BEFORE STARTING:

- In the beginning, you'll probably find it easier to use palettes and contextual (shortcut) menus, so the *Getting Started* section focuses mainly on those.

- The more you use Maple, the more you might want to do by hand (that is, using the keyboard), so in the on-line version of this, I follow that section with the section *Further Exploring Maple*, which contains a few additional tips and a list of the most relevant commands for Calc 2.

- Always check the output and make sure that Maple has executed your command in the way you expected before you move on to the next calculation. Often people didn't have parentheses where they were needed, and don't even realize that they've made a mistake. Other times, they've made an error and don't know it because they didn't read the output.

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

- Don't be afraid to explore! And remember, the online Help (available in the **Help** menu) is your friend!

WHAT YOU'LL SEE:

- Depending on how the computer you're working on is set up, when you open Maple, it may present you with a new file in document mode or in worksheet mode. If you don't like the format you are presented with, and would like to change it for a single use, just go to `File - New  - Document Mode` or `File - New - Worksheet Mode`. Experiment to get a feel for what you like better.

  Once you download Maple onto your own computer (if you do), you will have some choices on how to set it up. Go to Maple 12-Preferences (mac) or Tools-Options (pc) to choose whether the default is that you're working in worksheet mode or document mode, and also to choose whether as you type, the input gets converted straightaway to mathematical notation or looks just the same as how you type it. You change the mode by going to the interface tab; you change the input display by going to the display tab. Experiment until you find what you're comfortable with. You may decide that you want it to look like it does on the computers you use in class, or you may find that in class you are always switching to a different mode, in which case at home you may want to choose that mode as the default.

- In either format, there are two types of input – mathematical commands and text. Unless you choose to enter text, you'll be entering mathematical commands. You can switch between them by choosing the button text or math (these buttons are located a bit above the main input window, but below the menu bar that scrolls across the entire Maple window).

- If you choose to use worksheet mode, then to execute your commands, you need to end each command with a semi-colon or a colon, then hit *return..* A semi-colon displays the result, a colon suppresses the result.

GETTING STARTED

- There are many palettes available on the left side of the Maple window. You can open (or close) one by clicking on the triangle next to its name. The *Expression* palette, and perhaps also the *Common Symbols* palette, will be especially useful for Calculus 2: by clicking on your choice, you can enter all the operations (addition, subtraction, multiplication, division) as well as square roots, exponents, sines and cosines, logarithms, functions, derivatives, integrals, and summations. You can then enter all your specifics by tabbing from one entry to the next.

- Over time, you will find that it is easier to enter some expressions using the keyboard rather than the palettes. A few handy ones are:

  - use the standard keys for addition, subtraction and division.

– use * for multiplication.

You may be tempted to omit the * when typing in something like $5x$ or $5\cos(x)$. Sometimes, Maple will be able to figure out what you mean, but in other situations, it will not. I therefore recommend that you just get in the habit of always typing in the *: otherwise in those situations where it turns out that Maple needs it, you may have a hard time figuring out what's gone wrong. You may not even know that something **has** gone wrong, as sometimes Maple simply treats everything as one long variable, and doesn't produce an error message.

– use ^ for exponents

– type Pi for π.

Maple is case-sensitive! `pi` is **not** the same as `Pi` ! Whichever one you type, you will see the Greek letter, but whether it is representing a number or is acting as a variable will depend on what you type: `pi` represents the Greek letter, while `Pi` is the number.

– enter `exp(x)` for e^x; Maple has allowed the letter `e` to represent a variable, so (similarly to the situation with π) if you enter `e^x` and hit enter, you'll see something that *looks* right, but Maple won't know you intend `e` to represent the irrational number.

– enter `sqrt(x)` for $\sqrt{x}$.

• Maple prefers to deal with exact numbers, rather than approximations. That means that unless you tell it otherwise, it will produce results involving e, π, fractions, etc.

For example, suppose you want to find $\int_1^5 \frac{1}{x}\,dx$. If, using the expression palette, or typing on the keyboard, you tell it to evaluate this, it will give you `ln(5)`. This is the exact answer, but if you were evaluating this integral because you need to know volume or position, you may want an approximation.

In this case, you have three options:

1. In many cases, the simplest option is to add a decimal point: change (for example) `5` to `5.`, and Maple will return the approximation for you.

2. You may also use the `evalf` command, in one of two ways.

   – Go back to your original command line and enclose your command with `evalf( )`.

   – In Maple, the `%` sign refers to the last result Maple calculated, So you can simply type in `evalf(%)`

• Contextual, or shortcut, menus are accessed by right-clicking (control-clicking, on a Mac) on an item you've entered. Different options will appear in the pop-up menu, depending on the context. For example, if you control-click on an expression like e^x, Maple will give you to options to:

Differentiate, Integrate, 2-D Plot, Evaluate at a point, Approximate, etc

Experiment!

• When we get to numeric integration, you may want to quickly calculate a left sum, right sum, or midpoint sum. For this, you'll need to load the calculus student package that contains the necessary commands (as well as many others!).

– To load this package, from the menu bar across the top of your screen, choose
`Tools-Load Package - Student Calculus 1`.

– The Maple function that will calculate or plot the approximation is `RiemannSum( )`. For example,

RiemannSum(exp(x)*sin(x),x=0..2*Pi, partition=30, method=left, output=sum)

will output the summation notation for the left hand sum with 30 subdivisions for $\int_0^{2\pi} e^x \sin(x)\,dx$. You can then control-click on your entry (or the output) and select `Approximate` to find the numeric value.

– The other options we will use for `method` are `right` and `midpoint`. (`sum` is also an option, but if your result involves numbers like π, e, ln(5) etc, it will list every term in the sum separately.)

– The other option we will use for `output` is `plot`. (`animation` is also an option; feel free to explore it).

FURTHER EXPLORING MAPLE:

On the course website is a link to some Maple tutorials; although developed for an older version of Maple, you still might find them helpful.

Here are many of the commands we'll use, roughly organized by type.

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 $\sqrt{45 + \sin(x)}$.
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 $f(x) = x^3 + \sin(x)$.
`f := (x,y) -> 3*x^2 + 2*x*y`	Defines a function of *two* variables
`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:	
`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.
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 COMMANDS:	
`Diff(x^3+sin(x), x)`	Returns the expression $\frac{\partial}{\partial x}(x^3 + \sin(x))$. This allows you to check whether you've entered everything correctly.
`value(%)`	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 top of page 2.
`diff(x^{3}+sin(x),x$2)`	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)`	Returns the expression $\int x^3 + \sin(x)\, dx$.
`value(%)`	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 top 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 "into", 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.