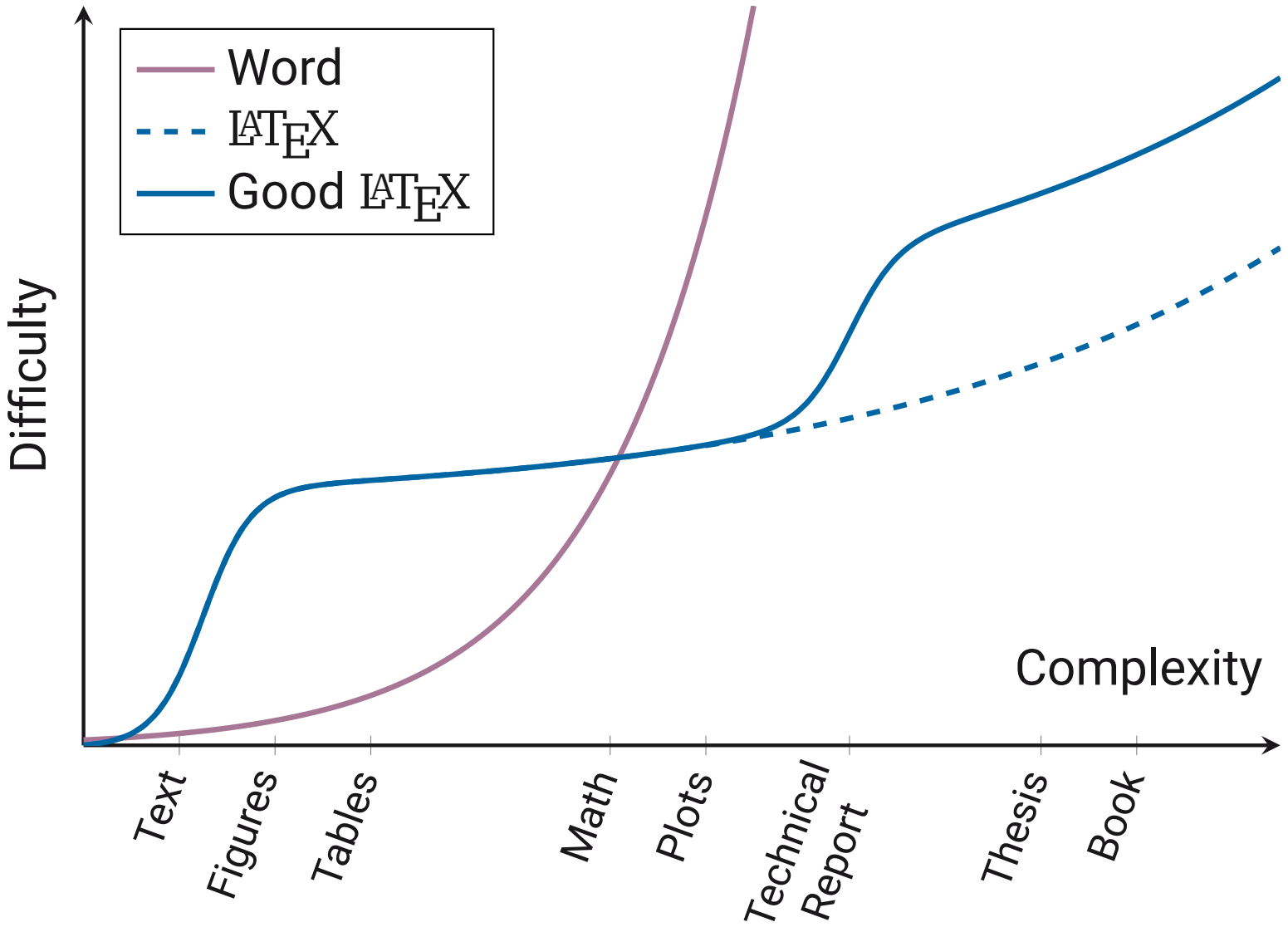
# Advanced LaTeX 2ε Workshop

Naoki Pross – np@0hm.ch

OST FHO Campus Rapperswil

Spring Semester 2022

# I lied to you sorry

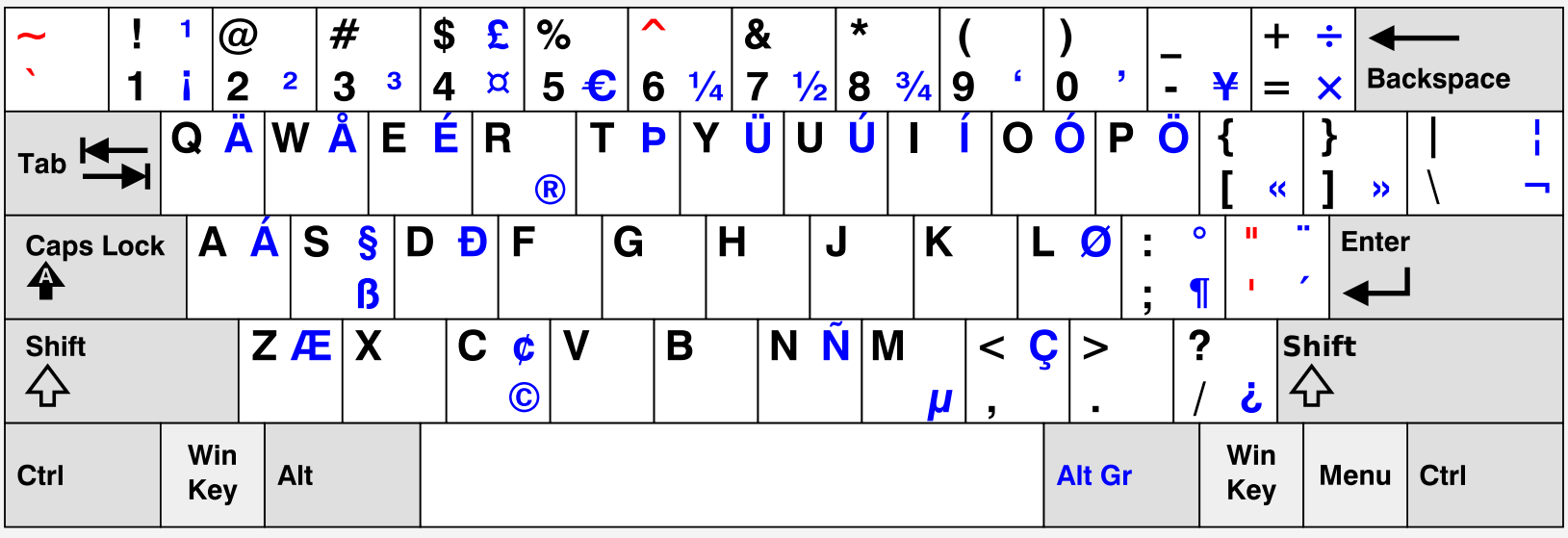


# Goals for today

- Organize your $\LaTeX 2_\varepsilon$ code because your last document was an *absolute fucking mess*
