Support of Mathematical Writing through LaTeX

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Slides prepared with assistance from ChatGPT 5.

Why LaTeX?

- High-quality typesetting highly customizable for math.

  Lots of "packages" and "classes" for math symbols, style, diagrams, etc.

- Encourages structure.

  You focus on content and meaning; let LaTeX handle the formatting.

- Universal *standard* for math publications.

  Standard for math journals, collaborations, webpages (via MathJax).

- Works in the browser via **Overleaf** — no local setup.

  ↓

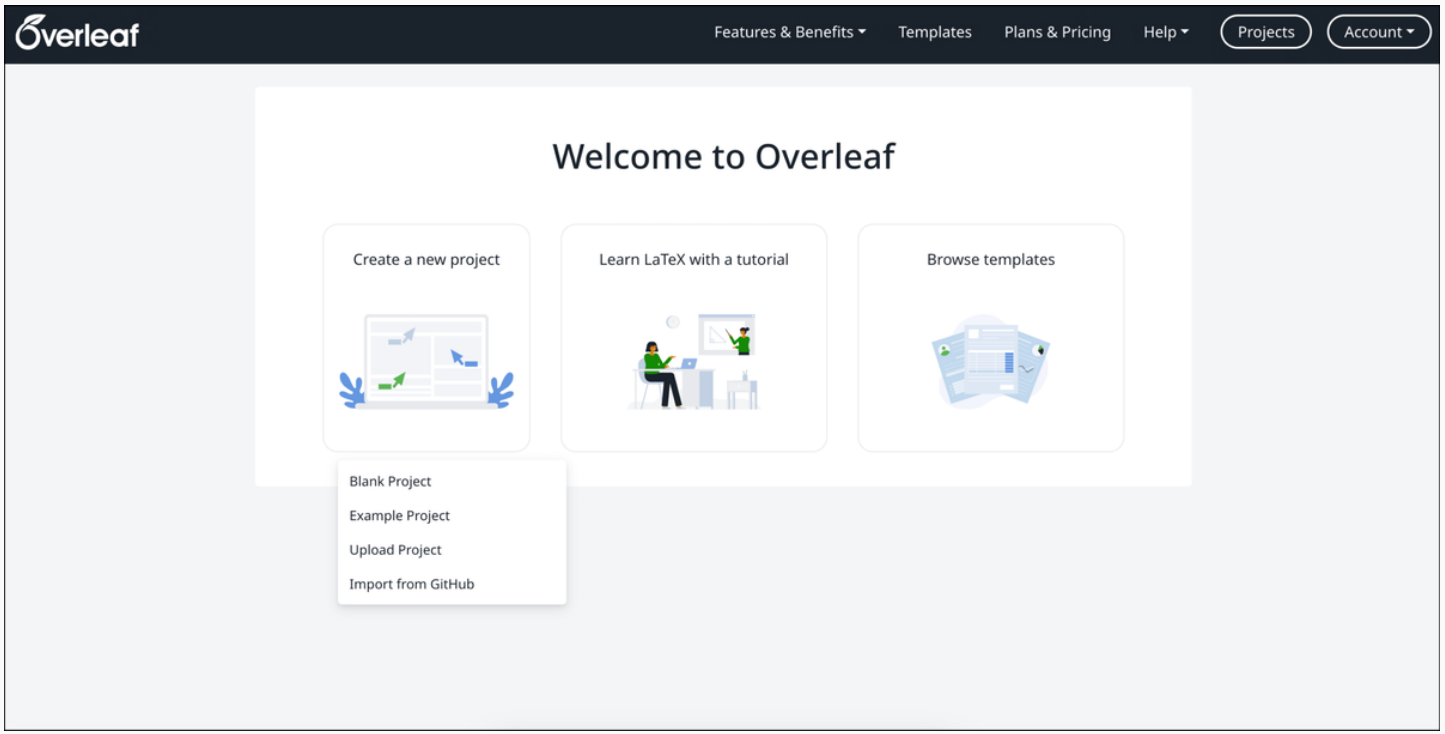
  `https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes`

  You may also choose to use LaTeX locally without Overleaf.
  In that case, create a plain text file and name it with extension `.tex`

Getting started with Overleaf

1. Go to `overleaf.com`.
2. Enter your email address, set a password and sign up.

   ETH offers a premium subscription to students.
3. Create new project, edit your source file, and compile.



