



# Sistemas de Operação / Fundamentos de Sistemas Operativos

## Course Overview

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# Outline

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# Objectives and outcomes

- Objectives

- To present the most important concepts about the internal organization of present day operating systems
- To introduce concurrent programming and the core mechanisms for interprocess communication and synchronization
- To acquaint the students with the Unix internal organization

- Acquired competencies

- To gain a good understanding of how multiprogramming works and of the general organization of present day operating systems
- To develop skills for the project and implementation of simple concurrent applications
- To be able to carry out productive work as a member of a team that develops system programming software

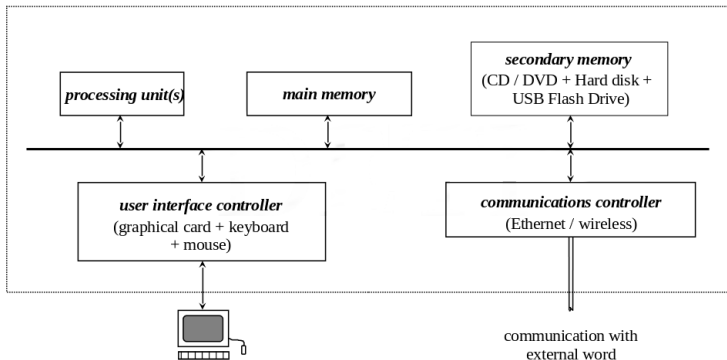
# Prerequisites

- **At the computer architecture level:**
  - basic notions on computer architecture
  - basic notions on communication protocols with input-output devices (pooled I/O, interrupt driven I/O and DMA based I/O)
- **At the programming level:**
  - programming skills in C/C++ language at a fair to good level
- **At the data structure level:**
  - operational and conceptual knowledge of the most common static and dynamic data structures used to build different types of memory (RAMs, stacks, FIFOs and associative memories)

# Course contents

## Computational system

- Simple view of a computational system:



# Course contents

## Summary

- Theoretical topics:
  - Introductory concepts
  - Processor management in multiprogramming
  - Interprocess communication and synchronization
  - Memory management
  - Input / Output
  - File systems
  - Protection and Security (some introductory notions, if possible)
- Practical and Lab topics:
  - File system development
  - Concurrent programming, involving inter-process/thread communication and synchronization

# Bibliography

- Support bibliography:
  - Operating Systems: Internals and Design Principles, W. Stallings, Prentice-Hall International Editions, 7th Ed, 2012
  - Operating Systems Concepts, A. Silberschatz, P. Galvin and G. Gagne, John Wiley & Sons, 9th Ed, 2013
  - Modern Operating Systems, A. Tanenbaum and H. Bos, Pearson Education Limited, 4th Ed, 2015
  - Sistemas Operativos, J. Marques, C. Ribeiro, L. Veiga, P. Ferreira and R. Rodrigues, FCA, 2012
- *Lecture Slides*

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- The lecture slides are not enough for a robust understanding of the course topics!

# Practical classes

## Schedule

- **General schedule:**
  - Bash scripting - 1 session
  - File system project - 6/7 sessions
  - Inter-process communication and synchronization (IPC) - 5/6 sessions
- **File system project:**
  - Implementation of a file system, including its integration into the Linux operating system
- **IPC and concurrent programming:**
  - Exercise on concurrent programming, based on processes, shared memory and semaphores
  - Exercise on concurrent programming, based on threads, mutexes and condition variables
  - Training exercise for the practical exam



# Assessment

## General rules

- **2 components:**
  - theoretical component: 45%, with a minimum of 7.0
  - practical component: 55%, with a minimum of 8.0
- all intermediate marks are rounded to **one decimal place**
- **Theoretical component with 1 element:**
  - written exam, at the exam periods
- **Practical component with 3 elements:**
  - a file system project: 20%
  - midterm quiz (on the file system project): 15%
  - practical exam on concurrent programming: 20%
  - Marks above 17 may required some extra work
- **Repeating students:**
  - Can inherit, but ...

# Assessment

## Appeal and special exam periods

- In the appeal and special exam periods, the assessment elements are exactly the same
- The following inheritance rules apply:
  - the grade of theoretical exam can be inherited from a previous exam period
  - the grade of practical exam can be inherited from a previous exam period
  - the grades of the file system project and of the midterm quiz can be inherited as a whole from a previous exam period
  - Repeating the file system project and of the midterm quiz involves a new file system, not the sofs21

# Assessment

## Inheritance rules for repeating students

- **By default:**
  - grades obtained in previous years are not inherited directly
- **However, a grade can be inherited based on the following rules:**
  - written exam: 100% of the grade
  - file system project: previous grade with penalty
  - midterm quiz: 100% of the grade
  - concurrent programming exam: 100% of the grade
- **Deadline:**
  - October, 2021