
L^AT_EX-Cookbook

Questions & Answers

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Preface

Usually, texts are created with a WYSIWYG word processor. However, these are not sufficient for professional texts. Thus, higher demands are placed on diploma theses or dissertations. \LaTeX is a typesetting system that meets these requirements. Whether in a university, a technical college or a higher technical school - sooner or later everyone stumbles over \LaTeX .

Admittedly, those who are used to a word processor like OpenOffice, LibreOffice or Microsoft Office will find the introduction to \LaTeX very hard to get used to. This is because \LaTeX uses a comprehensive text typesetting system that is intended for books, scientific papers and articles.

\LaTeX is a software package that simplifies the use of the text typesetting system LaTeX through the use of macros. The text typesetting system was once created in view of the deterioration of typesetting due to the introduction of computers and is now frequently used especially in the scientific field. Reasons for this are, for example, the extensive possibilities with which the system allows the typesetting of mathematical symbols up to musical notes. But also with regard to the necessary formalities of scientific papers, \LaTeX helps the authors of these papers to concentrate mainly on the text without confronting them with unnecessary visual issues, as typically WYSIWYG software (e.g. Microsoft Word) does. However, this also means that the hurdles for the entry into \LaTeX are somewhat higher than in WYSIWYG software, since the inexperienced user does not recognize at first glance, how his document will ultimately look and how he can influence the design.

With \LaTeX one does not continuously take care of the layout, which one merely selects at the beginning of a new document, but primarily of the text itself. In the past, there was a division of labor in text production: the author wrote the text and a trained typesetter created the layout. He was familiar with typography and had an eye for the appropriate design of font sizes, line lengths, footnotes, bibliographies, tables or keyword lists. This is important because a good layout makes reading easier and increases comprehensibility.

\LaTeX plays its great advantage especially in documents with mathematical formulas. Because these can be entered with the appropriate \LaTeX commands directly into the text and are automatically set correctly at the end. \LaTeX is therefore the first choice in the scientific field for work with formulas as well as graphics and professional layout.

Where there is light, there is always shadow. One major disadvantage should also be mentioned:

The first steps with \LaTeX are quite complicated, the entry into WYSIWYG programs is much easier at the beginning. However, the - admittedly quite demanding - introduction is followed by much easier work than with the aforementioned competition.

To work with \LaTeX is therefore not as easy as with a normal WYSIWYG word processor. Those who have not programmed before may be intimidated at first sight of \LaTeX , but will be rewarded with a document in professional layout. There are also helpful tools to make things easier.

This document contains a collection of various problems and their solutions in \LaTeX , arranged by topic. The examples are structured in such a way that each example deals with a single topic. This makes it easy to see which packages and which commands are needed for the specific topic.

Basic knowledge in \LaTeX is advantageous for understanding this document. If you have never worked with \LaTeX before, I recommend the (german) tutorial of the TU Graz¹, and the (english) online Tutorial², among others.

For the first practical steps with \LaTeX I recommend Overleaf³, an easy-to-use online \LaTeX editor. No installation required, version control, hundreds of \LaTeX templates, a great documentation, tutorials and much more.

¹<https://latex.tugraz.at/latex/tutorial>

²<https://www1.cmc.edu/pages/faculty/aaksoy/latex/latextutorialmain.html>

³<https://www.overleaf.com/edu/ethz>

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1. Mathematical formulas

1.1. Inline formulas

I would like to ...

... have a mathematical formula in my running text.

Printed/Typeset

Pythagoras says: If a and b are the cathets and c the hypotenuse, then $a^2 + b^2 = c^2$. Thus the following is true for the hypotenuse: $c = \sqrt{a^2 + b^2}$.

... or even ...

For $a, b \in \mathbb{R}$ applies: $(a + b)^2 = a^2 + 2ab + b^2$

\LaTeX is known to live with the prejudice that it was primarily developed for publications in the technical or scientific field. Nowadays, this is no longer an argument, even though it must be clearly stated that it is precisely the mathematics set that distinguishes \LaTeX advantageously from other programs.

I do this by ...

... the packages for the representation of mathematical formulas and symbols, which are included in the preamble and by marking the formula in the continuous text with a \$ character at the beginning and at the end respectively.

L^AT_EX-Code

In the preamble:

```
% für mathematische Symbole und Formeln
\usepackage{amsmath, amssymb}
```

In the document:

Pythagoras says: If a and b are the cathets and c the hypotenuse, then $a^2+b^2=c^2$. Thus the following is true for the hypotenuse: $c=\sqrt{a^2+b^2}$.

```
\bigskip
... or even ...
\bigskip
```

For $a, b \in \mathbb{R}$ applies: $(a+b)^2 = a^2 + 2ab + b^2$

The L^AT_EX command `\bigskip` is placed between the formula sentences and the line (... or even ...) to get spacing in the text box (`tcolorbox`) as well. This command has nothing to do with the actual problem and is not necessary outside the text box, because the spacing between the sections (paragraphs) can be set in the document class.

As this example shows, there are limits to this form. L^AT_EX sets the formulas so that the line spacing in the continuous text remains the same. Of course, there are limits to this form. Fractions, formulas with subscript or superscript quickly do not work satisfactorily.

This Online-Tutorial⁴ will cover how to typeset mathematics. It will also cover how to handle complicated equations and multiple equation environments.

⁴<https://www1.cmc.edu/pages/faculty/aaksoy/latex/latexthree.html>

1.2. Separated formulas

I would like to ...

... separate (set off) my formulas.

Printed/Typeset

Pythagoras sagt: Seien a und b die Katheten und c die Hypotenuse, dann gilt:

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

Somit gilt für die Hypotenuse:

$$c = \sqrt{a^2 + b^2}$$

... oder auch ...

Für

$$a, b \in \mathbb{R}$$

gilt:

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

$$(a - b)(a + b) = a^2 - b^2$$

In addition, the individual formulas are also to be printed on their own line.

I do this by ...

... the packages for displaying mathematical formulas and symbols, which are included in the preamble and by placing the formulas in the math environment `displaymath`.

