

Day 1: Introduction to LaTeX Basics

Document Structure, Formatting & Essential Commands

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Today's Agenda

- 1 What is LaTeX?
- 2 Getting Started
- 3 Document Structure
- 4 Text Formatting
- 5 Mathematical Formulas
- 6 Tables and Figures
- 7 Cross-References
- 8 Hands-On Practice
- 9 Troubleshooting
- 10 Resources

What is LaTeX?

Definition

LaTeX is a document preparation system for high-quality typesetting, widely used for scientific and technical documents.

Why Use LaTeX?

- Professional typesetting, especially for mathematical formulas
- Consistent formatting throughout documents
- Easy management of references and bibliographies
- Industry standard for academic publishing
- Free and cross-platform

LaTeX vs. Word Processors

Traditional Word Processors

- WYSIWYG interface
- Click-and-drag formatting
- Good for simple documents
- Formatting can be inconsistent

LaTeX

- Code-based formatting
- Excellent for complex documents
- Consistent professional output
- Steep learning curve

Installing LaTeX

LaTeX Distributions:

- **Windows:** MiKTeX or TeX Live
- **macOS:** MacTeX
- **Linux:** TeX Live (via package manager)

Online Options (No Installation):

- **Overleaf:** <https://www.overleaf.com>
- **Papeeria:** <https://papeeria.com>

Recommendation

For today's workshop, we'll use Overleaf for quick access!

Your First LaTeX Document

Basic Structure:

```
\documentclass{article}

\begin{document}
Hello, World!
\end{document}
```

Three essential components:

- ❶ `\documentclass{article}` - Document type
- ❷ `\begin{document}` - Content starts
- ❸ `\end{document}` - Content ends

Document Classes

Choose the right document class:

<code>\documentclass{article}</code>	% Papers
<code>\documentclass{report}</code>	% Reports
<code>\documentclass{book}</code>	% Books
<code>\documentclass{beamer}</code>	% Slides

Common Options:

<code>\documentclass[12pt, a4paper]{article}</code>

Preamble: Loading Packages

The preamble comes before `\begin{document}`:

```
\documentclass{article}

% Essential packages
\usepackage[utf8]{inputenc}
\usepackage{graphicx}
\usepackage{amsmath}

\title{My Document}
\author{Your Name}

\begin{document}
% Content here
\end{document}
```


Title, Author, and Date

```
\documentclass{article}

\title{Workshop Title}
\author{Your Name}
\date{\today}

\begin{document}
\maketitle
\end{document}
```

Basic Text Formatting

Code:

```

1 \textbf
  {
    Bold
  }

2 \textit
  {
    Italic
  }

3 \underline
  {
    Under
  }

```

Output:

- **Bold text**
- *Italic text*
- Underlined
- Monospace

Sections and Subsections

```
\section{Introduction}  
This is the introduction.  
  
\subsection{Background}  
Some background info.  
  
\subsubsection{Details}  
More detail here.  
  
\section{Methods}  
Methodology here...
```

LaTeX automatically numbers and formats sections.

Lists: Itemize and Enumerate

Bulleted List:

1		1
2		2
3		3
4		4

Numbered List:

1	<code>\begin</code>	1
	<code>{</code>	
	<code> itemize</code>	
	<code>}</code>	
2	<code>\item</code>	2
	<code> First</code>	
3	<code>\item</code>	3
	<code> Second</code>	
4	<code>\item</code>	4

Description Lists

```
\begin{description}  
\item[Term 1] Definition of term 1  
\item[Term 2] Definition of term 2  
\item[Term 3] Definition of term 3  
\end{description}
```

Output:

- LaTeX Document preparation system
- BibTeX Bibliography management tool
- Beamer Presentation package

Inline vs. Display Math

Inline Math

Use `$...$` for math within text:

```
The equation $E = mc^2$ is famous.
```

Output: The equation $E = mc^2$ is famous.

Display Math

```
\begin{equation}  
E = mc^2  
\end{equation}
```

Output:

$$E = mc^2 \tag{1}$$

Common Math Symbols

Greek Letters:

Operators:

\$

`\alpha`

,

`\beta`

,

`\gamma`

\$

`\Delta`

,

`\theta`

,

Fractions and Subscripts

```
 $\frac{numerator}{denominator}$
```

```
 $x^2$    % Superscript
```

```
 $x_i$    % Subscript
```

```
 $x_i^2$  % Both
```

Examples:

- Fraction: $\frac{a+b}{c+d}$
- Power: $x^2 + y^2 = r^2$
- Subscript: x_1, x_2, \dots, x_n

