

Degree Programme
Systems Engineering
Major Infotronics

BACHELOR'S THESIS

DIPLOMA 2021

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Guide to Thesis

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Submission date of the report
March 23, 2022



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1 | Thesis

The bachelor thesis is a scientific text for the completion of a bachelor's degree program, written by students. The bachelor thesis analyzes existing findings or brings forth new ones. A comprehensive knowledge base on how to write a thesis can be found at <https://www.scribbr.com/knowledge-base/>


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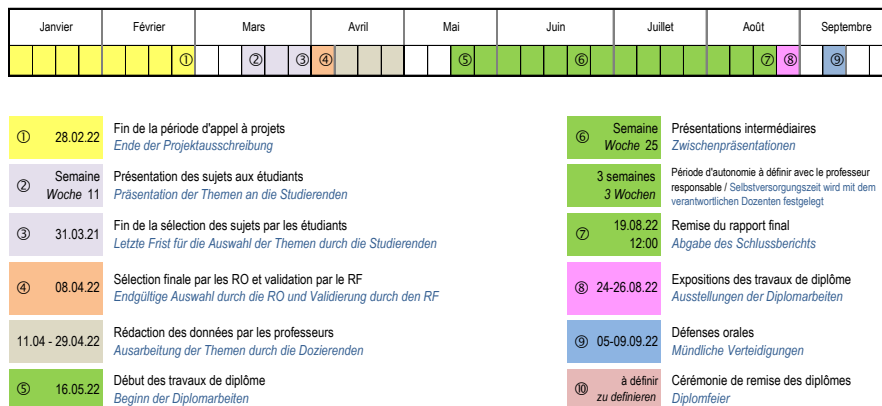
1.1 Planning

The thesis is conducted in the spring semester for around 15 Weeks. See current planning in figure 1.1.

 Filière Énergie et techniques environnementales
Studiengang Energie und Umwelttechnik

 Filière Systèmes industriels
Studiengang Systemtechnik

Echéancier des travaux de diplôme bachelor 2022 / Planung der Bachelorarbeiten 2022



13.10.2021

Figure 1.1 Thesis Planning

1.2 Phases

The bachelor thesis consists of three main phases: **Preparation, writing phase and follow-up.**

Preparation

- ✓ Select topic
- ✓ View examples
- ✓ Create a schedule
- ✓ Conduct literature research
- ✓ Choose methodology
- ✓ Write synopsis

Writing

- ✓ Finalize structure and outline
- ✓ Write introduction
- ✓ Determine theoretical framework
- ✓ Write methodology section
- ✓ Present research results
- ✓ Write conclusion

Follow Up

- ✓ Create bibliography
- ✓ Sign declaration
- ✓ Have proofreading done
- ✓ Perform plagiarism check
- ✓ Printing Binding

1.3 Sections

1.3.1 Abstract

The abstract is a summary of your complete work. It should not exceed one page and contain the following information:

- General background information
- Objective(s)
- Approach and method
- Conclusions

1.3.2 Acknowledgements

The acknowledgement is an optional part of your academic paper. You acknowledge and thank those who have supported you during your studies. These can be, but are not limited to, individuals, institutions, or organizations.

Although your acknowledgements are not used to evaluate your work, they are still an important section of your dissertation. This is because it can positively (or negatively) influence the reader's perception even before they reach the main body of your paper.

1.3.3 Introduction

Your introduction serves to introduce the topic of your Bachelor thesis and to arouse the reader's curiosity with an overview. Why it is important and how it is structured, we explain here.

You can consider an introduction as a teaser for your bachelor thesis. You arouse interest and give a foretaste by presenting your motivation, your method and the state of research in your introduction.

Convince your examiners already in the introduction that your Bachelor thesis will be exciting. If your professor starts reading your thesis with anticipation and interest, the chances of getting good grades are higher.

Pay particular attention to the following in your introduction:

- **Introduce the topic** - What characterizes the topic?
- **Introduce the goal** - What do you want to achieve with your thesis?
- **Make the reader curious** - What motivates the reader to read on?
- **Describe the relevance** - Why is this bachelor thesis scientifically relevant?

The introduction should have the following content:

- **Initial situation presentation of the topic** - You introduce the topic with an exciting 'bait'. You provide initial information on the topic and the object of research and explain the current state of research.

- **Relevance of the topic motivation** - You justify the relevance of your topic (scientifically) and place it in the context of your field. In addition, it is often required that you disclose your personal motivation.
- **Problem description and thematic delimitation** - By means of a specific research question (or hypothesis) you present your explicit research interest. If necessary, explain technical terms.
- **Objectives** - Your introduction should clearly state what the goal of your paper is and what outcome you hope to achieve upon completion of the bachelor thesis.
- **Method** - You explain the approach and justify the choice of method.
- **Structure of the Bachelor's thesis** - Finally, you give the reader a general overview of your Bachelor's thesis by explaining the structure, showing the red thread and how the research question is answered.

1.3.4 Analysis

In the analysis part a so called **"State of the Art"** analysis is done. It describes the knowledge about the studied matter through the analysis of **similar or related published work**. It provides a comprehensive overview of what was done, what has been done in the field and what should be further investigated.

A State of the Art is done in multiple phases:

1. Problem formulation (Research questions)
2. Literature search
3. Literature evaluation
4. Analysis and interpretation
5. Presentation

Good sources for a literature search depend on your subject matter. For engineering hereafter a incomplete list:

- [IEEE Xplore](#)
- [Science Direct](#)
- [Google Books](#)
- [ProQuest](#)
- [JSTOR](#)

1.3.5 Design

In the design section a general overview about the to be implemented system is shown. All the hardware and software and other topics can be evaluated and selected.

1.3.6 Implementation

The implementations shows specifically how your research was conducted. All the implementation details and practical tests can be listed.

1.3.7 Validation

The results section of your bachelor's thesis presents the **results of your research in relation to your research question**.

Your readers must be able to understand at a glance which data set belongs to which research question or hypothesis.

- Describe your data objectively
- Use graphs and tables to illustrate your data.
- Refer to your research question with each result
- Rank your results in order of importance
- Confirm or reject your hypotheses

1.3.8 Conclusion

A conclusion succinctly **summarizes the most important results** and thus represents the highlight of your Bachelor thesis.

In the conclusion, you only mention information and conclusions that you have already mentioned in the course of your body text. New information is not mentioned here.

The conclusion should have the following content:

- Project summary
- Comparison with the initial objectives
- Encountered difficulties
- Future perspectives

A subsection of the validation is the discussion. In the discussion, you deal with the results of your investigation in a more interpretative way.

While you keep the conclusion of your bachelor thesis short and to the point, you deal with your results in more detail in the discussion.

2 | Latex

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2.1 Installation

1. Install <https://miktex.org/download>
2. MiKTeX Packages
 - minted
 - pip install pygments
 - add Python Scripts to PATH Environment Variable
3. Install your preferred IDE
 - We use [Visual Studio Code](#)
 - With the following extensions
 - [LaTeX language support](#)
 - [LaTeX Workshop](#)

2.2 Page Formatting

2.2.1 General Formatting

Page Formatting

```
\newpage      % jump to new page

\par          % new paragraph
\\           % new paragraph
\\* or \newline % new line

%            % start line comment
```

Font sizes

Huge
huge
LARGE
Large
large
normal (default)
small
footnotesize
scriptsize
tiny

```
{\Huge Huge}
{\huge huge}
{\LARGE LARGE}
{\Large Large}
{\large large}
{\normalsize normal (default)}
{\small small}
{\footnotesize footnotesize}
{\scriptsize scriptsize}
{\tiny tiny}
```

Decorations

Italic
Typewriter
Bold
Text
Serif Font
Serif (Roman)
Underline
Emphasis

```
\textit{Italic}
\texttt{Typewriter}
\textbf{Bold}
\texttt{Text}
\textsf{Serif}
\textrm{Sans Serif (Roman)}
\underline{Underline}
\emph{Emphasis}
```

Text Alignment

left aligned text
right aligned text
centered text

```
\raggedright
left aligned text \\
\raggedleft
right aligned text \\
\centering
centered text \\
%\justify
%justified text \\
```

Links

<http://hevs.ch>
silvan.zahno@hevs.ch
[Hevs Website](http://hevs.ch)

```
\url{http://hevs.ch}  
\href{mailto:\AuthorEmail}{\AuthorEmail}  
\href{http://hevs.ch}{Hevs Website}
```

Cross referencing

Set labels and reference them afterwards. Labels can be set anywhere hereafter examples for sections, equations and images.

2.2.1 Cross referencing

$$\sum_{i=0}^{\infty} a_i x^i \tag{2.1}$$

The equations [2.1](#) is a power series.



Figure 2.1 *Figure with reference label*

Figure [2.1](#) shows the image.

```
\section{Cross referencing} \label{crossref}  
\ref{crossref} \nameref{crossref}  
  
\begin{equation} \label{eq:1}  
  \sum_{i=0}^{\infty} a_i x^i  
\end{equation}  
The equations \ref{eq:1} is a power series.  
  
\begin{center}  
  \begin{group}  
    \includegraphics[width=0.5\columnwidth]{placeholder.pdf}  
    \captionof{figure}{Figure with reference label}  
    \label{fig:figurelabel}  
  \end{group}  
\end{center}  
figure \ref{fig:figurelabel} shows the logo.
```

2.3 General Elements

2.3.1 Sections

For creating Chapters, Sections and Subsections there are multiple levels available. Good practice is to limit the number of level to `\subsubsection`

```
0 = \chapter{Chapter}
1 = \section{First Section}
2 = \subsection{Second Section}
3 = \subsubsection{Third Section}
4 = \paragraph{Paragraph}
5 = \subparagraph{Subpararaph}
```

2.3.2 Lists

- One
- Two

```
\begin{itemize}
  \item One
  \item Two
\end{itemize}
```

- One
 - Two
 - Three
- Four

```
\begin{itemize}
  \item One
  \begin{itemize}
    \item Two
    \item Three
  \end{itemize}
  \item Four
\end{itemize}
```

1. One
2. Two

```
\begin{enumerate}
  \item One
  \item Two
\end{enumerate}
```

1. One
 - (a) Two
 - (b) Three
2. Four

```
\begin{enumerate}
  \item One
  \begin{enumerate}
    \item Two
    \item Three
  \end{enumerate}
  \item Four
\end{enumerate}
```

- ☐ Normal item
- ☒ cmark item
- ☒ xmark item
- ☒ done item
- ☒ wontfix item

```
\begin{todolist}
\item Normal item
\item[\cmark] cmark item
```

```
\item[\xmark] xmark item
\item[\done] done item
\item[\wontfix] wontfix item
\end{todolist}
```

2.3.3 Multicolumns

Column 1

Column 2

```
\begin{multicols}{2}
Column 1
\vfill\null\columnbreak
Column 2
\end{multicols}
```

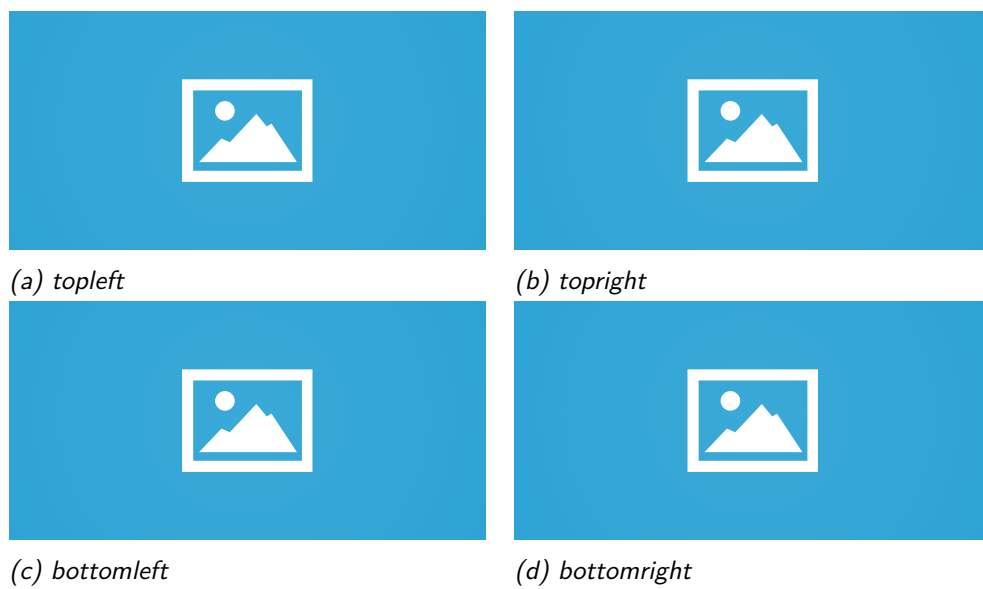


Figure 2.4 Example subcaption

2.5 Tables

| | | | | |
|------|--------|-------|-------|-------|
| Left | Center | Right | Right | Right |
| 1.1 | 1.2 | 1.3 | 1.4 | 1.5 |
| 2.1 | 2.2 | 2.3 | 2.4 | 2.5 |
| 3.1 | 3.2 | 3.3 | 3.4 | 3.5 |
| 4.1 | 4.2 | 4.3 | 4.4 | 4.5 |
| 5.1 | 5.2 | 5.3 | 5.4 | 5.5 |
| 6.1 | 6.2 | 6.3 | 6.4 | 6.5 |
| 7.1 | 7.2 | 7.3 | 7.4 | 7.5 |

Table 2.1 Table Example 1

```

\begin{group}
\begin{tabular}{l : c | r || r V{2.7}
↪ r \vline}
Left & Center & Right & Right &
↪ Right \\
1.1 & 1.2 & 1.3 & 1.4 & 1.5 \\
↪ \hdashline
2.1 & 2.2 & 2.3 & 2.4 & 2.5 \\
3.1 & 3.2 & 3.3 & 3.4 & 3.5 \\
↪ \hline \hline
4.1 & 4.2 & 4.3 & 4.4 & 4.5 \\
↪ \hlineB{2.7}
5.1 & 5.2 & 5.3 & 5.4 & 5.5 \\
↪ \toprule
6.1 & 6.2 & 6.3 & 6.4 & 6.5 \\
↪ \midrule
7.1 & 7.2 & 7.3 & 7.4 & 7.5 \\
↪ \bottomrule
\end{tabular}
\captionof{table}{Table Example 1}
\label{tab:ex1}
\end{group}

```

| X | Q ₁ | Q ₀ | Y |
|---|----------------|----------------|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

Table 2.2 Table Example 2

```

\begin{group}
\begin{tabular}{c V{2.7} c c V{2.7}
↪ c}
X & $Q_1$ & $Q_0$ & Y \\
↪ \hline
0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 \\
0 & 1 & 0 & 1 \\
0 & 1 & 1 & 0 \\
1 & 0 & 0 & 1 \\
1 & 0 & 1 & 1 \\
1 & 1 & 0 & 1 \\
1 & 1 & 1 & 0 \\
\end{tabular}
\captionof{table}{Table Example 2}
\label{tab:ex2}
\end{group}

```

| Operator | Beschreibung |
|----------|--------------|
| + | Addition |
| - | Substraktion |

Table 2.3 Table Example 3

```

\begin{group}
\begin{tabular}{| c | c | }
\hline
\multicolumn{1}{|c|}{\emph{
↪ Operator }} &
↪ \multicolumn{1}{|c|}{\emph{
↪ Beschreibung}} \\
+ & \multicolumn{1}{|l|}{Addition} \\
↪ \hline
- & \multicol-
↪ umn{1}{|l|}{Substraktion} \\
↪ \hline
\end{tabular}
\captionof{table}{Table Example 3}
\label{tab:ex3}
\end{group}

```


`\endgroup`

| Room \ Date | Col 1 | Col 2 |
|-------------|-------|-------|
| Row 1 | | |
| Row 2 | | |
| Row 3 | | |

Table 2.4 Table Example 4

```
\begin{group}
\begin{tabular}{|l||*2{c|}}\hline
\backslash
→ \box{Room}{Date}&\makebox[3em]{Col
→ 1}&\makebox[3em]{Col 2} \\
→ \hline\hline
Row 1 &&\hline
Row 2 &&\hline
Row 3 &&\hline
\end{tabular}
\captionof{table}{Table Example 4}
\label{tab:ex4}
\end{group}
```

2.6 Colors

| Latex Symbol | Latex Code |
|----------------|---|
| black | <code>\textcolor{black}{black}</code> |
| | <code>\textcolor{white}{white}</code> |
| red | <code>\textcolor{red}{red}</code> |
| yellow | <code>\textcolor{yellow}{yellow}</code> |
| lime | <code>\textcolor{lime}{lime}</code> |
| olive | <code>\textcolor{olive}{olive}</code> |
| green | <code>\textcolor{green}{green}</code> |
| teal | <code>\textcolor{teal}{teal}</code> |
| blue | <code>\textcolor{blue}{blue}</code> |
| HEICyan | <code>\textcolor{HEICyan}{HEICyan}</code> |
| HEIMagenta | <code>\textcolor{HEIMagenta}{HEIMagenta}</code> |
| HEIYellow | <code>\textcolor{HEIYellow}{HEIYellow}</code> |
| HEIGreen | <code>\textcolor{HEIGreen}{HEIGreen}</code> |
| SPLGreen | <code>\textcolor{SPLGreen}{SPLGreen}</code> |
| SPLBlue | <code>\textcolor{SPLBlue}{SPLBlue}</code> |
| SPLPurple | <code>\textcolor{SPLPurple}{SPLPurple}</code> |
| mGray20 | <code>\textcolor{mGray20}{mGray20}</code> |
| mGray40 | <code>\textcolor{mGray40}{mGray40}</code> |
| mGray60 | <code>\textcolor{mGray60}{mGray60}</code> |
| mGray80 | <code>\textcolor{mGray80}{mGray80}</code> |
| | <code>\textcolor{mWhite}{mWhite}</code> |
| mBlack | <code>\textcolor{mBlack}{mBlack}</code> |
| mPink | <code>\textcolor{mPink}{mPink}</code> |
| Accent Color 1 | <code>\textcolor{coloraccent1}{Accent Color 1}</code> |
| Accent Color 2 | <code>\textcolor{coloraccent2}{Accent Color 2}</code> |
| Accent Color 3 | <code>\textcolor{coloraccent3}{Accent Color 3}</code> |

Test text

colorbox

```
%\pagecolor{black} % would make this
↪ and all coming pages black
{
\color{mGray80}
Test text \\\
}
{
\color{coloraccent1}
\rule{\linewidth}{1mm}
}
\colorbox{coloraccent2}{colorbox}
```

2.7 Code

2.7.1 Inline Code

Inline minted `int x = 0`

Inline code `int x = 0`

```
Inline minted \mintinline{cpp}{int x =
↪ 0}
Inline code \lstinline{int x = 0}
```

