



OTTO-FRIEDRICH-UNIVERSITÄT  
BAMBERG

**Qualitative Analyse von Stakeholdern  
in einem Unternehmen zu Sichtweisen  
auf Privatsphäre bei  
Softwareentwicklern bzw.  
-administratoren**

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# Zusammenfassung

Diese qualitative Analyse beschäftigt sich mit den Sichtweisen auf Privatsphäre und Sicherheit von Stakeholdern in einem Softwareentwicklungs-Unternehmen. Mit der stetig wachsenden Digitalisierung spielt der Datenschutz, und somit die Privatsphäre und Sicherheit, eine immer größere Rolle bei Nutzern des Internets. Aus praktischer Sicht sind die Sichtweisen auf diese unterschiedlich, weswegen bei der Recherche darauf Wert gelegt wurde, möglichst viele Experten aus unterschiedlichen Berufsgruppen (z.B. Werkstudenten, Festangestellte, Team-Leads o.Ä.) einzubeziehen und deren Aussagen auszuwerten. Nach erfolgreicher Auswertung der Expertenbefragungen hat sich ergeben, dass die Berufsgruppe, damit verbunden die Arbeitsweise und der -umfang, [...]keinen Einfluss auf die Einstellung gegenüber personenbezogenen Daten und die Verarbeitung dieser in DevOps-Tools haben.



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# 1 Relevanz von Privatsphäre und Sicherheit in der heutigen Zeit - eine Einleitung

This introductory chapter will give you an overview of the PSI Thesis template and its usage. It also contains pointers to recommended reading for learning  $\LaTeX$ .

The remaining chapters of this guide contain conventions and recommendations that will help you create a visually appealing and coherent thesis.

## 1.1 A Quick Welcome

Welcome to this LaTeX thesis template guide.<sup>1</sup> This template has been created mainly for students who want to submit a high-quality thesis to the Chair of Privacy and Security in Information Systems. The design of the template and the recommendations in this guide reflect, at least to some degree, the personal taste of members of the chair. Our students can use the template without any changes.

The template and the guide are, however, available under an open license (cf. Sect. ??). If you want to use the template for a thesis submitted at a different department or organization, feel free to make changes at your discretion.<sup>2</sup>

1: It is based on the guide of the *MastersDoctoralThesis* template. The original text has been revised and extended. *MastersDoctoralThesis* is available at <https://www.latextemplates.com/template/masters-doctoral-thesis>.

2: Redistribution of this guide and the template is subject to the details outlined in Sect. ??.

## 1.2 Learning LaTeX

If you are new to LaTeX, we recommended to carry on reading this section.

If you are writing a thesis and its subject is technical, then creating it in LaTeX is highly recommended. LaTeX allows you to focus on the essential

writing without having to worry over formatting or wasting time arguing with your word processor.

LaTeX can professionally typeset documents that run to hundreds or thousands of pages long. With simple mark-up commands, it automatically sets out the table of contents, margins, headers, and footers and keeps the formatting consistent and visually pleasing. One of its main strengths is the way it can easily typeset mathematics, even *heavy* mathematics.

LaTeX is not a WYSIWYG (What You See is What You Get) tool, unlike word processors such as Microsoft Word or Apple's Pages. Instead, a document written for LaTeX is a simple, plain text file that contains *no formatting*. LaTeX is a „mark-up“ language (like HTML): You tell the LaTeX processor about the desired formatting in simple commands amongst the text. For instance, if you want to use *italic text for emphasis*, you write the `\emph{text}` command and put the text you want in italics in between the curly braces.

### 1.2.1 Introduction to LaTeX

If you are new to LaTeX, there is an excellent eBook, „The Not So Short Introduction to LaTeX“ (aka „lshort“), which is freely available online.

<http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf>.

To learn how LaTeX works, we recommend creating small test documents to reduce complexity. You can also learn from others by looking at other templates.

**A Short Math Guide for LaTeX** If you are writing a technical or mathematical thesis, then you may want to read the document by the AMS (American Mathematical Society) called „A Short Math Guide for LaTeX“ under the „Additional Documentation“ section towards the bottom of the page.

<http://www.ams.org/tex/amslatex.html>

**Common LaTeX Math Symbols** LaTeX supports many mathematical symbols and it would take a great effort to memorize the commands for all of them. Sunil Patel's website shows the most common ones. You can use Sunil's page as a reference or crib sheet. The symbols are rendered as large, high-quality images, so you can quickly find the LaTeX command for the symbol you need.

<http://www.sunilpatel.co.uk/latex-type/latex-math-symbols/>

### 1.2.2 LaTeX Distributions

The LaTeX distribution is available for Windows, Linux, and macOS. On Windows and Linux systems, the recommended distribution is T<sub>E</sub>X LIVE (<https://www.tug.org/texlive/>). The package for macOS is called M<sub>A</sub>C T<sub>E</sub>X (<http://www.tug.org/mactex/>) and it contains all the applications you need – bundled together and pre-customized – for a fully working LaTeX environment and workflow. M<sub>A</sub>C T<sub>E</sub>X includes a custom dedicated LaTeX editor called T<sub>E</sub>X SHOP for writing your ‘.tex’ files and B<sub>I</sub>B D<sub>E</sub>SK, a program to manage your references and create your bibliography section.



## 1.3 Required Software

To use the PSIThesis template, you need a working LaTeX installation with **LuaLaTeX**, **biblatex**, and **biber**.<sup>3</sup> Usually, these tools are available in a typical LaTeX installation. We have tested the template with TeX Live 2019 in December 2019.

Use a current version of TeX Live that is available at <https://www.tug.org/texlive/>. The TeX Live version that is part of Debian Linux may contain an outdated version of `lualatex`. If you are using an outdated version of `lualatex`, compilation may fail with **error: (vf): invalid DVI command (i)**. This is a known bug<sup>4</sup> in old versions of `lualatex` that is triggered by the `microtype` package. In this case we recommend upgrading to a current version of TeX Live.

Moreover, there is known layout issue with old versions of the `caption` package. Version 3.4 of that package (released on 2019-09-11) is known to work well.<sup>5</sup> You can update your TeX Live installation by running `tlmgr`.

**Using Overleaf and XeTeX** As of December 2019, the template does not work with <https://www.overleaf.com>. Overleaf uses the outdated version `lualatex 1.07` from TeX Live 2018, which is subject to the aforementioned bug that prevents compilation of documents that use the `microtype` package.

The template includes `microtype`, not only because of the better typography, but also because it uses `microtype`'s command `\textls{text}` to change the letter spacing of the uppercase text on the title page.

You *can* use the template with Overleaf if you remove the line that loads the `microtype` package in `setup.tex`. Moreover, you will have to remove all calls to `textls`.

Another option is typesetting the template with XeTeX. To compile the template with XeTeX, you have to remove the line that loads the package `luainputenc` from `setup.tex` as well as all calls to `textls`.

3: We have compiled this guide with TeX Live 2019 (LuaLaTeX 1.10.0, biber 2.14).

4: <https://de.comp.text.tex.narkive.com/fC1xfeb2/lualatex-microtype-error-vf-invalid-dvi-command-1>

5: Check the version of `caption` in the log file that is created by LuaLaTeX during compilation.

