

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

Naoki Pross – np@0hm.ch

OST FHO Campus Rapperswil

Fall Semester 2022

## Me

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

# About me and polls

## Me

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

## You

- Faculty?
- $\text{\LaTeX}$  knowledge?

# My credentials

(none)

# How do you write a document?

Appearance  
before structure



Structure before  
appearance

$\text{\LaTeX} 2_{\epsilon}$



# How do you write a document?

Appearance  
before structure



**“WYSWYG”  
worse at both**

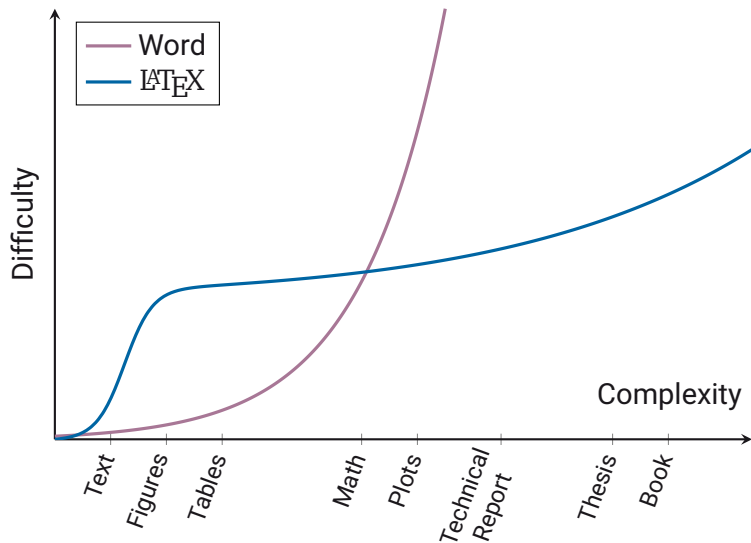


Structure before  
appearance

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



# 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

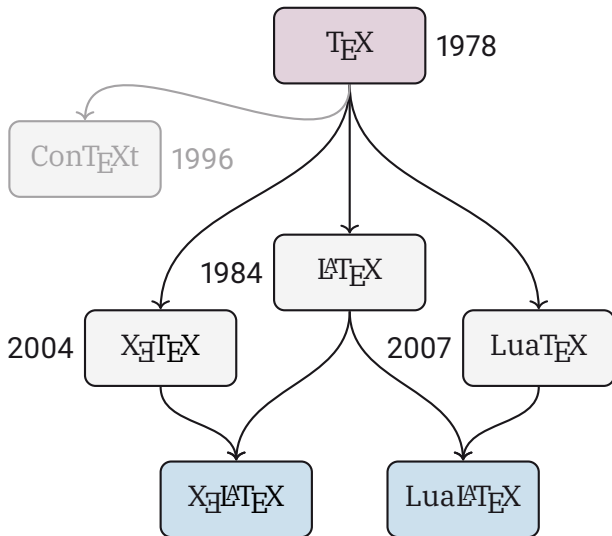
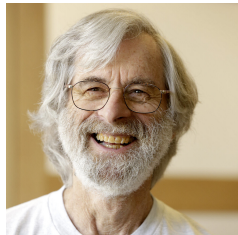
Things in red boxes are tips or extras

# Do yourself a favor

## Use the International US Keyboard Layout

~	! 1	@ 2	# 3	\$ 4	£ 5	% 6	^ 7	& 8	* 9	( 0	) 1	- 2	+ 3	÷ 4	← Backspace							
Tab ↵	Q	Å	W	Ä	E	É	R	T	P	Y	Ü	U	I	Í	O	Ó	P	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>Ǝ</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 Collaboration

6 Extras

# Commands aka Macros

*\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`, `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 “–”, «–», ...).

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 ’.



# 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

$\text{\LaTeX}$  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.

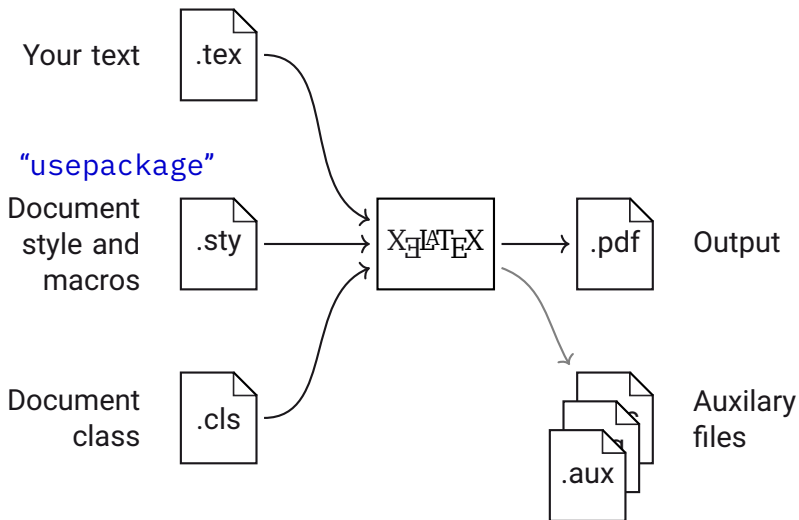
LaTeX will in indent this sentence because it is a new paragraph.

## What is CTAN

The Comprehensive 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.