2.7.2 Bloc Code

```
1 import numpy as np
2 class PiClass:
3     """ Pi class for getting pi value """
4     def __init__():
5         """ Returns value of Pi """
6         return np.pi
```

```
\begin{minted}
[
  fontsize=\scriptsize,
  linenos
]{python}
import numpy as np
class PiClass:
    """ Pi class for getting pi value
↪ """
    def __init__():
        """ Returns value of Pi """
        return np.pi
\end{minted}
```

```
import numpy as np
class PiClass:
    """ Pi class for getting pi value """
    def __init__():
        """ Returns value of Pi """
        return np.pi
```

```
\usemintedstyle{monokai}
\begin{minted}[bgcolor=black!80]{python}
import numpy as np
class PiClass:
    """ Pi class for getting pi value """
    def __init__():
        """ Returns value of Pi """
        return np.pi
\end{minted}
```

```
import numpy as np
class PiClass:
    """ Pi class for getting pi value """
    def __init__():
        """ Returns value of Pi """
        return np.pi
```

```
\usemintedstyle{bw}
\begin{minted}
[frame=lines,
framesep=2mm,
baselinestretch=1.2,
bgcolor=gray!20,]{python}
import numpy as np
class PiClass:
    """ Pi class for getting pi value """
    def __init__():
        """ Returns value of Pi """
        return np.pi
\end{minted}
```

Listings

```
/**
 * The HelloWorldApp class implements
 * ↪ an application that
 * ↪ simply prints "Hello World!" to
 * ↪ standard output.
 */
class HelloWorldApp {
    public static void main(String[]
        ↪ args) {
        System.out.println("Hello
            ↪ World!"); // Display the
            ↪ string.
    }
}
```

```
\begin{center}
\inputminted{java}{02-
    ↪ main/listings/HelloWorld.java}
\captionof{listing}{listing example}
\label{lst:listing_example}
\end{center}
```

Listing 2.1 *listing example*

2.8 MathJax

- [Mathjax Latest Documentation](#)
- [Stack Exchange Basic Tutorial and Quick Reference](#)
- [List of LaTeX Mathematical Symbols](#)
- [List of LaTeX Symbols](#)

2.8.1 Equations

Environments

The package `amsmath` features 2 different environments `align`, `split`, `multiline`

align Numbered equations aligned at points marked with `\&` usually just before a relation.

$$a_1 = b_1 + c_1 \quad (2.2)$$

$$a_2 = b_2 + c_2 - d_2 + e_2 \quad (2.3)$$

```
\begin{align}
a_1&=b_1+c_1\\
a_2&=b_2+c_2-d_2+e_2
\end{align}
```

split Similar alignment to `align`, but the whole construct fits within equation and is numbered as a unit.

$$\begin{aligned} a &= b + c - d \\ &\quad + e - f \\ &= g + h \\ &= i \end{aligned} \quad (2.4)$$

```
\begin{equation}
\begin{split}
a&=b+c-d\\
&\quad +e-f\\
&=g+h\\
&=i
\end{split}
\end{equation}
```

multiline For long expressions taking more than one line, with no specified alignment points.

$$\begin{aligned} a + b + c + d + e + f + g \\ l + m + n + o + p + q + r \end{aligned} \quad (2.5)$$

```
\begin{multiline}
a+b+c+d+e+f+g\\
l+m+n+o+p+q+r
\end{multiline}
```

2.8.2 Symbols

Mathjax code need to be places between `$` Symbols

- `$...$`: for inline Mathjax

- `$$...$$`: for bloc Mathjax

2.8.3 Text & Additions

| Symbol | Code | Symbol | Code |
|--|---------------------------------------|---|--|
| normal text | <code>\text{normal text}</code> | bold text | <code>\textbf{bold text}</code> |
| <i>italic text</i> | <code>\textit{italic text}</code> | fixspace text | <code>\texttt{fixspace text}</code> |
| $Q_1 I_{\min}$ | <code>Q_1 I_{\min}</code> | $x^2 x^{20}$ | <code>x^2 x^{20}</code> |
| \acute{x} | <code>\acute{x}</code> | \grave{x} | <code>\grave{x}</code> |
| \dot{x} | <code>\dot{x}</code> | \ddot{x} | <code>\ddot{x}</code> |
| \bar{x} | <code>\bar{x}</code> | \tilde{x} | <code>\tilde{x}</code> |
| \hat{x} | <code>\hat{x}</code> | \check{x} | <code>\check{x}</code> |
| \vec{x} | <code>\vec{x}</code> | \breve{x} | <code>\breve{x}</code> |
| $\overset{\text{over}}{X}$ | <code>\overset{over}{X}</code> | $\underset{\text{under}}{XXX}$ | <code>\underset{under}{X}</code> |
| \overline{xxx} | <code>\overline{xxx}</code> | \underline{xxx} | <code>\underline{xxx}</code> |
| \overbrace{xxx} | <code>\overbrace{xxx}</code> | \underbrace{xxx} | <code>\underbrace{xxx}</code> |
| \overleftarrow{xxx} | <code>\overleftarrow{xxx}</code> | \overrightarrow{xxx} | <code>\overrightarrow{xxx}</code> |
| $\xleftarrow[\text{under}]{\text{over}}$ | <code>\xleftarrow[under]{over}</code> | $\xrightarrow[\text{under}]{\text{over}}$ | <code>\xrightarrow[under]{over}</code> |

