

## Q.NO. 1

### a. Describe THREE (3) features of multi-tasking system.

Ans:- Three Features of Multi-Tasking Systems:

**1. Concurrent Execution:** Multi-tasking systems allow multiple tasks or processes to run concurrently. This means that several programs or operations can execute simultaneously without waiting for one another to complete. This feature enhances system efficiency and responsiveness.

**2. Task Scheduling:** Multi-tasking systems employ task scheduling algorithms to allocate CPU time to different tasks or processes. These algorithms prioritize tasks based on factors such as priority levels, deadlines, and resource availability. This ensures fair and efficient utilization of system resources.

**3. Resource Management:** Multi-tasking systems efficiently manage system resources such as CPU, memory, and I/O devices. They allocate and deallocate resources as needed to prevent resource conflicts and maximize system utilization. Resource management also includes providing protection mechanisms to isolate processes from one another to prevent unauthorized access or interference.

### b. Explain any THREE (3) roles of operating systems in supporting the system components.

Ans:- Three Roles of Operating Systems in Supporting System Components:

#### 1. Resource Management

- CPU Allocation: The operating system manages the CPU by scheduling processes to ensure fair and efficient utilization. It uses scheduling algorithms like round-robin or priority-based scheduling to allocate CPU time to different tasks.

- Memory Management: The OS allocates and deallocates memory for processes, manages virtual memory, and handles memory protection to prevent one process from accessing another's memory space.

- Device Management: Operating systems control and manage input and output devices. They provide device drivers and abstract the complexities of hardware interactions, making it easier for applications to use these devices.

## 2. User Interface

- Graphical User Interface (GUI): Many modern operating systems provide graphical interfaces, making it user-friendly for individuals to interact with the computer. GUIs offer icons, windows, and menus for easy navigation.

- Command-Line Interface (CLI): For advanced users and system administrators, operating systems often offer command-line interfaces, where users can interact with the system using text-based commands.

## 3. Security and Access Control:

- User Authentication: Operating systems handle user authentication and access control. They require users to log in and authenticate themselves, ensuring that only authorized users can access the system.

- File Permissions: OSs manage file and directory permissions, determining who can read, write, or execute files. This is essential for data security and privacy.

- Virus and Malware Protection: Many operating systems include security features like firewalls and antivirus software to protect against malicious threats.

### c. Discuss TWO (2) reasons of child processes creation and TWO (2) reasons of child processes termination by the parent process.

Ans:- **Reasons for Child Process Creation:**

**1. Parallel Execution:** One of the primary reasons for creating child processes is to achieve parallel execution. In modern computing systems, tasks are often divided into smaller subtasks that can be executed concurrently to improve efficiency. By creating child processes, the parent process can distribute different parts of a task to these child processes, allowing them to execute in parallel and potentially reducing the overall execution time.

**2. Modularization and Maintainability:** Child processes also facilitate modularization and maintainability of code. By breaking down a complex task into smaller subprocesses, each encapsulated within its own child process, the overall codebase becomes more organized and easier to manage. This modular approach allows for easier debugging, testing, and future updates, as changes to one subprocess are less likely to impact others.

## Reasons for Child Process Termination by the Parent Process:

**1. Resource Management:** Parents may terminate child processes to manage system resources efficiently. Child processes consume system resources like memory, CPU time, and open file descriptors. If a parent process determines that a child process is consuming excessive resources or has completed its task, it may choose to terminate the child process to free up those resources for other tasks.