LaTeX-Code

In der Präambel:

```
% für mathematische Symbole und Formeln
\usepackage{amsmath, amssymb}
```

Im Dokument:

Pythagoras sagt: Seien a und b die Katheten und c die Hypotenuse, dann gilt:

```
\begin{displaymath}
a^2+b^2=c^2
\end{displaymath}
```

Somit gilt für die Hypotenuse:

```
\begin{displaymath}
c=\sqrt{a^2+b^2}
\end{displaymath}
```

```
\bigskip
... oder auch ...
\bigskip
\bigskip
```

Für

```
\begin{displaymath}
a,b \in \mathbb{R}
\end{displaymath}
```

gilt:

```
\begin{displaymath}
\begin{split}
(a+b)^2 &= a^2 + 2ab + b^2 \\
(a-b)^2 &= a^2 - 2ab + b^2 \\
(a-b)(a+b) &= a^2 - b^2
\end{split}
\end{displaymath}
```

The LaTeX environment `split` can be used to wrap formulas in the parent environment `displaymath` with two `\`.

The LaTeX command `\bigskip` is placed between the formula sentences and the intermediate line (... oder auch ...) to get spacing in the text box (`tcolorbox`) as well. This command has nothing to do with the actual problem and is not necessary outside the text box, since the spacing between sections (paragraphs) can be set in the document class.

How the formulas are aligned to the equal sign is shown in the next example.

1.3. Separated formulas, aligned and numbered

I would like to ...

... typeset formulas that are separated, aligned and numbered so they can be referenced in the text.

Printed/Typeset
<p>Da gibt es zwei Formeln, die jedes Kind kennt:</p> $a^2 + b^2 = c^2 \tag{1}$ $e = mc^2 \tag{2}$ <p>Wobei (1) Pythagoras und (2) Albert Einstein zugeschrieben wird.</p>

Here, too, the individual formulas are to be printed on a separate line.

I do this by ...

... the packages for displaying mathematical formulas and symbols, which are included in the preamble and by placing the formulas in the math environment `align` and aligning the formulas to the location of the `&` character.

\LaTeX -Code

In der Präambel:

```
% für mathematische Symbole und Formeln
\usepackage{amsmath, amssymb}
```

Im Dokument:

Da gibt es zwei Formeln, die jedes Kind kennt:

```
\begin{align}
  a^2 + b^2 &= c^2 && \label{eq:pythagoras} \\
  e &= m c^2 && \label{eq:einstein}
\end{align}
```

Wobei `\eqref{eq:pythagoras}` Pythagoras und
`\eqref{eq:einstein}` Albert Einstein zugeschrieben wird.

In the \LaTeX environment `align` formulas can be wrapped by setting two `\`.

To be able to reference the formulas a label is set with (`\label{<labelname>}`) which can be referenced in the body text with `\eqref{<labelname>}`.

As we see here, in the \LaTeX environment `align` each new line is automatically numbered. We will see in the next example how to manually control (suppress) that.

1.4. Separated formulas, aligned, numbered and not-numbered

I would like to ...

... typeset separated (set off) formulas, aligned, but only the first one is numbered so that the "formula-block" can be referenced in the running text.

Printed/Typeset

Da gibt es drei weitere Formeln, die jeder Oberstufenschüler kennt:

$$\begin{aligned}(a+b)^2 &= a^2 + 2ab + b^2 \\ (a-b)^2 &= a^2 - 2ab + b^2 \\ (a-b)(a+b) &= a^2 - b^2\end{aligned}\tag{3}$$

Die Binome (3). Binome leiten sich von den Polynomen ab. Polynome sind mathematische Ausdrücke, deren Glieder durch Addition und Subtraktion verbunden sind. Diese Glieder können selber Produkte oder Ähnliches sein. Binome bezeichnen Polynome, die zwei Glieder besitzen. Entsprechend gibt es auch sogenannte Trinome, die drei Glieder besitzen und Monome, die nur aus einem Glied bestehen.

Der Binomische Lehrsatz liefert eine Darstellung für beliebig hohe Potenzen eines Binoms:

$$(a+b)^n = \sum_{k=0}^n \binom{n}{k} a^{n-k} b^k\tag{4}$$

Here, too, the individual formulas are to be printed on a separate line.

I do this by ...

... the packages for displaying mathematical formulas and symbols, which are included in the preamble and by placing the formulas in the math environment `align` and aligning the formulas to the location of the `&` character is aligned.

\LaTeX -Code

In der Präambel:

```
% für mathematische Symbole und Formeln
\usepackage{amsmath, amssymb}
```

Im Dokument:

Da gibt es drei weitere Formeln, die jeder Oberstufenschüler kennt:

```
\begin{align}
(a+b)^2 &= a^2 + 2ab + b^2 & \text{\label{eq:binome}} & \\
(a-b)^2 &= a^2 - 2ab + b^2 & \text{\nonumber} & \\
(a-b)(a+b) &= a^2 - b^2 & \text{\nonumber} & \\
\end{align}
```

Die Binome `\eqref{eq:binome}`. Binome leiten sich von den Polynomen ab. Polynome sind mathematische Ausdrücke, deren Glieder durch Addition und Subtraktion verbunden sind. Diese Glieder können selber Produkte oder Ähnliches sein. Binome bezeichnen Polynome, die zwei Glieder besitzen. Entsprechend gibt es auch sogenannte Trinome, die drei Glieder besitzen und Monome, die nur aus einem Glied bestehen.

`\bigskip`

Der Binomische Lehrsatz liefert eine Darstellung für beliebig hohe Potenzen eines Binoms:

```
\begin{equation}
(a+b)^n = \sum_{k=0}^n \text{\binom{n}{k}} a^{n-k} b^k
\end{equation}
```

In the \LaTeX environment `align` formulas can be wrapped directly with `\\`.

To reference the formulas, a label is set with `(\label{<labelname>})`, which can be referenced in the body text with `\eqref{<labelname>}`.

With `\nonumber` or `\notag` the numbering can be suppressed manually.

1.5. Additional formulas

Following formula(s) ...

