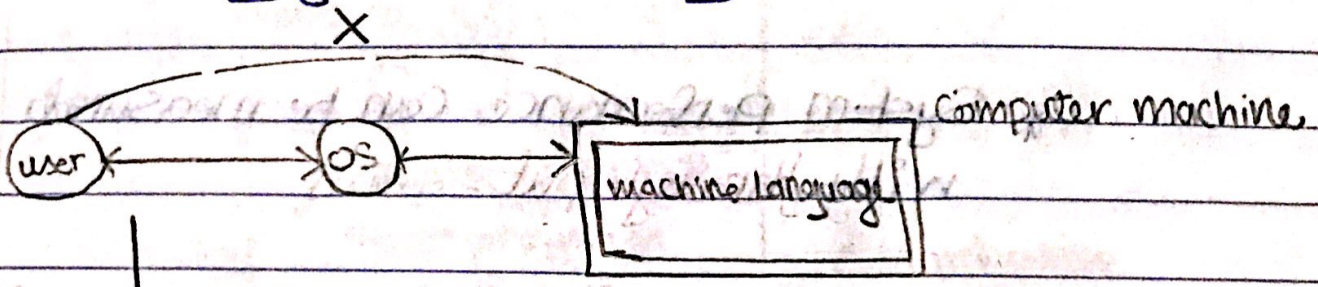
# Chapter#1
## Introduction

lecture#1
Feb.10.2018

### Operating Systems Goals:

(1) overall goal: Execute user programs.
(2) primary goal: Conveniency




↳ it's easier for the user to interact with the OS.

(3) Secondary goal: efficiency.

### Computer Resources:

(1) CPU.
(2) Memory.
(3) I/O devices.

} OS manages Resources.

**Operating System (OS):** A set of Algorithms that run the Computer machine.

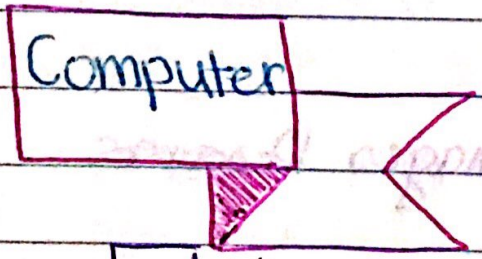
↳ OS manages the Computer resources.
↳ OS must manage the Computer Resources efficiently.

→ Other goals of OS:

- Utilization of Computer resources.
  - Utilization of CPU: make the CPU as busy as possible.
  - Utilization of Memory: - to benefit or use memory as much as possible.
  - Utilization of I/O devices.

* System performance can be measured with throughput.

* Throughput: number of jobs (programs) that finish execution per unit of time.



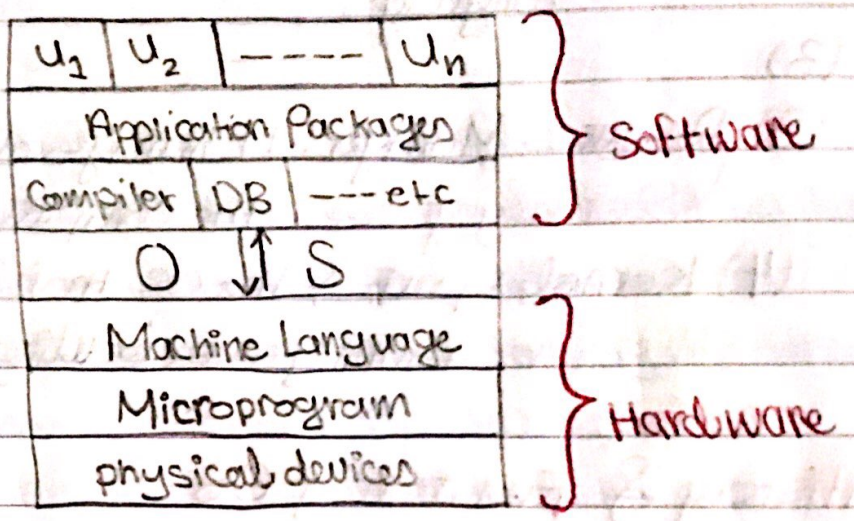

1. HARDWARE: -
   - physical devices: chips, wires, Power supplies...
   - micro program: A primitive software that communicates with Physical devices which is an Interpreter that fetches

language

→ Fetch: execute machine instruction.

— machine Language (Assembly Language)

## 2 OPERATING SYSTEM:




## 3 APPLICATION PACKAGES:

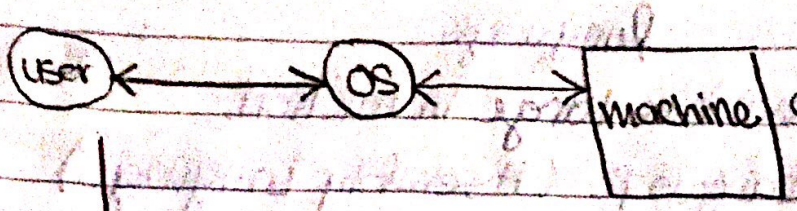
## 4 User Programs.

## Operating System Views: OS Goals

(1) It's a control Program: It controls the execution of all programs.
↳ overall goal.

(2) Extended machine: Extension of the physical machine.
↳ primary goal.

That is it hides all the complexity of system programming and provide the user with a simple clean machine to deal with

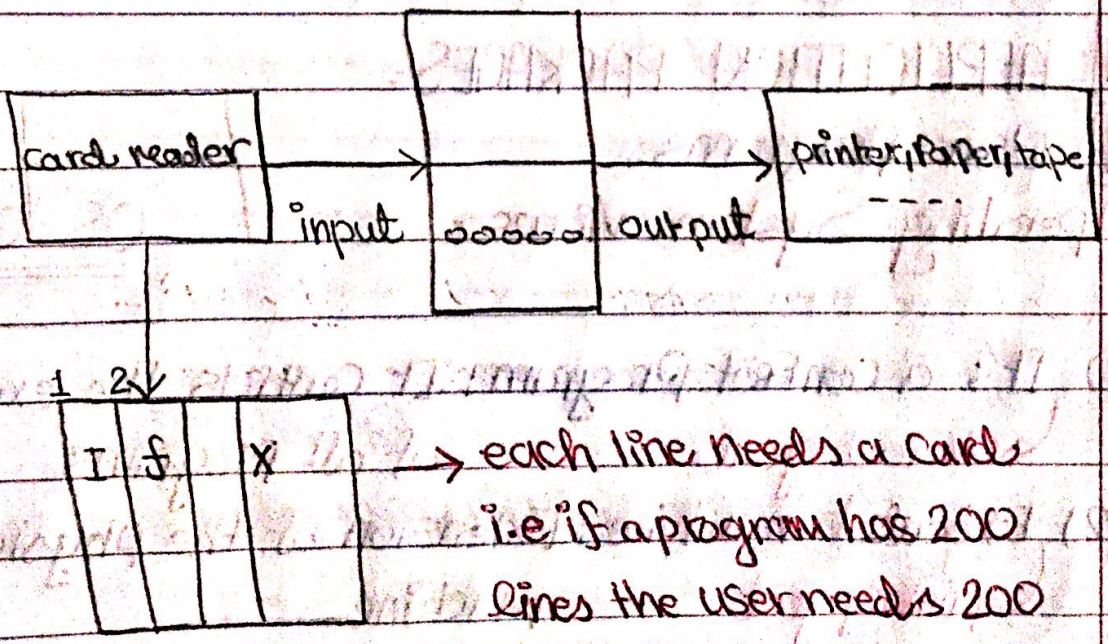



↳ The user doesn't have to deal with machine or use assembly / machine Language..

(3) Resource Manager: It manages efficiently the computer resources.
↳ Secondary goal.

(4) Kernel: part of the OS that's always running and executing instructions

## ⊞ History & Evolution of OS :-




→ each line needs a card i.e if a program has 200 lines the user needs 200 cards.

* Hexadecimal was used.

[+] Early software :-

- machine Language.
- Assembly Language. (Assemblers)
- Loaders
- Linkers: the addition of software to program.
- Compilers.

* Performance is poor
  - a great deal of time is wasted in set up time.
  - No overlap between I/O & CPU execution
  - Low CPU utilization (due the big difference between I/O speed & CPU speed)

example:

A fast card reader can read 1200 cards/min

1200/60 = 20 card/sec.

The CPU can process 300 cards/sec.

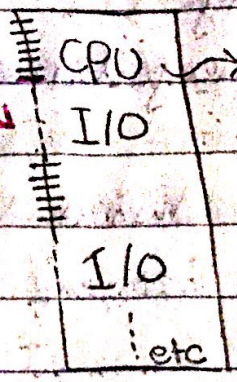
| Card reader | CPU | Card reader | CPU |
|---|---|---|---|
| 60 Sec | 4 Sec | 60 Sec | 4 Sec |

∴ Percentage of CPU utilization

= 4/64 ≈ 1/16 ≈ 6%

# Lecture #2

Feb. 12. 2018
Monday

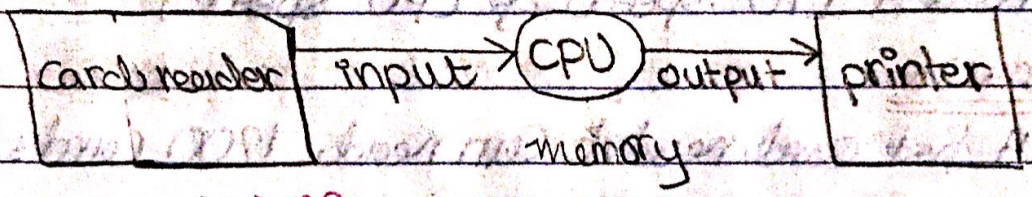



CPU Instruction

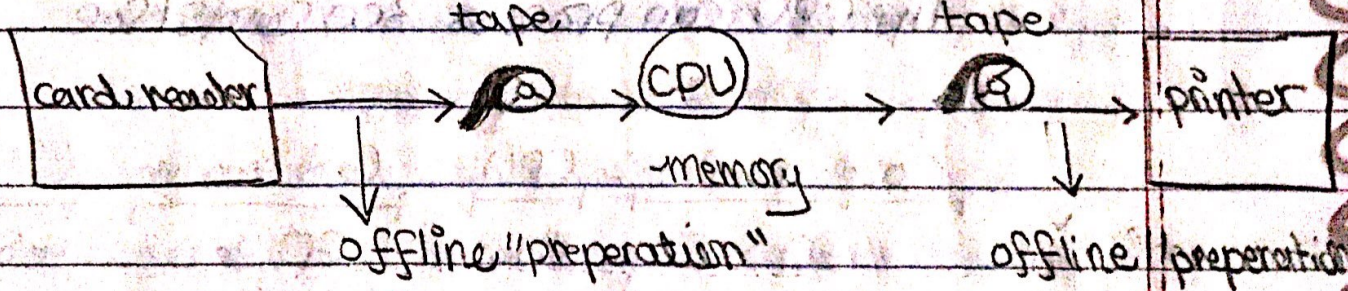
⚠ CPU instruction executes until reaching I/O
↳ printing or reading input.

## [A] offline Operation:

(1) Before

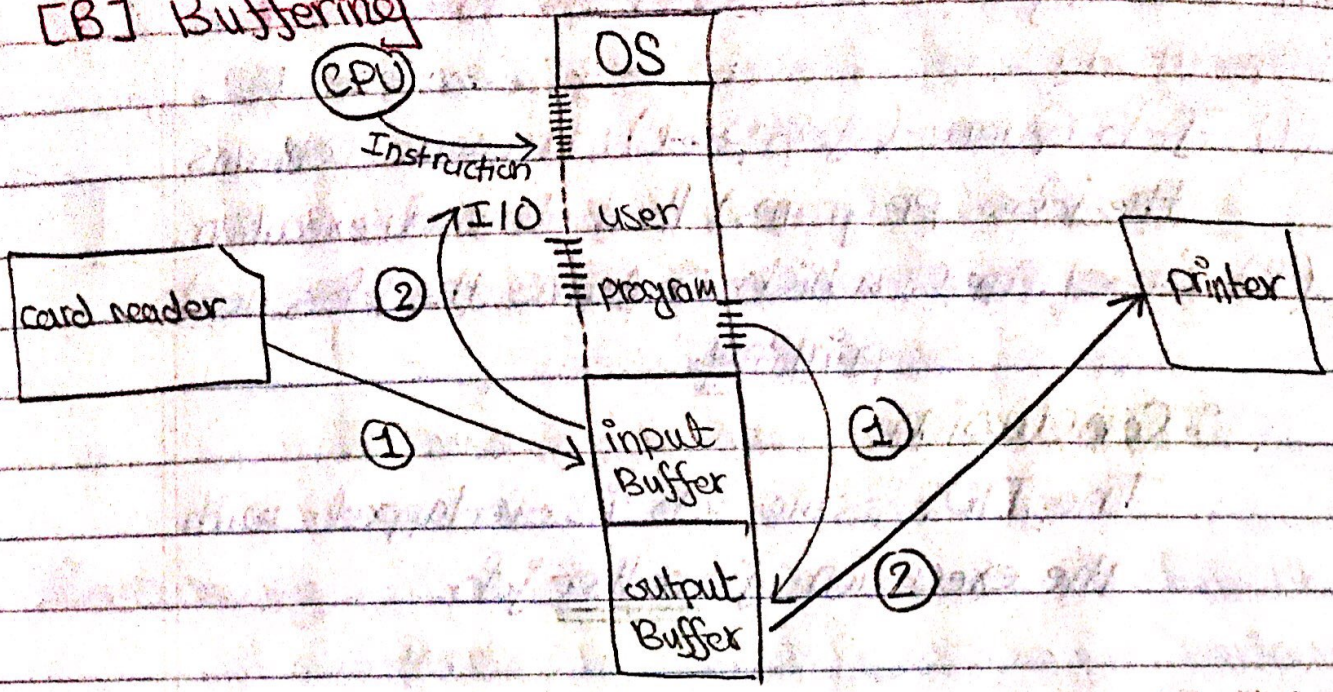



(2) After




⚠ Tape to memory is much more faster than Card reader to memory.
↳ improve execution.

