COMPUTER ARCHITECTURE, NETWORK TECHNOLOGY & OPERATING

Grado en Computación e Inteligencia Artificial / Bachelor in Computer Science and Artificial Intelligence BCSAI SEP-2025 CANTO-CSAI.2.M.A

Area Computer Science

Number of sessions: 33

Academic year: 25-26

Degree course: SECOND

Number of credits: 6.0

Semester: 1º

Category: COMPULSORY

Language: English

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Managing technical projects within the Blockchain and Aeronautics sectors

Working on blockchain based combat cloud prototype for FCAS/NGWS project.

Project manager at Zervus: http://skios.es

? Specialising in Hyperledger Fabric permissioned network projects.
? Recognised as a Technical Expert in the fields of Artificial Intelligence and Blockchain through the MDIA organisation5 in Malta.
? Currently conducting a technical assessment for a Generative A.I. project in the University of Malta.

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Office Hours

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SUBJECT DESCRIPTION

Welcome to this wonderful module for Computer Architecture, Network Technology and Operations. We look at how computers actually work, what their components are and how they fit together. It's a fascinating subject, because it enables you to understand from the most simple transistor to the hugely complex networks of data centres and interconnected networks what is actually going on, and how it works.

Know and understand the main elements of Computer Architecture.

Know the evolution of Operating systems over the last fifty years and how to operate with it.
Know the major components of most modern operating systems.

List architectural elements of modern operating systems and processors and explain their impact on performance.
Know the fundamentals of Networks and the breakdown of the layers involved.

LEARNING OBJECTIVES

The principle objective of this course is to give you a solid understanding of the how computers are built, how their operating systems work, and how they connect with each other via networks.

This objective can be broken down into a series of more specific objectives :

- To understand the main elements of Computer Architecture

- To be able to explain the interaction between them

- To understand the principle components of Operating Systems

- To be able to explain the interaction between Operating Systems and elements of hardware of a computer system

- To understand how networking connects machines and systems

TEACHING METHODOLOGY

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

Learning Activity	**Weighting**	**Estimated time a student should dedicate to prepare for and participate in**
Lectures	30.0 %	45.0 hours
Exercises in class, Asynchronous sessions, Field Work	20.0 %	30.0 hours
Group work	23.3 %	35.0 hours
Individual studying	26.7 %	40.0 hours
TOTAL	100.0 %	150.0 hours

AI POLICY

In this course, the use of generative artificial intelligence (GenAI) is encouraged, with the goal of developing an informed critical perspective on potential uses and generated outputs.

However, be aware of the limits of GenAI in its current state of development:

·If you provide minimum effort prompts, you will get low quality results. You will need to refine your prompts to get good outcomes. This will take work.

·Don't take ChatGPT's or any GenAI's output at face value. Assume it is wrong unless you either know the answer or can cross-check it with another source. You are responsible for any errors or omissions. You will be able to validate the outputs of GenAI for topics you understand.

·AI is a tool, but one that you need to acknowledge using. Failure to do so is in violation of academic honesty policies. Acknowledging the use of AI will not impact your grade.

Suggested format to acknowledge the use of generative AI tools:

I acknowledge the use of [AI systems link] to [specify how you used generative AI]. The prompts used include [list of prompts]. The output of these prompts was used to [explain how you used the outputs in your work].

If you have chosen not to include any AI generated content in your assignment, the following disclosure is recommended:

No content generated by AI technologies has been used in this assignment.

PROGRAM

SESSION 1 (LIVE IN-PERSON)

Course Introduction

SESSION 2 (LIVE IN-PERSON)

Introduction to Computer Architecture

Topics:

- Internal components of a basic microprocessor
- History and Evolution of computer architectures
- Alternative computational architectures
- Peripherals

SESSION 3 (LIVE IN-PERSON)

Microprocessors

Topics:

- Internal components of a basic microprocessor
- X86, X64, ARM, RISCV
- Introduction to assembly language

SESSION 4 (LIVE IN-PERSON)

Memory

- Memory types and technologies

- Data buses
- DMA
- Addressing

SESSION 5 (LIVE IN-PERSON)

Compilers and Virtualization

- C Compiler Structure
- Virtual Machines and byte code
- Virtualization tech.

