Latex

Document Structure

- Basic document setup with preamble, document classes, and section organization
- Document class options and structure commands
- Including multiple files with `\include` and `\input`

Text Formatting

- Font styles: bold, italic, underline, small caps, etc.
- Font sizes from tiny to huge
- Text alignment and spacing options
- Special environments like quote, verbatim, and verse

Lists

- Unordered (bullet) lists with `itemize`
- Ordered (numbered) lists with `enumerate`
- Description lists and custom list formatting
- Nested lists and custom bullets

Math Typesetting

- Math modes: inline (`$...$`) and display (`\[...\]`)
- Common math symbols, Greek letters, and operators
- Fractions, roots, matrices, and multi-line equations
- Functions, summations, integrals, and cases

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- Basic table structure with the `tabular` environment
- Column types and alignment options
- Table elements: borders, merged cells
- Professional tables with the `booktabs` package

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- Figure environments with captions and labels
- Subfigures and placement options
- Controlling image size and orientation

References and Citations

- Cross-referencing with `\label` and `\ref`
- Bibliography management with BibTeX
- Citation styles and formatting
- Modern bibliography with BibLaTeX

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- Page geometry and margins
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- Creating new commands with `\newcommand`
- Defining custom environments
- Command arguments and optional parameters

Special Characters and Packages

- LaTeX special characters and symbols
- Accents and non-English characters
- Essential packages for enhancing documents
- Specialized packages for math, graphics, tables, etc.

Presentations with Beamer

- Creating slides and presentations
- Overlay specifications for incremental reveals
- Themes, colors, and blocks
- Multi-column slide layouts

LaTeX Cheatsheet

Table of Contents

Document Structure

Basic Document

\documentclass[12pt, letterpaper]{article}

\usepackage[utf8]{inputenc}

\usepackage[english]{babel}

\usepackage{graphicx}

\title{Document Title}

\author{Author Name}

\date{\today}

\begin{document}

\maketitle

\tableofcontents

\section{Introduction}

Your content here.

\end{document}

Document Classes

\documentclass{article}   % Articles, default choice for short documents

\documentclass{report}   % Reports, has chapters

\documentclass{book}   % Books, more elaborate structure

\documentclass{beamer}   % Presentations

\documentclass{letter}   % Letters

\documentclass{memoir}   % Highly customizable class for books

Document Class Options

\documentclass[11pt]{article}   % Font size (10pt, 11pt, 12pt)

\documentclass[letterpaper]{article} % Paper size (a4paper, letterpaper)

\documentclass[twocolumn]{article}   % Two-column layout

\documentclass[landscape]{article}   % Landscape orientation

\documentclass[draft]{article}   % Draft mode (shows overfull boxes)

\documentclass[leqno]{article}   % Equation numbers on left

Document Structure Commands

\part{Part Title}   % Highest level division (mainly books)

\chapter{Chapter Title}   % Available in report and book

\section{Section Title}   % Major section

\subsection{Subsection}   % Subsection

\subsubsection{Subsubsection}% Subsubsection

\paragraph{Paragraph}   % Not numbered by default

\subparagraph{Subparagraph} % Not numbered by default

% Star versions don't number and don't appear in ToC

\section*{Unnumbered Section}

Comments

% This is a comment

Multiple Files

\include{filename}   % Starts new page before including

\input{filename}   % Doesn't start new page

Text Formatting

Basic Formatting

\textbf{Bold text}

\textit{Italic text}

\textsl{Slanted text}

\textsc{Small Caps}

\texttt{Monospaced/Typewriter}

\textrm{Roman/Normal font}

\textsf{Sans-serif font}

\underline{Underlined text}

\emph{Emphasized text}   % Context-dependent (italic in normal text)

Font Size Commands

{\tiny Tiny text}

{\scriptsize Script size}

{\footnotesize Footnote size}

{\small Small text}

{\normalsize Normal size}

{\large Large text}

{\Large Larger text}

{\LARGE Very large text}

{\huge Huge text}

{\Huge Largest text}

Alignment

\begin{flushleft}

Left-aligned text

\end{flushleft}

\begin{center}

Centered text

\end{center}

\begin{flushright}

Right-aligned text

\end{flushright}

Spacing

Line break: \\

Line break with space: \\[5mm]

Horizontal space: \hspace{1cm}

Horizontal fill: \hfill

Vertical space: \vspace{1cm}

No paragraph indent: \noindent

% Paragraph spacing

\setlength{\parindent}{0pt} % No paragraph indents

\setlength{\parskip}{1em}   % Paragraph spacing

Special Text Environments

\begin{quote}

Indented quote block.

