

The L^AT_EX Document Preparation System

A Brief Introduction and the Essentials
for Lab Report Writers

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Outline

Preface

1 Introduction

- What is L^AT_EX?
 - Why L^AT_EX?

2 Breaking Down a Document

- The Bare Minimum
 - General Organization
 - Environments

3 The Good Stuff

- Math
 - Figures and Tables
 - Bibliographies

Preface

- This presentation **can't** and **won't** cover everything.
- But **that's okay**, because there are *TONS* of other resources available:
 - <https://tex.stackexchange.com/>
 - https://www.overleaf.com/learn/latex/Main_Page
 - <https://www.latex-project.org/help/documentation/>
 - Generally, searching for “`latex <your problem>`” will turn up a solution, or at least put you on the right track
 - Your friends and colleagues! (POA might be a spot to find some people well versed in `LATEX`)

What is L^AT_EX?

- Not a word processor, but a “document preparation system for high-quality typesetting” [1]
- /'la:tɛx/ “LAH-tekh” or /'leɪtɛx/ “LAY-tekh”
- ~~WYSIWYG~~ vs WYSIWYM
 - Most commands are self explanatory

Example

- \newpage
- \maketitle
- \usepackage{geometry}

- Online or offline
 - I recommend [Overleaf](#) for beginners.

Why L^AT_EX?

- Global presence
- Wide range of applications
 - Scientific documents
 - Books
 - Reports
 - Presentations
 - Posters
- Free and open source
 - Free speech
 - Endless applications with user written packages
- Style and content separated
 - Templates

Hello World

Saving four short lines as a `.tex` file and compiling to `.pdf` is all it takes to implement this ubiquitous program in \LaTeX .

Example

```
Hello, World!
```

```
1 \documentclass{article}
2 \begin{document}
3 Hello, World!
4 \end{document}
```

Hello World

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Example

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```

```
1 \documentclass{article}
2 \begin{document}
3 Hello, World!
4 \end{document}
```

Common document classes include:

- article – most common, for short documents and journal articles
- report – for longer documents
- book – self explanatory
- letter – also self explanatory
- beamer – presentations like this one

The Preamble - Adding a Title

Example

First \LaTeX Document
The beginning

Your Name

August 1, 2022

Your \LaTeX document now has a title, author, and date.

```
1  \documentclass[12pt]{article}
2  % ----- Begin preamble -----
3  % Add comments with '%'. This comment
   is part of the preamble
4  \title{First \LaTeX{} Document}
5  \subtitle{The beginning}
6  \author{Your Name}
7  \date{\today}
8  % ----- End Preamble -----
9  \begin{document}
10 \maketitle
11 Your \LaTeX{} document now has a title
   , author, and date.
12 \end{document}
```

The Preamble - Using Packages

Example

```
\documentclass[12pt,letterpaper]{article}
% Add extra (optional) options in [square brackets] when including packages
% and running other commands
\usepackage[utf8]{inputenc} % Change your font encoding
\usepackage[margin=1in]{geometry} % Setup geometry (often used to change
% margins)
% Make links look nice
\usepackage{color}
\usepackage[colorlinks, linktocpage, linktoc=all, urlcolor=blue, linkcolor
=blue, citecolor=red]{hyperref}
\usepackage{graphicx} % Necessary to include images
\usepackage{float} % Add options for controlling content in Figures/
% Tables
\usepackage{amsmath} % Math/equation support package from the AMS
\usepackage{amssymb} % Additional mathematical symbols
\usepackage{enumerate} % Adds options for lists
\usepackage{braket} % Adds commands for Dirac notation
```

General Organization - (Sub)Sections

- `\section{Section name}`
- `\subsection{Subsection name}`
- `\subsubsection{Subsubsection name}`
- All automatically numbered, and will show up in the table of contents when using `\tableofcontents`
- Can `\label{label_name}` and `\ref{label_name}` dynamically later

Text

Example

Between (sub)section headings is all of your text. I recommend starting a new line in the .tex document for each sentence to facilitate resolving any issues later. The proper way to make a quotation is to use "two graves and two single quotes" rather than the usual "double quotes". Möst accéñts hâvê shôrtcûts. **Bold**, underlined, and *italics* are also easy. Use a '\ to escape special characters like \$, %, and &.

- 1 Between (sub)section headings is all of your text.
- 2 I recommend starting a new line in the \texttt{.tex} document for each sentence to facilitate resolving any issues later.
- 3 The proper way to make a quotation is to use ``two graves and two single quotes'', rather than the usual "double quotes".
- 4 M\"ost acc\'e\nts h\`av\^e sh\=ortc\uts.
- 5 \textbf{Bold}, \underline{underlined}, and \emph{italics} are also easy.
- 6 Use a '\textbackslash' to escape special characters like \\$, %, and &.

Environments

Environments show up literally everywhere. I've already shown the highest level and most basic environment, which demonstrates the consistent structure:

Example

```
\begin{document}
%
% --- Document space ---
%
Hello, World!
%
% --- Still part of the document ---
%
\end{document}
```

Environments - Abstract

Example

Abstract

Use the abstract environment to provide an overview of your report

```
1 \begin{abstract}  
2 Use the abstract environment to  
3   provide an overview of your report  
4 \end{abstract}
```

Environments - Itemize/Enumerate

Example

- 0 First item
- 0 Second item
 - With a sub-item
 - And another one
- 0 Third item

```
1 \begin{enumerate}
2   \item First item
3   \item Second item
4   \begin{itemize}
5     \item With a sub-item
6     \item And another one
7   \end{itemize}
8   \item Third item
9 \end{enumerate}
```

Math - Don't Do This

Example

Inline $2+2=4$ and $\backslash\omega$ math vs. display math:

$$\forall n \geq 3 \in \mathbb{N}, \exists a, b, c \in \mathbb{N} \text{ such that } a^n + b^n = c^n \quad (0)$$

A derivation:

$$\hat{H} |\Psi(x)\rangle = E |\Psi(x)\rangle \quad (0)$$

$$\left[\frac{-\hbar^2}{2m} \nabla^2 + \frac{1}{2} m \omega^2 x^2 \right] |\Psi(x)\rangle = E |\Psi(x)\rangle \quad (0)$$

$$\Rightarrow \dots \Rightarrow E = \hbar\omega \left(n + \frac{1}{2} \right) \quad (0)$$

```
1  Inline 2+2=4 and \textbackslash omega
2   math vs. display math:
3   \begin{equation}
4     \forall n \geq 3 \in \mathbb{N}, \exists a, b, c \in \mathbb{N} \text{ such that } a^n + b^n =
5       c^n
6   \end{equation}
7   A derivation:
8   \begin{equation}
9     \hat{H} |\Psi(x)\rangle = E |\Psi(x)\rangle
10  \end{equation}
11  \begin{equation}
12    \left[ \frac{-\hbar^2}{2m} \nabla^2 + \frac{1}{2} m \omega^2 x^2 \right] |\Psi(x)\rangle = E |\Psi(x)\rangle
13  \end{equation}
```

Math - Correct

Example

Inline $2 + 2 = 4$ and ω math vs. display math:

$$\forall n \geq 3 \in \mathbb{N}, \nexists a, b, c \in \mathbb{N} \text{ s.t. } a^n + b^n = c^n$$

Align multiple equations for derivations:

$$\hat{H} |\Psi(x)\rangle = E |\Psi(x)\rangle$$
$$\left[\frac{-\hbar^2}{2m} \nabla^2 + \frac{1}{2} m \omega^2 x^2 \right] |\Psi(x)\rangle = E |\Psi(x)\rangle$$
$$\implies \dots \implies E = \hbar \omega \left(n + \frac{1}{2} \right)$$

```
1   Inline $2+2=4$ and $\omega$ math vs
2   . display math:
3   \begin{equation*}
4   \forall n \geq 3 \in \mathbb{N}, \nexists a, b, c \in \mathbb{N} \text{ s.t. }
5   . a^n + b^n = c^n
6   \end{equation*}
7   Align multiple equations for
8   derivations:
9   \begin{aligned}
10  \hat{H} |\Psi(x)\rangle &= E |\Psi(x)\rangle \\
11  \left[ \frac{-\hbar^2}{2m} \nabla^2 + \frac{1}{2} m \omega^2 x^2 \right] |\Psi(x)\rangle &= E |\Psi(x)\rangle \\
12  \implies \dots \implies E &= \hbar \omega \left( n + \frac{1}{2} \right)
13  \end{aligned}
```

