2) Operating System structures

Page No. 15
Date

Different services of operating systems:-

Operating system provides an environment which is suitable to execute programs. It provides many services for smooth functioning of overall system.

Services provided to help the user:

① User Interface:- It is a medium through which the user interacts with the computer system.

Types of User Interfaces:

- Command Line Interface:- It provides an environment where user can write their commands in text format on command prompts.
- Batch Interface:- In this commands and directives to control those commands are entered into files (batch), and those files are executed.
- Graphical User Interface (GUI):- It contains pointing device to direct I/O, choose from menus, graphical icons and make selections and a keyboard to enter text.

② Program execution:- OS provides an environment which is suitable for executing the programs. The system must be able to load a program into memory and run that program. The program must be able to end its execution, either normally or abnormally.

③ I/O operations:- A running program may require I/O, which may involve a file or an I/O device. OS makes I/O devices available to user in a user friendly manner whenever required.

④ File System Manipulation :-
Programs need to read and write files and directories. They also need to create and delete them by name, search for given file and list file information. OS also include permissions management to allow or deny access to files or directories.
OS provide a variety of filesystems. Complete filesystem manipulation fall under the responsibility OS.

⑤ Communication :- Many time, a process needs to exchange information with another process. Such communication may occur between processes that are executing on the same or different computer systems tied in a network.
Communications can be implemented via:
① Shared Memory
② Message Passing

⑥ Error detection :- OS needs to detect and correct errors constantly. For each type of error, the os should take appropriate action to ensure correct and consistent computing. Sometimes, OS has no choice but to halt the system. Sometimes, it might generate error and return code to a process to detect and possibly correct.

Services provided to help the system itself:

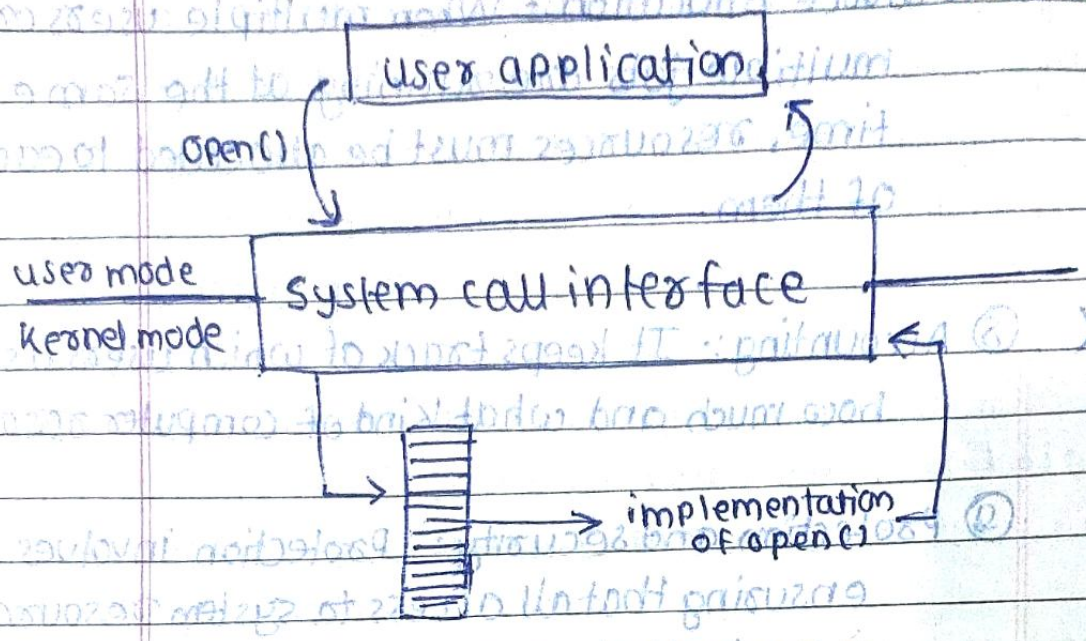
⑦ Resource Allocation :- When multiple users or multiple jobs are running at the same time, resources must be allocated to each of them.

⑧ Accounting :- It keeps track of which users use how much and what kind of computer resources

⑨ Protection and security :- Protection involves ensuring that all access to system resources is controlled. Security of the system from unwanted and outside users require user authentication.

System calls :- System call is a communication made by an operating system with the processes. It provides an interface to the services made available by an operating system. It allows user-level processes to request some services from the operating system which process itself is not allowed to do. System executes thousands of system calls per second. System calls are written in C, C++ or assembly language.

System Call implementation :-



Generally a number is associated with each system call. System call interface maintains a table indexed according to those numbers. The caller needs to know nothing about how the system call is implemented. The API (Application Programming Interface) hides background details from users and makes interaction user friendly. It is managed by run-time support library.