- Understand *why the hell* the compiler is complaining
- Consume your precariously short existence trying to learn to draw pictures with a terrible programming language called *TikZ*

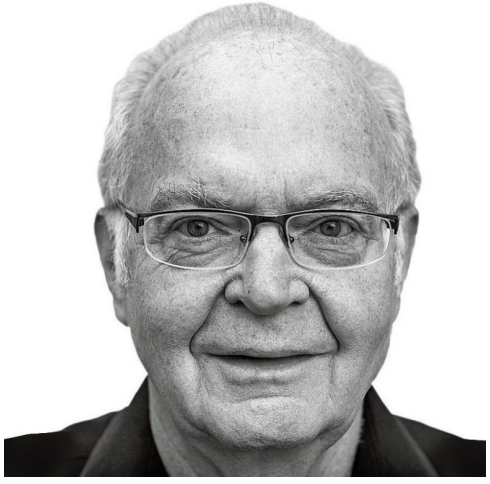
# Do yourself a favor

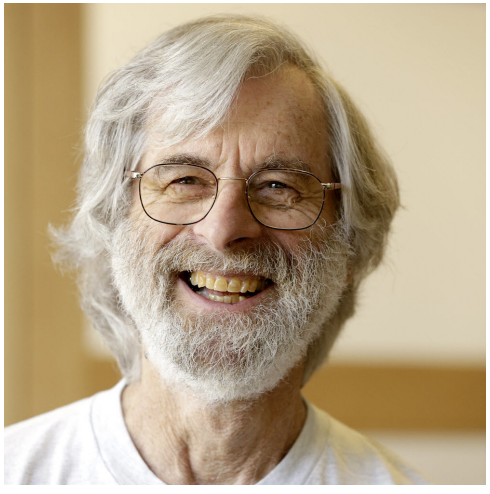
## Use the International US Keyboard Layout

