Writing your

MSc Thesis

at Department of Computer Science

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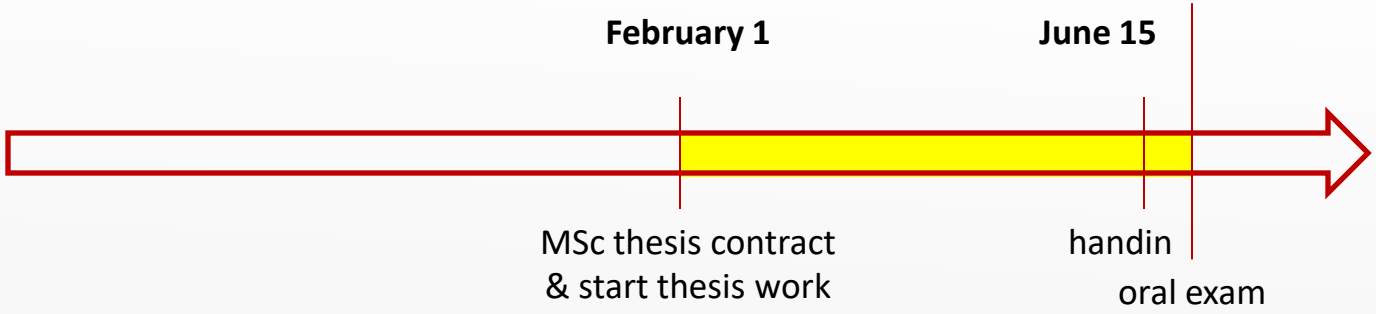
November 2024

Plan

- Formalities
- Choosing advisor and topic
- The process
- The master's thesis report
- The examination

Formalities

You will be registered administratively to the MSc thesis without the possibility of cancelling the registration



Formalities

- 5 month of work, incl. exam ~ 30 ECTS
- Thesis written in Danish or English
- Advisor: a member of the permanent scientific staff at Department of Computer Science (+ co-supervisors)
- Individually or in groups (2-3 persons)
  - for group projects: the thesis must show which parts of the report the different members are responsible for (possibly “everybody is responsible for all of the thesis”)
  - from a study environment survey: “179 of 331 believe it will be lonely to write the thesis”
  - group theses are encouraged!

MSc thesis contract
kontrakt.nattech.au.dk

- Done jointly by the student and the advisor before the thesis work starts
- States who, general title, hand-in date, etc.
- Each group member must create a contract
- **Short project description and project plan**
  - Do not overthink this one
  - Every project starts with a question and a rough plan how to attack it, not with answers
  - The question can change on the way…

From study regulations

The study regulations for your MSc education:
https://kursuskatalog.au.dk/en?department=15&search=thesis

"For the Master's thesis, the student works independently on an academic issue, on completion of which the graduate can:

- identify, define and formulate an academic issue on a scientific basis
- define and present testable hypotheses/research questions within a subject area
- independently plan and complete a major academic project using the subject's scientific methodology
- analyze, critically discuss and put into perspective an academic issue
- assess, critically analyze and summarize the scientific literature within a defined topic area
- relay academic results objectively and concisely to a scientific audience."

Plan

identify, define and formulate an academic issue on a scientific basis

- Formalities
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Choosing a project

- In principle the student's responsibility, but there are ways to get inspiration…
- Contact a potential advisor – we often have ideas for new projects
- Make sure to have flexibility in your project!
  - as opposed to “all-or-nothing” projects

I want to prove P ≠ NP

I want to read litterature on barries to proving P ≠ NP and present it in a coherent framework

Maturing your idea

- From a loosely defined **idea** to a concrete **problem statement** and an outline for your **work plan**

- Begin early – before your official starting date!

- “Individual project work” (5 or 10 ECTS) is a possibility if you are trying to define an area of interest before your master’s thesis work

Different project types

- Experimental evaluation of theoretical result
- New theoretical result
  - E.g., design better protocol or algorithm
- Generalising theory into a framework
- Survey of experimental area
- ...

- Many thesis projects originate from an existing research project
- 5-10% of the thesis projects lead to scientific publications

Industry collaboration

- Via advisor or your own initiative
- MSc thesis focuses on an ***academic*** issue
- Thesis advisor must approve the topic
- Be aware of AU technology transfer office offers templates for NDAs and collaboration agreements

  https://medarbejdere.au.dk/administration/forskning-talent/erhvervssamarbejde/samarbejdsaftaler/fast-track-agreements/

- Warning: Companies sometimes change plans and get busy with other things than helping you…

- Check out cs.au.dk/jobwall

Courses while working on your thesis?

Allowed, but...

- requires self discipline!
- thesis work is full-time
- “the urgent kills the important”

What Topic?

- Have fun!
- You get to spend half a year on just *one* thing, and you choose what it is!
- Pick something which interest you!
  - "Lysten driver værket" / "Time flies when you are having fun"
- You advisor will help you formulate it in a way that is academically relevant
- You advisor needs the question to be within their scientific discipline to be able to advice…

Was that a Question?

- “identify, define and formulate an academic issue on a scientific basis
- define and present testable hypotheses/research questions within a subject area”

Was that a Question?

- "define and present testable hypotheses/research questions within a subject area"
- Deductive sciences:
  - Mathematics, formal logic, theoretical physics, theoretic computer science, statistics and probability theory, …
  - Typically phrased as *Question Driven*
  - "We ask the following question: Is it possible with the state-of-the-art to design a system for secure multiparty computation on large data with practical communication among ten servers?"
- Inductive sciences:
  - Experimental physics, applied computer science, biology, medicine, …
  - Typically phrased as *Hypothesis Driven*
  - "We hypothesize that anti-matter falls up"
  - "We hypothesize that this paper describing a static analysis algorithm can be implemented with success on that dataset over there!"
- Do not overthink what to call your problem ☺

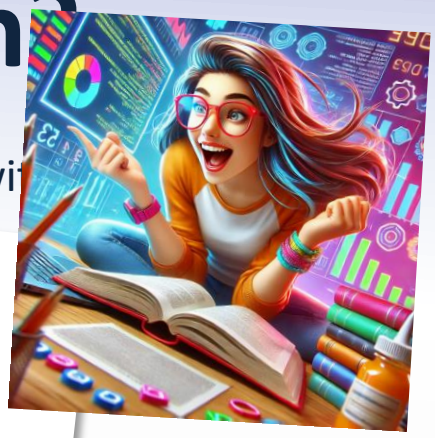
Was that a Question?

