

# Guideline for the Composition of Master Theses, Seminar Papers and Lab Reports

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17.12.2008

## 1 Why?

This guideline for composing master theses, seminar papers and lab reports was inspired by the observation that, in the process of their work, students often repeat the same mistakes that could easily be avoided. On this background, the idea for this guideline was born with the intention to reduce your (and also, of course, our) time input, and provide you with a set of techniques for composing scientific texts which have proven very effective for improving the presentation of contents as well as as their comprehensibility for the reader.

### 1.1 The Purpose of a Lab Report

Preparing the report is an inherent part of every lab offered by our work group during the main study period. The report should give the reader a detailed picture of

- which task was tackled during the practical exercises,
- which challenges had to be coped with in order to accomplish the task,
- in what way and how well these challenges were mastered.

The report is **not a protocol of procedures**, i.e. it should not provide a detailed listing of all steps made in order to solve the problem. It is rather a documentation of the applied solution and should also motivate why this particular solution was chosen. It can be appropriate to also mention other possible solutions that were tried but later on abandoned for good reasons. However, the description of the implemented solution must definitely outweigh such references.

## 1.2 The Purpose of a Seminar Paper

A seminar paper should summarize in short the vital aspects of a given subject. Since the size of the text sources usually outnumbers the admitted paper volume by far, it is inevitable for the author to reduce the sources to the relevant facts. The paper should be written in the author's own words and never be literally copied from the original text. This rule particularly applies to text sources in foreign languages: literal translations are usually easy to recognize for the simple reason that they are difficult to read; apart from that, they simply miss the point of the matter. One of the excuses for using literal translations is that the original text could not be understood. If this is the case, rather consult your tutor for help – that is what he is there for. Other popular excuses like „This source was so excellent, I could not have said it better“ certainly do not require any further comments.

## 1.3 The Purpose of a Master Thesis

According to the MaPO (conditions of study) of 2008 [MaPO08], the Master thesis is defined as (original quotation from the German language MaPO):

„§17 (1) Die Masterarbeit ist eine schriftliche Prüfungsarbeit, die zeigen soll, dass der Prüfling in der Lage ist, innerhalb einer vorgegebenen Frist ein Problem aus dem Gebiet des Studienganges selbständig nach wissenschaftlichen Methoden zu bearbeiten, einer Lösung zuzuführen und diese angemessen darzustellen.“

A corresponding English meaning would be:

„... the Master thesis is expected to show that the student is capable of independently applying scientific methods to a problem in the field of computer science within a set period of time, proving his/her aptitude for self-dependent scientific work.“

The Master thesis is reviewed on the basis of the written elaboration handed in by the student. Therefore, for the student's own benefit it is recommended to focus not only on the contents, but also on an appealing form of their presentation. Normally, the grade is not strongly influenced by formal aspects of the thesis. If, however, we have to make a choice between two possible gradings, the form of presentation can be of vital significance.

## 2 Choosing the Appropriate Tool

Prior to starting the actual writing process, the student has to decide which text processing program he will use. The answer to this question is quite easy to give: Basically we do not have any preference as to the tools used as long as we receive the result as a **PDF-file**.

### 2.1 LaTeX

LaTeX (spoken: „Lahtech“) ([Lam94], [LAT05]) sets scientific texts in premium quality. Comparing LaTeX with other text processing programs, like MS Word or Open Office, you will easily note the difference in quality. Also, LaTeX is highly reliable; it will not fail even with the 100th page, the 100th reference, the 100th mathematical formula and the 100th picture within one document.

Those who have so far worked only with WYSIWYG-tools might have to get used to giving layout instructions by embedding the respective LaTeX commands in the text. Also, some (few) basic structures have to be understood. Once the necessary „working set“ of LaTeX-structures is established, the composition of further texts with LaTeX will be very easy.

On this background, it is recommended that you get used to working with LaTeX as early as possible, for example in the course of working on the seminar paper or lab report. A lot of excellent assistance can be found in the Web, for example on the site of DANTE e.V. ([DAN05]).