Printed/Typeset		
$x = y$	$w = z$	$a = b + c$
$2x = -y$	$3w = \frac{1}{2}z$	$a = b$
$-4 + 5x = 2 + y$	$w + 2 = -1 + w$	$ab = cb$

Printed/Typeset	
$\left\{ \begin{array}{l} \textit{Zeile 1 links} \\ \textbf{Zeile 2 links} \\ \textit{Zeile 3 links, länger} \end{array} \right\}$	$\longleftrightarrow \left\{ \begin{array}{l} a^2 + b^2 = c^2 \\ c = \sqrt[2]{a^2 + b^2} \\ \text{sagt Pythagoras} \end{array} \right\}$

I do this by ...

L^AT_EX-Code

```
\begin{align*}
x&=y & w&=z & a&=b+c\\
2x&=-y & 3w&=\frac{1}{2}z & a&=b\\
-4 + 5x&=2+y & w+2&=-1+w & ab&=cb
\end{align*}
```

L^AT_EX-Code

```
\begin{displaymath}
\left.
\begin{cases}
\multicolumn{1}{@{}c@{\quad}}{\textit{Zeile 1 links}} & \backslash\backslash \\
\multicolumn{1}{@{}c@{\quad}}{\textbf{Zeile 2 links}} & \backslash\backslash \\
\multicolumn{1}{@{}c@{\quad}}{\texttt{Zeile 3 links, länger}} \\
\end{cases}
\mkern-18mu
\right\}
\quad\longrightarrow\mkern-3mu\longrightarrow\quad
\left.
\begin{cases}
\multicolumn{1}{@{}c@{\quad}}{a^2 + b^2 = c^2} & \backslash\backslash \\
\multicolumn{1}{@{}c@{\quad}}{c = \sqrt{2}\{a^2 + b^2\}} & \backslash\backslash \\
\multicolumn{1}{@{}c@{\quad}}{\text{sagt Pythagoras}} \\
\end{cases}
\mkern-18mu
\right\}
\end{displaymath}
```

2. Mathematical theorems and proofs

2.1. Theorem, Proof

I would like to ...

... typeset a theorem (or lemma, or proposition, or corollary) in my document.

In mathematics, a theorem is a logical statement that is free of contradictions and can be recognized as true by means of a proof, i.e. it can be derived from axioms, definitions and already known theorems.

A theorem is often referred to differently according to its role, meaning, or context. Within an article or monograph (e.g., a dissertation or textbook), one uses:

- **Lemma** for a statement that is used only in proof of other propositions in the same work and has no meaning independently of them,
- **Proposition** for a statement that is also mainly locally significant, such as an auxiliary sentence that is used in more than one proof,
- **Theorem** for an essential insight presented in the work, and
- **Corollary** for a trivial inference that follows from a theorem or definition without much effort.

The classification of a proposition into one of the above categories is subjective and has no consequences for the use of the proposition. Many authors dispense with the term proposition and use lemma or sentence instead. Corollary is also not always distinguished from proposition. On the other hand, it is quite common and helpful for the reader if purely auxiliary propositions are recognizable as such.

Printed/Typeset

Für Sätze, Lemmata und so weiter stellt LaTeX eine generische Theoremumgebung zur Verfügung. Man kann sich nach seinem Gutdünken Umgebungen zusammenbasteln. Hier einige Beispiele:

Satz 1. *Ein nummerierter Satz.*

Proof. Den wir hier gleich auch mit der Standard-Umgebung proof Beweisen! □

Die Sätze werden automatisch nummeriert. Sollen die Sätze in einem Abschnitt die entsprechende Kapitelnummer haben, so sieht das wie folgt aus:

Theorem 2.1. *Ein nummeriertes Theorem, das die Kapitelnummer enthält.*

Proof. Das wir hier gleich auch mit der Standard-Umgebung proof Beweisen! □

Theoreme auch ganz ohne Nummer sind möglich:

Behauptung. *Eine Behauptung*

Proof. Die wir hier gleich auch mit der Standard-Umgebung proof Beweisen! □

That's not all about the \LaTeX theorem environment. For many more options, please refer to the documentation of the package ⁵.

⁵<https://ctan.org/pkg/theorem?lang=en>

I do this by ...

... using the generic theorem environment of L^AT_EX.

L^AT_EX-Code

In der Präambel:

```
% Packages für Symbole, Formeln und Theoreme:
\usepackage{amsmath, amssymb}
\usepackage{amsthm}
```

Im Dokument:

```
% Definition der Theoreme, Sätze, etc.
% Empfehlung: direkt nach \begin{document}
\newtheorem{satz}{Satz}
\newtheorem{theorem}{Theorem}[section]
\newtheorem*{behauptung}{Behauptung}
```

...

Für Sätze, Lemmata und so weiter stellt LaTeX eine generische Theoremumgebung zur Verfügung. Man kann sich nach seinem Gutdünken Umgebungen zusammenbasteln. Hier einige Beispiele:

```
\begin{satz}
  Ein nummerierter Satz.
\end{satz}
```

```
\begin{proof}
  Den wir hier gleich auch mit der Standard-Umgebung proof Beweisen!
\end{proof}
```

Die Sätze werden automatisch nummeriert. Sollen die Sätze in einem Abschnitt die entsprechende Kapitelnummer haben, so sieht das wie folgt aus:

```
\begin{theorem}
  Ein nummeriertes Theorem, das die Kapitelnummer enthält.
\end{theorem}
```

```
\begin{proof}
  Das wir hier gleich auch mit der Standard-Umgebung proof Beweisen!
\end{proof}
```

Theoreme auch ganz ohne Nummer sind möglich:

```
\begin{behauptung}
  Eine Behauptung
\end{behauptung}
```

```
\begin{proof}
  Die wir hier gleich auch mit der Standard-Umgebung proof Beweisen!
\end{proof}
```

3. Code Listings

3.1. Matlab, Python, Java, C++

I would like to ...

... have a printed (syntax-highlighted) source listing (Matlab, Python, Java, C++) in my Document.

Printed/Typeset

Der euklidische Algorithmus ist ein Algorithmus aus dem mathematischen Teilgebiet der Zahlentheorie. Mit ihm lässt sich der grösste gemeinsame Teiler zweier natürlicher Zahlen berechnen. Das Verfahren ist nach dem griechischen Mathematiker Euklid benannt, der es in seinem Werk „Die Elemente“ beschrieben hat.

