

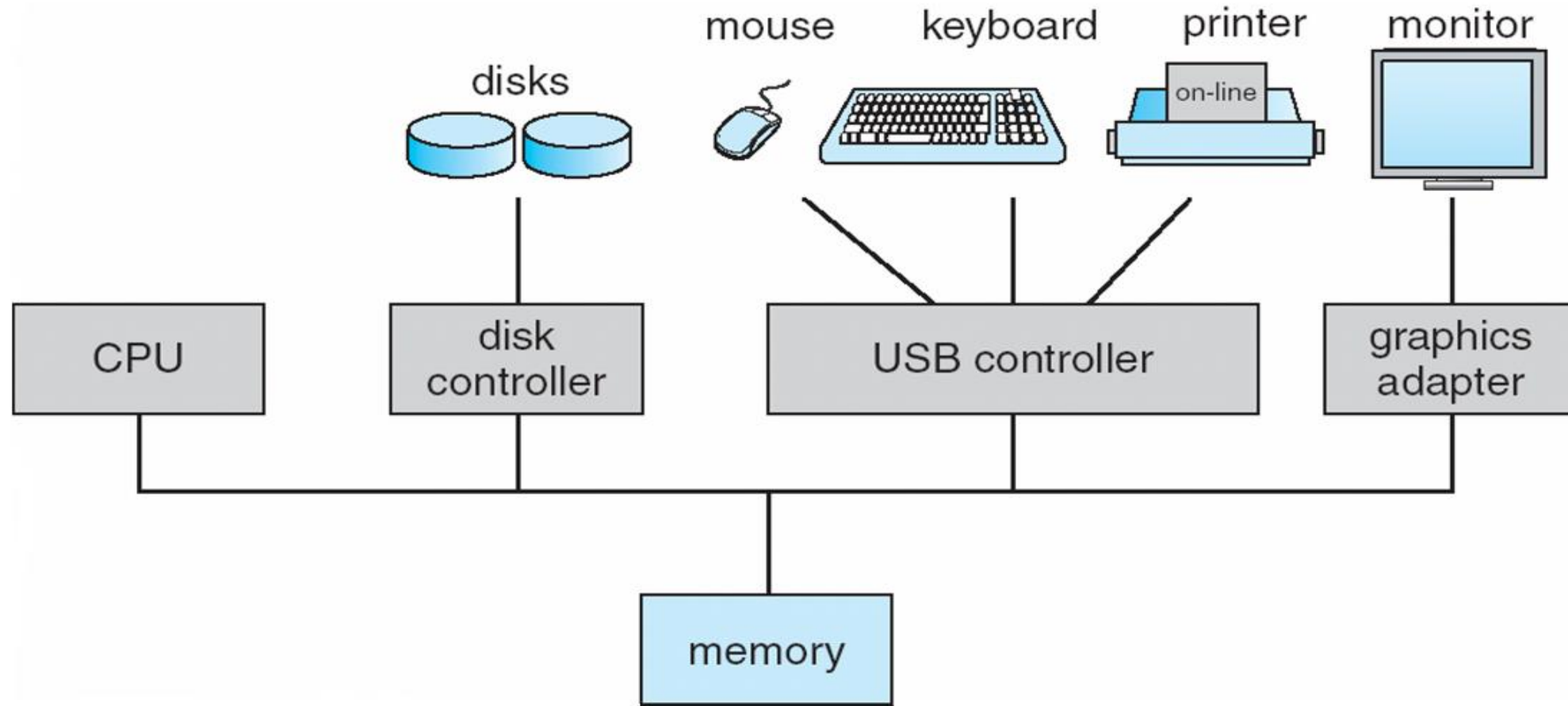
# Computer Fundamentals

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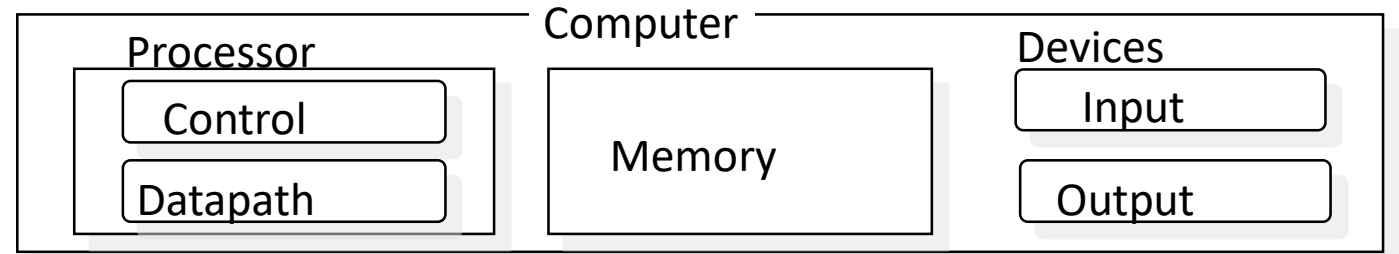


# A Computer System



# What is computer?

- **Computer is a machine/hardware which does different tasks for the user efficiently and effectively.**
- Since the 1940's, computers have 5 classic components
- **Input devices**
  - Keyboard, mouse, ...
- **Output devices**
  - Display, printer, ...
- **Storage devices**
  - Volatile memory devices: RAM, DRAM, SRAM, ...
  - Permanent storage devices: Magnetic, Optical, and Flash disks, ...
- **Data path (ALU)**
- **Control (ROM)**
- Newly added 6<sup>th</sup> component: **Network**
  - Essential component for communication in any computer system



} Together, they are called the **Processor**



# Computer System Components

1. **Hardware** – provides basic computing resources (CPU, Memory, I/O devices, Communication).
2. **Operating System** – controls and coordinates use of the hardware among various application programs for various users.
3. **System & Application Programs** – ways in which the system resources are used to solve computing problems of the users (Word processors, Compilers, Web browsers, Database systems, Video games).
4. **Users** – (People, Machines, other computers).



