

MASTER THESIS



Creating a Master Thesis with LaTeX

A Rough Summary with Code Examples

Supervisors:

Prof. Dr. Chris Code

Prof. Dr. Peter Program

Author:

Jan Küster

www.jankuester.com

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Executive Summary

This work is intended for all those, who want to start writing immediately. For those who aim to avoid the procedure, I went through - all night long figuring out what packages to include. Finding the right syntax to make the intended layout to work. Debugging all those micro errors which may appear. Getting the bibliography to work. And then finally include the citations into the newly written text. By providing this 'out of the box' template, I hope to make things easier for you and to make you start your thesis without hesitation. You should focus on the content your work and not on it's layout because this may stop you from starting to write.

This work backs all the topics you need, to get started with your thesis immediately. You may just copy some of the code examples here, which is fine. If you want to create a thesis with your own taste of style, you should dig deeper into the functionality of the packages. The packages and features are focused for work in the field of computer science and include tables, pseudo code, syntax highlighting, mathematical equations and more.

Chapter 1

General Tools and Techniques for Your Master Thesis

At this point it may be good for the reader to get an overview about this chapter. What does it cover? What is its purpose in the bigger picture of your thesis? It is like a micro-abstract and it helps your audience to keep on track. This is especially useful, when your thesis is an interdisciplinary work.

1.1 Basic Commands and Writing Topics

1.1.1 Introduction to Writing in LaTeX

The text appearance and the thesis layout is sometimes determined by formal requirements. This text, for example is *Times* using 11pt size and a slight increase in space between the text lines. There are also requirements for indenting a new paragraph sometimes.

As you can see, this template does not indent the new paragraph. However, you can always change this setting in the *declarations.tex* file.

Some faculties require to include all references to external sources in *footnotes*.¹²³

You can enumerate or list some points and sketches of a topic using *list or enumerations*:

1. Start
2. Work
3. Finish

1.1.2 Structure of the Thesis

Since the current template is structured into chapters, sections and subsections. This is mainly because a master thesis may easily grow up to 100 pages and in some cases even bigger. Structuring your big parts into *chapters* makes it perfect for separating in logical units, such as:

- Introduction
- Related Work
- Research Design
- Proceedings and Data Collection
- Data Analysis and Evaluation
- Discussion and Conclusion

¹ This is a footnote. You can also include citations and many text formatting LaTeX commands.

² You may also explain background information on a topic, which may be interesting for further reading.

³ Footnotes also often include weblinks, for example <http://www.jankuester.com>

The next smaller units are *sections* which structure a chapter into it's subtopics. Using *subsections* allows to cover these topics step by step and keep the reader on track with a mental model of all the parts of the current topic.

Now there are also *subsubsections* available in LaTeX. It would become very confusing when even *including subsubsections in the table of contents (toc)*. For this reason, the toc is set to remove these subsubsections. You may alter this by taking a look into the main.tex and the declaration.tex.

This Subsubsection is not listed in the Table of Contents

The advantage is, that your work becomes more structured along the complexity of your topic. It may occur, that topics can become very granular, which is why this is the perfect counterpart for this issue.

1.1.3 Using a Shorthand Command in Writing

In the *declaration.tex file*, there is a shorthand command called *NOTE*. It is created to quickly emphasize important words and let them point out. It is declared by using the *newcommand* tag. You may read on the web about this command, since it is very handy once you understand how to use it. You can of course create your own commands but you can also stick to this, if you want to get things done fast.

1.1.4 Including a citation

Since we use the natbib environment, we need to use citep or citet as commans for our citations. This may look like the following:

Standard - [S. Skiena, 2008] [Lombard et al., 2002] [Ben-David and Frank, 2009]

With page - [Ryan, 2010, p.123]

When the authors, e.g. Mayring and Fenzl [2014] said something and you want to embed the citation in your text.

1.2 Including Figures and Tables

1.2.1 Including a Graphic

Including a graphics is not that hard. Important is to wrap it as a figure, so that it will be included into the *list of figures*. You can also *label* it, which allows to refer directly to this figure without the need of keeping track of it's id or name. Another handy parameter is the *width* parameter, which allows to set the dimensions according to the current text width.



Figure 1.1: This is the description of the figure. You may even include citations here, which is often important for a master thesis. For example: [S. Skiena, 2008]

1.2.2 Including a Table

When declaring a table, you have multiple options to project complex structures. The following example uses *multirows* and *multicolumns* to create a multi-faceted overview of complex data. If you want the table to be listed in the *list of tables*, you need to wrap the tabular within a table declaration.

