How to Write a Great Thesis?

Best (and worst) practices from choosing a topic to handing in

Roman Haas

With material from Dr. Elmar Juergens

In close cooperation with the Academic Advisors at TUM Computer Science

2011 – 2017

2017 – now

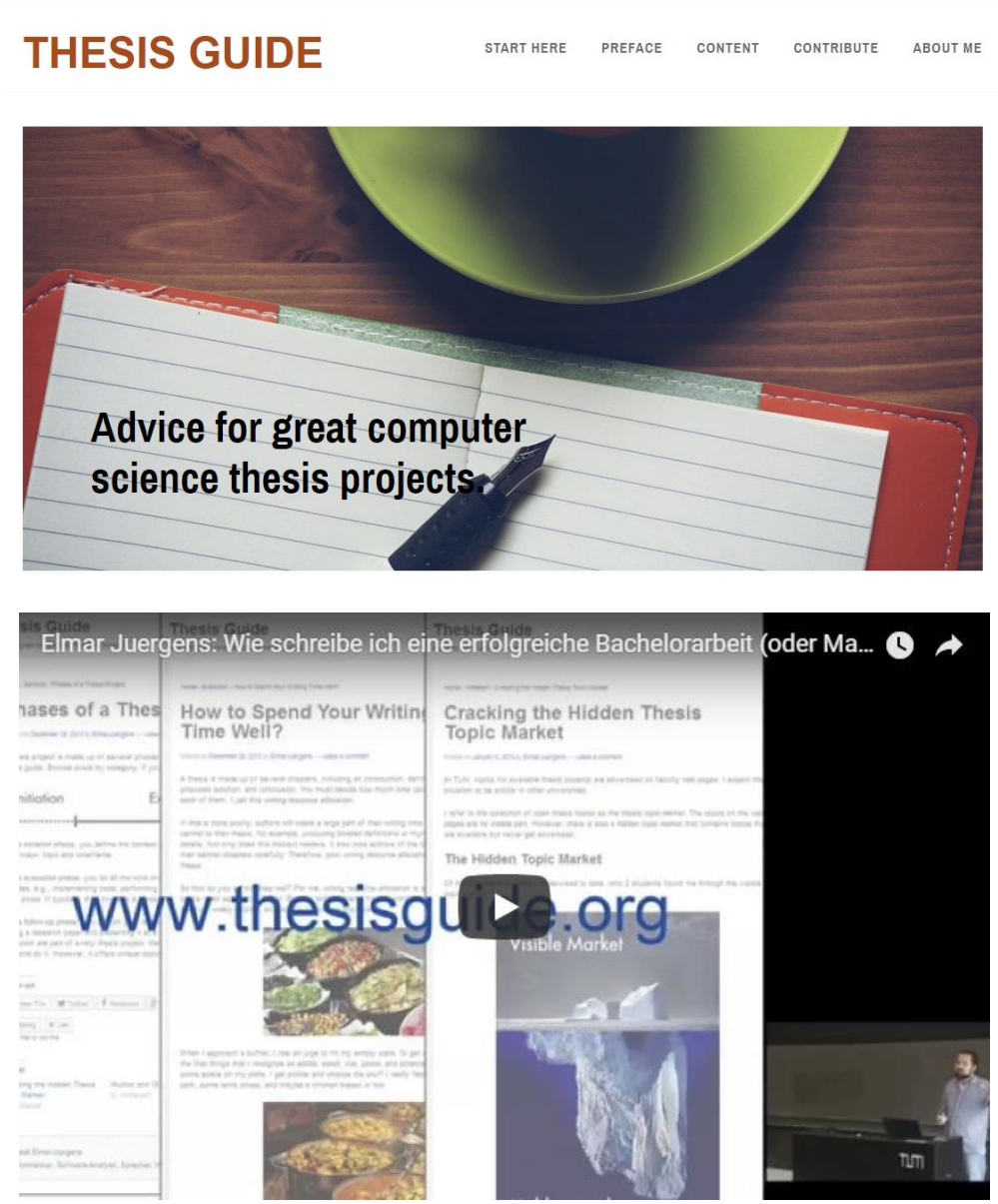
Research project “Q-SOFT”

Agenda

1. Why?
2. What‘s important?
3. Choosing a topic
4. Doing the work
5. Presentation

thesisguide.org

- Slides
- Video
- Detailed Essays
- FAQ



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5. Presentation

Refactoring Suggestions for Long Methods

```
public void writeComment(final DatenDownload datenDownload) {
    if (datenDownload.film == null) {
        // kann bei EinmalDownloads nach einem Neuladen der Filmliste/Programmneustart der Fall sein
        return;
    }
    final Path filmPath = Paths.get(datenDownload.arr[DatenDownload.DOWNLOAD_ZIEL_PFAD_DATEINAME]);
    if (Files.exists(filmPath)) {
        final String strFilePath = filmPath.toString();
        String strComment = datenDownload.film.arr[DatenFilm.FILM_BESCHREIBUNG];
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                builder.command().add(script);
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                                "<html>Es trat ein Fehler beim Schreiben des Spotlight-Kommentars auf.<br>" +
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                                        "das Entwicklerteam.</html>",
                                null,
                                null,
                                ex,
                                Level.SEVERE,
                                null);
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                    }
                } catch (NullPointerException ignored) {
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                }
            }
        }
    }
}
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                } catch (NullPointerException ignored) {
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                }
            }
        }
    }
}
```
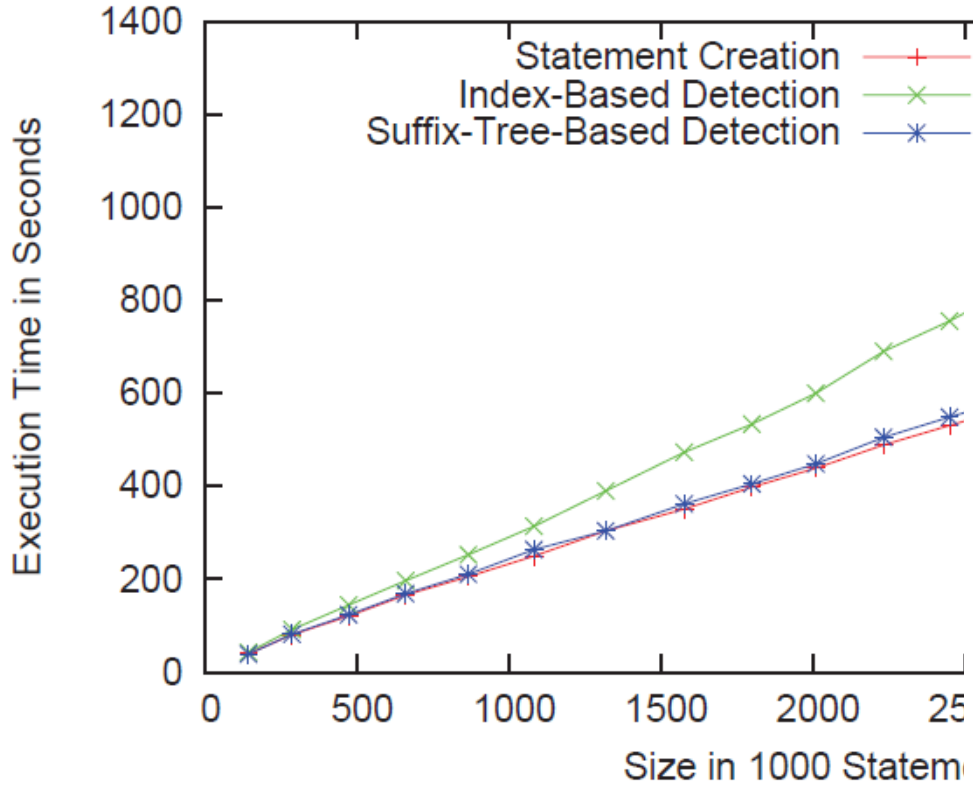
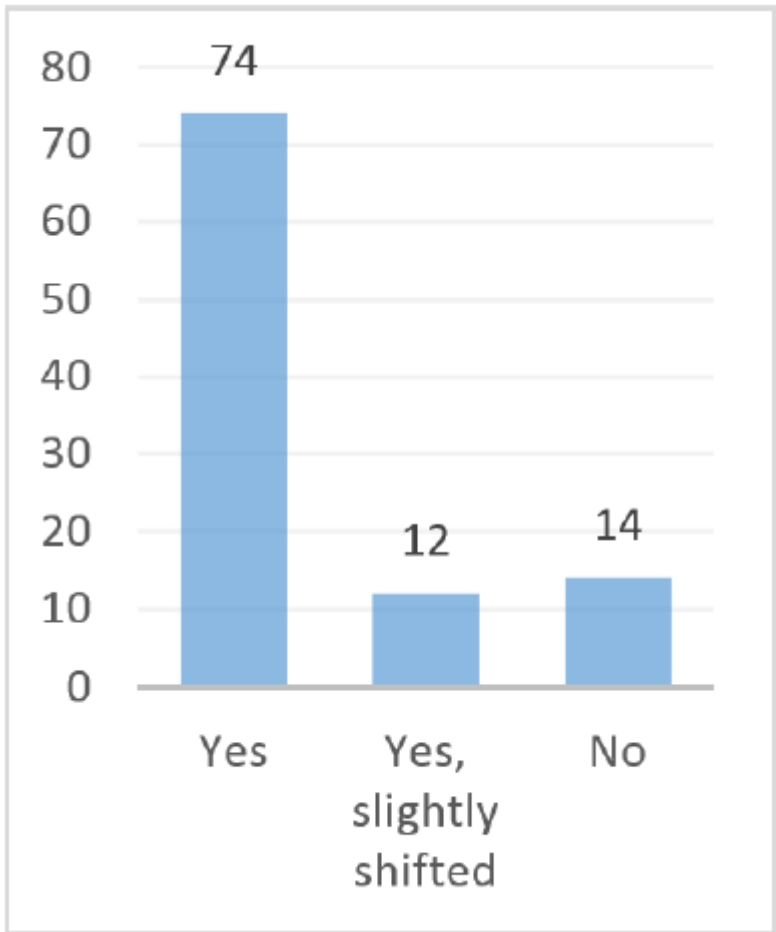

