

Short Guide to Typesetting Math for MAT2125

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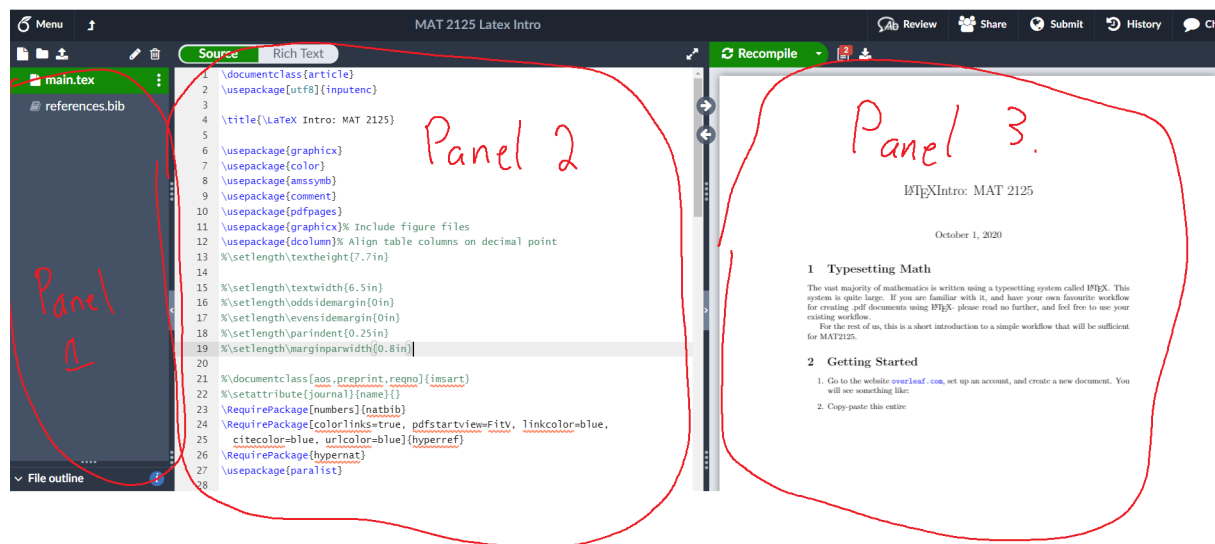
1 Typesetting Math

The vast majority of mathematics is written using a typesetting system called \LaTeX . This system is quite large. If you are familiar with it, and have your own favourite workflow for creating .pdf documents using \LaTeX - please read no further, and feel free to use your existing workflow.

For the rest of us, this is a short introduction to a simple workflow that will be sufficient for MAT2125.

2 Getting Started

1. Go to the website overleaf.com, set up an account, and create a new document. You will see three panels that look something like:



The middle panel is where you write your \LaTeX source; the right panel is where you see the output.

2. Copy-paste the short “template.tex” source file into the middle panel.
3. Hit “compile.”

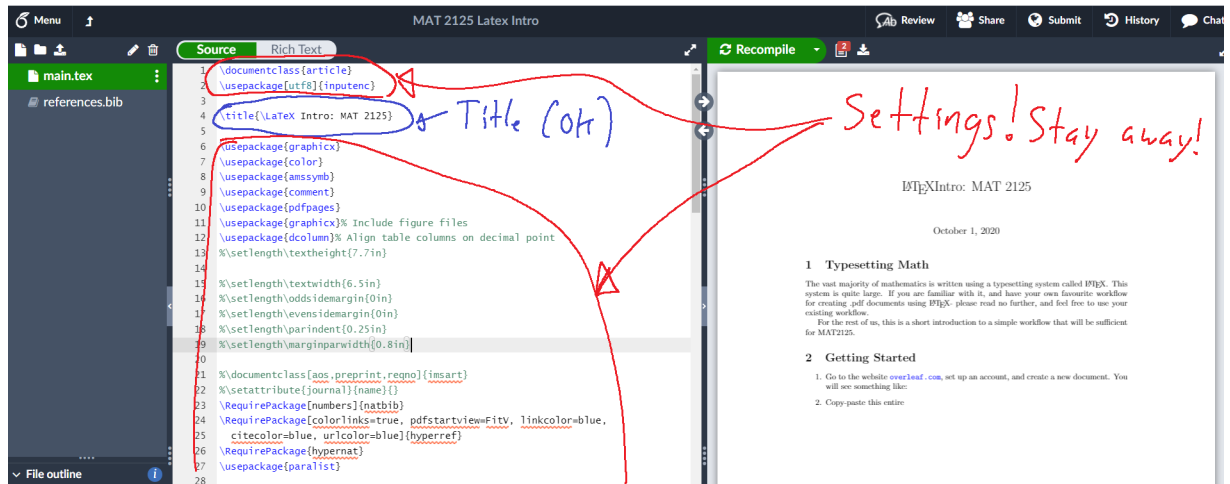
This gets you started. For all of your homework solutions, you should start by creating a new copy of the “template.tex” file and proceeding from there.