Der grösste gemeinsame Teiler zweier Zahlen kann auch aus ihren Primfaktorzerlegungen ermittelt werden. Ist aber von keiner der beiden Zahlen die Primfaktorzerlegung bekannt, so ist der euklidische Algorithmus das schnellste Verfahren zur Berechnung des grössten gemeinsamen Teilers:

In Python sieht der euklidische Algorithmus wie folgt aus:

```
1  '''
3  Beispielprogramm in Python
5      Bestimmen des ggT von zwei eingegebenen
      Zahlen mit dem Euklidschen Algorithmus
7  '''
9
11 # Einlesen der 1. Zahl
x = int(input("1. Zahl: "))
13
15 # Einlesen der 2. Zahl
y = int(input("2. Zahl: "))
17
17 # Euklidischer Algorithmus zur Bestimmung des ggT
while x > 0:
19     if x < y:
        h = x
21         x = y
        y = h
23     x = x - y
25
25 # Ausgeben des Ergebnisses
print(" —> ggT = ", x+y)
```

Even if you are not a computer scientist, you may want to show source code in your document.

This is another use case that shows the superiority of L^AT_EX over WYSIWYG Word processors. The program listing is read from the source file and can be customized with L^AT_EX regarding syntax coloring and syntax highlighting of the usual development environment (IDE). Thus program listings in the L^AT_EX document look like in the usual development environment.

The package has many other settings for displaying the source code. The numbering of the lines also makes it possible to reference concrete program lines in the running text.

I do this by ...

... using the package `listings` and some settings for syntax coloring and highlighting that are included or defined in the preamble. The settings in the document for the listing are self-explanatory.

LaTeX-Code

In der Präambel:

```
% Packages für Programm-Listings:
\usepackage{listings}
\usepackage{color}
\definecolor{dkgreen}{rgb}{0,0.6,0}
\definecolor{mauve}{rgb}{0.58,0,0.82}
```

Im Dokument:

Der euklidische Algorithmus ist ein Algorithmus aus dem mathematischen Teilgebiet der Zahlentheorie. Mit ihm lässt sich der grösste gemeinsame Teiler zweier natürlicher Zahlen berechnen. Das Verfahren ist nach dem griechischen Mathematiker Euklid benannt, der es in seinem Werk „Die Elemente“ beschrieben hat.

\bigskip

Der grösste gemeinsame Teiler zweier Zahlen kann auch aus ihren Primfaktorzerlegungen ermittelt werden. Ist aber von keiner der beiden Zahlen die Primfaktorzerlegung bekannt, so ist der euklidische Algorithmus das schnellste Verfahren zur Berechnung des grössten gemeinsamen Teilers:

\bigskip

In Python sieht der euklidische Algorithmus wie folgt aus:

\begin{quote}

```
\lstinputlisting[language=Python,
    basicstyle=\scriptsize,
    numbers=left,
    numberstyle=\tiny,
    stepnumber=2,
    numbersep=5pt,
    frame=1,
    framerule=0.1pt,
    showstringspaces=false,
    showspace=false,
    showtabs=false,
    keywordstyle=\color{blue},
    commentstyle=\color{dkgreen},
    stringstyle=\color{mauve},
    backgroundcolor = \color{white}
]{themen/listings/listing_ggT.py}
```

\end{quote}

For the many other options, please refer to the documentation of the package⁶.

⁶<https://ctan.org/pkg/listings?lang=en>

4. Footnotes

4.1. Set footnotes

I would like to ...

... to set footnotes.

Printed/Typeset

Hier^a und hier^b haben wir zwei unterschiedliche Fussnoten.

Soll von mehreren Stellen im Dokument auf eine Fussnote^c verwiesen werden, z. B. auch von hier^c und auch noch von hier^c, so muss die entsprechende Fussnote mit einem Label versehen werden und dann wird in den weiteren Malen auf dieses Label verwiesen.

^aDas ist die erste Fussnote

^bDas ist die zweite Fussnote

^cDas ist eine Fussnote, auf die von mehreren Stellen verwiesen werden soll

Note: Since the examples in this document are set in textboxes, the footnotes here are with letters instead of numbers (L^AT_EX default). The way footnotes are set is exactly as described on the opposite page. If the footnotes are not set in a text box, they are numbered normally in the document.

To illustrate, here is the same thing on a 'normal' page:

Here⁷ and here⁸ we have two different footnotes.

If a footnote⁹ is to be referred to from several places in the document, e.g. also from here⁹ and also from here⁹, the corresponding footnote must be provided with a label and then this label will be referred to in the further times.

⁷This is the first footnote

⁸This is the second footnote

⁹a footnote with multiple references

I do this by ...

... setting a label for the footnote to be referenced multiple times and then referencing that label.

L^AT_EX-Code

In der Präambel:

```
% keine speziellen Einträge in der Präambel für Fussnoten
```

Im Dokument:

```
Hier\footnote{Das ist die erste Fussnote}  
und hier\footnote{Das ist die zweite Fussnote}  
haben wir zwei unterschiedliche Fussnoten.
```

```
\bigskip  
Soll von mehreren Stellen im Dokument auf eine  
Fussnote\footnote{Das ist eine Fussnote, auf die von  
mehreren Stellen verwiesen werden soll\label{ftn:multiUse}}  
verwiesen werden, z.~B. auch von hier\footref{ftn:multiUse}  
und auch noch von hier\footref{ftn:multiUse}, so muss die  
entsprechende Fussnote mit einem Label versehen werden und  
dann wird in den weiteren Malen auf dieses Label verwiesen.
```

The L^AT_EX command `\bigskip` is set to get spacing in the text box as well. This command has nothing to do with the actual problem and is not necessary outside the text box because the spacing between sections (paragraphs) can be set in the document class.

5. PDF files

5.1. Embedding PDF files

I would like to ...

... include a PDF file into my document¹⁰.

Printed/Typeset

Das Einbinden einer ganzen PDF-Vorlagen-Seite kann nicht in einem Minifenster angezeigt werden. Kontrollieren Sie bitte die Eigenständigkeitserklärung auf Seite 61 in diesem Dokument.