## 1.4 Getting Started with the Template

Once you are familiar with LaTeX, you should explore the directory structure of the template (cf. Abschnitte 1.4.1 und 1.4.2). Before you start to make changes, we recommend you to compile this guide on your own machine (cf. Abschnitt 1.4.3). If there are no errors, it is time to place your details into the THESIS INFORMATION block of the `main.tex` file (cf. Abschnitt 1.4.4). You will also have to make some changes to the file `misc/titlepage.tex`, which sets up the title page.

Additional features of the template are described in ??.

### 1.4.1 Folder Structure

This template comes as a single ZIP file that expands out to several files and folders. The folder names are mostly self-explanatory:

A typical structure looks like this:

- 4 Chap. 1: Introduction RELEVANZ VON PRIVATSPHÄRE UND SICHERHEIT IN DER HEUTIGEN ZEIT - EINE EINLEITUNG
- ▶ Chap. 2: Background information
- ▶ Chap. 3: Experimental setup
- ▶ Chap. 4: Implementation considerations
- ▶ Chap. 5: Presentation of results
- ▶ Chap. 6: Discussion of results & limitations
- ▶ Chap. 7: Conclusion and future directions

This chapter layout is specialized for an experimental thesis; your thesis may be different.

**Appendices** – this is the folder where you put the appendices. Each appendix should go into a separate `.tex` file. You have to include your appendix files in `main.tex`.

**Chapters** – this is the folder where you put the thesis chapters. Each chapter should go into a separate `.tex` file that is included from `main.tex`.

**Examples** – this folder contains a Python script to generate a figure used in this guide. You do not need that folder for your thesis.

**Figures** – this folder contains all figures for the thesis. These are the final images that will go into the thesis document.

Two additional folders contain files that are internally used by the template. The folder **fonts** contains the TTF and OTF files of the template's fonts, the folder **misc** contains `setup.tex`, `titlepage.tex`, and the logo of University of Bamberg.

### 1.4.2 Files

Most of the template's files are plain text, and you can see their contents in a text editor. Important files are:

**literature.bib** – This is a BibTeX file that contains all the bibliographic information for literature that you cite in the thesis. You can write it manually, but there are reference manager programs available that will create and manage it for you. Bibliographies in LaTeX are a subject of their own, and you may need to read about BibTeX before starting with this.

**main.pdf** – This is your typeset thesis created by LaTeX. It is part of the template's ZIP file. When you compile the template, you should get an identical version.

**main.tex** – This is the file that you tell LaTeX to compile to produce `main.pdf`. It contains the framework and constructs that tell LaTeX how to layout the thesis. It contains many comments that explain the purpose of each line of code. Fill in your details into the THESIS INFORMATION block.

**titlepage.tex** – This file creates the titlepage. In its initial form, several elements (e. g., displaying supervisor) are commented out. This is because the initial content of `titlepage.tex` sets up the title page of the PSIThesis Guide. Please check the content next to the TODO markers and remove the comments as instructed.

**PSIThesis.cls** – This is the class file that tells LaTeX how to format the thesis. You should not have to make changes here.

**setup.tex** – This file loads and sets up additional LaTeX packages. It changes some defaults of the MastersDoctoralThesis, on which this template is based, and controls the layout of the thesis. If you want to need the layout, you should do that here.

During compilation, LuaLaTeX and biber will create additional auxiliary files such as `main.aux`, `main.bbl`, `main.aux`, `main.blg`, `main.lof`,

`main.log`, `main.lot`, and `main.out`. The auxiliary files can be ignored or deleted. They will be regenerated as needed.

### 1.4.3 Compiling the PDF

You have to compile this template with `lualatex` (or `XeTeX`, cf. Sect. 1.3). Using `pdfLaTeX` is not possible, because the template uses TTF and OTF fonts.

On Windows, you can use the TeXworks application for compilation. To obtain the final PDF, you have to compile `main.tex` with `lualatex`, then execute `biber`, and once more compile `main.tex` with `lualatex`.

On Linux and macOS, you can use the provided **Makefile**.<sup>6</sup> Just navigate to the “en” directory and enter `make` in a terminal. Running `make` will automatically call the programs `lualatex` (which creates the PDF) and `biber` (which is used to compile the bibliography).

6: Alternatively, you should be able to compile the thesis by executing `latexmk -lualatex -pdf main.tex`.

The `make` command keeps track of changes in your source files. If you add additional files that should be tracked for changes, you should edit the list of files at the top of the `Makefile`. Otherwise, `make` may refuse to compile a new version because it believes that `main.pdf` is already up to date. In this case, a call to `make clean` will help: It removes all files generated during compilation. After that, a call to `make` will regenerate them, including `main.pdf`.

We haven’t prepared the template to be used with the convenient LaTeX editor LyX. LyX hides the LaTeX code from authors and offers a user interface, which resembles a word processor. If LaTeX code puts you off, check out LyX and start writing there. Eventually, you can still export the LaTeX source code and copy and paste it into the PSIThesis template. Be sure to reserve some days to debug compatibility issues.

<https://www.lyx.org>

### 1.4.4 Filling in Your Information in *main.tex*

You will need to personalize the thesis template by filling in your details in `main.tex` with a text editor or your favorite LaTeX environment.

Open the file and scroll down to the third large block titled *THESIS INFORMATION*. You will see entries for *University Name*, *Department Name*, etc. Fill out the information about yourself, your group, and institution.<sup>7</sup> You can also insert web links; if you do, make sure you use the full URL, including the `http://` for this. If you don’t want these to be linked, simply remove the `\href{url}{name}` and only leave the name.

7: If you write a thesis at the PSI chair, you can keep the defaults.

Next, open the file `misc/titlepage.tex`. Remove and add the comments as instructed by the TODO notes.

When you have done this, save all changed files and recompile `main.tex`. All the information you filled in should now be in the PDF. You can now begin writing your thesis!

### 1.4.5 More Information on *main.tex*

The `main.tex` file contains the structure of the thesis. There are plenty of written comments that explain what pages, sections, and formatting the LaTeX code is creating. Each major document element is divided into commented blocks with titles in all capitals to make it obvious what the following bit of code is doing. Initially, there seems to be a lot of LaTeX code. Most of that code takes care of the formatting of the thesis, so you don't have to worry about it.

Begin by checking that your information on the title page is correct. For the thesis declaration, your institution may insist on something different than the text given. If this is the case, replace the text in the *DECLARATION PAGE* block.

After that, you can insert a page with a quote (disabled by default).

Next up is the abstract page, which concisely summarizes your work.

After the abstract you can insert an acknowledgments page (disabled by default). You can use this space to write about all the people who you wish to thank.

The table of contents and the list of figures and tables are taken care of for you.<sup>8</sup> The next pages are optional: a list of abbreviations, a list of the physical constants and numbers, and a list of mathematical symbols. The next optional page contains a one-line dedication.

After the definitions of the lists, there is a block that includes all the individual chapters. Each chapter should be saved in a separate file and put into the *chapters* folder. Uncomment the respective lines (delete the % character) as you add chapters to your thesis. Similarly for the appendices, uncomment the respective lines as you need them. Appendices should be saved in the *appendices* folder.

The next block sets up the bibliography. The template uses the bibliography style *alpha*. The alpha style creates reference labels that contain the first letters or initials of authors and a two-digit number for the year such as [Hintz02].

## 1.5 Your Turn Now

The easiest way to start your thesis is replacing text in the existing files. You might want to keep copies of the `.tex` to look up the source code as you move on.

