

Horst Lichter · Jochen Ludewig · Marcus Deininger · Kurt Schneider

Student Thesis Projects

**A Guide to Organizing,
Conducting, and
Presenting**



**Student Thesis Projects
Using the Example of
Computer Science**

v/dl/f

7th Edition



Student Thesis Projects

A Guide to Organizing, Conducting, and Presenting
Student Thesis Projects Using the Example of
Computer Science

Horst Lichter
RWTH Aachen University

Jochen Ludewig
Universität Stuttgart

Marcus Deininger
Hochschule für Technik Stuttgart

Kurt Schneider
Leibniz Universität Hannover

Declaration on the Use of AI-Based Tools

DEEPL TRANSLATOR: We initially translated all text passages from the 6th edition that were incorporated into the 7th edition, either wholly or in part, using DeepL Translator. We then carefully reviewed all translated material, edited it manually, reformulated it where necessary, and integrated it into the new context.

GRAMMARLY V1.2: We used Grammarly to correct grammatical and stylistic errors.

This work is licensed under creative commons licence CC BY NC ND 4.0:



Producer

vdf Hochschulverlag AG
Schwendenhaustrasse 16
CH – 8702 Zollikon
verlag@vdf.ch
Responsible: Ernst Schärer

EU Importer

Brockhaus Kommissionsgeschäft GmbH
Kreidlerstrasse 9
DE – 70806 Kornwestheim bei Stuttgart
info@brocom.de

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.dnb.de>.

ISBN 978-3-7281-4240-5 (Print version)

Download open access:

ISBN 978-3-7281-4241-2 / DOI 10.3218/4241-2

© 7., completely revised edition 2026, vdf Hochschulverlag AG

Previous editions (in German):

1. edition 1992
- 2., reviewed edition 1993
- 3., revised and expanded edition 1996
- 4., revised edition 2002
- 5., revised edition 2005
- 6., revised edition 2017

www.vdf.ch
verlag@vdf.ch

Vorwort zur 1. Auflage

Dieser Leitfaden ist als Skriptum des Kolloquiums “Wissenschaftliches Arbeiten” entstanden. Das Kolloquium wird auf Anregung der Fachschaft Informatik seit 1990 an der Universität Stuttgart regelmäßig abgehalten. Planung und Durchführung liegen bei der Abteilung (oder nach anderem Sprachgebrauch bei dem Lehrstuhl) Software Engineering, wo die vier Autoren arbeiten.

Dass gerade unsere Abteilung diese Aufgabe übernommen hat, war kein Zufall: Für die Bearbeitung eines technisch-wissenschaftlichen Textes (z. B. einer Diplomarbeit) gelten ähnliche Regeln wie für die Bearbeitung einer Software-Komponente: In beiden Fällen geht es um Information, für die gewisse Eigenschaften wie Korrektheit, Lesbarkeit, Strukturiertheit usw. angestrebt werden.

Dieser Schrift liegen die Erfahrungen in der Fakultät Informatik zugrunde, und so stammen auch die Beispiele aus diesem Gebiet. Aber die Unterschiede gegenüber anderen technischen Disziplinen sind marginal, so dass sich auch Studierende benachbarter Fächer, vor allem der Ingenieur- und der Naturwissenschaften, beim Lesen nicht fremd fühlen werden.

Ähnliches lässt sich für die lokalen Bezüge sagen: Wir sprechen von der Universität Stuttgart, aber unsere Erfahrungen in Hannover, München, Kaiserslautern, Erlangen und Zürich lassen darauf schließen, dass die Regelungen, Gepflogenheiten und Maßstäbe an den Technischen Universitäten im deutschsprachigen Raum nicht stark variieren, nur die Fristen für die Arbeiten sind unterschiedlich.

Marcus Deininger, Horst Lichter, Jochen Ludewig, Kurt Schneider

Stuttgart, im Januar 1992

Vorwort zur 6. Auflage

Schon bei der Vorbereitung der 3. Auflage waren meine Koautoren nicht mehr dabei, alle drei haben die Universität Stuttgart verlassen, um die Erkenntnisse des Software Engineerings praktisch anzuwenden und weiter zu verbreiten. Anscheinend haben sie das sehr erfolgreich getan, sodass einer nach dem anderen auf eine Professorenstelle berufen wurde. Heute stehen auf diesem Buch die Namen von vier Hochschullehrern. Das ist, bezogen auf den Umfang, wohl ein Rekord.

Der Inhalt ist im Kern immer gleich geblieben: Das Buch soll Ihnen, den Leserinnen und Lesern, dabei helfen, zu einem Thema, das Ihnen vorgegeben wurde, eine größere schriftliche Arbeit anzufertigen und Ihre Ergebnisse im Vortrag zu präsentieren. Dabei kann es sich um einen Seminarbeitrag, eine Bachelor- oder Masterarbeit oder eine Dissertation handeln. Natürlich sind weite Teile des Buches auch für solche Arbeiten nützlich, die keinen wissenschaftlichen Anspruch erheben, z. B. für technische Dokumentationen.

Wir orientieren uns an den Fächern, die wir selbst vertreten, also an Informatik und Softwaretechnik; aber unsere Erfahrung zeigt, dass das Buch und der Kurs dazu auch Naturwissenschaftlern und Ingenieuren gut bekommen, zumal viele ihrer Arbeiten auch Informatik-Anteile enthalten.

Da wir für einen sorgfältigen Umgang mit der Sprache werben, müssen wir uns natürlich auch fragen, ob unser Text diesem Anspruch genügt. Wir beziehen darum die Abschnitte 5.5 und 5.6 auch auf die eigene Arbeit. Falls Ihnen etwas ungewöhnlich oder falsch erscheint, finden Sie dort möglicherweise eine Erklärung.

Aber vielleicht haben Sie ja einen bislang unentdeckten Fehler gefunden; davor sind wir auch in der 6. Auflage nicht gefeit, zumal etliche Abschnitte ergänzt oder neu formuliert wurden. Ich wünsche uns und diesem Buch auch weiterhin aufmerksame und kritische Leserinnen und Leser, und ich freue mich über Ihre Anmerkungen und Anregungen. Schreiben Sie bitte unter dem Stichwort "Studien-Arbeiten" an

ludewig@informatik.uni-stuttgart.de

Jochen Ludewig

Stuttgart, im Januar 2017

Preface to the 7th Edition

It has now been nine years since the 6th edition of our guide was published. Regarding student thesis projects, some aspects have remained largely unchanged over the years, while others have evolved considerably. We therefore decided to comprehensively revise the 6th edition of our guide and further develop its content.

We also decided to publish the 7th edition of the guide in English for several reasons: International students have been studying at our universities for many years, and we have repeatedly received inquiries asking whether an English version of the guide was available. In addition, our experience shows that the number of theses written in English at universities has been steadily increasing.

The revision of the content and its adaptation for international students have resulted in numerous changes and additions. However, we have not made any fundamental changes to the content of this guide (it is, in fact, an evolution, not a revolution). What are the main changes in this edition?

- Based on the 6th edition, we have written a new, separate chapter on the topic of “Working with Scientific Literature.” Therein, we also provide an introduction to the use of modern AI-based tools for literature search and analysis.
- We revised and restructured the content of the old chapter “Structure and Content of the Thesis” resulting now in the two chapters “The Structure and Content of a Thesis” and “Writing and Formatting a Thesis.”
- At the end of this guide, we included checklists and practical tips for thesis projects and examinations, that were previously scattered throughout the guide.
- We visually highlighted the most important statements and messages throughout the text.

We hope that, through these revisions and enhancements, we have further improved this guide so that it will continue to provide valuable support to you. To make this guide accessible to a wider audience, the 7th edition will be published not as a printed book, but as an Open Access publication.

We would like to express our sincere gratitude to [vdf Hochschulverlag AG](#) for the highly professional and pleasant collaboration throughout this project. We are especially grateful to *Angelika Rodlauer* for her support and assistance in preparing this book.

We would also like to extend our special thanks to *Joseph Smith* from [SATZSPIEGEL](#), who carefully reviewed the manuscript with great attention to detail, identified numerous linguistic inaccuracies, and contributed many valuable suggestions that significantly improved both the quality and clarity of the content.

Finally, we are delighted that *Selin Coban* contributed several illustrations to this guide, beautifully bringing to life some of the figurative language used throughout it. We hope you like them as well.

Despite careful proofreading, the 7th edition will inevitably still contain errors or inaccuracies. Should you discover any, we would be very grateful if you would inform us so that we can make the necessary corrections. And, of course, we welcome all your comments and suggestions.

You can reach us at: horst.lichter@rwth-aachen.de

Horst Lichter, Jochen Ludewig
Aachen and Stuttgart, July 2026

Table of Contents

1	The Scope and Goals of this Guide	11
2	The Rules and Principles of Thesis Projects	13
2.1	Examination regulations	13
2.2	The roles involved	14
2.3	Independence	15
2.4	Science and engineering	15
2.5	The scientific principle	16
2.6	Excursus on the legend of purposeless and objective science	20
3	The Building Block Nature of Scientific Results	23
3.1	Useful scientific results	23
3.1.1	Scientific progress	24
3.1.2	Closing a gap	24
3.1.3	Pioneering achievement	24
3.2	Other scientific results	25
3.2.1	The reinvented wheel	25
3.2.2	The castle in the air	25
3.2.3	L'art pour l'art (Art for art's sake)	26
3.2.4	Old wine in new bottles	26
3.3	Breadth and depth	26
4	Organizing a Thesis Project	27
4.1	Selection of topic and preparation	28
4.2	Planning the work	29
4.3	Advice and tips	33
5	Working with Scientific Literature	35
5.1	Terminology	35
5.2	Types of publications	36
5.3	Gray literature	37
5.4	Literature search	38
5.5	AI-supported literature search	41

5.6	Specifying references	44
5.7	Organizing the literature	45
5.7.1	Filtering out irrelevant publications	46
5.7.2	Managing publications	47
5.8	Analyzing publications	49
5.9	Citations and references	50
5.9.1	The citation-key citation style	50
5.9.2	The name-year citation style	52
6	The Structure and Content of a Thesis	53
6.1	Objectives and requirements	53
6.2	The sections of a thesis	54
6.3	The process of writing the sections	58
6.4	The content-related form of the thesis	59
6.4.1	The “red thread”	59
6.4.2	The advantages of using illustrations	61
6.5	Types of scientific statements	62
6.5.1	Citations	62
6.5.2	General knowledge	63
6.5.3	Working hypothesis	63
6.5.4	Measurement results and practical experience	64
6.5.5	Conclusions and evaluations	64
6.5.6	Argumentation	65
7	Writing and Formatting a Thesis	67
7.1	A brief introduction to style and language	67
7.1.1	Choose precise and correct terms, avoid buzzwords	67
7.1.2	Metaphors	68
7.1.3	Noun style	69
7.1.4	Long and nested sentences	70
7.1.5	Word variations and process descriptions	71
7.1.6	Filler words and conjunctions for convenience	72
7.1.7	Enumerations	73
7.1.8	The author’s representation	74
7.1.9	Spelling, grammar, and punctuation	74
7.2	The external appearance of the thesis	75
7.2.1	Fonts	75
7.2.2	Page layout	76
7.3	Tools for word processing	77
7.3.1	Risks of using word processors	78
7.3.2	Using AI tools	80

8	Presentation and Demonstration	83
8.1	The presentation	83
8.1.1	Preparation is more than half of any presentation	83
8.1.2	What a good slide looks like, and how to present it?	84
8.1.3	Time management and contact with the audience	85
8.1.4	The dramaturgy of a presentation	86
8.2	The demonstration	88
9	Supervising Thesis Projects	91
9.1	The interests of those involved	91
9.2	The supervision tasks	92
9.2.1	Defining the topic and task	93
9.2.2	Introducing the candidate to the topic	94
9.2.3	Advising on work planning	94
9.2.4	Monitoring work progress	95
9.3	Supervision effort	95
9.4	Teaching and assessment: the two roles of the supervisor	97
9.5	The assessment	98
10	A Compact Guide to Thesis Projects	103
11	Checklists and Tips	107
A.	Checklist for candidates	107
B.	Checklist for supervisors	109
C.	Checklist for creating presentation slides	110
D.	Checklist for the presentation and demonstration	111
E.	Tips for citations and references	112
F.	Tips for written exams	113
G.	Tips for oral exams	115
12	Closing Notes	117
13	References	119

1 The Scope and Goals of this Guide

This guide provides rules, guidance and techniques for conducting **student thesis projects** at the university level (hereinafter referred to as “thesis projects”). The ambiguity of the word “apply” is intentional: These rules *can* be and indeed *should* be applied. There are two main thesis project types: **bachelor’s** and **master’s thesis projects**, the central result of which we refer to as a “**thesis**.”

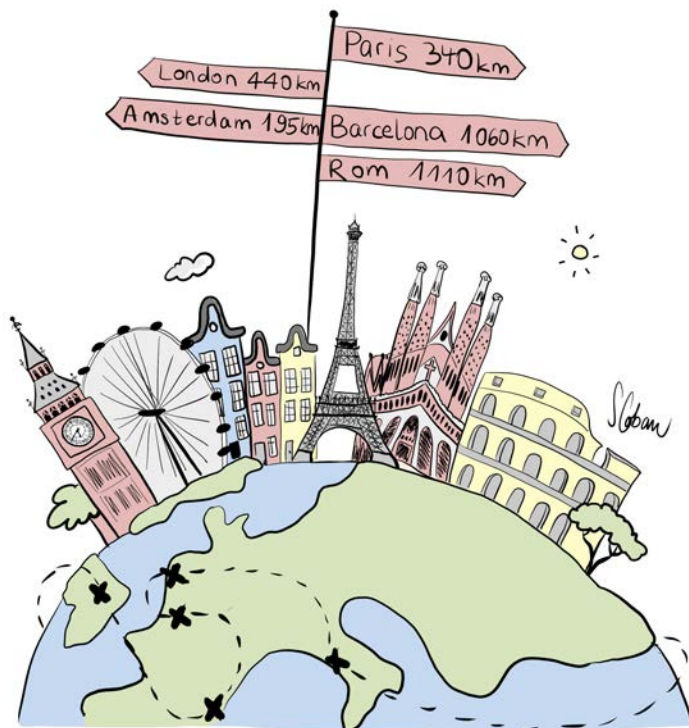
This guide focuses on these thesis projects. In terms of academic standards and independence, they lie somewhere between a **seminar work** and a **dissertation project**, documented in a **dissertation**, also referred to as a “doctoral thesis.” However, most of our statements can also be applied to these and other project types, such as writing an **academic paper** or documents lacking academic standards. Thus, we can formulate the objectives of this guide more concisely as follows:

- To enable *students* with the necessary skills to select, prepare, and carry out a thesis project and present their results in the form of a written document and an oral presentation.
- To enable *supervisors* to define thesis projects, follow up on them, support them, and ultimately assess the results.

To make the advice, techniques, and examples in this guide more concrete, we use computer science and software engineering in particular as an example, as that is the field we are most familiar with. However, we believe that many of our statements are also applicable to other degree programs, especially in the natural sciences and engineering.

Of course, we are aware that this guide can only make a small contribution, as we will be skimming over several areas in just a few pages, each of which would take a lifetime to explore in depth (e. g., work and leadership techniques, rhetoric).

For this reason, this guide significantly resembles the cliché of American or Asian tour groups who want to explore Europe in a short period of time, ironically referred to as “Europe in five days.”



2 The Rules and Principles of Thesis Projects

Now that we have clarified that this guide focuses on thesis projects, we would like to outline the regulations governing their conduct, the roles involved, and the basic rules that generally apply to scientific work.

2.1 Examination regulations

University laws, examination regulations, and other relevant guidelines legally define the thesis projects conducted by students. Which regulations are important?

Of course, every university has its own examination regulations. Because their content is similar in many areas, let's look at an example, the "General Examination Regulations Governing All Bachelor's and Master's Courses of Study," issued by RWTH Aachen University.

General Examination Regulations Governing All Bachelor's and Master's Courses of Study at RWTH Aachen University (Except for the Teacher Education Degree Programs), Now Issued in Their Eighteenth Revised Version, February 11, 2025 (Excerpt)

§ 17 Bachelor's or Master's Thesis

- (1) The Bachelor's or Master's thesis consists of written work by the **candidate**. It should demonstrate that the candidate is able to work independently on a problem within a given time frame using scientific methods and under **supervision**.
- (2) For Bachelor's or Master's theses, any professor working in the research and teaching of the respective degree program at RWTH and, based on a corresponding regulation of the responsible examination board, any member of RWTH with the right to independently hold lectures has the right to serve as an **examiner**. [...] In addition, the chair of the examination board may appoint additional persons as second examiners who fulfill the requirements of § 12 (1) sentence 4. The topic is assigned and the thesis is **supervised** by the first examiner. Scientific staff members can also assist with supervision. [...]
- (8) The course of study-specific examination regulations may stipulate that the results of the Bachelor's or Master's thesis are to be presented in the context of a Bachelor's or Master's **final colloquium**. Here, § 7 (12) applies. [...]

§ 18 Acceptance and Assessment of the Bachelor's or Master's Thesis

- (1) The Bachelor's or Master's thesis must be submitted electronically (via CMS) by the deadline. Deviations from these provisions can be stipulated in the course of study-specific examination regulations. Together with the Bachelor's or Master's thesis, the candidate must submit a separate **Declaration of Academic Integrity** (to be included in their exam records) stating that they have completed the thesis **independently** and **no sources or aids** other than those specified have been

used. This includes in particular software and services for language, text, and media production. [...]

- (2) The examiner is the person who issued the assignment. The Bachelor's or Master's thesis usually represents the final examination and always has to be assessed by two examiners in accordance with § 10 (1) with a written statement. [...]

We do not reproduce the regulations for doctoral degrees. Important for a dissertation is the requirement set out, for example, in § 2(1) of the “Doctoral Degree Regulations of the University of Stuttgart” (March 1, 2019):

The dissertation must satisfy **scientific requirements**, provide **scientific progress** and be an **independent work** by the candidate.

You will most likely find the examination regulations of your university, faculty, or degree program on the web.



We strongly recommend to read through these regulations (even if they are not exciting to read)!
Knowing them is often very useful, especially when problems arise!

2.2 The roles involved

According to such examination regulations, at least two persons are involved in a thesis project: the candidate and the examiner. In many cases, the examiner does not supervise the candidate directly but rather delegates this task to a third person, the supervisor (see the General Examination Regulations of RWTH Aachen University, § 17(2)).

Thus, the following three roles are involved in a thesis project:

- The **candidate**, who conducts the project, works on the topic, and writes the thesis.
- The **examiner**, who issues the topic and checks the results after completion. The examiner must also ensure that the candidate is adequately supervised.
- The **supervisor**, who guides and supports the candidate during their thesis project. This is usually a Research Assistant from the examiner's research group.

In individual cases, two roles may coincide, e. g., in a dissertation project, one of the examiners is often the supervisor as well. Sometimes, one role

can be split between several persons, such as when two persons are supervising the same candidate.

2.3 Independence

As the examination regulations state, a thesis project must be completed independently and only with the specified aids, particularly the cited literature (see §18 (1), General Examination Regulations Governing All Bachelor's and Master's Courses of Study at RWTH Aachen University). This means that third parties are not permitted to contribute to the work. Anything taken verbatim or in spirit from other people's work must be referenced precisely. See [Section 5.9](#) for detailed instructions on how to cite. If no reference is cited for a text section or image in the thesis, the candidate is claiming authorship of it. If this claim is false, it is **plagiarism**. Plagiarism detection with software support is routine in many universities. If plagiarism is proven, the candidate can expect significant trouble.



The obligation to cite does not apply to generally recognized facts and knowledge (see [Section 6.5.2](#)), such as those taught in introductory lectures. Nor does it apply to information and advice the candidate received during supervision!

However, independence does not mean isolation! This is ruled out because of the educational aspect of thesis projects (see [Section 9.4](#)). Candidates who ask their supervisor meaningful questions are not dependent. On the contrary, they are independent and well-suited to scientific work. Supervisors and examiners are essential sources for theses, even if they are not explicitly cited in the case of oral information. Their contributions are documented by listing their names on the title page of the theses.

2.4 Science and engineering

The terms “science” and “engineering” are frequently used and discussed in academia. What do these terms mean?

In **science**, we seek *applicable rules* that are as universally valid as possible. In physics, these are referred to as the *laws of nature*, which signifies an interpretation: We can (within certain limits) act as if nature actually follows these laws, thereby predicting and influencing future develop-

ments. For example, according to astronomical laws, we know the exact time of future solar eclipses; thanks to our knowledge of tides and fluid mechanics, we can prevent flooding by building dikes. Conversely, we can also explain or interpret past events (e. g., the formation of the Earth, the building of the Egyptian pyramids).

Engineering strives to *solve problems* by finding solutions to given problems under specified boundary conditions, applying scientific and practical knowledge. The boundary conditions include, in particular, a cost function that practically always implies time and effort limits. Engineering produces **technology**, and technology enables further engineering advancements. Engineering is therefore neither a science nor a part of it; rather, it uses the results of science.

The study of computer science¹ at the university level is a scientific degree program. It is designed to enable graduates to work both scientifically and constructively, thereby preparing them for research and development. While one aspect or the other usually clearly predominates in individual courses, both should be visible in all kinds of theses. This means that a thesis *should* be **useful** in science and/or practice and *must* be **scientifically sound** in terms of its methodology. Since the topic of a thesis determines its usefulness and is therefore essentially predetermined, candidates must above all ensure that their thesis meets the required scientific standards.