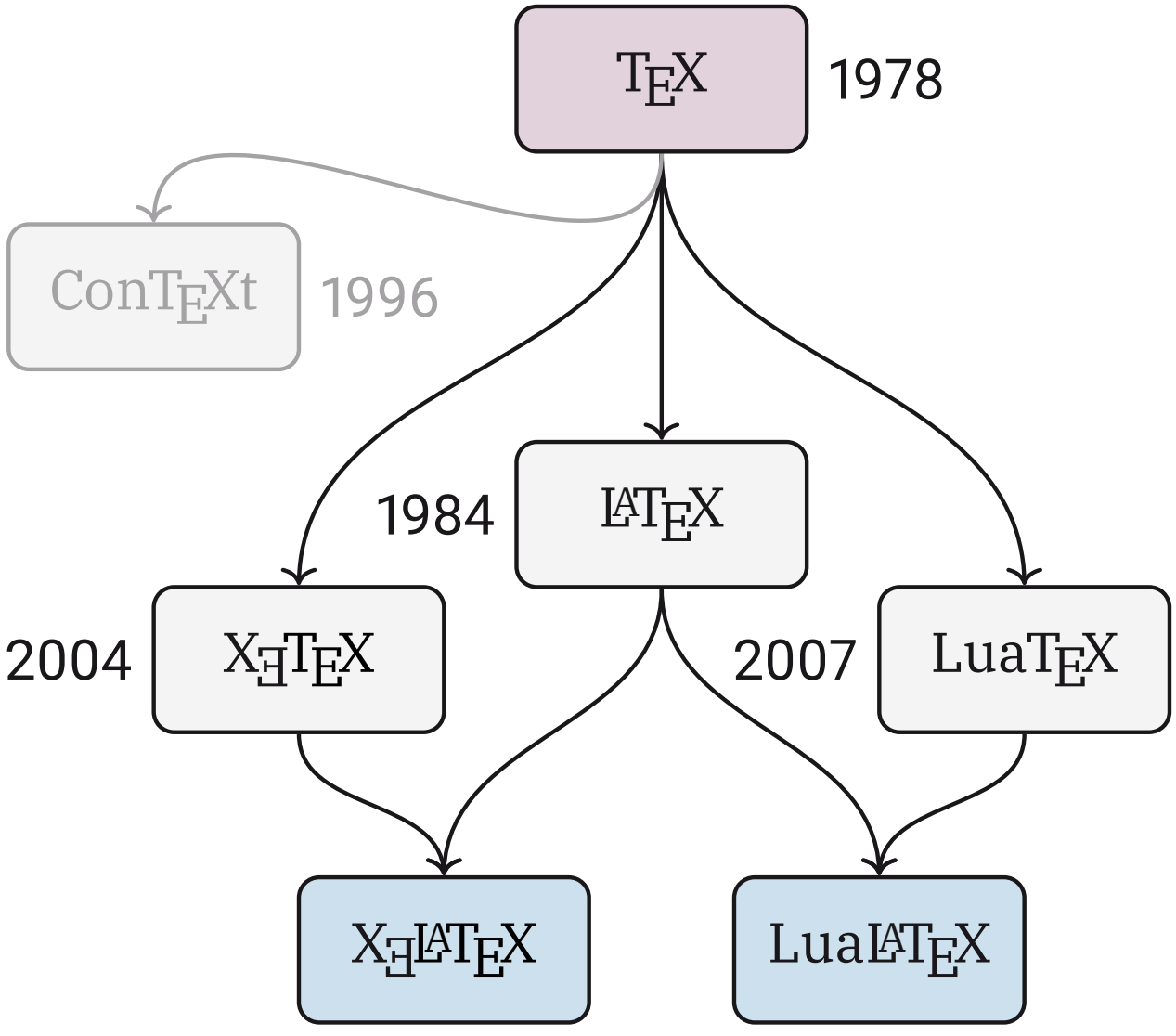


# Table of Contents

# Please enter the 21th century








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

# Stop putting line breaks everywhere.

## Don’t

```
%% wrong
This is a sentence in the first paragraph. \\
This is another paragraph.
```

## Do

```
This is a sentence in the first paragraph.

This is another paragraph.
```

Use `\\` only in `tabular`

# Don’t do manual styling

## Don’t

```
I want that \textbf{this part} stands out.
```

There is an *emphasis* macro

## Do

```
I want that \emph{this part} stands out.
```

Click here if you want to change how `\emph` looks like.

# Don’t do manual styling (bis)

## Never manually create headings

Yes, I’ve seen it done.

### Don’t

```
% NEVER do this
\textit{\textsf{My custom heading}} \\[1em]
```

# Customize headings

## With the `titlesec` package

```
% in the preamble
\usepackage{titlesec}

\titleformat{\paragraph}[hang]
  {\normalfont\itshape\sffamily}
  {\theparagraph}{1em}{}

% later in the document
\paragraph{My custom heading}
```

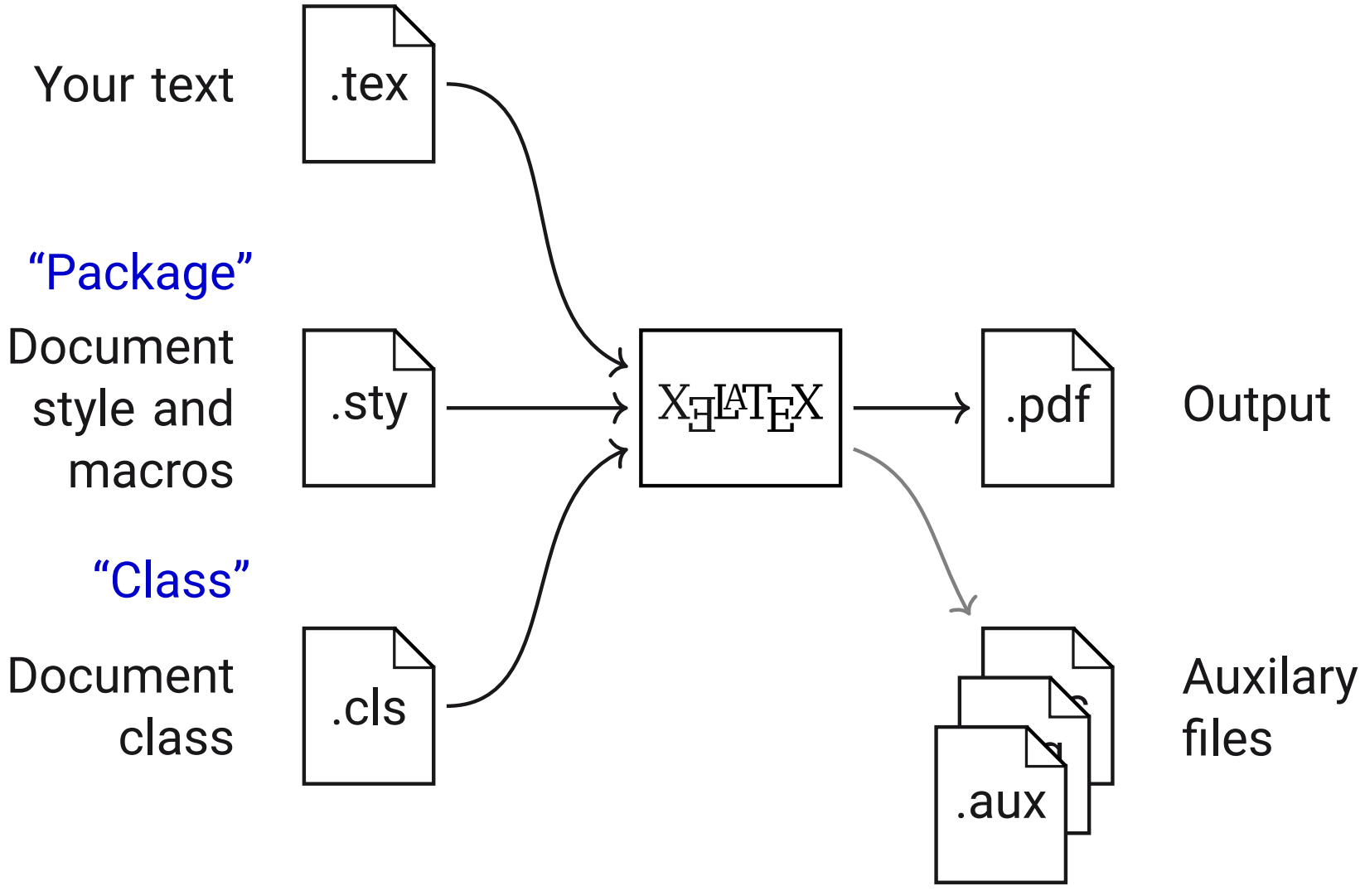
## 

KOMA classes have their own customization commands

# Stop making ugly tables

# Table of Contents

# What is a package?



# Table of Contents

# The root of the problem

Essentially, because D. Knuth is too clever.

## DemocracyFTW on HN under 29672872

*TeX uses recursive rewrites of the code that is the document to achieve what it does, without properly keeping track of where it is and what it does. There is no technical necessity for doing so, but the technique introduces huge complexity costs. On a somewhat related note, TeX's syntax at its very heart is also not trivial to parse short of executing (compiling) a given document (i.e. TeX's syntax itself is Turing-complete).*

# Turing completeness of TEX

## Sanity check

Wait, so you're saying that in theory TEX could compute *anything*? **YES**.

## Insane projects

- AVR CPU emulator in TEX: `avremu` package
- BASIC interpreter in TEX: `BASIX` package
- "Mars rover problem" solution in TEX: `link`
- Play reversi against an AI written in TEX with `reverxii`
- Tower of Hanoi problem solution in TEX: `hanoi` package

# Let me give you an example

## Power tower function

```
\tower[a] % {a}
\tower[a][b] % {a^{b}}
\tower[a][b][c] % {a^{b^{c}}}
```

## Output

$$a \quad a^{b} \quad a^{b^{c}}$$

## How you think it's done

```
def tower(args):
  write("{")
  for a in args:
    write("%s^{" % a)
  write("}" * len(args))
```

# Let me give you an example

## How it's actually done

```
# txt is like a pointer or iterator
def tower(txt):
  endtower = ""

  def step(t):
    if nextchr(t) == "[":
      endtower += "}"
      write("%s^{" % t + step(nextchr(t)))
    else:
      write(endtower)

  step(txt)
```

# Let me give you an example

## Easy!

```
\makeatletter
\def\tower{\@ifnextchar[
  {\def\endtower{}\towerstep}
  {}
}
\def\towerstep[#1]{#1%
  \@ifnextchar[
    {\edef\endtower{\endtower\egroup}
      ^\bgroup\towerstep}
    {\endtower}
}
\makeatother
```

# What execution (compiling) looks like

## Execution flow

1. Load file
2. Recursively expand macros (in the aux file)
3. Something goes wrong
4. You're probably deep in a recursion but you don't know because you don't keep a stack
5. Print an incomprehensible message about a missing variable or something
6. Wait for user input or die

# Amazing error messages

## Almost as good as C++ template errors

```
) [13] (/var/folders/w1/cmd2jfv1229gcxvtdyfg1vjc0000gn/T/latex-
build-1457ae9381593aa61ed49d5df3bb1135/advanced.toc) [14] [15]
build-1457ae9381593aa61ed49d5df3bb1135/advanced.vrb (/Users/npr
dist/tex/latex/listings/lstlang1.sty)) [16] (/var/folders/w1/cm
build-1457ae9381593aa61ed49d5df3bb1135/advanced.vrb) [17]
Runaway argument?
{{Let me give you an example} \begin {block}{Easy!} \begin {lstli
./advanced.tex:555: Paragraph ended before \beamer@@@checkoldfra
<to be read again>
                   \par
l.555

Output written on /var/folders/w1/cmd2jfv1229gcxvtdyfg1vjc0000g
build-1457ae9381593aa61ed49d5df3bb1135/advanced.pdf (17 pages).
Transcript written on /var/folders/w1/cmd2jfv1229gcxvtdyfg1vjc0
build-1457ae9381593aa61ed49d5df3bb1135/advanced.log.
```

