What is the operating System ?

program that acts as intermediary between the user of a computer and the computer hardware

- ❖ **OS is resource allocator** : Manages all resources and Decides between conflicting requests for efficient and fair resource use
- ❖ **OS is control program :** Controls execution of programs to prevent errors and incorrect use of the computer

What is the operating system goals ?

- ❖ Execute user programs
- ❖ Make the computer system suitable to use
- ❖ Make solving user problems easier

What is the computer system component ?

- ❖ **Hardware** : provides basic computing resources , CPU , memory , I/O
- ❖ **Operating system**
- ❖ **Application program** : define the ways in which the system resources are used to solve the computing problems , word , excel
- ❖ **System program** : compiler , database system , assembler
- ❖ **Users**

What is the different between program and process ?

It is the program image that is in RAM to be execution . process It is a unit of work within the system. Program is a passive entity, process is an active entity.

What is the kernel ?

The one program running at all times on the computer

What is CPU component ?

- ❖ Register
- ❖ ALU
- ❖ Control unit

What does the RAM content ?

Instruction or data

What is the bootstrap program ?

- ❖ It's the program the loaded typically in ROM and it known as firmware

o It Initializes all aspects of system

o Loads operating system kernel and starts execution

Explain the 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

❖ 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 from the device to local buffer of controller

❖ Controller is response fro move the date from/to devices

❖ Device controller informs CPU that it has finished its operation by causing an **interrupt**

Explain the interrupt ?

❖ Signals the CPU to a temporary suspension of the current execution

❖ Interrupt transfers control to the interrupt service routine ISR, through the interrupt vector, which contains the addresses of all the service routines

❖ Incoming interrupts are *disabled* while another interrupt is being processed to prevent a *lost interrupt*

❖ Operation system is **interrupt driven**

❖ Interrupt driven by hardware .

What is the different between interrupt and trap with example ?

Trap : software-generated interrupt caused either by an error or a user request **example** : division by zero , invalid memory access

 Interrupt : some time hardware-generated **example:** problem in hard disk or Power outage

What is the types of interrupt handling ?

❖ **polling**

❖ **vectored** interrupt system

What is the Interrupt types ?

❖ **User interrupt** : user cancel the program before it finished

❖ **Software interrupt** : deviation by zero

- ❖ **Hardware interrupt** : power outage
- ❖ **I/O interrupt** : Device controller informs CPU that it has finished
- ❖ **Timer interrupt** : round robin algorithm

How can the operation system save the CPU state ?

storing registers and the program counter

What is the methods of I/O structure ?

- ❖ **After I/O starts, control returns to user program only upon I/O completion**
  - Wait instruction idles the CPU until the next interrupt
  - Wait loop (contention for memory access)
  - At most one I/O request is outstanding at a time

- ❖ **After I/O starts, control returns to user program without waiting for I/O completion**
- **System call** : request to the operating system to allow user to wait for I/O completion
- **Device-status table :** contains entry for each I/O device indicating its type, address, and state
- Operating system access into I/O device table to determine device status and to modify table entry

What is the direct memory access ?

- ❖ Used to allow high-speed I/O devices 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 one interrupt is generated per block, rather than the one interrupt per byte

What is the storage structure in computer system ?

- ❖ **Main memory (RAM)** : array and volatile and 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

What does disk surface contain ?	
Disk surface is logically divided into **tracks**, which are subdivided into **sectors**	

|	
What is the disk controller ?	
It determines the logical interaction between the device and the computer	

According to what the storages organized ?	
❖ Speed ❖ Cost ❖ Volatility ❖ Capacity	

What is the caching ?

- ❖ **copying information(not process) into faster storage system that means Information in use copied from slower to faster storage temporarily :**
  - cache memory is cache for main memory
  - main memory is *cache* for secondary storage
- ❖ **Faster storage (cache) checked first to determine if information is there**
  - If it is, information used directly from the cache (fastest)**(cache hit)**
  - If not, data copied to cache and used there (cache miss)

Summarize in figure how the computer work ?
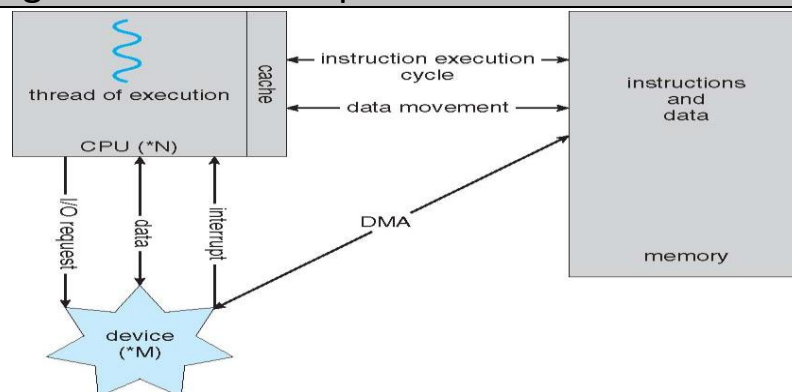
Who manage the transition between storage device ?

- ❖ Hard ware is response to the transition between cache, RAM and register
- ❖ OS is response to transition between RAM and hard disk

Sort the storage device from small to large ?

- ❖ Register
- ❖ Cache
- ❖ RAM

- ❖ Electronic disk
- ❖ Magnetic disk
- ❖ Optical disk
- ❖ Magnetic tapes

What is the current computer system architecture ?

- ❖ Most systems use a single general-purpose processor
- ❖ Most systems have special-purpose processors like multiprocessors, multi-cores and Clustered .

What is the advantages of multiprocessors (parallel, coupled) computer ?

- ❖ **Increased throughput** : increase the rate of process finished on unit time because of each processors work in one process .
- ❖ **Economy of scale** : because of shared recourses such as I/O and RAM .
- ❖ **Increased reliability** : continue to run even if one or more processor get failure .

What is the types of multiprocessing ?

Asymmetric multiprocessing : on of the processors is master and it monitor the other processors , and if one is failure it do its task .
Symmetric multiprocessing : all the processors are the same .

What is the ready queue ?

To run the process, this process should be in ready queue , this main this process hold all of its resources .

What is the different between multiprocessor and multi-cores architecture ?

Multiprocessor : every processor in different ship .
Multi-cores : all core are in the same ship .

What is the advantages of multi-core architecture on multiprocessor ?

- ❖ Faster because every core in the same ship .
- ❖ Use less power .

What is the clustered system .

- ❖ Like multiprocessor systems, but multiple systems working together .
- ❖ Usually sharing storage via a storage-area network (SAN)
- ❖ Provides a high-availability service which survives failures

What is the types of clustered ?

- ❖ **Asymmetric clustering**: has one machine in hot-standby mode
- ❖ **Symmetric clustering** : has multiple nodes running applications, monitoring each other

What is the CPU utilization ?

Keep CPU busy as possible , and it apposite of idle .

What is the multiprogramming ?

- It used for efficiency .
- Because single user cannot keep CPU busy all time .
- **Multiprogramming** organize the process so CPU always has one to execute .

What is job scheduling ?

- Because subset of total jobs in the system is kept in the memory .
- **Job scheduling** is part of OS and it used to select the process that will be loaded to memory from job pool .

What is the time sharing (multitasking) ?

It is logical extension of multiprogramming in which CPU switch jobs so frequently that users can interact with each job while it is running, creating **interactive** computing

What is the response time ?

It's the time required to get the first response o the process (not outing)

What is the requirements of interactive computing ?

- Response time should be < 1 second .
- Each user has at least one program executing in memory **process**

What is CPU scheduling ?

- It is part of OS and it used to select a process from ready queue of the RAM to be execute .
- It used if several jobs ready to run at the same time .

What is the swapping ?

- It used if the process don't fit in the memory
- It move the data from memory to VM in HD (swap out)

- It move the date from VM in HD to memory (swap in)

What is virtual memory ?

It is in HD and it allows execution of processes not completely in memory . if the process don't fit in the memory

What is the dual-mode operation ?

- It allow OS to protect itself and other system component .
- It is divide the mode to : user mode – kernel mode .

What mode bit ?

- mode bit provided by hardware .
  - Provides ability to distinguish when system is running user code or kernel code
  - Some instructions designated as **privileged**, only executable in kernel mode . (change the time)

Explain the transition between the processes ?

- Timer to prevent infinite loop
- Set interrupt after specific period
- Operating system decrements counter
- When counter zero generate an interrupt
- Set up before scheduling process to regain control or terminate program that exceeds allotted time

Explain the transition between user mode and kernel mode ?