2.5 The scientific principle

The concepts of science have developed throughout at least the last two and a half millennia. An attempt to recapitulate this history would go far beyond the scope of this guide and our competence. The following two, largely undisputed contrasting experiences shape our fundamental attitude toward scientific findings:

1. In our field of work, some non-trivial findings and insights are worth sharing with the scientific community to be used or applied directly and further developed in other scientific work.
2. At least in the empirical sciences, there are no definitive truths, only **hypotheses** that remain valid until new observations falsify them.

¹ The term “computer science studies” includes all related degree programs, e. g., Data Science, Software Engineering, and Artificial Intelligence.

The second insight does not apply when a science constructs its own “world,” as is the case in mathematics, for example. In this case, **proofs** in the sense of tautologies are possible. However, it is impossible to prove scientific statements when we search for so-called natural laws. This is because we only ever have a *finite number* of observations (e. g., records of astronomical data) from which we attempt to derive a universal correlation (e. g., Kepler’s laws) presumed to apply to an infinite number of cases. An observation-based (empirical) hypothesis is therefore always at risk of (potentially) being **falsified** by new observations.

Karl Raimund Popper (1902–1994), an Austrian–British philosopher and one of the 20th century’s most influential philosophers of science, formulated it as follows in his essay “Objective Knowledge – A Realist View of Logic, Physics, and History”:

*“Now I should distinguish between two main uses of logic, namely
(1) its use in the demonstrative sciences
– that is to say, the mathematical sciences – and
(2) its use in the empirical sciences.*

In the demonstrative sciences logic is used in the main for proofs – for the transmission of truth – while in the empirical sciences it is almost exclusively used critically – for the retransmission of falsity.”

Popper (1972)

In other words, mathematics starts from axioms (A) and demonstrates, for example through proofs, that these imply further propositions ($A \Rightarrow P$). The empirical sciences formulate a hypothesis (H) and derive their consequences ($H \Rightarrow C$). A hypothesis H remains valid only as long as it is not falsified by an observation $\neg C$. Therefore, a defining characteristic of scientific hypotheses is that they are falsifiable. When we formulate hypotheses, we must present them in a way that allows them to be *confirmed* or *falsified*.

Strictly speaking, general statements such as “The weight is proportional to the mass at a certain location” cannot be proven, since we can test this assumption with only a finite number of experiments. Given this problem, the natural sciences resort to *metaphysics*. Their foundational statements on the stability, continuity, and independence of observed phenomena are fundamentally unprovable. But if we accept them, we can arrive at universally valid statements.

Metaphysics is, therefore, not something nebulous (in the usual sense of “metaphysical”), but rather an essential basic science that makes phys-

ics possible in the first place. In ancient times, it was considered the *highest science*.

Example: “Natura non facit saltus” (Nature does not leap)

This means, that the laws of nature have no gaps or irregularities, but apply continuously. For example, if we measure the weight of bodies with the masses 1 g, 13 g, 233 g, and 78002 g and realize that the weight is proportional to the mass, then we can assume that this also applies to any other masses, e. g., 103.57 g. Of course, this principle cannot be proven, and the presumption may be incorrect. For example, the phenomenon of superconductivity confuses anyone who derives a hypothesis about the relationship between temperature and electrical resistance from measurements at temperatures far from absolute zero.

Conclusion: A hypothesis cannot be proven, but it can be falsified by a single observation incompatible with the hypothesis. [Richard Feynman \(1918–1988\)](#), a famous American theoretical physicist, put it this way:

*“It does not make any difference how beautiful your guess is.
It does not make any difference how smart you are, who made the guess, or
what his name is – if it disagrees with experiment it is wrong.”*

Feynman (1965)

This resembles that of a program test, which – except for trivial programs – does not provide a proof of correctness, since the number of test cases exceeds any manageable amount. On the other hand, a single “positive” test case that reveals an error proves that a program is not error-free. [Edsger W. Dijkstra \(1930–2002\)](#), a Dutch computer scientist, formulated this as follows:

*“Program testing can be used to show the
presence of bugs, but never to show their absence!”*

Dijkstra (1972)

Therefore, a scientific result hopefully has a benefit, but it is valid only as long as it has not been falsified. In line with the two characteristics of scientific results (**usefulness** and **provisionality**), we expect scientific results to be relevant and verifiable.

- Scientific results are **relevant** if they provide answers to relevant questions (otherwise, we call them *irrelevant* and *useless*).
- Scientific results are **verifiable** if they withstand criticism by disclosing, as far as possible, how they were arrived at (otherwise, we call them *unscientific* and therefore *worthless*).

To illustrate these characteristics, let's analyze the following three fictional statements about two Java programs, ALPHA and BETA.

Statement A: The code of the ALPHA program contains an even number of vowels and an odd number of consonants. The figures are exactly the opposite for the BETA program.

Statement B: Experience shows that the ALPHA program is much easier to maintain because of its clearer structure. The literature also confirms this.

Statement C: According to the MacNess (2010) metric, the ALPHA program achieves a value of 12.3, and the BETA program has a value of 7.8. As Passepartout (2014) showed, there is a high negative correlation between the MacNess metric and the maintenance effort (defined according to Head, 2005). This leads to the expectation that the ALPHA program causes lower maintenance costs under the same conditions.

- Statement A is verifiable! It can be criticized because everyone knows how to count vowels and consonants; thus, everyone can verify the results. In practice, there are often major obstacles, but *in principle*, it is possible. Unfortunately, statement A is entirely useless and irrelevant.
- Statement B would be extremely important for assessing maintainability based on easily recognizable characteristics. Unfortunately, however, this statement is entirely unscientific because it is based on
 - unspecified experiences of unnamed persons,
 - unclear terms (structure, maintainability),
 - undefined assessments (clearer structure, easier to maintain),
 - an undefined reference to literature.
 Therefore, statement B cannot be criticized: "You can't nail jelly to a wall."
- Statement C is verifiable if the cited literature exists! Of course, that does not prove this statement. Perhaps there will be a future publication showing that the calculation contains errors, or that MacNess, Passepartout, or both made completely different assumptions in their investigations. The important thing is that statement C – unlike B – allows for such verification in the first place!

A scientific statement is therefore verifiable if it is based on arguments that are essentially verifiable and thus potentially falsifiable.

Example: A well-known flop in recent scientific history, which can serve as a prime example, was “cold nuclear fusion,” [Fleischmann and Pons \(1989\)](#) supposedly observed and published. The initially published statement was inaccurate and hardly allowed for verification elsewhere (the experiment could not work as described). With more precise information, the claim was quickly falsified, i. e., it was shown that the conditions described could not have brought about a measurable fusion. Although this episode was embarrassing, the scientific control mechanism was a success.

Practically speaking, there are two further characteristics of scientific results in addition to those already discussed: A scientific result must be **novel** and **apparently correct**, i. e., it must not be easy to falsify. In the case of thesis projects, a large part of the responsibility for both characteristics lies with the supervisor, who should be aware of the state of the research and, if necessary, recognize an unreasonable result with the help of the examiner.

2.6 Excursus on the legend of purposeless and objective science

Since we are dealing with science, we should also examine its margins and ask how it is embedded in political, social, and cultural contexts. This topic is often avoided with the argument that science is quasi “free-floating,” i. e., **purposeless** and **objective**.

We consider this claim to be a myth. Research, including university research, receives funding and demands from its environment, particularly from governments and industry, and it obeys these funders and serves them to the best of its ability. We see no fundamental alternative to this. However, the connection should be clear so that every scientist can recognize and take their individual responsibility seriously.

Computer Science, in particular, is an example of external control. In the former Eastern Bloc, Computer Science was condemned by those in power at the end of the 1950s and thus suppressed for many years, which had consequences far beyond the end of the Eastern Bloc. In Western countries, on the other hand, computer scientists were seen as the “yeast” of future economic growth. Accordingly, numerous new chairs for Computer Science were established. Their research was often designed to allow and even encourage cooperation with industry. This is still the case today.

From this, we can conclude that Computer Science and IT in general pursue goals that are often determined by economic interests. These goals are neither inherently positive nor negative, but must be evaluated individually, and all parties involved have a moral obligation to do so. The claim that science is “value-free” serves to prevent such a discussion.

In many cases, especially in foundational research, the application of novel scientific results is not foreseeable, so researchers can hardly predict what impact their work will have. Buzzwords are of no help here. Nevertheless, we believe that everyone should ensure that the global impact of their work is commensurate with its global significance. In practice, however, this is often difficult if not impossible. For example, [Albert Einstein \(1879–1955\)](#) effectively supported the development of the atomic bomb, but later could not prevent its use, when his motivation for doing so no longer existed. Scientists always bear social and ethical responsibility for their work, which they should fulfill. At the end of the 1980s, for example, many scientists turned against the “Strategic Defense Initiative” project initiated by the US Army and openly voiced their protest ([Kogut, 1987](#)).

Since we do not approach our research neutrally, but rather with our own goals, prejudices, experiences, knowledge and gaps in knowledge, desires, and fears, we cannot be objective. Scientific objectivity, along with freedom from purpose, is another elusive ideal in the world of intellectuals.

Therefore, we would like to make it clear from the outset that we do not claim that our statements are scientific or objective in any other sense. There are two reasons for this disclaimer: On the one hand, the fundamental argument is that science is not objective; on the other hand, there is the practical insight that we are laymen who have nothing more to offer than our personal, more or less random experiences and insights.

Finally, by acknowledging subjectivity, we also recognize that there is no consensus on various aspects of theses projects, nor can one be reached in the foreseeable future, not even within a single faculty of a single university. We can therefore only present our point of view, justify it, and put it up for discussion.

The considerations outlined here have the following implications for the subject of this guide, i. e., for conducting thesis projects:

- **No one should accept a topic as “God-given” and thus remove it from discussion!**

Instead, each candidate should also address the topic and its legitimacy in their work. This applies all the more to a dissertation, whose topic is usually determined by the doctoral candidate, or at least co-determined by them.

- **Scientific results are not immune to criticism!**

Because we recognize their subjectivity, scientific results are on an equal level with other results. Any arrogance toward other intellectual approaches, such as religious and ideological ones, is unfounded and unjustified by the numerous historical experiences. When we argue with scientific insights, we must not suppress the premises of our statements. However, this often occurs when politicians or managers simplify a complex context into a simple yet catchy half-truth.

3 The Building Block Nature of Scientific Results

It is virtually impossible to evaluate the value of scientific results. However, in addition to useful results, some are hardly usable or not usable at all and should therefore be avoided.

The remark that someone has “reinvented the wheel” in their scientific work is not praise; it’s harsh criticism. Scientific results are not primarily evaluated based on the *distance* between the starting and the end point of the research (How far has the author come from their starting point?). Instead, scientific results are evaluated according to the *level* achieved by the result (Where are we now thanks to the result?). So if someone solves a problem that has already been solved, the difference between the starting point and the result achieved may well be considerable, but this result is still of little value.



This is why, whenever possible, we follow the example of the wren from the old Scottish fairy tale “The Eagle and the Wren.” In this fairy tale, the bird that can fly the highest becomes the king of birds. The little wren becomes king of the birds by sitting on the eagle’s back and flying with him to great heights, before finally adding a small δ by flying a little higher.

3.1 Useful scientific results

To explain the building-block nature of scientific results, we use the metaphor of the “science tower.” In this metaphor, science is represented by a tower consisting of many building blocks stacked on top of each other. Each building block represents an individual scientific result, consisting of thoughts and ideas.

A scientific result is *generally accepted* if the respective building block is considered reliable and stable by a large majority of the scientific community. It is regarded as a **significant contribution** to science if many scien-

tists base their own research on this building block to raise the science tower.

3.1.1 Scientific progress

A good scientific work uses all relevant and available research results and creates a new result on top of them for subsequent research. According to our metaphor, it creates a new building block for a science tower (Figure 3-1). This is referred to as *scientific progress*. It can also be useful when a work concludes that a particular approach is not feasible.

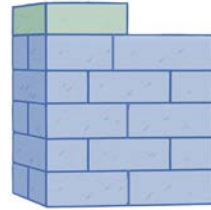


Fig. 3-1 Scientific progress.

3.1.2 Closing a gap

Another way to make a scientifically useful contribution is to solve a problem that has not yet been satisfactorily solved and has therefore been circumvented. This is called “closing a gap” (Figure 3-2).

In software engineering, for example, the problem of how to economically guarantee the correctness of large-scale software systems is unsolved. Although we can prove the correctness of small programs using formal verification methods, we do not yet know how to do the same for large systems. Closing this gap would have significant consequences for software engineering and its applications.

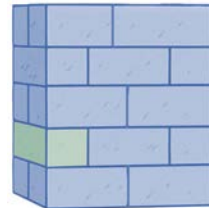


Fig. 3-2 Closing the gap.

3.1.3 Pioneering achievement

Pioneering achievements are a special type of scientific result that are difficult to evaluate (Figure 3-3). They address unexplored research questions and are usually based on little literature, as not much is available, and often achieve astonishing results (the first part of a new tower can be built quickly). Even with such a result, the supervisors must decide whether the topic is relevant. If the topic remains an erratic block with no influence on subsequent research, the effort could have been better spent elsewhere.

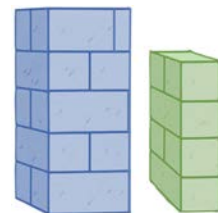


Fig. 3-3 Pioneering.

The introduction of software design patterns by Erich Gamma, a Swiss computer scientist, in his dissertation (Gamma, 1992) is widely regarded as a pioneering achievement. This result formed the general basis for research into design patterns and other patterns in software engineering.

3.2 Other scientific results

However, some types of scientific results are useless for various reasons.

3.2.1 The reinvented wheel

The green block shown in Figure 3-4 represents results that are not new. They already exist and are well published. As mentioned above, the supervisor and the examiner are responsible for avoiding these results. Such results can occur when scientists do not, or do not want to, engage intensively with existing research. (“Why read and cite something I could invent myself?”)



Fig. 3-4 The reinvented wheel.

The results of thesis projects carried out externally, e. g., in industrial settings, often exhibit similar characteristics. These cases do not reinvent the wheel but merely implement it in a new form. One possible reason for this is that companies do not have interest in scientific results, but rather in using students to solve problems for which no resources are currently available.

3.2.2 The castle in the air

A castle in the air (Figure 3-5) refers to a scientific result where it remains unclear which problem has actually been solved. Since there is often no defined research question, the result is “up in the air.”

Such results could be very welcome if they were based on solid foundations. In many cases, however, completely unfounded premises are stated (or worse: not stated, but used). Castles in the air are less common, but they do occur.

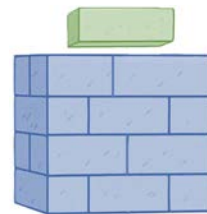


Fig. 3-5 The castle in the air.

3.2.3 L'art pour l'art (Art for art's sake)

Of course, science does not always have to be designed so that the results can be commercially exploited. However, if industry or science does not use the results to create new results based on them, we refer to them as “l'art pour l'art” (Figure 3-6).

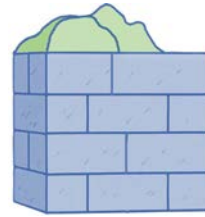


Fig. 3-6 L'art pour l'art.

3.2.4 Old wine in new bottles

Anyone who summarizes existing results in a new, shorter, and more comprehensible way, for example, by applying a new model for a known context, can make a useful contribution. However, simply collecting and compiling other people's results is insufficient (Figure 3-7). Diligence cannot replace ideas and innovations, even if old wine is repeatedly offered in new bottles – even in dissertations.

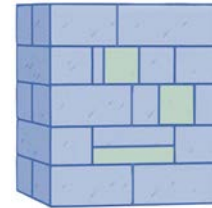


Fig. 3-7 Old wine in new bottles.

3.3 Breadth and depth

Scientific projects can deal with a specific, narrow aspect down to the supposedly last detail or cover a larger area less thoroughly. In the latter case, the work has *breadth* (Figure 3-8a), and in the former case, *depth* (Figure 3-8b).



Fig. 3-8a Breadth only.

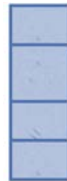


Fig. 3-8b Depth only.



Fig. 3-8c Breadth and depth.

How much of both is appropriate depends on the task. A combination is usually necessary, i. e., you first create a broad basis and then work on a specific section (Figure 3-8c). A dissertation project should contain both. It is, therefore, a good idea to design a broad dissertation project and only dig deep once you have thoroughly explored the area.

4 Organizing a Thesis Project

This chapter describes the process followed in a thesis project. Of course, we can say nothing about the topic-specific focus of the work.

The most important activities of each thesis project are:

- topic selection,
- planning and controlling of the project,
- searching, processing and managing literature,
- solving the problem,
- creating and checking the thesis and
- creating the oral presentation.

Figure 4-1 illustrates these activities as a simple bar chart. Furthermore, a reference is made to the chapter or section where respective methods and guidelines are presented.

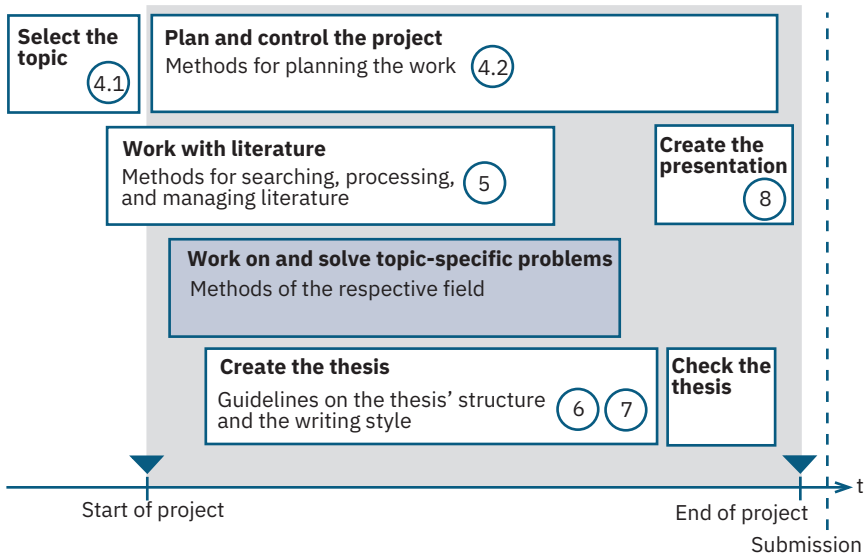


Fig. 4-1 Main activities of a thesis project.

This chart assumes that the oral presentation takes place before the thesis submission date. Adjust the chart accordingly if the presentation takes place after the submission.



The “end of project” date must be scheduled significantly earlier than the “submission” date!

This creates a buffer should unexpected delays occur. In many cases, without such a buffer, the thesis cannot be completed with the necessary care, significantly impairing the overall quality. If a printed thesis must be issued, the buffer must also include sufficient time for printing it.

In addition to the final presentation, candidates often have to give a so-called **proposal talk**, where the candidate presents the problem to be solved and initial ideas for its solution. The proposal talk is intended to ensure that all persons involved — i. e., candidate, supervisor, and examiner — have a common understanding of the topic and the problem at hand. After selecting a topic, the candidate must, of course, familiarize themselves with the topic to prepare this presentation.

4.1 Selection of topic and preparation

No other decision is as important for the success of a thesis project as the choice of topic, as it has a special significance in your degree program and is therefore listed on your transcript. In addition, the thesis serves as a showpiece when seeking employment, as the subject area of the thesis is viewed as the applicant’s area of expertise.

For these reasons, the candidate should not make this choice spontaneously but gather all necessary information and weigh it carefully. To do so, the candidate must be familiar with the focus areas of the individual research groups of their university.

To do this, take the following steps:

- Ask the individual research groups about the currently available thesis topics. Look for topics on the research groups’ notice boards and websites.
- Ask experienced friends and colleagues about their impressions of the research groups, supervisors, and examiners. The Student Council often has valuable experience to share as well.
- Talk to potential supervisors and clarify the requirements to start a thesis project.

- Assess potential difficulties: On the one hand, choosing a very challenging topic provides a chance of presenting a brilliant result; on the other hand, it is easier to fail with such a topic than with a simpler one that can be tackled through systematic work. Familiarize yourself with the topic to the point where you can roughly identify what is required to solve the problem.

Last but not least, be clear about your objectives!

- Where is your greatest interest?
- What do you want to do after graduation?
- Are you pursuing a career in industry or research?

The examination regulations, for good reason, prohibit assigning a thesis topic months in advance. However, if the thesis project is to be carried out within an ongoing research project that requires specialized knowledge and utilizes specific technologies (e.g., languages or tools), prior initial training is necessary. In some cases, 6 to 12 months' lead time is required to build up the necessary knowledge or to attend the relevant lectures.



Make sure that you and your supervisor feel equally committed to all agreements!
Otherwise, you could lose the effort invested in the initial training!

Discussions with the potential supervisor not only clarify the topic, the required knowledge, and other conditions, they also indicate the expected level of supervision. If a supervisor has no time to present the topic comprehensibly, they will probably not show much more commitment once the thesis project has started. If you harbor a personal dislike for the examiner or supervisor (for whatever reason), you should continue looking for another thesis topic.

4.2 Planning the work

Good supervision is essential to the success of a thesis project. Even more important, however, is the candidate's attitude.

- Does the topic interest or, even better, challenge the candidate?
- Does the candidate identify with the problem to be solved and draw additional motivation from the intermediate results?

- Or is the candidate trying to avoid difficulties, avoid the supervisor, and fulfill the examination requirements with minimal effort?

However, even an interesting topic does not protect candidates from losing their train of thought and running out of time without realizing it. By the time this becomes apparent, it is often too late to correct course.

Therefore, every thesis project must be carefully planned! To create a schedule, the candidate must have identified all essential activities required to produce the results necessary to complete the project. To this end, the candidate must clearly understand the problem to be solved. Each activity is defined by the following attributes:

Attribute	Example
Description of the task	Search for literature
Work result	List of publications
End date	2025-07-15
Subtasks (optional)	Gather papers/Check their relevance

Tab. 4-1 Attributes of an activity definition.

A simple technique for identifying relevant activities is to break down the overall work into the activities necessary to complete it. Repeat this until it is possible to estimate the effort and time required to complete the resulting activities with a high degree of certainty. Ultimately, this process creates a tree (a **work breakdown structure**, WBS) whose leaves represent all activities that need to be performed.

Figure 4-2 shows a condensed example WBS for a master's thesis project that aims to answer research questions using experiments. Except for the highlighted, topic-specific activity "Collect and analyze data," the WBS includes only general activities relevant to every thesis project (see Figure 4-1).

Once you have identified and defined the activities, identify the dependencies between their work results. The following questions help with this:

- Which work results are needed to create another result?
- Which activities can be processed in parallel or partially in parallel?

Next, arrange all activities chronologically in the calendar to create a simple bar chart called the **schedule**. The schedule shows important milestones in addition to the activities. For each milestone, you define one or

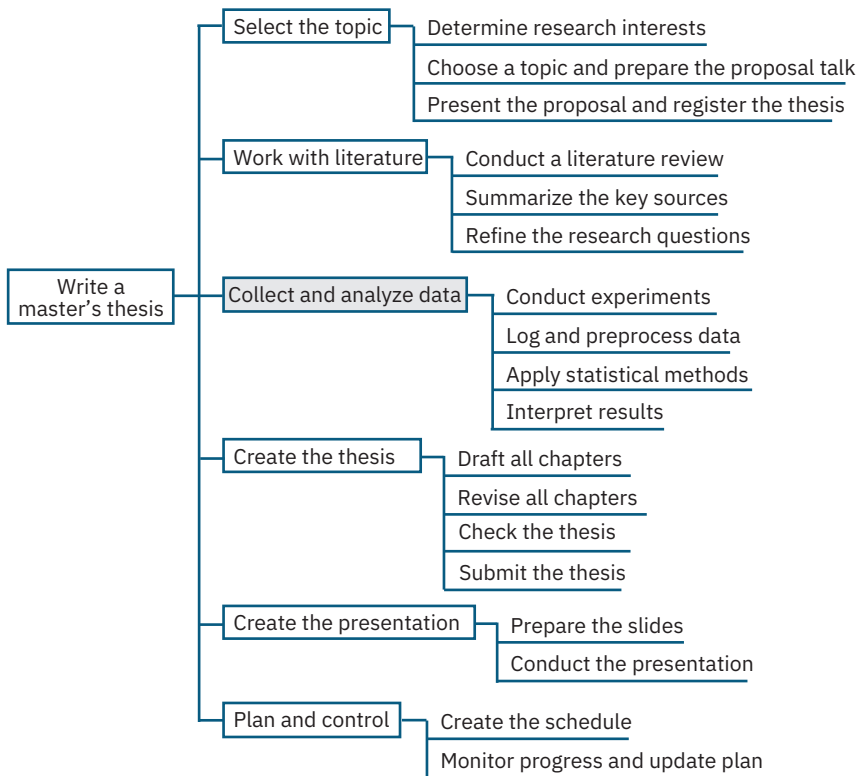


Fig. 4-2 An example WBS for a master's thesis project.

more work results to be completed and checked. The bar chart visualizes the dependencies between the individual activities indirectly via their graphical positions.

In addition, the schedule must include all activities not directly related to the project but still take the candidate's time, e. g., a planned holiday trip. [Figure 4-3](#) depicts a fictitious example.

The supervisor must support the candidate in setting up the schedule since the candidate usually plans too optimistically and forgets necessary buffer times to accommodate inevitable disruptions. Candidates often assume that 3 or 4 weeks are sufficient to write the thesis once the conceptual work has been completed. The popular saying "Now I just have to write it down" only obscures the reality. Writing is a creative activity in

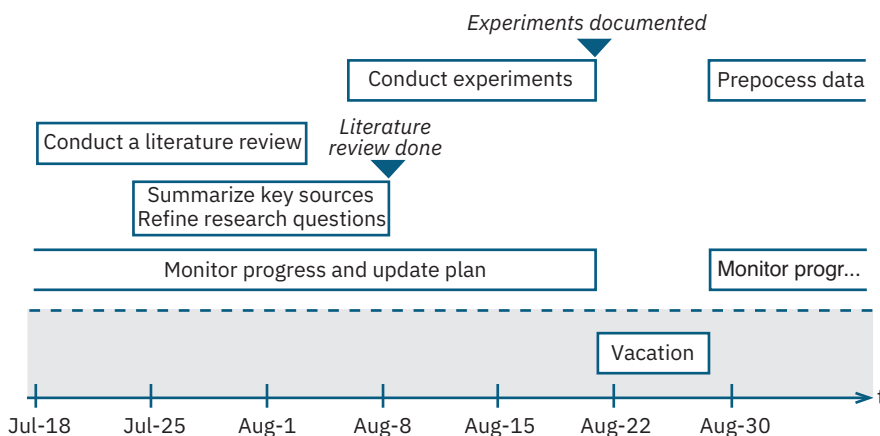


Fig. 4-3 Excerpt of a fictitious schedule.

which all kinds of ambiguities and contradictions emerge that become noticeable only when formulating thoughts and results.



A schedule can only serve as a basis for the project if the candidate and the supervisor are confident that it can be adhered to!

The schedule is the most important tool for monitoring progress. Of course, it does not guarantee that all work will be completed as planned. At the beginning of the project, the candidate and supervisor should agree to meet regularly. Regular meetings have the advantage over spontaneous or random meetings by motivating the candidate to work continuously, and the supervisor and the candidate can – and should – prepare for them. These meetings have two main objectives:

- The candidate discusses any problems and questions that have arisen since the last meeting. This may also include suggestions for changing the thesis title.
- The supervisor and the candidate review the project's progress according to the schedule. If a delay becomes apparent, it must be addressed immediately. Depending on the causes identified, the following reactions are possible:
 - The scope of the thesis can be modified (usually reduced).

- The schedule can be adapted (activities shortened or even removed).
- In extreme cases, the thesis project can be terminated.

The supervisor and examiner would decide to terminate the project in particular if the candidate shows insufficient commitment over a longer period of time. Of course, there are various tools available to structure and describe the activities. The same applies to creating the project schedule.

4.3 Advice and tips

Psychologists and scientists in the fields of ergonomics and human factors have long studied ways to improve human performance. We cannot and do not want to compete with them, but instead we would offer some advice for successful scientific (or other intellectual) work.

Create conditions that promote your work!

If possible, organize and prepare your work environment. This includes:

- **a pleasant workplace** – only those who work in a comfortable environment can fully utilize their potential. Design a workplace that suits you.
- **a smooth start without hurdles** – for example, you waste your time and energy by having to search for your work equipment.
- **fixed working habits** – establish fixed working hours and break times, and adhere to them whenever possible. Sometimes it is more effective to take a walk to think about how to solve a problem while stay sitting at your desk at home.

Set measurable sub-goals!

Working without a defined goal consumes time and energy but does not deliver results. Determine the goals to be achieved and formulate them at the beginning of every activity, based on the activity's definition.



Setting goals is pointless unless you check how far they have been achieved!

That is why you need to introduce a *control mechanism* that forces you to regularly compare actual with planned figures. This should occur often enough for goals to be permanently visible. For example, the goals can be noted on index cards and pinned to the wall. When a goal has been achieved, take down the corresponding card or mark it as completed.

Use appropriate tools!

Engineers differ from artisans by solving problems on the drawing board rather than on the machine! The same applies to a good scientist, who also (initially) needs paper and pencil!

Of course, we use notebooks or tablets for our work. These offer a wide range of tools for organizing ideas and thoughts (e. g., in the form of a mind map) or writing down and organizing our notes and concepts (e. g., with the help of digital notebooks). Tablets, in particular, allow us to quickly create illustrations and sketches with a digital pencil. All these tools have the advantage that the data generated are stored, allowing us to modify and further develop it.



Choose the tools you want to use carefully!

Ask your supervisor which tools they recommend for specific activities!

In general, the following applies: Tools help only if our minds are not empty. *The muse does not kiss us in front of the computer screen!*



5 Working with Scientific Literature

In Chapter 3, we explained and justified to base all scientific projects on all the relevant and available results from other researchers. Thus, working with literature is a crucial activity in scientific projects. Carefully searching and analyzing the literature provides the foundation for our work and helps avoid repetitions and creating “castles in the air.”

5.1 Terminology

The “Understanding Science Glossary” published by the University of California Berkeley defines the term “**scientific literature**” as follows ([UC Berkeley, 2026](#)): *“The body of scientific publications that contain firsthand reports of research, often reviewed by experts. The scientific literature provides the cumulative, permanent record of scientific research that can be consulted to learn about research in a field.”*

The field of scientific literature has its own technical language. Since many terms are interpreted in very different ways, here are some key terms we use in this guide; we based our definitions on the citation guidelines published by ETH Zurich Library ([ETH Zurich, 2025](#)):

- **Source** – A source comprises material produced by others or in one’s previous work. Sources include texts, images, code, interview data, etc.
- **Publication** – A source that has been published and is therefore publicly accessible.
- **Online publication** – A publication that is electronically published and available on the web.
- **Citation** – A way of giving credit to the information you have mentioned explicitly by pointing the reader to the source of information. A citation appears in the main text of your thesis.
- **Reference** – A detailed specification of the source that you want to give credit to via a citation (also referred to as a *bibliographical reference*).
- **References** – A section including all sources directly cited at least once. In a thesis, references are usually given in a list at the end of the document.

- **Bibliography** – It contains all the sources used for your work, whether cited or not. Include all materials you consulted to prepare your work in a bibliography.
- **Citation style** – This defines the rules for the presentation and structure of citations and references. They differ depending on the scientific field, publisher, and journal.

5.2 Types of publications

Because there are different types of publications, be aware of and consider their advantages and disadvantages. Table 5-1 shows the advantages and disadvantages of the most often used publication types.

Type	Advantages	Disadvantages
Book	● comprehensive in content ● rather distanced, comparative (i. e., almost objective)	● rarely very current ● often unspecific ● not available for new research areas
Journal article	● topic-specific ● up-to-date	● often biased (author focuses on the strengths of their ideas)
Contribution to proceedings	● like journal articles ● even more up-to-date	● like journal articles ● less mature

Tab. 5-1 Comparison of the most often used publication types.

Publications of varying quality can be found in all three types. We can certainly assume that a renowned publisher publishes less junk than a publisher whose revenue is based on fast-moving “Tips and Tricks” books. The same applies for academic papers: A paper with weak content is more likely to be accepted at a regional workshop than at a well-known international conference.

Papers in scientific journals, such as those published by renowned associations or publishers (e.g., IEEE, ACM, or Springer), are **peer-reviewed**. This means that reviewers strictly check the papers, and the authors must improve the paper before publication. Therefore, non-peer-reviewed journals should only be used with great caution.



Ask your supervisor about journals and conferences relevant to your topic!

Nowadays, many publishers make their journals available electronically on the web. Most conference proceedings are also published electronically, with the publisher guaranteeing the long-term stability of the publications. In recent years, many publishers and authors have also decided to make their publications “open-access,” i. e., anyone can access them for free. In these cases, you can access the publications easily and quickly and can rely on their quality and stability.

To ensure that online publications can be found over the long term, the publishers assign them a unique identifier: the **digital object identifier** (DOI). A publication’s DOI never changes, though its metadata, such as the URL under which the publication is accessible, may.

5.3 Gray literature

Besides the traditional publications, so-called **gray literature** exists on the web. This term is used to describe a wide range of different sources produced outside of traditional publishing and distribution channels. The term was defined 2004 at the 6th International Conference on Grey literature in New York City as follows¹: “*Information produced on all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing i. e. where publishing is not the primary activity of the producing body.*”

A wide – and growing – range of sources can be considered as gray literature. Examples include blogs, preprints, survey results, wikis or white papers. Gray literature has two main advantages:

- It can be accessed quickly, from anywhere, and often at no cost.
- Most of the time, it is very up-to-date.

However, this is offset by the following disadvantages:

- Usually, gray literature carries *no quality assurance*, which is why these sources should be treated with suspicion.
- Gray literature is *not formally published*. Therefore, you need to consider the longevity of the source. What is on the web today may change tomorrow, to be found under a different URL, or disappear altogether. This is why URLs, in contrast to DOIs, are almost worthless as refer-

¹ This definition clarifies the so-called “Luxembourg definition” from 1997. Schöpfel (2011) describes how this definition has come about.

ences. Even if a reader finds something under a URL, they cannot know whether the content will remain the same.

- Those who publish text on the web generally do so not out of charity, but rather to pursue a goal; authors often want to sell something. As these sources are not checked for correctness and neutrality by any independent body, there is much junk among them, which makes searching for information more difficult.

For these reasons, searching the web is beneficial if you want to discover the current state of a particular scientific field and identify publications suitable for familiarizing yourself with it. Ultimately, however, your work must cite reputable, stable, and long-term accessible sources.



Carefully consider the quality of gray literature before using it as a source of information in your work!

5.4 Literature search

Working with scientific literature begins with the search and procurement of sources, followed by their analysis. These activities are not conducted sequentially but rather iteratively. The initial emphasis lies on searching for and reviewing publications, then shifting to analyzing the collected publications. When analyzing a high-quality publication, you will find references to additional publications, that must be collected and analyzed again.

In the past, such a cycle often took weeks, especially if you had to procure a publication physically from far away. Today, thanks to the web, only hours are required for the search and procurement. Of course, the effort needed to analyze the publications remains unchanged.

At the beginning of any thesis project, you must identify the publications that are useful for your work. The literature search serves this purpose. It provides a list of references that have been assessed as possibly relevant.



When starting a thesis project, the candidate should usually receive some references from their supervisor!

In the past, searching for literature always started in a library. Today, in most cases, we can do this from the comfort of our homes, as almost all recent scientific publications are also published electronically. In addition, a plethora of older publications have been digitized in recent years and are now available for searching. Hence, **academic digital libraries** are the most important sources when searching for publications.

The following libraries providing direct access to sources are significant for computer science:

- **ACM Digital Library** → <https://dl.acm.org>
Managed by the Association for Computing Machinery, this database is a key resource for computer science and IT research.
- **IEEE Xplore Digital Library** → <https://ieeexplore.ieee.org>
Published by the IEEE, it provides access to journals, conferences, and standards in computer science, engineering, and related fields.
- **SpringerLink** → <https://link.springer.com>
A repository of scientific and technical research, including journals, conference papers, and books in computer science.
- **arXiv** → <https://arxiv.org>
A free distribution service and an open-access archive in physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science, and economics. Please note: arXiv is *not* peer-reviewed!

In addition, you can search **bibliographic databases** and use **academic search engines**; both provide only bibliographic data for publications. These are some examples:

- **Scopus** → <https://www.scopus.com>
A multidisciplinary database including computer science, engineering, medicine, social sciences, and the humanities managed by Elsevier.
- **Bielefeld Academic Search Engine** → <https://www.base-search.net>
A search engine for academic web resources. It aims to locate web resources that are ignored by commercial search engines or get lost in the vast quantity of hits.
- **Semantic Scholar** → <https://www.semanticscholar.org/>
A free, AI-powered research tool and search engine for scientific literature covering all essential bibliographic libraries and databases.

- **DBLP Computer Science Bibliography** → <https://dblp.org>

A freely accessible database providing information on major computer science journals and proceedings.



Every scientific field has its specific literature databases!
Your supervisor and your examiner can assist you here!

All of these databases allow structured **search queries** using keywords and logical operators. To do this, you must first determine the keywords relevant to the search query.

Example: We want to search for publications that report on using the combinatorial test in industry. The following search query serves this purpose:

```
("industry" OR "industrial") AND
("combinatorial testing" OR "combinatorial test") AND
("application" OR "experience")
```

This query resulted in 33 publications at IEEE Xplore on 2025-07-25. By default, the hits are ranked according to the number of terms in the metadata that match the search query.

These are the five top-ranked publications:

- Z. Li, Y. Chen, G. Gong, D. Li, K. Lv and P. Chen, "A Survey of the Application of Combinatorial Testing," 2019 IEEE 19th International Conference on Software Quality, Reliability and Security Companion (QRS-C), Sofia, Bulgaria, 2019, pp. 512–513.
 - D. Jarman et al., "Applying Combinatorial Testing to Large-Scale Data Processing at Adobe," 2019 IEEE International Conference on Software Testing, Verification and Validation Workshops (ICSTW), Xi'an, China, 2019, pp. 190–193.
 - P. Wojciak and R. Tzoref-Brill, "System Level Combinatorial Testing in Practice – The Concurrent Maintenance Case Study," 2014 IEEE Seventh International Conference on Software Testing, Verification and Validation, Cleveland, OH, USA, 2014, pp. 103–112.
 - M. Leithner, J. Zivanovic, R. Kugler and D. E. Simos, "Towards Continuous Integration for Combinatorial Testing," 2025 IEEE International Conference on Software Testing, Verification and Validation Workshops (ICSTW), Naples, Italy, 2025, pp. 288–291.
 - J. Hagar, R. Kuhn, R. Kacker and T. Wissink, "Introducing Combinatorial Testing in a Large Organization: Pilot Project Experience Report," 2014 IEEE Seventh International Conference on Software Testing, Verification and Validation Workshops, Cleveland, OH, USA, 2014, pp. 153–153.
-



Discuss your search queries and the resulting hit-lists with your supervisor so they can suggest improvements if necessary!

Normally, you have to try out different variants of a search query until you get a suitable set of publications.

If you query several databases, the hit-lists will contain duplicates, as some databases often index the same publishers. For example, DBLP indexes all publications that appear in arXiv and many publications included in ACM DL and IEEE Xplore. Some sources are also published by several publishers. For example, the proceedings of the International Conference on Software Engineering are jointly published by the IEEE and ACM.

Ideally, your literature search turns up some high-quality, up-to-date publications that introduce the topic and contain further useful references that can be analyzed again, etc. This process is also referred to a **snowballing** or **citation chaining**.



Unfortunately, some digital libraries and bibliographic databases are not freely accessible. In this case, contact your supervisor, as universities often grant access all students to them!

If you cannot find a publication on the web, search for it in the university library catalog. As the library catalogs are interconnected, you can also find publications in other libraries and obtain them via interlibrary loan.

5.5 AI-supported literature search

AI tools for academic literature search have been available for some time now, and the number of such tools is growing continuously. Roughly speaking, these tools are often divided into **responders** (also called finders) and **explorers** (also called connectors).

We cannot provide a comprehensive overview of these tools here. Instead, we briefly introduce both types, provide an example of how these tools can be used, and discuss their benefits and limitations. Of course, there are also AI tools that offer features from both types.

Responders

Responders work like traditional digital libraries or bibliographic databases: You enter a query and get a list of hits. However, you don't need to create a detailed search query for your research question. Instead, you can enter the research question in natural language, in your mother tongue. Many of these tools provide not only a list of hits but also a well-formulated answer to the question asked based on the relevant top-x publications. Of course, you can export the bibliographic data of those and other relevant publications.

As an example of a responder, we selected the ORKG Ask tool, provided by the Technische Informationsbibliothek (TIB), Hanover (Germany).

Example: ORKG Ask → <https://ask.orkg.org>

We entered the following research question on 2025-07-16:

“What publications report experiences on using the combinatorial test in the industry?”

The tool returns the following answer (based on the five top-ranked papers):

“The use of combinatorial testing in industry has been reported in several studies [1][2][5]. For instance, one case study investigated the applicability of a combinatorial testing tool in the company SOfTEAM [1], while another paper measured the combinatorial coverage of manually created test cases by industrial engineers [2]. Moreover, a review article highlighted the importance and evolution of research on Combinatorial Testing [3][4] and identified areas for future research, including improving analysis of testing results and exploring its application to various types of systems [3]. Despite the potential benefits, the lack of industrially applicable tools for combinatorial modeling and test generation has limited its uptake in industry [5].”

Additionally, the answer listed the bibliographic data of all cited publications:

- [1] Condori-Fernandez, O.N., Krusse, P., Vos, T., Brosse, E., Bagnato, A, Rodrigues da Silva, A., and Rito Silva, A, “Combinatorial Testing in an Industrial Environment – Analyzing the Applicability of a Tool.” IEEE, 1 2014.
 - [2] Miraldi Fifo and Eduard Enoiu, “On Measuring Combinatorial Coverage of Manually Created Test Cases for Industrial Software,” 4 2019.
 - [3] Nie, C and Leung, H, “A survey of combinatorial testing,” 1 2011.
 - [4] “A Survey of Combinatorial Testing,” 10 2016.
 - [5] Abdullah, A., Hassan, R., and Shah, Z. A., “A systematic literature review of combinatorial testing,” 1 2017.
-

However, the quality of references provided is poor, as much of the bibliographic data is missing (e.g., for reference [4]). Even worse, these references do not include essential publications we got when applying the respective search query to IEEE Xplore.

