

L^AT_EX 2_ε Workshop

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How do you write a document?

Appearance
before structure



**“WYSWYG”
worse at both**

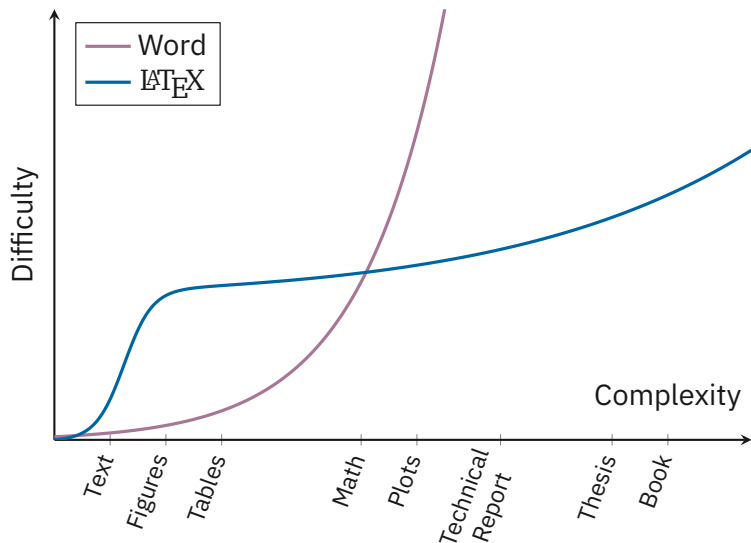


Structure before
appearance

$\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X } 2_{\epsilon}$



Why engineers should know \LaTeX



Goal: Learn to typeset something like this

The last equality follows by observing that $(\Omega \setminus B_R(\mathbf{r}_0)) \cap B_R(\mathbf{r}_0) = \emptyset$, and the argument above. The RHS is the electric flux generated by a charged sphere, and so:

$$\Phi(R) = \frac{Q(R)}{\varepsilon_0} = \frac{1}{\varepsilon_0} \int_{B_R(\mathbf{r}_0)} \rho(\mathbf{r}') \, d\mathbf{r}' = \frac{1}{\varepsilon_0} \rho(\mathbf{r}'_c) |B_R(\mathbf{r}_0)| \quad \text{with } r'_c \in B_R(\mathbf{r}_0)$$

Where the last equality follows by the mean value theorem for integrals. Finally for the Squeeze theorem and the continuity of ρ :

$$\nabla \cdot \mathbf{E}_0(\mathbf{r}_0) = \lim_{R \rightarrow 0} \frac{\Phi(R)}{|B_R(\mathbf{r}_0)|} = \frac{\rho(\mathbf{r}_0)}{\varepsilon_0}$$

7.2 Deriving Coulomb's law from Gauss's law

Strictly speaking, Coulomb's law cannot be derived from Gauss's law alone, since Gauss's law does not give any information regarding the curl of \mathbf{E} (see Helmholtz decomposition and Faraday's law). However, Coulomb's law can be proven from Gauss's law if it is assumed, in addition, that the electric field from a point charge is spherically symmetric (this assumption, like Coulomb's law itself, is exactly true if the charge is stationary, and approximately true if the charge is in motion).

About this presentation

Content

- \LaTeX is *learn by doing*
- Will be mostly examples
- Sorry for the crowded slides

