

CISC 7310X R6

Overview of Computer Systems and Operating Systems

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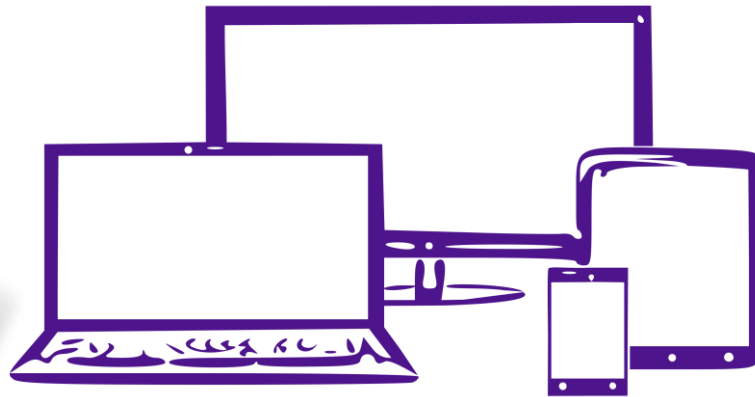
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Let's discuss ...

- Where can you find computers?
- What are computers for?
- What are Operating Systems for?
- Can we run a program on a computer without an Operating System?

Various Computer Systems

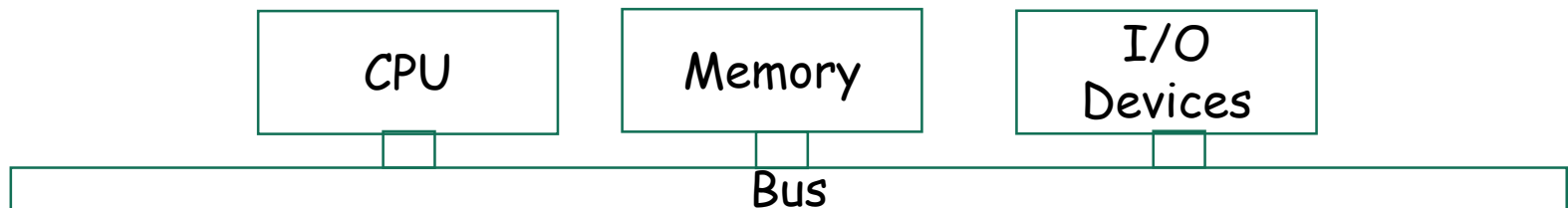


So, lots of computers ...

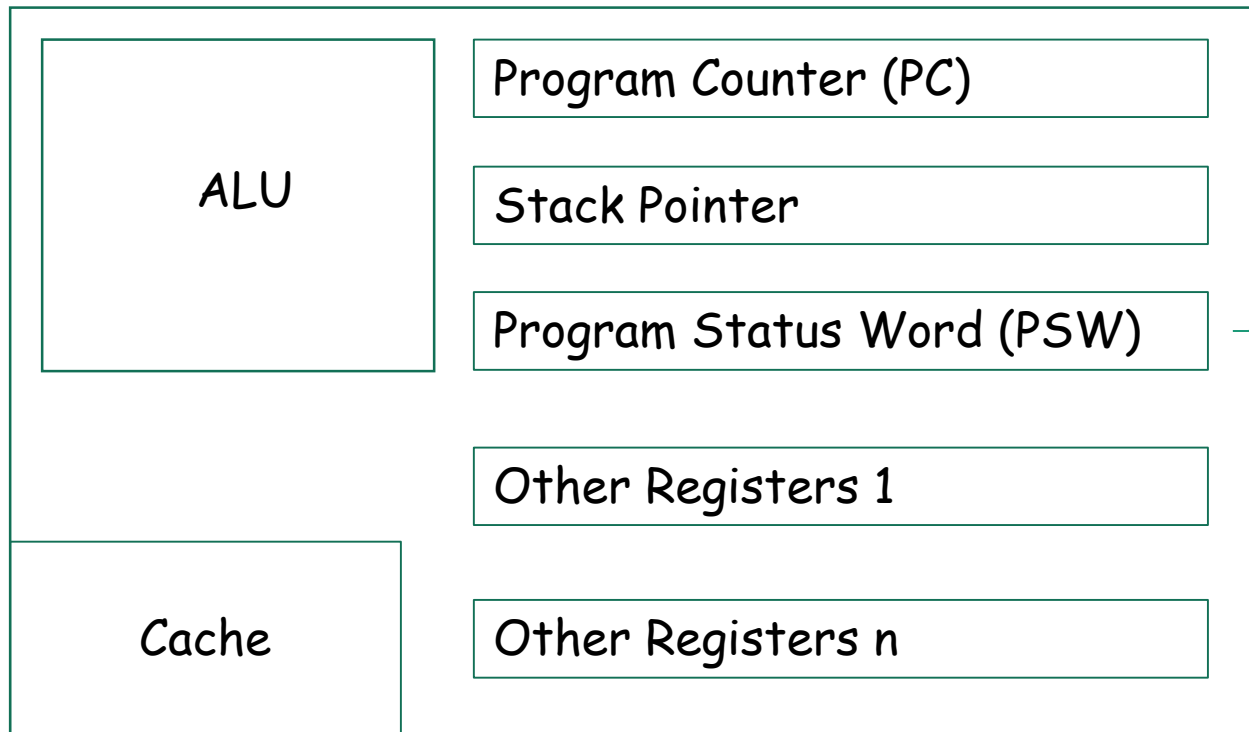
- Question and discussion: what are in common and what are different?

Major Hardware Components

- Processors (CPU)
 - Multithreaded and multicore processors
- Main Memory (Memory)
- Secondary Memory (Disks)
- I/O Devices
- Buses



Processors



Kernel mode:
can execute all
instructions
and access all
hardware
features

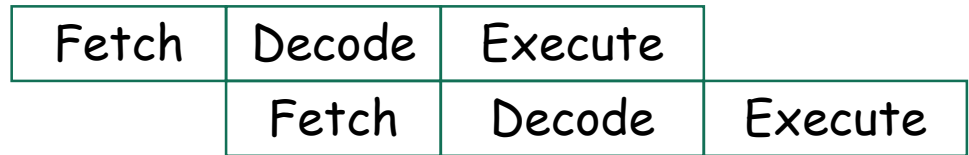
User mode: can
execute subset
of instructions
and access
subset of
hardware
features

Instructions

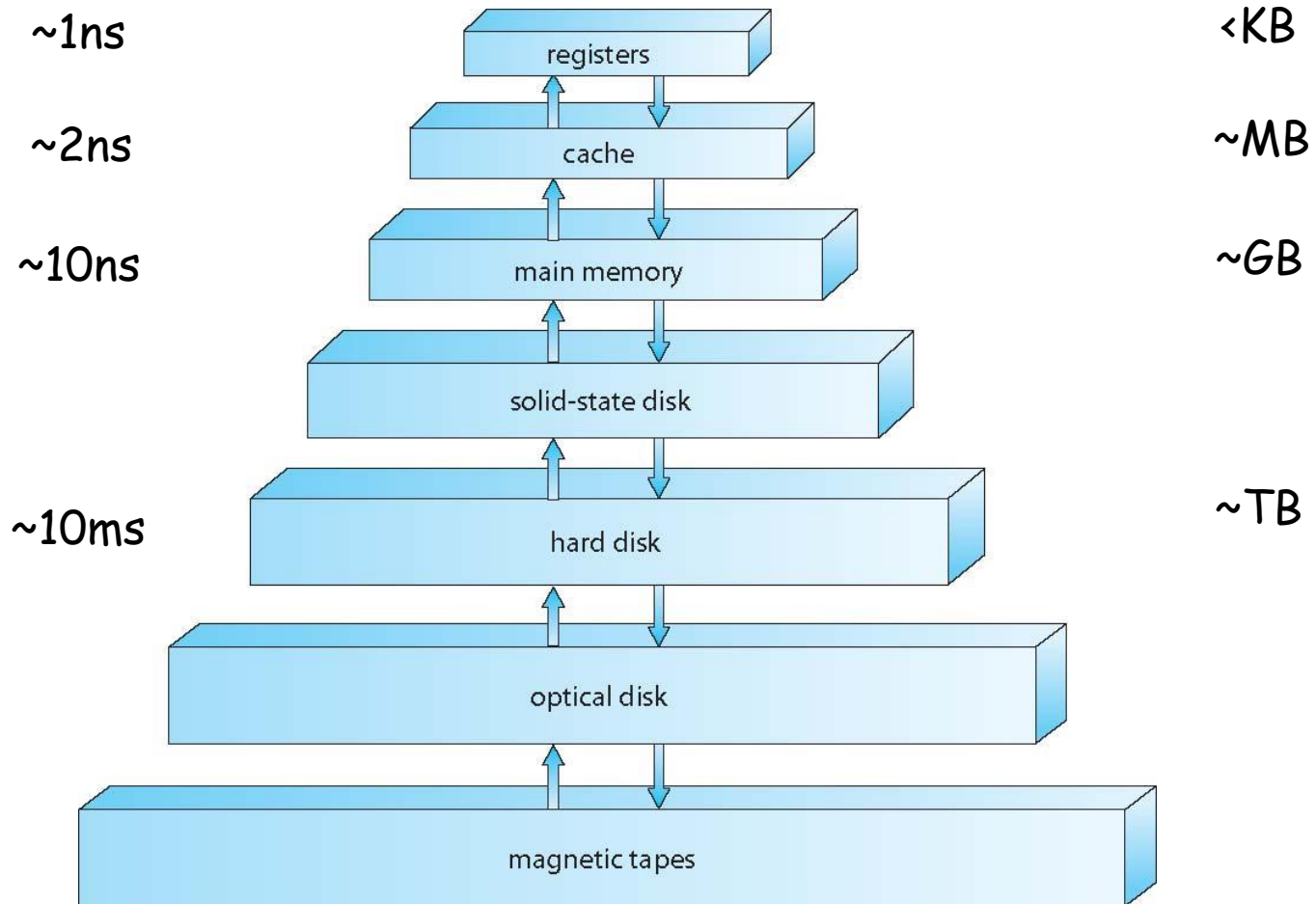
- Basic cycle
 - Fetch, decode, execute
 - Enhance: e.g., pipelining

- Instruction set

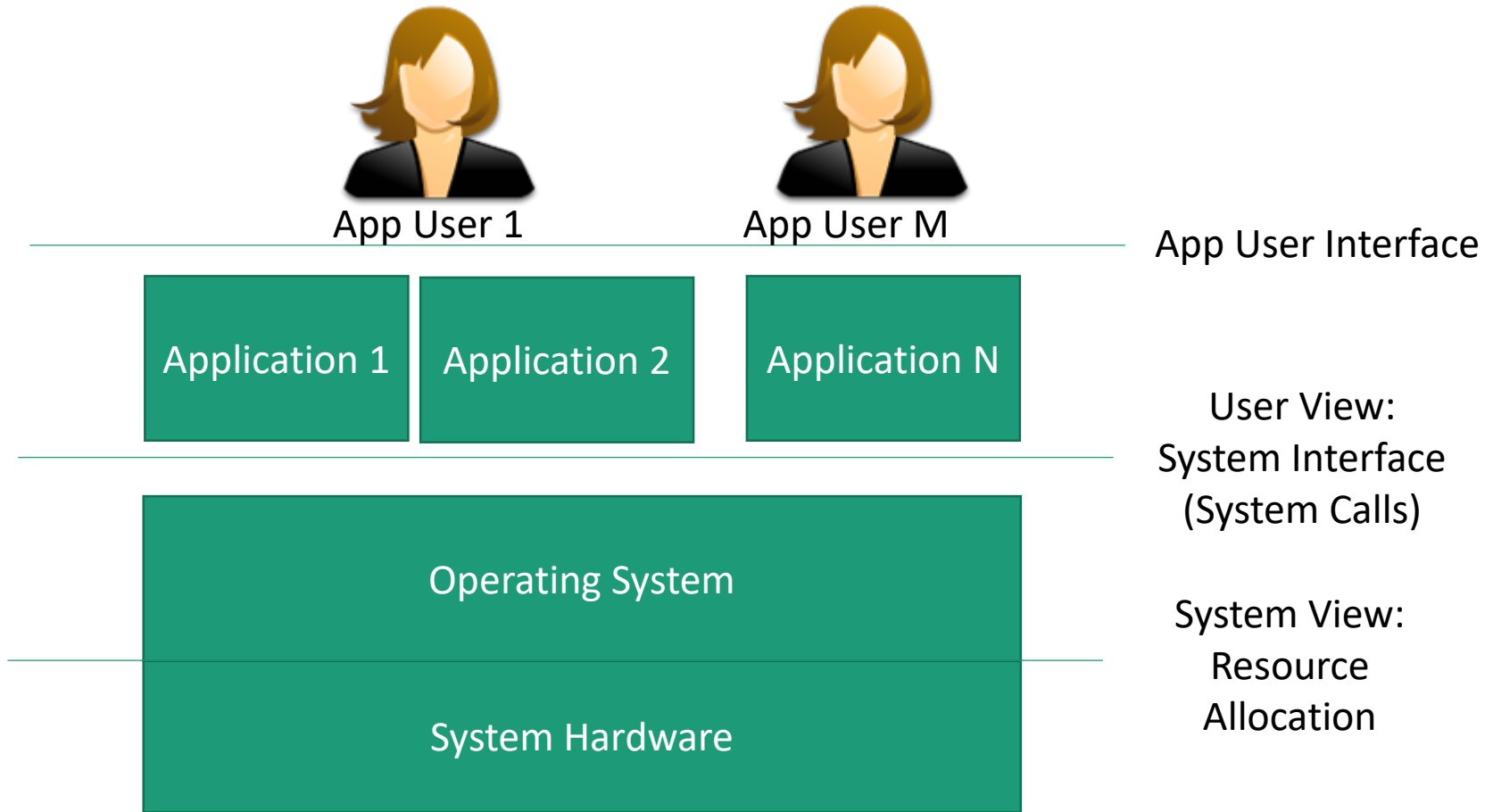
- Examples
 - x86
 - amd64 or x64
 - ARM



