Unit-1 Introduction to Operating System

Lecture – 3

Functions of Operating System

- The main functions of an operating system include:
  - **Process management:** The operating system is responsible for the following activities in connection with process management:
    - Creating and deleting both user and system processes
    - Scheduling processes and threads on the CPUs
    - Suspending and resuming processes
    - Providing mechanisms for process synchronization
    - Providing mechanisms for process communication, i.e. IPC.
  - **Memory management:** The operating system is responsible for the following activities in connection with memory management:
    - Keeping track of which parts of memory are currently being used and which process is using them.
    - Deciding which processes (or parts or processes) and data to move into and out of memory.
    - Allocating and deallocating memory space as needed
  - **File management:** The operating system is responsible for the following activities in connection with File management:
    - Creating and deleting files
    - Creating and deleting directories to organize files
    - Supporting primitives for manipulating files and directories
    - Mapping files onto mass storage
    - Backing up files on stable (nonvolatile) storage media
  - **Mass Storage Management:** The operating system is responsible for the following activities in connection with secondary storage management:
    - Mounting and unmounting
    - Free-space management
    - Storage allocation
    - Disk scheduling
    - Partitioning
    - Protection
  - **Device management:** The operating system is responsible for the following activities in connection with device management:
    - Managing and controlling I/O devices such as printers, scanners, and network cards
    - Communicating with devices using device drivers

        - Providing a uniform interface between hardware devices and user-level software.
        - Buffering and caching of data during device operations
        - Handling device scheduling and access control
        - The OS manages communication between the computer and its peripheral devices, such as printers, scanners, and network cards.
    - **I/O Management:** The operating system is responsible for the following activities in connection with I/O management:
        - Providing standard input/output interfaces to applications
        - Handling I/O interrupts and errors effectively
        - Supporting spooling for slow I/O devices like printers
        - Ensuring efficient and secure data transfer between memory and devices
    - **Protection and security:** The operating system is responsible for the following activities in connection with protection and security:
        - Controlling access to system resources by users and processes
        - Providing user authentication mechanisms
        - Ensuring isolation between processes and data
        - Detecting and responding to unauthorized access or malware
        - Maintaining system integrity and data confidentiality through security policies.

Services of Operating System

Services from the user's point of view.

- **User Interface**
    - All operating systems have either command-line interface, Graphical User Interface, touch screen interface, or a combination of these.
    - The command-line interface (CLI), which uses text commands that are entered by the user.
    - The graphical user interface (GUI) uses windows, menus, a mouse as a pointing device, and a keyboard to enter text.
    - Touch-screen interfaces, used in mobile systems like phones and tablets, allow users to slide their fingers or tap on-screen buttons to make selections.
- **Program execution**
    - The system must be able to load a program into memory and run it.
    - The program must be able to end its execution, either normally or abnormally (if an error occurs).
- **I/O operations**

  - For efficiency and protection, users usually cannot control I/O devices directly. The Operating system provides I/O services.
  - A running program may need to perform input/output operations, such as reading from a file or writing to a display or network. Some devices require special functions, like reading from a network interface or writing to the file system.
- **File-System manipulation**
  - Operating systems provide file system services such as reading, writing, creating, deleting, updating, searching, and listing files and directories.
  - Some systems also support permissions management to allow or restrict access based on file ownership.
  - Many operating systems support multiple file systems.
- **Communications**
  - An operating system allows for inter-process communication, which can occur between processes on the same computer or across different computers.
  - This is typically done through shared memory or message passing.
- **Error detection**
  - The operating system provides error detection and correction features.
  - These errors may be related to the CPU, memory, or I/O devices.

Services from the system point of view

- **Resource Allocation**
  - When multiple processes run simultaneously, the operating system must allocate resources to them efficiently.
  - Resources may include CPU time, memory, file storage, or I/O devices.
  - Special routines (like CPU scheduling) help determine how to best assign CPU time based on factors like CPU speed and number of cores.
  - Peripheral devices like printers or USB drives are also managed.
- **Logging**
  - The operating system maintains resource usage logs. These logs are useful to system administrators when reconfiguring the system or analyzing system performance.
- **Protection and security**
  - The operating system provides both protection and security services.
  - Protection ensures that authorized users and processes can only access resources they are permitted to
  - Security prevents unauthorized users from accessing the system by requiring authentication before granting access.

Reference:

Operating System Concepts: Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Ninth Edition, Wiley India.