                                                                                                     |          |
| <b>*SYSTEM-DIRECTORY*</b>                                                                                                                                                                                                                                                                                                                                                                                   | Variable |
| Package:SI GCL specific: Holds the name of the system directory of GCL.                                                                                                                                                                                                                                                                                                                                     |          |
| <b>FRS-IHS</b> ( <i>i</i> )                                                                                                                                                                                                                                                                                                                                                                                 | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Returns the invocation history stack index of the i-th entity in the frame stack.                                                                                                                                                                                                                                                                                                             |          |
| <b>RESET-GBC-COUNT</b> ()                                                                                                                                                                                                                                                                                                                                                                                   | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL specific: Resets the counter of the garbage collector that records how many times the garbage collector has been called for each implementation type.                                                                                                                                                                                                                                                   |          |
| <b>CATCH-BAD-SIGNALS</b> ()                                                                                                                                                                                                                                                                                                                                                                                 | Function |
| Package:SI                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| GCL/BSD specific: Installs a signal catcher for bad signals: SIGILL, SIGIOT, SIGEMT, SIGBUS, SIGSEGV, SIGSYS. The signal catcher, upon catching the signal, signals an error (and enter the break-level). Since the internal memory of GCL may be broken, the user should check the signal and exit from GCL if necessary. When the signal is caught during garbage collection, GCL terminates immediately. |          |

- RESET-STACK-LIMITS** () Function  
 Package:SI  
 GCL specific: Resets the stack limits to the normal state. When a stack has overflowed, GCL extends the limit for the stack in order to execute the error handler. After processing the error, GCL resets the stack limit by calling SI:RESET-STACK-LIMITS.
- \*GBC-MESSAGE\*** Variable  
 Package:SI GCL specific: If the value of SI:\*GBC-MESSAGE\* is non-NIL, the garbage collector prints some information on the terminal. Usually SI:\*GBC-MESSAGE\* should be set NIL.
- \*GBC-NOTIFY\*** Variable  
 Package:SI GCL specific: If the value is non-NIL, the garbage collector prints a very brief one line message about the area causing the collection, and the time spent in internal time units.
- \*AFTER-GBC-HOOK\*** Variable  
 Package:SI Defaults to nil, but may be set to a function of one argument TYPE which is a lisp variable indicating the TYPE which caused the current collection.
- ALLOCATED** (*type*) Function  
 Package:SI  
 Returns 6 values:  
 nfree        number free  
 npages      number of pages  
 maxpage     number of pages to grow to  
 nppage      number per page  
 gbccount    number of gc's due to running out of items of this size  
 nused       number of items used  
 Note that all items of the same size are stored on similar pages. Thus for example on a 486 under linux the following basic types are all the same size and so will share the same allocated information: CONS BIGNUM RATIO COMPLEX STRUCTURE.
- \*MAKE-SPECIAL** (*symbol*) Function  
 Package:SI  
 GCL specific: Makes the SYMBOL globally special.
- MAKE-STRING-OUTPUT-STREAM-FROM-STRING** Function  
 (*string*)  
 Package:SI  
 GCL specific: Creates a string-output-stream corresponding to the STRING and returns it. The STRING should have a fill-pointer.

**\*IGNORE-EOF-ON-TERMINAL-IO\***

Variable

Package:SI GCL specific: If the value of SI:\*IGNORE-EOF-ON-TERMINAL-IO\* is non-NIL, GCL ignores the eof-character (usually ^D) on the terminal and the terminal never becomes end-of-file. The default value of SI:\*IGNORE-EOF-ON-TERMINAL-IO\* is NIL.

**ADDRESS** (*object*)

Function

Package:SI

GCL specific: Returns the address of the OBJECT as a fixnum. The address of an object depends on the version of GCL. E.g. (SI:ADDRESS NIL) returns 1879062044 on GCL/AOSVS dated March 14, 1986.

**\*LISP-MAXPAGES\***

Variable

Package:SI GCL specific: Holds the maximum number of pages (1 page = 2048 bytes) for the GCL process. The result of changing the value of SI:\*LISP-MAXPAGES\* is unpredictable.

**ARGC** ()

Function

Package:SI

GCL specific: Returns the number of arguments on the command line that invoked the GCL process.

**NANI** (*fixnum*)

Function

Package:SI

GCL specific: Returns the object in the address FIXNUM. This function is the inverse of SI:ADDRESS. Although SI:ADDRESS is a harmless operation, SI:NANI is quite dangerous and should be used with care.

**\*NOTIFY-GBC\***

Variable

Package:SI GCL specific: If the value of this variable is non-NIL, then the garbage collector notifies that it begins to run whenever it is invoked. Otherwise, garbage collection begins silently.

