$\LaTeX\,2_\varepsilon$ Workshop

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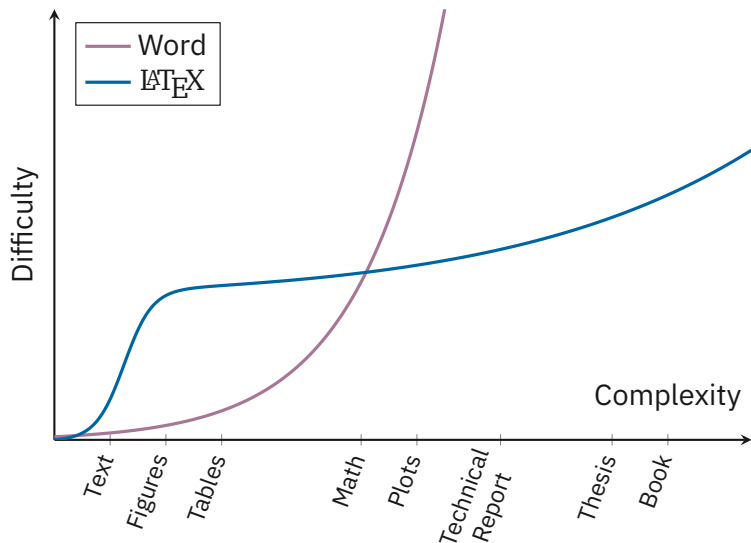| Appearance before structure	**"WYSWYG" worse at both**	Structure before appearance

$\LaTeX\,2_\varepsilon$

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:

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

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

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

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
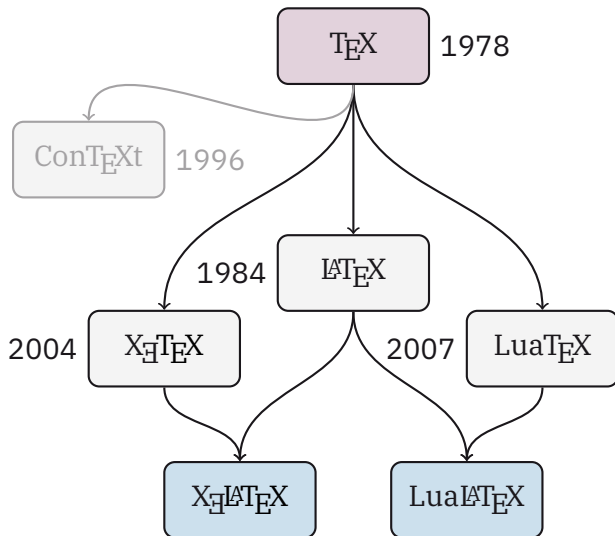- Sorry for the crowded slides

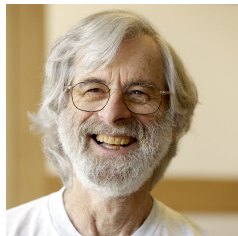## Example

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

History of TₑX, what should you use?

A: Use X∃LATₑX, it has UTF-8 support! (ä, ü, ô, ...)

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Commands aka Macros

$\backslash command\ [options]\ \{parameters\}$

```
\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, ð, ... 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

LaTeX 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 '.

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

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

\begin{quote}   \end{quote}

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

Document structure

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

% preamble
\title{A very simple document}
\author{Naoki Pross}
\date{\today}

% content
\begin{document}

\maketitle
...

\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")

Your text — .tex

"usepackage"

Document style and macros — .sty

Document class — .cls

$\longrightarrow$ X$_{\text{E}}$LAT$_{\text{E}}$X $\longrightarrow$ .pdf — Output

.aux — Auxilary files
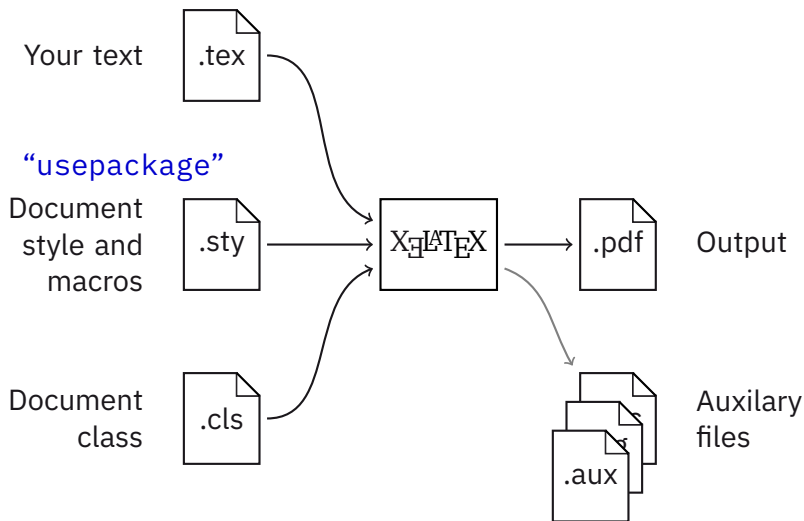
Very big projects (like a thesis or a book)

```
 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[1], Roman or Typewriter.

---

[1] 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

```latex
\begin{description}
  \item[Programmer] A person who is paid to
      professionally scream at a computer.

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

Floating elements

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)

---

[2]Requires the "float" package, i.e. "\usepackage{float}"

Tables and tabular

```latex
 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

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	LaTeX	TeX[3]
math	\(… \)	$ … $
displaymath	\[… \]	$$ … $$

---

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

Example

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

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

Math styles

With the packages `amsmath`, `amssymb`

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

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

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

$$\sum_{k=1}^{\infty} k = -\frac{1}{12} \qquad F(\omega) = \int\limits_{-\infty}^{\infty} f(t)e^{-i\omega t}\, \mathrm{d}t$$

Matrices

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

The complex matrix

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

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^2_x \psi + V\psi
6 \end{equation}
```

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

$$i\hbar \, \partial_t \psi = -\frac{\hbar^2}{2m} \, \partial^2_x \psi + V\psi \qquad (1)$$

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*}
```

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

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

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

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

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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}{99} % 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 sw.)
4   style = ieee, % or any other
5 ]{biblatex}
6
7 \addbibresource{MyDocument.bib}
```

and then

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

BibTeX files (Example I)

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

BibTeX files (Example II)

```
1 @inproceedings{Tidal,
2   author    = {Macmillan, Alex and Marina, Mahesh K
      . and Triana, Jhair Tocancipa},
3   booktitle = {2010 INFOCOM IEEE Conference on
      Computer Communications Workshops},
4   title     = {Slow Frequency Hopping for
      Mitigating Tidal Fading on Rural Long
      Distance Over-Water Wireless Links},
5   year      = {2010},
6   pages     = {1-5},
7   doi       = {10.1109/INFCOMW.2010.5466612}
8 }
```

BibTeX files (Example III)

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

and many more

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

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