# What happens when we start a computer?? (Booting Process)

- Hardware doesn't know where the operating system resides and how to load it.
- **Bootstrap Program :**
  - Initial program to run a system
  - Locating and Loading OS Kernel in main memory
- Where it is stored ??? ROM
- What it does???
  - Initialize the system from CPU registers, device controllers and memory controllers

• If any storage device/partition contains one special program called as "**bootstrap program**" in its first sector i.e. in a boot sector then such a device/partition is referred as **bootable device/partition**.  
• e.g. hard disk drive, pen drive, CD/DVD



## 1. Machine Boot

- When we switch on the power current gets passed to the motherboard and one program gets invoked named as "**BIOS**" which exists in the ROM memory on motherboard.
- BIOS -- Basic Input Output System -- which is a **micro-program**.
- A micro-program is a program which is smaller in size and can be stored into the memory with its all possible set of input values.
- first step of BIOS is "**POST**" - **Power On Self Test**, under POST BIOS checks whether all peripherals are connected properly or not and their working status.
- "**peripherals or peripheral devices**" -- devices which are connected to the motherboard externally are called as peripherals.
- after POST BIOS executes "**bootstrap loader**", bootstrap loader searches for available bootable devices and selects any one out of it as per the defined priorities.

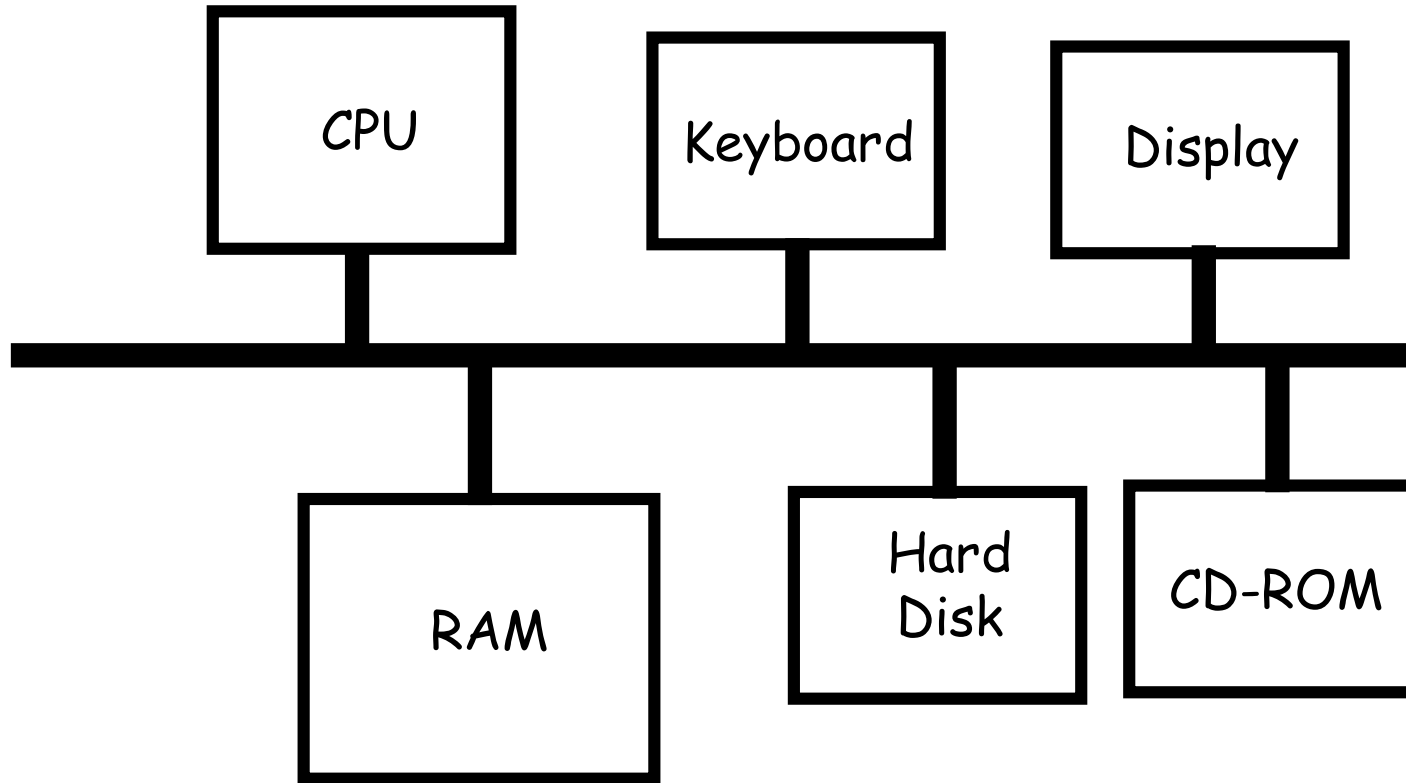


## 2.System boot:

- if hard disk drive got selected as a bootable device and if it contains multiple OS's have installed on it, then "**bootloader**" program gets executes.
- **Boot loader program** displays list of operating system installed onto the machine, so that user can select any one at a time from and it invokes bootstrap program of selected operating system.
- Bootstrap program locates the kernel and load it into the main memory.