Agenda

1. Why?
2. What‘s most important?
3. Choosing a topic
4. Doing the work
5. Presentation

FAKULTÄT FÜR INFORMATIK
DER TECHNISCHEN UNIVERSITÄT MÜNCHEN
FAKULTÄT FÜR INFORMATIK
DER TECHNISCHEN UNIVERSITÄT MÜNCHEN
Bachelor's Thesis in Computer Science
Discovery of missed reuse opportunities
Tobias Völke


Execution Time in Seconds
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
Statement Creation
Index-Based Detection
Suffix-Tree-Based Detection
Size in 1000 Statem


80
70
60
50
40
30
20
10
0
74
12
14
Yes
Yes, slightly shifted
No

Roles

Author

Supervisor

Examiner

Roles

Author

- Creates solution
- Implements code
- Writes text
- Presents work

Supervisor

- Invents topic
- Feedback for work
- Evaluation

?

Examiner

- Feedback topic
- Formal Evaluation

?

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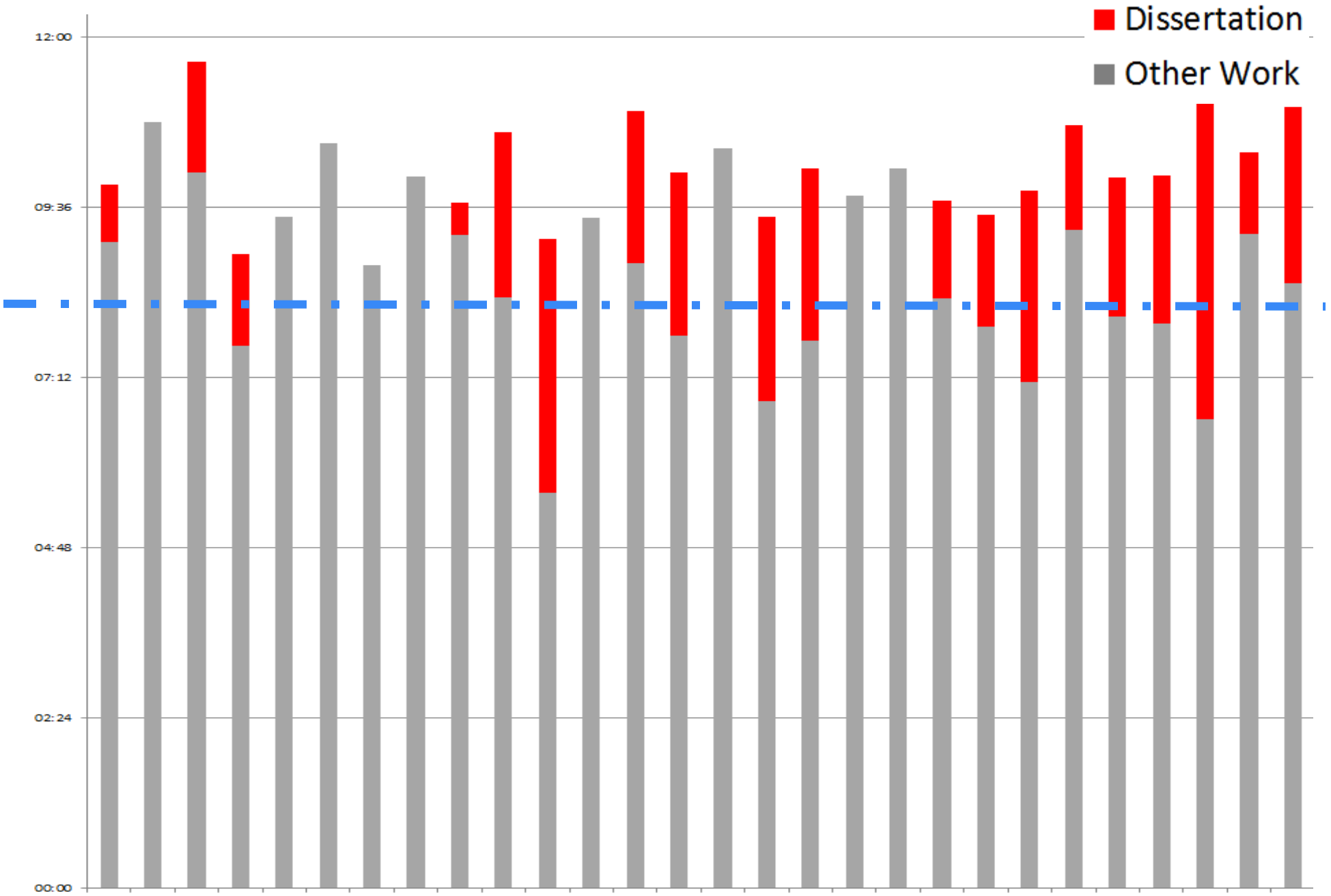
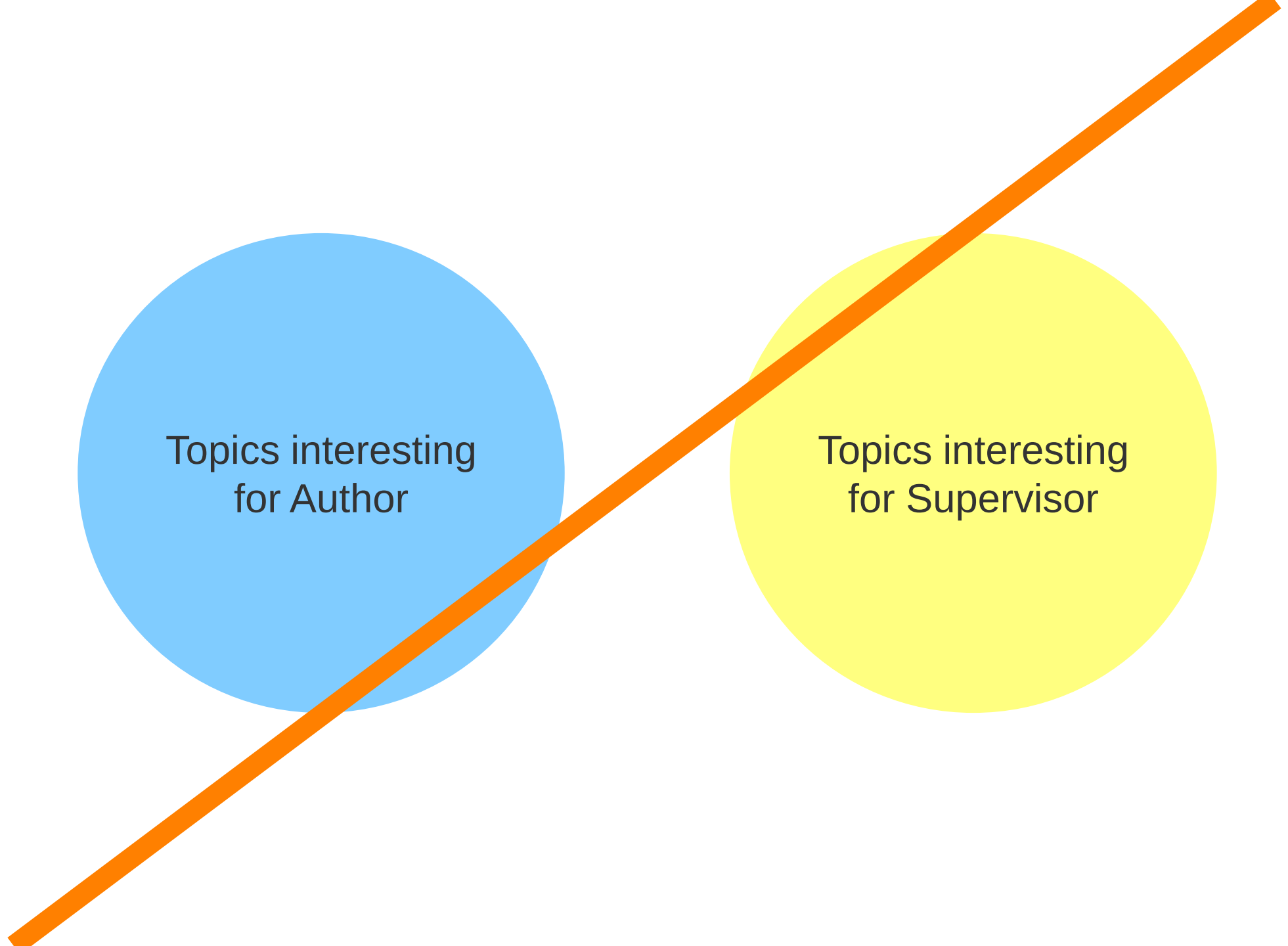

Dissertation
Other Work
12:00
09:36
07:12
04:48
02:24
00:00


Topics interesting
for Author
Topics interesting
for Supervisor

Sources

- Courses of studies
- Chair webpages
- (Old) topic descriptions

Ask potential supervisors! They are looking forward to your initial application!

Thesis Application is an Application!

You should address two important points:

- Motivation: why are **you** interested?
- Strengths: why should **you** work on the topic?

Optionally

- CV, motivation letter

What if I don‘t have a Topic in Mind?

- Ask potential supervisors for ideas

- As a supervisor, I do **not** expect
  - Students to come up with thesis topics
  - Students to apply only for documented topics

From: Roman Haas
To: Elmar Juergens
Date: 10.12.2013

Hallo Herr Juergens,

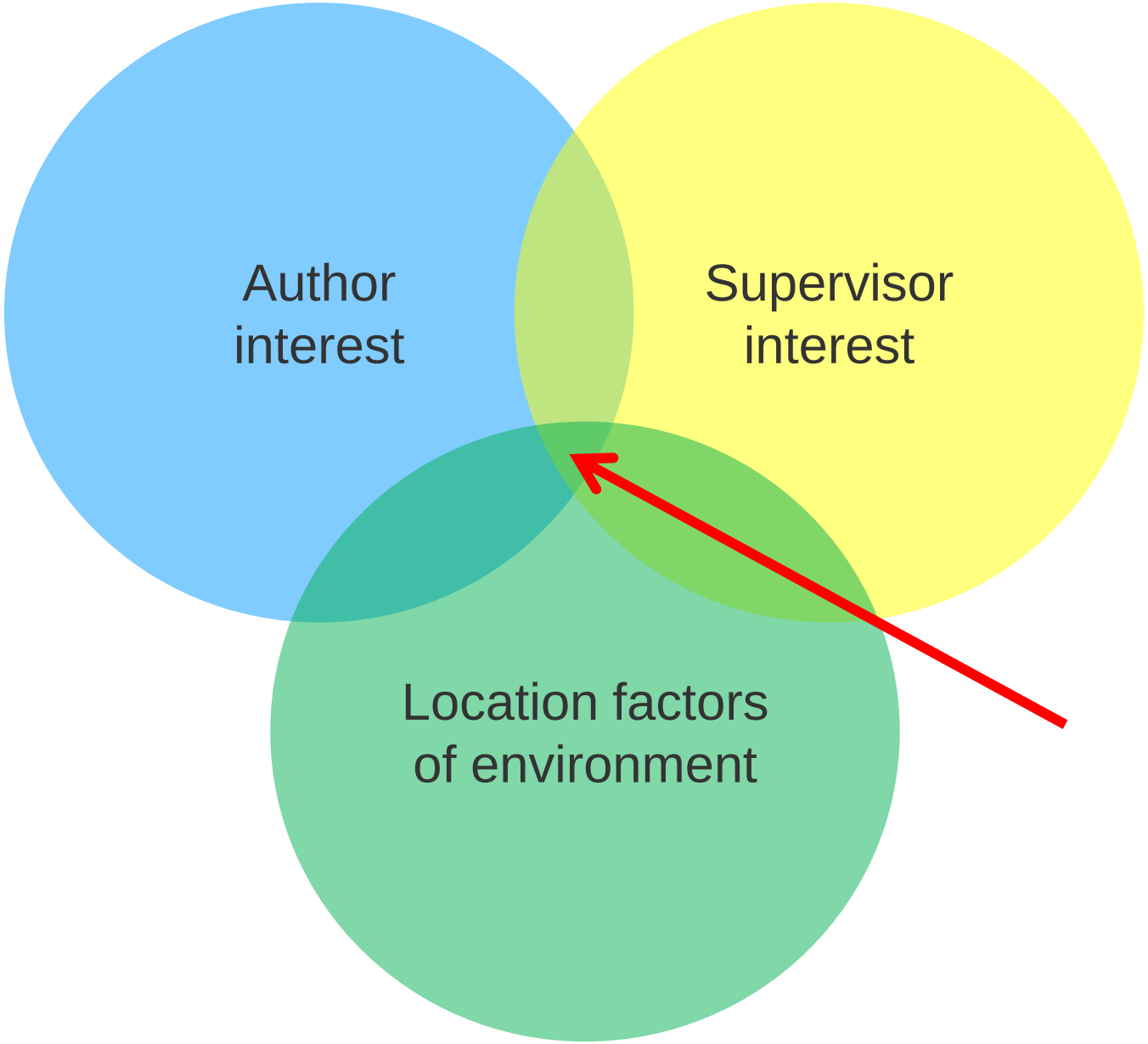
ich studiere Informatik an der TUM im fünften Semester und möchte im kommenden Sommersemester meine Bachelorarbeit schreiben. Ich interessiere mich für Software Engineering-Themen wie z. B. Tests, Analyse, Softwarequalität und habe im Rahmen meiner Werkstudententätigkeit auch erste Erfahrungen in diesen Bereichen gesammelt. Beispielsweise beschäftige ich mich damit, Tests einer Komponente in einem Flugsimulator zu automatisieren. Außerdem habe ich im Sommer bei der Ferienakademie an einem Kurs zum Thema "Programmanalyse" teilgenommen, der mir viel Spaß gemacht hat.

Haben Sie noch Themen für eine Bachelorarbeit aus den Bereichen Software Engineering/ Testing/ Analyse?
Falls ja, könnten wir uns mal auf einen Kaffee treffen, um uns darüber genauer zu unterhalten?

Danke für Ihre Antwort!

Viele Grüße

Roman Haas


Author
interest
Supervisor
interest
Location factors
of environment

TUM

- Contact to research (PhD?)
- Easier to find supervisor
- Scientific publication more probable
- More visionary topics
- Experience in Supervision

⇒ Insight into scientific work

Industry

- Contact to company (Job?)
- Easier to find topic relevant in practice
- You might get paid
- Publication more difficult (Exception: Case study)
- Synchronization of supervisors requires more effort

⇒ Insight into Company

Special Case

Spin-Offs/Research institutes: sometimes best of both worlds

CQSE

Teamscale

Development
Operations

Services

Audits
Quality Control

Research

Software Quality
e.g., Coding, Testing

For Students

Forschungsarbeiten @ CQSE

Register

Jakob Rott

Jetzt anmelden

Informations-Event, wie Abschlussarbeiten bei der CQSE GmbH ablaufen und welche Themen es gerade gibt

Jakob Rott • Roman Haas

gate Garchinger Technologie- und Gründerzentrum →

01. February 2024

17:00 - 19:00

When does a topic suck?

If you cannot tell, whether a solution for it is good, or not.

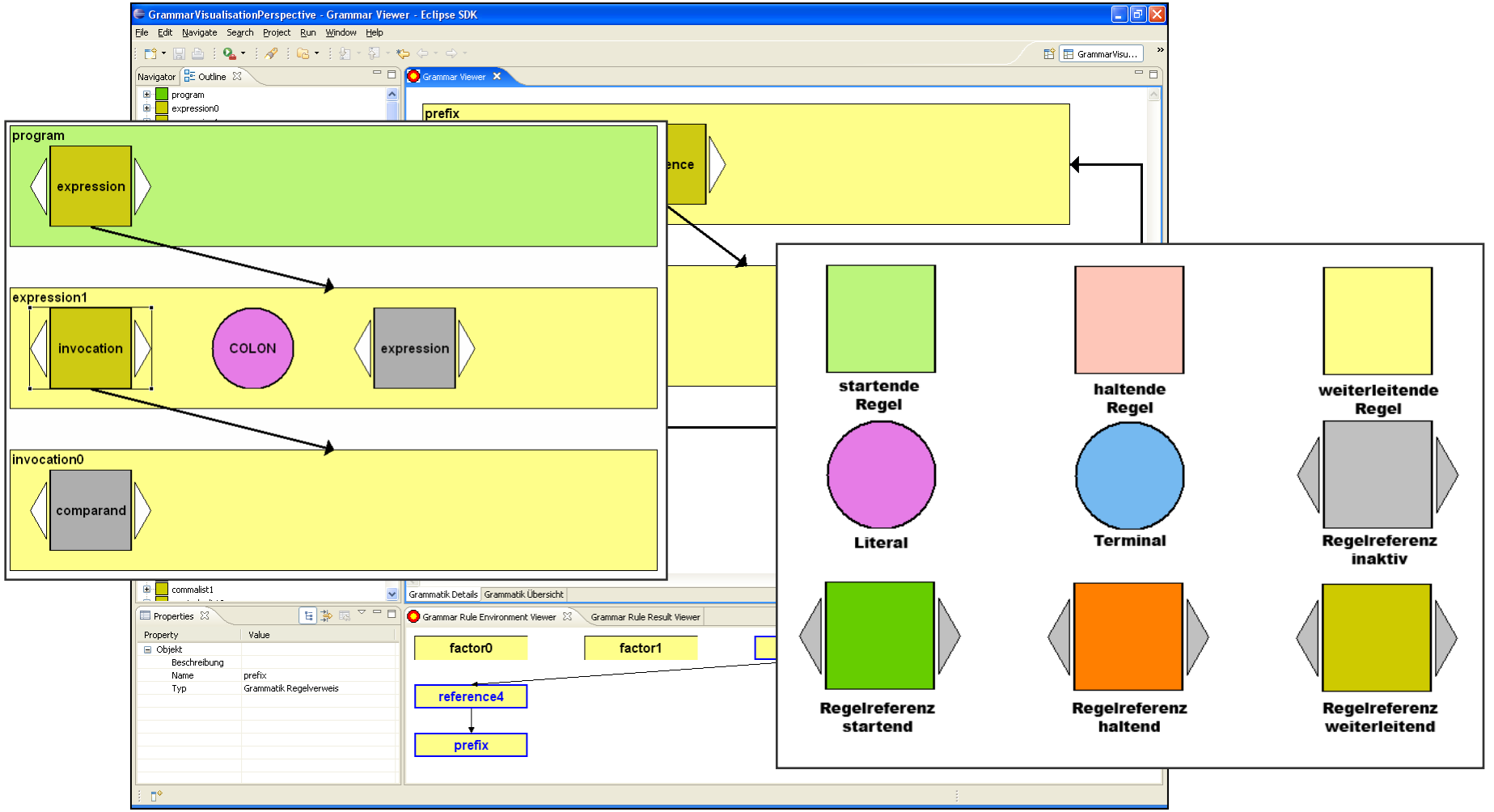
Most important factors:

- Is there a clear problem statement?
- Is there a way to evaluate alternative solutions?

Why important?

- Helps you choose between alternatives
- Helps you convince your supervisor
- Helps your advisor to convince his professor (your examiner)

Unterstützung von Sprachentwicklung durch Visualisierung



Images taken from slides from Ludwig

Refactoring Suggestions for Long Methods

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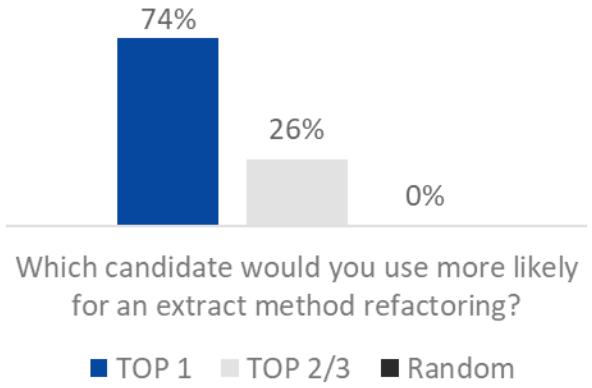
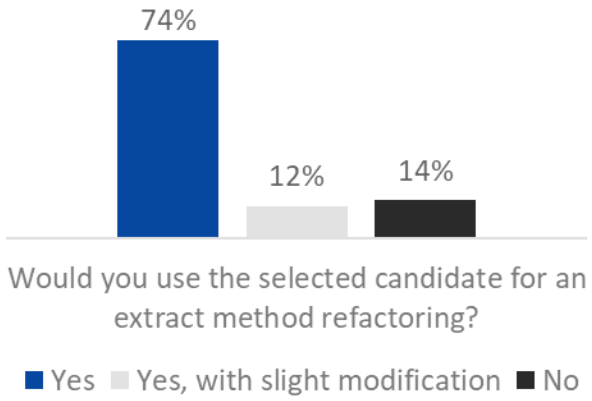




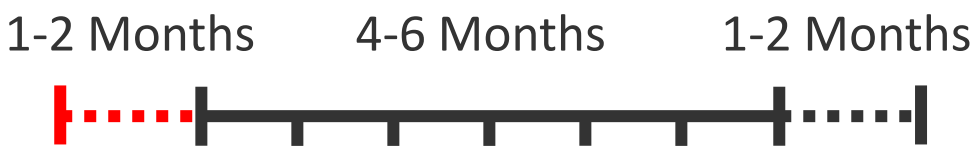
Topic-Antipatterns

- Search my Literature
- Implementation only
- Choose my Tool

– Lack of objective evaluation criteria
– Hard to guide your own work
– Publication difficult

Schedule

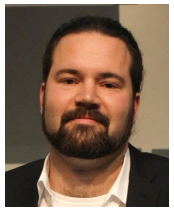
- Internal Thesis

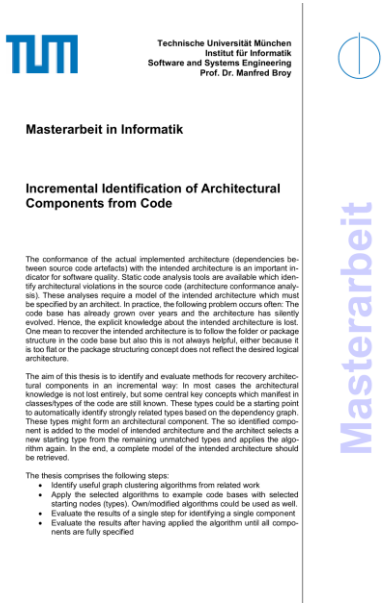


- External Thesis

- Spin-Offs/Research Institutes

Formal Registration





Technische Universität München
Institut für Informatik
Software and Systems Engineering
Prof. Dr. Manfred Broy

Masterarbeit in Informatik

Incremental Identification of Architectural Components from Code

The conformance of the actual implemented architecture (dependencies between source code artefacts) with the intended architecture is an important indicator for software quality. Static code analysis tools are available which identify architectural violations in the source code (architecture conformance analysis). These analyses require a model of the intended architecture which must be specified by an architect. In practice, the following problem occurs often: The code base has already grown over years and the architecture has silently evolved. Hence, the explicit knowledge about the intended architecture is lost. One mean to recover the intended architecture is to follow the folder or package structure in the code base but also this is not always helpful, either because it is too flat or the package structuring concept does not reflect the desired logical architecture.

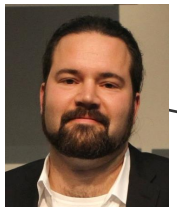
The aim of this thesis is to identify and evaluate methods for recovery architectural components in an incremental way: In most cases the architectural knowledge is not lost entirely, but some central key concepts which manifest in classes/types of the code are still known. These types could be a starting point to automatically identify strongly related types based on the dependency graph. These types might form an architectural component. The so identified component is added to the model of intended architecture and the architect selects a new starting type from the remaining unmatched types and applies the algorithm again. In the end, a complete model of the intended architecture should be retrieved.

