LaTeX

Prof. Pranay Kumar Saha

March 19, 2025

What is LaTeX?

- LaTeX is a document preparation system
- Based on TeX (created by Donald Knuth in 1978)
- Focuses on content over formatting
- Excellent for:
  - Academic papers
  - Books and technical documentation
  - Mathematical formulas
  - Presentations (like this one!)
- Free and open-source

Basic Document Structure

Minimal LaTeX Document

```
\documentclass{article}

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

Key Components

- Preamble (before `\begin{document}`)
- Document body (between `\begin{document}` and `\end{document}`)
- Commands start with `\`
- Environments use `\begin{}` and `\end{}`

Document Classes

Common Document Classes

article	Scientific journals, presentations, short reports
report	Longer reports with chapters, dissertations
book	Books
letter	Letters
beamer	Presentations (like this one)

Syntax

```
\documentclass[options]{class}
```

Common options: `12pt`, `a4paper`, `twocolumn`

Basic Text Formatting

```
Normal text
\textbf{Bold text}
\textit{Italic text}
\underline{Underlined text}
\texttt{Monospaced text}
\textsf{Sans serif text}
\textsc{Small Caps text}

\emph{Emphasized text}
```

Normal text
Bold text
Italic text
Underlined text
`Monospaced text`
Sans serif text
SMALL CAPS TEXT
Emphasized text

Font Sizes

```
{\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 Enormous text}
```

{\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 Enormous text}

Paragraphs and Spacing

```
First paragraph. Lorem ipsum
dolor sit amet, consectetur
adipiscing elit.

Second paragraph. Line breaks
in your source code don't
create line breaks in output.

Line break with \\
creates a new line.
\vspace{1cm} Vertical space
\hspace{1cm} Horizontal space
```

First paragraph. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
Second paragraph. Line breaks in your source code don't create line breaks in output.
Line break with
creates a new line.

Vertical space
Horizontal space after indentation

Lists

Unordered List

```
\begin{itemize}
  \item First item
  \item Second item
    \begin{itemize}
      \item Nested item
      \item Another nested item
    \end{itemize}
  \item Third item
\end{itemize}
```

Unordered List

- First item
- Second item
  - Nested item
  - Another nested item
- Third item

Lists

Ordered List

```
\begin{enumerate}
  \item First item
  \item Second item
    \begin{enumerate}
      \item Nested item
      \item Another nested item
    \end{enumerate}
  \item Third item
\end{enumerate}
```

Ordered List

1. First item
2. Second item
   2.1 Nested item
   2.2 Another nested item
3. Third item

Lists

Description List

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

Description List

Term 1 Definition 1

Term 2 Definition 2

Math Mode

Inline Math

```
Einstein's famous equation
$E = mc^2$ revolutionized physics.

The quadratic formula is
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}
{2a}$
```

Inline Math

Einstein's famous equation $E = mc^2$ revolutionized physics.
The quadratic formula is
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Math Mode

Display Math

```
$$E = mc^2$$

or

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}
{2a} \]
```

Display Math

$$E = mc^2$$

or

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

Mathematical Symbols

```
$\alpha, \beta, \gamma, \Gamma$

$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$

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

$\lim_{x \to \infty} \frac{1}{x} = 0$

$\nabla \times \vec{F} =
\left( \frac{\partial F_z}{\partial y}
    -
\frac{\partial F_y}{\partial z} \right)
     \vec{i}$
```

$\alpha, \beta, \gamma, \Gamma$

$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$

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

$\lim_{x \to \infty} \frac{1}{x} = 0$

$\nabla \times \vec{F} = \left(\frac{\partial F_z}{\partial y} - \frac{\partial F_y}{\partial z} \right) \vec{i}$

Equation Environments

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

\begin{align}
  a &= b + c \\
  &= d + e \\
  &= f
\end{align}

\begin{cases}
  x + y = 2 \\
  x - y = 0
\end{cases}
```

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

$$\begin{aligned} a &= b + c && (2)\\ &= d + e && (3)\\ &= f && (4) \end{aligned}$$

$$\begin{cases} x + y = 2 \\ x - y = 0 \end{cases}$$

Tables

```
\begin{table}
\caption{Simple Table Example}
\begin{tabular}{|l|c|r|}
\hline
Left & Center & Right \\
\hline
Data & Data & Data \\
More data & More data & More data \\
\hline
\end{tabular}
\end{table}
```

Table: Simple Table Example

Left	Center	Right
Data More data	Data More data	Data More data

- `l` = left-aligned
- `c` = center-aligned
- `r` = right-aligned
- `|` = vertical line
- `\hline` = horizontal line

Figures

```
\begin{figure}
  \centering
  \includegraphics[width=0.7\textwidth]
    {image-filename.png}
  \caption{Figure caption text}
  \label{fig:example}
\end{figure}

Later, refer to Figure
\ref{fig:example}.
```

Key Points

- Use `graphicx` package
- `\includegraphics` inserts images
- Common image formats: PNG, JPG, PDF
- `\label` and `\ref` for cross-referencing
- Common options:
  - `width=0.8\textwidth`
  - `height=5cm`
  - `scale=0.5`
  - `angle=45`

LaTeX

Thank You for Listening!