## [B] Buffering

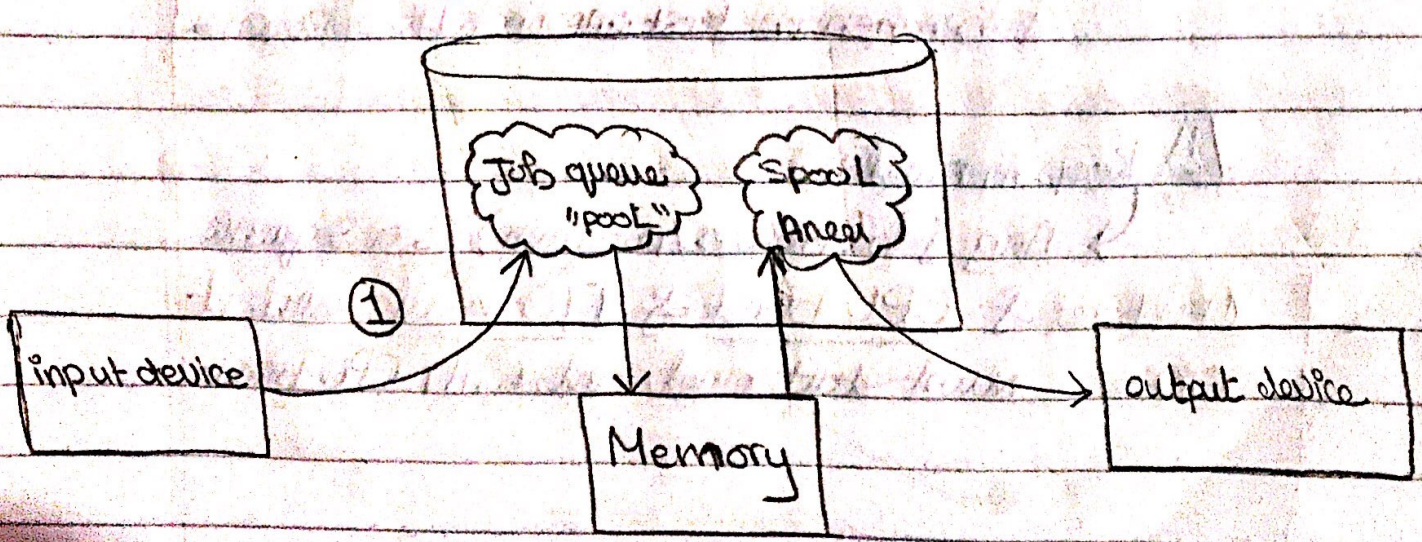



* when CPU reaches I/O it brings data from buffer not from the card reader

∴ Conclusion:

the I/O of one job is overlapped with the execution of same job.

## [C] Spooling



In Spooling 2 kinds of data structures were introduced:

(1) Job Queue (Job Pool): A queue contains the jobs (programs) that demand execution.

(2) Spool Area: which contains the jobs need printing.

∴ Conclusion:

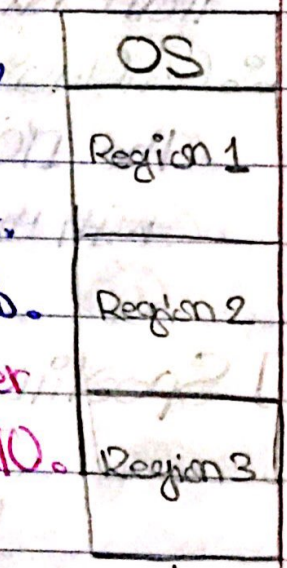
The I/O of one job is overlapped with the execution of another job.

## [D] Multiprogramming Batch Systems

"Multi-programming"

- Memory is divided into several Regions (Partitions).
- Regions sizes normally different.
- Each region contains only one job.

* The CPU switches to another job when the first one needs I/O.




⚠ Keep in mind:

↳ Any job (process/program) is a sequence of CPU burst & I/O wait and it must start and end with CPU burst.

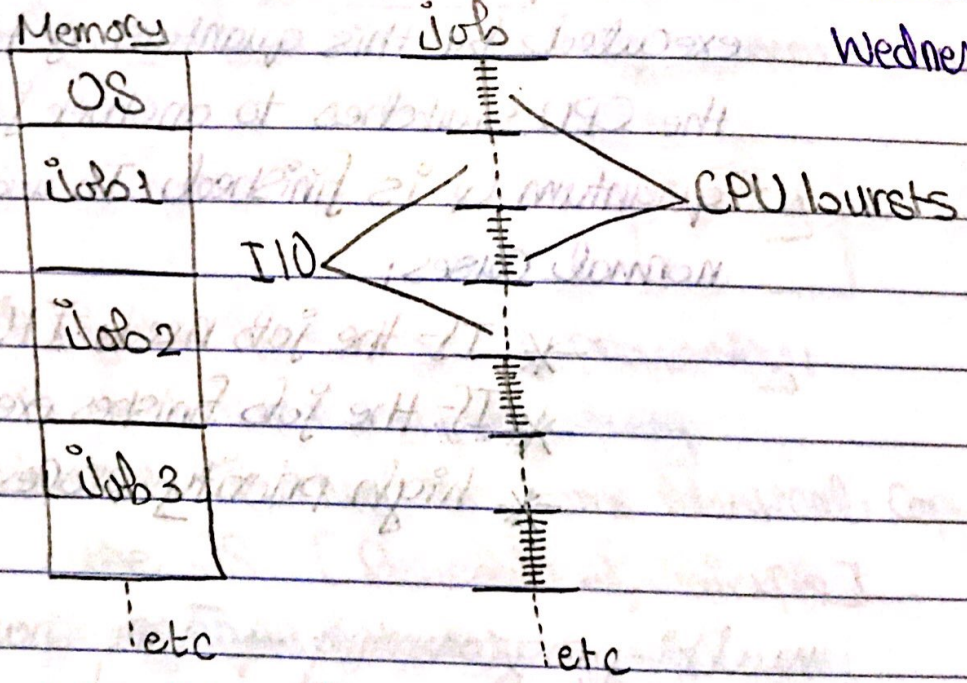
## Two kinds of jobs:

(1) CPU-bound job: Contains few very long CPU bursts.
   → most of the time, job needs CPU.