We hope that this template helps you get up to speed. The tedious task of setting up the structure has been taken care of for you. It's now your job to create the content.

Good luck and happy writing!

<sup>8</sup>: If you write a thesis at the PSI chair, your thesis should only contain a table of contents. Therefore, all remaining lists are disabled by default.

## 2 | Conventions

An essential property of a long document, such as a thesis, is consistency. It is, however, challenging to keep track of terminology, style, and structure over an extended period.

Todo notes like this one can help with consistency. You can hide all todo notes before printing the final version by adding *final* to the documentclass.

Following certain conventions can help you achieve a consistent result. This chapter summarizes conventions and recommendations for effective thesis writing. Appendix A contains additional guidelines, while Appendix B provides more information on designing figures and tables.

This chapter contains only selected recommendations. For a more comprehensive list that also includes links to useful tools, consider <https://github.com/TheHairyJ/StudentResources/blob/master/Writing.md>.

Having a signpost paragraph before the first section in a chapter is considered good style.

### 2.1 Links and References

You will most certainly include links and references in your thesis.

#### 2.1.1 Links to Websites

Special care is necessary when you include links in your thesis. URLs are generally embedded using the `\url{}` command. Using this command allows LaTeX to break URLs at the end of a line. Moreover, the URLs will become clickable.

It is a frequently asked question whether one should embed *all* links as proper references (with a dedicated entry in the bibliography) or not. We recommend to follow these principles:<sup>1</sup>

- ▶ **Use a link** in the text (or a footnote when it is a long link) when the primary purpose is to *provide a reference to a particular location*. Examples: websites of services or products or weblogs; when the purpose is to make readers aware of its existence as a whole.
- ▶ **Use a reference** when the purpose is to *refer to or discuss the content* on a website. Note that bibliographic references should generally mention the author and the publication date (at least the year). If you cannot identify the author, you can resort to using the name of the respective organization instead (use an additional pair of curly braces in BibTeX – otherwise, LaTeX will misinterpret the name as first name and last name). Example: linking to a *particular* blog post.

1: In the interest of ease of use, we neglect the principles in this guide.

2: See also: Link Rot in Wikipedia

3: We have archived all websites mentioned in this guide. In the interest of readability, we omit the archival remark after links.

**Link Rot** Many links become invalid at some point. Content may change or move to different URLs. Sites may go out of service altogether. This phenomenon is called *link rot*, and it has become an issue for academia.<sup>2</sup>

Therefore, we ask you to **archive all websites** whose URLs you provide using THE WAYBACK MACHINE of the Internet Archive, which is available at archive.org. This preserves the content of a website at the given point in time and makes it permanently available in the Internet Archive.

You should inform the reader about the availability of an archived version. We recommend to provide the *original URL* and add “(archived at [date])” after the URL.<sup>3</sup> Alternatively, you can just provide the *archive.org* URL of a location. This practice applies to URLs in the main text, in footnotes, and in references.

Archiving is not necessary for academic papers that have a Digital Object Identifier (DOI), have an ISBN/ISSN, or are available on preprint servers such as arxiv.org.

### 2.1.2 Citation and References

Whenever possible, you should **cite the primary reference**, i. e., the seminal paper that introduced a particular concept. When there is no fitting (seminal) paper, you can also choose to cite a well-known academic textbook that covers the topic. No citation is necessary for widespread knowledge, for instance, in the following sentence: “Many web sites rely on passwords for user authentication.”

Most of the time, **paraphrasing content is preferred** over literally citing text with quotation marks. The most expressive way to integrate references to literature is to insert the labels right behind key terms or author names:

EMV systems [anderson\_ross\_emv:\_2014] are used to secure payment cards. Murdoch et al. [murdoch\_steven\_j.\_chip\_2010] have shown that EMV systems are broken.

Alternatively, you can append the label to the end of a sentence or sentence fragment. In this case, the label must come *before* the punctuation mark (such as a comma or period). An example is this sentence [Hintzo2].

When you paraphrase longer pieces, it is considered poor style to add the label at the end of a paragraph that paraphrases content from the literature. Instead, you should make this explicit at the beginning of a paragraph, e. g., like this:

The following paragraph describes the foo system [kou\_weidong\_secure\_2003].  
...

This approach is also suitable to indicate more copious amounts of paraphrasing:

Before we discuss the limitations of the foo system, we present its main functions in this section [kou\_weidong\_secure\_2003].  
...

When you cite from books or long papers, you can insert the page number like this: `\cite[p. 5]{label}`, which results in [kou\_weidong\_secure\_2003].

When you cite multiple references in one spot, you should include them in one `\cite` command:

The FOO approach appears in a wide variety of applications [murdoch\_steven\_j.\_chip\_2010; anderson\_ross\_emv:\_2014; kou\_weidong\_secure\_2003].

Note, however, that the result is not very informative.<sup>4</sup> The following version provides much more information:

The FOO approach appears in a wide variety of applications, such as qux systems [murdoch\_steven\_j.\_chip\_2010], baz systems [anderson\_ross\_emv:\_2014], and – much earlier – in bar readers [kou\_weidong\_secure\_2003].

4: Source of this advice: <https://nhigham.com/2014/12/22/more-tips-on-book-and-thesis-writing/>

A remark on style: **Do not treat references as nouns.** You should, therefore, avoid “[murdoch\_steven\_j.\_chip\_2010] shows that many EMV systems are broken ...” The label becomes less distracting like this: “Murdoch et al. show that EMV systems are broken [murdoch\_steven\_j.\_chip\_2010].”

**BibTeX Snippets** For many publications, you will find BibTeX snippets online, for instance, in the ACM Digital Library or on <https://dblp.org>. Using these snippets is generally recommended. Unfortunately, the quality of publicly available BibTeX snippets varies a lot. You will have to edit them to create a consistent bibliography.

For instance, make sure that the name of a particular conference is always spelled consistently in all entries. Moreover, you should **remove superfluous information** such as precise dates, multiple occurrences of the year, and the location of the conference.<sup>5</sup> An example of a poorly styled reference is [BuchananRSSo8], a cleaned up item is [DietrichKBF18].

5: We have not cleaned up all items in the bibliography of this guide.

A common issue is the **capitalization of words in titles**. Whether you use sentence case or title case is up to you – as long as you stick to the choice. You may have to enclose the whole title of a bibitem in double curly braces to preserve capitalized letters. Alternatively, you can only enclose capitalized words or abbreviations in curly braces to protect them.<sup>6</sup> Consider the following example, which ensures that TCP remains in uppercase:

```
@inproceedings{..., title = "A new {TCP}-based System", ...}
```

6: The template will print the items exactly as they are defined in the BibTeX file, i. e., you will probably not have to worry about abbreviations.

## 2.2 Side Notes, Margin Notes, and Footnotes

The template offers you the option to use side notes, margin notes, and footnotes. We **do not recommend footnotes** (`\footnote`) because the reader’s eye has to travel long distances. You should use **side notes** (`\sidenote`) as a replacement instead of footnotes.



You can also use **margin notes** (`\marginnote`). In contrast to side notes, margin notes are not numbered. By default, margin notes are set flush left or flush right (i. e., as close as possible to the main text), while side notes are justified.

Margin notes can be used to add remarks to a paragraph that are not closely related to a particular sentence or word. Moreover, you can use margin notes for links whose relationship with the main text is obvious. Finally, you can use margin notes as a means of emphasis: placing important keywords in the margin captures the reader's attention. Whatever you choose to use margin notes for, be consistent.

Like footnotes side notes are either inserted directly after the particular word<sup>7</sup> they refer to or after the punctuation if they relate to the whole clause or sentence.<sup>8</sup> Side notes should be full, descriptive sentences (beginning with a capital letter and ending with a full stop).

Using a mixture of side notes, margin notes, and footnotes creates an inconsistent appearance and is therefore discouraged. If you decide to mix side notes and margin notes, consider changing the layout of margin notes to *justified* for better consistency. We have prepared commands for the necessary changes in `setup.tex` (look for the comment "justified margin notes").

One final remark on margins: If you cannot find any relevant content to put into the margin, leave it empty. We will use the empty space during grading the thesis for our comments.

7: This is a side note after a word.

8: Consider, e. g., the Chicago Manual of Style: „A note number should be placed at the end of a sentence or clause. The number follows any punctuation mark except the dash, which it precedes. It follows a closing parenthesis.“

## 2.3 Tables, Figures, and Listings

You should use tables, figures, and (optionally) listings to illustrate your writing. This section explains how these floating elements are included in the source code.

### 2.3.1 Tables

Tables are an important way of displaying your results in a concise way. Tabelle 2.1 is an example of a table showing experimental results. This table was generated with the following LaTeX code:

```
1 \begin{table}
2 \caption{The effects of treatments X and Y on the ...}
3 \label{tab:treatments}
4 \footnotesize
5 \centering
6 \begin{tabular}{r r r}
7 \toprule
8 & \multicolumn{2}{c}{\tabhead{Observed results}} \\ \cmidrule(lr){2-3}
9 \tabhead{Group} & \tabhead{Treatment X} & \tabhead{Treatment Y} \\
10 \midrule
11 1 & 0.2 & 0.8 \\
12 2 & 0.17 & 0.7 \\
13 3 & 0.24 & 0.75 \\ \addlinespace
```

Due to the many examples and varying styles, this section is visually disturbing. Avoid such a wild mixture in your thesis.



**Tabelle 2.1:** The effects of treatments X and Y on the four groups studied.

Group	Observed results	
	Treatment X	Treatment Y
1	0.2	0.8
2	0.17	0.7
3	0.24	0.75
4	0.68	0.3
5	0.61	0.9
6	0.18	0.1

```

14 | 4 & 0.68 & 0.3\\
15 | 5 & 0.61 & 0.9\\
16 | 6 & 0.18 & 0.1\\
17 | \bottomrule
18 | \end{tabular}
19 | \end{table}

```

As shown in Tabelle 2.1, **column heads** should use sentence-style capitalization, i. e., do not use *title case* as you would in section headings. In general, we recommend using a slightly smaller font size in tables than in the main text. The text in the example table uses `footnotesize`.

Tables have **captions** that always appear *above* the `tabular` environment. You must **reference all tables** in the main text at least once. To reference a table you use the command `\ref{<label>}`, where `<label>` corresponds to a label defined within the table environment. See `chapter2.tex` for an example of the label and citation (e. g., Table 2.1).

In the PSI Thesis template, tables use the *booktabs* style, which **avoids visual clutter such as vertical lines**. If you want to group columns, do it in the headers using `\cmidrule`.

**Horizontal lines** should be used sparingly as well. Instead of horizontal lines, you should group consecutive rows with additional vertical space (using `\addlinespace`, cf. Table 2.1). You can also use bold print to highlight especially relevant parts.

Note that Table 2.1 is not laid out ideally: the numbers are given with different precision, which disturbs their alignment. Besides, strictly aligning all numeric columns to the right is not always appropriate. Centered alignment makes more sense here (cf. Table 2.2). For a step-by-step illustration of cleaning up tables, watch the presentation entitled “Less is more (attractive)”. Moreover, consider the guidelines on organizing information in Sect. ?? in the appendix.

<https://www.darkhorseanalytics.com/blog/clear-off-the-table>

Example of more complex tables are Tables 2.3 and 2.4. Table 2.4 shows how to build *wide tables* that span the margin and the text. If you need to create similar tables, feel free to re-use the code from `chapter2.tex`.

If you are in a hurry, you may find <https://www.tablesgenerator.com> and <https://www.latex-tables.com> useful. You can also use the convenient LaTeX editor LyX (<https://www.lyx.org/>) to build tables and export their source code.

**Tabelle 2.2:** The effects of treatments X and Y on the four groups studied.

Group	Results	
	Treatment X	Treatment Y
1	0.20	0.80
2	0.17	0.70
3	0.24	0.75
4	0.68	0.30
5	0.61	0.90
6	0.18	0.10

**Tabelle 2.3:** A more complex table comparing experimentally obtained results for five systems.

OS	Tool	A: Usability			B: Security				C: Privacy			
		A1	A2	A3	A4	B1	B2	B3	C1	C2	C2	C4
Windows	Bora	●	●	▲	▲	●	■	▲	▲	▲	▲	■
	Dicks	▲	●	●	●	●	●	▲	■	■	■	▲
Android	NEW++	▲	●	●	●	●	●	●	▲	▲	▲	▲
macOS	P2I	▲	▲	■	■	●	●	▲	.....	no results	.....	.....
iOS	Carmadillo	▲	▲	●	●	■	▲	▲	▲	...no results	...	...

**Further Reading** Creating good tables is a challenge on its own. Recommended readings:

- ▶ Nick Higham. Better LaTeX Tables with Booktabs (<https://nhigham.com/2019/11/19/better-latex-tables-with-booktabs/>),
- ▶ Lapo Filippo Mori. Tables in  $\text{\LaTeX}$ : Packages and Methods (<http://tug.org/pracjourn/2007-1/mori/mori.pdf>),
- ▶ Markus Püschel. Small Guide to Making Nice Table (<https://inf.ethz.ch/personal/markusp/teaching/guides/guide-tables.pdf>), and
- ▶ Adrian P. Robson.  $\text{\LaTeX}$  Table Hints and Tips (<https://www.cl.uni-heidelberg.de/courses/ss19/wissschreib/material/tableTricks.pdf>).

## 2.3.2 Figures

This section provides general advice and pointers on designing effective figures. After that, it explains the layout options offered by this template.

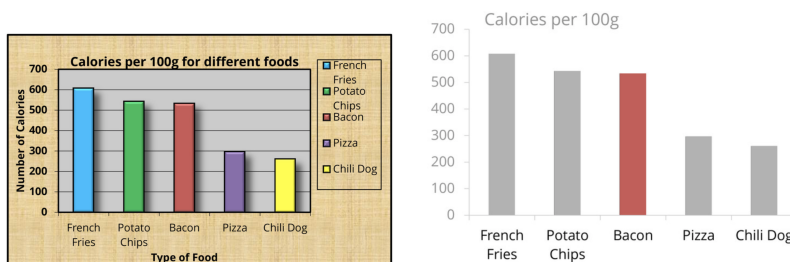
### 2.3.2.1 Effective Figure Design

There will hopefully be many figures in your thesis. Creating effective and visually pleasing figures is challenging.

Ideally, you draw all figures yourself to ensure that they use a **consistent graphical language**, which includes colors, fonts, text sizes, line styles, arrowheads, fill styles, padding, margins, and the radius of rounded corners. Ensure to align elements properly and to provide sufficient

**Tabelle 2.4:** Overview of related literature on the topic of the thesis.

Class	No.	Description	Authors	Year	Relevant
A	1	Northern Wheatears had higher reproductive success in higher vegetation height	Arlt and Part	2007	●
	2	Mallards that avoided wetlands with large expanses of open water had higher reproductive success	Bloom et al.	2013	
	3	American Redstarts that occupied wet forest habitat in the winter raised more offspring than conspecifics occupying other habitats in the winter	Norris et al.	2003	●
B	4	Great Tits nesting in mature woodland produced larger broods than conspecifics nesting in gardens and hedgerows	Riddington and Gosler	1995	
	5	Reduction in winter stubble has led to a reduction in Reed Bunting survival rate	Peachet al.	1999	●
	6	Fledgling Ovenbird survival increased with vegetation structure	King et al.	2006	●
C	7	Daily nest survival of eight forest species was positively related to nest distance from the forest edge and nest height	Newmark et al.	2011	

**Abbildung 2.1:** Removing unnecessary clutter.

whitespace.

When it comes to figures and data plots, **less is more!** According to Edward Tufte,<sup>9</sup> you should remove all non-data ink and redundant data ink, within reason, to increase the data to ink ratio and create a sound graphical design. This means, among others, that you should avoid shadows and 3D effects.

9: Edward Tufte (1983): The Visual Display of Quantitative Information.

Watch the illustrative presentation entitled “Remove to improve.” The plots in Fig. 2.1 (taken from linked website) demonstrate the benefits of removing unnecessary clutter. Find more guidelines in Appendix ??.

<https://www.darkhorseanalytics.com/blog/data-looks-better-naked/>

Make sure that your figures work when **printed in monochrome**, i. e., you shouldn’t rely on the colors too much. If you do use colors, use the same color palette in all figures, and ensure that readers with color blindness can differentiate all colors.

If you present plots of experimental results, use a tool that allows you to automatically **recreate plots**. To this end, you recommend to write scripts that create the plots based on raw data. Another benefit is that you will be able to change the design of all plots with little effort. Common tools are Python’s MATPLOTLIB (consider using SEABORN), R’s GGPLOT2, and GNUPLLOT. Make sure to export your plots as PDFs.

<https://matplotlib.org>, <https://seaborn.pydata.org>, <https://ggplot2.tidyverse.org>, and <http://www.gnuplot.info>




---

**Abbildung 2.2:** A black cat (Source: <https://www.stockvault.net/photo/147894/little-cat-vector> (“non-commercial license”).

### 2.3.2.2 Figure Layout Options

Place your figures in the `figures` folder, which allows you to omit the directory name in the `\includegraphics{filename}` command. The following code produces Fig. 2.2:

```

1 | \begin{figure}[t] % [t]: place at top of page (recommended)
2 | \centering
3 | \includegraphics[width=0.75\textwidth]{cat.pdf}
4 | \decoRule
5 | \caption[A black cat]{A black cat (Source: \url{https://www.stockvault↵
   |   .net/photo/147894/little-cat-vector}, ``non-commercial license'')↵
   |   .}
6 | \label{fig:cat}
7 | \end{figure}

```

You can also use the custom command `\image` for inserting a figure:

```

1 | \image[h]{\textwidth}{A black cat}{An image of a black cat.}{cat.pdf}

```

This command will produce the same result as the previously shown commands. For further information on the usage of the custom commands you should take a look at the extensive documentation in `commands.tex` in the `misc` folder.

Figures should appear on the page where they are referenced first or on one of the subsequent pages. The recommended **figure placement** is the top of the page (denoted by `[t]`). Don't worry about figures not appearing exactly where you write them in the source. Sometimes there is not enough room to fit a figure directly where it should go (in relation to the text) and so LaTeX puts it at the top of the next page.

Every figure needs a **descriptive caption and a label**. Figure captions must always appear below the included graphics file within the `figure` environment.

Every figure **must be referenced** in the text at least once, either in parentheses (cf. Fig. 2.2) or explicitly in the sentence: Figure 2.2 shows an electron. Refer to figures using the abbreviation `Fig.` followed by a protected space (`\`) and `\ref`. Exception: write `Figure` if it is the first word of a sentence. Note `Fig.` and `Figure` are capitalized when they are used as part of a reference.

The `\caption` command contains two parts, the first part, inside the square brackets<sup>10</sup> is the title that will appear in the *List of Figures*, and so should be short. The second part in the curly brackets should contain the longer and more descriptive caption text.

10: Theses at PSI usually do not have a List of Figures. You can, therefore, omit the part in square brackets.

The `\decoRule` command is optional and simply puts a horizontal line below the image. Such a line can be useful with figures that are not symmetrical or whose exterior is uneven at the bottom. There is also the more flexible variant `\decoRuleFlex{dim}`, where `dim` determines the length of the rule, e. g., `1.0\textwidth`.

Resize your figures, ideally consistently, to an appropriate size, e. g., a fraction of `\textwidth`. Check that the font size (after scaling) is consistent. This advice is especially important when you include figures with different aspect ratios.

LaTeX is capable of using images in PDF, JPG, and PNG format. Whenever possible, use **vectorized figures** (PDF). PDFs provide sharper results at smaller file sizes. If you *have* to use pixel graphics, create them with a sufficiently high resolution (at least 300 dpi).

**Wide Figures** You can also add wide figures that span the full width of a page. These should be placed at the top of the page. The following code creates the example figure (Fig. 2.3):

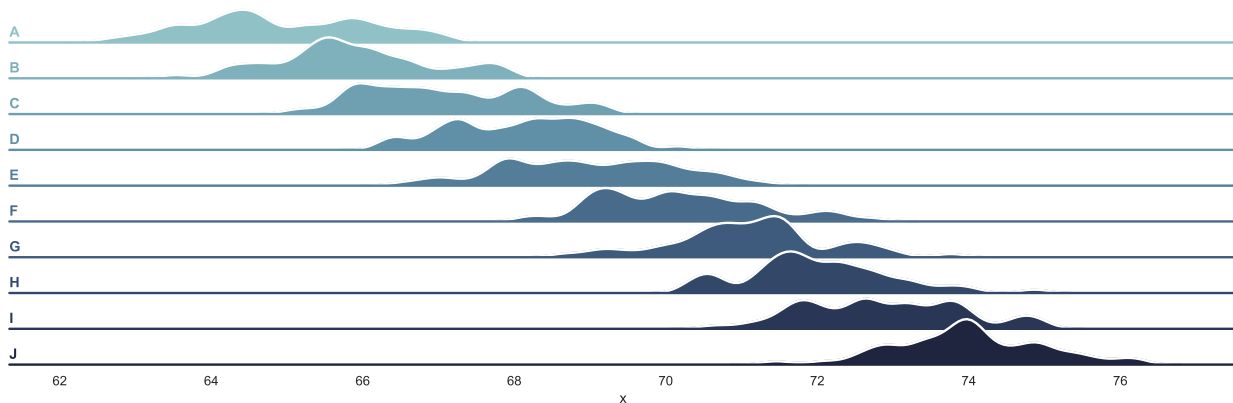
```
1 | \begin{figure*}[t] % place at top
2 | \includegraphics[width=\widefigurewidth]{plot.pdf}
3 | \caption{\label{fig:widefig}}
4 |   This is a full-width figure. Lorem ipsum dolor sit amet, ...
5 | }
6 | \end{figure*}
```

You can also use the custom command `wideimage` for inserting a figure:

```
1 | \wideimage[h]{plot.pdf}{This is a full-width figure. Lorem ipsum dolor↵
   |   sit amet, ...}{widefig}
```

This command will produce the same result as the previously shown commands. For further information on the usage of the custom commands you should take a look at the extensive documentation in `commands.tex` in the *misc* folder.

