UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: COMPUTER ARCHITECTURE
Code: 42323
Type: CORE COURSE
ECTS credits: 6
Degree: 346 - DEGREE IN COMPUTER SCIENCE AND ENGINEERING
Academic year: 2019-20
Center: 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)
Group(s): 10 11 12
Year: 3
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: N
Web site:
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	Se publicará en las páginas web del DSI y de la ESII.

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	Se publicará en las páginas web del Departamento de Sistemas Informáticos y de la ESII. Upon request.

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

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ESII / 1.C.7	SISTEMAS INFORMÁTICOS	967599298	francisco.quiles@uclm.es	Se publicará en las páginas web del Departamento de Sistemas Informáticos y de la ESII.

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' and the 'Computer Organization' 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 takes part of the 'Computing Engineering' subject of 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'.

In regards to your profession, the knowledges 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
CO1	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.
CO8	Ability to analyse, design, build and maintain applications in a strong, safe, and efficient manner by selecting the most appropriate paradigms and programming languages.
CO9	Ability to know, understand, and assess the structure and architecture of computers, and their basic components.
INS1	Analysis, synthesis, and assessment skills.
PER2	Ability to work in multidisciplinary teams.
PER4	Interpersonal relationship skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Understanding of the principles of computer architecture.

Knowledge of assessment techniques for computer performance.

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 paralelisms at instruction level trhoughout segmentation and problems linked to it.

Additional outcomes

Providing additional sources of information for a particular topic. This learning outcome is related to the INS3 degree competence.
Summarizing the information obtained from the Internet and from the bibliographic sources.
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 (only degrees before RD 822/2021)	ECTS	Hours	As	Com	R	Description
Class Attendance (theory) [ON-SITE]	Lectures	CO1 CO8 CO9	1.38	34.5	Y	N	N	
Class Attendance (theory) [ON-SITE]	Problem solving and exercises	CO1 CO8 CO9 PER4	0.42	10.5	Y	N	N	Classroom participation, through problem solving, quizzes, etc.
Laboratory practice or sessions [ON-SITE]	Work with simulators	CO1 CO8 CO9 PER4	0.36	9	Y	N	N	Group work with simulators
Group tutoring sessions [ON-SITE]	Guided or supervised work	CO1 CO8 CO9 INS1 PER2 PER4	0.06	1.5	Y	N	N	Supervision / monitoring of final course projects in the classroom
Project or Topic Presentations [ON-SITE]	Assessment tests	CO1 CO8 CO9 INS1 PER2 PER4	0.12	3	Y	N	N	Final course project presentations in the classroom
Final test [ON-SITE]		CO1 CO8 CO9	0.06	1.5	Y	Y	Y	Written exam, composed of multiple choice questions and

								several problems
Study and Exam Preparation [OFF-SITE]	Self-study	CO1 CO8 CO9	1.76	44	Y	N	N	
Writing of reports or projects [OFF-SITE]	Cooperative / Collaborative Learning	CO1 CO8 CO9 INS1 PER2 PER4	0.64	16	Y	N	N	Final course project preparation
Practicum and practical activities report writing or preparation [OFF-SITE]	Cooperative / Collaborative Learning	CO1 CO8 CO9 PER4	0.88	22	Y	N	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)
On-line Activities [OFF-SITE]	Assessment tests	CO1 CO8 CO9	0.32	8	Y	N	N	Individual (and out of the classroom) resolution of online quizzes, at the end of each unit
		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
R: Rescheduling training activity

8. Evaluation criteria and Grading System

	Grading System		
Evaluation System	**Face-to-Face**	**Self-Study Student**	**Description**
Laboratory sessions	20.00%	0.00%	The work in the laboratory will be assessed by means of several quizzes in Campus Virtual, which will be carried out individually at the lab, and after the completion of each lab assignment. Corresponds to the "LAB" category of the degree memory.
Progress Tests	10.00%	0.00%	Quizzes in Campus Virtual at the end of each unit, which will be carried out individually and out of the classroom. 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%	0.00%	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. Corresponds to the "ESC" category of the degree memory.
Theoretical papers assessment	20.00%	0.00%	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%**	**0.00%**	

Evaluation criteria for the final exam:

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.

Specifications for the resit/retake exam:

In the extra exam session, all the learning activities marked as "R" in the table above will be assessed again.

Specifications for the second resit / retake exam:

In this exam session, all the learning activities marked as "R" in the table above will be assessed again.

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). Course activities will begin during the third week of the semester (starting at September 23). As a general rule, the course is taught in three weekly sessions of 1.5 hours each. Although the course is taught in the morning, some assessment or recovery activities could be scheduled exceptionally during the evening (from 16h to 20:30h). 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]	5
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	3
On-line Activities [AUTÓNOMA][Assessment tests]	1

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]	5
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	3
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	6
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	8
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	6
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	6
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	4
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	6
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	4
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	5
Writing of reports or projects [AUTÓNOMA][Cooperative / Collaborative Learning]	16
On-line Activities [AUTÓNOMA][Assessment tests]	1
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]	5
On-line Activities [AUTÓNOMA][Assessment tests]	1
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
On-line Activities [AUTÓNOMA][Assessment tests]	8
Final test [PRESENCIAL][]	1.5
Class Attendance (theory) [PRESENCIAL][Lectures]	34.5
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]	44
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	