System call parameter passing :-

There are three methods to pass the parameters to the operating system.

① Register :- We can pass parameters in registers.

② Table/Block :- When more parameters than registers, then the parameters are stored in a block / table. The address is passed parameter in register.

③ stack :- Parameters are placed, or pushed, onto the stack by the program and popped of the stack by operating system.

Types of System Calls :- There are five major types of system calls. They are as follows :

① Process Control :- These are related to process management. It includes:
- end, abort
- load, execute
- create process, terminate process
- get process attributes, set process attributes
- wait for time
- wait event, signal event
- allocate and free memory

② File Management :- These are used for manipulation of files. It includes:
- create file or delete file
- open, close
- read, write, reposition
- get file attributes, set file attributes.

③ Device Management :- These are required for managing devices. It includes:
- request device, release device
- read, write, reposition
- get device attributes, set device attributes
- logically attach or detach devices.

Date

④ Information Maintainence:- These are used to do information maintainence:

- get time or date, set time or date
- get system data, set system data
- get process, file or device attributes
- set process, file or device attributes

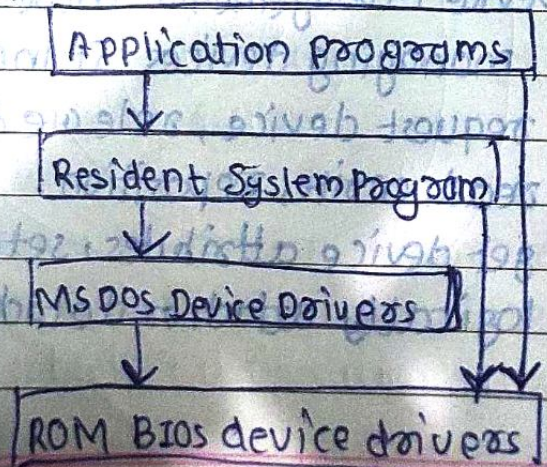
⑤ Communications:- These are used for communication among calls and processes

- create, delete communication connection
- send, receive message.
- transfer status information
- attach or detach remote devices.

Operating System structures:

Simple structure:- Many operating systems do not have well defined structures; such structures can be called as simple structure. Generally, such systems started as small, simple and limited systems and then grew beyond their original scope.

