Notes on getting started using LaTeX

Biddle/Math 330/Fall 2020

If you are interested in reading a little bit about this way of typesetting mathematics, check out: http://spiff.rit.edu/classes/ast601/latex/latex.html

I have found that one of the most versatile ways to learn LaTeX, without having to download anything, is to create a free account through www.overleaf.com. You can also store all of your LaTeX documents in their cloud for easy retrieval on the go. If you decide to go this route, you can submit homework by simply sending me the url of the file you are working on; I'll click on it and will be able to comment immediately in real time (technically we can both add things to your file at the same time).

Most people learn LaTeX by playing around with someone else's source files, so I've included the source file for our first assignment down below and will keep updating this file to include the source files of everything I type out in this course (see the bottom of this file).

Another way to jump in is to go through a short tutorial; I highly recommend this one for that purpose: https://www.latex-tutorial.com/tutorials/

If you are looking for symbols: here is Wikipedia's symbol bank – if you can't find something here, google will do just a good a job:

https://en.wikipedia.org/wiki/Wikipedia:LaTeX_symbols

Here is another extremely useful WikiBooks page on useful tips:

https://en.wikibooks.org/wiki/LaTeX/Tips_and_Tricks

Here is a very easy to use tutorial on starting your first LaTex document:

https://www.latex-tutorial.com/tutorials/first-document/

BASIC MATH TYPOGRAPHY:

1. To typeset math, you need to enclose your math typography within special brackets: either

   $ ...math typography... $

   or

   \begin{equation}
   ...math typography...
   \end{equation}

   The difference between the former and the latter is that the former is ``inline" while the latter is typeset in its own (center) lines.

2. Math symbols are typeset in italics. So variables like "x” should be written as “x".
3. Greek symbols: these have obvious names like

   \alpha, \Alpha, \beta, \Beta, \gamma, \Gamma, …

4. Subscripting and superscripting:

You type this	To get this
x_i:	"x sub i"
x_{i,j}	"x sub i,j"
x^i	"x sup i"
x^{i,j}	"x sup i,j"
x_i^j (equivalently, x^j_i)	"x sub i sup j"

5. Here is how you typeset a 3x3 matrix with (i,j)-th entry of $a_{i,j}$:

\left(	**-- this is the left paren of the matrix**
\begin{array}{ccc}	**-- this declares the matrix to have 3 columns (c=centered)**
**a_{1,1} & a_{1,2} & a_{1,3} **	**-- the first row**
**a_{2,1} & a_{2,2} & a_{2,3} **	**-- the second row**
**a_{3,1} & a_{3,2} & a_{3,3} **	**-- the third row**
\end{array}	**-- finish declaring matrix entries**
\right)	**-- this is the right paren of matrix**

OTHER USEFUL FACTS:

- The percentage character (%) indicates that the rest of the input line is to be ignored (treated as a comment). This is what I will use to give you feedback right in your source file.

- Include files: if you have some texts in another file (say, report1.tex), you can ask latex to insert it into your current file by issuing the latex command

\input{report1}

- Fonts: you can have bold font, italics font, etc as follows:

{\bf This is in bold} and

{\it this is in italics}

and this is in default roman

{\rm as is this}.

- If you want something to appear "as is" you can enclose it within the following:

\begin{verbatim}

...text, e.g., VRML nodes...

\end{verbatim}

- There are various kinds of lists. Here is one:

\begin{enumerate}

\item First item...

\item Second item...

...

\end{enumerate}

The numbers 1, 2, etc, are automatically generated for each item.

Instead of the "enumeration" list above, you can use a "description" list instead:

\begin{description}

\item[(a)] First item...

\item[(b)] Second item...

\end{description}

Note that the main difference is that "\item" now takes an argument (enclosed in square brackets), and these are used as the labels for your items.

