

WS 2021/22

# Efficient Algorithms and Data Structures

Harald Räcke

Fakultät für Informatik  
TU München

<http://www14.in.tum.de/lehre/2021WS/ea/>

Winter Term 2021/22

## Part I

# Organizational Matters

## Part I

# Organizational Matters

- ▶ Modul: IN2003
- ▶ Name: “Efficient Algorithms and Data Structures”  
“Effiziente Algorithmen und Datenstrukturen”
- ▶ ECTS: 8 Credit points
- ▶ Lectures:
  - ▶ 4 SWS  
Mon 10:00–12:00 (Room Interim2)  
Fri 10:00–12:00 (Room Interim2)
- ▶ Webpage: <http://www14.in.tum.de/lehre/2021WS/ea/>

- ▶ Required knowledge:
  - ▶ IN0001, IN0003  
“Introduction to Informatics 1/2”  
“Einführung in die Informatik 1/2”
  - ▶ IN0007  
“Fundamentals of Algorithms and Data Structures”  
“Grundlagen: Algorithmen und Datenstrukturen” (GAD)
  - ▶ IN0011  
“Basic Theoretic Informatics”  
“Einführung in die Theoretische Informatik” (THEO)
  - ▶ IN0015  
“Discrete Structures”  
“Diskrete Strukturen” (DS)
  - ▶ IN0018  
“Discrete Probability Theory”  
“Diskrete Wahrscheinlichkeitstheorie” (DWT)

## The Lecturer

- ▶ Harald Räcke
- ▶ Email: raecke@in.tum.de
- ▶ Room: 03.09.044
- ▶ Office hours: (by appointment)

## Tutorials

- |   |            |              |            |                        |
|---|------------|--------------|------------|------------------------|
| 1 | Monday,    | 12:00–14:00, | 00.08.038  | (Michael Laraia)       |
| 3 | Monday,    | 14:00–16:00, | 02.09.023  | (Ruslan Zabrodin)      |
| 4 | Tuesday,   | 10:00–12:00, | 00.08.053  | (Letian Shi)           |
| 5 | Tuesday,   | 14:00–16:00, | 00.08.038  | (Arnor Kristmundsson)  |
| 6 | Wednesday, | 10:00–12:00, | 03.11.018  | (Abdelrahman Metwally) |
| 2 | Wednesday, | 12:00–14:00, | online     | (Arnor Kristmundsson)  |
| 8 | Wednesday, | 14:00–16:00, | online     | (Abdelrahman Metwally) |
| 9 | Thursday,  | 16:00–18:00, | online     | (Michael Laraia)       |
| 7 | Friday,    | 12:00–14:00, | 00.13.009A | (Ruslan Zabrodin)      |

## Registration for Tutorials

Registration Period for Tutorial Sessions:

Saturday, 23 Oct– Tuesday, 26 Oct

via TUMonline; you have to choose at least 3 options...

## Registration for Attending the Lecture

- ▶ For the following lectures we will do random checks of ca. 10% of the vaccination certificates.
- ▶ Then you have to sit one seat apart according to current Corona regulations.
- ▶ The number of seats reduces to roughly 140.
- ▶ Therefore, you must register if you want to attend the lecture inside the lecture hall.
- ▶ This is done via Moodle.

## Assignment sheets

In order to pass the module you need to pass an exam.

## Assessment

### Assignment Sheets:

- ▶ An assignment sheet is usually made available on Friday on the module webpage.
- ▶ Solutions have to be handed in in the following week before the lecture on Monday.
- ▶ Solutions are submitted electronically via Moodle.
- ▶ Solutions have to be given in English.
- ▶ Solutions will be discussed in the tutorial of the week when the sheet has been handed in, i.e., **sheet may not be corrected by this time.**
- ▶ **You should submit solutions in groups of up to 2 people.**

## Assessment

### Assignment Sheets:

- ▶ Submissions must be handwritten by a member of the group. Please indicate who wrote the submission.
- ▶ Don't forget name and student id number for each group member.

## Assessment

Assignment can be used to improve your grade

- ▶ If you obtain a bonus your grade will improve according to the following function

$$f(x) = \begin{cases} \frac{1}{10} \text{round} \left( 10 \left( \frac{\text{round}(3x)-1}{3} \right) \right) & 1 < x \leq 4 \\ x & \text{otw.} \end{cases}$$

- ▶ It will improve by 0.3 or 0.4, respectively.

Examples:

- ▶ 3.3 → 3.0
- ▶ 2.0 → 1.7
- ▶ 3.7 → 3.3
- ▶ 1.0 → 1.0
- ▶ > 4.0 no improvement

## Assessment

Assignment can be used to improve you grade




### Requirements for Bonus

- ▶ 50% of the points are achieved on submissions 2–8,
- ▶ 50% of the points are achieved on submissions 9–14,
- ▶ each group member has written at least 4 solutions.





## 1 Contents

- ▶ Foundations
  - ▶ Machine models
  - ▶ Efficiency measures
  - ▶ Asymptotic notation
  - ▶ Recursion
- ▶ Higher Data Structures
  - ▶ Search trees
  - ▶ Hashing
  - ▶ Priority queues
  - ▶ Union/Find data structures
- ▶ Cuts/Flows
- ▶ Matchings





## 2 Literatur

-  Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman:  
*The design and analysis of computer algorithms*,  
Addison-Wesley Publishing Company: Reading (MA), 1974
-  Thomas H. Cormen, Charles E. Leiserson, Ron L. Rivest,  
Clifford Stein:  
*Introduction to algorithms*,  
McGraw-Hill, 1990
-  Michael T. Goodrich, Roberto Tamassia:  
*Algorithm design: Foundations, analysis, and internet  
examples*,  
John Wiley & Sons, 2002

## 2 Literatur

-  Ronald L. Graham, Donald E. Knuth, Oren Patashnik:  
*Concrete Mathematics*,  
2. Auflage, Addison-Wesley, 1994
-  Volker Heun:  
*Grundlegende Algorithmen: Einführung in den Entwurf und  
die Analyse effizienter Algorithmen*,  
2. Auflage, Vieweg, 2003
-  Jon Kleinberg, Eva Tardos:  
*Algorithm Design*,  
Addison-Wesley, 2005
-  Donald E. Knuth:  
*The art of computer programming. Vol. 1: Fundamental  
Algorithms*,  
3. Auflage, Addison-Wesley, 1997

## 2 Literatur

-  Donald E. Knuth:  
*The art of computer programming. Vol. 3: Sorting and Searching,*  
3. Auflage, Addison-Wesley, 1997
-  Christos H. Papadimitriou, Kenneth Steiglitz:  
*Combinatorial Optimization: Algorithms and Complexity,*  
Prentice Hall, 1982
-  Uwe Schöning:  
*Algorithmik,*  
Spektrum Akademischer Verlag, 2001
-  Steven S. Skiena:  
*The Algorithm Design Manual,*  
Springer, 1998