# Computer Fundamentals

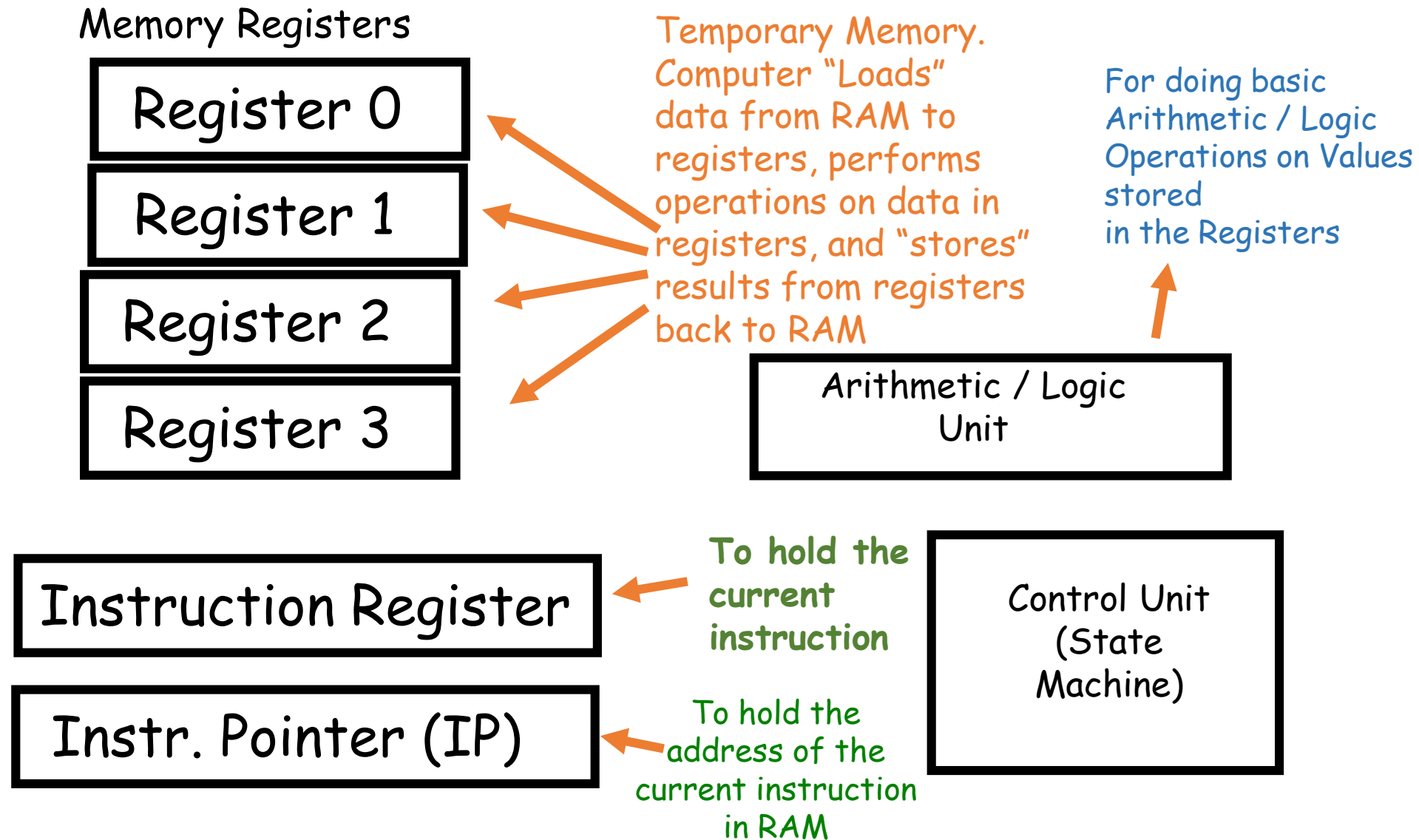


**It is a system concept integrating software and hardware to specify the design of computing systems**





# CPU



# Bus,CU,ALU,Memory

## Bus

- It is a simplified way for many devices to communicate to each other.
- It is internal arrangement of computer system which includes design of the processor , memory and input/output units.

## Control Unit

- Control is responsible for determining what action is to be performed on what data.
- controls all operations and it controls devices which are connected to the computer system by coordinating with device controllers.
- Fetch-Decode-Execute

## ALU (Arithmetic Logic Unit)

- ALU is mainly comprised of logic gates, circuits made from transistors that take inputs.
- ALU performs all arithmetic and logical operations.

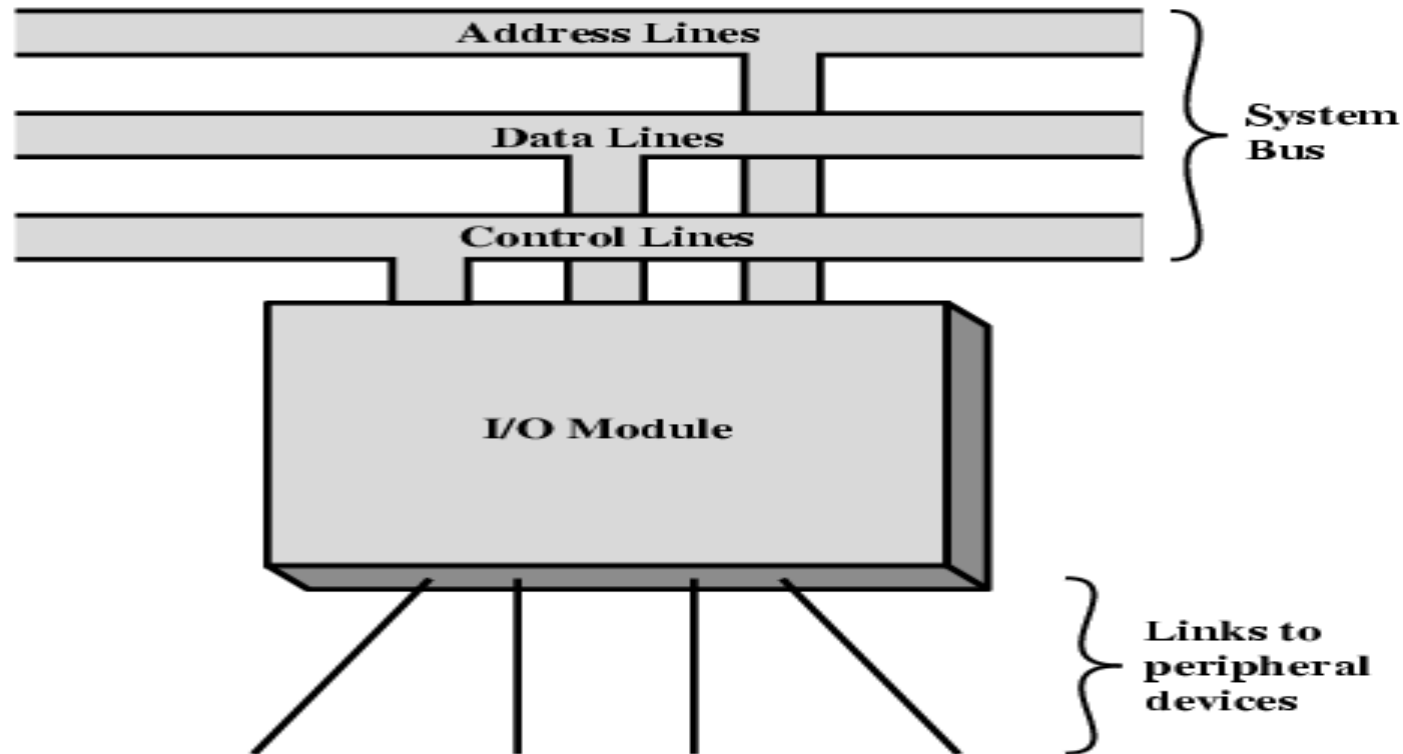
## Memory

- Memory consists of circuits whose primary purpose is to **hold information**, but only temporarily.
- When you talk about the memory of a computer, most often you're talking about its RAM.