Summation and Integration

$$\sum_{i=1}^n x_i$$

$$\int_0^1 f(x) dx$$

$$\prod_{k=1}^n a_k$$

Display versions:

- $\sum_{i=1}^n x_i$
- $\int_0^1 f(x) dx$
- $\prod_{k=1}^n a_k$

Complex Equations

```
\begin{equation}
f(x) = \int_{-\infty}^{\infty}
\hat{f}(\xi) e^{2\pi i \xi x} d\xi
\end{equation}
```

Output:

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi) e^{2\pi i \xi x} d\xi \quad (2)$$

Multi-line Equations

```
\begin{align}  
x &= a + b \\  
y &= c + d \\  
z &= e + f  
\end{align}
```

Output:

$$x = a + b \tag{3}$$

$$y = c + d \tag{4}$$

$$z = e + f \tag{5}$$

Creating Tables

```
\begin{table}[h]
\centering
\caption{Sample Data}
\begin{tabular}{|c|c|c|}
\hline
Name & Age & Grade \\
\hline
Alice & 22 & A \\
Bob & 23 & B \\
\hline
\end{tabular}
\end{table}
```

Table Alignment

```
\begin{tabular}{lcc}  
% l = left, c = center, r = right
```

Name	Age	Grade
Alice	22	A
Bob	23	B+
Charlie	21	A-

Including Figures

```
\begin{figure}[h]  
\centering  
\includegraphics[width=0.5\textwidth]{image.  
  png}  
\caption{Figure caption}  
\label{fig:sample}  
\end{figure}
```

Size Options:

- `width=0.5\textwidth`
- `height=5cm`
- `scale=0.8`

Figure Placement

```
\begin{figure}[htbp]
% h = here
% t = top of page
% b = bottom of page
% p = separate page
% ! = override LaTeX rules
\end{figure}
```

Tip

Use `[!h]` to force placement approximately here.

Labels and References

```
\section{Introduction}  
\label{sec:intro}
```

See Section~\ref{sec:intro} for details.

```
\begin{equation}  
E = mc^2  
\label{eq:einstein}  
\end{equation}
```

Equation~\ref{eq:einstein} shows...

Note: Use ~ for non-breaking space before ref.

Label Naming Convention

Good Practice:

<code>\label{sec:introduction}</code>	% Sections
<code>\label{fig:results}</code>	% Figures
<code>\label{tab:data}</code>	% Tables
<code>\label{eq:quadratic}</code>	% Equations

Benefits:

- Easy to remember
- Avoid naming conflicts
- Clear documentation
- Better organization

Practice Exercise 1

Create your first document:

- 1 Open Overleaf, create new project
- 2 Add title, author, date
- 3 Create 3 sections
- 4 Add one bulleted list
- 5 Include one equation
- 6 Compile and check PDF

Time: 15 minutes

Tip

Start simple! You can always add more later.

Practice Exercise 2

Advanced formatting:

- ① Create a 3x4 table with headers
- ② Add a figure (use placeholder or example-image)
- ③ Label your sections, table, and figure
- ④ Add cross-references in text
- ⑤ Compile successfully

Time: 15 minutes

Help Available

Raise your hand if you need assistance!

Common Errors

❶ Missing \$ inserted

- Forgot to close math mode with \$
- Special characters need escaping

❷ Undefined control sequence

- Misspelled command
- Missing package in preamble

❸ File not found

- Check image path and filename
- Ensure file is uploaded to project

Debugging Tips

When compilation fails:

- ❶ Read error message carefully
- ❷ Check line number indicated
- ❸ Look for:
 - Unclosed braces `{}`
 - Missing `\end{...}`
 - Special characters without backslash
- ❹ Comment out recent changes
- ❺ Search error online

Pro Tip

Compile frequently! Easier to find errors when you know what changed.

Learning Resources

Documentation & Tutorials:

- Overleaf Learn: <https://www.overleaf.com/learn>
- LaTeX Wikibook: <https://en.wikibooks.org/wiki/LaTeX>
- CTAN: <https://www.ctan.org>

Q&A Communities:

- TeX Stack Exchange: <https://tex.stackexchange.com>
- r/LaTeX: <https://reddit.com/r/LaTeX>

Tools:

- Detexify (draw symbols): <http://detexify.kirelabs.org>
- Tables Generator: <https://www.tablesgenerator.com>

Day 2 Preview

Tomorrow we'll cover:

- Bibliography management with BibTeX
- Advanced document structuring
- Custom commands and environments
- Multi-file projects
- Professional reports and theses
- Beamer presentations

Optional Homework

Create a 2-page document about your research topic with sections, equations, a table, and a figure.

Thank You!

Questions?

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See you tomorrow for Day 2!