UNIVERSIDAD DE CASTILLA - LA MANCHA
GUÍA DOCENTE

1. General information

Course: COMPUTER ARCHITECTURE

Type: CORE COURSE

Degree: 406 - UNDERGRADUATE DEGREE IN COMPUTER SCIENCE AND ENGINEERING (AB)

Center: 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)

Year: 3

Main language: Spanish

Use of additional languages:

Web site:

Code: 42323

ECTS credits: 6

Academic year: 2023-24

Group(s): 10 11 12

Duration: First semester

Second language: English

English Friendly: N

Bilingual: Y

Lecturer: AURELIO BERMUDEZ MARIN - Group(s): 12

Building/Office	Department	Phone number	Email	Office hours
Agrupación Politécnica / 1.D.4	SISTEMAS INFORMÁTICOS	926052984	aurelio.bermudez@uclm.es	It will be made available on the web pages of the Computer Science Department and ESII. https://www.esiiab.uclm.es/tutorias.php. Upon request.

Lecturer: Mª DEL CARMEN CARRION ESPINOSA - Group(s): 10 11 12

Building/Office	Department	Phone number	Email	Office hours
ESCUELA SUPERIOR DE INGENIERIA INFORMATICA - 0.A.9	SISTEMAS INFORMÁTICOS	2414	carmen.carrion@uclm.es	It will be made available on the web pages of the Computer Science Department and ESII. https://www.esiiab.uclm.es/tutorias.php. Upon request.

Lecturer: FRANCISCO JOSE QUILES FLOR - Group(s): 10 11 12

Building/Office	Department	Phone number	Email	Office hours
ESII / 1.C.7	SISTEMAS INFORMÁTICOS	967599298	francisco.quiles@uclm.es	It will be made available on the web pages of the Computer Science Department and ESII. https://www.esiiab.uclm.es/tutorias.php. Upon request.

Lecturer: LUIS RODA SÁNCHEZ - Group(s): 10 11

Building/Office	Department	Phone number	Email	Office hours
	SISTEMAS INFORMÁTICOS		Luis.Roda@uclm.es	

2. Pre-Requisites

To successfully follow this course, you need to know the basic operation of a computer. It is also advisable understanding the operation and the problems of pipelining, and be able to write asembler programs. In particular, we assume that you are familiarized with the DLX/MIPS architecture.

If you do not control these concepts and skills, you will need an extra effort to follow the course. You should revise the contents of both the 'Computer Structure' (1st year) and the 'Computer Organization' (2nd year) courses. The book from Patterson & Hennessy (included in the bibliography) is also a good source to achieve these previous knowledges.

3. Justification in the curriculum, relation to other subjects and to the profession

This course is part of the 'Computing Engineering' subject in included the degree programme. The course revises the architectural concepts present in most of the modern computers, from a laptop to a big internet server, and underlies the next courses: 'Advanced Computers', 'Operating Systems II', 'Design of Microprocessor-based Systems', and 'Computing Systems Integration'.

Regarding to your profession, the knowledge acquired in the course will ease the task of selecting the most suitable computer system for a client. Also, you will acquire basic knowledge for working in the computer design industry.

4. Degree competences achieved in this course

Course competences

Code	Description
CO01	Ability to design, develop, select, and assess, applications and digital systems, guaranteeing their reliability, security, and quality, according to ethical principles and the current and common laws.
CO08	Ability to analyse, design, build and maintain applications in a strong, safe, and efficient manner by selecting the most appropriate paradigms and programming languages.
CO09	Ability to know, understand, and assess the structure and architecture of computers, and their basic components.
INS01	Analysis, synthesis, and assessment skills.
PER02	Ability to work in multidisciplinary teams.
PER04	Interpersonal relationship skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Understanding of the principles of computer architecture.

Identification of main types of architectures.

Knowledge of the structure of a CPU, identification of its functioning units, and explanation of their role in the execution of instructions.

Knowledge and identification of parallelism at instruction level throughout pipelining and problems linked to it.

Knowledge of assessment techniques for computer performance.

Additional outcomes

Providing additional sources of information for a particular topic. This learning outcome is related to the INS3 degree competence.

Identifying the architecture most appropriate for a specific computing application.

Identifying different types of current parallel computers that exploit parallelism beyond ILP (instruction-level parallelism).

Summarizing the information obtained from the Internet and from the bibliographic sources.