Many of you will learn the system best by doing. If this describes you, go open up the template file and the HW1 file, and start messing around. The system is not terribly complicated, especially if you have used HTML or done any programming.

For the rest of us, I give a more explicit guide.

3 Structure of the Template

At the beginning, you’ll see:



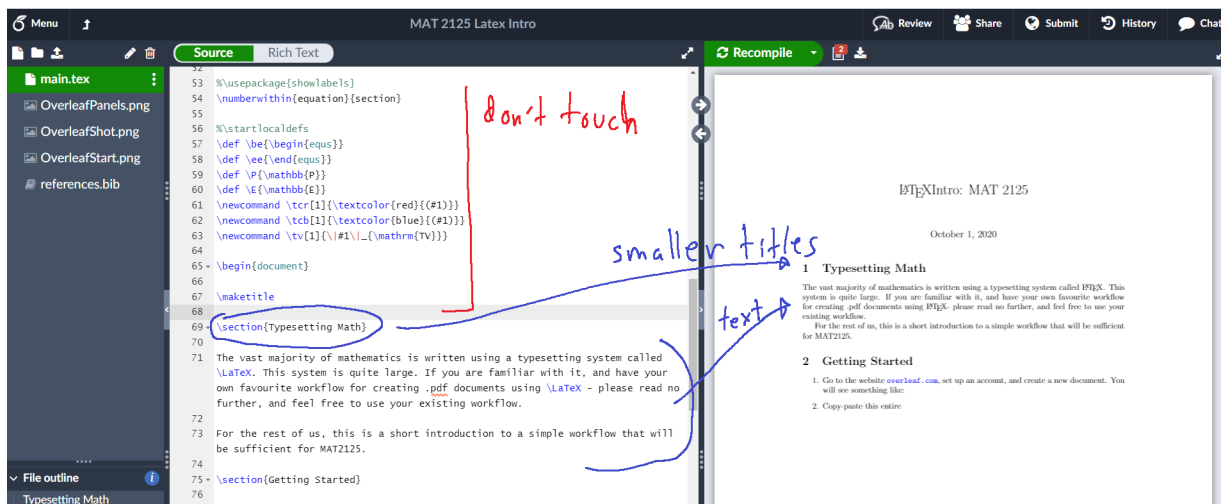
You’ll see something starting:

```
\title{
```

In \LaTeX , the “backslash” tells you that there is a special command. Everything between the curly braces are arguments to the command. In this case, the name of the command gives a good clue: whatever goes between the curly braces is the title of the document, and will show up at the very top in big letters.

After the title command, there are lots of weird-looking things. Don’t touch them if you don’t know what you’re doing.

After all the weird-looking things, you’ll see:



the

`\section{`

command works exactly like the

`{\title{`

command. You should mimic the sections in the homework questions.

After you've set the title and section, you just type stuff in! For the most part, plain text just works - you don't need to do anything. A few small exceptions:

1. Certain characters have special meaning in \LaTeX , like the dollar sign, backslash and curly brackets. The easiest way to write them is to enter math mode (see below) and write down the associated command. For example, to display the three mentioned symbols $\$, \backslash,$ and $\{$, you could type:

$$\text{\$}\text{\$}\text{\$} \quad \text{\$}\text{\backslash}\text{\$} \quad \text{\$}\text{\{}\text{\$}$$

2. If you want to have a number list, you can use the “enumerate” command. Look for this text in source file for an example; it should be pretty self-explanatory.

4 Math Mode

The main reason to use \LaTeX is “math mode,” which lets you type up math symbols like $\int_1^3 \sin(x)dx$ or $\frac{x^2-3}{2x+1}$ or $\binom{7}{3}$. You need to know two things: how to get into math mode, and what to write when you're in it.

