UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Languages and Computability

2425-2-E3101Q111

Aims

The course puts in relation formal language theory with the parsing of programming languages and aims to make the student aware of the limits of computing. The student will be able to define regular and context-free grammars that are necessary to use standard parsing tools, and to use basic mark-up languages

Contents

Finite automata, regular languages and regular expressions. Context-free languages, context-free grammars and pushdown automata. Elements of the theory of computation: Turing machine, the Church-Turing thesis, the Universal Turing machine, unsolvable problems.

Detailed program

1. Introduction and motivations. Basic mathematical concepts for automata theory
2. Deterministic finite state automata. Non-deterministic finite state automata. An application: searching in texts. Finite state automata with epsilon-moves
3. Regular expressions. Finite state automata and regular expressions. Applications of regular expressions. Algebraic properties of regular expressions
4. Properties of regular languages. The Pumping Lemma as a tool to (dis)prove regularity of a language. Regular languages closure in respect to boolean operations. Equivalence and minimization of automata
5. Grammars. Context free grammars. Parse trees. Applications of context free grammars. Ambiguity of grammars and of languages
6. Turing Machines. Uncomputable problems. The basic Turing machine. Extensions of the basic Turing machine. Reduced Turing Machines

7. Computability. Non Recursively Enumerable languages. Recursively Enumerable and Recursive languages. Undecidable problems and Turing Machines
8. Lexical and syntactic parsers. Basic notions on mark-up and serialization languages and their relation to grammars

Prerequisites

The contents of the first year's courses

Teaching form

Classroom lessons and exercises, carried out in delivered mode, in person.
Laboratory exercises, carried out in interactive mode, in person.

The course is delivered in Italian.

Some self-assessment exercises will be weekly published on the eLearning (Moodle) web page.

Textbook and teaching resource

Textbook (the english version is also available):

- J.E. Hopcroft, R. Motwani, J.D. Ullman, Automi, linguaggi e calcolabilità, Addison Wesley

Didactic material provided on the e-learning platform

Semester

First semester, Academic Year 2024-2025

Assessment method

The assessment method consists of written and oral examination, and exercises performed during the lab.

The written exam consists of some exercises, which are similar to the ones made in class during the lectures and present on the e-learning platform, and in some open questions on the theory of computability. The evaluation objective of the written test consists in the intensive control of the preparation on some fundamental topics of the exam program, and in the control of disciplinary problem solving skills.

During the course, there are two written tests in progress. These tests have the same format and the same

objectives as the written test, and focus respectively on the first half and the second half of the exam program.

The student is admitted to the oral exam if he/she has passed the written test or both of the ongoing tests, and if the exercises related to the laboratory have been delivered, as specified on the web page of the course on the eLearning platform (Moodle). The objective of the laboratory exercises is to evaluate the student's ability to apply some of the course topics to a practical problem. During the oral interview, in addition to the discussion of the written exam, questions are asked on the topics of the course. The objective of the oral interview is to evaluate the student's ability to present the topics of the course, and to make brief thoughts on them.

The assessment is comprehensive and is defined in the oral interview.

Office hours

On appointment

Sustainable Development Goals

QUALITY EDUCATION