Course guide
270018 - AC - Computer Architecture

Last modified: 30/01/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE FRANCISCO LLOSA ESPUNY

Others:

Primer quadrimestre:
JOSE FRANCISCO LLOSA ESPUNY - 11, 13
MIQUEL MORETÓ PLANAS - 11, 13
FERMIN SÁNCHEZ CARRACEDO - 41, 42

Segon quadrimestre:
CARLOS ALVAREZ MARTINEZ - 33
RAMON CANAL CORRETGER - 33
ANTONIO JUAN HORMIGO - 13, 14
JOSE FRANCISCO LLOSA ESPUNY - 11, 12, 13, 14
FERMIN SÁNCHEZ CARRACEDO - 11, 12

PRIOR SKILLS

Students are expected to have an understanding of statistics and probability, operating systems, digital circuits and computer organization.

REQUIREMENTS

- Prerequisite EC
- Pre-Corequisite PE
- Prerequisite SO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CT2.3. To design, develop, select and evaluate computer applications, systems and services and, at the same time, ensure its reliability, security and quality in function of ethical principles and the current legislation and normative.
CT2.4. To demonstrate knowledge and capacity to apply the needed tools for storage, processing and access to the information system, even if they are web-based systems.
CT3.6. To demonstrate knowledge about the ethical dimension of the company: in general, the social and corporative responsibility and, concretely, the civil and professional responsibilities of the informatics engineer.
CT5.2. To know, design and use efficiently the most adequate data types and data structures to solve a problem.
CT6.2. To demonstrate knowledge, comprehension and capacity to evaluate the structure and architecture of computers, and the basic components that compound them.
CT7.1. To demonstrate knowledge about metrics of quality and be able to use them.
CT7.2. To evaluate hardware/software systems in function of a determined criteria of quality.
CT7.3. To determine the factors that affect negatively the security and reliability of a hardware/software system, and minimize its effects.
CT8.1. To identify current and emerging technologies and evaluate if they are applicable, to satisfy the users needs.
CT8.4. To elaborate the list of technical conditions for a computers installation fulfilling all the current standards and normative.

Generical:
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

TEACHING METHODOLOGY

Theory lectures interleaved with small problems. In the theory classes homework will be assigned to students for the next practice class.

Problem-solving classes are based on group activities. Using problems solved individually at home, students will work together in small groups to resolve the doubts that may have emerged. Because the methodology used in practice classes it is recommended that students do not enroll to courses that overlap with this one.

The laboratory classes support the theory. Students have the documentation available before each practice session. It is mandatory that students prepare the session beforehand (read the documentation, study the concepts used, etc.). It is also recommended, once the session ends, to review the concepts seen. Students have to prepare a preliminary work that will be delivered at the beginning of each session. The lab sessions are performed on-site and used to produce the lab grade, so it is essential that there is no overlap of the laboratory with any other course.

LEARNING OBJECTIVES OF THE SUBJECT

1.Students shuldbe able to translate routines and high-level code fragments to assembly of a real machine (IA32) and link routines in assembler with a high-level language (C) using the Linux Application Binary Interface
2.Students should be able to describe the internal structure and operation of the main components of the memory hierarchy and the techniques to improve their performance.
3.Students should be able to describe the operation and to use the main mechanisms for error detection and correction.
4.Students should be able to describe the structure and operation of data storage systems and evaluate their reliability.
5.Students should be able to describe the taxonomy of instruction sets □□(ISA) and the characteristics of the different paradigms (such as RISC-CISC).
6.Students should be able to describe the techniques used in computer design based on parallelism (such as pipelining, superscalar processors, VLIW processors, vector SIMD extensions, multithreading processors, multiprocessors and multicomputers) and their principles of operation.
7.Students should be able to evaluate the performance of code fragments and/or applications (both in assembler and high level) taking into account components such as: memory hierarchy, storage systems, instruction set architecture (ISA) and the main processor design techniques based on parallelism.
8.Students should be able to assess the impact on power and energy consumption of code fragments and/or applications (in both assembler and high level) taking into account components such as: memory hierarchy, storage systems, the design of the instruction set architecture (ISA) and the main processor design techniques based on parallelism.
9.Students should be able to apply simple optimizations to code fragments to improve their performance and/or power consumption taking into account: the memory hierarchy, storage systems, the design of the instruction set architecture (ISA) and the main processor design techniques based on parallelism.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	84,0	56.00
Hours large group	30,0	20.00
Guided activities	6,0	4.00
Hours medium group	15,0	10.00

Total learning time: 150 h

CONTENTS

Fundamentals of computer design and evaluation

High-level / assembler language interface

Memory Hierarchy

Storage Systems

Instruction Set Architecture Design

Pipelining and parallelism in computer design

ACTIVITIES

C1

Specific objectives:
1, 2, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 5h
Guided activities: 2h
Self study: 3h

Fundamentals of computer design and evaluation

Specific objectives:
7, 8

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 15h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study: 7h

C2

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 10h
Guided activities: 3h
Self study: 7h

High-level/assembly language interface

Specific objectives:
1, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 32h
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 5h
Self study: 20h

Memory Hierarchy

Specific objectives:
2, 3, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 48h
Theory classes: 10h
Practical classes: 5h
Laboratory classes: 5h
Self study: 28h

Storage Systems

Specific objectives:
3, 4, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 1h
Laboratory classes: 1h
Self study: 6h

Instruction set design

Specific objectives:
5, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 8h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Self study: 4h

Pipelining and parallelism in computer design

Specific objectives:
6, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 11h
Theory classes: 3h
Practical classes: 1h
Laboratory classes: 1h
Self study: 6h

Visita Supercomputador Marenostrum

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 3h
Guided activities: 2h
Self study: 1h

Documental "The E-Waste Tragedy" + debat

Full-or-part-time: 3h
Guided activities: 2h
Self study: 1h

Computer Engineering/Architecture Computers

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9

Related competencies :
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

Full-or-part-time: 3h
Guided activities: 2h
Self study: 1h

GRADING SYSTEM

The course grade is based on the two tests (C1 and C2), the laboratory grade (LAB) and the practice class activity (AP).

The final grade (NF) is calculated (with a single decimal and rounded to nearest even) as:
NF = 0,3*C1 + 0,4*C2 + 0,2* LAB + 0,1* AP

Students can only be evaluated of LAB and AP if they ATTEND THE GROUP where THEY ARE ENROLLED.

BIBLIOGRAPHY

Basic:
- Hennessy, John L.; Patterson, D. Computer architecture: a quantitative approach. 6th ed. Elsevier, Morgan Kaufmann, 2019. ISBN 9780128119051.

Complementary:
- Bryant, R.E.; O'Hallaron, D.R. Computer systems: a programmer's perspective. 3rd ed. Pearson, 2016. ISBN 9781292101767.
- Patterson, D.A.; Hennessy, J. L. Computer organization and design: the hardware/software interface. 5th ed. Elsevier Morgan Kaufmann, 2014. ISBN 9780124077263.