Explorers

Explorers generate networks or graphs based on the bibliographic and thematic relationships between publications. You only need to feed in a so-called **seed paper** (e.g., by its DOI), usually a relevant publication you have already found. The tool then analyzes its databases and returns a graph showing the seed paper's most related publications (based on citations or other metrics). As an example for an explorer, we selected the RESEARCHRABBIT tool.

Example: ResearchRabbit → <https://www.researchrabbit.ai/>

As seed paper, we used the following frequently cited survey on the combinatorial test (DOI: 10.1145/1883612.1883618):

Nie, C., & Leung, H. (2011). A survey of combinatorial testing. *ACM Comput. Surv.*, 43(2).
<https://doi.org/10.1145/1883612.1883618>

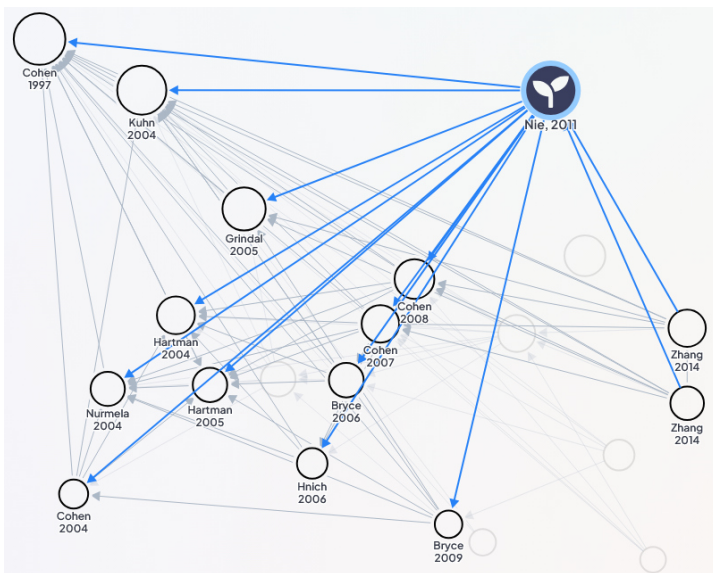


Fig. 5-1 An example graph generated by ResearchRabbit visualizing related publications.

Figure 5-1 shows the generated graph visualizing the seed paper's similar publications. You can interactively explore the graph, focus on a specific publication to get detailed information, and generate further graphs for publications you assess as relevant, etc. Of course, you can download the references of the publications considered.

AI tools for literature research are easy to use and require little effort. The results are presented compellingly. But, can these AI tools for literature search substitute for a conventional literature search? Like many others, this question cannot be answered with a simple YES or NO! This is what we know, as things stand today:

- AI tools for literature search allow us to *quickly* and *efficiently* find an initial set of possibly relevant publications and obtain an overview of the publications and the most important authors in the respective field.
- It is difficult, if not impossible, to *verify* whether the provided relevance or similarity ranking is appropriate, as the ranking methods are often not transparent.
- We have to *check* the results, as we cannot trust these tools.
- We *cannot rely* solely on AI tools results for literature searches.



AI tools for literature research can (and should) be used!
Contact your university library. They should have specialized expertise in using AI tools for literature searches!

5.6 Specifying references

To ensure that readers can actually find the publications listed in the references of your thesis or paper, all references must include all necessary bibliographical data. Anyone who has ever had problems with inaccurate references should spare their readers these superfluous difficulties. Table 5-2 lists the data required for the most often referenced publication types. The data fields in square brackets are optional; they should be specified when available.

Publication type	Bibliographic data
Book	author or editor, title, publisher, year [series, address, edition, DOI]
Journal article	author, title, journal, year [volume/number, pages, month, DOI]
Contribution to proceedings	author, title, book title, pages, year [editor, volume, number, series, address, location, date, organization, publisher, DOI]
Gray literature	author, title, URL, access date [website name (if different from URL), publication date]

Tab. 5-2 *Bibliographic data per publication type.*

Additionally, store the following information with each reference:

- **Tags** – These are used to classify the content of a publication. Using a fixed set of tags, you can later easily find all publications classified accordingly.
- **Summary** – It describes the results and findings of the publication (at least in key words).
- **Storage location** – If you borrowed the publication from a library, use its signature. If you have paper copies or PDF files of publications, indicate their storage location at your workplace. PDF files are best saved in folders and numbered consecutively. According to this scheme, the signature “A10” indicates that the corresponding PDF file can be found in the folder “A” and has A10 as a prefix in its file name. You can also use the same scheme to organize the paper copies in physical folders.

5.7 Organizing the literature

If the literature search was successful, the number of publications you found may be so large that it is easy to lose track of them. Therefore, you should

- immediately *register* the publications and their references,
- quickly *review* the publications to filter out irrelevant publications.

Both saves a lot of work and time!

5.7.1 Filtering out irrelevant publications

To identify and filter out irrelevant publications, you need to be somewhat familiar with their content, as otherwise, you may overlook essential publications. In most cases, it suffices to look at the title, abstract, and table of contents of a publication, as described in the Preview-step of the PQ4R method (see [Section 5.8](#)).

Alternatively, AI tools can also be used for this purpose. They can quickly create a summary of a publication, which may be more detailed than the original abstract and often better suited to assessing the publication's relevance.

Example: We selected CHATGPT to provide an extended abstract for the following paper with which we are very familiar:

Aydin, S., & Lichter, H. (2024). Tool-supported Development of ML Prototypes. *2024 31st Asia-Pacific Software Engineering Conference (APSEC)*, Chongqing, China, 477–481. <https://doi.org/10.1109/APSEC65559.2024.00063>.

This is the original abstract from the paper (136 words):

“Prototyping of machine learning (ML) solutions represents a pivotal stage in developing ML-enabled systems. In this course, the prototype serves as a means of communication and should demonstrate the technical feasibility and value to technical and non-technical stakeholders. But, in the context of the current ML solution prototyping process and tooling environment, non-technical stakeholders are limited in their ability to participate effectively, primarily due to the difficulty of understanding the specific ML solution strategy being implemented. In addition, valuable knowledge is lost during the prototype development process because the process is not sufficiently documented, preserved, or made easily accessible for future projects. To significantly improve the development of ML prototypes, we propose an extended ML prototyping process and tool support in the form of a toolbox. Preliminary implementations of some tools of the toolbox are presented.”

We instructed CHATGPT not to exceed 150 words and provided the paper's PDF file. The following prompt was submitted to ChatGPT on 2025-07-23:

“Create an extended abstract of the provided academic paper to be used for a literature review. Very important: The extended abstract must not contain more than 150 words and must contain the most essential information for the defined purpose.”

As a response, CHATGPT generated the following abstract (141 words):

“This paper addresses key challenges in machine learning (ML) prototyping, notably the limited involvement of non-technical stakeholders and the lack of cross-project reuse due to missing documentation. To overcome these issues, the authors propose an extended ML prototyping process and a tool-

supported approach. The enhanced process introduces activities for documenting solution strategies and design rationales, enabling better stakeholder communication and informed decision-making. A complementary toolbox—ML PROTOBOX—supports these activities through tools like CELLFLOW (workflow visualization), HISTREE (versioned prototype history), and JUPYRECSYS (code recommendation). Implemented as JupyterLab extensions, these tools facilitate automatic documentation, artifact persistence, and reuse of ML solutions. Preliminary feedback indicates improved prototype transparency, reduced cognitive load, and enhanced reuse potential. The work contributes a structured methodology for developing interpretable, traceable, and collaborative ML prototypes, laying the foundation for broader adoption and continuous improvement in ML-enabled software engineering practices.”

In this example, the generated abstract provides a concise summary of this paper. Although roughly the same length as the original abstract, it contains significantly more information and is therefore well-suited for assessing the paper’s relevance.



AI tools can summarize academic papers quickly and accurately!

A generated summary should never be the sole basis for citing a paper in your work!

Only cite what you have read and understood yourself!

5.7.2 Managing publications

To store and manage the references and the publications you want to use, set up a suitable **bibliography management infrastructure**, as their number can be considerable. An evaluation of the scientific works created at the Software Construction Research Group of the RWTH Aachen University, which is certainly not representative, yielded the following average number of publications cited therein: seminar paper (25), bachelor’s thesis (30), master’s thesis (50), dissertations (150). Managing a large mass of publications is challenging; having a tool’s support is essential!

Of course, you can manage the references with a general-purpose tool, e.g., a text processing or a spreadsheet software. However, it is advisable to use a dedicated **bibliography manager** (also referred to as a *citation manager*), as these tools offer many valuable functions. There are many such tools; some can be used free of charge, while others require a license.

A bibliography manager allows you to quickly create, sort, group, and search through references. In addition to these essential functions, it should also offer the following functions:

- **Importing references** – This makes adding a new reference much easier. Most literature databases export the references in various formats. The so-called BIBTEX format has been established and proven as a quasi-standard for references for many years.
- **Exporting references in the required format** – Let's assume you are writing your thesis using a word processor such as OPENLIBRE. In that case, the bibliography manager should export the references in the required citation format (see [Section 5.9](#)), so that you can insert the references directly in your document and do not need to reformat them.



Set up the bibliography management infrastructure in good time!
Contact your supervisor and the university library; they should have special expertise in using bibliography managers!
Sloppy handling of references can considerably delay your thesis project!



[Figure 5-2](#) shows the components of the bibliography management infrastructure and the central role of the bibliography manager. It stores all references to all publications found in your literature search and provides the references for those publications cited in your thesis or paper.

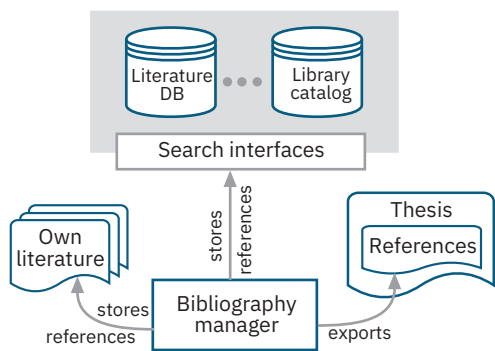


Fig. 5-2 Components of a bibliography management infrastructure.

5.8 Analyzing publications

When analyzing a publication, it is important to recognize and incorporate its central statements into your work. The **PQ4R method**, as presented by [Thomas and Robinson \(1972\)](#), can help read and analyze a publication in a focused and structured manner. The aim is not to increase reading speed but to ensure you have understood and retained the content. The PQ4R method can be used chapter by chapter for long documents or books. [Table 5-3](#) briefly lists the six steps of this method.

STEP 1 - Preview	Try to obtain an overview. The author, title, abstract, and table of contents are hints for a rough classification. The text should then be “screened,” paying particular attention to headings, illustrations, and highlighting.
STEP 2 - Questions	Derive from the overview questions you have gained that you want to answer with the text. Write down the questions!
STEP 3 - Read	Read the text carefully and try to answer your questions. Highlight the relevant sections or paragraphs.
STEP 4 - Reflect	When reading, constantly relate the content to what you already know. Look for arguments and counter-arguments, examples and counter-examples.
STEP 5 - Recite	Try to reproduce the text (orally) in your own words. Try to answer the formulated questions. If you find this difficult or you fail, read the text again.
STEP 6 - Review	Go through the entire text in retrospect. Have all questions been answered? Finally, formulate a critique!

Tab. 5-3 Steps of the PQ4R method.

If, during one of the steps, it becomes apparent that the effort involved does not yield the expected benefits, briefly summarize the publication, document your assessment (so that you do not analyze this publication a second time later), and discard it.

5.9 Citations and references

References enable readers to access the cited publications. For this reason, they must be precise and refer to sources that are actually accessible. In practice, there are two exceptions to this rule:

- Sources that are *not publicly accessible* because they were written exclusively for internal use by a company or an institution. In this case, the word “unpublished” is added at the end of the reference. This means: “The author citing the work guarantees that this publication exists and that they own it or at least have access to it.”
- If the only source for essential information is a *verbal statement* from a conversation, cite it with the addition of “private communication.”

The citations should always be placed in the text as close as possible to the relevant text passage. They refer to references included at the end of the thesis or paper.

There are different **citation styles** in the various scientific fields. For example, publications in chemistry are usually cited differently from those in mechanical engineering or computer science. The required citation styles are often variations of well-known styles, such as APA (American Psychological Association), Chicago, or Harvard.

In general, we can distinguish between *citation-key* and *name-year* citation styles.

5.9.1 The citation-key citation style

The citations in the text are given using a generated key. Two different types of keys are used:

- **Numbers** – In these citation styles, e.g., in the IEEE citation style (IEEE, n.d.), the references are numbered by order of their citation in the text. So, the first publication cited is 1, the second 2, and so on. In other styles, e.g., in the CSE (Council of Science Editors) citation-name style (CSE, 2025), the references are numbered alphabetically by the last name of the first author. This is an example using the IEEE style:

Security testing is an integral part of quality assurance [1]. As clearly outlined by Korir [2], more research is needed to improve our security testing capabilities to reduce the security risks in the software development life cycle [3].

- [1] M. Felderer, M. Büchler, M. Johns, A. D. Brucker, R. Breu, and A. Pretschner, "Chapter one – security testing: A survey," in *Advances in Computers*, A. Memon, Ed. Elsevier, 2016, vol. 101, pp. 1–51.
- [2] F. C. Korir, "An investigation into software quality and security: Past research works and existing gaps," *Global Journal of Engineering and Technology Advances*, vol. 14, no. 3, pp. 149–171, 2023.
- [3] M. Alenezi and S. Almuairfi, "Security risks in the software development lifecycle," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, no. 3, pp. 7048–7055, 2019.

- **Initials-year key** – These citation keys are usually generated from the authors' last names and the publication year. The following example uses the so-called BibTeX alpha style (if a publication has more than three authors, the forth author and all other authors are replaced in the citation key with "+"):

Security testing is an integral part of quality assurance [FBJ+16]. As clearly outlined by [Kor23], more research is needed to improve our security testing capabilities to reduce the security risks in the software development life cycle [AA19].

- [AA19] M. Alenezi and S. Almuairfi, "Security risks in the software development lifecycle," *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, no. 3, pp. 7048–7055, 2019.
- [FBJ+16] M. Felderer, M. Büchler, M. Johns, A. D. Brucker, R. Breu, and A. Pretschner, "Chapter one – security testing: A survey," in *Advances in Computers*, A. Memon, Ed. Elsevier, 2016, vol. 101, pp. 1–51.
- [Kor23] F. C. Korir, "An investigation into software quality and security: Past research works and existing gaps," *Global Journal of Engineering and Technology Advances*, vol. 14, no. 3, pp. 149–171, 2023

The citation-key style has the advantage that only brief keys appear in the text so that the text is not bloated with citation information. However, the reader does not receive any information about the publication itself. Therefore, the reader must look for the corresponding reference to better place the publication in the context of the text.

5.9.2 The name-year citation style

In this style, references are sorted alphabetically by the last name of the first author, using the authors' last names and the publication year. The following example uses the APA citation style (7th ed.)². Styles based on this are often referred to as “APA-like.”

According to Felderer et al. (2016), security testing is an integral part of quality assurance. As clearly outlined by Korir (2023), more research is needed to improve our security testing capabilities to reduce the security risks in the software development life cycle, as argued by Alenazi and Almuairifi (2019).

Alenezi, M., & Almuairifi, S. (2019). Security risks in the software development lifecycle. *International Journal of Recent Technology and Engineering (IJRTE)*, 8(3), 7048–7055. <https://www.doi.org/10.35940/ijrte.C5374.098319>

Felderer, M., Büchler, M., Johns, M., Brucker, A. D., Breu, R., & Pretschner, A. (2016). Security testing: A Survey, In *Advances in computers* (Vol. 101, pp. 1–51), Elsevier. <https://doi.org/10.1016/bs.adcom.2015.11.003>

Korir, F. C. (2023). An investigation into software quality and security: Past research works and existing gaps. *Global Journal of Engineering and Technology Advances*, 14(3), 149–171. <https://doi.org/10.30574/gjeta.2023.14.3.0059>

If a publication has more than three authors, the second and all subsequent authors are replaced in the citation by the Latin suffix “et al.,” which means “and others.” If several publications by the same author (or authors) with the same year of publication are cited, this is indicated in the citation by adding a letter (a, b, etc.) to the year.

In contrast to the citation-key style, the name-year style allows the writer to semantically integrate the cited publication into the text by naming the author(s) and thus giving the publication a “face” without the reader having to search for it in the references.

² The Purdue University's Online Writing Lab (OWL) provides useful details and examples of the APA citation style (https://owl.purdue.edu/owl/research_and_citation/apa_style/index.html).

6 The Structure and Content of a Thesis

The thesis is the most important deliverable of a thesis project. It must be prepared with the utmost care. In this chapter, we provide guidance on structuring a thesis.

6.1 Objectives and requirements

A thesis is not written for its author, but for readers who

- are interested in the topic of the thesis but know less about it,
- need to be motivated to read,
- want to spend as little time and effort as possible on reading,
- expect something in return (usually new insights).

Whether you can win over a reader depends mainly on how you prepare and present the content. When candidates work intensively on a topic, they often struggle to put themselves in the shoes of readers who have little or no knowledge of the thesis's background. Discussions with the supervisor about this can steer candidates in the wrong direction, as the supervisor is usually very well-informed and hopes that the results will contribute to their research.

Since the examiners – not the supervisor – grade the thesis, they represent very important readers. When grading, they rely primarily on the content of the thesis, and the second examiner relies exclusively on it. Therefore, the thesis must be complete and comprehensive in both content and form.



Theses are not written for their author, but for readers!

Do not assume that examiners or other readers know what the thesis is about!

Accordingly, there are guidelines for theses which intend

- to clarify who might benefit from the thesis and who is wasting their time reading it,
- to facilitate access to the thesis's topic,
- to make reading it as pleasant as possible, both in terms of its external appearance and its content structure, and
- to describe everything as concisely as possible.

Readers are always at the mercy of the author of the thesis. Of course, they can read more slowly or quickly, turn back and repeat, and interrupt their reading, but they cannot ask questions as they would during a presentation.

The author of a thesis must take this into account. That's why many minor weaknesses are acceptable in a presentation, but not in a thesis. You can give a mediocre presentation, but when writing your thesis, you should be very disciplined and proofread what others will later read over and over again



Always remember to help the reader understand your thesis and the solution you have developed!



6.2 The sections of a thesis

There is no universal structure for a thesis, as it always depends on the topic. A thesis often consists of the sections listed in Table 6-1. Sections 3 to 8 constitute the main chapters of the thesis, though a section may be divided into several chapters. This structure serves as the preliminary skeleton of your thesis. Of course, the chosen working titles for these sections can be replaced with more appropriate ones.

1	Cover page with title, bibliographic data, abstract
2	Table of contents, possibly a list of figures, tables, etc.
3	Problem statement, research questions
4	Related work (relevant literature) / foundations
5	Solution approach
6	Solution description (concepts, design, realization)
7	Results, evaluation
8	Review (of the course of the work), future work
9	References
10	(Appendices)

Tab. 6-1 Sections of a thesis.

Title and abstract – The title and abstract together form the “shop window” of every thesis. As in a real shop window, you are presenting exactly what is available, no more and no less. If you promise too much, the reader will later feel deceived. On the other hand, you may lose readers if you present important results inadequately.

Table of contents – The table of contents (TOC) should accurately reflect the thesis’s structure and focus. The headings must be meaningful, i. e., they should summarize the respective content as concisely as possible but should not exceed one line. Use abbreviations only if they are widely known, such as “UNO,” as otherwise the reader will not be able to understand what the chapter is about. Since sections of text are often moved or changed during the course of work, check the headings at the end and correct or adjust them as necessary. Modern word processors automatically create and update the TOC.



Check the TOC at the end and correct it if necessary!

Never include more than the first three heading levels in the TOC. Otherwise, it becomes confusing and no longer serves its purpose!

Problem statement – Each thesis project begins with a given topic and a proposed title. However, during the project, some previously unclear or unrecognized aspects may change. Therefore, describe the problem to be solved as precisely as possible.

Based on the problem statement, the candidate should derive the objectives of their work and the research questions they propose to answer. In this sense, this section forms a central basis for evaluating the results and grading the thesis.

Related work and foundations – This section presents the relevant literature and other essential foundations, e. g., other theses already completed in the same research group on which the present thesis project is based. This describes the starting point of the work (“What was available when you started?”)

However, this section describes more than just the current status. By selecting the publications to be cited or omitted and the previous work on which to build, a candidate demonstrates how they approached the topic.

If previously published solutions to the problem already exist, discuss the advantages and disadvantages of these solutions in detail at the end of this section. In addition, specify the requirements for the solution to be developed in this thesis project in detail.

Solution approach – Together with a detailed description of the implementation of your solution (presented in the next section), this section forms the core – the central contribution – of the thesis. It describes the methodological approach you chose and the steps you took to develop the solution. Unfortunately, many theses are missing this central information (Figure 6-1).

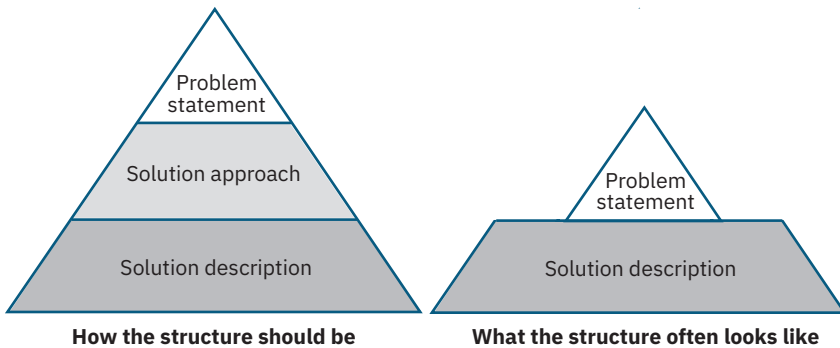


Fig. 6-1 Solution approach and solution description – target versus actual result.

If this section is missing or only very superficially written, the reader may find it very difficult to understand the solution to the problem described later. It is not sufficient to include a few sentences on the topic and the problem, and then dive into the details of the developed solution! That's like visiting a building blindfolded. How can you grasp the structure of the entire building and gain an overview?

In our experience, this section poses the most significant challenge to candidates. Therefore, carefully check whether you have described why and how you chose the approach on which your solution is based! These questions may help you:

- Is the reasoning logical and complete?
- Are alternatives described?
- Are your decisions plausibly justified?

When talking about your thesis with a colleague, you will likely strike the right balance by outlining the central idea without getting lost in the details of your solution.

Solution description – This section is much more comprehensive than the previous one, as it must detail all aspects of the solution. Accordingly, it should be clearly and systematically structured and, if possible, supplemented with informative illustrations and well-chosen examples.

Results and evaluation – This section describes all the results achieved within the thesis project: What is available at the end of the project, what has been achieved? The evaluation discusses the results in the context of the problem statement and research questions and places them in the related work. This means that, in this section, you report on the successes achieved and any failures: This was accomplished, but that was not.

Review and future work – The final review discusses the topic and the problem statement and answers the following questions:

- Did it make sense?
- Was the right approach chosen?
- Was something important overlooked?

Mistakes that impacted the results and the chosen approach should also be discussed. Since the review refers to the past, the past tense is appropriate in this section for once! This section often concludes with an outlook that demonstrates how your work can be meaningfully continued in the future.

References – Place the references at the end of the thesis (even after any appendices); otherwise, the reader will always have to search for them when looking for a reference to a citation. The information to be included in the references was discussed in [Section 5.9](#).

Appendix – In some cases, it may be necessary to include extensive information presented only in excerpts in the thesis in full in an appendix (e. g., transcripts of interviews conducted with experts to evaluate the work). Alternatively, this data can be stored in a suitable data archive and referenced in the thesis.

A remark about the thesis's length: Most theses are too long! Because of the very different circumstances, it is hard to give an exact guideline. In most cases, 40 pages should be sufficient for a bachelor's thesis, while a master's thesis should be about twice as long. In many cases, the examination regulations contain guidelines for the thesis's length. Doctoral theses have a greater range – 150 to 200 pages are often appropriate.

6.3 The process of writing the sections

A thesis does not grow linearly but quasi-parallel in many places. The candidate will generally hit some dead ends during the project, though the final version should not contain all the wrong turns. Instead, it should document the results and the project as precisely, concisely, and comprehensibly as possible. This may serve as an analogy: If you are describing to a friend the way to a particular previously discovered destination, you give the most straightforward route, not necessarily the one you took, as this is usually more complicated.

The following steps serve as a guideline for writing the sections of your thesis:

- **Step 1:** Compile the *literature collection*, the source for the references of your thesis. Sappy handling of references can significantly delay the thesis and reduce its value. Also, it isn't enjoyable to have to think about where you read this or that.
- **Step 2:** Create the core of the chapter on *related work and fundamentals*, based on the task description, which contains references to existing literature and, if applicable, to previous work.
- **Step 3:** Create a *draft outline*, i. e., the top-level headings of the TOC. Table 6-1 can be used as a basis. As you refine the individual chapters, the TOC changes accordingly.
- **Step 4:** Develop the *solution approach* in steps. It should be largely mature in terms of content before describing the solution approach. Then come the results, their evaluation, and a critical review of the thesis project.
- **Step 5:** Create the *cover page* and the *abstract*. Because many people don't look at anything else, make a special effort to write an insightful abstract. Therefore, include the cover page and abstract in the final proofreading to avoid errors in these prominent parts.

If some parts of the solution have become too extensive, they can be documented in appendices, though this is often just a lazy compromise:

- Are these parts *really essential* for the overall understanding? Then, they belong in one of the main chapters.
- Are they *dispensable* for the reader but necessary for the work to proceed? Then, like test data, they should be stored and handed over to the supervisor.

Every thesis must be revised at the end in terms of language and content. Unfortunately, many theses reveal that this revision has been neglected because of time pressure. The reader then has to contend with confusing text, spelling mistakes, and arbitrary punctuation. If you want to annoy the reader quickly, dispense with this review!

If, on the other hand, you want a satisfied reader, then plan several days for the revision. If possible, find a friend from outside the field who is willing and able to read your thesis.



Although the examination regulations do not allow a third party to help the candidate, a purely linguistic review by a friend is generally accepted!

6.4 The content-related form of the thesis

As mentioned several times above, a thesis should be designed to help the reader understand the content. Below find some advice on this.

6.4.1 The “red thread”

Coherent and well-prepared knowledge is much easier to understand and is more likely to be remembered than a mishmash of disconnected, memorized facts and data. This is an implication of the so-called **forgetting curve**¹, introduced by [Hermann Ebbinghaus \(1885\)](#), which visualizes how information is lost over time. Later research adapted Ebbinghaus’ forgetting curve: The more meaningful the content, the slower the forgetting. In [Michel and Novak \(1991, p. 119\)](#) this curve is shown for four types of information (see [Figure 6-2](#)).

¹ https://en.wikipedia.org/wiki/Forgetting_curve

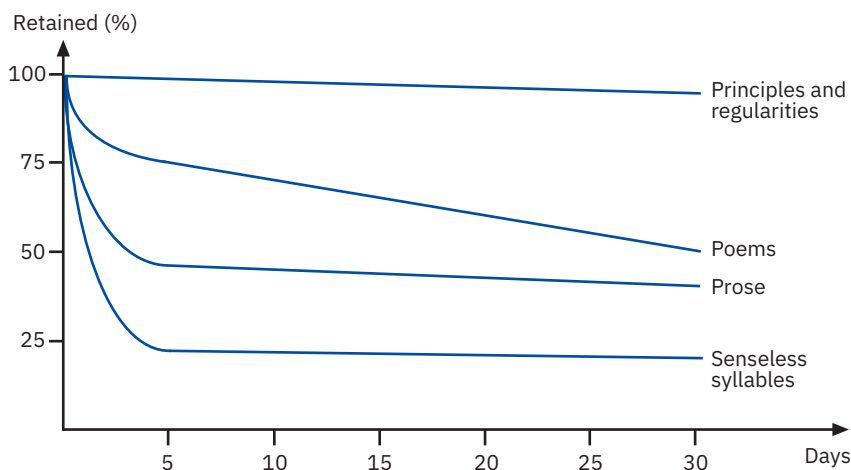


Fig. 6-2 How long can you remember learning content? (*Michel and Novak, 1991*)

It follows that the candidate must endeavor to prepare the content so that it is explained as clearly and concisely as possible for the reader (just as we would expect from principles and regularities). This is supported when

- the chapters are structured from the simple to the complex,
- repetitions are included (e. g., a summary of the content at the end of a chapter),
- readers know what is coming next (e. g., by including a short introduction and overview at the beginning of a chapter),
- the TOC and well-chosen subheadings provide orientation for the reader.

Therefore, the candidate's didactic and writing capabilities are not minor matters; they significantly influence the success of their thesis project. For this reason, the individual results must not – whether apparently or actually – stand next to each other at random. Instead, they must be linked so that the reader understands the thesis' internal coherence and the argumentation.

Therefore, the candidate must “spin the red thread” that runs through the thesis. In other words, the candidate must have defined the thesis structure before working out the details. Once drafted, this structure is hardly ever changed, even if it is inappropriate to the problem. In this

case, cross-references, repetitions, and insertions overgrow and corrupt the structure, ultimately failing to orient the reader.

6.4.2 The advantages of using illustrations

A picture is worth a thousand words²

Illustrations, also called figures, are often the best way to clarify complex relationships. In academic papers and theses, this usually means schematic representations. A figure initially attracts attention because it appears to the eye as an oasis in a desert of letters. But that is not enough; the figure must convey information as clearly and concisely as possible. The quicker and easier a reader can understand a figure's message, the more they benefit from the illustration. This means that a figure must be clear not be overloaded with decorative elements (see Figure 6-3b). When designing a figure, observe a few principles:

- **Avoid graphical elements that have no content or message!** Often, you see figures with a 3D effect, including shadows. But, if the third dimension and the shadows have no semantic meaning, they only unnecessarily complicate the figure and obscure the message behind irrelevant “make-up” (see Figure 6-3a).

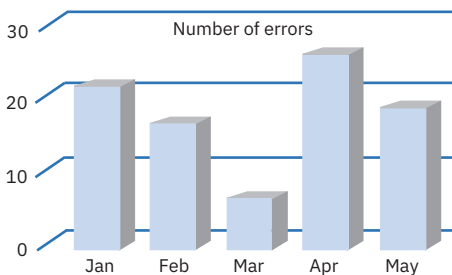


Fig. 6-3a More elaborate is not better.

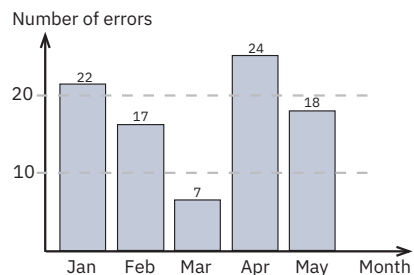


Fig. 6-3b Simple, clear figures are better.

- **Explain everything that is not clearly understandable!** In particular, define the meaning of boxes, arrows, and colors. Coordinate systems without labeling and dimensioned axes are worthless (as in Figure 6-3a). If possible, resort to a meaningful legend!

² This saying is generally attributed to [Fred Barnard \(1846–1896\)](#), an English illustrator, who used it in the 1920s as an advertising slogan.

- **Review the figures!** Like words and sentences, a figure should contribute to the whole: Anything that can be deleted without losing content should be deleted.

Whenever you can explain a complicated context only with a very long text, try to find a suitable illustration that can shorten and supplement the explanation.



In the best case, the figure illustrates the text, and the text explains the figure!

Of course, figures must be designed so that the text they contain is easy to read. The same applies to the image quality; a blurred image is useless.

6.5 Types of scientific statements

As a rule, a paper or thesis is based on various types of scientific statements and insights.

6.5.1 Citations

By citing another author directly (verbatim) or indirectly, the candidate “imports” the author’s thoughts and results into their own, unless they relativize them with their own comments. It is, therefore, not only unserious but also risky to cite sources one has not read. Think carefully about whom and what you cite. If the statements are of very little value, refrain from citing them.



It is always advisable to read first and then cite!

Verbatim citations (quotes) are rare in technical documents. If you do use quotes, mark them with the appropriate formatting. When a quote is used as a motto, as in this example, the author’s name is sufficient:

“Nullum est iam dictum, quod non sit dictum prius.”
(Nothing is said that has not been said before.)

Publius Terentius Afer

6.5.2 General knowledge

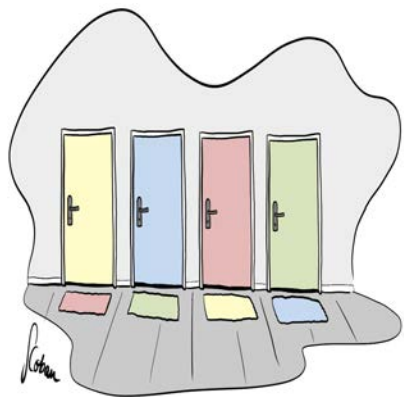
Everyone who writes a paper or thesis starts from certain foundations that are considered valid. Such knowledge, also referred to a *general knowledge*, is to science what compost is to the garden: created by the decomposition of what once grew there, whereby the original form is lost, and only the substance remains. So anyone who uses natural numbers does not need to cite [Giuseppe Peano \(1858–1932\)](#), because his results have since become general knowledge. The same applies to numerous concepts in computer science (e.g., algorithm, compiler, transaction). With some newer concepts (such as the REST interface), the originators probably still have a recognizable relationship. In these cases, mentioning the authors' names is sufficient (in our example: [Roy Fielding](#)).

In general, be very skeptical of general knowledge in computer science, as much of it remains controversial. What is a truism for one author is a bold hypothesis for another. Therefore, describing the prerequisites and assumptions a little too extensively in your thesis is better than being too short. Then, you are on the safe side.

6.5.3 Working hypothesis

If you find yourself in an unfamiliar room with many unlabeled doors and want to leave, after a moment's hesitation, you will randomly choose one of the doors. It would be pointless to try to justify this decision rationally; it simply has to be made, whatever the outcome.

When writing a thesis, you sometimes find yourself in the same situation: You have to choose one of several approaches. The decision is often based on simple practical reasons: One has prior knowledge of a solution approach, knows a tool that could be used, or has an aversion to a particular formalism. In the thesis, these “motives” are then replaced by scientific arguments. Anyone who does this is deliberately misleading the reader. An honest statement that one had to choose a path without a compass is far better, as it facilitates criti-



cism. If someone wants to reproduce a work, they know exactly where to apply an alternative solution approach.

6.5.4 Measurement results and practical experience

Since [Galileo Galilei \(1564–1642\)](#), quantitative results, i. e., the results of calculations and measurements, have been the backbone of all work in the (natural) sciences. This also applies to computer science. However, quantitative data are often (indeed, too often) omitted because the data are considered unimportant or unrepresentable. However, this decision should be left to the reader: Readers would rather know that the response time of a system for defined operations is 0.4 seconds on average, with a maximum of 1.5 seconds, than read that the response is “sufficiently fast” (unless “sufficiently fast” had been defined beforehand).

Again, we can learn from physicists here: Physics evolved from a philosophy to a modern natural science by giving preference to quantitative analysis. Therefore, every calculation and every measurement, i. e., the data used for research, must be documented in a comprehensible manner. Unfortunately, computer science is still a long way from achieving this state. However, we are convinced that this is the only direction it can take in the long term.

6.5.5 Conclusions and evaluations

Each candidate must also discuss and evaluate their results, as well as those cited. Candidates find this very difficult because they feel they do not yet have the necessary overview to make an evaluation. However, since they cannot avoid making an evaluation, they use verbal “softeners” and replace precise statements with formulations that could have come from a government spokesperson.

We advocate courageous evaluation. *Be bold!* Use the active voice, avoid the passive voice. Use the first person (“I”) or, in the case of group work, the first person plural (“we”) (see [Section 7.1.8](#)). Stake your claim to your research and your research results. Anyone who has developed, for example, a new sorting algorithm, a new database architecture, or a new software metric should clearly explain how they evaluate their own research and the results they achieved in retrospect, as well as whether further work is worthwhile.

Many candidates feel compelled to arrive at a positive conclusion in their evaluation. They want to confirm their hypotheses at all costs. *That is*

wrong! All research is an attempt to explore unknown territory (otherwise it is not research, but development). Oil companies, for example, owe their wealth to test drilling, even unsuccessful attempts. Of course, unsuccessful attempts must be recognized and stopped on time.

A scientific work that comes to the (well-founded) conclusion that the chosen approach does not lead to the desired goal is therefore per se not bad. It is undoubtedly better than a work that merely presents old wine in new bottles.

6.5.6 Argumentation

Of course, the arguments presented in the thesis should not stand alone, but should be linked together in an easily understandable, coherent chain of thought. Depending on the topic and scope of the thesis, you may need to make redundant statements, for example, through previews, summaries, or repetitions.

There are few rules to follow here. Whatever applies elsewhere also applies here: Anything defined 40 pages earlier requires at least a reference if not used continuously. On the other hand, the reader can understand a one-page list even without a preview and summary. In general, a statement is superfluous if it is more harmful than helpful.

7 Writing and Formatting a Thesis

After discussing the structure and content of a thesis, this chapter provides tips and advice on what language to use when writing a thesis, as well as how to create the thesis technically.

7.1 A brief introduction to style and language

The content of the thesis should determine the reader's impression, but the style of the thesis also considerably influences that impression. This section is intended to help you avoid some of the most common mistakes.

7.1.1 Choose precise and correct terms, avoid buzzwords

Precision is a hallmark of good scientific texts. Terms are either introduced and defined or used in their generally accepted sense – and then always have the same meaning. It is particularly embarrassing when the author clearly does not understand the meaning of a word, as in the following example.

Example: *"Our perfectest controls ensure that all products are identical."*

This is nonsense!

- "Perfect" is an absolute adjective that cannot be intensified grammatically further (it is non-gradable).
- "Identical" does not mean "indistinguishable," but rather "one and the same."

If all products were identical, there would only be one! The evening star and the morning star are identical; both are the planet Venus.

Therefore, the above sentence should be worded as follows:

"Our thorough controls ensure that all products are entirely equal."

New terms continue to emerge in journalistic sources, often becoming *buzzwords*. For example, people often talk about a "quantum leap" when there has been noticeable or significant progress or "degrees of freedom" to characterize possible scope for action. Look up these terms in the dictionary before incorporating them into your texts! You may be surprised to learn that in fact a quantum leap represents a discrete, but extremely small, change of state. Degrees of freedom in mechanics are not defined

as (measurable) tolerances, but as the number of directions and axes in which an object is not fixed.



Do not simply adopt terms, especially if you are unsure of their meaning!

7.1.2 Metaphors

The results presented in a thesis are often complex, abstract, and difficult to describe. We have already mentioned that figures can facilitate the understanding of such issues.

Another means to increase understandability is to use metaphors, which link the new and unknown with familiar memories and ideas. When we say that a program has “crashed,” it sounds more vivid than if we describe this situation as “abnormally terminated.” Computer science frequently uses metaphors to describe complex concepts. [Table 7-1](#) shows some well-known examples.

Metaphor	Meaning	Meaning in computer science
Handshake	Two people shaking hands to establish trust.	Establishing a connection between two systems, often used in network protocols
Sandbox	A child’s sandbox used to play safely.	An isolated environment for running code or applications to prevent harm to the broader system.
Spaghetti code	A tangled mess of spaghetti noodles.	Code that is poorly structured and difficult to follow, with many interwoven dependencies.
Firewall	A wall that stops fire from spreading.	A security system that blocks unauthorized access to or from a network.

Tab. 7-1 Examples of metaphors used in computer science.

A detailed discussion of this topic (see [Ludewig, 2003](#)) lies beyond the scope of this guide. The most important findings are as follows:

- A good metaphor can significantly enhance the presentation of a complex concept, as it helps make it easier to remember.
- In most cases, using two metaphors at once is one too many, as they may not be compatible. For example, when talking about “flying high,” you shouldn’t point out the risk of “shipwreck” because ships do not

fly. Or if you use the metaphor of “layered architecture,” you have to stick to it and not suddenly introduce other metaphors, such as “maps” or “planetary systems.”



Introduce an appropriate metaphor and stick to it!

Don't use metaphors that you don't believe in or that are likely to mislead!

7.1.3 Noun style

Scientific texts often contain numerous nouns; the same is true of official announcements. Some of these nouns are **nominalizations**. In linguistics, nominalization refers to the process of turning a main verb into a noun. The resulting noun, also called the nominalization, is then used to describe an action or process with just one word. Nominalizations make sentences seem somewhat lifeless, as only the main verb fully describes the action or process. Often, verbs in sentences with many nominalizations are used solely to correctly complete the sentence grammatically.

Example: “The optimization of the algorithm resulted in the improvement of the database efficiency, leading to the enhancement of application performance and the reduction of processing time.”

Here, the verbs “optimize,” “improve,” “enhance,” and “reduce” are nominalized. The two verbs of the sentence, “result” and “lead,” are only needed for grammatical reasons.

This sentence can be rephrased as follows:

“Optimizing the algorithm improved the database efficiency, which enhanced the application performance and reduced the processing time.”

Certain suffixes indicate nominalizations (see [Table 7-2](#)). The use of gerunds, i. e., nominalized infinitives with the suffix “-ing” (e. g., the coding, the initializing), also make the text cumbersome. A common consequence of using gerunds as the subject of a sentence are chained “of-genitives,” which is stylistically unacceptable and often unclear in terms of content.

Suffix	Examples
-tion /-sion	inform → information, decide → decision
-ment	develop → development, agree → agreement
-al	propose → proposal, refuse → refusal
-ance /-ence	appear → appearance, persist → persistence
-ure	fail → failure, depart → departure
-age	marry → marriage, break → breakage

Tab. 7-2 Common suffixes for the nominalization of verbs.

Let us examine the following example:

Example: "The debugging of the system of the students is difficult."

Does this mean that it is difficult to debug the system belonging to the students (1), or is the debugging performed by the students difficult? (2)

The sentence can be formulated precisely if we use the main verb "debug":

(1) "It is difficult to debug the system of the students."

(2) "It is difficult for the students to debug the system."



Always search for and use main verbs, making nominalizations unnecessary!

7.1.4 Long and nested sentences

Many languages, German certainly more than English, with their numerous means of packaging references and cross-references in an grammatically ingenious, not to say elegant, way, tempt the author, who wants to emulate his literary idols, to adopt a style that can be called artistic, but distracts the reader's attention from the actual subject matter, the content of the work, and in severe, not infrequent cases even overexerts it, so that the reader wonders when the sentence will finally reach the end, which must come at some point.

Did you understand this sentence completely without reading it a second time? Regardless, excessively long and convoluted sentences make it unnecessarily difficult for the reader to understand the statements being described. Nested relative clauses and that-clauses can also contribute to the complexity of a sentence and make the entire sentence difficult to

understand. Here is an example of such a sentence containing several that-clauses:

Example: “Always check the specification that the program that should be developed must meet.”

We can rephrase this sentence to make it easier to understand as follows:

“Always check the specification the program to be developed must meet.”

When writing a thesis, follow the advice of **Kurt Tucholsky (1890–1935)**, a German journalist, satirist, and writer.

“Main clauses, main clauses, main clauses!”
Kurt Tucholsky¹

Formulate your statements in main clauses! Use subordinate clauses to make them more precise and link them to others.

7.1.5 Word variations and process descriptions

Technical and scientific texts should describe things as precisely as possible, which means that sometimes word repetitions are perfectly acceptable. References to things such as “the former” and “the latter,” “this” and “which” are no more elegant than the term to which they refer, but they are often imprecise. In the example below, the three consecutive sentences refer to the installation manual. The pronoun “it” may lead to ambiguity. In this case, simply use the word “installation manual” three times.

Example: “As a first step, verify the server hardware against the requirements outlined in the **installation manual**. While installing the database cluster, follow **it** to set up the environment configuration. After deployment, log all deviations from **it** in the project’s change log.”

And, of course, the term “installation manual” should never be replaced by another term, like “the description” or “the instructions,” as the reader

¹ Advice for a good speaker (published under Tucholsky’s pseudonym Peter Panter, 1930)

will then not know whether these terms refer to the same thing, i. e., have the same meaning.



Create a glossary containing the key terms!
Use these, and only these, without any variation!

In computer science, we often describe processes or sequences of actions. In such cases, the description should correspond to the actual sequence. If the actions A, B, C, and D are performed in sequence, they should also be described in that order and not in a twisted order organized by complicated links, as in this example.

Example: “The sum of so-called function points represents the development effort of a project. The evaluators obtain these points by assessing the previously identified project characteristics according to various criteria.”

In this process, the evaluators *first* identify the relevant project characteristics, *then* assess the project in terms of function points, which are *finally* added up!

Therefore, reformulate this statement so that the order of the descriptions corresponds to the order of the actions. This could look as follows:

“After the evaluators have identified the relevant characteristics of the project, they evaluate each characteristic using function points. The sum of the function points for all characteristics then represents the total development effort required for a project.”

7.1.6 Filler words and conjunctions for convenience

When we talk, we use filler words to smooth the flow of the sentence, decorate the speech, or make a stronger impression. Linguistics refers to filler words as “expletives” (Latin *expletivus*: serving to fill). Avoid filler words in technical or scientific texts, as they are often misleading.



Many filler words simply add nothing to the sentence!
Get rid of them!

Check filler words like “mostly,” “very,” “at all,” “rarely,” “easily,” “considerably,” or “in general.” Delete them if the statement in the sentence remains valid without them — perhaps the statement will even become

more precise. However, if the word expresses an important caveat or restriction, it should be explicitly stated.

Example 1: "It is usually more difficult to maintain large programs than small ones."

What exactly does "usually" mean? Does that mean 9 out of 10 cases, or only 5 out of 10? If we don't know, then it's better to leave it out.

Better: "It is more difficult to maintain large programs than small ones."

Even better: "It is more difficult to maintain large programs than small ones if all other characteristics of the programs remain the same."

Example 2: "Statement A is certainly correct."

Apparent affirmations often express the opposite. The word "certainly" indicates that the author is not at all certain. It is more convincing to write "Statement A is correct."

However, if you have not verified that statement A is correct, but merely assume that it is correct, you should phrase it as follows: "Statement A *appears* to be correct."

7.1.7 Enumerations

Bulleted lists are very popular in a thesis, especially on the presentation slides. List all keywords and sentences related to a topic, put a bullet point in front of each list item, and you are done!

However, this often leads to useless statements. An enumeration must be homogeneous in content and language, i. e., each item must answer an overarching question. It does not matter whether the question is explicitly mentioned or not.

Example:

- | | |
|--|---|
| <ul style="list-style-type: none"> • bread • cheese • chocolate • from the garden • healthy | <p>The first three items "bread," "cheese," and "chocolate" fit very well with the question "What can we eat?" On the other hand, "from the garden" and "healthy" do not fit into this enumeration because they do not answer this question. They also do not fit syntactically because, unlike the matching items, they are not nouns.</p> |
|--|---|
-



Check each enumeration by comparing it to the overarching question and deciding whether the individual items in the list fit the question!

Check whether all items are syntactically similar, i. e., whether they are nouns, main clauses, place names, etc.!

7.1.8 The author's representation

The opinions of the author influence every text. However, the author is rarely represented in the text by the first-person pronoun singular “I,” but rather by “we” (first-person pronoun plural), “one” (indefinite personal pronoun), or by the use of passive voice. We distinguish between the following cases:

- **You are the sole author** – In this case, “I” is the standard form. However, since many scientific publishers stipulate in their guidelines that the first-person singular pronoun should be avoided, “we” is often used even in publications with only one author. But, even in this case, we recommend sticking with the “I” form when describing and justifying an important decision you have made.
If you always write in the “I” form but then use “we” at some point, this means that at this point, you are referring to yourself and the reader.
- **You are a co-author** – Then “we” always refers to all authors, and the “I” form can no longer be used.

Table 7-3 shows the positive and negative aspects of these forms and provides examples.

7.1.9 Spelling, grammar, and punctuation

In computer science, the following applies: Only a syntactically correct program has semantics! If we transfer this to scientific publications, we expect them to be grammatically correct and free of spelling errors. Of course, as readers, we can understand sentences even when they contain spelling and grammatical errors. However, if these errors occur frequently, they can significantly impair reading comprehension. It is therefore surprising that some candidates apparently invest too little time in correct spelling, grammar, and punctuation.

Form	Emphasizes	Example	Danger	Bad example
I or we	Individuality of the author(s)	"However, I am (we are) of the opinion that this tool is more suitable."	Arrogance	"I discovered years ago that these mistakes are often made."
We	Author as a group member	"In these experiments, we found that this effect occurs frequently."	Author hides themselves	"We are convinced of the correctness of this assumption."
We	Consensus between author and reader	"We are still not in a position to avoid these mistakes."	Reader is included	"We have all been eagerly awaiting a tool that automates this task."
One	General validity	"In this domain, one still uses COBOL."	Generalization	"One could argue that the results indicate a correlation."
Passive voice	Effect of the action	"The identifiers are written in the boxes."	The actor is obscured	"These guidelines are often ignored."

Tab. 7-3 *The author's representation.*

Some candidates seriously believe that the word processor is the final authority on spelling and hyphenation. That's not true, of course! Although the spelling-correction abilities of word processors have improved a lot, the dictionaries used are not perfect. Just as a chef cannot excuse the poor quality of the food by blaming the kitchen equipment, a candidate cannot blame the shortcomings of their word processor for mistakes.

Nowadays, however, we use AI-based tools for checking spelling and grammar which are very powerful (see [Section 7.3.2](#)).

7.2 The external appearance of the thesis

What is true for figures applies to the overall appearance of a thesis: Headings and highlights that make the thesis easier to read and understand are mandatory, while purely visual make-up is detrimental.

7.2.1 Fonts

Word processors offer a virtually inexhaustible number of fonts. Font design is a broad field and a subject of outstanding artistry. [Hermann Zapf \(1918–2015\)](#), who designed over 200 fonts, was one of the greatest masters in the field. Thanks to him and other designers, we now have many fonts at our disposal, even if we can rule out most of them for scientific

texts (such as *Comic* or *Pristina*). Therefore, choose a simple and profound font, such as Garamond or IBM Plex (the fonts used in this guide), for your thesis and stick with it.

There are fonts with and without serifs. Serifs are the small feet on the letters, as can be seen in this text. The use of serif fonts for longer texts, from newspaper articles to books, has proven to be a good choice. Posters and other short texts, including headlines, are often set in sans serif fonts.

In addition, there are so-called monospaced fonts. With these fonts, each character has the same width. Otherwise, a font is referred to as proportional. Monospaced fonts (e.g., *Courier* or *Consolas*) are often used for program code or algorithms when structural indentation is done with spaces.

7.2.2 Page layout

Font size and line spacing, in particular, affect the readability of the thesis. Texts with large line spacing contain very little text per page, which makes them difficult to read. This may also give the impression that the candidate is trying to artificially lengthen a thesis that is too short. On the other hand, it is easy to lose track when reading texts with very narrow line spacing. Proportional fonts combined with a small font size and narrow margins often result in overloaded lines. This creates so-called “letter deserts” in which the eye cannot find its way around; for this reason, newspapers are set in several columns.

Take the following points into account when designing the page layout:

- The width and height of the text area, line spacing, and formatting of headings should remain consistent throughout the thesis.
- The structure of the chapters is reflected in the numbering (as in this guide). In printed theses, headings are included in the TOC only up to the second or third level.
- Each chapter begins on a right-hand (i.e., odd-numbered) page. If the chapter’s last page contains only a few words, shorten the text in appropriate places to avoid this. Using uniform hyphenation often allows the text to be set more compactly, which can also solve this problem.

- Footnotes contain additional information, references to sources, and other text sections. If possible, footnotes should be placed on the same page as their “hooks.”
- Paragraphs should group units of meaning in the text and not just organize the page visually. As a rule, content that belongs closely together should not be scattered over several paragraphs. Separate the paragraphs visually.
- We use **bold face** and *italics* to highlight words or text, as well as a larger sans-serif font for headings. Names are occasionally set in SMALL CAPS.
- CAPITAL LETTERS, S p a c i n g, and underlining date back to the typewriter era. We can do without them!



Whenever you use a new style of the font, check whether it improves the overall result!

You should agree on the formatting guidelines of your thesis with the supervisor in good time to avoid additional effort to change the formatting!

7.3 Tools for word processing

We use word processors (also referred to as “text editors”) to write papers and theses. Unlike in the era of typewriters, documents can be easily changed and rearranged repeatedly with little effort, and finally printed or converted to the PDF format. In general, we distinguish between two distinct types of word processors, both of which were introduced around the same time in the late 1970s.

- **WYSIWYG editors** – These text editors display the layout with all formatting made by the author on the screen while typing (WYSIWYG = what you see is what you get). Examples include MICROSOFT WORD or the text editors in the LIBREOFFICE or OPENOFFICE packages.
- **Typesetting systems** – In these editors, the author uses commands from a typesetting language to specify the layout and format the text. The first widely adopted typesetting system designed explicitly for academic papers was T_EX (pronounced “tech”), created by Donald Knuth² in 1978. T_EX, and in particular L^AT_EX, which is based on T_EX and was developed in the mid-1980s by Leslie Lamport (L^AT_EX: Lamp-

ort + TeX), became the standard for writing theses in mathematics, physics, computer science, and many other scientific fields.

The following short LaTeX snippet gives you an impression of how formatting commands are specified:

Example: To format the two enumerations as shown above, the following “code” is needed:

```
\begin{itemize}
  \item[$\bullet$] \textbf{WYSIWYG} editors -- Such text editors display
    the layout ... Examples include \textsc{Microsoft Word} or the text
    editors in the \textsc{LibreOffice} or \textsc{OpenOffice} packages.
  \item[$\bullet$] \textbf{Typesetting systems} -- In these systems ...
    The first widely adopted typesetting system designed explicitly for
    academic papers was \textsc{TeX} (pronounced "tech"), created by
    Donald Knuth\footnote{Donald Ervin Knuth is one of the most famous
    computer scientists ...} in 1978 ...
\end{itemize}
```

Both types of word processors have their specific advantages and disadvantages. WYSIWYG editors are easy for beginners to use and are suitable for short to medium-length texts. However, if you want to write a comprehensive thesis comprising multiple chapters, with numerous illustrations, references, cross-references, and possibly even formulas, a typesetting system like L^AT_EX is the tool of choice. The initial effort required to learn its commands and use them correctly pays off very quickly. Many L^AT_EX distributions and editors, such as M^IK_TE_X, T_EX_LI_VE, or O_VE_RL_EA_F, a web-based L^AT_EX environment, are available for the standard operating systems.

In most cases, the candidate must use a predefined document template when writing a thesis. These are available for WYSIWYG word processors, but are especially useful for typesetting systems.

7.3.1 Risks of using word processors

However, using word processors carries certain risks. In particular, when using WYSIWYG editors, candidates who lack experience writing longer texts but are fascinated by the word processors’ capabilities tend to create

² [Donald Ervin Knuth](#) is one of the most famous computer scientists and mathematicians. Knuth designed TeX to write his multi-volume book “The Art of Computer Programming,” after being frustrated with the poor quality of existing typesetting systems.

an overly elaborate example that showcases the available formatting and design options, rather than writing a document with substantial content.



In science, the medium is not the message!

A thesis should be visually clean and clear, not dressed up. Too much polish looks suspicious!

The second risk is more subtle. A text written on a good old typewriter went through several clearly defined stages. After being written by hand, it usually had to be typed up at least twice. Especially when the author used the typewriter themselves, it was almost irrelevant how significant the changes were: Each sentence was reread, improved, and rewritten.

Word processors encourage us to leave thoughts and sentences unchanged once they have been entered and saved, and “cut and paste” can be used without checking the content. Undoubtedly, many theses have never been read in full by their authors which becomes evident when you read them. In these cases, the examiner (and any other person, for that matter) has to read a text whose quality corresponds to a beta release. Even if it is technically possible to compose a thesis from existing fragments, allow yourself the luxury of rethinking everything once the content of the work is reasonably complete. People are often surprised to find that some parts are entirely superfluous, while others are missing. This is the only way to achieve a great result.

In this quote, Paul R. Halmos³ describes this process very clearly:

“When you comes to rewrite, however, and however often that may be necessary, do not edit but rewrite. [...] You must be merciless about changes of all kinds, and, especially, about wholesale omissions. Rewrite means write again – every word.”

Halmos (1970, pp. 131–132)

³ Paul R. Halmos (1916–2006) chaired the American Mathematical Society Committee that wrote the AMS style guide for academic mathematics, published in 1973.

A perfect example of a successful rewrite (reconstruction) is the Grand Place in Brussels: Despite their diversity, the buildings appear stylistically uniform after being completely rebuilt within a few years following a devastating fire in 1695.

Anyone who must start writing from scratch after losing files should be ashamed, because everyone should implement the principle of data backup! However, if the loss occurs at the right time, the supposed misfortune can sometimes turn into an advantage.



7.3.2 Using AI tools

The development of modern transformer-based large language models (LLMs), such as CHATGPT, has created powerful tools that are also used in the field of academic writing. LLMs are specialized generative AI tools (genAI); they have permanently and significantly changed scientific work and will continue to do so.

Therefore, the question arises as to the extent to which the use of LLMs or genAI tools is permissible. We certainly cannot and do not want to answer this question definitively at this point. However, we can provide some guidelines currently considered reasonable by the scientific community. In doing so, we rely on and summarize the statements made by [Sumaya Laher \(2025\)](#) in her editorial article “Using AI in academic writing: what’s allowed and what’s not.”

In principle, a distinction is made between AI-assisted and AI-generated content.

- **AI-assisted content** – This is a text written by the author but improved with the help of AI tools. For example, an author can use AI to assist with grammar checking, improve sentence clarity, or receive style suggestions. In this case, the author retains complete control, and AI serves merely as a helpful tool to improve the text.
- **AI-generated content** – This refers to content (text or images) that the AI tool generates, either partially or in full, based on the author’s input, known as the “prompt.”

Nowadays, many institutions and publishers accept the use of AI tools when they are employed to improve the readability and quality of language in scientific texts. This means using AI tools for translations, to correct spelling and grammar, or to ensure a consistent writing style, for example.

On the other hand, the following statements apply to AI-generated content:

- **AI-generated content is prohibited!** This should no longer need to be emphasized, as AI-generated content does not originate with the author or author(s).
- **Generative AI tools cannot and should not be cited as authors!** Tools cannot be authors.

However, there are sometimes clear and understandable reasons that justify the use of genAI tools for research (e.g., to generate a massive test dataset). In these cases, the author must clearly distinguish and label AI-generated content as such.

In general, always observe the following rules and recommendations, an excerpt from the rules published by the ETH Zurich Library ([ETH Zurich, 2026](#)):

- Ask your supervisor which AI tools you are allowed to use and in what form you have to declare them.
- Clarify with your supervisor whether you need to include the prompts and, if so, possibly the generated texts in an appendix to your thesis.
- Be transparent and honest: Identify the AI tools used and document for which tasks you have used them.
- Read the generated output carefully and check it for accuracy.
- Consider that AI tools do not (reliably) identify verbatim or content-based quotations, so the output can closely resemble the original. The AI-generated content must not violate copyright or lead to plagiarism.



Approach the use of AI tools in writing a thesis with caution, and respect ethical standards!

Depending on how you use AI tools, you must clearly declare their use in the thesis!

8 Presentation and Demonstration

The results of a thesis project are presented and explained in an oral presentation. This presentation allows candidates to achieve the following goal: The audience should receive their results *positively* and be able to *understand* and, if necessary, *apply* them.

8.1 The presentation

In the presentation, the candidate (now in the role of the **presenter**) determines the pace and order in which they present and discuss the results. Since the audience has to consume what the presenter offers – sometimes without any enjoyment – it is up to the presenter to adapt to the audience and present the results successfully.

8.1.1 Preparation is more than half of any presentation

Every presentation should be very well prepared. First, the candidate should clarify the topic and the goal, because these are two different things. While the title of the presentation is usually predetermined (e. g., the thesis title), the objective can vary greatly. For example, if the topic is “A Code Completion Component for MyScript in Visual Studio Code,” one goal may be to explain the component’s central concepts so that the audience can compare it with similar ones. Another goal may be to introduce how to apply this component.



The presentation must be tailored to what the audience should take away from listening to the talk!

Some candidates attempt to incorporate all the results into the presentation because, in their view, all their results are equally important. This overwhelms the audience with information, which ultimately takes nothing away from it. *Avoid this at all costs!* Selecting the results to be presented is therefore extremely important, and deciding what to include and what to leave out is not always easy. As a presenter, you should therefore ask yourself the following questions:

- How much time is allocated for my presentation? Is the timing problematic (e. g., after lunch or late in the afternoon)?
- Is anyone speaking before me, and on what topic?
- How many listeners will be present? What prior knowledge and expectations do they have?
- How is the room equipped? How are the projector and lighting system operated?

8.1.2 What a good slide looks like, and how to present it?

There are many courses on how to structure and deliver good scientific presentations. We do not want to repeat them here; rather, we want to summarize what we believe are the most important properties of good slides:

- **Everyone must be able to read every slide!** This is the most important property and applies even to the listener seated at the back, even if they are not wearing ideal glasses. To achieve this, the font must be large and legible. Never show a slide that requires you to say, “Sorry, this text is a little too small and probably not legible for you!”
- **Each (essential) statement should have one slide (or two), and each slide should have one statement!** Avoid giving the impression that the slides and your verbal explanation do not match.
- **Each slide (or group of slides) needs a heading!** Even attentive listeners have lapses in concentration. Headings enable them to find their way back into the presentation.
- **Only show well-designed graphics!** These are easy to understand and require no written explanations on a slide. Give the explanations verbally but always provide a caption.
- **Only show key statements and graphics!** Slides should not contain long sentences or texts. Copying longer texts from your thesis or similar sources is definitely inappropriate.
- **Each slide should display the presentation’s metadata!** These include the author, date, and numbering. This information always appears in the same place (often at the bottom of the slides).
- **Never just read aloud what’s on the slide!** Instead, always refer to the content of the slide currently being displayed. And never discuss something completely unrelated to the current slide.

- **Guide the audience through complex slides!** The more complicated the slide, the longer it takes the listener to understand it!
- **Content that is too complicated for a slide is just that: too complicated!** A small font size or illegible graphics do not solve the dilemma.
- **Except for very simple slides, present and explain the content of a slide step-by-step.** This way, you do not overwhelm the audience, because a slide is not immediately visible in its entirety. All modern presentation programs support the step-by-step display of content. But don't forget: It's always about the content, not the gimmicks that a presentation program offers!

8.1.3 Time management and contact with the audience

A presentation is like a small project: You aim to achieve a specific goal within a given timeframe. But as with many projects, the time planning may be too optimistic, which usually leads to either exceeding the time limit or being kindly asked by the moderator to end the presentation early. In the latter case, the presentation usually ends with the sentence: "I still have many slides, but I can no longer present them to you." This does not do the audience any favors.

Presenters tend to have too many slides, because they fear nothing more than having to say, "That's it!" two-thirds of the way through their presentation. If only! You could still ask questions, discuss interesting aspects, or even go home earlier than planned. But, no, they have far too many slides and want to show them all to their audience. That is why the following truism applies to many presentations: *Less would have been more.*



A good rule of thumb is to allow about 3 to 4 minutes per slide!

Rehearse your presentation at home, but know that, when you present to an audience, you will need much more time, even if the audience doesn't interrupt you!

Therefore, you should prepare a maximum of

- 15 slides for a 45-minute presentation,
- 10 slides for a 30-minute presentation, and
- 8 slides for a 20-minute presentation.

If the individual slides are complex and convey much information or require detailed discussion (e.g., the presentation of an algorithm or a software architecture), reduce the number of slides accordingly.

In the last third of the presentation, plan on taking a shortcut if you have presented less than 50 % to 70 % of the slides by this point. You can achieve an inconspicuous shortcut by omitting an aspect, a special case, or an example. Increasing the pace is not the solution! Your audience will not understand any faster if you speak faster or show the slides for only a few seconds at a time.

From the audience's point of view, a presentation is a special form of conversation whereby predominantly the presenter drives the activity. But it remains a conversation. In other words, every listener wants to be addressed. The presenter must therefore look at them and perceive their reactions; otherwise, contact is lost, and the presenter ends up talking to themselves while the audience gets bored. That is why a verbatim presentation is a nightmare, and focusing on just one person in the audience (e.g., the examiner) is not much better.



Look around the auditorium at regular intervals and observe the expressions on the audience's faces!

Don't rush through the material at a constant pace. A good presenter is like a shepherd, gathering up the stragglers from time to time: Insert an example, a comparison, or a brief recap, and some people will be back on track.

Many presenters annoy their audience by filling every pause in their speech with sounds such as "ähhh." The unconscious reason is probably that they don't want to lose the initiative; the message is "I'm still talking!" Eliminate this habit; instead, consciously pause while speaking during your presentation and assess the success of this measure by recording your own presentations.

8.1.4 The dramaturgy of a presentation

The AIDA marketing principle¹ is well known in advertising (Table 8-1). To successfully convey a message, you first need to attract *attention*. Only then do you have the chance to arouse *interest*. Once you have succeeded in doing this, you need to promote your audience's *desires*. Finally, you have to tell them what *actions* they can take to satisfy their desires. If you

¹ The AIDA marketing model was developed by Elias St. Elmo Lewis (1872–1948), an American advertising pioneer.

watch closely how skilled salespeople sell their vegetable graters or stain removers to passers-by, you can learn a lot about the effectiveness of this principle.

Keyword	Objective	Means
Attention	attract the Attention of the audience	a surprising picture or example
Interest	arouse Interest in the topic	the presentation of the current situation (known to the audience), ...
Desire	create the Desire for change	... supplemented by a description of possible improvements
Action	inform about what Actions to take to fulfill the desires	explain the individual steps that the audience should take to achieve the improvements

Tab. 8-1 The AIDA marketing principle.

Of course, the thesis presentation is not about selling something, though ultimately you want to achieve something in this situation, too. For example, if a presentation on program testing is to have an impact, it needs to start with a statement likely to grab the audience's attention. A good way to illustrate this is to refer to a well-known software disaster caused by inadequate testing. Interest is then piqued by a concise but vivid description of the shortcomings that typically remain undetected when programs are tested unsystematically. Once the audience has learned about the advantages of systematic testing, they will want to enjoy these advantages themselves. This ultimately allows you to successfully convey the appropriate procedure.

Here, we must emphasize once again: It is not a matter of “pulling the wool over someone's eyes.” But if we take up the audience's time, we should also make an effort to offer them the added value that – hopefully – lies in the content of our presentation. The AIDA principle contributes to this.



Presenting is something that can be learned only through practice and constructive criticism!

That's why you should always aim for detailed feedback. To improve your presentation style, consider recording your presentation on video and

reviewing it later together with a friendly critic. You can also learn a great deal from other presenters. Every time you get annoyed by a presentation, ask yourself whether your presentations have the same shortcomings. Then work on avoiding them.

8.2 The demonstration

A demonstration intends to show something and inspire the audience with the results presented. Since software is developed as part of many thesis projects, especially in computer science, it makes sense to demonstrate it to the audience. Such a demonstration represents a special form of presentation. The demonstration often takes place in the final part of the presentation, before the summary.

Good demonstrations are about as common as error-free programs. As a rule, the audience watches as the presenter rapidly opens and closes windows, types in short texts, or generates graphics, all while making comments that are directed less toward the audience than toward themselves. This excerpt illustrates this point:

“Now I’m opening the comment window, and the menu appears. Of course, we could make everything even nicer. If I click here now... Wait, that was wrong. I’ll undo that. So, if I click here now, you can see how the values increase. There’s nothing there yet. These are the values that are now being generated...”

What are the most common mistakes?

- **The presenter increases the speaking pace!** Executing an interactive program is a kind of “waiting ping-pong”: Either the program waits for input or the user waits for output. We typically design our programs to minimize waiting times. However, in a demonstration, do not adjust your explanations to the speed at which the program runs; rather, always speak at a pace appropriate for the audience.
- **The presenter is overwhelmed!** As a result, the presenter focuses neither on using the program (and therefore makes mistakes) nor on the presentation (and thus loses contact with the audience).
- **The audience cannot follow the presenter!** The steps for operating the program are logically linked. The presenter is familiar with this structure and can navigate the system blindly, just as one might walk through one’s own home in the dark. However, because the audience

is unfamiliar with this structure, they cannot effectively follow the demonstration.

- **The audience is overwhelmed!** User interfaces with windows, icons, graphics, and other elements are full of messages. Anyone familiar with these interactive elements knows which ones are important and which ones are irrelevant and unconsciously overlooks everything irrelevant. But the audience typically does not have such a filter; they must examine everything, which can lead to being overwhelmed by the plethora of information, most of which is useless.



A poor demonstration serves no purpose; it doesn't show the audience anything, but instead wastes their time!

What can you do to convey your message?

- A demonstration is primarily a presentation and must proceed much, much more slowly than regular use of the program – and it must not be a monolog.
- It is challenging to operate the program being demonstrated while explaining the inputs and outputs to the audience simultaneously. Therefore, if possible, separate these roles. Here are some possible alternatives:
 - Record the use of the program intended for the demonstration beforehand and create a video of it. During the presentation, you can stop the video at predefined points and explain what has been seen so far. Then play the next sequence.
 - Insert the most important screenshots of the program into your slides and use them to explain how to use the program.
 - Perform the demonstration in pairs, with the presenter prompting the operator to initiate the next step.
- Do not show anything irrelevant. In indirect demonstrations (i.e., when working with slides), show excerpts; in live demonstrations, keep the display simple. Get rid of the colorful background photo! Get rid of any unneeded windows! Get rid of superfluous menus!

[Michael A. Jackson](#), a British computer scientist and consultant, offers the following wise advice on optimizing program runtime:

Rule 1. Don't do it.

Rule 2 (for experts only). Don't do it yet – that is, not until you have a perfectly clear and unoptimized solution.

Michael A. Jackson

This advice can be applied to program demonstrations as well:

Rule 1. Don't give a demonstration!

Rule 2. If the program needs to be demonstrated, don't run it!
Instead, show screenshots.

Rule 3. If running the program is unavoidable, make sure that you don't operate the program yourself.

9 Supervising Thesis Projects

All theses projects must be supervised. This chapter presents our experiences and insights into supervising these projects.

9.1 The interests of those involved

Since the assigned thesis topics are usually closely related to research projects, both the candidate and the supervisor have a personal interest in achieving a good result.

From the supervisor's point of view, every thesis should contribute to their research, which is usually the supervisor's dissertation project. This often leads to further conflicts of interest:

- **The results of a thesis project should be as usable as possible.** This applies in particular to the conceptual results achieved. However, if software was developed as part of the thesis project that the supervisor considers more important than the thesis itself, the supervisor will pay more attention to the software than to the conceptual results, which ultimately gets graded.
- **The effort spent on supervision should pay back.** If the candidate knows little or nothing about their future working environment, the supervisor will have to spend considerable time and effort training them. For this reason, many supervisors (in accordance with Barry Boehm's¹ principle of "use better and fewer people") tend to keep good students for as long as possible, i. e., as student assistants and as bachelor's and master's thesis students. However, candidates should strive for a comprehensive education.

The supervisor is, of course, also responsible for ensuring that the candidate achieves the learning objectives of the "thesis" module, i. e., the supervisor must teach the candidate how to work systematically and scientifically in an academic context. This applies even more to the bachelor's thesis, which serves as a preliminary exercise for the master's thesis.

¹ [Barry W. Boehm \(1935–2022\)](#) was a pioneer in software engineering. Among other pioneering works, he published seven basic principles of software engineering ([Boehm, 1983](#)). This is the sixth principle and applies not only to software engineering.

To this end, the thesis project needs to be supervised sufficiently and continuously.

The candidates also associate certain expectations and interests with a thesis:

- They want to learn about a new field as well as expand and deepen their knowledge.
- They want to learn how to carry out scientific work and systematically gain project experience.
- They want to pass the associated examination and achieve the best possible grade.

Supervisors and candidates benefit most from a thesis project if they have carefully selected and formulated the topic, and if both parties consider not only their own interests but also those of the other and contribute to the success of the thesis project: the supervisor through sufficient and adequate supervision, the candidate through sufficient and continuous effort.

Of course, there is no guarantee that a thesis will be successfully completed. A thesis can fail! Especially if the examiners and advisors have very specific expectations regarding the results, and the candidate does not meet them. This resembles what already occurred during Columbus' voyage of discovery: If he fails to reach India via the Western route, he must return home empty-handed, and all his efforts will have been in vain².

Thus, design a topic so that the candidate can achieve single sub-tasks at different levels. Then, the examiner can make full use of the grading spectrum during the evaluation. The criteria ultimately applied in the assessment should be apparent from the topic description. In particular, it should be clear what performance by the candidate is considered sufficient and what is considered very good.

9.2 The supervision tasks

The supervisor must perform certain tasks for each thesis project that are independent of the specific topic. These "standard supervision tasks" are necessary for the smooth and successful completion of a thesis project.

² Of course, [Christopher Columbus \(1451–1506\)](#) was successful, though what he discovered was not India, something he never found out.

Every supervisor must perform them; the candidate is entitled to them. These tasks are briefly explained in the following sections.

9.2.1 Defining the topic and task

The thesis project description must comply with the examination regulations regarding type and scope. It must fully describe the work that can be completed under normal working conditions within the specified time (e.g., six months). Additionally, a master's thesis project must include a scientific component. These constraints have the following consequences and responsibilities for supervisors:

- They must identify a task in the respective research project that is manageable enough and allows them to estimate the associated effort as accurately as possible. The effort required must be appropriate to the specified duration of the thesis project.
- They must determine the sub-tasks that must be completed in any case. In addition, they should always define several sub-tasks that can be carried out as independently as possible. This makes it possible to reduce the scope of the project later if necessary.
- They must clearly describe the content and scope of the task so that the candidate knows what needs to be done to complete it.
- They must ensure that the practical work (e.g., programming and testing) does not require so much effort that the scientific component is neglected. 50% is a reasonable limit.
- They must provide initial references to literature to help the candidate get started with their literature search and review.
- They must teach scientific methods and help candidates apply them correctly.

The responsible examiner ensures that the supervisor has fulfilled these responsibilities.

The extent to which the candidate may or should participate in task definition is debatable. Where necessary and appropriate, the candidate may suggest modifications to the task, particularly if the initial steps produce a different result than expected.

Each thesis project must be described formally, as it serves as the basis for the project and is part of the “contract” between the examiner and the candidate. It should contain at least the information listed in Table 9-1.

Type of thesis	e. g., bachelor's thesis
Information about the candidate	Name, student ID number, and degree program
Thesis title	A concise title that reflects the central aim of the work.
Problem statement	A concise and precise description of the problem the thesis aims to address. It outlines the goals and scope of the thesis.
Task and subtask description	A description of all sub-tasks that fall within the project's scope which the candidate must perform.
Background information	A brief description of how the thesis project is embedded within the overarching research project.
Organizational matters	Issue date, submission date, name of examiner, and name of supervisor.
Literature	A list of initial literature references that introduce the topic and serve as a starting point for the candidate's own literature research.

Tab. 9-1 Elements of a thesis project description.

9.2.2 Introducing the candidate to the topic

Students can decide on a thesis topic only if they have at least a rough understanding of it and the problem to be solved. To this end, the potential supervisor must explain the topic and the research project from which it originates, and provide appropriate introductory literature.

Once the topic has been accepted, the candidate needs further information and explanations to familiarize themselves with the topic independently and develop a draft schedule.

9.2.3 Advising on work planning

Each candidate must plan their thesis project. This means drawing up a draft schedule at the beginning of the project (see [Section 4.2](#)). The schedule depicts all essential project activities, their estimated duration, and their sequence. To this end, the candidate must possess a thorough understanding of the topic of the work. The schedule is updated as the work progresses.

Since candidates often lack experience in project scheduling, their supervisors must provide guidance on this matter. Without this help, almost all candidates make the same two mistakes:

1. They underestimate the effort required to complete the thesis.

2. They fail to consider that they may also reach a dead end, resulting in days or even weeks of unproductive work.

If software development is part of the thesis project, the milestones “end of programming” and “software development completed” are often set too late. In contrast, the “start of programming” milestone is often set too early, probably because candidates prefer to do this rather than specification and design activities.

9.2.4 Monitoring work progress

Only if the supervisor is aware of the thesis project’s status at all times can they ensure that the thesis project will – presumably – be completed on time. To do this, they must use the schedule, which defines milestones for all important intermediate results.

If the supervisor does not react to minor deviations between the planned and actual status, the plan may no longer be able to be appropriately corrected later. In such cases, experience shows that the thesis project cannot be completed successfully, i.e., it is either discontinued or, what is often worse, accepted and graded poorly. Therefore, discuss the project’s status at every meeting. If the candidate fails to meet a milestone on time, they must justify this. If the candidate did not cause the delay and neither the candidate nor the supervisor sees any way to make up for lost time, they may have to reduce the scope of the remaining work to ensure it is completed within the remaining time.

9.3 Supervision effort

The supervisor invests a lot of time in a thesis project, which they must factor in when planning their own workload. The effort required for supervision is not constant, but is distributed roughly as shown in [Figure 9-1](#).

- Defining the work ④ involves effort even before assigning the thesis project to a candidate. However, the effort invested in this phase pays off during the execution of the thesis project.
- During the introductory phase ⑤, the candidate needs intensive support from the supervisor to thoroughly understand the topic, plan the project, and develop possible solutions. During this phase, the supervisor and candidate should meet at short intervals, at least once a week.

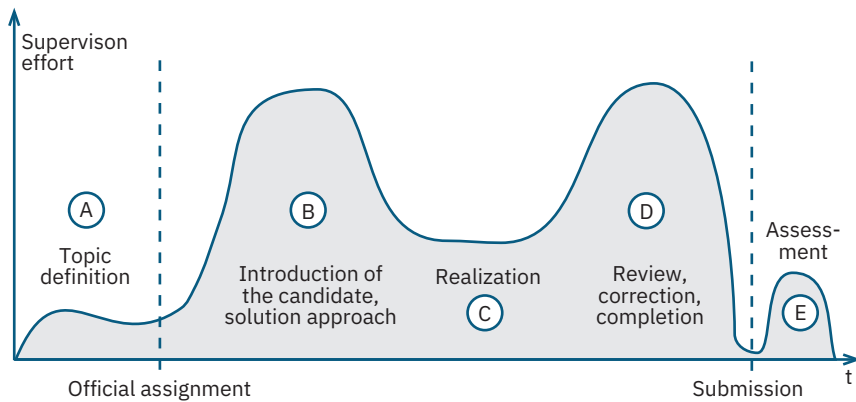


Fig. 9-1 Distribution of the supervision effort.

- After that, the candidate can realize their solutions largely independently ©. However, this does not mean that they should be left without supervision during this phase. The supervisor must closely monitor the project's progress to ensure it remains within the planned duration. For this reason, the supervisor should meet with the candidate at least every 2 weeks. Should difficulties arise, the candidate and supervisor can meet more often. If the problems are severe, the examiner should be involved.
- In the following phase ④, the workload for the supervisor increases because they must review the results, typically the thesis itself, and, if available, the software developed. In this phase, the meeting intervals should again grow shorter, about once a week. However, the candidate should not assume that the supervisor is responsible for the quality of the thesis. Rather, the supervisor's role is to point out fundamental deficiencies to the candidate. Under no circumstances should the supervisor review the thesis and other results in detail. The candidate, not the supervisor, is responsible for the results!
- Once the thesis has been submitted, it must be assessed ⑤. It makes perfect sense for the supervisor to refer to notes previously made for this purpose.



As a supervisor, you must take into account the time and effort required to supervise a thesis project when planning your own workload!

Never supervise so many theses simultaneously that the supervision of any of the individual theses suffers!

9.4 Teaching and assessment: the two roles of the supervisor

A thesis project always serves two purposes:

1. On the one hand, it is an essential element of the *curriculum*. That is why a thesis project is supervised, and we naturally expect the candidates to learn something from the project.
2. On the other hand, it is an *examination*. The supervisor typically prepares a proposal for assessing the thesis, which serves as the basis for the examiner's grading.

These two aspects are not easily compatible, and their interrelationship repeatedly causes difficulties for the supervisor. Figure 9-2 illustrates schematically (and in a greatly simplified form) the shift in the supervisor's role throughout the work.

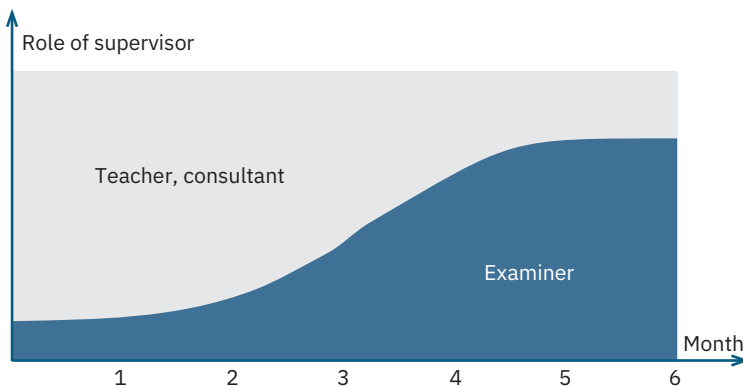


Fig. 9-2 Shift in the roles of the supervisor.

The supervisor always holds both roles, acting as teacher and examiner, which means the candidate can learn from the supervisor throughout the entire thesis project, even shortly before submitting the thesis.

9.5 The assessment

Thesis projects and their results are assessed and graded; indeed, formally, that is the main purpose and the examiner's central task. However, it is not always easy, in some cases even very difficult, to assess a thesis because the resulting grade has special importance for the candidate. To ensure that a thesis is not assessed based solely on gut feeling, we need to know the objectives of the thesis project and the **assessment criteria**.

Each concrete topic and task description outlines the requirements and goals to be met. In addition, there are general requirements for a thesis project defined by the curriculum and the examination regulations. In summary, these require that candidates

- demonstrate that they have acquired the necessary knowledge during their studies to carry out the thesis project,
- prove that they can independently solve a given problem within a limited time,
- demonstrate that they can apply scientific methods in a determined and systematic manner,
- are able to formulate and present their results.

A doctoral student must also present new scientific results (in the sense of scientific progress). From these general requirements, we can derive the following essential criteria for assessing a thesis project:

- A **Knowledge and skills** – Of course, the candidate must have certain prerequisite knowledge before starting the project. However, they should also be able to acquire new knowledge during the project.
- B **Systematic approach and scientific rigor** – The candidate should demonstrate that they can approach their task systematically and use scientific methods. This includes working with literature and tools provided to them or selected and procured by them.
- C **Initiative and commitment, independence** – The candidate must be able to work independently. This does not mean that they are not supervised; the decisive factor is whether they recognize for themselves what needs to be done next, or whether they repeatedly need to be instructed by their supervisor. Initiative and commitment are closely

related to independence. The candidate always has the opportunity to contribute and pursue their own ideas. The extent to which they do so is decisive for the assessment.

- D **Quality of results** – Of course, the quality of the results achieved carries the most weight. This also includes whether the candidate has completed all sub-tasks, or whether they have achieved results that increase the value of the thesis, even unexpected ones.
- E **Presentation of results** – The thesis documents all results achieved, which the candidate presents in a talk at the end of the thesis project. Both achievements are subject to assessment.

Table 9-2, which suggests a four-level **rating scheme**, summarizes these assessment criteria. We have quantified the assessment by specifying point ranges for each rating level, based on the following assumptions:

- The maximum score is 100 points.
- Assessment criteria A and B each contribute 15 points; criteria C and E contribute 20 points each. The most crucial criterion, D, contributes 30 points.
- Rating level 1 represents an excellent performance, level 2 a good performance, and level 3 a satisfactory and sufficient performance. A level 4 performance is too low and unacceptable.

Based on the specified minimum score for passing and the rating scheme used, the scores can then be mapped to grades. **Table 9-3** provides an example of such a mapping, using a minimum score of 40 and the German grading system. Using this or another rating scheme ensures that all criteria are taken into account.

Once the thesis project has been completed, the supervisor writes an assessment, which may be based on the rating scheme. Together with the thesis, this assessment forms the basis for the grade awarded by the examiner(s).



The examiner should not rely too heavily or solely on the rating schema!

