

CINEC Campus

Introduction to LaTeX with OverLeaf

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1 Introduction to LaTeX and Overleaf

1.1 What is LaTeX?

LaTeX (pronounced “Lay-tech” or “Lah-tech”) is a high-quality typesetting system. It is widely used for:

- Research papers
- Theses
- Technical reports
- Books
- Presentations

LaTeX is especially strong when handling documents that include:

- Mathematical equations
- Scientific notations
- References and bibliographies

Unlike traditional word processors (like Microsoft Word), LaTeX separates **content** from **formatting**, allowing you to focus on writing while LaTeX handles the document’s professional appearance.

1.2 Why Use LaTeX?

- **Professional Quality:** Produces neat, consistent, publication-quality documents.
- **Excellent for Mathematics:** Typeset complex equations with ease.
- **Cross-Platform:** Works on any device.
- **Version Control Friendly:** Plain text format is ideal for Git and backups.
- **Widely Accepted:** Standard in academia, especially in engineering, mathematics, physics, and computer science.

1.3 Real-World Applications

- Academic journals and conference papers
- Ph.D. dissertations
- Scientific posters
- Resumes and CVs
- Books and manuals

1.4 What is Overleaf?

Overleaf is an **online LaTeX editor** that:

- Runs completely in the browser
- Requires no software installation
- Allows real-time collaboration (like Google Docs for LaTeX)
- Compiles documents automatically and shows previews

1.5 Getting Started with Overleaf

1. Create a Free Account

- Visit <https://www.overleaf.com/>
- Sign up using email or a Google account

2. Explore the Interface

- Left side: Code editor
- Right side: PDF output preview
- Top bar: Project settings, file uploads, sharing options

3. Create Your First Project

- Click “New Project” > “Blank Project”
- Name your project (e.g., “First LaTeX Document”)

4. Run the First Compilation

- Overleaf automatically compiles when you save or can manually compile by clicking “Recompile”.

1.6 Key Features of Overleaf

- **Real-time preview** of changes
- **Collaboration:** Share your project with classmates and edit together
- **Rich Template Library:** Access templates for journals, resumes, reports
- **Backup Options:** Sync with GitHub, Dropbox, or download source files

Quick Example (First Look at LaTeX Code)

```
\documentclass{article}
\begin{document}
Hello, world! This is my first LaTeX document.
\end{document}
```

This simple code creates a fully compiled PDF with just three lines!

2 Basic LaTeX Document Structure

Every LaTeX document follows a specific structure, which includes:

1. **Document Class Declaration**
2. **Preamble** (optional settings and package imports)
3. **Document Body** (the main content)

A very basic LaTeX document looks like this:

```
\documentclass{article}
```

```
\begin{document}
```

```
Hello, this is my first LaTeX document!
```

```
\end{document}
```

2.1 Key Parts Explained

- `\documentclass{article}`
Defines the overall layout and style of the document.
Common classes:
 - `article` (for papers and short documents)
 - `report` (for longer documents like theses)
 - `book` (for full-length books)
- `\begin{document}` and `\end{document}`
Marks where the actual content starts and ends.
- Anything before `\begin{document}` is called the **preamble**.

2.2 Adding Sections and Paragraphs

Organizing your document with sections makes it readable and structured.

```
\section{Introduction}
```

```
This is the introduction paragraph.
```

```
\subsection{Background}
```

```
Some background information.
```

```
\subsubsection{Detailed Background}
```

```
Even more detailed information.
```

2.3 Common Commands

- `\section{}`: Creates a major section
- `\subsection{}`: Creates a subsection
- `\subsubsection{}`: Creates a smaller subsection

LaTeX automatically numbers sections and can create a table of contents if needed.

2.4 Creating New Paragraphs

Simply leave a blank line between two blocks of text.

Example:

This is the first paragraph.

This is the second paragraph.

2.5 Saving and Compiling in Overleaf

- In Overleaf, your LaTeX document is automatically compiled when you make changes.
- Click on the **Recompile** button if needed.
- Always check for errors at the top of the preview panel. Errors usually indicate missing brackets, typos, or unrecognized commands.

2.6 Hands-On Activity: Create Your First Document

Task:

- Create a new Overleaf project.
- Write a document with the following structure:
 - Title: *My First LaTeX Document*
 - A main section called *About Me*
 - A subsection called *Education*
 - A second main section called *My Hobbies*

Sample Code to Guide:

```
\documentclass{article}
\begin{document}
```

```
\section{About Me}
This is a short paragraph about me.
```

```
\subsection{Education}
Details about my educational background.
```

```
\section{My Hobbies}
```

List of hobbies and activities I enjoy.

`\end{document}`

3 Text Formatting and Lists

LaTeX provides simple commands to format your text professionally.

3.1 Bold Text

```
\textbf{This text is bold}
```

3.2 Italic Text

```
\textit{This text is italic}
```

3.3 Underlined Text

```
\underline{This text is underlined}
```

3.4 Quoted Text

For quotes, use:

```
\begin{quote}
This is a quoted paragraph.
\end{quote}
```

3.5 Special Characters

Certain characters are reserved in LaTeX and must be escaped using a backslash (\) if you want them to appear normally.

Character	How to write
#	\#
\$	\\$
%	\%
&	\&
_	_
{ }	\{ \}
~	\textasciitilde{ }
^	\textasciicircum{ }
\	\textbackslash{ }

Example:

5\% of the total cost

3.6 Lists in LaTeX

LaTeX makes it easy to create **itemized** (bulleted) and **enumerated** (numbered) lists.

3.7 Itemized List (Bullets)

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

3.8 Enumerated List (Numbers)

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

Nested lists:

```
\begin{itemize}
  \item Main bullet
    \begin{itemize}
      \item Sub-bullet
    \end{itemize}
\end{itemize}
```

3.9 Hands-On Activity: Formatting Text and Creating Lists

Task:

- Create a new Overleaf project or open your previous one.
- Write a paragraph about yourself using:
 - Bold for your name
 - Italic for your major/field of study
 - Underline for your hobbies
- Create two lists:
 - An itemized list of your favorite foods
 - An enumerated list of your top 3 skills

Sample Code to Guide:

```
\documentclass{article}
\begin{document}
```

My name is `\textbf{Jane Doe}`. I study `\textit{Mechanical Engineering}`.

My hobbies include `\underline{reading, hiking, and painting}`.

```
\section{Favorite Foods}
```

```
\begin{itemize}
```

```
  \item Pizza
```

```
  \item Sushi
```

```
  \item Ice Cream
```

```
\end{itemize}
```

```
\section{Top 3 Skills}
```

```
\begin{enumerate}
```

```
  \item Problem-solving
```

```
  \item Teamwork
```

```
  \item Public speaking
```

```
\end{enumerate}
```

```
\end{document}
```

4 Adding Mathematical Equations

LaTeX was originally built for typesetting mathematical content. It provides powerful tools to create beautiful mathematical expressions.

There are two main ways to include math:

- **Inline math** (inside a paragraph)
- **Display math** (separated and centered)

4.1 Inline Math

Inline math is written between dollar signs $\$ \dots \$$ inside a paragraph.

Example:

The area of a circle is given by $A = \pi r^2$ where r is the radius.

This renders math within the line of text.

4.2 Display Math

Display math is placed on its own line for better emphasis. Use either:

- Double dollar signs $\$ \dots \$$ (basic method)
- $\left[\dots \right]$ (preferred method)
- equation environment (for numbering)

Example (un-numbered display math):

```
\[
A = \pi r^2
\]
```

Example (numbered display math using equation):

```
\begin{equation}
A = \pi r^2
\end{equation}
```

4.3 Basic Math Symbols

Some commonly used math symbols in LaTeX are:

Symbol	Command
+	+
−	-
×	\times
÷	\div
=	=
≠	\neq
≈	\approx
<	<
>	>
≤	\leq
≥	\geq
π	\pi

4.4 Fractions, Powers, and Roots

4.4.1 Fractions

```
\[
\frac{a}{b}
\]
```

4.4.2 Powers (Exponents)

```
\[
x^2, \quad e^{i\pi} + 1 = 0
\]
```

4.4.3 Roots

```
\[
\sqrt{x}, \quad \sqrt[3]{x}
\]
```

4.5 Example: Writing a Quadratic Formula

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

4.6 Hands-On Activity: Simple Math Assignment

Task:

- Create a document with the following:
 - Write the formula for the area of a circle inline.
 - Write the formula for kinetic energy using display math.
 - Write the quadratic equation using the equation environment.