- “…stable hypotheses/research questions within a subject area”
- “…
  - “We… …sign a system for secure multiparty … communication among ten servers?”
- Inductive sciences:
  - E… …computer science, biology, medicine, …
  - T…
  - …
  - …thm can be
- Do not overthink …

Problem statement:
Can one use state-of-the-art to design a system for secure multiparty computation on large data with practical communication among ten servers?

Problem statement:
Can this paper describing a static analysis algorithm can be implemented with success on that dataset over there?

Was that a Question?



I want to read litterature on barries to proving P ≠ NP and present it in a coherent framework

- "define an[d] [hy]potheses/research questions wi[th]
- Deductive
  - Math
    statis
  - Typically phrased as Ques
  - "We ask the following question: Is it possible with the state-of-the-art to design a system for secure multiparty computation on large data with practical communication among ten servers?"
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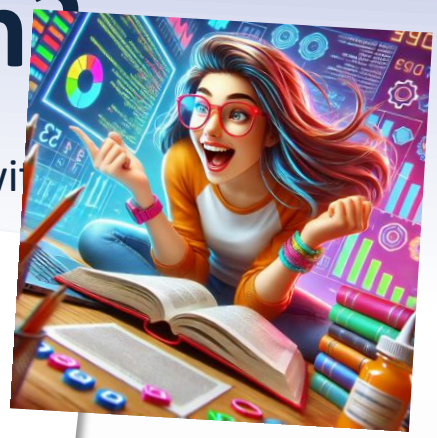
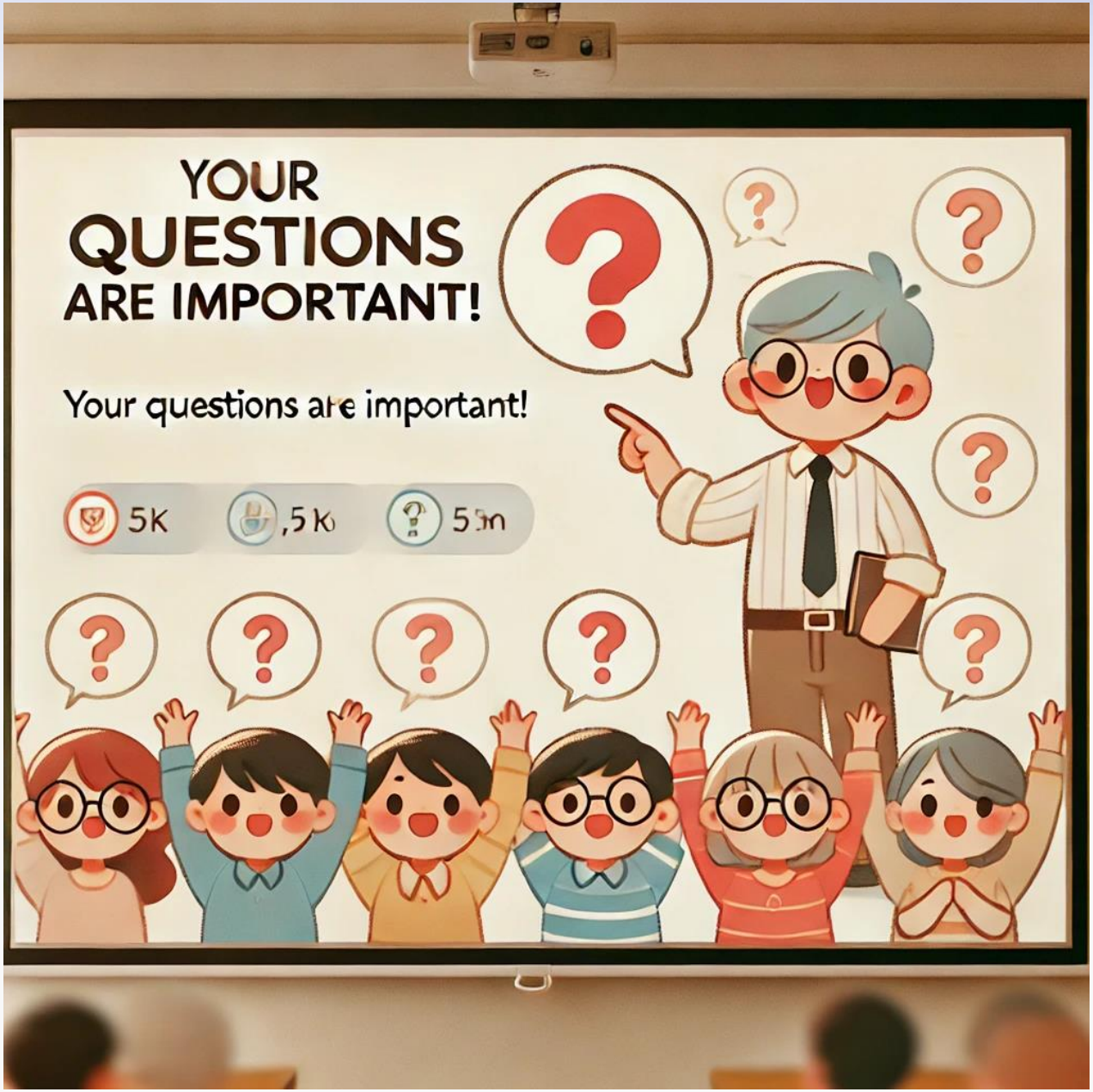


- "define an… …theses/research questions wi…
- Deductive …
  - Math … statis…
  - Typically phrased as Ques…
  - "We ask the following question: Is it possible with the state-of-the-art to design a system for secure multiparty computation on large data with practical … among ten servers?"
- Do not overthink what to call …

I want to read litterature on barries to proving P ≠ NP and present it in a coherent framework

Problem Statement:
There is a lot of litterature on barries to proving P ≠ NP but no presentation in a coherent framework. The purpose of the project is to create such a coherent framework.