6. Units / Contents

Unit 1: Introduction
    Unit 1.1 Computer architecture
    Unit 1.2 Performance
    Unit 1.3 Classes of computers

Unit 2: Instruction-Level Parallelism
    Unit 2.1 Pipelining basics
    Unit 2.2 Reducing stalls
    Unit 2.3 Study of dependences

Unit 3: Code Scheduling
    Unit 3.1 Static scheduling
    Unit 3.2 Dynamic scheduling

Unit 4: Branch Handling
    Unit 4.1 Introduction
    Unit 4.2 Branch prediction
    Unit 4.3 Other approaches

Unit 5: Speculation
    Unit 5.1 Introduction
    Unit 5.2 Software speculation
    Unit 5.3 Hardware speculation

Unit 6: Multiple-issue Processors
    Unit 6.1 Introduction
    Unit 6.2 VLIW
    Unit 6.3 Superescalar processors
    Unit 6.4 Examples

Unit 7: Current Processors
    Unit 7.1 Introduction
    Unit 7.2 Intel microarquitectures
    Unit 7.3 AMD processors
    Unit 7.4 Evolution Intel vs AMD
    Unit 7.5 PowerPC processors
    Unit 7.6 Alpha processors
    Unit 7.7 ARM processors
    Unit 7.8 Multicore processors
    Unit 7.9 GPU

Unit 8: Introduction to Parallel Computers
    Unit 8.1 Introduction
    Unit 8.2 The need for parallel computers
    Unit 8.3 Classification

ADDITIONAL COMMENTS, REMARKS

The final structure of these units could undergo slight modifications.

Theoretical contents are complemented by several problem lists and the following lab assignments:
Lab 1. Performance evaluation
Lab 2. Pipeline hazards
Lab 3. Static code scheduling
Lab 4. Dynamic code scheduling
Lab 5. Dynamic scheduling with speculation and superscalars
Lab 6. Superscalars and VLIW processors

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CO01 CO08 CO09	1.38	34.5	Y	N	
Class Attendance (theory) [ON-SITE]	Problem solving and exercises	CO01 CO08 CO09 PER04	0.42	10.5	Y	N	Classroom participation, through problem solving, quizzes, etc.

					As	Com	
Laboratory practice or sessions [ON-SITE]	Work with simulators	CO01 CO08 CO09 PER04	0.36	9	Y	N	Working in groups with simulators. The evaluable training activities will be recovered in the non-continuous modality by means of a test including all the lab sessions, either in the ordinary or extraordinary calls.
Group tutoring sessions [ON-SITE]	Guided or supervised work	CO01 CO08 CO09 INS01 PER02 PER04	0.06	1.5	Y	N	Supervision / monitoring of final course projects in the classroom. The evaluable training activity will be recovered in the non-continuous modality through the presentation of an equivalent work either in the ordinary or extraordinary call.
Project or Topic Presentations [ON-SITE]	Assessment tests	CO01 CO08 CO09 INS01 PER02 PER04	0.12	3	Y	N	Final course project presentations in the classroom. The evaluable training activity will be recovered in the non-continuous modality through the presentation of an equivalent work either in the ordinary or extraordinary call.
Final test [ON-SITE]		CO01 CO08 CO09	0.06	1.5	Y	Y	Written exam, composed of multiple choice questions and several problems.
Study and Exam Preparation [OFF-SITE]	Self-study	CO01 CO08 CO09	2.08	52	Y	N	
Writing of reports or projects [OFF-SITE]	Cooperative / Collaborative Learning	CO01 CO08 CO09 INS01 PER02 PER04	0.64	16	Y	Y	Final course project preparation
Practicum and practical activities report writing or preparation [OFF-SITE]	Cooperative / Collaborative Learning	CO01 CO08 CO09 PER04	0.88	22	Y	N	Completion of the tasks indicated in the lab assignments and preparation of the lab quizzes (which will be carried out individually at the lab)
Total:			**6**	**150**			
Total credits of in-class work: 2.4							**Total class time hours: 60**
Total credits of out of class work: 3.6							**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Laboratory sessions	20.00%	20.00%	The work in the laboratory will be assessed by means of several quizzes in Campus Virtual, which will be carried out individually, and after the completion of each lab assignment. In the non-continuous evaluation, there will be a final lab quiz. Corresponds to the "LAB" category of the degree memory.
Progress Tests	10.00%	10.00%	Quizzes in Campus Virtual at the end of each unit, which will be carried out individually. In the non-continuous evaluation, a similar quiz will take place, but including all the units. Corresponds to the "ESC" category of the degree memory.
Assessment of active participation	10.00%	0.00%	Classroom activities (either collaborative or individual). Corresponds to the "PRES" category of the degree memory.
Final test	40.00%	50.00%	There will be a single final exam (written and individual), on the date of the ordinary call and on the date of the extraordinary call. To overcome it, a minimum grade will be required (4 out of 10). Corresponds to the "ESC" category of the degree memory.
Theoretical papers assessment	20.00%	20.00%	Elaboration (10%) and oral presentation (10%) of a group project related to Unit 7. To overcome it, a minimum grade will be required (3 out of 10). Corresponds to the categories "INF" (10%) and "PRES" (10%) of the degree memory.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:
  Continuous assessment:

Plagiarism in a deliverable will cause its immediate cancellation. The source of all the material included in each deliverable must be explicitly indicated by the students.

