

Math 235: Introduction to LaTeX

The LaTeX word processing system was built to do mathematical typesetting. It is different than word processors; in LaTeX you type in text and typesetting commands, then the program builds the pages of text, then you can view the end result- That is, LaTeX does not work as a “what you see is what you get” (or WYSIWYG) kind of processor. We’ll follow the steps below to build a document.

Three Steps to a LaTeX Document

- Use a regular text editor (we’re using Texmaker) to type in words, mathematical notation, and other typesetting commands. Save this plain text document with the file suffix `.tex`
(Our example file is called `Template.tex`)

- Run the LaTeX program on the tex file, either by pressing the **Quick Build** button in the editor or by going to **Tools -> Latex** in the menu.

What happens is that LaTeX builds a file called a DVI file (DVI stands for Device Independent). We typically don’t view the DVI file, we usually take one more step and

- Build the PDF file.
- Texmaker can be programmed to do these steps for you. Go to the menu options at the top of the monitor, and select **Options -> Configure Texmaker**

Once in the configuration menu, select the second button on your left (this is the Quick Build button), and then you have lots of choices. I rather like the **Pdflatex + View PDF** option.

You can test these options on the template file- Try it out.

The smallest LaTeX document

- Every LaTeX document must begin with the command `\documentclass` followed by some options.
- Next, we include any packages (discussed later).
- Finally, every document must *begin* and *end*, and all of our typesetting commands go in between. Here is our template document:

```
\documentclass[12pt]{article}
\usepackage{graphicx,fullpage}

\begin{document}

Text goes here...

\end{document}
```

That’s it! Here are some observations about the template:

1. We will use the backslash a lot- The backslash is to denote a typesetting command, and will not be printed. To actually get a backslash, you would have to type `\textbackslash`
2. Curly braces are used to gather things in LaTeX- In our document, they are used to contain typesetting arguments.
3. I like the 12 point font for readability, and we use the “article” template (that’s what the options are in the first line).
4. The two packages we will just about always use: `graphicx` (for figures) and `fullpage` (to set the margins to a nice size).

Typesetting Mathematics

All mathematical symbols (including single variables like y , t , x , etc.) should be typeset using what is called *Math Mode*. Mathematics may be typeset within a line (or *Inline Math Mode*), or we may want to highlight certain formulas and important ideas by writing the formula on its own line- called *Display Math Mode*

To write things *inline* in math mode, use single dollar signs to denote the beginning and ending of the expression. Here are some examples. The text in the Courier font is what you type in, and the paragraph below is what LaTeX will produce:

```
\documentclass[12pt]{article}
\usepackage{graphicx,fullpage}

\begin{document}
You can see from the figure that the function  $y=\sin(x)$  is not one to one,
but the function  $y=\sin(x)$ ,  $-\pi/2\leq x \leq \pi/2$  is one to one.
Therefore, the inverse exists and is given by:

$$\sin^{-1}(x)=y \iff \sin(y)=x$$


$$\text{and } -\frac{\pi}{2}\leq y \leq \frac{\pi}{2}$$


\end{document}
```

You can see from the figure that the function $y = \sin(x)$ is not one to one. But the function $y = \sin(x)$, $-\pi/2 \leq x \leq \pi/2$ is one to one. Therefore, the inverse exists and is given by:

$$\sin^{-1}(x) = y \quad \Leftrightarrow \quad \sin(y) = x \quad \text{and} \quad -\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$$

Notes about the LaTeX:

- Mathematics “inline” is provided by single dollar signs, and double dollar signs may be used to start/end the display math mode.
- We see that $\sin$ (as all named functions) should be typeset in normal font using math mode (use the backslash).
- Fractions are made using the `\frac` command, followed by the numerator in braces, then the denominator in braces.

- Extra horizontal white space is denoted by `\quad` (leaving these out will squish all your text together).
- Try this- There are other ways of highlighting mathematical formulas:
 - Use `\[ \]` in place of the double dollar signs. You'll get an identical look.
 - Use `\begin{equation}` and `\end{equation}` in place of the double dollar signs- What happens then?

A New Document

The best way to learn LaTeX is to play around with files that are already put together. Here is an example- You should type this into the LaTeX editor and produce a PDF document from it. We'll start it on the next page for easier copying.

```

\documentclass[12pt]{article}
\usepackage{graphicx, fullpage}

\title{The Mean Value Theorem}
\author{Your Name(s) Go Here}

\begin{document}

\date{\today}
\maketitle

{\bf THE MEAN VALUE THEOREM.} Let  $f$  be a continuous function on the
interval  $[a,b]$ , and differentiable on  $(a,b)$ . Then there is a  $c$ 
in  $(a,b)$  so that:

$$f'(c)=\frac{f(b)-f(a)}{b-a}$$

{\bf Discussion:} In order to use the MVT, we see that there are two
hypotheses that must be true:
\begin{itemize}
\item The function  $f$  is continuous on  $[a,b]$ 
\item The function  $f$  is differentiable on  $(a,b)$ .

\begin{itemize}
\item This means that  $f$  may not be differentiable at  $a$  or  $b$ .
\item Second note
\end{itemize}
\end{itemize}

\begin{align}
E &= mc^2 && \\\
m &= \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \\
\end{align}

\end{document}

```

Save this file as `MVT.tex`. and use Texmaker to compile the tex file and produce a PDF file (use your folders to make sure these files have been constructed).

New commands we see:

- Did you copy and paste the LaTeX commands from the PDF file to your LaTeX editor? It does save time (rather than typing everything from scratch).
- We see how to create a document with a title and author. Notice that the title and author commands are *before* the `\begin{document}` command.
- To create boldface text, we used: `{\bf text }`. Notice that these are *curly braces* and not parentheses.
- A “bulleted” list is created by the use of `itemize`. Try changing one `begin-end` pair to use `enumerate` instead of `itemize`.
- Notice that we nested the lists- That is, one list of items is under another.
- Often, we have equations that run over a single line. Now we have a third way of expressing something in display math mode- This time, we can organize the material into columns. Ampersands (&) are used to end a column, and double backslash ends a row.

Using the Editor

Be sure to take a little time and play around with the editor settings- In particular, you might take a look at the menu buttons on the far left- There are a lot of commonly used symbols there.

Finding and Fixing Errors

What should we do if we get an error? Here’s an example: Put some white space here:

```
\begin{equation}
```

```
f'(c)=\frac{f(b)-f(a)}{b-a}
\end{equation}
```

and try to run LaTeX- You should see **Process exited with error(s)** in the Message Window, and the errors are listed in red- in this case, it actually points to the wrong line, so you can see that sometimes the error message doesn’t correspond exactly to what is wrong.

HOMEWORK:

- Watch the LaTeX video tutorials that are linked from the class website. There is some excellent information there (and quite a bit of information!). Be sure to see these videos before class next week.
- Read through the primer on writing mathematics that is also on the class website.
- The assignment (Lab 0, part 1) will be given out next week.