




## How it works?

1. Enter text and formulas into the "Code" box on the left.
2. Press **F5** or click  to **calculate**. The results will appear in the "Output" box on the right as a professionally formatted Html report.
3. Click  to **print** or  to **copy** the output.

You can also **export** it to **Html** , **PDF**  or **MS Word**  document.

## The language

The Calcpad language includes the following elements (click an item to insert):

- Real numbers: digits **0 - 9** and decimal point **."**;
- Complex numbers: **re ± imi** (e.g. **3 - 2i**);
- Real vectors: **[ $v_1$ ;  $v_2$ ;  $v_3$ ; ...;  $v_n$ ]**;
- Real matrices: **[ $M_{11}$ ;  $M_{12}$ ; ... ;  $M_{1n}$  |  $M_{21}$ ;  $M_{22}$ ; ... ;  $M_{2n}$  ... |  $M_{m1}$ ;  $M_{m2}$ ; ... ;  $M_{mn}$ ]**;
- Variables:
  - Latin letters: **a - z, A - Z**;
  - Greek letters:  **$\alpha$  -  $\omega$ , A -  $\Omega$** ;
  - digits: **0 - 9**;
  - comma: **" , "**;
  - prime symbols: **' , " , "" , ""'** ;
  - superscripts: **<sup>0</sup> , <sup>1</sup> , <sup>2</sup> , <sup>3</sup> , <sup>4</sup> , <sup>5</sup> , <sup>6</sup> , <sup>7</sup> , <sup>8</sup> , <sup>9</sup> , <sup>n</sup> , <sup>+</sup> , <sup>-</sup> ;**
  - special symbols: **<sup>-</sup> ,  $\emptyset$  ,  $\emptyset$  , <sup>°</sup> ,  $\text{‰}$  ;**
  - **" \_ "** for subscript;

A variable name must start with a letter. Names are case sensitive.

- Constants:
 

**$\pi$ ,  $e$ ,  $\phi$ ,  $\gamma$ ,  $g$ ,  $G$ ,  $M_E$ ,  $M_S$ ,  $c$ ,  $h$ ,  $\mu_0$ ,  $\epsilon_0$ ,  $k_e$ ,  $e$ ,  $m_e$ ,  $m_p$ ,  $m_n$ ,  $N_A$ ,  $\sigma$ ,  $k_B$ ,  $R$ ,  $F$ ,  $\gamma_c$ ,  $\gamma_s$ ,  $\gamma_a$ ,  $\gamma_g$ ,  $\gamma_w$**
- Operators:
  - "!"** – factorial;
  - "^"** – exponent;
  - "/"** – division;
  - "÷"** – force division bar;
  - "\"** – division;
  - "⊗"** – modulo (remainder);
  - "\*"** – multiplication;
  - "-"** – minus;
  - "+"** – plus;
  - "≡"** – equal to;

- “ $\neq$ ” – not equal to;
- “ $<$ ” – less than;
- “ $>$ ” – greater than;
- “ $\leq$ ” – less or equal;
- “ $\geq$ ” – greater or equal;
- “ $\wedge$ ” – logical “AND”;
- “ $\vee$ ” – logical “OR”;
- “ $\oplus$ ” – logical “XOR”;
- “ $=$ ” – assignment;
- Custom functions type  $f(x; y; z; \dots)$ ;
- Built-in functions:
  - Trigonometric:
    - $\sin(x)$  - sine;
    - $\cos(x)$  - cosine;
    - $\tan(x)$  - tangent;
    - $\csc(x)$  - cosecant;
    - $\sec(x)$  - secant;
    - $\cot(x)$  - cotangent;
  - Hyperbolic:
    - $\sinh(x)$  - hyperbolic sine;
    - $\cosh(x)$  - hyperbolic cosine;
    - $\tanh(x)$  - hyperbolic tangent;
    - $\operatorname{csch}(x)$  - hyperbolic cosecant;
    - $\operatorname{sech}(x)$  - hyperbolic secant;
    - $\operatorname{coth}(x)$  - hyperbolic cotangent;
  - Inverse trigonometric:
    - $\operatorname{asin}(x)$  - inverse sine;
    - $\operatorname{acos}(x)$  - inverse cosine;
    - $\operatorname{atan}(x)$  - inverse tangent;
    - $\operatorname{atan2}(x; y)$  - the angle whose tangent is the quotient of  $y$  and  $x$ ;
    - $\operatorname{acsc}(x)$  - inverse cosecant;
    - $\operatorname{asec}(x)$  - inverse secant;
    - $\operatorname{acot}(x)$  - inverse cotangent;
  - Inverse hyperbolic:
    - $\operatorname{asinh}(x)$  - inverse hyperbolic sine;
    - $\operatorname{acosh}(x)$  - inverse hyperbolic cosine;
    - $\operatorname{atanh}(x)$  - inverse hyperbolic tangent;

