

# Introduction to Maple

Maple is a computer algebra system. It is capable of doing a great many things, a few of which are described in this document. In order to become acquainted with these commands, work through the tutorial beginning on the next page.

You can get into Maple at any of the machines in

Science and Tech I room 124  
Robinson B rooms 101, 105, 106, 107, 109  
Johnson Center room 341.

To find it on any of these machine, click on the following sequence: Start, Programs, Instructor Apps, MapleV. Maple will then come up on the screen, ready for you to use.

You can also get into Maple in the Math Department lab in Science and Tech I room 220. Though it is more complicated to access Maple (the directions are below), the benefit is that there is a TA on duty who is able to answer technical questions you may have about Maple. Also my office is just around the corner, so you can ask me questions if I happen to be around. There is no such help in the other locations. On the other hand, I believe the directions given in these notes for using Maple on the machines in Robinson B, Sc and Tech I room 124 and Johnson Center are straightforward and you may very well have no trouble in following them.

## Getting into MAPLE from the Math Department Lab (Science and Tech I room 220)

(1) Make sure that the console (the little grey box) is outlined in green. If not, click on “windowMgr”, then click on “NCD Window Manager...”

(2) Click on “Terminals”, then “New Terminal ...”. In the “Service” box, type **mason** and hit Return. Log in. (If you don’t have a mason account, see me or see one of the consultants in any campus lab.)

(3) At the mason prompt, type **xmapple**, and wait a bit for the MAPLE windows to pop up (it is important you type xmapple and not merely maple). When they do, you’ll probably want to enlarge both by

clicking on the top right-hand corners. You'll be entering commands where you see the [ $\gt$ ] prompt.

(4) When you are done with your MAPLE session in the math lab, close your file by clicking on "file" and then click on "close". To exit MAPLE, click on "file" and then click on "exit". Logout of mason as usual.

### **Saving Things and Retrieving Them**

MAPLE has a bad habit of crashing. It does this frequently and for no apparent reason. Therefore, save your work often. Do so by following these steps:

1) Click on "File" at the top of the main MAPLE window. Then click on "Save As ..." the first time and just "Save" once you have given your file a name.

2) For "filename", type whatever you want to call your file. (Note: when you save a file, MAPLE will append ".mws" to your filename. This stands for "MAPLE worksheet".) Then click on "OK".

To retrieve a MAPLE file that you've saved:

1) Click on "File", then on "Open...".  
2) Click on the name of your file to highlight it, and then click on "OK". A new MAPLE window will appear with whatever work you've saved in your file.

### **Printing Files in the Math Lab in Sc and Tech I, room 220**

1) First, save the file.  
2) Click on "File", then click on "Print ...".  
3). Click on "Print Command", and type **lpr -Pst220** (the command is case-sensitive). It doesn't seem to work if you include the filename in this command. ("-Pst220" is the name of the printer in the math computer lab. If you want to send your file elsewhere, you'll type something different after "lpr". If you are in another lab on campus, the name of the printer there is usually posted on the printer itself.)

4) Click on "Print".

## A Maple Tutorial

- To insert text comments in your MAPLE output, click on “insert”, then “text input”. You can then type your text. To return to MAPLE input, click on the [>] button at the top. You should do this on each page of your assignments in order to identify yourself as the author.

- After every line that you type in MAPLE, you must type a semicolon (;) before hitting Return.

- You can use the mouse to move the cursor back and forth on a command line and up and down between command lines if you want to change something.

- You can do with MAPLE the usual things you do with calculators. Type in the following and see what happens:

```
2+3;
```

```
100-1;
```

```
10*9;
```

```
1/3;
```

```
1.0/3; (Note the difference. If you want a decimal number, write one of the numbers in decimal form. Otherwise it will keep your answer as a fraction.)
```

```
4^2
```

```
sqrt(16); which is the same as 16^(1/2);
```

```
Pi; evalf(Pi); (Note Maple recognizes this as the number Pi only if you capitalize the P.)
```

```
sin(3);
```

Note this gives back “sin(3)”. To get a decimal approximation of this type:

```
evalf(sin(3));
```

or

```
sin(3.0);
```

The command evalf will evaluate sin(3) as a floating point number (this means decimal number). You will find the evalf command often useful when you want to get a decimal answer to a particular question.