Example

Things in green boxes are examples

Tip

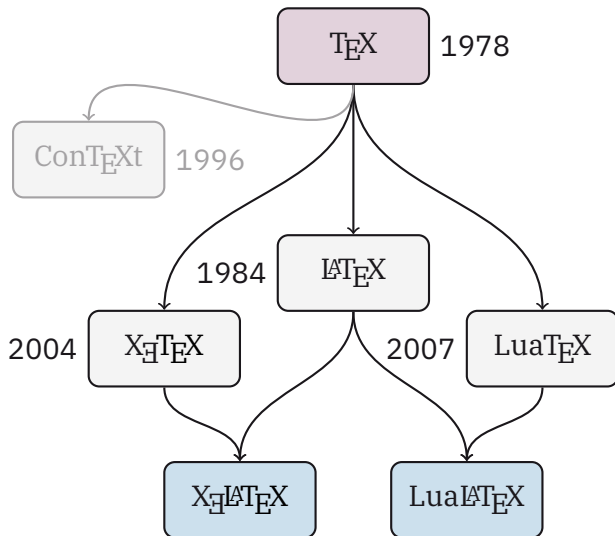
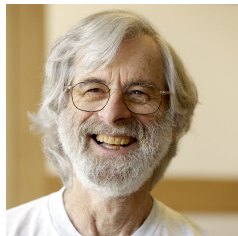
Things in red boxes are tips or extras

Do yourself a favor

Use the International US Keyboard Layout

~	! 1	@ 2	# 3	\$ £ 4	% 5	^ 6 ¼	& 7 ½	* 8 ¾	() 9 ‘	0 ’	- ¥	+ ÷	← Backspace	
Tab ↵	Q Ä	W Å	E É	R ®	T Þ	Y Ü	U Ú	I Í	O Ó	P Ö	{ }	[«] »	~
Caps Lock ⬆	A Á	S Š	D Đ	F	G	H	J	K	L Ø	:	°	" °	'	↵ Enter
Shift ⬆	Z Æ	X	C ¢	V	B	N Ñ	M	< Ç	>	?	/ ÷	↵ Shift		
Ctrl	Win Key	Alt							Alt Gr		Win Key	Menu	Ctrl	

History of T_EX, what should you use?



A: Use X_YL^AT_EX, it has UTF-8 support! (ä, ü, ô, ...)

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- 1 Fundamentals
- 2 Basics
- 3 Mathematics
- 4 Bibliography management
- 5 Extras

Commands aka Macros

\command [*options*] {*parameters*}

```
\documentclass[a4paper]{article}
```

```
\LaTeX{}
```

```
\newpage
```

Special characters

Reserverd characters

\$ % ^ & _ { } ~ \

Replacement macros

```
\# \$ \% \^{} \& \_ \{ \}  
\textasciitilde{}  
\textbackslash{}
```

Accents and Unicode

Accents

If you use `pdflatex` you cannot use unicode!
That means no `ä`, `ú`, `ò`, `ô`, `å`, `ě`, You will need to use

`\"a`, `\'u`, `\'o`, `\^o`, ...

instead.

Tip

If you compile with `xelatex` or `lualatex` you will not have this problem!

Quotation marks

L^AT_EX changes the style of the quotation mark according to the language (for ex “–”, «–», ...).

- 1 This is an incorrect way to have a "quoted word".
- 2 This is the correct way to have a ‘‘quoted word’’.

This is an incorrect way to have a "quoted word".

This is the correct way to have a “quoted word”.

To have “quotation marks”, *do not* use " (shift + 2).
Use 2 grave accents ‘ and two apostrophes ’.

Environments

```
\begin{environment} [options]
```

```
...
```

```
\end{environment}
```

```
\begin{document}    \end{document}
```

```
\begin{quote}    \end{quote}
```

```
\begin{math}    \end{math}
```

Document structure

```
1 \documentclass[a4paper]{article}
2
3 % preamble
4 \title{A very simple document}
5 \author{Naoki Pross}
6 \date{\today}
7
8 % content
9 \begin{document}
10
11 \maketitle
12 ...
13
14 \end{document}
```

Spacing and newlines

In general

\LaTeX does not care too much about whitespace

```
1 I can put          however many spaces      here.  
2 However if I leave    an empty   line, like  this  
3  
4 LaTeX will in indent this sentence because  
5 it is a new paragraph.
```