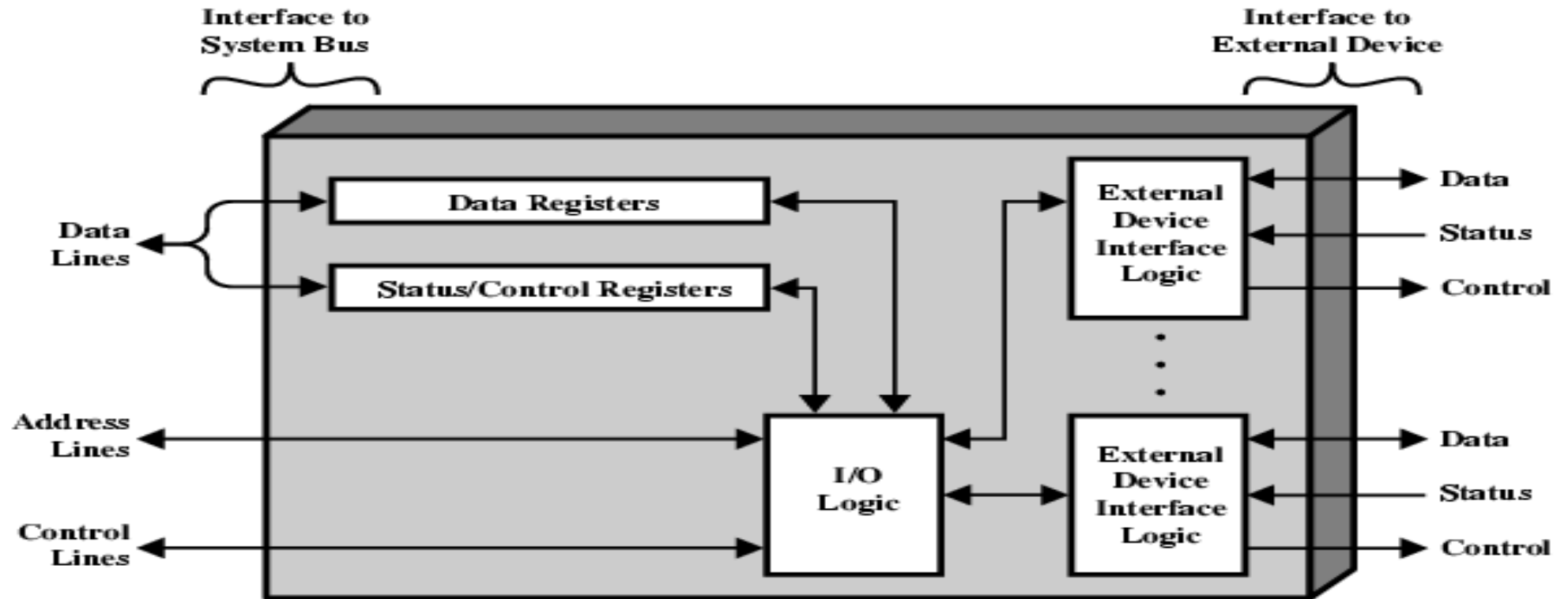


# Input/Output

- The Input unit allows programs and data to be entered into the computer.
- The Output unit allows the results of processing to be exported to the