

# Complexity Theory

VU 181.142, WS 2019

## 1. General Information

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TU Wien

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## Classes

- **Time and Place.** Regular classes:
  - Mondays, 11:00 - 13:00, Seminarraum FAV 01 B (Sem 187/2); no Monday classes in the first two weeks.
  - Tuesdays, 11:00 - 13:00, Seminarraum FAV EG C (Sem Gödel)
  - No classes on 28/29 October and 11/12 November
  - Quiz at the beginning of the semester: EI 5, Hochenegg HS.
  - Course ends before the Christmas holidays
- Please check the course homepage:  
<https://www.dbai.tuwien.ac.at/staff/pichler/complexity>

## Outline

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## Prerequisites and Admission

- **Prerequisites.**
  - This course is designed for **master's students**.
  - It is highly recommended to attend this course **after** the course **Formale Methoden der Informatik (185.291)**.
- **Knowledge and skills required.**
  - basic knowledge in mathematical logic
  - introduction to complexity theory
  - in particular, the central concept of “**problem reduction**”
- **Admission.**
  - primarily for **master's students!**
  - **positive assessment in a quiz is required**
  - each student has at most two attempts

## Quiz

- **Goal.**
  - ensure that students have the required knowledge and skills
  - basic knowledge in mathematical logic and complexity theory;
  - in particular, the central concept of “**problem reduction**”.
- **Organization.**
  - **Student's card required!!**
  - **closed book** (no material allowed)
  - Being able to solve all questions of the exercise sheet of block 1 (complexity theory part) of the course “Formale Methoden der Informatik” clearly suffices for the quiz.
  - max. 10 credits; passed with  $\geq 5$ .
- **Time and place.**
  - Thursday, 10 October, 09:00 - 11:00: EI 5, Hocheneegg HS
  - Thursday, 17 October, 09:00 - 11:00: EI 5, Hocheneegg HS
  - 60 min actual working time

## Course Overview

### Further details on topics from “Formale Methoden”

- Logarithmic Space
- Boolean Logic, proof of the Cook-Levin Theorem
- More NP-Completeness

### Further topics

- The polynomial hierarchy
- The class PSPACE
- Applications (Logic-based Abduction)
- Parameterized Complexity

## Communication

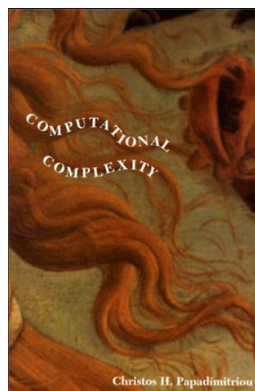
- (during, after) classes
- Course Homepage:  
<http://www.dbai.tuwien.ac.at/staff/pichler/complexity>
- TISS: please check your mail address in TISS

## References

- Christos H. Papadimitriou:  
Computational Complexity.  
Addison Wesley, 1994.
- M. R. Garey, D. S. Johnson:  
Computer and Intractability:  
A Guide to NP-Completeness.  
W. H. Freeman 1979.
- Further references (articles from journals, conferences, ...): see course homepage

## References

- **Christos H. Papadimitriou: Computational Complexity.** Addison Wesley, 1994.
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## Assessment

### Components

- Quiz
- Homework
- Exam

### Final Mark

- Quiz and homework: 50%
- Written exam: 50%  
(in the week before the Christmas holidays)
- Requirements for positive assessment:
  - quiz + homework: 30 (out of 60)
  - exam: 30 (out of 60)
- Marks 1–4:  
1 [105, 120], 2 [90, 105], 3 [75, 90], 4 [60, 75]

## References



### Homework Assignments

- 5 Homework assignments: max. 10 credits each
- maximum in total: **50** credits  
(normally, no excuses are accepted if a student misses a homework).
- Submission: **per mail in electronic form**  
(use of Latex is strongly encouraged)
- Submission deadline:
  - will be unambiguously stated on the problem sheet and/or on the course homepage (normally, 1 week is allotted for each homework)
  - late submission: -2 credits per day of delay

## Homework Assignments (cont'd)

- **good practice.**
  - discuss the problems with other students
  - team up to solve the problems
  - write down the solutions in your own words
- **bad practice.**
  - copy other students' solutions
  - search for solutions on the web and copy them

## Some Related Lectures

- **Complexity Analysis**  
184.215 – 2.0 VU – Komplexitätsanalyse  
Thomas Eiter (in the summer semester)
- **Numerous courses by the Algorithms and Complexity Group**  
e.g., 186.855 Fixed-Parameter Algorithms and Complexity  
Robert Ganian
- **Database Theory**  
181.140 – 2.0 VU – Datenbanktheorie  
Mondays and Tuesdays, 9:00 - 11:00  
Reinhard Pichler

## ECTS Breakdown

3 ECTS corresponds to 75h of work for “standard students” fulfilling the prerequisites (i.e., VU Formale Methoden der Informatik - 185.291).

quiz:	2h
15 classes:	30h
homework assignments (5×):	30h
exam preparation:	13h
=====	=====
in total:	75h