**SAVE-SYSTEM** (*pathname*)

Function

Package:SI

GCL specific: Saves the current GCL core image into a program file specified by PATHNAME. This function differs from SAVE in that the contiguous and relocatable areas are made permanent in the saved image. Usually the standard image of GCL interpreter/compiler is saved by SI:SAVE-SYSTEM. This function causes an exit from lisp. Various changes are made to the memory of the running system, such as closing files and resetting io streams. It would not be possible to continue normally.

**UNCATCH-BAD-SIGNALS** ()

Function

Package:SI

GCL/BSD specific: Undoes the effect of SI:CATCH-BAD-SIGNALS.

- VS** (*i*) Function  
 Package:SI  
 GCL specific: Returns the *i*-th entity in the value stack.
- DISPLACED-ARRAY-P** (*array*) Function  
 Package:SI  
 GCL specific: Returns T if the ARRAY is a displaced array; NIL otherwise.
- ARGV** (*fixnum*) Function  
 Package:SI  
 GCL specific: Returns the FIXNUM-th argument on the command line that invoked the GCL process.
- \*DEFAULT-TIME-ZONE\*** Variable  
 Package:SI GCL specific: Holds the default time zone. The initial value of SI:\*DEFAULT-TIME-ZONE\* is 6 (the time zone of Austin, Texas).
- GETENV** (*string*) Function  
 Package:SI  
 GCL/UNIX specific: Returns the environment with the name STRING as a string; if the environment specified by STRING is not found, returns NIL.
- FASLINK** (*file string*) Function  
 Package:SI  
 GCL/BSD specific: Loads the FASL file FILE while linking the object files and libraries specified by STRING. For example, (faslink "foo.o" "bar.o boo.o -lpixrect") loads foo.o while linking two object files (bar.o and boo.o) and the library pixrect. Usually, foo.o consists of the C language interface for the functions defined in the object files or the libraries.  
 A more portable way of making references to C code, is to build it in at the time of the original make. If foo.c references things in -lpixrect, and foo.o is its compilation in the gcl/unixport directory  
 (cd gcl/unixport ; make "EXTRAS= foo.o -lpixrect ")  
 should add them. If EXTRAS was already joe.o in the unixport/makefile you should of course add joe.o to the above "EXTRAS= joe.o foo.o.."  
 Faslink does not work on most UNIX systems which are derived from SYS V or AIX.
- TOP-LEVEL** () Function  
 Package:SI  
 GCL specific: Starts the standard top-level listner of GCL. When the GCL process is invoked, it calls SI:TOP-LEVEL by (FUNCALL 'SI:TOP-LEVEL). To change the top-level of GCL, redefine SI:TOP-LEVEL and save the core image in a file. When the saved image is invoked, it will start the redefined top-level.

**FRS-VS** (*i*)

Function

Package:SI

GCL specific: Returns the value stack index of the *i*-th entity in the frame stack.

**WRITE-DEBUG-SYMBOLS** (*start file &key (main-file*

Function

*"/usr/local/schelter/xgcl/unixport/raw\_gcl") (output-file "debug-symbols.o" )*)

Package:SI

Write out a file of debug-symbols using address *START* as the place where *FILE* will be loaded into the running executable *MAIN-FILE*. The last is a keyword argument.

**PROF** (*x y*)

Function

Package:SI

These functions in the SI package are GCL specific, and allow monitoring the run time of functions loaded into GCL, as well as the basic functions. Sample Usage: (si::set-up-profile 1000000) (si::prof 0 90) run program (si::prof 0 0) ;; turn off profile (si::display-prof) (si::clear-profile) (si::prof 0 90) ;; start profile again run program .. Profile can be stopped with (si::prof 0 0) and restarted with (si::prof 0 90) The *START-ADDRESS* will correspond to the beginning of the profile array, and the *SCALE* will mean that 256 bytes of code correspond to *SCALE* bytes in the profile array.

Thus if the profile array is 1,000,000 bytes long and the code segment is 5 megabytes long you can profile the whole thing using a scale of 50 Note that long runs may result in overflow, and so an understating of the time in a function.

You must run intensively however since, with a scale of 128 it takes 6,000,000 times through a loop to overflow the sampling in one part of the code.

**CATCH-FATAL** (*i*)

Function

Package:SI

Sets the value of the C variable *catch\_fatal* to *I* which should be an integer. If *catch\_fatal* is 1, then most unrecoverable fatal errors will be caught. Upon catching such an error *catch\_fatal* becomes -1, to avoid recursive errors. The top level loop automatically sets *catch\_fatal* to 1, if the value is less than zero. Catching can be turned off by making *catch\_fatal* = 0.