Sample Code to Guide:

```
\documentclass{article}  
\usepackage{amsmath}  
\begin{document}
```

The area of a circle is $A = \pi r^2$.

```
\[  
KE = \frac{1}{2}mv^2  
\]
```

```
\begin{equation}  
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}  
\end{equation}
```

```
\end{document}
```

5 Working with Tables and Figures

Tables and figures are essential for presenting structured data and visual content. LaTeX offers powerful tools to insert, format, and label them professionally.

5.1 Creating Tables

Tables in LaTeX are created using the `tabular` environment.

5.1.1 Basic Table

```
\begin{tabular}{|c|c|c|}
\hline
Header 1 & Header 2 & Header 3 \\
\hline
Row 1, Col 1 & Row 1, Col 2 & Row 1, Col 3 \\
Row 2, Col 1 & Row 2, Col 2 & Row 2, Col 3 \\
\hline
\end{tabular}
```

5.1.2 Explanation

- `|c|c|c|` means three centered columns, each separated by vertical lines.
- `\hline` creates horizontal lines.
- `\\` is used to end a row.

5.1.3 Adding a Table with Caption and Label

To properly manage tables in large documents, use the `table` environment:

```
\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
Item & Quantity \\
\hline
Apples & 5 \\
Oranges & 8 \\
\hline
\end{tabular}
\caption{Fruit Inventory}
\label{tab:fruit_inventory}
\end{table}
```

- `\caption{}` adds a title to the table. - `\label{}` assigns a reference label. - Use `\ref{tab:fruit_inventory}` to reference the table inside your document.

5.2 Inserting Figures (Images)

To insert images, use the `graphicx` package. Add this in the preamble:

```
\usepackage{graphicx}
```

5.2.1 Basic Figure

```
\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{example-image}
\caption{Sample Image}
\label{fig:sample_image}
\end{figure}
```

5.2.2 Explanation

- `\includegraphics[width=0.5\textwidth]{filename}`: Adjust image size relative to text width.
- `\caption{}`: Adds a title below the image.
- `\label{}`: Allows referencing the figure.

Note: The image file must be uploaded to Overleaf, and the name should match (without file extension if it's a .pdf, .png, or .jpg).

5.2.3 Referencing Figures

You can refer to a figure in your text using:

As shown in Figure~\ref{fig:sample_image}, the result is clear.

5.3 Hands-On Activity: Create a Table and Insert an Image

Task:

- Create a table of your favorite books and their authors.
- Insert an image (any sample image) with a caption.

Sample Code to Guide:

```
\documentclass{article}
\usepackage{graphicx}
\begin{document}

\section{My Favorite Books}

\begin{table}[h]
\centering
```

```

\begin{tabular}{|l|l|}
\hline
Book Title & Author \\
\hline
The Alchemist & Paulo Coelho \\
1984 & George Orwell \\
\hline
\end{tabular}
\caption{List of Favorite Books}
\label{tab:books}
\end{table}

\section{Sample Image}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{example-image}
\caption{An Example Image}
\label{fig:example}
\end{figure}

\end{document}

```

6 Basic Document Customization

Customizing your LaTeX document helps you create a polished, professional appearance. In this section, we'll learn how to add a title, author, date, and customize the look using document classes and packages.

6.1 Adding Title, Author, and Date

You can define the title, author, and date at the beginning of your document using specific commands.

Example:

```
\title{My First LaTeX Document}
\author{John Doe}
\date{April 28, 2025}
```

Then, after `\begin{document}`, use `\maketitle` to display them:

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

If you want to omit the date, use:

```
\date{}
```

6.2 Changing Document Classes

The document class defines the overall structure of your document. Common classes include:

- `article`: Default for short documents, papers, assignments.
- `report`: Suitable for longer documents like theses or technical reports.
- `book`: Best for writing books.

Example:

```
\documentclass{report}
```

You can also add options inside square brackets:

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

Where:

- `12pt`: Sets font size.
- `a4paper`: Sets paper size.

