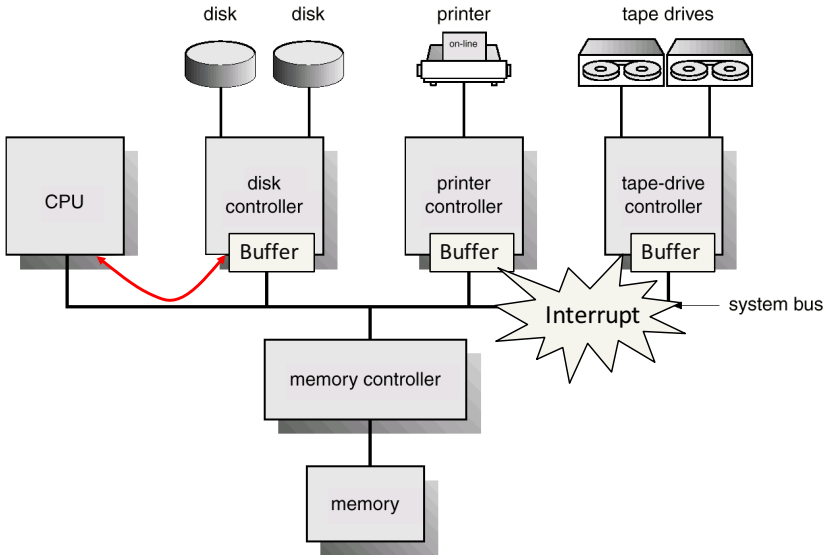
1. Review the following concepts on Computer System Operation, and explain how they are related to Operating Systems.

a) Computer Organization

b) Interrupts

c) I/O Structure: Interrupt-Driven Data Transfer, Direct Memory Access (DMA) Data Transfer

Computer Organization



- Computer Organization
  - What is a device controller?

    Each device controller is in charge of the operations for a particular device type.
  - What is the channel through which devices and the CPU communicate?

    A system bus.
  - How do devices notify CPU that I/O operations are done?

    Interrupt.

1. Review the following concepts on Computer System Operation, and explain how they are related to Operating Systems.

a) Computer Organization

b) Interrupts

c) I/O Structure: Interrupt-Driven Data Transfer, Direct Memory Access (DMA) Data Transfer

Interrupt

- Why do we say "Operating systems are interrupt driven"?

  If there are no interrupts, OS will not execute (idle).
- What are the major steps of interrupt handling?

  Three steps:
  - First, OS saves the state of the current execution.
  - Second, it determines the interrupt service routine according to the interrupt type.
  - Third, the interrupt service routine is executed.

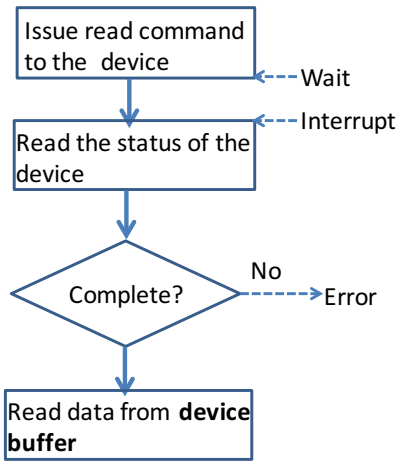
1. Review the following concepts on Computer System Operation, and explain how they are related to Operating Systems.

a) Computer Organization

b) Interrupts

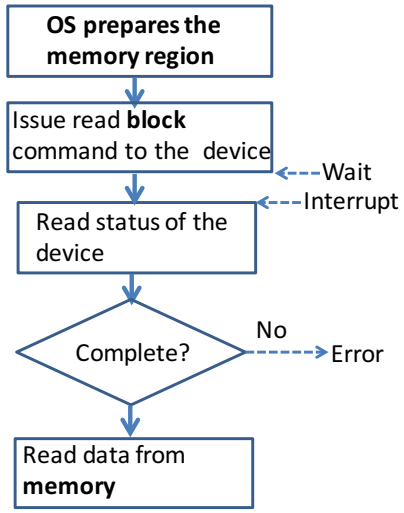
c) I/O Structure: Interrupt-Driven Data Transfer, Direct Memory Access (DMA) Data Transfer

What are Major Differences between Interrupt Driven I/O and DMA?



(a) Interrupt driven I/O

- **Small size I/O**
- **More Interrupts**
- **Low-speed devices**



(b) DMA

- **Block based I/O**
- **Less interrupts**
- **High-speed devices**

2. Indicate whether the following statements are true or false. Justify your answers.

a) All I/O instructions are privileged instructions.

b) Given a base register value of 0x1000 and a limit register value of 0x1000, access to memory location 0x1FFF will generate a trap.

c) Popular operating systems for personal computer use (such as Windows and Linux) are real-time systems.

d) A system call always generates a trap.

2a) All I/O instructions are privileged instructions.

→ True.

Justification: I/O operations must go through OS to ensure their correctness and legality.

2b) Given a base register value of 0x1000 and a limit register value of 0x1000, access to memory location 0x1FFF will generate a trap.

→ False.

Justification: For memory protection, each access to memory by a process must be in the range [base, base+limit-1]. In this case, it translates to the range [0x1000, 0x1FFF]. Hence the access to memory location 0x1FFF will succeed and not generate a trap.

2c) Popular operating systems for personal computer use (such as Windows and Linux) are real-time systems.

→ False.

Justification: Those systems are usually time sharing system.

More: Real-time scheduling in e-learning video.

2d) A system call always generates a trap.

→ True.

Justification: When a system call is encountered, hardware switches from user to kernel mode and generates a trap. The appropriate system call function in the kernel is then identified and executed.

3. Distinguish between multiprogramming and multiprocessing. What were the key motivations for the development of each?

Multiprogramming vs. Multiprocessing

- Multiprogramming refers to the running of **more than one program** concurrently in a computer system (even if it has only a single-core CPU).
  - Goal: improve CPU utilization.
- Multiprocessing is the execution of programs on a computer system comprised of **more than one processing cores (multi-core CPU)**.
  - Goal: increase computing power with **parallel** architectures.

Multiprogramming vs. Multiprocessing (cont')

Process: Order→Wait till food is ready →Get food

- User A: buy chicken wings
- User B: buy noodles

Multiprogramming shop

Multiprocessing shop