### 2.2 Open Office, MS Word, etc.

From a very simplified point of view, there are as many shortcomings to LaTeX as there are advantages to common WYSIWYG text processing programs, such as Open Office or MS Word (and vice versa), where it is possible to start working right away and quickly get to an acceptably formatted result. The difficulties often start in the course of working on long texts containing numerous pictures and formulas, since they will lead to a rapid decrease of reliability and processing speed.

### 2.3 Recommendation

Basically, our experience shows that LaTeX is the best choice when working with complex documents. The initial work input which is necessary to get used to this tool will later on be rewarded by high stability, a minimum of layout work, high print quality, and, last but not least, a significant reduction of trouble.

## 3 Formal Basics

### 3.1 The Volume of a Paper

The volume of a paper consists of the amount of pages beginning with *the first page of the introduction* and ending with the *last page of the summary*. Hence, the cover page, the table of contents, reference lists, and attachments do *not* count as parts of the volume. Here are some tried and tested benchmarks for the volume of different kinds of papers and scripts:

- 25–100 pages for a Master thesis (see [MaPO08] §17 (5)),
- 5–10 pages for a seminar paper (see [MaPO08] §16 (3)),
- 15–20 pages for a lab report.

If the paper/report/thesis exceeds the given volume, it should be reconsidered whether the conceptual formulation is too complex and, with the tutor's agreement, needs to be reduced.

### 3.2 The Front Page

Every written elaboration has a front page containing the following information:

- a reference to the type of elaboration (Master thesis, seminar paper, lab report),
- for lab reports and seminar papers: Title and semester of the course,
- title of the elaboration,
- author's name and matriculation number,
- date of the current version of the elaboration.

Master theses must also contain a separate page with the annotation that the author prepared the thesis on his own (for further information refer to the conditions of study/MaPO).

### 3.3 Font

Naturally, the choice of a font is influenced by the individual preferences and style of the author. However, we do not recommend to use the entire range of available beautiful (or less beautiful) fonts. You will always be on the safe side with a **12 point serif font**. Serifs are tiny dashes added to the main lines of the letters in order to make the font more distinct and the reading process more comfortable. One of the most widely-used serif fonts is *Times Roman*, and accordingly, the respective Microsoft variation *Times New Roman*. The standard font for LaTeX documents is *Computer Modern* which was also used for this text.

In print, serif fonts are considered to feature a higher legibility than sans-serif fonts (such as *Helvetica*, *Arial*, or *Verdana*) and thus are especially recommendable for long texts. Almost every newspaper, magazine, or book uses a serif font for the actual text body.

As to the formatting, a single-column **Center justification** and single line spacing are most favourable for the simple reason that it looks best. For the page layout we recommend a **standard margin** (e.g. 2.5 cm) on all sides.

## 4 Language

Generally, the language of a scientific research text should be neutral, matter-of-factly, and not contain colloquial wording. After all, the reader of a scientific text wishes to receive precise information rather than to be entertained.

**Example (poor)**

After a short while the sender wants to post the message again.

**Example (better)**

After 10 seconds the sender retries to transmit the message.

The „first person“ should not be used in the type of elaborations discussed in this text. In German texts it is common to use the passive voice. In English texts you will often encounter the usage of „we“.

**Example (poor)**

Therefore I decided to use solution XY.

**Example (better)**

Therefore, we decided to implement solution XY. („English style“)

or

Therefore, it was decided to implement solution XY („German style“)

Generally, in a scientific text it is obligatory to substantiate all statements that are not obvious. This can be done by means of own research results (as, for example, in a Master thesis), or by referring to other sources providing either evidence or a logical and coherent motivation.

During the writing process, the author should imagine himself in the place of the reader, making sure that he, being the reader, would still understand the text. It is a matter of course to write in full, grammatically correct sentences and avoid spelling mistakes. We highly recommend to use spell checkers (in LaTeX e.g. GNU ispell [IS05]) and thoroughly proof-read the text at least once before handing it in.

# 5 Structure

A very common method of starting an elaboration is the so-called *top-down*, i. e. the drafting of an appropriate structure of chapters that lateron will be refined and filled with text. The most basic structure divides the text into introduction, main part, and conclusion.

