**Arithmetic**

- add, subtract, multiply, divide: `+`, `-`, `*`, `/`
- raise to a power, nth root: `^`, `n` (n is the nth root)
- change sign: `_`
- reciprocal 1/x: `1/x`
- square root \( \sqrt{\phantom{0}} \): `sqrt`
- round off last two digits: `c 2`
- set precision: `p`
- convert to fraction, float: `c f`, `c f`
- enter using algebraic notation: `>2+3*4`
- refer to previous result: `>3+8^2`
- refer to higher stack entries: `>1+8^2*2`
- finish alg entry without evaluating: `LFD`
- set mode where alg entry used by default: `m a`

**Stack Commands**

Here \( S_n \) is the nth stack entry, and \( N \) is the size of the stack.

- key: `RET` copy \( S_1 \), `LFD` copy \( S_1 .. S_n \)
- prefix no prefix: `prefix n`, `prefix -n`
- `RET` copy \( S_1 \) to \( S_n \)
- `LFD` copy \( S_1 .. S_n \) to \( S_1 .. S_n \)
- `DEL` delete \( S_1 \), delete \( S_1 .. S_n \)
- `M-DEL` delete \( S_2 \), delete \( S_1 .. S_n \)
- `TAB` swap \( S_1 \leftrightarrow S_2 \), roll \( S_1 \), to \( S_n \)
- `M-TAB` roll \( S_1 \), to \( S_n \)

With a 0 prefix, these copy, delete, or reverse the entire stack.

**Display**

- scroll horizontally, vertically: `<`, `>`, `{}`
- home cursor: `o`
- line numbers on/off: `d l`
- trail display on/off: `t d`
- scientific notation: `d s`
- fixed-point notation: `d f`
- floating-point (normal) notation: `d n`
- group digits with commas: `d g`

For display mode commands, \( \mathbb{H} \) prefix prevents screen redraw and \( \mathbb{I} \) prefix temporarily redraws top of stack.

**Notations**

- scientific notation: `6.02e23`
- minus sign in numeric entry: `_23` or `23 n`
- fractions: `3:4`
- complex numbers: `x`, `y`
- polar complex numbers: `(r; \theta)`
- matrices (or nested vectors): `[1, 2; 3, 4]`
- error forms (p key): `100 \times 0.5`
- interval forms: `[2 .. 5]`
- modulo forms (M key): `6 mod 24`
- HMS forms: `50 30' 0``
- date forms:
- infinity, indeterminate

**Scientific Functions**

- \( \ln, \log_{10}, \log_b \)
- exponential \( e^x, 10^x \)
- \( \sin, \cos, \tan \)
- \( \arcsin, \arccos, \arctan \)
- \( \text{inverse hyperbolic prefix keys} \)
- \( \text{two-argument arctan} \)
- \( \text{degrees, radians modes} \)
- \( \pi \)
- \( \text{factorial, double factorial} \)
- \( \text{combinations, permutations} \)
- \( \text{prime factorization} \)
- \( \text{next prime, previous prime} \)
- \( \text{GCD, LCM} \)
- \( \text{random number, shuffle} \)
- \( \text{minimum, maximum} \)
- \( \text{error functions} \)
- \( \text{gamma, beta functions} \)
- \( \text{incomplete gamma, beta functions} \)
- \( \text{Bessel} \)
- \( \text{complex magnitude, arg, conjugate} \)
- \( \text{real, imaginary parts} \)
- \( \text{convert polar/rectangular} \)

**Financial Functions**

- enter percentage:
- convert to percentage:
- percentage change:
- present value:
- future value:
- rate of return:
- number of payments:
- size of payments:
- net present value, int. rate of return:

Above computations assume payments at end of period. Use \( \mathbb{I} \) prefix for beginning of period, or \( \mathbb{H} \) for a lump sum investment.

