Operating System Concepts

Course Code: CSC 2209 Course Title: Operating Systems

Dept. of Computer Science
Faculty of Science and Technology

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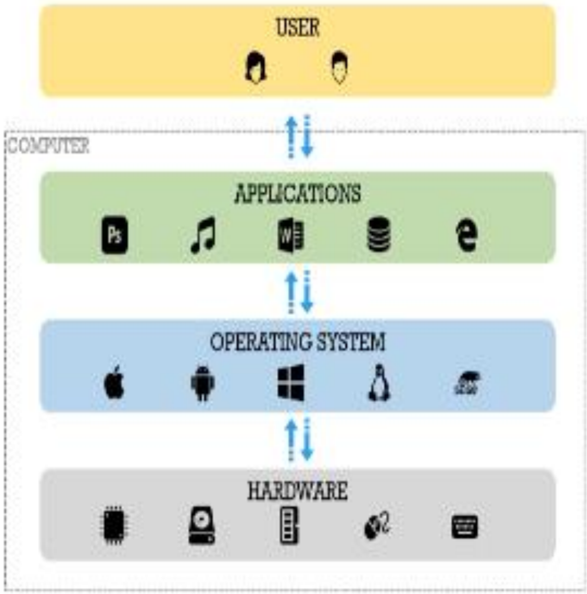
Lecture Outline

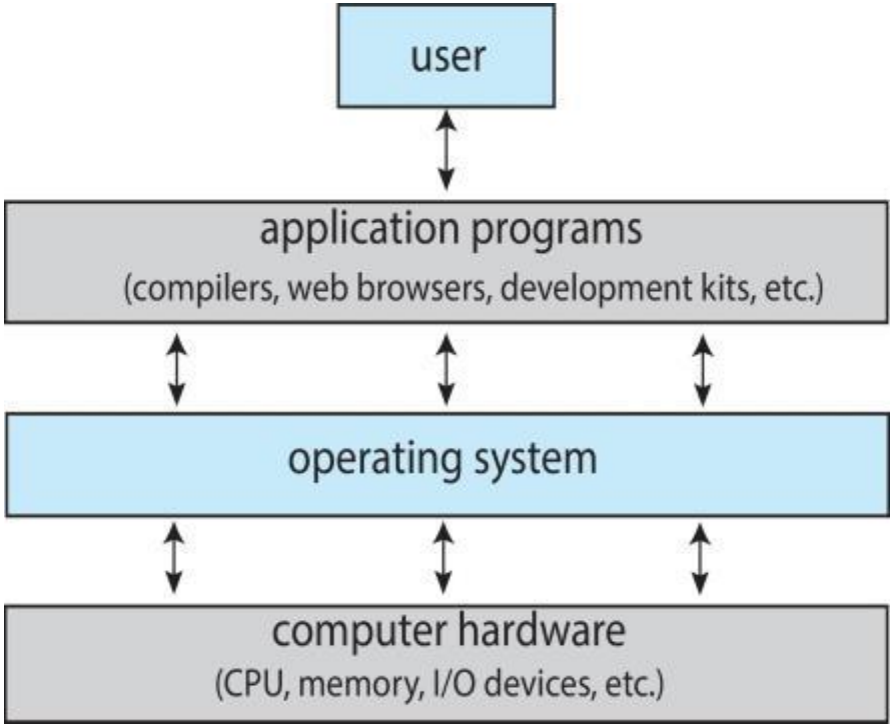
1. Computer System
2. Abstract View of Computer Components
3. What Operating Systems Do
4. Defining Operating Systems
5. Computer System Organization
6. Computer-System Operation
7. Interrupt
8. Computer Startup
9. Interrupt Handling
10. Interrupt-drive I/O Cycle

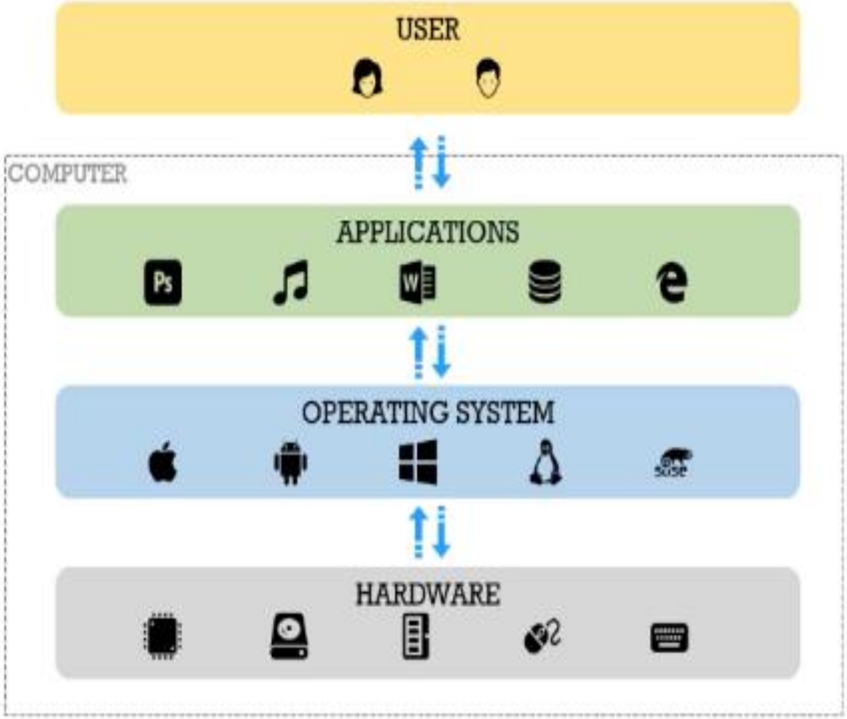
Computer System

- Computer system can be divided into four components:
  - Hardware – provides basic computing resources
    - CPU, memory, I/O devices
  - Operating system
    - Controls and coordinates use of hardware among various applications and users
  - Application programs – define the ways in which the system resources are used to solve the computing problems of the users
    - Word processors, compilers, web browsers, database systems, video games
  - Users
    - People, machines, other computers



Abstract View of Computer Components


user
application programs
(compilers, web browsers, development kits, etc.)
operating system
computer hardware
(CPU, memory, I/O devices, etc.)



What Operating Systems Do

- Depends on the point of view
- Users want convenience, **ease of use** and **good performance**
  - Don’t care about **resource utilization**
- But shared computer such as **mainframe** or **minicomputer** must keep all users happy
  - Operating system is a **resource allocator** and **control program** making efficient use of Hardware and managing execution of user programs
- Users of dedicate systems such as **workstations** have dedicated resources but frequently use shared resources from **servers**

What Operating Systems Do (cont'd)

- Mobile devices like smartphones and tables are resource poor, optimized for usability and battery life
  - Mobile user interfaces such as touch screens, voice recognition
- Some computers have little or no user interface, such as embedded computers in devices and automobiles
  - Run primarily without user intervention

Defining Operating Systems

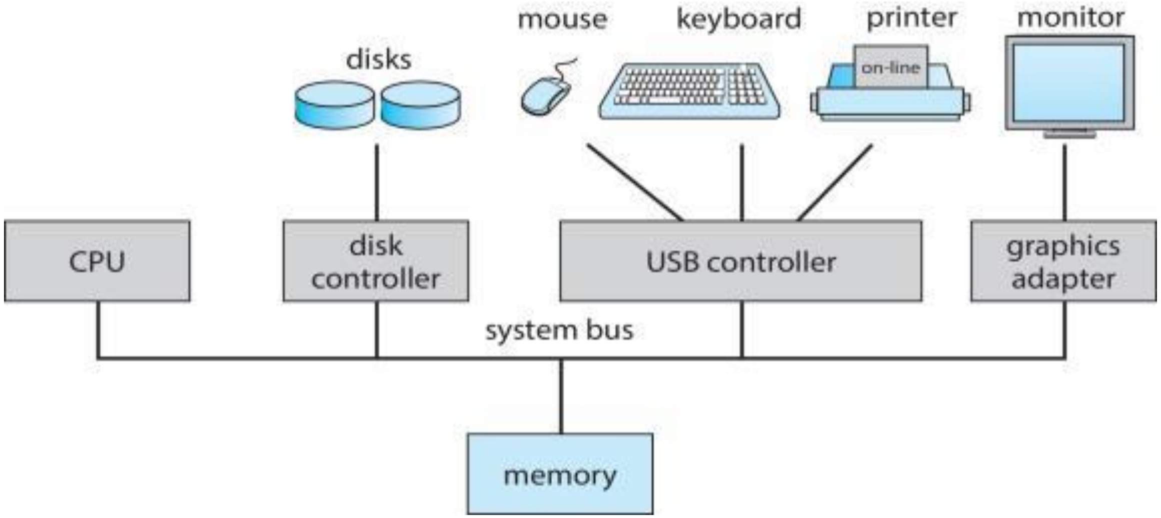
- Term OS covers many roles
  - Because of myriad designs and uses of OSs
  - Present in toasters through ships, spacecraft, game machines, TVs and industrial control systems
  - Born when fixed use computers for military became more general purpose and needed resource management and program control

Operating System Definition (cont'd)

- No universally accepted definition
- "Everything a vendor ships when you order an operating system" is a good approximation
  - But varies wildly
- "The one program running at all times on the computer" is the **kernel,** part of the operating system
- Everything else is either
  - a **system program** (ships with the operating system, but not part of the kernel) , or
  - an **application program**, all programs not associated with the operating system
- Today's OSs for general purpose and mobile computing also include **middleware** – a set of software frameworks that provide addition services to application developers such as databases, multimedia, graphics

Computer System Organization

- ❑ Computer-system operation
  - ❑ One or more CPUs, device controllers connect through common **bus** providing access to shared memory
  - ❑ Concurrent execution of CPUs and devices competing for memory cycles



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**
- Each device controller type has an operating system **device driver** to manage it
- CPU moves data from/to main memory to/from local buffers
- I/O is from the device to **local buffer of controller**
- Device controller informs CPU that it has finished its operation by causing an **interrupt**

Common Functions of Interrupts

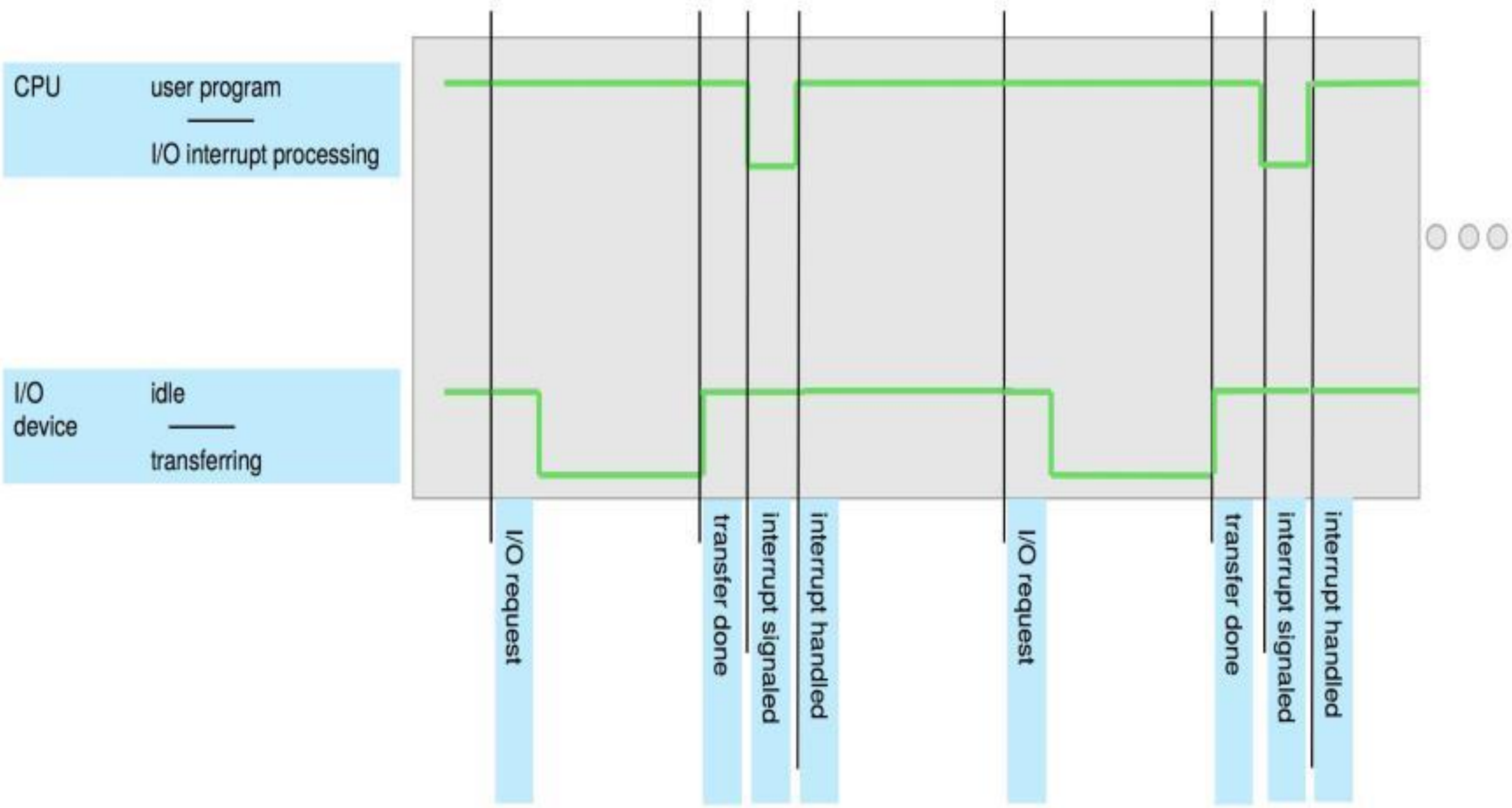
- ❑ Interrupt transfers control to the interrupt service routine generally, through the **interrupt vector**, which contains the addresses of all the service routines

- ❑ Interrupt architecture must save the address of the interrupted instruction

- ❑ A **trap** or **exception** is a software-generated interrupt caused either by an error or a user request

- ❑ **An operating system is interrupt driven**

Interrupt Timeline



Computer Startup

- **bootstrap program** is loaded at power-up or reboot
  - Typically stored in **ROM** or **EPROM**, generally known as **firmware**
  - **Initializes all aspects of system**
  - **Loads operating system kernel and starts execution**

