BERGISCHE
UNIVERSITÄT
WUPPERTAL

Faculty of Electrical
Engineering, Information Technology
and Media Technology

Chair of Automation Technology/Computer Science

Bachelor thesis

This is the topic of the thesis

Max Mustermann
1234567

Information technology
Systems & Components

Wuppertal, 03 August 1972

Supervisor First name Last name M.Sc.

First reviewer Prof. Dr.-Ing. first name surname
Second assessorProf . Dr.-Ing. first name surname

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AREA E
ELECTRICAL ENGINEERING / INFORMATION TECHNOLOGY / MEDIA TECHNOLOGY
Univ.-Prof. Dr.-Ing. Dietmar Tutsch

Bachelor Thesis

CANDIDATE	Max Mustermann
MATRIX NUMBER	123456
STUDY COURSE	Information Technology
FIELD OF STUDY	IS
SUPERVISOR	First name Last name

T O P I C

Design and development of a Lorem Ipsum generator TASK POSITION

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer libero erat, tincidunt quis molestie nec, ultrices nec felis. Cras tincidunt tempor sapien ac cursus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Nunc eu magna ut sem condimentum posuere. Nulla ullamcorper sapien et sem placerat in blandit libero tempor. Pellentesque non justo in arcu porta lacinia non eget massa. Integer vel lectus sed ipsum sagittis mollis. Cras congue, orci et suscipit tristique, enim metus congue ante, et adipiscing neque justo eget mi. Aliquam ut ligula tortor, eu commodo ante. Nam faucibus lorem ultricies metus suscipit cursus. Maecenas adipiscing convallis felis, mattis sollicitudin sapien aliquam eget. Vivamus cursus mattis massa id scelerisque. Quisque dolor tellus, bibendum in adipiscing in, imperdiet vel augue. Fusce posuere lacus vel neque molestie in congue leo ultrices.

Wuppertal, the .....
(Signature of the carer)

FIRST GUARDIAN : Prof. Dr.-Ing.
SECOND GUARDIAN : Prof. Dr.-Ing.

Examination Office
Reference number : Date of issue :
Date of issue and signature : .....
(Signature)

Affidavit

I hereby certify that I have written this thesis independently, that I have not used any sources and aids other than those stated and that I have marked quotations.

Wuppertal, 03 August 1972 _____

(Signature)

Declaration of consent

I agree that my thesis may be made available to academically interested persons or institutions. Correction or evaluation notes in my thesis may not be quoted.

Wuppertal, 03 August 1972 _____

(Signature)

Abstract

The text of the abridged version is included here.

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Does it make no difference whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the figures are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

Abstract

The english version.

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift - not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Table of contents

1 Introduction

The appendix of this document contains the chapters Questions and Answers (FAQs) and LAT EX examples, who can help you with problems or questions about LaTeX and the thesis template.

1.1 Motivation

The topic should be motivated here. Please do not say "I am particularly motivated because ..." but "Topic/project XY is important/must be investigated/should be developed because ...".

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1.2 Problem definition & goals

Here, the problem and the aim of the thesis are briefly explained in my own words.

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1.3 Structure of the thesis

Overview of the structure of the thesis. Which chapters deal with what?

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1.4 Notation

(optional)
If a special notation is introduced/used in the thesis, it should be briefly explained here. Otherwise, this section can be omitted.

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2 Basics

The basics of the topic are explained here. These can be, for example, mathematical principles, communication protocols or special algorithms.
Common knowledge from our faculty, such as the formula $U = R * I$ or the functionality of loops and arrays, can be assumed.

Rule of thumb: everything you didn't know beforehand, but also didn't develop yourself.

However, the first and second assessors also need to be taken into account here. If you know that one of them does not know a topic very well, it should perhaps be included in the basics.

=> if in doubt, ask the counsellor

2.1 Protocols used

2.1.1 I3C (Inter-Integrated IC Circuit)

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Is it equally valid whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the characters are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

2.1.2 BUW 4.0

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2.1.3 HTML (famous internet protocol)

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2.2 Electrical engineering

2.2.1 Directional dependence of passive components

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2.2.2 Newbie's "works without capacitor" assumption

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2.2.3 Liquid Crystal LCD displays

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2.3 Mathematics

2.3.1 Numerical evaluation of division by zero

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2.3.2 The fully convoluted inverse transformation

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2.3.3 Vørwæršé Ķţņķ

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2.4 Economy

2.4.1 The acquisition rules of the Ferengi Alliance

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2.4.2 Toilet paper - crisis-proof investment?

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2.4.3 Cost evaluation of extensively rambling and, for the reason just mentioned, completely exaggeratedly long section headings in text documents

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3 Draft

3.1 title

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3.2 title

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4 Realisation

4.1 title

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4.2 title

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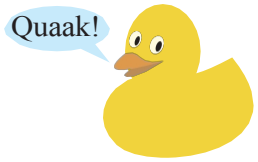

Figure 4.1 Image descriptions are important so that the reader understands what they are seeing. However, they should not be unnecessarily long - longer texts, such as this one here, which explains in detail that the picture shows a yellow duck with its beak open and saying "Quaak!", belong in the normal continuous text.

4.2.2 title

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5 Analysis

In this chapter you will analyse your results.

What works as desired?
What is not yet working (or not quite right)?
-> can then also be mentioned in the outlook

Important: How good are the results (e.g. error rate, accuracy, repeatability, ...)?

In the analysis you write a scientific evaluation, not a personal opinion! (this may be included in the conclusion)

If something does not work well, an error analysis should be included here. Even if you have not been able to solve the error completely, you can show that you have systematically searched for a solution (Under what conditions does the problem occur? Regular or unpredictable? Are there any other anomalies? etc.).

5.1 title

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Is it equally valid whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the characters are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

5.2 title

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Is it equally valid whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the characters are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

6 Concluding remarks

Here again your own opinion is allowed

6.1 Conclusion

What has been achieved? What is missing or has not been completed? Has anything been done that goes beyond the task?

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Does it make no difference whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the figures are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

6.2 Outlook

How could we continue working on the project? This section is a good opportunity to address any outstanding issues and make brief suggestions if necessary

This is a dummy text for testing text editions. If you read this text, it's your own fault. The text only indicates the grey value of the font. Is that really the case? Does it make no difference whether I write: "This is a dummy text" or "Huardest gefburn"? Kjift - not at all! A dummy text provides me with important information. I use it to measure the legibility of a font, its appearance, how harmonious the figures are in relation to each other and check how wide or narrow it runs. A dummy text should contain as many different letters as possible and be set in the original language. It does not have to make sense, but should be legible. Foreign-language texts such as "Lorem ipsum" do not serve the actual purpose, as they convey a false impression.

List of illustrations

Source code directory

List of tables

Symbols

alpha	Description text for alpha	α	42
beta	Description text for beta	β	42
gamma	Description text for gamma	γ	42
Empty	setThe empty set	$\emptyset$	42

Abbreviations

e.g.	For example	42
	SVMSupport Vector Machine	42

Acronyms

CLK Clock *see* SCL & SCK
CRC Cyclic Redundancy Check 42
SCK Serial Clock *see* SCL & CLK
SCL Serial Clock Line *see* SCK & CLK

Glossary

Example

Exemplary execution to illustrate a certain fact or idea. Often helpful for learning new skills. 42

Recursion

see Recursion, 42

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A Source code

```
1 # include <stdio.h>
2
3 int main(void){
4     printf(" Hello _ World !\n");
5
6     return 0;
7 }
```

Source code A.1 A sample source code

B Questions and answers (FAQs)

Frequently asked questions

B.1 contains the FAQ specifically for this template and how to use it. B.2 deals with typical questions for beginners on the subject of LAT X.E

B.1 About this template

B.1.1 What do I need?

B.1.1.1 This template

The template is distributed as a compressed archive. This must first be unpacked.

B.1.1.2 A LaTeX distribution

Depending on the operating system, there are different packages in which LATEX is combined with the most frequently used packages to form a so-called *LATEX distribution.* TEXLive and MiKTeX are the most frequently used variants:

TeX Live

Linux | Windows | MacOS[1] | FreeBSD | NetBSD | Solaris http://tug.org/texlive/

Is already included in many Linux distributions and is automatically updated via the Linux package manager. Under Ubuntu/Mint/Debian, for example, it can be installed via the terminal
with `sudo apt install texlive`. There are different sized packages depending on the application. With `texlive` you install a simple TeX system with frequently used packages. This is sufficient for most applications. `texlive-base` would be the minimum installation, all other packages must be installed manually. `texlive-full` contains all packages. Of course, this also requires the most memory.

MiKTeX

Linux | Windows | MacOS https://miktex.org/download

Loads packages only on request, so potentially requires less memory. During installation, you are asked what should happen if MiKTeX notices that a package is missing:

Do not install Missing packages are not installed automatically - so you have to do this yourself. *(Not recommended for beginners)*

As soon as a package is missing, MiKTeX opens a window in which you can select whether the package may be installed. Simple and transparent. In the beginning, however, you may be asked quite often until all packages have been downloaded.

[1] For MacOS, there is also the specially customised version *MacTeX*, which is based on *TE XLive*

Install automatically Missing packages are installed automatically without asking the user. Simple, but non-transparent.

You can also change this option later in the MiKTeX settings.

B.1.1.3 A (LaTeX) editor

Because LATEX source code is also just normal text, in principle any text editor[2] can be used.

However, it is much easier (and clearer) if you use a LATEX editor. These programmes usually know most of the commands and can complete them automatically, offer preview functions, simple compilation and much more.