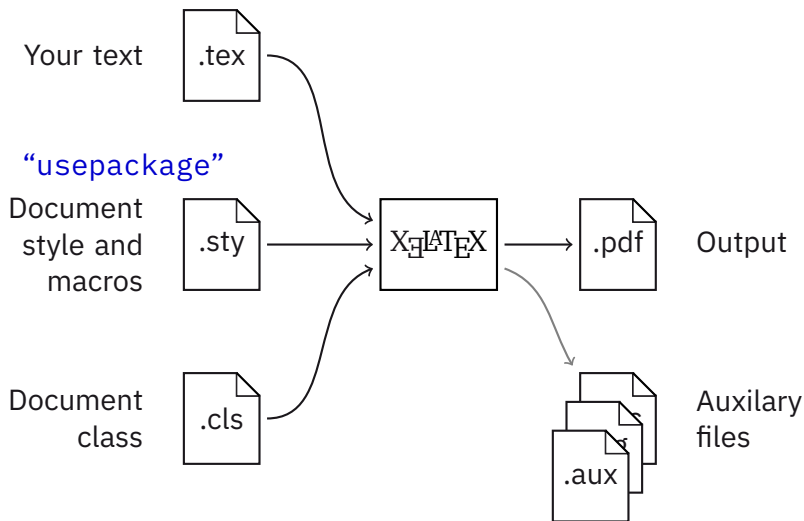
I can put however many spaces here. However if I leave an empty line, like this.

LaTeX will in indent this sentence because it is a new paragraph.

What is CTAN

The Comprehensive T_EX Archive Network is a set of Internet sites around the world that offer T_EX-related material for download.

Typesetting (aka “compilation”)



Very big projects (like a thesis or a book)

```
1 \documentclass{thesis}
2
3 \usepackage{tex/mystyle}
4 \usepackage{tex/docmacros}
5 % preamble ...
6
7 \begin{document}
8   \maketitle
9   \tableofcontents
10
11   \include{chapters/intro}
12   \include{chapters/purpose}
13   % ...
14 \end{document}
```

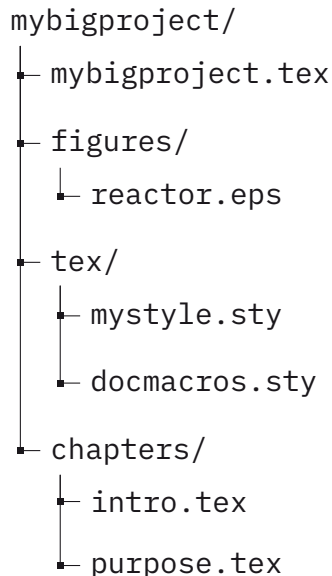


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Headings

Emphasis, Bold, Italic, ...

```
1 This is \emph{emphatized}.
2 You may, but should not, also use
3 \textbf{Bold},
4 \textit{Italic},
5 \textsf{Sans-Serif},
6 \textsc{SmallCaps},
7 \textrm{Roman},          % with serif
8 \texttt{Typewriter}.    % monospaced
```

This is *emphatized*. You may also use **Bold**, *Italic*, Sans-Serif, SmallCaps¹, Roman or Typewriter.

¹The font used in this presentation does not have smallcaps shapes

Lists

```
1 \begin{itemize}
2   \item Tomatoes
3   \item Peppers
4   \item Broccoli
5 \end{itemize}
```

Itemize

- Tomatoes
- Peppers
- Broccoli

```
1 \begin{enumerate}
2   \item Discover coffee
3   \item Get addicted
4   \item Congratulations
5 \end{enumerate}
```

Enumerate

- 1 Discover coffee
- 2 Get addicted
- 3 Congratulations

You can customize itemize, enumerate, description with the enumitem package.

Description

```
1 \begin{description}
2   \item[Programmer] A person who is paid to
      professionally scream at a computer.
3
4   \item[Manager] A person who appears to know how
      all tasks should be accomplished but can't
      actually do any of those tasks themselves.
5 \end{description}
```

Programmer A person who is paid to professionally scream at a computer.

