How to Write a Thesis, or a Research Paper

A Short Introduction

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- Updated versions of these slides will be available in our Github repository.

- Special thanks to Prof. Dr. Alex Norta, who taught the course *"How to Conduct Research? Thinking, research methods, structuring publications"* at Tallinn University of Technology, which inspired and formed the foundation of this presentation.

INTRODUCTION

Introduction
Overview

- **How to write a thesis, or a research paper?**
  -
  -
  -

Introduction
Overview

- **How to write a thesis, or a research paper?**
  - What are the required theoretical concepts to write a good thesis/paper?
  -
  -

Introduction
Overview

- **How to write a thesis, or a research paper?**
  - What are the required theoretical concepts to write a good thesis/paper?
  - What is the general document structure
  -

Introduction
Overview

- **How to write a thesis, or a research paper?**
  - What are the required theoretical concepts to write a good thesis/paper?
  - What is the general document structure?
  - What are the specific steps of writing your thesis/paper?

Introduction

The Creative Process

1) This is awesome
2) This is tricky
3) This is shit
4) I am shit
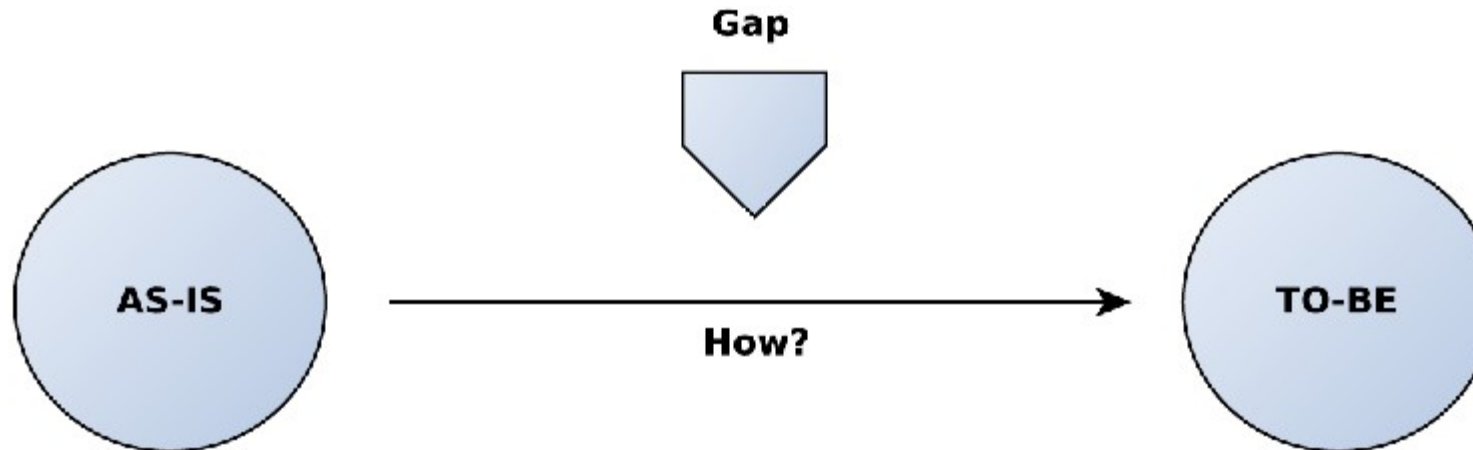5) This might be OK
6) This is awesome

Introduction
"Why?"

- **Why should someone read your thesis/paper?**
  - Introduce and motivate your topic/problem statement
  - Describe the State of the Art (SoA)
  - Detect a knowledge gap
  - Close the knowledge gap by providing an answer to the problem statement

Introduction
Detecting a Gap

@Mattes:
RECREATE (TU Clausthal Colors)

Introduction
Closing the Gap

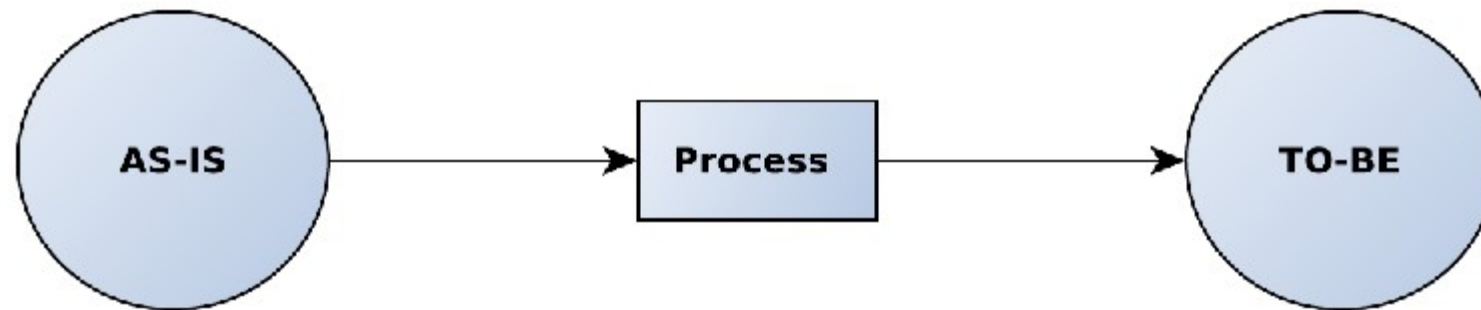**@Mattes:**
RECREATE (TU Clausthal Colors)

Introduction
Closing the Gap

@Mattes:
RECREATE (TU Clausthal Colors)
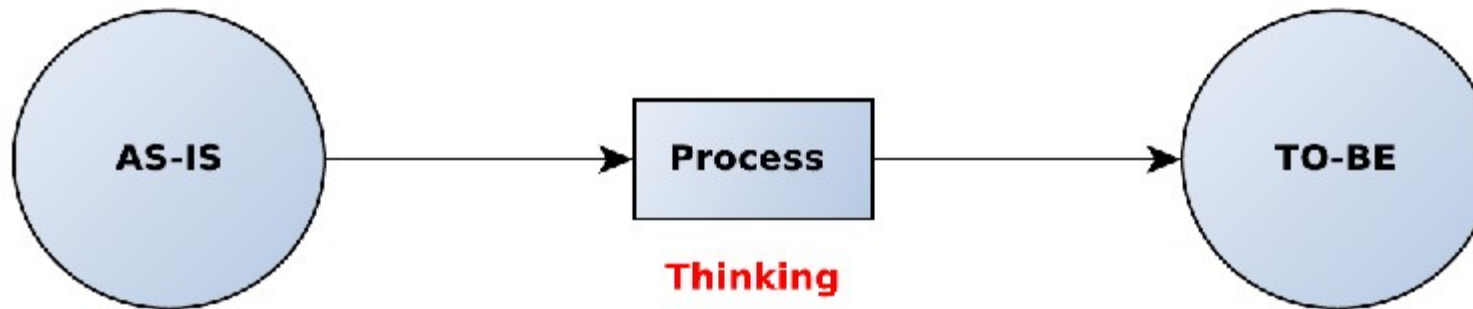
Introduction

Trivium

@Mattes:
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General Grammar (Input Knowledge) — What? Who? When? Where?