**2. Error Handling:** Another reason for terminating child processes is error handling. If a child process encounters an unrecoverable error or completes its task unsuccessfully, the parent process might decide to terminate the child process to prevent it from causing further issues or generating incorrect results. This can help in maintaining the overall stability and integrity of the application.

d. Discuss the process state transitions in Figure 1:

(12 MARKS)

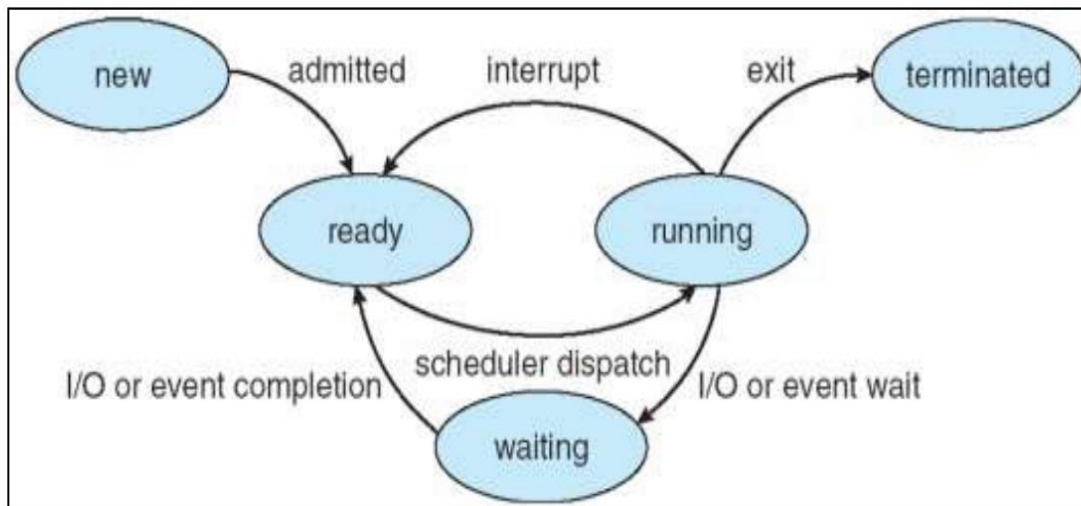


Figure 1

Ans:- Process state transitions involve several states and events that a process can go through during its execution. Here's a description of these states and events using the provided terms:

**1. New:** The process starts in the "New" state when it is created but has not yet been admitted to the system for execution.

**2. Admitted:** When the system accepts the process for execution, it transitions from the "New" state to the "Admitted" state. This step is usually initiated by a user or system request.

**3. Ready:** After being admitted, the process moves to the "Ready" state, where it waits in a queue to be scheduled by the operating system's scheduler for execution. It is ready to run but hasn't been allocated CPU time yet.

**4. Scheduler Dispatch:** When the scheduler selects the process from the "Ready" queue, it transitions to the "Scheduler Dispatch" state. This is the moment when the process is assigned CPU time and starts running.

**5. Running:** The process is said to be "Running" when it is actively executing its instructions on the CPU. It will remain in this state until it is interrupted or voluntarily releases the CPU.

**6. Interrupt:** An interrupt can occur while a process is running. This can be due to various reasons, such as a hardware interrupt (e.g., a keyboard input) or a software interrupt (e.g., a system call). When an interrupt occurs, the process moves from the "Running" state to a temporary "Interrupt" state.

**7. I/O or Event Waiting:** After an interrupt, if the process needs to wait for an I/O operation or an event to complete (e.g., reading data from a file or waiting for a timer), it transitions to the "I/O or Event Waiting" state. In this state, the process is temporarily suspended until the required I/O or event is finished.

**8. I/O or Event Completion:** When the I/O operation or event that the process was waiting for is completed, the process moves back to the "Ready" state, becoming eligible for execution again.

**9. Terminate:** When a process finishes its execution or explicitly requests termination, it enters the "Terminate" state. At this point, any resources associated with the process are released, and it is removed from the system.

## Q.NO. 2

### a. Define the concept of static and dynamic memory allocation

Ans:-

**Static Memory Allocation:** In this approach, memory is allocated for a program's variables during compile-time and remains fixed throughout the program's execution. This means that the amount of memory needed must be known in advance. Variables, arrays, and data structures are typically allocated statically. This method is relatively simple but can lead to memory wastage if the allocated memory is not fully utilized.

**Dynamic Memory Allocation:** In contrast, dynamic memory allocation involves acquiring memory during runtime as needed. It allows for more flexibility as memory can be allocated and deallocated dynamically based on the program's requirements. Common functions like `malloc` (memory allocation) and `free` (memory deallocation) in C/C++ are used for dynamic memory management. Dynamic memory allocation is useful when the size of data structures isn't known beforehand or when memory efficiency is crucial.

### b. Explain the fragmentation phenomena in computer memory.

Ans:- Fragmentation refers to the phenomenon where the memory space becomes divided into smaller, non-contiguous blocks due to allocation and deallocation of memory. There are two main types of fragmentation:

- **Internal Fragmentation:** This occurs when allocated memory blocks are larger than what is actually needed. For instance, if a program allocates a block of 64 bytes but only uses 40 bytes, the remaining 24 bytes are wasted. Internal fragmentation wastes memory within allocated blocks.

- **External Fragmentation:** This occurs when free memory blocks are scattered throughout the memory space, making it difficult to allocate a contiguous block of memory even if the combined free space is enough. This can lead to inefficient memory usage as larger contiguous blocks might be needed for some operations.

**c. Discuss with an example how the file access in indexed file method.**

Ans:- In indexed file access, an index is used to facilitate efficient data retrieval from a file. This index is a data structure that stores key-value pairs, where the key represents some attribute of the data (e.g., a unique identifier) and the value points to the actual location of the data in the file.

For example, consider a database of student records. Each record has a unique student ID. Instead of scanning the entire file to find a specific student's record, an index can be created where each student ID is associated with the byte offset or block number in the file where that student's record resides. When searching for a student's record, the index is consulted to quickly locate the relevant part of the file.

**d. Explain the input/output (I/O) function for each layer in input/output (I/O) software.**

Ans:- Input/Output software is responsible for managing data transfer between the hardware and higher-level software applications. It is often organized into layers, each with specific responsibilities.

**The layers can be summarized as follows:**

- **User/Application Layer:** This layer represents the software applications and programs that interact with I/O devices. Application-specific I/O functions are provided here.

- **Operating System Layer:** The operating system manages the hardware and provides a standardized interface for applications to perform I/O operations. It handles device driver management, buffer management, and error handling.

- **Device Driver Layer:** Device drivers are software components that facilitate communication between the operating system and specific hardware devices. They abstract hardware complexities, allowing the OS to interact with a variety of devices using a uniform interface.

- **Hardware Layer:** This is the physical layer where actual data transfer occurs between I/O devices and the computer's hardware components.

**Q.NO. 3**

**a. Given the following processes and burst time in Table 1.**

**Table 1**

<b>Process</b>	<b>Burst Time</b>
P1	13
P2	5
P3	23
P4	3
P5	31
P6	14

**i. Draw a Gantt Chart for First Come First Served (FCFS) scheduling algorithm.**

Ans:- A Gantt Chart for First Come First Served (FCFS) scheduling algorithm.

P1	P2	P3	P4	P5	P6	
0	13	18	41	44	75	89

**ii. Draw a Gantt Chart for Round Robin scheduling algorithm with the Time Quantum = 6**

Ans:- A Gantt Chart for Round Robin scheduling algorithm

Time Quantum = 6

P1	P2	P3	P4	P5	P6	P1	P3	
0	6	11	17	20	26	32	38	44

P5	P6	P1	P3	P5	P6	P3	P5	
44	50	56	57	64	70	72	76	89

**b. Write the Turnaround Time of the scheduling algorithms in Question 3(a)(i) and Question 3(a)(ii).**

Ans:-

**3(a)(i) Round – Robin Turn around time**

Process	AT	BT	CT	TAT
P1	0	13	57	57
P2	0	5	11	11
P3	0	23	76	76
P4	0	3	20	20
P5	0	31	89	89
P6	0	14	72	72

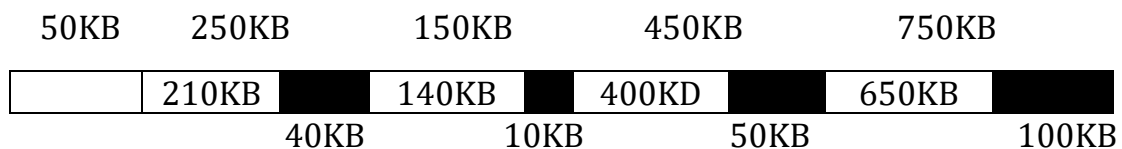
**3(a)(ii) First Come First Served (FCFS)**

Process	AT	BT	CT	TAT
P1	0	13	13	13
P2	0	5	18	18
P3	0	23	41	41
P4	0	3	44	44
P5	0	31	75	75
P6	0	14	89	89

**c. Assume that the main memory has the following five fixed partitions with the following sizes: 50KB, 250KB, 150KB, 450KB and 750KB (in order).**

**Draw an appropriate table on how the Best-fit algorithm would allocate the processes 210KB, 400KB, 140KB and 650KB (in order).**

Ans:- Best-fit algorithm





d. Given the following information in Table 2:

**Table 2**

User	File Name				
	File_1	File_2	File_3	File_4	File_5
<b>Alice</b>	Owner Read Write Execute	Read Write	Read Write		Read Write
<b>Jamil</b>	Read	Owner Read Write Execute	Read Write	Read	
<b>Sandra</b>	Read Write	Read	Owner Read Write Execute	Read	Read Write

Draw a matrix that shows the access control list of File\_1, File\_2, File\_3, File\_4 and File\_5 for each user.

Ans:-

User	File Name				
	File_1	File_2	File_3	File_4	File_5
<b>Alice</b>	rwX	rw	rw	-	rw
<b>Jamil</b>	r	rwX	rw	r	-
<b>Sandra</b>	rw	r	rwX	r	rw

## Q.NO. 4

a. List the information contain in the following Linux files:

- **/etc/passwd**

Ans:- This file contains user account information, including usernames, user IDs (UIDs), group IDs (GIDs), home directories, login shells, and more. Each line in the file represents a user account with fields separated by colons (":").

- ``username``: User's login name.
- ``x``: The password field is usually encrypted and stored in the ``/etc/shadow`` file for security reasons.
- ``1001``: User's UID (User ID).
- ``1001``: User's GID (Group ID).
- ``John Doe``: User's full name or comment.
- ``/home/username``: User's home directory.
- ``/bin/bash``: User's default shell.

- **/etc/shadow**

Ans:- This file stores the encrypted passwords of user accounts. It is only readable by the root user and contains additional security-related information for user accounts.

- ``username``: User's login name.
- ``$6$9a2vhWUL$xHJbGJLrAkQhMQDXKtTH9Gx8l0Zs/tU3ciKg9ksjdXsVv2JDA9TdOqX5HVyOy.Pd3i.57yHXI9pMm/YjONvL0``: Encrypted password and additional password-related information.
- ``18860``: Last password change date (in days since January 1, 1970).
- ``0``: Minimum password age.
- ``99999``: Maximum password age.
- ``7``: Password warning period.
- ``::``: Reserved for future use.

- **/etc/group**

Ans:- This file contains group information, including group names, GIDs, and a list of users who are members of each group.

- ``groupname``: Name of the group.
- ``x``: Placeholder for the group password, which is not commonly used.

- `1002`: GID (Group ID) of the group.
- `user1,user2,user3`: List of users who are members of the group.

