

WS 2021/22

Efficient Algorithms and Data Structures

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Fakultät für Informatik
TU München

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

Winter Term 2021/22

Part I

Organizational Matters

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- ▶ 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 Räche
- ▶ 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.**

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 you 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

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