\end{quote}

\begin{quotation}

Indented quotation with paragraph indents.

\end{quotation}

\begin{verse}

For poetry\\

and verse

\end{verse}

\begin{verbatim}

Text with special characters like $ % &

is displayed exactly as written.

\end{verbatim}

\begin{verbatim*}

Shows spaces as ␣ visibly

\end{verbatim*}

Lists

Unordered Lists

\begin{itemize}

   \item First item

```
    \item Second item

    \begin{itemize}

        \item Nested item

        \item Another nested item

    \end{itemize}

    \item Third item

\end{itemize}
```

Ordered Lists

```
\begin{enumerate}

    \item First item

    \item Second item

    \begin{enumerate}

        \item Nested item

        \item Another nested item

    \end{enumerate}

    \item Third item

\end{enumerate}
```

Description Lists

```
\begin{description}

    \item[Term 1] Description of term 1

    \item[Term 2] Description of term 2

\end{description}
```

Custom List Formatting

% Requires enumitem package

\usepackage{enumitem}

% Change default symbol

\begin{itemize}[label=$\bullet$]

    \item Bullet item

\end{itemize}

% Change numbering

\begin{enumerate}[label=\Alph*.]

    \item A item

    \item B item

\end{enumerate}

% Custom counter

\begin{enumerate}[start=3]

    \item Third item

    \item Fourth item

\end{enumerate}

Math Typesetting

Math Modes

% Inline math

$E = mc^2$

% Displayed math

\[E = mc^2\]

% Numbered equations

\begin{equation}

E = mc^2

\label{eq:einstein}

\end{equation}

% Multiple numbered equations

\begin{align}

A &= B + C \\

&= D + E

\end{align}

% Multiple unaligned equations

\begin{gather}

A = B + C \\

X = Y - Z

\end{gather}

Common Math Symbols

% Greek letters

$\alpha, \beta, \gamma, \delta, \epsilon, \varepsilon$

$\pi, \phi, \varphi, \mu, \Gamma, \Delta, \Omega$

% Operators

$+, -, \times, \div, \pm, \mp, \cdot$

% Comparison

$=, \ne, \approx, \equiv, \cong, \le, \ge, \ll, \gg$

% Sets

$\in, \notin, \subset, \supset, \cap, \cup, \emptyset$

% Logic

$\forall, \exists, \nexists, \neg, \lor, \land, \Rightarrow, \Leftrightarrow$

% Arrows

$\rightarrow, \leftarrow, \Rightarrow, \Leftarrow, \leftrightarrow, \mapsto$

% Misc

$\infty, \nabla, \partial, \int, \oint, \sum, \prod$

Fractions and Binomials

$\frac{a}{b}$ % Regular fraction

$\dfrac{a}{b}$ % Display style fraction

${a \over b}$ % Alternative fraction

$\binom{n}{k}$ % Binomial coefficient

Roots

$\sqrt{x}$ % Square root

$\sqrt[3]{x}$ % Cubic root

Functions

$\sin \theta$

$\cos \theta$

$\tan \theta$

$\exp(x)$

$\ln(x)$

$\log_{10}(x)$

$\lim_{x \to \infty}$

$\min(x,y)$

$\max(x,y)$

Matrices

$\begin{pmatrix}

a & b \\

C & D

\end{pmatrix}$ % Round brackets

$\begin{bmatrix}

A & B \\

C & D

\end{bmatrix}$ % Square brackets

$\begin{Bmatrix}

A & B \\

C & D

\end{Bmatrix}$ % Curly brackets

$\begin{vmatrix}

A & B \\

C & D

\end{vmatrix}$ % Determinant

$\begin{matrix}

A & B \\

C & D

\end{matrix}$ % No brackets

Common Constructs

$\bar{a}$ % Bar

$\vec{a}$ % Vector arrow

$\hat{a}$ % Hat

$\dot{a}$ % Dot

$\ddot{a}$ % Double dot

$\overrightarrow{ABC}$ % Arrow over text

$\widehat{ABC}$ % Wide hat

$\sum_{i=1}^{n} i^2$ % Summation

$\int_{a}^{b} f(x) dx$ % Integral

$\prod_{i=1}^{n} i$ % Product

$a_{i,j}^{2}$ % Subscript and superscript

$\sideset{_1^2}{_3^4}\sum$ % Left/right positioning

% Multi-line equation with alignment

\begin{align}

(a+b)^2 &= (a+b)(a+b) \\

&= a^2 + ab + ba + b^2 \\

&= a^2 + 2ab + b^2

\end{align}

% Cases

f(x) = \begin{cases}

```
  x^2 & \text{if } x \geq 0 \\

  -x^2 & \text{if } x < 0

\end{cases}
```

