$\mathrm{\LaTeX\,2_\varepsilon}$ Workshop

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OST FHO Campus Rapperswil

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About me and polls

Me

- BSc in Electrical Engineering OST FH (here)
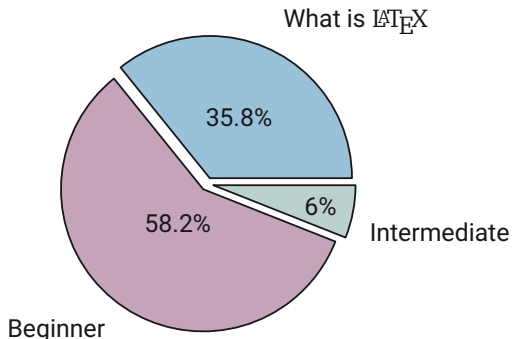- MSc in EE spec. Control Theory (Regelungstechnik) at ETH

Me

- BSc in Electrical Engineering OST FH (here)
- MSc in EE spec. Control Theory (Regelungstechnik) at ETH

You

- Faculty?
- $\LaTeX$ knowledge?
- Thesis to write?

What is $\LaTeX$

35.8%

6%

Intermediate

58.2%

Beginner

probably none

(well, I wrote a thesis once)

How do you write a document?

Appearance
before structure

Structure before
appearance

$\mathrm{\LaTeX\,2_\varepsilon}$

How do you write a document?

Appearance before structure	**"WYSWYG" worse at both**	Structure before appearance
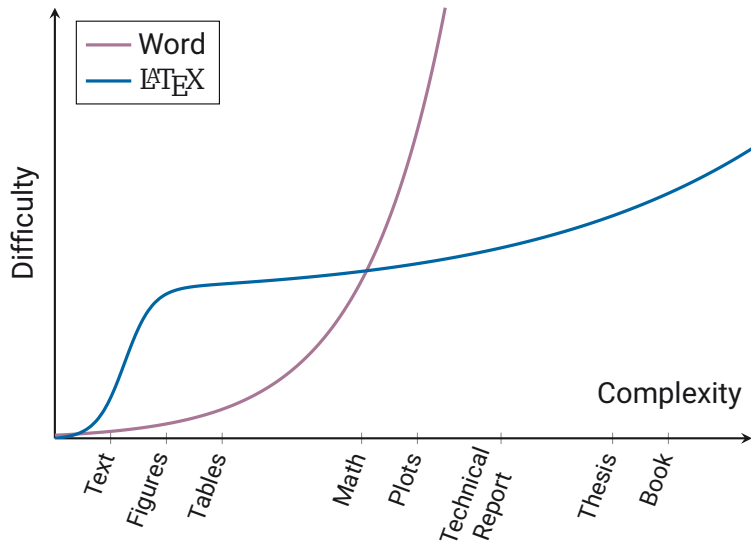
Goal: Learn to typeset something like this

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

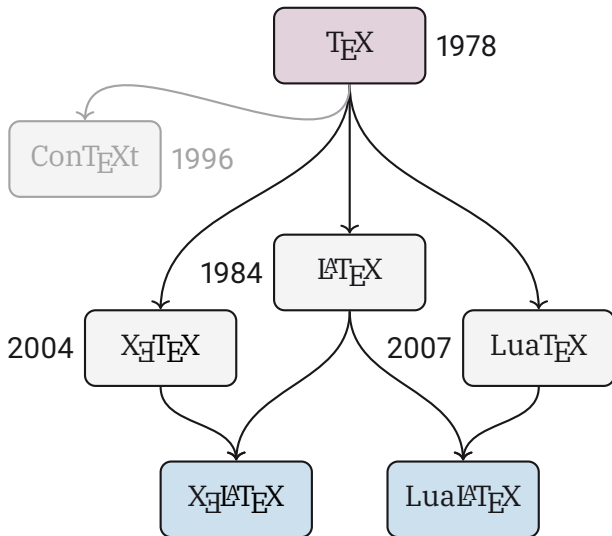## Example

Things in green boxes are examples

Tip

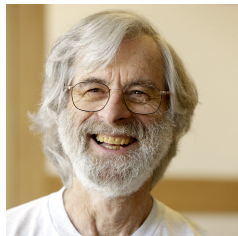Things in red boxes are tips or extras

Do yourself a favor

Use the International US Keyboard Layout

History of T_EX, what should you use?

