

Course guide

270641 - OS - Operating Systems

Last modified: 13/07/2022

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).

Academic year: 2022 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: JORDI GUITART FERNANDEZ

Others: Primer quadrimestre:
JUAN JOSÉ COSTA PRATS - 10
JORDI GUITART FERNANDEZ - 10

PRIOR SKILLS

Programming and basic concepts on traditional operating systems

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.

CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

Generical:

CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.

CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers, particularly in research and innovation in all areas of Computer Science.

CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

Transversal:

CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.

CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information in the area of informatics engineering, and critically assess the results of this effort.

CTR5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.

CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Basic:

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

This course will be based on three kinds of activities.

- a. Traditional teaching: The professor will describe some theoretical concepts in the class
- b. Self learning: The student will learn about some specific systems by
 - b1. Reading papers/documents selected by the professor
 - b2. Applying the acquired knowledge in the laboratory
- c. Discussions: Group discussion of the self-learning activities

LEARNING OBJECTIVES OF THE SUBJECT

- 1. Understand the definition of an operating system for a warehouse-scale computer, as well as the challenges for its design and implementation.
- 2. Understand the methodology to evaluate the behavior of an operating system for a warehouse-scale computer.
- 3. Understand the differences among several approaches to build O.S. components and be able to discuss the advantages and disadvantages of each approach.
- 4. Understand the features of an O.S. for a warehouse-scale computer, whether they evolve from a desktop computer O.S. or they are brand-new.
- 5. Know how some features of an O.S. for a warehouse-scale computer are implemented in real systems.

STUDY LOAD

Type	Hours	Percentage
Guided activities	12,0	8.00
Self study	96,0	64.00
Hours large group	42,0	28.00

Total learning time: 150 h

CONTENTS

Desktop computers: architecture & O.S. review

Warehouse-scale computers: features & challenges

Process management

In-memory data management

On-disk-storage data management

Power management

ACTIVITIES

Developing the lesson "Desktop computers: architecture & O.S. review"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application.

Full-or-part-time: 8h

Theory classes: 4h

Self study: 4h

Developing the lesson "Warehouse-scale computers: features & challenges"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application.

Full-or-part-time: 8h

Theory classes: 4h

Self study: 4h

Reading assignment #1

Description:

Read of the proposed article. Understanding and assimilation of the contents of the article. Making of a reading report.

Specific objectives:

1

Related competencies :

CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

Full-or-part-time: 2h

Self study: 2h

Developing the lesson "Process management"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application.

Full-or-part-time: 20h

Theory classes: 10h

Self study: 10h

Reading assignment #2

Description:

Read of the proposed article. Understanding and assimilation of the contents of the article. Making of a reading report

Specific objectives:

4, 5

Related competencies :

CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.

CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Full-or-part-time: 2h

Self study: 2h

Practical seminar #1

Description:

Preparation of the seminar with the help of the support material. Implementation and analysis of the requested mechanism. Making of a report of the seminar explaining the work done and the conclusions drawn

Full-or-part-time: 18h

Theory classes: 6h

Self study: 12h

Developing the lesson "In-memory data management"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application

Full-or-part-time: 16h

Theory classes: 8h

Self study: 8h

Reading assignment #3

Description:

Read of the proposed article. Understanding and assimilation of the contents of the article. Making of a reading report

Specific objectives:

4, 5

Related competencies :

CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.

CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Full-or-part-time: 2h

Self study: 2h

Practical seminar #2

Description:

Preparation of the seminar with the help of the support material. Implementation and analysis of the requested mechanism. Making of a report of the seminar explaining the work done and the conclusions drawn

Full-or-part-time: 12h

Theory classes: 4h

Self study: 8h

Developing the lesson "On-disk-storage data management"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application.

Full-or-part-time: 16h

Theory classes: 8h

Self study: 8h

Reading assignment #4

Description:

Read of the proposed article. Understanding and assimilation of the contents of the article. Making of a reading report

Specific objectives:

4, 5

Related competencies :

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CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Full-or-part-time: 2h

Self study: 2h

Practical seminar #3

Description:

Preparation of the seminar with the help of the support material. Implementation and analysis of the requested mechanism. Making of a report of the seminar explaining the work done and the conclusions drawn

Full-or-part-time: 12h

Theory classes: 4h

Self study: 8h

Developing the lesson "Power management"

Description:

Class preparation with the help of the support material. Understanding and assimilation of the lesson contents and their subsequent application.

Full-or-part-time: 8h

Theory classes: 4h

Self study: 4h

Reading assignment #5

Description:

Read of the proposed article. Understanding and assimilation of the contents of the article. Making of a reading report

Specific objectives:

4, 5

Related competencies :

CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.

CEE4.2. Capability to analyze, evaluate, design and optimize software considering the architecture and to propose new optimization techniques.

CEE4.3. Capability to analyze, evaluate, design and manage system software in supercomputing environments.

CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Full-or-part-time: 2h

Self study: 2h

Final exam

Specific objectives:

1, 2, 3, 4, 5

Related competencies :

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CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

Full-or-part-time: 8h

Guided activities: 2h

Self study: 6h

GRADING SYSTEM

The evaluation of this course will take into account three different items

- A final exam that will account for 50% of the grade
- Practical assignment that will account of 30% the grade
- Questionnaires about the self-learning activities that will account for 20% of the grade

BIBLIOGRAPHY

Basic:

- Barroso, L.A.; Hölzle, U.; Ranganathan, P. The datacenter as a computer: designing warehouse-scale machines. 3rd ed. Morgan & Claypool Publishers, 2018. ISBN 9781681734330.

Complementary:

- Silberschatz, A.; Galvin, P.B.; Gagne, G. Operating system concepts. 10th ed., global edition. John Wiley & Sons, 2019. ISBN 9781119454083.



- Arpaci-Dusseau, R.H.; Arpaci-Dusseau, A.C. Operating systems: three easy pieces. Madison: Arpaci-Dusseau Books, 2018. ISBN 9781985086593.
- Hennessy, J.L.; Patterson, D.A. Computer architecture: a quantitative approach,. 6th ed. Elsevier/Morgan Kaufmann, 2019. ISBN 9780128119051.
- Tanenbaum, A.S.; Bos, H. Modern operating systems. 5th ed. Harlow: Pearson Education Limited, 2023. ISBN 9781292727899.