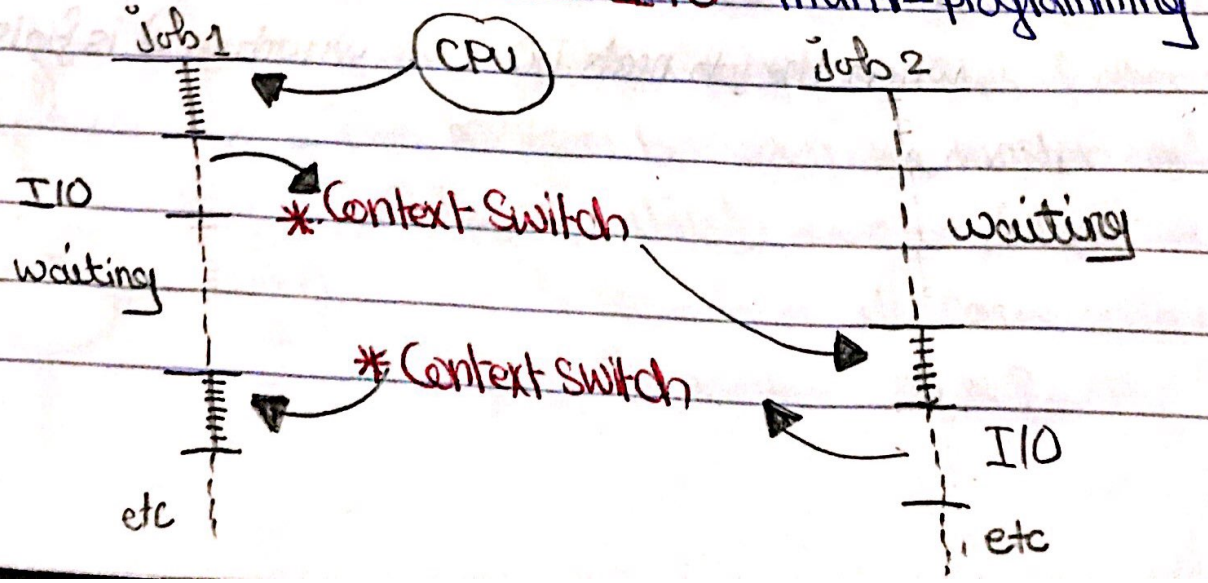
(2) I/O-bound job: Contains many very short CPU bursts.
   → most of the time, the job needs I/O.

## Lecture #3

Feb. 14. 2018
Wednesday




⚠ CPU switches (changes) to another job when the first one needs I/O "multi-programming"



* Context switch: Saves Register for job 1
Reloads Register for job 2.

[E] Time Sharing Systems:

- Same as multi-programming.
- Memory is divided into regions.
- Several jobs are kept in memory.
- Each job is assigned a slice of time called quantum Q. Each job is executed for this quantum of time & the CPU switches to another job when quantum Q is finished. In addition to normal cases:
  * If the job needs I/O.
  * If the job finishes execution.
  * high priority process.

multi-programming ≠ Time Sharing

↓ The CPU switches when the job needs I/O

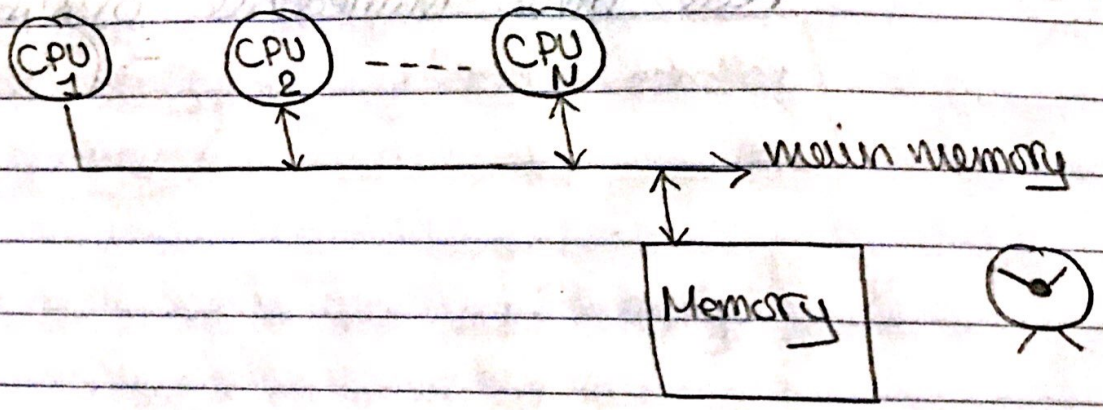
↓ The CPU switches when Quantum Q is finished.

## [F] Parallel Systems:-

Multi-processor systems with more than one CPU in close communication.

### (1) Tightly Coupled Systems:

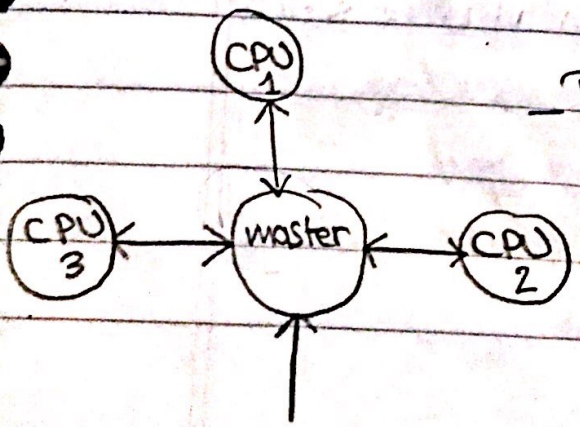
processors share memory, clock, & communication usually takes place in memory




* There are two types of processing:

a- Symmetric multi-processing
↳ Each CPU has the same identical copy of the OS [Reliable & Simple]

b- Asymmetric multi-processing
- There's a huge OS that runs this scheme.
- There's one CPU called master CPU which controls other activities of other CPUs
- The relation between the master and other CPUs is called master/slave relationship
  ↳ Reliable on all cases unless the master CPU is faulty.



