Introduction to Discrete Mathematics and Algorithms (IDMA 2025)

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Datalogisk Institut – Københavns Universitet (DIKU)

Lecture 1
February 3, 2025

Introduction to Discrete Mathematics...

Discrete

- numbers, logic, graphs, combinations
- **not** continuous functions, derivatives, integrals, et cetera

Mathematics

- Start from obvious facts — axioms
- Derive true facts from these axioms
- We'll be far from fully axiomatic treatment, but will stress rigorous reasoning
- In mathematics, we establish absolute truths
- Very different from other fields of science using hypotheses and experiments

. . . and Algorithms

- Our computational problems have concrete, correct answers (so no ML predictions)
- Algorithms are precise descriptions of automated methods for solving such problems (focusing on discrete objects)
- Can be coded up in different programming languages
- But we won't have programming assignments in this course — focus on descriptions in pseudocode rather than exact syntax

Pro Tips

- Read course material before lectures
- Maybe even watch online videos for challenging topics (on Absalon or the internet)
- Read course material again after lectures
- Work on exercises
- The material covered in this course is absolutely fundamental — learning it well will save you tons of time throughout your studies

Course Contents

Mathematics

- Definitions of important concepts
- Theorems (and lemmas)
- Proofs
- Develop your abilities for rigorous (but creative!) reasoning

Algorithms

- (Pseudo)code
- Proofs of correctness
- Analysis of efficiency/complexity

Main Lecturer

Jakob Nordström

Professor

Algorithms and Complexity Section

Department of Computer Science (DIKU)

University of Copenhagen

(and Lund University)

`www.jakobnordstrom.se`

In my day job, I do research on

- Proving really hard problems are really hard
- Solving them as fast as possible anyway
- Generating proofs that solutions are correct

All instructors

Lecturers

- Jakob Nordström
- Srikanth Srinivasan
- Amir Yehudayoff

Teaching assistants

- Magnus Aabech
- Florestan Brunck
- Theo Fabris
- Anton Friis
- Monika Haubro
- Peter Trip Malmroes
- Tove Eggert Olsen
- Johannes Reuss

Language of Tuition

- **The good news:** You have a legal right to have this course taught in Danish
- **The bad news:** According to university rules, Swedish counts as Danish for official purposes
- **The pragmatic solution:** Let's continue in English...

What **You** Need to Do

- Be on top of course planning
- Follow lectures (or digest course material on your own)
- Read textbooks before and in between lectures (lectures do **not** cover everything)
- Work on exercises (and use TAs at exercise classes)
- Solve and hand in problem sets (required for exam)
- Interact with coursemates — help each other!

Do yourself a big favour:

- Work really hard on this course!
- Will help you massively in later courses
- (And pay back all time invested)

Problem Sets

- Will help you study throughout the course (instead of panicking the week before the exam, when it will be far too late)
- Problems are from old exams, so tell you what to expect
- Graded in the same way that exam will be graded
- You get individualized coaching for your attempted solutions
- And even personal feedback on whether revised solutions are corrected as needed
- And it's for free! You don't even have to pay for it! Amazing...
- It is hard to think about a better way of preparing for the exam

Summary of Problem Set Rules (Check Absalon for Details)

- Collaborate in groups of 2–3 but write everything up individually
- **No copying or sharing** of text, pseudocode, formulas, figures, whatever
  - from each other
  - from the internet
- Plagiarism will be reported (but more importantly, it's stupid and self-destructive)
- Submit on time via Absalon as PDF file
- Write up in LaTeX (or possibly other math-aware typesetting system)
- Graded solutions returned after roughly one week
- Corrections needed? One week for resubmission
- Need to pass all problem sets to be eligible for exam
- Any problems or questions regarding the problem sets? Ask your TAs!

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Questions? Ask now or see me after the lecture!