Unit I
Introduction

Computer software: is the collection of all programs stored in and executed by a computer system. There are two types of software.

- Application software
- System software

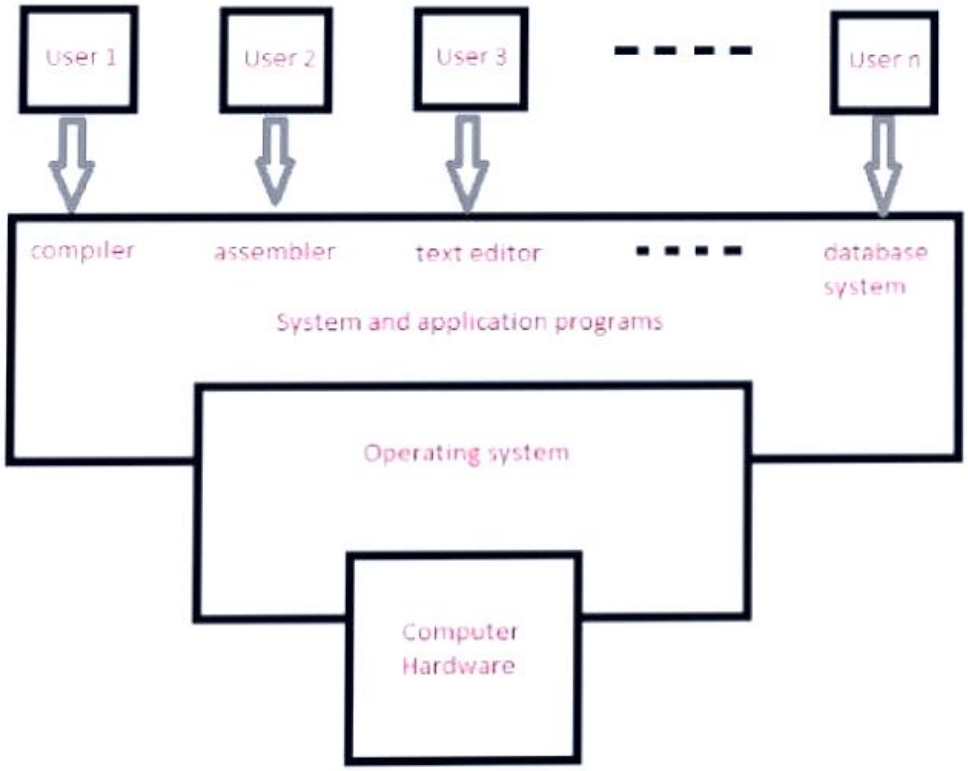
1. **Application software:** It performs specific task for the user. Such as creating word documents, spreadsheets, presentations, graphics, send the email, etc.

2. System software: It operates and controls the computer system, and provides a platform to run application software. Such as compiler, device Drivers, Operating system etc.

Computer hardware: is the collection of all physical elements of the computer system. Such as CPU, memory, storage devices, and input/output (I/O) devices.

- **What Operating Systems Do –**

  An operating system is a piece of software that manages all the resources of a computer system, both hardware and software, and provides an environment in which the user can execute his/her programs in a convenient and efficient manner. It is software that works as an interface between a user and the computer hardware.



Abstract view of the components of a computer system

The operating system can be observed from the point of view of the user or the system. This is known as the user view and the system view respectively.

User View

Most computer users sit in front of a PC, consisting of a monitor, keyboard, mouse, and system unit. Such a system is designed for one user to use its resources. In this case, the operating system is designed mostly for single user multitasking.

- In other cases, a user sits at a client machine connected to a server. Other users are also accessing the server through other client machines. These users are share resources. The operating system in such cases is designed to maximize resource utilization

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System View

According to the computer system, the operating system is the bridge between applications and hardware. the system view of the operating system as a resource allocator. There are many resources such as CPU time, memory space, file storage space, I/O devices etc. that are required by processes for execution. It is the duty

a)System View –

From the system's point of view, the operating system is the program that mostly involved with the computer hardware.

A computer system has many resources such as CPU, memory, I/O and storage devices. The operating system acts as the manager of these resources.

The operating system must decide how to allocate these resources to specific programs.

a)Defining Operating Systems:-

Operating system is system software, which manages all resources of a computer system and its functions or Operating system is a collection of system programs that, when executed, controls operation of a computer system.

* Computer System Organization:-

a)Computer System Operation:–

A modern general-purpose computer system consists of one or more CPUs and a number of device controllers as shown in following figure,

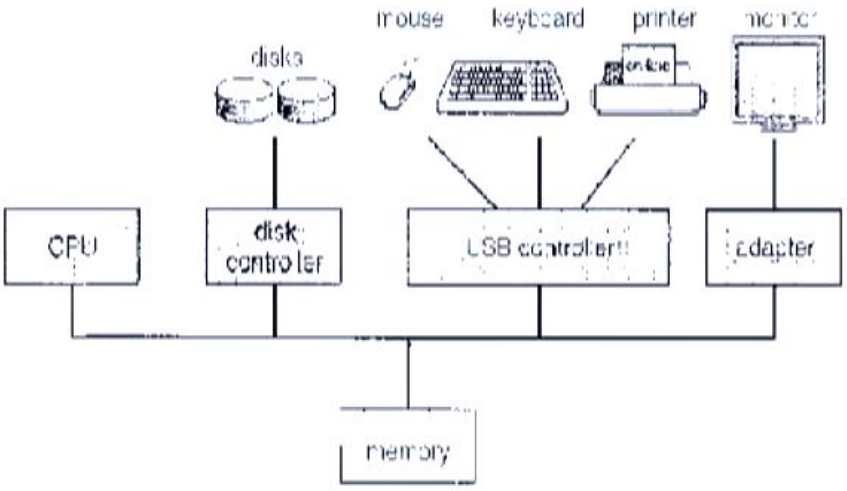

Figure – A modern computer system.

Each device controller is In-charge of a specific type of device.

For a computer to start it needs to have an initial program to run called as bootstrap program, it is stored in read-only memory (ROM).

It initializes all aspects of the system, from CPU registers to device controllers to memory contents.

Once the operating system is loaded in memory then waits for some event to occur. The event is signaled by an interrupt from either the hardware or the software.

An interrupt becomes a hardware interrupt when it is requested by one of the computer's hardware components.

Interrupt generated by executing an instruction is called software interrupt. It's also called "**trap**".

For example, a ĐoutorĐiŶ statement in C++ would generate a software interrupt.

An operating system usually has some code to handle interrupt that is called interrupt handler.

b) Storage Structure: –

Computer programs must be in main memory to be executed. Main memory is the only large storage area that the processor can access directly.

Interaction is achieved through a sequence of load or store instructions to specific memory addresses.

The load instruction moves the content from main memory to register, whereas the store instruction moves the content of a register to main memory.

Main memory is usually too small and volatile storage device thus, most computer systems provide secondary storage.

The main requirement for secondary storage is that it be able to hold large quantities of data permanently. The most common secondary-storage device is a magnetic disk.

Most programs (web browsers, compilers, word processors, and so on) are stored on a disk until they are loaded into memory.

The wide variety of storage systems in a computer system can be organized in a hierarchy as shown in following figure, according to speed and cost.

The higher levels are expensive, but they are fast. As we move down the hierarchy, the cost per bit generally decreases, whereas the access time generally increases.

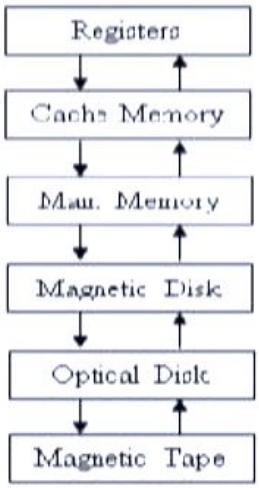

Figure – Storage device hierarchy

The various storage systems are either volatile or non-volatile.

In above figure, the storage systems including main memory are volatile, whereas those below are nonvolatile.

* Computer System Architecture:–

A computer system may be organized in a number of different ways, which we can categorize roughly according to the number of general-purpose processors used.

The different components in the computer system architecture are:

1) Input Unit
2) Output Unit
3) Storage Unit,
4) Arithmetic Logic Unit
5) Control Unit etc.

a) Single Processor Systems:–

A computer system, which is having only one general-purpose processor and multiple special-purpose processors that systeŵ is Ðalled as, ˛siŶgle proÐessor systeŵ.

On a single-processor system, there is only one general-purpose processor capable of executing instructions from user processes. All of these special-purpose processors do not run user processes.

Single processor system is not reliable. If general purpose processor fails entire system is fail even if multiple special purpose processors are properly working.

b) Multiprocessor Systems:–

A computer system, which is having more than one general-purpose processor, and multiple special-purpose processors that systeŵ is Ðalled as, ŵultiproÐessor systeŵ. It is also called as parallel system.

Multiprocessor systems have three main advantages:

a. Economy of scale
b. Increased reliability
c. Increased throughput

There are two types of multiprocessor systems.

First, asymmetric multiprocessing, in which each processor is assigned a specific task.

A master processor controls the system.

This scheme defines a master-slave relationship. The master processor schedules and allocates work to the slave processors.

