

IOWA STATE UNIVERSITY

Department of Electrical and Computer Engineering

Lecture 02: OS Introduction I



Agenda

- **Recap**
- **OS Introduction I**
 - **Computer System Structure**
 - **Computer Hardware Review I**

Recap

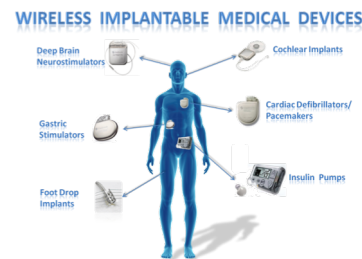
- Instructor
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 - Tuesdays 11:00 - 12:00, Coover 3223, Wenhao
 - Wednesdays 11:00 - 12:00, Durham 314, Kaihang

Recap

- Grading
 - Class Participation (3%, bonus)
 - 9 lab assignments (30%)
 - 2 programming projects (15%)
 - 3 homework assignments (15%)
 - 2 midterms (20%)
 - 1 final exam (20%)

Recap

- Why OS
 - Fundamental to computer systems
 - Affects correctness, security, performance ... of entire system
 - Fundamental to modern society



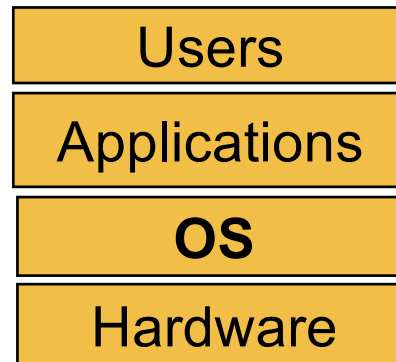
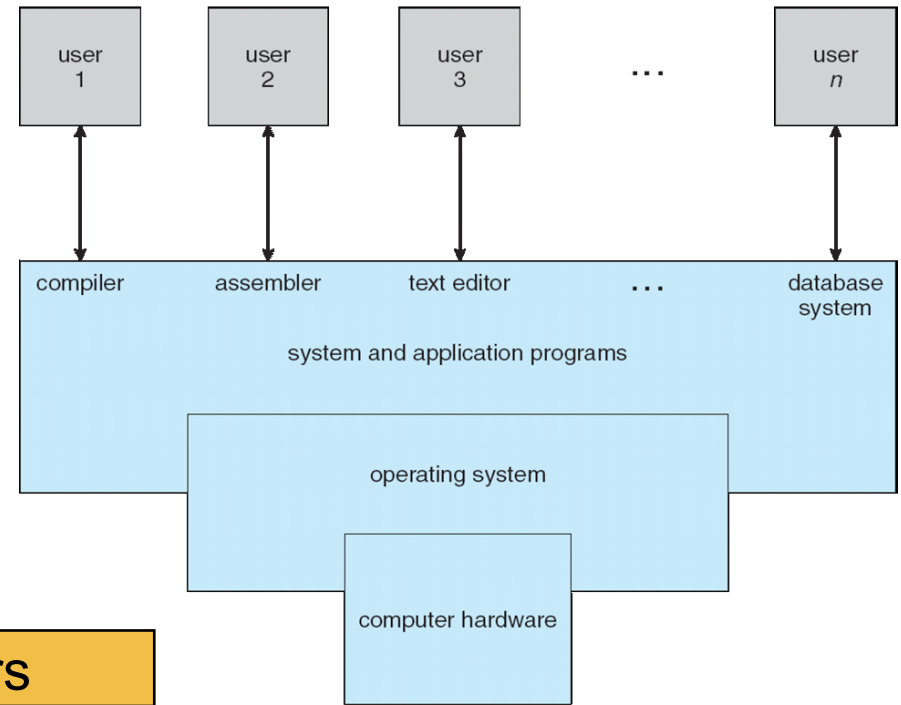
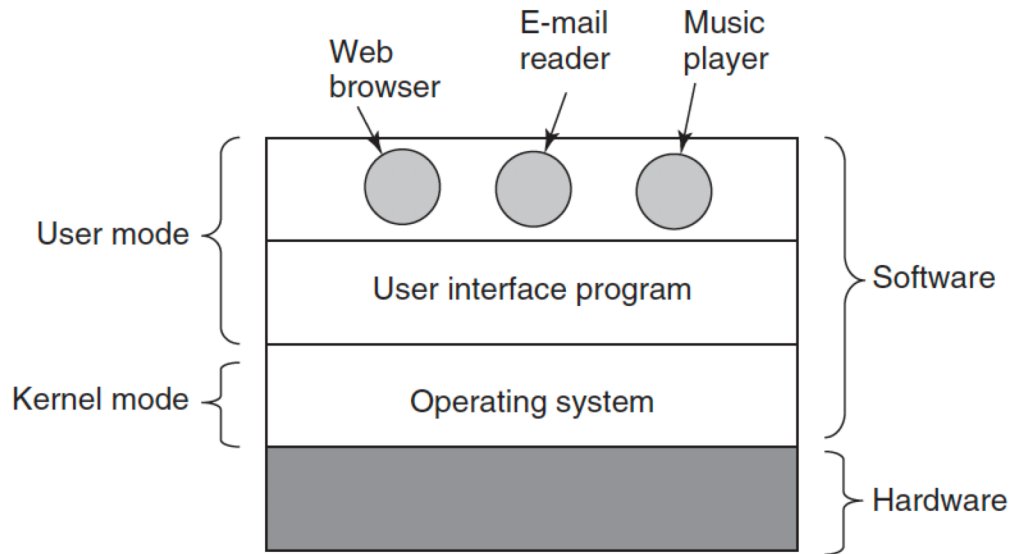
- What's OS
 - OS is a resource manager
 - OS is a control program
 - an extended/virtualized machine with abstraction

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Computer System Structure

- Where the OS fits in



Computer System Structure

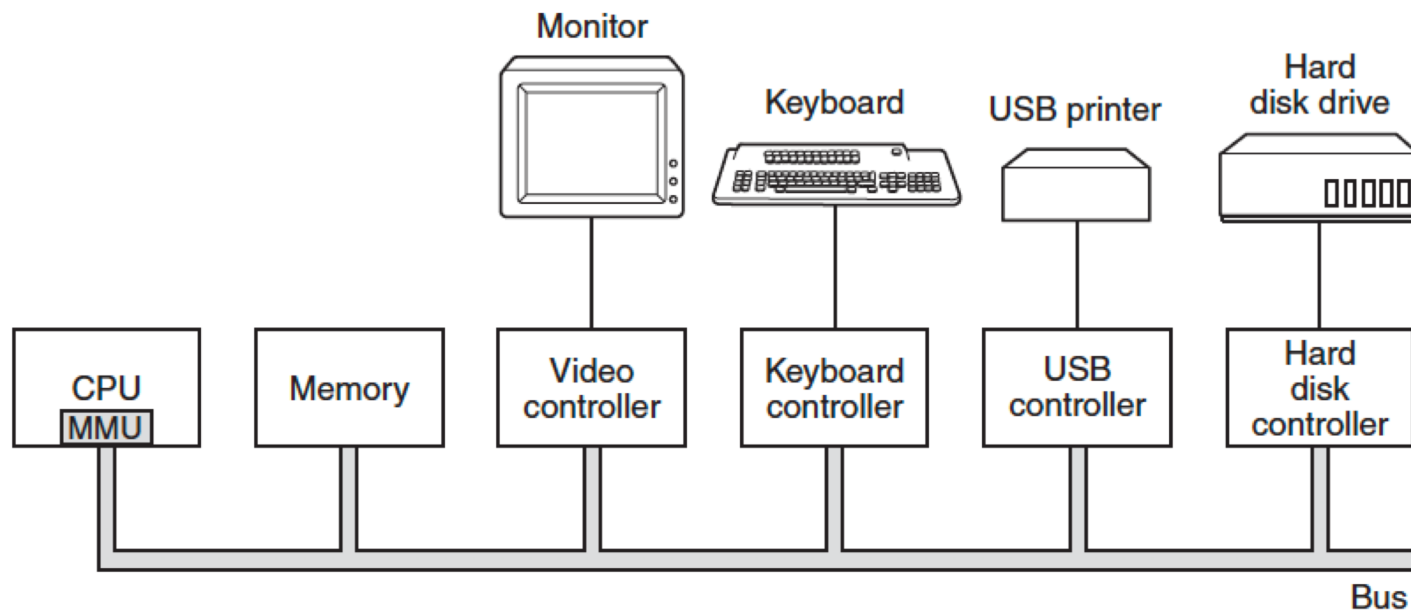
- How OS takes control
 - A **bootstrap** program is loaded and executed at power-up/reboot
 - typically stored in ROM/EPROM as firmware on the motherboard
 - initializes all aspects of the system
 - loads OS kernel and gives control to the kernel

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Computer Hardware Review

- Basic hardware components of a personal computer (PC)

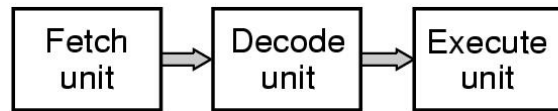


Computer Hardware Review

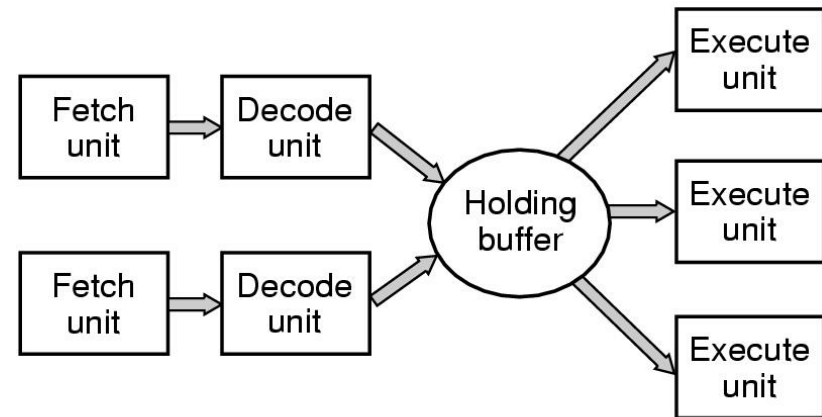
- CPU
 - The “brain” of a computer
 - Executes a specific set of instructions
 - ISA (Instruction Set Architecture)
 - Has a specific set of registers to control the state
 - OS updates the registers to control execution
 - Some important registers
 - **program counter** (PC) contains the memory address of the next instruction to be fetched
 - **stack pointer** points to the top of the current stack in memory
 - **PSW** (Program Status Word) stores control bits
 - e.g., user/kernel mode bit
 - **performance counters** count hardware events

Computer Hardware Review

- CPU
 - Common features to improve performance
 - Pipeline
 - Superscalar



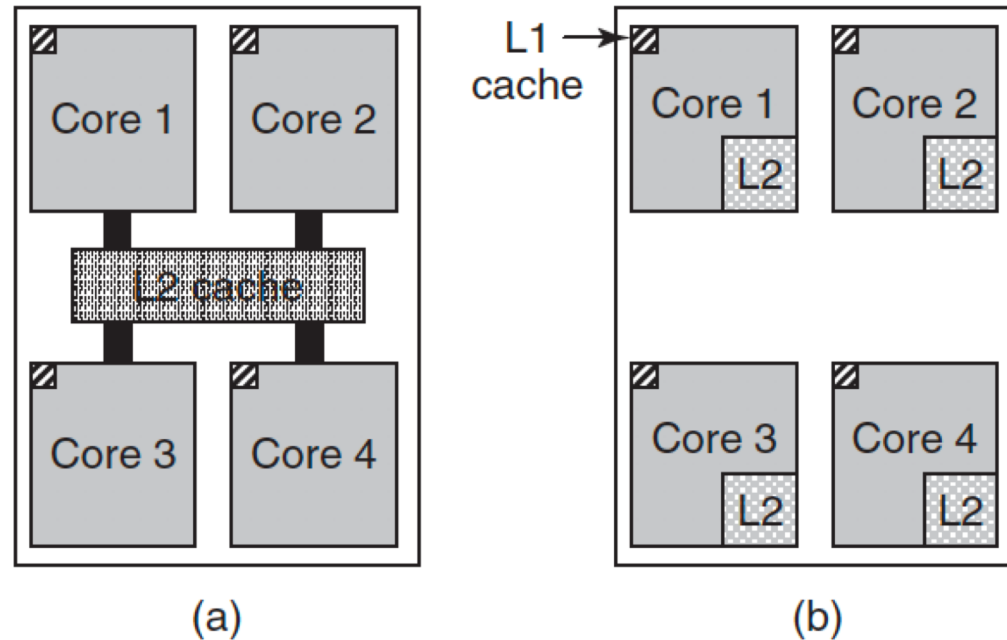
(a)



(b)

Computer Hardware Review

- CPU
 - Common features to improve performance (cont')
 - Multi-core
 - Cache



Computer Hardware Review

- Memory
 - A typical memory hierarchy (a little outdated)