Classical Rhetoric (Output Wisdom) — How?

Formal Logic (Processing) — Why?
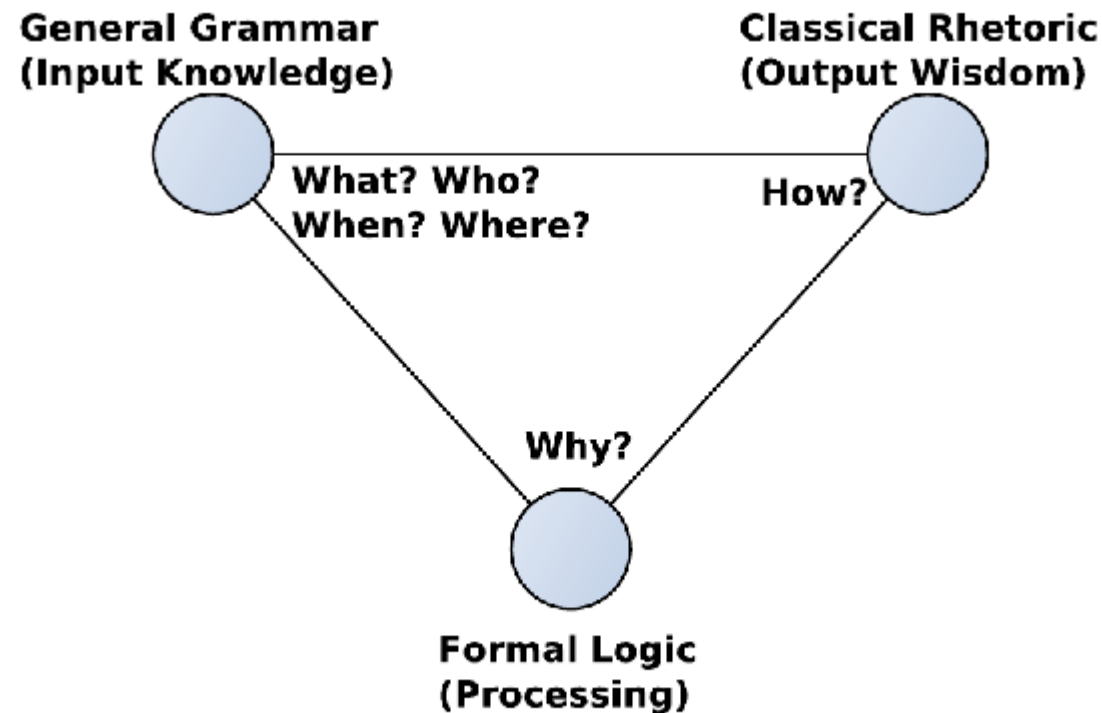
Introduction