<http://detexify.kirelabs.org/classify.html>

- Draw the symbol you want and it will give you the command

Figures

Example

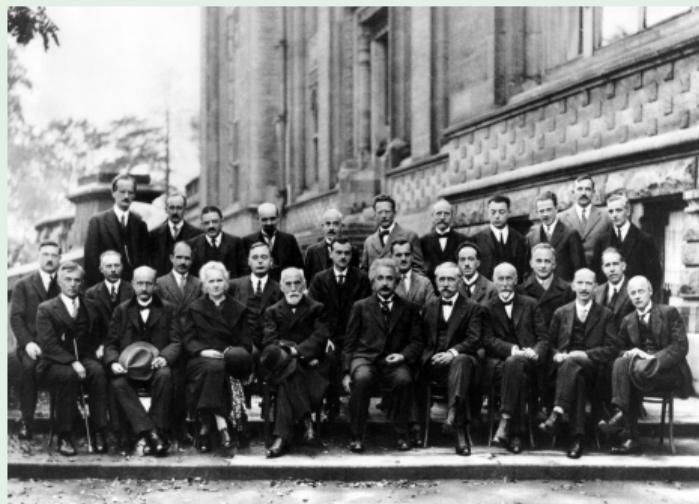


Figure: The 5th Solvay conference, 1927

```
1 \begin{figure}[H] % "Put figure HERE"
2 \centering
3 \includegraphics[width=0.9\columnwidth]
4   ]{Solvay_conference_1927.jpg}
5 \caption{The 5\textsuperscript{th}
6   Solvay conference, 1927}
7 \label{fig:solvay} % label for later
8   reference
9 \end{figure}
```

Tables

Example

Lens	Big Biconvex	Small Biconvex	Plano-convex
Focal Length [mm]	50	56	97
Uncertainty [mm]	8	6	5

Table: Reported focal lengths (in mm) of the three indicated lenses, along with one std deviation uncertainty.

```
1 \begin{table}[H] % "Put table HERE"
2 \centering
3 \def\arraystretch{2}
4 \resizebox{0.9\columnwidth}{!}{%
5 \begin{tabular}{@{}cccc@{}}
6 \toprule
7 Lens & Big Biconvex & Small Biconvex &
8 Plano-convex \\ \midrule
9 Focal Length [mm] & 50 & 56 & 97 \\
10 Uncertainty [mm] & 8 & 6 & 5 \\ \bottomrule
11 \end{tabular}%
12 \caption{Reported focal lengths (in mm
13 ) of the three indicated lenses,
14 along with one std deviation
15 uncertainty.}%
16 \label{tbl:focalLengths}
17 \end{table}
```

\LaTeX Table Generator

http://www.tablesgenerator.com/latex_tables

- Paste table data from a spreadsheet; automatically convert to \LaTeX .

Bibliographies

Example

```
\usepackage[backend=bibtex,  
style=numeric,%https://www.overleaf.com/learn/latex/Biblatex\_citation\_styles  
bibencoding=ascii  
]{biblatex}  
  
\addbibresource{references.bib}  
  
\printbibliography
```

Reference file

Example

```
article{einstein05,
  author = "Albert Einstein",
  title = "{Zur Elektrodynamik bewegter K\"orper}. ({German})
            [{On} the electrodynamics of moving bodies]",
  journal = "Annalen der Physik",
  volume = "322",
  number = "10",
  pages = "891--921",
  year = "1905",
  DOI = "http://dx.doi.org/10.1002/andp.19053221004"
}

\cite{einstein05}
```

For Further Reading

-  *An introduction to LaTeX.* 2019. URL:
<https://www.latex-project.org/about/>.
-  *Creating a document in LaTeX.* 2019. URL: https://www.overleaf.com/learn/latex/Creating_a_document_in_LaTeX.
-  *Learn LaTeX in 30 minutes.* 2019. URL:
https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes.

Workshop Exercise¹



<https://www.overleaf.com/read/kvmzsjqnkfth>

¹Thanks to Garrett Beals for his help in creating this exercise!

Workshop Exercise (Solution)



<https://www.overleaf.com/read/gxpsrdktbmtp>

Example Lab Report



<https://www.overleaf.com/read/pfvhcdvtbcvm>

These Presentation Slides



<https://www.overleaf.com/read/tfdbzdbgqtvn>