Getting Started with LaTeX

A Resource Guide for New Research Assistants and Students

SPEC
SECURITY AND POLITICAL ECONOMY LAB

USC SPEC Lab Resources for Academic and Professional Development

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Introduction

This guide is intended for research assistants and students who want to create polished documents using LaTeX, a powerful document preparation system widely adopted in academia. LaTeX enables you to produce professional-quality documents and is the standard for academic publishing in many disciplines.

Whether you're writing research papers, writing up your solutions to your math assignments, preparing presentations, crafting your CV/resume, or drafting reports, this guide will help you master LaTeX.

Why Use LaTeX?

- **Professional Typesetting** – LaTeX takes care of the formatting for you, ensuring everything looks polished with proper spacing, hyphenation, and alignment, just like professional documents.
- **Mathematical Expressions** – If you're dealing with math, LaTeX has you covered. It's the best tool out there for typesetting formulas, equations, and complex notation.
- **Structured Documents** – LaTeX helps you keep your large documents organized by automatically numbering sections, figures, tables, equations, and cross-references.
- **Bibliographies & Citations** – It integrates smoothly with reference management tools like BibTeX, making it easy to handle citations and generate accurate bibliographies.
- **Separation of Content & Design** – With LaTeX, you can focus on writing the content while it handles the formatting. This is especially handy for collaborative projects where multiple people are involved.
- **Consistent Templates** – LaTeX lets you create and reuse templates, ensuring your documents are always consistent.

Recommended Editors

Before writing your first document in LaTeX, you'll need either an online editor or a local installation with appropriate software. While several good options exist, **we strongly recommend Overleaf** for beginners due to its intuitive interface, extensive documentation, and thousands of free templates.

- **Overleaf** (www.overleaf.com) – Cloud-based LaTeX editor with real-time preview, collaboration features, and templates. Free tier available.
  - No installation required—start writing immediately
  - Includes hundreds of templates for academic papers, lab reports, and theses
  - Real-time collaboration and version history—ideal for group projects
  - Direct integration with Mendeley, Zotero, and other reference managers

– Built-in LaTeX error detection and suggestions

- **Textifier** (www.textifier.com) – Simple, cloud-based editor for beginners with an easy-to-use interface and real-time compilation.
    – No installation required—works in any modern browser
    – Simplified interface with fewer technical options—perfect for beginners
    – Real-time preview and basic collaboration features
    – Basic set of academic templates and tools for document creation
    – Free tier with premium options for additional storage

- **TeXstudio** (www.texstudio.org) – Feature-rich, cross-platform LaTeX editor with an integrated environment, syntax highlighting, and advanced editing features.
    – Requires installation of both the editor and a LaTeX distribution
    – Cross-platform (Windows, macOS, Linux)
    – Advanced features including auto-completion, spell checking, and reference checking
    – Customizable interface and keyboard shortcuts
    – Works offline—no internet connection required

LaTeX Distributions

If you choose a desktop editor like TeXstudio, you'll also need to install a LaTeX distribution:

- **MiKTeX** (miktex.org) – Popular for Windows users, installs packages on-demand
- **TeX Live** (tug.org/texlive) – Comprehensive distribution for all platforms
- **MacTeX** (tug.org/mactex) – Specialized distribution for macOS users

LaTeX Basics: Getting Started

Document Structure

Every LaTeX document has this basic structure:

```
\documentclass{article}  % Specifies the document type. 'article' is
    common for short documents.

% Load packages for additional functionality.
% For example, you might use 'amsmath' for advanced math, 'graphicx'
    for images, or 'geometry' for page layout.
\usepackage{...}

% Document metadata: set your title, author, and date.
\title{Your Document Title}  % Replace with your document's title.
\author{Your Name}           % Replace with your name.
\date{\today}                % Automatically uses the current date.

\begin{document}             % Begins the document content.

\maketitle  % Generates the title section based on the metadata above.

% Place your main content here...

\end{document}  % Ends the document.
```

Sections and Structure

LaTeX provides commands to organize your document hierarchically:

```latex
\section{Introduction}   % Level 1: Major sections, auto-numbered (e.g.,
    1, 2, 3...)
This is the main introduction to your document.

\subsection{Background}   % Level 2: Subsections, providing further
    detail (e.g., 1.1, 1.2...)
Additional background information goes here.

\subsubsection{Historical Context}   % Level 3: Sub-subsections for more
    specific details (e.g., 1.1.1, 1.1.2...)
A detailed look into historical context.

\paragraph{Key Points}   % Level 4: Typically unnumbered headings for
    short, highlighted text.
A brief list of key points or a summary.
```

> **Quick Tip: Unnumbered Sections**
>
> For unnumbered sections (which won't appear in the table of contents), use the starred version, e.g., \section*{Title}. This is especially useful for sections like the Abstract, Acknowledgments, or Conclusion.

Basic Text Formatting

Command	Result
\textbf{Bold text}	**Bold text**
\textit{Italic text}	*Italic text*
\underline{Underlined text}	<u>Underlined text</u>
\texttt{Monospaced text}	`Monospaced text`
This is a \emph{emphasized} word	This is a *emphasized* word

> **Quick Tip: Paragraphs in LaTeX**
>
> In LaTeX, paragraphs are separated by blank lines, not by indentation as in word processors. To create a new paragraph, simply leave an empty line between blocks of text.
> For line breaks without starting a new paragraph, use \\ at the end of a line.

Including Mathematics

Mathematics is where LaTeX truly shines. The amsmath package provides extensive support for mathematical typesetting.

```latex
% In preamble - add this to unlock more advanced math features
\usepackage{amsmath}
```

Inline Math

Use inline math to incorporate short formulas within paragraphs:

```
% Option 1 (common):
The formula for the area of a circle is $A = \pi r^2$, where $r$ is the
    radius.

% Option 2 (recommended in some cases):
The formula for the area of a circle is \(\displaystyle A = \pi r^2\),
    where \(r\) is the radius.
```

Result: The formula for the area of a circle is $A = \pi r^2$, where r is the radius.

Display Math

For standalone equations, use double dollar signs or the \[...\] environment:

```
% Double dollar signs center math on its own line
The quadratic formula is given by:
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

% Alternative syntax that is preferred in modern LaTeX
\[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\]
```

Result: The quadratic formula is given by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Equation Environments

For numbered equations that can be referenced:

```
% The equation environment automatically numbers your equations
\begin{equation}
    \int_{a}^{b} f(x) \, dx = F(b) - F(a)
    \label{eq:ftc}  % Label for referencing this equation elsewhere
\end{equation}

% Use \ref to cite the equation by its number
As we can see in Equation \ref{eq:ftc}, the Fundamental Theorem of
    Calculus...
```

Result:

$$\int_a^b f(x)\,dx = F(b) - F(a) \tag{1}$$

As we can see in Equation 1, the Fundamental Theorem of Calculus...

> **Quick Tip: Common Math Elements**
>
> Fractions: `\frac{numerator}{denominator}`
> Subscripts: `x_i` for x_i; use braces if more than one character, e.g. `x_{i+1}`
> Superscripts: `x^2` for x^2; again, use braces for multi-character exponents, e.g. `x^{10}`
> Greek letters: `\alpha, \beta, \gamma, \pi`, etc.
> Summation: `\sum_{i=1}^{n} x_i`
> Integration: `\int_{a}^{b} f(x)\,dx`
> Square roots: `\sqrt{x}` or `\sqrt[n]{x}` for nth roots

Multi-line Equations

For aligned equations or multi-step derivations:

```
% align environment for multi-line equations with alignment points
\begin{align}
    (a+b)^2 &= (a+b)(a+b) \\      % & symbol marks the alignment point
    &= a^2 + ab + ba + b^2 \\     % All equations align at the = sign
    &= a^2 + 2ab + b^2
\end{align}
```

The & symbol indicates alignment point, and \\ creates a new line.