¹⁰<https://ethz.ch/students/en/studies/performance-assessments/plagiarism.html>

I do this by ...

... following L^AT_EXcommand sequence.

L^AT_EX-Code

In der Präambel:

```
% Packages um PDF-Dateien einzubinden
\usepackage{pdfpages}
```

Im Dokument (an der Stelle, an der die PDF-Datei eingebunden werden soll):

```
% Einfügen einer Leerseite ohne Seitennummer
\newpage
\thispagestyle{empty}
\mbox{}

% Einbinden der Eigenständigkeitserklärung mit Eintrag in ToC
\newpage
\addcontentsline{toc}{section}{Eigenständigkeitserklärung}
\section*{Eigenständigkeitserklärung}
\footnote{Eingebundene PDF-Vorlage der ETH Zürich}
\label{eigenstaendigkeitserklaerung}}
\begin{figure}
\includepdf[scale=0.8, pagecommand={}]
{themen/pdfDateien/ethz_eigenstaendigkeitserklaerung.pdf}
\end{figure}
```

6. Custom commands

6.1. Define your own commands

I would like to ...

... a simple variant to set complicated terms that occur frequently in my work.

Printed/Typeset

Der Frobeniushomomorphismus ist in der Algebra ein Endomorphismus von Ringen, deren Charakteristik eine Primzahl ist. Der Frobeniushomomorphismus ist nach dem deutschen Mathematiker Ferdinand Georg Frobenius benannt.

Der Begriff Frobeniushomomorphismus ist schon nicht einfach zu lesen, zu schreiben aber noch einiges mühsamer.

The term Frobeniushomomorphismus¹¹ should be easier to set somehow.

¹¹<https://de.wikipedia.org/wiki/Frobeniushomomorphismus>

I do this by ...

... the definition of an own command.

LaTeX-Code

In der Präambel:

```
% Definition eigener Befehle
\newcommand{\frob}{Frobeniushomomorphismus }
```

Im Dokument:

Der `\frob` ist in der Algebra ein Endomorphismus von Ringen, deren Charakteristik eine Primzahl ist. Der `\frob` ist nach dem deutschen Mathematiker Ferdinand Georg Frobenius benannt.

`\bigskip`

Der Begriff `\frob` ist schon nicht einfach zu lesen, zu schreiben aber noch einiges mühsamer.

`\bigskip`

`\bigskip`

The LaTeX command `\bigskip` is set to get spacing in the text box as well. This command has nothing to do with the actual problem and is not necessary outside the text box because the spacing between sections (paragraphs) can be set in the document class.

7. Figures & List of Figures

7.1. Insert figures

I would like to ...

... Images/graphics (incl. caption for list of figures and label for references in continuous text) inserted into my document.

Images can be inserted into \LaTeX with a few lines.



Figure 1: Wissenschaftliche Arbeiten schreiben mit \LaTeX

The book in Figure 1 on page 26 is a highly recommended book on the subject of \LaTeX .

Note: Inserting images in mini-windows is very awkward and rather unusual. That's why the image on this page is not in a mini window like the examples on the previous pages.

I do this by ...

... the package for graphics to be included in the preamble and the corresponding commands for inserting the graphic in the document.

LaTeX-Code

In der Präambel:

```
% Packages für Bilder
\usepackage{graphicx}
```

Im Dokument:

Images can be inserted into \LaTeX with a few lines.

```
\bigskip
```

```
\begin{figure}[h!]
```

```
\centering
```

```
\includegraphics[width=0.5\textwidth]{./bilder/LaTeX_Buch.jpg}
```

```
\caption{Wissenschaftliche Arbeiten schreiben mit \LaTeX}
```

```
\label{fig:schlosser}
```

```
\end{figure}
```

```
\bigskip
```

The book in figure \ref{fig:schlosser}

on page \pageref{fig:schlosser}

is a highly recommended book on the subject of \LaTeX.

Note: How to include a book in a bibliography and how to create a bibliography is shown in a separate chapter (recipe).

7.2. Create a list of figures

I would like to ...

... the previously inserted figures are listed in a list of figures. The list of figures should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see ToC on page 5).

Printed/Typeset

The list of figures cannot be displayed in a mini window. Please check the list of figures on page 51 in this document.

Please note the page opposite.

I do this by ...

... following L^AT_EXcommand sequence.

L^AT_EX-Code

In der Präambel:

```
% keine weiteren Einträge nötig
```

Im Dokument (an der Stelle, an der das Abbildungsverzeichnis erscheinen soll):

```
% Einfügen einer Leerseite ohne Seitennummer
```

```
\newpage
```

```
\thispagestyle{empty}
```

```
\mbox{}
```

```
% Erstellen des Abbildungsverzeichnisses
```

```
% Eintrag in ToC wird automatisch erstellt
```

```
\newpage
```

```
\label{abbildungen}
```

```
\listoffigures
```

The list of figures should appear on an odd (right) page of the document.

8. Keywords & Index of keywords

8.1. Define keywords

I would like to ...

... mark keywords (subject words, names) so they can be printed in an index.

Printed/Typeset

Um einen Begriff (oder Namen) in das Stichwortverzeichnis aufzunehmen, muss dieser entsprechend markiert werden.

Die Begriffe System, Systemzustand und Systemelement sollen im Stichwortverzeichnis aufgenommen werden.

Im gedruckten Text ist nicht zu erkennen, ob ein bestimmter Begriff (oder Name) im Stichwortverzeichnis aufgenommen wird.

Note: To create the index, a special \LaTeX tool must be called (in TeXmaker this is MakeIndex - F12).

I do this by ...

... the package for keywords to be included in the preamble and the corresponding marker in the body text of the words to be listed in the keyword index.

L^AT_EX-Code

In der Präambel:

```
% Packages für Stichwortverzeichnis
\usepackage{makeidx}
\makeindex
```

Im Dokument:

Um einen Begriff (oder Namen) in das Stichwortverzeichnis aufzunehmen, muss dieser entsprechend markiert werden.

```
\bigskip
```

Die Begriffe `System\index{System}`, `Systemzustand\index{System!Zustand}` und `Systemelement\index{System!Element}` sollen im Stichwortverzeichnis aufgenommen werden.

```
\bigskip
```

Im gedruckten Text ist nicht zu erkennen, ob ein bestimmter Begriff (oder Name) im Stichwortverzeichnis aufgenommen wird.

Thus, the keywords (or even names) to be included in the keyword directory are marked/defined.

8.2. Create index of keywords

I would like to ...

... the previously defined/marked keywords are listed in a keyword directory. The keyword index should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see table of contents on page 5).

Printed/Typeset

The index cannot be displayed in a mini window. Please check the index on page 49 in this document.

Please note the page opposite.

I do this by ...

... following \LaTeX command sequence.

\LaTeX -Code

In der Präambel:

```
% Packages für Stichwortverzeichnis
\usepackage{makeidx}
\makeindex
```

Im Dokument (an der Stelle, an der das Stichwortverzeichnis erscheinen soll):

```
% Einfügen einer Leerseite ohne Seitennummer
\newpage
\thispagestyle{empty}
\mbox{}

% Erstellen des Stichwortverzeichnisses mit Eintrag in ToC
\newpage
\addcontentsline{toc}{section}{Index of Keywords}
\renewcommand{\indexname}{Index of Keywords \bigskip}
\label{index}
\printindex
```

The index should appear on an odd (right) page of the document.

Keep in mind: The creation of the index requires a special \LaTeX tool (MakeIndex). To make sure that everything is created correctly, the following sequence must be followed¹².

1. PDFLaTeX (F6)
2. PDFLaTeX (F6)
3. MakeIndex (F12 - only if index exists)
4. PDFLaTeX (F6)
5. PDFLaTeX (F6)
6. PDF ansehen (F7)

Note: In most IDEs the above command sequence can be set and executed via "fast compile" with one mouse click.

¹²commands and function keys used as in TeXmaker

9. Sources & Bibliography

9.1. Cite sources

I would like to ...

... cite foreign sources and literature (incl. preparation of a bibliography).



Figure 2: A book recommendation for \LaTeX

Above shown book[1] is a highly recommended book on the subject of \LaTeX .

Note: Inserting images in mini windows is very cumbersome and rather unusual. That's why the image on this page is not in a mini window like other examples on previous pages.

I do this by ...

... the package for graphics to be included in the preamble and the corresponding commands for inserting the graphic in the document.

\LaTeX -Code

In der Präambel:

```
% Packages für Literaturverzeichnis und Zitierungen
\usepackage[numbers]{natbib}
\bibliographystyle{plainnat}
\renewcommand*{\bibfont}{\raggedright}
```

Im Dokument:

```
The book\cite{Schlosser2017} shown above is a very
recommended book on the subject of \LaTeX.
```

The cited sources must be recorded in a bib file, which \LaTeX can then use to create a bibliography. In this example we use BibTeX to manage the bibliography. A very good tutorial on this can be found on Wikipedia¹³.

The bib file with the references has the following format¹⁴:

\LaTeX bib-Datei

```
@MISC{Lamport2017,
  AUTHOR    = {Lamport, Leslie},
  YEAR      = {2017},
  TITLE     = {{LESLIE LAMPORT'S HOME PAGE}},
  URL       = {http://lamport.org/},
  NOTE      = {Online; gesehen 20. September 2017}
}

@BOOK{Schlosser2017,
  title      = {Wissenschaftliche Arbeiten schreiben mit
                LaTeX: Leitfaden für Einsteiger, 6},
  author     = {Schlosser, Joachim},
  year       = {2017},
  publisher  = {MITP-Verlags GmbH \& Co. KG}
}
```

The number of entries does not matter (as long as the entries are included that are cited/referenced in the text). All sources not cited in the text are not output in the bibliography.

¹³<https://de.wikipedia.org/wiki/BibTeX>

¹⁴Was covered in Basics Lunch Session 1

9.2. Create bibliography

I would like to ...

... the cited foreign sources are listed in a source & bibliography. The bibliography should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see table of contents of this document on page 5).

Printed/Typeset

The list of figures cannot be displayed in a mini window. Please check the list of figures on page 5 in this document.

Please note the page opposite.

I do this by ...

... following L^AT_EX command sequence.

L^AT_EX-Code

In der Präambel:

```
% Packages für Literaturverzeichnis und Zitierungen
\usepackage[numbers]{natbib}
\bibliographystyle{plainnat}
\renewcommand*{\bibfont}{\raggedright}
```

In the document (at the place where the source list/ bibliography is to be output):

```
% Einfügen einer Leerseite ohne Seitennummer
\newpage
\thispagestyle{empty}
\mbox{}

% Erstellen des Quellen- / Literaturverzeichnis
\newpage
\addcontentsline{toc}{section}{Bibliography}
\renewcommand{\refname}{Bibliography}
\bibliography{./verzeichnisse/literatur}
```

The bibliography should appear on an odd (right) page of the document.

Reminder: The creation of the bibliography requires a special L^AT_EX tool (bibLaTeX). In order to create everything correctly, the following command sequence must be followed¹⁵.

1. PDFLaTeX (F6)
2. PDFLaTeX (F6)
3. BibTeX (F11 - only if bibliography exists)
4. MakeIndex (F12 - only if index exists)
5. PDFLaTeX (F6)
6. PDFLaTeX (F6)
7. PDF ansehen (F7)

Reminder: In this example we work with BibTeX, not with biber. For editors or IDEs that work with biber as a backend for literature management, other L^AT_EX commands and L^AT_EX packages are necessary.

Note: In most IDEs the above command sequence can be set and executed via "fast compile" with one mouse click.

¹⁵commands and function keys used as in TeXmaker

10. Tables & List of Tables

10.1. Create tables

I would like to ...

... have a table in my document.

At this point a first table.

Wer	Wo	<i>Was</i>
ich	da	<i>dies</i>
du	hier	<i>das</i>

Table 1: A first L^AT_EX-Table

The table has three columns, each 2 cm wide, and three rows. The first row is used for the column headers and delimited with a line. The first column is left-aligned, the second column is centered, and the third column is right-aligned. The table is to be output centered on the page at this location in the text.

Note: Inserting tables in mini-windows is very cumbersome and rather unusual. That's why the table on this page is not in a mini window as in examples on previous pages.

I do this by ...

... the package for tables that is included in the preamble and the corresponding table commands in the body text.

\LaTeX -Code

In der Präambel:

```
% Packages für Tabellen
\usepackage{tabularx}
\usepackage{booktabs}
\newcolumntype{R}[1]{>\raggedleft\arraybackslashp{#1}}
\newcolumntype{C}[1]{>\centering\arraybackslashp{#1}}
```

Im Dokument:

At this point a first table.

```
\begin{table}[h!]
\begin{center}
\begin{tabular}{p{2cm} C{2cm} R{2cm}}
\toprule
\textbf{Wer} & & Wo & & \textit{Was} & \\
\midrule
\textbf{ich} & & da & & \textit{dies} & \\
\textbf{du} & & hier & & \textit{das} & \\
\bottomrule
\end{tabular}
\caption{A first \LaTeX-Table}
\end{center}
\end{table}
```

Note: If the table is to be referenced in the text, `\label{tab:table1}` can be used to assign a label to the table, which can then be used for referencing in the text. The label must be inserted after `\caption{A First \LaTeX table}`.

Note: At this point a simple \LaTeX table will be shown. The table module of \LaTeX is very powerful and allows many kinds of self-designed tables. More examples of tables can be found in the extensive \LaTeX tutorial on my GitHub repository.

10.2. Create list of tables

I would like to ...

... the tables present in the document are listed in a table directory. The table list should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see page 5).

Printed/Typeset

The list of tables cannot be displayed in a mini window. Please check the list of tables on page 53 in this document.

Please note the page opposite.

I do this by ...

... following L^AT_EX command sequence.

L^AT_EX-Code

In der Präambel:

```
% keine zusätzlichen Packages für Tabellenverzeichnis
```

In the document (at the place where the list of tabels should appear):

```
% Einfügen einer Leerseite ohne Seitennummer
```

```
% Eintrag in ToC wird automatisch erstellt
```

```
\newpage
```

```
\thispagestyle{empty}
```

```
\mbox{}
```

```
% Erstellen des Tabellenverzeichnis
```

```
\newpage
```

```
\listoftables
```

The list of tables should appear on an odd (right) page of the document.

11. Abbreviations & List of abbreviations

11.1. Define abbreviations

I would like to ...

... use abbreviations in my document.

My employer is the Eidgenössische Technische Hochschule (ETH), more precisely the Eidgenössische Technische Hochschule Zürich (ETHZ). In addition to the ETHZ, there is also a ETH in the French-speaking part of Switzerland, namely the École polytechnique fédérale de Lausanne (EPFL). At the ETH, I am involved in the Informatikdienste (ID) in the Portfolio Management (PM). The PM is a group within the Procurement and Portfolio Management (PPF) section.

In a scientific paper, frequently repeated terms may be abbreviated. However, the use of abbreviations should be adapted to the reader. In addition to the abbreviations listed in the Duden, abbreviations of special technical terms may also be used. Be sparing with abbreviations. Under no circumstances should they disrupt the flow of your work.

When working with abbreviations in the way presented here, LaTeX takes care of the correct use of abbreviations (write out a term the first time it is used in the text section and put the abbreviation in parentheses, use only the abbreviation on all subsequent times). Of course, LaTeX allows various ways of overriding this behavior.

Unlike technical terms, the meaning of which is not obvious at first glance to people unfamiliar with the subject, common expressions such as 'e.g.' or 'etc.' do not belong in the list of abbreviations.

I do this by ...

... by creating a file to record all the abbreviations I want to refer to in the text.

L^AT_EX-Code

In der Präambel:

```
% Package for list of abbreviations
\usepackage[printonlyused]{acronym}
%\usepackage[printonlyused,withpage]{acronym}
```

Capture the abbreviations in a separate file:

```
\acro{eth}[ETH]{Eidgenössische Technische Hochschule}
\acro{ethz}[ETHZ]{Eidgenössische Technische Hochschule Zürich}
\acro{epfl}[EPFL]{École polytechnique fédérale de Lausanne}
\acro{id}[ID]{Informatikdienste}
\acro{pm}[PM]{Portfolio Management}
\acro{ppf}[PPF]{Procurement and Portfolio Management}
```

Im Dokument:

My employer is \ac{eth}, more precisely \ac{ethz}. Besides the \ac{ethz} there is also a \acs{eth} in the French part of Switzerland, namely the \ac{epfl}. At the \acs{eth}, I am involved in the \ac{id} in the \ac{pm} department. The \ac{pm} is a group within the \ac{ppf} section.

11.2. Create list of abbreviations

I would like to ...

... list the abbreviations used in the document. The list of abbreviations should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see page 5).

Printed/Typesetted

The list of abbreviations cannot be displayed in a mini window. Please check the list of abbreviations on page 57 in this document.

Please note the page opposite.

I do this by ...

... with following L^AT_EX command sequence.

L^AT_EX-Code

In der Präambel:

```
% no additional packages for list of abbreviations
```

In the document (at the place where the list of abbreviations should appear):

```
% Einfügen einer Leerseite ohne Seitennummer
```

```
\newpage
```

```
\thispagestyle{empty}
```

```
\mbox{}
```

```
% Erstellen des Abkürzungsverzeichnis
```

```
\newpage
```

```
\section*{List of Abbreviations}
```

```
\addcontentsline{toc}{section}{List of Abbreviations}
```

```
\begin{acronym}[SEPSEPSEP]
```

```
\setlength{\parskip}{0ex}
```

```
\input{./verzeichnisse/abkuerzungen.tex}
```

```
\end{acronym}
```

The list of abbreviations should appear on an odd (right) page of the document.

12. List of symbols

12.1. Create list of symbols

I would like to ...

... to the symbols used in the document listed in a directory. The directory should be displayed in a separate chapter (section) on a separate page. The chapter should not be numbered, but still be displayed in the table of contents (see page 5).

Printed/Typeset

The list of symbols cannot be displayed in a mini window. Please check the symbol directory on page 59 in this document.

I do this by ...

