Introduction

Algorithm Theory
Winter Term 2023/24

## Fabian Kuhn

About the Course

Design and analysis techniques for algorithms

- Topics of the course (tentative):
  - divide and conquer
  - greedy
  - dynamic programming
  - advanced data structures
  - amortized analysis
  - graph algorithms
  - randomization
  - approximation algorithms
 - online algorithms
  - parallel algorithms

Requirements

- I assume that you have basic algorithms and data structures knowledge as well as some mathematical maturity
  - E.g., from the BSc course Algorithmen & Datenstrukturen and basic math courses

- In particular, you should be (at least partly) familiar with
  - math. induction, basic combinatorics & (discrete) probability theory, …
  - Big-O notation and Landau notation more generally
  - searching and sorting (binary search, mergesort, quicksort)
  - binary search trees, balanced binary search trees
  - priority queues (heaps)
  - hash tables
  - basic graph-theoretic definitions
  - representations of graphs
  - basic graph algorithms: traversal (depth-first, breadth-first), minimum spanning trees, shortest paths
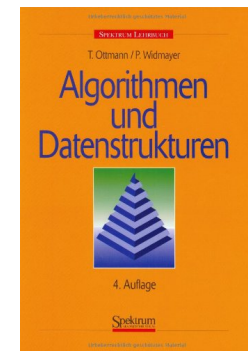
Literature

- J. Kleinberg, E. Tardos
  Algorithm Design
  Addison Wesley, 2005
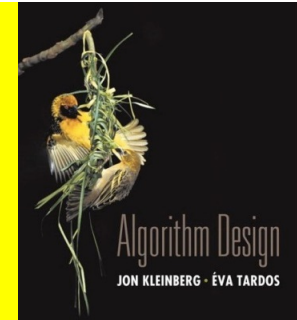
- T. Cormen, C. Leiserson, R. Rivest, C. Stein
  Introduction to Algorithms, Third Edition,
  MIT Press, 2009

- T. Ottmann, P. Widmayer
  Algorithmen und Datenstrukturen
  4th Edition, Spektrum Akademischer Verlag,
  Heidelberg, 2002
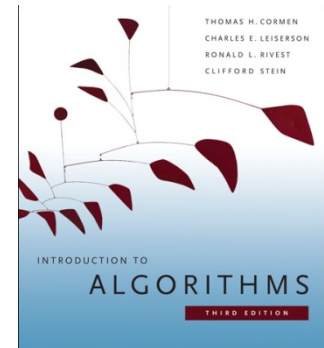
- Original literature

Lecture Organization

Lectures: Tuesdays 16:15 – 18:00 (101-00-026)

- The lecture will be fully in-person (physical)
  - With the exception of a couple of weeks, where I cannot be in Freiburg

Exercise Tutorials: Fridays 10:15 – 12:00 (101-00-026)

- We will have weekly exercises and exercise tutorials

Video Lectures

- We also provide approx. 60 mins of video lectures for most weeks
  - broken down into shorter parts (where it makes sense)
  - Same content as in the physical lectures
  - We will use the video lectures together with physical Q&A sessions in the three weeks, where I cannot be here.

General Remark: theory lecture (i.e., there will be math)

Web Page

http://ac.informatik.uni-freiburg.de

→ Teaching → Winter Term 2023/24 → Algorithm Theory

- We will publish all important information there!

- Check the web page regularly!

- Video lectures will be available through the course web page

Zulip for Discussions

- In addition to the web page, we use Zulip as an online forum for questions, online discussions, further information, etc.
  - Zulip is a group chat / forum (https://zulip.com).
  - Use Zulip to discuss questions regarding the lecture / exercises.
  - Also check Zulip for additional announcements.

- Information on how to sign up, see later slide...

- If you have a question about the lecture or the exercises, please use Zulip instead of writing an email to one of us!
  - Like this, all of us and also your colleagues see the question and can answer to it
  - We can directly answer a question for everybody
  - Of course feel free to also use Zulip to discuss anything related to the topics and organization of the lecture

Zulip Organization

Zulip has a 2-Level Hierarchy

- 1st level: streams
  - They are predefined by us (see below)

- 2nd level: topics
  - Every message is assigned to a topic. Messages of the same topic can be grouped. Please use short, but meaningful topic names when creating new topics.

Zulip Streams for Algorithm Theory:

- *AC-announcements*: read-only, general info for all lectures

- *algtheory2023/exercises*: questions related to exercise sheets

- *algtheory2023/lecture*: questions related to the lectures

Exercises

General Information

- There will be (theoretical) exercises to practice the material
  - We will try to provide *sample solutions* (not always guaranteed)

- 1 exercise sheet per week

- You need to do the exercises alone or in groups of 2, 3, or 4. We encourage you to team up and do them in groups of size 2 or 3!
  - Each of you should hand in a solution, if you work in a group, please hand in the same solution!
  - When you hand in an exercise, clearly write on your solution with whom you worked on it. (We don't want to grade the same solution twice. ☺)
  - If you want to work in a group, but don't have a partner, you can try to find somebody through Zulip. We will try to set up something on Zulip that should simplify this.

50% of all exercise points needed to pass the "Studienleistung"

Exercises Online Organization

Daphne

- We use the Daphne system to
  - Electronically hand in exercises and give feedback on exercises
  - Manage your exercise points
- Information on how to sign up, see next slide…

Exercise Schedule

- Exercise sheet will be published at the latest on Friday
- Exercises are due in the following week on Friday at 24:00
- Exercise tutorials: Fridays, 10:15 – 12:00 (101-00-026)

Subversion (SVN)

- When signing up to Daphne, you get access to an SVN repository.
- You need to upload your solution to your repository
  - Up to the deadline, you can update your solution as often as you like

Signing Up to Zulip & Daphne

- Links to sign up are available on the course website
  - You need to separately sign up for both systems!

Zulip

- Sign-up link is on a separate page on the website
  - Only accessible from within the university network (e.g., by VPN)
- If you already signed up to our Zulip for another lecture:
  - In this case, the link does not work
  - Follow instructions given on AC-announcements stream on Zulip
    - Send private Zulip msg. to Marc Fuchs or Salwa Faour

Daphne

- Sign-up link is on main course website
- Use your RZ account to sign up!

Exam

Final Exam

- Final exam will take place after the semester
  - It will be a written 120 min exam.
  - As soon as we know the date, we will publish it on the web page

- You will be allowed to bring 6 A4 pages of handwritten notes to the exam. No other material will be allowed
  - 6 A4 pages $\widehat{=}$ 6 singly-sided A4 sheets