Lists, Tables, and Figures

Lists

```
% Bullet Points (unordered list)
\begin{itemize}
    \item First item
    \item Second item
    \item Third item with \textbf{formatting}
\end{itemize}

% Numbered List (ordered list)
\begin{enumerate}
    \item First step
    \item Second step
    \item Third step
\end{enumerate}

% Definition List (for terms and their definitions)
\begin{description}
    \item[Term 1] Definition of first term
    \item[Term 2] Definition of second term
\end{description}
```

Tables

```
\begin{table}[h]                  % 'table' is a float environment; [h]
    suggests placing it 'here'.
    \centering                    % Centers the table.
```

```
3        \caption{Sample Data}          % Caption appears above or below the
            table (depending on your style).
4        \label{tab:sample}            % Label for referencing this table (e.g
            ., Table \ref{tab:sample}).
5        \begin{tabular}{lcr}          % Defines column alignment: left,
            center, right.
6          \toprule                     % Commands from the 'booktabs' package
                for professional-looking rules.
7          \textbf{Category} & \textbf{Value} & \textbf{Percentage} \\
8          \midrule
9          First & 10.5 & 35\% \\
10         Second & 7.8 & 26\% \\
11         Third & 11.7 & 39\% \\
12         \bottomrule
13       \end{tabular}
14   \end{table}
```

> ### Quick Tip: Table Referencing
>
> To reference tables in your text, add \label{tab:sample} inside the table environment, then cite it with \ref{tab:sample}. LaTeX automatically numbers tables and updates references.

Figures

```
1  \begin{figure}[h]    % 'figure' is a float environment; [h] tries to
      place it near the text.
2    \centering          % Centers the figure.
3    \includegraphics[width=0.7\textwidth]{filename.png}
4    % 'filename.png' is your image file. Supported formats: PNG, PDF,
          JPEG, EPS (depending on engine).
5    % Adjust the width as needed, or use scale (e.g., scale=0.5).
6
7    \caption{Description of your figure}  % A short caption describing
          the figure.
8    \label{fig:example}                   % Label for referencing this
          figure.
9  \end{figure}
10
11 % Refer to the figure using: Figure \ref{fig:example}
12 As shown in Figure \ref{fig:example}, we can visualize...
```

> ### Quick Tip: Figure Formatting
>
> If your figure doesn't appear exactly where you expect, remember that LaTeX tries to optimize page layout. You can experiment with optional arguments like [h!], [t], [b], [p], or use the float package ([H]) for stricter control.

Citations and Bibliography

Setting Up Bibliography

```
1  % In your preamble, load a citation package (natbib or biblatex).
2  \usepackage{natbib}
3  % \usepackage{biblatex}  % Uncomment if you'd rather use biblatex (
       requires different commands).
4
5  % At the end of your document, specify the style and your .bib file.
6  \bibliographystyle{apalike}  % e.g., apalike, plain, etc.
7  \bibliography{references}    % references.bib in the same folder as
       your .tex
```

> **Quick Tip: Compiling References**
>
> LaTeX's citation system needs multiple passes to properly generate references. Here's the usual sequence:
>
> 1. `pdflatex yourfile.tex`
> 2. `bibtex yourfile` (or `biber yourfile` if using `biblatex`)
>
> Make sure your `.bib` file is in the same folder as your `.tex` file. If references or citations still appear undefined, check for typos in the citation keys, then recompile again.

BibTeX Entry Example

```
1  @article{smith2020,
2    author  = {Smith, John and Johnson, Robert},
3    title   = {A Study of Everything},
4    journal = {Journal of Important Research},
5    year    = {2020},
6    volume  = {42},
7    number  = {3},
8    pages   = {100--115},
9    doi     = {10.1234/jir.2020.42.3.100}
10 }
```

> **Quick Tip: Managing Your .bib File**
>
> Place all your references in a `.bib` file (e.g., `references.bib`) in the same directory as your main `.tex` file. Each reference has a unique key (like `smith2020`), which you use to cite it in your document.