**b. State FOUR (4) system directories required by Linux operating system.**

Ans:- Four system directories required by the Linux operating system:

- 1. `/bin`**: This directory contains essential binary executables and commands that are required for system booting and repair. It includes basic system utilities like `ls`, `cp`, `mv`, `rm`, `mkdir`, and more.
- 2. `/etc`**: This directory stores system-wide configuration files and scripts. It contains various configuration files for the operating system, services, and applications. The `/etc/passwd`, `/etc/shadow`, and `/etc/group` files mentioned in part (a) are also located here.
- 3. `/lib` and `/lib64`**: These directories house shared libraries and kernel modules that are essential for the functioning of the Linux system. `/lib` typically contains 32-bit libraries, while `/lib64` contains 64-bit libraries on 64-bit systems.
- 4. `/usr`**: The `/usr` directory holds user-related data and is often referred to as the "user directory." It includes subdirectories such as `/usr/bin`, `/usr/sbin`, `/usr/lib`, and others that contain user-installed applications, system utilities, libraries, and documentation.

**c. Write a Linux command for the following instructions:**

**i. Janet wants to change from current working directory to subdirectory Tutorials in directory EC3239 which located in her user's home directory.**

Ans:- `cd ~ / EC3239 / Tutorials`

**ii. Jessica wants to copy the file Exercise1 in directory EC3120 which located in her user's home directory to directory /tmp with the same file name.**

Ans:- `cp ~ / EC3120 / Exercise1 /tmp`

iii. Puvénash wants to move the file Test1 in her user's home directory to directory Submission which is located in /etc.

Ans:- `mv ~ /Test1 /etc / Submission`

iv. The current working directory for user Mohammed is /tmp. He wants to create a new directory called CoCurricular in his user's home directory from the current working directory.

Ans:- `mkdir ~ / CoCurricular`

v. Joanne wants to remove the directory MinuteMeeting and its sub-directory from her system.

Ans:- `rm -r MinuteMeeting`

d. Figure 2 consists of the list of files with the file permission. Write a Linux command for the following instructions:

```
uclient@uclient-virtual-machine:~$ ls -l
total 68
-rw-r--r-- 1 uclient uclient  0 Jul  11 00:31 Activity
-rw-r--r-- 1 uclient uclient  0 Jul  11 00:31 Agenda
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Desktop
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Documents
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Downloads
drwxr-xr-x 2 uclient uclient 4096 Jul  1 10:28 Exam
-rw-r--r-- 1 uclient uclient 8980 Feb  2 22:52 examples.desktop
-rw-r--r-- 1 uclient uclient  0 Jul  11 00:31 EXEC3120
drwxr-xr-x 3 uclient uclient 4096 Jun 24 10:55 exercises
drwxr-xr-x 2 uclient uclient 4096 Feb 19 08:38 lab
drwxr-xr-x 2 root   root   4096 Jul  1 10:51 LabTutorial
-rw-r--r-- 1 uclient uclient  0 Jul  11 00:31 LabTutorial1
drwxr-xr-x 2 uclient uclient 4096 Jun 24 11:09 lecture
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Music
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Pictures
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Public
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Templates
drwxrwxr-x 2 uclient uclient 4096 Feb 19 08:09 Test
drwxr-xr-x 2 uclient uclient 4096 Feb  3 09:23 Videos
```

Figure 2

**i. Modify the file permission of file Agenda so that the user can execute the file, the group and other can read and write to the file in octal format.**

Ans:- `chmod 733 Agenda`

**ii. Modify the file permission of file ExEC3120 so that group can read and write but other has no access to the file in octal format.**

Ans:- `chmod 640 ExEC3120`

**iii. Modify the file permission for directory Exam so that group and other have no access to the file in octal format.**

Ans:- `chmod 700 Exam`

**iv. Modify the file permission for directory lecture so that group and other can read and write but other has no access to the file in octal format.**

Ans:- `chmod 770 lecture`

**v. Change the ownership of file LabTutorial1 from uclient to Moganna.**

Ans:- `chown Moganna LabTutorial1`

**vi. Change the group of directory Test to group Year2Students.**

Ans:- `chgrp Year2Students Test`

**vii. Change the ownership of file Exercises from uclient to wanashekin.**

Ans:- `chown wanashekin Exercises`

**viii. Modify the file permission for file Activity so that all users from the entire world can read, write and execute to the file in octal format.**

Ans:- `chmod 777 Activity`