4.1 Getting Into Math Mode

You can write very short expressions using “inline” math mode. This is accessed by writing a dollar sign at the beginning and the end of your math. For example, to write the fraction $\frac{3}{7}$, you would type:

```
\frac{3}{7}
```

Longer expressions and especially multi-line calculations are more complicated. In this template, we have a slightly simplified language. To get:

$$\begin{aligned}\int_0^3 x^2 dx &= \frac{1}{2}x^2 \Big|_0^3 \\ &= \frac{1}{2}(3^2 - 0^2) \\ &= \frac{9}{2},\end{aligned}$$

you would type:

```
\be
\int_{0}^{3} x^{2} dx &= \frac{1}{2} x^{2} \Big|_{0}^{3} \\
&= \frac{1}{2}(3^{2} - 0^{2}) \\
&= \frac{9}{2},
\ee
```

There’s a lot going on. Let’s take it slowly:

1. The commands

```
\be
[... ]
\ee
```

stand for “begin equations” and “end equations.” They function like the dollar signs, telling the compiler that everything between them should be in math mode.

2. The line

```
\int_{0}^{3} x^{2} dx
```

is how we write integrals. The command

```
\int
```

makes an integral symbol. The commands

```
_{...}
```

and

$\hat{\{...\}}$

make subscripts and superscripts. You'll notice something funny here: the superscripts and subscripts aren't *part* of the integral command (the same commands are used to make x^2), but the typesetting does *adapt* to the fact that they are used in an integral (the subscripts and superscripts are nestled right in next to the integral symbol, while they are more offset for x^2). This is one of the nice things about using L^AT_EX - the commands adapt to what you're doing to some degree.

3. There is an ampersand next to the "equal" sign. This ampersand is part of a system for aligning multi-line calculations, and it is best to understand that system all at once. A multiline calculation needs to look like:

```
[Stuff] &= [More Stuff] \\
[Yet More Stuff] &= [The Last Stuff.]
```

The

\\

tells you that the line is over, and that L^AT_EX should start a new line. **Note that the compiler only pays attention to these signals in math mode!** Whenever you write \\, L^AT_EX will start a new line (even if the source you are typing does not have a new line); conversely, even if you start a new line in the source, L^AT_EX will *not* start a new line without seeing \\.

The ampersand tells L^AT_EX how the lines should be aligned. Every line should have exactly one ampersand; the ampersand won't be displayed, but the symbols right next to the ampersands will be aligned vertically.

Usually, as in this example, you should just put them next to equal signs (or signs like \geq or \leq). Occasionally you might want to space things a little differently, for example if one line is very long. In that case you can use commands such as

```
\, \quad \quad \quad
```

to create extra blank space.

4.2 What to Write

At this point, you've already seen many of the most common commands for typesetting special symbols. For a very quick reference, I type a few examples of symbols you'll be using near the start of the course:

$$x^2, a_n, \int_1^3, \frac{d}{dx}, \forall, \exists, \in, \ni, \subset, \subsetneq, \{, \lim_{n \rightarrow \infty}, \leq, \geq, \mathbb{N}, \mathbb{R}, \cos(x).$$

these are typeset using:

`x^{2}`, `\`, `a_{n}`, `\`, `\int_{1}^{3}`, `\`, `\frac{d}{dx}`, `\`, `\forall`, `\`, `\exists`, `\`,
`\in`, `\`, `\ni`, `\`, `\subset`, `\`, `\subsetneq`, `\`, `\{`, `\`, `\lim_{n \rightarrow \infty}`, `\`,
`\leq`, `\`, `\geq`, `\`, `\mathbb{N}`, `\`, `\mathbb{R}`, `\`, `\cos(x)`.

I call attention to the last one: if you just write

```
cos(x)
```

it looks fine. However, putting the backslash in front tells L^AT_EX that you really want the common trig function, and gives you a nicer and slightly special display. Many other common functions have a similar “command” version.

5 Moving On

This document is far from exhaustive. I expect that the most common questions will be about typing new symbols that are not covered here. Google is usually good at telling you the command for a symbol if you know its name.

Beyond this, the most common symbols are covered at the reference:

https://oeis.org/wiki/List_of_LaTeX_mathematical_symbols

If you don't know the name of a symbol, there is a beautiful website that will suggest a few names based on a sketch:

<https://detexify.kirelabs.org/classify.html>