Trivium – Research Paper
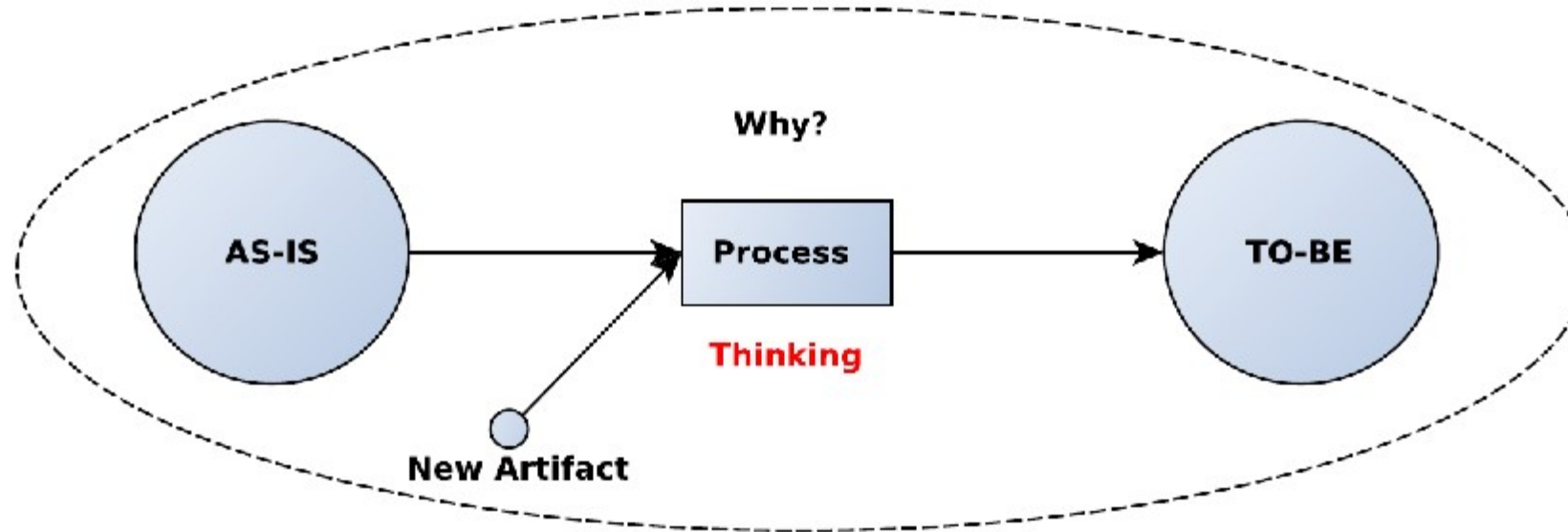
Introduction

Research Questions (RQ) – Paper

**@Mattes:
RECREATE (TU Clausthal Colors)**
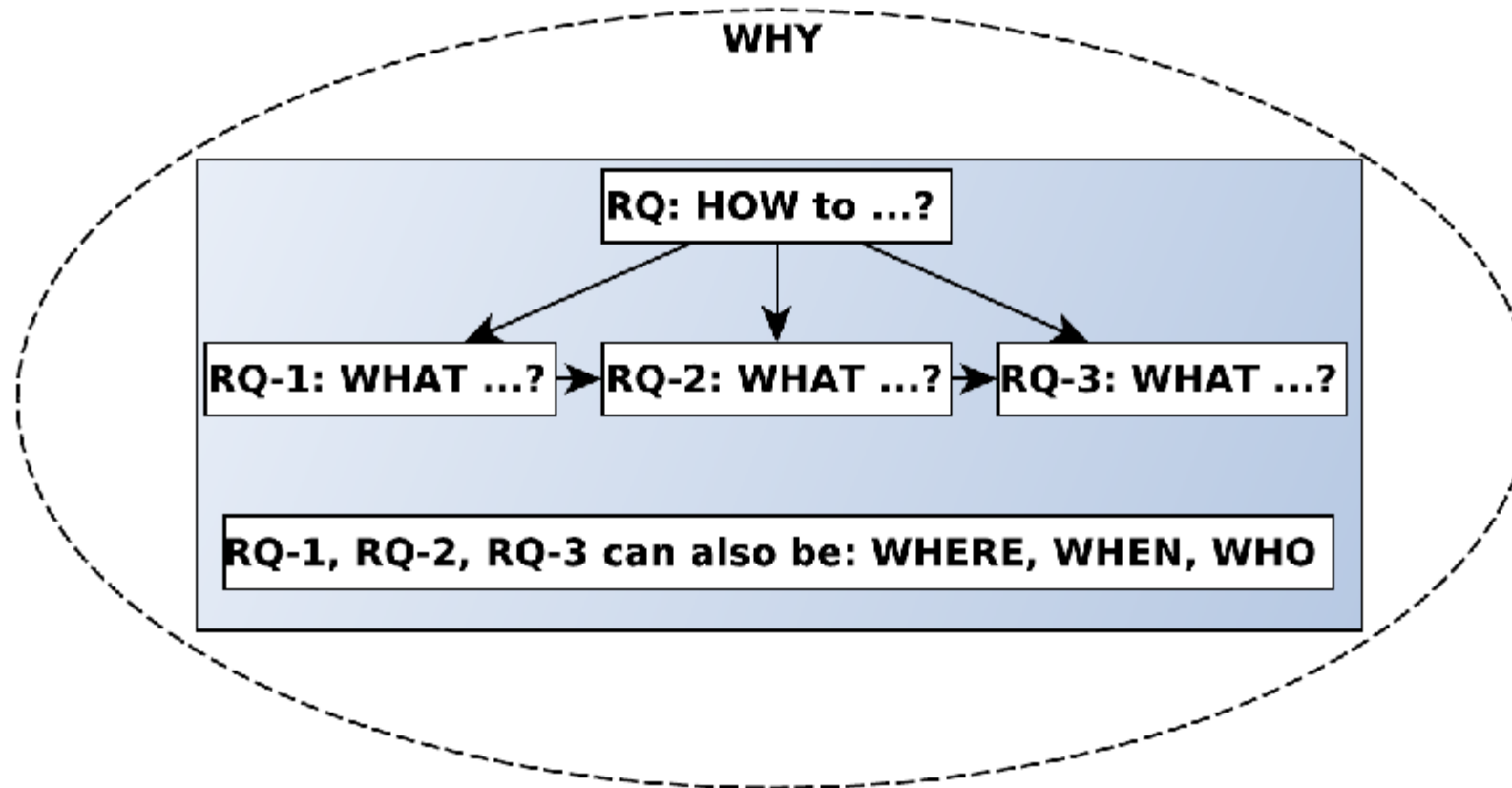
Introduction

Research Questions (RQ) – Thesis

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WHY?

Meta - HOW

Sub-HOW-1 → Sub-HOW-2 → Sub-HOW-3

Grammar-Q1.1
Grammar-Q1.2
Grammar-Q1.3

Grammar-Q2.1
Grammar-Q2.2
Grammar-Q2.3

Grammar-Q3.1
Grammar-Q3.2
Grammar-Q3.3

Grammer-Q are mostly WHAT, but can also be WHO, WHERE, WHEN
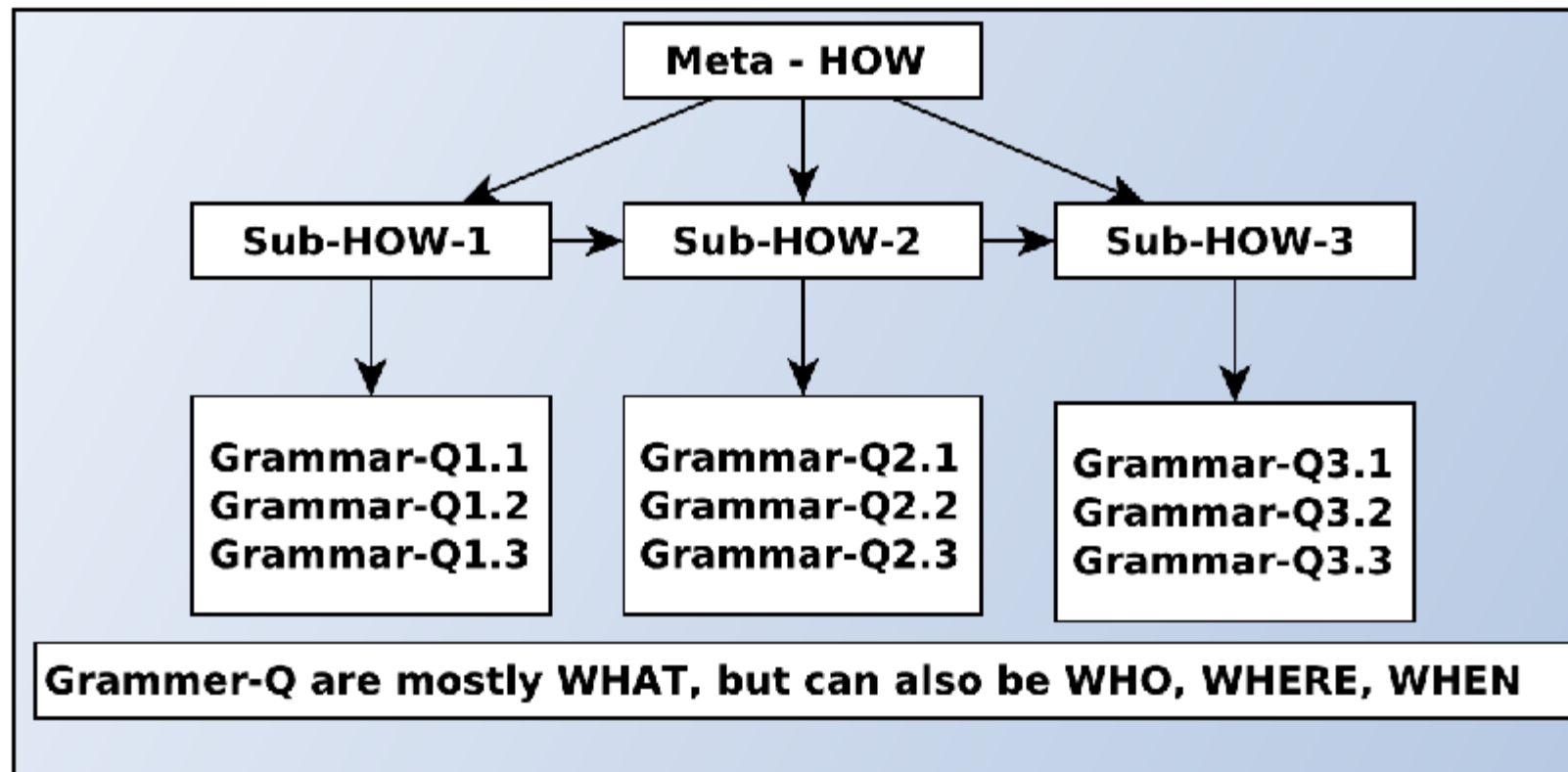
RESEARCH METHODS

