MID TERM-II
OPERATING SYSTEM, ITPC 20
Time limit: 40 min
Attempt any three questions

1. (i) Consider the virtual page reference string 1, 2, 3, 2, 4, 1, 3, 2, 4, 1 On a demand paged virtual memory system running on a computer system that main memory size of 3 pages frames which are initially empty. Let LRU, FIFO and OPTIMAL denote the number of page faults under the corresponding page replacements policy. Calculate the number of page faults in OPTIMAL, LRU and FIFO. (2 marks)

(ii) A processor uses 36 bit physical addresses and 32 bit virtual addresses, with a page frame size of 4 Kbytes. Each page table entry is of size 4 bytes. A three level page table is used for virtual to physical address translation, where the virtual address is used as follows • Bits 30- 31 are used to index into the first level page table • Bits 21-29 are used to index into the second level page table • Bits 12-20 are used to index into the third level page table, and • Bits 0-11 are used as offset within the page. What is the number of bits required for addressing the next level page table (or page frame) in the page table entry of the first, second and third level page tables are respectively. (3 marks)

2.(i) Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, What is the effective memory access time (in milliseconds)?
(2 marks)
(ii) Consider a system with a two-level paging scheme in which a regular memory access takes 150 nanoseconds, and servicing a page fault takes 8 milliseconds. An average instruction takes 100 nanoseconds of CPU time, and two memory accesses. The TLB hit ratio is 90%, and the page fault rate is one in every 10,000 instructions. What is the effective average instruction execution time? (3 marks)

3 (i) Consider a process executing on an operating system that uses demand paging. The average time for a memory access in the system is *M* units if the corresponding memory page is available in memory, and *D* units if the memory access causes a page fault. It has been experimentally measured that the average time taken for a memory access in the process is *X* units. Which one of the following is the correct expression for the page fault rate experienced by the process and why?
(2 marks)

(A) *(D – M) / (X – M) (b) (X – M) / (D – M) (c) (D – X) / (D – M) (d) (X – M) / (D – X)*

(ii) Consider a disk with 200 tracks and the queue has random requests from different processes in the order:

55, 58, 39, 18, 90, 160, 150, 38, 184

Initially arm is at 100. Find the Average Seek length using FIFO, SSTF, SCAN and C-SCAN algorithm. (3 marks)

4. (i) Assume that you have a page-reference string for a process with m frames (initially all empty). The page-reference string has length p; n distinct page numbers occur in it.Answer these questions for any page replacement algorithms: (3 marks)

a. What is a lower bound on the number of page faults?

b. What is an upper bound on the number of page faults?

(ii) Consider a computer system with ten physical page frames. The system is provided with an access sequence (a1,a2,...,a20,a1,a2,...a20),(a1,a2,...,a20,a1,a2,...a20), where each a_i is a distinct virtual page number. The difference in the number of page faults between the last-in-first-out page replacement policy and the optimal page replacement policy is _____.
(2 marks)

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