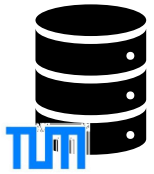
The thesis comprises the following steps:

- Identify useful graph clustering algorithms from related work
- Apply the selected algorithms to example code bases with selected starting nodes (types). Own/modified algorithms could be used as well.
- Evaluate the results of a single step for identifying a single component
- Evaluate the results after having applied the algorithm until all components are fully specified

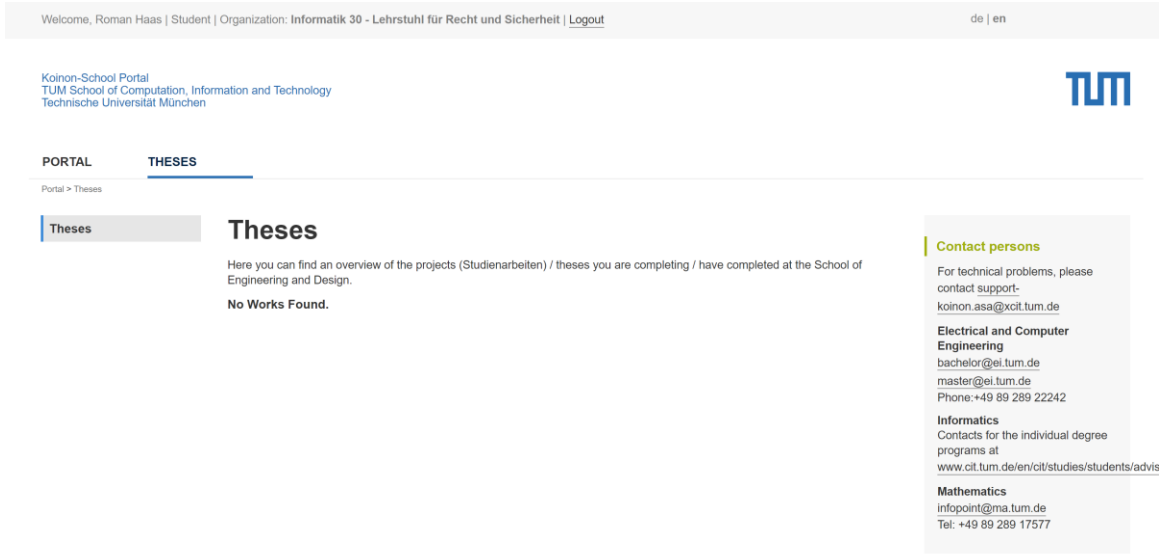
Masterarbeit

Formal Registration

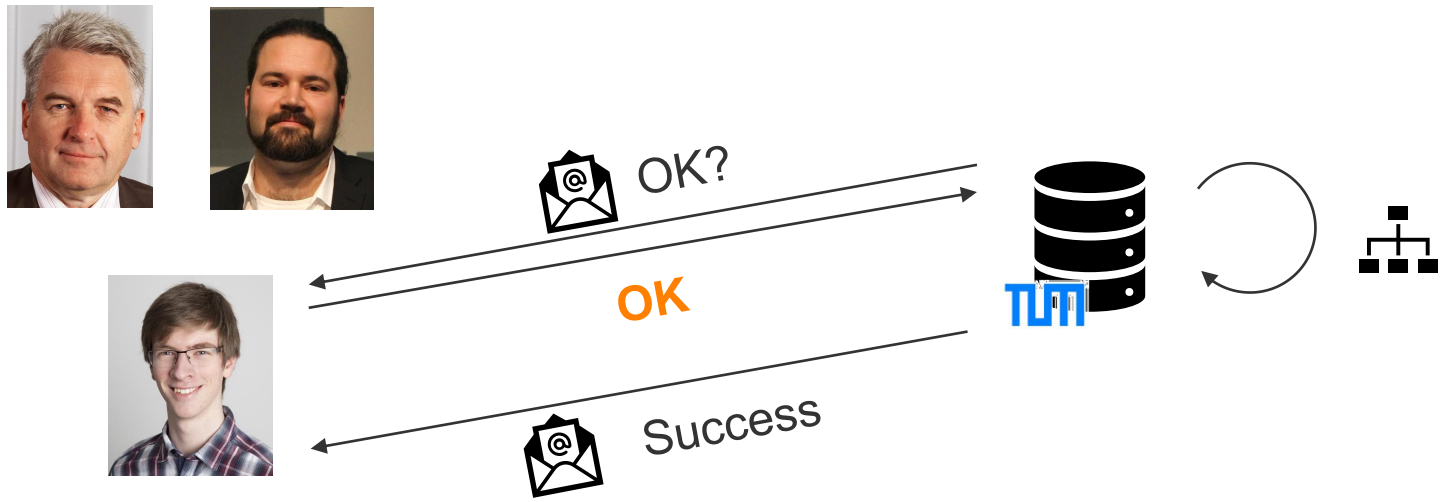




NEW: Koinon



Formal Registration



NEW: You can start the thesis on every day of a month

My Advice: Register immediately.

When to Register?

- My advice: **Register immediately**!

- Still, there is no risk: you can withdraw without any consequences within the first third of your writing time.

- Extension
  - Because of Sick Leave: No problem
  - Because of other reasons: Potentially complex. Try to address using scoping

Questions?

- Choosing a topic?
- Topic quality criteria?
- Internal vs. external thesis?
- Registration?

Agenda

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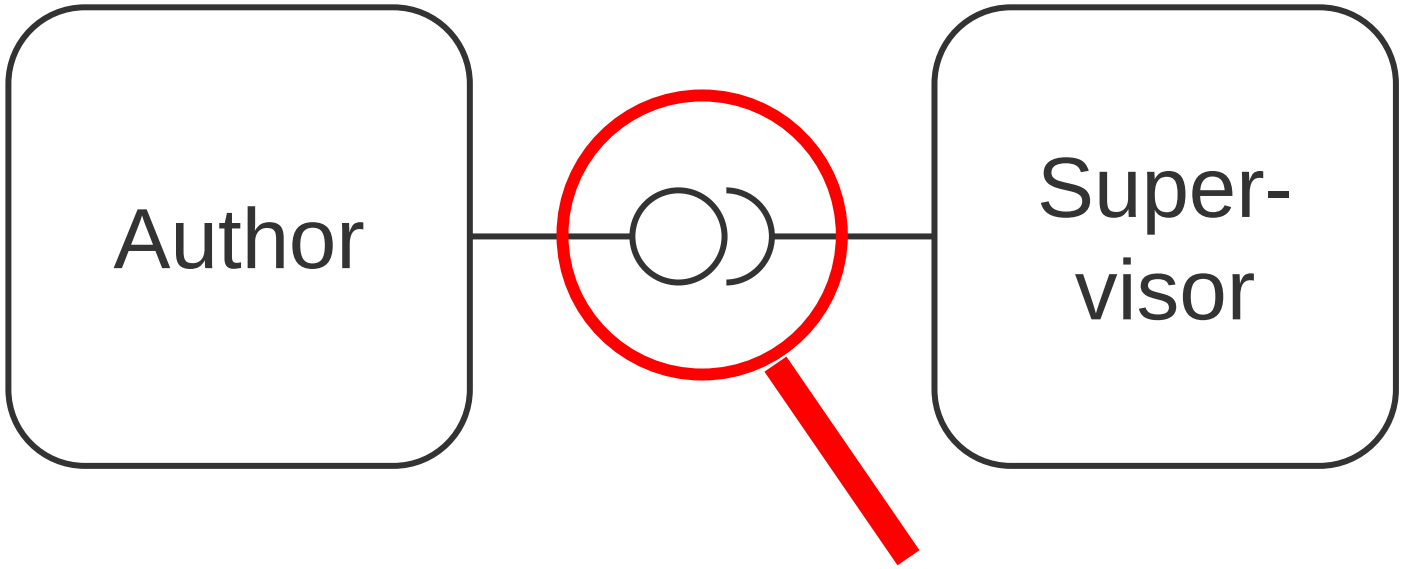
What characterizes scientific work?

German: Wissenschaftliches Arbeiten: schafft Wissen.

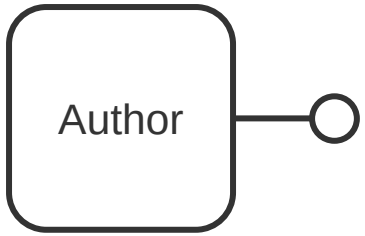
$\Rightarrow$ Scientific work creates knowledge

- Separate opinion / hypothesis from empirical results
- Separate your results from previous work

Goal: Enable reader to trace (or in some cases reproduce) your results.


Author
Super-
visor

Author Responsibilities

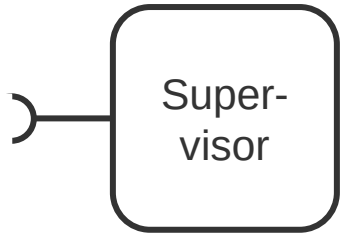


- Time management
- Request feedback
- Communicate problems
- Make decisions

To make supervisor happy, report in each meeting

- Status last meeting
- What happened since then
- What you plan to do next, which problems you see

Supervisor Responsibilities



- Topic definition and -clarification
- Scoping
- Giving Feedback

Not Responsibility

- Micro-Management & Time management
- Take away decisions
- Proof-read complete work

How often to meet?

