POLI ESCOLA SUPERIOR TECNOLOGIA GESTÃO TÉCNICO GUARDA	**SUBJECT DESCRIPTION**	**MODELO** PED.013.03

Course	**Data Science and Artificial Intelligence**					
Subject	**Computer Architecture**					
Academic year	2023-2024	*Curricular year*	1	*Study period*	2nd semester	
Type of subject	Compulsory	*Student workload (H)*	Total: 168	Contact: 90	*ECTS*	6
Professor(s)	Luis Figueiredo					
☒ *Area/Group Coordinator* ☐ *Head of Department* *(select)*	Fernando melo Rodrigues					

PLANNED SUBJECT DESCRIPTION

1. LEARNING OBJECTIVES

Upon completion of the UC, students should be able to:

1. Identify and measure the quantities Electric Potential Difference, Electric Current, and Electrical Resistance, and understand how to relate them through Ohm's Law, as well as interpret simple electronic circuits by applying Kirchhoff's Laws (Mesh Law and Node Law).
2. Understand the representation of signed and unsigned integers in binary, as well as the representation of single and double precision floating-point numbers, and be familiar with various mathematical and logical operations in binary.
3. Utilize microcontrollers for the acquisition and control of analog and digital signals, establishing the connection between software and hardware, enabling bidirectional data communication between a microcontroller and a computer.
4. Anticipate the future evolution of computers based on knowledge of their evolution up to the present day.
5. Identify the general architecture of computers.
6. Develop algorithms and implement programs and/or procedures in low-level languages, and compare their performance with programs and/or procedures implemented in high-level languages.
7. Identify different techniques for increasing application processing speed, both at the hardware and software levels.

2. PROGRAMME

1. *Basic concepts of electrical circuits*
    a. *Ohm's Law, Kirchhoff's Laws (Mesh Law, Node Law)*
    b. *Practical use of a multimeter for measuring electric potential difference, electrical resistance, and electric current*
    c. *Series and parallel resistor configurations*
    d. *Comparison of theoretical results with practical measurements of quantities in electrical circuits*
2. *Basic concepts of digital systems*
    a. *Logical operations AND, OR, and XOR*
    b. *Bits, Bytes, Words, Dwords, Qwords*
    c. *Representation of numbers in different bases*
    d. *Operations with numbers in different bases*
    e. *Representation of negative numbers*
    f. *Single and double precision floating-point numbers*
    g. *Representation of non-numeric data*
3. *Introduction to microcontrollers*
    a. *Introduction to ESP32 at hardware and software levels*
    b. *Development of applications for reading analog and digital signals*
    c. *Development of applications for controlling analog and digital signals.*
    d. *Development of applications for communication with a computer*
    e. *Use of interrupts and timers: advantages and limitations.*
4. *Brief history of computers*
5. *General computer architecture*

a. *Overall CPU organization*

b. *Different types of buses*

c. *I/O devices*

d. *80XXX architecture.*

e. *CISC/RISC architectures*

6. *Introduction to low-level programming*

a. *Instructions*

b. *Integration of Assembly with high-level languages*

c. *Functions*

7. *Techniques for increasing processing speed*

a. *Pipeline*

b. *SIMD*

c. *Superscalar architecture*

d. *Branch prediction*

e. *Speculative execution*

3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

Content 1 enables achieving objective 1, considering that this subject matter hasn't been covered in the academic path and is essential for understanding simple electronic circuits involving microcontrollers and their interface with the physical world.

Content 2 enables achieving objective 2, which is crucial for understanding the subsequent content.

Content 3 enables achieving objective 3 by providing students with the practical knowledge necessary for using microcontrollers.

Content 4 enables achieving objective 4 by showing students the evolutionary process of computers over time.

Content 5 enables achieving objective 5 by providing students with basic knowledge of computer architecture.

Content 6 enables achieving objective 6 by showing students how the execution of basic instructions by the CPU allows executing any code generated in high-level languages.

Content 7 enables achieving objective 7 by providing students with different techniques for increasing CPU processing speed.

4. MAIN BIBLIOGRAPHY

Mandatory:

Lecture notes provided by the teacher

ChatGPT

John L. Hennessy, David A. Patterson. Computer Architecture: A Quantitative Approach, 2003

http://spike.scu.edu.au/~barry/interrupts.html

Recommended:

http://www.intel.com/content/www/us/en/processors/architectures-software-developer-manuals.html

http://www.arduino.cc/

5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

Teaching methodologies:

1. *Lecture*
2. *Interactive lesson*
3. *Problem solving*
4. *Project*

Evaluation methodologies:

40% for a theoretical test.

35% for the development of a project, including a report and defense, based on the use of a microcontroller up to the 10th week of classes.

35% for the development of a project, including a report and defense, based on the use of Assembly\C up to the 15th week of classes.

The PDF report must be sent to the email luis.figueiredo@ipg.pt at least 48 hours before the date of each evaluation.

Practical projects can be done in groups, with a maximum of 3 members, but the evaluation will always be individual.

The assessment focuses on what each student knows about the project, not just the project itself. This means that even if the project meets all the required criteria, one or more students may receive a negative evaluation.

As a rule, any student unable to justify any part of the code or electrical diagram, or unable to independently complete the code or diagram, will inevitably receive a negative grade.

The minimum grade for each component of the evaluation will be 8 points.

Students who receive a negative grade in one or more components of the evaluation during a grading period, and who do not pass the course, may, if they choose, in the next grading period, only present/complete the components in which they received a negative grade, while maintaining the grades for the remaining components..

6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES

1. *A lesson in exposition is coherent with the objectives because it is necessary to present theoretical content to students so that they can later begin developing practical assignments for the course.*
2. *An interactive lesson is coherent with the objectives because demonstrating practical solutions encourages students to seek solutions for new problems actively.*
3. *Problem-solving activities are coherent with the objectives because it is absolutely essential for students to create their own programs to not only consolidate theoretical*

knowledge but also gain experience in practical implementation, moving beyond knowing how to do something to actually doing it.

4. *Project work is coherent with the objectives because it encompasses the development of applications that allow students to exercise their abilities in conception and practical realization, involving the development of algorithms and implementation of programs and/or procedures..*

5. ATTENDANCE

Not applied

6. CONTACTS AND OFFICE HOURS

Office 9, mail luis.figueiredo@ipg.pt

Wednesday 11:30 am to 5:30 pm

DATE

20 de fevereiro de 2024

SIGNATURES

Professor(s), Area/Group Coordinator or Head of Department signatures

Professor

(signature)

Area/Group Coordinator

(signature)