In both the regular and the extra exam session, if the student does not obtain a mark greater that a mininum in the final written exam, they will get a final mark lower than 4.00 points, even in the case where the global mark is greater than 5.00 points.

Taking any face-to-face evaluation test remotely (without prior agreement with the professor), will result in the corresponding disciplinary procedure.

Any student may change to the non-continuous evaluation modality as long as he/she has not participated in evaluable activities that together account for more than 50% of the total evaluation of the subject. If a student has reached 50% of evaluable activities, he/she will be considered in continuous evaluation without the possibility of changing evaluation mode.

By default, the student will be evaluated by continuous evaluation. If you wish to change to non-continuous evaluation, you must indicate it to the professors and through the following link: https://www.esiiab.uclm.es/alumnos/evaluacion.php before the end of the academic period of the semester.

Non-continuous evaluation:
Plagiarism in a deliverable will cause its immediate cancellation. The source of all the material included in each deliverable must be explicitly indicated by the students.

In both the regular and the extra exam session, if the student does not obtain a mark greater that a mininum in the final written exam, they will get a final mark lower than 4.00 points, even in the case where the global mark is greater than 5.00 points.

Taking any face-to-face evaluation test remotely (without prior agreement with the professor), will result in the corresponding disciplinary procedure.

Any student may change to the non-continuous evaluation modality as long as he/she has not participated in evaluable activities that together account for more than 50% of the total evaluation of the course. If a student has reached 50% of evaluable activities, he/she will be considered in continuous evaluation without the possibility of changing evaluation mode.

By default, the student will be evaluated by continuous evaluation. If you wish to change to non-continuous evaluation, you must indicate it to the professors and through the following link: https://www.esiiab.uclm.es/alumnos/evaluacion.php before the end of the academic period of the semester.

Specifications for the resit/retake exam:
In the extra exam session, the student will be assesed according to the same criteria used in the ordinary evaluation.

Specifications for the second resit / retake exam:
In this exam session, the student will be assesed according to the same criteria used in the ordinary evaluation.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Final test [PRESENCIAL][]	1.5

General comments about the planning: This course schedule is APPROXIMATE. It could vary throughout the academic year due to teaching needs, bank holidays, etc. A weekly schedule will be properly detailed and updated on the online platform (Campus Virtual). As a general rule, the course is taught in three weekly sessions of 1.5 hours each. Note that all the lectures, practice sessions, exams and related activities performed in the bilingual groups will be entirely taught in English.

Unit 1 (de 8): Introduction

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	1.5
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	3

Teaching period: Weeks 3-4

Unit 2 (de 8): Instruction-Level Parallelism

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	1.5
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	3

Teaching period: Weeks 4-6

Unit 3 (de 8): Code Scheduling

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	7.5
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	3
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	8

Teaching period: Weeks 5-8

Unit 4 (de 8): Branch Handling

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	7

Teaching period: Weeks 8-9

Unit 5 (de 8): Speculation

Activities	Hours

Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	1.5
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	4

Teaching period: Weeks 10-11

Unit 6 (de 8): Multiple-issue Processors

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	1.5
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	4

Teaching period: Weeks 11-13

Unit 7 (de 8): Current Processors

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Group tutoring sessions [PRESENCIAL][Guided or supervised work]	1.5
Project or Topic Presentations [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Writing of reports or projects [AUTÓNOMA][Cooperative / Collaborative Learning]	16

Teaching period: Weeks 12-15

Unit 8 (de 8): Introduction to Parallel Computers

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	6

Teaching period: Weeks 14-15

Global activity

Activities	hours
Writing of reports or projects [AUTÓNOMA][Cooperative / Collaborative Learning]	16
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	22
Final test [PRESENCIAL][]	1.5
Class Attendance (theory) [PRESENCIAL][Problem solving and exercises]	10.5
Laboratory practice or sessions [PRESENCIAL][Work with simulators]	9
Group tutoring sessions [PRESENCIAL][Guided or supervised work]	1.5
Project or Topic Presentations [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	52
Class Attendance (theory) [PRESENCIAL][Lectures]	34.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
David A. Patterson, John L. Hennessy	Estructura y diseño de computadores: la interfaz software / hardware (4ª edición original)	Reverté			2011	
John L. Hennessy, David A. Patterson	Computer architecture: a quantitative approach (5th Edition)	Morgan Kaufmann		978-0-12-383872-8	2012	
John L. Hennessy, David A. Patterson	Computer architecture: a quantitative approach (4th Edition)	Morgan Kaufmann			2006	
Julio Ortega, Mancia Anguita, Alberto Prieto	Arquitectura de computadores	Thomson			2006	
John L. Hennessy, David A. Patterson	Computer architecture: a quantitative approach (6th Edition)	Morgan Kaufmann		9780128119051	2017	
David A. Patterson, John L. Hennessy	Computer organization and design: the hardware-software interface (4th Edition)	Morgan Kaufmann			2009	