UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: COMPUTER ARCHITECTURE
Code: 42323
Type: CORE COURSE
ECTS credits: 6
Degree: 406 - UNDERGRADUATE DEGREE IN COMPUTER SCIENCE AND ENGINEERING (AB)
Academic year: 2022-23
Center: 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)
Group(s): 10 11 12
Year: 3
Duration: First quarter
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: N
Web site: http://campusvirtual.uclm.es/
Bilingual: Y

Lecturer: **AURELIO BERMUDEZ MARIN** - Group(s): **10 11 12**

Building/Office	Department	Phone number	Email	Office hours
Agrupación Politécnica / 1.D.4	SISTEMAS INFORMÁTICOS	926052984	aurelio.bermudez@uclm.es	They will be published in the DSI and ESII web sites

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

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ESCUELA SUPERIOR DE INGENIERIA INFORMATICA - 0.A.9	SISTEMAS INFORMÁTICOS	2414	carmen.carrion@uclm.es	They will be published in the DSI and ESII web sites. Upon request.

Lecturer: **JESÚS ESCUDERO SAHUQUILLO** - Group(s): **12**

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ESII / 1.C.4	SISTEMAS INFORMÁTICOS	926053203	Jesus.Escudero@uclm.es	They will be published in the DSI and ESII web sites

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

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ESII / 1.C.7	SISTEMAS INFORMÁTICOS	2466	francisco.quiles@uclm.es	They will be published in the DSI and ESII web sites

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

Identification of main types of architectures.

Knowledge of assessment techniques for computer performance.

Knowledge and identification of parallelism at instruction level throughout pipelining and problems linked to it.
Understanding of the principles of computer architecture.
Knowledge of the structure of a CPU, identification of its functioning units, and explanation of their role in the execution of instructions.

Additional outcomes

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

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	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. The evaluable training activities will be recovered in the non-continuous modality through the presentation of the resolution of exercises and problems either in the ordinary or extraordinary calls.

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	N	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%	10.00%	Classroom activities (either collaborative or individual). In the non-continuous evaluation, there will be a final test about the activities performed at the classroom. Corresponds to the "PRES" category of the degree memory.
Final test	40.00%	40.00%	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. Corresponds to the categories "INF" (10%) and "PRES" (10%) of the degree memory.
Total:	**100.00%**	**100.00%**	

According to art. 6 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. 13.2) 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	Computer organization and design: the hardware-software interface (4th Edition)	Morgan Kaufmann			2009	
David A. Patterson, John L. Hennessy	Estructura y diseño de computadores: la interfaz software / hardware (4ª edición original)	Reverté			2011	
Hennessy, John L.	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 Hennessy, David Patterson	Computer architecture: a quantitative approach (6th Edition)	Morgan Kaufmann		9780128119051	2017	