LaTeX 2ε Workshop

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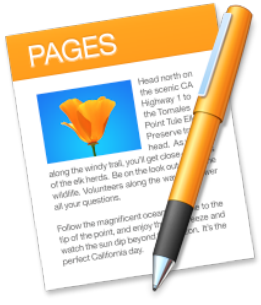
How do you write a document?

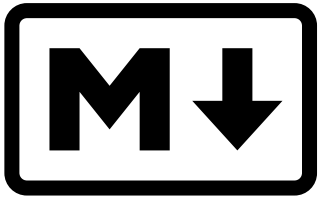
Looks good but no structure

“WYSWYG” Worse at both

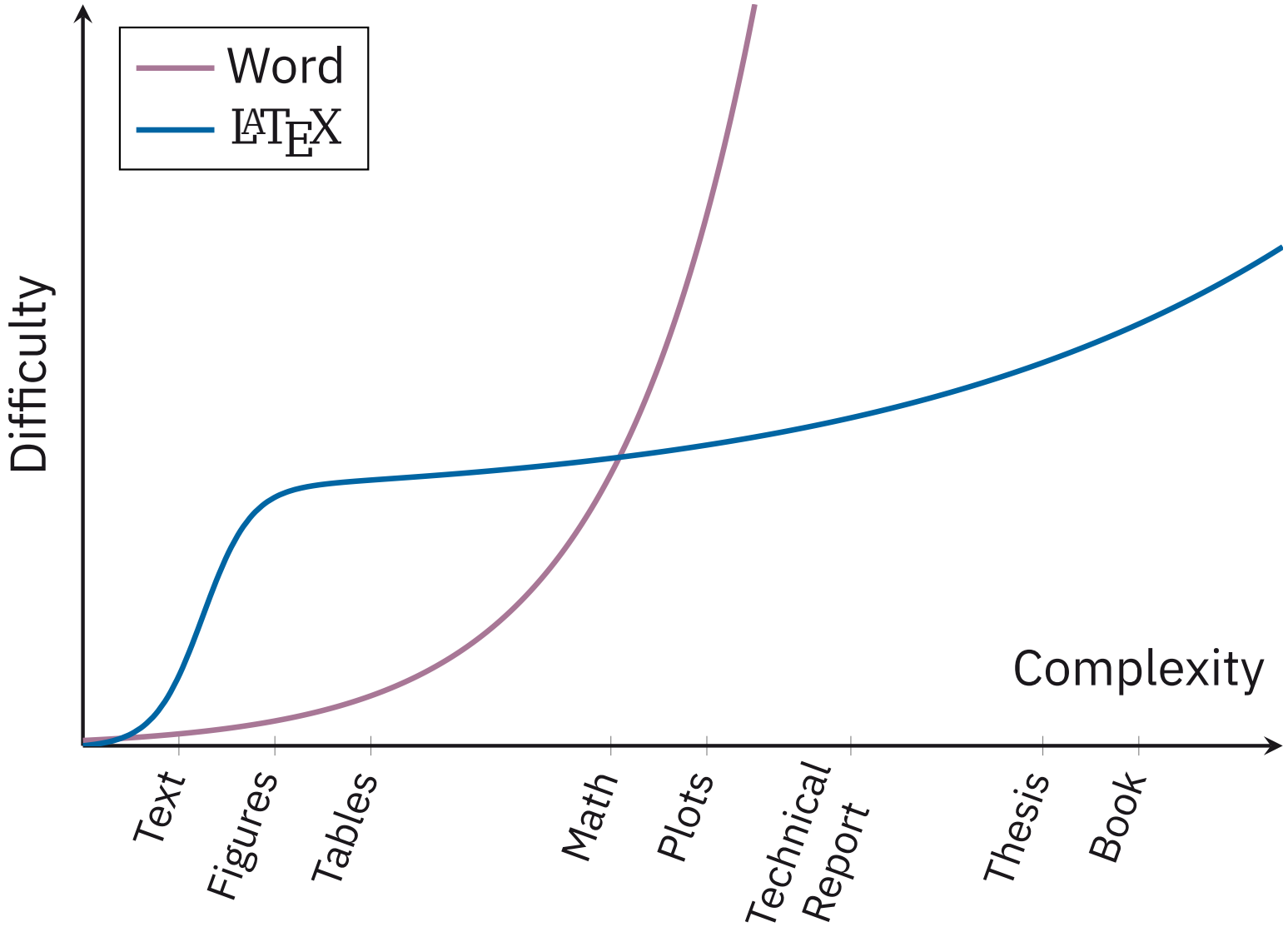
Declarative, structured

LaTeX 2ε





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

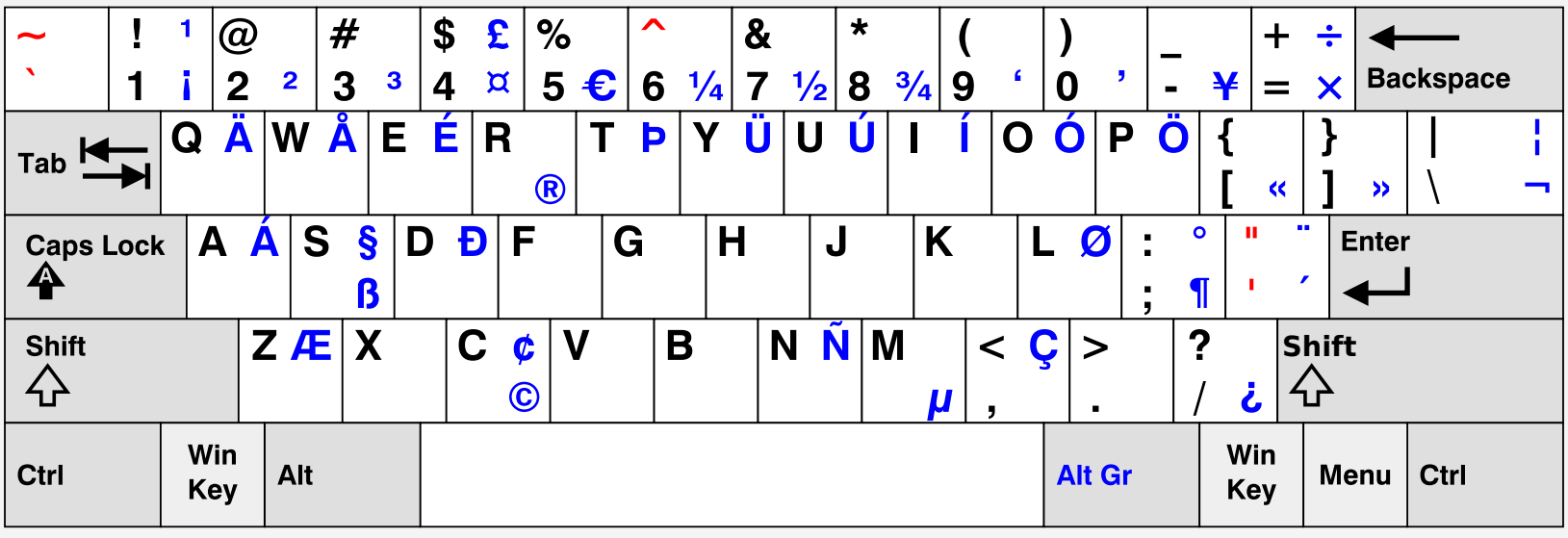
Things in green boxes are examples

Tip

