Title of your thesis

Bachelor-Arbeit

zur Erlangung des Grades

Bachelor of Science (B.Sc.)

im Studiengang Mathematik

am Department Mathematik der
Friedrich-Alexander-Universität Erlangen-Nürnberg

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von **Your Name**

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About

1.1 Purpose of this document

This document is a bundle of various finds and techniques that I came across with during the process of *writing mathematics*. It both serves as an introduction to the programming language LaTeX as well as an user guide for the class `fau-math-theis`. Concerning the first aspect, one has to note that there are in fact a number of very good tutorials and courses available online and in print [**latex**]. The reader is strongly encouraged to use the given sources, however the introduction presented here may suffice for the target audience and is a fortiori to be understand as a memory aid for frequent LaTeX users, which was a strong motivation for me to write this document. Concerning my perception of the target audience, I will note the following: Primarily it consists of FAU students that are in the process of writing any thesis involving mathematics, secondarily of anybody else with the same problem. The topics mentioned so far cover the task of making the computer do what you want, thus in order to help you write a good thesis I will also present some guidelines that improve your wants. Finally it should be noted that the style of writing and respectively teaching is rather casual and informal, which is a purposely implemented feature, especially the use of the personal pronoun—which is highly uncommon when writing a thesis—is a product of this directive.

1.2 What is the class `fau-math-theis`?

If you are a beginner and didn't look into the LaTeX basics yet you may skip this section. To answer the question of the title plain and simple, `fau-math-theis` is a LaTeX class. While there is a humongous amount of cleverly written class files available, especially for the purpose of writing a thesis in mathematics, one should note an important difference concerning the philosophy of `fau-math-theis`.

> Simplicity over flexibility! This template is designed for a specific purpose and is to be customized only within the boundaries of this task.

Many packages and class files [**refLatex**] tend to offer very flexible solutions that are applicable to a vast variety of problems, the main goal of this project is to offer a rather intuitive LaTeX template that on the one hand allows beginners to get started with writing mathematics and on the other hand helps students write their thesis. Hence, the mentioned *specific purpose* is best described by

- learning LaTeX,

- writing a Bachelors or Master thesis that involves mathematics.

One has to take into account that `fau-math-theis` was not written from scratch but rather is a melting pot of different techniques I employed in various documents. Historically it bases off of my Bachelor thesis, which was a rebase of another one and so on. In fact, it was this frustrating process of sending code around via email to students and colleagues that showed the need for an unified framework. So it is indeed an aspiration to substitute the template that is currently provided by the mathematics department of FAU, [l]. Especially for beginners this is hard to use and does not offer enough functionality, thus it is not entirely wrong to claim that `fau-math-theis` is a cleaned and pumped up version that is easy to handle and specifically provides the lacking functionality mentioned before. Furthermore it is important to note the didactic structure of the code, as it is also to be—and was in fact—used as LaTeX tutorial.

1.3 Structure of this document

As mentioned before we will cover three main topics that are briefly summarized below,

- ?? gives a very quick introduction to LaTeX which showcases the basic concepts of this programming language that will allow the reader to write his own thesis,

- Chapter 2 is somewhat of a documentation for the class `fau-math-theis`,

- ?? gives an introduction to the world of *writing mathematics*.

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How to do math

This chapter is dedicated to the functionality of the template concerning its actual and inherent purpose: mathematics. We use material from [0] to showcase the possibilities.