“identify, define and formulate an academic issue on a scientific basis”



Plan

"independently plan and complete a major academic project using the subject's scientific methodology"

- Formalities
- Choosing advisor and topic
- The process
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Planning the Project

- **Variation** is good for productivity
- Make a **work plan**, and revise it as often as necessary
  - the plan is not made so that you have to follow it
    - but it will make you aware if you don't follow it!
  - Maybe just be a few lines with milestones and dates
  - "Plan:
    - December: stating the problem
    - January-February: reading literature 50% done
    - …"

Planning the Project

"independently plan and complete a major academic project using the subject's scientific methodology"

- Be aware of the different activities in the process:
  - stating the problem
  - reading literature
  - collecting data (test cases etc.)
  - implementing
  - experimenting
  - writing the report (begin writing early in the process!)
  - proofreading
  - …

Inductive

Planning the Project

"independently plan and complete a major academic project using the subject's scientific methodology"

- Be aware of the different activities in the process:
  - stating the problem
  - reading literature
  - comparing theoretical results
  - generalising/abstracting theories
    - In a survey this can be the main project…
  - extending/applying the theory
  - writing the report (begin writing early in the process!)
  - proofreading
  - …

Deductive

Guidance

"For the Master's thesis, the **student works independently** on an academic issue"

- You are not an employee who got a job to complete
  - "Implement this analysis…"
- You are no longer a student being told what to read
  - "Read these three papers and you are good…"
- You are a scientist with a problem to solve!
  - *You* find what to read
  - *You* assess, critically analyze and summarize the scientific literature
  - *You* decide what to implement, and how
  - *You* plan the experiment
  - *You* compare results to the theory
  - *You* will answer for what is in the thesis
- **You use the advisor as a guide!**

Guidance

"For the Master's thesis, the **student works independently** on an academic issue"

- Weekly meetings, focused feedback
  - be prepared, you can for example email questions and the newest PDF 1-2 days before the meeting (with a description of what you would like to get feedback on!)
  - *you* have the overview – not your advisor
  - it is not the advisor's job to ensure activity in your working process
    - its advisor not supervisor
  - schedule time for the next meeting and make a plan for your work until the meeting
    - fixed weekly meetings work best, cancel if no questions
  - take notes at the meetings and ask if you can send a recap e-mail to your advisor: "we talked about … we concluded … I now plan to do …"
  - consider sending along the updated work plan every week to commit yourself

Procrastination and perfectionism

- Try to get an office close to advisor and show up every day
  - Check availability of office spaces early!
- Send along the work plan before or after each meeting
- Have realistic ambitions
- Mutual expectations
  - “is this good enough to pass/get 7/get 10?”
  - No reason to pretend you are going for 12 if you just want to pass…

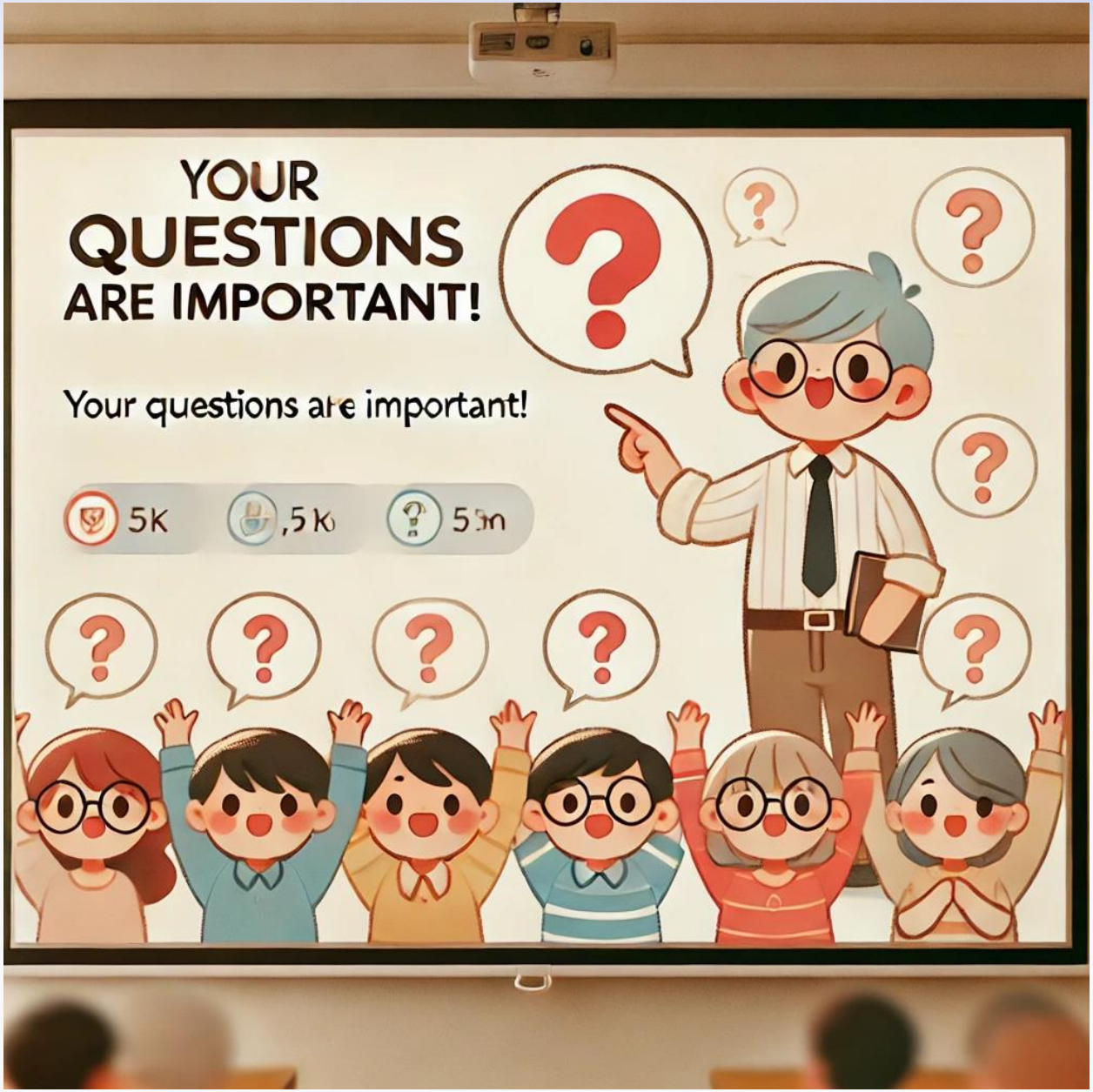
“My advisor doesn’t understand me”

Extra contact persons:

- Andreas Juul Jespersen and Marc Tao Stender (student counselors)
- Andreas Birch Olsen (education advisor)
- Søren Poulsen (education coordinator, IT)
- Louise Bødker Wøbbe (education consultant)

Always ready to help! ☺

“independently plan and complete a major academic project using the subject’s scientific methodology”



Plan

"relay academic results objectively and concisely to a scientific audience."

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Writing techniques

- Work **top-down**
  - make an early template (headlines, cues)
  - "stepwise refinement" (as in programming)
- Work **iteratively**
  - scientific texts are rarely formulated perfectly in the first try
- Use the report as a **working document**
  - mark ideas, to-do's using colours, margin notes, or the like (e.g. using LaTeX macros)

Two understandings of the writing process

Writing for
communicating knowledge

intended readers:

- the advisor as an evaluator
- the external examiner
- your past self…

Writing as a
tool for thinking

intended readers:

- you
- your advisor

time

Two understandings of the writing process

Use both approaches!

