INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Operating Systems			Field of study	Computer Engineering		
Bachelor in	Informatics Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9119-706-2105-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): José Carlos Rufino Amaro, Jose Luis Miranda Goncalves, Rui Alexandre Coelho Alves

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. know the fundamental principles of the architecture and operation of modern operating systems
2. master a set of basic concepts and techniques on system-level programming, using Linux as reference environment

Prerequisites

Before the course unit the learner is expected to be able to:
1. to program in the C language
2. master fundamental concepts on Computer Architectures

Course contents

Introductory Concepts, Operating System Structures, Processes, CPU Scheduling, Process Synchronization, Main Memory, Virtual Memory, File-System. System Level Programming in Linux.

Course contents (extended version)

1. Introductory Concepts
   - Operating System Concept
   - Computing System Operation
   - Hardware Protection
   - Specialised Systems and Environments
2. Operating System Structures
   - System Services
   - User Interfaces
   - System Calls
   - System Programs
   - System Design and Implementation
   - Operating System Structure
   - System Generation
3. Processes
   - Process Concept
   - Process Scheduling
   - Operations on Processes
   - Interprocess Communication
   - Client-Server Communication
4. CPU Scheduling
   - Basic Concepts
   - Scheduling Criteria
   - Scheduling Algorithms
   - Scheduling in Multiprocessor Systems
   - Scheduling in Real-Time Systems
5. Process Synchronization
   - Basic Concepts
   - The Critical-Section Problem
   - Peterson's Solution
   - Synchronization Hardware
   - Locks and Semaphores
   - Classical Problems of Synchronization
6. Main Memory
   - Basic Concepts
   - Contiguous Allocation
   - Paging
   - Structure of the Page Table
   - Swapping
7. Virtual Memory
   - Basic Concepts
   - Demand Paging
   - Copy-on-Write
   - Page Replacement
   - Allocation of Frames
   - Thrashing
8. File-System
   - File-System Architecture
   - File-System Implementation
   - Allocation Methods
   - Free-Space Management
   - Efficiency and Performance
   - Recovery
9. System Level Programming in Linux
   - Process Management
   - Shared Memory
   - Semaphores
   - Files and Pipes

Recommended reading

1. "Operating System Concepts, 10th Ed. ", Silberschatz, Galvin & Gagne, John Wiley & Sons, 2018
2. "Fundamentos de Sistemas Operacionais, 9a Ed. ", Silberschatz, Galvin & Gagne, LTC, 2015
3. "Programação de Sistemas em Linux", José Rufino, ESTiG/IPB, 2020
4. "The Linux Programming Interface", Michael Kerrisk, No Starch Press, 2010
5. "Linux System Programming, 2nd Ed. ", Robert Love, O'Reilly, 2013

Teaching and learning methods

The unit will be primarily taught using lectures that alternate the exposition of theoretical concepts with the resolution of exercises, complemented by practical works to be solved outside classes. All documentation (slides, exercises, solutions, assignments) will be provided through e-learning facilities. Additional support in the form of tutoring is provided.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 12% (Theoretical Part T1: Introductory Concepts, Operating System Structures, Processes.)
   - Intermediate Written Test - 12% (Practical Part P1: Process Management.)
   - Intermediate Written Test - 12% (Theoretical Part T2: CPU Scheduling, Process Synchronization.)
   - Intermediate Written Test - 12% (Practical Part P2: Shared Memory and Semaphores.)
   - Final Written Exam - 11% (Theoretical Part T3: Main Memory, Virtual Memory, File-Systems.)
   - Final Written Exam - 11% (Practical Part P3: Files and Pipes.)
   - Practical Work - 30% (Optional. If not done, the 30% are equally divided by the 6 parts.)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 70% (Exam divided in the 6 parts of Alternative 1.)
   - Practical Work - 30% (Optional. If not done, the 30% are equally divided by the 6 parts.)

Language of instruction

1. Portuguese
2. English

Electronic validation

José Carlos Rufino Amaro	José Luís Padrão Exposto	Luísa Maria Garcia Jorge	Paulo Alexandre Vara Alves
31-10-2022	02-11-2022	02-11-2022	03-11-2022