

Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science and Engineering
MCA III-Sem, End-Sem Exam, December 2016
Operating System (CA3301)

Time 3 Hour

M.M. 60

All questions are compulsory. Assume any missing data and mention it at the top of answer.

Q 1 Consider a pre-emptive priority scheduling algorithm based on dynamically changing priorities. Larger priority numbers imply higher priority. When a process is waiting for the CPU (in the ready queue, but not running), its priority changes at a rate δ ; when it is running, its priority changes at a rate μ . All processes are given a priority of 0 when they enter the ready queue. The parameters δ and μ can be set to give many different scheduling algorithms. 2+2 marks

1. What is the algorithm that results from $\mu > \delta > 0$?
2. What is the algorithm that results from $\delta < \mu < 0$?

Q 2 Consider a memory system with a cache access time of 10ns and a memory access time of 200ns, including the time to check the cache. What hit rate H would be required in order to achieve an effective access time 10% greater than the cache access time? 4 marks

Q 3 Consider the following page reference string:
1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.
How many page faults would occur for the following replacement algorithms, assuming five frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each. 2*3 marks

- LRU replacement
- FIFO replacement
- Optimal replacement

Q 4 Suppose that you wish to design a virtual memory system with the following characteristics: 3*2 marks

- The size of a page table entry is 4 bytes.
 - Each page table must fit into a single physical frame.
 - The system must be able to support virtual address spaces as large as 256 GB.
1. Suppose that you decide to use a multi-level paging scheme with no more than two levels of page tables. What is the minimum page size that your system must have?
 2. Suppose instead that you are willing to use a three-level paging scheme. What is the minimum page size that your system must have in this case?

Q 5 Consider a system with three smoker processes and one agent process. Each smoker continuously rolls a cigarette and then smokes it. But to roll and smoke a cigarette the smoker needs three ingredients: tobacco, paper and matches. One of the smoker processes has paper another has tobacco and the third has matches. The agent has an infinite supply of all three materials. The agent places two of the ingredients on the table. The smoker who has the remaining ingredient then makes and smokes a cigarette, signalling the agent on completion. The agent then puts out another two of the three ingredients, and the cycle repeats. Write a program to synchronize the agent and the smokers using synchronization. 10 marks

Q 6 Consider a demand-paged computer system where the degree of multiprogramming is currently fixed at four. The system was recently measured to determine utilization of CPU and the paging disk. The results are one of the following alternatives. For each 3*2 marks

case, what is happening? Can the degree of multiprogramming be increased to increase the CPU utilization? Is the paging helping?

1. CPU utilization 13 percent; disk utilization 97 percent
2. CPU utilization 87 percent; disk utilization 3 percent
3. CPU utilization 13 percent; disk utilization 3 percent

Q 7 Name and explain the four conditions of the deadlock.

4 marks

Q 8 Assume that a task is divided into four equal-sized segments and that the system builds an eight-entry page descriptor table for each segment. Thus, the system has a combination of segmentation and paging. Assume also that the page size is 2 Kbytes.

1+2+2
marks

- a. What is the maximum size of each segment?
- b. What is the maximum logical address space for the task?
- c. Assume that an element in physical location 00021ABC is accessed by this task. What is the format of the logical address that the task generates for it? What is the maximum physical address space for the system?

Q 9 Explain the following.

1*5
marks

1. Thrashing
2. Working set model
3. Multiprogramming vs. timesharing
4. TLB
5. ULT and KLT

Q 10 You have been hired by Allahabad Development Authority (ADA) to automate the flow of traffic on a one-lane bridge between Jhunsi and Allahabad that has been the site of numerous collisions. ADA wants you to implement the following rules: 10 marks

- Traffic can flow in only a single direction on the bridge at a time.
- Any number of cars can be on the bridge at the same time, as long as they are all traveling in the same direction.
- To avoid starvation, you must implement the "five car rule": once 5 or more consecutive Allahabad bound cars have entered the bridge, if there are any Jhunsi bound cars waiting then no more Allahabad bound cars may enter the bridge until some Jhunsi bound cars have crossed. A similar rule also applies once 5 or more consecutive Jhunsi bound cars have entered the bridge.