Research Methods

Overview

TODO!

- <mark>TODO – different research methods for different fields of research, context, etc.</mark>

Research Methods

Information Systems Research Methods

- **Common Information System (IS) Research Methods**
  - Design Science Research (DSR)
  - Action Research (AR)
  - Action Design Research (ADR)

Research Methods

Design Science Research (DSR)

TODO!

- DSR in one page

Research Methods
Action Research (AR)

TODO!

- AR in one page

Research Methods

Action Design Research (ADR)

TODO!

- ADR in one page

STRUCTURE

Structure

RQs – Paper vs. Thesis
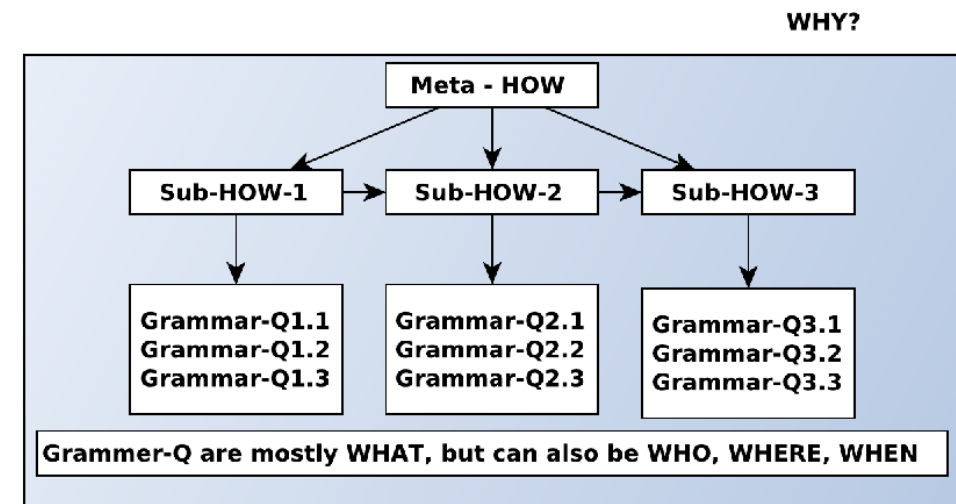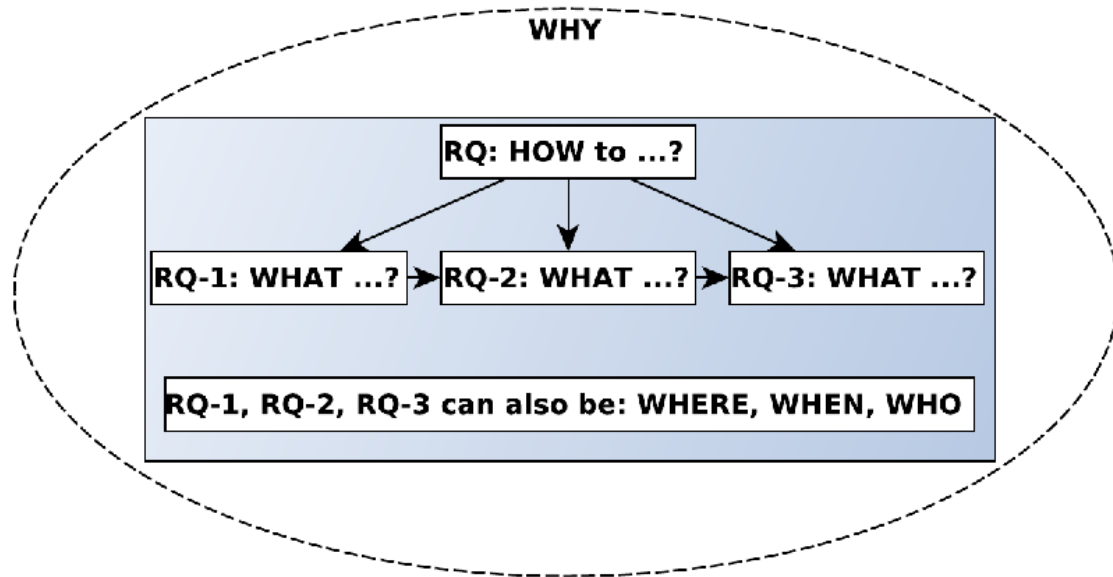
STRUCTURE – RESEARCH PAPER

Structure – Paper

Mind Map – Overview

TODO

Structure – Paper

Mind Map – Abstract

TODO

Structure – Paper

Mind Map – Section 1 (Introduction)

TODO

Structure – Paper

Mind Map – Section 2 (Bridge Section) **TODO**

Structure – Paper

Mind Map – Section 3/4/5 (Answers to RQs)

Structure – Paper

Mind Map – Section 6/7/8 (Evaluation/Conclusion/References)

STRUCTURE – THESIS

Structure – Thesis

Mind Map – Overview

Thesis Title

- **Meta Instructions**
  - Github Repository
  - Follows Moves 1-4

- **Abstract**
  - A Good Abstract:
    - 1.) What is the paper about?
    - 2.) What is the State of the Art?
    - 3.) What is the detected gap?
    - 4.) What are the main questions to be answered pertaining to the gap?
    - 5.) Why is the solution good/better than other solutions?
    - Roughly 100-200 words, depending on scope of publication, e.g., seminar paper vs. PhD-Thesis

- **Chapter 1**
  - Move 1 — Set the scene, what the manuscript is about
  - Move 2 — Existing body of knowledge, state-of-the-art
    - leads to a gap detection
  - Move 3
    - RQ: Research Question
      - RQ1: Research Question
      - RQ2: Research Question
      - RQ3: Research Question
    - Explanation of RQ> RQ1+RQ2+RQ3
  - Move 4
    - Explanation of remaining thesis structure, i.e., Chapters 2-7
    - Should reveal a research method execution
      - Action Research
      - Design Science Research (DSR)
      - Action Design Research

- **Chapter 2**
  - Bridge chapter — to understand Chapters 3-6
  - Typically expands Move 2 (state-of-the-art)

- **Chapter 3**
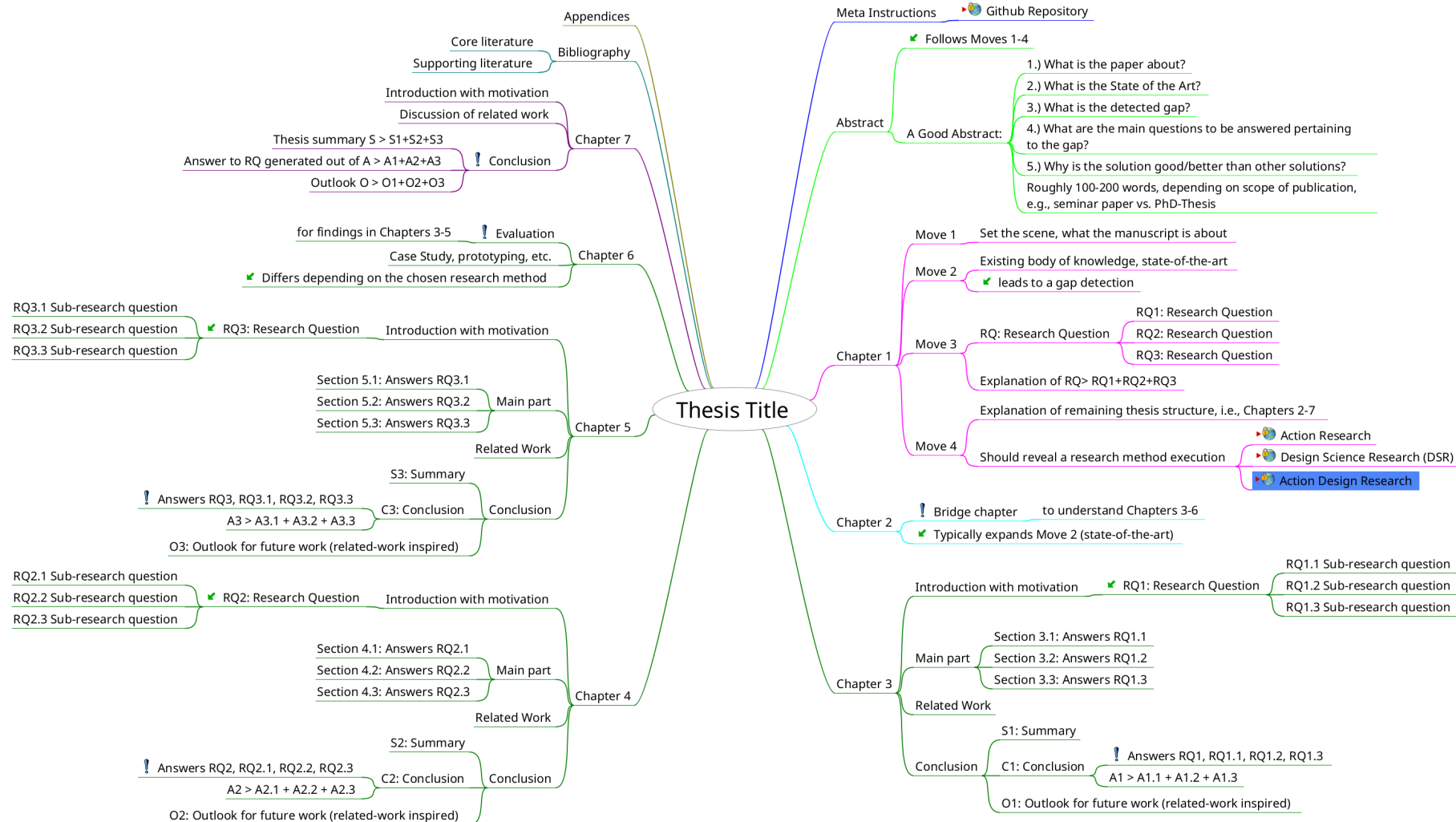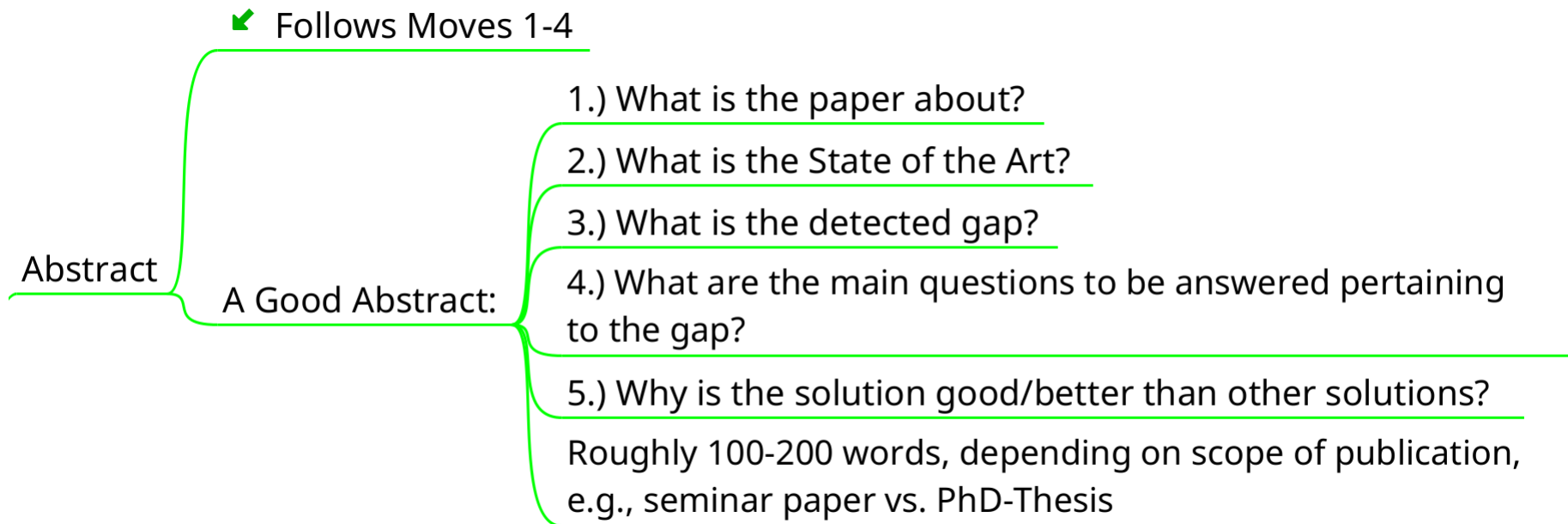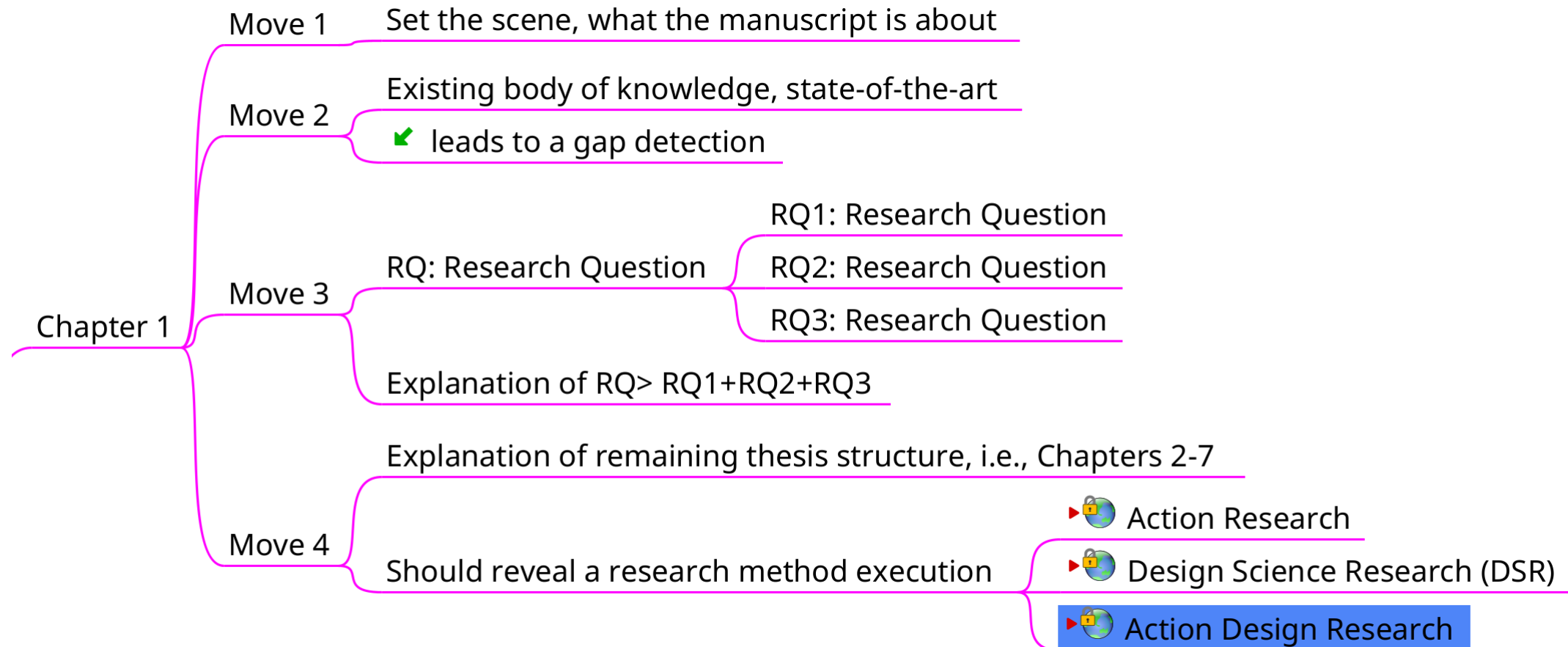 - Introduction with motivation — RQ1: Research Question
    - RQ1.1 Sub-research question
    - RQ1.2 Sub-research question
    - RQ1.3 Sub-research question
  - Main part
    - Section 3.1: Answers RQ1.1
    - Section 3.2: Answers RQ1.2
    - Section 3.3: Answers RQ1.3
  - Related Work
  - Conclusion
    - S1: Summary
    - C1: Conclusion — Answers RQ1, RQ1.1, RQ1.2, RQ1.3
    - A1 > A1.1 + A1.2 + A1.3
    - O1: Outlook for future work (related-work inspired)

