The first thing to remember about Maple is this: Experiment, and make copious use of the Help menu! You can learn all sorts of cool things just by doing "topic searches".

- *If you'd like to install Maple on your own computer*, you can do so for the semester, as long as your computer is connected to the campus network and you have a sufficiently recent operating system. Instructions for installing it on either a Mac or a Windows PC are available through the course web page.

  Maple now has a choice of two interfaces. When first installed, it will open up in *Document Mode*. The computers in A102 and the computer lab (and possibly those scattered around campus that run Maple) are set to work in *Worksheet Mode*. I would suggest setting your computer to *worksheet mode* also, so that you can easily switch between your own computer and the publically available ones. To do so, go to

  Maple 11 - Preferences - Interface

  and under *Default format for new worksheet*, select *worksheets*. Then switch to the *Display* tab, and under *Output display*, select *2D Math Notation*.

  Then click on the *Apply Globally* button, and you are (hopefully) good to go.

- *If you're new to Maple, or would like a refresher*, there's a link to some Maple tutorials, along with instructions for using them, on the course web page. I've looked at them at least once for the last three years and am still learning new things, since I – like everyone else – focus on what will help me *now*, for whatever course I'm teaching at the moment.

  Give Maple a chance: The way you learn it is just by diving in. By the end of the course, if you give it a chance, you can really know your way around Maple.

- *There are two types of input* in worksheet mode– mathematical commands and text. You can switch between them through buttons at the top of the worksheet.

- *Include the* `*` *for multiplication:* type `cos(3*(x+y))` for $cos(3(x+y))$.

- *Maple is case-sensitive:* `plot` is **not** the same as `Plot` !

- *End every command line with a semi-colon* or a colon, then hit return. A semi-colon displays the result, a colon suppresses the result.

- *Check the output before you move on:* Make sure that Maple has executed your command in the way you expected! Often people didn't have parentheses where they were needed, or have made some other error, and don't even realize that they've made a mistake.

  If you do make an error, spend a few seconds reading the error message – often you can figure out what you did wrong.

- *Explore the buttons on the left* - most of these open up palettes to choose from. I believe the *Expressions* button in particular may prove helpful.

- *Maple comes with extra commands* that only work if you've loaded the appropriate package. One package you'll be using a lot is the *plots* package. All you have to do to load it is to type in on a command line
  `with(plots);`
  (When you hit return, the list of new commands available to you will appear. If you don't want to see them all, just end your line with a colon rather than with a semi-colon.)

- *Change a graph by right-clicking (or control-clicking)* on the graph, and then selecting what you want to change – the axes, the color, etc. This is particularly handy for allowing you to limit the range of the z-values – I haven't found any other way to do this. It also allows you to easily insert axes into your picture, or to look at the contours of a plot.

- *Take the time to explore!* And remember, the online Help (available in the **Help** menu) is your friend!

On the next couple pages are some of the commands we'll use, very roughly organized by type. If you're already familiar with Maple, and just want the commands specific to Multivariable Calculus, those are on the last two pages.

Command	Description
CONSTANTS:	
`Pi`	The constant π
`exp(1)`	The constant e
`sqrt(5)`	$\sqrt{5}$
`cos(Pi/4)`	$\cos(\pi/4)$
COMMON FUNCTIONS:	
`exp(x)`	The natural exponential e^x. For example, to get e^2, you would enter `exp(2)`.
`sqrt(45+sin(x))`	The expression $\sqrt{45+\sin(x)}$.
THE BASICS OF DEFINING FUNCTIONS AND ASSIGNING VALUES:	
`w := x^2 + 3*x`	Assigns w to be the *expression* x^2+3x. From that point on, whenever you use w, Maple will substitute x^2+3x.
`w:='w'`	Unassigns w. Now, w is just w.
`f := x -> x^3 + sin(x)`	Defines a *function* of one variable $f(x)=x^3+\sin(x)$.
`L:=[ [1,10], [2,5], [4,2]]`	Defines a list of points
`A:=matrix[ [2,3], [4,5] ]`	Defines a 2 x 2 matrix with top row consisting of 2 and 3, second row consisting of 4 and 5
`restart`	Clears all definitions and reinitializes Maple.
VARIOUS USEFUL COMMANDS:	
`value(3*sqrt(Pi))`	Returns the *exact* value (not a decimal approximation). `value( )` can be combined with other expressions like `Diff( )` to find a value.
`evalf(3*sqrt(Pi) )`	Returns a decimal approximation of $3\sqrt{\pi}$ using 10 significant digits. evalf stands for "evaluate to floating point".
`evalf(3*sqrt(Pi), 20)`	Returns a decimal approximation using 20 significant digits.
`%`	The output from the last executed statement.
`simplify( sin(x)^2 + cos(x)^2 )`	Simplifies the expression. In this case, the result is 1.
`solve(x^2+3*x+1)`	Solves the equation $x^2+3x+1=0$.
`solve(t*x^2+3*x*t+1, t)`	Solves the equation $tx^2+3xt+1=0$ for t.
THE BASICS OF GRAPHING:	
`plot(sin(x)+Pi/2, x=-2..Pi, color=blue)`	Generates a plot of $y=\sin(x)+\pi/2$ from $x=-2$ to $x=\pi$ in blue. You can leave out the color if you want.
`plot( [x^2, cos(x)], x=0..2*Pi, color=[blue,red])`	Plots the two functions $y=x^2$ and $y=\cos(x)$ on the same set of axes. The color is useful for distinguishing the plots.
`plot(L, x=0..5)`	If you have defined L to a list of points (see above) whose x coordinates are all between 0 and 5, this command will plot these points and draw lines connecting them.

