270066 - CASO - Advanced Concepts on Operating Systems

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: Catalan, Spanish

Teaching staff

Coordinator: - Xavier Martorell Bofill (xavim@ac.upc.edu)
Others: - Jordi Fornes De Juan (jfornes@ac.upc.edu)

Prior skills

- User-level Operating Systems
- Basic level on the internal structure of the operating system
- Programming languages C and C++
- Compile and link mechanisms
- Basic concepts of computer architecture

Requirements

- Pre-Corequisite SO2
- Pre-Corequisite SOA

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.
CEC2.3. To develop and analyse software for systems based on microprocessors and its interfaces with users and other devices.
CEC2.4. To design and implement system and communications software.
CEC2.5. To design and implement operating systems.
CEC3.1. To analyse, evaluate and select the most adequate hardware and software platform to support embedded and real-time applications.
CEC4.1. To design, deploy, administrate and manage computer networks.
CEC4.2. To demonstrate comprehension, to apply and manage the guarantee and security of computer systems.
CTI1.4. To select, design, deploy, integrate, evaluate, build, manage, exploit and maintain the hardware, software and network technologies, according to the adequate cost and quality parameters.
CTI3.4. To design communications software.

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.
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**Teaching methodology**

The teacher presents the topics proposed in the theory sessions, while open discussions among and with students on various topics. Each session includes the theory of motion of various topics related to the class, students work independently on his compte. Les lab follow the issues raised in the theory and serve to entrench the use and evaluation of abstractions and system services operatiu. Per to work in the competition for autonomous learning, the course will be 2 staff work activities related to the services offered by operating systems. The themes of the activities will be defined during the course. Will for example, the introduction of new system calls, the interacio between Android and Linux systems, add the OS services through libraries, performance evaluation system, etc...

**Learning objectives of the subject**

1. Working with the abstractions of the operating system
2. Analysis and evaluation of operating system abstractions
3. Use the operating system development tools
4. Know how to use the hardware support for the operating system
5. Use the techniques of performance evaluation of operating systems
6. Operating System Support for file systems
7. To know, know how to use and implement management devices within the operating system
8. Implement and evaluate support for real time
9. Implement and evaluate virtualization support
10. Use the operating system support for mobile devices
11. Manage facilities informatiques

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 30h</td>
<td>20.00%</td>
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<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 84h</td>
<td>56.00%</td>
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</tbody>
</table>
## Content

### OS Abstractions

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

**Description:**

This topic presents the abstractions operating systems offer the user level and applications: processes and flows, regions of memory, data storage and input / output device management. Comparisons are made between different abstractions offered as equivalent and determine which are most appropriate.

### Development tools for operating systems

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

**Description:**

It presents the tools needed to develop operating systems: compiler and linker, management protocols, etc..

### Hardware tools supporting the operating system

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

**Description:**

Basic tools provided by the hardware in order to implement operating systems.

### Synchronization Tools

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

**Description:**

Using the tools provided by the synchronization of hardware and operating system are provided as efficiently at the level of applications.

### Evaluation of performance of the operating system

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

**Description:**

To determine the overhead introduced by using the abstraction of the operating system and performance appraisal system.

### File Systems

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

Degree competences to which the content contributes:
Description:
Representation of devices within operating systems, treatment of the different devices: disk, network, user interaction.

Development of device drivers

Degree competences to which the content contributes:
Description:
Introduction of new management devices in the operating system

Operating system support for real time applications

Degree competences to which the content contributes:
Description:
Tools and libraries to support applications that respond in real time

Operating system support for virtualized environments

Degree competences to which the content contributes:
Description:
Deploying virtual machines with / without hardware support. Options for implementing virtual machines native and non-native (in physically different environments).

Operating System Support for Mobile Devices

Degree competences to which the content contributes:
Description:
We present the differences between a system desktop / laptop and operating system that supports mobile devices

Management of computer installation

Description:
Managing data in file systems and tools to support the integrity
Degree competences to which the content contributes:

Description:
Managing a facility computer science from the planning and purchase, installation, commissioning and maintenance
### Planning of activities

#### OS Abstractions

<table>
<thead>
<tr>
<th>Hours: 12h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

**Description:**
The student participates actively in the session, working group on the topics presented, and comparisons of the possible implementations.