(2) Loosly Coupled Systems:

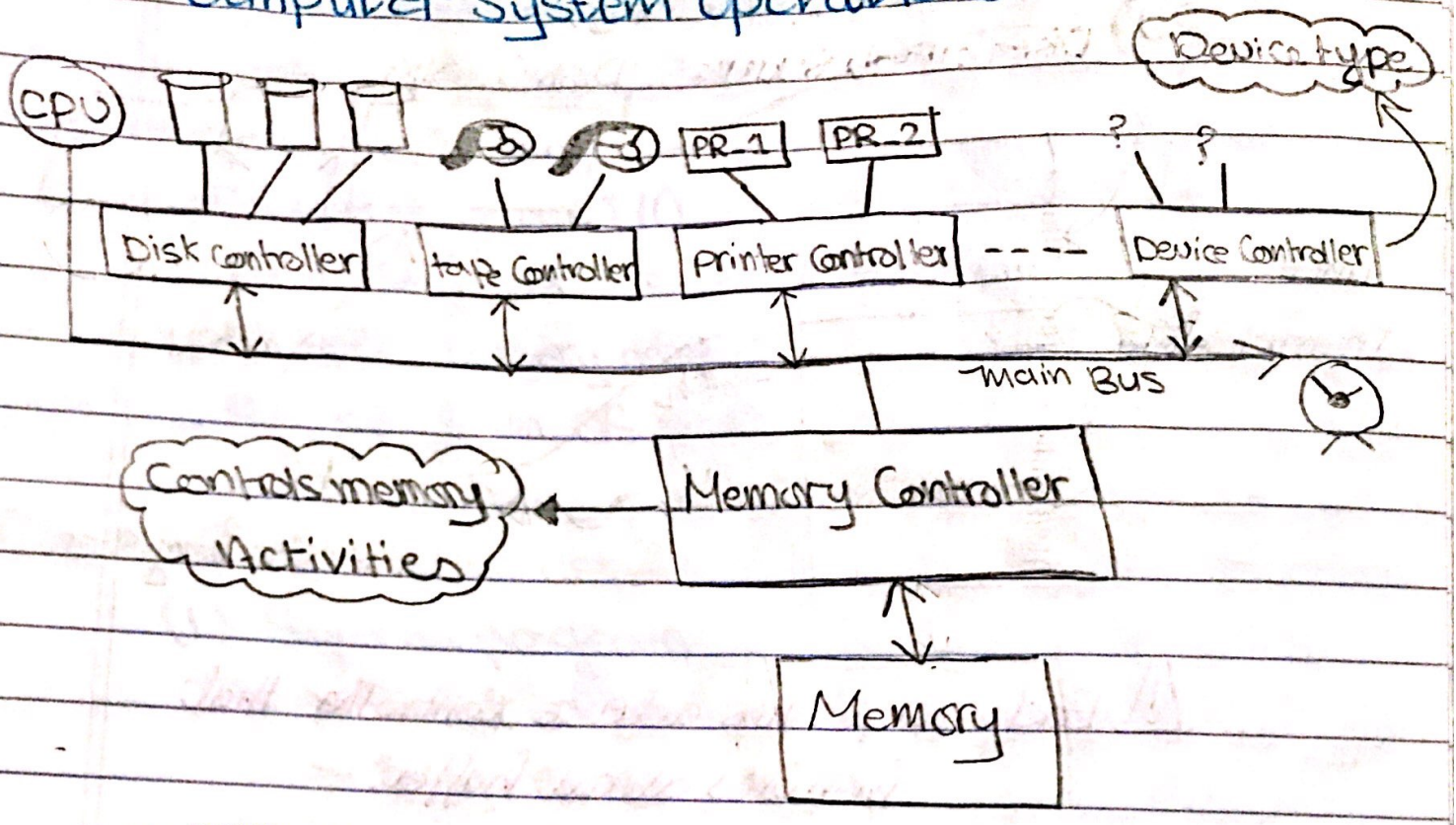
- Networks
  - "Distributed Systems"
- كل نظام قائم بذاته
  - Connect via servers.

[G] Real time Systems:

- takes data using Sinsors.
- for systems that need Response real time "immediate" استجابة مباشرة