**acsch**( $x$ ) - inverse hyperbolic cosecant;  
**asech**( $x$ ) - inverse hyperbolic secant;  
**acoth**( $x$ ) - inverse hyperbolic cotangent;

◦ Logarithmic, exponential and roots:

**log**( $x$ ) - decimal logarithm;  
**ln**( $x$ ) - natural logarithm;  
**log\_2**( $x$ ) - binary logarithm;  
**exp**( $x$ ) - exponential function;  
**sqr**( $x$ ) or **sqrt**( $x$ ) - square root;  
**cbrt**( $x$ ) - cubic root;  
**root**( $x$ ;  $n$ ) -  $n$ -th root;

◦ Rounding:

**round**( $x$ ) - round to the nearest integer;  
**floor**( $x$ ) - round to the smaller integer (towards  $-\infty$ );  
**ceiling**( $x$ ) - round to the greater integer (towards  $+\infty$ );  
**trunc**( $x$ ) - round to the smaller integer (towards zero);

◦ Integer:

**mod**( $x$ ;  $y$ ) - the remainder of an integer division;  
**gcd**( $x$ ;  $y$ ;  $z...$ ) - the greatest common divisor of several integers;  
**lcm**( $x$ ;  $y$ ;  $z...$ ) - the least common multiple of several integers;

◦ Complex:

**abs**( $x$ ) - absolute value/magnitude;  
**re**( $x$ ) - the real part of a complex number;  
**im**( $x$ ) - the imaginary part of a complex number;  
**phase**( $x$ ) - the phase of a complex number;

◦ Aggregate and interpolation:

**min**( $A$ ;  $\vec{b}$ ;  $c...$ ) - minimum of multiple values;  
**max**( $A$ ;  $\vec{b}$ ;  $c...$ ) - maximum of multiple values;  
**sum**( $A$ ;  $\vec{b}$ ;  $c...$ ) - sum of multiple values;  
**sumsq**( $A$ ;  $\vec{b}$ ;  $c...$ ) - sum of squares  
**srss**( $A$ ;  $\vec{b}$ ;  $c...$ ) - square root of sum of squares;  
**average**( $A$ ;  $\vec{b}$ ;  $c...$ ) - average of multiple value;  
**product**( $A$ ;  $\vec{b}$ ;  $c...$ ) - product of multiple values;  
**mean**( $A$ ;  $\vec{b}$ ;  $c...$ ) - geometric mean;  
**take**( $n$ ;  $A$ ;  $\vec{b}$ ;  $c...$ ) - returns the  $n$ -th element from the list;

**line**( $x$ ;  $A$ ;  $\vec{b}$ ;  $c...$ ) - linear interpolation;

**spline**( $x$ ;  $A$ ;  $\vec{b}$ ;  $c...$ ) - Hermite spline interpolation;

◦ Conditional and logical:

**if**( $cond$ ;  $value-if-true$ ;  $value-if-false$ ) - conditional evaluation;

**switch**( $cond1$ ;  $value1$ ;  $cond2$ ;  $value2$ ; ...;  $default$ ) - selective evaluation;

**not**( $x$ ) - logical "NOT";

**and**( $A$ ;  $\vec{b}$ ;  $c...$ ) - logical "AND";

**or**( $A$ ;  $\vec{b}$ ;  $c...$ ) - logical "OR";

**xor**( $A$ ;  $\vec{b}$ ;  $c...$ ) - logical "XOR";

◦ Other:

**sign**( $x$ ) - sign of a number;

**random**( $x$ ) - random number between 0 and  $x$ ;

◦ Vector:

Creational:

**vector**( $n$ ) - creates an empty vector with length  $n$ ;

**fill**( $\vec{v}$ ;  $x$ ) - fills the vector  $\vec{v}$  with value  $x$ ;

**range**( $x_1$ ;  $x_n$ ;  $s$ ) - creates a vector with values spanning from  $x_1$  to  $x_n$  with step  $s$ ;

Structural:

**len**( $\vec{v}$ ) - returns the length of the vector  $\vec{v}$ ;

**size**( $\vec{v}$ ) - the actual size of the vector  $\vec{v}$  (the index of the last non-zero element);

**resize**( $\vec{v}$ ;  $n$ ) - sets a new length  $n$  of the vector  $\vec{v}$ ;

**join**( $\vec{a}$ ;  $\vec{b}$ ;  $c...$ ) - creates a vector by joining the arguments in the list - vectors and scalars;

**slice**( $\vec{v}$ ;  $i_1$ ;  $i_2$ ) - returns the part of the vector  $\vec{v}$  bounded by indexes  $i_1$  and  $i_2$  inclusive;

**first**( $\vec{v}$ ;  $n$ ) - the first  $n$  elements of the vector  $\vec{v}$ ;

**last**( $\vec{v}$ ;  $n$ ) - the last  $n$  elements of the vector  $\vec{v}$ ;

**extract**( $\vec{v}$ ;  $\vec{i}$ ) - extracts those elements from  $\vec{v}$  which indexes are contained in  $\vec{i}$ ;

Data:

**sort**( $\vec{v}$ ) - sorts the vector  $\vec{v}$  in ascending order;

**rsort**( $\vec{v}$ ) - sorts the vector  $\vec{v}$  in descending order;

**order**( $\vec{v}$ ) - the indexes of  $\vec{v}$ , in ascending order by the elements of  $\vec{v}$ ;

**revorder**( $\vec{v}$ ) - the indexes of  $\vec{v}$ , in descending order by the elements of  $\vec{v}$ ;

**reverse**( $\vec{v}$ ) - vector containing the elements of  $\vec{v}$  in reverse order;

**count**( $\vec{v}$ ;  $x$ ;  $i$ ) - the number of elements of  $\vec{v}$  equal to  $x$  with index  $\geq i$ ;

**search**( $\vec{v}$ ;  $x$ ;  $i$ ) - the index of the first element in  $\vec{v}$  with index  $\geq i$  that is equal to  $x$ ;

**find**( $\vec{v}; x; i$ ) or

**find\_eq**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $= x$ ;

**find\_ne**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $\neq x$ ;

**find\_lt**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $< x$ ;

**find\_le**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $\leq x$ ;

**find\_gt**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $> x$ ;

**find\_ge**( $\vec{v}; x; i$ ) - the indexes of all elements in  $\vec{v}$ , after the  $i$ -th, that are  $\geq x$ ;

**lookup**( $\vec{a}; \vec{b}; x$ ) or

**lookup\_eq**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $= x$ ;

**lookup\_ne**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $\neq x$ ;

**lookup\_lt**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $< x$ ;

**lookup\_le**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $\leq x$ ;

**lookup\_gt**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $> x$ ;

**lookup\_ge**( $\vec{a}; \vec{b}; x$ ) - all elements of  $\vec{a}$  for which the corresponding elements of  $\vec{b}$  are  $\geq x$ ;

Math:

**norm\_1**( $\vec{v}$ ) - L1 (Manhattan) norm of the vector  $\vec{v}$ ;

**norm**( $\vec{v}$ ) or

**norm\_2**( $\vec{v}$ ) or

**norm\_e**( $\vec{v}$ ) - L2 (Euclidean) norm of the vector  $\vec{v}$ ;

**norm\_p**( $\vec{v}; p$ ) - Lp norm of the vector  $\vec{v}$ ;

**norm\_i**( $\vec{v}$ ) - L $\infty$  (infinity) norm of the vector  $\vec{v}$ ;

**unit**( $\vec{v}$ ) - normalized form of the vector  $\vec{v}$  (with L2 norm = 1);

**dot**( $\vec{a}; \vec{b}$ ) - scalar product of two vectors  $\vec{a}$  and  $\vec{b}$ ;

**cross**( $\vec{a}; \vec{b}$ ) - cross product of two vectors  $\vec{a}$  and  $\vec{b}$  (with length 2 or 3);

○ Matrix:

Creational:

**matrix**( $m; n$ ) - creates an empty matrix with dimensions  $m \times n$ ;

**identity**( $n$ ) - creates an identity matrix with dimensions  $n \times n$ ;

**diagonal**( $n; d$ ) - creates a diagonal matrix with dimensions  $n \times n$  and fills the diagonal with value  $d$ ;

**column**( $m; c$ ) - creates a column matrix with dimensions  $m \times 1$ , filled with value  $c$ ;

**utriang**( $n$ ) - creates an upper triangular matrix with dimensions  $n \times n$ ;

**ltriang**( $n$ ) - creates a lower triangular matrix with dimensions  $n \times n$ ;

**symmetric( $n$ )** - creates a symmetric matrix with dimensions  $n \times n$ ;  
**vec2diag( $\vec{v}$ )** - creates a diagonal matrix from the elements of vector  $\vec{v}$ ;  
**vec2col( $\vec{v}$ )** - creates a column matrix from the elements of vector  $\vec{v}$ ;  
**vec2diag( $\vec{v}$ )** - creates a diagonal matrix from the elements of vector  $\vec{v}$ ;  
**vec2col( $\vec{v}$ )** - creates a column matrix from the elements of vector  $\vec{v}$ ;  
**join\_cols( $\vec{c}_1; \vec{c}_2; \vec{c}_3 \dots$ )** - creates a matrix by joining column vectors;  
**join\_rows( $\vec{r}_1; \vec{r}_2; \vec{r}_3 \dots$ )** - creates a matrix by joining row vectors;  
**augment( $A; B; C \dots$ )** - creates a matrix by appending matrices  $A; B; C$  side by side;  
**stack( $A; B; C \dots$ )** - creates a matrix by stacking matrices  $A; B; C$  one below the other;

#### Structural:

**n\_rows( $M$ )** - number of rows in matrix  $M$ ;  
**n\_cols( $M$ )** - number of columns in matrix  $M$ ;  
**resize( $M; m; n$ )** - sets new dimensions  $m$  and  $n$  for matrix  $M$ ;  
**fill( $M; x$ )** - fills the matrix  $M$  with value  $x$ ;  
**fill\_row( $M; x; i$ )** - fills the  $i$ -th row of matrix  $M$  with value  $x$ ;  
**fill\_col( $M; x; j$ )** - fills the  $j$ -th column of matrix  $M$  with value  $x$ ;  
**copy( $A; B; i; j$ )** - copies all elements from  $A$  to  $B$ , starting from indexes  $i$  and  $j$  of  $B$ ;  
**add( $A; B; i; j$ )** - adds all elements from  $A$  to those of  $B$ , starting from indexes  $i$  and  $j$  of  $B$ ;  
**row( $M; i$ )** - extracts the  $i$ -th row of matrix  $M$  as a vector;  
**col( $M; j$ )** - extracts the  $j$ -th column of matrix  $M$  as a vector;  
**extract\_rows( $M; \vec{i}$ )** - extracts the rows from matrix  $M$  whose indexes are contained  
in vector  $\vec{i}$ ;  
**extract\_cols( $M; \vec{j}$ )** - extracts the columns from matrix  $M$  whose indexes are contained  
in vector  $\vec{j}$ ;  
**diag2vec( $\vec{v}$ )** - extracts the diagonal elements of matrix  $M$  to a vector;  
**submatrix( $M; i_1; i_2; j_1; j_2$ )** - extracts a submatrix of  $M$ , bounded between rows  $i_1$  and  $i_2$   
and columns  $j_1$  and  $j_2$ , incl.;

#### Data:

**sort\_cols( $M; i$ )** - sorts the columns of  $M$  based on the values in row  $i$   
in ascending order;  
**rsort\_cols( $M; i$ )** - sorts the columns of  $M$  based on the values in row  $i$   
in descending order;  
**sort\_rows( $M; j$ )** - sorts the rows of  $M$  based on the values in column  $j$   
in ascending order;  
**rsort\_rows( $M; j$ )** - sorts the rows of  $M$  based on the values in column  $j$

in descending order;

**order\_cols**( $M; i$ ) - the indexes of the columns of  $M$  in ascending order by the values in row  $i$ ;

**revorder\_cols**( $M; i$ ) - the indexes of the columns of  $M$  in descending order by the values in row  $i$ ;

**order\_rows**( $M; j$ ) - the indexes of the rows of  $M$  in ascending order by the values in column  $j$ ;

**revorder\_rows**( $M; j$ ) - the indexes of the rows of  $M$  in descending order by the values in column  $j$ ;

**mcount**( $M; x$ ) - number of occurrences of value  $x$  in matrix  $M$ ;

**msearch**( $M; x; i; j$ ) - vector with the two indexes of the first occurrence of  $x$  in the matrix  $M$ , starting from indexes  $i$  and  $j$ ;

**mfind**( $M; x$ ) - the indexes of all elements in matrix  $M$  equal to  $x$ ;

**mfind\_eq**( $M; x$ ) - the indexes of all elements in matrix  $M$  equal to  $x$ ;

**mfind\_ne**( $M; x$ ) - the indexes of all elements in matrix  $M$  not equal to  $x$ ;

**mfind\_lt**( $M; x$ ) - the indexes of all elements in matrix  $M$  less than  $x$ ;

**mfind\_le**( $M; x$ ) - the indexes of all elements in matrix  $M$  less than or equal to  $x$ ;

**mfind\_gt**( $M; x$ ) - the indexes of all elements in matrix  $M$  greater than  $x$ ;

**mfind\_ge**( $M; x$ ) - the indexes of all elements in matrix  $M$  greater than or equal to  $x$ ;

**hlookup**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are equal to  $x$ ;

**hlookup\_eq**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are equal to  $x$ ;

**hlookup\_ne**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are not equal to  $x$ ;

**hlookup\_lt**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are less than  $x$ ;

**hlookup\_le**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are less than or equal to  $x$ ;

**hlookup\_gt**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are greater than  $x$ ;

**hlookup\_ge**( $M; x; i_1; i_2$ ) - the values from row  $i_2$  of  $M$ , for which the elements from row  $i_1$  are greater than or equal to  $x$ ;

**vlookup**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are equal to  $x$ ;

**vlookup\_eq**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are equal to  $x$ ;

**vlookup\_ne**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are not equal to  $x$ ;

**vlookup\_lt**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are less than  $x$ ;

**vlookup\_le**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are less than or equal to  $x$ ;

**vlookup\_gt**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are greater than  $x$ ;

**vlookup\_ge**( $M; x; j_1; j_2$ ) - the values from column  $j_2$  of  $M$ , for which the elements from column  $j_1$  are greater than or equal to  $x$ ;

Math:

**hprod**( $A; B$ ) - Hadamard product of matrices  $A$  and  $B$ ;

**fprod**( $A; B$ ) - Frobenius product of matrices  $A$  and  $B$ ;

**kprod**( $A; B$ ) - Kronecker product of matrices  $A$  and  $B$ ;

**mnorm**( $M$ ) or

**mnorm\_e**( $M$ ) - Euclidean norm of matrix  $M$ ;

**mnorm\_1**( $M$ ) - L1 norm of matrix  $M$ ;

**mnorm\_2**( $M$ ) - L2 norm of matrix  $M$ ;

**mnorm\_i**( $M$ ) - L $\infty$  norm of matrix  $M$ ;

**cond**( $M$ ) or

**cond\_e**( $M$ ) - condition number of  $M$  based on the Euclidean norm of the matrix;

**cond\_1**( $M$ ) - condition number of  $M$  based on the L1 norm;

**cond\_2**( $M$ ) - condition number of  $M$  based on the L2 norm;

**cond\_i**( $M$ ) - condition number of  $M$  based on the L $\infty$  norm;

**det**( $M$ ) - determinant of matrix  $M$ ;

**rank**( $M$ ) - rank of matrix  $M$ ;

**trace**( $M$ ) - trace of matrix  $M$ ;

**transp**( $M$ ) - transpose of matrix  $M$ ;

**adj**( $M$ ) - adjugate of matrix  $M$ ;

**cofactor**( $M$ ) - cofactor matrix of  $M$ ;

**eigenvals**( $M$ ) - eigenvalues of matrix  $M$ ;

**eigenvecs**( $M$ ) - eigenvectors of matrix  $M$ ;

**cholesky**( $M$ ) - Cholesky decomposition of a symmetric, positive-definite matrix  $M$ ;

**lu**( $M$ ) - LU decomposition of matrix  $M$ ;

**qr**( $M$ ) - QR decomposition of matrix  $M$ ;

**svd**( $M$ ) - singular value decomposition of  $M$ ;

**inverse**( $M$ ) - inverse of matrix  $M$ ;



**lsolve**( $A$ ;  $b$ ) - solves the system of linear equations  $Ax = b$  using  $LDL^T$  decomposition for symmetric matrices, and LU for non-symmetric;

**elsolve**( $A$ ;  $b$ ) - solves the linear matrix equation  $Ax = b$  with a symmetric, positive-definite matrix  $A$  using Cholesky decomposition;

Double interpolation:

**take**( $x$ ;  $y$ ;  $M$ ) - returns the element of matrix  $M$  at indexes  $x$  and  $y$ ;

**line**( $x$ ;  $y$ ;  $M$ ) - double linear interpolation from the elements of matrix  $M$  based on the values of  $x$  and  $y$ ;

**spline**( $x$ ;  $y$ ;  $M$ ) - double Hermite spline interpolation from the elements of matrix  $M$  based on the values of  $x$  and  $y$ .

- Comments: "Title" or 'text' in double or single quotes, respectively.

**HTML**, **CSS**, **JS** and **SVG** are allowed.

- Graphing and plotting:

$\$Plot\{f(x) @ x = a : b\}$  - simple plot;

$\$Plot\{x(t) | y(t) @ t = a : b\}$  - parametric;

$\$Plot\{f_1(x) \& f_2(x) \& \dots @ x = a : b\}$  - multiple;

$\$Plot\{x_1(t) | y_1(t) \& x_2(t) | y_2(t) \& \dots @ x = a : b\}$  - multiple parametric;

$\$Map\{f(x; y) @ x = a : b \& y = c : d\}$  - 2D color map of a 3D surface;

*PlotHeight* - height of plot area in pixels;

*PlotWidth* - width of plot area in pixels;

*PlotStep* - grid size for map plotting.

- Iterative and numerical methods:

$\$Root\{f(x) = const @ x = a : b\}$  - root finding for  $f(x) = const$ ;

$\$Root\{f(x) @ x = a : b\}$  - root finding for  $f(x) = 0$ ;

$\$Find\{f(x) @ x = a : b\}$  - similar to above, but  $x$  is not required to be a precise solution;

$\$Sup\{f(x) @ x = a : b\}$  - local maximum of a function;

$\$Inf\{f(x) @ x = a : b\}$  - local minimum of a function;

$\$Area\{f(x) @ x = a : b\}$  - adaptive Gauss-Lobatto numerical integration;

$\$Integral\{f(x) @ x = a : b\}$  - Tanh-Sinh numerical integration;

$\$Slope\{f(x) @ x = a\}$  - numerical differentiation;

$\$Sum\{f(x) @ k = a : b\}$  - iterative sum;

$\$Product\{f(k) @ k = a : b\}$  - iterative product;

$\$Repeat\{f(k) @ k = a : b\}$  - general inline iterative procedure;

*Precision* - relative precision for numerical methods [ $10^{-2}$ ;  $10^{-16}$ ] (default is  $10^{-12}$ )

- Program flow control:

Simple:

```
#if condition
  your code goes here
#end if
```

Alternative:

```
#if condition
  your code goes here
#else
  some other code
#end if
```

Complete:

```
#if condition1
  your code goes here
#else if condition2
  your code goes here
#else
  some other code
#end if
```

You can add or omit as many "#else ifs" as needed. Only one "#else" is allowed.

