Uni Scientific Writing Notes

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Contributing

These study materials are heavily based on professor Charzinski's "Anleitung zum wissenschaftlichen Arbeiten" lecture at HdM Stuttgart.

Found an error or have a suggestion? Please open an issue on GitHub (github.com/pojntfx/uni-sciwriting-notes):



Figure 1: QR code to source repository

If you like the study materials, a GitHub star is always appreciated



License



Figure 2: AGPL-3.0 license badge

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Organization

- Primarily based on the inverted classroom principle
- Sent files should not contain metadata on person-specific info (make pseudonymous)
- Paper must be sent in by 2022-01-09
- Notes must be sent in by 2022-02-27
- Paper may be in German or English



Overview

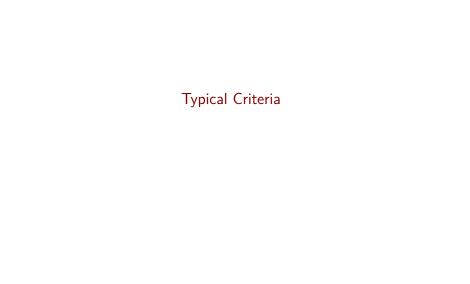
- 1. What is the scientific method?
- 2. Formulating scientific questions
- 3. Designing experiments
- 4. Analyzing experiments
- 5. Planing scientific papers
- 6. Researching topics and staying up-to-date
 - $\textbf{6.1} \ \, \mathsf{Finding} \,\, \mathsf{papers} \to \mathsf{Sci}\text{-}\mathsf{Hub}$
 - 6.2 Analyzing papers
 - 6.3 Referencing papers
- 7. Writing a scientific paper

What is the Scientific Method?



Writing Style

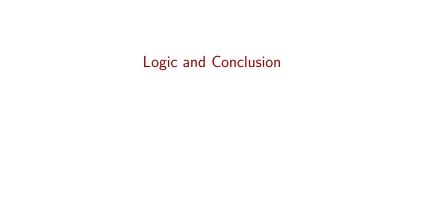
- Structure should not follow the timeline research, but the semantic structure of the discovery
- No rhetorical questions
- No judgmental formulations
- Sentences should be able to stand on their own; reference people and things by their name, not implicit references
- Do not use the present tense when referring to past events, even if it is popular in journalism
- Do not use metaphors which are highly imprecise, even if they are common among technical people
- "I" should not be used in texts
- Summaries should be about the effect of the research on the subject, not the author's view on the subject
- ➤ The "motivation" at the start of the paper should not be the personal factors, but prior pointers



Typical Criteria

- Complexity of the theme
- ▶ Amount of personal research
- Quality of the content
- Depth of research
- Selection of sources
- Implementation of prior knowledge
- Structure of the paper
- Visual style (used fonts, formatting etc.)
- Quote style (standardized quotes)

Formulating Scientific Questions



Logic and Conclusion

- Argumentation
- Logical conclusions
- Proofs (i.e. mathematical proofs)
- Experiments and their design, execution and analysis
- New analysis is always based on existing knowledge
- ▶ There are different levels of formalism: Argumentation, validation, predicate-based proofs
- Referencing ideas can be done in an "informal" way (whitepapers etc.), but they must not be the base of any claims!

The Purpose of Writing

The Purpose of Writing

- Communication is the primary purpose of scientific writing
- But scientific writing is also a means of analysis
 - Formulating thesis helps to grasp the connections between arguments
 - Clear formulation makes it much harder to avoid critical questions
 - Gaps in analysis and open questions become obvious and lead to new research opportunities
 - Writing leads to a deeper internal understanding
- Even if scientific writing is limited to Uni, research methods are always required



The Scientific Thought Model

- 1. Outlook
- 2. Own research
 - 2.1 Discussion
 - 2.2 Proofs, research, experiments, studies
 - 2.3 Hypothesis, underlying idea
- Summary of the current state of research/technology ("related work")
- 4. Sources (own and external)



