

# L<sup>A</sup>T<sub>E</sub>X Overview

## Mathcamp 2019

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August 2019

## 1 Introduction - What is L<sup>A</sup>T<sub>E</sub>X?

L<sup>A</sup>T<sub>E</sub>X (pronounced *lay-tek* or *lah-tek*) is a standard mathematical typesetting language that is used across academic disciplines for producing professional-looking documents. It is particularly useful for typesetting mathematical equations and figures.

Working in L<sup>A</sup>T<sub>E</sub>X is different than writing in a word processor such as Microsoft Word. Whereas in Word, you see the final document as you type, in L<sup>A</sup>T<sub>E</sub>X, you will not see formatting, graphics, etc. until after you have decided to compile the document. The main advantage to this is that you will be able to focus on the content of your paper, rather than its appearance (or page length). You are also able to manipulate the way your document looks much more easily than with other word processors.

In this session, I will lead you through the basics of writing in L<sup>A</sup>T<sub>E</sub>X and R Markdown by demonstration. This document includes basic information that might be helpful throughout this session and as you practice using L<sup>A</sup>T<sub>E</sub>X to write seminar papers.

## 2 Where can I get L<sup>A</sup>T<sub>E</sub>X and what resources can I use to learn more?

L<sup>A</sup>T<sub>E</sub>X can be installed locally on your computer whether you use a Windows, Mac, or Linux operating system. Instructions are available here: <https://www.latex-project.org/get/>

Alternatively, I highly recommend using an online platform like Overleaf, especially for beginners. This allows you to seamlessly integrate Zotero bibliographies and simplifies many of the common functions that will be outlined below. It also allows you to collaborate with colleagues in real-time,

similar to Google Docs. Additionally, Overleaf offers a lot of instructional guides that are helpful for beginners. To my knowledge, the basic version is free, and the paid subscription is very affordable for many of the features it includes.

Other resources that might be of use are

- for Beginners Workbook
  - <http://www.docs.is.ed.ac.uk/skills/documents/3722/3722-2014.pdf>
- A Beginner's Guide to , by David Xiao
  - <https://www.cs.princeton.edu/courses/archive/spr10/cos433/Latex/latex-guide.pdf>
- The Comprehensive Latex Symbol List, for finding out how to code a pesky symbol
  - <http://tug.ctan.org/info/symbols/comprehensive/symbols-a4.pdf>

### 3 Basics

Basic latex is nothing more than text with typesetting commands, which are generally preceded by "`\`" and followed by "`{}`"

Latex will automatically wrap text across line breaks as long as they are part of the same paragraph. To start a new paragraph, you only need to insert an extra return (there is no need to indent). To start a new line without starting a new paragraph, use the command "`\\`"

Every  $\text{\LaTeX}$  document has 3 main parts:

```
\documentclass{}
```

```
\begin{document}
```

```
\end{document}
```

To start a document, just include these commands and whatever you want to write between the begin and end document commands.

To include a title, your name, and a date, insert the following codes *before* the `\begin{document}` command:

```
\title{}  
\author{}  
\date{}
```

Then include the command `\maketitle` after the `\begin{document}` command.

## 4 Organizing your document

### 4.1 Formatting

By default, produces documents that are single-spaced with 10 pt font size and 1.875 inch margins, and uses a distinct font. Aside from increasing the font slightly, I've maintained these default settings in this document so you can see how they look.

While these settings may work for some documents, you may wish to adjust them for your own purposes/preferences.

To change the font size, go to the `\documentclass{}` command at the beginning of your file and add the argument `[12pt]` between the word `documentclass` and the brackets, like this:

```
\documentclass[12 pt]{article}
```

To change the margins, include the following command before the `\begin{document}` line:

```
\usepackage[margin=1 in]{geometry}
```

You can modify the margins by changing the size within the command.