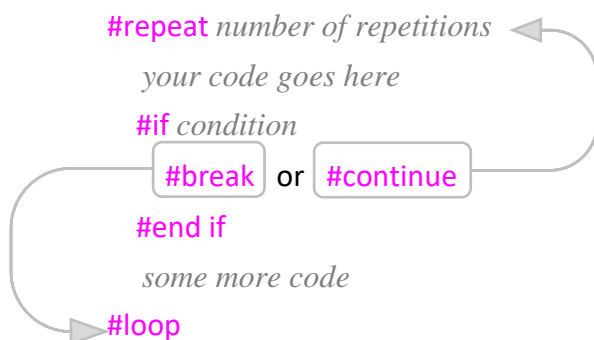
You can omit this too.

- Iteration blocks:

Simple:

```
#repeat number of repetitions
  your code goes here
#loop
```

With conditional break/continue:



With counter:

```
#for counter = start : end
  your code goes here
#loop
```

With condition:

```
#while condition  
  your code goes here  
#loop
```

- Modules and macros/string variables:

Modules:

```
#include filename - include external file (module);  
#local - start local section (not to be included);  
#global - start global section (to be included);
```

Inline string variable:

```
#def variable_name$ = content
```

Multiline string variable:

```
#def variable_name$  
  content line 1  
  content line 2  
  ...  
#end def
```

Inline macro:

```
#def macro_name$(param1$; param2$; ...) = content
```

Multiline macro:

```
#def macro_name$(param1$; param2$; ...)  
  content line 1  
  content line 2  
  ...  
#end def
```

- Output control:

```
#hide - hide the report contents;  
#show - always show the contents (default);  
#pre - show the next contents only before calculations;  
#post - show the next contents only after calculations;  
#val - show only the result, without the equation;  
#equ - show complete equations and results (default);  
#noc - show only equations without results (no calculations);  
#nosub - do not substitute variables (no substitution);  
#novar - show equations only with substituted values (no variables);  
#varsub - show equations with variables and substituted values (default);  
#round n - rounds the output to n digits after the decimal point.
```

- Breakpoints for step-by-step execution:

**#pause** - calculates down to the current line and waits for the user to resume manually;

**#input** - renders an input form to the current line and waits for user input.

Each of the above commands is effective after the current line until the end of the report or another command that overwrites it.

- Units for trigonometric functions: **#deg** - degrees, **#rad** - radians, **#gra** - gradians;
- Separator for target units: **|**;
- Return angles with units: **ReturnAngleUnits** = 1;

- Dimensionless: **%**, **‰**;

- Angle: **°**, **'**, **"**, **deg**, **rad**, **grad**, **rev**;

- Metric units (SI and compatible):

Mass: **g**, **hg**, **kg**, **t**, **kt**, **Mt**, **Gt**, **dg**, **cg**, **mg**, **µg**, **Da** (or **u**);

Length: **m**, **km**, **dm**, **cm**, **mm**, **µm**, **nm**, **pm**, **AU**, **ly**;

Time: **s**, **ms**, **µs**, **ns**, **ps**, **min**, **h**, **d**, **w**, **y**;

Frequency: **Hz**, **kHz**, **MHz**, **GHz**, **THz**, **mHz**, **µHz**, **nHz**, **pHz**, **rpm**;

Speed: **kmh**;

Electric current: **A**, **kA**, **MA**, **GA**, **TA**, **mA**, **µA**, **nA**, **pA**;

Temperature: **°C**, **Δ°C**, **K**;

Amount of substance: **mol**;

Luminous intensity: **cd**;

Area: **a**, **daa**, **ha**;

Volume: **L**, **daL**, **hL**, **dL**, **cL**, **mL**, **µL**, **nL**, **pL**;

Force: **N**, **daN**, **hN**, **kN**, **MN**, **GN**, **TN**, **gf**, **kgf**, **tf**, **dyn**;

Moment: **Nm**, **kNm**;

Pressure: **Pa**, **daPa**, **hPa**, **kPa**, **MPa**, **GPa**, **TPa**, **dPa**, **cPa**, **mPa**, **µPa**, **nPa**, **pPa**,  
**bar**, **mbar**, **µbar**, **atm**, **at**, **Torr**, **mmHg**;

Viscosity: **P**, **cP**, **St**, **cSt**;

Energy work: **J**, **kJ**, **MJ**, **GJ**, **TJ**, **mJ**, **µJ**, **nJ**, **pJ**,