## 5.1 The Introduction

Ideally, the introduction convinces the reader that it is worthwhile reading the rest of the paper, i.e. it should name the tasks of the work and explain why their investigation is of interest. In order to demonstrate the relevance of a problem it can be helpful to present it in a larger context.

While the beginning of the introduction should sufficiently motivate the reader to continue reading, the end of the introduction should give a survey of the chapters to follow, outlining in short how the task was approached.

## 5.2 The Main Part

The main part is the actual core of the paper and consists of several chapters which in terms of argument and presentation should form a logical line. Lab reports and Master theses often require the following structure, with each point possibly leading to several chapters:

- **Introduction of basics.** First of all, it is important to introduce the basic concepts of the work. It can be taken for granted that the reader is familiar with the contents of the lecture „High Performance Networking (MA-INF 3101)“ (for seminar or lab in the second semester) and of the lecture(s) „Network Security (MA-INF 3201)“ and/or „Mobile Communication (MA-INF 3202)“ (for seminar, lab or Master thesis in the third or higher semester). By no means we must lapse into writing a piece of universal technical literature. It is important to introduce only those basics that the paper/thesis will lateron refer to. Additional details of no relevance for the work will just distract the reader’s attention and not only waste space but also strain the reader’s (and the assessor’s :-)) patience.
- **Specification of the task.** Whereas in the introduction the task was outlined rather abstractly and in a larger context, it should now be specified: What exactly will be examined in this work (and what will not)?
- **Description of possible solutions.** Drawing upon the former chapters, we now have to develop our own solutions. To „look beyond one’s own nose“ and document what others hitherto contributed to the task are essential parts of scientific work. If task-related works do exist, it is good to emphasize the differences between them and our own work.

- **Assessing the methods of solution.** It is easy to allege things! However, it needs formal evidence or an empirical proof to make a statement valuable. Therefore, a significant part of the work accounts for examining the methods of resolution. This is the place for presenting analytical, simulative, or prototypical measuring results in order to emphasize the quality and special applicability of our own method (in comparison with other approaches). The „road“ leading from assumptions to conclusions should be comprehensible for the reader to an extent that enables him to repeat the research for verification.

If the length of a chapter exceeds a certain limit, it is helpful to start with a brief introduction that picks up the thread leading through the document and outlines the contents of the following chapter. Also, each chapter should end with a short summary stressing essential points of the chapter.

## 5.3 The Conclusion

The final chapter („Summary“) summarizes the primary aspects of the work and present its essence. The summary should be comprehensible even for readers who are not familiar with the contents of the main part. The reader, just by reading the introduction and the summary, should get an idea of the document’s tasks as well as their solutions.

Also, this is the adequate place for presenting our own notions about the task in a short résumé.

In lab reports and Master theses, conclusion should also mention the prospects of possible further work, especially questions that arose in the course of the work but for reasons of time and/or space could not be dealt with in depth.

# 6 The Correct Usage of ...

## 6.1 Footnotes

Footnotes were invented by the humanities, where dealing with research sources is of high significance. Footnotes here mainly serve as references to the source of a citation. In the field of computer science, however, footnotes are **used rather scarcely**. If a reference to an external source is required, the source will be referenced (see chapter 6.6).

Footnotes are often used for remarks that are not supposed to appear within the actual text. However, if the remark is important enough to be mentioned, it can as well be placed in the main text. Otherwise it is probably not that important and we can do without it. <sup>1</sup>

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<sup>1</sup>Do you realize how this meaningless footnote obstructs the read flow?

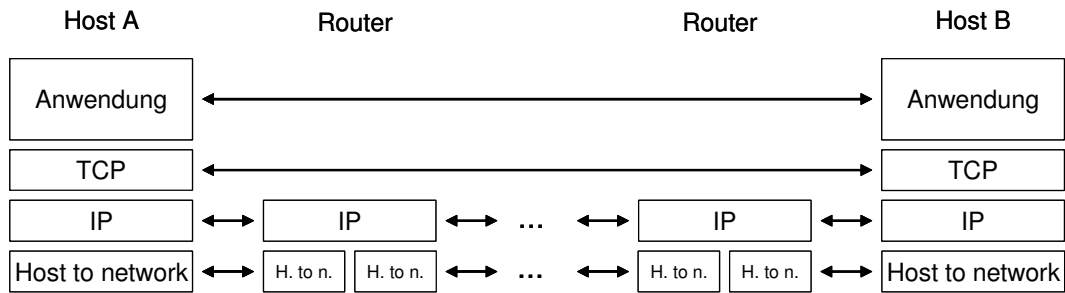


Figure 1: The TCP/IP protocol stack during the communication process between two hosts