Manager A person who appears to know how all tasks should be accomplished but can't actually do any of those tasks themselves.

Table 1: Floats placing permissions

Specifier	Permission
h	Place around here
t	At the top of the page
b	At the bottom of the page
p	On a special page containing only floats
!	“I don’t care if it will be ugly”
H ²	Place exactly here (may look very ugly)

²Requires the “float” package, i.e. “\usepackage{float}”

Tables and tabular

```
1 \begin{table}[h]
2   \caption{Not up to date numbers}
3   \begin{tabular}{l r r}
4     \toprule
5     Country      & Infected & Deaths \\
6     \midrule
7     China        & 80'652 & 3'070 \\
8     South Korea  & 7'041  & 44 \\
9     Italy        & 5'833  & 233 \\
10    \bottomrule
11  \end{tabular}
12 \end{table}
```

Pro Tip

Add “`\usepackage{booktabs}`” to use rulers. Do not use vertical rulers.

Tables and tabular

Example Table

Table 2: Not up to date numbers

Country	Infected	Deaths
China	80'652	3'070
South Korea	7'041	44
Italy	5'833	233

Figures

Cross-References

```
1 \section{Introduction}  
2 ... will be discussed in \S \ref{sec:nvstokes} ...  
3  
4 \section{Stokes equation} \label{sec:nvstokes}
```

Document

1 Introduction

... will be discussed in §4 ...

4 Stokes Equation

...

Pro Tip

Use prefixes such as `sec:`, `fig:`, `tab:`, `bib:`, `eqn:` to avoid mistakes.

Cross-References

```
1 \begin{figure} % or table
2   \includegraphics{...}
3   \caption{
4     A stereographic projection.
5     \label{fig:projection}
6   }
7 \end{figure}
8
9 ... as shown in figure \ref{fig:projection} ...
```

Put `\label` inside of `\caption`!

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Math environments

Environment	\LaTeX	\TeX ³
<code>math</code>	<code>\(... \)</code>	<code>\$... \$</code>
<code>displaymath</code>	<code>\[... \]</code>	<code>\$\$... \$\$</code>

³Don't use them in \LaTeX . **For real: don't use them.**

Example

```
1 The Pythagoran Theorem states that for a right
   triangle with sides \((a,b,c)\) there is the
   relation
2 \[
3   c^2 = a^2 + b^2
4 \]
```

The Pythagoran Theorem states that for a right triangle with sides a, b, c there is the relation

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

Spacing and text in math mode

Math styles

With the packages amsmath, amssymb

```
1 \[
2   \mathrm{R}      \quad % roman
3   \mathit{R}      \quad % italic
4   \mathbf{R}      \quad % bold
5   \mathsf{R}      \quad % sans-serif
6   \mathtt{R}      \quad % typewriter
7   \mathbb{R}      \quad % blackboard bold
8   \mathcal{R}     \quad % calligraphy
9   \mathfrak{R}    \quad % fraktur
10 \]
```

R R \mathbf{R} R \mathtt{R} \mathbb{R} \mathcal{R} \mathfrak{R}

Sub. and Superscript

```
1 \[  
2 c = \sqrt{a^2 + b^2 - 2ab \cos( \alpha_{ab} )}  
3 \]
```

Cosine theorem

$$c = \sqrt{a^2 + b^2 - 2ab \cos(\alpha_{ab})}$$

Sum and Integral

```
1 \[
2 % math community meme
3 \sum_{k = 1}^{\infty} k = - \frac{1}{12}
4 \hspace{1.5cm}
5
6 % fourier transform
7 F(\omega) = \int\limits_{-\infty}^{\infty}
8   f(t) e^{-i\omega t} \mathrm{d}t
9 \]
```

$$\sum_{k=1}^{\infty} k = -\frac{1}{12}$$

$$F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt$$

Matrices

```
1 \[  
2   \mathbf{J} = \begin{pmatrix}  
3     0 & 1 \\  
4     1 & 0 \\  
5   \end{pmatrix}  
6 \]
```

