

# L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> Workshop

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# How do you write a document?

Appearance  
before structure



**“WYSWYG”  
worse at both**

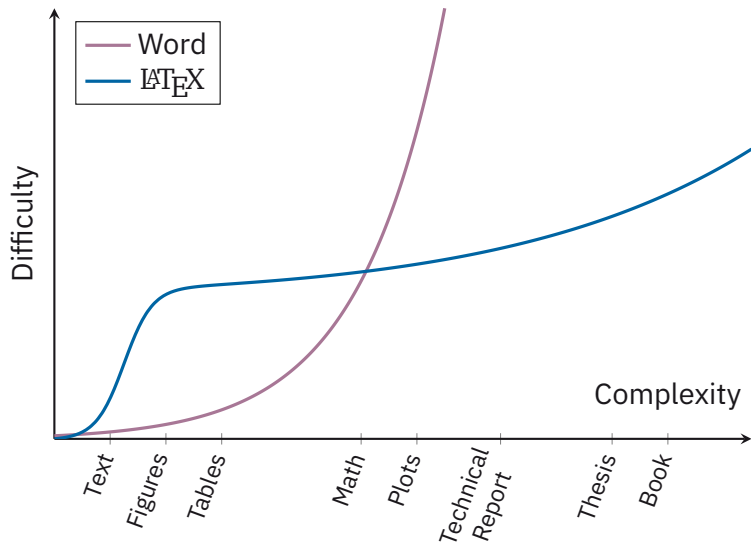


Structure before  
appearance

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



# Why engineers should know $\text{\LaTeX}$



# 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  $\rho$ :

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

## 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

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

## Example

Things in green boxes are examples

## Tip

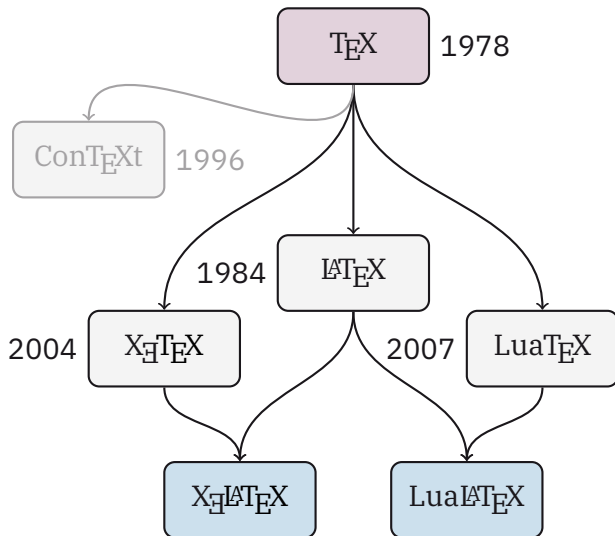
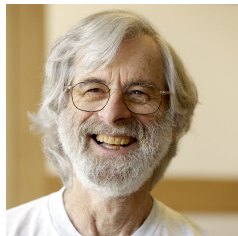
Things in red boxes are tips or extras

# Do yourself a favor

## Use the International US Keyboard Layout

~	! 1	@ 2	# 3	\$ 4	£ 5	% 6	^ 7	& 8	* 9	( 0	) 1	+ 2	÷ 3	← Backspace						
Tab ↵	Q	Å	W	Ä	E	É	R	T	Þ	Y	Û	Ü	Í	İ	Ó	Ö	{	}		~
Caps Lock ⬆	A	Å	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<sub>E</sub>X, what should you use?



A: Use X<sub>Y</sub>L<sup>A</sup>T<sub>E</sub>X, it has UTF-8 support! (ä, ü, ô, ...)

# Table of Contents

- 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<sup>A</sup>T<sub>E</sub>X 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

$\text{\LaTeX}$  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.

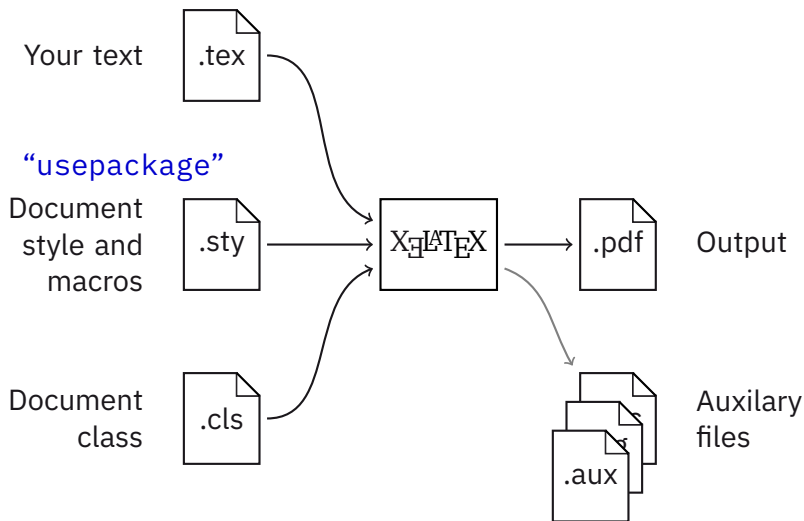
LaTeX will in indent this sentence because it is a new paragraph.

## What is CTAN

The Comprehensive T<sub>E</sub>X Archive Network is a set of Internet sites around the world that offer T<sub>E</sub>X-related material for download.



# Typesetting (aka “compilation”)



# Very big projects (like a thesis or a book)

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

```
mybigproject/
├── mybigproject.tex
├── fig/
│   └── engine-diagram.eps
└── tex/
    ├── mystyle.sty
    ├── intro.tex
    ├── purpose.tex
    └── ...
```

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# 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, SmallCaps<sup>1</sup>, Roman or Typewriter.

---

<sup>1</sup>The 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}
```

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

## Itemize

- Tomatoes
- Peppers
- Broccoli

## Enumerate

- 1 Discover coffee
- 2 Get addicted
- 3 Congratulations

# 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 <sup>2</sup>	Place <b>exactly here</b> (may look very ugly)

---

<sup>2</sup>Requires 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.



## 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:stereographic-projection}
6   }
7 \end{figure}
8
9 ... as shown in figure \ref{fig:refl} ...
```

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

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# Math environments

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

---

<sup>3</sup>Don't use them in  $\text{\LaTeX}$ . **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 \[
2   \mathrm{R}      \quad % roman
3   \mathit{R}      \quad % italic
4   \mathbf{R}      \quad % bold
5   \mathsf{R}      \quad % sans-serif
6   \mathtt{R}      \quad % typewriter
7   \mathbb{R}      \quad % blackboard bold
8   \mathcal{R}     \quad % calligraphy
9   \mathfrak{R}    \quad % fraktur
10 \]
```

$\mathrm{R}$     $\mathit{R}$     $\mathbf{R}$     $\mathsf{R}$     $\mathtt{R}$     $\mathbb{R}$     $\mathcal{R}$     $\mathfrak{R}$

# 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

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

# 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  $\psi$ .

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

# Alignment

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

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

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

# External bibliography

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# Source code listings

# Plots

