BUCKNELL UNIVERSITY
Computer Science

CSCI 315 Operating Systems Design

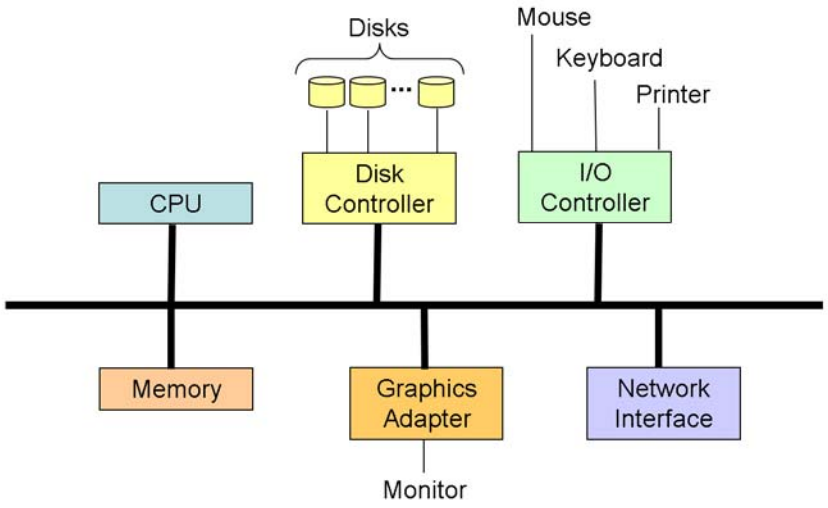
Computer System Structures

Notice: The slides for this lecture have been largely based on those accompanying the textbook *Operating Systems Concepts with Java*, by Silberschatz, Galvin, and Gagne. Many, if not all, the illustrations contained in this presentation come from this source.

Chapter 2: Computer-System Structures

- Computer System Operation
- I/O Structure
- Storage Structure
- Storage Hierarchy
- Hardware Protection
- Network Structure

A Modern Computer System



Computer-System Operation

- I/O devices and the CPU can execute concurrently.
- Each device controller is in charge of a particular device type.
- Each device controller has a local buffer.
- CPU moves data from/to main memory to/from local buffers.
- I/O is between the device to the local buffer of controller.
- Device controller informs CPU that it has finished its operation by causing an *interrupt.*

Common Functions of Interrupts

- Interrupts transfer control to the interrupt service routine generally through the *interrupt vector*, which contains the addresses of all the service routines.
- Interrupt architecture must save the address of the interrupted instruction.
- Incoming interrupts are *disabled* while another interrupt is being processed to prevent a *lost interrupt.*
- A *trap* is a software-generated interrupt caused either by an error or a user request.
- An operating system is *interrupt* driven.

Interrupt Handling

- The operating system preserves the state of the CPU by storing registers and the program counter.
- The OS determines which type of interrupt has occurred:
  - *polling,*
  - *vectored* interrupt system.
- Separate kernel routines determine what action should be taken for each type of interrupt.

I/O Systems

I/O subsystem hides peculiarities of devices from rest of system. It contains:

- *Memory management component*
- *General device driver interface*
- *Drivers for specific hardware devices*

DMA Structure

- Used for high-speed I/O devices able to transmit information at close to memory speeds.
- Device controller transfers blocks of data from buffer storage directly to main memory without CPU intervention.
- Only on interrupt is generated per block, rather than the one interrupt per byte.

Storage Structure

- *Main memory* – the only large storage media that the CPU can access directly.
- *Secondary storage* – extension of main memory that provides large nonvolatile storage capacity.
- *Magnetic disks* – rigid metal or glass platters covered with magnetic recording material:
  - Disk surface is logically divided into *tracks*, which are subdivided into *sectors,*
  - The *disk controller* determines the logical interaction between the device and the computer.

Storage Hierarchy

- Storage systems organized in hierarchy:
  - Speed,
  - Cost,
  - Volatility.
- *Caching* – copying information into faster storage system; main memory can be viewed as a last *cache* for secondary storage.

Caching

- Use of high-speed memory to hold recently-accessed data.
- Requires a *cache management* policy.
- Caching introduces another level in storage hierarchy:
  - This requires data that is simultaneously stored in more than one level to be *consistent.*

From Disk to Register

Consider a system with virtual memory in which an integer variable A has been swapped out of main memory and currently resides on disk. Consider that a machine instruction moves that variable from memory into a register.

Question: What is the sequence of events that ensues until the value of A is finally stored in a register?