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

Table of Contents

command [*options*] {*parameters*}

```
\documentclass{article}

\LaTeX{}

\usepackage[a4paper]{geometry}
```

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 "−", «−», …).

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

```
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.
```

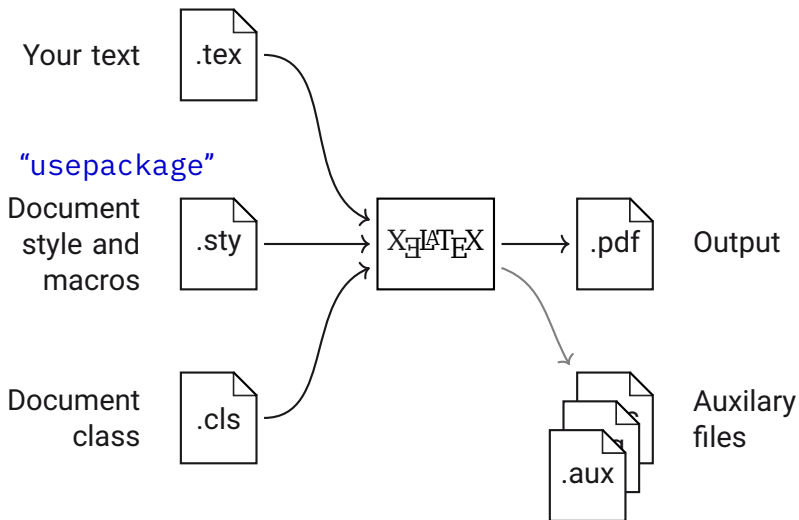I can put however many spaces here. However if I leave an empty line, like this.

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

What is CTAN

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

Wow, that doesn't mean anything. Just go to `https://ctan.org`

Typesetting (aka "compilation")

Very big projects (like a thesis or a book)

```latex
\documentclass{thesis}

\usepackage{tex/mystyle}
\usepackage{tex/docmacros}
% preamble ...

\begin{document}
  \maketitle
  \tableofcontents

  \include{chapters/intro}
  \include{chapters/purpose}
  % ...
\end{document}
```
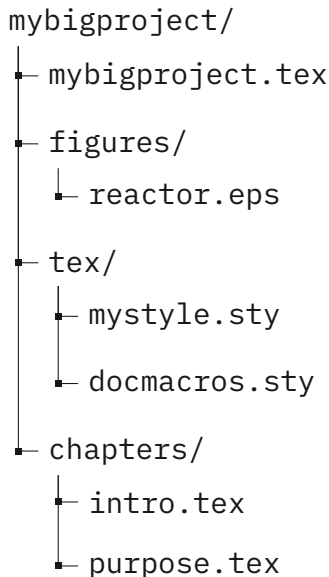
```
mybigproject/
├── mybigproject.tex
├── figures/
│   └── reactor.eps
├── tex/
│   ├── mystyle.sty
│   └── docmacros.sty
├── chapters/
│   ├── intro.tex
│   └── purpose.tex
```

Table of Contents

Headings

Numbered sections:

```
\part{}
\chapter{}
\section{}
\subsection{}
\subsubsection{}
\paragraph{}
\subparagraph{}
```

Unnumbered sections:

```
\section*{}
\subsection*{}
\subsubsection*{}
```

Pro Tip

You can customize what these commands do with the `titlesec` package.

Emphasis, Bold, Italic, …

```
This is \emph{emphatized}.
You may, but should not, also use
\textbf{Bold},        % \bfseries
\textit{Italic},      % \itshape
\textsc{SmallCaps},   % \scshape
\textsl{Slanted},     % \slshape
\textsf{Sans-Serif},  % \sffamily
\textrm{Roman},       % \rmfamily
\texttt{Typewriter}.  % \ttfamily
```

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

Lists

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

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

Itemize

- Tomatoes
- Peppers
- Broccoli

Enumerate

1. Discover coffee
2. Get addicted
3. Congratulations

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

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[1]	Place **exactly here** (may look very ugly)

Pro tip

The algorithm is very good, it's better not give a specifier at all.