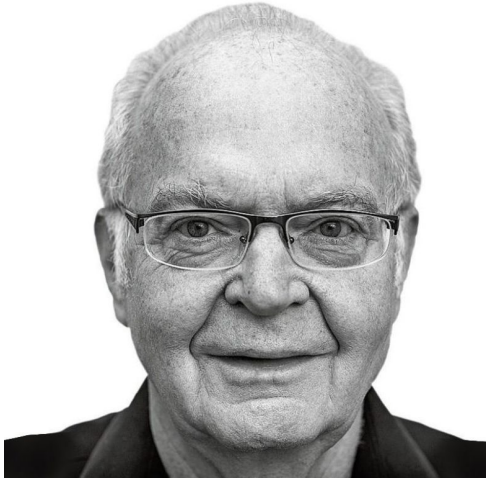
Things in red boxes are tips or extras

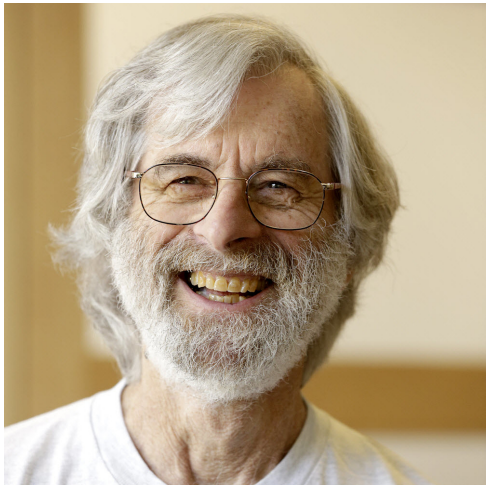
Do yourself a favor

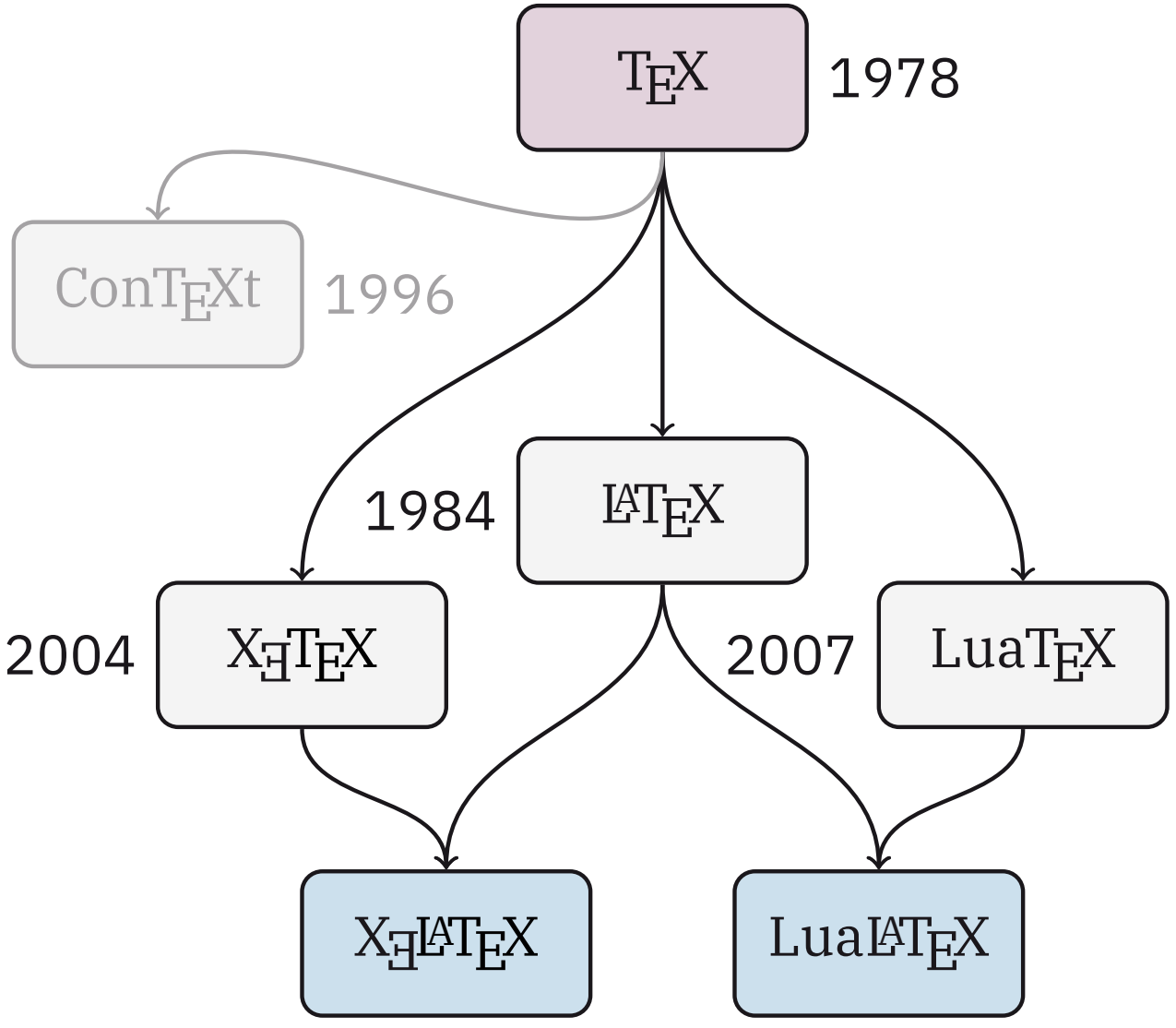
Use the International US Keyboard Layout



