Introduction to LaTeX

Donlapark Ponnoprat

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Abstract

We will cover basic syntax, math typesetting, figures and tables, bibliography management, and Beamer presentations.

Part 1: The Basics of LaTeX and Overleaf

- **Introduction**

  - What is LaTeX?
    * Separation of content and style: You describe *what* it is (a section, a caption), not *how it looks* (24pt bold, centered).
    * Better typesetting for mathematics.
    * Automatic handling of numbering, cross-references, and citations.
    * The standard for academic publications.
  - What is Overleaf?
    * Cloud-based LaTeX editor. No installation needed. Real-time collaboration.
    * Quick tour of the Overleaf interface: Source, PDF, file list, Recompile.

- **Our First Document: The Core Structure**

  - The anatomy of a `.tex` file: Preamble and Document Environment.
  - **Preamble**: Global settings.
    * `\documentclass{article}`. Others: `report`, `book`, `beamer`.
    * `\usepackage{...}`: Loading extra functionality.
  - **Document Environment**: `\begin{document}` ... `\end{document}`. This is where your content goes.
  - **Comments**: Use `%` to add notes that LaTeX ignores. Crucial for collaboration.

- **Text and Document Structuring**

- **Spacing and Paragraphs**:
  * One or more spaces between words are treated as a single space.
  * One or more blank lines marks the end of a paragraph.
- **Special Characters**: Explain the need to escape: \%, \&, \#, \$, _, \{, \}.
- **Quotes**: Use backtick (`) for opening quotes and apostrophe (') for closing quotes. For double quotes, use two of each (``...'').
- **Sectioning**: \section, \subsection, \subsubsection. Add a * (e.g., \section*) to create an unnumbered section.
- **Text Formatting**: \textbf, \textit, \underline.
- **Lists**: itemize for bullets, enumerate for numbers.

- **Handling Errors**
  - Overleaf will show errors in the log.
  - **Tip 1**: Don't panic! Errors happen.
  - **Tip 2**: Fix errors as they arise. If you just typed something that caused an error, start debugging there.
  - **Tip 3**: If there are multiple errors, always start with the first one.

Part 2: Writing Mathematics

- Inline (`$...$`)

- superscript (`^`), subscript (`_`)

- fraction (`\frac{}{}`), square root (`\sqrt`)

- $>$, $\geq$ (`\ge`) $<$, $\leq$ (`\le`), $\neq$ (`\not=`)

- Display (`\[ ... \]`): Unnumbered, centered equation.

- summation (`\sum`), product (`\prod`), limit (`\lim`), integral (`\int`), ∞ (`\infty`),

- ... (`\ldots`), `\underbrace{}{}`.

- Common functions: Use commands like `\log`, `\sin`, `\exp`, `\det` instead of typing them directly. This ensures proper font and spacing.

- Greek letters: `\alpha`, `\beta`, `\gamma`, `\epsilon`

- `\bar`, `\hat`, `\tilde`

- `\mathbb`, `\mathbf`, `\mathcal`

- parentheses, brackets, braces, `\left( ... \right)`, `\bigl( ... \bigr)`

- `equation`: Centered equation with an automatically generated number. Use this for any equation you plan to refer to.

- label (`\label`) and cross-reference (`\eqref`)

- `align`: For aligning multi-line equations (e.g., at the equals sign). Use `&` to mark alignment points. The `*` version (`align*`) suppresses numbering.

- |, `\mid`, `\vert`

- `\quad`, `\qquad`

- Matrices, Cases

- To write text within a math environment, use `\text{...}`. This requires the `amsmath` package.

- To write an operator (e.g. Var, Cov), use `\operatorname{...}`.

- **Custom Commands**: A powerful tool for efficiency. Use `\newcommand` in the preamble. For example, `\newcommand{\R}{\mathbb{R}}` lets you type `\R` to get the symbol for real numbers, $\mathbb{R}$. (Requires `amsfonts` or `amssymb` package).

- `theorem` environments using `amsthm` package

- **External Tools**: **Detexify**.

Part 3: Figures and Tables

- **Floats**: Figures and tables are "floats" because their exact position is determined by LaTeX to avoid awkward page breaks.

- Use the `figure` and `table` environments.

- **Placement Specifiers**: Control where LaTeX can place the float using options in square brackets, e.g., `\begin{figure}[htbp]`.

  - `h`: "here" - at this point in the text (if possible).
  - `t`: "top" - at the top of the page.
  - `b`: "bottom" - at the bottom of the page.
  - `p`: "page" - on a special page of floats.
  - Use `!` to be more insistent, e.g., `[!h]`.

- **Cross-Referencing**:

  - Place `\label{... }` *after* the `\caption{...}` inside the float environment. A common mistake is to place it before.
  - Refer to it in the text with `\ref{...}`. Use a non-breaking space: `Figure \ref{fig:myplot}`.
  - You can also reference the page number with `\pageref{...}`.

- **Tables**:

  - The `tabular` environment builds the table itself. The argument defines columns: e.g., `{lcr}` for three columns (left, center, right aligned).
  - Use `|` for vertical lines, e.g., `{|l|c|r|}`. However, for professional tables from the `booktabs` package, avoid vertical lines.

- **External tool**: **Tables Generator** (tablesgenerator.com).

Part 4: Managing Bibliography with BibTeX

- **Why BibTeX?**: Manually formatting references is tedious and error-prone. BibTeX separates the bibliographic data from the presentation style.

- Create a `.bib` file. Each entry has a type (`@article`, `@book`), a unique key, and fields (`author`, `title`, `year`, etc.).

- **External tool**: Get BibTeX entries from Google Scholar, DBLP or the publisher's website.

- In your main `.tex` file:

    - `\bibliographystyle{...}`: Sets the citation style (e.g., `plain`, `unsrt`, `alpha`).
    - `\bibliography{...}`: Points to your `.bib` file (without the extension).

- Citing in text: `\cite{key}`. Multiple citations: `\cite{key1, key2}`.

Part 5: Presenting Your Work with Beamer

- **Introduction to Beamer**

  - **Document Class**: Use \documentclass{beamer}. A useful option is \documentclass[handout]{beamer}, which compiles a version without the pauses, suitable for printing.

  - **Frames**: Each slide is a frame environment. Use \frametitle{...} and \framesubtitle{...}.

  - **The Title Page**: Use \title, \author, \institute, and \date in the preamble, then generate the slide with \frame{\titlepage}.

  - **Themes**: Instantly change the appearance.

    * Presentation themes: \usetheme{SimplePlus}, \usetheme{metropolis}, etc.

  - **Structure**: You can use \section and \subsection in the preamble to structure your talk. Many themes will display this structure (e.g., in a header). You can create a table of contents slide with \frame{\tableofcontents}.

- **Advanced Beamer Features**

  - **Blocks**: Highlight content.

    * block: A standard highlighted block.
    * alertblock: An eye-catching block, often red, for important points.
    * exampleblock: A block for examples, often green.

  - **Columns**: Divide a frame into vertical sections using the columns and column environments.

  - **Incremental Uncovering (Overlays)**: This is a key feature for dynamic presentations.

    * \pause: The simplest method. Ends the current "slide" and starts a new one.
    * **Overlay Specifications <...>**: Attach to commands like \item or functions like \uncover.
    * \uncover<2->{text}: Text is hidden but takes up space until slide 2, then it is revealed. This prevents the layout from jumping.
    * \only<2>{text}: The text and the space it occupies exist *only* on slide 2. Can cause layout shifts.
    * \alt<2>{text on 2}{text on others}: Shows different content on slide 2 versus all other slides in the frame. Very powerful.