

Math 235: Calculus Lab

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Whitman College

Week 3

Introduction to Maple

Maple is a (C)omputer (A)lgebra (S)ystem (or CAS).

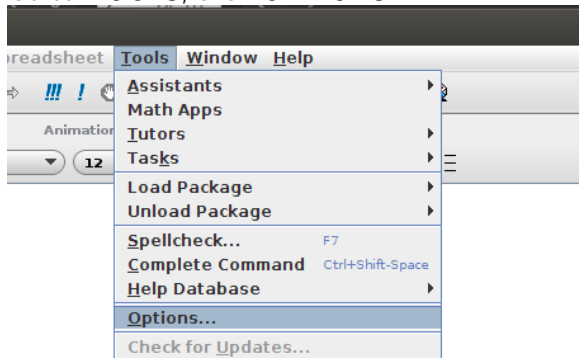
- ▶ Performs symbolic computations (like factoring, differentiating, etc)
- ▶ Can do computations exactly (using fractions, exponentials, trig functions, etc).
- ▶ Is a great way to visualize two and three dimensional graphs

To put Maple on your own machine

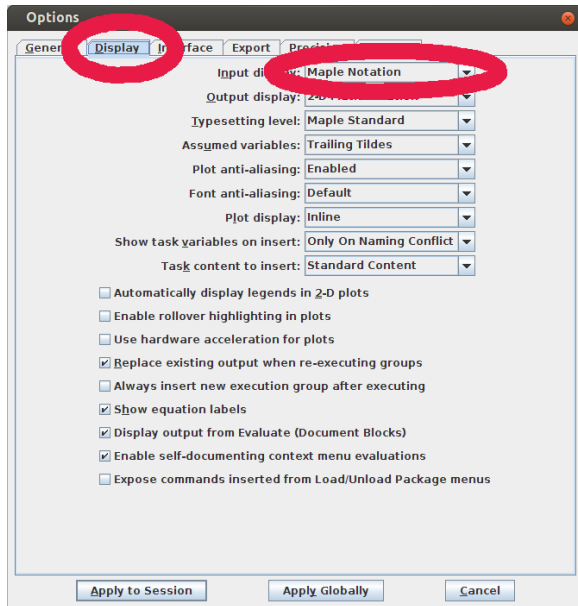
- ▶ The college has a license to run 50 copies at once, so you can use it on your home machine (unless we run into a shortage of copies).
- ▶ Go to the following website:
`http://math.whitman.edu/Maple-16/`
- ▶ Read the README file carefully!! It has all the instructions you need.
- ▶ If you open Maple and it asks you to put in a passcode, you've installed it incorrectly!

Setting up Maple

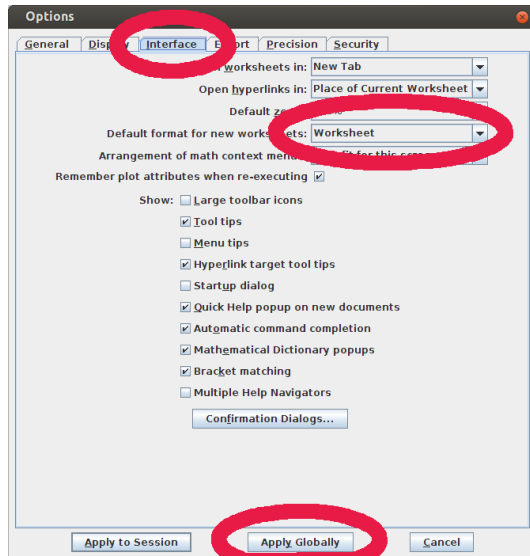
Go to TOOLS, then OPTIONS



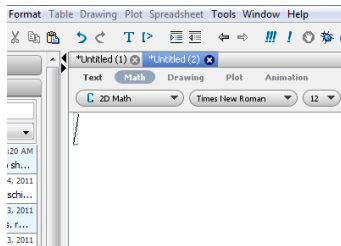
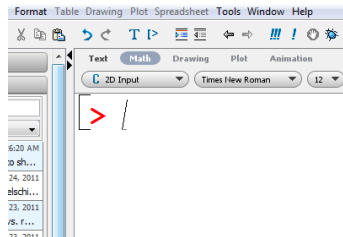
Go to DISPLAY, then
change INPUT DISPLAY to MAPLE NOTATION:



Go to INTERFACE, then
change "Default format for new worksheets" to WORKSHEET
select APPLY GLOBALLY



Take a moment to close/re-open Maple for a check:
You should have a red prompt (like image to the left), the image to the right is incorrect (Document style).



