

Operating Systems

Summary

Prof. Dr. Oliver Hahm

Frankfurt University of Applied Sciences
Faculty 2: Computer Science and Engineering
`oliver.hahm@fb2.fra-uas.de`
<https://teaching.dahahm.de>

February 07, 2023

Agenda

■ Exam

■ Overview

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Organizational

- The **exam** will take place at **4-8** on **February 17, 2023** at 14:00 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.

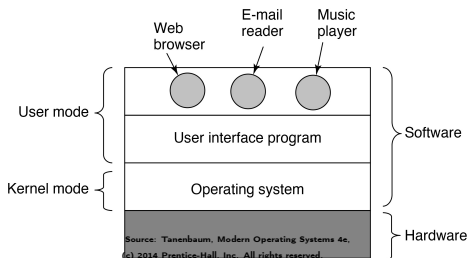
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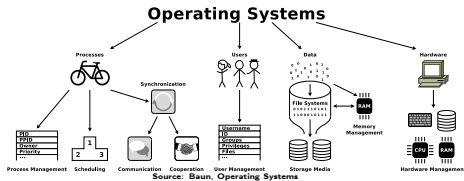
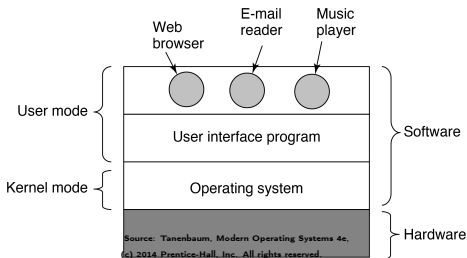
■ Overview

Definition: Operating System

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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
- NAND and NOR Flash
- SLC, MLC, TLC, and QLC
- 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 (1/2)

- 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`