Introduction to Maple

Maple is a software package that performs mathematical calculations algebraically as well as numerically for the user. To start *Maple*, click on the appropriate icons. The *Maple* worksheet is the screen where you will do your work. Two things you need to know about *Maple* are that your input math prompt is the greater than sign, ">" and that you must end each *Maple* command with a semicolon, ";". Also, editing within your worksheet is done "the Windows way" using your mouse to highlight areas to be deleted or copied.

You should begin each *Maple* session by typing your name on the worksheet. To change to a text prompt, click **T** on the task bar. Label the top of your worksheet with

```
Your Name
Date
```

You can use this text mode at any point in the worksheet. Click on ">" to switch back to *Maple* input mode. Begin each worksheet with the following two *Maple* commands:

```
> with(student);with(plots);
```

These two commands allow you to access all of the commands in the `student` and `plots` libraries that come with the *Maple* software. *Maple* always give a respond for every command that ends with a semicolon. To suppress the list of these commands, use : rather than ; at the end of each `with` command.

Arithmetic

We start with some basic arithmetic that you could perform on your calculator. For example, to compute 2+3-3*6, type

```
> 2+3-3*6;
```

and then hit the enter key. To enter the fractional expression "$\frac{1}{2} + \frac{3}{7}$", type

```
> 1/2+3/7;
```

Notice that *Maple* gives you a fractional answer. To get a decimal approximation of a numerical expression, the command **evalf** is used, as in

```
> evalf(1/2+3/7);
```

Other basic operations are exponents and roots. Some examples are:

```
> 2^200;
> 3^(-10);
> sqrt(36);
> root(36,5);
> (sin(Pi/4))^2;
```

Now use the `evalf` command to get a decimal approximation to the last answer. How do you think *Maple* will handle exponents and roots of negative numbers? Experiment on your own and discuss what you find.

How to define Functions and Expressions

Suppose we have a function $f(x) = x^2 - 3x + 1$ that we need to evaluate f at several values of x. We can of course use *Maple* as a calculator and simply re-type the expression for every value of input x. However, we can also define f as a **function**.

```
> f:=x->x^2+3*x+1;
> f(1);
> f(2);
```

Notice the special definition syntax for the function $f(x)$ using an arrow. The notation `:=` can be read as "is defined as". *Maple* explicitly defines a function as a *rule* that assigns output to each input x. The notation `->` can be seen as an arrow "$\rightarrow$", which signifies that x is *mapped* to 2^x.

We can also define f as an **expression**. A function is different from an expression; an expression is a formula and not a rule, and *Maple* excludes the arrow in this case:

```
> f:=x^2+3*x+1;
> subs(x=1,f);
> subs(x=2,f);
```

Here f is simply a *tag* that represents the *expression* 2^x. There is no indication in the definition that f is a function dependent on x.

Exercises:

(1) Consider the quadratic function $f(x) = 4x^2 + 8x + 1$.

    (a) Define f as a **function** in *Maple*.

    (b) Find the values of $f(1)$, $f(-3)$, $f(\pi)$. (Hint: In *Maple*, π is entered as `Pi`).

    (c) Plot the graph on screen using the `plot` command, choose an appropriate range to show both roots. (Hint: Look at the help page for the syntax of plot command)

    (d) Find the roots of the polynomial using the `solve` command.

(2) Consider the functions

$$g(x) := x^3 + 2x^2 - \frac{2}{x} + \frac{2}{x^2}, \quad h(x) := 4x^3 - 2x^2 - \frac{2}{x^2}$$

    (a) Define g and h as **expressions** in *Maple*.

    (b) Evaluate $g(2)$.

    (c) Find the sum and the difference of g and h using *Maple*.

    (d) Find the product gh, express the answer in the expanded form by using the `expand` command.

    (e) Find the quotient g/h in the expanded form by using the `rationalize` command.