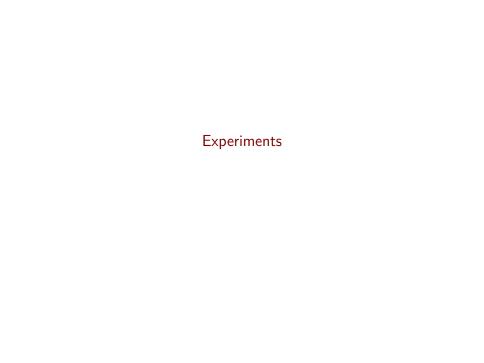
Quality Assurance

- New ideas should be able to be based on existing works
- Peer reviews try to check the quality of scientific works and ensures that existing work can serve as a solid base
- Own share of own work must be made obvious



Scientific Questions

- ► Formulation a concrete question is required in order to reduce the scope of topics
- ► The question doesn't have to be clear in the beginning of the writing process, but must be at the end
- ➤ The focus is always on the question, not the means: "Does the raft algorithm work reliably?" for example would not include/require an implementation of the raft algorithm, so always make the implementation a requirement of the question!
- ▶ The scientific question is not the title of the paper
- Just like the goals of the research need to be clearly defined, the "non-goals" need to be too!



Experiments

- Gathering of data
- Hypothesis
 - Creating the hypothesis
 - Designing the experiment
 - Executing the experiment
 - Testing the hypothesis with the result
 - Further, refined hypothesis ideas
- The hypothesis is often "my idea/solution/architecture works"
 - Experiments support the hypothesis
 - Paper then describes the current technological state, experiments and results
- ► All dependencies and state required to reproduce the experiment must be notes



Methods of Experiments

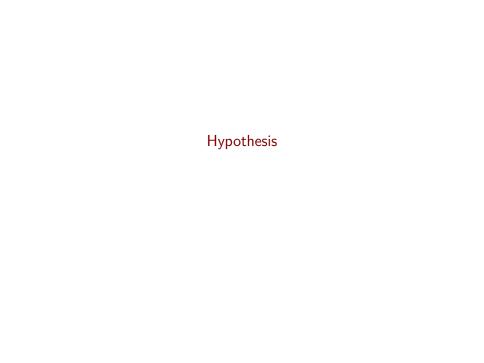
- 1. Design
 - 1.1 Matches the scientific question
 - 1.2 Creativity is required
- 2. Planning
 - 2.1 Prevention of side effects
 - 2.2 No convenience samples 2.3 No unethical experiments
- 3 Execution
 - 3.1 With proper process
 - 4. Analysis
 - 4.1 Objective analysis

1.3 Viability in time, budget and with available technology

- 4.2 No suppression of "unwanted" results
- Interpretation 5.1 Objective interpretation
- 5.2 Usage of statistics: Is the result even statistically relevant? 5.3 Testing the feedback loop: Has the research question actually been answered?

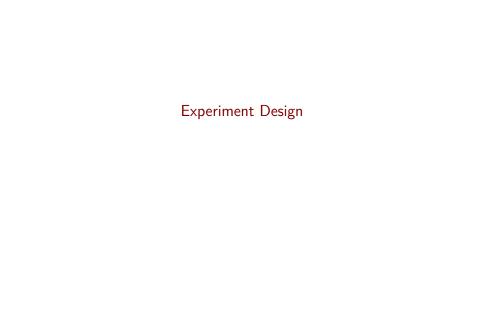
3.2 Proper documentation, including all unexpected incidents

6. Description: Include all information required to reproduce the



Hypothesis

- Verification using proofs
- ▶ Validation based on empirical data
- ▶ Multiple supporting hypothesis can build a theory



Experiment Design

- Experiments should produce a result
- ▶ Testing in a specific set of parameters
 - Searching for optimal parameter combinations
 - Checking for valid sets
- Sensitivity analysis
 - Checking the hypothesis with parameters
 - Checking if parameters influence results
- Hypothesis tests: Statistically testing the results of experiments