Theory Assignment 2- 2024

Design Principles of Operating Systems (CSE 3249)

Programme: B.Tech. (CSE & CSIT) Semester: 5th

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Course Learning Outcome	*Taxonomy Level
To analyze the mechanisms involved in handling, scheduling and synchronizing processes.	L4
To learn the different methods used to prevent and deal with deadlock.	L4
To explore various memory management, file handling and input output schemes, analyzing their effectiveness in a different scenario.	L4

This assignment is designed to give you practice with the concepts of

- Synchronization
- Deadlocks and methods of handling deadlock
- Memory management strategies
- Virtual memory management
- **Disk scheduling policies(Self Study)**

1. Let S be a binary semaphore variable with initial value 0. Assume that no blocked processes exist in the system. How many number of processes will be blocked in semaphore S after performing the following signal (V), wait (P) operations:
   5 P, 7 V, 10 P

2. Consider the following threads T1, T2 and T3 executing on a single processor, synchronized using three binary semaphore variables S1, S2, and S3. The threads can be context switched in any order and at any time.

T1	T2	T3

while(true) {
wait(S3);
printf("C");
signal(S2);
}
	while(true){
	wait(S1);
	printf("B");
	signal(S3);
	}
		while(true){
		wait(S2);
		printf("A");
		signal(S1);
		}

   For which initialization of the semaphores, the sequence "BCABCABCA…." will be printed.

3. Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared Boolean variables S1 and S2 are randomly assigned.

```
P1( )                          P2( )
{                              {
    while (S1 = = S2);             While (S1! = S2);
    Critical Section               Critical Section
    S1 = S2;                       S2 =! S1;
}                              }
```

Which one of the following statements describes the properties achieved? (Justify you answer.)

a) Mutual exclusion but not progress

b) Progress but not mutual exclusion

c) Neither mutual exclusion nor progress

d) Both mutual exclusion and progress

4. Consider a system with four processes P1, P2, P3, P4 and 4 resource types R,R2,R3,R4 each one with a single instance. Draw the resource allocation graph corresponding to following resource allocation state:
   - P1 requests for R3 and R1.
   - P2 holds R3 and requests for R1
   - P3 holds R2 and requests for R4
   - P4 holds R1 and requests for R2

   Using wait for graph, check whether the system is in deadlock or not? If so how many processes are involved in deadlock?

5. Consider a system with 12 tape drives and 3 processes: P0, P1, and P2. P0 requires 4 tape drives, P1 requires 10 tape drives, and P2 requires 9 tape drives for completing their task. Suppose at time t0, P0 is holding 2 tape drives, P1 is holding 5 tape drives and P2 is holding 2 tape drives. Then check whether the current resource allocation state is safe or not. If yes specify the safe sequence. If P2 will request for 1 more instances of the tape drives, check the request can be granted immediately or not?

6. Consider the following resource allocation state with 3 processes and 3 resources: There are 3 instances of type X, 2 instances of type Y and 2 instances of type Z still available.

Process	Allocation			Max		
	X	Y	Z	X	Y	Z
P_0	0	0	1	7	4	3
P_1	3	2	0	6	2	0
P_2	2	1	1	3	3	3

   a) Find the content of the need matrix.
   b) Is the system in a safe state?
   c) If P0 will request for 2 more instances of type Z, Can the request be granted immediately or not?

7. Given four memory partitions of 200k, 600k, 300k, 400k, and 700k (in order). How would the First-fit, Best-fit, Worst-fit algorithms place processes of 312k, 517k, 212k, 526k (in order). Which algorithm makes the most efficient use of memory?

8. Using Page size of 16 bytes, a physical memory of 2048 byte and logical memory of 128 bytes,
   a) Find the number of bits required to represent logical address.
   b) Find the number of bits required to represent physical address.
   c) Find the number of entries in the page table.
   d) Find the total number of frames.
   e) Find the physical address of the logical address 20 with the following page table:

8
6
5
2
3
1
4
7

9. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	100
2	90	110
3	1327	400
4	1950	50

   What are the physical addresses for the following logical addresses?
   a. 0,430 b. 1, 10 c. 2,100 d. 2,500

10. Consider a main memory with four page frames and the following sequence of page references: 3, 8, 2, 3, 9, 1, 6, 3, 8, 9, 3, 6, 2, 1, 3. assuming all the page frames are initially empty. Find the total number of page faults that will occur using the following page replacement policy:
    a. FIFO b. Optimal c. LRU

11. Let total no. of frames is 50. There are two processes. Process P1 needs 10 pages and P2 needs 90.
    a. How many frames will be allocated to P1 and P2 using equal allocation scheme?
    b. How many frames will be allocated to P1 and P2 using proportional allocation scheme?

12. Consider a disk drive with 400 cylinders, numbered from 0 to 399. The request to access the cylinder in the order received by the disk scheduler are:
    85, 240, 164, 275, 150, 360, 225, 140, 330, 45
    Let the current position is 120 and the previous request was served at 352. The seek time is 4ms/cylinder. Compute the average seek length and total seek time obtained with respect to the following disk scheduling algorithms: **(Self Study)**
    - FIFO,
    - SSTF,
    - SCAN,
    - CSCAN,
    - LOOK,
    - CLOOK