**Units**

- enter with units:
- convert to new units, base units:
- convert temperature units:
- simplify units expression:
- view units table:

**Common units:**

- distance: \( \text{m, cm, mm, km; in, ft, mi, mfi; point, lyr} \)
- volume: \( \text{l or L, ml; gal, qt, pt, cup, floz, tbsp, tsp} \)
- mass: \( \text{g, mg, kg, t; lb, oz, ton} \)
- time: \( \text{s or sec, ms, us, ns, min, hr, day, wk} \)
- temperature: \( \deg C, \deg F, K \)

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### Algebra
- enter an algebraic formula
- enter an equation
- symbolic (vs. numeric) mode
- fractions (vs. float) mode
- suppress evaluation of formulas
- return to default evaluation rules
- “Big” display modes
- C, Pascal, FORTRAN modes
- \( \text{T}x \), \( \text{La}T\text{x} \), eqn modes
- Maxima
- Unformatted mode
- Normal language mode
- simplify formula
- put formula into rational form
- evaluate variables in formula
- evaluate numerically
- let variable equal a value in formula
- declare properties of variable
- \( \text{s} \)

### Common decls:
- \( \text{pos} \), \( \text{int} \), \( \text{real} \), \( \text{scalar} \), \( [a..b] \).

### Common markers:
- \( \text{AlgSimpRules} \)
- \( \text{Put rules in} \ \text{EvalRules} \)
- \( \text{a r } \ [\text{f}(0) := 1, \text{f}(n) := n \text{f}(n-1) :: n > 0] \)
- \( \text{a r } \cos(n \ \pi) := 1 :: \text{integer}(n) :: n\%2 = 0 \)
- \( \text{Example: a r } \sin(x)^2 := 1-\cos(x)^2 \)
- \( \text{Example: a r a*b + a*c := a*(b+c) } \)

### Numerical Computations
- sum formula over a range
- product of formula over a range
- tabulate formula over a range
- integrate numerically over a range
- find zero of formula or equation
- find local min, max of formula
- fit data to line or curve
- mean of data in vector or variable
- median of data
- geometric mean of data
- sum, product of data
- minimum, maximum of data
- sample, pop. standard deviation

### Selections
- select subformula under cursor
- select nth subformula
- select more
- unselect this, all formulas
- copy indicated subformula
- delete indicated subformula
- commute selected terms
- commute term leftward, rightward
- distribute, merge selection
- isolate selected term in equation
- negate, invert term in context
- rewrite selected term

### Graphics
- graph function or data
- graph 3D function or data
- replot current graph
- print current graph
- add curve to graph
- set number of data points
- set line, point styles
- set log vs. linear
- set range for \( x, y \) axis
- close graphics window

### Programming
- begin, end recording a macro
- replay keyboard macro
- read region as written-out macro
- if, else, endif
- equal to, less than, member of
- repeat \( n \) times, break from loop
- “for” loop: start, end; body, step
- save, restore mode settings
- query user during macro
- put finished macro on a key
- define function with formula
- edit definition
- record user-defined command permanently
- record variable value permanently
- record mode settings permanently

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**GNU Calc Reference Card**

### Programmer’s Functions
- binary, octal, hex display
- decimal, other radix display
- display leading zeros
- entering non-decimal numbers
- binary word size
- binary AND, OR, XOR
- binary DIFF, NOT
- left shift
- logical right shift
- arithmetic right shift
- integer quotient, remainder
- integer square root, logarithm
- \( \text{floor, ceiling, round to integer} \)
- \( \text{b R} \)
- \( \text{arithmetic right shift} \)
- \( \text{b r} \)
- \( \text{b l} \)

### Variables
- Variable names are single digits or whole words.
- store to variable
- store and keep on stack
- recall from variable
- shorthands for digit variables
- unstore, exchange variable
- edit variable

### Vector Operations
- \( \text{vector of } 1, 2, \ldots, n \)
- \( \text{vector of } n \) counts from \( a \) by \( b \)
- \( \text{vector of copies of a value} \)
- \( \text{concatenate into vector} \)
- \( \text{pack many stack items into vector} \)
- \( \text{unpack vector or object} \)
- \( \text{length of vector (list)} \)
- \( \text{reverse vector} \)
- \( \text{sort, grade vector} \)
- \( \text{histogram of vector data} \)
- \( \text{extract vector element} \)
- \( \text{matrix determinant, inverse} \)
- \( \text{matrix transpose, trace} \)
- \( \text{cross, dot products} \)
- \( \text{identity matrix} \)
- \( \text{extract matrix row, column} \)
- \( \text{intersection, union, diff of sets} \)
- \( \text{cardinality of set} \)
- \( \text{add vectors elementwise (i.e., } \oplus \ldots \oplus \) \)
- \( \text{sum elements in vector (i.e., } \ominus \ldots \ominus \) \)
- \( \text{sum rows in matrix} \)
- \( \text{sum columns in matrix} \)
- \( \text{sum elements, accumulate results} \)

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