I recommend *TeXstudio*[3] , for example, in which I am currently writing this text and have already developed various templates and packages. It contains an autocomplete function for common LATEX commands, a simple spell checker and many auxiliary functions for finding symbols, formatting tables and so on...

I find the option to jump directly to the corresponding location in the source code by Ctrl+clicking in the PDF particularly practical (this also works the other way round, of course). Or Ctrl+click on a package name to open the corresponding documentation. Or e.g. to display the preview of a formula directly in the source code. And there is so much more...

B.1.1.4 Literature management (optional)

The bibliography can already be edited sufficiently well in a LATEX editor. However, reference management programmes can make your work easier. The following is freely available e.g. the programme *JabRef*[4] . This programme can also search various scientific online directories and is therefore also suitable (to a limited extent) for literature research.

B.1.2 Change title page and settings

The setting options intended for users can be found in the Settings.tex file. These can be used, for example, to change the information on the title page, switch between single-page and double-sided layout or decide which directories should be generated and much more. All options are commented on in detail.

[2]Just please do not use Word, Writer etc. These are not text editors![3] https://www.texstudio.org/, available for Linux, Windows & Mac OS[4] Runs on Linux, Windows and Mac OS, http://www.jabref.org/

B.1.3 Literature/sources

The literature entries are loaded from this template from the file Literatur.bib. If something has changed in this file, the bibliography must be recompiled.
(see B.2.3 *Compiling the bibliography*)

B.1.4 Glossary entries, abbreviations, acronyms

are entered in the Glossary.tex file.

B.1.5 There are several blank pages at the beginning of the PDF

Depending on whether you have selected the single-page or double-page layout in Settings.tex, blank pages are generated between chapters. This looks in the PDF
This may look strange, but it is intentional: for example, the contents section starts on the right-hand page (this is a common convention). To prevent the rest of the table of contents from appearing on the left-hand page, which can look a little strange, the first left-hand page before the start of the text is left blank. If the table of contents ends on the left-hand page, there will also be an empty right-hand page.

The assignment, extension (if applicable) and affidavit are each stand-alone elements, so make sure that the left-hand side next to them remains empty.

B.1.6 Page margins jump back and forth

The double-sided layout has an inner and an outer margin.

A single-page layout can also be selected in the settings if required.

B.1.7 Page numbers jump back and forth

In the double-page layout, there is an inner and an outer margin. The page numbers are always on the outer edge of the page.

A single-page layout can also be selected in the settings if required.

B.1.8 The print shop counts b/w pages as colour pages

Colour pages are usually significantly more expensive than black and white or greyscale pages. It can therefore make sense if only the pages with coloured images etc. are printed as colour pages. Many thesis printers and copy shops have software that can automatically recognise colour pages[5] .

In most cases, this works perfectly with this thesis template. However, a few printers behave *somewhat strangely* in this regard. If your printer is having problems, you can adjust the ¥colormodel parameter in the *Settings.tex* file.

Rule of thumb for ¥colormodel:

- Leave the default setting cmyk first. This is the professional print format.
- if the printer is causing problems, switch to rgb. This has already helped in one case we know of.
- if the printer still has problems, switch to grey.

[5]Or at least should be able to ;-)

B.2 About LATEX in general

B.2.1 LATEX becomes a PDF

LATEX source code is compiled, i.e. a special programme (the *compiler*) reads the source code and creates a document in the target format. Depending on the compiler and its settings, different target formats can result. One of the most important compilers is *PdfLATEX*. It creates a PDF document from the code. This can then simply be viewed, printed, commented on or attached to the thesis on a data carrier.

Virtually all print shops accept PDF documents. However, print shops often prefer to have nothing to do with Writer or Word documents, LaTeX code or other file formats[6]

B.2.2 Compile LATEX

The thesis can be compiled in the terminal with the command `pdflatex Thesis.tex`. In *TeXstudio, you* can do this by clicking on the Compile button or by pressing the F5.

In some cases you have to compile twice, more on this in section B.2.4 *Compiling twice (and why)*.

B.2.3 Compile bibliography

The bibliography is usually processed by a separate programme (e.g. BibTeX, BibLaTeX or Biber).

This must be called up explicitly. In *TeXstudio, for* example, this can be done with the F8, in the terminal via `bibtex Thesis.aux`.

The LATEX document must then be compiled (in *TeXstudio* with F5) must then be compiled.

In the worst case[7] **you have to**:

1. Compile LATEX *X code (so that you know which source references exist)*
2. Compile literature *(compile sources)*
3. LATEX Compile X code *(layout of the document, prepare directories)*
4. LATEX Compile X code *(set directories correctly)*

In practice, however, this is not a major problem, as you usually compile as required when working on the document...

---

[6] In the worst case, the print job will be rejected. Alternatively, you may have to pay a surcharge for the conversion. With a PDF, on the other hand, you are on the safe side with practically all reputable providers .

