

Course Unit	Computer Architecture			Field of study	Computer Engineering		
Bachelor in	Informatics Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits 6.0	
Туре	Semestral	Semester	2	Code	9119-706-1201-00-23		
Workload (hours)	162	Contact hours	T - Lectures; TP - Lectures a		C - S	E - OT - O Fieldwork; S - Seminar, E - Placement, OT - Tutorial; O - Other	
Name(s) of lecturer(s)  José Carlos Rufino Amaro, ARNALDO ANTÓNIO PINTO PEREIRA, Gilberto Sousa Ferraz							

#### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

- At the end of the course unit the learner is expected to be able to.

  1. understand the role of each computing system component

  2. know the operating mechanism of a processor and its interaction with the other system components

  3. understand the effect produced by high-level programming languages code fragments at the level of computing systems hardware

  4. predict the impact that a specific hardware upgrade would produce in the entire system performance

  5. size and evaluate computing systems

# Prerequisites

- Before the course unit the learner is expected to be able to:

  1. know the role of digital logic in the context of computing systems

  2. understand the operation and the goal of small programmes written in C language

# Course contents

Introduction to computer architecture and organization. Data representation. MARIE simplified architecture. Instruction set architectures. Memory. Input/Output and storage systems. Performance measurement and optimization. Alternative architectures.

# Course contents (extended version)

- Introduction to computer architecture and organization
   SI and IEC units of measurement

  - main components of a computer
  - standards organizationshistorical evolution

  - the computer level hierarchy
     the von Neumann model
- 2. Data representation

  - positional numbering systems
     conversion between different number bases
     signed integer representation
     floating-point representation
     character codes
     error detection and correction

- error detection and correction
  3. Study of a simulated architecture
   basic components of a CPU
   basic organization of the Main Memory
   MARIE CPU structure and organization
   MARIE instruction set architecture
   MARIE instruction processing
   MARIE assembly programs
- MARIE assembly programs
   MARIE assembly programs
   MARIE instructions decoding
   Instruction set architectures
   instruction formats

- Instruction tornats
   instruction types
   addressing
   instruction-level pipelining
   CISC vs RISC
- 5. Memory types of memory the memory hierarchy
   main memory
- cache memory
   virtual memory
  6. Input/Output and storage systems
   buses

  - I/O subsystemI/O architectures
  - storage technologies RAID schemes
- 7. Performance measurement and optimization mathematical metrics
  - benchmarkingCPU performance optimization
- Amdahl's law8. Alternative architectures
  - Flynn's taxonomy parallel systems
  - other systems

# Recommended reading

- "The essentials of computer organization and architecture, 5th Ed."; Linda Null, Julia Lobur; Jones and Bartlett Publishers; 2018
   "Princípios Básicos de Arquitetura e Organização de Computadores, 2ª Edição"; Linda Null, Julia Lobur; Bookman; 2010
   "Arquitectura de Computadores, 5ª Edição"; José Delgado, Carlos Ribeiro; FCA; 2014

# This document is valid only if stamped in all pages.

### Recommended reading

- 4. "Computer Organization and Design: The Hardware/Software Interface, 5th Revised Ed. "; D. A. Patterson, J. L. Hennessy; Morgan Kaufman; 2013 5. "Computer Architecture: A Quantitative Approach, 6th Ed. "; J. L. Hennessy, D. A. Patterson; Morgan Kaufman; 2017

# Teaching and learning methods

The subject is taught by interleaving the exposition of theoretical concepts with the resolution of exercises. All documentation (slides, exercises, solutions) is provided through the IPB e-learning platform.

# Assessment methods

- 1. Alternative 1 (Regular, Student Worker) (Final)
   Intermediate Written Test 40% (first intermediate test (part P1))
   Intermediate Written Test 40% (second intermediate test (part P2))
   Final Written Exam 20% (first oficial exam (part P3))
  2. Alternative 2 (Regular, Student Worker) (Supplementary)
   Final Written Exam 100% (second oficial exam (structured in parts P1, P2 and P3; allows evaluation of any part combination))
  3. Alternative 3 (Regular, Student Worker) (Special)
   Final Written Exam 100% (exam with the same structure of the 2nd oficial exam and reuse of the previous grades of the 3 parts)

# Language of instruction

- Portuguese
   English

lectro		

José Carlos Rufino Amaro	Tiago Miguel Ferreira Guimaraes Pedrosa	Luís Manuel Alves	Nuno Adriano Baptista Ribeiro
23-02-2024	14-03-2024	16-03-2024	17-04-2024