Course guide
270060 - AC2 - Computer Architecture II

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Optional subject).
Academic year: 2022 ECTS Credits: 6.0 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: RAMON CANAL CORRETGER
Others: Primer quadrimestre:
RAMON CANAL CORRETGER - 10
MIQUEL MORETÓ PLANAS - 10

PRIOR SKILLS


REQUIREMENTS

- Prerequisite AC

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEC1.1. To design a system based on microprocessor/microcontroller.
CEC1.2. To design/configure an integrated circuit using the adequate software tools.
CEC2.1. To analyse, evaluate, select and configure hardware platforms for the development and execution of computer applications and services.
CEC3.2. To develop specific processors and embedded systems; to develop and optimize the software of these systems.
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.

General:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

TEACHING METHODOLOGY

In the theory classes expose the concepts of the course with student participation.
The exercise classes the students apply the theoretical concepts in solving exercises.
In laboratory classes students work in small groups and apply the concepts on a simple pipelined processor.
LEARNING OBJECTIVES OF THE SUBJECT

1. Understanding concurrency techniques transparent to the programmer of machine language used by processors to reduce the execution time.
2. Understand some of the technological constraints in the implementation of a processor.
3. Knowledge of a hardware description language (VHDL) and application in the design of digital systems.
4. Training to assess the performance of a processor.
6. Basic understanding of the processor microarchitecture.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**Von-Neumann architecture and performance.**

Description:

**Techniques to increase the number of operations per unit time.**

Description:
Pipelining and replication. Interpretation of instructions. Structural hazards.

**Linear pipeline processor.**

Description:

**Techniques to reduce and tolerate the pipeline effective latency.**

Description:
Static instruction scheduling. Data bypasses. Fixed branch prediction.

**Pipeline with multicycle operations.**

Description:
### Design tools and simulation

**Description:**
Learning tools for specification and simulation of logic circuits. Review of the operation and basic characteristics of the components of a single-cycle datapath.

**Specific objectives:**
3

**Full-or-part-time:** 15h
- Laboratory classes: 6h
- Self study: 9h

### Von-Neumann machine and performance

**Description:**
Development of item 1 of the course

**Specific objectives:**
2, 4

**Related competencies:**
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

**Full-or-part-time:** 16h
- Theory classes: 4h
- Practical classes: 2h
- Self study: 10h

### Techniques to increase the number of operations per unit time

**Description:**
Development of item 2 of the course

**Specific objectives:**
1, 4, 6

**Related competencies:**
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

**Full-or-part-time:** 18h
- Theory classes: 5h
- Practical classes: 3h
- Self study: 10h
Linear pipeline processor

Description:
Development of item 3 of the course

Specific objectives:
1, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 28h
Theory classes: 7h
Practical classes: 3h
Laboratory classes: 4h
Self study: 14h

Partial Test

Specific objectives:
1, 2, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 10h
Guided activities: 2h
Self study: 8h

Techniques to reduce and tolerate pipeline effective latency

Description:
Development of item 4 of the course

Specific objectives:
1, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 30h
Theory classes: 7h
Practical classes: 4h
Laboratory classes: 5h
Self study: 14h
Processor with multicycle operations

Description: Development of item 5 of the course

Specific objectives: 1, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 19h
Theory classes: 5h
Practical classes: 3h
Self study: 11h

Consolidation

Description: Consolidation of concepts developed during the course

Specific objectives: 1, 2, 3, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 3h
Guided activities: 3h

Final Exam

Specific objectives: 1, 2, 3, 4, 6

Related competencies:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Full-or-part-time: 11h
Guided activities: 3h
Self study: 8h

GRADING SYSTEM

There are three elements:

Final (F): final written exam covering all the objectives of the course. Partial (P): written test on the first three topics. Lab (L) from the reports made in each of the sessions and, where appropriate, a personal interview.

NF = 0.2 \times L + \max[0.8 \times F, (0.65 \times F + 0.15 \times P)]
BIBLIOGRAPHY

Basic:

Complementary: