Question Paper

Exam Date & Time: 11-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

Department of Information and Communication Technology
IV semester B.Tech(CCE) End Semester Examinations May 2024

OPERATING SYSTEMS [ICT 2227]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Missing data if any can be assumed with proper reasoning.

1a)	Suppose there are five processes P1, P2, P3, P4 and P5 that need to access a shared resource R. The access policy for R is as follows: P1 and P2 can access R concurrently, but no other process can access R when they are accessing it. P3, P4 and P5 can access R concurrently, but no other process can access R when they are accessing it. Design a solution using semaphores to implement this policy and check for possibility of deadlock. Demonstrate using a pseudocode for each process.	(5)
1b)	Consider a scenario where two processes P1 and P2, are trying to update a shared bank account balance. Design a solution to the critical section problem and demonstrate correct implementation of deposit and withdraw operations on the shared bank account, balance initially set to 1000.	(3)
1c)	With a neat diagram, illustrate how transition of operating system from user mode to kernel mode happens when an application uses a system call to create a process.	(2)
2a)	Consider a machine with 64 MB byte addressable physical memory and a 32bit virtual address space. If the page size is 4 KB, find the following with proper justification. (a) Number of bits in physical address (b) Number of frames in main memory (c) Number of bits in frame number and page offset. What is the approximate size of the page table? (d) Process size (e) Number of entries in page table	(5)
2b)	A system has 12 resources of A type, 14 resources of B type and 15 resources of C type. Find the current availability of the resources and apply Banker's algorithm and check whether the system is in safe state. Write the safe sequence if the system is deadlock free. Show the steps.	(3)

Process	MAX			Allocation		
	A	B	C	A	B	C
P1	8	7	5	2	3	4
P2	7	4	4	4	2	3
P3	2	5	5	1	4	4
P4	5	5	4	3	3	4

2c) Consider the set of processes and their priority (smaller the number, higher the priority), arrival time and their burst time in milliseconds as given. Schedule the set of processes using pre-emptive priority scheduling and first come first serve algorithms. Draw Gantt charts for both. (2)

Process	Arrival Time	Burst Time	Priority
P1	1	6	1
P2	0	5	2
P3	2	2	1
P4	3	3	2

3a) Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB in order. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. Show memory allocation using first fit, best fit and worst fit algorithms. Calculate internal and external fragmentation if any in each case. (5)

3b) Consider a system employing a deadlock-avoidance scheme for single instance of each resource type. Let P1, P2 and P3 be three processes in the system. Let P1 declare that it may request resources W, X and Y; P2 declare that it may request resources X, Y and Z; P3 declare that it may request resources W, Y and Z. Construct the resource-allocation graph by considering the resource requests declared by P1, P2 and P3. Consider each of the following pairs of independent resource requests to determine whether requests can be granted without a deadlock possibility. Justify your answer. (3)

a) P1 requesting X and P2 requesting Z

b) P2 requesting Y and P3 requesting W

c) P1 requesting Y and P3 requesting W

d) P1 requesting X and P2 requesting Y

3c) What is the advantage and dis-advantage of Shortest Job First scheduling algorithm? Consider a system of 5 processes and their burst times P1(10), P2(5), P3(3), P4(4) and P5(5). Predict the burst time of P6, using exponential averaging method, if τ=10ms and α=0.5. (2)

4a) Given main memory address sequence which are referred by the user: 1536, 2912, 4096, 6144, 7680, 1536, 2912, 4096, 6144, 7680, 1536, 2912, 4096, 6144, 7680, 1536, 2912, 4096, 6144, 7680, 1536. If there exists 100 bytes per page, find the reference string. Apply the following page replacement algorithms and find the number of page faults if the main memory has 4 frames. (5)

a. First In First Out (FIFO). Also, check if there exists Belady's anomaly or not.

b. Least Recently Used page replacement algorithm (LRU)

c. Optimal page replacement algorithm

4b) In a computer system utilizing demand paging, the system experiences page faults based on a (3)

page fault rate 'p', where $0 \leq p \leq 1.0$. The system has the following characteristics:

Memory Access Time: 330 nanoseconds

Page fault overhead: 5 milliseconds.

Swap page out time: 20 milliseconds.

Swap page in time: 25 milliseconds.

Restart overhead: 10 milliseconds.

Calculate the Effective Access Time (EAT) for the following scenarios:

Case 1: When there are no page faults (p=0)

Case 2: When there is a 50% chance of a page fault (p=0.5)

Case 3: When every memory reference results in a page fault (p=1.0)

4c) A Unix file system uses a i-node structure containing 10 direct block addresses, one indirect, one double and one triple indirect block addresses. The size of each block is 128bytes and the size of each block address is 8bytes. Find the maximum possible file size. (2)

5a) Consider a scenario if there exist three files: File A, File B, and File C. File A takes 3 blocks in the disk, File B takes 2 blocks in the disk, File C takes 5 blocks in the disk. With neat diagrams/table show how these three files (File A, File B, and File C) are allocated to the disk using the following disk allocation methods. (5)

a. Contiguous allocation

b. Linked Allocation

c. Indexed Allocation

5b) Suppose the total physical memory frames (m) is 300, Number of processes (n) available in the system is 5, Memory requirements for each process: (3)

Process 1: 40 frames, Process 2: 30 frames, Process 3: 20 frames, Process 4: 50 frames and Process 5: 60 frames.

a. Calculate the total number of frames allocated to each process using Equal allocation and Proportional allocation strategy.

b. Calculate Internal Fragmentation and External Fragmentation using Equal allocation and Proportional allocation strategy.

5c) Consider a real time system having three periodic tasks with their period, execution time and deadlines $T_i(p_i, e_i, d_i)$ as T1(10,1,6), T2(5,1,4), T3(3,1,2). Draw the pre-emptive Earliest Deadline First schedule of jobs on a single processor for timeline from 0-10 time units (2)

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