UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Design and Analysis of Algorithms

2425-3-E3101Q113

Aims

Students will acquire knowledge of the main techniques for the design and analysis of algorithms and the ability to identify the most appropriate algorithmic techniques to efficiently solve specific computational problems.

Contents

The course will introduce the main algorithmic techniques (dynamic programming, greedy), with particular attention to the efficiency of the algorithms, with the main analysis methods. The main algorithms for several combinatorial optimization problems, especially over sets, sequences, and graphs will be presented, including minimum spanning trees construction and shortest path problems.

Detailed program

1. Mathematical tools (review)

- Growth of functions, asymptotic notations
- Execution time of iterative algorithms
- Recursion and recursive algorithms
- Recurrence equations and Execution times of recursive algorithms

2. Algorithmic Techniques: Dynamic Programming (DP)

- Introductory examples
- Main features - Recursion

- Implementation with matrices
- Combinatorial optimization problems over sequences and sets

3. Algorithmic Techniques: Greedy method

- Introductory examples
- Matroids
- Rado Theorem

4. Disjoint-set data structure

- Definitions and operations
- Linked list representation and forest representation

5. Minimum spanning trees

- Kruskal algorithm
- Prim algorithm

5. Shortest path problems

- Dijkstra Algorithm
- Floyd-Warshall Algorithm

6. Hash Tables

- Direct-address tables
- Hash tables

7. Introduction to NP-completeness and reducibility

- NP-complet problems
- Reducibility

Prerequisites

Basic notions of programming, algorithms and data structures

Teaching form

Lectures, practice exercises, and classroom laboratory exercises in presence. The course is in Italian.
Lectures will be carried out in a traditional lecture mode while practice exercises and classroom laboratory exercises in both traditional and interactive mode.

Textbook and teaching resource

T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduzione agli Algoritmi e Strutture dati, Ed. Mc. Graw Hill

Further material and exercises are available through the e-learning website.

Semester

First semester

Assessment method

Written examination: It consitsts of

- exercises related to the main topics

- open questions on the theoretical aspects of the topics explained in the course

The maximum total score deriving from exercises and open questions is 31 points.
The exam is passed only if the final score is at least equal to 18.
3 additional points may be assigned (related to an optional exercise/open question).
The final score will just correspond to the usual score expressed in thirtieths (30 e lode if the final score is greater than 30).

Partial written examinations:
The written exam can be substituted by two partial written examinations in the middle and at the end of the course.

Each partial written examination is about the topics of the corresponding part of the course and it consists of exercises to the main topics and open questions on the related theoretical aspects.

Each partial written examination has a maximum score of 31/31: the final score of the exam is the average of the two partial scores. The exam is passed only if the score of each partial examination is greater than 14 and the final score is at least equal to 18.
3 additional points may be assigned (related to an optional exercise/open question).

The final score will just correspond to the usual score expressed in thirtieths (30 e lode if the final score is greater than 30).

Office hours

By appointment

Sustainable Development Goals