# MATH 212 HOMEWORK 0: INTRODUCTION TO LaTeX

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## 1. Introduction

One of the strengths of our textbook is that it aids in the learning of LaTeX, the typesetting language in which virtually all mathematics (and many works in computer science and the natural sciences) are produced. LaTeX is not particularly hard to learn, but it will take a little bit of time before you are completely comfortable.

You will write your weekly homework in LaTeX. This is a precondition for passing the assignment! It will also help you revise your assignments based on feedback from the TA and professor.

Here is my best advice for getting started:

- **Solve the problem before writing it up!** In other words, scratch paper is your friend. Work out the details in as messy a fashion as you want, but take care to write things in a logical way, as though you were writing a short essay.
- **Google is your friend when you can't find that symbol you want!** If you can think of something you want to do in LaTeX, chances are it can be done, and someone has written about it on the Internet somewhere. The number of times I've searched something like "`latex blah symbol`" is nigh uncountable.
- Appendix C of our textbook is worth referring to, as well.
- This guide is helpful, too: http://bit.ly/m212s19latexguide
- Detexify is useful for determining the command for a symbol: http://detexify.kirelabs.org/classify.html
- **Google is your friend when you're presented with a compiler error!** I would guess that approximately 95% of the LaTeX compiler errors you will see this semester will be the result of a missing '}' or using a command/environment that is undefined (or misspelled). But for all other errors, try Google first.
- **LaTeX helpfully ignores most whitespace!** Hitting a carriage return once after a period is the same as pressing space after a period. It is good form to put every sentence on a new line, as the errors will refer to a line number, and this will cut down the area you need to search when presented with an error.
- **Send me an email!** One advantage of using LaTeX is that it gives us a way to discuss mathematics (or LaTeX itself) via email, so if you can't find what you're looking for on Google, make sure to send me your questions.

## 2. The assignment

2.1. **Getting Started. Instructions.** There are seven exercises that follow, some of which have multiple parts. In the LaTeX document you create in Exercise 1, you should create one new section per exercise, following the Introduction, which you should rename to 'Exercise 1' e.g., `\section{Exercise 2}`, etc. I have done my best to **bold** text which describes something that should go into your final document. When you are done, download the PDF and submit it on Canvas.

There are several ways you can write in LaTeX, all of them free.

(1) By far the easiest choice is Overleaf, found at http://overleaf.com, which you can think of Overleaf as Google Docs for LaTeX. **You should register for an account there.** Our course notes will be hosted at http://bit.ly/m212s19notes, so you'll get plenty of practice with it.
(2) Alternatively, if you have a Mac, MacTeX is great: http://www.tug.org/mactex/. The downside is that the download and installation take up a lot of space on your drive, but the upside is that you no longer need internet access to use LaTeX. MacTeX comes with the TeXShop editor.
(3) If you are using Windows, the usual choice of engine is MiKTeX: https://miktex.org. TeXnicCenter is a solid choice for an editor.

**Exercise 1.** Create a new document. If you are using Overleaf, create a blank document. You should end up with something like this:

```
\documentclass{article}
\usepackage[utf8]{inputenc}

\title{Intro to LaTeX}
\author{Mike Janssen}
\date{January 2019}

\begin{document}

\maketitle

\section{Introduction}

\end{document}
```

**Rename the Introduction section to be 'Exercise 1'.**
**Type "Hello, world" into the Introduction section.**

**Exercise 2.** This blank document is nice and simple, but we want to add features to our document that makes it easier to produce mathematical symbols.

(a) One of the major strengths of LaTeX is that it allows you to easily insert mathematical symbols in either inline math mode or display math mode. **First, read Section C.5 (pp. 140–141 of the text). Then attempt to typset the limit definition of the derivative on p. 141 in both inline and display math modes.** Which looks better? [Make sure to recompile when you've made a change to your document!]
(b) Eventually we will need symbols not accessible to our simple document; for example, $\mathbb{Z}$ is the standard notation for the set of all integers. **Try typesetting `$\mathbb{Z}$`.** What happens?
(c) We can extend the functionality of our document by including new packages in the preamble (the part before `\begin{document}`). **In the line after `\usepackage[utf8]{inputenc}`**, type `\usepackage{amssymb}` and recompile. Now what happens?

**Exercise 3.** In order to make your solutions and proofs more readable, it is often advisable to move Very Important Steps into the center of the page. There are multiple ways to do this. When you just have one line, using display math mode is easiest: `\[ math goes here \]`. If you have a single line you'd like to refer to later, using the equation environment is best.

```
\begin{equation}\label{Equation:IBP}
\int u\, dv = uv - \int v\, du.
\end{equation}
```

(a) **Reproduce the equation environment from above.** Then, in a line after the equation, type `\ref{Equation:IBP}` and recompile. What do you notice?

A final reason you might want to center math in the page is to show a series of steps. You can do this with the `array` environment (see an example on p. 147 of our text), or the align* environment:

```
\begin{align*}
1 + 2 + \cdots + k + (k+1) &= \frac{k(k+1)}{2} + k + 1\\
&= \frac{k^2 +k}{2} + \frac{2k+2}{2} \\
&= \frac{k^2 + 3k + 2}{2} \\
&= \frac{(k+1)(k+2)}{2} \\
&= \frac{(k+1)((k+1)+1)}{2}.
\end{align*}
```

Here, the lines are aligned along the ampersands, and the double backslash `\\` creates a new line.

(b) **Try typesetting the `align*` example above**. After recompiling, remove the asterisk from the opening and closing `align` commands. What happens?

**Exercise 4.** As described above, LaTeXhelpfully ignores most white space (spaces and carriage returns).

(a) Rather than putting spaces between sentences, you can hit return. **Type the following into your document.**

```
For He must reign until He has put all His enemies under His feet. The last
enemy to be destroyed is death.

For He must reign until He has put all His enemies under His feet.
The last enemy to be destroyed is death.
```

The advantage to this is that errors

(b) The best way to create a new line in LaTeX is by putting a blank line into the text document. **Type the following into your blank document.**

```
But Christ has indeed been raised from the dead, the firstfruits of those
who have fallen asleep. For since death came through a man, the resurrection
of the dead comes also through a man. For as in Adam all die, so in Christ
all will be made alive. But each in his own turn: Christ the firstfruits;
then at His coming, those who belong to Him.

Then the end will come, when He hands over the kingdom to God the Father after
He has destroyed all dominion, authority, and power. For He must reign until He
has put all His enemies under His feet. The last enemy to be destroyed is death.
```

Let me emphasize: *this is the desired way for you to start new paragraphs.* Do not use forced new lines unless absolutely necessary.

**Exercise 5.** Early this semester, you will need to typset some tables. Use the example of the truth table for $P \wedge Q$ at the bottom of p. 145 as a model, and **typeset the truth table for** $P \Rightarrow Q$, which can be found near the bottom of p. 23.

**Exercise 6.** You will likely make several LaTeX errors as you learn to use it. Here are two of the most common.

(a) Many LaTeX commands involve typing curly braces, { and }. A very common error is to forget the closing curly brace. **Try typing the following into your document. Then, replace the faulty command with the type of error message you receive.**

```
$ \frac{\int x\, dx}{2 $
```

Notice that we have forgotten the right curly brace on the denominator of our fraction.

(b) Another common error is to forget to start math mode. **Try typing**

```
\frac{\int x\, dx}{2}.
```

**In the document, replace the faulty command with the type of error message you receive.**

**Exercise 7.** LaTeX is a *typesetting* language, meaning that your job is to provide the text of your document and use commands to tell LaTeXwhat the various types of text are. It worries about how to format and present them. We have seen that it will typeset text/commands in math mode as mathematical expressions, and that it ignores lots of whitespace. The last big idea we'll explore is that of an *environment*. Environments typically begin with `\begin{`*environment name*`}` and end with `\end{`*environment name*`}`.

(a) The `enumerate` and `itemize` environments are good for making lists. Use the following as a guide, and **make a grocery list with at least four items on it** (you choose the items):

```
\begin{enumerate}
\item Your first item goes here
\end{enumerate}
```

(b) **Make a copy of your list, but change `enumerate` to `itemize`**. What happens?

(c) We will use the `theorem` and `proof` environments to contain our theorems and proofs. However, our current document does not support it. **Add the `amsthm` package**, then create a new theorem in the preamble with `\newtheorem{theorem}{Theorem}`. With the help of your resources, type the following exactly as it appears:

**Theorem 1.** *For all natural numbers $n$, $n^2 + 3n + 2$ is even.*

*Proof.* Let $n$ be a natural number. Observe that

$$n^2 + 3n + 2 = (n + 1)(n + 2).$$

We notice that $n + 1$ and $n + 2$ are consecutive integers, and by Statement 2.18, their product is even. Therefore, $n^2 + 3n + 2$ is even. □

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