

LaTeX for Mathematicians: A Comprehensive Guide

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1 Lesson 1: Introduction to LaTeX and Basic Document Structure

Objective

Understand the basics of LaTeX and how to create a simple document.

Topics Covered

- What is LaTeX and why it is used in mathematics.
 - Installation of LaTeX (e.g., TeX Live, MiKTeX, Overleaf).
 - Basic structure of a LaTeX document:

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

- Adding a title, author, and date using `\title`, `\author`, and `\date`.
- Compiling a document into PDF format.

Exercise

Create a simple document with a title, your name as the author, and today's date.

2 Lesson 2: Writing Mathematical Expressions

Objective

Learn how to write mathematical expressions in LaTeX.

Topics Covered

- Inline math mode: `$...$` or `\(...\)`. Example: $E = mc^2$.
 - Display math mode: `\[...\]` or `\begin{equation}...\end{equation}`. Example:

$$\int_0^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}.$$

- Common mathematical symbols: α , β , \sum , \prod , etc.
- Fractions: `\frac{numerator}{denominator}`. Example: $\frac{a}{b}$.

Exercise

Write the quadratic formula in display math mode.

3 Lesson 3: Equations and Numbering

Objective

Learn how to number and reference equations.

Topics Covered

- Using `\begin{equation}` to automatically number equations. Example:

$$F = ma \tag{1}$$

- Referencing equations using `\ref` or `\eqref`. Example: Equation (1) represents Newton's second law.

- Unnumbered equations with `\begin{equation*}`.

Exercise

Write and reference two numbered equations.

4 Lesson 4: Aligning Equations

Objective

Learn how to align multiple equations.

Topics Covered

- Using the `align` environment. Example:

$$x + y = 5, \tag{2}$$

$$x - y = 3. \tag{3}$$

- Aligning at specific points using `&`.
- Breaking long equations with `split`.

Exercise

Align three equations in a system.

5 Lesson 5: Matrices and Arrays

Objective

Learn how to create matrices and arrays.

Topics Covered

- Using `bmatrix`, `pmatrix`, `vmatrix`, etc. Example:

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

- Creating arrays with `array`. Example:

$$\begin{array}{cc} a & b \\ c & d \end{array}$$

Exercise

Create a 3×3 matrix.

6 Lesson 6: Theorems and Proofs

Objective

Learn how to define and use theorem-like environments.

Topics Covered

- Using `\newtheorem` to define custom environments. Example:

```
\newtheorem{theorem}{Theorem}
\begin{theorem}
This is a theorem.
\end{theorem}
```

- Writing proofs with `\begin{proof}... \end{proof}`.

Exercise

Define a lemma and write its proof.

7 Lesson 7: Lists and Enumerations

Objective

Learn how to create lists and enumerations.

Topics Covered

- Using `itemize` for bullet points.
 - Using `enumerate` for numbered lists.
 - Customizing lists with `enumitem`.

Exercise

Create a nested list.

8 Lesson 8: Figures and Graphics

Objective

Learn how to include figures and graphics.

Topics Covered

- Including images with `\includegraphics`.
- Using the `figure` environment for captions. Example:

```
\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{example-image}
\caption{An example image.}
\end{figure}
```

Exercise

Include an image with a caption.

9 Lesson 9: Tables

Objective

Learn how to create tables.

Topics Covered

- Using the `tabular` environment. Example:

```
\begin{tabular}{|c|c|}
\hline
A & B \\
\hline
1 & 2 \\
\hline
\end{tabular}
```

- Adding captions with `table`.

Exercise

Create a table with three rows and two columns.

10 Lesson 10: Advanced Topics

Objective

Explore advanced features of LaTeX.

Topics Covered

- Bibliography management with `biblatex`.
 - Cross-referencing with `\label` and `\ref`.
 - Custom commands with `\newcommand`. Example:

```
\newcommand{\R}{\mathbb{R}}
```

`\R^n` represents n -dimensional space.

Exercise

Define a custom command for the set of integers (\mathbb{Z}).