If today were my last day, would I do what I'm doing?...If the answer was "NO" too many days in a row, I'd make a change.

----Steve Jobs----

Lecture: 1
The Basics...What & Why?

Assume **hardware as a car and operating system as a driver** and yourself as the passenger. You are just going to tell him the destination and the driver knows how to start, when to accelerate, when to change the gear, when to apply brakes, how to reach destination faster.

So this is what actually happens, you just instruct the computer to do something through user-interface of the application and the operating system know how to start the process, what are the resources required, how to use RAM efficiently, how to complete the process faster etc.

Operating System:
- An operating system is a **program that manages the computer hardware**. It acts as an intermediary between the computer user and the computer hardware.
- It manages the computer's computational activities associated with the hardware and provides services for application-level programs.
- Specifically, an operating system hides hardware complexity, manages computational resources and provides isolation and protection.
- An operating system converts the 1's and 0's flowing around at the computer chip-level into human-readable graphics that can be seen and interacted with by a user.
- All user software needs to go through the operating system in order to make use of the hardware, whether it a mouse-click or a complex Internet application feature.
- The OS coordinates access to the central processing unit (CPU), memory and storage to ensure each program gets what it needs.

Main functions of Operating System are:

- managing the resources (memory, registers, I/O devices) efficiently.
- allocating the processor for different processes.
- reading and writing data from memory.
- managing application software's and resolving if some error occurs during process.
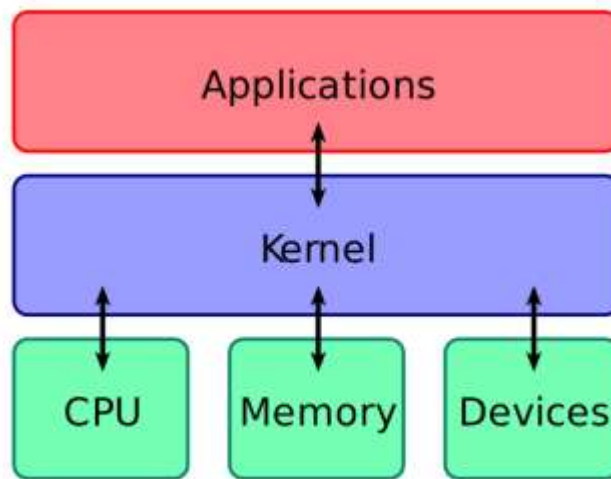
Basic Operating System Components

Kernel:

Kernel is the **program that does all the heavy lifting in an operating system**.

- It handles the hardware, timing, peripherals, memory, disks, user access and everything that you do on a computer.
- It decides when a software should run and what should be the permissions given to it.
- It makes sure that no program access memory that do not belong to it and that no program causes other programs to crash.
- It divides the time up for processes to use the processor.
- Kernel is the one program running at all times on the computer.

Shell:

A shell is the part of an OS that you as a user interact with.

- It is **an interface created so that a user can communicate with the Kernel**. Command line and GUI shells exist.

Operating System Components:

An operating system provides the environment within which programs are executed. To construct such an environment, the system is partitioned into small modules with a well-defined interface. The various components of an operating system are:

1. **Process Management:**
   - A process is basically a program in execution. The execution of a process must progress in a sequential fashion.
   - When we write a computer program in a text file and when we execute this program, it becomes a process which performs all the task mentioned in the program.
   - The operating system is responsible for the following activities in connection with processes managed:
     - i. The creation and deletion of both user and system processes.
     - ii. The suspension or resumption of processes.
     - iii. The provision of mechanisms for process synchronization.
     - iv. The provision of mechanisms for deadlock handling.

2. **Memory Management:**
   - Memory management is the functionality of an operating system which handles or manages primary memory and moves processes back and forth between main memory and disk during execution.
   - Memory is a large array of words or bytes, each with its own address.
   - Interaction is achieved through a sequence of reads or writes of specific memory address. The CPU fetches from and stores in memory.
   - The operating system is responsible for the following activities in connection with memory management:
     - i. Keep track of which parts of memory are currently being used and by whom.
     - ii. Decide which processes are to be loaded into memory when memory space becomes available.
     - iii. Allocate and deallocate memory space as needed.

3. **Secondary Memory Management:**
   - The main purpose of a computer system is to execute programs.
   - These programs, together with the data they access, must be in main memory during execution.
   - Since main memory is too small to permanently accommodate all data and program, the computer system must provide secondary storage to backup main memory.

- Most programs, like compilers, assemblers, sort routines, editors, formatters and so on, are stored on the disk until loaded into memory, and then use the disk as both the source and destination of their processing.
- The operating system is responsible for the following activities in connection with disk management:
    i. Free space management
    ii. Storage allocation
    iii. Disk scheduling

4. **Operating System Services:**
- An operating system provides services to both the users and to the programs:
    i. It provides programs an environment to execute.
    ii. It provides users the services to execute the programs in a convenient manner.
- Following are a few common services provided by an operating system:
    i. Program Execution
    ii. I/O operations
    iii. File System Manipulation
    iv. Communication
    v. Error Detection
    vi. Resource Allocation
    vii. Protection
    viii. User Interface (sh, bash, terminal)