## 6.2 Page Numbers

Page numbers are important for the simple reason that the printed document is not always stapled when it lies on a desk, and a draft through the open door is sometimes enough to sweep the whole stack off the desk and turn it upside down. In addition, page numbers are very helpful in the process of reviewing („ The first paragraph on page 67 should be rephrased“). Therefore, we recommend to **always use page numbers**.

## 6.3 Figures

Figures are meant to improve the comprehensibility of the text and should therefore be **generously applied** (mind that „generously“ must not be taken too literal). According to our experience, an average of one figure in **2-3 pages** is acceptable. Too many figures would cause the impression of a comic strip.

A figure says more than a thousand words, however, it can not replace descriptive comments in the text. A general rule says that a figure should support the comprehension of a text, but by no means can be planted into it without further explanation. It is important to always make sure that the text provides **references and descriptions** to the figures. In addition, each figure should be captioned in an explanatory way.

### Example

TCP and IP have different functions. Figure 1 shows the interaction of both protocols during the communication of the two nodes A and B that are interconnected via several routers. IP, being the protocol analog to the third layer in the OSI-Model, has the function of ... (*... continue discussion of the figure*)

### Figures of Other Authors

Lots of figures have been created, among them may even be figures that exactly match your work. If you find such a figure, you might want to use it in your paper/thesis. In



this case you have to make a **figure reference** to the source of the figure; either in the figure itself or in the annex.

If you wish to use a figure that is not available in an electronic format, the simplest of all solutions is to scan it. If the figure is part of an electronic document, you can make a screenshot. Mind that, using this type of figures, it is important to choose a sufficiently high resolution to ensure that the printer will not turn it into a load of „pixel mud“. At the same time, the resolution should be as low as possible in order to not unnecessarily blow up the size of the document.

Therefore, it is worth considering to draw the picture yourself with a tool of your own preference and embed it as a **vector graphics**. In most of the cases you will end up having to apply changes to a foreign figure, because it eventually turns out to not 100% match with the situation in your work. If after that the figure still strongly resembles the source, and if it is not a commonly well-known picture, as e.g. the TCP/IP protocol stack, the source must be marked as „according to [reference]“. We recommend to choose a vector format (.wmf, .emf, .eps, .pdf), since they do not occupy much space and scale arbitrarily without looking „pixelish“.

## Colors

A colored figure is a nice thing - provided you will use a color printer. In a black-and-white-print the colors will be reduced to their grades of brightness, as a result of which the contrast distribution will not remotely reach the intended quality. Therefore, when creating colored figures, make sure that even in a black-and-white print the necessary information will still be distinct. You can as well abstain from colors and use different shades of gray instead. In plots, different curves can be distinguished by using different line types.

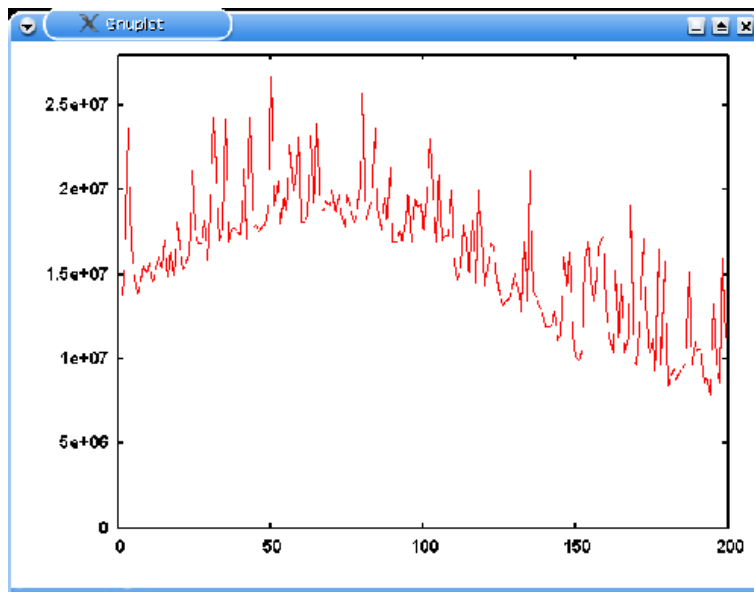
However, if you wish to use colored figures, do not refer to the colors in the text. Phrases like „Active nodes are marked red, passive nodes blue and inactive nodes green“ in a black-and-white print have a rather comical effect and will lead to confusion rather than comprehension.