[7] everything has changed

B.2.4 Compile twice (and why)

- *The new chapter is not listed in the table of contents?*
- *The link to an image points to the wrong page?*

Solution: Compile twice.

But why actually?

Normally, the LATEX code is run through once from front to back and compiled in the process. The example of the table of contents makes it immediately clear that certain things are not possible: If the table of contents is to be placed at the front of the document, LATEX does not even know at this point which page the chapters will be on and which chapters there are at all - after all, these only follow later in the source code.

Instead, the LATEX compiler runs through the entire document once and remembers which chapters exist and on which pages they began. This information is then saved in a file[8] . In the second run, this information is read in again and used to create the table of contents, i.e. the table of contents lags one compiler step behind, so to speak.

The same applies to

- References (or anything that has to do with page numbers)
- all other lists, e.g. list of figures, list of tables, bibliography.

B.2.5 Floating environments

Help, my picture/table/... is not where it should be! - Images, tables etc. are so-called *floating environments* in LATEX, i.e. they are not fixed in one place, but are moved during compilation so that the page looks good. Now, *what looks good* is not necessarily the same for everyone, and there are also cases in which LATEX seems to make very strange decisions. Therefore, you can specify preferences for positioning in square brackets, which LATEX then takes as a guide - but may also ignore in case of doubt:

t the top of the page

b please go to the bottom of the page

h please here at this point in the text

[8]This is why, in addition to the actual LATEX document and the literature file, there are so many other files with extensions such as .aux or .toc lying around after compilation

please put **p** on a separate page where only other floats are allowed

! LATEX should ignore its own rules for good placement of floats

Tip: ¥clearpage not only closes the current page and starts a new one for further content. All open float objects are also output. The
command offers an easy way to ensure that objects are not taken to the next section.

B.2.6 Space after a command is missing

The problem

If you write a sentence such as *I use LATEX because LATEX is great for formulae, you will notice that* there is no space between *LATEX* and *for*. Have I simply forgotten it?

No, here is the source code:

```
I␣use␣\LaTeX,␣because␣\LaTeX␣is␣super␣for␣formula typesetting␣.
```

As you can see, there is clearly a space after the second `\LaTeX.` However, this is omitted because commands in LATEX normally expect parameters, so look at the next character and see if there is another parameter. With bold print
Text like this ¥textbf{Text} is in bold (this **text** is in bold) this is obvious, with `\LaTeX it is` not. As you can see on closer inspection, it is not a problem with the first `\LaTeX` because it is immediately followed by a comma. Only spaces are
is "eaten" by such commands because a space would be allowed.

This behaviour also makes sense because sometimes you may not want to have a space after a LATEX command. For example ¥LaTeXcommand is not a valid LATEX command, and we actually only wanted to append `\LaTeX` and command here. Consequently, there is a space between `\LaTeX` and command, by which LATEX recognises where the command ends and the text continues. However, because the space character only marks where the
LATEX command ends, it does not appear in the text.

The solution

In such cases (or always, it never hurts) simply write ¥LaTeX{}, i.e. add empty parameter brackets. This makes it immediately clear where the command ends and the
Spaces are no longer "eaten":

I use LATEX because LATEX is great for formulae.

```
I␣use␣\LaTeX,␣because␣\LaTeX{}␣is␣super␣for␣formula typesetting␣.
```

C LATEX examples

This chapter contains examples and brief explanations of various LATEX functions that could be useful in a scientific paper.

C.1 Chapters, sections, paragraphs

Chapters are created with ¥chapter{chapter name}. The next levels are ¥section{title}, ¥subsection{title} and ¥subsubsection{title}. If that's still not enough, there is also ¥paragraph{title} and, in an extreme emergency,[1] even ¥subparagraph{title}.

C.1.1 Subsection

Here we are in a subsection.

C.1.1.1 Subsubsection

Here we are in a subsection.

Paragraph Here we are in a paragraph.

C.2 Text labelling

Text can be emphasised in **bold**, *italics* or underlined, for example. You can also do this with SMALL CAPS, equal thickness font or sans serif font.

```
1 For example, text can be ¥textbf {bold}, ¥textit {italic}
  ↪ or ¥underline {emphasise underline}. But that works
  ↪ also with ¥textsc {captains}, ¥texttt {thicker equaliser
  ↪ font} or ¥textsf {sans serif font}.
```

[1] Anyone who needs so many hierarchical levels is usually doing something wrong - even exceptionally long Bachelor's and Master's theses are usually not so extensive that sub-paragraphs are necessary

C.3 Footnotes

A text can contain footnotes[2] . These are set with ¥footnote{text}. Formatting in the footnote is generally not a problem[3] . But be careful: Some commands such as z. e.g.¥lstinline cannot easily/not always be placed in a footnote[4] .

