COURSE DATA

Data Subject	
Code	34837
Name	Computer structure
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1407 - Degree in Multimedia Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1407 - Degree in Multimedia Engineering	4 - Ingeniería de Computadores	Obligatory

Coordination

Name	Department
BOLUDA GRAU, JOSE ANTONIO	240 - Computer Science

SUMMARY

The course “Computers Structure” is a core course of the second year of the Multimedia Engineering Degree. The course workload is 6 ECTS and it is given in the first four-month period of the second year. This course is a part of the subject “Computer Engineering” of the Multimedia Engineering Degree curriculum.

The course “Computer Structure” deals with the Von Neumann computer architecture. During this course, the presentation of the elementary computer structure, which it was started in the first year course “Fundamental of Computers”, is completed. “Fundamental of Computers” is focused on the microprocessor architecture and machine language. Following the Von Neumann computer structure, this course continues the study introducing the rest of its internal components (memory, buses and input / output system) and the computer peripherals.

The first section of the course is focused on the hierarchical memory system. At the beginning of this section, various memory technologies that can be used to build the computer memory system are presented. It is intended that students know their capabilities in terms of performance, capacity and cost. Then, the main memory and its internal organization are introduced. Once the students have learnt how to build a memory system, the hierarchical design is presented as the logical solution to the optimization of memory system design under capacity, performance and cost constraints. Cache memory is located at the higher level of the hierarchical system. The student must understand the cache structure, its design parameters, operation policies and its impact on the system performance. Finally, this section ends with the description of the virtual memory that automatically handles the exchange of information between the two lower levels in the hierarchy, i.e.: main memory and secondary storage. The virtual memory completes the presentation of the hierarchical memory system. One of the most important competences that students should gain during this course is the understanding of the combined operation of the three memory levels and how to evaluate the performance.

In the second section of the course, the student will gain understanding of how the process of exchanging information between the computer and peripherals is performed. The contents of this section include the system input / output structure and the data transactions. The student should be able to determine the best method to carry out and manage the data transactions depending on the peripheral, whether based on polling, interruption or by DMA. Finally, this section finishes presenting the internal buses. These elements interconnect all the computer internal components and allow the information exchange between them. Students will learn the structure of the current buses and the way the data is transferred.

The following section of the course provides a basic knowledge of the most common computer peripherals and their operation. It begins with data input devices i.e.: keyboard, mouse, etc. Then it moves on to study the mass storage and RAID technologies and the problems associated with the sequential data access and the way in which the information is organized. Finally, video terminals complete the contents of this part.

The last block is focused on a brief presentation of parallel computer architectures. First, it is introduced a classification of different architectures according to the way in which the data processing is performed and the degree of coupling in the execution of programs. After that, several advanced techniques applied to conventional computers are explained, i.e. segmentation and superscalar processors. Then, systems running the same program on multiple data, such as vector and matrix processor, and multicomputer and multiprocessor architectures are introduced. Finally, the section ends with some examples of specific architectures, such as: GPUs for graphics processing.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is advisable to have attended the courses corresponding to the subject "Informatics".

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1405 - Degree in Multimedia Engineering

- G3 - Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and women.
- B4 - Have basic skills in the use and programming of computers, operating systems, databases and computer software for use in engineering.
- I2 - Know, design and make an efficient use of the data types and data structures that are most suited to solving a problem.
- I5 - Know the features, functionalities and structure of operating systems and be able to implement applications based on their services.
- MM1 - Have knowledge and ability to understand essential facts, concepts, principles and theories related to multimedia systems including all the disciplines covered by these systems.
- MM2 - Be able to understand and manage the different technologies involved in multimedia systems, both from the point of view of hardware and electronics and of software.
- MM3 - Be able to implement methodologies, technologies, processes and tools for the professional development of multimedia products in a real context of use by applying the appropriate solutions for each environment.
- MM5 - Know how to apply the theoretical and practical resources to deal with a multimedia application as a whole.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

Learning goals of the course:

1. To understand the main types of memory technologies according to their application and benefits.

2. To understand the effect of the memory latency at runtime.

3. To have the ability to take into account the memory hierarchy to reduce the effective latency of memory.

4. To understand the role of the cache and virtual memory in the memory system.

5. To understand the advantages and limitations of RAID architectures.

6. To value the advantages of multithreading and the factors that limit its benefits.

7. To understand the different types of buses in a computer system.

8. To have the ability to evaluate the impact of the form of access to data from a secondary storage device and its organization.

9. To have the ability to assess the technological needs for multimedia support.

17. To have the ability to work as a team to make the necessary designs and configurations, distributing the workload to face complex problems.