2.8.4 Spaces

| Symbol | Code | Symbol | Code | Symbol | Code |
|--------|--------------------------------|--------|------------------------|--------|---------------------------------|
| $a\,b$ | <code>a \mspace{3mu} b</code> | $a\,b$ | <code>a \, b</code> | $a\,b$ | <code>a \thinspace b</code> |
| $a\,b$ | <code>a \mspace{4mu} b</code> | $a\,b$ | <code>a \: b</code> | $a\,b$ | <code>a \medspace b</code> |
| $a\,b$ | <code>a \mspace{5mu} b</code> | $a\,b$ | <code>a \; b</code> | $a\,b$ | <code>a \thickspace b</code> |
| $a\,b$ | <code>a \mspace{6mu} b</code> | $a\,b$ | <code>a \quad b</code> | - | - |
| $a\,b$ | <code>a \mspace{18mu} b</code> | $a\,b$ | <code>a \quad b</code> | - | - |
| $a\,b$ | <code>a \mspace{36mu} b</code> | $a\,b$ | <code>a \quad b</code> | - | - |
| ab | <code>a \mspace{-3mu} b</code> | ab | <code>a \, b</code> | ab | <code>a \negthinspace b</code> |
| ab | <code>a \mspace{-4mu} b</code> | - | - | ab | <code>a \negmedspace b</code> |
| ab | <code>a \mspace{-5mu} b</code> | - | - | ab | <code>a \negthickspace b</code> |

2.8.5 Quotes

| Symbol | Code | Alt Code |
|--------|-------------------|--|
| ' | <code>\q</code> | <code>\textnormal{\textquotesingle}</code> |
| ' | <code>\ql</code> | <code>\textnormal{\textquoteleft}</code> |
| ' | <code>\qr</code> | <code>\textnormal{\textquoteright}</code> |
| ” | <code>\qq</code> | <code>\textnormal{\textquotedblright}</code> |
| “ | <code>\qql</code> | <code>\textnormal{\textquotedblleft}</code> |
| ” | <code>\qqr</code> | <code>\textnormal{\textquotedblright}</code> |

2.8.6 Greek Letters

| Symbol | Code |
|-------------------------|--|
| $A\alpha$ | A <code>\alpha</code> |
| $B\beta$ | B <code>\beta</code> |
| $\Gamma\gamma$ | <code>\Gamma</code> <code>\gamma</code> |
| $\Delta\delta$ | <code>\Delta</code> <code>\delta</code> |
| $E\epsilon$ | E <code>\epsilon</code> <code>\varepsilon</code> |
| $Z\zeta$ | Z <code>\zeta</code> |
| $H\eta$ | H <code>\eta</code> |
| $\Theta\theta\vartheta$ | <code>\Theta</code> <code>\theta</code> <code>\vartheta</code> |
| $I\iota$ | I <code>\iota</code> |
| $K\kappa$ | K <code>\kappa</code> |
| $\Lambda\lambda$ | <code>\Lambda</code> <code>\lambda</code> |
| $M\mu$ | M <code>\mu</code> |
| $N\nu$ | N <code>\nu</code> |
| $\Xi\xi$ | <code>\Xi</code> <code>\xi</code> |
| $O\ominus$ | O <code>\ominus</code> |
| $\Pi\pi\varpi$ | <code>\Pi</code> <code>\pi</code> <code>\varpi</code> |
| $P\rho$ | P <code>\rho</code> |
| $\Sigma\sigma\varsigma$ | <code>\Sigma</code> <code>\sigma</code> <code>\varsigma</code> |
| $T\tau$ | T <code>\tau</code> |
| $\Upsilon\upsilon$ | <code>\Upsilon</code> <code>\upsilon</code> |
| $\Phi\phi\varphi$ | <code>\Phi</code> <code>\phi</code> <code>\varphi</code> |
| $X\chi$ | X <code>\chi</code> |
| $\Psi\psi$ | <code>\Psi</code> <code>\psi</code> |
| $\Omega\omega$ | <code>\Omega</code> <code>\omega</code> |