SESSION 6 (LIVE IN-PERSON)

Interrupts

- Registers
- Interrupts
- Heap and Stack

SESSION 7 (LIVE IN-PERSON)

Memory Addressing

- Memory Address Maps
- Assembly addressing modes
- Peripherals Interaction

SESSION 8 (LIVE IN-PERSON)

Booting Process

- Baremetal startup
- bootloaders
- BIOS - UEFI

SESSION 9 (LIVE IN-PERSON)

Heterogeneous computers

- Co-Processors
- Advanced Instruction sets
- GPU
- Crypto processors

SESSION 10 (LIVE IN-PERSON)

Introduction to Operating Systems / A Unix/Linux Perspective

- Understanding what an Operating System (OS) is and its role.
- The history and evolution of Unix/Linux.
- Basic Unix/Linux commands.
- Introduction to the Unix/Linux file system.

SESSION 11 (LIVE IN-PERSON)

File Systems and Memory management

- Understanding File Systems: Structure and Types
- Memory Management in Operating Systems
- Virtual Memory, Paging, and Segmentation
- Basic Unix/Linux File Operations

Lab 1: Computer Assembly

SESSION 12 (LIVE IN-PERSON)

Process Management and Scheduling Algorithms

- Understanding Processes in Unix/Linux
- Process Life Cycle and States
- CPU Scheduling: Concepts and Criteria
- Scheduling Algorithms: LIFO, FIFO, Round Robin

SESSION 13 (LIVE IN-PERSON)

Advanced process management

- Inter-Process Communication (IPC)
- Process Synchronization and Deadlocks
- Implementing Process Scheduling Algorithms in Unix/Linux

File Systems

SESSION 14 (LIVE IN-PERSON)

Unix kernel Architecture And Boot Process

- Kernel Architecture in Unix/Linux
- Understanding the Boot Process
- Kernel Modules and Device Drivers
- System Calls and Kernel Space vs User Space

SESSION 15 (LIVE IN-PERSON)

Multithreading and Concurrent Programming

- Introduction to Threads, Fibers, Coroutines, and Multi-threading
- Thread Management and Synchronization in Unix/Linux
- Concurrent Programming Challenges and Patterns

SESSION 16 (LIVE IN-PERSON)

Device Mapping and /proc Filesystem

- Understanding Device Files in Unix/Linux
- Exploring the /proc Filesystem
- Mapping and Managing Devices in Unix/Linux

- Practical Exercises with /proc

SESSION 17 (LIVE IN-PERSON)

Bash programming

- Basics of Bash Scripting
- Automating Tasks with Bash Scripts
- Advanced Bash Scripting Techniques

SESSION 18 (LIVE IN-PERSON)

Networking

- Overview of the module and Key Objectives
- Basic Concepts of Computer Networking
- History of the Internet: From ARPANET to the World Wide Web
- Evolution of Networking Technologies and Protocols

SESSION 19 (LIVE IN-PERSON)

OSI Model and TCP/IP Basics

- Understanding the OSI Model: Layers and Functions
- Introduction to TCP/IP Model
- Comparison between OSI and TCP/IP Models
- Basic Networking Protocols and Their Roles

SESSION 20 (LIVE IN-PERSON)

Understanding Ports and Port Management

- Introduction to IP Addressing
- Differences between IPv4 and IPv6
- Addressing Schemes and Subnetting
- Transition Strategies from IPv4 to IPv6

SESSION 21 (LIVE IN-PERSON)

TCP/IP and UDP

- Deep Dive into TCP (Transmission Control Protocol)
- Understanding UDP (User Datagram Protocol)
- Differences and Use-Cases of TCP vs UDP
- 04 Practical Examples and Applications

SESSION 22 (LIVE IN-PERSON)

NAT, DNAT, DNS, and DynDNS

- Network Address Translation (NAT) and Dynamic NAT (DNAT)
- Understanding DNS (Domain Name System)
- Dynamic DNS (DynDNS) and its Applications

- Configuring and Troubleshooting DNS

Exam. Mid term . Closed Book.