Storage Hierarchy



Operating System



Concept of Operating Systems

- A large piece of software function as
 - an extended machine (user view)
 - to provide an “beautiful” interface for application programs via the application developers
 - a resource manager (system view)
 - to provide a “beautiful” allocation scheme to share the processors, memories, and I/O devices in a “computer system”

“beautiful”

- Question & Discussion: what is “beautiful”?

Operating Systems

- Mainframe Operating Systems
- Server Operating Systems
- Multiprocessor Operating Systems
- Personal Computer Operating Systems
- Handheld Computer Operating Systems
- Embedded Operating Systems
- Sensor-Node Operating Systems
- Real-Time Operating Systems
- Smart Card Operating Systems

So, a zoo of operating systems?

- Question: why? How are they differ?

Design Goals

- Resource utilization
- Timeliness
- Throughput
- Robustness
- Energy efficiency

Operating Systems Concepts

- Processes
- Address spaces
- Files
- I/O
- Protection
- The Shell
- The Kernel
- System Calls

Process

- A program in execution
 - Address space
 - Divided into a few parts: e.g., stack, heap, program code, program data
 - Resources
 - List of open files
 - List of related processes
- Current working directory

Systems Research Literature

- Digital Libraries
 - ACM, IEEE, and USENIX
- Google Scholar
 - The Computer Systems subcategory
- List of researches in Section 1.9

Computing Research

- Computation is synthetic
 - Different from natural sciences, such as, biology and physics
 - We create and study artifacts – must show the artifacts are “better”
- Two paradigms
 - Theory and experimentation
 - Theory: Similar to mathematics of an abstract phenomena
 - Experimentation: Property of artifacts
 - System research are largely experimental.

“Better” Property

- Examples
 - “solves a problem in less time”
 - “solves a larger class of problems”
 - “is more efficient of resources”
 - “is more expressive by some criterion”
 - “is more visually appealing in the case of graphics”
 - “presents a totally new capability”

What Makes it Better?

- The “better” property is not simply an observation
- More about postulating that a new idea that something fundamental leads to the “better” result
- Examples
 - Data structure, algorithm, language, mechanism, process, representation, protocol, methodology, optimization or simplification, and model

Research and Practice

- “Research” is broadly defined.
- In practice, the same principle applies
 - When you design a system solution, is it because this is the first design that comes to your mind or it is a better design?

Questions

- Policy and organization of the course
- Overview of computer systems and operating systems
- Assignments
 - See the class website for due dates
 - Descriptions are on CUNY Blackboard