

SS 2015

# Komplexitätstheorie

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<http://www14.in.tum.de/lehre/2015SS/kt/>

Sommersemester 2015

# Chapter 0 Organizational Matters

- Lectures:
  - 4SWS Mon 14:15–16:00 (MI 00.08.038)  
Thu 14:00–15:45 (MI 00.08.038)  
Compulsory elective in areas Algorithms and Scientific Computing, Informatics, Bioinformatics  
Module No. IN2007
- Exercises/Tutorial:
  - 2SWS Central exercise: Tue 12:15–13:45 (03.11.018)
  - Tutor: Chris Pinkau
- Valuation:
  - 4V+2ZÜ, 8 ECTS Points
- Office hours:
  - Mon 12:00–13:00 and by appointment

- Tutorials:
  - Chris Pinkau, MI 03.09.057 ([pinkau@in.tum.de](mailto:pinkau@in.tum.de))  
Office hours: Tue 14:00–15:00
- Secretariat:
  - Mrs. Lissner, MI 03.09.052 ([lissner@in.tum.de](mailto:lissner@in.tum.de))

- Problem sets and final exam:
  - problem sets are made available on Mondays on the course webpage
  - must be turned in a week later before class
  - are discussed in the tutorial
- Exam:
  - final exam: Monday, July 27, 2015, 08:30–11:30, room **MW 0350**
  - the final exam is closed book, no auxiliary means are permitted except for one sheet of DIN-A4 paper, handwritten by yourself
  - to pass the final exam, it is necessary to obtain at least **40%** of the point total
  - probably 10 problem sets

- Prerequisites:
  - Fundamentals of Algorithms and Data Structures (GAD)
  - Discrete Probability Theory (DWT)
  - Efficient Algorithms and Data Structures (EA)
  - Randomized Algorithms
- Supplementary courses:
  - Approximation Algorithms
  - Internet Algorithmics
  - Quantum Algorithms
  - ...
- Webpage:





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# 1. Planned topics for the course


- 1 The computational model
- 2  $\mathcal{NP}$  and  $\mathcal{NP}$ -completeness
- 3 Diagonalization
- 4 Space complexity
- 5 The polynomial hierarchy and alternation
- 6 Boolean circuits
- 7 (Randomized computation)
- 8 Interactive proofs
- 9 (Cryptography)
- 10 ...

## 2. Literature

-  Sanjeev Arora, Boaz Barak:  
*Computational Complexity — A Modern Approach*,  
Cambridge University Press: Cambridge-New York-Melbourne, 2009  
[http://proquest.tech.safaribooksonline.de.eaccess.ub.tum.de/  
9780511530753](http://proquest.tech.safaribooksonline.de.eaccess.ub.tum.de/9780511530753)
-  Giorgio Ausiello, Pierluigi Crescenzi, Giorgio Gambosi, Viggo Kann, Alberto Marchetti-Spaccamela, Marco Protasi:  
*Complexity and approximation — Combinatorial optimization problems and their approximability properties*,  
Springer-Verlag: Berlin-Heidelberg, 1999
-  José L. Balcázar, Josep Díaz, Joaquim Gabarró:  
*Structural Complexity I (and II)*,  
EATCS Monographs on Theoretical Computer Science, Springer-Verlag:  
Berlin-Heidelberg, 1995

-  Christos H. Papadimitriou:  
*Computational Complexity*,  
Addison-Wesley Publishing Company: London-Amsterdam-New York, 1994
-  Christos H. Papadimitriou, Kenneth Steiglitz:  
*Combinatorial optimization: Algorithms and complexity*,  
Prentice-Hall, Englewood Cliffs, NJ, 1982
-  Karl Rüdiger Reischuk:  
*Komplexitätstheorie — Band I: Grundlagen*,  
B.G. Teubner: Stuttgart-Leipzig, 1999  
[http://link.springer.com.eaccess.ub.tum.de/book/10.1007%  
2F978-3-322-80139-5](http://link.springer.com.eaccess.ub.tum.de/book/10.1007%2F978-3-322-80139-5)
-  Michael Sipser:  
*Introduction to the Theory of Computation*,  
International Edition, Thomson Course Technology:  
Australia-Canada-Mexico-Singapore-Spain-United Kingdom-United States, 2006



 Ingo Wegener:  
*The complexity of Boolean functions*,  
Wiley-Teubner Series in Computer Science: Stuttgart-Chichester-New York, 1987,  
[http://eccc.hpi-web.de/static/books/The\\_Complexity\\_of\\_Boolean\\_Functions/](http://eccc.hpi-web.de/static/books/The_Complexity_of_Boolean_Functions/)

Further relevant research papers will be made available during the course.

### 3. Notational conventions

We use standard notation and basic concepts, as detailed e.g., in the introductory course on

Discrete Structures, IN0015

<http://wwwmayr.in.tum.de/lehre/2012WS/ds/index.html.en>

# Chapter I The Computational Model

## 1. Some basic concepts

See



Sanjeev Arora, Boaz Barak:

*Computational Complexity — A Modern Approach*,

p. 9–12, Cambridge University Press: Cambridge-New York-Melbourne, 2009