

Assignment Sheet – 1

Course: B.Tech (CSE)

Year/Semester: II/III

Session: 2024-2025

Subject Name & Code: Operating Systems (BCSC 0004)

Max. Marks:

Time allowed

Set-1 (Roll No. 1-11)

1. I have purchased a laptop which consists of three types of memory: cache memory, RAM and Hard disk. I am excited to know why laptop comes with the cache memory? If cache memory is so useful and important, why we cannot replace other memories with it? Kindly help me in finding answers of these two questions.

2. Examine the given lines of code. How many numbers of Processes created?

```
#include <stdio.h>
```

```
#include <unistd.h>
```

```
int main()
{
    int i;
    for (i = 0; i < 4; i++)
        fork();
    return 0;
}
```

3. Many CPU-scheduling algorithms are parameterized. For example, the RR algorithm requires a parameter to indicate the time slice. Multilevel feedback queues require parameters to define the number of queues, the scheduling algorithms for each queue, the criteria used to move processes between queues, and so on.

These algorithms are thus really sets of algorithms (for example, the set of RR algorithms for all time slices, and so on). One set of algorithms may include another (for example, the FCFS algorithm is the RR algorithm with an infinite time quantum). What (if any) relation holds between the following pairs of algorithm sets?

- Priority and SJF
 - Multilevel feedback queues and FCFS
 - Priority and FCFS
 - RR and SJF
4. Consider three CPU-intensive processes, which require 10, 20 and 30 time units and arrive at times 0, 2 and 6, respectively. How many context switches are needed if the operating system implements a shortest remaining time first scheduling algorithm? Do not count the context switches at time zero and at the end. [gate 2006]
5. You are an IT consultant working with a small business owner who is setting up a computer network for their office. The business owner has specific requirements for the operating system, and your task is to recommend the most suitable classification of operating system based on these requirements.
- The business owner needs an operating system for their office desktop computers. They want an OS that is user-friendly, supports common office software, and is cost-effective. What classification of operating system would you recommend, and why?
 - The business owner also has a server in the office, and they require an OS that can handle multiple user connections, provide file sharing, and ensure data security. What classification of operating system would you recommend for the server, and why?
 - The business owner plans to integrate a real-time system for monitoring and controlling

manufacturing equipment. What classification of operating system would you recommend for this specialized task, and why?

6. Find the average waiting time (A.W.T) and (A.T.A.T) for executing the following process using Preemptive short-job first

Process	P1	P2	P3	P4	P5
Burst time	5	13	8	4	10
Arrival time	2	3	0	5	1

7. Three processes A, B and C each execute a loop of 100 iterations. In each iteration of the loop, a process performs a single computation that requires t_c CPU milliseconds and then initiates a single I/O operation that lasts for t_{io} milliseconds. It is assumed that the computer where the processes execute has sufficient number of I/O devices and the OS of the computer assigns different I/O devices to each process. Also, the scheduling overhead of the OS is negligible. The processes have the following characteristics:

Process id	t_c	t_{io}
A	100 ms	500 ms
B	350 ms	500 ms
C	200 ms	500 ms

The processes A, B, and C are started at times 0, 5 and 10 milliseconds respectively, in a pure time sharing system (round robin scheduling) that uses a time slice of 50 milliseconds. Calculate the time in milliseconds at which process C would complete its first I/O operation is

8. You are the administrator of a multi-user server. One of the users complains that their commands are not executing as expected. Upon investigation, you find that their processes are stuck in the "Blocked" state due to waiting for a network resource. Explain how processes transition between states and how you would address this issue.
9. Imagine a simple round-robin scheduling algorithm with a time quantum of 10 milliseconds. Two processes, X and Y, are competing for CPU time. Process X consistently uses less than 10 milliseconds per quantum, while process Y requires more than 10 milliseconds to complete. How would the CPU scheduler handle this situation, and what might be the user's experience with these processes?
10. Imagine you're working with a group of non-technical colleagues who are curious about computers. While discussing operating systems, they ask, "Why do we even need an operating system in our computers?" How would you explain the main purpose and significance of an operating system in a relatable scenario or example?

Set-2 (Roll No. 12-23)

11. If Mr. Abhishek aims to run his five programs, each of which typically takes 15 minutes to complete, but he's constrained to a time window of only 15-16 minutes, which operating system would you recommend for optimizing his task? Please explain your choice.
12. Under what circumstances, it is suitable to use time-sharing system rather than a PC or a single user workstation? Explain.
13. Examine the given lines of code. How many numbers of Processes created?

```
#include <stdio.h>
```

```
#include <unistd.h>
```

```
int main()
```

```

{
int i;
for (i = 0; i < 5; i++)
fork();
return 0;
}

```

14. Consider a set of 5 processes whose arrival time, CPU time needed and the priority are given below:

Process number	Arrival time(ms)	CPU time	Priority
p1	0	10	5
p2	0	5	2
p3	2	3	1
p4	5	20	4
p5	10	2	3

If the CPU scheduling policy is SJF, the average waiting time (without preemption) will be?

15. Consider the 3 processes, P1, P2 and P3 shown in the table.

Process	Arrival time	Time Units Required
P1	0	5
P2	1	7
P3	3	4

The completion order of the 3 processes under the policy round robin scheduling with CPU quantum of 2 time units is

16. Consider the following set of processes, with length of CPU bursts given in Millisecond as follows:

Process	Burst Time	Arrival Time	Priority
P1	8	0	3
P2	1	1	1
P3	3	2	2
P4	2	3	3
P5	6	4	4

- Draw the Gantt Charts for FCFS, SJF, Preemptive priority and RR(Quantum=2)
- What is the turnaround time of each process for above algorithm?
- What is the waiting time of each process for each of the above algorithm?
- Which algorithm results in minimum average waiting time?

17. You are part of a team working on a robotics project for an industrial automation task. Your team needs to choose an appropriate operating system for the robot's control unit. The choice of operating system will impact the robot's performance and reliability.

- Explain the key characteristics and requirements of the robotics project that should influence your choice of operating system classification.
- Considering the project's requirements, justify whether a real-time operating system, a general-purpose operating system, or a specialized embedded operating system would be most suitable for the robot's control unit. Provide reasons for your choice.
- Outline the potential advantages and drawbacks of your selected operating system classification in the context of the robotics project.

18. A software development team is working on a complex project with multiple components. Describe how you would use process states like "New," "Ready," "Running," and "Terminated" to manage the software development lifecycle, from project initiation to final delivery.

19. You are managing a real-time operating system for an autonomous drone. The drone has to perform various tasks with different deadlines, such as navigation and obstacle avoidance. How would you choose a scheduling algorithm to ensure that critical tasks meet their deadlines while maximizing CPU utilization?

20. In a computer lab at a university, students are using shared workstations for various tasks, including coding, word processing, and browsing. Describe how a fair-share scheduling algorithm could be employed to ensure that all students have a fair opportunity to use the CPU resources, regardless of their specific tasks.

Set-3 (Roll No. 24-35)

21. Consider a GLA university computer lab 330 where various students and researchers have access to a shared computing environment. Some students want to use this lab for doing programming assignments and data analysis while Professors want to utilize this lab to train their deep learning models. Describe which type of operating system in this lab can be utilized that effectively allocates resources, such as CPU time, memory, and peripheral devices, to ensure fairness and optimize productivity among multiple users.

22. Predict the output?

```
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>

void forkexample()
{
    int x = 1;

    if (fork() == 0)
        printf("Child has x = %d\n", ++x);
    else
        printf("Parent has x = %d\n", --x);
}

int main()
{
    forkexample();
    return 0;
}
```

23. Consider the following set of processes that need to be scheduled on a single CPU. All the times are given in milliseconds.

Process Name	Arrival Time	Execution Time
A	0	6
B	3	2
C	5	4
D	7	6
E	10	3

Using the shortest remaining time first scheduling algorithm, the average process turnaround time (in msec) is?

24. For the processes listed in the following table, which of the following scheduling schemes will give the lowest average turnaround time?

- a) First Come First Serve
- b) Non – preemptive Shortest Job First
- c) Shortest Remaining Time

Process	Arrival Time	Processing Time
A	0	3
B	1	6
C	4	4
D	6	2

25. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use nonpreemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

- a. What is the average turnaround time for these processes with the FCFS scheduling algorithm?
 - b. What is the average turnaround time for these processes with the SJF scheduling algorithm?
 - c. The SJF algorithm is supposed to improve performance, but notice that we chose to run process P_1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P_1 and P_2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling.
26. Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5 , all at time 0.

- a. Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non preemptive priority (a smaller priority number implies a higher priority), and RR scheduling.
 - b. What is the turnaround time of each process for each of the scheduling algorithms in part a?
 - c. What is the waiting time of each process for each of the scheduling algorithms in part a?
Assume an operating system maps user-level threads to the kernel using the many-to-many model where the mapping is done through LWPs. Furthermore, the system allows the developers to create real-time threads. Is it necessary to bound a real-time thread to an LWP? Explain.
27. You are developing an operating system for a personal computer. A user opens a word processing application and starts typing a document. Describe the process creation steps that occur from the user's action to the actual execution of the word processing program.
28. In a real-time control system for an autonomous robot, there are multiple processes responsible for sensor data processing, decision-making, and motor control. Describe how you would manage and prioritize processes in different states to ensure the robot's responsiveness to changing environmental conditions.
29. A user on a personal computer has opened multiple applications, including a text editor, a web

browser, and a media player. Describe how the operating system handles process states such as "Running," "Ready," and "Blocked" to provide a smooth user experience, especially when switching between applications.

30. Assume that, you work for a space exploration company, and your team is responsible for programming the software that controls a rover on a distant planet. Your colleague, who is new to this project, asks, "What exactly is a real-time operating system, and why are we using it for the rover's software?" How would you explain the concept of a real-time operating system and its importance in the context of controlling the rover's actions and data processing on a distant planet?

Set-4 (Roll No. 36-46)

31. The following C program is executed on a Unix/Linux system:

```
#include <unistd.h>
int main ()
{
    int i ;
    for (i=0; i<10; i++)
        if (i%2 == 0) fork ( ) ;
    return 0 ;
}
```

The total number of child processes created is _____ and Justify your output.

32. In a multiprogramming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems. What are two such problems?
33. Assume arrival order is: P1, P2, P3, P4, P5 at time 0, 1, 2, 3, 4 respectively and a smaller priority number implies a higher priority. Draw the Gantt charts for pre-emptive and non-pre-emptive priority scheduling. Calculate Average Turnaround Time and Average Waiting Time.
34. Consider a set of 5 processes whose arrival time, CPU time needed and the priority are given below:
- | Process number | Arrival time(ms) | CPU time | Priority |
|----------------|------------------|----------|----------|
| p1 | 0 | 10 | 5 |
| p2 | 0 | 5 | 2 |
| p3 | 2 | 3 | 1 |
| p4 | 5 | 20 | 4 |
| p5 | 10 | 2 | 3 |

If the CPU scheduling policy is SJF, the average waiting time (with preemption) will be?

35. Find the waiting time of P4 process using priority scheduling algorithm (Assume lowest number has highest priority).

Process	P1	P2	P3	P4	P5
Burst time	5	13	8	6	12
Priority	1	3	0	4	2

36. The traditional UNIX scheduler enforces an inverse relationship between priority numbers and priorities: the higher the number, the lower the priority. The scheduler recalculates process priorities once per second using the following function: $\text{Priority} = (\text{recent CPU usage} / 2) + \text{base}$ where base = 60 and recent CPU usage refers to a value indicating how often a process has used the CPU since priorities were last recalculated. Assume that recent CPU usage for process P1 is 40, for process P2 is 18, and for process P3 is 10. What will be the new priorities for these three processes when priorities are recalculated? Based on this information, does the traditional UNIX scheduler raise or lower the relative priority of a CPU-bound process?
37. You are designing a task scheduler for an operating system that supports both foreground and

background tasks. Explain how the "Ready" and "Running" states are managed in the context of a multi-core CPU, and how the scheduler decides which process to move from "Ready" to "Running."

38. In a multi-user operating system, several users are running CPU-bound tasks. One user has a high-priority task, while the others have lower-priority tasks. Explain how a priority-based scheduling algorithm would handle this situation and its potential advantages and drawbacks
39. In a computer lab, there are multiple student workstations running various applications. A student is complaining that their computer is running slowly because of a CPU-intensive application running on another workstation. How could a CPU scheduler address this issue and ensure fair CPU allocation among all users?
40. Consider you're in a tech support role, and a colleague from another department asks you to clarify what the term "kernel" means in the context of an operating system. They also want to know about the different types of kernels that exist. How would you explain the concept of a kernel, and what examples?

Set-5 (Roll No. 47-till end Last Roll No.)

41. There are two different ways that commands can be processed by a command interpreter. One way is to allow the command interpreter to contain the code needed to execute the command. The other way is to implement the commands through system programs. Compare and contrast the two approaches.
42. The issue of resource utilization shows up in different forms in different types of operating systems. List what resources must be managed carefully in the following settings:
 - a. Mainframe or minicomputer systems
 - b. Workstations connected to servers
43. Predict the output?

```
#include <stdio.h>
#include <unistd.h>
int main()
{
    fork();
    fork() && fork() || fork();
    fork();

    printf("forked\n");
    return 0;
}
```
44. Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of does the CPU remain idle?
45. Consider the following processes, with the arrival time and the length of the CPU burst given in milliseconds. The scheduling algorithm used is preemptive shortest remaining-time first.

Process	Arrival Time	Burst Time
P_1	0	10
P_2	3	6
P_3	7	1
P_4	8	3

The average turnaround time of these processes is milliseconds _____

46. Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

47. Consider the set of 4 processes whose arrival time and burst time are given below-

Process No.	Arrival Time	Burst Time		
		CPU Burst	I/O Burst	CPU Burst
P1	0	3	2	2
P2	0	2	4	1
P3	2	1	3	2
P4	5	2	2	1

If the CPU scheduling policy is Shortest Remaining Time First, calculate the average waiting time and average turnaround time.

48. While using your computer, you notice that one application has become unresponsive. Describe how you would use the operating system's task manager or equivalent feature to identify and terminate the unresponsive process.
49. How does the FCFS scheduling algorithm work in the context of allocating computers to students in the lab? What are the potential advantages and drawbacks of using FCFS for this purpose?
50. Imagine you're leading a team meeting at a software development company. You want to discuss the various types of operating systems and their pros and cons to help your team make informed decisions about which OS to use for their upcoming project. How would you guide the discussion, explaining the different types of operating systems while highlighting their advantages and disadvantages?