SESSION 23 (LIVE IN-PERSON)

Understanding Ports and Port Management

- Overview of Network, Ports and Their Importance
- Common Ports: SSH (22) HTTP (80) and Others
- Reserved Ports and Their Uses
- Port Forwarding and Security Implications

SESSION 24 (LIVE IN-PERSON)

Secure Networking, HTTPS and Security Practices

- Basics of HTTPS and SSL/TLS
- Implementing Secure Web Communication
- Best Practices for Network Security
- Port Forwarding and Security Implications

SESSION 25 (LIVE IN-PERSON)

Network Scanning and Analysis with Nmap and Wireshark

- Introduction to Nmap (Network Mapper)
- Basic and Advanced Scanning Techniques
- Network Discovery and Security Auditing with Nmap
- Using Nmap in Various Scenarios

SESSION 26 (LIVE IN-PERSON)

Lab Session 1 (Computer architecture)

SESSION 27 (LIVE IN-PERSON)

Lab session 2 (Operating system installation)

SESSION 28 (LIVE IN-PERSON)

Lab session 3 (networking configuration)

SESSION 29 (LIVE IN-PERSON)

Mid term exam

SESSION 30 (LIVE IN-PERSON)

Group presentations

SESSION 31 (LIVE IN-PERSON)

Group presentations

SESSION 32 (LIVE IN-PERSON)

Global course review

SESSION 33 (LIVE IN-PERSON)

Final Exam

EVALUATION CRITERIA

criteria	percentage	Learning Objectives	Comments
Final Exam	30 %		
Individual presentation	15 %		
Group Presentation	15 %		
Class Participation	10 %		
Intermediate tests	30 %		

RE-SIT / RE-TAKE POLICY

Each student has four chances to pass any given course distributed over two consecutive academic years: ordinary call exams and extraordinary call exams (re-sits) in June/July.

Students who do not comply with the 80% attendance rule during the semester will fail both calls for this Academic Year (ordinary and extraordinary) and have to re-take the course (i.e., re-enroll) in the next Academic Year.

Evaluation criteria:

Students failing the course in the ordinary call (during the semester) will have to re-sit the exam in June / July (except those not complying with the attendance rule, who will not have that opportunity and must directly re-enroll in the course on the next Academic Year).
The extraordinary call exams in June / July (re-sits) require your physical presence at the campus you are enrolled in (Segovia or Madrid). There is no possibility to change the date, location or format of any exam, under any circumstances. Dates and location of the June / July re-sit exams will be posted in advance. Please take this into consideration when planning your summer.
The June / July re-sit exam will consist of a comprehensive exam. Your final grade for the course will depend on the performance in this exam only; continuous evaluation over the semester will not be taken into consideration. Students will have to achieve the minimum passing grade of 5 and can obtain a maximum grade of 8.0 (out of 10.0) – i.e., “notable” in the in the re-sit exam.
Retakers: Students who failed the subject on a previous Academic Year and are now re-enrolled as re-takers in a course will be needed to check the syllabus of the assigned professor, as well as contact the professor individually, regarding the specific evaluation criteria for them as retakers in the course during that semester (ordinary call of that Academic Year). The maximum grade that may be obtained in the retake exam (3rd call) is 10.0.
After ordinary and extraordinary call exams are graded by the professor, you will have a possibility to attend a review session for that exam and course grade. Please be available to attend the session in order to clarify any concerns you might have regarding your exam. Your professor will inform you about the time and place of the review session. Any grade appeals require that the student attended the review session prior to appealing.

Students failing more than 18 ECTS credits in the academic year after the June-July re-sits will be asked to leave the Program. Please, make sure to prepare yourself well for the exams in order to pass your failed subjects.
In case you decide to skip the opportunity to re-sit for an exam during the June / July extraordinary call, you will need to enroll in that course again for the next Academic Year as a re-taker and pay the corresponding extra cost. As you know, students have a total of four allowed calls to pass a given subject or course, in order to remain in the program.

BEHAVIOR RULES

Please, check the University's Code of Conduct here. The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy here. The Program Director may provide further indications.

ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.