---

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

Tables and tabular

```
\begin{table}[h]
  \caption{Not up to date numbers\label{tab:covid}}
  \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. 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

```latex
\begin{figure}[h]
  % center stuff
  \centering

  % to include a picture, use eps, pdf, dvi
  % preamble: \usepackage{graphicx}
  \includegraphics[width = 5cm]{path/to/picture}
  % or if you have some TikZ code
  \input{path/to/tikz/code}

  \caption{
    A meaningful caption for my picture.
    \label{fig:meaningful-name}
  }
\end{figure}
```
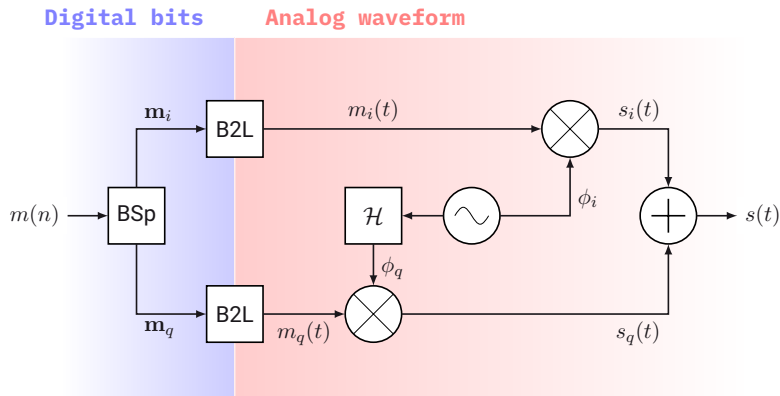
Figures

Figure 1: Block diagram of a QAM Modulator.

Cross-References I: Floatings

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

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

Pro Tip

Put \label inside of \caption!

Cross-References II: Parts of text

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

\section{Stokes equation} \label{sec:vstokes}
```

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.

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Math environments

Environment	LaTeX	TeX[2]
math	\(… \)	$ … $
displaymath	\[… \]	$$ … $$
equation	–	–
align	–	–
gather	–	–

---

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

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:

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

Math styles

With the packages `amsmath`, `amssymb`

```
\[
  \text{normal} % normal text
  \mathrm{R}    % roman
  \mathit{R}    % italic
  \mathbf{R}    % bold
  \mathsf{R}    % sans-serif
  \mathtt{R}    % typewriter
  \mathbb{R}    % blackboard bold
  \mathcal{R}   % calligraphy
  \mathfrak{R}  % fraktur
\]
```

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

Sub- and Superscript

Hats and underscores

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

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
\]
```

Limits are similar with: `\lim_{t\to a}`

$$\sum_{k=1}^{\infty} k = -\frac{1}{12} \hspace{2cm} F(\omega) = \int\limits_{-\infty}^{\infty} f(t)e^{-i\omega t}\,\mathrm{d}t$$

Matrices with `amsmath`

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

The complex matrix

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

There are also bmatrix, vmatrix, Bmatrix, Vmatrix.

Cross-References III: Equations

```
Equation \eqref{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*} % numbered when without *
  \nabla \cdot \vec{F}(1,1)
    &= \partial_x F_x + \partial_y F_y \\
    &= 2x + 3y^4 \\
    &= 2 + 3 \\
    &= 5
\end{align*}
```

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

Subequations

