Day 1: Introduction to LaTeX Basics

Document Structure, Formatting & Essential Commands

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Today's Agenda

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:

```
^^I^^I^^I\documentclass{article}
^^I^^I^^I
^^I^^I^^I\begin{document}
^^I^^I^^IHello, World!
^^I^^I^^I\end{document}
^^I^^I^^I
```

Three essential components:

1. `\documentclass{article}` - Document type
2. `\begin{document}` - Content starts
3. `\end{document}` - Content ends

Document Classes

Choose the right document class:

```
^^I^^I^^I\documentclass{article}    % Papers
^^I^^I^^I\documentclass{report}     % Reports
^^I^^I^^I\documentclass{book}       % Books
^^I^^I^^I\documentclass{beamer}     % Slides
^^I^^I
```

Common Options:

```
^^I^^I^^I\documentclass[12pt, a4paper]{article}
^^I^^I
```

Preamble: Loading Packages

The preamble comes before \begin{document}:

```
^^I^^I^^I\documentclass{article}
^^I^^I^^I
^^I^^I^^I% Essential packages
^^I^^I^^I\usepackage[utf8]{inputenc}
^^I^^I^^I\usepackage{graphicx}
^^I^^I^^I\usepackage{amsmath}
^^I^^I^^I
^^I^^I^^I\title{My Document}
^^I^^I^^I\author{Your Name}
^^I^^I^^I
^^I^^I^^I\begin{document}
^^I^^I^^I% Content here
^^I^^I^^I\end{document}
^^I^^I
```

Title, Author, and Date

```
^^I^^I^^I\documentclass{article}
^^I^^I^^I
^^I^^I^^I\title{Workshop Title}
^^I^^I^^I\author{Your Name}
^^I^^I^^I\date{\today}
^^I^^I^^I
^^I^^I^^I\begin{document}
^^I^^I^^I\maketitle
^^I^^I^^I\end{document}
^^I^^I
```

Basic Text Formatting

Code:

```
^^I^^I^^I^^I\textbf{Bold}
^^I^^I^^I^^I\textit{Italic}
^^I^^I^^I^^I\underline{Under}
^^I^^I^^I^^I\texttt{Mono}
^^I^^I^^I^^I
```

Output:

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

Sections and Subsections

```
^^I^^I^^I\section{Introduction}
^^I^^I^^IThis is the introduction.
^^I^^I^^I
^^I^^I^^I\subsection{Background}
^^I^^I^^ISome background info.
^^I^^I^^I
^^I^^I^^I\subsubsection{Details}
^^I^^I^^IMore detail here.
^^I^^I^^I
^^I^^I^^I\section{Methods}
^^I^^I^^IMethodology here...
^^I^^I
```

LaTeX automatically numbers and formats sections.

Lists: Itemize and Enumerate

Bulleted List:

```
^^I^^I^^I^^I^^I\begin{itemize}
^^I^^I^^I^^I^^I\item First
^^I^^I^^I^^I^^I\item Second
^^I^^I^^I^^I^^I\item Third
^^I^^I^^I^^I^^I\end{itemize}
^^I^^I^^I^^I
```

Numbered List:

```
^^I^^I^^I^^I^^I\begin{enumerate}
^^I^^I^^I^^I^^I\item First
^^I^^I^^I^^I^^I\item Second
^^I^^I^^I^^I^^I\item Third
^^I^^I^^I^^I^^I\end{enumerate}
^^I^^I^^I^^I
```

Description Lists

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

Output:

LaTeX Document preparation system

BibTeX Bibliography management tool

Beamer Presentation package

Inline vs. Display Math

Inline Math

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

```
^^I^^I^^I^^IThe equation $E = mc^2$ is famous.
^^I^^I^^I
```

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

Display Math

```
^^I^^I^^I^^I\begin{equation}
^^I^^I^^I^^IE = mc^2
^^I^^I^^I^^I\end{equation}
^^I^^I^^I
```

Output:

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

Common Math Symbols

Greek Letters:

```
^^I^^I^^I^^I^^I$\alpha, \beta,
    \gamma$
^^I^^I^^I^^I^^I$\Delta, \theta,
    \pi$
^^I^^I^^I^^I
```

Output: $\alpha, \beta, \gamma, \Delta, \theta, \pi$

Operators:

```
^^I^^I^^I^^I^^I$\sum, \int,
    \prod$
^^I^^I^^I^^I^^I$\lim, \sqrt{x}$
^^I^^I^^I^^I
```

Output: $\sum, \int, \prod, \lim, \sqrt{x}$

Fractions and Subscripts

```
^^I^^I^^I$\frac{numerator}{denominator}$
^^I^^I^^I
^^I^^I^^I$x^2$  % Superscript
^^I^^I^^I
^^I^^I^^I$x_i$  % Subscript
^^I^^I^^I
^^I^^I^^I$x_i^2$  % Both
^^I^^I
```

Examples:

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

Summation and Integration

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

Display versions:

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

Complex Equations

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

Output:

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

Multi-line Equations

```
^^I^^I^^I\begin{align}
^^I^^I^^Ix &= a + b \\
^^I^^I^^Iy &= c + d \\
^^I^^I^^Iz &= e + f
^^I^^I^^I\end{align}
^^I^^I
```

Output:

$$x = a + b \tag{3}$$
$$y = c + d \tag{4}$$
$$z = e + f \tag{5}$$

Creating Tables

```
^^I^^I^^I\begin{table}[h]
^^I^^I^^I\centering
^^I^^I^^I\caption{Sample Data}
^^I^^I^^I\begin{tabular}{|c|c|c|}
^^I^^I^^I\hline
^^I^^I^^IName & Age & Grade \\
^^I^^I^^I\hline
^^I^^I^^IAlice & 22 & A \\
^^I^^I^^IBob & 23 & B \\
^^I^^I^^I\hline
^^I^^I^^I\end{tabular}
^^I^^I^^I\end{table}
^^I^^I
```

Table Alignment

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

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

Including Figures

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

Size Options:

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

Figure Placement

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

Tip

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

Labels and References

```
^^I^^I^^I\section{Introduction}
^^I^^I^^I\label{sec:intro}
^^I^^I^^I
^^I^^I^^ISee Section~\ref{sec:intro} for details.
^^I^^I^^I
^^I^^I^^I\begin{equation}
^^I^^I^^IE = mc^2
^^I^^I^^I\label{eq:einstein}
^^I^^I^^I\end{equation}
^^I^^I^^I
^^I^^I^^IEquation~\ref{eq:einstein} shows...
^^I^^I
```

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

Label Naming Convention

Good Practice:

```
^^I^^I^^I\label{sec:introduction}  % Sections
^^I^^I^^I\label{fig:results}       % Figures
^^I^^I^^I\label{tab:data}          % Tables
^^I^^I^^I\label{eq:quadratic}      % Equations
^^I^^I
```

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

1. **Missing $ inserted**
   - Forgot to close math mode with $
   - Special characters need escaping
2. **Undefined control sequence**
   - Misspelled command
   - Missing package in preamble
3. **File not found**
   - Check image path and filename
   - Ensure file is uploaded to project

Debugging Tips

When compilation fails:

1. Read error message carefully
2. Check line number indicated
3. Look for:
   - Unclosed braces {}
   - Missing `\end{...}`
   - Special characters without backslash
4. Comment out recent changes
5. 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!