

How to write a Research Proposal: Input from a Course on Scientific Writing



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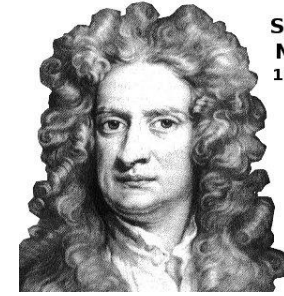
Why is this relevant for you?

- You'll write (or have written)
 - a Bachelor's thesis
 - several seminar papers
 - a Master's thesis
 - scientific papers
 - a Doctoral thesis (Dissertation)?
 - habilitation thesis
 - **research proposals**
 - e.g., Research proposal for ASEA-UNINET grant application
- Thesis vs. Paper vs. Proposal
 - Commonalities: basic structure, writing style (partly), scientific rigor/methods, (need for evaluation)
 - Differences: length/space, target audience, purpose



Used/Useful Sources

"If I have seen further, it
has been by standing on
the shoulders of giants."



Sir Isaac
Newton
1643-1727

- Simon Peyton Jones 2013. How to write a great research paper. Talk given at Cambridge, <https://www.microsoft.com/en-us/research/academic-program/write-great-research-paper/> (accessed Jan 19, 2017).
- Steve Easterbrook 2012. How theses get written, some cool tips. Talk given at the University of Toronto, <http://www.cs.toronto.edu/~sme/presentations/thesiswriting.pdf> (accessed Jan 19, 2017).
- Joshua Schimel 2012. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded. 1st Edition. Oxford University Press.
- Justin Zobel 2004. Writing for Computer Science. 2nd Edition. Springer.
- Walter F. Tichy and Frank Padberg 2007. Empirical Methods in Software Engineering Research. In *Companion to the proceedings of the 29th International Conference on Software Engineering (ICSE COMPANION '07)*. IEEE Computer Society, Washington, DC, USA, 163-164. DOI= <http://dx.doi.org/10.1109/ICSECOMPANION.2007.33>
- Lionel Briand 2017. Why and How To Get a PhD. ISSRE. https://www.slideshare.net/mobile/briand_lionel/why-and-how-to-get-a-phd-in-software-engineering (wrt writing papers, see esp. Slides 25-28)

Why do we write papers?

- Fallacy (Irrtum): we write and give talks mainly/only to impress others, gain recognition, get promoted
- Your goal: to infect the mind of your reader with **your idea**
- Papers are far more durable than programs (think Mozart)
 - Personal example: I frequently refer to a paper by David Parnas from 1976 (On the Design and Development of Program Families)
- **The greatest ideas are (literally) worthless if you keep them to yourself**



Influenced by Simon Peyton Jones, Microsoft Research, Cambridge

Purpose of a Paper/Proposal

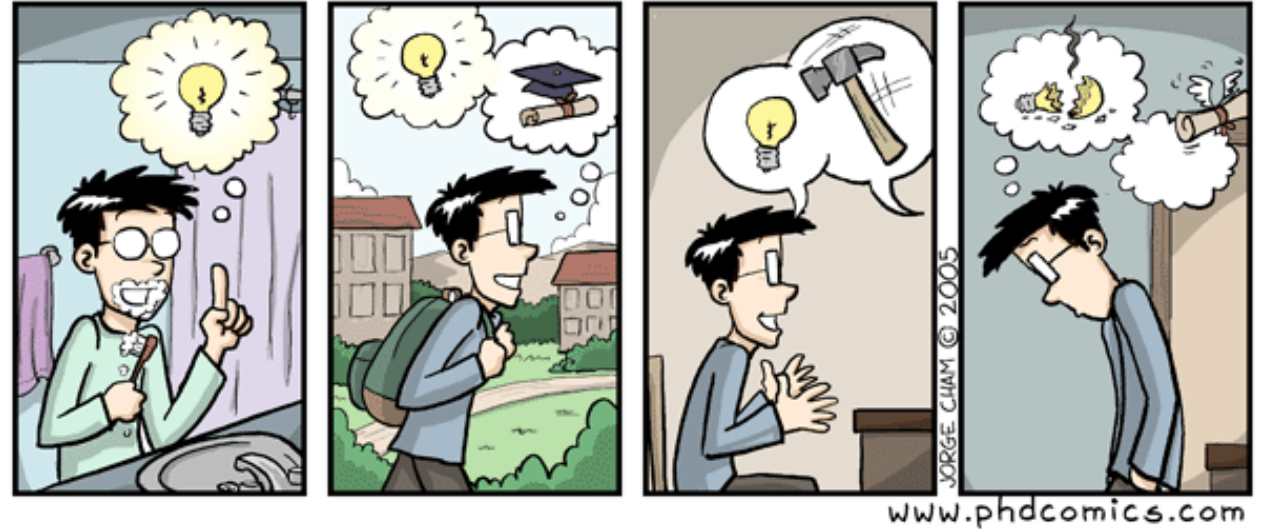
- To convey your idea
- ...from your head to your reader's head
- Everything serves this single goal
- NOT
 - to purely describe your cool development/tool
 - executable artifacts. Your reader is primarily interested in re-usable brain-stuff (ideas)!