## Plots

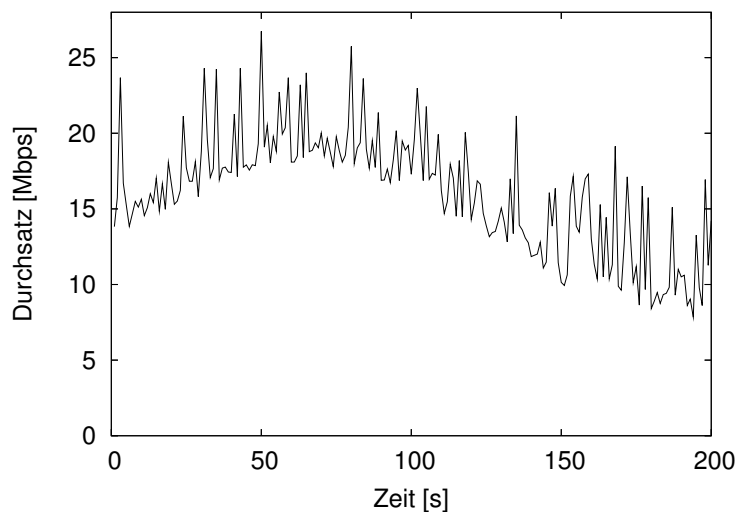
Plots should be created e.g. with Gnuplot [GP05], R [R05], OpenOffice [OO05], or Excel. They can easily be embedded as vector formats, so it is not necessary to use screen shots. When using plots, it is important to **label the axes** and indicate the **units**.

Make sure to use an **appropriate scaling**. For example, instead of saying „10000000 bps“ or „1.0e-07 bps“ the more concise „10 Mbps“ is preferable.

An example of how not to do it is shown in figure 2 (a): a pixelish Gnuplot-screenshot without units at the axes and a badly chosen scaling. Example (b) shows the same plot with a reasonable labeling as .eps import.



(a) Poor



(b) Better

Figure 2: Examples for a presentation of measurement results

Test Series	Sender	Recipient
1	heineken	grolsch
2	heineken	bitburger
3	grolsch	bitburger

Table 1: Sender- and recipient configurations of the implemented test series

## 6.4 Tables

The same rules that apply to figures also apply for tables: Tables have to be numbered, captioned, and referenced in the text.

### Example

To analyse the aspect XYZ, three test series were carried out in the test systems. Table 1 summarizes the sender- and receiver configurations used in the test series.

In case you wish to present extensive measurement- or simulation results, a graphic representation could possibly convey the information more concisely than a table.

## 6.5 Quotations

We recommend to not extensively quote text sources. Computer scientists usually make it short; instead of quoting a source, they reference it in the appropriate place. However, it can be helpful to now and then quote a particular paragraph containing information which is crucial for your work. In this case, the quotation has to be put in **quotation marks** and stand out against the rest of the text (for example, by indented paragraphs or italicized font). Furthermore, the source has to be indicated by a reference (see quote from the DPO in chapter 1.3).

By no means quotations may be used to describe the basics of your work. Although it is easy to find elaborate introductions to most subjects, it would by far miss the purpose of your work to simply adopt them. On the contrary, they can be rather incoungruous since they most probably will not confine themselves to the essentials of this aspect of your work.

If, in addition, the reference to the quotation is missing, it means that the author tries to pass off a foreign work as his own. This is called plagiarism and is incompatible with the methods of academic work which, as a purpose of our lectures, we want the students to acquire.

**If we identify a case of plagiarism, we will get very angry - sometimes angry to an extent that we will refuse the certificate, or grade the Master thesis as**

not passed.

## 6.6 References

### 6.6.1 What do I reference?

When choosing a source, it is of great importance to check its reliability. Usually, the books, articles of scientific magazines or conference proceedings, standards, and other sources that we make available for you undergo a scientific review to ensure a certain reliability.

Computer magazines, such as *c't*, *iX* etc., belong to a scientific twilight zone. They do get reviewed, however, the reviews are editorial, not scientific, hence they should be referenced for non-technical aspects only. For example, you should *not* reference a TCP/IP-tutorial from the *c't* or, even worse, the *Computer-Bild* - more appropriate here would be a reference to books or the relevant standards. However, in an introduction it is not at all out of place to quote from an article about the commercial predominance of a new radio communication standard and reference the sales figures for end devices mentioned in the article.

You will need a good deal of scepticism when dealing with internet publications (including, among others, seminar/study papers from other authors) that were not obviously subject to review. You better avoid this kind of sources, since the internet makes it quite easy to publish the most amazing nonsense.

### 6.6.2 How do I reference?

Two different ways of referencing have been established. The first one are found mainly in English publications: The references are simply bracketed and serially numbered:

#### Example

In [1] we introduce an alternative mechanism for congestion control which recognizes congestion by the increase of round trip time.

Alternatively, the signature of the reference consists of the initials of the authors' last names and the last 2 digits of the year of publication. This form of referencing is most customary in German publications:

#### Example

In [JWL04] we introduce an alternative mechanism for congestion control which recognizes congestion by the increase of round trip time.

The following rules have proven useful for both notations:

- To prevent a signature from getting too long, only the first three authors will be mentioned. If there are more than three authors, this is indicated by a „+“ behind

the list of authors (e.g. [IML+01] for a paper published by Inamure, Montenegro, Ludwig, Gurtov, and Khafizov in 2001).

- In case there is only one author, the first three letters of his last name will be indicated (e.g. [Hus01] for an article published by Geoff Huston in 2001).
- If an author or a group of authors produced more than one publication in one year, the referenced publications of the same year will be distinguished by an attached lowercase letter (e.g. [Pos81a], [Pos81b]).
- If there is no designated author or publisher (which can happen in case of standards), arbitrarily choose an explicit letter combination (e.g. [IEEE99] for an IEEE standard).

The references will be listed in a separate chapter at the end of the document. Each reference appears as a separate entry in the following format:

[Signature] author(s), title of publication, specification about magazine, conference, book in which the source was published, page number (if possible), year of publication, ISBN.

The information contained in the reference list has to be exhaustive enough to enable the reader to find the source (in fact, without using Google or CiteSeer).

### **Examples for RFCs/Standards:**

- [Pos81a] J. Postel, *Internet Protocol*, September 1981, IETF, RFC 791, Status: Standard.
- [Pos81b] J. Postel, *Transmission Control Protocol*, September 1981, IETF, RFC 793, Status: Standard.
- [IEEE99] IEEE Computer Society LAN MAN Standards Committee, *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, IEEE Std 802.11*, 1999 Edition, Institute of Electrical and Electronics Engineers (IEEE), 1999.

### **Example for a Conference Paper**

- [JWL04] C. Jin, D. Wei, and S. Low, *FAST TCP: Motivation, Architecture, Algorithms, Performance*, Proceedings of the 23rd Annual Joint Conference of the IEEE Computer and Communications Societies, INFOCOM 2004, March 2004.

### Example for a Journal Article

[Hus01] G. Huston, *Analyzing the Internet's BGP Routing Table*, The Internet Protocol Journal 4 (2001), no. 1, pp 2-15.

### Example for a Web Site

[TCP03] Homepage of Tcptrace - a tool for TCP trace Analysis,  
<http://www.tcptrace.org>, November 2003.

In a web site reference it is obligatory to indicate the date of the reference, since web sites are not usually static nor permanent.