2.1 Theorems and Referencing

In this section the term *theorem* does not only refer to a theorem in a mathimatical sense, but in fact to definitions, lemmata, examples, remarks, etc., i.e. the environments you usually need to write a math thesis and want to follow some consistent numbering scheme. The package used for theorem numbering and styling is `tcolorbox`, which offers a modern and versatile way to create nice boxes around your theorems, while providing the full functionality of the more traditional `amsthm` package. The necessary commands for theorems are defined in the file *styles/fau-appearence.sty*, so you do not have to worry about that (unless you want to). Hence, we will not fully explain how to define these commands, but we will showcase how to use them. The following code snippet

```
\begin{theorem}{Euler 1763}{fermat}
Here could be your result.
\end{theorem}
```

will result in the output

THEOREM 2.1 (Euler 1763). *Here could be your result.*

The number of the theorem is assigned automatically. The second argument defines the theorem addition as displayed above and the third argument defines the name of the label that is used to reference Theorem 2.1. While LaTeXprovides the basic commands for cross-referencing, the use of `tcolorbox` suggests to employ `cleveref` package that enhances some of the basic features and is indeed very clever. The above reference was defined by the command

```
\cref{thm:fermat}
```

where the prefix `thm:` was defined in the `tcolorbox` settings. The following environment prefix combinations are provided by *styles/fau-appearence.sty*:

- theorem - thm,
- definiton - def,
- lemma - lem,

- corollary - cor,

- remark - rem.

The actual appearance of the theorem can be specified by the packet option `thmboxing` for `fau-appearence.sty`, for example

`\usepackage[thmboxing=thmstyle_plain]{styles/fau-appearence}`.

is used to create the document you are reading right now. It is currently not supported to simply add custom box styles. If you don't want to use the solutions provided by `fau-appearence.sty` use the `thmcust` option

showcase some of the boxes we provide

`\usepackage[thmcust]{styles/fau-appearence}`

which will not define any theorem environments.

The `cleveref` links are preset such that link labels are capitalized and carry the link in them. The link colours are set via the `hyperref` package and follow the defined colour scheme. This can be customized globally by

```
\hypersetup{
        urlcolor=blue,
        citecolor=red,
        linkcolor=green}
```

but also locally for each link.

2.2 Lists and Enumerations

Another key feature you may want to use inside your thesis are lists and enumerations. In LaTeX you can simple use the `itemize` environment like this

Listing 1: Itemize

```
\begin{itemize}
\item The first item,
\item[$\circ$] a second item with a different bullet type.
\end{itemize}
```

- The first item,

○ a second item with a different bullet type.

For enumerations we use the `enumitem` package, that provides vast options for customization. Take a look at the following definition taken from [0],

DEFINITION 2.2. *A mapping* $\mu : 2^X \rightarrow [0, \infty]$ *is called a* **measure** *on the nonempty set* X *provided*

(i) $\mu(\emptyset) = 0$ *and*

(ii) *if*

$$A \subset \bigcup_{k \in \mathbb{N}} A_k,$$

then

$$\mu(A) \leq \sum_{k \in \mathbb{N}} \mu(A_k).$$

We can reference single items of an enumeration, for example concerning Definition 2.2 we can add the information that Item 2.2(ii) is called subadditivity. The code that produces this enumeration looks like this:

```
\begin{enumerate}[roman, ref=\thetcbcounter (\roman*)]
\item ... % first item
\item\label{en:subadd} ... % second item
\end{enumerate}
```
Listing 2: Enumerate

The option `roman` is a preset from `fau-appearence.sty` but you can use any valid style provided by `enumitem` itself or define one yourself. The argument `ref=\thetcbcounter (\roman*)` specifies how the label for the reference of this item should be displayed, where `\thetcbcounter` refers to the number of the theorem an enumeration was defined in, thus `\cref{en:subadd}` results in Item 2.2(ii) instead of Item (ii). An enumeration outside of a theorem has to use a different argument for referencing.

```
\begin{enumerate}[label=(K\theenumi), ref=MyEnum (K\theenumi)]
\item ... % first item
\item\label{en:second} ... % second item
\end{enumerate}
```
Listing 3: Enumerate

(K1) ...

(K2) ...

Here the reference look like this, Item MyEnum (K2).

2.3 B

Hello

2.4 C

This is pretty cool section.

Do you like lewis huey and the news?

Books

[0] L. C. Evans. *Measure Theory and Fine Properties of Functions, Revised Edition (Textbooks in Mathematics)*. Chapman und Hall/CRC, Apr. 2015.