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Subject - Operating Systems

Slot - B22+B24+F21

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Term End Examination

1)

a) An operating system (OS) is a critical software component that manages computer hardware and software resources, providing essential services for computer programs.

Functions of an Operating System

* Process Management - A process is a program in execution. A process needs certain resources including CPU time, memory, files and I/O devices to accomplish its task. Simultaneous execution leads to multiple processes. Hence creation execution and termination of a process are the most basic functionality of an OS.

* Memory Management - It is a repository of quickly accessible data shared by the CPU and I/O devices. Main memory is a volatile storage device. When the computer made turn off everything stored in RAM will be erased automatically. The OS keep tracks of which parts of memory are currently being used and by whom. Allocate and deallocate memory space as needed.

* File Management - File systems provide the conventions for the encoding, storage and management of data on a storage device such as hard disk. The OS is Responsible for -

* File Creation and Deletion
* Directory Creation and Deletion
* Mapping files onto Secondary Storage
* File Backup on stable storage media

* Device Management or I/O Management - Device controllers are components on the mother board that act as an Interface between the CPU and the actual device. Device Drivers which are the OS software components that Interact with device controllers.

* Keeps tracks of all devices connected to system.
* Designates a program responsible for every device known as I/O Controller.
* Decides which process gets access to a certain device and for how long.
* Allocates devices in an effective and efficiant way.
* Deallocates devices when they are no longer required

*Security and Protection - The OS uses password protection to protect user data and similar other techniques. It also prevents unauthorized access to programs and user data by assigning access right permission to files and directories. The owners of information stored in a multiuser or networked computer system may want to control use of that information, concurrent processes should not interfere with each other.

User Interface - A UI controls how you enter data and instructions and how information is display on the screen.

Types -

* Command Line Interface
* Graphical User Interface

Types of Operating System

* Batch Operating System - The users of this type of OS does not interact with computer directly. Each user prepares his job on an offline device like punch cards and submits it to computer operator. Ex- IBM's MVS

* Multiprogramming OS - This type of OS is used to execute more than one jobs simultaneously by a single processor. It increases CPU utilization by organizing jobs so that the CPU always has one job to execute. Multiprogramming OS use the mechanism of job scheduling and CPU scheduling.

* Time Sharing OS -

* Each task is given some time to execute so that all tasks work smoothly.

* These systems are known as Multi Tasking System

* The task can be from a single user or different users also.

* The time that each task gets to execute is called quantum.

Ex - Multics, Unix, etc.

*Multiprocessor OS - Also known as parallel OS or tightly coupled OS. Such OS have more than one processor in close communication that sharing the computer bus, the clock. It supports large physical address space and virtual address space. IPC mechanism is provided and implement.

* Distributed OS - Various autonous interconnected computers communicate with each other using a shared communication network. These are referred as loosely coupled system. Ex - LOCUS, DYSEAC.

* Network OS - These systems run on a server and provide the capability to manage data users, groups, security, applications. Also known as tightly coupled system. These type of OS allow shared access of files, printers, security, etc. Ex - Microsoft window Server 2003/2008/2012, UNIX, LINUX, Mac OS X.

* Real Time OS - These type of OS serve real time system. The time interval required to process and respond to inputs is very small. Time interval is Response Time. Ex - Missile System Robots, ATC System.

2)

b) A Page fault occurs when a program attempts to access a memory page that is not currently loaded in the physical memory (RAM).

* Demand Paging - The Program tries to access a page that has not been loaded into memory yet, which is common in systems using demand paging where pages are only loaded when needed.

* Invalid Memory Access - The Program attempts to access memory that it is not allowed to, either because it is beyond its allocated boundaries or because the page has been marked as invalid.

* Swapping - If the OS has swapped out a page to free up memory, accessing that page will result in a page fault.

Actions Taken By OS when Page Fault Occurs

* Trap Handling - The CPU generates an exception (trap) indicating a page fault which signals the OS to take action.

* Determine Reference Validity - The OS checks whether the accessed virtual address is valid and whether it corresponds to a legitimate page in the program's address space. If the reference is invalid, the OS may terminate the process due to illegal access.

* Check For Free Frame - If the reference is valid the OS checks if there are any free frames available in physical memory. If no free frames are available, it may need to invoke a page replacement algorithm to free up space by swapping out an existing page.

* Disk Operation Scheduling - If a frame is available or after a frame has been freed, the OS schedules a disk operation to read the required page from secondary storage into the allocated frame in memory.

* Update Page Tables - Once the required page is loaded into memory, the OS updates its internal data structures, including page table, to reflect that the page is now present in physical memory.

* Resume Execution - After updating the necessary information, the OS restores the state of the progress (including registers and program counter) and resumes execution of the instruction that caused the page fault as if it had always been in memory.

3)
b)

Directory Structure in Linux - The Linux directory is organized in a hierarchical format, resembling an upside down tree. At the top of this hierarchy is the root directory denoted by a single forward slash (/). All other directories and files branch off from this root forming a structured layout that helps organize system files and user data efficiently.

* /bin - Contains essential binary executable
* /etc - Holds configuration files
* /home - Contains user specific directory
* /usr - Contains user related programs
* /var - Holds variable data such as logs

File Naming -

* Case Sensitivity - File Names are case sensitive meaning 'File1' and 'file1' are considered different files.

* Hidden Files - Files that begin with a period (.) are treated as hidden and do not appear in standard directory listings unless specifically requested.

* No Spaces - It is advisable to avoid spaces in file names instead use underscores or dashes to separate words

* Limited Punctuation - only certain punctuation marks are allowed, primarily periods, dashes, and underscores to avoid confusion in CLI command line operations.

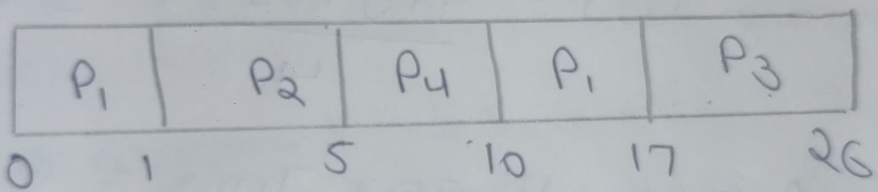
File Organization - File organization refers to how data is structured on storage device. The Linux file system employs a hierarchical approach, allowing files to be grouped logically within directories. This organization supports various file systems such as ext4, XFS, Btrfs.

Files can be organized based on their purpose or type, with users able to create subdirectories within their home directories for documents, images and scripts. This logical arrangement not only aids in efficient data but also enhances system performance.

4)

Process	Arrival Time	Burst Time
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

Gantt Chart -



Step 1 - Calculate Completion Time (CT)

Step 2 - Calculate Turn Around Time (TAT)

Step 3 - Calculate Waiting Time (WT)

Step 4 Calculate Average Waiting Time &

TAT = Completion Time - Arrival Time

WT = Turn Around Time - Burst Time

Process	CT	AT	TAT	BT	WT
P_1	17	0	17	8	9
P_2	5	1	4	4	0
P_3	26	2	24	9	15
P_4	10	3	7	5	2

Calculate Average Waiting Time :

$$\text{Average WT} = \frac{9+0+15+2}{4} = \frac{26}{4} = 6.5\text{ms}$$

∴ Average waiting Time = 6.5

51

No of cylinders - 200 (0 to 199)

Initial Position of Disk Head = 53

Request queue = 98, 183, 37, 122, 14, 124, 65, 67

Scan Scheduling

Sorted Request Queue -

14, 37, 65, 67, 98, 122, 124, 183

Requests below 53 = 14, 37

Request above 53 - 65, 67, 98, 122, 124, 183

Process requests

53 -> 37 -> 14 -> 0

Reverse Direction

0 - 65 -> 67 - 98 - 122 - 124 - 183

Head movment

53 -> 37 = 53 - 37 = 16

37 -> 14 = 37 - 14 = 23

14 -> 0 = 14 - 0 = 14

0 → 65 = 65 - 0 = 65

65 → 67 = 65 - 67 = 2

67 → 98 = 98 - 67 = 31

98 → 122 = 122 - 98 = 24

122 → 124 = 124 - 122 = 2

124 → 183 = 183 - 124 = 59

Total Head Movement

16 + 23 + 14 + 65 + 2 + 31 + 24 + 2 + 59 = 236

CSCAN

Total Head Movement

16 + 23 + 199 + 16 + 59 + 2 + 24 + 31 + 2 = 388