

Mathematica

Mathematica is a general system for doing symbolic and numeric mathematics—including root finding, integration, differentiation, matrix algebra, plotting, fitting, ... Note: pay close attention to capitalization as **Mathematica commands are case dependent!**

Starting Mathematica: On a UNIX workstation, open a terminal and at the tcsh (%) prompt type:

math	... For those using the command-line form.
mathematica	... For those using notebooks.

Alternatively, *Mathematica* can be started from the Mandrake yellow star “start” menu: star→CSBSJU Menu→ Physics→ math (or mathematica).

Exiting Mathematica: At the *Mathematica* (In[n]:=) prompt type:

Quit	... Note capitalization. Control-D also quits. Control-C aborts.
------	--

Input and Output:

With notebooks all input and output appears in a browser. You can print selected portions by selecting from a menu. If you run the command-line version, using an editor, cut and paste from an open file.

In[1]:= <<file.m	... <i>Mathematica</i> will execute all the commands in <i>file.m</i> (note: .m is the suggested extension).
In[2]:= Import["file.dat", "Table"]	... <i>Mathematica</i> will create a list with the data from the <i>file</i> (note: .dat is the suggested extension). Also see Export .
In[3]:= ! <i>cs</i> h command	... <i>Mathematica</i> will execute the <i>cs</i> h command (e.g., ls , nedit).
In[4]:= ? <i>Fi</i> *	... Help for terms starting <i>Fi</i> , e.g., Fit .
In[5]:= Options[Plot]	... List options for commands, e.g., AspectRatio -> Automatic .

Examples:

In[1]:= Solve[x ² + b _□ x + c == 0, x]	... <i>Mathematica</i> knows the quadratic equation. A space is here denoted “□” and means multiplication. You could just as well write “b*x”, but “bx” is one variable’s name, not the intended “b · x”.
--	---

$$\text{Out}[1]= \left\{ \left\{ x \rightarrow \frac{-b + \sqrt{b^2 - 4c}}{2} \right\}, \left\{ x \rightarrow \frac{-b - \sqrt{b^2 - 4c}}{2} \right\} \right\}$$

In[2]:= x ² + b _□ x + c /. First[%]	... Apply the first rule in the set.
---	--------------------------------------

$$\text{Out}[2]= \frac{b(-b + \sqrt{b^2 - 4c})}{2} + \frac{(-b + \sqrt{b^2 - 4c})^2}{4} + c$$

In[3]:= Together[%]	... seek a common denominator, also see Simplify
---------------------	---

Out[3]= 0	... it works!
-----------	---------------

In *Mathematica*, % always stands for the last result. You can type %% to use the next-to-last result or %n to use the result Out[n].

In[4] := Integrate[x^2 Exp[x], x] ... $\int x^2 e^x dx$

Out[4] = ... $e^x(2 - 2x + x^2)$

In[5] := D[%, x] ... Take the derivative of the previous result.

Out[5] = ... Simplify to get $x^2 e^x$

In[6] := N[Pi, 50] ... 50 accurate digits of π .

In[7] := FindRoot[Tanh[y]==1/(2/y-1), {y, .9}] ... Finds a solution near $y = .9$

In[8] := Series[Cos[x], {x, 0, 6}] ... Taylor's expansion near $x = 0$ up to x^6

In[9] := f[x_] := Re[Exp[I x]] ... Define the function: $f(x) = \cos(x)$
the hard way

In[10] := m = {{a, b}, {c, d}} ... Define matrix $m = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$

Mathematica knows lots of matrix operations including: Det[m], Inverse[m], Eigenvalues[m], Eigenvectors[m], Eigensystem[m], m.n, m+n, ...

Graphics:

Mathematica can produce both screen and hardcopy plots.

In[1] := Plot[Sin[2 Pi x], {x, 0, 2}] ... A graph of $\sin(2\pi x)$ appears on your screen.

In[2] := PSPrint[%] ... Prints a copy on the Physics laserprinter.

In[3] := Export["file.eps", %, "EPS"] ... Saves a file of graphic.

You may want to try some fancy color graphics like:

In[4] := Plot3D[Sin[x + Sin[y]], {x, -6, 3}, {y, -9, 9}, Lighting->True, Mesh->False, PlotRange->All, PlotPoints->90]

Including Mathematica Packages:

For example, to load the **Graphics`Animation`** package, at the *Mathematica* prompt type:

In[1] := Needs["Graphics`Animation`"] ... Note capitalization and odd quote: `

In[2] := <<Graphics/Polyhedra.m ... Other ways of adding packages.

In[3] := <<Graphics`Shapes`

In[4] := theta = .3; irat = .3; phidot = 1; psidot = (irat - 1) Cos[theta]

In[5] := ShowAnimation[Table[RotateShape[AffineShape[Polyhedron[Cube], {1, 1, irat}], -psidot t, -theta, -phidot t], {t, 0, 4 Pi, .1 Pi}]]

More Information:

For more information about *Mathematica*, please refer to

- *The Mathematica Book, Fifth Edition*, by Stephen Wolfram, ISBN: 1579550223
- *Mathematica 4: Standard Add-on Packages*
- [/net/local/mathematica_5.0/Documentation/English](#)