CS-524 **Computational complexity**

Svensson Ola Nils Anders

Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1	Opt.
Data Science	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	3 weekly
Exercises	1 weekly
Number of positions	

Summary

In computational complexity we study the computational resources needed to solve problems and understand the relation between different types of computation. This course advances the students knowledge of computational complexity, and develop an understanding of fundamental open questions.

Content

- Complexity classes (time, space, nondeterminism)
- Boolean circuits and nonuniform computation
- Role of randomness in computation (extractors, pseudo-random generators)
- Interactive proofs and zero knowledge proofs
- Probabilistically checkable proofs and their characterization of the complexity class NP (PCP Theorem)
- Communication complexity

Keywords

theoretical computer science
computational complexity

Learning Prerequisites

Recommended courses

Theory of computation (CS-251)
Algorithms (CS-250)

Learning Outcomes

By the end of the course, the student must be able to:

- Demonstrate an understanding of computational complexity and the P vs NP problem
- Formalize and analyze abstractions of complex scenarios/problems
- Express a good understanding of different concepts of proofs
- Prove statements that are similar to those taught in the course
- Use and understand the role of randomness in computation

- Illustrate a basic understanding of probabilistically checkable proofs and their characterization of the class NP (the PCP-Theorem)
- Explain recent exciting developments in theoretical computer science
- Compare different models of computation

Transversal skills

- Demonstrate the capacity for critical thinking
- Summarize an article or a technical report.

Teaching methods

Lecturing and exercises

Expected student activities

Actively attending lectures and exercise sessions. Also homeworks and exam.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Sanjeev Arora and Boaz Barak: *Computational Complexity: A Modern Approach, Cambridge University Press.*

Ressources en bibliothèque

- Computational Complexity: A Modern Approach / Arora

Websites

- http://theory.epfl.ch/courses/complexity/