Typical access time

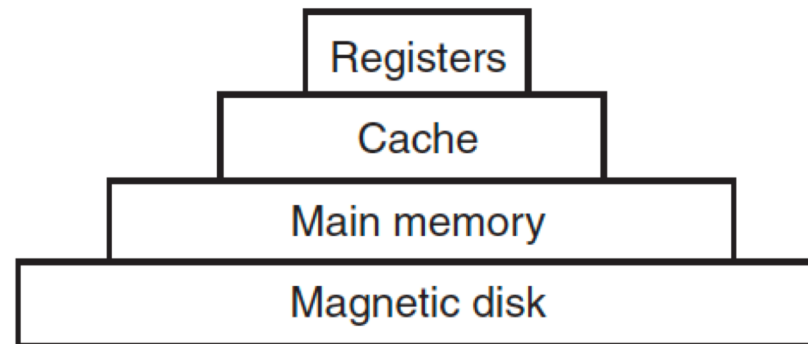
Typical capacity

1 nsec

2 nsec

10 nsec

10 msec



Registers

Cache

Main memory

Magnetic disk

<1 KB

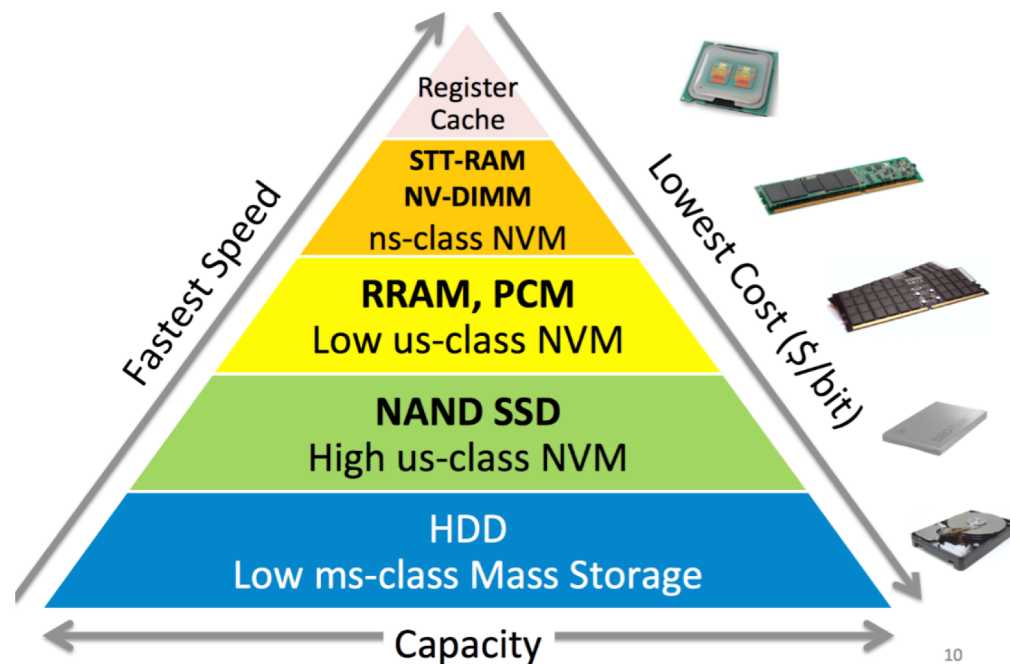
4 MB

1-8 GB

1-4 TB

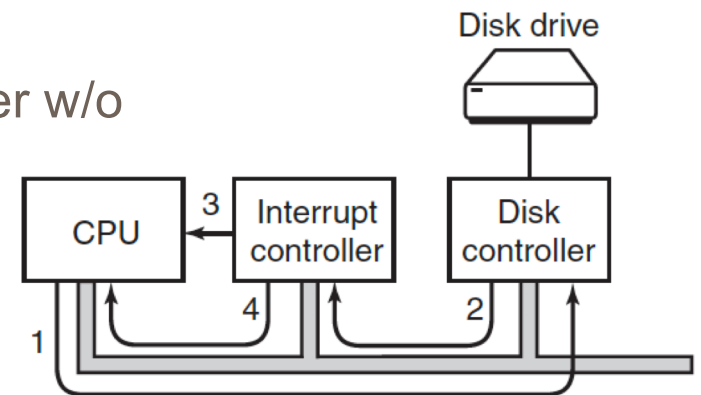
Computer Hardware Review

- Memory
 - A newer version w/ Non-Volatile Memory (NVM)



Computer Hardware Review

- I/O devices
 - Has a controller with multiple registers
 - Three ways of doing I/O
 - Busy waiting
 - CPU keeps polling the device until it is finished
 - Interrupt
 - device tells CPU when it needs attention
 - DMA
 - special HW controlling the bit transfer w/o constant CPU intervention
 - rely on interrupt



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Questions?



*acknowledgement: slides include content from “Modern Operating Systems” by A. Tanenbaum, “Operating Systems Concepts” by A. Silberschatz etc., “Operating Systems: Three Easy Pieces” by R. Arpaci-Dusseau etc., and anonymous pictures from internet.