UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

## Computer Architecture

**2324-1-E3101Q104**

### Aims

At the end of the course the student will knowledge of the components of a basic computer architecture and of the basics of assembly programming, skills for designing small modifications to the internal structure of a computer and for writing simple assembly programs, a also competence in choosing the best technology, in terms of performance, for some specific computing tasks.

### Contents

- Main components of the hardware architecture of a computer.
- Instruction set architecture.
- Programming toolchain.
- Control of the datapath.
- Exception handling.
- I/O techniques.
- Memory hierarchies: cache

### Detailed program

1. Information representation in digital computers

- representation of non numeric information
- representation of positive and negative integer numbers
- fixed and floating point representation of number
- +: details of computing with IEEE754 floating point numbers.

3. Logic circuits

- combinatorial circuits
- sequential circuits and FSMs (Finite State Machines)
- overview of relevant circuits: decoder, multiplexer, register file, ALU, etc.

5. Instruction Set Architecture

- von Neumann architecture,
- CPU, registers, ALU and memory,
- fundamental cycle of instruction execution (fetch/decode/execute),
- types and formats of MIPS instructions,
- addressing modes.

7. Assembly language

- Symbolic format of instructions,
- Software development toolchain (compiler, assembler, linker, loader, debugger, etc.),
- Pseudo-instructions and assembler directives,
- Development of simple assembly programs,
- Programming conventions (memory, register names, etc.).

9. Datapath

- Data path for each type of instruction,
- Data path control with FSM (multi-cycle implementation).
- +: pipelining and hazard handling

11. Exception handling

- Taxonomy of exceptions in MIPS32 parlance.
- Modifications to the Control Unit FSM, Cause register, etc.

13. Techniques for handling I/O

- Polling (transfers under program control),
- Interrupt,
- Direct Memory Access.

15. Memory classess : cache

- Direct mapping cache,
- Fully associative cache,
- N-way set associative cache
- +: LRU replacement.

## Prerequisites

Nothing

## Teaching form

- lectures
- practice / exercise
- laboratory
- personal study

The course is taught in Italian and are as usual held in the lecture room.

## Textbook and teaching resource

- Textbook: David Patterson, John Hennessy: Computer Organization and Design, The Hardware/Software Interface. Fifth edition. Morgan Kaufmann (Elsevier)
- Other teaching material available on the elearning platform concerning lectures, practices, and laboratory, some self-evaluation tests, etc.

## Semester

Second semester

## Assessment method

The exam will be possible to be completed in two partial tests, to be held around mid-course and at the end of the period, or as always in a single test among those scheduled all aorund the academic year.

Each test is based only on a two-part computer-based assessment, one part blocking and one extended. A valid score is attainable only after the extended part.

The first part is built around questions with closed answers (mainly exercises).

The second part is with closed and open answers and can be taken only by students who passed the first assessment. This assessment revolves also around topics not asked in the first part, marked with '+' in the program in this syllabus.

## Office hours

Send email to arrange an appointment.

## Sustainable Development Goals