System call changes mode to kernel, return from call resets it to user
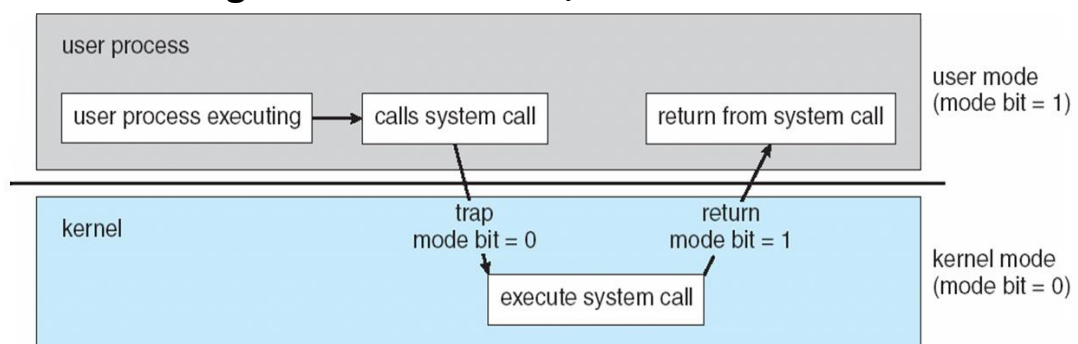
Explain the process management ?

- Process need recourses to accomplish its task (CPU,RAM,I/O, files, data).
- Process termination requires reclaim of any reusable resources .
- Single threaded process has one counter , so the process executes

instructions sequentially, one at a time, until completion .
- Multi-threaded process has one program counter per thread

What does OS do to manage the process ?

- Creating and deleting both user and system processes : **load programs**
- Suspending and resuming processes : **interrupt**
- Providing mechanisms for process synchronization : **time sharing**
- Providing mechanisms for process communication : **data sharing**
- Providing mechanisms for deadlock handling : **cycle needing**

Explain memory management ?

- All data in memory before and after processing
- All instructions in memory in order to execute
- Memory management determines what is in memory
- Optimizing CPU utilization **(largest possible)** and computer response **(smallest possible)** to users

What does OS do to manage the memory ?

- Keeping track of which parts of memory are currently being used and by whom
- Deciding which processes (or parts thereof) and data to move into and out of memory
- Allocating and deallocating memory space as needed

Explain storage management ?

- o Abstracts physical properties of information storage to logical storage unit - **file**
- o Each medium is controlled by device (i.e., disk drive, tape drive)
- **File-System management**
  - o Files usually organized into directories **(folder)**
  - o Access control on most systems to determine who can access what

What does OS do to manage the storage ?

- Creating and deleting files and directories **(folder)**
- Primitives to manipulate files and directories **(folder)**
- Mapping files onto secondary storage
- Backup files onto stable (non-volatile) storage media

Explain mass storage management ?

- Usually disks used to store data that does not fit in main memory or data that must be kept for a "long" period of time
- Entire speed of computer operation hinges on disk subsystem and its algorithms

What does OS do to manage the mass storage ?

- Free-space management
- Storage allocation
- Disk scheduling

Explain performance of different storage ?

Level	1	2	3	4
Name	registers	cache	main memory	disk storage
Typical size	< 1 KB	> 16 MB	> 16 GB	> 100 GB
Implementation technology	custom memory with multiple ports, CMOS	on-chip or off-chip CMOS SRAM	CMOS DRAM	magnetic disk
Access time (ns)	0.25 – 0.5	0.5 – 25	80 – 250	5,000.000
Bandwidth (MB/sec)	20,000 – 100,000	5000 – 10,000	1000 – 5000	20 – 150
Managed by	compiler	hardware	operating system	operating system
Backed by	cache	main memory	disk	CD or tape

What is cache coherency ?

Is used to ensure that all caches of all processes has the most recent value .

What is the I/O subsystem Responsibility ?

- Memory management of I/O including
  - ✓ **buffering** (storing data temporarily while it is being transferred),
  - ✓ **caching** (storing parts of data in faster storage for performance),
  - ✓ **spooling** (the overlapping of output of one job with input of other jobs)
- General device-driver interface
- Drivers for specific hardware devices

What is the different between protection and security ?

Protection : any mechanism for controlling access of processes or users to resources defined by the OS

Security : defense of the system against internal and external attacks