Regular meeting

Meeting on demand

Feedback for outline

Parts

1. Introduction
2. Fundamentals
3. Related Work
4. Solution Approach
5. Evaluation
6. Future Work
7. Conclusion

Parts

1. Introduction
2. Fundamentals
3. Related Work
4. **Solution Approach**
5. **Evaluation**
6. Future Work
7. Conclusion

> 2/3 of thesis

OCTOBER 13, 2014 | ELMARJUERGENS | EXECUTION | EDIT

Thesis Architecture

The outline is the architecture of your thesis. It decomposes your document into components (called chapters) with dependencies between them (called references). As for software, the architecture plays a crucial role for the success of your project.

Since text is hard to refactor (much harder than source code), it is tedious manual work to fix an outline that does not work properly later. Minimize this risk by 1) using a standard architecture and 2) early validation of a prototype (through supervisor feedback).

Standard Architecture

A suitable *software* architecture allows the most important operations to be performed with high performance, even if this increases the cost of other operations. A search engine architecture, for example, is optimized for performance of search queries. Other text operations, say spell checking, are slow or not supported at all.

A suitable *thesis* outline allows a readers to answer the most frequent questions with high performance (i.e. without having to read the whole document). Which problem does the thesis solve? Did the approach work? What are its results and limitations? Which section should I read for details? Less important questions, say in which order the ideas occured to the author, may not be answerable at all.

https://thesisguide.org/2014/10/13/thesis-architecture/

Tools

- LaTeX
- Version Control System (including a backed up server)
- JabRef / Zotero / Mendeley / Citavi

- Template (example)
- Formal requirements (DE, EN)

Work Routine

09:00

10:00 Coffee Break, 10:00

11:00

12:00 Lunch, 12:00

13:00

14:00

15:00 Coffee Break, 15:00

16:00

17:00

Questions?

- Interface Author / Supervisor?
- Supervision?
- Tools?
- Where and how to write?

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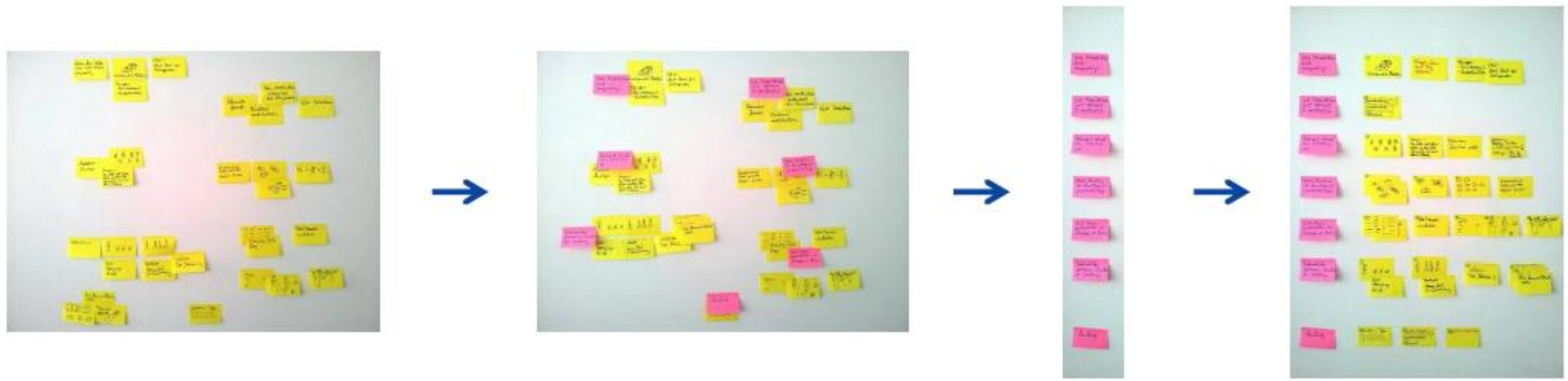
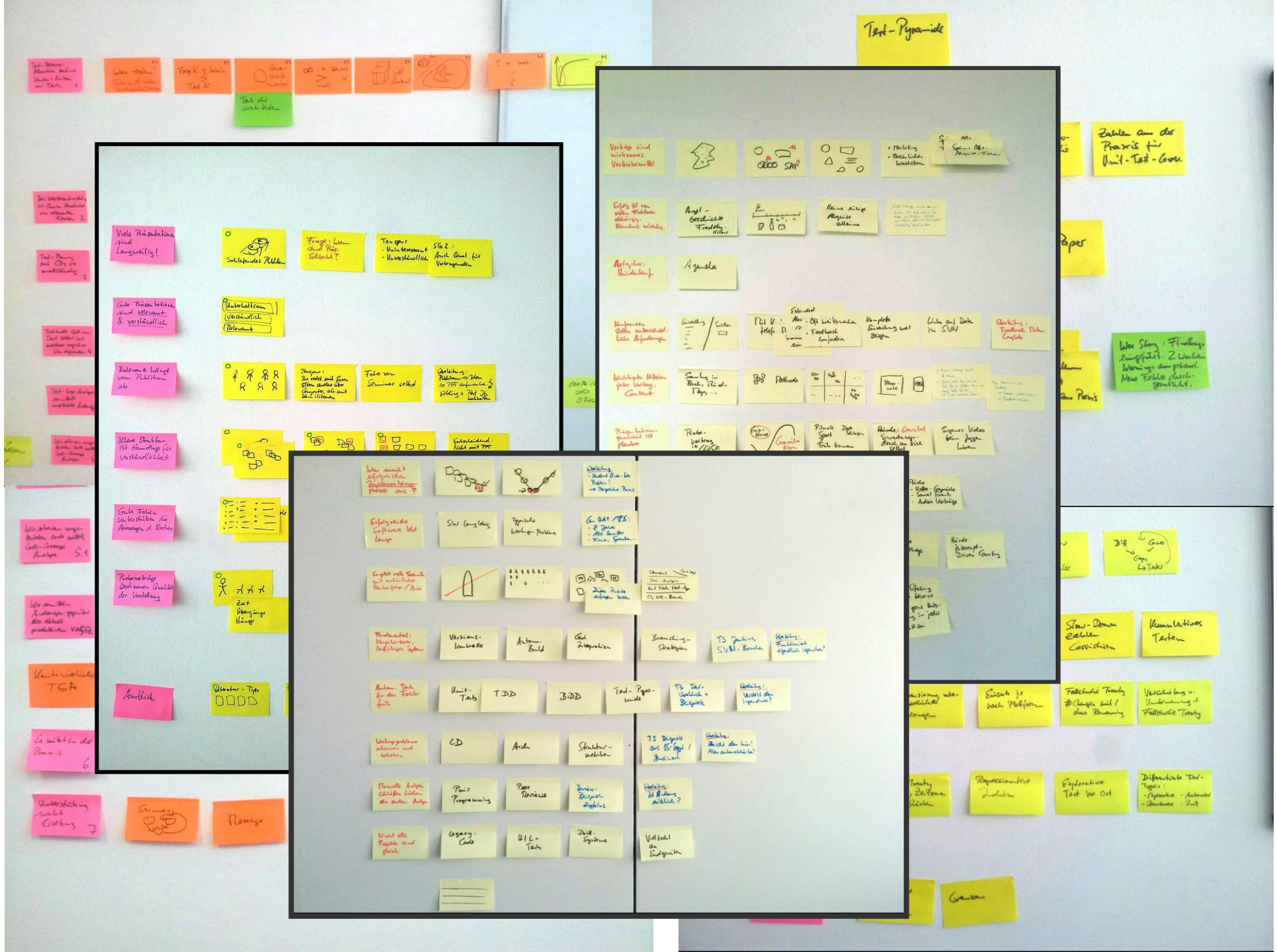


IKEA-Schrank
Arbeit Daniela
Problem + Ansatz
Teamscale-Folie
Gliederung
Erwartung
Uni
Entern
Feedback
Scoping
Zeitmanagement
Versionskontrolle
LaTeX
JabRef
allein
Mit Betreuer


Test-Pyramide
Viele Präsentationen sind langweilig!
Gute Präsentationen sind relevant & verständlich
Relevanz hängt vom Publikum ab
Klare Struktur ist Grundlage für Verständlichkeit
Gute Folien unterstützen die Aussagen d. Redners
Probevorträge bestimmen Qualität der Vorstellung
Ausblick
Zahlen aus der Praxis für Unit-Test-Cover.
Paper
Kumulatives Testen
Slow-Down Zahlen Cassidian
Granzen
Message
Unit-Tests
TDD
BDD
Test-Pyramide
CD
Arch
Pair Programming
Peer Reviews
Legacy-Code
HIL-Tests
Drill-Systeme
Versions-Kontrolle
Automatic Build
Cont Integration
Branching-Strategien
Agenda
Angel-Geschichte Freddy
Heime einzige Akquise alleine
Unterhaltsam
Verständlich
Relevant
Foto vom Seminar selbst
Zeit Übergänge Hänger
Kontinuierliche TGA
Unterstützung nicht Ersetzung
Summary
Unterstützung
Vorträge sind wirksames Vertriebsmittel
Erfolg ist von vielen Faktoren abhängig. Kenntnis wichtig.
Aufgabe: Hürdenlauf
Kontinuierliche Kriterien guter Vortrag: Content
Präsentationsqualität ist planbar
Wer Storg: Findbarkeit eingeführt. 2 Wochen Warnung angekündigt. Neue Fehler durchgesetzt.
Hürde: Interrupt-Driven Counting
Eigenes Video bei jeden Hören
Fehler: Kaffee-Gespräche
Sonst Events
Aber Verträge
Diff
Cover
Gaps
Tester
Einsatz je nach Plattform
Fallstudie Treaty
Regressionstest Indien
Explorative Test Vor Ort
Differentiate Test-Types
Sonstige Unit
Wer macht erfolgreiche Implementierungsprozesse aus?
Erfolgreiche Software lebt lange
SW langlebig
Typische Wartungs-Probleme
Ein QAT / TS:
Fundamental: Kompilierbarkeit, lauffähiges System
Automatic Test für den Fehler früh
Wartungsprobleme erkennen und beheben
Manuelle Analysen schließen Lücken der auten Analyse
Nicht alle Projekte sind gleich
Dieses Punkte erfragen lassen
Unit-Tests
TDD
BDD
Test-Pyramide
TS Test-Wahlheit + Beispiele
TS Beispiele aus BS-Sprgt. / Bundesrat
Vielzahl an Endgeräten

THESIS GUIDE

START HERE PREFACE CONTENT CONTRIBUTE ABOUT ME

MARCH 4, 2015 | ELMARJUERGENS | PRESENTATION | EDIT

How to Draft Your Presentation

When I listen to a thesis presentation, I need to get the big picture before I care about the details. Until I have understood the problem statement, for example, I do not care how an algorithm works or how its average-case amortized runtime complexity beats existing solutions. Not even if it is presented with a nifty visualization.

In other words, if the big picture of a presentation—its structure—is messed up, no amout of clever visuals can save it. The first priority is thus to get the presentation structure right.

What do I mean by *presentation structure*? The presentation's composition of of its constituent parts. How much time you spend on which part. Which one you focus on. Which thesis content you shorten, or leave out entirely. Whether you include an example, presentation. Which running example. And so on.

Creating the structure is about making choices. Much like software architecture decisions, these choices are difficult to change later on. The goal of creating the presentation structure is thus to deliberately make and evaluate these choices early on, when they are still cheap to change.

When I prepared my first presentations, I always started by creating slides right away. This is a fundamentally bad idea, as it distracts from the structure.

As soon as I write my first letter on a slide, it has a font, a size, a color and a position. If I draw objects to form an info graphic, they have relative positions, alignment, proximity, contrast. All these properties force me to make choices. Or accept default settings, which are often ugly. Since ugly slides are irritating, they demand fixing. This ties up my time with tweaking. However, none of the visual properties of slides matter for presentation structure.

The key to focus on structure is to avoid details altogether. Use a medium that *does not allow details*. Thus shy slide-ware (Powerpoint and such) when drafting presentation structure.

My favourite drafting medium are whiteboard marker, post-its and a wall [1]. Since I am pretty clumsy with the whiteboard marker, and since the post-its are small, I simply cannot do details.

I use the process described by Nancy Duarte in her book *Resonate*. To make it tangible, I use examples from a presentation I did on presentation design [2].

Brainstorm

https://thesisguide.org/2015/03/04/how-to-draft-your-presentation/

No signal
01:30

Audience sees this

Next slide

SHOW TASKBAR DISPLAY SETTINGS END SLIDE SHOW

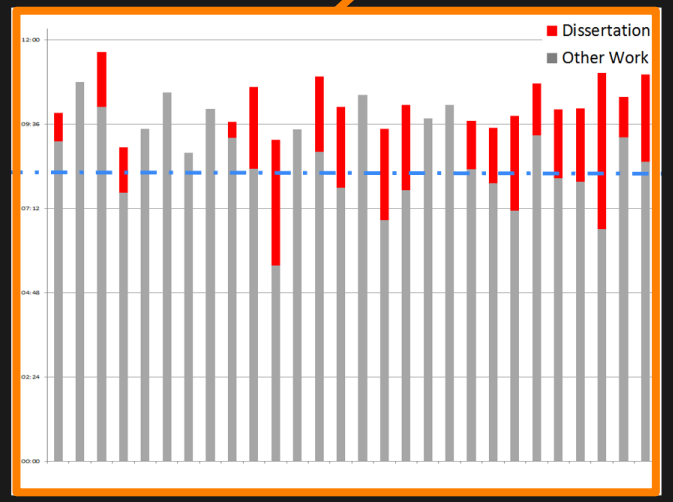
0:02:33 07:44

Agenda

1. Why?
2. What's important?
3. Choosing a topic
4. Doing the work
5. Presentation

Slide 19 of 77

Next slide



Choosing the topic also means choosing an advisor. This is obvious.
It also means choosing the amount of time the advisor has. This is less obvious. Let me explain.

My notes

MARCH 4, 2015 | ELMARJUERGENS | PRESENTATION | EDIT

How to Rehearse Your Thesis Presentation

A new set of presentation slides is like a program that ha
probably contains bugs. It reduces the pain for all stakeh
yours, if you test it to discover (and fix) its bugs before ex

My test process for presentations has three steps. The fi
test of a program. The second one is in front of a test au
done by representative users. The third one is with your

Step One: Alone

The first rehearsal step is to give the presentation to an i

Step Two: Test Audience

The second rehearsal step is to give the presentation to a test audience.

Two to four persons make the perfect test audience size. A single person can miss too many problems or be too subjective. More than four add little value but complicate the rehearsal, since everybody wants their say. Personally, I prefer three test audience members.

The test audience comments are the more helpful, the more similar the test audience is to the audience of the final presentation. Computer science students are thus preferable over parents over grandparents. However, take what you can get. A rehearsal in front of your grandparents is still far better than no rehearsal in front of an audience.

I use this process for test presentations with an audience:

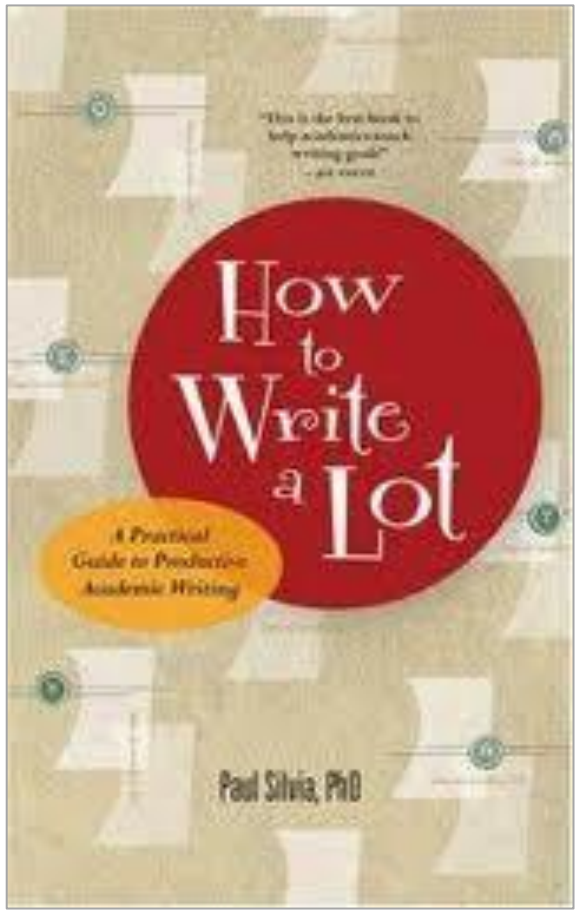
- Hand out pen and paper, including a printout of the slides. It is easiest to note down visual slide problems on the slides themselves. It also allows you to collect the notes afterwards.