Command	Description
Calculus I and II Commands:	

`Diff(x^3+sin(x), x)`
 	
`value(%)`
	Returns the expression $\frac{d(}{dx}x^3+\sin(x))$. This allows you to check whether you've entered everything correctly.
	
	If you follow the command `Diff(x^3+sin(x),x)` immediately with this one, it will return the derivative of $x^3+\sin(x)$ with respect to x.

`diff( x^3 + sin(x), x)`	Returns the derivative of $x^3+\sin(x)$ with respect to x, $3x^2+\cos(x)$. Once you feel comfortable both with Maple and with differentiation, you can use this command rather than the previous one.
`diff(f(x),x)`	Returns the derivative of a function you have already entered, see middle of page 2.
`diff(x^{3}+sin(x),x,x)`	Returns the second derivative of $x^3+\sin(x)$ with respect to x, $6x-\sin(x)$. You can also do second derivatives as above, where the expression is returned first, by simply capitalizing the "d" in `diff`.

`Int(x^3+sin(x),x)`
 	
`value(%)`
	Returns the expression $\int x^3+\sin(x)\,dx$.
	
	If you follow the above command with this one, Maple will return the indefinite integral (i.e. the antiderivative) of $x^3+\sin(x)$.

`int( x^3 + sin(x), x)`	Returns the indefinite integral, or antiderivative, of $x^3+\sin(x)$, $\frac{1}{4}x^4-\cos(x)$.
`int(f(x),x)`	Returns the antiderivative (indefinite integral) of a function you've already entered (see middle of page 2).
`int(x^{3}+sin(x),x=2..5)`	Returns the definite integral of $x^3+\sin(x)$ from 2 to 5. If you capitalize the "i" in "int", it will return the expression $\int_2^5 x^3+\sin(x)\,dx$. To get the value, you would then enter `value(%)`.
`Sum( j^2, j=1..300)`	This creates the sum $\sum_{j=1}^{300} j^2$, but does not evaluate it. You'll need to use `value(%)` to get a numeric value.
`sum(j^{2}, j=1..300)`	This returns the value of the sum directly.

Command	Description

Calculus Graphing Commands:

`with(student)`	Loads the student package. You must load this package before you can use `leftsum( )`, `leftbox( )` and related commands.
`leftsum(x^2, x=0..3, 10)`	Generates the leftsum approximation of $\int_0^3 x^2\ dx$ using 10 equal subintervals. You need to use `evalf( )` to get the decimal approximation. There are also `rightsum( )`, `middlesum( )`, and `trapezoid( )` commands.
`leftbox(x^2, x=0..3, 10)`	Draws the diagram associated with the left sum. There is also a `rightbox( )` command.
`with(plots)`	Loads the plots package. You must load this package before you can use `tubeplot()` command.
`tubeplot( [x, 0, 0], x=0..4*Pi, radius =sin(x)+ 2)`	This will draw the surface obtained by rotating the graph of $y = \sin(x) + 2$ about the x-axis from $x = 0$ to $x = 4\pi$. For all of our plots, you should not change the `[x,0,0]` part of the command.

Multivariable Calculus Commands:

`<1,2,3>`	The vector $< 1, 2, 3 >$.
`f := (x,y) -> 3*x^2 + 2*x*y`	Defines a function of *two* variables
`Diff(3*x^2+2*x*y,x)'`	Returns the expression $\frac{\partial}{\partial x}(3x^2 - 2xy)$ so you can check if you've entered everything correctly. To actually find what the partial derivative with respect to x *is*, you can follow up with `value(%)`.
`diff(3x^2+2*x*y,x)'`	Using the lower case d in *diff* tells Maple to actually find the partial deriviative, just as is true with derivatives of functions in one variable.
`with(VectorCalculus):`	Loads the commands in the Vector Calculus program. This allows you to find the dot product, cross product, norm, and numerous other things – if you want to see the commands, just use a semi-colon rather than a colon at the end of the line.
`<1,2,3>.<4,5,6>`	Returns the dot product of $< 1, 2, 3 >$ and $< 4, 5, 6 >$. You can also use the commands `DotProd(<1,2,3>,<4,5,6>)` and `DotProduct(<1,2,3>,<4,5,6>)`.
`<1,2,3>&x<4,5,6>`	Returns the cross product of $< 1, 2, 3 >$ and $< 4, 5, 6 >$. You can also use `CrossProd(<1,2,3>,<4,5,6>)` or `CrossProduct(<1,2,3>,<4,5,6>)`.

Command	Description
Multivariable Graphing Commands:	
`plot3d(x^2-cos(y), x=-5..5, y=-7..7);`	Generates a graph of the surface $z = x^2 - cos(y)$ over the domain $-5 \leq x \leq 5$ and $-7 \leq y \leq 7$.
`plot([cos(t),t^3, t=-2..2]);`	Graphs the 2D parametric curve defined by $x = \cos(t)$, $y = t^3$. (To plot a 3D parametric curve, see `spacecurve` below.) After the square brackets, you can add in `x=-3..3, y=-2..5` if you like. **Note:** placing the range for t inside the square brackets graphs the parametric curve; placing it outside the square brackets plots the two functions $\cos(t)$ and t^3 on the same axes.
`spacecurve([sin(t),=3*cos(t),2*t], t=0..30);`	Plots a parametric curve in 3D, without any axes. Add the axes by including the `axes=normal` option. (For other options, see `plot3d[options]` in Maple help.) Maple only plots and connects 625 points, which may not be enough. For more points, try `numpoints=2000`.
`plot3d([s*t, s^2*t^3,cos(s)], s=-2..2, t=-4..4);`	Produces a graph of a parametric surface.
`with(plots)`	The plots package allows you to use the commands below.
`implicitplot(x^2-y^2/9=1, x=-10..10, y=-4..4);`	Returns a 2D plot of this implicitly defined curve. Notice that you must give bounds for both x and y. To change the colors, the tickmarks on the axes, or anything else, investigate `plot[options]` in Maple Help.
`implicitplot3d(x^2+y^2/9+z^2/4=1, =-2..2, y=-4..4,z=-2..2);`	Returns a 3D plot of this implicitly defined surface – without any axes. To add axes, change the color, etc, investigate `plot3d[options]` in Maple Help.

`plot1:=plot3d(7-x^2/9+y^2/16, x=-5..5,y=-5..5):`
`plot2:=plot3d(x+y/2+3,x=-5..5, y=-3..4):`
`display(plot1,plot2);`
	Allows you to display multiple plots structures (that may have been defined over different domains) on the same set of axes. Notice the colon at the end of the first two lines, to suppress the output from these commands.

`polarplot(sin(2*theta), theta=0..2*Pi);`	Generates a graph of the polar equation $r = \sin(2\theta)$, $0 \leq \theta \leq 2\pi$.
`contourplot(x^2-y^2,x=-5..5, y=-5..5);`	Returns a contour plot of the surface $z = x^2 - y^2$. Try the `filled=true` and/or `coloring=[blue,red]` options.
`densityplot(x^2-y^2,x=-5..5, y=-5..5);`	Generates a density plot of the surface $z = x^2 - y^2$. Try the options `colorstyle=HUE`, `style=PATCHNOGRID`, and `grid=[100,100]`Be careful not to make the grid too big.
`fieldplot([[x-y,2*x], x=-5..5, y=-5..5);`	Generates a graph of the vector field $f(x,y) =< x - y, 2x >$. Control how many vectors are graphed with `grid=[10,10]`. Change the color with `color=red`, and control how bold the arrows look with `fieldstrength=maximal(2)`.
`gradplot(x^2-y^2, x=-5..5, y=-5..5);`	Returns a gradient vector field.