A Gentle Introduction to Latex

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1   What is LaTeX?

It is an advanced typesetting system that is primarily used for scientific and technical reports. LaTeX is **not** the same as a Word editor and should not be treated as such. Whereas Word is ideal for projects requiring more "artistic" freedom, LaTeX is far better for more formal documents where we want to get straight to the point (e.g., projects for a math class). These notes are meant to be a gentle introduction and are in absolutely no way exhaustive. More detailed documentation can be found at https://www.latex-project.org/ or any book on LaTeX (most books you'll find on the topic are fine).

2   Things before getting started

Although you can download and install the software directly onto your laptop from the LaTeX website, most people just make an account on https://overleaf.com/.

Exercise 1. Make an account on Overleaf.

There are roughly four components to a LaTeX file, as can be seen in the example on the next page.

1. Declare the documentclass (e.g., article, report, book).

This indicates what *type* of document you intend to have; article is the most common documentclass.

2. Declare the packages you plan to use.

Say you want to include images, type math symbols, or make tables. All of these require certain packages that you'll need to tell LaTeX to use.

3. Set or fix certain parameters to your liking (e.g., I want every new paragraph should have an indent of 1 inch) and declare shortcut commands (e.g., instead of typing "partial" ∂ all the time, maybe you just want to shortcut it with a new command "p").

*note - some parameters can be fixed when declaring the packages (e.g., margin size).

4. Start the document.

You must begin and end to your document (see example below).

See the images below for an example.

```
1   \documentclass{article}
2
3   % PACKAGES
4   \usepackage[utf8]{inputenc}
5   \usepackage[margin=1in]{geometry} % used for margin sizes
6   \usepackage{authblk} % for author affiliations
7   \usepackage{graphicx} % package to manage images
8   \usepackage{tabularx} % for 'tabularx' environment
9   \usepackage{amsmath} % Advanced maths commands
10  \usepackage{amssymb} % Extra maths symbols
11  \usepackage{amsthm} % for theorems, corollaries, proofs
12  \usepackage[compact]{titleps} %compact spacing
13
14  % PRE-SET STUFF
15  \setlength\parindent{3em}
16
17  % NEW COMMANDS
18  \newcommand{\p}{\partial}
19
20  % TITLE INFORMATION
21  \title{A Gentle Introduction to Latex}
22  \author[1]{J. Nakao}
23  \affil[1]{University of Delaware}
24  \date{19 October 2020}
25
26
27  % % % BEGIN DOCUMENT % % %
28
29  \begin{document}
30
31  \maketitle
32  This is the start of the file. Notice the slight indent of this first paragraph!
    Blah blah blah blah blah blah blah blah blah blah blah!
33
34  \end{document}
```

Figure 1: Example set up.

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This is the start of the file. Notice the slight indent of this first paragraph! Blah blah blah blah blah blah blah blah blah blah blah!

Figure 2: Output of the example set up.

3   Starting your first LaTeX document!

> *Exercise 2. Start a new document in Overleaf. You can do this by clicking "New Project" and then "Blank Project". Title this new document "myfirsttexfile". Clear the stuff that Overleaf fills in for you. Then, just copy everything from the example provided above. Click "Recompile" to run LaTeX.*
> *Note - If I gave you the template, you may just use that.*
>
> *Exercise 3. Change the author, affiliation, and date as they pertain to you. Then, delete the first paragraph and replace it with the sentence "This is the first sentence of my first LaTeX document"*

Note that the "maketitle" command prints all of the title information that you declared ahead of time before officially beginning the document.

4   Some basics to get you started

A few general things as you get going are the following:

- If you want to start a new line, you must end the last sentence of the previous line with two backslashes\\before hitting the Enter key.

- If you want to **bold some text**, you use the command \textbf{}, where you put the desired bolded text in the curly braces. The same is done with \textit{} for italicizing text and \underline{} for underlining text.

- If you ever want to insert the symbols & and $, you must put a backslash right before the desired symbol (e.g., \$).