Occasionally, LaTeX misplaces wide figures on the **horizontal axis**. For instance, figures may end up partly outside of the page instead of being



**Abbildung 2.3:** This ridge plot is an example of a full-width figure (Source: `plot.py` in the *examples* folder, obtained from [https://seaborn.pydata.org/examples/kde\\_ridgeplot.html](https://seaborn.pydata.org/examples/kde_ridgeplot.html)). Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

properly aligned with the text block. Often, these problems happen only sporadically. Compiling `main.tex` again with a single invocation of `lualatex` will fix the layout.

**Side-by-Side Figures** Sometimes it is desirable to show multiple figures next to each other. There are several approaches for that, e. g., using the `subfigure` package. In many cases, however, a comprehensive subfigure support is not needed. A lightweight approach as shown in Fig. 2.1 may be sufficient. This result is achieved with the following code:

```

1 | \begin{figure}[t]
2 | \centering
3 | \includegraphics[width=0.48\textwidth]{barplot-before}%
4 | \hspace{\fill}%
5 | \includegraphics[width=0.48\textwidth]{barplot-after}
6 | \sidecaption{\label{fig:barplot}}%
7 |   Removing unnecessary clutter.][-2\baselineskip]
8 |   % using optional last parameter: negative offset to correct vertical
9 |   % position of caption (this caption is two lines high)
10 | \end{figure}

```

You can also use the custom command `twoimages` for inserting two figures next to each other:

```

1 | \twoimages[h]{barplot-before}{barplot-after}{Removing unnecessary
   | clutter.}{barplot}

```

This command will produce the same result as the previously shown commands. For further information on the usage of the custom commands you should take a look at the extensive documentation in `commands.tex` in the *misc* folder.

Figure 2.1 uses a **side caption** (`sidecaption`). Whether you use side captions or not is up to you. Just ensure to place all captions consistently, i. e., either in the margin or above or below floats for tables and figures, respectively. Note that `sidecaption` does not work with floating listings.

**Margin Figures** Sometimes, it makes sense to place figures in the margin. Margin figures work best for figures that are simple and unobtrusive. They are a useful mechanism to include figures that illustrate concepts and for graphs that are meant to give an overall impression. Do not use margin figures for figures that convey essential results.

You can create margin figures like Fig. 2.4 with the following code:

```
1 \begin{marginfigure}[-1\baselineskip] % move figure up by 1 line
2 \includegraphics[width=0.6\marginparwidth]{cat.pdf}
3 \caption{\label{fig:marfig}This is a margin figure with a reasonably ↵
   short caption (Source cf. Fig.~\ref{fig:cat}).}
4 \end{marginfigure}
```

You can also use the custom command `marginimage` for inserting a figure in the margin:

```
1 \marginimage[-1]{cat.pdf}{This is a margin figure with a short caption↵
   .}{marfig}
```

This command will produce the same result as the previously shown commands. For further information on the usage of the custom commands you should take a look at the extensive documentation in `commands.tex` in the *misc* folder.

**Margin Tables** You can also place tables into the margin. Due to the limited space of the margin the content of a margin table should be carefully considered. Otherwise the table will clip into the main body or overflow over the page. In general, we recommend to create the table with the full width of the margin, otherwise the margin layout may become ragged. Moreover, we reduce the font size of margin tables to *footnotesize* so that they do not attract too much attention. You can create a full-width margin table like Table 2.5 with the following code:

```
1 % left-aligned table columns with automated line breaks
2 \newcolumntype{L}{>\RaggedRight\arraybackslashX}
3 \begin{marginfigure}[1\baselineskip] % move figure down by 1 line
4 \caption{\label{tab:martab}This is a margin table with a short caption↵
   that spans two lines.}
5 \footnotesize
6 \begin{tabularx}{\textwidth}{Lcc}
7 \toprule
8 & \multicolumn{2}{c}{\tabhead{Observed results}} \\ \cmidrule{2-3}
9 \tabhead{Group} & \tabhead{X} & \tabhead{Y} \\ \midrule
10 & & & \\
11 1 & 0.20 & 0.81 \\
12 2 & 0.17 & 0.70 \\
13 3 & 0.24 & 0.75 \\
14 \bottomrule
15 \end{tabularx}
16 \end{marginfigure}
```



**Abbildung 2.4:** This is a margin figure with a reasonably short caption (Source cf. Fig. 2.2).

**Tabelle 2.5:** This is a margin table with a short caption that spans two lines.

Group	Observed results	
	X	Y
1	0.20	0.81
2	0.17	0.70
3	0.24	0.75

11: If you have Python, you can consider the more modern package `minted`, which uses `pygments` for syntax highlighting.

12: As of now, the template does not offer wide listings that span the text and the margin.

### 2.3.3 Listings

If you are new to LaTeX, we recommend to use the *listings* package for code listings.<sup>11</sup> With the template’s default monospace font, lines can have up to 70 characters. Longer lines are automatically wrapped. An arrow at the end of the line indicates the line wrapping. Format your listing in such a way that the number of wrapped lines is low to improve readability.

You can create floating listings, which behave very much like floating figures and tables, i. e., they have a caption and can be referenced (cf. Listing 2.1 for an example).<sup>12</sup> Sometimes, however, the properties of floating listings are undesirable. For short code fragments, it often makes more sense to use a non-floating listing.

Listing 2.1 has been generated with the following code:

```

1 \begin{lstlisting}[language=Python,float=t,
2   caption={This is an example of syntax highlighting of
3   Python code with a relatively long caption},label={lst:listing}]
4 import numpy as np
5
6 test = "This is a test string"
7
8 def incmatrix(genl1,genl2):
9     ...
10    return M
11 \end{lstlisting}

```

## 2.4 Mathematics

13: <http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf>

14: “A Short Math Guide to LaTeX,” available at <ftp://ftp.ams.org/pub/tex/doc/amsmath/short-math-guide.pdf>

The „Not So Short Introduction to LaTeX“<sup>13</sup> should tell you everything you need to know for most cases of typesetting mathematics. If you need more information, a much more thorough mathematical guide is available from the AMS.<sup>14</sup>

There are many different LaTeX symbols to remember, luckily you can find the most common symbols in “The Comprehensive  $\text{\LaTeX}$  Symbol List” (<http://ctan.org/pkg/comprehensive>).

