

Math 397  
Homework #1  
Due Wednesday, April 11

LaTeX is a typesetting system that is widely used by mathematicians. It has the ability to typeset just about any mathematical notation, as well as complex diagrams. When first getting started it is harder to use than Microsoft Word, but after you learn the system you find that LaTeX is much more powerful than Word and also more predictable.

**Some history:** Just so you can understand some of the lingo in this world, let me explain a little history. The actual typesetting system we are using is called “TeX” (pronounced like “tech”), which was first designed in the late 1970s by Donald Knuth—a computer scientist and mathematician at Stanford. It took a while for the system to catch on, but with the rise of personal computers in the 1980s and 90s TeX became almost universally used by mathematicians (and it is also very commonly used by physicists and computer scientists).

The program “LaTeX” (pronounced “lay-tech”) is a modification of the basic TeX system, designed to be easier to use. The basic typesetting is still done by TeX, but LaTeX offers a more user-friendly environment.

The steps for creating a document using LaTeX are as follows:

- (1) Create and edit an appropriate “.tex” file using any text editor that can produce a simple ASCII file (don’t worry if you don’t know what this means). The “.tex” file contains instructions for the typesetting system.
- (2) Run LaTeX, giving your .tex file as input. This compiles your document into a PDF file.
- (3) View your PDF file using a previewer, and see whether the instructions in your .tex file were the correct ones to produce what you intended. If not, go back to step (1) and edit your file appropriately.

It takes a while to get used to this system. Learning LaTeX is like learning a new language, and it takes trial and error until you get things right. That is all part of the process, and in this course you will perform a series of exercises designed to gradually develop your familiarity with this “language”.

Maybe all of this sounds kind of complicated. Nowadays there are various packages that combine the editor/LaTeX compiler/previewer into one, and this makes things a bit easier. There are even websites where you can use LaTeX without ever having to install software onto your computer.

On this homework assignment, I am going to teach you how to use LaTeX via a website. This is easier for most students when they are first starting out, since they don’t have to install any software. If you already have LaTeX installed on your computer, feel free to use that—you don’t HAVE to use the website version. If you WANT to install LaTeX on your computer, I will give instructions at the end of this homework; but you don’t have to do this.

The instructions below describe how to Sagemath (or CoCalc) online to compile LaTeX documents. In addition to this program, you can also use [www.overleaf.com](http://www.overleaf.com) to compile LaTeX documents. I've worked with both and the only thing I've noticed that is different is that Overleaf appears to require you to compress your file into a zip format before uploading it. (If anybody who has used Overleaf knows how to directly upload a file, feel free to let me know.)

### Homework assignment

- (1) Download the file “ma397\_hmwk1.tex” from Canvas under Modules.
- (2) Go to [cloud.sagemath.com](http://cloud.sagemath.com) (it redirects to [cocalc.com](http://cocalc.com)) and create an account for yourself. This site doesn't seem to work very well with some versions of Safari. If you have problems, switch to Chrome or Firefox (or maybe any other browser).

*Warning:* The sagemath site is sometimes incredibly slow, due to the number of users (and because we are using the free version). I find the site most reliable during the mornings and nights. If you find yourself having problems with the site not responding, consider trying again at a less busy time of day. If you try this and it is slow, maybe check out Overleaf instead.

- (3) Once you have an account, create a new project called “MATH397” or whatever you want. The website will spin for a few moments (it's a bit clunky and can take up to a minute) saying things like “Starting...” and “Loading...”, but eventually you should see an empty “Filename” box and a big box that says “Create or upload files”.
- (4) Click the “Create or upload files” box. Either drag the “ma397\_hmwk1.tex” from your desktop into the big “Drop files to upload” box, or click on this box and select the “ma397\_hmwk1.tex” file for upload. The system will take a few moments to upload and then give you a green checkmark.
- (5) Click the “Files” icon in the upper left corner of your browser window. You should see the “ma397\_hmwk1.tex” file come up. Click on this file.
- (6) After a few moments your browser window will be divided into two halves. The left half is the editor window and contains the actual contents of the “ma397\_hmwk1.tex” file, whereas the right half is the previewer window showing the PDF file created by the LaTeX compiler.
- (7) Now go back to the editor window. Find the name “Charlie Brown” and change it to your name. Click on the green “Save” icon at the top of the editor window. It takes about 10 seconds or so, but the site will have LaTeX compile your change and the result should show up in the preview window.

When you are working on documents, the website will periodically save and recompile on its own. But if you make a change and want to see it immediately, you will have to force the save by clicking the icon.

- (8) Make the following changes in the LaTeX document:
- (a) Change line (1) so that it includes some italics and some bold-face, using lines (2)–(4) as a model.
  - (b) In line 5, change both occurrences of “x” to “b”.
  - (c) Re-write line (6) so that it (correctly) computes the integral of  $x^7$ .
  - (d) In line (7) change sin to cos and  $\infty$  to 5.
  - (e) Change line (8) so that it reads “Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be given by  $f(x) = x^3 + 3x^2 - 1$ .”

If you make a mistake in the TeX commands and end up confusing the compiler, you will see the red “Issues” tab come up at the top of the preview window. Clicking on this tab will show you the error encountered by the LaTeX compiler. Try to fix the error and then click “Save” again to recompile. Note that when the error is fixed you have to click on the “Preview” tab to go back to the previewer.

*Warning:* Diagnosing LaTeX error messages is very tricky at first and takes some experience. It can be quite frustrating until you develop a feeling for what to look for.

- (9) LaTeX uses curly brackets { and } as group delimiters (analogous to the way we use parentheses in math). So to typeset  $\frac{x+1}{x+5}$  you need to use the LaTeX code

`“$ \frac{x+1}{x+5}$”.`

The first dollar sign says “enter math mode”, then you see the `\frac` command (LaTeX uses backslashes for its special commands), and then you see the two terms `{x+1}` and `{x+5}` which give the numerator and denominator. The final dollar sign tells LaTeX to “leave math mode”.

Note that dollar signs must come in pairs: if you enter math mode then at some time you have to leave it. Also, the curly brackets { and } must come in pairs: an opening left bracket must come with a closing right bracket. If you violate these rules then the LaTeX compiler will become confused and give you an error. These are by far the most common errors when using LaTeX!

Try this out. Go back to the editor window and remove ONE of the curly brackets (left or right) somewhere in the document. Try compiling and see what happens. You will see the “Runaway argument” error, and LaTeX will show you the line where that is happening. With some practice you will be able to find these errors and correct them.

Fix the error by putting the missing curly bracket back, and recompile. Make sure everything is back to normal. Now try removing one dollar sign somewhere, and then compile. You will see some errors showing up. If you go to the first one and click where it says “line ?? of ma397\_hmwk1.tex”, it will take you to the approximate place in the editor where the error is occurring. You still have to look around to figure out what is wrong, but usually this isn’t too hard.

- (10) It's easy to use Google to find lists of LaTeX commands. Try googling "Greek alphabet Latex" or "latex math symbols". Change the document so that line (7) uses the Greek letter  $\mu$  instead of  $\theta$ .
- (11) Erase line (11) of the document and rewrite it so that it says

$$(f \circ g)(x) = f(g(x)) \text{ and } A \cap B \subseteq A \text{ and } X \neq Y.$$

Be careful about your dollar signs!

- (12) As the final piece of this homework you need to complete your response to the next reading. go and read the "Geography&Math" handout on the Canvas site. Write a paragraph in your LaTeX document talking about your thoughts on this article and try to use lots of math symbols. However, don't take this too seriously; learning LaTeX is hard at first, and I'm not going to penalize you if things don't look perfect or if you can't figure out how to do something. Just try to play around with the system, and come ask me if you can't figure something out.

Note this means this counts for both your first homework and a response to a reading.

- (13) When you are done, print out your document. There are two ways to do this. There is a "print" icon at the top of the editor window, and theoretically that is supposed to work—I haven't had too much luck with it myself, though. The alternative is to use the "PDF" tab at the top of the previewer window. Clicking on this will have the browser download the PDF file onto your computer, at which point you can handle it like you would any other PDF file.

Installing LaTeX on your own computer is optional, but here is how you do it.

### **Instructions for installing LaTeX on a Mac:**

- (1) Go to <http://tug.org/mactex> and click on the “MacTeX Download” link. Then click the link “MacTeX.pkg” in the middle of the page. This should start the downloading process, which will take a while.
- (2) After the package has downloaded you will see the “MacTeX-2016 installer” window. Click on the appropriate buttons until you get to the “Install” button, and click on that too.
- (3) To check that the software was installed, open up a “Finder” window. Go to “Applications”, and then “TeX”. Finally, click on “TeXShop”. This should launch the “TeXShop” program and open a small window with “Untitled” at the top. If this happens, you are ready to go!

### **Instructions for installing LaTeX on a PC:**

(warning: I don’t have access to a PC and so these might be slightly outdated)

- (1) Go to <http://miktex.org> and click “Download” in the menu bar at the top of the page.
  - (2) Click the blue download box under “Basic MikTeX Installer”.
  - (3) Your computer will ask if you want to run or save—click run.
  - (4) Your computer will ask if you want to install MikTeX—click yes.
  - (5) A dialog box will ask you to accept the MikTeX copying conditions. Check the given box to accept, and click ‘Next’ to accept the recommended settings.
  - (6) To check that the software was installed, go to the Start menu and look for TeXWorks in the list of programs. Click on this to run it. This should launch the “TeXWorks” program and open a small window with “untitled” at the top. If this happens, you are ready to go!
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