Computations in Maple

Standard operators, with $*$, $^$, and `exp()` for multiplication, exponentiation, and the exponential function.

Examples (See the tutorial):

```
2/5;
```

```
2^5;
```

```
exp(2);          # This is e^2
```

```
(1+3*I)*(1-I);  # Complex Numbers
```

```
ifactor(60);
```

```
evalf(Pi);
```

```
evalf(pi);
```


Assignments and Expression

- ▶ Typing `a:=6;` assigns the value of 6 to variable `a`.
What happens: `6:=a`
- ▶ Example:
Store the expression $(x - 5)^2$ in the variable `F`: `F:=(x-5)^2;`
- ▶ Store the equation: $E = mc^2$ in the variable `G`: `G:=E=m*c^2`
Solve $E = mc^2$ for the variable `m`: `solve(G,m);`
- ▶ Expand expression stored in `F`: `expand(F);`
- ▶ Clear the variables `F` and `G`:
`F:='F'; G:='G'`

Evaluation and Substitution

Example: Store the expression $a(x + 3)^2$ into the variable f , then evaluate the expression if $a = 3$ and $x = 1$.

SOLUTION:

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

Example: If $x = z^2$, substitute in f , store the result in $f2$:

```
f2:=subs(x=z^2,f);
```

Check what the variables are: f , a , x , $f2$

Functions versus Assignments

Functions take inputs and create outputs. Assignments store expressions in variables. Here's an example of the difference:

```
f:=x^2-3*x+5;  
f(1);           #Maple will not understand this  
subs(x=1,f);
```

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

How to make a function from an expression: `unapply`

```
h:=unapply(f,x);  
h(3);
```

Some commands will only operate on *functions*, some only work with *expressions*, some will work with both, but how you call the operation may change.

Clear out the workspace, and we'll do create some plots.

```
restart;  
f:=x^2+4*x-2;    #f is an expression  
g:=x->sin(x)+x;  #g is a function  
  
plot(f,x=-8..8);    #This is OK  
plot(g,x=-8..8);    #This is an error  
  
plot(g(x),x=-8..8); #This is OK  
plot(g, -8..8);     #This is OK  
plot(f, -8..8);     #This is an error
```

Hint: Always use one form or the other (Probably easier to use the expression).

Other plot options

You can include a range for y if you'd like:

```
plot(f,x=-8..8,y=-3..3);
```

You can plot multiple functions:

```
plot({f,g(x)},x=-8..8,y=-5..8);
```

You can plot *parametric equations*!

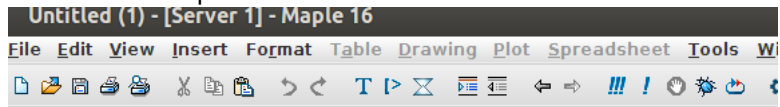
```
plot([sin(t),cos(3*t),t=0..2*Pi]); #Brackets include t
```

You can plot in polar coordinates as well!

```
plot([sin(t),cos(3*t),t=0..2*Pi],coords=polar);
```

Buttons on the top toolbar

Some of the important buttons:



- ▶ The usual copy/paste keys.
- ▶ T is for text. Go to a prompt, and insert some text.
- ▶ To get a new “execution group”, use the [> key...
Or: Insert->Execution Group
- ▶ The stop sign: Try to stop the computation.
- ▶ A debugger (we won't typically use this)
- ▶ Restart

- ▶ Note on turning Maple Worksheets in:
 - ▶ Go to Edit->Remove Output->From Worksheet
 - ▶ Save the worksheet.
 - ▶ Exit Maple.
 - ▶ Open Maple back up, and find the worksheet.
 - ▶ To execute all commands, use the !!! button.

Sources for help and more information:

- ▶ Go to: Tools, then *Assistants*, *Tutors* or *Tasks*
Helpful: Take some time to browse through these!
- ▶ Help on a certain command: ?command (like ?plot)
- ▶ General help: There is a lot of stuff on the web, and a lot is accessible from the *Help* option at the top of the page.

Homework:

1. Finish working through the introduction.
2. Use the introduction and help files to answer the Maple questions on the class website.
3. DUE: for Wed Section- Feb 13 (next Thursday). For Fri Section- Feb 15 (next Sat).
4. Discuss text and execution groups...