UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Operating Systems and Networks

2526-2-E3101Q110

Aims

This course aims at to the following specific learning outcomes:

- **Knowledge and understanding** (DD1): providing the students an advanced understanding of the main concepts of modern operating systems and telecommunication networks.
- **Applying knowledge and understanding** (DD2): the student shall learn what are the main abstractions and services that a modern operating system offers, how to use them, and the basic concepts about the architectures and implementation strategies of modern operating systems. Moreover, the student will acquire knowledge about the fundamental architecture and protocols of TCP/IP telecommunication networks.

Contents

Operating systems: Structure and services; Processes and threads: Services; Memory management: services; File system: services; Interface and structure of the kernel; Processes and threads: Structure; Memory management: Structure; Introduction to Networks and the Internet, Application Layer, Transport Layer, Network Layer - Data Plane, Network Layer - Control Plane, Link Layer and Local Area Networks.

Detailed program

Operating Systems

1: Operating systems: Structure and services:

- Structure of operating systems
- Services offered by operating systems

2: Processes and threads: Services:

- Processes and their management
- Interprocess communication
- Threads and multithreading programming

3: Memory management: Services:

- Virtual address spaces
- The POSIX API mmap

4: File systems: Services:

- Files and attributes
- Directory structures

5: Interface and structure of the kernel:

- API and system calls
- Structure of the kernel
- Politics and mechanisms

6: Processes and threads: Structure:

- Multiprogramming and multitasking
- Implementation of processes
- Implementation of threads
- Main CPU scheduling algorithms (first-come first-served, shortest job first, round-robin, priority)
- Multilevel queues with feedback

7: Memory management: Structure:

- Contiguous allocation
- Paging
- Swapping
- Virtual memory
- Degree of multiprogramming

Networks

8: Introduction to Computer Networks and the Internet:

- Network architecture
- Definition of protocol
- Packet switching
- Layered architecture and encapsulation

9: Application Layer:

- Domain Name System (DNS)

10: Transport Layer:

- UDP protocol
- Principles of reliable data transfer (Stop-and-Wait, Go-Back-N, Selective Repeat)
- TCP protocol

11: Network Layer - Data Plane:

- Router architecture
- IPv4 protocol and IPv4 addressing
- Network Address Translation (NAT)

12: Network Layer - Control Plane:

- Routing algorithms (Link State, Distance Vector)
- Interior Gateway Routing Protocols (OSPF)
- Border Gateway Protocol (BGP)
- Internet Control Message Protocol (ICMP)

13: Link Layer and Local Networks:

- Offered services
- Multiple Access Protocols (Random Access Protocols, Taking-Turns Protocols)
- Switch architecture
- Ethernet protocol
- Link Layer addresing and Address Resolution Protocol (ARP)

Prerequisites

The fundamental concepts taught in the following courses: Computer Architecture, Programming 1 and Programming 2

Teaching form

The course is in **blended e-learning**. Lectures will be given in classroom, exercitations will be given in e-learning and will encompass videos, exercises, self-assessment tests, and on-line tutoring.

Operating systems
16 hours (2 cfu) of lectures in presence ("didattica erogativa");
20 hours (2 cfu) of exercises and student support in remote ("didattica erogativa" and "didattica interattiva").

Networks
16 hours (2 cfu) of lectures in presence ("didattica erogativa");
20 hours (2 cfu) of exercises and student support in remote ("didattica erogativa" and "didattica interattiva").

The course will be held in Italian.

Textbook and teaching resource

A. Silberschatz, P. Galvin, G. Gagne, "Sistemi Operativi - concetti ed esempi", 10th Edition, Pearson, ISBN: 978-88-9190-455-3 (also available in English, entitled "Operating Systems Concepts", 10th Edition).

J. Kurose, K. Ross, "Reti di Calcolatori e Internet", 8va Edizione, Pearson, ISBN: 978-88-9191-600-6 (also available in English, entitled “Computer Networking: A Top-Down Approach”, 8th Edition).

Slides of lessons, exercises and other material will be available on-line.

Semester

Second year, first semester.

Assessment method

The assessment consists in a written test, with the possibility of partial intermediate tests (*in itinere*).

There are two *in itinere* tests and are held at the midterm and at the end of the course. It is necessary to pass both of them to pass the exam. In the event that one of the two *in itinere* tests has not been passed or has not been sustained, it is possible to recover it in the first exam session, provided that the other test has been positively passed. Passing only one of the two *in itinere* tests does not give rise to any bonus for the subsequent full examination tests.

The tests include both multiple choice questions and open-ended questions, requiring a reasoned argument on one of the course topics.

The students will be assessed on the degree of understanding of the concepts exposed during the course, and on their capacity of applying some kinds of quantitative analyses.

Office hours

Prof. Braione: by appointment via email.

Prof. Savi: by appointment via email.

Sustainable Development Goals