As is turns out, you can divide your document into sections (and subsections), just like this very document! To do so, simply type the command

\section{}

where you put the title of the section in the curly braces. If you DO NOT wish to (automatically) number the section, then use the slightly different command

\section*{}

> *Exercise 4. Start a new section titled "This is the first section of my document."*

5   Typing mathematical symbols and expressions

Have you ever used an online calculator? For instance, you might type 3∧2+sin(pi) to get an answer of 9. Well, LaTeX works in a very similar way! For example, if you want to type the Pythagorean theorem, then you simply type a∧2+b∧2=c∧2.

However, mathematical symbols and expressions must either be:

- Put between dollar signs $a∧2+b∧2=c∧2$

    You use two dollar signs when you want to type the math in a sentence, $a^2 + b^2 = c^2$.

- Put between \[and \]. This will put the expression centered in a line all its own.

$$a^2 + b^2 = c^2$$

- Sandwich the expression between the commands \begin{equation} and \end{equation}.

This does the same thing as \[and \], but it now labels your equation with a number.

There are other little accessories (see example below).

For example, using the begin/end equation commands I type the following lines:

\begin{equation}
\centering
a∧2+b∧2=c∧2
\end{equation}

$$a^2 + b^2 = c^2 \tag{1}$$

Notice that the equation is labeled as equation (1). Now, what if later on I want to reference this equation, but don't want to bother remembering which number it was? Even worse, what if later on I end up changing the number of this equation and then have to go looking for every place I referenced it?!

There's an easy remedy. We label (or rather, name) this equation so that we can easily reference it. For instance, let's label/name the equation (1) as "pythagorean". To do this, we slightly modify the previous command to be the following lines:

\begin{equation}\label{pythagoren}
\centering
a∧2+b∧2=c∧2
\end{equation}

Whenever we want to reference equation (1), we simply type "\eqref{pythagorean}". Notice that from now on, if the number changes, then LaTeX will automatically change the numbering in all the references to this equation throughout the document!

Some other useful mathematical symbols and expressions are:

- \frac{}{} for a fraction (numerator in first braces, denominator in second braces).

- \pm for the symbol $\pm$.

- \sqrt{} for the square root symbol (e.g., $\sqrt{x}$).

- \Rightarrow for a right implication arrow $\Rightarrow$.

- \lambda for the Greek letter λ.

  NOTE - this applies for any Greek letter; you just need to make sure it's in an equation (e.g., λ).

Exercise 5. Using begin/end equation commands, type the quadratic formula. Label it as "quadratic" and reference it in a short sentence. The output that you should get is shown below.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{2}$$

I just typed the quadratic formula, as seen above in equation (2).

AN IMPORTANT NOTE - When you want to put a longer expression in a subscript or superscript (e.g., $e^{2x^2 - x + 4}$), you must put that expression in curly braces. For example, the expression I just typed in this paragraph is $e∧{2x∧2-x+4}$.

WRITING PROOFS - This pertains to students that have already started taking proof-based math courses. If you want to type a proof, then use the following command:

\begin{proof}
(type the proof here)
\end{proof}

For example, say I want to prove that 10 is an even number.

Proof. We know that 10 is an even number if $10 = 2n$, for some $n \in \mathbb{Z}$. This is clearly true if $n = 5$.   □

Look up online or in a reference how to define theorems and corollaries; you will put these with the pre-set stuff and new commands defined before beginning the document.

6   Inserting images into your document

First, you must upload and save a .png or .jpeg file in the SAME folder that you have the main file saved. I recommend putting these images in a subfolder titled "images" although that is not necessary. Once an image is saved, the command to insert it is as follows (note that this represents the image output beneath it):

\begin{figure}[h!]
\centering
\includegraphics[width=0.4\textwidth]{./twostream_pic.png}
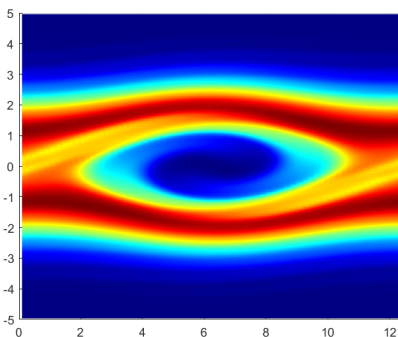\caption{This is an example image.}
\label{pic1}
\end{figure}

Figure 3: This is an example image.