18. Analyze the requirements of any multimedia application and choose the appropriate peripherals that best suit to it.

19. Evaluate the performance of any multimedia peripheral attending to the most important parameters.

21. Ability to analyze the advantages and disadvantages of advanced architectures such as multicore processors.

DESCRIPTION OF CONTENTS

1. Memory Hierarchy

Technologies of the integrated circuits that form the main memory
Main memory organization
Design of the hierarchical memory system
Cache memory
Mapping algorithms for cache memory
Benefits of cache memory
Virtual Memory

2. Communications between processor and peripheral devices

Input/Output Modules
Synchronization by polling and interrupt
Direct Memory Access (DMA)

3. Buses and Interfaces

Features of a bus
Types of transfers
Examples of Buses

4. Peripheral devices

Input devices
Data Storage Systems
Video Terminals

5. Advanced architectures

Introduction and classification of parallel systems
Advanced conventional architectures
Vector and matrix processors
Shared memory multiprocessors
Distributed memory systems
Examples: GPU

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	5,00	0
Development of individual work	5,00	0
Study and independent work	5,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	20,00	0
Resolution of online questionnaires	5,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theoretical activities.

Description: The lectures will present the course contents providing a global vision, a detailed analysis of the key concepts and encouraging the student participation. The workload of this section for the students is 19% of the total of the course.

Practical activities.

Description: The practical activities complement the theoretical classes and allow the students to put into practice the contents and improve the understanding of the course concepts. They include the following types of classroom activities:

• Solving problems in class.
• Regular discussion of exercises and problems that the students have previously tried to work out.

• Laboratory sessions.

• Oral presentations.

• Support tutorial sessions (individualized or in group).

• Individual evaluation of questionnaires to be done in class with the help of teachers.

The workload of this section for the students is 21% of the total of the course.

Personal work.

Description: It is the work that the student must carry out individually out of the classroom timetable. It tries to promote the autonomous work habit. Activities in this group are: monographs, guided literature search, exercises and problems as well as preparation of classes and exams. The workload of this section for the students is 45% of the total of the course.

Teamwork in small groups.

Description: It will be carried out by small groups of students (2-4). It consists of work to be done out of the class timetable in form of exercises and problems. This work tries to improve the teamwork and leadership skills. The workload of this section for the student is 15% of the total charge of the course.

During the course the e-learning (pizarra virtual) platform of the University of Valencia will be used to support the teaching activities. This platform allows the access to the course materials used in the classes as well as additional documents, solved problems and exercises.

EVALUATION

The course evaluation will be performed in the first call preferably by continuous assessment (C) and the evaluation of laboratory activities (L).
The continuous assessment mark (C) is calculated as the weighted average of 3 continuous assessment tests, done during the course, at the end of each group of subjects: P1, P2 and P3. The following expression will be used, which reflects the relative weight of each topic:
C = 0,4 * P1 + 0,3 * P2 + 0,3 * P3
If the continuous assessment mark (C) is greater or equal than 5 the student may not make the official first call examination, calculating the qualification of the first call (N1a) as:
N1a = 0,8 * C + 0,2 * L
Where the laboratory mark (L) is calculated as the arithmetic mean of the laboratory sessions.
In the case that C is less than 5, the student must make the official first call examination (Ex1), calculating the qualification of the first call (N1b) as:
N1b = 0,7 * Ex1 + 0,2 * L + 0,1 * C
If a student, who has passed the first call with continuous assessment (C greater or equal to 5), wants to improve its qualification N1a, they may take the examination Ex1, calculating the 1st call qualification with both methodologies, N1a and N1b, and keeping the higher one.
The qualification of the second call (N2) is calculated in only one way, from the second call exam (Ex2), the lab notes (L) and continuous assessment (C) defined before. The marks L and C cannot be repeated.
N2 = 0,7 * Ex2 + 0,2 * L + 0,1 * C
In any case, the evaluation of this subject will be done in compliance with the University Regulations in this regard, approved by the Governing Council on 30th May 2017 (ACGUV 108/2017)

REFERENCES

Basic

- Estructura y diseño de computadores. Patterson, D.A. y Hennesy, J.
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- Organización y arquitectura de computadores. 7ª Edición. Stallings, William. Prentice Hall, 2006.
  On Line:
  http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1266
- Estructura de computadores y periféricos Rafael Martínez Durá, José A. Boluda Grau, Juan José Pérez Solano. Rama. 2002

Additional

- Fundamentos de los Computadores. Novena Edición. P. de Miguel Anasagasti. Ed. Thomson. 2004
- Computer peripherícals. Barry Cook y Neil White. Edward Arnold, 3ª edición. 1995