Often just write your ideas down: *recording thoughts*

- new ideas might arise
- feeling of progress
- avoid only writing ”final text” since this can result in a writer’s block

Go over all text again from the beginning: *product phase*

- rewrite, add examples etc., to make it understandable by the intended readers
- can be done throughout the writing process when ideas and results have settled (should not be postponed to last minute!)

Typical structure of a thesis

Inductive

- Introduction
  - Motivation
  - Hypothesis (problem statement)
  - Method and overview
- Background and related work

IMPORTANT!!!

- Explaining existing theory
  - assess, critically analyze and summarize the scientific literature within a defined topic area
- Implementation, experiments
- Conclusion (connected to the introduction), possibly ideas for further work
- References
- (Appendices with technical details)
- (Web page with programs and data)

Typical structure of a thesis

Deductive

- Introduction
  - Motivation
  - Research questions (problem statement)
  - Method and overview

IMPORTANT!!!

- Background and related work
- Explaining existing theory
  - assess, critically analyze and summarize the scientific literature within a defined topic area
- Generalising / applying the theory
- Conclusion (connected to the introduction), possibly ideas for further work
- References

About the introduction

- Background and topic
  - General introduction
- General scientific method
- Specific problem statement / hypothesis / question
- Explanation of key concepts
- Why is the problem interesting?
  - analyze, critically discuss and put into perspective an academic issue
- How did you address the problem in more details?
  - E.g., via outline of the structure of the thesis
    - I read these papers … presented in section 1.
    - I implemented in this framework … discussed in in section 2
    - I experiemented as follows … discussed in section 3.

About the introduction

- Background and topi
  - General introductio
- **General scientific m**
- Specific problem st
- Explanation of key
- Why is the problem
  - analyze, critically
- How did you addr
  - E.g., via outline o
    - I read these pa
    - I implemented in this framework … discussed
    - I experiemented as follows … discussed in section 3.

My method is that of experimental computer science. Concretely I study the state-of-the-art of static analysis, implement the theory in practice, run experiments and evaluate whether the experiments give the results claimed by the theory.

In more detail, I read the papers…

I find that …

The rest of the thesis is structured as follows…

About the introduction

- Background and
  - General introdu
- **General scientif**
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Some methods of deductive sciences:

- Formalization and Symbolic Representation
- Define Axioms and Primitives
- Logical Deduction
- Exploration of Consequences and Extensions
- Proof and Verification
- Abstraction and Generalization

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Some methods of deductive sciences:

- Formalization and Symbolic Representation
- Define Axioms and Primitives
- Logical Deduction
- Exploration of Consequences and Extensions
- Proof and Verification
- Abstraction and Generalization

My method is that of theoretical computer science. Concretely I study the state-of-the-art of barriers to proving $P \neq NP$, explores some of its conseqeunce and present it in a general framework.

My method is that of theoretical computer science. Concretely I study the state-of-the-art of the theory of MPC and extended the theory by applying it to the special case of … with ten servers.

Readability

“relay academic results objectively and concisely to a scientific audience.”

Have particular attention to:

- Introduction
- Main arguments of the paper
- Meta-communication (continuously guide the reader through the text)
  - ”In this chapter we analyze X, which will be used in the analysis of Y in chapter Z”
- Use a clear language (avoid cryptic sentences and words not generally known)
  - Take pride in giving better explanation than the sources you used!
- Audience:
  - Anyone with a general CS background
  - Yourself before you started the project

Use of references

- Credibility of your sources? (the most credible from the top)
  - book (monograph)
  - dissertation
  - article from a journal
  - article from a conference
  - article from a workshop
  - master's thesis
  - technical report
  - homepage
  - personal communication