As above, "twostream_pic" must be replaced with the name of your image; the "centering" is purely to center your image; the width can be adjusted to be any fraction of the textwidth; caption is the caption that will go under the image; label is what you will use to reference this image, just like with equations.

NOTE 1 - A caption and label are not required and can be omitted if desired.
NOTE 2 - Whereas referencing equations uses the command \eqref{}, we reference images using the command \ref{}, where the label for the image goes in the curly braces.
NOTE 3 - If you saved the image into a folder titled "images" then be sure to use the modified line
\includegraphics[width=0.8\textwidth]{./images/mypic.png}

Exercise 6. Start a new section titled "Inserting an image". Find an image online (preferrably a .png file), save it under the filename "pic.png", and upload it to the folder that's housing your main file. Give it the caption "This is my first image." and label it however you wish. Lastly, type a sentence afterwards that references the image.

7   Creating tables and matrices

Let's learn how to create tables. The command for a table is as follows (note that it represents the table output beneath it):

\begin{figure}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
Day of Week&Do I have school?&Buying lunch at school?\\
\hline
Monday&Yes&No\\
Tuesday&Yes&No\\
Wednesday&Yes&Yes\\
Thursday&Yes&Yes\\
Friday&Yes&No\\
Saturday&No&N/A\\
Sunday&No&N/A\\
\hline
\end{tabular}
\end{figure}

As above, the number of c's in {|c|c|c|} indicates **how many columns** you want and the vertical bars indicate that you want a vertical border between columns; the \hline indicates when you want a horizontal line (as seen below in the output table); the ampersands separate the columns in each row; each row ends with the double backslashes \\ to skip to a new row.

Day of Week	Do I have school?	Buying lunch at school?
Monday	Yes	No
Tuesday	Yes	No
Wednesday	Yes	Yes
Thursday	Yes	Yes
Friday	Yes	No
Saturday	No	N/A
Sunday	No	N/A

NOTE - You can enter mathematical phrases into a table! Just put them in between dollar signs $ $.

Exercise 7. Start a new section titled "Making a table" and recreate the following table. Be sure to put x, $f(x) = x$, and $g(x) = x^2$ in between dollar signs when you type them out!

x	$f(x) = x$	$g(x) = x^2$
-2	-2	4
-1	-1	1
0	0	0
1	1	1
2	2	4

Building matrices is very similar to building a table! We just have to be sure to put it in an equation, such as in between \[\]. The command for a matrix is as follows (note that it represents the matrix output beneath it):

\[
\begin{bmatrix}
1&2&3\\
4&5&6\\
7&8&9\\
\end{bmatrix}
\]

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

NOTE 1 - You can use pmatrix for curved matrices rather than the bracket matrices.

$$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

NOTE 2 - You can insert matrices using the begin/end equation command, or two dollar signs.

Exercise 8. Start a new section titled "Matrices" and recreate the following expression.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 & 3 \\ 4 & 6 & 6 \\ 7 & 8 & 10 \end{bmatrix}$$

---

8   Bulleted Lists

Let's learn how to make bulleted (or numbered) lists. The command is as follows (note that it represents the list output beneath it):

\begin{itemize}
\item This is item 1.
\item This is item 2.
\item This is item 3.
\end{itemize}

- This is item 1.

- This is item 2.

- This is item 3.

If you desire a numbered list instead of a bulleted list, use the slightly modified command (note that it represents the list output beneath it):

\begin{itemize}
\item[] 1. This is item 1.
\item[] 2. This is item 2.
\item[] 3. This is item 3.
\end{itemize}

1. This is item 1.

2. This is item 2.

3. This is item 3.

NOTE - Using \item[] in the itemize command deletes the bullet point.

Exercise 9. Recreate the following list.

- Bananas

- Bread

- Peanut Butter

- Honey