UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Models and Computation

2122-1-F1801Q132

Aims

The main objective of the course is the acquisition of skills related to the analysis and development of computational models and methods in computer science. The student should gain the ability of formalizing and modelling problems using theoretical models and modern computational approaches to solve problems arising from the WEB and the analysis and verification of software systems. The course consists of two sessions, the first one devoted to Concurrent models deals with the theoretical tools used to face basic concepts in computer science concerning the behaviour and description of processes, such as concurrency. The second session introduces to the Theory of Computation and deals with the acquisition of basic theoretical tools that allow to understand the computational complexity of problems, how they are classified according to their complexity and then how they can be solved by algorithmic methodologies.

Contents

Theory of Computation: Basic notions of theory of computation (decidability, intractability,
Classification of problems with respect their computational complexity. Approximation complexity. Modern approaches to indexing, compression of large data sets by using novel data structures and algorithmic techniques. Indexed data structures (ex. Suffix-tree, trie, hashing), pattern matching.

Concurrent models: Formal Models for correctness specification and verification. Interactive and reactive models, process calculi, Petri nets. Syntax and semantics of interleaving (transition systems) and of partial orders (petri nets), observational semantics and bisimulation. Specifying and verifying properties (modal and temporal logics, verification algorithms).

Detailed program

1 Basic notions of theory of computation (decidability, intractability, reductions). Classification of problems with respect their computational complexity. Approximation complexity.
2 Modern approaches to indexing, compression of massive data sets by using novel data structures and algorithmic techniques.
3 Indexed data structures (ex bloom filters, hashing), pattern matching, the paradigm shift-and, data compression, succinct data structures.
4 "Applications to the analysis of massive data.
5 Formal Models for correctness specification and verification, assiomatic semantics
6 Concurrent models: models of reactive systems, process calculi, Petri nets
7 Syntax and semantics of interleaving (transition systems) and of partial orders (Petri nets), observational semantics and bisimulation.
8 Specifying and verifying properties (modal and temporal logics, verification algorithms).

Prerequisites

None.

Teaching form

Lectures and practice exercises- the course is in Italian

Textbook and teaching resource

Notes and papers available on the course site. Reference texts suggested on the course site.

Semester

First semester.

Assessment method

Oral and written exams. The written exam consists of two assignments one for each module of the course, Theory and Models. Each assignment consists of a list of exercises whose solution requires the acquisition of skills related to the main topics of the course syllabus. The oral exam consists in a discussion of the written assignments with the main aim (see the details of the two modules).

The final grade is the average of the two grades obtained for each single module.

Office hours

By appointment or as indicated by the web-site.