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Conveying the Idea → Influences Structure!

- Here is a problem
- It's an interesting problem
- It's an unsolved problem
- **Here is my idea**
- My idea works (details, data)
- Here's how my idea compares to other people's approaches
- (This is what we I learned when developing my idea/solution that you might find useful = lessons learned)



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Typical Paper Structure (Deviations Possible) assuming 10 pages

- **Abstract** (4 sentences)
- **Introduction** (1 page)
- **The problem** (1 page)
 - maybe part of introduction
 - maybe including a motivating, easy-to-understand example
- **My idea/approach** (2 pages)
- **The (technical) details/implementation** (2 pages)
- **Evaluation/Validation** (3 pages)
- **Related work** (1-2 pages)
 - maybe as 2nd section if you really are “the first one” (seldom)
- **Conclusions and future work** (0.5 pages)

Common DEVIATIONS

- **(Industrial) Experience Papers**
 - Focus e.g., on development and/or application of a particular technology
 - Conclude with Lessons Learned useful for others
- **Literature Studies**
 - **Overview + discussion of a field/topic (=PAT Paper)**
 - Systematic approaches can be employed
 - e.g., systematic literature review, systematic mapping study
- **Vision/Idea/Research Preview Papers**
 - Describe open issues and outline possible solutions
- **Tool Demo Papers**
 - Describe a particular tool, typically only 1-2 pages
- **Journal Papers and Book Chapters**
 - Should be self-contained, usually detailed background section after introduction
- **Research Proposals**
 - Focus on convincing reviewers and a funding agency to fund your research

Typical Proposal Elements (Depends a lot on funding agency)

- Overview of Planned Research
- State of the Art
- Own earlier research/information on the Applicant(s)
- Open Research Issues/Investigated Research Questions
- Planned Research in more Detail incl. Eval Plan
- Research Contributions
- Collaborations
- Work Plan
- Staff
- Required Equipment and Facilities
- Schedule and Cost Plan

Writing: How do I get started?

- **Do this ASAP (as now you have been assigned a topic):**
 - Decide on a **(working) title**
 - Download the **templates**, start a file and write your title on the first page
 - (Look at some theses/papers in your area/for your topic and read them)
 - For proposals: get **examples** from colleagues (very helpful!)
 - Plan your **argument** (can become the abstract and will influence the structure)...
- **You can change things later**
 - But you can't change it unless you have something to change!