You can write a numbered equation like this:

```

1 \begin{equation}
2 E = mc^2
3 \label{eqn:Einstein}
4 \end{equation}

```

This will produce Einstein’s famous energy-matter equivalence equation:

$$E = mc^2 \quad (2.1)$$

LaTeX automatically gives all equations you write equation numbers. If you don’t want a particular equation numbered, use the unnumbered form:



**Listing 2.1:** This is an example of syntax highlighting of Python code with a relatively long caption

```

1 import numpy as np
2
3 test = "This is a test string"
4
5 def incmatrix(genl1,genl2):
6     m = len(genl1)
7     n = len(genl2)
8     M = None # to become the incidence matrix
9     VT = np.zeros((n*m,1), int) # dummy variable
10
11     # compute the bitwise xor matrix
12     M1 = bitxormatrix(genl1)
13     M2 = np.triu(bitxormatrix(genl2),1)
14
15     for i in range(m-1):
16         for j in range(i+1, m):
17             [r,c] = np.where(M2 == M1[i,j])
18             for k in range(len(r)):
19                 VT[(i)*n + r[k]] = 1;
20                 VT[(i)*n + c[k]] = 1;
21                 VT[(j)*n + r[k]] = 1;
22                 VT[(j)*n + c[k]] = 1;
23
24             if M is None:
25                 M = np.copy(VT)
26             else:
27                 M = np.concatenate((M, VT), 1)
28
29             VT = np.zeros((n*m,1), int)
30
31     return M

```

$\backslash[ a^{\{2\}}=4 \backslash]$

You can also have equations in the middle of a paragraph, e.g.,  $x = \sum_{i=1}^{10} \hat{a} \cdot \frac{\alpha}{\psi} \cdot i^{2^3}$ , with this syntax:

```

1 e.\,g., \ ( x = \sum_{i=1}^{10} \hat{a} \cdot \frac{\alpha}{\psi} \cdot i^{2^3} \), with this syntax:

```

## 2.5 Structuring Your Thesis

You should break your thesis up into chapters and sections. LaTeX automatically builds a Table of Contents by looking at all the `\chapter{}`, `\section{}` and `\subsection{}` commands you write in the source. You may even think about using *subsubsections* (`\subsubsection{}`). All of these will be hierarchically numbered.

Use **(sub-)subsections** only if you use them consistently in all or at least multiple chapters. Otherwise, you should opt for a `\paragraph{}`, which structures pieces of content with bold non-numbered inline headings (examples throughout this guide).

**Avoid dangling elements** in the hierarchy: If you have a Section 1.1, you should also have (at least) Section 1.2. This rule applies to all levels of the hierarchy.

The Table of Contents is configured to only list *chapters* and *sections*. We do not recommend to include *(sub-)subsections* as this results in a very long Table of Contents, which may become difficult to read. If you do want to change the depth of the Table of Contents, you can change the value `\etocsettocdepth` in `setup.tex`.

Use **title case** in *chapter*, *section*, *(sub)section*, and *paragraph* environments. Consider, for instance, <https://capitalizemytitle.com> for common title case capitalization rules.

Within a section, you should **walk the reader through your text**:

In the following, we describe the three primitives of concept X. First, X uses the Y algorithm. ...

The second concept is Z ...

## 2.6 Typography

Use emphasis sparingly. This advice is especially true for **bold print** (`\textbf{bold print}`).<sup>15</sup> Resist the urge to use it in the main text; use *italics* (`\emph{italics}`) instead.

Note, however, that **too frequent use of italics** can also be annoying. We recommend using it to emphasize ordinary words that are used as special terms – and only at its first occurrence. Also, you should emphasize words that you would stress when reading aloud, indicating that they are especially relevant for the meaning. Do not mix italics and quotes for emphasis, because this confuses the reader.<sup>16</sup>

Generally, we recommend **avoiding scare quotes**.<sup>17</sup> Some authors use scare quotes to signal that they are using a word in a non-standard, ironic, or otherwise special sense (cf. Chicago Manual of Style). Scare quotes convey an informal tone. Moreover, they cause ambiguity, as the reader cannot be sure about the intention of the author.

You should split your content into **proper paragraphs** by adding empty lines between adjacent blocks of text in the source file. Using a mixture of paragraphs and line breaks, which you could create with `\\` at the end of a line, is strongly discouraged because this practice creates a noisy layout.

Use **thin spaces** (`\,`) in the appropriate places. For instance, write `i.\,e.`, to obtain “i. e.” (pronunciation: “that is”). The same applies to “e. g.” (pronunciation: “for example”). These two abbreviations are normally followed by a comma in American English.

**Dashes** can be used instead of colons or pairs of commas to mark off a nested clause. Use an *en dash* for that purpose – like in this example. If you cannot type an *en dash* on your keyboard, you can write two regular hyphens next to each other. LaTeX will substitute them with an *en dash*.

15: To allow for fast skimming, we use bold print liberally throughout this guide (which would not be appropriate in a thesis).

16: More on the topic “Italics or Scare Quotes?” is available at <https://sblhs2.com/2016/09/15/italics-scare-quotes/>.

17: Reasons given in “Quotes When Nothing Is Being Quoted”, which is available at <https://style.mla.org/quotes-when-nothing-is-being-quoted/>.

While we have no strict preference, we recommend using *en dashes* instead of the longer *em dashes*.

Use en dashes also for ranges, e. g., when you write something like 5–10 % (note the thin space before the % symbol).

Use a proper **minus symbol** (e. g., by using math mode like this  $-1.337$ ). Also, use a sensible number of digits after the decimal point.<sup>18</sup>

Use proper **directional quotation marks** like “these.” Directional quotation marks are created ‘‘like this’’, by using `\enquote{text}`, or by copy-and-pasting the respective Unicode characters. Note that in contrast to conventions in the German language, the closing quotation mark is placed *after* any subsequent punctuation, e. g., “like this,” and “like that.”

18: Have you noticed that the main text uses *old-style figures* for numbers, while math mode uses *lining figures*? Do not print numbers with differing figure styles close to each other (as we are doing in this section).

**Further Reading** If you speak German, consider reading TYPOKURZ (<https://zvisionwelt.wordpress.com/downloads/>), a short introduction to typographic issues. You can also browse Matthew Butterick’s website <https://practicaltypography.com>.

## 2.7 Language and Style

Language issues distract readers from the content and make it difficult to assess its merits. You should, therefore, pay close attention to language and style.

### 2.7.1 Spelling, Hyphenation, and Grammar

Ensure correct spelling throughout your text. Check your writing with a spell checker. There are special spellcheckers for LaTeX, but copy-and-pasting the text into Word may also be an option.

Ensure proper hyphenation throughout your text. You will have to intervene, for instance, when words extend into the margin of the page (creating so-called overfull hboxes). You can override LaTeX’s hyphenation rules by inserting `\-` into a word. This special character indicates a conditional hyphenation point.

Often, it makes sense to define custom hyphenation rules globally. To this end, define your custom hyphenation definitions with `\hyphenation{FORTTRAN Hyphen-a-tion}` and insert them after the `\begin{document}` clause. The example definition prevents any hyphenation of the word FORTTRAN and defines three hyphenation points for the word Hyphenation.

Oh no, an overfull hbox!

Also, check your text for common grammar issues (cf. Sect. 2.7.2).

### 2.7.2 Style

This section contains selected pieces of advice on particular aspects and typical errors. For a more comprehensive treatment, we refer the reader to the paragraph Common Bugs in Writing at the end of this section.

19: <http://hemingwayapp.com>, <https://grammarly.com>, <https://languagetool.org>, and the command-line tool (<https://github.com/devd/academic-Writing-Check>).

20: George D. Gopen and Judith A. Swan. The Science of Scientific Writing. Appeared in *American Scientist* 78(6):550-558 (Nov-Dec 1990), available online at <https://cseweb.ucsd.edu/~swanson/papers/science-of-writing.pdf> and <https://www.americanscientist.org/blog/the-long-view/the-science-of-scientific-writing>.