6.3 Adding Useful Packages

Packages extend the functionality of LaTeX. Add them in the preamble using `\usepackage{}`.

6.3.1 Common Packages

- `graphicx`: Insert images.
- `amsmath`: Advanced math formatting.
- `hyperref`: Create clickable links.
- `geometry`: Customize page size and margins.
- `fancyhdr`: Create custom headers and footers.

Example:

```
\usepackage{graphicx}
\usepackage{amsmath}
\usepackage{hyperref}
\usepackage{geometry}
\usepackage{fancyhdr}
```

6.4 Hands-On Activity: Customize Your Document

Task:

- Create a document with:
 - A custom title, author name, and today's date.
 - Use the `report` document class.
 - Add at least two packages: `graphicx` and `amsmath`.
 - Insert a title page using `\maketitle`.

Sample Code to Guide:

```
\documentclass[12pt]{report}
\usepackage{graphicx}
\usepackage{amsmath}

\title{Exploring LaTeX Customization}
\author{Jane Student}
\date{April 28, 2025}

\begin{document}

\maketitle

\chapter{Introduction}
This document demonstrates basic customization in LaTeX.

\end{document}
```

7 Creating a Professional Document Structure

In this section, we learn how to create professional-quality LaTeX documents. We'll structure the document with:

- A4 paper size
- Cover page
- Table of contents
- List of figures
- List of tables
- Proper page numbering

7.1 Setting the Paper Size to A4

When starting your LaTeX document, specify A4 paper size:

```
\documentclass[a4paper,12pt]{report}
```

Or use the 'geometry' package for more control:

```
\usepackage[a4paper, margin=1in]{geometry}
```

7.2 Creating a Cover Page

Create a dedicated cover page using the 'titlepage' environment:

```
\begin{titlepage}
  \centering
  \vspace*{2cm}
  {\Huge\bfseries Document Title\par}
  \vspace{1.5cm}
  {\Large Author: Your Name\par}
  \vspace{1cm}
  {\Large Date: \today\par}
  \vfill
  {\large Institution Name\par}
\end{titlepage}
```

Use `\vspace*{}` to adjust vertical spacing. Include logos using `\includegraphics{}`.

7.3 Adding a Table of Contents

After your title page and before your main content, add:

```
\tableofcontents
```

> Note: Compile the document twice to update the table correctly.

7.4 Adding a List of Figures and Tables

Insert these commands:

```
\listoffigures
```

```
\listoftables
```

Place them after `\tableofcontents`. but before the main chapters.

7.5 Managing Page Numbering

Use Roman numerals for the front matter and Arabic for the main content:

Roman for front matter:

```
\pagenumbering{roman}
```

Arabic for main content:

```
\newpage
```

```
\pagenumbering{arabic}
```

7.6 Using Hyperlinks for Navigation

Add this package:

```
\usepackage{hyperref}
```

This will automatically create clickable Table of Contents, figure references, and table references.

You can also manually insert hyperlinks:

```
\href{https://www.overleaf.com}{Visit Overleaf}
```

This creates a clickable text `Visit Overleaf` linking to Overleaf website.

7.7 Complete Sample Document

Here is a complete professional LaTeX document example about Magnetic Cooling:

```
\documentclass[a4paper,12pt]{report}
```

```
\usepackage[a4paper, margin=1in]{geometry}
```

```
\usepackage{graphicx}
```

```
\usepackage{amsmath}
```

```
\usepackage{hyperref}
```

```
\title{Magnetic Cooling and the Magnetocaloric Effect}
```

```

\author{Your Name}
\date{\today}

\begin{document}

\begin{titlepage}
  \centering
  \vspace*{2cm}
  {\Huge\bfseries Magnetic Cooling and the Magnetocaloric Effect\par}
  \vspace{1.5cm}
  {\Large Author: Your Name\par}
  \vspace{1cm}
  {\Large Date: \today\par}
  \vfill
  {\large A LaTeX Project\par}
\end{titlepage}

\pagenumbering{roman}
\tableofcontents
\listoffigures
\listoftables

\newpage
\pagenumbering{arabic}

\chapter{Introduction to Magnetic Cooling}
Magnetic cooling is a technology based on the magnetocaloric effect (MCE),
where certain materials heat up when magnetized and cool down when removed
from a magnetic field.

For more information, visit \href{https://en.wikipedia.org/wiki/Magnetocaloric_effect}
{Magnetocaloric Effect on Wikipedia}.

\chapter{Magnetocaloric Effect}
\section{Basic Principle}
The magnetocaloric effect can be described as:

\[
\Delta T = - \frac{T}{C} \left( \frac{\partial S}{\partial B} \right)_T \Delta B
\]

where  $\Delta T$  is the change in temperature,  $T$  is the temperature,  $C$ 
is the heat capacity,  $S$  is the entropy, and  $B$  is the magnetic field.

\section{Applications}
\begin{itemize}
  \item Refrigeration without harmful gases
  \item Energy-efficient cooling systems
\end{itemize}

\chapter{Material Examples}

```

```

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
Material & Temperature Range (K) \\
\hline
Gadolinium (Gd) & 293-320 \\
La-Fe-Si alloys & 250-300 \\
Mn-based alloys & 200-250 \\
\hline
\end{tabular}
\caption{Materials Exhibiting Magnetocaloric Effect}
\label{tab:materials}
\end{table}

\chapter{Magnetic Cooling Device}
\begin{figure}[h]
\centering
\includegraphics[width=0.6\textwidth]{example-image}
\caption{Conceptual diagram of a magnetic cooling device.}
\label{fig:magnetic_cooling}
\end{figure}

\chapter{Conclusion}
Magnetic cooling offers a promising, eco-friendly alternative to conventional refrigeration.

\end{document}

```

This LaTeX document is available [here](#). First go to the menu and copy the project before starting editing.

8 Real-World Examples and Templates

Once you are comfortable with the basics of LaTeX, using templates can save you significant time and effort. Overleaf provides a large collection of free templates for different types of documents.

8.1 Why Use Templates?

- **Save Time:** No need to format everything manually.
- **Professional Appearance:** Templates follow best practices and industry standards.
- **Focus on Content:** You can concentrate on writing instead of worrying about styling.
- **Accepted Formats:** Many institutions require documents in specific LaTeX formats (especially journals, universities).

8.2 Common Template Types

- Resumes and CVs
- Research Papers
- Theses and Dissertations
- Technical Reports
- Presentations (Beamer)
- Posters for Conferences

8.3 How to Find and Import Templates in Overleaf

1. Go to [Overleaf Templates Gallery](#).
2. Browse or search for a specific template (e.g., “Resume”, “IEEE Paper”, “Master’s Thesis”).
3. Click “Open as Template”.
4. It will automatically create a new project with the template.

You can now edit the sample content to suit your needs!

8.4 Popular Real-World Templates to Explore

- **Academic Journal Template:** IEEE, ACM, Elsevier journal templates.
- **Thesis Templates:** University-specific thesis templates (e.g., University of Cambridge, MIT).

- **Resume Templates:** ModernCV, AwesomeCV.
- **Conference Poster Templates:** Templates that use the beamerposter class.
- **Presentation Templates:** Using beamer class for LaTeX presentations.

8.5 Hands-On Activity: Explore a Template

Task:

- Open Overleaf.
- Search for a “ModernCV” or “Resume” template.
- Open it as a new project.
- Identify how the template uses sections, commands, and packages.

9 Resources

Here are some useful resources to learn more about LaTeX:

- [Overleaf Official Documentation](#) — Beginner to advanced LaTeX tutorials.
- [LaTeX Wikibook](#) — A detailed, open-source LaTeX reference.
- [Detexify](#) — Draw a symbol and find the LaTeX code.
- [CTAN \(Comprehensive TeX Archive Network\)](#) — Official repository of LaTeX packages.
- [LaTeX Math Symbols Reference](#) — Extensive list of math symbols.
- [Why You Should Use LaTeX Instead of MS Word for Technical Writing](#) — A detailed comparison between MS Word and LaTeX.
- [LaTeX – Full Tutorial for Beginners](#) — A YouTube tutorial from freecodecamp covering the basics of LaTeX.
- [Install LaTeX Workshop and compile PDF in VSCode](#) — A YouTube tutorial covering the installation of LaTeX Workshop in VSCode - Windows.

Tip: Bookmark these links for quick access while working on your LaTeX documents!