**Wh**, **kWh**, **MWh**, **GWh**, **TWh**, **mWh**, **µWh**, **nWh**, **pWh**,

**eV**, **keV**, **MeV**, **GeV**, **TeV**, **PeV**, **EeV**, **cal**, **kcal**, **erg**;

Power: **W**, **kW**, **MW**, **GW**, **TW**, **mW**, **µW**, **nW**, **pW**, **hpM**, **ks**,

**VA**, **kVA**, **MVA**, **GVA**, **TVA**, **mVA**, **µVA**, **nVA**, **pVA**,

**VAR**, **kVAR**, **MVAR**, **GVAR**, **TVAR**, **mVAR**, **µVAR**, **nVAR**, **pVAR**;

Electric charge: **C**, **kC**, **MC**, **GC**, **TC**, **mC**, **µC**, **nC**, **pC**, **Ah**, **mAh**;

Potential: **V**, **kV**, **MV**, **GV**, **TV**, **mV**, **µV**, **nV**, **pV**;

Capacitance: **F**, **kF**, **MF**, **GF**, **TF**, **mF**, **µF**, **nF**, **pF**;

Resistance: **Ω**, **kΩ**, **MΩ**, **GΩ**, **TΩ**, **mΩ**, **µΩ**, **nΩ**, **pΩ**;

- Conductance: S, kS, MS, GS, TS, mS,  $\mu$ S, nS, pS,  $\text{G}$ , k $\text{G}$ , M $\text{G}$ , G $\text{G}$ , T $\text{G}$ , m $\text{G}$ ,  $\mu\text{G}$ , n $\text{G}$ , p $\text{G}$ ;
- Magnetic flux: Wb, kWb, MWb, GWb, TWb, mWb,  $\mu$ Wb, nWb, pWb;
- Magnetic flux density: T, kT, MT, GT, TT, mT,  $\mu$ T, nT, pT;
- Inductance: H, kH, MH, GH, TH, mH,  $\mu$ H, nH, pH;
- Luminous flux: lm;
- Illuminance: lx;
- Radioactivity: Bq, kBq, MBq, GBq, TBq, mBq,  $\mu$ Bq, nBq, pBq, Ci, Rd;
- Absorbed dose: Gy, kGy, MGy, GGy, TGy, mGy,  $\mu$ Gy, nGy, pGy;
- Equivalent dose: Sv, kSv, MSv, GSv, TSv, mSv,  $\mu$ Sv, nSv, pSv;
- Catalytic activity: kat;
- Non-metric units (Imperial/US):
 

Mass: gr, dr, oz, lb (or lbm, lb\_m), kipm (or kip\_m), st, qr, cwt (or cwt\_uk, cwt\_us), ton (or ton\_uk, ton\_us), slug;

Length: th, in, ft, yd, ch, fur, mi, ftm (or ftm\_uk, ftm\_us), cable (or cable\_uk, cable\_us), nmi, li, rod, pole, perch, lea;

Speed: mph, knot;

Temperature:  $^{\circ}\text{F}$ ,  $\Delta^{\circ}\text{F}$ ,  $^{\circ}\text{R}$ ;

Area: rood, ac;

Volume, fluid: fl\_oz, gi, pt, qt, gal, bbl, or: fl\_oz\_uk, gi\_uk, pt\_uk, qt\_uk, gal\_uk, bbl\_uk, fl\_oz\_us, gi\_us, pt\_us, qt\_us, gal\_us, bbl\_us;

Volume, dry: (US) pt\_dry, (US) qt\_dry, (US) gal\_dry, (US) bbl\_dry, pk (or pk\_uk, pk\_us), bu (or bu\_uk, bu\_us);

Force: ozf (or oz\_f), lbf (or lb\_f), kip (or kipf, kip\_f), tonf (or ton\_f), pdl;

Pressure: osi, osf psi, psf, ksi, ksf, tsi, tsf, inHg;

Energy/work: BTU, therm (or therm\_uk, therm\_us), quad;

Power: hp, hpE, hpS;
  - Custom units - .Name = expression.  
Names can include currency symbols: €, £, ₤, ¥, ¢, ₧, ₹, ₪, ₮.