- **Chapter 4**
  - Introduction with motivation — RQ2: Research Question
    - RQ2.1 Sub-research question
    - RQ2.2 Sub-research question
    - RQ2.3 Sub-research question
  - Main part
    - Section 4.1: Answers RQ2.1
    - Section 4.2: Answers RQ2.2
    - Section 4.3: Answers RQ2.3
  - Related Work
  - Conclusion
    - S2: Summary
    - C2: Conclusion — Answers RQ2, RQ2.1, RQ2.2, RQ2.3
    - A2 > A2.1 + A2.2 + A2.3
    - O2: Outlook for future work (related-work inspired)

- **Chapter 5**
  - Introduction with motivation — RQ3: Research Question
    - RQ3.1 Sub-research question
    - RQ3.2 Sub-research question
    - RQ3.3 Sub-research question
  - Main part
    - Section 5.1: Answers RQ3.1
    - Section 5.2: Answers RQ3.2
    - Section 5.3: Answers RQ3.3
  - Related Work
  - Conclusion
    - S3: Summary
    - C3: Conclusion — Answers RQ3, RQ3.1, RQ3.2, RQ3.3
    - A3 > A3.1 + A3.2 + A3.3
    - O3: Outlook for future work (related-work inspired)

- **Chapter 6**
  - Evaluation — for findings in Chapters 3-5
  - Case Study, prototyping, etc.
  - Differs depending on the chosen research method

- **Chapter 7**
  - Conclusion
    - Introduction with motivation
    - Discussion of related work
    - Thesis summary S > S1+S2+S3
    - Answer to RQ generated out of A > A1+A2+A3
    - Outlook O > O1+O2+O3

- **Bibliography**
  - Core literature
  - Supporting literature

- **Appendices**

Structure – Thesis

Mind Map – Abstract

Abstract
- A Good Abstract:
  - ↙ Follows Moves 1-4
  - 1.) What is the paper about?
  - 2.) What is the State of the Art?
  - 3.) What is the detected gap?
  - 4.) What are the main questions to be answered pertaining to the gap?
  - 5.) Why is the solution good/better than other solutions?
  - Roughly 100-200 words, depending on scope of publication, e.g., seminar paper vs. PhD-Thesis

Structure – Thesis

Mind Map – Section 1 (Introduction)

