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: Log on to a UNIX workstation and at the csh (%) prompt type:

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

Alternatively, *Mathematica* can be started from the "Toolchest:" Applications→Mathematics→Mathematica.

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

`Quit`	...Note capitalization. Control-D also quits.

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]:= <<Dialog.m`	...This will send all input and output into a file called `math.lis`.
`In[2]:= %>>`*file.ext*	...*Mathematica* will create *file.ext* and write the last output in it.
`In[3]:= <<`*file*`.m`	...*Mathematica* will execute all the commands in *file*.m (note: .m is the suggested extension).
`In[4]:= !` *csh command*	...*Mathematica* will execute the csh command (e.g., `ls`, `jot`).
`In[5]:= ?Fi*`	...Help for terms starting `Fi`, e.g., `Fit`.

Examples:

```
In[1]:= Solve[x∧2 + b␣x + c == 0, x]          ...Mathematica knows the quadratic
                                                 equation.
```

```
                    2                          2
          -b + Sqrt[b - 4 c]         -b - Sqrt[b - 4 c]
Out[1]= {{x -> ------------------ }, {x -> ------------------ }}
                    2                          2
```

```
In[2]:= x∧2 + b␣x + c /.  First[%]            ...Apply the first rule in the set.
```

```
                2                    2       2
        b(-b + Sqrt[b - 4 c])    (-b + Sqrt[b - 4 c])
Out[2]=  -------------------- +  -------------------- + c
                2                        4
```

```
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]
```
$\dots \int x^2 e^x \, dx$

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

```
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]`, `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]:= Display["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*, by Stephen Wolfram, Cambridge Univ Pr. ISBN: 0521643147

- *Mathematica 4: Standard Add-on Packages*