Ex/CSE/MCA/T/211A/44-3/2016 (New)

MCA Third Semester Examination, 2015 (New)
Operating Systems

Time – 3 Hours **Full Marks – 100**

Answer any five questions
Different parts of a question must be answered together

1.

a. State if starvation is possible in priority based process scheduling. If so, propose a solution to overcome this problem.
b. Explain how the size of time quanta in round robin process scheduling impacts its performance.
c. Define turnaround time and waiting time.
d. Consider the following set of processes with the arrival times and the CPU burst times given in milliseconds

Process	Arrival Time	Burst Time
P_1	0	6
P_2	1	4
P_3	2	4
P_4	4	2
P_5	6	8

Determine the turnaround time and waiting time for all the processes using Shortest Remaining Time First (SRTF) and Longest Remaining Time First (LRTF) scheduling policy. In both the cases ties are broken by giving priority to the process with lowest id.

e. What is multi-level feedback scheduling?

3+3+2+8+4=20

2.

a. Differentiate binary and counting semaphores.
b. A system implements only binary semaphore. Describe how wait and signal operations on counting semaphores can be implemented using wait and signal operations on binary semaphores. Make suitable assumptions.
c. What is race condition? Explain with a suitable example.
d. P_1, P_2, and P_3 are three processes executing their respective tasks. They should synchronize among themselves using semaphores such that the string "ABCACB" is printed infinite times. Determine, minimum number of semaphores required and their initial values. Also identify places where operations on those semaphore should be inserted in the code of P_1, P_2, and P_3. Describe how your solution works.

```
P1
while(true){
        print("A");
}
```

```
P2
while(true){
        print("B");
}
```

```
P3
while(true){
        print("C");
}
```

2+6+4+8=20

3.

a. What are the different requirements that any solution to the critical section problem must satisfy? Explain each briefly.
b. What is a TestAndSet instruction? Describe how this instruction can be used to solve critical section problem. Explain if your solution satisfies the bounded waiting requirement. Provide justification for your answer.
c. What is a spinlock? In which scenario spin lock is useful?
d. What are the synchronization requirements of the producer and consumer processes in both bounded-buffer and unbounded-buffer producer consumer problem?
e. For the following code segment determine how many times "Hello" will be printed. Provide justifications for your answer.

```
int i=0;
int pid;
do{
        pid=fork();
        if(pid!=0);
                i++;
        else
                i+=2;
}while(i<=3);
printf("Hello");
```

3+6+3+2+6=20

4.

a. What are the necessary conditions of deadlock? Explain each briefly.
b. Propose a method that will deny circular wait condition in a system. Prove the correctness of this method.
c. What is a resource allocation graph? Show how it can be used for detecting deadlock.
d. Describe two ways by which an operating system can recover from deadlock.
e. A system has four processes and five allocable resource types. The current allocation and maximum needs are as follows:

Process	Allocated	Maximum	Available
P_1	1 0 2 1 1	1 1 2 1 3	0 0 x 1 1
P_2	2 0 1 1 0	2 2 2 1 0	
P_3	1 1 0 1 1	2 1 3 1 1	
P_4	1 1 1 1 0	1 1 2 2 1	

What is the minimum value of x for which this is a safe state? Provide suitable justification for your answer.

4+4+4+2+6=20

5.

a. Differentiate between load time address binding and execution time address binding.
b. What is external fragmentation? How can external fragmentation be reduced?
c. A computer system uses 8 kilobyte pages and a 32-bit physical address. Each page table entry contains a valid bit, a dirty bit, three permission bits, and the frame number. If the maximum size of the page table of a process is 24 megabytes, determine the length of the logical address supported by the system.
Now, if multi level page table is implemented then determine number of levels of the page table required. Determine the division of bits of the logical address that is required

to address each levels of the multi level page table. Also determine the size of the multilevel page table.
Assume that, A TLB with hit ratio of 90% and access time 1 nanosecond, is introduced to cache recently used page table entries. Compare the effective memory access time of the single level and multi level paging scheme with TLB. Physical memory access time is 10 nanoseconds.

d. In a demand paging system memory access time is 10 ns and page fault service time is 10 ms. What should be the maximum page fault rate so that performance does not degrade more than 12%?

3+3+10+4=20

6.

a. What is thrashing? What measures should an operating system take to prevent thrashing.
b. In a system inverted page table is used. Each entry of the inverted page table stores process id and page number. Logical address is 40 bit, physical memory size is 64 GB and page size is 8 KB. Process id is represented by 8 bit. Determine size of the inverted page table.
c. Consider six memory partitions of sizes 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB. These partitions need to be allotted to four processes of sizes 380 KB, 250KB, 470 KB and 490 KB in that order. Which partitions are NOT allotted to any process if best fit algorithm is used? What happens if worst fit algorithm is used?
d. 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. Determine number of page faults using page replacement policies First-In-First Out (FIFO), Least Recently Used (LRU) and Optimal respectively?

3+4+4+9=20

7.

a. Differentiate between seek time and latency time.
b. Differentiate between sequential and direct file access.
c. A disk pack has 16 surfaces, 256 tracks per surface and 64 sectors per track. Size of each sector is 512 bytes. Determine the size of the disk pack. Also determine the number of bits required to address each cylinder and each sector.
d. Suppose the following disk request sequence (track numbers) for a disk with 100 tracks is given: 45, 20, 90, 10, 50, 60, 80, 25, 70. Assume that present position of the R/W head is on track 52 and the previous request was for track no 25. Determine the additional distance (in terms of number of tracks) that will be traversed by the R/W head when the Shortest Seek Time First (SSTF) algorithm is used compared to the SCAN (Elevator) algorithm.
e. In a particular Unix OS, each data block is of size 4096 bytes, each i-node has 8 direct data block addresses and three additional addresses: one for single indirect block, one for double indirect block and one for triple indirect block. Also each block can contain addresses for 256 blocks. What is the approximate maximum size of a file?

2+2+4+6+6=20

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