

CS643: Operating Systems.

Instructor: Prof. Rodriguez.

Text: Operating System Concepts 8th edition, Silberchatz.

Grading: Midterm (40%), Final (40%), Assignments and Labs (20%).

In this course we explore the major components of modern operating systems: Process Management, Memory Management, and File Systems.

The following topics will be covered:

Introduction to OS's: What do operating systems do. Computer Systems Organization. Computer Systems Architecture: Single processor systems, multiple processor systems, clustered systems. Multiprogrammed systems, Time sharing systems. Dual-mode operation. Process management, memory management, storage management, mass-storage management. Computing environments: traditional, client-server, web-based.

Operating-System Structures: Services, User Interface, System calls, System programs. OS structure: Monolithic, layered, microkernel, modules. Virtual machines.

Processes: Process concept. Process states. Process Control Block. Process Scheduling: Scheduling queues, Schedulers. Context switching. Operations on processes: Process creation and termination. Interprocess communication: Shared memory, message passing, synchronization. Examples of IPC: POSIX shared memory, Sockets, Remote Procedure Calls, Remote Method Invocation.

Threads: Overview. User-level vs Kernel-level threads. Thread libraries: POSIX, Win32, Java. Lab: Matrix multiplication.

CPU Scheduling: Basic concepts: I/O burst cycle. CPU Scheduler: Preemptive scheduling, Dispatcher. Scheduling criteria. Scheduling algorithms: First-come-first-serve, Shortest Job First, Shortest-remaining-time-first, Priority scheduling, Round-robin scheduling, Multilevel queue scheduling. Multiprocessor scheduling. Examples: Windows XP scheduling, Linux scheduling.

Process Synchronization: Why needed. The Critical-Section Problem. Software solutions. Hardware solutions. Semaphores. Classic Synchronization Problems: Bounded-buffer, Readers-Writers, Dining Philosophers. Monitors. Example: synchronization in Pthreads. Lab: Producer-Consumer using Pthreads.

Deadlocks: Model. Characterization. Resource-allocation graph. Deadlock prevention. Deadlock avoidance. Safe states. Banker's algorithm for deadlock avoidance. Deadlock detection.

Memory management: Hardware. Address binding. Logical vs Physical Address space. Dynamic loading. Dynamic linking and Shared Libraries. Swapping. Contiguous memory allocation. Paging. Hardware support for paging. Page Tables. Segmentation. Segmentation with paging. Example: Intel Pentium.

Virtual Memory: Introduction. Demand paging. Copy-on-write. Page replacement algorithms; FIFO, Optimal, LRU. Approximations to LRU. Frame allocation. Thrashing. Memory-mapped files. Impact of program structure and I/O on demand paging.

File-System Interface: File concept. File attributes, file operations, file types, internal file structure. Access methods: sequential, direct access, indexed. Directory structure. Tree-structured directories. Acyclic-graph directories. File-system mounting. Remote file systems. Protection: Access control lists. UNIX-style access control: Owner-group-other.

File-system implementation. File-system structure. File-system implementation. Directory implementation. Allocation methods: contiguous, linked, indexed. Free space management. Network file system (NFS).

Disks and Disk algorithms: Magnetic disks. Disk structure. Disk scheduling. Disk management. Redundant arrays of inexpensive disks (RAID).

Security The security problem. Program threats. Network threats. Cryptography. Encryption. Authentication.