Tables

Basic Tables

```
\begin{tabular}{|l|c|r|}

  \hline

  Left & Center & Right \\

  \hline

  1 & 2 & 3 \\

  4 & 5 & 6 \\

  \hline

\end{tabular}
```

Column Types

```
l    % Left-aligned column

c    % Center-aligned column

r    % Right-aligned column

p{width}  % Paragraph column with specified width

|    % Vertical line
```

Table Elements

```latex
\hline    % Horizontal line

\cline{2-4}  % Partial horizontal line from column 2-4

\multicolumn{2}{|c|}{Merged cells}  % Merge cells horizontally

\multirow{2}{*}{Merged} % Merge cells vertically (needs multirow package)
```

Table Environments

```latex
% Basic table

\begin{table}

  \centering

  \caption{Table caption}

  \label{tab:mytable}

  \begin{tabular}{lcr}

    % table content

  \end{tabular}

\end{table}


% Tables that span multiple pages

\usepackage{longtable}

\begin{longtable}{lcr}

  % table content spanning pages

\end{longtable}


% Professional tables

\usepackage{booktabs}
```

```
\begin{tabular}{lcr}

  \toprule

  Col1 & Col2 & Col3 \\

  \midrule

  1 & 2 & 3 \\

  4 & 5 & 6 \\

  \bottomrule

\end{tabular}
```

Figures and Images

Basic Figures

```
\usepackage{graphicx}
```

```
\begin{figure}

  \centering

  \includegraphics[width=0.7\textwidth]{filename}

  \caption{Figure caption}

  \label{fig:myfigure}

\end{figure}
```

Image Options

```
\includegraphics[width=5cm]{filename}      % Set width

\includegraphics[height=3cm]{filename}      % Set height
```

```latex
\includegraphics[scale=0.5]{filename}          % Scale by factor

\includegraphics[width=\textwidth]{filename}    % Full text width

\includegraphics[angle=45]{filename}           % Rotate by 45 degrees

\includegraphics[width=5cm, height=3cm, keepaspectratio]{filename}
```

Subfigures

```latex
\usepackage{subcaption}


\begin{figure}

  \centering

  \begin{subfigure}[b]{0.4\textwidth}

    \includegraphics[width=\textwidth]{image1}

    \caption{First subfigure}

    \label{fig:sub1}

  \end{subfigure}

  \hfill

  \begin{subfigure}[b]{0.4\textwidth}

    \includegraphics[width=\textwidth]{image2}

    \caption{Second subfigure}

    \label{fig:sub2}

  \end{subfigure}

  \caption{Overall figure caption}

  \label{fig:both}

\end{figure}
```

Float Placement Specifiers

\begin{figure}[htbp]

    % figure content

\end{figure}

- **h** - Here (place the float at the position in the text where it occurs)
- **t** - Top (place at the top of a page)
- **b** - Bottom (place at the bottom of a page)
- **p** - Page (place on a page containing only floats)
- **!** - Override internal LaTeX parameters

References and Citations

Labels and Cross-References

\section{Introduction}

\label{sec:intro}

As discussed in Section~\ref{sec:intro} on page~\pageref{sec:intro}...

\begin{equation}

    E = mc^2

    \label{eq:einstein}

\end{equation}

Referring to Equation~\eqref{eq:einstein}... % Requires amsmath package

Basic Bibliography with BibTeX

```
% In the main .tex file

\bibliographystyle{plain}

\bibliography{references}   % references.bib is the bibliography file


% Citing in the text

\cite{einstein1905}        % Basic citation [1]

\citet{einstein1905}       % Textual citation: Einstein (1905)

\citep{einstein1905}       % Parenthetical: (Einstein, 1905)
```

Bibliography Entry (in .bib file)

```
@article{einstein1905,

    author = {Einstein, Albert},

    title = {Zur Elektrodynamik bewegter K{\"o}rper},

    journal = {Annalen der Physik},

    volume = {322},

    number = {10},

    pages = {891--921},

    year = {1905},

    doi = {10.1002/andp.19053221004}

}


@book{latexcompanion,

    author = {Goossens, Michel and Mittelbach, Frank and Samarin, Alexander},
```

```
    title = {The \LaTeX\ Companion},

    publisher = {Addison-Wesley},

    year = {1994}

}
```

Bibliography Styles

```
\bibliographystyle{plain}      % Basic style [1]

\bibliographystyle{unsrt}      % Unsorted

\bibliographystyle{alpha}      % [Ein05] - author + year abbreviation

\bibliographystyle{abbrv}      % Uses abbreviations

\bibliographystyle{ieeetr}     % IEEE style

\bibliographystyle{acm}        % ACM style

\bibliographystyle{apalike}    % APA style
```

Bibliography with BibLaTeX (modern alternative)

```
\usepackage[style=authoryear]{biblatex}

\addbibresource{references.bib}


% In text

\autocite{einstein1905}


% At the end of document

\printbibliography
```

Page Layout

Page Geometry

\usepackage[margin=1in]{geometry}   % 1 inch margins all around

\usepackage[left=1in,right=1in,top=1in,bottom=1in]{geometry}

\usepackage[a4paper,landscape,margin=2cm]{geometry}

Headers and Footers

\usepackage{fancyhdr}

\pagestyle{fancy}

\fancyhead{}   % Clear all headers

\fancyhead[L]{Left header text}   % Left header

\fancyhead[C]{Center header text}   % Center header

\fancyhead[R]{Right header text}   % Right header

\fancyfoot{}   % Clear all footers

\fancyfoot[L]{Left footer text}   % Left footer

\fancyfoot[C]{Page \thepage}   % Center footer

\fancyfoot[R]{Right footer text}   % Right footer

\renewcommand{\headrulewidth}{0.4pt}   % Header rule thickness

\renewcommand{\footrulewidth}{0.4pt}   % Footer rule thickness

Page Numbering

```
\pagenumbering{arabic}   % 1, 2, 3, ...

\pagenumbering{roman}    % I, II, III, ...

\pagenumbering{Roman}    % I, II, III, ...

\pagenumbering{alph}     % A, B, C, ...

\pagenumbering{Alph}     % A, B, C, ...


\setcounter{page}{1}     % Reset page counter
```

Column Layout

```
% Two-column layout

\begin{multicols}{2}

    Content that will be formatted in two columns...

\end{multicols}


% Three columns with rule between

\begin{multicols}{3}[\section{Section Title}][1cm]

    Content in three columns...

\end{multicols}
```

Custom Commands and Environments

New Commands

```
% Basic command
```

```
\newcommand{\grad}{\nabla}
```

```
% Command with arguments
```

```
\newcommand{\norm}[1]{\lVert#1\rVert}
```

```
% Command with optional argument
```

```
\newcommand{\highlight}[2][yellow]{\colorbox{#1}{#2}}
```

New Environments

```
\newenvironment{boxed}
```

```
  {\begin{center}\begin{tabular}{|p{0.9\textwidth}|}\hline\\}
```

```
  {\\[2pt]\\\hline\end{tabular}\end{center}}
```

Redefining Commands

```
\renewcommand{\vec}[1]{\mathbf{#1}}
```

Special Characters

Special LaTeX Characters

```
\# \$ \% \& \_ \{ \} \~{} \^{} \textbackslash \textbar
```

Quotation Marks

```
`single quotes'
```

```
``double quotes''
```

Dashes

- (hyphen)

-- (en-dash)

--- (em-dash)

Accents

\`{a} – à

\'{a} – á

\^{a} – â

\"{a} – ä

\~{a} – ã

\-{a} – ā

\.{a} – ȧ

\u{a} – ă

\v{a} – ǎ

\H{a} – a̋

\c{c} – ç

\d{a} – ạ

\b{a} – a̠

\t{oo} – o͡o

\oe – œ

\OE – Œ

\ae – æ

\AE - Æ

\AA - Å

\AA - Å

\O - Ø

\O - Ø

\L - Ł

\L - Ł

\ss - ß

Other Special Characters

\ldots   % …

\cdots   % ⋯

\vdots   % ⋮

\ddots   % ⋱

\LaTeX   % LaTeX logo

\TeX   % TeX logo

\copyright % ©

\textregistered % ®

\texttrademark % ™

\EUR   % € (requires eurosym package)