**\*MULTIPLY-STACKS\***

Variable

Package:SI

If this variable is set to a positive fixnum, then the next time through the *TOP-LEVEL* loop, the loop will be exited. The size of the stacks will be multiplied by the value of *\*multiply-stacks\**, and the *TOP-LEVEL* will be called again. Thus to double the size of the stacks:

```
>(setq si::*multiply-stacks* 2) [exits top level and reinvokes it, with the new stacks in place] >
```

We must exit *TOP-LEVEL*, because it and any other lisp functions maintain many pointers into the stacks, which would be incorrect when the stacks have been moved. Interrupting the process of growing the stacks, can leave you in an inconsistent state.

**GBC-TIME** (&optional *x*)

Function

Package:SI

Sets the internal C variable `gc_time` to *X* if *X* is supplied and then returns `gc_time`. If `gc_time` is greater or equal to 0, then `gc_time` is incremented by the garbage collector, according to the number of internal time units spent there. The initial value of `gc_time` is -1.

**FWRITE** (*string start count stream*)

Function

Package:SI

Write from *STRING* starting at char *START* (or 0 if it is nil) *COUNT* characters (or to end if *COUNT* is nil) to *STREAM*. *STREAM* must be a stream such as returned by `FP-OUTPUT-STREAM`. Returns nil if it fails.

**FREAD** (*string start count stream*)

Function

Package:SI

Read characters into *STRING* starting at char *START* (or 0 if it is nil) *COUNT* characters (or from start to length of *STRING* if *COUNT* is nil). Characters are read from *STREAM*. *STREAM* must be a stream such as returned by `FP-INPUT-STREAM`. Returns nil if it fails. Return number of characters read if it succeeds.

**SGC-ON** (&optional *ON*)

Function

Package:SI

If *ON* is not nil then SGC (stratified garbage collection) is turned on. If *ON* is supplied and is nil, then SGC is turned off. If *ON* is not supplied, then it returns T if SGC is on, and NIL if SGC is off.

The purpose of SGC is to prevent paging activity during garbage collection. It is efficient if the actual number of pages being written to form a small percentage of the total image size. The image should be built as compactly as possible. This can be accomplished by using a settings such as `(si::allocate-growth 'cons 1 10 50 20)` to limit the growth in the cons maxpage to 10 pages per time. Then just before calling `si::save-system` to save your image you can do something like:

```
(si::set-hole-size 500)(gbc nil) (si::sgc-on t) (si::save-system ..)
```

This makes the saved image come up with SGC on. We have set a reasonably large hole size. This is so that allocation of pages either because they fill up, or through specific calls to `si::allocate`, will not need to move all the relocatable data. Moving relocatable data requires turning SGC off, performing a full gc, and then turning it back on. New relocatable data is collected by SGC, but moving the old requires going through all pages of memory to change pointers into it.

Using `si::*notify-gbc*` gives information about the number of pages used by SGC.

Note that SGC is only available on operating systems which provide the `mprotect` system call, to write protect pages. Otherwise we cannot tell which pages have been written too.



**ALLOCATE-SGC** (*type min-pages max-pages percent-free*)

Function

Package:SI

If MIN-PAGES is 0, then this type will not be swept by SGC. Otherwise this is the minimum number of pages to make available to SGC. MAX-PAGES is the upper limit of such pages. Only pages with PERCENT-FREE objects on them, will be assigned to SGC. A list of the previous values for min, max and percent are returned.

**ALLOCATE-GROWTH** (*type min max percent percent-free*)

Function

Package:SI

The next time after a garbage collection for TYPE, if PERCENT-FREE of the objects of this TYPE are not actually free, and if the maximum number of pages for this type has already been allocated, then the maximum number will be increased by PERCENT of the old maximum, subject to the condition that this increment be at least MIN pages and at most MAX pages. A list of the previous values for min, max, percent, and percent-free for the type TYPE is returned. A value of 0 means use the system default, and if an argument is out of range then the current values are returned with no change made.

Examples: (si::allocate-growth 'cons 1 10 50 10) would insist that after a garbage collection for cons, there be at least 10% cons's free. If not the number of cons pages would be grown by 50% or 10 pages which ever was smaller. This might be reasonable if you were trying to build an image which was 'full', ie had few free objects of this type.

(si::allocate-growth 'fixnum 0 10000 30 40) would grow space till there were normally 40% free fixnums, usually growing by 30% per time.

(si::allocate-growth 'cons 0 0 0 40) would require 40% free conses after garbage collection for conses, and would use system defaults for the the rate to grow towards this goal.

(si::allocate-growth 'cons -1 0 0 0) would return the current values, but not make any changes.

