EPFL

CS-450

Advanced algorithms

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Cursus	Sem.	Type
Computational science and Engineering	MA2, MA4	Opt.
Computer and Communication Sciences		Opt.
Computer science minor	E	Opt.
Computer science	MA2, MA4	Obl.
Cyber security minor	E	Opt.
Cybersecurity	MA2, MA4	Obl.
Data Science	MA2, MA4	Obl.
Data science minor	E	Opt.
Robotics, Control and Intelligent Systems		Opt.
SC master EPFL	MA2, MA4	Obl.

Language of teaching	English
Credits	7
Session	Summer
Semester	Spring
Exam	Written
Workload	210h
Weeks	14
Hours	**7 weekly**
Courses	4 weekly
Exercises	3 weekly
Number of positions	

Summary

A first graduate course in algorithms, this course assumes minimal background, but moves rapidly. The objective is to learn the main techniques of algorithm analysis and design, while building a repertory of basic algorithmic solutions to problems in many domains.

Content

Algorithm analysis techniques: worst-case and amortized, average-case, randomized, competitive, approximation. Basic algorithm design techniques: greedy, iterative, incremental, divide-and-conquer, dynamic programming, randomization, linear programming. Examples from graph theory, linear algebra, geometry, operations research, and finance.

Keywords

See content.

Learning Prerequisites

Required courses

An undergraduate course in Discrete Structures / Discrete Mathematics, covering formal notation (sets, propositional logic, quantifiers), proof methods (derivation, contradiction, induction), enumeration of choices and other basic combinatorial techniques, graphs and simple results on graphs (cycles, paths, spanning trees, cliques, coloring, etc.).

Recommended courses

An undergraduate course in Data Structures and Algorithms.
An undergraduate course in Probability and Statistics.

Important concepts to start the course

Basic data structures (arrays, lists, stacks, queues,trees) and algorithms (binary search; sorting; graph connectivity); basic discrete mathematics (proof methods, induction, enumeration and counting, graphs); elementary probability and statistics (random variables, distributions, independence, conditional probabilities); data abstraction.

Learning Outcomes

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

- Use a suitable analysis method for any given algorithm

- Prove correctness and running-time bounds
- Design new algorithms for variations of problems studied in class
- Select appropriately an algorithmic paradigm for the problem at hand
- Define formally an algorithmic problem

Teaching methods

Ex cathedra lecture, reading

Assessment methods

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes
Others	For details, see the course web page.

Resources

Bibliography

See web page for the course.

Ressources en bibliothèque

- Randomized Algorithms / Motwani
- Approximation Algorithms / Vazirani
- Quantum Computation and Quantum Information / Nielsen
- Algebraic Complexity Theory / Buergisser
- Computational Complexity / Papadimitrou

Notes/Handbook

Class notes and references for the running semester will be provided as needed within a few days after each lecture.

Websites

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