

## MAPLE for Calculus

### 1210-2 November 2007

Here are some notes about how MAPLE might help you check Calculus work, but you might also get the idea that it will be helpful if you need to write a paper or do a research project in Math, Science, or Engineering, in which mathematical output and computations are important.

We use the version "Maple 8" in the Math Department, although you can also find "Maple 10" here and on most Campus computers. Maple 8 documents can be opened by Maple 10, but not vice-verse. (But you can save as MAPLE 8 from MAPLE 10.)

MAPLE acts as a rudimentary word processor, along with its math abilities, so you can choose to create a mixed text/math document in MAPLE (such as this one), or you can do computations in MAPLE and copy the output to another word processor like Microsoft Word.

### 1) TEXT and MATH fields

There are text areas and math areas in a MAPLE document. This is a text area, and you can type text and use the menu bar options to change the appearance of your text.

To create a Math area, click with your mouse on the [ $>$ ] symbol in the menu bar, and MAPLE will create a COMMAND FIELD in the next available line:

[  $>$

Commands in a command field end with ; or : followed by <RETURN> (or <ENTER>). To enter multiple-line commands before executing, hold down the "Shift" key while you hit <RETURN>

```
> 3+4;    #comment fields begin with #
    45*5;  #math commands end with ; or :,
          #followed by "Return" or "Enter"
    3*4:   #with the colon :, no output is shown
    sqrt(2);
    evalf(%); #evalf stands for evaluate
              #in floating point arithmetic
              7
              225
               $\sqrt{2}$ 
              1.414213562
```

There was a Math prompt here. I moused "T" in the menu bar to turn it into a new text field, and then highlighted and deleted the bracket on the left, *because I don't like brackets* when I'm typing text.

### 2) HELP

There is a "HELP" button at the top right of your menu. Some options you will find there include a "New User's Tour", "Introduction", "Topic Search", and all of these will be useful for you to peruse further.

### 3) PRINTING, EXPORTING, SAVING

Use the options under "File", in the upper left corner of your menu bar. It's good to save your MAPLE file every now and then, in case you mess up. To print a hard copy in the Math Department, a dialog box will appear and you will need to type in the UNIX command

lpr -P\_\_\_\_\_

where you replace the underscore with the name of the printer you want to print to, usually the building and room number in which the printer resides.

#### 4) DOING MATH

I thought it might be fun to redo some of the math we've been doing in homework and in class, using MAPLE. You can do the computational part of any such problem using MAPLE, and as long as you know you could do it by hand you're not cheating anyone.

##### Derivatives:

```
[ > g:=x->x^3; #this is the syntax define a function,
    #in this case it's g(x).
    g := x → x3
[ > g(1);
    g(2);
    1
    8
[ > (g(x+h)-g(x))/h;
    (x+h)3 - x3
    h
[ > Limit((g(x+h)-g(x))/h,h=0);
    #capital Limit displays the limit
    lim (x+h)3 - x3
    h → 0 h
[ >
[ > limit((g(x+h)-g(x))/h,h=0);
    #lower case limit computes it
    3 x2
[ > diff(g(x),x); #the diff commands computes the limit
    #using differentiation rules
    3 x2
[ > f(x)=x*(sin(x^2))^2/sqrt(1+x^2);
    #do you rem
    f(x) =  $\frac{x \sin(x^2)^2}{\sqrt{1+x^2}}$ 
[ >
```

Do you remember the function

$$f(x) = \frac{x \sin(x^2)^2}{\sqrt{1+x^2}}$$

Let MAPLE find its derivative for you!

##### Antidifferentiation and integration:

Try these commands:

```
[ > int(x^2,x); #antidifferentiation (without the +C)
[ > int(x^2,x=0..3); #definite integration
[ > Int(x^2,x=0..3); #what the previous command computed
```

Here's a current webworks problem (Set 8, #7)

```
[ > Int(sqrt(49-x^2),x=-7..7);
    int(sqrt(49-x^2),x=-7..7);
```

### Plotting:

Now where did that answer come from? Geometry! Here's a clue:

```
[ > with(plots): #load the plotting library
[ > plot(sqrt(49-x^2),x=-7..7,scaling=constrained);
    #once you make the plot and click on it, a lot
    #of menu options become available at the top of
    #your worksheet
```

You could even check various parts of a more complicated graphing problem. Here's one of the problems from class:

```
[ > f:=x->2/(x^2+2*x-3)+1;
[ > plot(f(x),x=-5..5,y=-8..8,color=black);
[ > ?plot; # to find out more about plotting
[ > diff(f(x),x); #first derivative
[ > f(-1); #local maximum value, clear from last command
[ > maximize(f(x),x=-2..0); #a really easy way to maximize
[ > ?maximize; #can I also find the x-value?
[ > maximize(f(x),x=-2..0,location=true);
    #find the x-value too.
```

### More limits:

```
[ > limit(f(x),x=infinity); #horizontal asymptote
[ > ?limit; #can I compute 1-sided limits?
[ > limit(f(x),x=1,right); #one-sided limits!
[ > limit(f(x),x=1,left);
```

**The sky's the limit!** Can you set up the Newton iteration scheme for the current webworks? We did an example like this in class, and the notes should be posted.

