Sistemas de Operação / Fundamentos de Sistemas Operativos

Course Overview

Artur Pereira <artur@ua.pt>

DETI / Universidade de Aveiro

Outline

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 students with internal organization of Unix/Linux

- Competencies to be acquired
  - 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

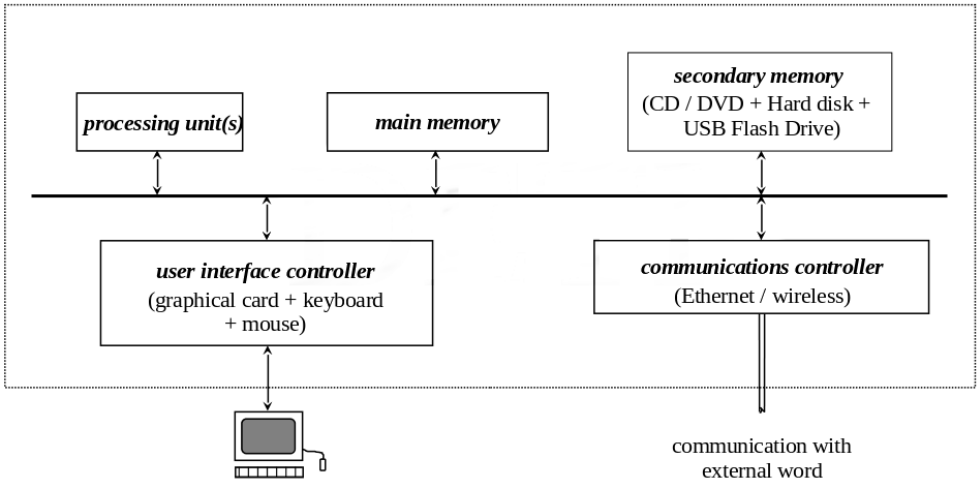
- At the computer architecture level:
  - basic notions on computer architecture
  - basic notions on communication protocols with input-output devices (pooled I/O, interrupt driven I/O and DMA based I/O)

- 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:
  - Concurrent programming, involving inter-process/thread communication and synchronization
  - Memory management project

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*

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

Practical classes
Schedule

- General schedule:
  - C/C++ programming - 1 session
  - Inter-process communication and synchronization (IPC) - 6 sessions
  - Bash scripting - 1 session
  - Memory management project - 5/6 sessions
- IPC and concurrent programming:
  - Exercise on concurrent programming, based on processes and signals
  - 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
- Memory management project:
  - Implementation of a memory management simulation application, including different allocation policies

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 grades are rounded to one decimal place

- Theoretical component with 1 element:
  - written exam, at the exam periods

- Practical component with 2 elements:
  - practical exam on concurrent programming: 25%
  - the memory management system project (may include a defense): 30%
  - 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 the theoretical exam can be inherited from a previous exam period
    - but, if repeated, the previous grade expires
  - the grade of the practical exam can be inherited from a previous exam period
    - but, if repeated, the previous grade expires
  - the grade of the memory management project can be inherited from a previous exam period
    - repeating the memory management project involves a new project, not improvements in the former

Assessment
Inheritance rules for repeating students

- By default:
  - grades obtained in previous years are not inherited directly

- However, grades for assessment elements of this academic year can be obtained from previous grades based on the following rules:
  - theoretical exame: 100% of the grade obtained in the previous one
  - only practical exam: 100% of the grade obtained in the previous one
  - only memory management project (MMP):

    $$(20 * \min(90\% * \text{SOFS}, 14.5) + 15 * \text{MT})/35$$

    where SOFS and MT represent the grades obtained in the file system project and in the midterm quiz
  - whole practical component:

    $$(20 * \min(90\% * \text{SOFS}, 14.5) + 15 * \text{MT} + 20 * \text{EP})/55$$

    where EP represents the grade obtained in the practical exame

- Deadline:
  - October 1st, 2022