2.8.7 Symbols

Relational Operators

| Symbol | Code | Symbol | Code |
|---------------|--------------------------|---------------|--------------------------|
| $<$ | <code><</code> | $>$ | <code>></code> |
| \nless | <code>\nless</code> | \ngtr | <code>\ngtr</code> |
| \leq | <code>\leq</code> | \geq | <code>\geq</code> |
| \leqslant | <code>\leqslant</code> | \geqslant | <code>\geqslant</code> |
| \nleq | <code>\nleq</code> | \ngeq | <code>\ngeq</code> |
| \nleqslant | <code>\nleqslant</code> | \ngeqslant | <code>\ngeqslant</code> |
| \ll | <code>\ll</code> | \gg | <code>\gg</code> |
| \lll | <code>\lll</code> | \ggg | <code>\ggg</code> |
| \subset | <code>\subset</code> | \supset | <code>\supset</code> |
| $\not\subset$ | <code>\not\subset</code> | $\not\supset$ | <code>\not\supset</code> |
| \subseteq | <code>\subseteq</code> | \supseteq | <code>\supseteq</code> |
| \nsubseteq | <code>\nsubseteq</code> | \nsupseteq | <code>\nsupseteq</code> |

| Symbol | Code |
|--------|------------------------------------|
| = | = |
| ≡ | <code>\equiv</code> |
| ≈ | <code>\approx</code> |
| ≅ | <code>\cong</code> |
| ≈ | <code>\simeq</code> |
| ∼ | <code>\sim</code> |
| ∝ | <code>\propto</code> |
| ≠ | <code>\neq</code> <code>\ne</code> |

Arrows

| Symbol | Code | Symbol | Code |
|--------|---|--------|--|
| → | <code>\rightarrow</code> <code>\to</code> | ← | <code>\leftarrow</code> <code>\gets</code> |
| ⇒ | <code>\Rightarrow</code> | ⇐ | <code>\Leftarrow</code> |
| → | <code>\longrightarrow</code> | → | <code>\longrightarrow</code> |
| ⇒ | <code>\Longrightarrow</code> | ⇒ | <code>\Longrightarrow</code> |
| ↦ | <code>\mapsto</code> | - | - |
| ↦ | <code>\longmapsto</code> | - | - |
| ↑ | <code>\uparrow</code> | ↑ | <code>\Uparrow</code> |
| ↓ | <code>\downarrow</code> | ↓ | <code>\Downarrow</code> |
| ↕ | <code>\updownarrow</code> | ↕ | <code>\Updownarrow</code> |

Boolsche Algebra Symbols

| Operator | Symbol | Code |
|----------|----------------------------------|---|
| NEGATE | $\neg \overline{x} \overline{x}$ | <code>\neg</code> <code>\overline{x}</code> <code>\bar{x}</code> |
| AND | $\bigwedge \wedge * \&$ | <code>\bigwedge</code> <code>\wedge</code> <code>*</code> <code>\And</code> |
| OR | $\bigvee \vee + $ | <code>\bigvee</code> <code>\vee</code> <code>+</code> <code>\mid</code> |
| XOR | \oplus | <code>\oplus</code> |

Other Symbols

| Symbol | Code | Symbol | Code | Symbol | Code |
|--------|----------------------------|--------|---------------------------------|--------|-----------------------------|
| # | <code>\#</code> | ‡ | <code>\sharp</code> | § | <code>\S</code> |
| ◇ | <code>\lozenge</code> | ◆ | <code>\blacklozenge</code> | ∞ | <code>\infty</code> |
| □ | <code>\square</code> | ■ | <code>\blacksquare</code> | ♠ | <code>\spadesuit</code> |
| △ | <code>\triangle</code> | ▲ | <code>\blacktriangle</code> | ♣ | <code>\clubsuit</code> |
| ▽ | <code>\triangledown</code> | ▼ | <code>\blacktriangledown</code> | ♥ | <code>\heartsuit</code> |
| / | <code>\diagup</code> | \ | <code>\diagdown</code> | ◇ | <code>\diamondsuit</code> |
| ∅ | <code>\varnothing</code> | ∅ | <code>\emptyset</code> | ∠ | <code>\angle</code> |
| □ | <code>\square</code> | √ | <code>\surd</code> | ∠ | <code>\measuredangle</code> |

2.8.8 Math Symbols

Trigonometry

| Symbol | Code | Symbol | Code | Symbol | Code |
|--------|-------------------|--------|----------------------|--------|--------------------|
| sin | <code>\sin</code> | arcsin | <code>\arcsin</code> | sinh | <code>\sinh</code> |
| cos | <code>\cos</code> | arccos | <code>\arccos</code> | cosh | <code>\cosh</code> |
| tan | <code>\tan</code> | arctan | <code>\arctan</code> | tanh | <code>\tanh</code> |

Prefix Operators

| Symbol | Code | Symbol | Code | Symbol | Code |
|---------|-----------------------|-----------|------------------------|-----------|-------------------------|
| \int | <code>\int</code> | \oint | <code>\oint</code> | \sum | <code>\sum</code> |
| \prod | <code>\prod</code> | \coprod | <code>\coprod</code> | - | - |
| \odot | <code>\bigodot</code> | \oplus | <code>\bigoplus</code> | \otimes | <code>\bigotimes</code> |
| \cap | <code>\bigcap</code> | \cup | <code>\bigcup</code> | \sqcup | <code>\bigsqcup</code> |
| \vee | <code>\bigvee</code> | \wedge | <code>\bigwedge</code> | - | - |

