

CS-524

**Computational complexity**

Göös Mika

Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	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
<b>Hours</b>	<b>4 weekly</b>
Courses	3 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**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)
- Space complexity (Logspace,  $L=NL$ )
- Boolean circuits and nonuniform computation
- Power of randomness (interactive proofs,  $IP=PSPACE$ )
- Lower bounds for concrete models of computation: Decision trees, communication protocols, propositional proofs.

**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

- 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.

### Assessment methods

Three homeworks and final 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.

Stasys Jukna: *Boolean Function Complexity*, Springer

### Ressources en bibliothèque

- [Computational Complexity: A Modern Approach / Arora](#)
- [Boolean Function Complexity / Stasys](#)

### Websites

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