Citing in Text

```
1  According to \citet{smith2020}, the results show...
2
3  The theory has been tested extensively \citep{smith2020}.
```

Result:

- According to Smith and Johnson (2020), the results show...
- The theory has been tested extensively (Smith & Johnson, 2020).

> **Quick Tip: \citet vs. \citep**
>
> `\citet{}` produces a text citation (e.g., Smith and Johnson (2020)), while `\citep{}` produces a parenthetical citation (e.g., (Smith & Johnson, 2020)).

Advanced LaTeX Features

Below are some advanced topics that can elevate the professionalism of your documents. We won't delve into exhaustive detail here—think of this as a starting point for further exploration. For deeper guidance, check out the official documentation for each package or head over to resources like TeX Stack Exchange, where you'll find a community of programmers ready to help.

- **Custom Environments & Commands** – Define your own shortcuts to streamline repetitive tasks.
- **Cross-Referencing** – Use `\label{key}` and `\ref{key}` to reference parts of your document.
- **Multi-file Documents** – Organize long projects with `\include` or `\input`.
- **Beamer Presentations** – Use the Beamer class to create slide presentations directly in LaTeX.
- **TikZ for Graphics** – Generate high-quality vector graphics that blend perfectly with your text.

Common Issues & Troubleshooting

Problem	Solution
Compilation errors	Check the error log for line numbers and ensure no missing braces or environments.
Figures won't appear where expected	Use [h!], [t!], [b!], or [p!], or try the `float` package with [H].
Bibliography not appearing or missing citations	Check your `.bib` file to make sure you've inputted the bibtex correctly.
Unwanted page breaks	Use `\vspace{\fill}`, `\newpage`, or the `needspace` package.
Package conflicts	Load packages in the proper order; check docs for known incompatibilities.

> **Quick Tip: When in Doubt...**
>
> If the error messages aren't clear or the issue persists, consult community resources like TeX Stack Exchange for more detailed troubleshooting.

Additional Resources

USC SPEC Lab LaTeX Templates

The SPEC Lab offers a comprehensive suite of LaTeX templates designed specifically for USC students and researchers. Our collection includes templates for research papers, academic CVs and resumes, Beamer presentations with USC branding, conference posters, mathematically-focused documents with specialized packages, and problem sets for coursework. Each template comes pre-configured with appropriate formatting, margins, citation styles, and section structures to meet academic standards. Access all templates on our GitHub repository.

Using these templates:

- Clone or download the repository from GitHub
- Open the desired template in your preferred LaTeX editor
- Replace placeholder text with your content
- Compile to generate your PDF document

Online Learning Resources

- Overleaf Documentation – Comprehensive guides on all aspects of LaTeX
- LaTeX-Tutorial.com – Beginner-friendly tutorials with examples
- TeX Stack Exchange – Community Q&A for troubleshooting specific issues
- LaTeX Wikibook – Detailed, continuously updated resource
- CTAN (Comprehensive TeX Archive Network) – Repository of packages and documentation

Useful Tools

- Tables Generator – Online tool for creating LaTeX tables
- Mathpix – Convert images of equations to LaTeX code
- Detexify – Draw a symbol to find its LaTeX command
- draw.io – Create diagrams that can be exported to LaTeX
- Reference managers with LaTeX support:
    - Zotero with Better BibTeX extension
    - Mendeley
    - JabRef (specifically designed for BibTeX)

A Final Note: Remember that learning LaTeX is an investment that will pay dividends throughout your academic/professional career. Start with simple documents. As you get comfortable with the basics, begin experimenting with more advanced features. And do not feel discouraged! You'll pick it up!!

Happy LaTeXing!