C.4 Quotations & References

C.4.1 Quote

Correct citation is extremely important in science *(and elsewhere)* and is therefore mandatory. For everything[5] that you have taken from others, you must state where it comes from and who wrote/published it.

This clearly shows that information has been taken from another source. If you take over information but leave out the source reference, you falsely suggest that you yourself are the source.

This makes the corresponding passage plagiarised - u s u a l l y a devastating verdict for any work and normally a quick way to fail your thesis, internship, seminar etc. in disgrace!

Don't panic... *If you always cite conscientiously, but forget a citation bracket at some point, you will of course not fail directly...*

...but please show your own work *If you quote everything correctly but do not write your own text[6] , you have not plagiarised (good), but you have not shown your own work (bad). And your own performance is what is evaluated ;)*

[2]Like this one, for example
[3]This is a particularly **bold footnote** in red.
[4]The reason for this can be found at https://www.texfaq.org/FAQ-verbwithin
[5]As a rule, basic knowledge from your own subject area does not have to be cited: Students of the Electrical engineering students do not need to quote $U = R \cdot I$. However, art students who want to use an LED and calculate a series resistor but have never heard of this formula before should do so .
[6]It's all supposed to have happened before...

C.4.2 Bibliography

Literature is specified in the file Literatur.bib and then cited in the thesis with the command ¥cite{literaturname}[Loh21] - more on this in C.4.3: Citations in LAT EX,.

The easiest way to edit the Literatur.bib file is with a literature management programme such as the freely available *JabRef*

C.4.3 Quotes in LATEX

You can quote in many ways. However, it is not enough to s i m p l y put the text in inverted commas, e.g. "text"! For a correct citation, the source must always be recognisable. The citation bracket can be placed in a sentence after an assertion that has been adopted:
The AXI bus has a data width that is always a multiple of eight bits [ARM10].

```
The AXI bus has a data width that is always a multiple of
↪ of eight bits¥ cite { ARM : AMBA 4 AXI4 Stream Protocol : v1_0 }.
```

Of course, a citation is only really helpful if we also give the reader an indication of where (e.g. in which chapter or on which page) to look in the cited source:
The AXI bus has a data width that is always a multiple of eight bits [ARM10, p.42] amounts to.

```
The AXI bus has a data width that is always a multiple of
↪ of eight bits¥ cite [ p .42]{ ARM : AMBA 4 AXI4 Stream Protocol : v1_0 }
↪ amounts to.
```

Literal quote: "Here is the quote text"
Quote in another language: "An apple a day keeps the doctor away."

```
¥ foreignquote { english }{ An apple a day keeps the doctor away .}
```

Literal quotation directly with source: "Here is the quotation text" [Loh21, 33]

```
¥ textquote [{ \ cite [ page number ]{ thesis: template }}]{ Here it says
↪ the quote - text}
```

Block quotation: Above a certain length, the quotation is displayed as an indented block as below:

> Here is the quote text. Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation

text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.Here is the quotation text.

here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text.here is the quotation text. [Loh21, 33]

```
¥blockquote [{\cite [34]{thesis:template}}]{%
    Here is the quote text. Here is the quote text. Here
    ↪ is the quote text. Here is the quote text. Here
    ↪ is the quote text. Here is the quote text. Here
    ↪ is the quote text. Here is the quote text [...]
    ↪ is the quote text. Here is the quote text. Here
    ↪ is the quote text. Here is the quote text.
}
```

Cite several sources together: [ST 13; Ale01; Ana09]

```
\cite{Datasheet:LD1117,ADATspec96khz,AnalogDevices:MT-085}
```

C.5 Numbers and formulas

C.5.1 Number/unit representation

This thesis template uses the LaTeX package siunitx, which standardises the representation of numbers and units. The package settings can be found in the configuration file siunitx.cfg.

C.5.1.1 Figures

Numbers are set with ¥num{3.14159}. If very large/very small numbers are used, the appropriate scaling factor is automatically set in the engineering-typical 10 ^{3x} notation is generated. For example, ¥num{4210234} is set as 4 210 234 and ¥num{0.00000000002535} becomes 0.000 000 000 025 35.

Why not write directly?
This question is almost obvious: Why not just write the number like this? Firstly, using the appropriate commands ensures that the numbers are always formatted in the same way (and typographically correctly) and secondly, this presentation can be changed globally, i.e. for the entire document. Furthermore, the command as shown (if suitably preconfigured, which is the case in this template) automatically takes care of the representation in the typical engineering powers of ten.

C.5.1.2 Units

Units are set with ¥si{¥milli¥ampere}. The SI units and the units commonly used in computer science for data volumes are available. It is also possible to define your own units (see siunitx documentation).

The definition of the derived SI unit of stress can serve as an example for the application: ¥si{¥volt} = ¥si{¥kilogram¥meter¥squared¥per¥second¥cubed¥per¥ampere} becomes

$$\mathrm{V} = \mathrm{kg\ m\ s\ A}^{2\ -3\ -1} \tag{C.1}$$

C.5.1.3 Numbers with units

The most common are of course numbers with units. These are set with ¥SI{500}{¥milli¥volt}. It is also possible to express uncertainties with ¥SI{320¥pm 2}{¥micro¥volt} or a range of values with ¥SIrange{-10}{10}{¥volt}: The voltage offset was measured over the entire input voltage range in 500 mV steps and was in the range specified for
The range from -10 V to 10 V with measured values of 320(2) µV is almost constant.

C.5.2 Formulas

LATEX provides a large number of symbols, especially for maths. These include the usual Greek letters as well as variants of these that are only used in formulae (Table C.1). In general, however, LATEX has many more functions that also allow complex formulae and systems of equations.

Formulas in the text are set with $a^2 + b^2 = c^2$. It then looks like this: According to Pythagoras' theorem, the side lengths $a^2 + b^2 = c^2$ in a right-angled triangle, where c is the length of the hypotenuse.

```
1 According to the Pythagorean theorem, the following applies to a right-
  angled triangle
  '↪ for the side lengths $a ^2 + b^2 = c^2 $, where $c$ is the length
  '↪ of the hypotenuse.
```

Separate formulae, e.g. for systems of equations or derivations, can be set in the align environment. The name *align* comes from the fact that the formulae are *aligned* with the first & in the formula (which is later invisible in the PDF).

$$f(x) = x^3 + \frac{3}{2}x^2 - 5x + \pi \tag{C.2}$$

$$g(y) = \sum_{i=0}^{42} f(i) - f(y) \tag{C.3}$$

$$h(x, y, \varphi) = \int_{\frac{\pi}{4}}^{\infty} \frac{g(y) - g(y-1)}{\sqrt[3]{1 - f(x) - \varphi^2 + \frac{\pi}{2}}}\, d\varphi \tag{C.4}$$

```
\begin{align}
   % Formula C.2
   f(x) &= x^3 + \frac{3}{2}x^2 - 5x + \pi \\
   % Formula C.3
   g(y) &= \sum_{i=0}^{42} f(i) - f(y) \\
   % Formula C.4
   h(x,y, \varphi) &= \frac{\pi}{4} \pm \int\limits_{-\infty}^{\infty} \frac{g(y) \cdot g(y-1)}{\sqrt[3]{1 -
   ↪ f(x) \cdot \left[\varphi^2+ \frac{\pi}{2} \right]}}¥,
   ↪ \mathrm{d}\varphi
\end{align}
```

C.5.3 Greek alphabet

Table C.1 shows the LATEX commands for the Greek letters and the corresponding scientific spelling (where available).

Symbol	LAT XE	Symbol	LAT XE	Symbol	LAT XE	Symbol	LAT XE
α	¥alpha	A	A				
β	¥beta	B	B				
γ	¥gamma	Γ	¥Gamma			$\mathit{\Gamma}$	¥varGamma
δ	¥delta	Δ	¥Delta			$\mathit{\Delta}$	¥varDelta
ϵ	¥epsilon	E	E	ε	¥varepsilon		
ζ	¥zeta	Z	Z				
η	¥eta	η	¥eta				
ϑ	¥theta	Θ	¥Theta	θ	¥vartheta	$\mathit{\Theta}$	¥varTheta
ι	¥iota	I	I				
κ	¥kappa	K	K				
λ	¥lambda	Λ	¥Lambda			$\mathit{\Lambda}$	¥varLambda
μ	¥mu	M	M				
ν	¥nu	N	N				
ξ	¥xi	Ξ	¥Xi			$\mathit{\Xi}$	¥varXi
o	o	O	O				
π	¥pi	Π	¥Pi	ϖ	¥varpi	$\mathit{\Pi}$	¥varPi
ρ	¥rho	R	R	ϱ	¥varrho		
σ	¥sigma	Σ	¥Sigma	ς	¥varsigma	$\mathit{\Sigma}$	¥varSigma
τ	¥tau	T	T				
υ	¥upsilon	Υ	¥Upsilon			$\mathit{\Upsilon}$	¥varUpsilon
ϕ	¥phi	Φ	¥Phi	φ	¥varphi	$\mathit{\Phi}$	¥varPhi
χ	¥chi	X	X				
ψ	¥psi	Ψ	¥Psi			$\mathit{\Psi}$	¥varPsi
ω	¥omega	Ω	¥Omega			$\mathit{\Omega}$	¥varOmega

a Lower case **b** Capital letters **c** Formula variants small **d** Formula var. large

Table C.1 Greek letters (can only be used in maths mode)

Important: Special symbols (just like in normal text) may also have to be set to maths mode for the bibliography and integrated with the corresponding LATEX command.

C.5.4 Other

We have preconfigured a few special symbols for the thesis template (see Table C.2).

