UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Languages and Computability

2021-2-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. Mark-up and serialization languages and their relation to grammars

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. Mark-up languages: XML

Prerequisites

The contents of the first year's courses

Teaching form

Lectures, recitations, laboratory. Language: Italian.

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

During the Covid-19 emergency, lectures and recitations will be recorded and online. There will be some previously planned discussions and answers to questions in streaming and not recorded . Laboratory will be virtual, according to the indications given by our University.

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 2020-2021

Assessment method

Written and oral examination, 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 oral exam can be done if the written exam has been passed, and if the exercises made during the lab have been positively evaluated.

The oral exam consists of a discussion on the written exam, as well as some questions on the contents of the course.

The score is defined at the oral exam.

During the Covid-19 emergency, the oral exams will be online either on Cisco WebEx or on Google Meet. The written exam will be substituted by some exercises performed during the oral exam.

Office hours

On appointment