Source code for Homework #1:

```
\documentclass{article}
\usepackage{amsmath}
\usepackage{amssymb}
\usepackage{amsfonts}

\begin{document}


\large{


\textbf{\centerline{Math 330 \quad Homework 1 \quad Fall 2020 \quad Biddle}}

\vspace{.2in}

\textit{Directions:}\quad You are being graded not just on the accuracy of your mathematics
but also your written presentation. I expect you to turn in something that is legible, with no
crossed out messes, and please, no TINY writing, I am getting old and it hurts my eyes.
Please make sure to give me adequate room to write comments (write roughly double or triple
spaced). Typing up your homework is encouraged but not required (it will be looked upon fa-
vorably). The first draft of this homework is due MONDAY September 7th - you will have two
revisions after this all of which need to be submitted before WEDNESDAY September 16th.
Reach out if you have questions as always.

\vspace{.3in}

\textbf{Problem 1:}\quad Let $U$ be a universal set and suppose that $A,B\subseteq U$.
Prove that $(A\cup B)^c=A^c\cap B^c$ where $X^c=U-X$ is the complement. Switch the roles
of $\cap$ and $\cup$ in the statement "$(A\cup B)^c=A^c\cap B^c$" - is the resulting state-
ment true? If so prove it. If not provide a counterexample.
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\textbf{Problem 2:}\quad Recall from the textbook that the (Cartesian) product of two sets A,B, written $A\times B$, is the set $\{(a,b)\, | \, a\in A, b\in B\}$, i.e. the set of all ordered pairs with first entry in A and second in B. Determine which of the following are true and which are false - if they are true provide a proof, if false give a counterexample.

\vspace{.2in}

\begin{enumerate}
\item $\emptyset \times \mathbb{N}=\emptyset$
\item If $A\times B= B\times A$ implies $A=B$
\item If $A=B$ implies that $A\times B=B\times A$
\item $(A\times A)\times A=A\times (A\times A)$
\end{enumerate}

\vspace{.2in}

\textbf{Problem 3:}\quad Show that that for statements P,Q,R that the following compound statement is a tautology, with and without using a truth table as discussed in class:

$$
(P \implies Q) \implies ((P \vee R) \implies (Q \vee R)).
$$
\vspace{.2in}

For extra reading on truth tables please check out:

http://sites.millersville.edu/bikenaga/math-proof/truth-tables/truth-tables.html

\vspace{.2in}

\textbf{Problem 4:}\quad Prove that the function $f\, :\, \mathbb{Z}\rightarrow \mathbb{N}$ defined by

\begin{equation*}
f(n)=\left\{\begin{array}{cc}
|2n| & \quad n\geq 0\\
|2n|-1 & \quad n<0\end{array}
\right.
\end{equation*}

is $1-1$ and onto and hence a bijection. Find a formula for f^{-1} and verify that $f\circ f^{-1}=id_{\mathbb{N}}$ and that $f^{-1}\circ f=id_{\mathbb{Z}}$ where id_X is the function $id_X\, :\, X\rightarrow X$ defined by $id_X(a)=a$ for any $a\in X$.

\vspace{.2in}

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\textbf{Problem 5:}\quad Let $A=\{8,6,7,5,3,0,9\}$, $Y=\{q,u,e,e,n\}$ and let $\alpha\,:\,
A\rightarrow B$ be the function with

$$

graph(\alpha)=\{(8,u),(6,u),(7,q),(5,e),(3,u),(0,q),(9,n)\}.

$$

Determine if $\alpha$ has a left inverse, a right inverse, and/or a two-sided inverse. If it has
such an inverse provide an explicit example.

\vspace{.2in}

\textbf{Problem 6:}\quad Let $f$ be a real valued function with the rule $f(x)=x^3-x$. Find sets
$X,Y\subseteq \mathbb{R}$ so that $f : X\rightarrow Y$ is a bijection (and prove that it is in-
deed a bijection). Is there a maximal possible $X$ and a maximal $Y$ that make $f$ a bijec-
tion? (Hint: graph '$f$', use your calculus knowledge).

\large}

\end{document}
```

More source files to come……