# Chapter#2

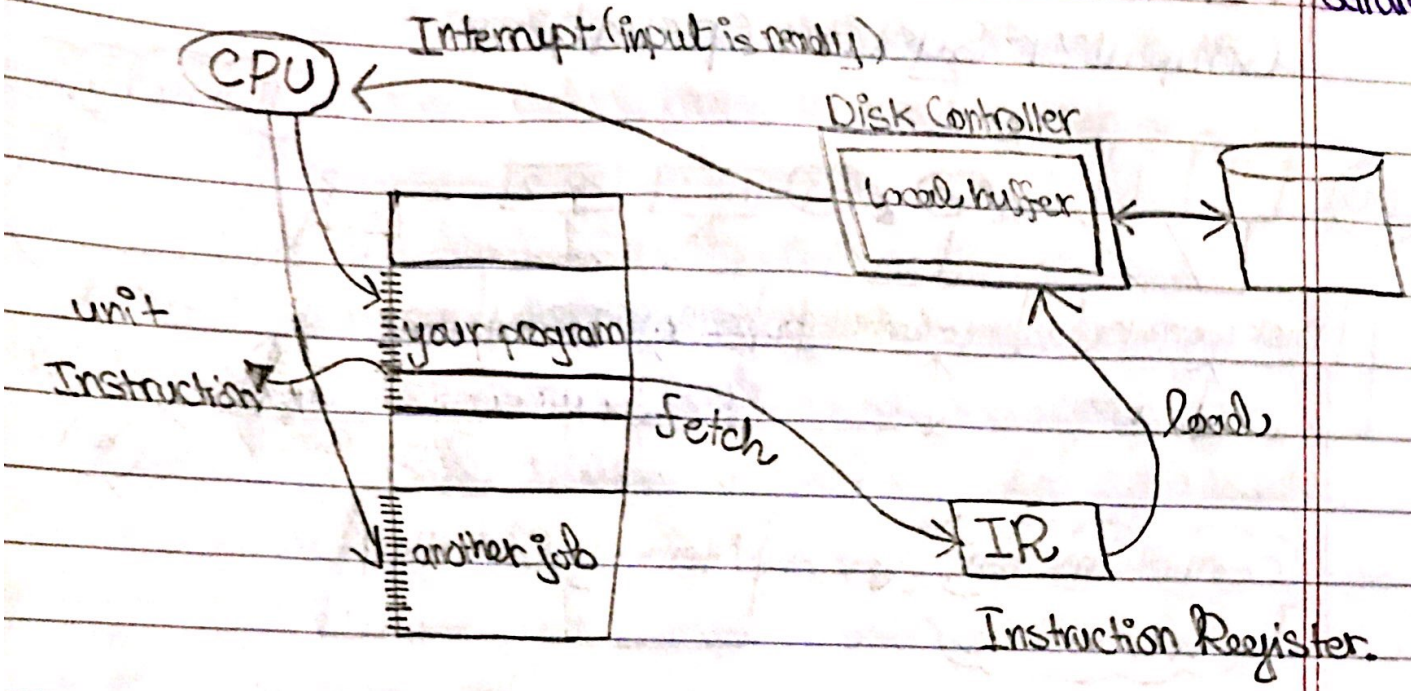
## Computer System operations.



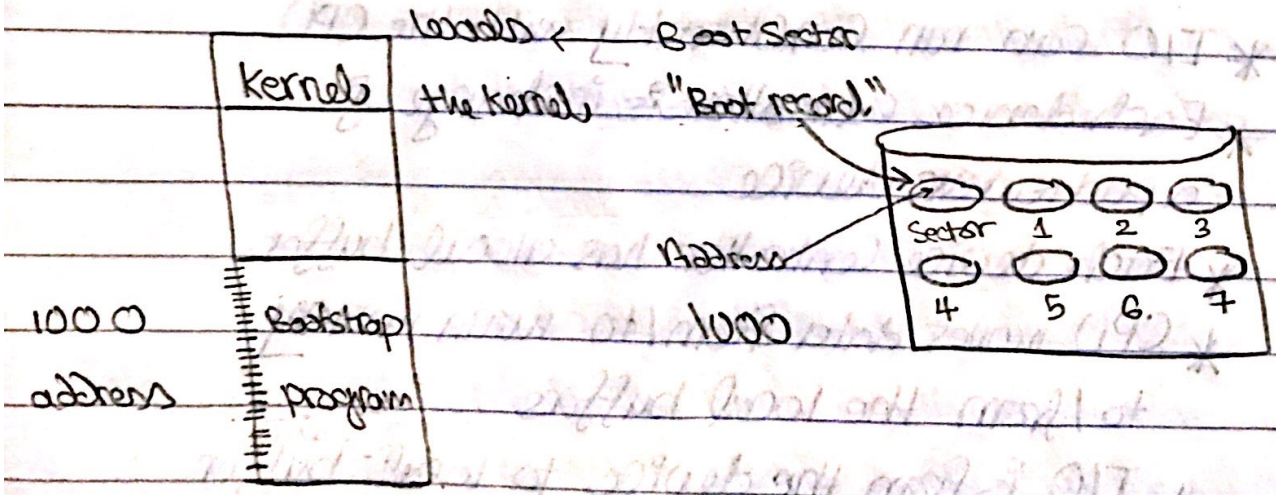

* I/O can run concurrently with the CPU.
* Each device controller is incharge of a particulars device.
* Each device controller has a local buffer.
* CPU moves data from/to main memory to/from the local buffers.
* I/O is from the device to local buffer of controller.
* Device controller informs CPU that it has finished its operation by causing an interrupt.

# Lecture #4

Feb. 17. 2018
Saturday




⚠ Each device has a device Controller that includes a local buffer.




⚠ Operating Systems are Interrupt driven (CPU is interrupted)

