Module Description, available in: EN

Advanced Algorithms and Data Structures

General Information

Number of ECTS Credits

3

Module code

FTP_AdvAlgDS

Valid for academic year

2024-25

Last modification

2019-12-08

Coordinator of the module

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Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction				**X** E 100%			
Documentation				**X** E 100%			
Examination				**X** E 100%			

Module Category

FTP Fundamental theoretical principles

Profile Recommendations

This module is recommended for the following profiles:

	Lugano
Profile	CS, DS

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

Familiarity with basic discrete math, logic and probability theory. Familiarity with one programming language such as C++, Java, or similar languages.

Brief course description of module objectives and content

Algorithms are at the heart of every computer program. Informally, an algorithm is a procedure to solve a (computational) problem within a finite number of elementary steps. The same problem can be addressed with different algorithms, hence it is important to compare the different options in order to choose the best one. Experimental analysis is one way to perform such comparison, but it has several limits. The main goal of this class is to learn how to analyze the performance of a given algorithm in a formal mathematical way. We will focus on some fundamental polynomial-time-solvable problems. Along the way, we will study some of the main techniques to design efficient algorithms, among which the use of efficient data structures.

Aims, content, methods

Learning objectives and competencies to be acquired

The main goal of this course is to learn basic techniques to design algorithms and data structures for fundamental polynomial-time-solvable problems, and mathematical tools to analyze their performance from a theoretical point of view.

Module content with weighting of different components

A. Analytical tools: worst-case analysis and asymptotic notation; analysis of recursive algorithms; analysis of randomized algorithms; amortized analysis.

B. Algorithmic techniques: greedy; dynamic programming; divide et impera; randomization; fast data structures.

C. Data structures: search trees; priority queues; union-find; hash tables.

D. Polynomial-time problems: sorting and selection; shortest paths; minimum spanning tree; maximum flow; maximum matching.

Teaching and learning methods

Interactive lectures both for theory and exercises.

Literature

- T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein. Introduction to Algorithms. MIT Press. Third edition.

- J. Kleinberg, E. Tardos. Algorithm Design. Addison-Wesley.

Assessment

Certification requirements

Module does not use certification requirements

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

No aids permitted

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted