270062 - MP - Multiprocessors

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture
Academic year: 2019
Degree: BACHELOR’S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Spanish

Teaching staff

Coordinator: - Jose M. Llaberia Griñó (llaberia@ac.upc.edu)

Prior skills

The subjects listed in IC, EC, EP, AC, PAR, AC2

Requirements

- Prerequisite AC2
- Prerequisite PAR

Degree competences to which the subject contributes

Specific:
- 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.

Generical:
- G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

Teaching methodology

Classes theory in which concepts are developed and there is student participation.
Classes of problems which apply the concepts developed in the theory classes and is an active student.
Laboratory classes in which to apply the concepts developed in theory class a concrete example of multiprocessor. The active agent is pupils and collaboration between elements of the group is the means to increase and consolidate knowledge.
The course is developed constructively. In other words, is part of the concepts learned in previous courses in each subject and the subject of increased knowledge and ability to understand, analyze and reason about aspects of a multiprocessor. This training is more quantitative.

Learning objectives of the subject

1. Training to understand the basic concepts in multiprocessors: terminology, organization, elements of a Multiprocessor, consistency and coherence in memory.
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2. Training to understand the basic concepts of communication and synchronization in a multiprocessor.
3. Training to understand the constraints imposed by technology, through the operation of ideal solutions adopted and implemented in a multiprocessor.
4. Capacity to analyze and critically evaluate a multiprocessor and its elements.
5. Training for the use of a hardware description language and its application in the specification of elements of a Multiprocessor

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
## Motivation

**Degree competences to which the content contributes:**

**Description:**
Obstacles exist to exploit the parallelism at the level of instruction. Increased productivity of a multithreaded processor using the technique. Use the available number of transistors on a chip using the technique of replication of processors.

## Consistency and coherence of memory

**Degree competences to which the content contributes:**

**Description:**
Concepts of memory consistency and cache coherency. Memory model specified in the machine language. Need to maintain consistency among copies of data.

## Multiprocessor core

**Degree competences to which the content contributes:**

**Description:**

## Communication and synchronization

**Degree competences to which the content contributes:**

**Description:**
Support the machine language for communication and synchronization. Basic mechanisms of synchronization.

## Small-scale multiprocessor

**Degree competences to which the content contributes:**

**Description:**

## Scalable multiprocessor

**Degree competences to which the content contributes:**
Description:
Implications of the number of processors in a multiprocessor architecture. Interconnection of several chip multiprocessor.
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Description</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consolidation</strong></td>
<td>11h</td>
<td>Final exam. Evaluation of all the objectives of the course.</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test</strong></td>
<td>12h</td>
<td>Evaluation goal for the first three issues.</td>
<td>1, 4, 5</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td>12h</td>
<td>To study the theoretical concepts of the subject and resolve financial problems and proposed.</td>
<td>1, 4, 5</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Consistency and coherence of memory</strong></td>
<td>19h</td>
<td>To study the theoretical concepts of the subject and resolve financial problems and proposed.</td>
<td>1, 5</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Guided activities: 3h
Self study: 8h

Guided activities: 2h
Self study: 10h

Theory classes: 3h
Practical classes: 2h
Laboratory classes: 1h
Guided activities: 0h
Self study: 6h

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 3h
Guided activities: 0h
Self study: 10h
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### Multiprocessor core

<table>
<thead>
<tr>
<th>Hours: 29h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 16h</td>
</tr>
</tbody>
</table>

**Description:**
To study the theoretical concepts of the subject and resolve financial problems and proposed.

**Specific objectives:**
1, 4, 5

### Communication and synchronization

<table>
<thead>
<tr>
<th>Hours: 19h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>

**Description:**
To study the theoretical concepts of the subject and resolve financial problems and proposed.

**Specific objectives:**
2, 5

### Small-scale multiprocessor

<table>
<thead>
<tr>
<th>Hours: 27h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 14h</td>
</tr>
</tbody>
</table>

**Description:**
To study the theoretical concepts of the subject and resolve financial problems and proposed.

**Specific objectives:**
3, 5

### Scalable multiprocessor

<table>
<thead>
<tr>
<th>Hours: 15h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 0h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>
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**Description:**
To study the theoretical concepts of the subject and resolve financial problems and proposed.

**Specific objectives:**
3, 4

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**Consolidation**

**Hours:** 6h
- Theory classes: 0h
- Practical classes: 0h
- Laboratory classes: 0h
- Guided activities: 6h
- Self study: 0h

**Description:**
Consolidation of concepts developed during the course.

**Specific objectives:**
1, 2, 3, 4, 5

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**Qualification system**

Proof (P): Written test which evaluated the goal for the first three issues.
Final exam (F): Written test which evaluated all the objectives of the course.
Laboratory (L) is evaluated based on reports submitted in each of the sessions and, if appropriate, a personal interview.

The final (NF) is calculated using the following expression:

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

The level of achievement of generic competition evaluated indirectly from the notes of evidence and the final exam.

The corresponding note is:
- A if \(8.5 =< NF\)
- B if \(7 =< NF < 8.5\)
- C if \(5 =< NF < 7\)
- D if \(NF < 5\)

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**Bibliography**

**Basic:**