Influenced by Steve Easterbrook, University of Toronto

Argument

One sentence for each:	Example
<i>Introduction (area of study)</i>	
<i>The problem (that I tackle)</i>	
<i>What the literature says about this problem</i>	
<i>How I tackle this problem</i>	
<i>How I implement my solution</i>	
<i>The result</i>	

(c) Steve Easterbrook, University of Toronto

Argument

can be converted into the paper/thesis structure: at least one chapter per sentence, ...maybe more than one for some sentences

One sentence for each:	Example
<i>Introduction (area of study)</i>	“The success of a software development project depends on capturing stakeholders’ needs in a specification ...
<i>The problem (that I tackle)</i>	“However, specifications often reflect the analyst’s own bias, rather than the inputs of the many different stakeholders...
<i>What the literature says about this problem</i>	“Current methods described in the literature fail to address identification and integration of multiple views.
<i>How I tackle this problem</i>	“By treating the specification activity as a dialogue between stakeholders, we can model each perspective separately.
<i>How I implement my solution</i>	“We provide a set of tools for exploring disagreement between perspectives, and use these tools as the basis for a computer-supported negotiation process.
<i>The result</i>	“This approach is shown to significantly improve traceability and validity of specifications and overall stakeholder satisfaction.”

(c) Steve Easterbrook, University of Toronto

Discussing Typical Elements of Scientific Papers/Proposals

- **Abstract**
- Introduction
- The problem
- My idea/approach
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Abstract

- Some write the abstract last, some first
- Used by program committee members/reviewers to decide which papers to read → “the first impression”
- Four sentences [Kent Beck] = “*Pitch Talk*”/”*Sales Pitch*”
 - 1. State the problem
 - 2. Say why it’s an interesting/relevant problem
 - 3. Say what your solution achieves
 - 4. Say what follows from your solution
- See the similarities to the argument by Easterbrook?



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Example Abstract

- 1. Many papers are badly written and hard to understand
- 2. This is a pity, because their good ideas may go unappreciated
- 3. Following simple guidelines can dramatically improve the quality of your papers
- 4. Your work will be used more, and the feedback you get from others will in turn improve your research

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SOME Important Hints

- Don't be afraid to change your mind
 - As you write the thesis/paper, your ideas will evolve
 - Don't wait for them to stop evolving: It's much easier to change an outline that you've written down than one you haven't.
- Of course, your plan will evolve as you proceed with the research/work

- How to get finished/not get stuck?
 - Re-think the outline, maybe you set yourself a too hard task?
 - Consult related work
 - Discuss with peers, get their feedback
 - Start early. Very early. Hastily-written papers get rejected.



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Introduction

- 1. Describe the **problem**
- 2. State your **contributions**

- Optional
 - Introduce and briefly explain key concepts/terms
 - Give an overview of the paper structure

- **NOT**
 - A longer version of the abstract
 - Abstract is minimalistic overview (containing intro)
 - Introduction is the begin of the story

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Introduction: Example



- The full behavior of a complex software system often only emerges during operation. As a result, testing [...] This is commonly referred to as runtime monitoring.
- Existing approaches are [...]
- This variety makes it hard to [...]
- The main contribution of this paper is, therefore [...]
- Specifically, we claim the following contributions: [...]

R. Rabiser, S. Guinea, M. Vierhauser, L. Baresi, and P. Grünbacher, A Comparison Framework for Runtime Monitoring Approaches, *Journal of Systems and Software*, vol. 125(March), pp. 309–321, 2017.

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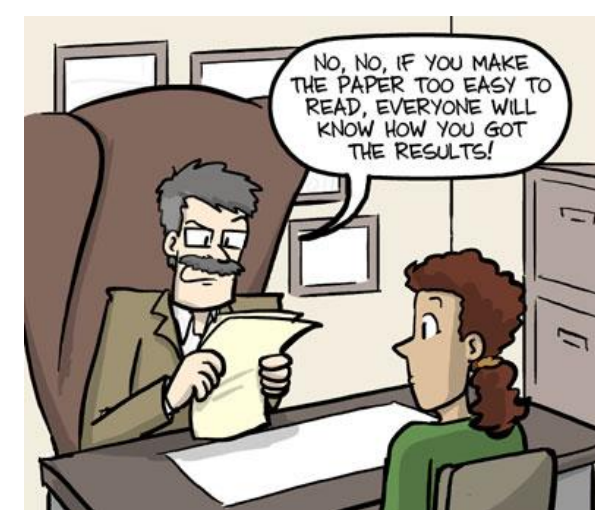
Problem, Idea, Implementation

- Concentrate single-mindedly on a narrative that
 - Describes the problem, and why it is interesting
 - Describes your idea
 - Defends your idea, showing how it solves the problem, and filling out the details
- On the way, cite relevant work in passing, but defer discussion to the end

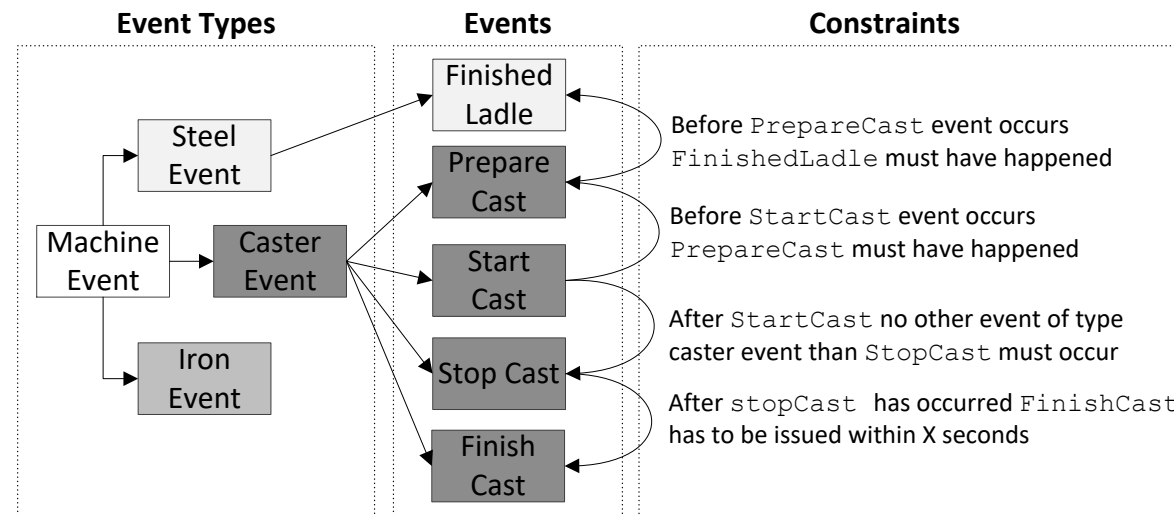
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CONVEYING THE IDEA

- In a paper you **MUST** provide the details, but **FIRST** convey the idea
- Introduce the problem, and your idea, using **EXAMPLES** and only then present the general case



- Example Example:



M. Vierhauser, R. Rabiser, P. Grünbacher, C. Danner, S. Wallner, and H. Zeisel, A Flexible Framework for Runtime Monitoring of System-of-Systems Architectures, 11th Working IEEE/IFIP Conference on Software Architecture, Sydney, Australia, IEEE, 2014, pp. 57-66.

Conveying the Idea

- Explain it as if you were speaking to someone using a whiteboard
- Conveying the idea is primary, not secondary
- Once your reader has got the idea, she can follow the details (but not vice versa)
- Even if she skips the details, she still takes away something valuable

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Discussing Typical Elements of Scientific Papers/Proposals

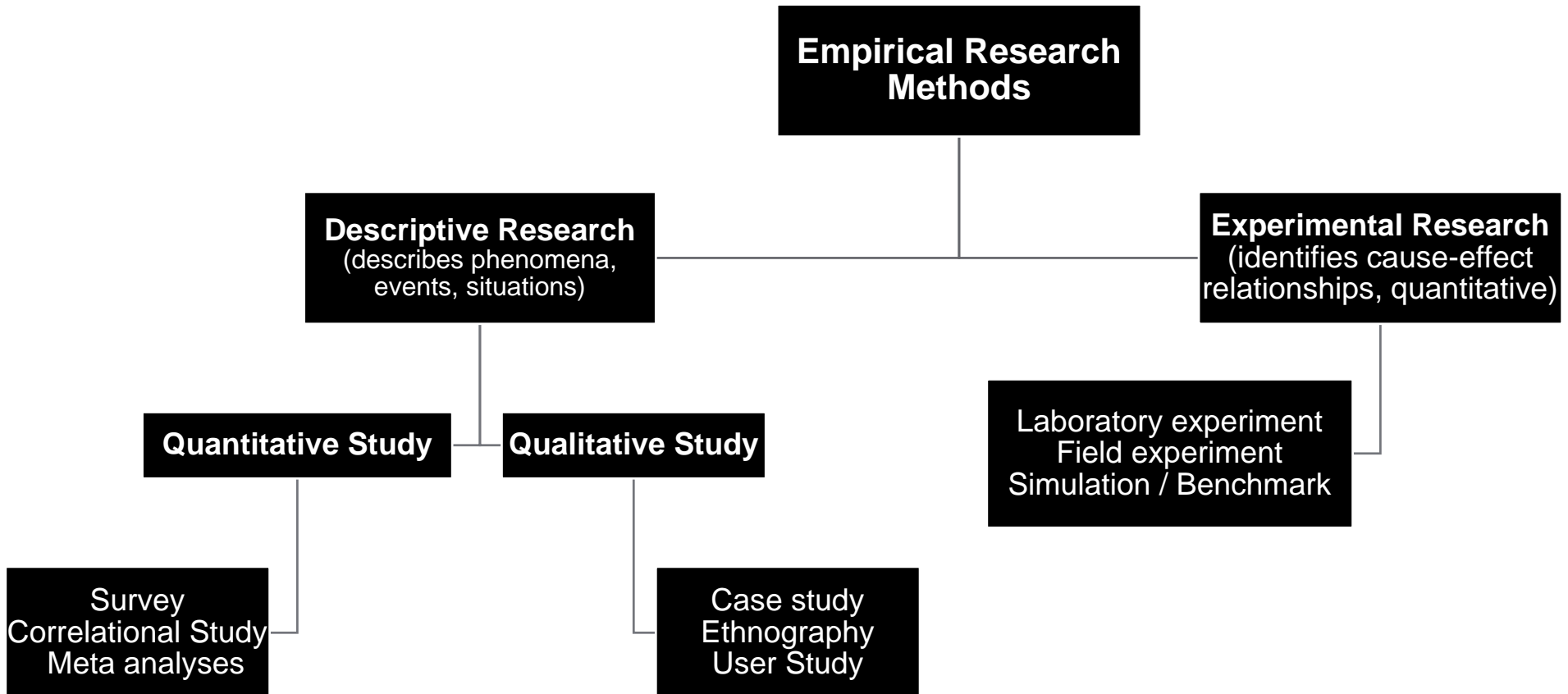
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Evaluation/Validation

- **Evidence!**
 - Your introduction makes claims
 - The body of the paper provides evidence to support each claim
 - Evidence can be:
 - analysis and comparison (e.g., with other, similar approaches or benchmarks)
 - theorems (formal/mathematical proof)
 - empirical studies
 - Quantitative (e.g., measurements)
 - Qualitative (e.g., user studies)
 - e.g., experiments, case studies, surveys
- **This is one of the key aspects that make it SCIENTIFIC**
- **For research proposals:** Plan the evaluations you want to conduct, this has a huge influence on the required resources and credibility of your proposal

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Empirical Studies (Types)



Inspired by Walter F. Tichy, Frank Padberg, University Karlsruhe

Discussing Typical Elements of Scientific Papers/Proposals

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Related Work

- **Fallacy (Irrtum): To make my work look good, I have to make other peoples' work look bad**
- Giving credit to others does not diminish the credit you get from your paper
- Acknowledge weaknesses in your approach!
- Failing to give credit to others can kill your paper
- If you imply that an idea is yours, and the referee knows it is not, then either
 - You don't know that it's an old idea (bad)
 - You do know, but are pretending it's yours (very bad)**→ Plagiarism, can cost you your career/title/position**

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It is a bad paper and, as a reviewer, I should reject it, but it cites five of my own papers...

Conclusions and Future Work

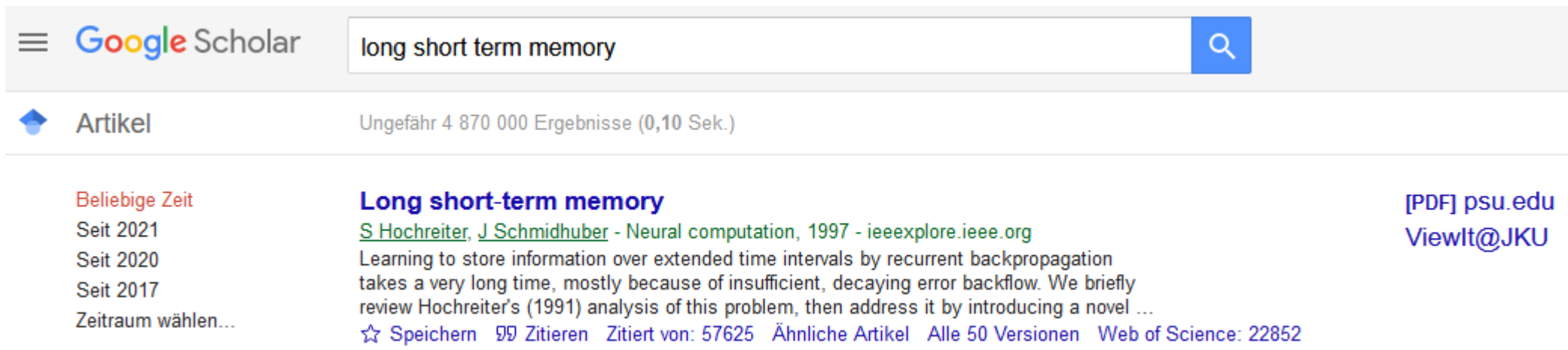
- Summarize the paper in 2-3 sentences
- Provide an outlook on future work/list remaining issues
- Avoid new topics/findings!
- Avoid citations

- **Acknowledgements** (Optional)
 - Extra Section after conclusions, before reference list
 - If you want (or legally have) to thank a person or organization

- Paper/Proposal concludes with **References**

References/Literature/Citing

- Some hints:
 - <http://scholar.google.com>
 - “Snowballing” (check references cited in good papers, “jump” from paper to paper)
 - Look for papers with many citations (Google Scholar shows this!)
 - Not necessarily good papers, but well-perceived/-known work



The screenshot shows the Google Scholar search interface. The search bar contains the text "long short term memory" and a search button. Below the search bar, it indicates "Artikel" and "Ungefähr 4 870 000 Ergebnisse (0,10 Sek.)". On the left, there is a filter for "Beliebige Zeit" with options for "Seit 2021", "Seit 2020", "Seit 2017", and "Zeitraum wählen...". The main search result is for the paper "Long short-term memory" by S. Hochreiter and J. Schmidhuber, published in Neural computation in 1997. The abstract is partially visible: "Learning to store information over extended time intervals by recurrent backpropagation takes a very long time, mostly because of insufficient, decaying error backflow. We briefly review Hochreiter's (1991) analysis of this problem, then address it by introducing a novel ...". To the right of the result, there are links for "[PDF] psu.edu" and "ViewIt@JKU". At the bottom of the result, there are links for "☆ Speichern", "Zitieren", "Zitiert von: 57625", "Ähnliche Artikel", "Alle 50 Versionen", and "Web of Science: 22852".

Why Citing Existing Work?

- All work builds on existing work
- Citations
 - show use of or relation to existing work/work by others
 - allow to differentiate own contribution and others' contribution
- Source needs to be defined unambiguously for used
 - Text
 - Figures
 - Ideas
 - Models
 - Approaches
 - Results
- Making small changes is NOT sufficient to avoid citing
- Using others' work/text without citing → plagiarism

Plagiarism

- Not to be taken lightly! It is Fraud!
- Think of Theodor Gutenberg and other prominent (also recent) examples
- Possible consequences
 - Negative mark
 - Loosing academic degrees
 - Legal proceedings
- JKU (must) checks for plagiarism
- There is also self-plagiarism →

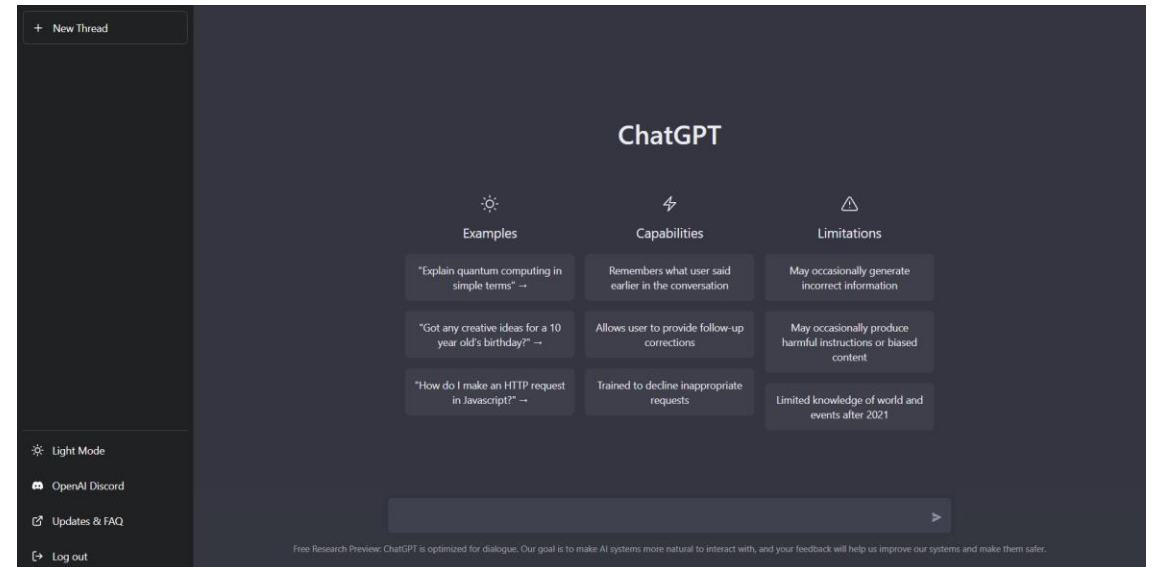


<https://www.plagiarismtoday.com/2011/09/07/self-plagiarism-ethical-shortcut-or-moral-scourge/>

Plagiarism Check and ChatGPT

- **ChatGPT**

- You can use ChatGPT to help you **improve readability and language**, but if you use ChatGPT to generate (almost) all of the paper/proposal, someone will find out
 - It does not provide correct citations
 - Language is too good for a non-native speaker
 - Writing style of sections doesn't match
 - Some arguments it produces sound authoritative but are factually wrong



Example from one of the biggest publishers in the world

- The use of Artificial Intelligence (AI) and AI-assisted technologies in scientific discourse has been in the spotlight recently, especially in relation to ChatGPT...
- Elsevier's new [AI author policy](#) focuses on ensuring the integrity of the scholarly record and aims to provide greater transparency and guidance to authors, readers, reviewers, editors and contributors.
- Where authors use AI and AI-assisted technologies in the writing process, **authors should:**
 - **Only use these technologies to improve readability and language, not to** replace key researcher tasks such as **interpreting data or drawing scientific conclusions.**
 - Apply the technology with human oversight and control, and carefully review and edit the result, as AI can generate authoritative-sounding output that can be incorrect, incomplete or biased.
 - Not list AI and AI-assisted technologies as an author or co-author, or cite AI as an author. Authorship implies responsibilities and tasks that can only be attributed to and performed by humans, as outlined in Elsevier's [AI author policy](#).
 - Disclose in their manuscript the use of AI and AI-assisted technologies in the writing process by following the instructions in our Guide for Authors (which will be updated centrally this month). When authors declare the use of AI in the writing process, a statement will appear in the published work. **Authors are ultimately responsible and accountable for the contents of the work.**

Thank you!

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