

1 How to interpret the fonts in this document

This document has text in three different fonts, described as follows:

- Anything written in this font is simply commentary what is going on.
- This font indicates what you would type in L^AT_EX or Overleaf.
- This font represents the output you get in your pdf.

2 How to use Overleaf - the big picture

When you type in L^AT_EX or Overleaf, you are producing code in a file which carries the file designation *.tex.

To compile this code, hit the “Recompile” button in Overleaf, and assuming your code has no errors, a pdf file will be created from your code.

Once everything compiles correctly, you can download your pdf by clicking the downward pointing arrow to the right of the “Recompile” button. (This file can then be submitted to me through Canvas.)

3 Structure of a *.tex file

A *.tex file has two parts.

The first part is called the *preamble*, and it contains all the code that sets the type of document to be produced, loads packages of code, sets margins and paper size, etc.

A blank Overleaf file starts with a very simple preamble. I suggest you copy and paste my template(s) (available on my web page and/or Canvas) into your Overleaf documents. Then, all you ever have to do in the preamble is to type your name in the right spot; otherwise you just type in the body.

The second part of a *.tex file is the *body*. This part starts with `\begin{document}` and ends with `\end{document}`. The body contains all the code you want to typeset.

4 Math mode vs. text mode

When you type in a L^AT_EX file, you toggle between text mode and math mode.

A *.tex file always starts in text mode after the `\begin{document}` line, and runs until it hits `\end{document}`. It has to be in text mode when it hits the last line.

To toggle between text and math modes within a paragraph, use a `$`. In Overleaf, code in math mode will appear in green (as of Spring 2021).

To produce a centered line of mathematical symbols, surround the symbols with `\[` and `\]` (without using a `$`).

For example: if you type

The integral `\int x^2 \, dx = \frac{x^3}{3} + C` is an example of the Fundamental Theorem of Calculus.

then the corresponding text that is produced is

The integral $\int x^2 dx = \frac{x^3}{3} + C$ is an example of the Fundamental Theorem of Calculus.

A second example: if you type

Here's a sentence and inside this sentence I will type `\[x = 7 + a_n\]` and then the sentence goes on.

then the corresponding text that is produced is

Here's a sentence and inside this sentence I will type

$$x = 7 + a_n$$

and then the sentence goes on.

WARNING: After typing each line or two of math symbols, compile your document to see if it worked. Then type some more and compile again, etc.

To comment code: If you want to type some comments in your *.tex file that you don't want to appear in your pdf, use a `%`. Everything after the `%`, until your next carriage return, will be ignored when your code is compiled. In Overleaf (as of Spring 2021), comments appear in green in your *.tex file.

5 What do you type to get what stuff?

For the most part, I suggest following the quick reference guide(s) on Overleaf/L^AT_EX that are distributed with this handout (or on my website). This will give you a good idea of how to make characters, arrows, symbols, etc.

There are a handful of special things that don't fit well on my quick reference guides, so I have included some examples here:

5.1 Matrices

To produce a matrix, use the following syntax while in math mode.

The number of `c`'s in the first line should equal the number of columns in the matrix. The `c` is for "center"; this will center each entry in its column; if you use `l` or `r` here, the entries would be left- or right-justified in their columns.

You can put in as many rows as you like; separate each entry in a single row by an `&` and separate each row by `\\`.

Example: when in math mode,

```
\left( \begin{array}{ccccc}
a & b & c & d & \int e \, dx \\
3f^2-4f & g_3^2 & h & i & j \\
\end{array} \right)
```

produces the matrix

$$\left(\begin{array}{ccccc} a & b & c & d & \int e \, dx \\ 3f^2-4f & g_3^2 & h & i & j \end{array} \right).$$

5.2 Aligned equations

To produce a sequence of equations that are lined up vertically, use the following syntax.

In particular, Overleaf/L^AT_EX will arrange the equations so that the symbols following the `&`s in each line are directly under one another.

As usual, use `\\` at the end of each line.

WARNING: This syntax is not to be used in math mode; do not surround it with `$`s.

As an example,

```
\begin{align*}
(a + b)^2 - ||a||^2 &= a^2 + 2ab + b^2 - ||a||^2 \\
&\bowtie a^2 - 2ab + b^2 + 4ab - ||a||^2 \\
&= (a - b)^2 + 4ab - ||a||^2 \\
\Rightarrow z &< 35000 \cdot \infty.
\end{align*}
```

produces

$$\begin{aligned}
 (a + b)^2 - ||a||^2 &= a^2 + 2ab + b^2 - ||a||^2 \\
 &\bowtie a^2 - 2ab + b^2 + 4ab - ||a||^2 \\
 &= (a - b)^2 + 4ab - ||a||^2 \\
 &\Rightarrow z < 35000 \cdot \infty.
 \end{aligned}$$

5.3 Referring to equations

One really nice thing about LaTeX is that you can “label” equations and refer to them later. For example, suppose you type

```
\begin{equation} \label{myfirstequation}
(a + b)^2 - ||a||^2 = a^2 + 2ab + b^2 - ||a||^2
\end{equation}
```

to produce the equation

$$(a + b)^2 - ||a||^2 = a^2 + 2ab + b^2 - ||a||^2 \tag{1}$$

Notice that this automatically numbers the equation (this one is numbered (1)). Now, to refer to this equation later, you can type something like:

Now it follows from equation (\ref{myfirstequation}) that so and so...

and this will produce (after you compile the document twice)

Now it follows from equation (1) that so and so...

If you go back and change the document, adding more equations earlier on, the numbering will change but all your references will be fine (i.e. if you were to insert another equation earlier, this one would now be numbered 2, and your subsequent sentence would refer to equation 2 as it is supposed to).

5.4 Piecewise-defined equations and functions

Example: when in math mode,

```
f(x) = \left\{
\begin{array}{cl}
x^2 - 4 & \text{if } x < 4 \\
3 \sin 2x & \text{if } x \geq 4
\end{array}
\right.
```

produces this:

$$f(x) = \begin{cases} x^2 - 4 & \text{if } x < 4 \\ 3 \sin 2x & \text{if } x \geq 4 \end{cases}$$