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

# Typesetting (aka “compilation”)



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

```
\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

1 Fundamentals

2 Basics

3 Mathematics

4 Bibliography management

5 Collaboration

6 Extras

# 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{emphasized}.  
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 *emphasized*. You may also use **Bold**, *Italic*, SMALLCAPS, *Slanted*, Sans-Serif, Roman, Typewriter.

# Lists

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

## Itemize

- Tomatoes
- Peppers
- Broccoli

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

## 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 <sup>1</sup>	Place <b>exactly here</b> (may look very ugly)

## Pro tip

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

<sup>1</sup>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

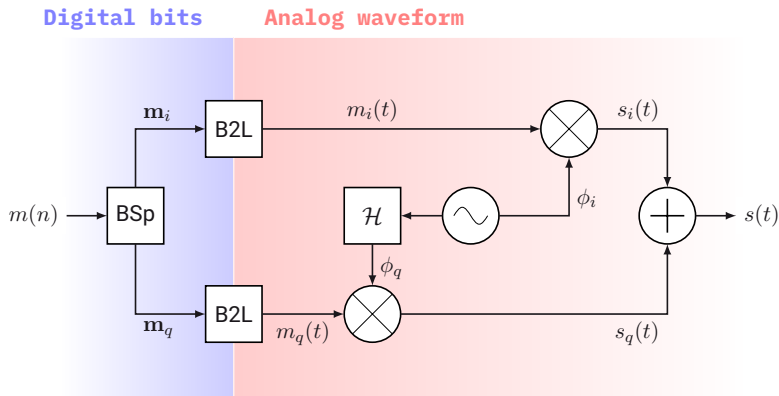
# Figures

```
\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

```
\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.

# Table of Contents

1 Fundamentals

2 Basics

**3 Mathematics**

4 Bibliography management

5 Collaboration

6 Extras

# Math environments

Environment	$\text{\LaTeX}$	$\text{\TeX}^2$
<code>math</code>	<code>\( ... \)</code>	<code>\$ ... \$</code>
<code>displaymath</code>	<code>\[ ... \]</code>	<code>\$\$ ... \$\$</code>
<code>equation</code>	—	—
<code>align</code>	—	—
<code>gather</code>	—	—

---

<sup>2</sup>Don't use them in  $\text{\LaTeX}$ . **For real: don't use them.**

# Example

The Pythagorean Theorem states that for a right triangle with sides  $(a,b,c)$  there is the relation:

$$\begin{aligned} &[ \\ & \quad c^2 = a^2 + b^2. \\ &] \end{aligned}$$

The Pythagorean Theorem states that for a right triangle 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    $\mathrm{R}$     $\mathit{R}$     $\mathbf{R}$     $\mathtt{R}$     $\mathbb{R}$     $\mathcal{R}$     $\mathfrak{R}$

# 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}`

$$\sum_{k=1}^{\infty} k = -\frac{1}{12}$$

$$F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt$$



# Matrices with amsmath

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

## The complex matrix

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

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_x^2 \psi + V\psi
\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

```
\begin{align*} % numbered when without *  
  \nabla \cdot \vec{F}(1,1)  
  &= \partial_x F_x + \partial_y F_y \\\br/>  &= 2x + 3y^4 \\\br/>  &= 2 + 3 \\\br/>  &= 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} \cdot d\mathbf{l} &= -\frac{d}{dt} \int_S \mathbf{B} \cdot d\mathbf{s} \dots
  \end{align}
\end{subequations}
```

Maxwell's equations in their integral form are:

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

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

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

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

Learn by doing: try to typeset these

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

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

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

# Table of Contents

1 Fundamentals

2 Basics

3 Mathematics

**4 Bibliography management**

5 Collaboration

6 Extras

# 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 @ieeetrans @inbook  
  @incollectedbook @incollection @injournal  
  @inproceedings @manual @mastersthesis @misc  
  @patent @periodical @phdthesis @preamble  
  @proceedings @standard @string @techreport  
  @unpublished
```

zotero

<https://www.zotero.org/>

# Table of Contents

1 Fundamentals

2 Basics

3 Mathematics

4 Bibliography management

**5 Collaboration**

6 Extras

# 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](mailto: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 Zusammenfassungen findest und wie man LaTeX und Git installiert.



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



## Problem

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

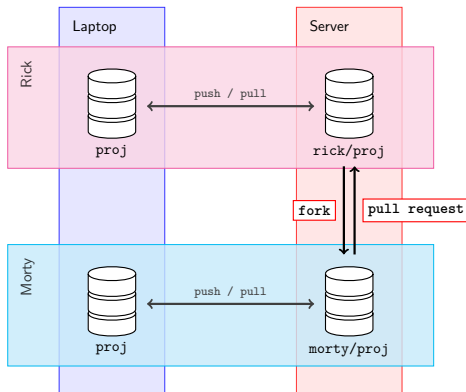
## Solution

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

- <https://studentenportal.ch>
- <https://github.com/hsr-stud>

# Git is kinda hard I know

Begriff: Fork



**E-Fachschaft git workshop?**

# How can you help?

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



# How can you help?

HSR-Stud / RegT4 Public

Edit Pins

Unwatch

<> Code

Issues 1

Pull requests

Actions

Wiki

Security

Insights

Settings

## 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

# Table of Contents

1 Fundamentals

2 Basics

3 Mathematics

4 Bibliography management

5 Collaboration

**6 Extras**

# Source code listings I: Settings

This presentation uses:

```
\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.

## Source code listings II: Usage (cont.)

Listing 1: FIR filter in 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  $\text{\LaTeX}$ 
  - `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.