Workflow

You write plain text interspersed with LaTeX commands.
A LaTeX command starts with "\", called a *backslash*.

Overleaf *suggests command completions and warns about mismatches.*

↓

Overleaf compiles and previews results as PDF.

↓

Often you have to debug.

No panic: check LaTeX error hints, like "undefined control sequence",
handle errors in order, concentrate on shorter paper segments,
errors are often mistyped commands or mismatched brackets.

A minimal LaTeX document

Input

```
\documentclass{article}

\begin{document}
Math Writing % your content goes here...
\end{document}
```

Output

Math Writing

- Every document begins with `\documentclass{...}`, which controls the overall appearance of the document.
- The main content goes between `\begin{document}` and `\end{document}`, and is called the **body**.
- The part before `\begin{document}` is called **preamble**, and specifies aspects of your setup.
- A percent sign % starts a *comment*:
  LaTeX ignores what is typed thereafter in that line.

A minimal LaTeX document, cont.

Input

```
\documentclass{article}

\begin{document}
We define the exponential $e^x$ as
\[
  e^x := \sum_{n=0}^{\infty} \frac{x^n}{n!}.
\]
\end{document}
```

Output

We define the exponential e^x as

$$e^x := \sum_{n=0}^{\infty} \frac{x^n}{n!}.$$

- To typeset **inline** math formulas use delimiter pairs `\(` ... `\)` or `$` ... `$`.
- To typeset **displayed** math formulas use `\[` ... `\]` or `\begin{equation}` ... `\end{equation}`.
- Math commands are mostly self-explanatory, for instance, `\sum` for $\sum$, `\int` for $\int$, `\frac{m}{n}` for $\frac{m}{n}$.
- Consult symbol lists for math symbols or consider Overleaf suggestions.

A minimal LaTeX document, cont.

Input

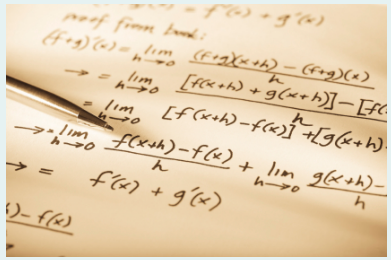
```
\documentclass{article}

\begin{document}
\begin{itemize}
\item Blackboard bold gives   $\mathbb{C}$.
\item Compare \textbf{F} with $\mathcal{F}$.
\end{itemize}
\end{document}
```

Output

- Blackboard bold gives $\mathbb{C}$.
- Compare **F** with $\mathcal{F}$.

```
\documentclass{article}
\usepackage{graphicx}
\begin{document}
\begin{figure}
\includegraphics[width=2cm]{scribble}
\end{figure}
\end{document}
```



- There are many font types for math and normal text.
- Multiple spaces in input collapse to single space in output.
- Avoid blank lines *inside* math environments.

  Outside math, blank lines in input yield a new paragraph in output.

Preamble

Common **document classes**:

- `article` — for short papers, homework, reports
- `amsart` — similar to `article` but conforming to AMS journal style
- `report` — for theses, longer documents
- `book` — for books, monographs
- `beamer` — for presentations

These are customizable. E.g.

- `\documentclass[amssymb,twoside,12pt]{amsart}`
- `\documentclass[11pt,a4paper]{report}`
- `\documentclass[handout]{beamer}`

Curly brackets `{...}` *enclose the required argument for the command.*

Square brackets `[...]` *enclose optional customizing arguments.*

Preamble, cont.

Load useful **packages** after the document class:

- `\usepackage{tikz}` **for** diagrams and figures
- `\usepackage[german]{babel}` writing in German
- `\usepackage{amsmath, amsthm, amssymb}`
  standard for formulas, environments and symbols
- `\usepackage{hyperref}` cross-references and hyperlinks
  Warning: `hyperref` should be listed last.

You may add your own **macros** for convenience. E.g.

`\def \CC {{\mathbb C}}` so that `$\CC$` yields "$\mathbb{C}$".

You may collect your macros in a separate file, perhaps called `macro.tex`, and then import it in the preamble with `\input{macro}`.

Preamble, cont.

For defining **title, author and date** add to **preamble**:

- `\title{My Paper 1}`
- `\author{Firstname Lastname}`
  `\author{First Last\thanks{Supported by ETH.}}`
- `\date{October 2025}`
  `\date{\today}`

For the title, author and date to actually be typeset, add

`\maketitle`

to the **body** of the document.

