LaTeX 2ε Workshop

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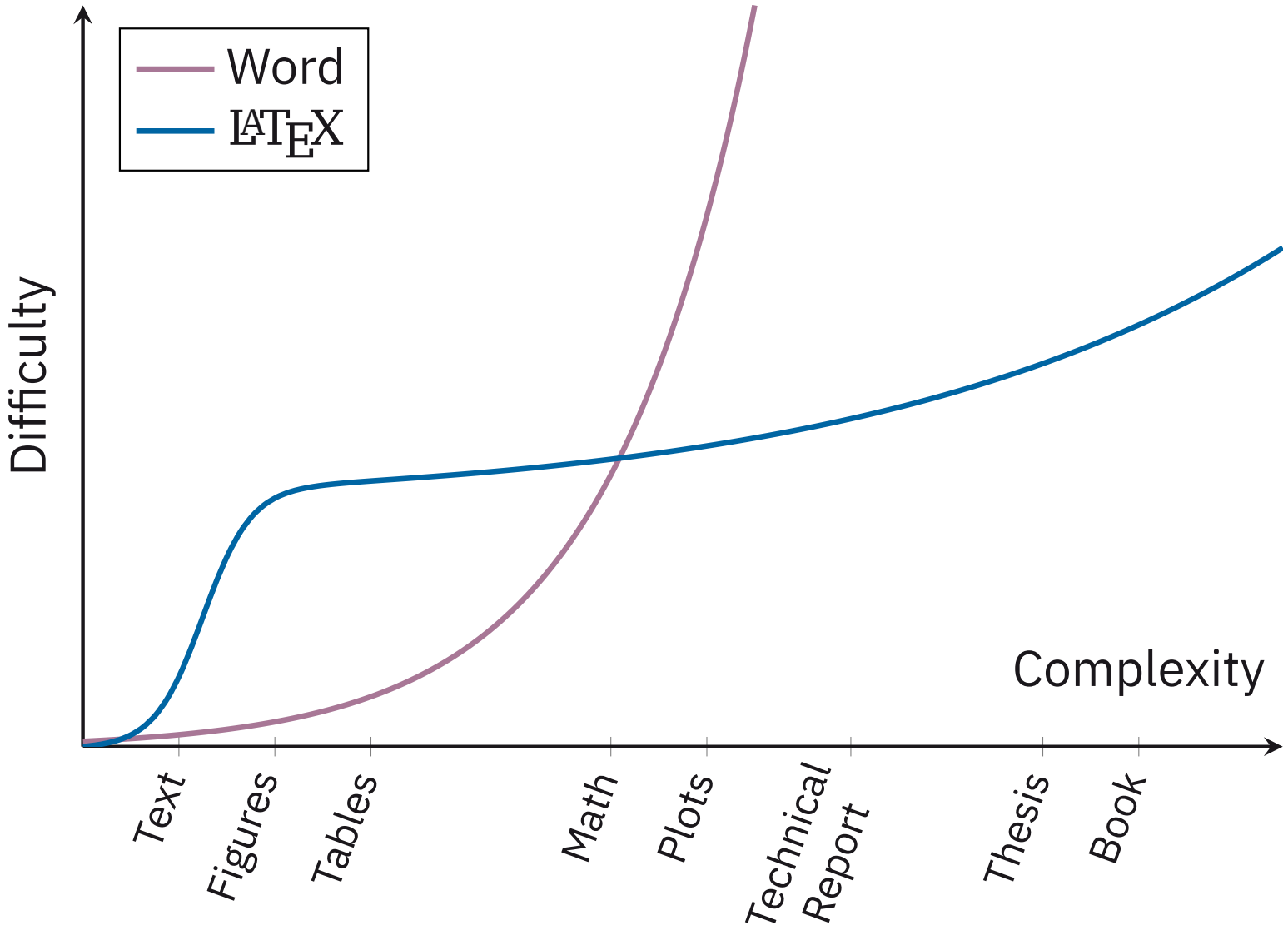
March 14, 2020

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:

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

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

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What is Typesetting

History & LaTeX

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Source code spacing

Special characters

Commands

Environments

Document structure

Spacing and newlines

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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

```
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

```
\begin{figure} % or table
  \includegraphics{...}
  \caption{Reflection and
      refraction of
      electromagnetic
      waves.}
  \label{fig:refl}
\end{figure}

... as shown in figure
\ref{fig:refl} ...
```

Figure reference

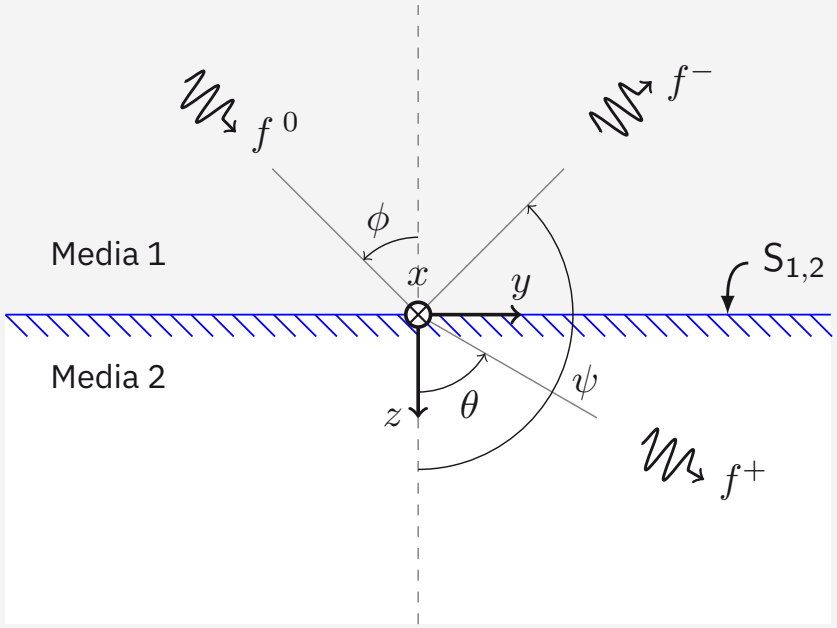

Figure 1: Reflection and refraction of electromagnetic waves.

... as shown in figure 1 ...

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Math environments

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

[3] This one is preferred

Example

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

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
\]
```

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

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

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

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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Source code listings

Plots

TikZ