**Specific objectives:**
1, 2

#### Development of Operating Systems

<table>
<thead>
<tr>
<th>Hours: 6h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 2h</td>
</tr>
</tbody>
</table>

**Description:**
Study of operating system development tools, participate in class discussions and the practices of compilation of the operating system.

**Specific objectives:**
3

#### Hardware support tools

<table>
<thead>
<tr>
<th>Hours: 8h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 2h</td>
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</table>

**Description:**
Participation in discussions about the use of hardware support within the operating system for the implementation of the address space and memory management, and synchronization.

**Specific objectives:**
1, 4

#### First control

<table>
<thead>
<tr>
<th>Hours: 12h</th>
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<tbody>
<tr>
<td>Guided activities: 2h</td>
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<tr>
<td>Self study: 10h</td>
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</tbody>
</table>
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**Description:**
This test assesses the knowledge and practice gained in the first 3 topics of the course. It consists of a written exam, done in a theory class.

### Performance Evaluation of the operating system

**Description:**
Participation in discussions on performance evaluation techniques and alternatives that exist for reliable measurements and low impact on the execution system

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

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h

### File Systems

**Description:**
Participation in discussions on the possibilities to implement filesystems in journaling

**Specific objectives:**
1, 2, 6

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h

### Development of management devices

**Description:**
Participation in discussions on the implementation of alternative device drivers

**Specific objectives:**
3, 4, 7

**Hours:** 18h  
Theory classes: 4h  
Practical classes: 0h  
Laboratory classes: 6h  
Guided activities: 2h  
Self study: 6h
# Second control

**Description:**  
This test assesses the knowledge and practice acquired in the first nine weeks of the course, including items 1 through 7.

**Specific objectives:**  
1, 2, 3, 4, 6, 7

**Hours:** 12h  
Guided activities: 2h  
Self study: 10h

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# Support for real-time applications

**Description:**  
Participation in discussions on the implementation of alternatives to support real-time applications

**Specific objectives:**  
1, 2, 8

**Hours:** 9h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 1h  
Self study: 4h

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# Operating system support for virtualized environments

**Description:**  
Participation in discussions on implementation techniques of virtualized environments in a non-native and native ways

**Specific objectives:**  
1, 2, 9

**Hours:** 6h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 2h

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# Operating System Support for Mobile Devices

**Description:**  
Participation in discussions about alternative operating systems for mobile devices

**Hours:** 12h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 6h
## Specific objectives:

<table>
<thead>
<tr>
<th>Management of informatica installation</th>
<th>Hours: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 0h</td>
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<tr>
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<td>Guided activities: 0h</td>
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<tr>
<td></td>
<td>Self study: 0h</td>
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</tbody>
</table>

### Description:
Participation in discussions on the sizing of a facility informatica

### Specific objectives:

1, 2, 11

<table>
<thead>
<tr>
<th>Third control</th>
<th>Hours: 12h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>

### Description:
This test assesses the knowledge and practice gained during the course.

### Specific objectives:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

<table>
<thead>
<tr>
<th>Laboratory exam</th>
<th>Hours: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guided activities: 2h</td>
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<tr>
<td></td>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

### Description:
In this exam, students solve practical problems related with all course subjects, individually. You can have books and notes.

### Specific objectives:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

<table>
<thead>
<tr>
<th>Final exam</th>
<th>Hours: 15h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Guided activities: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study: 12h</td>
</tr>
</tbody>
</table>

### Description:
For those students that would need to reach the minimum level of the course or those that want to raise their marks, this examination will be hold after the period of the classes

### Specific objectives:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Qualification system

The autonomous learning competence is evaluated based on the reports delivered by the student during the course. Its weight is 10% on the final mark.

The technical competences are evaluated based on the theory (40%) and the laboratory exam (50%).

The theory gets evaluated based on the partial and the final exams. The mark of the 3 partial exams is computed as the averaged mean of the 3 tests, with the following weights: 25, 25, and 50%. If this mark is equal or larger than 6.0, attending the final exam is optional.

In case a student attends the final exam, his/her theory mark will be the highest between the mark obtained in the final exam and the averaged mean of the partial exams.

Bibliography

Basic:
