Getting a copy of *Mathematica* for your personal machine: Some homework questions and projects we start in class will require the use of *Mathematica* (more information about this piece of software can be found on the next two pages of this file). Therefore you will need a copy on your computer. Here are directions on how to obtain *Mathematica*. First, visit the web page

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`http://www.wolfram.com/mathematica/pricing/students.php`

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At this page, you have two main options:

Option 1: download *Mathematica* onto your computer. Within this option, you have three pricing options; the only difference between the three options is the length of time your software will work:

1. Clicking "Buy Now" in the left-hand box will purchase a version of the software which works for four years (this costs $140);

2. You can pay "per year" (this costs $70 per year);

3. You can pay "per semester" (i.e. six month period) (this costs $45).

You should choose the edition which fits your academic interests. If this is the last math class you will take at Ferris, the semester edition will work fine. If you are interested in majoring in applied mathematics or a related field, I recommend the long-term edition (I would require this software if I was teaching Math 220, 230, 320, 330 and 340, and it is extremely useful in 322). It is not used by all math professors at Ferris, but is a great resource to have.

Warning: The software requires you to type in a code when you install it, and the same code will not work twice, so you cannot share one copy of the software or install it on multiple machines.

Option 2: buy online access to *Mathematica* which will work through a web browser (this costs $70). The advantage of this is that you can access *Mathematica* from any computer anywhere; the disadvantage is that it is more expensive than the "per semester" option above. This is also your only option if you use a tablet; the software runs only on Windows, Mac and UNIX systems.

No matter which option you choose, you will have to provide the manufacturers with proof that you are a student (otherwise the software will lock two weeks after installation). Directions on how to do this can be found once you install the program.

Mathematica is an extremely useful and powerful software package / programming language invented by a mathematician named Stephen Wolfram. Early versions of *Mathematica* came out in the late 1980s and early 1990s; the most recent version which is loaded onto the machines in Starr 105 is Mathematica 9.

Mathematica does symbolic manipulation of mathematical expressions; it solves all kinds of equations; it has a library of important functions from mathematics which it recognizes while doing computations; it does 2− and 3−dimensional graphics; it has a built-in word processor tool; it works well with Java and C++; etc. One thing it doesn't do is prove theorems, so it is less useful for a theoretical mathematician than it is for an engineer or college student.

A bit about how *Mathematica* works: When you use the *Mathematica* program, you are actually running *two* programs. The "front end" of *Mathematica* is the part that you type on and the part you see. This part actually resides on the machine at which you are seated. The "kernel" is the part of *Mathematica* that actually does the calculations. If you type in 2 + 2 and hit [ENTER], the front end "sends" that information to the kernel which actually does the computation. The kernel then "sends" the result back to the front end, which displays 4 on the screen.

Important: The first math command you type in *Mathematica* takes a bit of time to run, because the kernel has to be loaded. Subsequent commands are usually executed instantly. Because of this, each time you load *Mathematica* you should begin by asking it to do something fairly simple, like 2 + 3 before you do any serious work. If you don't get a response fairly quickly, then there was probably a problem loading the kernel. Exit *Mathematica* and restart the program.

About *Mathematica* notebooks and cells: The actual files that *Mathematica* produces that you can edit and save are called *notebooks* and carry the file designation *.nb; they take up little space and can easily be saved to Google docs or on a flash drive, or emailed to yourself if you want them somewhere you can retrieve them. **Suggestion:** when saving any file, include the date in the file name (so it is easier to remember which file you are supposed to be open).

A *Mathematica* notebook is broken into *cells*. A cell can contain text, input, or output. A cell is indicated by a dark blue, right bracket (a "]") on the right-hand side of the notebook. To select a cell, click that bracket. This highlights the "]" in blue. Once selected, you can cut/copy/paste/delete cells as you would highlighted blocks of text in a Word document.

To change the formatting of a cell, select the cell, then click "Format / Style" and select the style you want. You may want to play around with this to see what the various styles look like. There are three particularly important styles:

- **input:** this is the default style for new cells you type
- **output:** this is the default style for cells the kernel produces from your commands
- **text:** changing a cell to text style allows you to make comments in between the calculations

Executing mathematical commands: To execute an input cell, put the cursor anywhere in the cell and hit [ENTER]. Well, not any [ENTER]; you have to use the [ENTER] on the numeric keypad at the far-right edge of the keyboard. The [ENTER] next to the apostrophe key (a.k.a. [RETURN]) gives you only a carriage return. You can also hold down the [SHIFT] key and hit either [ENTER] or [RETURN] to execute a command.

Some important general concepts regarding the syntax of *Mathematica*:

1. **Multiplication:** use a star or a space: `2 * 3` or `2 3` will multiply numbers; `a x` means *a* times *x*; `ax` means the variable *ax* (in *Mathematica*, variables do not have to be named after one letter; they can be named by words or other strings of characters as well).

2. **Parentheses:** used for grouping only. Parentheses mean "times" in *Mathematica*.

3. **Brackets:** used to enclose all functions and *Mathematica* commands. For example, to evaluate a function $f(x)$, you would type `f[x]`. Brackets mean "of" in *Mathematica*.

4. **Capitalization:** All *Mathematica* commands and built-in functions begin with capital letters. For example, to find the sine of π, typing `sin(pi)` does you no good (this would be the variable "sin" times the variable "pi"). The correct syntax is `Sin[Pi]`.

5. **Spaces:** *Mathematica* commands do not have spaces in them; for example, the inverse function of sine is `ArcSin`, not `Arc Sin` or `Arcsin`.

6. **Pallettes:** Lots of useful commands are available on the Basic Math Assistant Pallette, which can be brought up by clicking "Pallettes / Basic Math Assistant" on the toolbar. If you click on a button in the pallette, what you see appears in the cell.

7. **Commands *Mathematica* knows:** Sqrt, Sin, Cos, Tan, Csc, Cot, Sec, ArcSin, ArcCos, ArcTan, ArcCsc, ArcSec, ArcCot, Log (this is the natural logarithm), ! (for factorial). It knows what Pi and E are (but not pi or e).

8. % refers to the last output (like "Ans" on a TI-calculator).

9. **Help:** To get help on a command, type "?" followed by the command you don't understand.

10. *Mathematica* gives exact answers for everything if possible. If you need a decimal approximation, use the command `N[ ]`. For example, `N[Pi]` spits out 3.14159...

11. If *Mathematica* freezes up in the middle of a calculation, click "Evaluation / Abort Evaluation" on the toolbar.