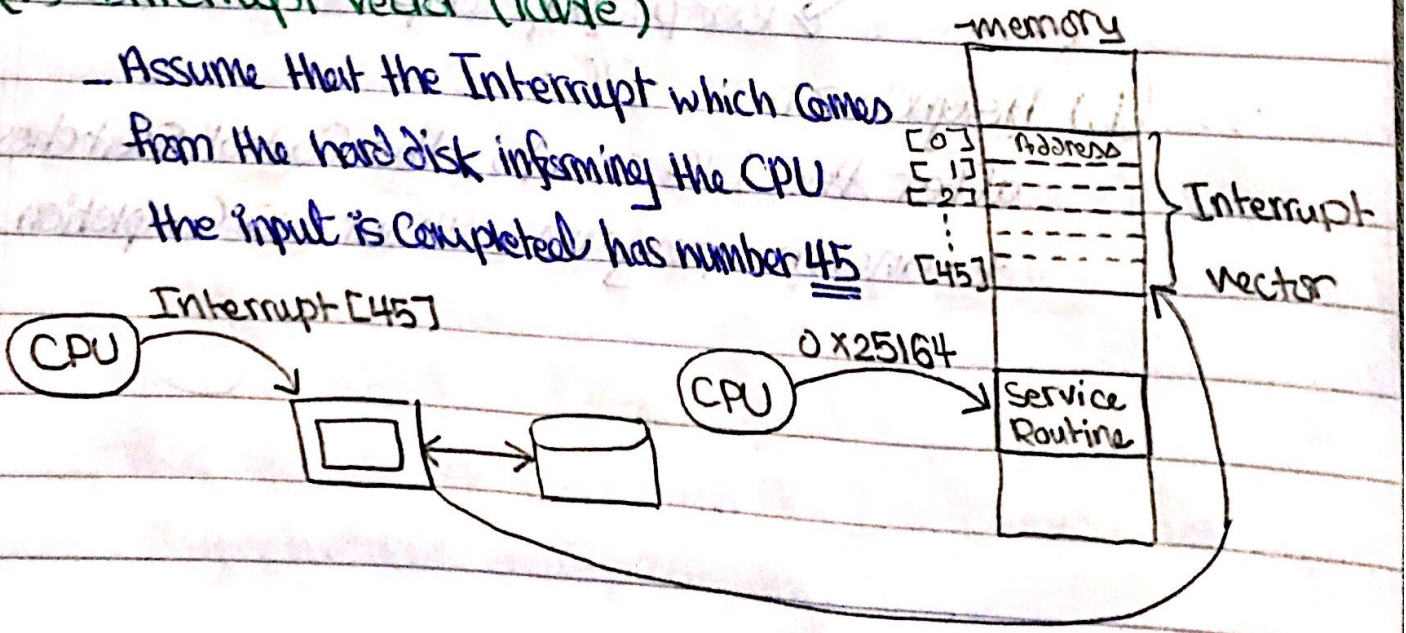
Interrupt: A Signal sent to the CPU by: "System Calls"
- Hardware
- Software "Trap"

examples:
- Completion of an I/O. "Hardware Interrupt"
- Division by zero. "Software Interrupt"
- Invalid memory access. "hardware Interrupt".
- Request of an OS service.

OS services can be asked:
(1) System program
> Format a:
> Copy A.dat B.dat.

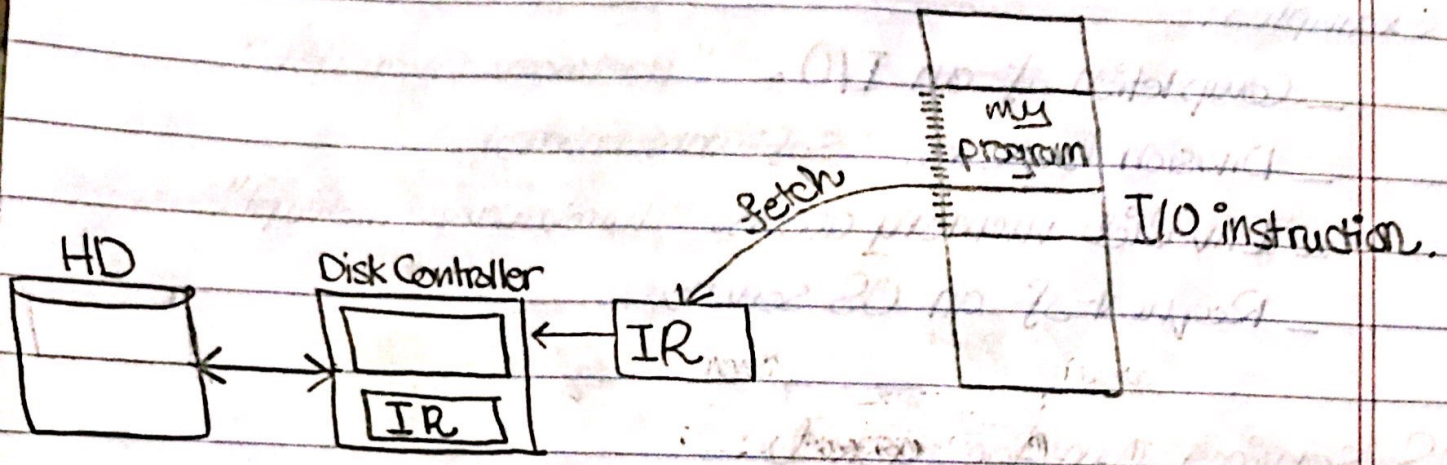
(2) System Calls
It's an assembly language Instruction.

Interrupt Handling:
(1) Interrupt vector (Table)
- Assume that the Interrupt which comes from the hard disk informing the CPU the input is completed has number 45



(2) By polling:

## I/O interrupt structure:




## There are two types of I/O:

(a) Synchronous I/O:

after the I/O starts, the control returns to program only upon I/O completion.

→ The CPU waits until the I/O is completed.

↳ wait Instruction "CPU is idle"

↳ loop: jmp loop

(b) Asynchronous I/O:

after the I/O starts, the control switches to another program without I/O completion.