Basic Maple Tutorial

The purpose of this document is to introduce some basic Maple commands, syntax, and programming concepts for Maple V Release 9.5.

1 Some Basic Maple Commands

After you log on to your terminal and access Maple, you will get a window containing a "prompt" > where you can immediately begin entering Maple commands. If you wanted to multiply the numbers 247 and 3756, you would enter

```
> 247*3756;
```

$$927732$$

NOTE: Every Maple V command must end with either a semicolon or a colon. If a command is ended with a colon then the calculation will be made but no output will be printed. When a semicolon is used the calculation will be made and the result will be printed.

If a colon were used on the previous command, the result would look like the following:

```
> 247*3756:
```

If the semicolon or colon is omitted from a command, the command will not execute. Maple will respond as follows:

```
> 247*3756

Warning, premature end of input
```

However, because Maple allows full screen editing, you can go back to the line where the problem occurred and correct it.

2 Arithmetic

The basic arithmetic operations of addition, multiplication, division, and exponentiation are recognized in Maple V by the following symbols:

+ and -	add and subtract
* and /	multiply and divide
^ or **	raise to a power

You can easily add two numbers

```
> 253+7775;
```

$$8028$$

or add two fractions.

```
> 25/27 + 3/51;
```

$$\frac{452}{459}$$

Operations can be performed on previous results by using the percent symbol %. The next calculation multiplies the previous result by 23.

```
> 23 * %;
```

$$\frac{10396}{459}$$

Double percent marks refers to the next to last result.

```
>  23 * %%;
```

$$\frac{10396}{459}$$

You can raise a number to a power as follows.

```
>  3^7;
```

$$2187$$

```
>  3**7;
```

$$2187$$

Like other computer algebra systems, Maple uses exact arithmetic. For example, if you divide two integers Maple V will return the exact answer.

```
>  3235/7478;
```

$$\frac{3235}{7478}$$

The Maple function **evalf** will give the following decimal representation.

```
>  evalf(%);
```

$$0.4326023001$$

3 Defining Variables and Functions

You can assign a value or a function to a variable by using the colon-equal notation "**:=**"

```
>  y := 5;
```

$$y := 5$$

This means that the variable "y" has been assigned the value 5 and will have this value throughout the session until it is assigned another value or its value is unassigned. To display the current contents of a variable, we enter the variable's name followed by a semicolon.

```
>  y;
```

$$5$$

We can perform basic calculations with the unassigned variable such as

```
>  4*y + 5;
```

$$25$$

Assigning a variable to itself enclosed in single quotes unassigns the variable.

```
>  y := 'y';
```

$$y := y$$

```
>  y;
```

$$y$$

There are two ways to define and work with functions. One way is to define the function as an expression. For the function f(x) = x^2, this would be done by entering

```
>  f := x^2;
```

$$f := x^2$$

This definition can be checked by entering:

```
>  f;
```

$$x^2$$

The Maple V procedure **subs** allows expressions such as this to be evaluated.

```
> subs(x=5,f);
```

$$25$$

The problem with defining functions as expressions is that standard functional notation, such as *f(5)*, is not understood by Maple V and results in nonsense.

```
> f(x);
```

$$\mathrm{x}(x)^2$$

```
> f(5);
```

$$\mathrm{x}(5)^2$$

If you wish to use standard functional notation, you must enter the function using the minus-greater than notation "**->**", made by typing the "minus sign" followed by the "greater than" sign. For example:

```
> f := x -> x^2;
```

$$f := x \to x^2$$

```
> f(x);
```

$$x^2$$

```
> f(5);
```

$$25$$

4 Case Sensitivity

Maple is case sensitive - it distinguishes between upper and lower case characters. If you want to factor the polynomial $x^2 + 2\,x + 3$, you would enter

```
> factor(x^2 - 2*x - 3);
```

$$(x+1)\,(x-3)$$

However, the following command results in nonsense.

```
> FACTOR(x^2 - 2*x - 3);
```

$$\mathrm{FACTOR}(x^2 - 2\,x - 3)$$

Even one letter not being the correct case returns nonsense.

```
> Factor(x^2 - 2*x - 3);
```

$$\mathrm{Factor}(x^2 - 2\,x - 3)$$

5 Algebra

Here are some of the important Maple V algebra commands:

Maple Command	**What it does**
expand	Expands expressions
simplify	Simplifies expressions
factor	Factors expressions
solve	solves equations

Some examples of these commands follow:

```
> expand( (x^2 + 1) * (x + 1) * (x + 3) );
```

$$x^4 + 4\,x^3 + 4\,x^2 + 4\,x + 3$$

```
> factor(%);
```

$$(x^2+1)\,(x+1)\,(x+3)$$

```
> sol := solve( x^3 - 9*x^2 + 20*x = 0, x);
```

$$sol := 0,\, 5,\, 4$$

The last equation has 3 roots, and we can pick a particular one by entering

```
> sol[1];
```

$$0$$

or

```
> sol[3];
```

$$4$$

6 Graphing

Maple has the ability the graph functions and equations. The **plot** command is the basic command used for plotting graphs. To demonstrate, suppose we enter the function

```
> f := x^2;
```

$$f := x^2$$

The following command will graph this function (note the quotes around the sentence in the title option).

```
> plot(f, x = -3..3, y = -5..10, title = "Graph of y = x^2");
```

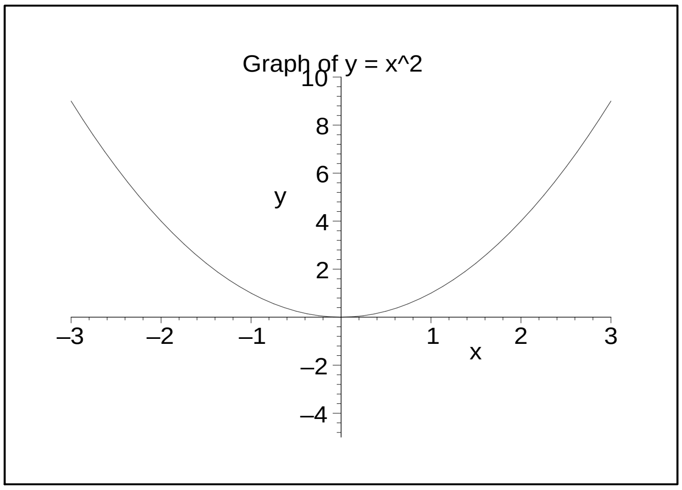

Figure 1: Maple graph of $y = x^2$

In the previous statement, the first parameter is the function that will be graphed. The second and third parameters are the ranges on the x and y axis over which we want our graph to be plotted.

Maple has the ability to graph multiple graphs. Suppose we enter the function

```
> g := x^3;
```

$$g := x^3$$

The following commands set up and store the plots for these graphs in the variables p1 and p2. An important fact to remember is to end these commands with a **colon :.** If you end the command with a semicolon, all the data points generated to plot the graph will be displayed.

```
> p1 := plot(f, x = -3..3, y = -9..9, color = blue):
> p2 := plot(g, x = -3..3, y = -9..9, color = green):
```

Using the **display** command, we can graph both functions. The **display** is in a package of routines called plots, which we read into the session by entering

```
> with(plots);
Warning, the name changecoords has been redefined
```

$[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, cylinderplot, densityplot, display, display3d, fieldplot, fieldplot3d, gradplot, gradplot3d, graphplot3d, implicitplot, implicitplot3d, inequal, interactive, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra\_supported, polyhedraplot, replot, rootlocus, semilogplot, setoptions, setoptions3d, spacecurve, sparsematrixplot, sphereplot, surfdata, textplot, textplot3d, tubeplot]$

This command now plots both graphs on the same axes.

```
> display([p1, p2], title = "Graphs of y = x^2 and y = x^3");
```

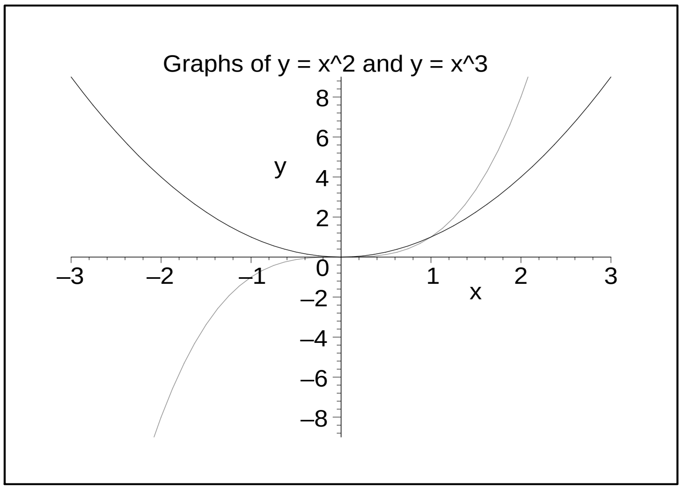

Figure 2: Maple graphs of $y = x^2$ and $y = x^3$

7 Help File

You can obtain the help file regarding most Maple functions and statements by entering **? *name*** where name is the function or statement you desire help on. To see help on factor, you can enter:

```
> ? factor
```

Help can also be obtain using the help option on the toolbar.