Assessment Criteria					
Rating level	Knowledge and skills	Systematic approach and scientific rigor	Initiative and commitment, independence	Quality of results	Presentation of results
Level 1	Profound knowledge and interest in acquiring missing knowledge.	The project was carried out in a scientific and systematic manner.	The candidate worked very independently and intensively, incorporating many new ideas.	All goals were met or even exceeded; the results achieved were very good.	Excellent presentation of the results.
Points	12 ... 15	12 ... 15	16 ... 20	26 ... 30	16 ... 20
Level 2	Profound knowledge and interest.	The project was carried out in a largely systematic manner.	The project was carried out independently, and the candidate contributed their own ideas.	All goals were met; the results were well achieved.	The presentation was competent and, for the most part, thorough.
Points	8 ... 11	8 ... 11	1 ... 15	18 ... 25	11 ... 15
Level 3	Medium knowledge, acquired knowledge if necessary.	The project was carried out systematically in part.	Some initiative was evident.	The goals were partially achieved; the results were satisfactory.	The presentation was not very thorough, just the bare minimum.
Points	4 ... 7	4 ... 7	6 ... 10	11 ... 17	6 ... 10
Level 4	Lack of knowledge, as well as little interest in expanding it.	The project was carried out unsystematically.	The candidate showed little initiative.	Only the minimal results were achieved.	The presentation was poor and sloppy.
Points	0 ... 3	0 ... 3	0 ... 5	0 ... 10	0 ... 5

Tab. 9-2 Rating scheme for thesis projects.

Very good		Good			Satisfactory			Sufficient	
100...94	93...88	87...82	81...76	75...70	69...64	63...58	57...52	51...46	45...40
1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0

Tab. 9-3 Mapping of scores to the German grading system.

The overall impression the examiner gains when reading the thesis takes precedence because the rating scheme does capture all aspects. For example, if a candidate does not conscientiously complete the assigned task, this results in only moderate point deductions when applying the rating scheme. In this case, the examiner should not adhere to the scheme, but rather rate the (presumably unusable) results as “sufficient” or “failed.” Conversely, a thesis with noticeable shortcomings may be so impressive because of an outstanding partial result that the examiner awards a grade of “very good.” The results of the rating scheme should therefore be used as a decision-making aid, not as a judgment.

10 A Compact Guide to Thesis Projects

Below, we summarize the regulations, instructions, and notes on completing thesis projects scattered throughout this guide and other documents, and supplement them with practical advice.

Preparation and registration

- **Decide as early as possible in which research group you would like to carry out your thesis project!**

Find out about current research projects and thesis topics, as well as the requirements for starting your desired thesis project (e. g., participation in certain courses, knowledge of specific technologies). Ask other students about their experiences in the various research groups; these experiences are typically collected by the student council.

- **Ensure you receive a broad education!**

Try to carry out your thesis projects in different research groups.

- **Prepare yourself!**

Read well-graded theses by other students on similar topics and attend the final presentations of your fellow students. Find out what criteria will be used to grade your thesis project.

- **Ensure that your thesis project is assigned by someone approved as an examiner for your degree program!**

Read your examination regulations carefully; they specify all of these details. If the work is to be supervised or examined outside your faculty, ensure that this is possible and how.

- **Ensure that your thesis project is clearly described and that the registration is actually completed!**

At the beginning, you will receive the thesis project description and the registration form, which you and the examiner must sign. These documents serve as a contract and form the basis for the assessment.

Supervision and execution

- **Create a schedule at the beginning of your thesis project!**

Experience shows that this contributes to the success of the project. Create the schedule together with your supervisor and update it when-

ever necessary so you always know what you have already done and what still needs to be done.

- **Obtain all necessary literature as early as possible!**

This helps create a stable foundation for your work right from the start and avoids considering solutions that may already be known and reusable.

- **Document your intermediate results as building blocks for the thesis!**

Of course, this takes time. But this time is well invested, because you can very quickly incorporate this documentation into the first version of your thesis.

- **Ensure you take full advantage of the available supervision!**

Prepare yourself thoroughly for the meetings with your supervisor. This is to your own benefit.

- **Avoid anything that could damage or “infect” the university’s technical equipment!**

This includes installing unlicensed software or transferring unprotected data. You are liable for any damage you cause, whether intentional or through gross negligence.

Problems and extensions

- **Avoid basing your thesis project on prerequisites yet to be fulfilled!**

This includes hardware or software deliveries or the completion of other thesis projects. Such dependencies may lead to delays.

- **Respond immediately if delays occur!**

Contact your supervisor or examiner to request an interruption or extension if difficulties or obstacles arise during the course of your project that lie beyond your control.

Thesis and presentation

- **Start writing the thesis in good time!**

You always need a considerable amount of time to proofread your thesis and correct errors before you can submit it. Your supervisor will give you important tips and advice if you let them.

- **Submit any results not included in the thesis in a well-documented form!**

Including, for example, software or interview data. Discuss with your supervisor in good time in how to submit these results.

- **Plan the dates of your presentations well in advance!**

Ensure that you set the dates for the final presentation and other required presentations well in advance.

Assessment and grading

- **Ensure you get feedback on the assessment and grade!**

Ask your supervisor when you can expect to receive your grade after the assessment. Contact your examiner so they can explain the assessment and your grade to you (attend their consultation hour).

11 Checklists and Tips

A. Checklist for candidates

Before finally choosing a thesis topic, you should be able to answer “yes” to the following questions:

- ☐ **Do I meet all the formal requirements for a thesis project?**
These include, for example, having passed certain exams or having achieved the minimum number of credit points.
- ☐ **Have I correctly understood the selected topic and the task to be solved?**
If you have doubts, consider meeting with the potential supervisor again. When you explain the topic and the task to your supervisor in your own words, they should be able to determine whether it matches their expectations.
- ☐ **Do I meet all the general and specific requirements for this thesis project?**
This includes, for example, knowledge of specific lecture content, programming languages, or tools. The project will inevitably be delayed if missing knowledge must first be acquired.
- ☐ **Do I consider the entire task to be solvable within the specified time?**
If not, discuss it again with your supervisor and present your arguments.
- ☐ **Can I spend sufficient time on my thesis project?**
Completing a thesis project usually requires 100% of your time. Are you planning a vacation, medical treatment, or any other time-consuming activity? If so, inform your supervisor so that this can be taken into account in the planning.
- ☐ **Can the relevant examination board approve the thesis project I have chosen?**
If you consider an external thesis project, be aware that a thesis must always be submitted, examined, and graded by the university. Identify and resolve potential conflicts of interest at an early stage.

☐ **Do I feel that I can work well with the supervisor?**

As in any project, people must work together on a thesis project. If the “chemistry” is right, then things usually go better.

☐ **Do I know the criteria used to assess and grade my thesis?**

Very often, assessments are based on a list of criteria. You should be familiar with these criteria.

B. Checklist for supervisors

This checklist is designed to help supervisors create adequate conditions for a thesis project. Of course, compromises will have to be accepted.

- ☐ **Have the topic and the task been described in full?**
Of course, you can't know every detail in advance and write it down. However, you must identify and describe all the central sub-tasks.
- ☐ **Do any sub-tasks support a differentiated assessment?**
Ideally, all sub-tasks should be defined so they can be achieved at different levels. However, this is not always possible.
- ☐ **Does the task description include a scientific component?**
This applies in particular to master's theses, as these must always contain a scientific component.
- ☐ **Can the task be completed within the available time, or is it too extensive or complex?**
This question is not always easy to answer. If you are unsure whether the task is appropriate, discuss it with the examiner and adapt it if necessary.
- ☐ **Can the task be reduced if necessary?**
This is possible only if you have defined some sub-tasks that are relevant to the topic, but can also be dispensed with if necessary.
- ☐ **Can I provide sufficient supervision?**
You must have sufficient time available to supervise each individual thesis project. Therefore, do not start several theses projects at the same time, but always stagger them.
- ☐ **Are all the necessary resources available?**
In addition to your own resources, all technical and organizational requirements should also be implemented so that the thesis project can be carried out without any delays attributable to them.

C. Checklist for creating presentation slides

Unfortunately, presentations often include slides that are inadequate in both content and design. This checklist is intended to help avoid this.

- ☐ **Do you know who will be participating and whether there are any special constraints?**

Only when you have a rough idea of the audience can you prepare yourself and your presentation accordingly.

- ☐ **Is the central message clear? Is it clear what statements are to be conveyed overall?**

Clarify the objective of the presentation. Typically, a presentation can convey no more than two or three messages. Less is more!

- ☐ **Is the presentation appropriately structured?**

The mandatory elements of each presentation are welcome statement, introduction, overview, and summary.

- ☐ **Are the individual slides well-designed?**

Determine the slide design. Always include the name, number, date, and total number of slides on each slide. Avoid gimmicks! If you need a specific slide template, obtain it on time.

- ☐ **Have the individual slides been designed regarding their content and checked for spelling and punctuation?**

Read through them again and again, especially after making changes; don't blindly trust spell checkers!

- ☐ **Have the slides been checked in their final version (i. e., after the very last change)?**

Check the slides again, even after a minor change!

- ☐ **Is there a planned shortcut option?**

Consider whether there are non-central aspects or dispensable examples.

- ☐ **Does the duration of the presentation match the allotted time?**

Rehearse the entire presentation! Note that, at home, the presentation proceeds more quickly than with an audience present.

- ☐ **Did you reflect on any weaknesses in previous presentations?**

Target each weakness individually, for example, speaking to the projection screen instead of directly to the audience.

D. Checklist for the presentation and demonstration

Murphy's Law also applies to presentations and demonstrations. Good preparation helps avoid embarrassing mishaps.

- ☐ **Have the start time and duration of the presentation been determined? Should there be time for discussion?**

Coordinate this planning data with your supervisor in due time.

- ☐ **Is the exact venue known? Are you sure you will arrive on time for your presentation?**

In unfamiliar buildings, the last hundred meters are often tricky. No means of transportation guarantees punctuality! If there will be several presentations, be present from the beginning of the event.

- ☐ **Is the presentation equipment available, and does everything work properly?**

Do the cables or adapters fit? Murphy's Law is reliable. Try everything out beforehand!

- ☐ **Are the necessary files on your laptop?**

Save the latest version of the slides in a special desktop folder.

- ☐ **Can you operate the presentation computer correctly (if you are not allowed to use your own laptop)?**

Simply opening the file and scrolling through the slides is often not enough. Are all fonts used displayed correctly?

- ☐ **Does the combination of your laptop and projector work? Are the slides completely visible?**

Determine the appropriate resolution! Check sharpness and image edges.

- ☐ **Do you have a backup copy of the slides and selected screenshots from the demonstration?**

Better safe than sorry! Always have your slides and files ready on a USB stick or some other compact storage medium.

- ☐ **Have you coordinated with the person assisting you during the demonstration (if the demonstration is being assisted)?**

Practice the coordination of the presentation and demonstration several times beforehand!

E. Tips for citations and references

The following tips are intended to help you create technically sound citations and references:

- **Whenever possible, use the name-year citation style!**
This allows to semantically integrate the cited publication into the text and leads to references being sorted alphabetically according to the last name of the first author.
- **Avoid citing unpublished sources and private communications!**
Unpublished sources (i. e., those not officially accessible) and private communications should be cited only in an emergency to acknowledge these authors, even though an available publication does not prove the authorship.
- **Cite relevant sections as accurately as possible!**
If a particular section of a longer work is cited, the citation should be extended by the corresponding chapter or page number.
- **Check the citations and references for consistency!**
Before finalizing a thesis or paper, check whether the publications cited in the text – and only these – are also included in the references. Some word processors, such as the BIBTEX tool used in LATEX documents, guarantee this consistency.
- **Check the references for completeness!**
Different types of publications require different bibliographic data to be easily accessed. Check that this information is provided in full for all references.
- **Format the references so that they are easy to read!**
For inexplicable reasons, the references are often displayed in a very small font size. This is a pity, considering the references are often a very valuable part of a publication.

F. Tips for written exams

Anyone writing a thesis also takes exams. That's why we're offering a few tips here, based on our experience as examiners. Of course, the following tips won't work miracles – solid preparation is still the best advice. But you can still make a surprising number of mistakes before and during an exam.

- **Seek support if you have underlying problems with exams!**

Don't force yourself! If, for example, you suffer from exam anxiety, seek psychotherapeutic counseling (which is usually free for students) and solve your problems one by one. Pointing out your problems during an exam will not help you.

- **Learn step by step with the lectures and take the exams as early as possible!**

Experience shows that students who do so have the least overall effort and the shortest study time. On the other hand, students who postpone exams and fail very late (after too many semesters) suffer twice as many problems.

- **Obtain and study old exams and similar material!**

For oral exams, ask previous candidates about their experiences. Sometimes the student council collects exam questions and reports on experiences with examiners and exams.

- **Prepare for the exams in pairs or in a group!**

Test each other's knowledge, especially by insistently asking follow-up questions. Don't settle for vague answers.

- **When preparing, take advantage of the research group's offer to answer any questions you may have!**

If you have questions during your preparation, many research groups offer the opportunity to consult with staff members for advice and assistance. Of course, this will backfire if you recognize your gaps only two days before the exam. Exam preparation also requires planning.

- **Don't study until just before the exam!**

Take a break beforehand. Otherwise, you may find yourself unable to see the forest for the trees during the exam.

- **Always have your student ID with you!**

Bring your student ID and other necessary documents with you to the exam. You must always authenticate yourself!

- **Don't start exams too hastily!**

It's easy to overlook the most straightforward approach (and the simplest tasks). First, read the tasks calmly and think them through. Then, draft a solution and write it down.

- **Don't panic at the end of an exam!**

When the exam is almost over, don't panic and start scribbling something down. Experience shows that this doesn't help at all. Instead, make sure you don't put your written exam in your bag. Unfortunately, this happens time and again.

G. Tips for oral exams

Oral exams are usually very different in nature from written exams. The questions and tasks to be solved in a written exam are prepared in advance; this is usually not the case with oral exams, where the examiner goes through the lecture content with their questions, and the examinee answers them. This creates a dialog in which the examinee's answers often influence the next question. The examinee thus plays a much more active role than in written exams. As an examinee, you should always be aware of this!

When preparing for an oral exam, keep the following points in mind:

- **Pay close attention to the questions and answer them precisely!**

The idea of answering just anything to pass the time is not very effective, and you are wasting time that you could use to give correct answers. If you don't know the answer, it's best to say so right away. If you truly don't understand the question, ask for clarification.

- **If you give a wrong answer, accept it and move on!**

Don't argue with the examiner and try to convince them that you actually said the right thing. Instead, answer the next question correctly.

- **Do not use terms in the exam that you do not understand!**

The examiner is obliged to ask for clarification if they hear unfamiliar or new terms. Examinees often fall into the trap they have set for themselves.

- **Your examiner will notice if you're nervous!**

You don't need to tell the examiner at the beginning that you are nervous or very nervous. This is true for almost all candidates. Examiners are humans, too! Avoid nervous tics during the exam, such as fiddling with a pen.

- **Cancel in good time if you are unable to take the exam!**

For oral exams, it is considered more than impolite if you neither cancel your registration nor show up for the exam.

A final note on exams

Every exam is a source of important feedback. If you have passed your exams with good grades, you have every reason to be proud. However, if you barely passed most of your exams, you should seriously ask yourself whether you are on the right track.

For obvious reasons (“in dubio pro reo”), examiners often set the passing threshold for oral exams so that only the worst candidates are officially graded as “fail.” The remaining examinees are then “satisfactory” on paper, but by no means so in practice. At least in your own field of expertise, you should not have any major problems. Otherwise, you have chosen the wrong major, or your self-assessment was off.

12 Closing Notes

Of course, every thesis project is a challenge for everyone involved, but especially for the candidate. However, if everyone does their part, there is a good chance the thesis project will be completed successfully and the thesis will receive a good grade.

As is usually the case, this also applies to a thesis project:

**“Only when you do something with joy
can it turn out well – or even very well!”**



We hope this guide helps you succeed in your thesis project.

13 References

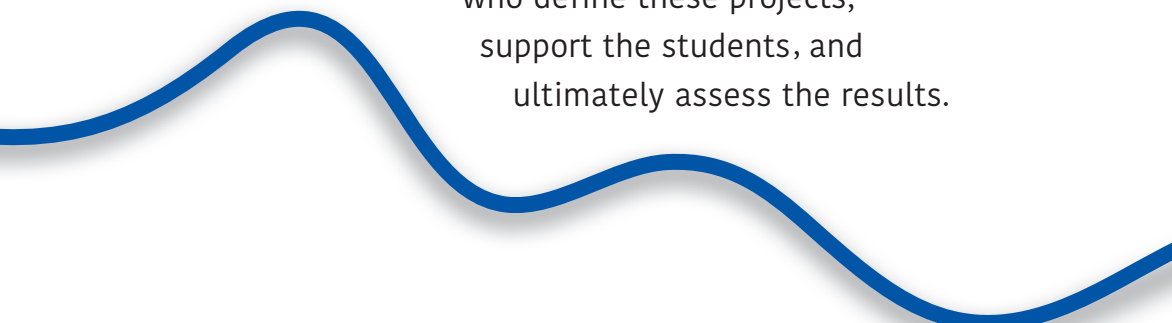
The references are formatted according to the APA citation style (7th edition).

- Boehm, B. W. (1983). Seven basic principles of software engineering. *Journal of Systems and Software*, 3(1), 3–24. [https://doi.org/10.1016/0164-1212\(83\)90003-1](https://doi.org/10.1016/0164-1212(83)90003-1).
- CSE (2025). *The CSE Manual : Scientific Style and Format for Authors, Editors, and Publishers (9th ed.)*. Council of Science Editors in cooperation with The University of Chicago Press. <https://www.csemanual.org/Home.html>
- Dijkstra, E. W. (1972). Notes on structured programming. In O.-J. Dahl, E. W. Dijkstra, & C. A. R. Hoare (Eds.), *Structured Programming* (pp. 1–82). Academic Press. <https://www.cs.utexas.edu/~EWD/transcriptions/EWD02xx/EWD249/EWD249.html>
- Ebbinghaus, H. (1885). *Über das Gedächtnis. Untersuchungen zur experimentellen Psychologie* [On memory: Studies in experimental psychology]. Duncker & Humblot. https://www.deutschestextarchiv.de/ebbinghaus_gedaechtnis_1885
- ETH Zurich (2025). *ETH Zurich citation guidelines* [Brochure]. ETH Zurich Library. https://ethz.ch/content/dam/ethz/associates/ethlibrary-dam/documents/ETH_Zurich_Citation-Guidelines.pdf
- ETH Zurich (2026, May 27). *Plagiarism and generative artificial intelligence*. ETH Zurich Library. <https://library.ethz.ch/en/researching-and-publishing/scientific-writing-at-eth-zurich/plagiat-und-kuenstliche-intelligenz-ki.html>
- Feynman R. (1965). *The character of physical law*. The M.I.T. Press. <https://nemenmanlab.org/~ilya/images/7/71/Feynman-1965.pdf>
- Fleischmann M., & Pons S. (1989). Electrochemically induced nuclear fusion of deuterium, *Journal of Electroanalytical Chemistry and Interfacial Electrochemistry*, 261(2), Part 1, 301–308. [https://doi.org/10.1016/0022-0728\(89\)80006-3](https://doi.org/10.1016/0022-0728(89)80006-3)
- Gamma E. (1992). *Objektorientierte Software-Entwicklung am Beispiel von ET++ Design-Muster, Klassenbibliothek, Werkzeuge* [Object-oriented software development: A case study of ET++ — Design patterns, class libraries, and tools], Springer. <https://doi.org/10.1007/978-3-642-77838-4>

- Halmos, P. R. (1970). How to write mathematics. *L'Enseignement Mathématique*, 16, 123–152. <https://www.di.ens.fr/~boulliar/Stages/Halmos-How-To-Write.pdf>
- IEEE (n.d.). *How to Cite References: IEEE Documentation Style* [Brochure]. <https://ieee-dataport.org/sites/default/files/analysis/27/IEEE%20Citation%20Guidelines.pdf>
- Kogut, J. B. (1987). The Scientists' Campaign against the Strategic Defense Initiative. *Journal of the American Medical Association*, 258 (5), 658–660. <https://doi.org/10.1001/jama.1987.03400050100035>
- Laher, S. (2025). Using AI in academic writing: what's allowed and what's not. *South African Journal of Psychology*, 55 (2), 155–158. <https://journals.sagepub.com/doi/10.1177/00812463251338244>
- Ludewig, J. (2003). Models in Software Engineering – an Introduction. *Software and Systems Modeling*, Springer, 2(1) 5–14. <https://doi.org/10.1007/s10270-003-0020-3>
- Michel, C., & Novak F. (1991). *Kleines psychologisches Wörterbuch* [A small psychological dictionary]. Erw. u. aktualisierte Neuausg., 7. Aufl., Herder-Taschenbuch-Verlag.
- Popper, K. (1972). *Objective Knowledge: An Evolutionary Approach*. Clarendon Press. <https://www.marxists.org/reference/subject/philosophy/works/at/popper.htm>
- Schöpfel, J. (2011). Towards a Prague definition of grey literature. *The grey journal*, 7(1), 5–18. http://archivesic.ccsd.cnrs.fr/sic_00581570/file/GL_12_Schopfel_v5.2.pdf
- Thomas, E. L., & Robinson H. A. (1972). *Improving Reading in Every Class: A Sourcebook for Teachers*. Allyn and Bacon.
- UC Berkeley (2026, May27). *Understanding Science – Glossary*. UC Museum of Paleontology. <https://undsci.berkeley.edu/glossary/scientific-literature>

This guide provides rules, recommendations, and techniques for conducting academic student thesis projects at the university level. It focuses on **bachelor's** and **master's thesis projects**, though most of its guidelines also apply to dissertation projects and other project types, such as academic papers or documents that do not meet academic standards.

This guide is intended for **students** seeking advice on selecting, preparing, conducting, and presenting a thesis project, and for the **supervisors** who define these projects, support the students, and ultimately assess the results.



Although the examples used are drawn mainly from Computer Science, the guidance is applicable to thesis projects across the engineering disciplines and the natural sciences.