```
Maxwell's equations in their integral form are:
\begin{subequations}
  \begin{align}
    \oint_{\partial S} \mathbf{E} ...
  \end{align}
\end{subequations}
```

Maxwell's equations in their integral form are:

$$\oint_{\partial S} \mathbf{E} \cdot d\mathbf{l} = -\frac{d}{dt} \int_S \mathbf{B} \cdot d\mathbf{s}, \tag{2a}$$

$$\oint_{\partial S} \mathbf{H} \cdot d\mathbf{l} = \int_S (\mathbf{J} + \partial_t \mathbf{D}) \cdot d\mathbf{s}, \tag{2b}$$

$$\oint_{\partial V} \mathbf{D} \cdot d\mathbf{s} = \int_V \rho \, dv, \tag{2c}$$

$$\oint_{\partial V} \mathbf{B} \cdot d\mathbf{s} = 0. \tag{2d}$$

Learn by doing: Resources

(These are clickable links!)

Wikis and References

- Guidelines: Do and Don't
- Wikibooks on LaTeX
- Overleaf Guides
- CTAN Manuals

How do I write that symbol?

- DeTeXify
- LaTeX Mathematical Symbols

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

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

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

How to write mathematics?

Examples?

- Do not abuse quantifier symbols ($\forall, \exists, \wedge, \nexists, \ldots$)
- Symbols have grammatical roles
- Equations are sentences

Concrete example

Definition of contractive map for $f : X \to X$

Bad $\exists \varrho \in [0, 1) \, \forall x, y \in X : \|f(x) - f(y)\| \leq \varrho \|x - y\|$

Good   There is a $\varrho \in [0, 1)$ such that for all $x, y \in X$ any two points get closer after applying f, that is, $\|f(x) - f(y)\| \leq \varrho \|x - y\|$.

Another example:

Thus the arrangement can be modelled as a linear time-*varying* system (LTV), if the transmitter or the receiver (or anything else in the channel) is moving, and as a linear time *invariant* (LTI) system if the geometry is stationary. We can rewrite an LTV version of equation (2.6) using a convolution product as follows:

$$r(t) = \sum_k c_k(t) s(t - \tau_k(t)) = \sum_k c_k(t) \int_{\mathbb{R}} s(\tau) \delta(\tau - \tau_k(t)) \, d\tau$$

$$= \int_{\mathbb{R}} s(\tau) \sum_k c_k(t) \delta(\tau - \tau_k(t)) \, d\tau = s(\tau) * h(\tau, t),$$

obtaining a new function

$$h(\tau, t) = \sum_k c_k(t) \delta(\tau - \tau_k(t)), \qquad (2.7)$$

that describes the *channel impulse response* (CIR). This function depends on two time parameters: actual time t and convolution time τ. To better understand $h(\tau, t)$, consider an example shown in Fig. 2.5. Each stem represents a weighted Dirac delta, so each series of stems of the same color, along the convolution time τ axis, is a channel response at some

For more: "How to write mathematics" by P. R. Halomos

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The Bibliography

Only for **very short** bibliographies! Highly error prone!

```
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}.
```

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

External bibliography (Better)

Put in the preamble:

```
%% Citations
\usepackage[
  backend = biber, % or bibtex (older)
  style = ieee, % or any other
]{biblatex}

\addbibresource{MyDocument.bib}
```

and then

```
\begin{document}
% use \cite{..} commands ...
\printbibliography
\end{document}
```

BibTeX files: Example I

```
@article{Alimohammad2009,
  title = {Compact Rayleigh and Rician fading ..},
  author = {Alimohammad, A. and Fard, ...},
  journal = {IET Commun.},
  publisher = {Institution of Engineering and ...},
  volume = {3},
  number = {8},
  pages = {1333},
  year = {2009},
  language = {en}
}
```

BibTeX files: Example II