... capturing the symbols used in the work in a separate file and print this file as a list of symbols.

L^AT_EX-Code

In der Präambel:

```
% Packages für Mathe (Symbolverzeichnis)
\usepackage{amsmath, amssymb, amsthm}
```

Capture the symbols used in a separate file.

```
\begin{table}[h!]
\noindent\begin{tabular}{@{}p{2cm}l}
 $\mathbf{N}$  & Set of all natural numbers without the zero \\
 $\mathbf{N}_0$  & Set of all natural numbers with zero \\
 $\pi$  & The circular number Pi \\
 $\Omega$  & The electrical resistance Ohm \\
 $\boldsymbol{\alpha}$  & Alpha, the first letter of the Greek alphabet \\
\end{tabular}
\end{table}
```

In the document (at the place where the list of symbols should appear):

```
% Einfügen einer Leerseite ohne Seitennummer
\newpage
\thispagestyle{empty}
\mbox{}

% Erstellen des Symbolverzeichnis
\newpage
\section*{List of Symbols}
\addcontentsline{toc}{section}{List of Symbols}
\input{./verzeichnisse/symbole.tex}
```

The symbol directory should appear on an odd (right) page of the document.

Index of Keywords

System, 30
 Element, 30
 Zustand, 30

List of Figures

Figure 1. Wissenschaftliche Arbeiten schreiben mit \LaTeX	26
Figure 2. A book recommendation for \LaTeX	34

List of Tables

Table 1. A first L^AT_EX-Table 38

Bibliography

- [1] Joachim Schlosser. *Wissenschaftliche Arbeiten schreiben mit LaTeX: Leitfaden für Einsteiger*, 6. MITP-Verlags GmbH & Co. KG, 2017.

List of abbreviations

ETH	Eidgenössische Technische Hochschule
ETHZ	Eidgenössische Technische Hochschule Zürich
EPFL	École polytechnique fédérale de Lausanne
ID	Informatikdienste
PM	Portfolio Management
PPF	Procurement and Portfolio Management

List of symbols

\mathbf{N}	Set of all natural numbers without the zero
\mathbf{N}_0	Set of all natural numbers with zero
π	The circular number Pi
Ω	The electrical resistance Ohm
α	Alpha, the first letter of the Greek alphabet

Declaration of autonomy¹⁶



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Eigenständigkeitserklärung

Die unterzeichnete Eigenständigkeitserklärung ist Bestandteil jeder während des Studiums verfassten Semester-, Bachelor- und Master-Arbeit oder anderen Abschlussarbeit (auch der jeweils elektronischen Version).

Die Dozentinnen und Dozenten können auch für andere bei ihnen verfasste schriftliche Arbeiten eine Eigenständigkeitserklärung verlangen.

Ich bestätige, die vorliegende Arbeit selbständig und in eigenen Worten verfasst zu haben. Davon ausgenommen sind sprachliche und inhaltliche Korrekturvorschläge durch die Betreuer und Betreuerinnen der Arbeit.

Titel der Arbeit (in Druckschrift):

Verfasst von (in Druckschrift):

Bei Gruppenarbeiten sind die Namen aller Verfasserinnen und Verfasser erforderlich.

Name(n):

Vorname(n):

Ich bestätige mit meiner Unterschrift:

- Ich habe keine im Merkblatt „[Zitier-Knigge](#)“ beschriebene Form des Plagiats begangen.
- Ich habe alle Methoden, Daten und Arbeitsabläufe wahrheitsgetreu dokumentiert.
- Ich habe keine Daten manipuliert.
- Ich habe alle Personen erwähnt, welche die Arbeit wesentlich unterstützt haben.

Ich nehme zur Kenntnis, dass die Arbeit mit elektronischen Hilfsmitteln auf Plagiate überprüft werden kann.

Ort, Datum

Unterschrift(en)

Bei Gruppenarbeiten sind die Namen aller Verfasserinnen und Verfasser erforderlich. Durch die Unterschriften bürgen sie gemeinsam für den gesamten Inhalt dieser schriftlichen Arbeit.

¹⁶Template from ETH Zurich <https://ethz.ch/students/en/studies/performance-assessments/plagiarism.html>

Closing words

The L^AT_EX recipes in this cookbook have been created from questions that have been addressed to me over the time. If you are missing interesting topics and/or problems, please send me a mail¹⁷ and I will add them to this document as soon as possible.

If you already have solutions/examples to topics and/or problems that are not yet included here, please feel free to send them to me so that I can include them in this document (with reference, of course).

L^AT_EX is never love at first sight. L^AT_EX is something you learn to love (with experience/exercise). The more L^AT_EX recipes are gathered here, the easier it will be for future students to get familiar with L^AT_EX.

The L^AT_EX recipes shown here are largely limited to the standards of L^AT_EX. Much can be adapted to your own preferences. To list only a few points:

- **Chapter numbers:** In the L^AT_EX standard the last number of a chapter number has no dot. If you would like to have a dot after the last number of a chapter number, this can be adjusted accordingly.
- **Title page:** In the L^AT_EX standard, the title page has only three entries (title, author, and date). In the standard, more than one author can be specified. It is also possible to create a completely self-designed title page..
- **Other packages:** The L^AT_EX standard already covers a lot. For various topics (tables, graphics, directories, etc.) there are additional packages, with many more setting options than in the L^AT_EX standard.
- **Indexes:** The indexes created here correspond to the default L^AT_EX standard. You can also customize everything according to your own wishes. Should the directories be formatted differently, should they have different titles, or should shorter names be used in the directories (e.g. Tab. instead of Table, Fig. instead of Figure, ...) - everything can be adapted with more or less effort..
- ...

Examples of the above topics can be found in the detailed L^AT_EX tutorial on my GitHub repo¹⁸.

This L^AT_EX document was created with TeXmaker and tested on macOS, Linux and Windows.

Don't forget: L^AT_EX is never love at first sight. L^AT_EX is something you learn to love (with experience/exercise). That's why it's best to create all your documents with L^AT_EX. Don't use L^AT_EX the first time when you're going to create your bachelor or master thesis.

¹⁷peter.kessler@id.ethz.ch

¹⁸<https://github.com/pkmlp>