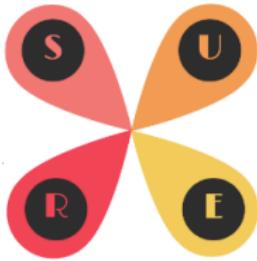


SURE L^AT_EX Tutorial

Yuhan Ding, Yuanxing Cheng

Department of Applied Math
Illinois Institute of Technology

May 29, 2024



Outline

- 1 Intro To \LaTeX
- 2 Tips to start your first \LaTeX project
- 3 How to cite
- 4 Tips to finish your first \LaTeX project
- 5 Tips on using Beamer
- 6 Conclusion



What is L^AT_EX¹

- A document preparation system
- Features designed for the production of technical and scientific documentation
 - mathematical equations
 - cross referencing
 - tons of packages to meet different needs
- De facto standard for the communication and publication of scientific documents
- An open-source software (**free!!!**)
- **NOT** What-You-See-Is-What-You-Get

¹From The L^AT_EX Project Website www.latex-project.org



One example

```
\documentclass[11pt]{article}
\usepackage{mathrsfs}
\usepackage{amsfonts}
\usepackage{amssymb, amsmath, amsthm, graphicx}
\usepackage{hyperref, multirow, enumerate}
\setlength{\oddsidemargin}{0.0cm} \setlength{\evensidemargin}{0.0cm}
\setlength{\topmargin}{-20mm} \advance\headheight by 2pt
\setlength{\footskip}{8mm} \setlength{\textheight}{165mm}
\advance\textheight by-\headheight \advance\textheight by-\headsep
\setlength{\textwidth}{165mm}
\setlength{\parindent}{0pt}
\def\baselinestretch{1.0}
\pagenumbering{arabic} \pagestyle{plain}

\begin{document}
Math 151-01 \hfill \parbox[t]{0.7}{\textwidth}\raggedleft Instructor: Yuhan Ding\\
Spring 2017 \\
\hspace{28mm} \large \textbf{(textbf{Name})} \normalsize \textbf{(rule[4cm]{0.8pt})} \hfill Feb 20th, 2017 \\
\normalize \\
\noindent \makebox[\textwidth]{\rule[\textwidth]{1pt}{1mm}} \\
\hline
\begin{center}
\phantom{.} \\
\center{\Large Quiz 1} \\
\end{center}
\hline
You must \textbf{(textbf{show})} all your work for full credit. \textbf{(textbf{No})} calculators.

\begin{enumerate}[1.-]
\item (10 points) Find the derivative of the function using the definition of derivative  


$$(f(x)=\sqrt{1-2x})$$

State the domains of the function and its derivative.
\item (10 points) Find the derivative of  


$$(f(x)=(3-x^2)(2x+x^3),)$$

in two ways: a) using the Product Rule b) performing the multiplication first.
\end{enumerate}
\end{document}
```

Math 151-01
Spring 2017

Name: _____

Instructor: Yuhan Ding
Feb 20th, 2017

Quiz 1

You must **show** all your work for full credit. **No** calculators.

1. (10 points) Find the derivative of the function using the definition of derivative

$$f(x) = \sqrt{1 - 2x}.$$

State the domains of the function and its derivative.

2. (10 points) Find the derivative of

$$f(x) = (3 - x^2)(2x + x^3).$$

in two ways: a) using the Product Rule b) performing the multiplication first.

Figure 1: Using LATEX to create a quiz. The left part is what you see/type and the right part is what you get.



What is L^AT_EX Used for

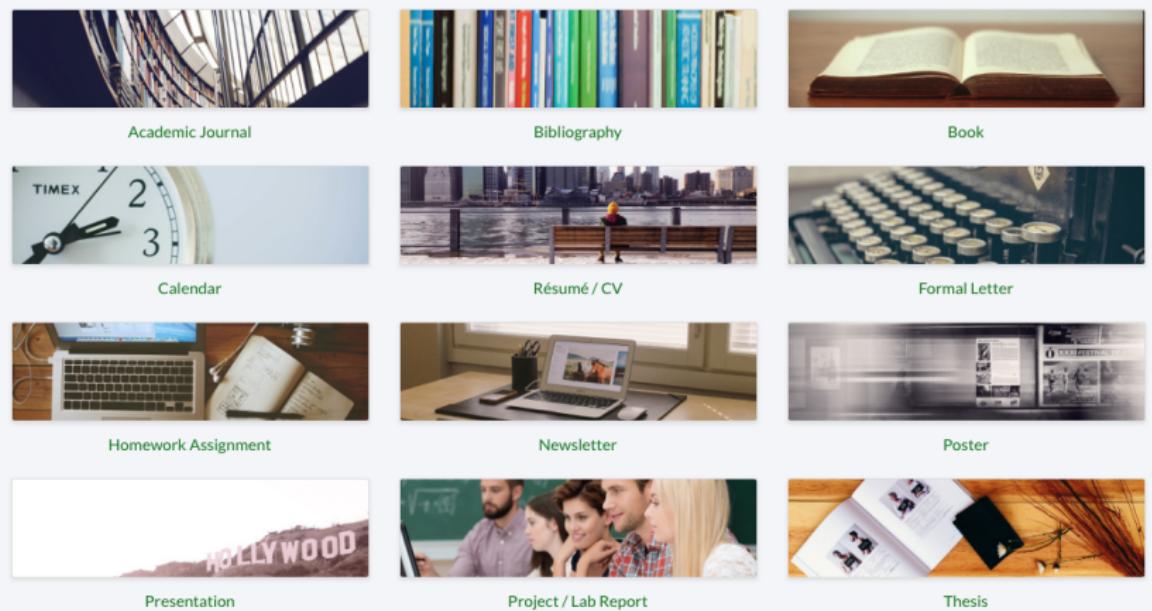


Figure 2: Various L^AT_EX projects. Source: Overleaf templates



Resources

- TeX system: TeXLive, www.tug.org/texlive/
- Online compiling tools
 - Equation Editor: latexeditor.lagrida.com
 - OverLeaf (Recommended): www.overleaf.com
- Offline compiling tools
 - VS Code + \LaTeX Workshop Extension
 - TeXStudio: www.texstudio.org
 - All in one portable version: TeXPortable (Windows only)
 - Real-time compiling: TeXifier (Mac, iOS only) (not free)
- Other tutorials
 - The levels of TeX
 - A First Set of \LaTeX Resources
 - Overleaf documentation
 - \LaTeX for Beginners with TeXworks
 - NYU Libraries \LaTeX guides



Software Interface

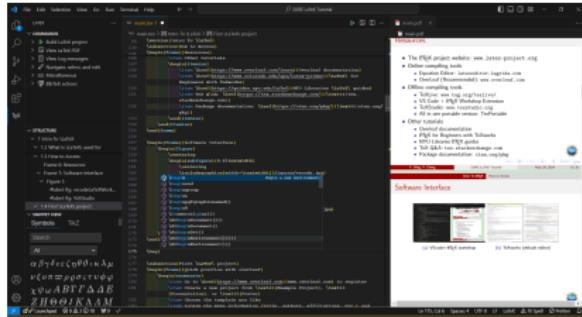


Figure 3: VScode+L^AT_EX workshop

- modern interface
- smart completions
- extensible and customizable

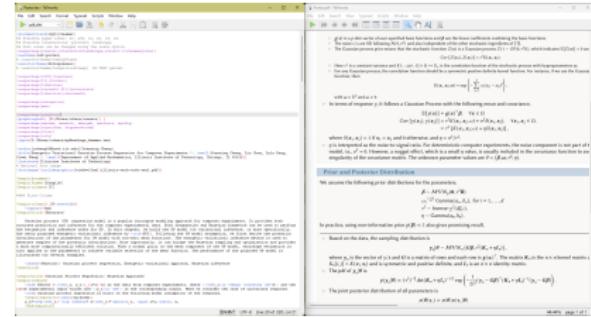


Figure 4: TeXworks (default editor)

- comes with TeXLive
- fast, clean and simple



Quick practice with overleaf

- ① Go to www.overleaf.com to register
- ② Create a new project from *Example Project*, *Presentation*, or *Poster*
- ③ Choose the template you like
- ④ Locate the meta information (title, authors, affiliations, etc.) and change them accordingly.
- ⑤ Make a title in the first page.
- ⑥ Write something in the main page. Change the font of some words. Then generate some dummy text.

You can open the beamer template used in Overleaf guide via this link.
Some codes about the title page to try out here.



Tips

- Start from a template (presentation and poster)
 - Overleaf templates: www.overleaf.com/latex/templates
 - more L^AT_EX templates: www.latextemplates.com
- Use % to add comments
- L^AT_EX macros format: \command[options]{args}{args}{...}
 - {\color{red}{red text}} gives red text
 - \textit{italic text} gives italic text
 - \usepackage{amssymb} to load commands defined in package amssymb
- Paired L^AT_EX macros format:
`\begin{options}{macro} ... \end{macro}`
- Hit Tab key to auto complete macro in the first hint
- Use Google or ChatBot to search solutions



How to type mathematical symbols

- Need to load package `amssymb`

αA	<code>\alpha</code>	A	<code>\mathrm{A}</code>
βB	<code>\beta</code>	B	<code>\mathrm{B}</code>
$\gamma \Gamma$	<code>\gamma</code>	Γ	<code>\Gamma</code>
$\delta \Delta$	<code>\delta</code>	Δ	<code>\Delta</code>
$\epsilon \varepsilon E$	<code>\epsilon</code>	ε	<code>\varepsilon</code>
ζZ	<code>\zeta</code>	Z	<code>Z</code>
ηH	<code>\eta</code>	H	<code>H</code>
$\theta \vartheta \Theta$	<code>\theta</code>	ϑ	<code>\vartheta</code>
ιI	<code>\iota</code>	I	<code>I</code>
κK	<code>\kappa</code>	K	<code>K</code>
$\lambda \Lambda$	<code>\lambda</code>	Λ	<code>\Lambda</code>
μM	<code>\mu</code>	M	<code>M</code>

νN	<code>\nu</code>	N	<code>\mathrm{N}</code>
$\xi \Xi$	<code>\xi</code>	Ξ	<code>\Xi</code>
$\circ O$	<code>\circ</code>	O	<code>\mathrm{O}</code>
$\pi \Pi$	<code>\pi</code>	Π	<code>\Pi</code>
$\rho \varrho P$	<code>\rho</code>	ϱ	<code>\varrho</code>
$\sigma \Sigma$	<code>\sigma</code>	Σ	<code>\Sigma</code>
τT	<code>\tau</code>	T	<code>\mathrm{T}</code>
$\upsilon \Upsilon$	<code>\upsilon</code>	Υ	<code>\Upsilon</code>
$\phi \varphi \Phi$	<code>\phi</code>	φ	<code>\varphi</code>
χX	<code>\chi</code>	X	<code>X</code>
$\psi \Psi$	<code>\psi</code>	Ψ	<code>\Psi</code>
$\omega \Omega$	<code>\omega</code>	Ω	<code>\Omega</code>

You can find more details via this link.



Example

Input:

- 1 Use paired dollar sign for inline math formula `$\int_0^2 \frac{\sqrt{x^2+1}}{x+1} dx$` and `\[... \]` for display math formula. For example,
- 2 `\[\int_0^2 \frac{\sqrt{x^2+1}}{x+1} dx \]`

Output:

Use paired dollar sign for inline math formula $\int_0^2 \frac{\sqrt{x^2+1}}{x+1} dx$ and `\[... \]` for display math formula. For example,

$$\int_0^2 \frac{\sqrt{x^2+1}}{x+1} dx$$



Some macros

code	usage
<code>\circ</code>	○, function composition
<code>\text{}, \textrm{}</code>	display text in equation
<code>\texttt{}</code>	show as typeset font
<code>\displaystyle</code>	change inline style to display style
<code>\nolimits</code>	change limits placement
<code>\,, \ :, \;, \quad</code>	some white space
<code>\max</code>	max operator, e.g. $\max_{x \in A}$
<code>\left(\right)</code>	parenthesis auto resized
<code>\begin{equation}</code>	to number and reference the equation
<code>\label{tag}</code>	to add a tag to the equation
<code>\ref{tag}, \eqref{tag}</code>	to refer to the content with the tag
<code>\begin{cases}</code>	to define piecewise function in equation
<code>\backslash</code>	to start from new line in piecewise
<code>&</code>	to align equations in piecewise



Practice

Try to type the following. You can start from this online tool.

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

$$y = \begin{cases} x + 5, & x > 3 \\ x - 5, & x \leq 3 \end{cases}$$

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \quad (1)$$

Equation (1) is the general form of a normal distribution's probability density function. By default, equations are auto numbered. Use the star variant `\begin{equation*}` or simply `\[... \]` to avoid numbering.



How to align several equations

Input:

```
1 \begin{equation}\label{eqn:exampleOpt}
2   \begin{split}
3     \min_{x \geq 2} & \quad \&\text{quad} \quad x^2 + 5x + 6 + y \\
4     \text{s.t.} & \quad \&\text{quad} \quad x + y = 5
5   \end{split}
6 \end{equation}
```

Output:

$$\begin{aligned} \min_{x \geq 2} \quad & x^2 + 5x + 6 + y \\ \text{s.t.} \quad & x + y = 5 \end{aligned} \tag{2}$$

In this way the whole equation is numbered as a block. To use multiple alignment, use `\begin{align*}` and number with the method mentioned here. More examples can be found in this website, and this website.



Practice

Try a few examples from above mentioned websites and type the following.

$$(a + b)^2 = c^2 + 4 \times \frac{ab}{2}$$

$$a^2 + 2ab + b^2 = c^2 + 2ab$$

$$a^2 + b^2 = c^2$$

$$\begin{pmatrix} f(x) & g(y) & h(z) \\ 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$$



How to insert a figure

```
1 \begin{figure}
2   \centering
3   \includegraphics[width = 0.3 \textwidth]{figures/pamu.
4   jpeg}
5   \caption{\label{fig:pom} My Figure}
\end{figure}
```



Figure 5: My Figure



How to put multiple figures together

Input:

```
1 \begin{figure}
2   \centering
3   \begin{subfigure}{0.3\textwidth}
4     \centering
5     \includegraphics[width=\textwidth]{figures/pamu}
6     \caption{left fig caption}
7     \label{fig: subfig1}
8   \end{subfigure}
9   \begin{subfigure}{0.3\textwidth}
10    \centering
11    \includegraphics[width=\textwidth]{figures/pamu}
12    \caption{right fig caption}
13    \label{fig: subfig2}
14  \end{subfigure}
15  \caption{2 subfigures}
16 \end{figure}
```

Output:



(a) left fig caption



(b) right fig caption

Figure 6: 2 subfigures

Also try to use .pdf as image format to have the best image quality. Say in Python matplotlib, you can use `plt.savefig('figure.pdf')`.



How to refer a figure

- Input

```
1 If you want to refer to the figure, you can type Fig \ref{fig:pom} to refer to the figure with number.
```

- Output: If you want to refer to the figure, you can type Fig 5 to refer to the figure with number.
- Note: In the beamer document, you need to add the following command to show the figure numbers.
`\setbeamertemplate{caption}{numbered}`
- Practice: Please insert a figure into your practice project, and include a caption for a short description. Then refer it in the next paragraph.
- Find more details on including images on Overleaf.



How to insert tables

Input:

```
1 \begin{table}
2     \centering
3     \begin{tabular}{l|r|c}
4         No. & Item & Quantity \\ \hline
5         1 & Widgets & 42 \\
6         2 & Gadgets & 13
7     \end{tabular}
8     \caption{\label{tab:widgets}An example table.}
9 \end{table}
```

Output:

No.	Item	Quantity
1	Widgets	42
2	Gadgets	13

Table 1: An example table.



Combining rows

Input: (Require multirow package)

```
1 \begin{center} % to put the table in the center of the page
2   \begin{tabular}{ |c|c|c| } \hline
3     col1 & col2 & col3 \\ \hline
4     \multirow{3}{4em}{Multiple row} & cell2 & cell3 \\
5     & cell5 & cell6 \\
6     & cell8 & cell9 \\
7     \hline
8   \end{tabular}
9 \end{center}
```

Output:

col1	col2	col3
Multiple row	cell2 cell5 cell8	cell3 cell6 cell9



Combining columns

Input:

```
1 \begin{tabular}{ |p{2cm}||p{1cm}|p{1cm}| } \hline
2   \multicolumn{3}{|c|}{Country List} \\ \hline
3   Country or Area Name & ISO ALPHA 2 Code & ISO Numeric
4   Code\\ \hline
5   Afghanistan & AF & 004\\ \hline
6 \end{tabular}
```

Output (without centering):

Country List		
Country or Area Name	ISO ALPHANUMERIC 2 Code	ISO Numeric Code
Afghanistan	AF	004



Practice

Table of Brownian Motions						
For Fun	j	0	1	2	3	4
	t_j	0	1/12	1/6	1/4	1/3
	$B(t_j)$	0	-0.1730	-0.3552	-0.1735	-0.3473

Table 2: Practice Table1

The next table is from normal distribution wikipedia page. The multiline equation inside table/tabular can be typed in \begin{array}.

Notation	$\mathcal{N}(\mu, \sigma^2)$
Parameters	$\mu \in \mathbb{R}$ $\sigma^2 \in \mathbb{R}_{>0}$
Support	$x \in \mathbb{R}$

Table 3: Practice Table2

More information on Overleaf guides.

Citation and references

- ① Prepare your `your-bib.bib` file used to store bibTeX entries.

```
1 @article{greenwade93,
2   author  = "George D. Greenwade",
3   title   = "The {C}omprehensive {T}ex {A}rchive {N}etwork
4             ({CTAN})",
5   year    = "1993",
6   journal = "TUGBoat",
7   volume  = "14",
8   number  = "3",
9   pages   = "342--351"}
```

- ② Specify a bibliography style in the `.tex` file:

```
\bibliographystyle{alpha}
```

- ③ Use `\cite{citation-key1, citation-key2}` to cite the paper in the documents. e.g. [Greenwade, 1993],

[Ross, 2010, Chan and Rissler, 2022].