21: Homepage of the lessons: <https://cgi.duke.edu/web/sciwriting/>, PDF slides: [https://cgi.duke.edu/web/sciwriting/resources/201108\\_DukeScientificWritingWorkshop.pdf](https://cgi.duke.edu/web/sciwriting/resources/201108_DukeScientificWritingWorkshop.pdf) (these URLs could not be archived).

22: Copyright © 1990 by Sigma Xi, The Scientific Research Society. Reprinted with the permission of American Scientist.

The main goal of a thesis is to convey information without ambiguity. Write concisely and use a simple language. Avoid complex sentence structures, unnecessary words, and unnecessarily complicated words. A thesis is not the place to show off your mastery of grammar and vocabulary. There are various (mostly web-based and commercial) tools<sup>19</sup> that can help you identify common issues in your text.

### 2.7.2.1 The Science of Scientific Writing

Even if a text uses a simple language, it may be difficult to read, because it does not convey the writer's train of thoughts coherently. In short, your goal is to connect every sentence explicitly to its predecessor – which is, of course, easier said than done.

A good resource to develop this skill is the article *The Science of Scientific Writing* by George D. Gopen and Judith A. Swan.<sup>20</sup> The advice from this article is also part of the three lessons on scientific writing offered by Duke University.<sup>21</sup>

The remainder of this section contains selected excerpts from *The Science of Scientific Writing*.<sup>22</sup> Consider reading the original article for a more extended treatment, including worked examples.

**Subject-Verb Separation (Excerpts)** Readers expect a grammatical subject to be followed immediately by the verb. Anything of length that intervenes between subject and verb is read as an interruption, and therefore as something of lesser importance. The reader's expectation stems from a pressing need for syntactic resolution, fulfilled only by the arrival of the verb. Without the verb, we do not know what the subject is doing, or what the sentence is all about.

As a result, the reader focuses attention on the arrival of the verb and resists recognizing anything in the interrupting material as being of primary importance. The longer the interruption lasts, the more likely it becomes that the “interruptive” material actually contains important information; but its structural location will continue to brand it as merely interruptive. Unfortunately, the reader will not discover its true value until too late – until the sentence has ended without having produced anything of much value outside of the subject-verb interruption.

**The Stress Position (Excerpts)** It is a linguistic commonplace that readers naturally emphasize the material that arrives at the end of a sentence. We refer to that location as a “stress position.” Beginning with the exciting material and ending with a lack of luster often leaves us disappointed and destroys our sense of momentum.

The stress position can change in size from sentence to sentence. Sometimes it consists of a single word; sometimes it extends to several lines. The definitive factor is this: The stress position coincides with the moment of syntactic closure. A reader has reached the beginning of the stress position when she knows there is nothing left in the clause or sentence but the material presently being read.

To summarize the principles connected with the stress position, we have the proverbial wisdom, “Save the best for last.”

**The Topic Position (Excerpts)** To summarize the principles connected with the other end of the sentence, which we will call the topic position, we have its proverbial contradiction, “First things first.” In the stress position the reader needs and expects closure and fulfillment; in the topic position the reader needs and expects perspective and context.

The information that begins a sentence establishes for the reader a perspective for viewing the sentence as a unit: Readers expect a unit of discourse to be a story about whoever shows up first. “Bees disperse pollen” and “Pollen is dispersed by bees” are two different but equally respectable sentences about the same facts. The first tells us something about bees; the second tells us something about pollen. In fact, “Pollen is dispersed by bees” is the superior sentence if it appears in a paragraph that intends to tell us a continuing story about pollen. Pollen’s story at that moment is a passive one.

Readers also expect the material occupying the topic position to provide them with linkage (looking backward) and context (looking forward).

### 2.7.2.2 Selected Syntactical Conventions

Avoid using **informal contractions** such as *can’t*, *don’t*, and *it’s*. Replace them with *cannot*, *do not*, and *it is*.

We recommend using the **serial comma** in all lists to avoid ambiguity. The serial comma is also known as the *Oxford comma*: Insert it right before the word *and* that leads the last item of a list. The following example<sup>23</sup> illustrates the benefit of using a serial comma:

Three important techniques in the design of algorithms are  
bisection, divide and conquer, and recursion.

Use **bullet lists** correctly. “Lists are common in all forms of writing. The list items can be included within the text or put on separate lines. Separate lines are used in order to draw attention to the items, to ease reading when the items are long or numerous, or to facilitate cross-reference to specific items.”<sup>24</sup> The environments `itemize` and `enumerate` produce lists on separate lines. It is considered good style to use punctuation in such a way that the lists form full sentences if their items were *not* split into separate lines. One way to achieve this goal is to only put full sentences into the list. If list items, however, are sentence fragments, additional punctuation is necessary (example taken from source mentioned in footnote):

We used three different algorithms in the experiments. The  
table reports the performance of

- ▶ Algorithm 3.1 (based on a Taylor series),
- ▶ Algorithm 3.2 (with parameter  $k = 1$ ), and
- ▶ Algorithm 3.3 (with tolerance  $10^{-8}$ ).

23: Source: <https://nhigham.com/2016/02/16/the-serial-or-oxford-comma/>

24: Source of cited text: <https://nhigham.com/2015/12/17/punctuating-lists/>.

**Common Bugs in Writing** Read the comprehensive list of common bugs in writing by Henning Schulzrinne, which is available at <http://www.cs.columbia.edu/~hgs/etc/writing-bugs.html>.

## 2.8 Concluding Remarks

Scientific work and writing are skills that you can practice. Seminar papers serve that purpose during the studies. The final thesis shows which methodical and technical skills you have acquired. In addition to proper time management, discipline, and willingness to research literature, communication with one's supervisor is the key to success.

**Further Reading** This guide is not meant to cover all topics of scientific writing in detail. Consider the very comprehensive document *Scientific Writing for Computer Science Students* by Wilhelmiina Hämäläinen.<sup>25</sup> Hämäläinen has collected a substantial amount of advice with a particular focus on English grammar and the peculiarities of computer science.

25: Available at <http://www.cs.joensuu.fi/pages/whamalai/sciwri/sciwri.pdf>.

If you are pressed for time, consider the pre-class parts of “Technical Writing Courses for Engineers”.<sup>26</sup> The pre-class parts cover essentials and are split into short sections taking less than 15 minutes each. There is also an abundant number of books on scientific writing. We can recommend the following, which are available in many libraries in printed and electronic form:

26: Available at <https://developers.google.com/tech-writing>.

- ▶ M. Alley. *The Craft of Scientific Writing*; and
- ▶ W. Strunk and E.B. White. *The Elements of Style*.

Finally, if you seek inspiration, we recommend to read these reports by well-known scientists:

- ▶ Randy Pausch: Time Management (<http://www.youtube.com/watch?v=oTugjssqOT0>),
- ▶ Richard Hamming: You and Your Research (<http://www.cs.virginia.edu/~robins/YouAndYourResearch.html>), and
- ▶ Nick Feamster: Writing Tips for Academics (<http://greatresearch.org/2013/10/11/storytelling-101-writing-tips-for-academics/>).

The remaining parts of this guide contain less-often needed technical details and historical information about the template as well as a loose collection of assorted advice.

## **References**





# Eidesstattliche Erklärung

Ich erkläre hiermit gemäß § 17 Abs. 2 APO, dass ich die vorstehende Bachelorarbeit selbständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.  
Bamberg, den \_\_\_\_\_

\_\_\_\_\_  
Samet Murat Akcabay