History of TEX, what should you use?







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

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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, 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 '.

Environments

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

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

\begin{quote}  \end{quote}

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

Document structure

```
\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

```
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.
```

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

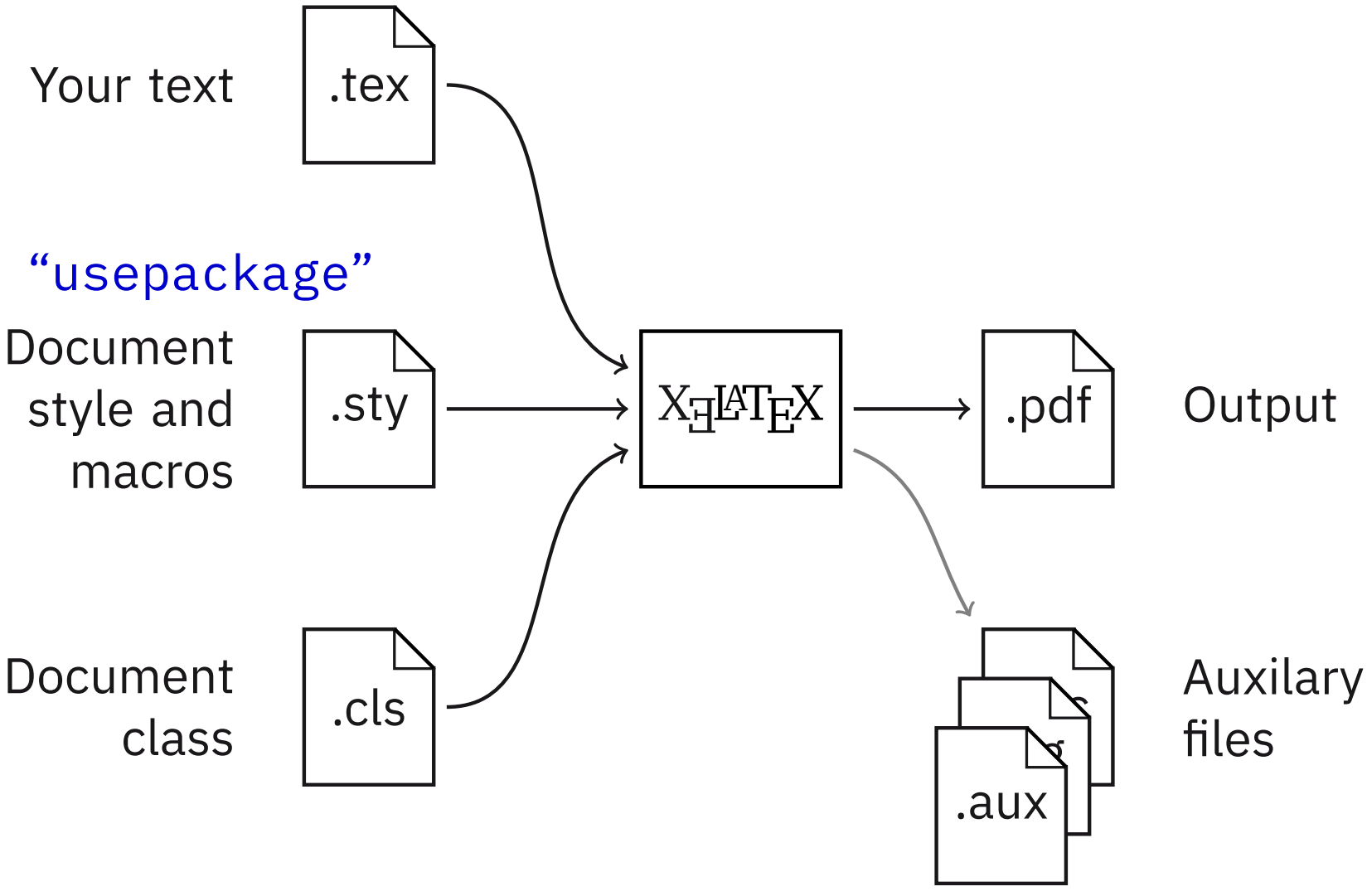
LaTeX will in indent this sentence because it is a new paragraph.

Packages and CTAN

What is CTAN

The Comprehensive TeX Archive Network is a set of Internet sites around the world that offer TeX-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 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