- ④ Use `\bibliography{your-bib}` to generate a reference section including all cited entries



How to get .bib file

- start from a blank text file and change the file extension to .bib
 - copy the bibTeX entries (Google scholar, Semantic scholar, BibItNow, etc.), or generated using reference management software
 - Zotero, with browser addon: www.zotero.org
 - bibDesk (Mac only) bibdesk.sourceforge.io
 - Mendeley

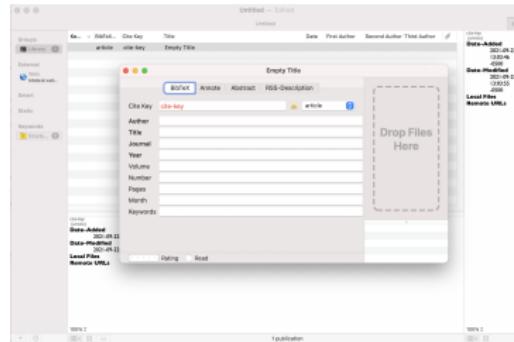


Figure 7: bibDesk interface



Practice

- ① obtain your own .bib file
- ② add one or two bibTeX entries
- ③ upload it to overleaf, or put it in the same folder with your .tex file
- ④ cite the paper in your .bib file
- ⑤ add a reference page in the end of your document



How to debug?

- Check whether commands are in pair or not. e.g.,
`\begin \end \[\] { }`
- Check missing & and \\ in table
- Read the error messages carefully

Runaway argument?

\par More information on <https://www.overleaf.com/learn/latex/ETC>.

! File ended while scanning use of \frame.

<inserted text>

\par

<*> main.tex

I suspect you have forgotten a `}; causing me
to read past where you wanted me to stop.
I'll try to recover; but if the error is serious,
you'd better type 'E' or 'X' now and fix your file.

- Syntax error reminder in OverLeaf



Minor adjustments

- check output to see if anything missing (successful but incomplete compiling)
- check typos
- use inverse search to locate the tex source code from the pdf. For example in LaTeXWorkshop
 - option "jump to source"
 - ctrl + click: from pdf to tex
 - ctrl + alt + j: both way
- use `\vspace{1mm}`, `\hspace{-0.5em}`, etc. to adjust spacing
- adjust figure size to avoid overlapping of document elements
- make a backup



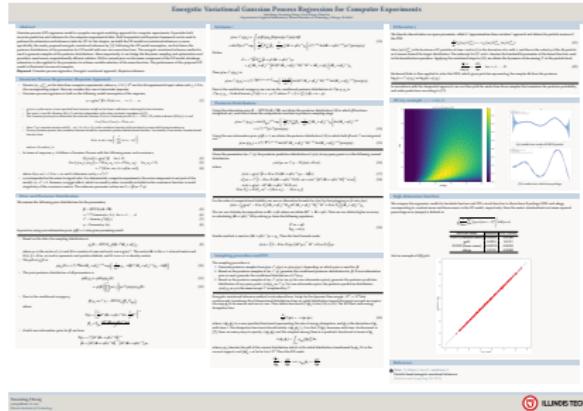
What is Beamer

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

- a type of document class
 - slides
 - poster
 - overlay control
 - theme

Some online tutorial

- Beamer tutorial by Tim Schulte
 - Overleaf beamer guide



Some macros

code	usage
<code>\begin{block}, \begin{theorem}</code>	to put text in an outstanding block
<code>\begin{columns} and \begin{column}</code>	to separate a slide into columns
<code>\usepackage{multimedia}</code>	to allow embedding multimedia
<code>\tableofcontents</code>	to generate a TOC
<code>\begin{center}</code>	to center element
<code>\scalebox from graphicx package</code>	to adjust equation size



Conclusion

L^AT_EX

- A very powerful document preparation system
 - Presentation: Slides, Poster
 - Document: Academic Article, Homework, Report, Resume/CV
- Similar to a programming language
 - Familiar with its syntax
 - Need to debug
- Some advanced topics with guide on Overleaf
 - build your own templates
 - explore more macros: enumerate, itemize, theorem
 - type an algorithm
 - list some code
 - draw with tikz package



Thank you



References I

-  Chan, C. and Rissler, M. (2022).
Data Science Foundations with Python with zyLabs.
zyBooks: A Wiley Brand, 8th edition.
-  Greenwade, G. D. (1993).
The Comprehensive Tex Archive Network (CTAN).
TUGBoat, 14(3):342–351.
-  Ross, S. (2010).
A First Course in Probability.
Pearson, 8th edition.