There are several ways that you can change the font of your document, if you wish, but one of the easiest is to simply include a package with the font that you want. For example, I prefer Times New Roman for my papers, so I include this command before the beginning of the document:

```
\usepackage{times}
```

Finally, to double-space your document, or even just a section of your document, include this command before the section that you wish to double-space:

```
\doublespacing
```

You can also use `\singlespacing` to return to single space.

## 4.2 Sections

When writing, you may wish to organize your document into different sections and subsections. To start a new section, use command `\section` section name. The default setting for section titles will include a number for each section. To remove these section numbers, you can either change the default formatting for section headers (more complicated than this overview) or simply write `\section*`{}

You can also include subsections (and even sub-subsections!) by using the commands `\subsection`{ } or `\subsection*`{ } for subsections and `\subsubsection`{ } for sub-subsections.

## 4.3 Comments

As you write or edit  $\text{\LaTeX}$ code, you may find it helpful to include inline comments that will not be included in a final document. To do so, just include a percentage sign (%) before the text that you want to exclude. This will prevent everything in the line after the % sign from compiling in the final version.

```
%Some sample text to omit from final writeup
```

```
Text that I want to include
```

## 5 Beyond just text

To this point, everything we've seen/done can be accomplished as well (and easier) in Word. However,  $\text{\LaTeX}$  excels when you need to include mathematical expressions, or want to include high-quality tables and figures. This section will outline the basics of these operations in  $\text{\LaTeX}$ .

### 5.1 Lists

There are two ways to include lists in  $\text{\LaTeX}$ . The first, `enumerate`, includes a number for each item on your list, as follows:

```
\begin{enumerate}
  \item First item
  \item Second item
\end{enumerate}
```

which produces the output:

1. First item
2. Second item

The second method, `itemize`, inserts a bullet for each item on your list:

```
\begin{itemize}
  \item First item
  \item Second item
\end{itemize}
```

which produces the output:

- First item
- Second item

## 5.2 Tables

If you want to include tables in your document, you will use the *tabular* function, as follows:

```
\begin{tabular}{|l|c|r|}
  \textbf{Name} & \textbf{Age} & \textbf{Hometown}\\\hline \hline
  George & 25 & New York City, NY\\
  Ana & 24 & Los Angeles, CA \\
  Sean & 28 & Salt Lake City, UT \\
  Sarah & 26 & Bloomington, IL \\ \hline
\end{tabular}
```

which produces the output:

<b>Name</b>	<b>Age</b>	<b>Hometown</b>
George	25	New York City, NY
Ana	24	Los Angeles, CA
Sean	28	Salt Lake City, UT
Sarah	26	Bloomington, IL

When formatting a table, keep in mind the following rules:

- the code `{-l-c-r-}` at the beginning of the table sets the alignment for each column. "l" means that the values are left-aligned, "c" = centered, and "r" = right aligned. The "-" places a vertical line between columns.
- `&` separates columns in the body of the table

- `\\` signifies the end of each line in the table
- `\hline` means that a horizontal line should be placed between rows.

Obviously, this can be a bit cumbersome for larger tables. To simplify this, some tables can be automatically generated in R using packages such as `stargazer` or `xtable`. Other tables can be generated using a table generator such as the one at <https://www.tablesgenerator.com/>, which allows you to set basic formatting rules and import existing tables from other formats, such as .csv, and convert to  $\text{\LaTeX}$ .

To include captions with your table, precede the above code with the `\begin{table}` and end it with `\end{table}` commands. Include the command `\caption{}` either before or after the tabular commands depending on whether you want the caption to be at the top or bottom of the table.

```
\begin{table}
\caption{A table with caption}
\begin{tabular}{|l|c|r|}
    \textbf{Name} & \textbf{Age} & \textbf{Hometown} \\ \hline
    George & 25 & New York City, NY \\
    Ana & 24 & Los Angeles, CA \\
    Sean & 28 & Salt Lake City, UT \\
    Sarah & 26 & Bloomington, IL \\ \hline
\end{tabular}
\caption{A caption at the bottom}
\end{table}
```

which produces the output:

Table 1: A table with caption		
<b>Name</b>	<b>Age</b>	<b>Hometown</b>
George	25	New York City, NY
Ana	24	Los Angeles, CA
Sean	28	Salt Lake City, UT
Sarah	26	Bloomington, IL

Table 2: A caption at the bottom

### 5.3 Figures

Similarly, you can also incorporate graphs, charts, and other images in your document, using the `figure` and `\includegraphics` command and the "graph-

icx” package, as follows:

```
\begin{figure}
  \centering
  \includegraphics{image.png}
  \caption{A smart pup}
  \label{fig:my_label}
\end{figure}
```

Which inserts this image:



Figure 1: A smart pup

## 5.4 Mathematical Expressions

To include mathematical expressions in L<sup>A</sup>T<sub>E</sub>X, simply type the equation between \$ figures, as follows:

`$2+2=4$`  $\longrightarrow$   $2+2=4$

`$$\frac {2}{2} = 1$`  $\longrightarrow$   $2_{2=1}$

`$2*2=4$`  $\longrightarrow$   $2*2=4$

You can also add mathematical notation, including Greek letters when necessary:

`$E=mc^2$`  $\longrightarrow$   $E=mc^2$

`$x_{t+1}=kx_t(1-x_t)$`  $\longrightarrow$   $x_{t+1} = kx_t(1 - x_t)$

$$\int_a^b x^2 dx \longrightarrow \int_a^b x^2 dx$$

$$\Phi(x) = \frac{1}{\sqrt{2\pi\rho}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$\longrightarrow \Phi(x) = \frac{1}{\sqrt{2\pi\rho}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$y = \alpha + \beta_1 + \beta_2 + \sigma$$

$\beta_2 + \sigma$

Another method of including equations is to use the equation command, which will number equations for easy reference, as follows:

```
\begin{equation}
\sum_{n=1}^{\infty} 2^{-n} = 1
\end{equation}
```

$$\sum_{n=1}^{\infty} 2^{-n} = 1 \tag{1}$$

More complex commands can also be used to create other figures, such as the game tree below:

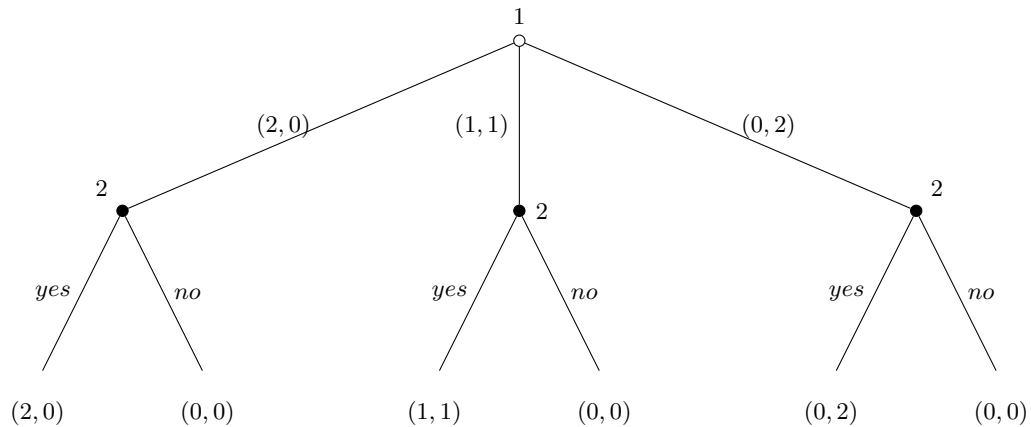


Figure 2: An extensive game

## 6 Final Thoughts

can certainly be intimidating for beginners, but for professional-quality academic writing, the output really can't be beat. As such, it's really a great



investment of time for a new graduate student to learn how to perform various functions to produce their own documents. I strongly recommend that you commit to using (or, if you prefer R Markdown or Sweave) for all of your writing assignments so you can get used to the typesetting language and learn how to make it work for your own style.