# Table of Contents

# What is TikZ

## TikZ = TikZ ist kein Zeichenprogramm

```
\usepackage{tikz}
\usetikzlibrary{calc, positioning, ...}
```

```
\begin{figure}
  \centering
  \begin{tikzpicture}[
      % global settings / styles
    ]

    % drawing commands

  \end{tikzpicture}
  \caption{... \label{fig:...}}
\end{figure}
```

# Elements

## Basics

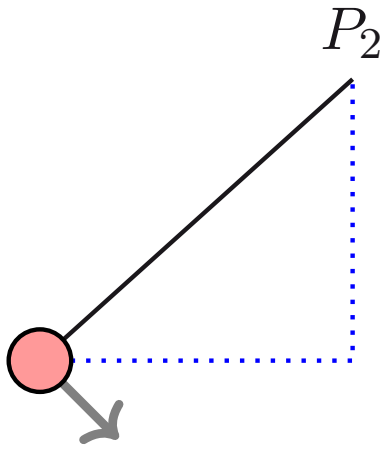
- `\coordinate (name)at (x,y);`
- `\node[options] (name)at (x,y){label};`
- `\draw[options] commands;`
- `\fill[options] commands;`

## Drawing commands

- Line `(A) -- (B)`
- Horiz. then vert. line `(A) -| (B)`
- Vert. then horiz. line `(A) |- (B)`
- Quadratic Bézier `(A).. controls (P)and (Q).. (B)`
- Advanced curve `(A) to[options] (B)`
- Nodes `node[options] (name){label}`
- Shapes `(A)rectangle (B)`, `(A)circle (2cm)`

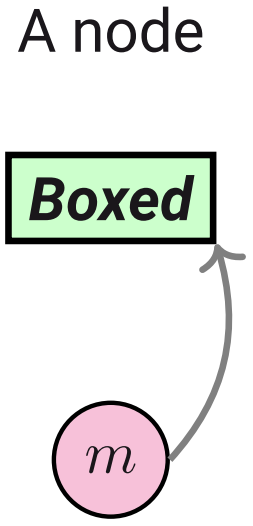
# Basic example

```
\begin{tikzpicture}
  \coordinate (O) at (0,0);
  \coordinate (A) at (2cm,18mm);
  % no units = cm

  \draw[thick] (O) -- (A);
  \draw[thick, dotted, blue]
    (O) -| (A);

  \draw[ultra thick, ->, gray]
    (O) -- ++(5mm, -5mm);

  \fill[thick, draw = black,
    fill = red!40] (O) circle (2mm);

  \node[above] at (A) {\(P_2\)};
\end{tikzpicture}
```



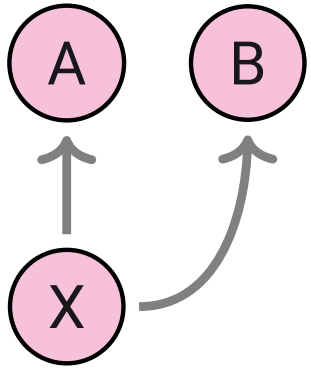
# Example with nodes

```
\node (A) at (0,0) {A node};

\node[
  rectangle, very thick,
  draw = black, fill = green!20,
  font = \bfseries\slshape,
  % positioning library
  below = 5mm of A,
] (B) {Boxed};

\node[
  circle, thick,
  draw = black, fill = magenta!20,
  below = 1cm of B,
] (C) {\(m\)};

\draw[very thick, gray, ->]
  (C.east) to[bend right] (B.south east)
    ;
```



# TikZ V: Matrix and scope

```
\matrix (M) [ % node with table of nodes
  row sep = 8mm,
  column sep = 4mm,
  nodes = {
    circle, thick,
    draw = black,
    fill = magenta!30,
    outer sep = 1mm,
  },
]{
  \node (A) {A}; & \node (B) {B}; \\
  \node (X) {X}; \\
};

\begin{scope}[ultra thick, gray, ->]
  \draw (X) -- (A);
  \draw (X) to[out = 0, in = -90] (B);
\end{scope}
```



# The End

It wasn't worth the time I know, but hey,
at least now you know how to draw pretty pictures