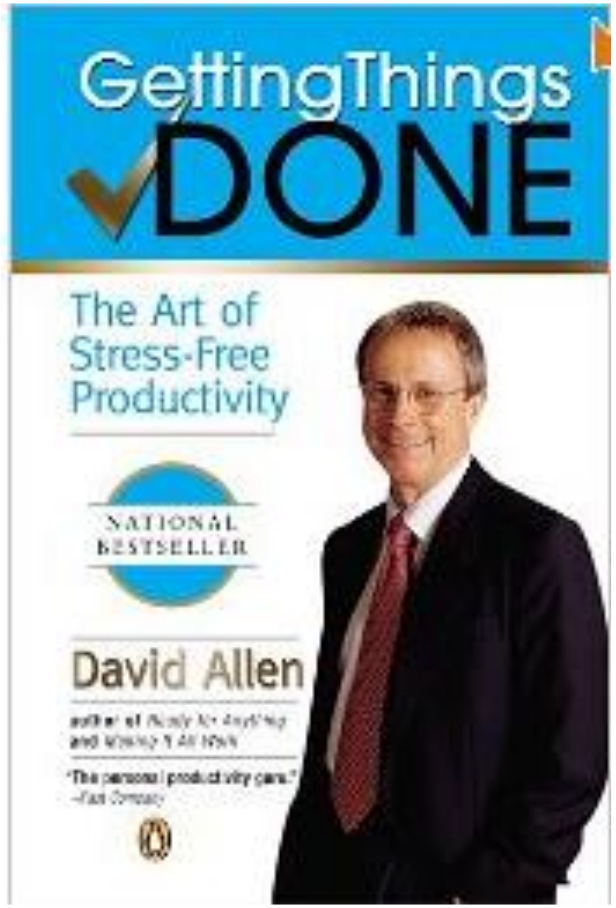
- Plan at least three times the amount of time of the presentation for the entire meeting (e.g. 60min rehearsal meeting to test a 20min presentation).

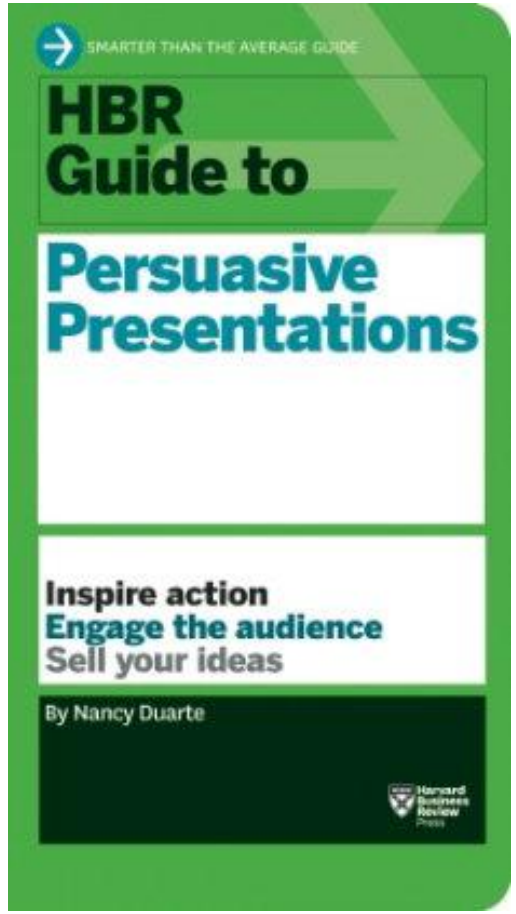
https://thesisguide.org/2015/03/04/how-to-draft-your-presentation/

After handing in

- Celebrate!
- Make presentation appointment early
- Communicate your time constraints early to advisor


How to Write a Lot
A Practical Guide to Productive Academic Writing
Paul Silvia, PhD


Getting Things DONE
The Art of Stress-Free Productivity
NATIONAL BESTSELLER
David Allen


SMARTER THAN THE AVERAGE GUIDE
HBR Guide to
Persuasive Presentations
Inspire action
Engage the audience
Sell your ideas
By Nancy Duarte

JUNE 10, 2016 | HAAS93 | FAQ, GENERAL | EDIT

Avoiding Typical Pitfalls (not only) at TUM

This post is from Roman Haas (he was advised by Elmar in his Bachelor's Thesis).

It focuses on more or less typical problems that appeared to him and his friends during our theses and how to avoid them. They are described by anti-patterns, i.e. there is always a description of a problem and a possible solution for it. The problems are sorted by the moment when you should pay attention to them: the first ones may appear at the beginning of your work, the latter ones appear during your work or at the end.

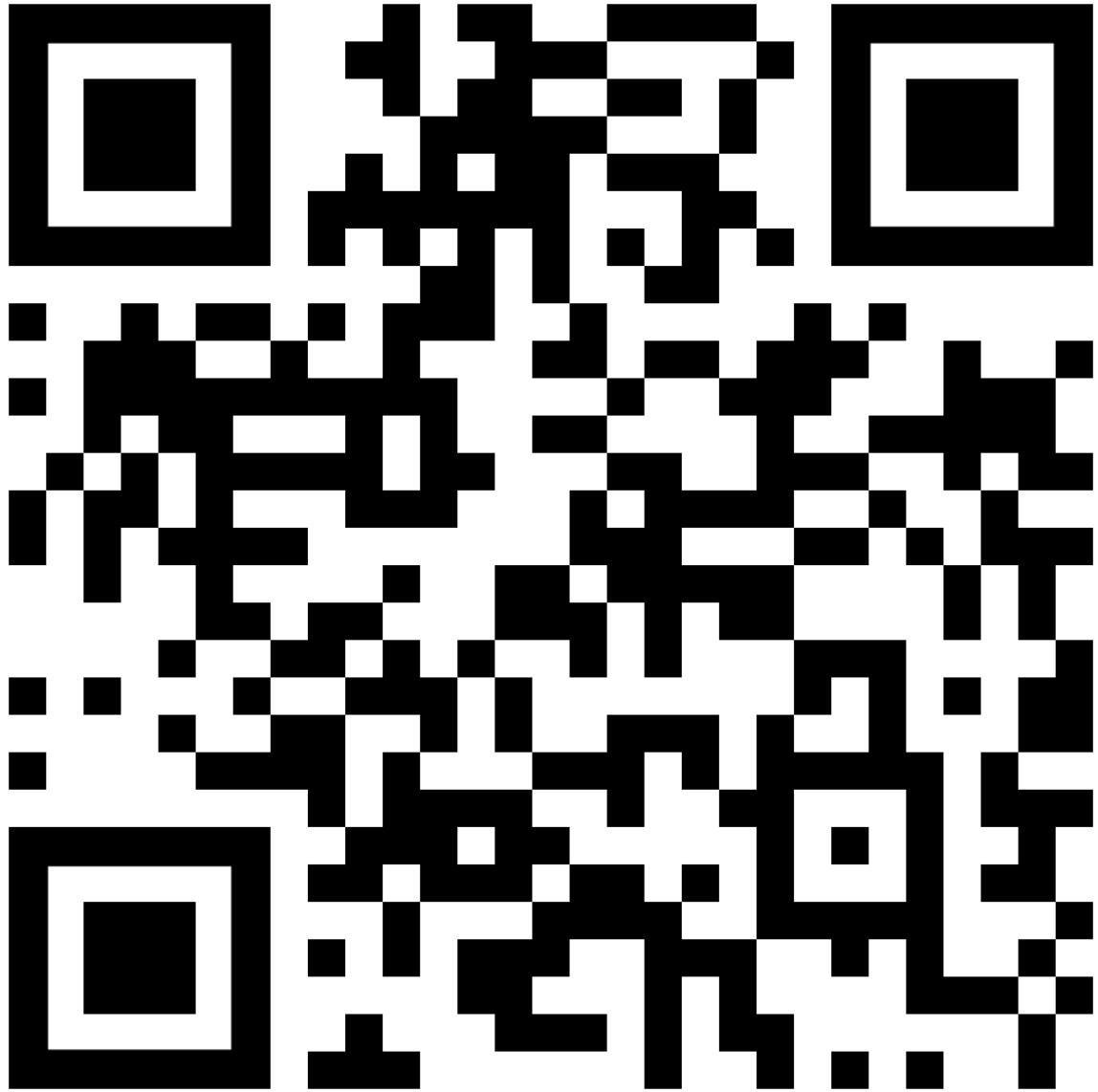
Rating Criteria Surprise

Problem: You are not happy with the final grade of your thesis because you spent too much time on things that are not (so) relevant for the grade.
Solution: Ask your supervisor at the beginning of the work which criteria will be used to rate the thesis. Does the code that you wrote for the thesis influence the grade? What about the presentation at the end?

Wasting Time on Thesis Template

Problem: At the end of your writing time you realize that there are formal errors like formatting issues and content of the cover page in your thesis.
Solution: Look for a thesis template at the very beginning of your work, e.g. ask your friends which template they used. Do also check at the beginning whether all formal

https://thesisguide.org/2016/06/10/avoiding-typical-pitfalls-not-only-at-tum/



https://cqse.eu/feedback-tum-talk

TUM provides the platform.

It is your responsibility, to create your environment to write a successful thesis.

Thanks!

haas@cqse.eu

More information available at https://thesisguide.org