MS-DOS:-

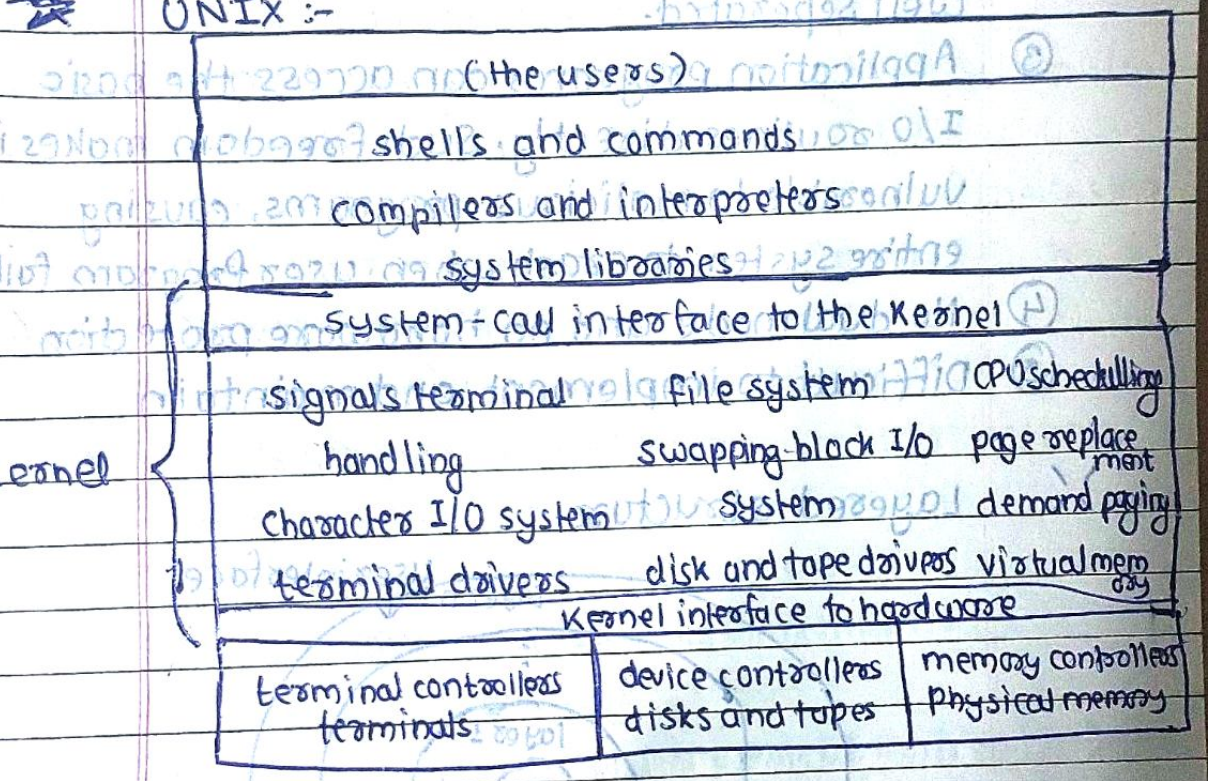


MS-DOS structure

MS-DOS was written to provide the most functionality in least space, so it was not carefully divided into modules.

In MS-DOS, the interfaces and level of functionality are not well seperated. For example, application programs can access the basic I/O routines directly. Such freedom makes MS-DOS vulnerable to errant programs, causing entire system to crash when user programs fail.

UNIX :-



Traditional UNIX structure

Like MS-DOS, UNIX was also limited by its hardware functionality. Such monolithic structure was difficult to implement and maintain, but advantage is that there is very little overhead in the system call interface or in communication within the kernel.

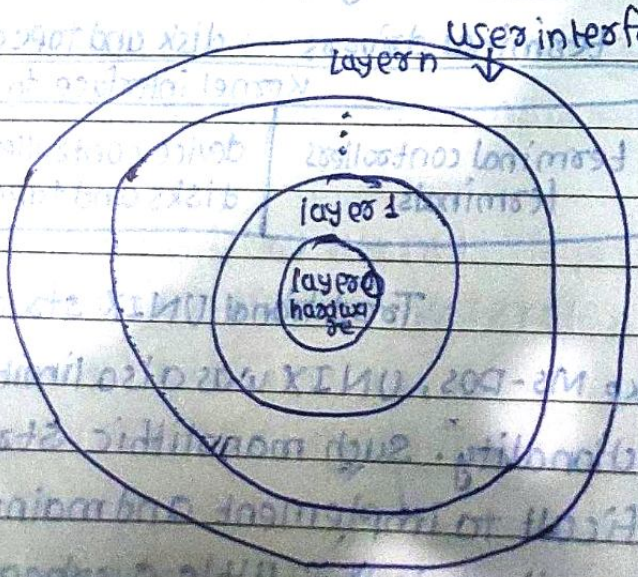
Advantages of simple structure:

① It provides most functionality in least space
② Very little overhead in the system call interface or in communication within kernel.
③ Fast.
④ Structural simplicity.

Disadvantages of simple structure:

① Not carefully divided into modules.
② The interface and levels of functionality are not well seperated.
③ Application programs can access the basic I/O routines directly. Such freedom makes it vulnerable to malicious programs, causing entire system to crash when user program fails.
④ No dual mode and no hardware protection
⑤ Difficult to implement and maintain

Layered structure:



Layered operating system

Operating system can be broken into smaller pieces with support of hardware; such a structure is called as layered structure. Due to layering, OS can retain much more greater control over the computer and applications. Overall fundianality and features are determined and seperated into components. The bottom layer (layer 0) is the hardware; the highest (layer N) is the user interface.

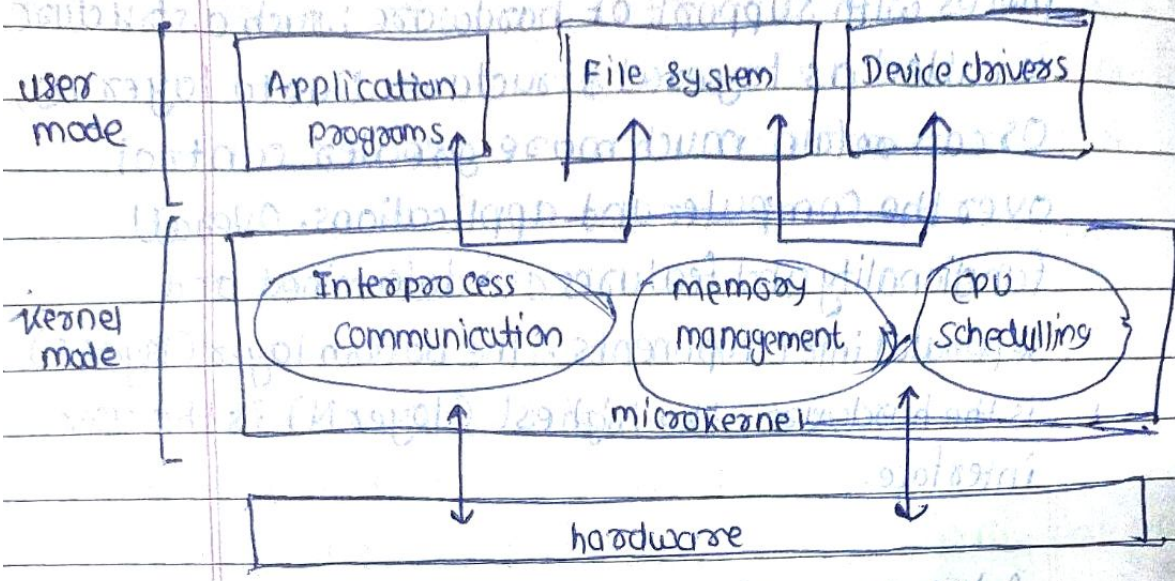
Advantages of Layered structure:

1. Simplicity of construction, debugging and system verification.
2. Simplified design and implementation of the system.
3. One layer can be debugged or changed without affecting ~~lower~~ other layer.
4. Appropriate and easy to understand.
5. Greater control over computer and applications.

Disadvantages of Layered structure:

1. Less efficient and takes more time.
2. Limitations in carrying big tasks
3. For every new function, a new layer is to be formed.
4. Overlayering can decrease the performance and efficiency of system.

Microkernel-structure:



Due to expansion of UNIX the kernel became large and it is very difficult to manage. So, modularizing the kernel using the microkernel approach was necessary. The main function of microkernel is to provide communication between the client program and the various services that are also running in user space. This method removes non-essential components from kernel and implementing them as system and user level programs.

Advantages of Micro-kernel:

1. Smaller and manageable kernel
2. Easy to modify kernel
3. New services can be added without modifying kernel.
4. Extending the operating system becomes easier
5. Portability.

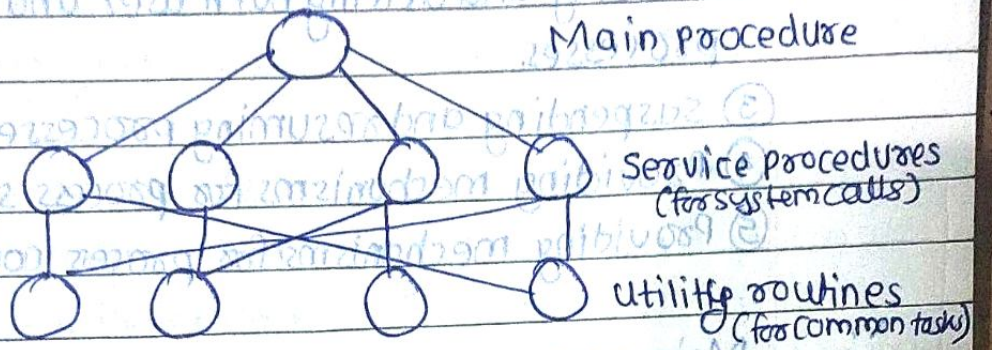
Date

Disadvantages of Microkernel:

① Difficult to decide which services should remain in the kernel and which should be implemented in user space.

② Performance of microkernel can suffer due to increased system-function overhead.

Monolithic structure:



Monolithic system does not have partition of the task into small components, or modules. Such structure is difficult to implement and maintain. The structure can be described, as there is no structure. But its advantage is; there is very little overhead in the system call interface or in communication with kernel. Information hiding is achieved in which much of the information is hidden away in modules. It was used in the UNIX, Linux and Windows.

Operating System Component Activities:

Process Management :-
A program in execution is known as process. Processes may be required to scheduled, allocate and deallocate its resources, etc.

Activities:
1. Scheduling process and threads on the CPU
2. Creating and deleting both user and system processes.
3. Suspending and resuming processes
4. Providing mechanisms for process synchronisation
5. Providing mechanisms for process communication.

Main memory management :-
Activities:
1. Keeping track of which parts of memory are currently being used and who is using them.
2. Deceiding which processes and data to move into and out of memory.
3. Allocating and deallocating memory space as needed.

File Management :-
Activities
1. Creating and deleting files
2. Creating and deleting directories to organise files.
3. Supporting primitives for manipulating files and directories.
4. Mapping files onto secondary storage.

⑤ Backing up files on stable (non-volatile) storage media.

Input/Output System Management:-

Activities:
① I/O operations management
② Hiding complexity of I/O device from users.
③ Keeping I/O devices continuously busy.
④ Memory management for I/O devices.

Secondary storage management:

Activities:
① Free Space Management
② Storage Allocation: Allotment of storage when new files have to be written or created
③ Disk scheduling:- Scheduling the requests for memory access.