Title

Author

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1 Introduction

LaTeX, pronounced *LAY-tek* or *LAH-tek*, is a software system for typesetting documents. It was created in the 1980s by the computer scientist Leslie Lamport, building on a more basic system called TeX, which had been created in the 1970s by the computer scientist Donald Knuth. Nowadays, these systems are extremely standard in scientific writing.

To create LaTeX documents on your own computer, you need a *compiler*, and for maximum convenience, an *editor* as well. You edit a `.tex` file in the editor, then click "compile" (or use a keyboard shortcut) to tell the compiler to create a `.pdf` document. In doing so, the compiler will create a bunch of extra files with extensions like `.aux`, `.log`, and so on. For this reason, it's helpful to keep all the documents for a given project within a single folder.

Alternatively, Overleaf is a website where you can create LaTeX documents online, after first creating a free account. The makers also wrote a very nice guide to LaTeX itself:

`https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes`

This webpage contains guidance on choosing and installing a compiler:

`https://www.overleaf.com/learn/latex/Choosing_a_LaTeX_Compiler`

2 Section

2.1 Subsection

A LaTeX document consists of

1. a `\documentclass[ ]{ }` command, specifying the type of document;
2. a *preamble* where packages can be loaded, and custom commands and/or environments can be defined; and
3. a `document` environment, where the actual document is written.

In general, the syntax for a `blah` environment is

```
\begin{blah}
...
\end{blah}
```

For instance, the list above was created using the `enumerate` environment. To get an unnumbered list, use the `itemize` environment.

The introduction section contains hyperlinks that were typeset using the `\href{ }{ }` and `\url{ }` commands. The latter were placed within `quote` environments. If you want to learn how to make custom commands, see:

> https://www.overleaf.com/learn/latex/Commands#Defining_a_new_command

2.2 Non-Mathematical Text

To typeset quotation marks, use ` and '. To typeset diacritics, use commands like `\'{}`, which produces an acute accent.

``` ``Poincar\'e'' ``` gives “Poincaré”.

Note that " does not produce correct double-quotation marks.

Use `\cite[ ]{ }` to create a citation. Use an en dash (in TEX: `--`) instead of a hyphen (`-`) to typeset page ranges. For instance,

```\cite[82--83]{munkres}``` gives [M, 82–83].

The hyperlink goes to a bibliography entry at the end of this document.

You can use commands like `\textbf{ }` or `\textit{ }` to produce text in **bold** or *italics*. Note that `\emph{ }` also produces italics. Use `\textsf{ }` or `\texttt{ }` to produce text in sans-serif or `typewriter` font.

2.3 Mathematical Text

To typeset math inline with non-math text (*inline mode*), use `$...$`. For instance,

```the identity $a^2 + b^2 = c^2$``` gives the identity $a^2 + b^2 = c^2$.

To typeset math as a centered display (*display mode*), there are several methods. The quickest is to use `$$...$$`. The `equation` environment will give the same result, but with a numbered label next to the display. To omit the numbered label, use `equation*`.
```

I tend to use the `align` and `align*` environments for everything, because they let you line up expressions using `&`:

$$X = Y \cap \bigcup_{i=1}^{\infty} Z_i \tag{2.1}$$

$$= \bigcup_{i=1}^{\infty} (Y \cap Z_i). \tag{2.2}$$

To make a multi-line display with a single label, put a `split` environment inside an `align` environment.

Note that `\bigcap`, `\bigcup` produce the large symbols $\bigcap, \bigcup$, whereas `\cap`, `\cup` produce the small symbols $\cap, \cup$. The display above shows how the larger symbols have a different use from the smaller ones.

Completely separately, some commands produce different sizes for inline mode versus display mode. For instance, compare $C_n = \frac{1}{n+1}\binom{2n}{n}$ to

$$C_n = \frac{1}{n+1}\binom{2n}{n}.$$

Use `\displaystyle` and `\textstyle` to modify this behavior.

Lastly, LaTeX offers several different alphabets in math mode, including

- `\mathbb{ }` for blackboard boldface ($\mathbb{A}$),
- `\mathbf{ }` for ordinary boldface ($\mathbf{A}$),
- `\mathcal{ }` for calligraphic ($\mathcal{A}$),

among others. LaTeX also offers several ways to decorate a symbol in math mode, including `\bar{ }`, `\hat{ }`, `\widehat{ }`, `\tilde{ }`, and `\vec{ }`.

2.4 More Math Environments

Proof. The `proof` environment is used for proofs. □

The `theoremstyle` commands in the preamble of this document define some other useful environments.

Theorem 2.1. *A theorem environment.*

Lemma 2.2 (Munkres)**.** *This lemma environment has a label in parentheses. To make it, I used the syntax* `\begin{lem}[Munkres]...\end{lem}`.

Definition 2.3. A definition environment. It has a link to Theorem 2.1.

Remark 2.4. A remark environment. It has a link to equation (2.1).

References

[M] J. Munkres. *Topology*. 2nd Edition. Pearson Education, Ltd. (2014).