### Example for a Book

[Ste94] W. R. Stevens, *TCP/IP Illustrated: The Protocols*, vol. 1,  
ISBN 0-201-63346-9, Addison Wesley 1994.

#### 6.6.3 BibTeX

When using the *BibTeX* addition to LaTeX, the signature is generated automatically, and you do not have to bother about their formats. In BibTeX, the references are managed in a separate .bib file, from which the necessary references will be extracted and embedded into the document by the `bibtex` command. References in BibTeX format are often available in the Web and save a lot of work.

## 6.7 Abbreviations

Please note that abbreviations and full text must not be mixed. When introducing an abbreviation for the first time, it should be written in full with the abbreviation attached in brackets. In the following text, only the abbreviation will be used. Common abbreviations can be applied without introducing them in full writing.

### Example

The *Transmission Control Protocol* (TCP) offers a reliable, connection-oriented transport service. TCP was ... (*from now on always use „TCP“*)

If a document contains a large amount of different abbreviations, it might be reasonable to summarize them in a list and attach it to the document.

## 6.8 Headlines and Titles

Headlines are not part of the text and therefore must not be interlaced with the text.

**Example (poor)**

**2.6 The TCP/IP Reference Model**

consists of four protocol layers which are depicted in figure 1.

**Example (better)**

**2.6 The TCP/IP Reference Model**

The TCP/IP Reference Model, which contains 4 layers, is depicted in figure 1.

## 6.9 Indices

If the volume of a document exceeds approximately 15 pages, it is advisable to generate a table of contents, for which every reasonable text system offers supportive tools.

In voluminous documents, such as Master theses, separate indices of figures and tables are recommended.

## 6.10 Programming Code

To quote and discuss a voluminous programming code is one of the most effective means of boring your reader. In case you decide to introduce an algorithm, you will rather use a Pseudocode representation that confines itself to explaining the main functions of the algorithm. If a reader is interested in the implementation, they can refer to the actual programming code. For discussing data structures, UML class diagrams have proven quite useful.

## 7 In Conclusion

As a matter of fact, every piece of written academic work is subject to the individual criteria of their authors, characterizing their personal style of presenting facts. This style is not necessarily identical with the reader's personal concept of presentation; hence, it is most likely that some aspects of this guideline are based on our subjective idea of what characterizes a good composition.

The majority of points mentioned in this guideline, however, reflect the practical values that have proven useful to us when presenting our own scientific texts. Therefore it is worthwhile keeping this guideline in the back of your mind when composing your scientific work in order to avoid the grossest mistakes from the very beginning.

## Literature- and Online References

- [DAN05] *Homepage der Deutschsprachigen Anwendervereinigung T<sub>E</sub>X(DANTE) e.V.*, February 2005. <http://www.dante.de/help>.
- [DPO03] *Diplomprüfungsordnung für den Studiengang Informatik an der Rheinischen Friedrich-Wilhelms-Universität Bonn*, March 2003. <http://www.informatik.uni-bonn.de/lehre+studium/pruefungen.html>.
- [GP05] *Homepage von Gnuplot*, February 2005. <http://www.gnuplot.info>.
- [IS05] *Homepage von GNU ispell*, February 2005. <http://www.gnu.org/software/ispell/ispell.html>.
- [Lam94] LAMPORT, LESLIE: *LaTeX: A Document Preparation System*. Addison Wesley Professional, 2 edition, June 1994. ISBN 0-2015-2983-1.
- [LAT05] *LaTeX – A document preparation system*, February 2005. <http://www.latex-project.org>.
- [MaPO08] *Prüfungsordnung für den Masterstudiengang Computer Science der Mathematisch-Naturwissenschaftlichen Fakultät der Rheinischen Friedrich-Wilhelms-Universität Bonn*, vom 17. Januar 2008. <http://www.informatik.uni-bonn.de/lehre+studium/pa-ordnungen.html>.
- [OO05] *Homepage von OpenOffice.org*, February 2005. <http://de.openoffice.org>.
- [R05] *The R Project for Statistical Computing*, February 2005. <http://www.r-project.org>.