Operating Systems

Summary

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February 06, 2024

Agenda

- Exam
- Overview

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Organizational

- The exam will take place at 4-Audimax on February 12, 2024 at 16:30 CET
- You will be allowed to bring a single-sided cheat sheet and a calculator
- Note the exam regulations, in particular . . .
  - You have to be registered for exam via HIS.
  - You can authenticate yourself with an photo ID and your student identity card.
  - In case of delay no additional time will be granted.

Content

- All necessary formulas and concrete numbers will be given in the exam
- The exam will consist of similar tasks as in the exercise sheets and look similar to the mock exam

Reminder

- What is necessary to pass the exam?
- You should be able to . . .
  - explain main concepts and ideas with your own words,
  - select a suitable solution for a given problem,
  - analyze a given solution and detect (potential) problems, and
  - explain your answers.

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Definition: Operating System

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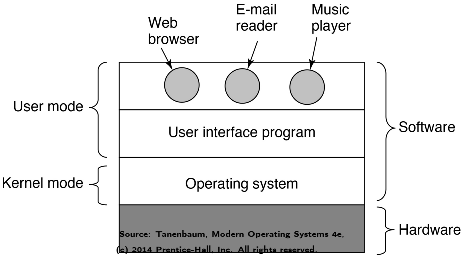

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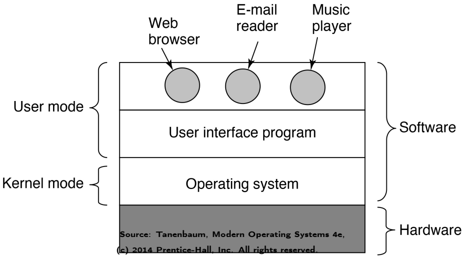

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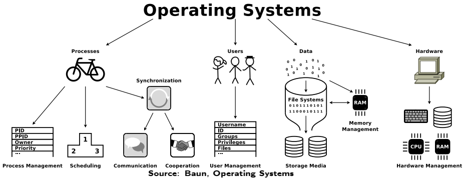

Source: Baun, Operating Systems

Objective

You should know . . .

- which resources are managed by the operating system
- how the OS manages processes, memory, and files
- that interrupts and multitasking may result in concurrency
- what the most common scheduling and caching strategies are
- which mechanisms an OS use to manage the resources of all running processes

Key Terms (1/7)

- Singletasking and multitasking
- Single-User and multi-user
- RTOS, embedded OS, and Distributed OS
- Kernel architectures
  - Monolithic kernel
  - Microkernel
- Layers of an OS

Key Terms (2/7)

- Von Neumann architecture
- CPU
  - ALU and Control Unit
  - Registers
- System Bus
  - Address Bus, Data Bus, and Control Bus
  - Southbridge and Northbridge
- I/O Devices
  - Character and block devices
  - Busy waiting/polling, interrupt-driven, and DMA
- Computer Data Storage
  - Storage technologies
  - Random access
  - Volatile vs. non-volatile/persistent
  - Memory hierarchy
  - Cache (write-back and write-through)

Key Terms (3/7)

- Process, Process Table, and Process Control Block
- User context, hardware context, and system context
- Context switching
- Process States and Process State Models
- Process creation, `fork()`, and `exec()`
- Process memory layout: Text, Data, BSS, Heap, and Stack
- System Calls
- User Mode and Kernel Mode

Key Terms (4/7)

- Interrupts, Faults, Exceptions, Traps
- Interrupt Request (IRQ) and Interrupt Service Routine (ISR)
- Scheduler and Dispatcher
- Idle Process
- Preemptive and non-preemptive scheduling
- Waiting time, CPU time, and Runtime
- Scheduling algorithms (priority-driven, FCFS, RR, SJF/LJF, SRTF/LRTF, EDF, CFS)

Key Terms (5/7)

- Inter-Process Communication (IPC): Files, Signals/Flags, Shared Memory, Message Queues, Pipes, and Sockets)
- Critical sections, Race Conditions, Starvation, and Deadlocks
- Semaphores and Mutexes
- Memory allocation (static/dynamic partitioning and buddy memory allocation)
- Direct Memory Access (Real Mode) and Virtual Memory (Protected Mode)
- Paging and Page Tables
- Memory Management Unit (MMU)
- Page Replacement Strategies (OPT, LRU, LFU, FIFO, Second Chance, TTL, Random)

Key Terms (6/7)

- Hard Disk Drives (HDDs) and Solid State Drives (SSDs)
- Blocks, Sectors, Clusters, Cylinders, Heads, Disks, and Platters
- Seek Time and Rotational Latency Time
- Wear Leveling
- RAID and RAID Levels (0, 1, and 5)

Key Terms (7/7)

- File Systems
- Files, directories, and absolute and relative path names
- Block Addressing, Inodes
- File Allocation Tables
- Journaling
- Extents
- Copy-on Write

Shell Basics (1/2)

- `cat`
- `chmod`
- `chown`
- `crontab`
- `date`
- `echo`
- `grep`
- `head`
- `kill`
- `ln`
- `ls`
- `pwd`
- `rm`
- `rmdir`
- `sed`
- `sort`
- `tail`
- `tar`
- `touch`
- `vim`
- `wc`

Shell Basics (2/2)

- Redirection into a new file: >
- Redirection appending to an existing file: >>
- Redirection to another command (*pipe*): |
- Assign variable: `VAR=123`
- Use variable: `COMMAND ${VAR}`
- Conditional execution:
  `if [ COND ]; then COMMAND; else COMMAND; fi`
- Foreach loop:
  `for ELEM in A B C ...; do COMMAND; done`