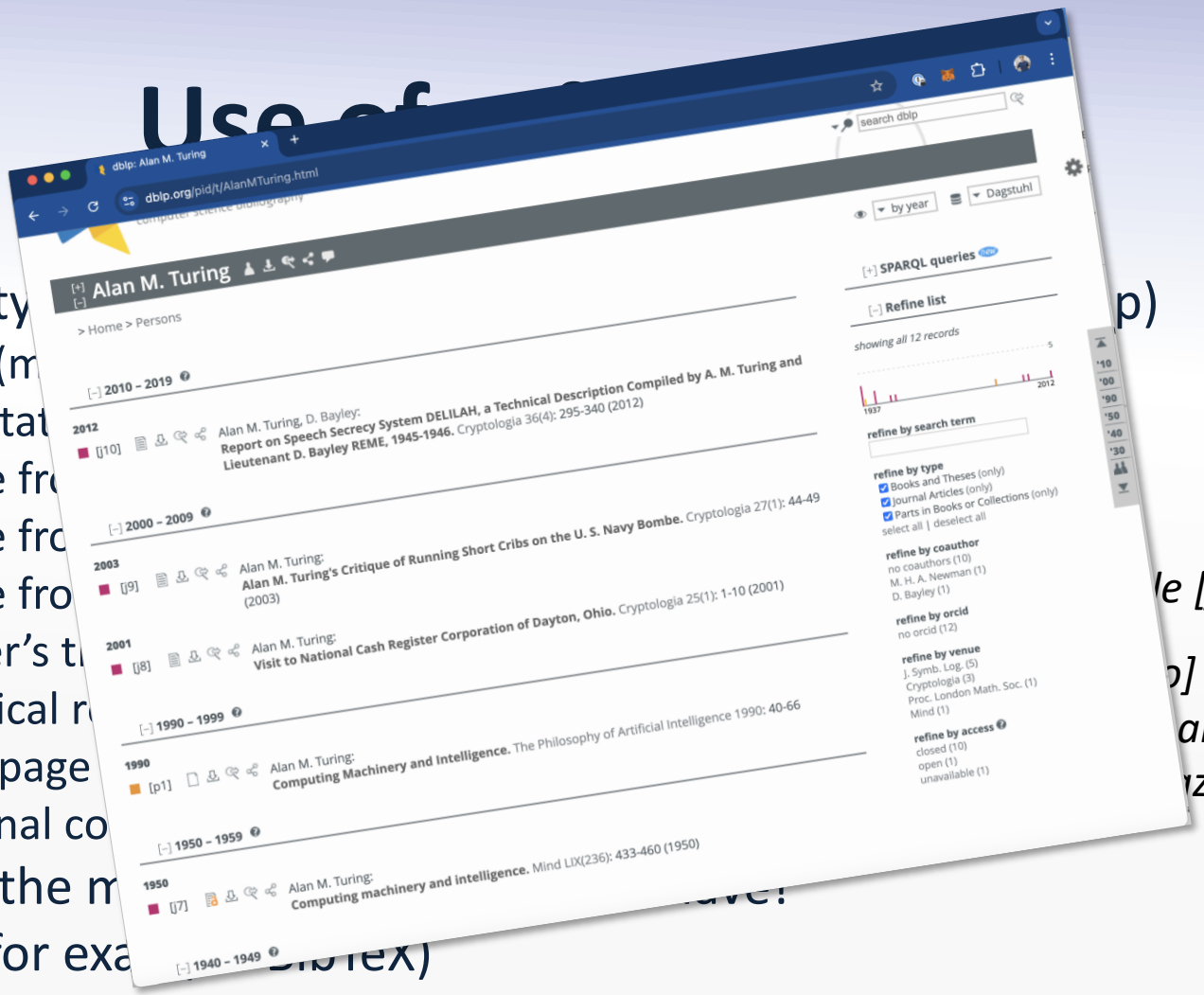
…I have read it on the internet

…it is written in the scientific article [foo]

…It is written in the article [foo] by the world leading expert [bar] and published in the top journal [baz]

- Refer to the most credible source you have!
- Layout (for example BibTeX)
  - Get BibTeX entry from DBLP
- Curriculum for exam, possibly separate "secondary literature"
  - Only the "referenced part" is curriculum, so be precise

Use of



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Avoid (self-)plagiarism!

- Always properly cite material you use
  - including your own material (from course projects, BSc thesis, etc.)
- Useful resources:
  - https://studerende.au.dk/en/examinations/cheating-at-exams
  - studypedia.au.dk/en/literature-referencing/reference-management
  - studypedia.au.dk/en/formal-requirements/references-and-bibliography
  - library.au.dk/en/students/plagiarism
  - https://studerende.au.dk/en/gai
- ChatGPT and other tools are allowed, but be aware of the rules for using GAI in exams
- First and foremost: Just be honest!
- Details differs between areas: If in doubt, ask your advisor!

Literature search

- DBLP dblp.uni-trier.de
  - based on the publishers' publication overview
  - covers practically all Computer Science journals, conferences, etc.
- Google Scholar scholar.google.com
  - number of *citations* gives an indication of impact
  - useful for finding relevant articles ("who is referring to this article?")
- The library (Nygaard-1) library@cs.au.dk
  - if you need a certain book or old article you cannot find elsewhere
  - Google Scholar, DBLP will likely cover 99% of your literature
- Discuss findings with advisor on weekly meeting if you want to make it a main source

Literature search

- DBLP
-

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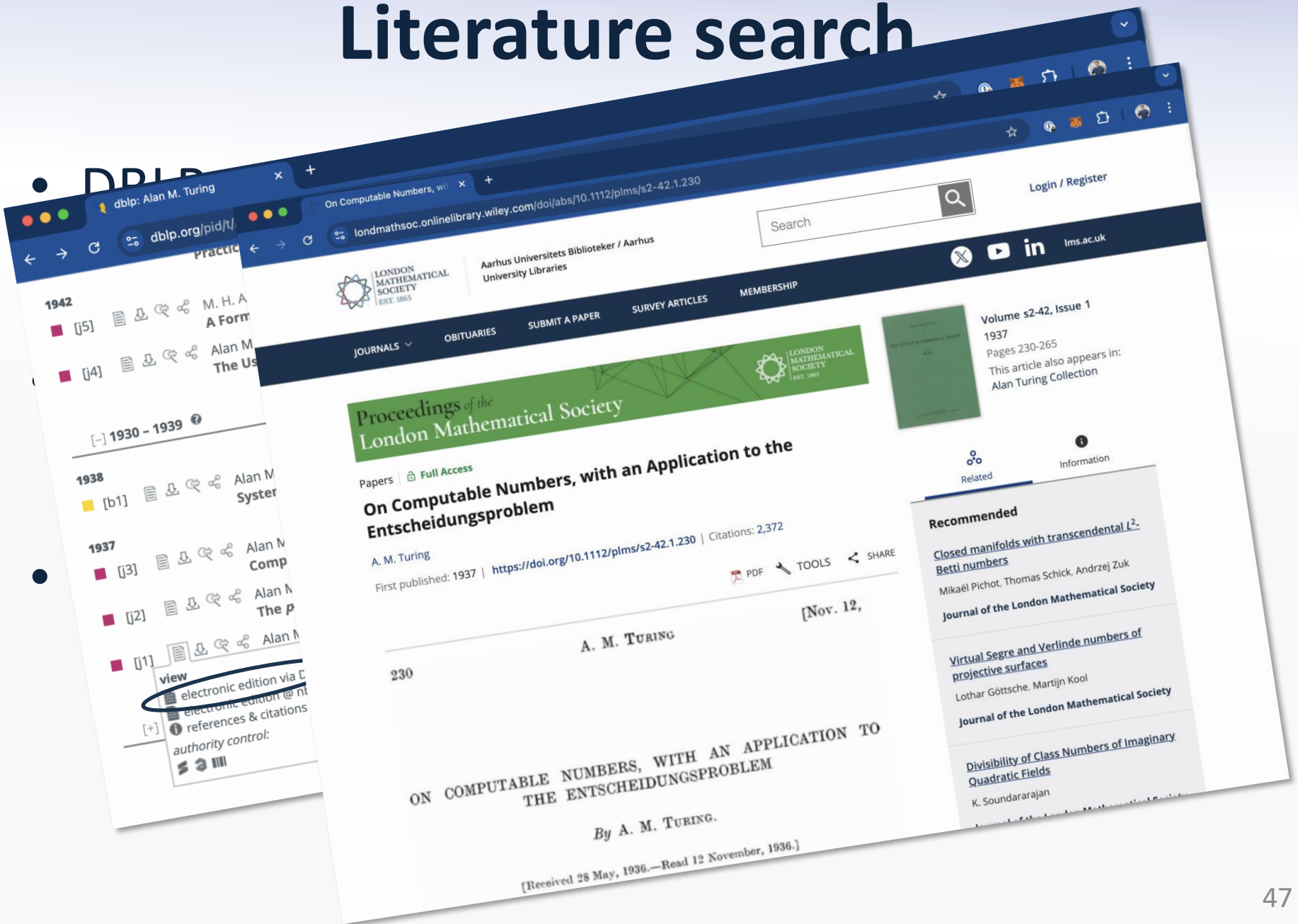
Literature search



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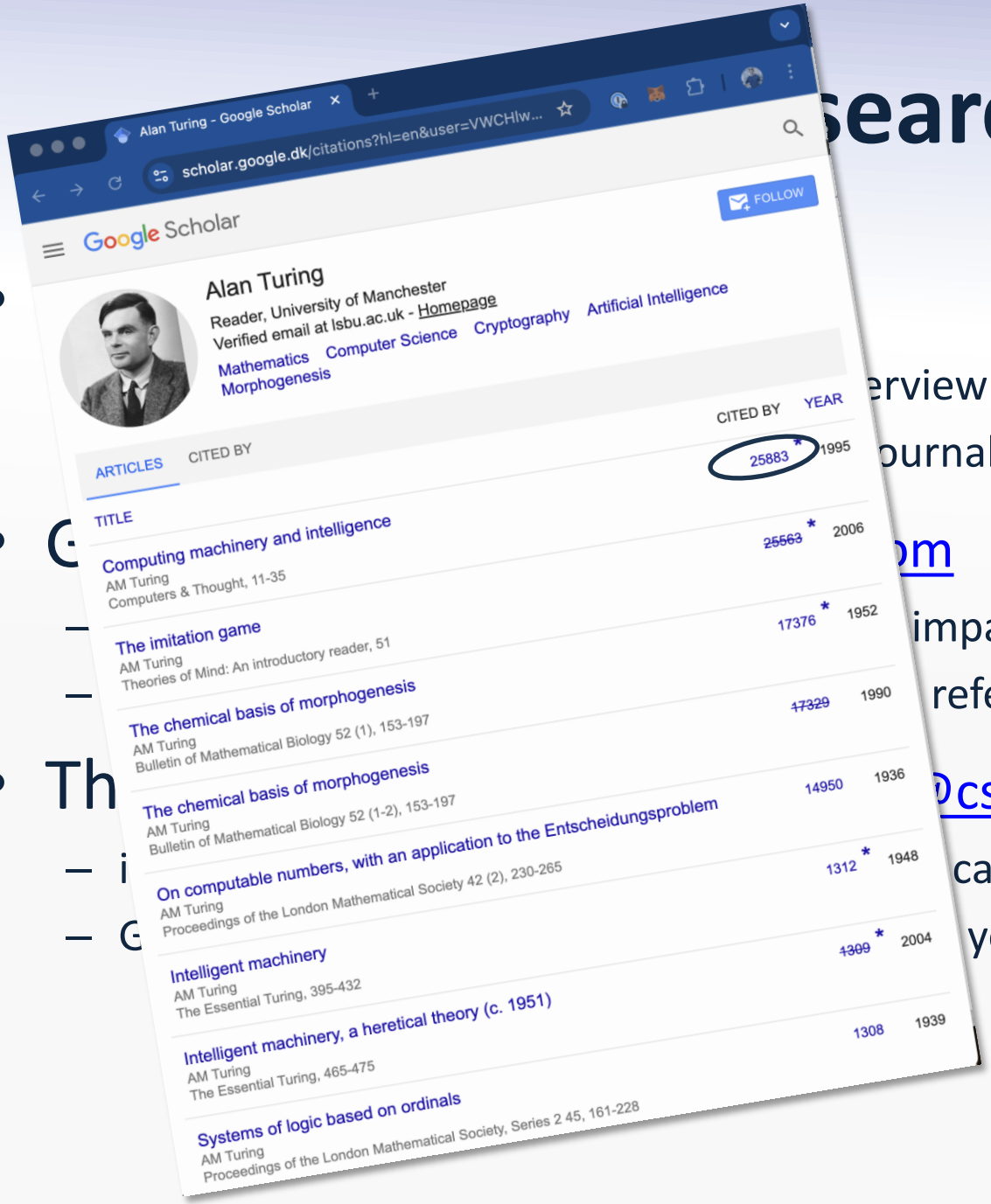