2.9 Fancy Additions

2.9.1 Comments

Comments can be activated and deactivated with the options packet in the file 01-settings/metadata.tex

- `\todo[author=tschinz]{Todo Comment with Authorname}`
- `\todo{Todo Comment}`
- `\unsure{Unsure Comment}`
- `\info{Info Comment}`
- `\critical{Critical Comment}`
- `\change{Change Comment}`
- `\question{Question Comment}`
- `\improvement{Improvement Comment}`

2.9.2 Boxes

The package awesomebox allows for some nice looking boxes.



| Lorem Ipsum ...

```
\notebox{Lorem Ipsum ...}
```



| Lorem Ipsum ...

```
\tipbox{Lorem Ipsum ...}
```



| Lorem Ipsum ...

```
\warningbox{Lorem Ipsum ...}
```



| Lorem Ipsum ...

```
\cautionbox{Lorem Ipsum ...}
```



| Lorem Ipsum ...

```
\importantbox{Lorem Ipsum ...}
```



| Lorem Ipsum ...

```
\awesomebox[violet]{2pt}{\faRocket}{violet}{Lorem  
↪ Ipsum ...}
```

2.9.3 Package Pifont Special Characters

Insert with `\ding{0}`

| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| 8 | | | | | | | | |
| 16 | | | | | | | | |
| 24 | | | | | | | | |
| 32 | | | | | | | | |
| 40 | | | | | | | | |
| 48 | | | | | | | | |
| 56 | | | | | | | | |
| 64 | | | | | | | | |
| 72 | | | | | | | | |
| 80 | | | | | | | | |
| 88 | | | | | | | | |
| 96 | | | | | | | | |
| 104 | | | | | | | | |
| 112 | | | | | | | | |
| 120 | | | | | | | | |
| 128 | | | | | | | | |
| 136 | | | | | | | | |
| 144 | | | | | | | | |
| 152 | | | | | | | | |
| 160 | | | | | | | | |
| 168 | | | | | | | | |
| 176 | | | | | | | | |
| 184 | | | | | | | | |
| 192 | | | | | | | | |
| 200 | | | | | | | | |
| 208 | | | | | | | | |
| 216 | | | | | | | | |
| 224 | | | | | | | | |
| 232 | | | | | | | | |
| 230 | | | | | | | | |
| 248 | | | | | | | | |

2.9.4 Awesome Font

Symbols from [Awesomefont](#) can be added by `\fa<IconName>`



```
\faStar
\faPlusCircle
\faMinusCircle
\faCode
\faRocket
```

2.10 References

2.10.1 Acronyms

| Latex Output | Latex Code | Description |
|------------------------|----------------------------|---|
| Augmented Reality | <code>\acrlong{ar}</code> | Displays the phrase which the acronym stands for. Put the label of the acronym inside the braces. |
| AR | <code>\acrshort{ar}</code> | Prints the acronym whose label is passed as parameter. |
| Augmented Reality (AR) | <code>\acrfull{ar}</code> | Prints both, the acronym and its definition. |

2.10.2 Glossary

| Latex Output | Latex Code | Description |
|--------------|----------------------------|--|
| Scrum | <code>\gls{scrum}</code> | To print the term, lowercase. For example, <code>Scrum</code> prints mathematics when used. |
| Scrum | <code>\Gls{scrum}</code> | The same as ut the first letter will be printed in uppercase. Example: <code>Scrum</code> prints Mathematics |
| Scrums | <code>\glspl{scrum}</code> | The same as ut the term is put in its plural form. For instance, <code>Scrums</code> will write formulas in your final document. |
| Scrums | <code>\Glspl{scrum}</code> | The same as ut the term is put in its plural form. For example, <code>Scrums</code> renders as Formulas. |

2.10.3 Bibliography

| Output | Code | Description |
|-------------------|--|--|
| [1] | <code>\cite{stateoftheArt}</code> | Default Citations |
| [before 1, after] | <code>\cite[before][after]{stateoftheArt}</code> | Citation with additions before and after |

Bibliography

- [1] Peter Fettke. "State-of-the-Art Des State-of-the-Art". In: *Wirtschaftsinformatik* (2006), pp. 257–266. DOI: [10.1007/s11576-006-0057-3](https://doi.org/10.1007/s11576-006-0057-3).

Acronyms

AR Augmented Reality. [26](#)

Glossary

Scrum Scrum is an agile process framework for managing complex knowledge work, with an initial emphasis on software development, although it has been used in other fields and is slowly starting to be explored for other complex work, research and advanced technologies.. [26](#)