

Syllabus of Record

Program: CET Siena

Course Code / Title: (SN/CS4414) Operating Systems

Total Hours: 45

Recommended Credits: 3

Primary Discipline / Suggested Cross Listings: Computer Science / Data Science

Language of Instruction: English

Prerequisites / Requirements: For UVA students: CS3330 Computer Architecture *or* (CS2501 COA 2 and CS2150 Program and Data Representation) *or* (CS3130 Computer Systems and Organization 2 and CS3100 Data Structures and Algorithms 2) *or* ECE3430 Introduction to Embedded Computer Systems *or* ECE3502 Embedded Computing & Robotics 2. Equivalent courses for students from another institution.

Description

This course provides students with an understanding of the main operating system concepts through a combination of lectures and laboratory classes, using Linux as a case study. The course focuses on computing system architecture and the structure and activities of the operating system.

Objectives

Through their participation in this course, students:

- Learn the basic concepts in modern operating systems.
- Gain knowledge of the main issues related to resource management.
- Learn how to implement concurrent programs.
- Understand Linux as a case study.

Course Requirements

Active participation is essential in this course. Students are expected to attend each class and lab session, as outlined in the CET Attendance Policy. Students are expected to read all assigned materials before each class session. Reading assignments are generally 20-30 pages per class session. Graded assignments include:

- Homework/Lab: weekly assignments.
- Midterm Exam
- Final Exam: concurrent programming, CPU scheduling, deadlock, virtual memory, and file system management.
- Oral Exam: aimed at verifying knowledge gained about the structure and operations carried out by common operating systems, using Linux as a case study.

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Grading

The final grade is determined as follows:

- Participation: 20%
- Homework/Lab: 20%
- Midterm Exam: 20%
- Final Exam: 20%
- Oral Exam: 20%

Readings

Anderson, Thomas and Michael Dahlin. *Operating Systems: Principles and Practice, Second Edition*. Recursive Books, 2014.

Dhamdhere, Dhananjay. *Operating Systems: A Concept-based Approach*. New York: McGraw-Hill, 2008.

Silberschatz, Abraham, Peter Galvin and Greg Gagne. *Operating System Concepts*, Hoboken, NJ: Wiley, 2013.

Outline of Course Content

Topic 1: Introduction to operating systems

- Operating systems concepts
- Organization of the computing system
- Computer architectures
- Structure and activities of the operating system
- Safety and security
- Kernel data structures
- Open-source operating systems

Topic 2: Structure of the operating system

- Operating system services
- User interface
- System calls
- System software
- Design and implementation
- Structure of the operating system
- Generation and debugging

Topic 3: Processes

- Process definition
- Process scheduling
- Operations on processes
- Cooperating processes

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- Communications between processes
- POSIX IPC
- Communications in client-server systems

Topic 4: Threads

- Motivations and definition
- Multicore programming
- Models of multithreaded programming
- Thread libraries
- Implicit threading
- Problems in multithreaded programming
- Linux threads

Topic 5: Process synchronization

- The critical section problem
- Synchronization hardware
- Semaphores
- Classical synchronization problems
- Monitors
- Examples of synchronization

Topic 6: CPU scheduling

- Basic concepts
- Scheduling criteria and algorithms
- Thread scheduling
- Multiprocessor scheduling
- Real-Time Scheduling
- Scheduling in Linux

Topic 7: Deadlock

- The problem of deadlock
- Deadlock characterization
- Methods for managing deadlocks
- Preventing deadlocks
- Avoiding deadlocks
- Detecting deadlocks
- Recovering from deadlock situations

Topic 8: Main memory management

- Swapping
- Memory allocation
- Segmentation
- Pagination

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- Page table structure

Topic 9: Virtual memory

- On-request pagination
- Copy-on-Write
- Page replacement
- Frame allocation
- Thrashing
- Memory mapped files
- Allocation of kernel memory
- Virtual memory in Windows

Topic 10: Secondary storage

- The structure of memory devices
- Disk structure
- Disk scheduling
- Disk management
- RAID disks

Topic 11: The file system interface

- The concept of file
- Access modes
- Files and directories
- File system mounting
- Protection
- UNIX as a case-study

Topic 12: Realization of the file system

- File system structure
- File system realization
- Implementation of directories
- File allocation methods
- Free space management
- Efficiency and performance
- NFS

Topic 13: Introduction to the shell scripting in Linux

- Why do we use the shell?
- Basic shell commands
- The shell
- Shell scripting