



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Analisi e Progetto di Algoritmi

2223-3-E3101Q113

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#### 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.

We introduce the NP-complexity and approximation algorithms.

#### 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 graph search, minimum spanning trees construction, Shortest path problems will be presented.

#### Detailed program

PART 1:

1. Mathematical tools

- Growth of functions, asymptotic notations
- Execution time of iterative algorithms
- Recurrence equations and Execution times of recursive algorithms
- Dichotomic Search, height of a binary tree

2. Algorithmic Techniques: Dynamic Programming (DP)

- Introductory examples
- Main features - Recursion
- Implementation with matrices

### 3. Algorithmic Techniques: Greedy method

- Introductory examples
- Matroids
- Rado Theorem

## PART 2:

### 4. Graph Algorithms

- Representations of graphs.
- Breadth first visit of graphs
- Depth first visit of graphs

### 5. Minimum spanning trees

- Kruskal algorithm
- Prim algorithm

### 5. Shortest path problems

- Dijkstra Algorithm
- Bellman-Ford Algorithm
- Floyd-Warshall Algorithm

### 6. Maximum flow problems

- Ford-Fulkerson Algorithm

### 7. NP completeness and reducibility. Approximation.

## **Prerequisites**

Basic notions of programming, algorithms and data structures

## **Teaching form**

Lectures, practice exercises, and classroom laboratory exercises. The course is in Italian.

## **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 slides and exercises are available through the e-learning website.

## **Semester**

First semester

## **Assessment method**

**Written examination:** the total score is 30/30. The exam consists of two sections, each of them regarding one of the two parts of the course. They consist of

- exercises related to the main topics
- open questions on the theoretical aspects of the topics explained in the course

2 additional points may be assigned if the exercises are perfectly solved

### **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 15/15: the final score of the exam is the sum of the two partial scores. 2 additional points may be assigned if the exercises are perfectly solved

## **Office hours**

By appointment

## **Sustainable Development Goals**

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