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;
452
459
```

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

```
> 23 * %;
10396
459
```

Double percent marks refers to the next to last result.
You can raise a number to a power as follows.

\[ 3^7; \]
\[ 2187 \]
\[ 3\cdot7; \]
\[ 2187 \]

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.

\[ \text{evalf}(%); \]
\[ 0.4326023001 \]

### 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

\[ 4\cdot y + 5; \]
\[ 25 \]

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.
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.

\[
\begin{align*}
\text{subs}(x=5,f) & = 25 \\
\text{f}(x) & = x(x)^2 \\
\text{f}(5) & = x(5)^2
\end{align*}
\]

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:

\[
\begin{align*}
\text{f} := x \rightarrow x^2; \\
\text{f}(x) & = x^2 \\
\text{f}(5) & = 25
\end{align*}
\]

\section{Case Sensitivity}

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

\[
\begin{align*}
\text{factor}(x^2 - 2x - 3); \\
(x + 1)(x - 3)
\end{align*}
\]

However, the following command results in nonsense.

\[
\begin{align*}
\text{FACTOR}(x^2 - 2x - 3); \\
\text{FACTOR}(x^2 - 2x - 3)
\end{align*}
\]

Even one letter not being the correct case returns nonsense.

\[
\begin{align*}
\text{Factor}(x^2 - 2x - 3); \\
\text{Factor}(x^2 - 2x - 3)
\end{align*}
\]

\section{Algebra}

Here are some of the important Maple V algebra commands:

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<th>What it does</th>
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<td>\text{expand}</td>
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<tr>
<td>\text{solve}</td>
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Some examples of these commands follow:

\[
\begin{align*}
\text{expand}\left( (x^2 + 1) * (x + 1) * (x + 3) \right); \\
x^4 + 4x^3 + 4x^2 + 4x + 3 \\
\text{factor}(%); \\
(x^2 + 1)(x + 1)(x + 3) \\
\text{sol} := \text{solve}(x^3 - 9x^2 + 20x = 0, x); \\
sol := 0, 5, 4
\end{align*}
\]
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");

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
This command now plots both graphs on the same axes.

```maple
> 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:

```maple
> ? factor
```

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