



Universitat de Lleida

# DEGREE CURRICULUM

# **OPERATING SYSTEMS**

Coordination: MATEO FORNES, JORDI

Academic year 2023-24

## Subject's general information

<b>Subject name</b>	OPERATING SYSTEMS			
<b>Code</b>	102377			
<b>Semester</b>	1st Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	Degree	Course	Character	Modality
	Bachelor's degree in Digital Interaction and Computing Techniques	2	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	Only examination			
<b>Coordination</b>	MATEO FORNES, JORDI			
<b>Department</b>	COMPUTER ENGINEERING AND DIGITAL DESIGN			
<b>Teaching load distribution between lectures and independent student work</b>	<p>Overall, the course has 150 hours of work distributed with 60 hours of class attendance and 90 hours of individual work of the student.</p> <p>6 ECTS = 25 * 6 = 150 hours of work</p> <p>40% -&gt; 60 classroom hours (face-to-face)</p> <p>60% -&gt; 90 hours of autonomous work of the student</p>			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Catalan (Spanish if any student shows difficulties with Catalan). All the supplementary material and technical documentation in English.			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MATEO FORNES, JORDI	jordi.mateo@udl.cat	0	

## Subject's extra information

To take this course it is highly recommended to have passed the *Computer Organization and Computer Structures* courses, as well as *Algorithms and Programming*.

Operating systems are the central pillar of any computer system. This course studies fundamental design and implementation ideas in the engineering of operating systems. Lectures are based on a study of UNIX and research papers. Topics include process management, communication mechanisms, task scheduling, and memory management. Individual laboratory assignments involve coding in C using system calls, and shell scripting.

The study of this subject will be completed with the subject of third-year *Administration of Systems and Virtualization*.

## Learning objectives

- To determine the functional characteristics and design of the elements that make up an Operating System (OS).
- Analyze the importance of each module that make up an operating system.
- To identify the different services provided by the operating system to users and applications.
- Efficient use of services provided by the OS for the design and development of computer applications.
- Critically analyze the characteristics and functionalities of the policies that make up an operating system.
- Applying the techniques described to other problems.
- Critically compare the different mechanisms of memory management.

## Competences

### Basic:

- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

### Transversals:

- CT3: Acquire training in the use of new technologies and information and communication technologies.
- CT6: Apply the gender perspective to the tasks of the professional field.

### Generals:

- CG3: Capacity to use appropriate hardware and software platforms for the development and execution of interactive digital applications.

### Specific:

- CE3: Basic knowledge of the use and programming of computers, operating systems and databases, and their use in the development of interactive applications.
- CE7: Know, manage and maintain systems, services and interactive applications.
- CE11: Knowledge of the characteristics, functionalities and structure of operating systems and design and implement applications based on their services.

## Subject contents

### Topic 1: Introduction

- Concept of an operating system
- Objectives
- History of the operating systems
- Types of operating systems

### Topic 2: Operating System Structure

- Components of the operating system
- Services of the operating system
- Calls and programs of the system
- Case study: UNIX / LINUX

### Topic 3: Process Management

- Concept of process
  - States of the processes
  - Process Control Block (PCB)
- Threads
- Communication between processes
- Types of communication
- Case study: Managing processes in UNIX.
- Case study: Communicating with pipes

### Topic 4: Scheduling of the CPU

- Basic concepts
- Types of schedulers
- Performance metrics
- Scheduling algorithms
- Multilevel queues

### Topic 5: Memory Management

- Basic principles
- Assigning contiguous Memory
  - Nude Machine
  - Resident Monitor
  - Multiple Partitions
- Assigning non-contiguous Memory
  - Pagation
  - Segmentation
- Combined systems
  - Page segmentation
  - Segmented pagination
- Virtual Memory
  - Demand paging
  - Effective Access Time
  - Frames allocation algorithms
  - Page replacement algorithms
  - Thrashing

### Topic 6: *Shell Script programming*

- Introduction
- Programming with Bash
- Programming with AWK

## Methodology

### Theory

- In these sessions, the theoretical contents of the subject will be explained, accompanied by illustrative examples. The slides of the subject will be used as support material
- An active methodology is used where the student is the protagonist by performing **HandsOn**.