**OPEN-FASD** (*stream direction eof-value table*)

Function

Package:SI

Given file STREAM open for input or output in DIRECTION, set it up to start writing or reading in fasd format. When reading from this stream the EOF-VALUE will be returned when the end a fasd end of dump marker is encountered. TABLE should be an eq hashtable on output, a vector on input, or nil. In this last case a default one will be constructed.

We shall refer to the result as a 'fasd stream'. It is suitable as the arg to CLOSE-FASD, READ-FASD-TOP, and as the second second arg to WRITE-FASD. As a lisp object it is actually a vector, whose body coincides with:

```
struct fasd { object stream; /* lisp object of type stream */ object table; /* hash
table used in dumping or vector on input*/ object eof; /* lisp object to be returned
on coming to eof mark */ object direction; /* holds Cnil or Kinput or Koutput */
object package; /* the package symbols are in by default */ object index; /* integer.
The current_dump index on write */ object filepos; /* nil or the position of the start
```

```
*/ object table_length; /* On read it is set to the size dump array needed or 0 */
object macro ; }
```

We did not use a defstruct for this, because we want the compiler to use this and it makes bootstrapping more difficult. It is in "cmpnew/fasdmacros.lsp"

### **WRITE-FASD-TOP** (*X FASD-STREAM*)

Function

Package:SI

Write X to FASD-STREAM.

### **READ-FASD-TOP** (*FASD-STREAM*)

Function

Package:SI

Read the next object from FASD-STREAM. Return the eof-value of FASD-STREAM if we encounter an eof marker put out by CLOSE-FASD. Encountering end of actual file stream causes an error.

### **CLOSE-FASD** (*FASD-STREAM*)

Function

Package:SI

On output write an eof marker to the associated file stream, and then make FASD-STREAM invalid for further output. It also attempts to write information to the stream on the size of the index table needed to read from the stream from the last open. This is useful in growing the array. It does not alter the file stream, other than for writing this information to it. The file stream may be reopened for further use. It is an error to OPEN-FASD the same file or file stream again with out first calling CLOSE-FASD.

### **FIND-SHARING-TOP** (*x table*)

Function

Package:SI

X is any lisp object and TABLE is an eq hash table. This walks through X making entries to indicate the frequency of symbols,lists, and arrays. Initially items get -1 when they are first met, and this is decremented by 1 each time the object occurs. Call this function on all the objects in a fasd file, which you wish to share structure.

### **\*LOAD-PATHNAME\***

Variable

Package:SI Load binds this to the pathname of the file being loaded.

### **DEFINE-INLINE-FUNCTION** (*fname vars &body body*)

Macro

Package:SI

This is equivalent to defun except that VARS may not contain &optional, &rest, &key or &aux. Also a compiler property is added, which essentially saves the body and turns this into a let of the VARS and then execution of the body. This last is done using si::DEFINE-COMPILER-MACRO Example: (si::define-inline-function myplus (a b c) (+ a b c))

- DEFINE-COMPILER-MACRO** (*fname vars &body body*) Macro  
 Package:SI  
 FNAME may be the name of a function, but at compile time the macro expansion given by this is used.  
 (si::define-compiler-macro mycar (a) '(car ,a))
- DBL** () Function  
 Package:SI  
 Invoke a top level loop, in which debug commands may be entered. These commands may also be entered at breaks, or in the error handler. See SOURCE-LEVEL-DEBUG
- NLOAD** (*file*) Function  
 Package:SI  
 Load a file with the readtable bound to a special readtable, which permits tracking of source line information as the file is loaded. see SOURCE-LEVEL-DEBUG
- BREAK-FUNCTION** (*function &optional line absolute*) Function  
 Package:SI  
 Set a breakpoint for a FUNCTION at LINE if the function has source information loaded. If ABSOLUTE is not nil, then the line is understood to be relative to the beginning of the buffer. See also dbf-break-function, the emacs command.
- XDR-OPEN** (*stream*) Function  
 Package:SI  
 Returns an object suitable for passing to XDR-READ if the stream is an input stream, and XDR-WRITE if it was an output stream. Note the stream must be a unix stream, on which si::fp-input-stream or si::fp-output-stream would act as the identity.
- FP-INPUT-STREAM** (*stream*) Function  
 Package:SI  
 Return a unix stream for input associated to STREAM if possible, otherwise return nil.
- FP-OUTPUT-STREAM** (*stream*) Function  
 Package:SI  
 Return a unix stream for output associated to STREAM if possible, otherwise return nil.
- XDR-READ** (*stream element*) Function  
 Package:SI  
 Read one item from STREAM of type the type of ELEMENT. The representation of the elements is machine independent. The xdr routines are what is used by the basic unix rpc calls.

- XDR-WRITE** (*stream element*) Function  
 Package:SI  
 Write to STREAM the given ELEMENT.
- \*TOP-LEVEL-HOOK\*** Variable  
 Package:SI If this variable is has a function as its value at start up time, then it is run immediately after the init.lsp file is loaded. This is useful for starting up an alternate top level loop.
- RUN-PROCESS** (*string arglist*) Function  
 Package:SI  
 Execute the command STRING in a subshell passing the strings in the list ARGLIST as arguments to the command. Return a two way stream associated to this. Use si::fp-output-stream to get an associated output stream or si::fp-input-stream.  
 Bugs: It does not properly deallocate everything, so that it will fail if you call it too many times.
- \*CASE-FOLD-SEARCH\*** Variable  
 Package: SI Non nil means that a string-match should ignore case
- STRING-MATCH** (*pattern string &optional start end*) Function  
 Package: SI Match regexp PATTERN in STRING starting in string starting at START and ending at END. Return -1 if match not found, otherwise return the start index of the first matchs. The variable \*MATCH-DATA\* will be set to a fixnum array of sufficient size to hold the matches, to be obtained with match-beginning and match-end. If it already contains such an array, then the contents of it will be over written.  
 The form of a regexp pattern is discussed in See (undefined) [Regular Expressions], page (undefined).
- MATCH-BEGINNING** (*index*) Function  
 Returns the beginning of the I'th match from the previous STRING-MATCH, where the 0th is for the whole regexp and the subsequent ones match parenthetical expressions. -1 is returned if there is no match, or if the \*match-data\* vector is not a fixnum array.
- MATCH-END** (*index*) Function  
 Returns the end of the I'th match from the previous STRING-MATCH
- SOCKET** (*port &key host server async myaddr myport daemon*) Function  
 Establishes a socket connection to the specified PORT under a variety of circumstances.  
 If HOST is specified, then it is a string designating the IP address of the server to which we are the client. ASYNC specifies that the connection should be made asynchronously, and the call return immediately. MYADDR and MYPORT can specify

the IP address and port respectively of a client connection, for example when the running machine has several network interfaces.

If `SERVER` is specified, then it is a function which will handle incoming connections to this `PORT`. `DAEMON` specifies that the running process should be forked to handle incoming connections in the background. If `DAEMON` is set to the keyword `PERSISTENT`, then the backgrounded process will survive when the parent process exits, and the `SOCKET` call returns `NIL`. Any other non-`NIL` setting of `DAEMON` causes the socket call to return the process id of the backgrounded process. `DAEMON` currently only works on BSD and Linux based systems.

If `DAEMON` is not set or `nil`, or if the socket is not a `SERVER` socket, then the `SOCKET` call returns a two way stream. In this case, the running process is responsible for all I/O operations on the stream. Specifically, if a `SERVER` socket is created as a non-`DAEMON`, then the running process must `LISTEN` for connections, `ACCEPT` them when present, and call the `SERVER` function on the stream returned by `ACCEPT`.

### **ACCEPT** (*stream*)

Function

Creates a new two-way stream to handle an individual incoming connection to `STREAM`, which must have been created with the `SOCKET` function with the `SERVER` keyword set. `ACCEPT` should only be invoked when `LISTEN` on `STREAM` returns `T`. If the `STREAM` was created with the `DAEMON` keyword set in the call to `SOCKET`, `ACCEPT` is unnecessary and will be called automatically as needed.

## **17.0.1 Regular Expressions**

The function `string-match` (`*Index string-match::`) is used to match a regular expression against a string. If the variable `*case-fold-search*` is not `nil`, case is ignored in the match. To determine the extent of the match use `*Index match-beginning::` and `*Index match-end::`.

Regular expressions are implemented using Henry Spencer's package (thank you Henry!), and much of the description of regular expressions below is copied verbatim from his manual entry. Code for delimited searches, case insensitive searches, and speedups to allow fast searching of long files was contributed by W. Schelter. The speedups use an adaptation by Schelter of the Boyer and Moore string search algorithm to the case of branched regular expressions. These allow such expressions as `'not_there|really_not'` to be searched for 30 times faster than in GNU emacs (1995), and 200 times faster than in the original Spencer method. Expressions such as `[a-u]bcdex` get a speedup of 60 and 194 times respectively. This is based on searching a string of 50000 characters (such as the file `tk.lisp`).

- A regular expression is a string containing zero or more *branches* which are separated by `|`. A match of the regular expression against a string is simply a match of the string with one of the branches.
- Each branch consists of zero or more *pieces*, concatenated. A matching string must contain an initial substring matching the first piece, immediately followed by a second substring matching the second piece and so on.
- Each piece is an *atom* optionally followed by `+`, `*`, or `?`.