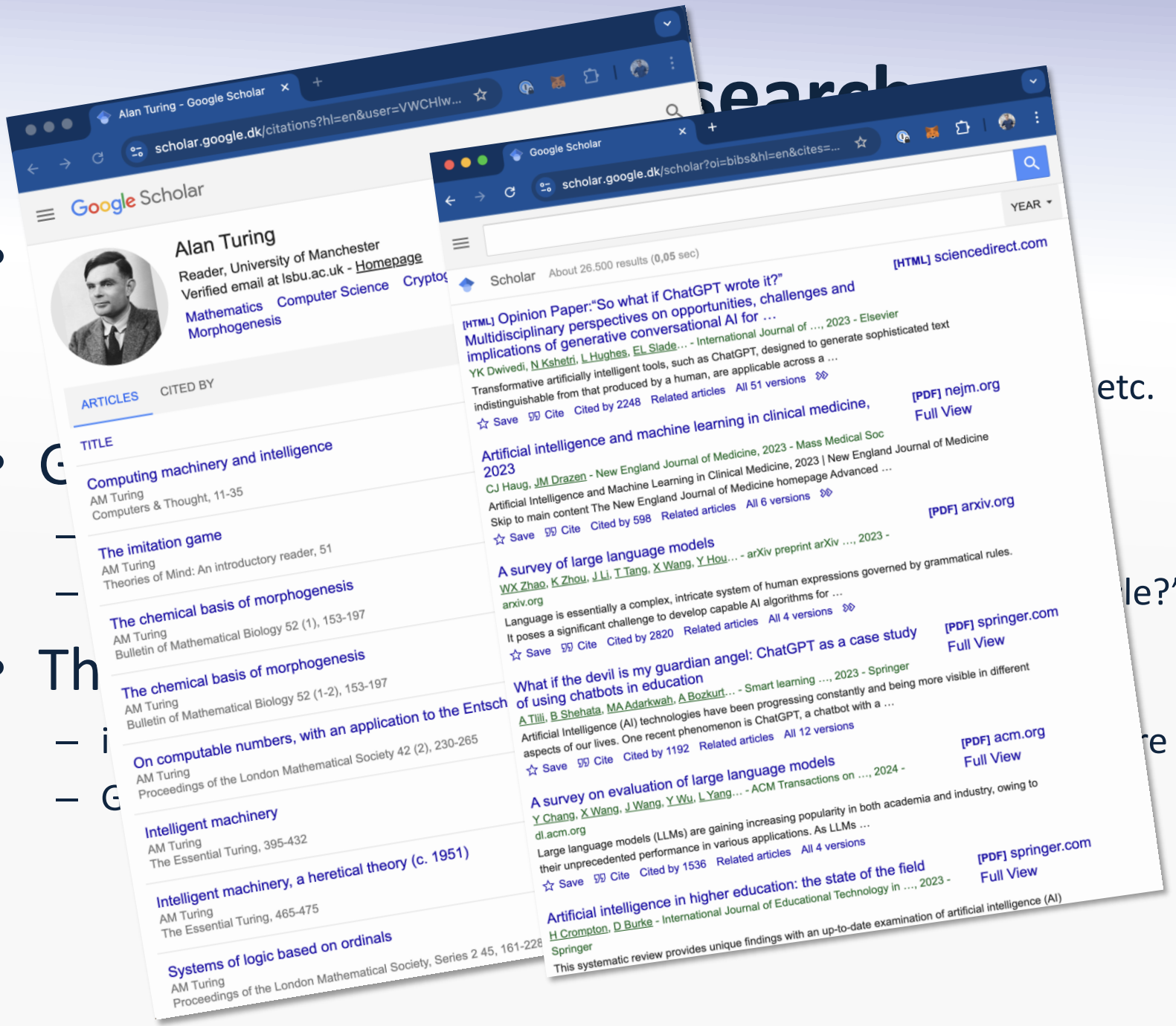
Alan Turing - Google Scholar
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Google Scholar
Alan Turing
Reader, University of Manchester
Verified email at lsbu.ac.uk - Homepage
Mathematics Computer Science
Morphogenesis
ARTICLES CITED BY
TITLE
Computing machinery and intelligence
AM Turing
Computers & Thought, 11-35
The imitation game
AM Turing
Theories of Mind: An introductory reader, 51
The chemical basis of morphogenesis
AM Turing
Bulletin of Mathematical Biology 52 (1), 153-197
The chemical basis of morphogenesis
AM Turing
Bulletin of Mathematical Biology 52 (1-2), 153-197
On computable numbers, with an application to the Entsch
AM Turing
Proceedings of the London Mathematical Society 42 (2), 230-265
Intelligent machinery
AM Turing
The Essential Turing, 395-432
Intelligent machinery, a heretical theory (c. 1951)
AM Turing
The Essential Turing, 465-475
Systems of logic based on ordinals
AM Turing
Proceedings of the London Mathematical Society, Series 2 45, 161-228
Google Scholar
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[HTML] Opinion Paper:"So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for …
[HTML] sciencedirect.com
YK Dwivedi, N Kshetri, L Hughes, EL Slade… - International Journal of …, 2023 - Elsevier
Transformative artificially intelligent tools, such as ChatGPT, designed to generate sophisticated text indistinguishable from that produced by a human, are applicable across a …
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WX Zhao, K Zhou, J Li, T Tang, X Wang, Y Hou… - arXiv preprint arXiv …, 2023 - arxiv.org
Language is essentially a complex, intricate system of human expressions governed by grammatical rules. It poses a significant challenge to develop capable AI algorithms for …
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What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education
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A Tlili, B Shehata, MA Adarkwah, A Bozkurt… - Smart learning …, 2023 - Springer
Artificial Intelligence (AI) technologies have been progressing constantly and being more visible in different aspects of our lives. One recent phenomenon is ChatGPT, a chatbot with a …
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A survey on evaluation of large language models
[PDF] acm.org Full View
Y Chang, X Wang, J Wang, Y Wu, L Yang… - ACM Transactions on …, 2024 - dl.acm.org
Large language models (LLMs) are gaining increasing popularity in both academia and industry, owing to their unprecedented performance in various applications. As LLMs …
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Artificial intelligence in higher education: the state of the field
[PDF] springer.com Full View
H Crompton, D Burke - International Journal of Educational Technology in …, 2023 - Springer
This systematic review provides unique findings with an up-to-date examination of artificial intelligence (AI)

Thesis front page

Must contain:

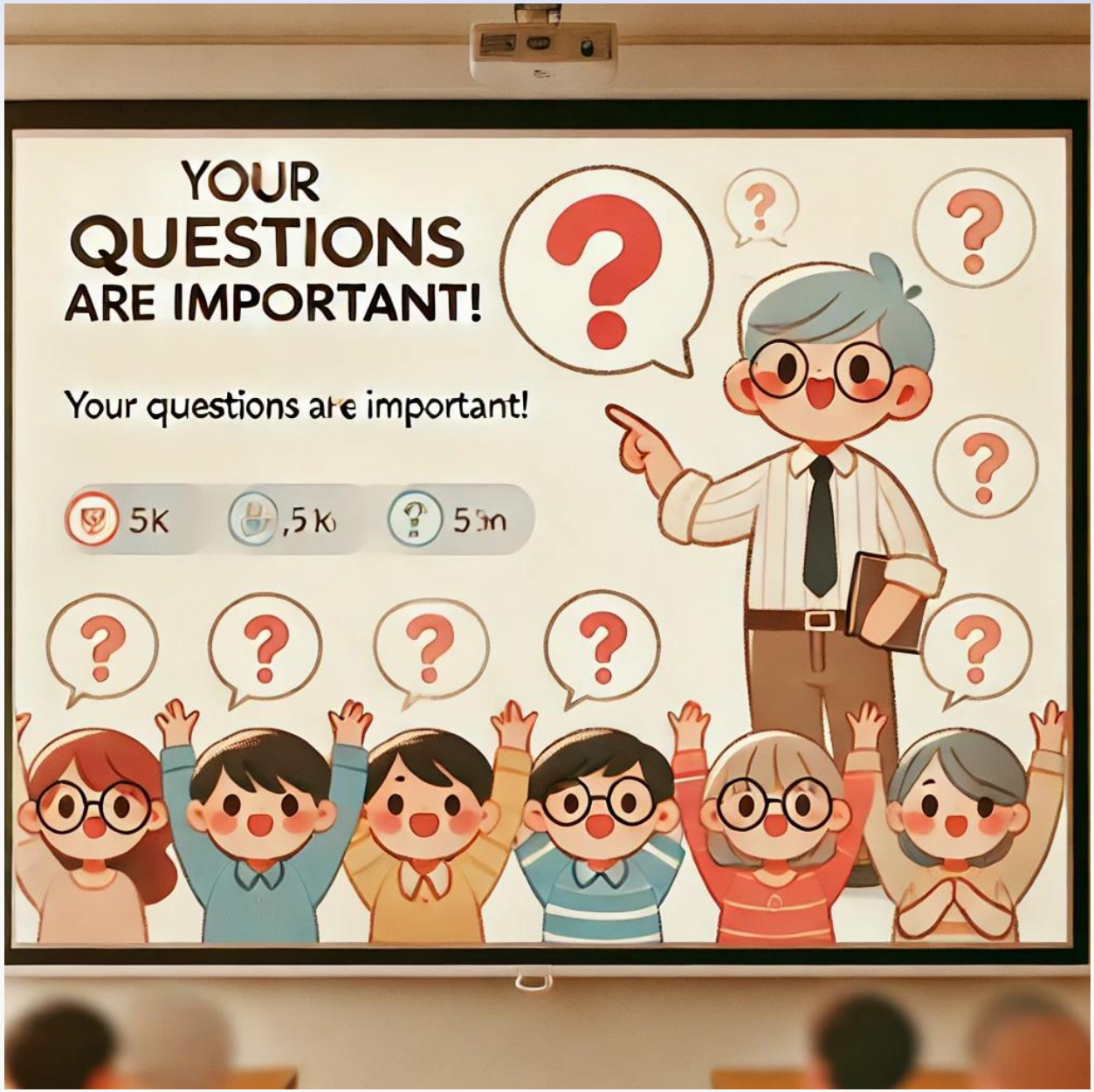
- Student ID number(s)
- Name(s)
- Thesis title
- Name of the advisor(s)
- Month and year
- The text “Master’s Thesis”