### Practices

- These sessions will be used to work on the most practical parts of the subject Linux Programming with C and also Shell Scripting Programming.
- A **social** learning methodology will be used with **live-coding** sessions, where we will read and implement, and propose activities to solve in the classroom with the help of the rest of the students.

### Self-employment

- A **cooperative methodology based on challenges** will be used, where students in groups will have to start from the basis of the knowledge acquired in the theoretical and practical sessions of the course and complement it with external information.

\* This course will not have face-to-face classes because the degree is in extinction.

## Development plan

Week	Theory	Laboratory	Homework
1	T1	Lab-01	EV1: Act01
2	T2	Lab-02	EV1: Act02
3	T2	Lab-03	EV1: Act03
4	T3	Lab-04	EV1: Act04
5	T3	HOLIDAYS	EV2: Act05
6	T3	Lab-05	EV2: Act06
7	T4	Lab-06	EV3: Act07
8	T4	Lab-07	EV3: Act08
9	First Exam (E1)		
10	T5	Lab-08	EV4: Act09

Week	Theory	Laboratory	Homework
11	T5	Lab09	EV4: Act10
12	T5	Lab-10	EV5: Act11
13	T6	HOLIDAYS	EV5: Act12
14	T6	Lab-11	EV5: Act13
15	T6	Lab-12	EV5: Act14
16	Second Exam (E2)		
17			
18			
19	Recovery		

## Evaluation

Acr.	Evaluation Activities	Weight	Minimum Mark	Groups	Recoverable
E1	1st partial exam	30%	NO	NO	YES
E2	2nd partial exam	45%	NO	NO	YES
PRA	Assesment	25 %	NO	NO	NO
*** To pass the course, <b>FINAL MARK</b> must be <i>greater than or equal to 5</i> .					
<b>Considerations:</b> <ul style="list-style-type: none"> <li>If you have not passed the subject, you can go to the recovery exam.</li> <li>In this case the grade will be calculated as follows: Final grade = 75% * recuperation grade + 25% * PRA</li> <li>The recovery exam can only be attended in case of having failed the subject.</li> </ul>					

## Bibliography

### Basic Bibliografy:

- Francesc Solsona. "Sistemes Operatius. Teoria aplicada". Edicions de la Universitat de Lleida (Col·lecció eines 78). ISBN: 978-84-8409-747-1. 2015.

### Additional Bibliografy:

- Linux Kernel in a Nutshell, by [Greg Kroah-Hartman](#), published by [O'Reilly](#).
- Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, and Dan Mackin. 2017. *UNIX and Linux System Administration Handbook (5th Edition)* (5th. ed.). Addison-Wesley Professional.
- Silberschatz A., Peterson J. Y Galvin P.: "Sistemas Operativos. Conceptos Fundamentales"; Addison-Wesley, 1999.
- Carretero Pérez, Jesús, y otros: "Sistemas Operativos. Una Visión Aplicada". McGraw-Hill, 2001.

- F.M. Marquez García: "Unix. Programación Avanzada", Edt. Rama 3a edició, 2004.
- E.Quigley: "UNIX Shells by Example", Edt. Prentice-Hall, 3ra edició, 2002
- Tanenbaum, Andrew S. "Sistemas Operativos, Diseño e Implementación", 2a edició, Edt. Prentice- Hall, 1998.
- Tackett J. y Gunter D., "Utilizando Linux", Prentice Hall, 1996
- Kay A. Robbins, Steven Robbins, "UNIX Programación Práctica. Guía para la Concurrencia, la Comunicación y los Multihilos", Edt. Prentice-Hall, 1997.
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