- An atom followed by `+` matches a sequence of 1 or more matches of the atom.
- An atom followed by `*` matches a sequence of 0 or more matches of the atom.
- An atom followed by `?` matches a match of the atom, or the null string.
- An atom is
  - a regular expression in parentheses matching a match for the regular expression
  - a *range* see below
  - a `.` matching any single character
  - a `^` matching the null string at the beginning of the input string
  - a `$` matching the null string at the end of the input string
  - a `\` followed by a single character matching that character
  - a single character with no other significance (matching that character).
- A *range* is a sequence of characters enclosed in `[]`. It normally matches any single character from the sequence.
  - If the sequence begins with `^`, it matches any single character *not* from the rest of the sequence.
  - If two characters in the sequence are separated by `-`, this is shorthand for the full list of ASCII characters between them (e.g. `[0-9]` matches any decimal digit).
  - To include a literal `]` in the sequence, make it the first character (following a possible `^`).
  - To include a literal `-`, make it the first or last character.

## Ordering Multiple Matches

In general there may be more than one way to match a regular expression to an input string. For example, consider the command

```
(string-match "(a*)b*" "aabaaabb")
```

Considering only the rules given so far, the value of `(list-matches 0 1)` might be `("aabb" "aa")` or `("aaab" "aaa")` or `("ab" "a")` or any of several other combinations. To resolve this potential ambiguity **string-match** chooses among alternatives using the rule *first then longest*. In other words, it considers the possible matches in order working from left to right across the input string and the pattern, and it attempts to match longer pieces of the input string before shorter ones. More specifically, the following rules apply in decreasing order of priority:

- [1] If a regular expression could match two different parts of an input string then it will match the one that begins earliest.
- [2] If a regular expression contains `|` operators then the leftmost matching sub-expression is chosen.
- [3] In `*`, `+`, and `?` constructs, longer matches are chosen in preference to shorter ones.
- [4] In sequences of expression components the components are considered from left to right.

In the example from above, `(a*)b*` matches **aab**: the `(a*)` portion of the pattern is matched first and it consumes the leading **aa**; then the `b*` portion of the pattern consumes the next **b**. Or, consider the following example:

```

(string-match "(ab|a)(b*)c" "xabc") ==> 1
(list-matches 0 1 2 3) ==> ("abc" "ab" "" NIL)
(match-beginning 0) ==> 1
(match-end 0) ==> 4
(match-beginning 1) ==> 1
(match-end 1) ==> 3
(match-beginning 2) ==> 3
(match-end 2) ==> 3
(match-beginning 3) ==> -1
(match-end 3) ==> -1

```

In the above example the return value of 1 (which is  $> -1$ ) indicates that a match was found. The entire match runs from 1 to 4. Rule 4 specifies that **(ab|a)** gets first shot at the input string and Rule 2 specifies that the **ab** sub-expression is checked before the **a** sub-expression. Thus the **b** has already been claimed before the **(b\*)** component is checked and **(b\*)** must match an empty string.

The special characters in the string `"\() []+.*|^$?"`, must be quoted, if a simple string search is desired. The function `re-quote-string` is provided for this purpose.

```

(re-quote-string "*standard*") ==> "\\*standard\\"

(string-match (re-quote-string "*standard*") "X *standard* ")
==> 2

(string-match "*standard*" "X *standard* ")
Error: Regexp Error: ?+* follows nothing

```

Note there is actually just one `\` before the `*` but the printer makes two so that the string can be read, since `\` is also the lisp quote character. In the last example an error is signalled since the special character `*` must follow an atom if it is interpreted as a regular expression.

## 18 Debugging

### 18.1 Source Level Debugging in Emacs

In emacs load (load "dbl.el") from the gcl/doc directory. [ It also requires gcl.el from that directory. Your system administrator should do make in the doc directory, so that these files are copied to the standard location.]

#### OVERVIEW:

Lisp files loaded with `si::nload` will have source line information about them recorded. Break points may be set, and functions stepped. Source code will be automatically displayed in the other window, with a little arrow beside the current line. The backtrace (command `:bt`) will show line information and you will get automatic display of the source as you move up and down the stack.

**FUNCTIONS:** break points which have been set. `si::nload (file)` load a lisp file collecting source line information.

`si::break-function (function &optional line absolute)` set up a breakpoint for FUNCTION at LINE relative to start or ABSOLUTE

**EMACS COMMANDS:** `M-x dbl` makes a dbl buffer, suitable for running an inferior gcl. It has special keybindings for stepping and viewing sources. You may start your favorite gcl program in the dbl shell buffer.

**Inferior Dbl Mode:** Major mode for interacting with an inferior Dbl process. The following commands are available:

`C-c l` `dbl-find-line`

`ESC d` `dbl::down` `ESC u` `dbl::up` `ESC c` `dbl::r` `ESC n` `dbl::next` `ESC i` `dbl::step` `ESC s` `dbl::step`

`M-x dbl-display-frame` displays in the other window the last line referred to in the dbl buffer.

`ESC i` and `ESC n` in the dbl window, call `dbl` to step and next and then update the other window with the current file and position.

If you are in a source file, you may select a point to break at, by doing `C-x SPC`.

**Commands:** Many commands are inherited from shell mode. Additionally we have:

`M-x dbl-display-frame` display frames file in other window `ESC i` advance one line in program `ESC n` advance one line in program (skip over calls). `M-x send-dbl-command` used for special printing of an arg at the current point. `C-x SPACE` sets break point at current line.

---

When visiting a lisp buffer (if `gcl.el` is loaded in your emacs) the command `c-m-x` evaluates the current defun into the process running in the other window. Line information will be kept. This line information allows you to set break points at a given line (by typing `C-x \space` on the line in the source file where you want the break to occur. Once stopped within a function you may single step with `M-s`. This moves one line at a time in the source code, displaying a little arrow beside your current position. `M-c` is like `M-s`, except that function invocations are skipped over, rather than entered into. `M-c` continues execution.



Keywords typed at top level, in the debug loop have a special meaning:

```
:delete [n1] [n2] .. – delete all break points or just n1,n2
:disable [n1] [n2] .. – disable all break points or just n1,n2
:enable [n1] [n2] .. – enable all break points or just n1,n2
:info [:bkpt] –print information about
:break [fun] [line] – break at the current location, or if fun is supplied in fun. Break at
the beginning unless a line offset from the beginning of fun is supplied.
:fr [n] go to frame n When in frame n, if the frame is interpreted, typing the name
of locals, will print their values. If it is compiled you must use (si::loc j) to print
‘locj’. Autodisplay of the source will take place if it is interpreted and the line can be
determined.
:up [n] go up n frames from the current frame.
:down [n] go down n frames
:bt [n] back trace starting at the current frame and going to top level If n is specified
show only n frames.
:r If stopped in a function resume. If at top level in the dbl loop, exit and resume an
outer loop.
:q quit the computation back to top level dbl loop.
:step step to the next line with line information
:next step to the next line with line information skipping over function invocations.
```

Files: debug.lsp dbl.el gcl.el

## 18.2 Low Level Debug Functions

Use the following functions to directly access GCL stacks.

```
(SI:VS i) Returns the i-th entity in VS.
(SI:IHS-VS i) Returns the VS index of the i-th entity in IHS.
(SI:IHS-FUN i) Returns the function of the i-th entity in IHS.
(SI:FRS-VS i) Returns the VS index of the i-th entity in FRS.
(SI:FRS-BDS i) Returns the BDS index of the i-th entity in FRS.
(SI:FRS-IHS i) Returns the IHS index of the i-th entity in FRS.
(SI:BDS-VAR i) Returns the symbol of the i-th entity in BDS.
(SI:BDS-VAL i) Returns the value of the i-th entity in BDS.
```

```
(SI:SUPER-GO i tag)
```

Jumps to the specified tag established by the TAGBODY frame at FRS[i]. Both arguments are evaluated. If FRS[i] happens to be a non-TAGBODY frame, then (THROW (SI:IHS-TAG i) (VALUES)) is performed.

## 19 Miscellaneous

### 19.1 Environment

The environment in GCL which is passed to `macroexpand` and other functions requesting an environment, should be a list of 3 lists. The first list looks like `((v1 val1) (v2 val2) ..)` where `vi` are variables and `vali` are their values. The second is a list of `((fname1 . fbody1) (fname2 . fbody2) ...)` where `fbody1` is either `(macro lambda-list lambda-body)` or `(lambda-list lambda-body)` depending on whether this is a macro or a function. The third list contains tags and blocks.

### 19.2 Initialization

If the file `init.lsp` exists in the current directory, it is loaded at startup. The first argument passed to the executable image should be the system directory. Normally this would be `gcl/unixport`. This directory is stored in the `si::*system-directory*` variable. If the file `sys-init.lsp` exists in the system directory, it is loaded before `init.lsp`. See also `si::*TOP-LEVEL-HOOK*`.

### 19.3 Low Level X Interface

A sample program for drawing things on X windows from lisp is included in the file `gcl/lsp/littleXlsp.lsp`

That routine invokes the corresponding C routines in `XLIB`. So in order to use it you must 'faslink' in the X routines. Directions are given at the beginning of the lisp file, for either building them into the image or using `faslink`.

This program is also a good tutorial on invoking C from lisp.