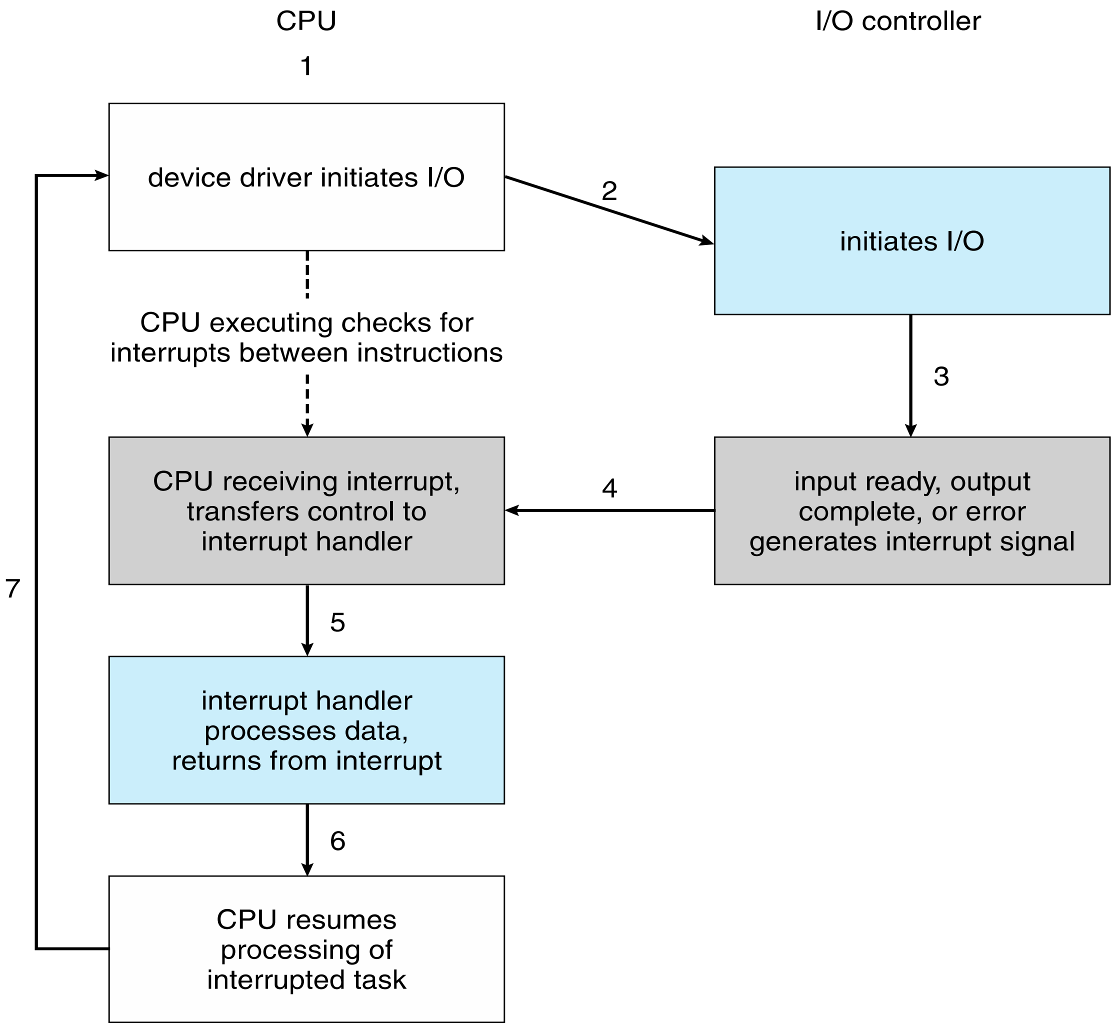
EPROM : Erasable Programmable Read-only Memory

ROM : Read Only Memory

Interrupt Handling

- The operating system preserves the state of the CPU by storing registers and the program counter
- Determines which type of interrupt has occurred:
  - **Polling** interrupt (CPU keeps polling at regular intervals if a device is ready)
  - **Vectored** interrupt (I/O device requests for attention)
- Separate segments of code determine what action should be taken (for each type of interrupt)

Interrupt-drive I/O Cycle


CPU
I/O controller
1
device driver initiates I/O
2
initiates I/O
CPU executing checks for interrupts between instructions
3
CPU receiving interrupt, transfers control to interrupt handler
4
input ready, output complete, or error generates interrupt signal
7
5
interrupt handler processes data, returns from interrupt
6
CPU resumes processing of interrupted task

Books

- Operating Systems Concept
  - Written by Galvin and Silberschatz
  - Edition: 9th

References

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