

SS 2012

# Komplexitätstheorie

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<http://www14.in.tum.de/lehre/2012SS/kt/>

Sommersemester 2012

# Chapter 0 Organizational Matters

- Lectures:
  - 4SWS Tue 08:25–09:55 (MI HS2)  
Fri 08:25–09:55 (MI 00.13.009A)  
Compulsory elective in areas Algorithms and Scientific Computing, Informatics, Bioinformatics  
Module no. IN2007
- Exercises/Tutorial:
  - 2SWS Central exercise: Thu 12:30–14:00 (01.10.011)
  - Tutor: Chris Pinkau
- Valuation:
  - 4V+2ZÜ, 8 ECTS Points
- Office hours:
  - Fri 11:00–12:00 and by appointment

- Tutorials:
  - Chris Pinkau, MI 03.09.057 ([pinkau@in.tum.de](mailto:pinkau@in.tum.de))  
Office hours: Wed 10:00–11:00
- 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 Tuesdays in class and/or on the course webpage
  - must be turned in a week later before class
  - are discussed in the tutorial
- Exam:
  - written exam, date: August 2, 2012, 08:15–11:30Uhr
  - the final exam is closed book, no auxiliary means are permitted except for one sheet of DIN-A4 paper, handwritten by yourself
  - probably 10 problem sets




- Prerequisites:
  - Grundlagen: Algorithmen und Datenstrukturen (GAD)
  - Diskrete Wahrscheinlichkeitstheorie (DWT)
  - Effiziente Algorithmen und Datenstrukturen
  - Randomisierte Algorithmen
- Supplementary courses:
  - Approximationsalgorithmen
  - Internetalgorithmik
  - Quantenalgorithmen
  - ...
- Webpage:

<http://www.mayr.in.tum.de/lehre/2012SS/kt/>

# 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
-  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
-  **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 coomplexity 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/2011WS/ds/index.html.en>

# Chapter I The Computational Model

## 1. Some basic concepts

See



Sanjeev Arora, Boaz Barak:

*Computational Complexity — A Modern Approach*,

p. 9–13, Cambridge University Press: Cambridge-New York-Melbourne, 2009