The complex matrix

$$\mathbf{J} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \mathbf{R}_\phi = e^{\phi \mathbf{J}}$$

There are also

Equations

```
1 Equation \eqref{eqn:schroedinger} is the
   Schrödinger Equation that describes the
   evolution of a quantum state  $(\psi)$ .
2
3 \begin{equation} \label{eqn:schroedinger}
4   i\hbar \partial_t \psi =
5   - \frac{\hbar^2}{2m} \partial_x^2 \psi + V\psi
6 \end{equation}
```

Equation (1) is the Schrödinger equation that describes the evolution of a quantum state ψ .

$$i\hbar \partial_t \psi = -\frac{\hbar^2}{2m} \partial_x^2 \psi + V\psi \quad (1)$$

Alignment

```
1 \begin{align*}
2   \nabla \cdot \vec{F}(1,1)
3   &= \partial_x F_x + \partial_y F_y \\
4   &= 2x + 3y^4 \\
5   &= 2 + 3 \\
6   &= 5
7 \end{align*}
```

$$\begin{aligned}\nabla \cdot \vec{F}(1,1) &= \partial_x F_x + \partial_y F_y \\ &= 2x + 3y^4 \\ &= 2 + 3 \\ &= 5\end{aligned}$$

Learn by doing: try to typeset these

$$x_{t+1} = kx_t(1 - x_t)$$

$$H = - \sum_{x \in \mathbb{X}} p(x) \log p(x)$$

$$\mathcal{L}^{-1}[F] = \lim_{T \rightarrow \infty} \frac{1}{2\pi i} \int_{\gamma - iT}^{\gamma + iT} e^{st} F(s) \, ds$$

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The Bibliography

Only for **very short** bibliographies!

- 1 The industrial-technological society cannot be reformed in such a way as to prevent it from progresively narrowing down the sphere of human freedom\cite{unabomber}.

- 1 \begin{thebibliography}{9} % widest label
- 2 % manually set up MLA style
- 3 \bibitem{unabomber} Kaczynski, Theodore.
- 4 \textit{''Industrial Society and Its Future.''}
5 The Washington Post, 19 Sept. 1995.
- 6 \end{thebibliography}

External bibliography (Better)

Put in the preamble:

```
1 %% Citations
2 \usepackage[
3     backend = biber, % or bibtex (older)
4     style = ieee, % or any other
5 ]{biblatex}
6
7 \addbibresource{MyDocument.bib}
```

and then

```
1 \begin{document}
2 % use \cite{..} commands ...
3 \printbibliography
4 \end{document}
```

BibTeX files (Example I)

```
1 @article{Alimohammad2009,  
2   title      = {Compact Rayleigh and Rician fading  
3   simulator based on random walk processes},  
4   author     = {Alimohammad, A. and Fard, S.F. and  
5   Cockburn, B.F. and Schlegel, C.},  
6   journal    = {IET Commun.},  
7   publisher  = {Institution of Engineering and  
8   Technology (IET)},  
9   volume     = {3},  
10  number    = {8},  
11  pages      = {1333},  
12  year       = {2009},  
13  language   = {en}  
14 }
```

BibTeX files (Example II)

```
1 @book{Griffith,  
2   title      = {Introduction to Electrodynamics,  
3     Fourth Edition},  
4   author     = {Griffiths, David J.},  
5   year       = {2017},  
6   publisher  = {Cambridge University Press; 4th  
7     edition},  
8   isbn       = {978-1108420419}  
9 }
```

and many more

```
1 @article @book @collectedbook @conference  
   @electronic @ieeetrans @inbook  
   @incollectedbook @incollection @injournal  
   @inproceedings @manual @mastersthesis @misc  
   @patent @periodical @phdthesis @preamble  
   @proceedings @standard @string @techreport  
   @unpublished
```

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Source code listings

Plots