\deg   % °

\prime   % ´

\circ   % °

Common Packages

Essential Packages

\usepackage[utf8]{inputenc}   % Input encoding

\usepackage[T1]{fontenc}   % Font encoding

\usepackage{lmodern}   % Latin Modern fonts

\usepackage{amsmath,amssymb}   % AMS math and symbols

\usepackage{graphicx}   % Graphics support

\usepackage{hyperref}   % Hyperlinks in document

Document Enhancement

\usepackage{geometry}   % Page layout

\usepackage{fancyhdr}   % Headers and footers

\usepackage{multicol}   % Multiple columns

\usepackage{booktabs}   % Professional tables

\usepackage{enumitem}   % Customize lists

\usepackage{setspace}   % Line spacing

\usepackage{caption}   % Caption customization

\usepackage{subcaption}   % Sub-figures and sub-tables

\usepackage{appendix}   % Better appendix handling

Mathematics

\usepackage{amsmath}   % Advanced math typesetting

\usepackage{amssymb}   % Extra math symbols

```
\usepackage{mathtools}      % Extends amsmath

\usepackage{amsthm}         % Theorem environments

\usepackage{bm}             % Bold math symbols

\usepackage{physics}        % Physics notations

\usepackage{siunitx}        % SI units
```

Graphics and Colors

```
\usepackage{graphicx}       % Graphics inclusion

\usepackage{xcolor}         % Color support

\usepackage{tikz}           % Drawing diagrams

\usepackage{pgfplots}       % Plotting functions
```

Tables

```
\usepackage{tabularx}       % Flexible column width

\usepackage{longtable}      % Tables over pages

\usepackage{multirow}       % Merge rows

\usepackage{booktabs}       % Professional tables

\usepackage{colortbl}       % Colored tables
```

Bibliography

```
\usepackage{natbib}         % Citation styles

\usepackage[style=apa]{biblatex} % Modern bibliography
```

Code Listings

```
\usepackage{listings}      % Code listings

\usepackage{minted}        % Syntax highlighting
```

Other Useful Packages

```
\usepackage{hyperref}      % Hyperlinks

\usepackage{cleveref}      % Smart references

\usepackage{todonotes}     % Todo notes

\usepackage{lipsum}        % Dummy text

\usepackage{microtype}     % Typography improvements

\usepackage{csquotes}      % Context-sensitive quotes
```

Presentations with Beamer

Basic Structure

```
\documentclass{beamer}

\usetheme{Madrid}

\usecolortheme{beaver}


\title{Presentation Title}

\author{Author Name}

\date{\today}


\begin{document}
```

```
\begin{frame}

    \titlepage

\end{frame}


\begin{frame}{Outline}

    \tableofcontents

\end{frame}


\section{First Section}


\begin{frame}{Slide Title}

    \begin{itemize}

        \item First point

        \item Second point

        \item Third point

    \end{itemize}

\end{frame}


\begin{frame}{Math Example}

    \[ E = mc^2 \]

\end{frame}


\end{document}
```

Overlay Specifications

\begin{frame}{Incremental Reveal}

  \begin{itemize}

    \item<1-> Appears on first slide

    \item<2-> Appears on second slide

    \item<3-> Appears on third slide

  \end{itemize}

  \onslide<4->{This appears on fourth slide and onwards}

  \only<5>{This appears only on the fifth slide}

  \uncover<6->{This is invisible but takes space until 6th slide}

  \visible<7->{This is completely hidden until 7th slide}

\end{frame}

Blocks

\begin{frame}{Blocks}

  \begin{block}{Basic Block}

    Block content

  \end{block}

  \begin{alertblock}{Alert Block}

Important information

\end{alertblock}

\begin{exampleblock}{Example Block}

Example content

\end{exampleblock}

</frame>

Themes and Colors

% Themes

\usetheme{default}

\usetheme{Madrid}

\usetheme{Berlin}

\usetheme{Copenhagen}

\usetheme{Warsaw}

% Color themes

\usecolortheme{default}

\usecolortheme{beaver}

\usecolortheme{orchid}

\usecolortheme{whale}

\usecolortheme{seahorse}

% Font themes

\usefonttheme{default}

\usefonttheme{professionalfonts}

\usefonttheme{serif}

Columns

\begin{frame}{Columns}

  \begin{columns}

    \begin{column}{0.5\textwidth}

      Left column content

    \end{column}

    \begin{column}{0.5\textwidth}

      Right column content

    \end{column}

  \end{columns}

\end{frame}