Icon	LAT XE
✓	¥ok
▪	¥x
▪	¥xg
Term®	\markRegistered{term}
Term©	\markCopyrighted{term}
Term \markTrademark{term}™	
€	¥euro{}

Table C.2 Special symbols

The Comprehensive LAT EX Symbol List contains over 300 pages of additional symbols organised by category.

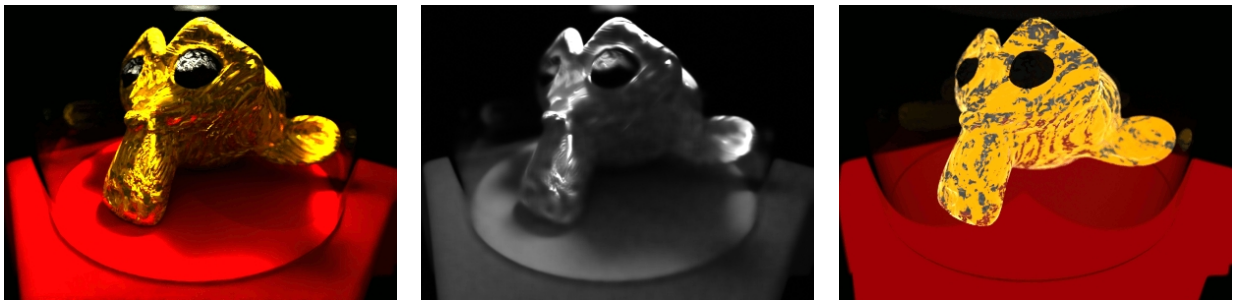
C.6 Illustrations

Figure C.1 shows an example figure. Figures are set in LATEX with a `figure` environment. This creates a *float object*, ensures automatic numbering and automatically moves the image to a favourable position for text typesetting.

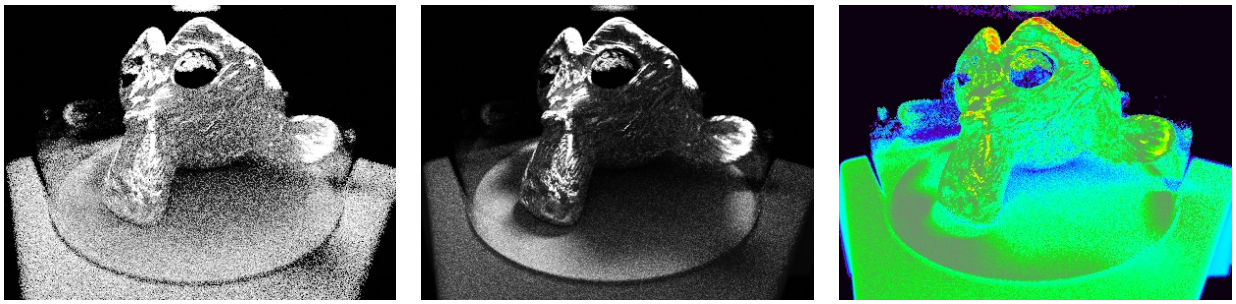
Figure C.1 Example of images (The logo of the University of Wuppertal)

```
\ begin {figure }
    \ includegraphics {Media / Uni_Wuppertal_Logo }% Image
    ↪integrate
    \ caption [Example of images ]{ Example of images ( The
    ↪ Logo of the University - Wuppertal)} % caption : Labelling of the
    ↪Figure
    \ label {fig : example} % can be referenced with \ref {...}
\end {figure }
```

Figure C.2 consists of several parts that `begin` with `\begin{subfigure}{0`.33¥linewidth} can be included in the figure `environment.` 0.`33\linewidth` indicates that



a Raw **b** Intensity **c** Albedo



d Variance **e** Black and white **f** False colours

Figure C.2 Suzanne, the mascot of Blender with gold material in different render passes

the width of the inserted sub-image should correspond to 33% of the current text width.

C.7 Tables

Table C.3 shows an example table. Tables are set in the table `environment` and are *float objects* just like images (see subsection B.2.5). The actual table can then be set using the `tabular environment`, for example. LATEX editors such as *TeXstudio* offer user-friendly tools for editing and automatic source text formatting of tables if you lose track of the source text.

(l)eft	(c)enter	(r)ight
Here	stands	
in		somet
	hing	
	one	table
This	is	further down
Text can also be	Go over several columns	

Table C.3 Example of tables

```
    \ begin {
      table }
  \ centering
  \ begin {tabular }{l|cr}
     (l)      eft& (c) enter & (r) ight
     \\
     ¥hline
              Here&       is& something
     This & text can      & further down¥¥
     also be & in&        ¥multicolumn {2}{ c}{ over several
     ↪ Go to columns }    a&table \\
     ¥hline
  \end {tabular }
  \ caption {Example of tables }
  \ label {tab:example}
\end {table }
```

C.8 Source code

This template uses the listings package for source code.

With ¥lstinline[language=C]|printf("%d", 42);| source code, e.g. printf("%d", ↪ 42); in the middle of the text. The optional parameter language=C specifies that the code shown is in the *C* programming language. The documentation of the listings package contains a complete list of predefined programming languages. It is also possible to define syntax highlighting for other languages yourself.

A separate code block is created with `\begin{lstlisting}[language=C]`. It is also possible to include source code files directly (`\lstinputlisting{/path/to/source.code}`), to display only a specific section of the source code or to use line numbering (see source code C.1).

```
1234 # include <stdio.h>     // For printf / scanf etc
1235 # include <stdlib.h>    // Memory management &
     ↪ EXIT_SUCCESS / EXIT_FAILURE - Macros
1236
1237 int main(void){
1238    printf("Hello_LaTeX!\n"); // Text output - example
1239    return EXIT_SUCCESS;
1240 }
1241
1242 // ä, ö, ü, ß and Ä, Ö, Ü are also permitted in this
     template
```

Source code C.1 Hello World example in the lstlisting example

In addition to language, there are other optional parameters that can be used to customise the appearance. In source code C.1, label=labelname (can be referenced), caption={labelling of the source code block} and firstnumber=1234 were used to adjust the line numbering.

C.9 Labels & References

Headings, figures, tables etc. are numbered automatically by LATEX.

If you want to refer to a specific text section or, for example, to a graphic, set a ¥label{labelname} at the target and then reference this with ¥ref{labelname}. ¥autoref{labelname} automatically adds the type of the referenced object:

If I reference the current section with ref, the result is C.9 (i.e. only the number), if I use ¥autoref{labelname}], the type of the object is also included: Section C.9. It is of course also possible to reference source code C.1 or figure C.1.

The command ¥nameref{labelname} gives you the name of the referenced object instead of the number:

The current section has the number C.9 and is called "Labels & References".

```
1 The current section has the number ¥ref{label-name} and
  ↪ means ¥enquote{¥nameref{label-name}}.
```

With ¥pageref{labelname} you get the page number of the referenced object: This section starts on page 41.

C.10 URLs

URLs can be set with ¥url{https://www.blender.org}, which can then also be clicked on in the PDF. The discreet frame around the link is only displayed on the screen.
is displayed, but not printed when printing.

The open-source software Blender (https://www.blender.org) is a powerful all-round tool for the creation of 3D graphics, which covers areas such as modelling, texturing, rendering, rigging, physics simulation, particle simulation, sculpting, animation, video tracking, video editing, compositing and scripting.

If you want to set a link in the PDF but display a different text instead of the URL, this is possible with ¥href{url}{text}: With the so-called Grease Pencil tool, artists can create 2D drawings in a 3D environment. Originally only
a simple tool for annotations (hence the name) has been available since Blender version 2.73 has evolved into a much more powerful tool for 2D-style animation.

C.11 Glossary entries & symbols

This template uses the glossaries-extra package for glossary entries and symbols

C.11.1 Glossary

Glossary entries are defined in the Glossar.tex file. They can be used in the text with ¥gls{labelname}:

There are great CRC algorithms that calculate a CRC exactly according to the scheme of typical CRCs. Here is an example of a glossary entry. And here is the great abbreviation Support Vector Machine (SVM), for example (e.g.) standing for SVM.

Sometimes the original text of the glossary entry does not fit grammatically into the text, but an entry should still be created. In this case, an alternative text can be specified with ¥glslink{labelname}{text}:

The field of recursion deals with recursive behaviour.

C.11.2 Symbols

Mathematical and physical symbols can also be specified in Glossary.tex. In the text, they are addressed with ¥glssymbol{labelname}[7] : The first three letters of the Greek alphabet are α, β and, of course, γ. The empty set is
noted with $\emptyset$.

[7] With \gls only your name would be displayed

C.12 Todos

As long as the thesis is not yet finished, you will always have "todos", i.e. things that still need to be done. Thanks to the LATEX package todonotes, these can be completely simply add with ¥todo{There is still something to do here}. With `\listoftodos` you can output a list of all todos in the current document:

Here is still Important: How good are the results (e.g. error rate, accuracy, repeatability)?

What still needs to be done:

something to do

availability, ...)
In the analysis, you write a scientific evaluation, not a

personal opinion! (which may appear in the conclusion)
If something is not working well, there should be an error analysis here. Even

If you have not been able to solve the error completely, you can show that you have systematically searched for a solution (Under what conditions does the problem occur? Regularly or unpredictably? Are there other abnormalities? etc.). 14

Your own opinion is allowed here again 15

What has been achieved? What is missing or has not been completed? Was anything done anything beyond the scope of the task? 15

How could we continue working on the project? This section is a good opportunity to address any outstanding issues and, if necessary, make brief suggestions to make....15

Something still needs to be done here....43

End ;-)