Introduction to *Mathematica*

Above all, remember that *Mathematica* is a program with a *rigid* structure. You must tell it what to do *in precise terms*—commas, colons, semicolons, spaces all must be in place. Success requires **patience** and **persistence**.

Firing-up *Mathematica*. Starting *Mathematica*will open a *notebook*—the “front end”—that provides the interface from which you send commands to the computational engine—called a *kernel*.

Basic input output.

1. Type the command or program to be evaluated. This material appears in an “evaluation cell.”

2. To evaluate the cell, press < Shift > − < Enter > simultaneously. *Note*: The *Mathematica* kernel will evaluate everything in the cell that you *activate* in the order in which it appears. Other cells will be left alone.

You can also enter text into the notebook. A cell can be selected to carry text that isn’t evaluated. An important part of your written lab work will be the descriptions of the computations and program that you create. Typically, you should *comment* on, at least, the crucial pieces in your notebook.

Getting started and getting help. On the menu bar pull down Help and select Wolfram documentation. This will start a *browser* which should be your primary tool for finding information. Notice that it’s searchable; often you can type the name of something that you’re interested in and get some positive response.

Poke around here. Look at some examples—you should actually run what’s in the examples (you can cut-and-paste from the browser into a notebook).

Naming things. The way to assign a name to something is with ‘`=`.’ Examples:

Mathematica expression	Description
`a = 7`	Assigns the number 7 to the symbol a
`v = {1,2}`	Assigns the “list” (point/vector in the plane) $(1, 2)$ to v
`M = {{1,2},{3,4}}`	Assigns the list of lists (2×2 matrix/array) $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ to the symbol M

Note: To *unname* something that you called `X`, use `Clear[X]`.

Functions and maps. The way to define a function is with '`:=`.' Examples:

Mathematica expression	Description
`f[x_] := x^2`	Defines the function/map $f(x) = x^2$ $x \xrightarrow{f} x^2$
`g[{x_,y_}] := {x^2 + y,y^2 - 1}`	Defines the map $g(x, y) = (x^2 + y, y^2 - 1)$ $(x, y) \xrightarrow{g} (x^2 + y, y^2 - 1)$

Notice the use of **square brackets** and the **underbar** '_' that indicates a variable. Try defining these functions and compute their values at two or three points. Now define the functions

$$f(x) = e^{\sin x} \qquad g(x) = \sin e^x$$

and compute a few values. Use the help facility to find *Mathematica*'s built-in trig and exponential functions.

Lists, vectors, and matrices. *Mathematica* uses lists for vectors and lists of lists for matrices. Under Lists in the Practical Introduction, look at the items Making Tables of Values and Vectors and matrices. Create the matrices

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \qquad B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}.$$

Compute the matrix products AB and BA. Now create the *symbolic* matrices

$$U = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \qquad V = \begin{pmatrix} e & f \\ g & h \end{pmatrix}.$$

and compute the matrix products UV and VU.

Derivatives. Use the help facility to learn how to take the derivative of a function of one variable. Compute the derivative with respect to x of the functions

$$f(x) = e^{\sin x} \qquad g(x) = \sin e^x.$$

Plotting. Use the help facility to learn how to plot a function of one variable. Plot the graphs of the functions

$$f(x) = e^{\sin x} \quad \text{for } -1 \le x \le 10 \qquad g(x) = \sin e^x \quad \text{for } -2 \le x \le 4.$$

Halting a computation in progress. If you decide that you want to stop a calculation, select Abort Evaluation from the Evaluation item on the menu. For "small" computations this usually produces the desired effect. However, sometimes this will have unfavorable results—like killing the program. A more desperate measure is to stop the kernel: Quit Kernel under Evaluation.

Save your work. Every time you enter a new item for calculation, save what you've done before starting the evaluation.