Guide to LaTeX

First and most importantly, LaTeX can be pronounced a number of ways. LAW-TECH is what I use. LAY-TECH is also common. By rights, the correct pronunciation is probably LUH-TECH, which I've never actually heard anyone say. But you definitely need the hard K sound. It comes from the Greek letter Chi (pronounced Kai). This tool is not related to rubber. Regardless…

What is LaTeX? LaTeX is a typesetting system. Basically that means it is used to arrange how a document looks. LaTeX was built off of TeX, both of which are designed to format mathematical and scientific documents. Once printing started to take off, academics realized it would be nice to be able to easily print mathematical documents. So Don Knuth invented TeX and the rest is history. These days, many college level courses in mathematics require you to use LaTeX, so we are deciding to require and teach the basics here.

LaTeX makes it easy to write mathematical symbols and equations. The nicely formatted

$$X^2+Y^2=Z^2$$

can be represented in LaTeX as

$$\[x^2 + y^2 = z^2\]$$

LaTeX gives a method for converting easy-to-type symbols (stuff that is on your keyboard) into hard-to-type symbols (such as superscripts, Greek letters, and other mathematical symbols). In this way, LaTeX is a little like a programming language, where the input is your LaTeX document and the output is a nicely rendered PDF. And every language needs a compiler. There are many options available, but we will only be discussing Overleaf. One downside of Overleaf is that you must have an active internet connection to be using it, but we appreciate the flexibility it allows to have two people editing the same document. You should make an account at Overleaf.com.

Structure of a Document

Documents in LaTeX start with a large amount of declarations. Type of document is declared, various packages are included, and some constants are defined. You don't need to worry about most of this. On your problem sets, there will be one definition section listed as

$$\author\{Your name(s) here\}$$

You should replace that with your name (and your partner's name, if this is a paired problem set). After that, you can safely skip to the start of the document labeled

$$\begin\{document\}$$

This is a tag, specifically a begin document tag. You'll see these tags all over the place in LaTeX,

declaring different things. They are always paired with the corresponding end tag, such as

$$\text{\textbackslash end\{document\}}$$

These tags give structure and formatting to any text placed in between the begin and end. The names generally describe what kind of section it is. For example

$$\text{\textbackslash begin\{proof\}}$$

Starts a proof. You'll mostly pick these up from context clues and comparing the LaTeX source with the generated PDF, which is quite easy to do using Overleaf.

LaTeX is great at formatting a document by breaking it into sections, paragraphs, bullet points, etc. We won't focus on how to create any of those points as your problem sets will already be formatted. All you need to know about is how to type math, and where to type it.

In general, areas of the problem set where you should be putting your answer are clearly delineated. Find the section corresponding to the appropriate question and get cracking.

Math Mode

The math tag is the most important tag you'll use in LaTeX. While you can get it by writing out

$$\text{\textbackslash begin\{math\}}$$
$$\text{X\^{}2+Y\^{}2=Z\^{}2}$$
$$\text{\textbackslash end\{math\}}$$

This is enormously tedious, as you'll be entering and exiting math mode all the time. Instead, use dollar signs.

$$\text{\$x\^{}2+y\^{}2 = z\^{}2\$}$$

The opening dollar sign functions as \begin{math} and the closing one functions as \end{math}. Any thing you type between dollar signs will be in math mode. It will be *italicized*, like a variable name. It will strip any whitespace. It allows for use of caret (^) and underscore (_) to super and subscript variables. It also allows you to use a number of symbol commands. For instance
$$\text{\$\textbackslash gamma\$}$$
Will create a lower case gamma.
$$\text{\$\textbackslash Gamma\$}$$
Will create an upper case gamma.

Below we list a number of symbols and how to make LaTeX display them. Note these all need math mode to work.

∪	\cup
∩	\cap
-	- (no special symbol needed)

Ø	\emptyset
℘	\wp
∈	\in
Δ	\Delta
⊆	\subseteq
≡$_k$	\equiv_k
≠	\neq

As a general rule, if you want to make the negation of a symbol with code \S (not a subset, not an element, so forth), you can type \not \S and that will create the symbol with a line through it.

This list is non-exhaustive for what will be needed over the course of the quarter. When you find a new symbol you don't know how to type, google the name of it plus LaTeX and see what comes up. You can also use the Detexify online tool.

Curly Braces

Curly braces are used like parentheses in LaTeX. They keep things happening in the correct order. For instance, one way to write a fraction is

$$\frac{x}{y}$$

Anything in the first braces will be in the numerator. Anything in the second will be in the denominator. You can even end up nesting those or using other complex operators.

Another method of accomplishing a similar thing is

$${x \over y}$$

Here, the braces are separating this fraction from the rest of the document.

You can also use braces to specify longer arguments. Some things such as ^ and _ only apply to the next character.

For instance

$$X^16$$

Produces

$X^1 6$

To fix this, we add braces.

$$X^{16}$$

Escape Symbols

But what if you wanted to actually type a brace or a dollar sign? You can type a \ before the character to make it appear, such as

$$B = \{\}$$

This would depict B as the empty set.

Equations and Formatting

One minor change you can do to your proofs to make them significantly more readable is to do some basic formatting on them, instead of just submitting one giant paragraph. Here are two techniques that help you do this.

The double slash \\ will create a new line. LaTeX can be a little bit unhappy by this sometimes, but in general it is a good tool to format documents. You can put it to separate out the two different techniques used in your proof, or the multiple different cases. Good formatting makes for happy Tas.

Another good technique is to use equations instead of inline math formulas. What we've described so far might have you writing some text, $then entering math mode$ then writing some text. This can be hard to read as math symbols are harder to parse.

To help with this, you can use equation mode instead of math mode. To enter equation mode, use \[as an open tag, and \] as a close tag.

As an example, typing

The equation of a circle, defined by \[x^2+y^2=z^2\] is a very powerful tool in geometry.

Yields

The equation of a circle, defined by

$$X^2+y^2=z^2$$

is a very powerful tool in geometry.

This will be centered and on a new line, which makes it significantly more visually distinct and easier to parse. We recommend using equation mode whenever your math symbols are more complex than a variable name or simple statement, such as an element belonging to a set.