# UNIVERSITÀ DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

# Linguaggi e Computabilità

**1920-2-E3101Q111**

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### 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.

## 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 2019-2020

## Assessment method

Written and oral examination, exercises 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. During the semester, two intermediate written exams will be done, that can substitute the final written exam.

The oral exam can be done if the written exam - or the two intermediate ones - has been passed, and if the exercises 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.

## Office hours

On appointment