outside world or other devices or saved to be used later.



# IO Module Diagram

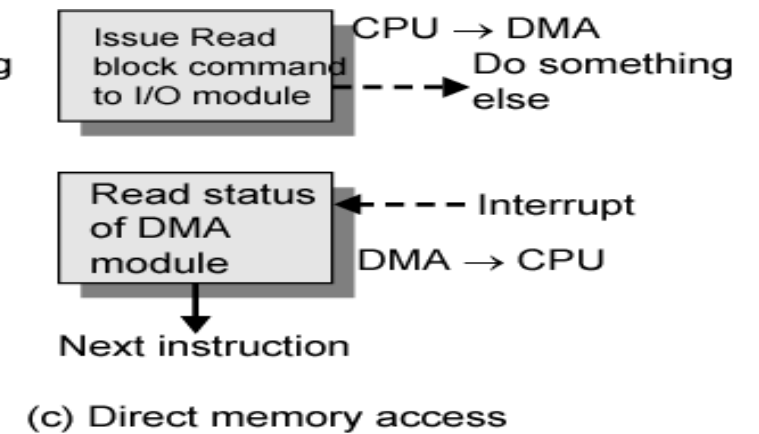
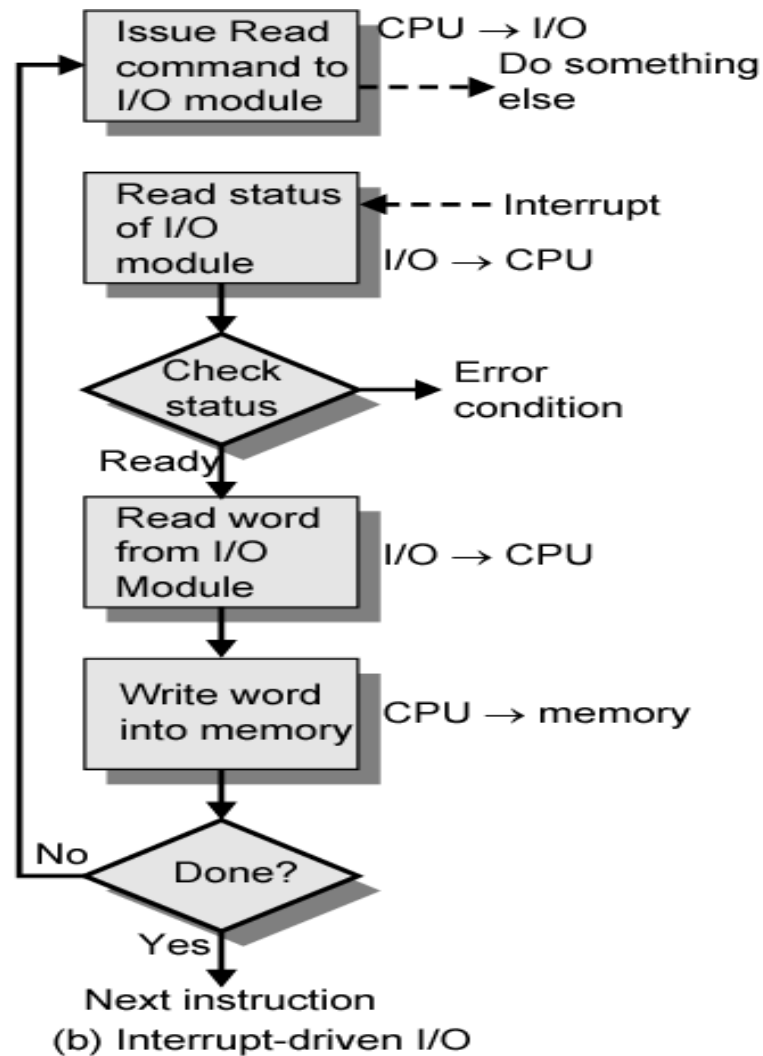
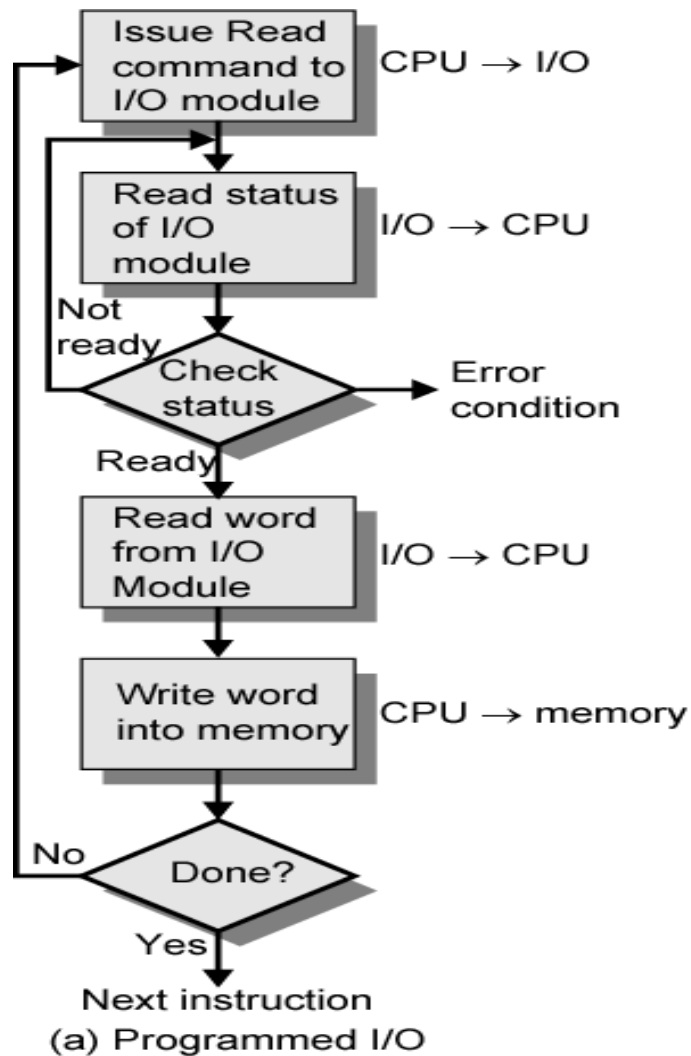