- **Chapter 1**
  - **Move 1** — Set the scene, what the manuscript is about
  - **Move 2** — Existing body of knowledge, state-of-the-art
    - ↙ leads to a gap detection
  - **Move 3**
    - RQ: Research Question
      - RQ1: Research Question
      - RQ2: Research Question
      - RQ3: Research Question
    - Explanation of RQ> RQ1+RQ2+RQ3
  - **Move 4**
    - Explanation of remaining thesis structure, i.e., Chapters 2-7
    - Should reveal a research method execution
      - ▶🌐 Action Research
      - ▶🌐 Design Science Research (DSR)
      - ▶🌐 Action Design Research

Structure – Thesis

Mind Map – Section 2 (Bridge Section)

Chapter 2
- ! Bridge chapter — to understand Chapters 3-6
- ↙ Typically expands Move 2 (state-of-the-art)

Structure – Thesis

Mind Map – Section 3/4/5 (Answers to RQs)

Chapter 3
- Introduction with motivation
  - ↙ RQ1: Research Question
    - RQ1.1 Sub-research question
    - RQ1.2 Sub-research question
    - RQ1.3 Sub-research question
- Main part
  - Section 3.1: Answers RQ1.1
  - Section 3.2: Answers RQ1.2
  - Section 3.3: Answers RQ1.3
- Related Work
- Conclusion
  - S1: Summary
  - C1: Conclusion
    - ❗ Answers RQ1, RQ1.1, RQ1.2, RQ1.3
    - A1 > A1.1 + A1.2 + A1.3
  - O1: Outlook for future work (related-work inspired)

Structure – Thesis

Mind Map – Appendix

RUNNING CASE – SEMINAR PAPER

Running Case – Seminar Paper

Overview

- **How to write a seminar paper?**
  - RQ-1: What is a good way to review and process literature?
  - RQ-2: What is a good way to structure your paper?
  - RQ-3: What is a good way to write your paper?
  -

Running Case – Seminar Paper
Overview

- **How to write a seminar paper?**
  - RQ-1: What is a good way to review and process literature?
  - RQ-2: What is a good way to structure your paper?
  - RQ-3: What is a good way to write your paper?
  -

Might not be the best and most well defined RQs

Running Case – Seminar Paper
Literature Sources

- Google Scholar → Link
- Journals/Conferences/Magazines/etc., eg.,
    - IEEE → Link
    - ACM → Link
    - AISeL → Link
    - Etc.
- Libraries
- Researcher
- Etc.

Running Case – Seminar Paper
Systematic Literature Review

- Systematic Literature Review in Computer Science - A Practical Guide → Link

Running Case – Seminar Paper
"Good" Literature – Examples

- Peer-reviewed paper, journals, poster, etc.
- Scientific books
- (Bachelor-, Master-, PhD-Thesis)
- (Patents)

Running Case – Seminar Paper
"Difficult" Literature – Examples

- Whitepaper / Technical Reports
- Websites (Blogs, Newspaper, etc.)
- Unreviewed scientific materials (e.g., arXiv.org)
- Peer-reviewed ≠ good literature (e.g., bogus/predatory conferences)

Running Case – Seminar Paper

How to Read a Paper?
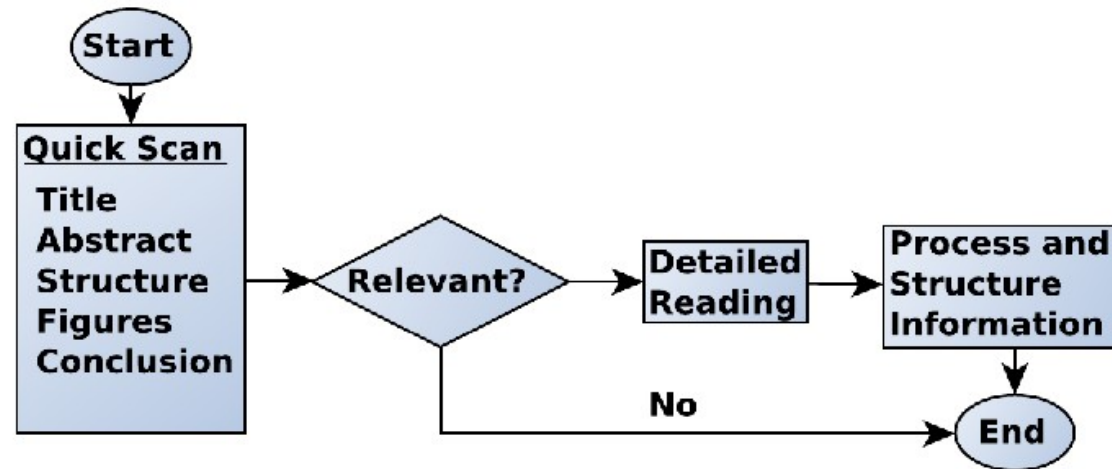
- Critical thinking!
- Check the references of papers that you read!

Running Case – Seminar Paper

Identify Your Gap and Define Your RQs @Mattes: RECREATE (TU Clausthal Colors)
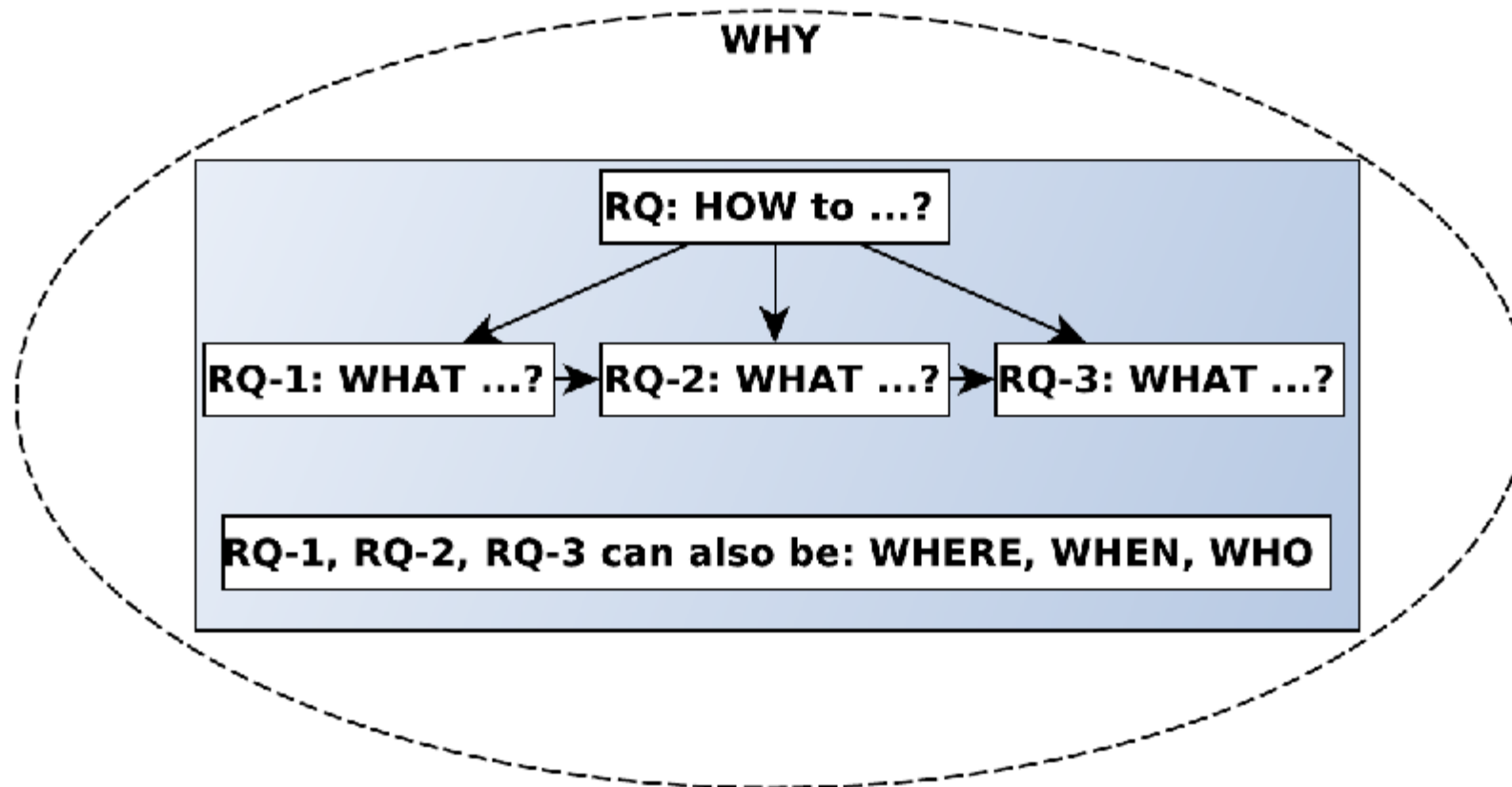
WHY

RQ: HOW to …?

RQ-1: WHAT …? → RQ-2: WHAT …? → RQ-3: WHAT …?

RQ-1, RQ-2, RQ-3 can also be: WHERE, WHEN, WHO

Running Case – Seminar Paper
Write Your Paper – LaTex vs. Word

- <u>LibreOffice / Word:</u>
  - Widespread
  - Nice for short paper (1-3 pages)
  - Awful for long papers and complex structures
  - Move one figure and you may accidentally summon Satan

Running Case – Seminar Paper
Write Your Paper – LaTex vs. Word

- <u>LibreOffice / Word:</u>
  - Widespread
  - Nice for short paper (1-3 pages)
  - Awful for long papers and complex structures
  - Move one figure and you may accidentally summon Satan

- <u>LaTex:</u>
  - Simple scripting language
  - Professional results, customizable and reusable
  - Visualize complex mathematical equations
  - Awesome reference management (Bibtex)
  - Required by most conferences, journals, etc.
  - Many templates available (Paper, Bachelor, Master, PhD, Book, etc.)

Running Case – Seminar Paper
Write Your Paper – Tips

- Tell a story!
- BUT, don't write about your personal journey from the problem to the solution. Instead, write about the final and "*correct*" approach that leads to the solution.
- Write for your audience? (Beginners vs. Experts)
- Are you writing a BA/MA/PhD-Thesis, a seminar paper or a research paper?
- Writing is only 25% of the work, the other 75% happen before you even start writing.

Running Case – Seminar Paper

Write Your Paper – Tips

- Avoid spelling mistakes.
- Many iterations and proof-read several times.
- Adhere to the template guidelines.
- Avoid long sentences.
- Clarify special notations.
- Figures are very helpful, but make sure to properly integrate them into you text (reference, comment, analyze).
- Use equations if necessary, but be careful (+ same as for figures).
- Balance between details and abstract ideas (page limits).
- Making a claim? Provide a source or proof it!

Running Case – Seminar Paper

Write Your Paper – A Good Abstract

1) What is the paper about?

2) What is the State of the Art?

3) What is the detected gap?

4) What are the main questions to be answered pertaining to the gap?

5) Why is the solution good/better than other solutions?

- Roughly 100-200 words, depending on scope of publication, e.g., seminar paper vs. PhD-Thesis

Running Case – Seminar Paper

TODO

Write Your Paper – Introduction

Running Case – Seminar Paper

TODO

Write Your Paper – Main Part

Running Case – Seminar Paper
Write Your Paper – A Good Conclusion

1) General summary
2) Answer to RQ-1
3) Answer to RQ-2
4) Answer to RQ-3
5) (Evaluation)
6) Future Work

Running Case – Seminar Paper
Write Your Paper – References

- Different sources (book, paper, phd/master thesis, website, journal, etc.)
- Direct vs. indirect citations
  - *"Penguins are black and white"* vs. *The authors [Ref.] argue that penguins are black and white.*
- Different citation styles (IEEE, APA, MLA, etc.)
- It is not your own idea or work? Provide reference to the original source!

Running Case – Seminar Paper

Write Your Paper – References (BibTex – Example)

- Example for the publication "Self-managed and blockchain-based vehicular ad-hoc networks " - Link

> @inproceedings{leiding2016self,
>
>   title={Self-managed and blockchain-based vehicular ad-hoc networks},
>
>   author={Leiding, Benjamin and Memarmoshrefi, Parisa and Hogrefe, Dieter},
>
>   booktitle={Proceedings of the 2016 ACM international joint conference on pervasive and ubiquitous computing: adjunct},
>
>   pages={137--140},
>
>   year={2016}
>
> }

ADDITIONAL RESOURCES

Additional Resources
Templates

TODO

- Mind Map Template (Freeplane) – Paper → Link
- Mind Map Template (Freeplane) – Thesis → Link
- Latex – Paper (Springer) → Link
- Latex – Paper (IEEE) → Link
- Latex – Thesis → Link

Additional Resources
LaTex Tutorials

- A simple guide to LaTeX – Step by Step → [Link](#)
- A Beginner's Guide to LaTex → [Link](#)
- Using BibTex: A Short Guide → [Link](#)

Additional Resources
Systematic Literature Review

- Systematic Literature Review in Computer Science - A Practical Guide → [Link](#)

Additional Resources

Research Methods

- Design Science Research → Link
- Action Research → Link
- Action Design Research → Link

Questions?