**Introduction**

**What is an Operating System?**

A set of programs that acts as an intermediary between user and the computer hardware

**Operating system goals:**

1. Execute user programs and solve user problems in easier way.
2. Make computer system convenient to use.
3. Use the computer hardware in an efficient manner.

**Computer System Structure**

Computer system can be divided into four components, they are:

1. **Hardware**: provides basic computing resources CPU, memory, I/O devices
2. **Operating system:** controls and coordinates use of hardware among various applications and users.
3. **Application programs:** define the ways in which the system resources are used to solve the computing problems of the users
4. **Users:** people, machines , other computers

**Figure 1:** **Four Components of Computer System**

**Operating system Definition:**

* **OS is a resource allocator** manages all resources decides between conflicting requests for efficient and fair resource use.
* **OS is a control program** Controls execution of programs to prevent errors and improper use of computer.

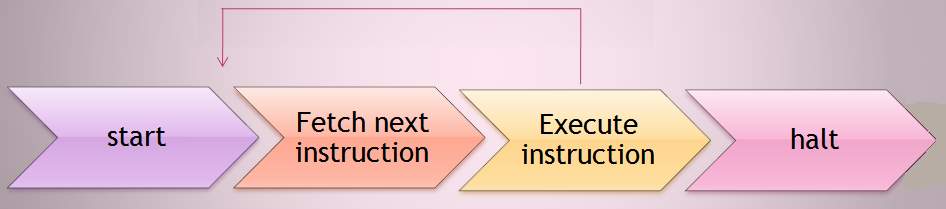
**Computer Startup**

**Bootstrap program** is loaded at power-up or reboot typically this program stored in **ROM (**Read Only Memory**)** or in **EEPROM (**Electrically Erasable Programmable Read Only Memory) generally known as **firmware.** Initializes all aspects of system, Load operating system kernel and starts execution.

**Instruction Execution**

Program counter (PC) holds the address of the next instruction to be fetched. Fetched instruction is loaded initial instruction register (IR). Processor interrupts the instruction and performs the required action. In general, these actions fall into four categories:

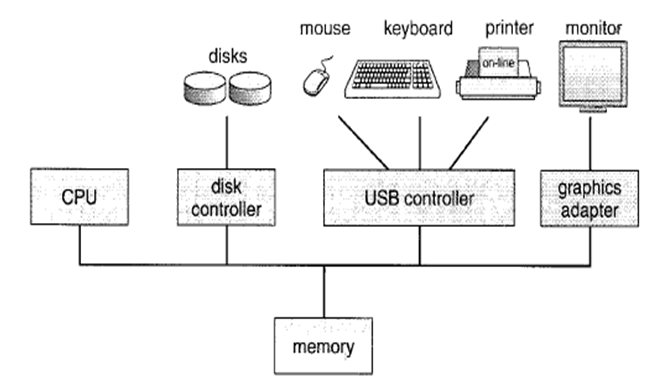
1. **Processor - memory**: data transferred from processor to memory or from memory to processor.
2. **Processor - I/O:** data transferred to or from peripheral device by transferring between the processor and I/O module.
3. **Data processing**: processor perform some arithmetic or logic operation on data
4. **Control**: an instruction specifies that the sequence of execution be altered.



**Figure 2: Basic Instruction Cycle**

**Computer System Organization**

Computer system operation, one or more CPUs (in modern general purpose computer system) and number of device controllers connected through common bus providing access to shared memory. This caused concurrent execution of CPUs and devices competing for memory cycles.



**Figure 3: Computer System Organization**

**Computer System Operation:**

I/O devices and the CPU can execute concurrently. 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. Device controller informs CPU that it has finished its operation by causing an interrupt.

**Common Functions of Interrupt:**

Interrupt transfer control to the interrupt service routine generally through the Interrupt vector, which contains the addresses of all the service routines. Interrupt architecture must save the address of the interrupted instruction. Incoming interrupts are disabled while another interrupt is being processed to prevent a lost interrupt.

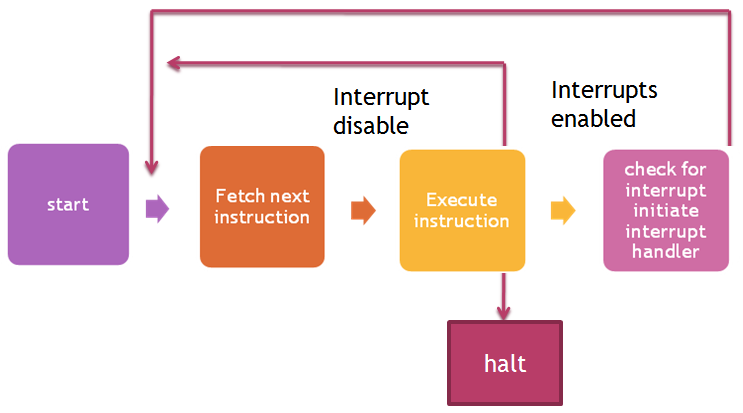
A trap is software generated interrupt caused either by an error or user request. An operation system is interrupt driven.

**Classes of interrupts:**

1. **Program**: Generated by some condition that occurs as a result of an instruction execution such as arithmetic overflow, division by zero
2. **Timer**: Generated by a timer within the processor .this allow the operating system to perform certain functions on a regular basis.
3. **I/O**: Generated by an I/O controller to signal normal completion of an operation or to a signal a variety of error conditions.
4. **Hardware Failure**: Generated by a failure such as power failure of memory parity error.

**Interrupt Handling**

* The operating system preserves the state of the CPU by storing registers and the program counter.
* Determines which type of interrupt has occurred through: Polling or Vectored interrupt system.
* Separate segments of code determine what action should be taken for each type of interrupt.



**Figure 4: Instruction cycle with interrupts**