LaTeX template:
https://cs.au.dk/~amoeller/thesis-template/

Handing in the report

via Wiseflow

“relay academic results objectively and concisely to a scientific audience.”



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MSc thesis exam

- Missed hand-in deadline or failed exam
  - revised contract, 3 more months, new assignment
  - This is *not* just an extension!
- As for other exams: max 3 exam tries

MSc thesis exam

- Exam question
  - is given a week before the exam
  - is typically chosen to give the student the possibility to shine / pick a focus
- Presentation (30 min.)
  - with the exam question as a starting point
- Examination (30 min.)
  - pleasant conversation in a friendly atmosphere (well, usually…)

MSc thesis exam

Preparation:

- read the exam questions
- read your thesis
- read the curriculum (=the referenced part of the references in your thesis)
- rehearse your presentation
- possibly get feedback from advisor on structure of presentation, etc.
  - Some might refuse to read large parts of thesis and give detailed feedback on presentation…

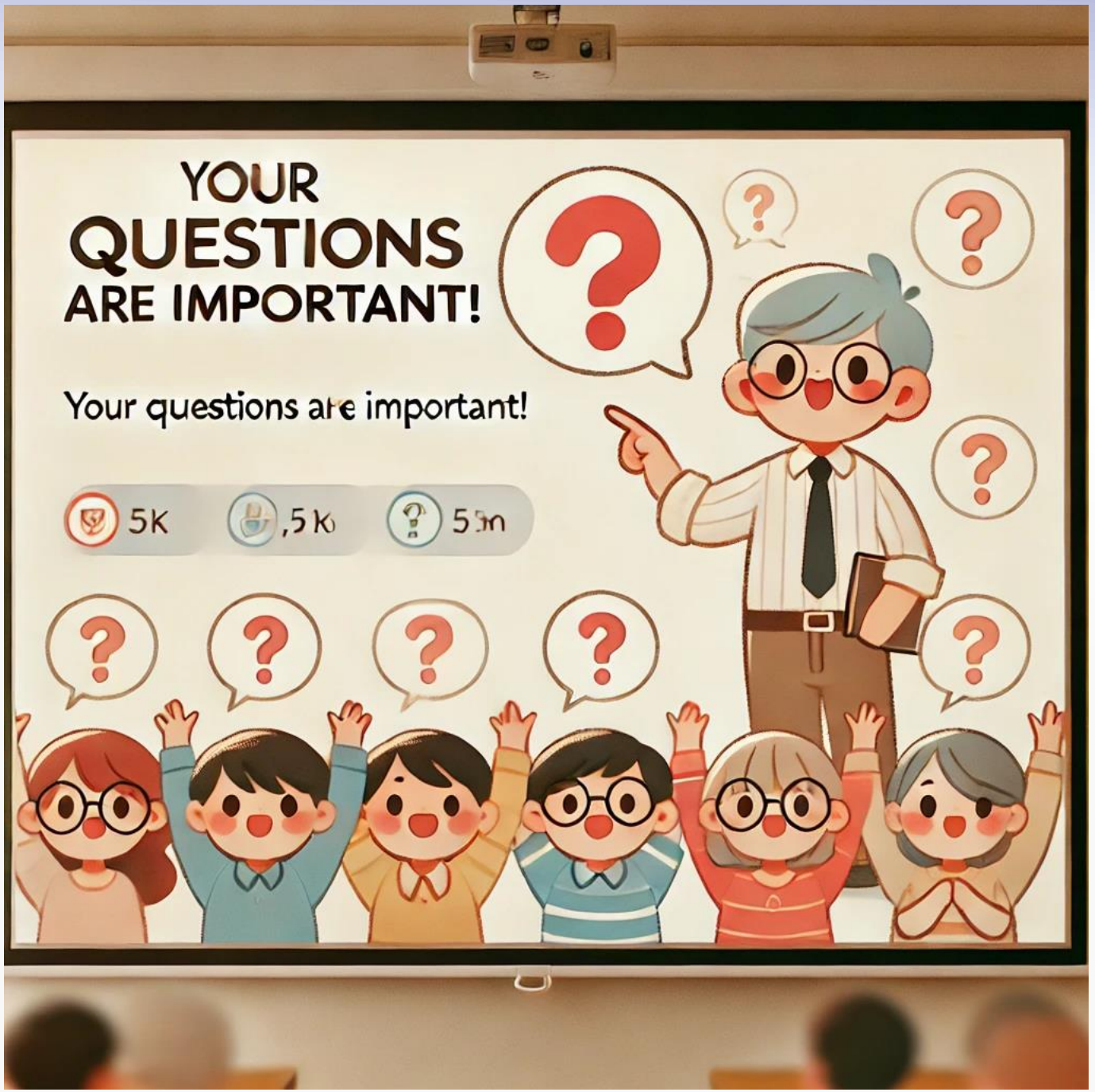
MSc thesis exam

The advisor's change of role:

- "why didn't you say this earlier?"
- probably the first time the advisor has seen the complete thesis report
  - By design…
- focused guidance meetings are the key to avoid surprises
- It is your thesis report: If the censor asks a critical question the answer is not, *because my advisor did not tell me otherwise*

Grading

- In principle the grade is given relative to the learning goals in the study regulations (see slide 6)
- In reality:
  - **ambition level** of the problem statement
  - **results** according to the problem statement
  - **readability** of the thesis
  - **coherence** between problem statement, methods, content and conclusion (“the red thread”)
  - the description of **related and future work**
  - **the presentation**
  - **the examination**
- Program code counts 0%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