Following figure shows a typical asymmetric multiprocessing architecture,

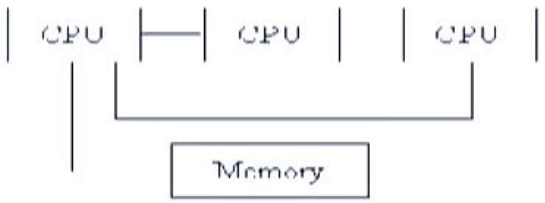

Figure – Asymmetric multiprocessing architecture

Second, symmetric multiprocessing (SMP) in which, each processor performs all tasks within the operating system. SMP means that all processors are peers; no master-slave relationship exists between processors.

Following figure shows a typical SMP architecture,

Figure – Symmetric multiprocessing architecture

* Operating System Structure:–

An operating system provides the environment within each programs are executed.

There are two types of programming supported by memory – uniprogramming and multiprogramming.

Uniprogramming allows only one process to be present in memory at a time, even if sufficient memory is available for another process.

There are several disadvantages of uniprogramming such as poor utilization of memory and poor utilization of processor.

One of the most important aspects of operating systems is the ability to multiprogramming. Multiprogramming allows one or more processes to be present in memory at a time, whenever sufficient memory is available.

The operating system keeps several processes in memory simultaneously as shown in following figure,

Operating System
Process 1
Process 1
. .
Process n

If several processes are ready to be loaded into memory, and if there is not enough space for all of them, then the system must choose among them. Making this decision is called as, job scheduling.

When the operating system selects a process, it loads that process into memory for execution. If several processes are ready to run at the same time, the system must choose among them. Making this decision is Ðalled as, CPU sÐheduliŶg' aŶd aÐtually alloÐatioŶ is perforŵed ďy a prograŵ Ðalled as, dispatÐher.

*An Operating System Resource Manager:-

The operating system must keep track of the status of each resource, decide which process is to get allocate it.

Operating system worked as resource manager each manager must do the following:

1) Keep track of the resource
2) Enforce policy that determines who gets what, when and how much
3) Allocate the resource
4) Reclaim the resource

We have grouped all programs of operating into four resource categories:

1) Memory management functions
2) Processor management functions
3) Device management functions
4) Information management functions

1) Memory management functions:-

- Keep track of the resource (memory). What parts in use and by whom? What parts are not in use (called free)?
- If multiprogramming, decide which process gets memory, when it gets and how much?
- Allocate the resource (memory) when the processes request it.
- Reclaim the resource (memory) when the process no longer needs it.

2) Processor management functions:-

- Keep track of the resource (Processor and the status of processor). The program that does this has been called traffic controller.
- Decide who will have a chance to use the processor.
- Allocate the resource(Processor).
- Reclaim the resource(Processor) when the process terminated.

3) Device management functions:-

- Keep track of the resource (Devices). This is typically called I/O traffic controller.
- Decide what an efficient way to allocate the resource.
- Allocate the resource (Device).
- Reclaim the resource.

4) Information management functions:-

- Keep track of the resource (Information). Its location, use, status ect This is typically called I/O traffic controller.
- Decide who gets the resource.
- Allocate the resource (Information) e.g. Open a file.
- Reclaim the resource e.g. close a file.

Extended Machine Concept:-

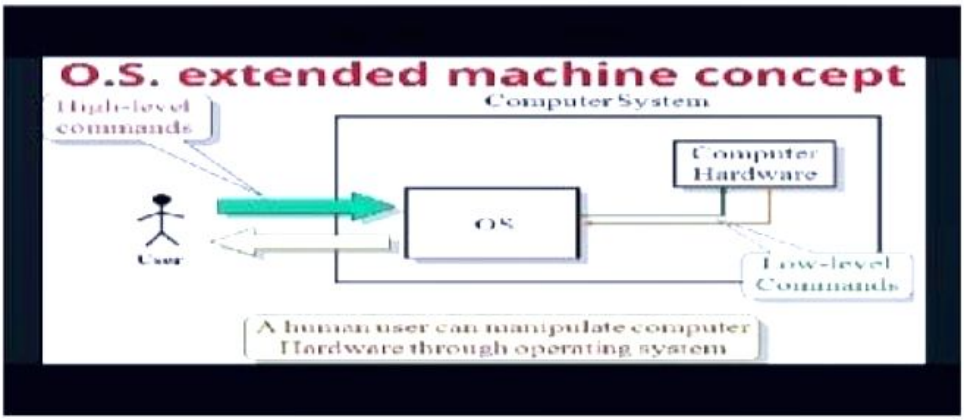

Figure:- Extended Machine Concept OS.

Extended Machine Concept:- is the software layer that is on top of the hardware to manage all parts of the system, and present the user with interface or virtual machine that is easier to understand and program.

Operating System as an Extended Machine.

The architecture (instruction set, memory, I/O, and bus structure) of most computers at the machine level language.

At the Machine level the structure of a computer's system is complicated to program, mainly for input.

Programmers do not deal with hardware. They will always mainly focus on implementing software. Therefore, a level of abstraction is supposed to be maintained. Operating systems provide a layer of abstraction for using disk such as files.