Special characters

The following characters have special meanings in LaTeX:

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

To have them actually typed need "escaping":

```
\$   \&   \%   \#   \_   \{   \}
```

Names: dollar, ampersand, percent, hash, underscore and curly brackets.

```
\textasciitilde \textasciicircum \textbackslash
```

E.g.

`$p(x) = x^3 +\pi x^2 - \mu$` gives $p(x) = x^3 + \pi x^2 - \mu$.

`$F_n = F_{n-1} + F_{n-2}$` gives $F_n = F_{n-1} + F_{n-2}$.

`$\int_a^b f(t) \, dt$` gives $\int_a^b f(t)\, dt$.

Quotation marks

For quotation marks, use a *backtick* on the left and an *apostrophe* on the right:

```
‘single quotes’   and   ‘‘double quotes’’
```

⟶ ‘single quotes’ and “double quotes”

Environments

The `\begin{...}` and `\end{...}` commands create different *environments*, i.e., contexts. E.g. lists:

Bulleted

```
\begin{itemize}
  \item $\cos(x)$
  \item $\sin(x)$
\end{itemize}
```

- $\cos(x)$
- $\sin(x)$

Numbered

```
\begin{enumerate}
  \item $\omega$
  \item $\Omega$
\end{enumerate}
```

1. ω
2. Ω

Environments, cont.

`equation` environment gives **numbered displayed math**.

```
\begin{equation}
   \int_{-\infty}^{+\infty} e^{-\pi x^2}dx=1
\end{equation}
```

$$\int_{-\infty}^{+\infty} e^{-\pi x^2} dx = 1 \tag{1}$$

`amsmath` provides the unnumbered version `equation*`, aligned equations `align` or `align*`, operators, etc.

```
\begin{align*}
    a &= b \\
    &= c.
\end{align*}
```

$$\begin{aligned} a &= b \\ &= c. \end{aligned}$$

Environments, cont.

```
\begin{theorem}[Wiles, 1994]\label{th-wiles}
  If $n\geq 3$ and $x$, $y$, $z$ are integers
  such that $x^n+y^n=z^n$,\\ then $xyz=0$.
\end{theorem}
\begin{proof}\dots\end{proof}
```

Theorem (Wiles, 1994)

If $n \geq 3$ and x, y, z are integers such that $x^n + y^n = z^n$, then $xyz = 0$.

Proof.

...

□

Other theorem-like environments may be defined using the `amsthm` *package.*
E.g. `\newtheorem{definition}{Definition}`.
E.g. `\newtheorem{corollary}{Corollary}`.

More LaTeX later on

1. special symbols
2. diagrams, graphs, figures
3. complex formulas, tables
4. bibliography, cross-referencing
5. links, footnotes
6. tables of contents, indexes, glossaries

   etc.

There are thousands of **templates** online.

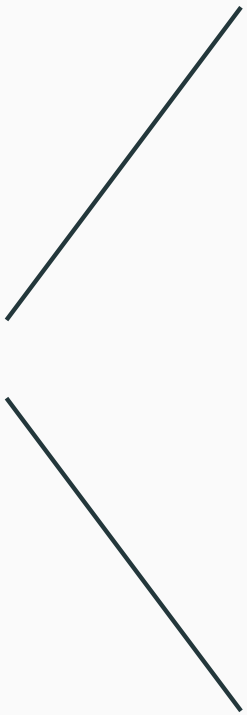
A LaTeX template is a LaTeX file that defines the layout and style of a particular document type, to be used as a base file for authors to simply add content, to obtain standardised or preferred appearance.

Convenience with Overleaf

- Easy back and forth between source and output/PDF:
  click → or ←
- Easy debugging and first language reviewing:
  click error symbol by line number
  choose AI model in bar above code
- Easy share with collaborators to work simultaneously.
  File history may be used to track changes or revert to old version.
- Multiple files (figures, `bib` file, ...) listed left in *file tree*.
  Can hide or show the file tree.

See live demo...

Homework for 1/Oct – not to turn in



Option A:

Go through about half of the numbered parts of Exercises 5.5, 5.8 and 6.1 of Vivaldi's book.

Option B:

Create your own LaTeX template for Paper 1, eventually by adjusting a template on Overleaf.

Anticipate homework for 8/Oct

Start typing in with LaTeX your chosen **definition or theorem** for **Paper 1**.

More resources online will be introduced in the next lecture.