- You can define a function, say  $f(x) = x - \sin x$ , by typing:

```
f:=x->x-sin(x);
```

and then calculate values, say  $f(3)$ , by typing:

```
f(3);
```

If this doesn't give a decimal answer type:

```
evalf(f(3));
```

•You can graph functions. To see the graph of  $f(x) = x - \sin(x)$ , define a function as above:

```
f:=x->x-sin(x);
```

and then type

```
plot(f);
```

You can graph more than one thing on the same set of axes. If two functions,  $f$  and  $g$ , have been defined as above, then type:

```
plot({f,g});
```

MAPLE will display both graphs in different colors. Try this on the functions  $f(x)=x^2$  and  $g(x)=x^3$  by typing:

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

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

```
plot({f,g});
```

•If you do not specify a domain or range (as above), MAPLE will choose one for you. You can specify your own domain as follows: say you want to plot the above  $f$  and  $g$  from  $-1$  to  $1$ . Then type:

```
plot({f(x),g(x)},x=-1..1);
```

If you want to graph it from  $-1$  to  $1$  and your  $y$ -values to range from  $-2$  to  $2$ , type:

```
plot({f(x),g(x)},x=-1..1,y=-2..2);
```

Of course the same thing works if you plot only  $f$ . This is particularly useful if you wish to zoom in on a particular part of the graph. For example, suppose you wish to look at the function  $f(x)=4x-x^3$  near  $x = 1$ . Try the following commands:

```
f:=x->4*x-x^3;
```

```
plot(f);
```

```
plot(f(x),x=-3..3);
```

```
plot(f(x),x=0.99..1.01);
```

Notice how the curve looks straight when we look in a small neighborhood of  $x = 1$ .

•You can take limits. Say you've defined a function  $h(x) = \frac{1 + 2x + 3x^2}{5x^2 + 1}$

and you want to find the limit of  $h(x)$  as  $x$  approaches 8, type:

```
h:=x->(1+2*x+3*x^2)/(5*x^2+1)
limit(h(x), x=8);
```

To find the limit of  $h(x)$  as  $x$  approaches infinity, type:

```
limit(g(x),x=infinity);
```

Do you see why these answers make sense?

•You can find the derivative of a function. If you have defined the function  $f(x)$ , then type:  $D(f)(x)$ ; Then  $D(f)$  is a function which is the derivative of  $f$ . For example, to get the derivative of  $f(x) = 4x^2 - \sin x$  type the following sequence of commands:

```
f:=x->4*x^2-sin(x);
D(f)(x);
D(f)(1); (This gives the value of the deriva-
```

tive at  $x=1$ , ie.  $f'(1)$ ).

•You can simplify rational expressions by using the “normal” command. For example, suppose you take the derivative of the function  $h(x) = \frac{1+x}{2+x}$  by typing:

```
h:=x->(1+x)/(2+x);
D(h)(x);
```

You will find the result a bit messy. To simplify it type:

```
normal(%);
```

(The percentage sign allows you to refer to what you typed on the previous line without retyping it.) You now find the different terms nicely combined.

•You can evaluate integrals of functions. For example, in order to evaluate the indefinite integral  $\int x^3 \exp(x) dx$  (note the exponential function  $e^x$  is denoted in Maple by  $\exp(x)$ ) just type

```
int(x^3 * exp(x), x);
```

To do the definite integral  $\int_0^4 \frac{x^3}{\sqrt{16-x^2}} dx$  just type

```
int(x^3/sqrt(16-x^2), x=0..4);
```

• You can sum sequences. For example, to sum the squares of all integers from 7 to 51 type

```
sum(i^2,i=7..51);
```