# Input Output Techniques

- Communication between memory and IO devices.
- IO Techniques:
  - Programmed IO:
    - CPU waits for IO operations to be completed
    - As CPU is faster so time is wasted
  - Interrupt driven IO
    - CPU issues a command, and proceed for its work until interrupt by IO device
  - Direct Memory Access (DMA)
    - transferring data within main memory and external device without passing it through the CPU.

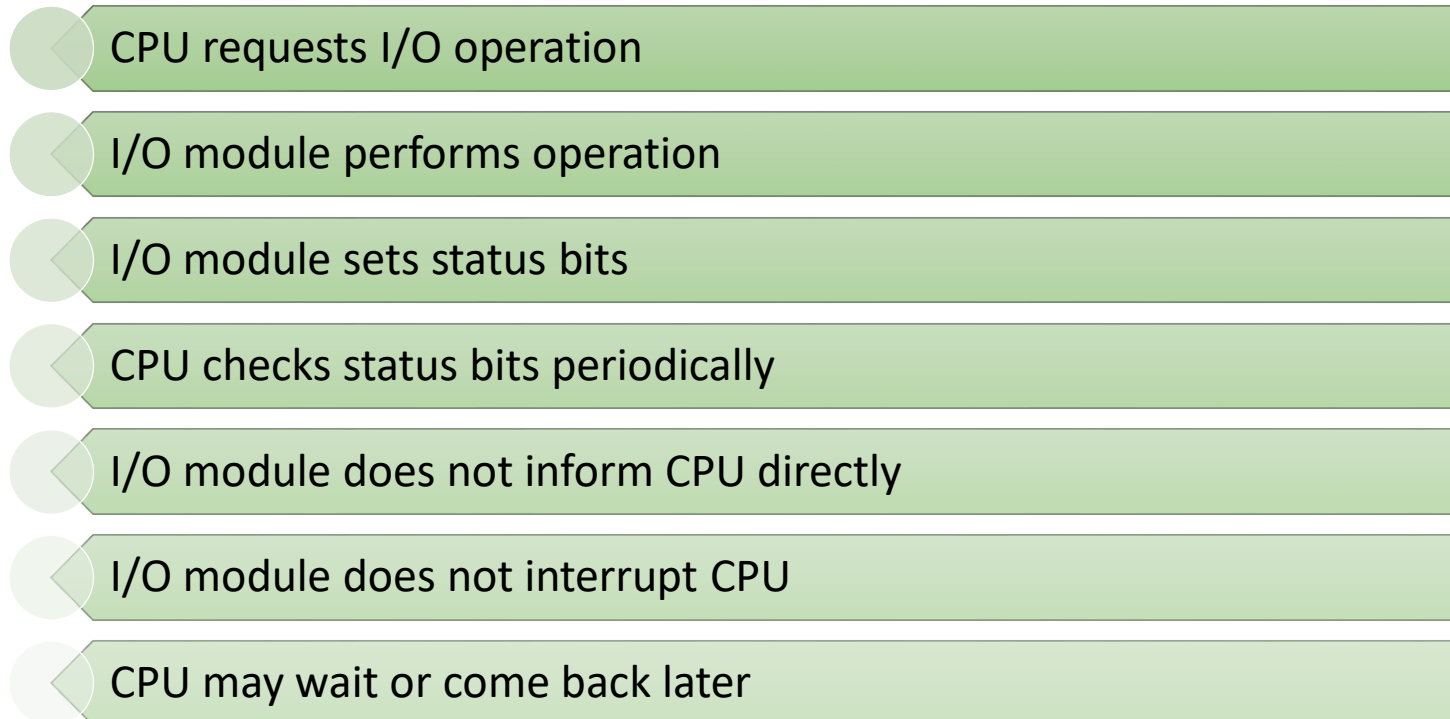


# IO Techniques for Input of a Block of Data



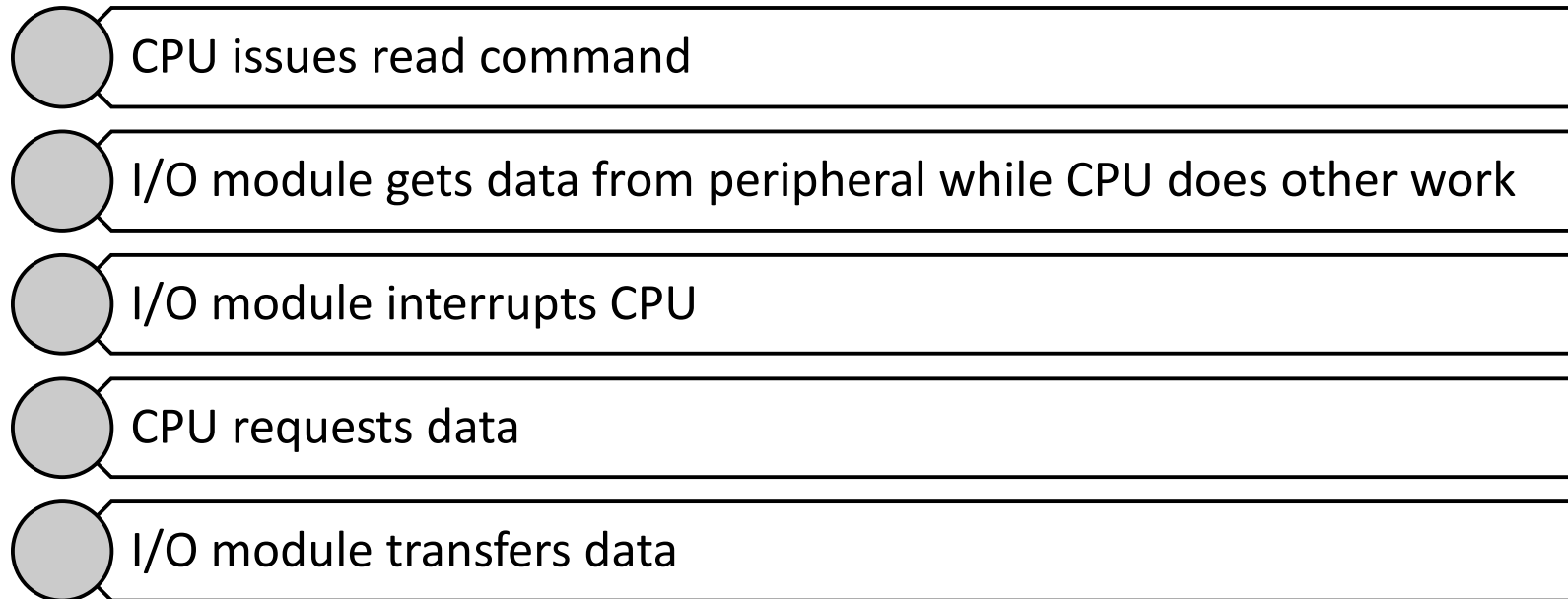
# Programmed I/O

- CPU has direct control over I/O
  - Sensing status
  - Read/write commands
  - Transferring data
- CPU waits for I/O module to complete operation
- Four IO Commands : Control, Test, Read, Write



# Interrupt Driven I/O

- Overcomes CPU waiting
- No repeated CPU checking of device
- I/O module interrupts when ready
- ISR (Interrupt Service Routine)
  - the processors enter an ISR
- **IVT and ISR**