```latex
\begin{itemize}
  \item Tomatoes
  \item Peppers
  \item Broccoli
\end{itemize}
```

Itemize

- Tomatoes
- Peppers
- Broccoli

```latex
\begin{enumerate}
  \item Discover coffee
  \item Get addicted
  \item Congratulations
\end{enumerate}
```

Enumerate

1. Discover coffee
2. Get addicted
3. Congratulations

Description

```
\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

```
\begin{table}[h]
  \caption{Not up to date numbers}
  \begin{tabular}{l r r}
    \toprule
    Country & Infected & Deaths \\
    \midrule
    China       & 80’652 & 3’070 \\
    South Korea &  7’041 &    44 \\
    Italy       &  5’833 &   233 \\
    \bottomrule
  \end{tabular}
\end{table}
```

Pro Tip

Add “\usepackage{booktabs}” to use 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

```
\section{Introduction}
... will be discussed in \S \ref{sec:nvstokes} ...

\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

```latex
\begin{figure} % or table
  \includegraphics{...}
  \caption{
    A stereographic projection.
    \label{fig:stereographic-projection}
  }
\end{figure}

... 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

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

Spacing and text in math mode

Sub. and Superscript

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

Cosine theorem

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

Sum and Integral

```
\[
  % math community meme
  \sum_{k = 1}^{\infty} k = - \frac{1}{12}
  \hspace{1.5cm}

  % fourier transform
  F(\omega) = \int\limits_{-\infty}^\infty
    f(t) e^{i\omega t} \mathrm{d}t
\]
```

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

Matrices

```
\[
  \mathbf{J} = \begin{pmatrix}
    0 & 1 \\
    1 & 0 \\
  \end{pmatrix}
\]
```

The complex matrix

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

Equations

```
Equation \ref{eqn:schroedinger} is the Schrödinger
    Equation that describes the evolution of a
    quantum state \(\psi\).

\begin{equation} \label{eqn:schroedinger}
  i\hbar \partial_t \psi =
    - \frac{\hbar^2}{2m} \partial^2_x \psi + V\psi
\end{equation}
```

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

$$i\hbar\,\partial_t\psi = -\frac{\hbar^2}{2m}\,\partial_x^2\psi + V\psi \tag{1}$$

Alignment

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

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

Math styles

Learn by doing: try to typeset these

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

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

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

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The Bibliography

External bibliography

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Source code listings

Plots

TikZ