Category	Levels	Scale		
		low	high	
A	1. first level	low	middle	high
	2. second level			
	Subsequence	none	some	many
	Extensions	none	some	all
	3. presentation	-	text	colored cell
B	4. fourth level			
	graphics	low	medium	high
	sound	mute	normal	loud
	input	mouse	keyboard	gamepad
	5. fifth leves	Low	Medium	High

Table 1.1: Detailed description of the table, which can also use various LaTeX commands and include citations.

Chapter 2

Specific Tools for a Thesis in Computer Science

This chapter covers more specific examples, which are useful in the field of computer sciences.

2.1 Writing Pseudo Code in LaTeX

The package *algorithm2e* allows you write nearly all imaginable code structures as pseudo code in LaTeX. A referece of commands can be found here: <http://www.cs.toronto.edu/~frank/Useful/algorithm2e.pdf>. Do not forget to wrap the pseudo code into a figure, thus it will be included into list of figures.

The following example demonstrates the package with a bubble sort algorithm. Note, that the directive *repeat - until* is the same as the *do-while* directive.

Algorithm 1: bubbleSort(Array A)

Data: A as Array to sort,

Result: A as sorted Array

```

1 int n ← A.size ; // cache the initial size of A
2 repeat
3   int newn ← 1 for int i=0; i<n-1; i++ do
4     if A[i] > A[i+1] then
5       A.swap(i, +1);
6     end
7   end
8   n ← newn
9 until n>1;
10 return A

```

Figure 2.1: PseudoCode f the BubbleSort Algorithm, derived from <https://de.wikipedia.org/wiki/Bubblesort>.

2.2 Mathematical Equations

Writing mathematical equations can be a very important part of your work. This applies especially, if you want to analyze and evaluate your gathered data. The following example shows a calculation of Kohen's Cappa, a measurement which represents the inter coder reliability in coding qualitative data.

Let's assume the following results of coding a text by two different persons:

result XY	Rater A					
Rater B		9	0	1	2	c(a)
	9	27	0	0	0	0.5510204082
	0	0	6	0	0	0.1224489796
	1	0	1	7	0	0.1632653061
	2	0	1	7	0	0.1632653061
	c(r)	0.5510204082	0.1632653061	0.2857142857	0	n=49

Table 2.1: A set of example data for further use in a mathematical equation.

Continuing from this basis, the calculation can be proceeded with Cohen's Kappa defined as

$$k = \frac{Pr(a) - Pr(e)}{1 - Pr(e)}$$

Where $Pr(a)$ is the actual observed agreement of the codes and $Pr(e)$ is the estimated agreement of the codes. The actual agreement can be calculated by building the sum of those codes, which have been assigned by both raters (in the table: diagonal from upper left to lower right). This sum is then divided by the amount of responses (n), which is expressed by the following calculation as

$$Pr(a) = (27 + 6 + 7 + 0)/49 = 0.8163265306$$

The estimated agreement is calculated out of the percentages of each code in relation to the amount of responses (n). The overall estimated agreement is then built by multiplying these chances and summing up their results. The term is described as

$$Pr(e) = \sum_{i=1}^m c(r)_i \times c(a)_i$$

where m is the number of all occurring codes, i is the current code and c(r) and c(a) are the chances of assigned codes (see table) for raters and auto. Applying this term is leading to:

$$Pr(e) = (0.5510204082 \times 0.5510204082) + (0.1632653061 \times 0.1224489796) + (0.285714285 \times 0.1632653061) + (0 \times 0) = 0.3702623907$$

The values for $Pr(a)$ and $Pr(e)$ are calculated and can be included into the kappa equation, resulting in the following kappa for item a2s1i1a:

$$k = \frac{0.8163265306 - 0.3702623907}{1 - 0.3702623907} = 0.708333333$$

2.3 Including Code into Your Text

Sometimes you want to include text which include characters that could trigger commands. At this point it useful to wrap them into the *verbatim* environment. The text is uninterpreted and listed as is.

```
2015_5_13/23-19-33:550: ***** LOG INFO *****
2015_5_13/23-19-33:550: name: user1
2015_5_13/23-19-33:550: [0]: 534
2015_5_13/23-19-33:550: [1]: 321
2015_5_13/23-19-33:550: [2]: 094832
2015_5_13/23-19-33:550: [3]: 3980429804
```

You can also include existing code and highlight it's syntax, using the *lstlisting* package. Look at the declarations.tex file for listings settings. The following example highlights xml syntax by given keywords.

```
<!-- an XML comment -->
<entry type="normal" pattern="a" />
<entry type="normal" pattern="b" />
<entry type="formula" pattern="t=a+b+c" required="1"/>
```

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