```
@book{Griffith,
  title = {Introduction to Electrodynamics ...},
  author = {Griffiths, David J.},
  year = {2017},
  publisher = {Cambridge University Press; ...},
  isbn = {978-1108420419}
}
```

and many more

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

https://www.zotero.org/

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HSR Students Community

HSR - Studenten

Wenn du das erste mal auf **@HSR-Stud** bist, sieh dir das Repo Willkommen an. Bei Fragen, E-Mail an fachschaft@elektrotechnik-hsr.ch.

👥 **3** followers · 📍 HSR Rapperswil

[Unfollow]

🏠 **Overview** | 📖 Repositories `147` | 📦 Packages | 👥 Teams `8` | 👤 People `79` | •••

Pinned

Customize pins

📖 **Willkommen** `Public` ⋮

Bist du das erste Mal hier? Dann schau doch in diesem Repo vorbei. Hier findest du Infos wie du die Zusammenfasungen findest und wie man LaTex und Git installierst.

⭐ 6 · 🔀 2

📖 **LaTex-Kurs** `Public` ⋮

Powerpoint-Präsentation zur Einführung in LaTex sowie einige Übungen zur Fehlererkennung und Behebung.

🟢 TeX · 🔀 2

📖 **VorlageZF** ⋮

`Public template`

Vorlage für Zusammenfassungen in

📖 **VorlageBericht** ⋮

`Public template`

Vorlage für Technische Berichte in

👁 View as: **Public** ▾

You are viewing the README and pinned repositories as a public user.

You can create a README file visible to anyone.

Get started with tasks that most successful organizations complete.

People

Summaries

Problem

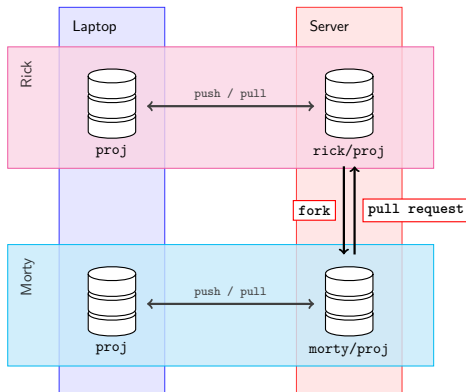Writing your own summary is good but something there is just not enough time.

Solution

Community! $\LaTeX$ + Git go along very well.

- `https://studentenportal.ch`
- `https://github.com/hsr-stud`

Begriff: Fork

E-Fachschaft git workshop?

- Fix typos
- Fix wrong formulae
- Remove outdated stuff and update it
- Missing? ⤳ Write a new one (warning: it's *a lot* of work!)

How can you help?

Edit Pins ▾   Unwatc

<> Code   ⊙ Issues 1   ⇄ Pull requests   ⊙ Actions   📖 Wiki   ⊘ Security   📈 Insights   ⚙️ S

Missing Topics #3

⊙ Open   **NaoPross** opened this issue on 13 Jul · 0 comments

NaoPross commented on 13 Jul · edited ▾   Member   ☺

The exam is tomorrow, I ran out of time. The following topics are still missing:

- State space ABCD rectangle trick
- PI Control in state space
- Reduced observers and linear quadratic gaussian estimation
- Empirical method for choosing the sampling time
- Algebraic criteria for the stability of discrete transfer functions
- Discretization of state space models
- Root Locus method for discrete systems
- Deadbeat controller design
- Jordan normal form (state space model and linear algebra)
- Caley Hamilton theorem

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Source code listings I: Settings

This presentation uses:

```latex
\usepackage{lstlistings}

% define a style
\lstdefinestyle{samplestyle}{
  belowcaptionskip=\baselineskip,
  breaklines=true,
  frame=none,
  inputencoding=utf8,
  % margin
  xleftmargin=\parindent,
  % numbers
  numbers=left,
  numbersep=5pt,
  ...
}

% use the style
\lstset{style=samplestyle, escapechar=`}
```

Source code listings II: Usage

Finally in your document:

```
\begin{lstlisting}[
  language = python,
  caption = {
    FIR filter in python.
  },
  label = {lst:py-fir}]
import numpy as np

def tap(c, tau, f):
    return np.exp(2j * np.pi * f * tau)

f = np.logspace(5, 9, samples = 500)
multipath = tap(.8, 500e-9, f) + tap(.4, 300e-9, f)
\end{lstlisting}
```

lstlistings is pretty good, but there is also minted as alternative. minted requires python to be installed.

Listing 1: FIR filter in python.

```python
import numpy as np

def tap(c, tau, f):
    return np.exp(2j * np.pi * f * tau)

f = np.logspace(5, 9, samples=500)
multipath = tap(.8, 500e-9, f) + tap(.4, 300e-9, f)
```

Real examples

- See README file in this workshop's repository
  `github.com/OpenHSR/LaTeX-Workshop`
- Documents I wrote in $\LaTeX$
    - `github.com/HSR-Stud/VorlageZF`
    - `github.com/NaoPross/DigDes`
    - `github.com/NaoPross/FuVar`
    - `git.thearcway.org/naopross/hsr`
- My semester thesis (see under `doc/thesis`)
  `github.com/NaoPross/Fading`
- Books Prof. Dr. Müller wrote
    - `github.com/AndreasFMueller/SeminarMatrizen`
    - `github.com/AndreasFMueller/SeminarNumerik`
- Another real book
  `github.com/hmemcpy/milewski-ctfp-pdf`

THE END

It was a lot, I know.