See also `defentry` and `faslink`.



## 20 Compiler Definitions

### **EMIT-FN** (*turn-on*)

Function

Package:COMPILER

If TURN-ON is t, the subsequent calls to COMPILE-FILE will cause compilation of foo.lisp to emit a foo.fn as well as foo.o. The .fn file contains cross referencing information as well as information useful to the collection utilities in cmpnew/collectfn. This latter file must be manually loaded to call emit-fn.

### **\*CMPINCLUDE-STRING\***

Variable

Package:COMPILER If it is a string it holds the text of the cmpinclude.h file appropriate for this version. Otherwise the usual #include of \*cmpinclude\* will be used. To disable this feature set \*cmpinclude-string\* to NIL in the init-form.

### **EMIT-FN** (*turn-on*)

Function

Package:COMPILER

If TURN-ON is t, then subsequent calls to compile-file on a file foo.lisp cause output of a file foo.fn. This .fn file contains lisp structures describing the functions in foo.lisp. Some tools for analyzing this data base are WHO-CALLS, LIST-UNDEFINED-FUNCTIONS, LIST-UNCALLED-FUNCTIONS, and MAKE-PROCLAIMS.

Usage: (compiler::emit-fn t) (compile-file "foo1.lisp") (compile-file "foo2.lisp")

This would create foo1.fn and foo2.fn. These may be loaded using LOAD. Each time compile-file is called the data base is cleared. Immediately after the compilation, the data base consists of data from the compilation. Thus if you wished to find functions called but not defined in the current file, you could do (list-undefined-functions), immediately following the compilation. If you have a large system, you would load all the .fn files before using the above tools.

### **MAKE-ALL-PROCLAIMS** (&rest *directories*)

Function

Package:COMPILER

For each D in DIRECTORIES all files in (directory D) are loaded.

For example (make-all-proclams "lsp/\*.fn" "cmpnew/\*.fn") would load any files in lsp/\*.fn and cmpnew/\*.fn.

[See EMIT-FN for details on creation of .fn files]

Then calculations on the newly loaded .fn files are made, to determine function proclamations. If number of values of a function cannot be determined [for example because of a final funcall, or call of a function totally unknown at this time] then return type \* is assigned.

Finally a file sys-proclaim.lisp is written out. This file contains function proclamations.

(load "sys-proclaim.lisp") (compile-file "foo1.lisp") (compile-file "foo2.lisp")

**MAKE-PROCLAIMS** (&optional (*stream* **\*standard-output\***)) Function  
 Package:COMPILER

Write to STREAM the function proclaims from the current data base. Usually a number of .fn files are loaded prior to running this. See EMIT-FN for details on how to collect this. Simply use LOAD to load in .fn files.

**LIST-UNDEFINED-FUNCTIONS** () Function  
 Package:COMPILER

Return a list of all functions called but not defined, in the current data base (see EMIT-FN).

```
Sample:
(compiler::emit-fn t)
(compile-file "foo1.lisp")
(compiler::list-undefined-functions)
or
(mapcar 'load (directory "*.fn")) (compiler::list-undefined-functions)
```

**WHO-CALLS** (*function-name*) Function  
 Package:COMPILER

List all functions in the data base [see emit-fn] which call FUNCTION-NAME.

**LIST-UNCALLED-FUNCTIONS** () Function  
 Package:COMPILER

Examine the current data base [see emit-fn] for any functions or macros which are called but are not: fboundp, OR defined in the data base, OR having special compiler optimizer properties which would eliminate an actual call.

**\*CC\*** Variable  
 Package:COMPILER Has value a string which controls which C compiler is used by GCL. Usually this string is obtained from the machine.defs file, but may be reset by the user, to change compilers or add an include path.

**\*SPLIT-FILES\*** Variable  
 Package:COMPILER This affects the behaviour of compile-file, and is useful for cases where the C compiler cannot handle large C files resulting from lisp compilation. This scheme should allow arbitrarily long lisp files to be compiled.  
 If the value [default NIL] is a positive integer, then the source file will be compiled into several object files whose names have 0,1,2,.. prepended, and which will be loaded by the main object file. File 0 will contain compilation of top level forms thru position \*split-files\* in the lisp source file, and file 1 the next forms, etc. Thus a 180k file would probably result in three object files (plus the master object file of the same name) if \*split-files\* was set to 60000. The package information will be inserted in each file.

**\*COMPILE-ORDINARIES\***

Variable

Package:COMPILER If this has a non nil value [default = nil], then all top level forms will be compiled into machine instructions. Otherwise only defun's, defmacro's, and top level forms beginning with (progn 'compile ...) will do so.



## Appendix A Function and Variable Index

(Index is nonexistent)





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