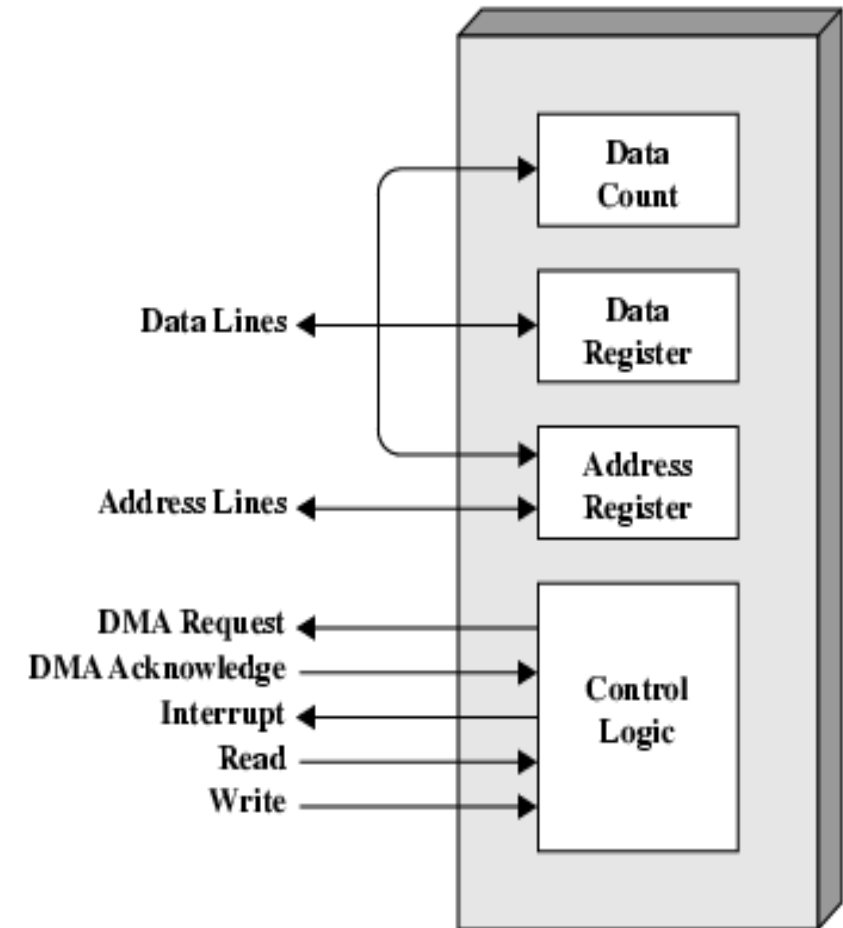




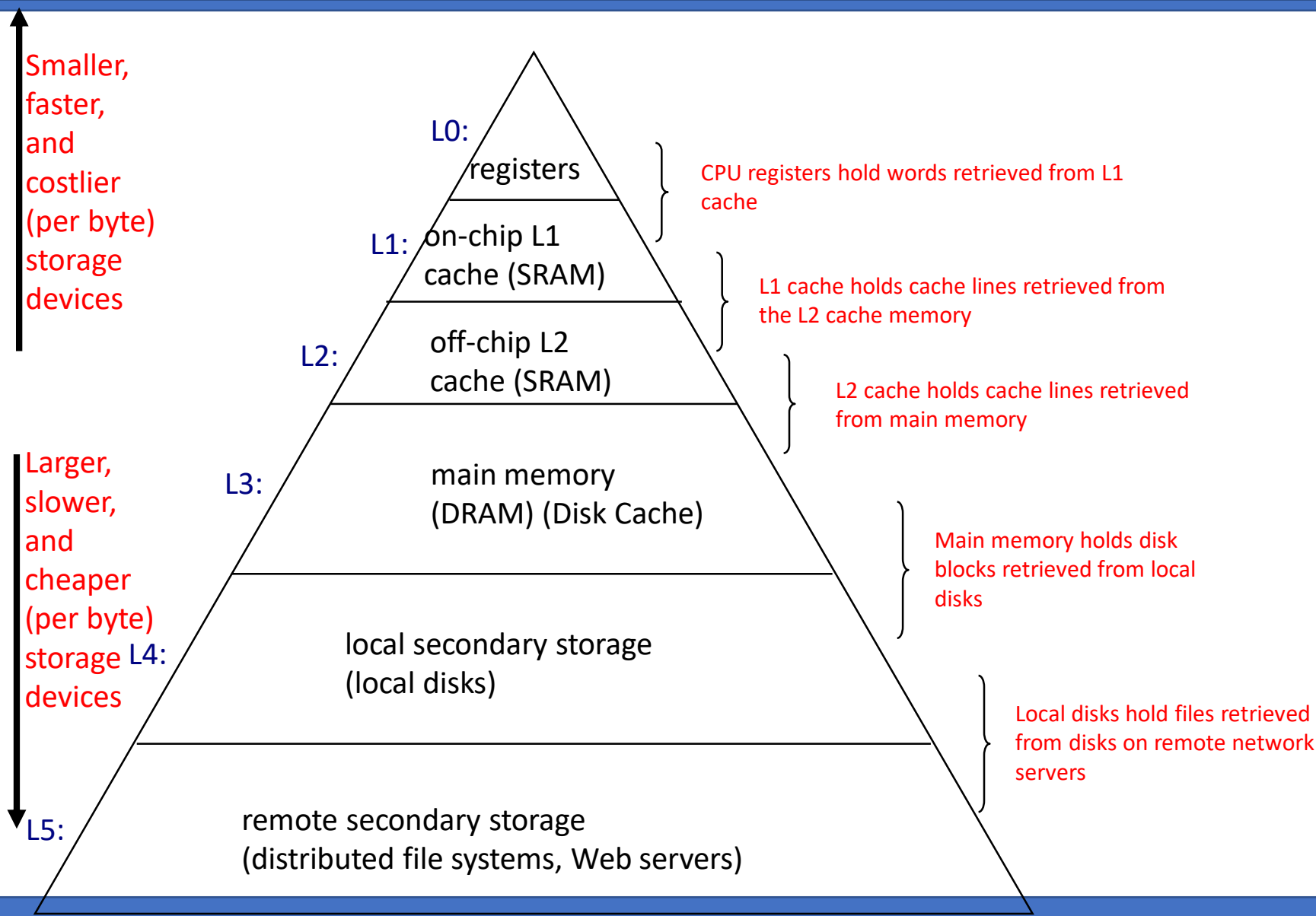
# Direct Memory Access

- Interrupt driven and programmed I/O require active CPU intervention
  - Transfer rate is limited
  - CPU is tied up
- DMA Operations:
  - When the processor wishes read or send a block of data, it issues a command to the DMA module by sending some information to DMA module.
  - The information includes:
    - read or write command, sending **through read and write control lines**.
    - number of words to be read or written, communicated on the **data lines** and stored in the **data count register**.
    - starting location in memory to read from or write to, communicated on data lines and stored in the **address register**.
    - **address of the I/O device** involved, communicated on the **data lines**.

When the transfer is complete, the DMA module sends an interrupt signal to the processor to inform that it has finish using the system bus



# Memory Hierarchy



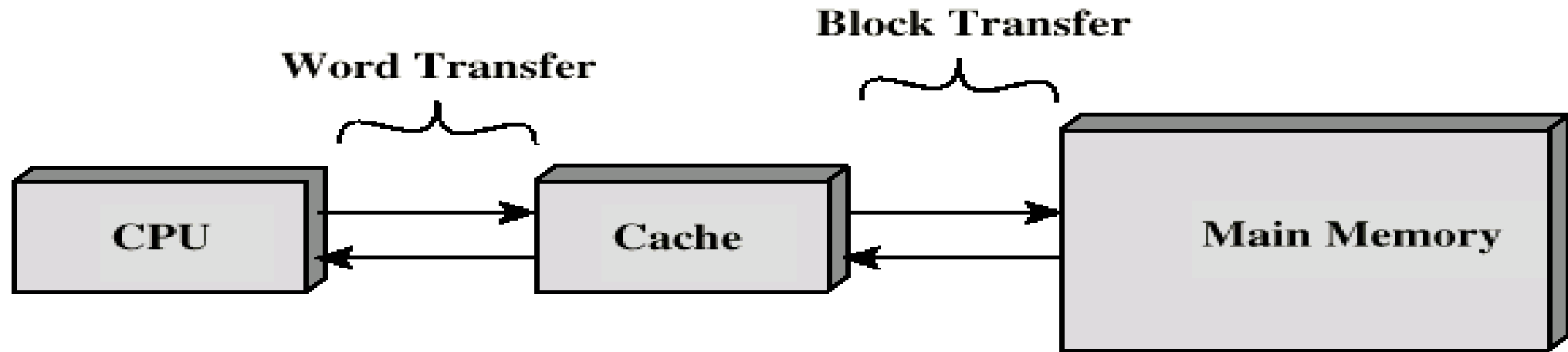
# Hierarchy List

- Registers
  - L1 Cache
  - L2 Cache
  - Main memory
  - Disk cache
  - Disk
  - Optical
  - Tape
- As one goes down the hierarchy
    - Decreasing cost per bit
    - Increasing capacity
    - Increasing access time
    - Decreasing frequency of access of the memory by the processor – locality of reference

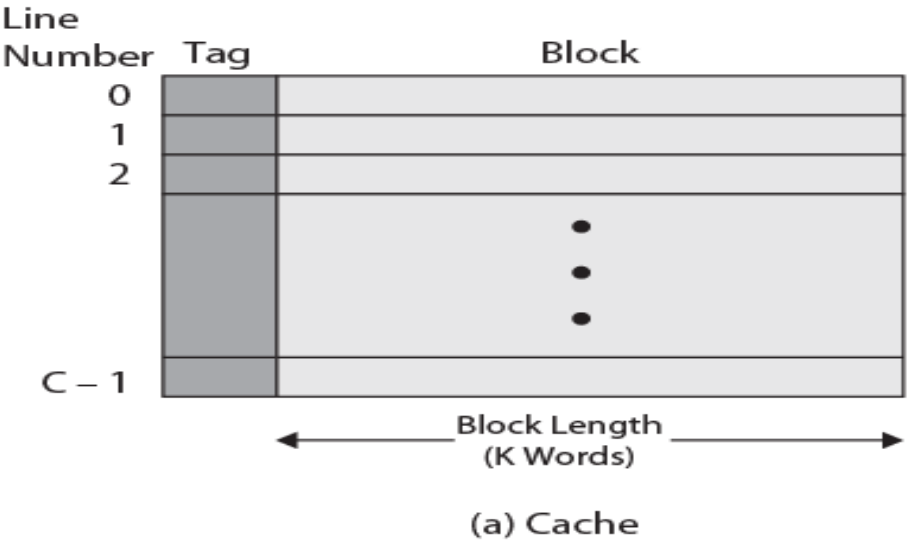


# Cache & Main Memory

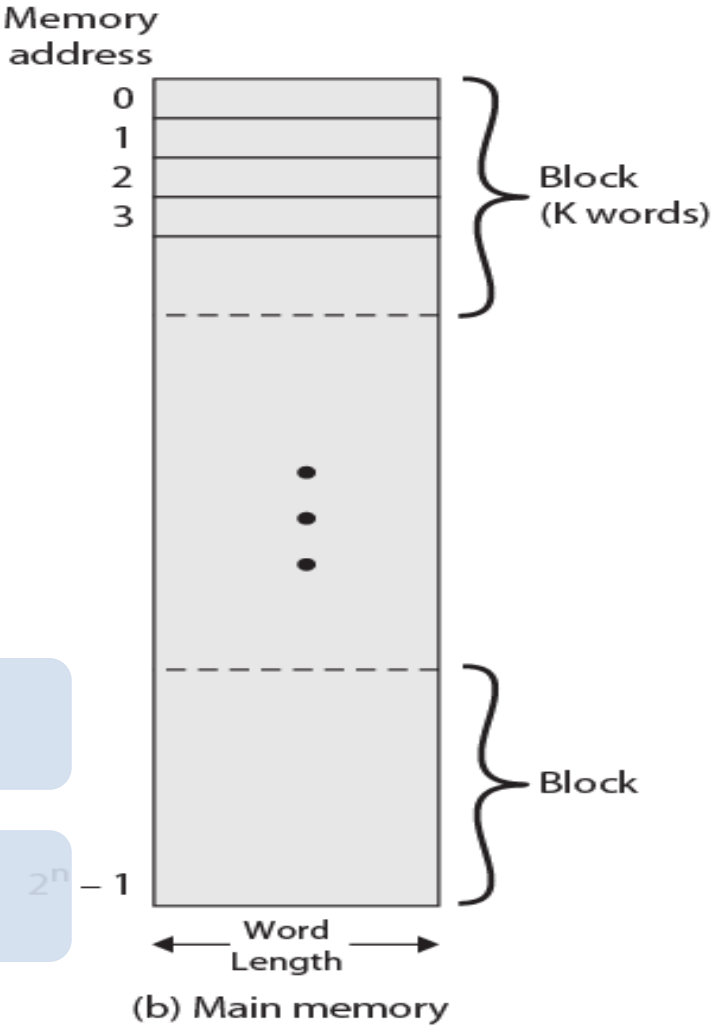
- Small amount of fast memory
- Sits between normal main memory and CPU
- May be located on CPU chip or module
  - An entire blocks of data is copied from memory to the cache because the principle of locality tells us that once a byte is accessed, it is likely that a nearby data element will be needed soon.



# Cache/Main Memory Structure



- A Hit
- is when data is found at a given memory level.
- A miss
- is when it is not found.



# Random-Access Memory (RAM)

- Key features
  - **RAM** is packaged as a chip, Basic storage unit is a **cell** (one bit per cell)
  - Its internal memory of the CPU for storing data, program, and program result
  - Used for Read/ Write
  - Volatile (Temporary Storage)

## Static RAM (SRAM)

- memory retains its contents as long as power is being supplied.
- Made up of transistor
- Static because it doesn't need to be refreshed
- SRAM is more often used for system cache.
- SRAM is faster than DRAM

## Dynamic RAM (DRAM)

- memory must be constantly refreshed or it will lose its contents.
- This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second
- Made up of memory cells composed of capacitors and one transistor.
- DRAM is typically used for the main memory in computing devices



# ROM(Read Only Memory)

- The memory from which we can only read but cannot write on it.
- This type of memory is non-volatile.
- The information is stored permanently in such memories during manufacture.
- A ROM stores such instructions that are required to start a computer. This operation is referred to as **bootstrap**.



# Memory Access Method

## Sequential

- Start at the beginning and read through in order
- Access time depends on location of data and previous location
- e.g. tape

## Direct

- Individual blocks have unique address
- Access is by jumping to vicinity plus sequential search
- Access time depends on location and previous location
- e.g. disk

## Random

- Individual addresses identify locations exactly
- Access time is independent of location or previous access
- e.g. RAM

## Associative

- Data is located by a comparison with contents of a portion of the store
- Access time is independent of location or previous access
- e.g. cache





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# Thank You

