

Operating System(CS341)
End-Semester Examination
Department of Computer Science and Engineering
Indian Institute of Technology Patna

Total Question -15

Total Marks :70

Time : Monday(03/05/21) 9 A.M to Tuesday (04/05/21) 9 A.M (24 Hours)

Q.1: Consider a system in which a program can be separated into two parts: code and data. The CPU knows whether it wants an instruction (instruction fetch) or data (data fetch or store). Therefore, two base– limit register pairs are provided: one for instructions and one for data. The instruction base–limit register pair is automatically read-only, so programs can be shared among different users. Discuss the advantages and disadvantages of this scheme. [5 Marks]

Q.2: What is the effect of allowing two entries in a page table to point to the same page frame in memory? Explain how this effect could be used to decrease the amount of time needed to copy a large amount of memory from one place to another. What effect would updating some byte on the one page have on the other page? [5 Marks]

Q.3 Discuss the hardware support required to support demand paging. [4 Marks]

Q.4 In a particular Unix OS, each data block is of size 1024 bytes, each node has 10 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 128 blocks. What is approximately the maximum size of a file in the file system? [5 Marks]

Q.5 Segmentation is similar to paging but uses variable-sized “pages.” Define two segment-replacement algorithms based on FIFO and LRU page replacement schemes. Remember that since segments are not the same size, the segment that is chosen to be replaced may not be big enough to leave enough consecutive locations for the needed segment. Consider strategies for systems where segments cannot be relocated, and those for systems where they can. [5 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 case, what is happening? Can the degree of multiprogramming be increased to increase the CPU utilization? Is the paging helping? [5 Marks]

a. CPU utilization 13 percent; disk utilization 97 percent

- b. CPU utilization 87 percent; disk utilization 3 percent
- c. CPU utilization 13 percent; disk utilization 3 percent

Q.7 An operating system has 13 tape drives. There are three processes P1, P2 & P3. Maximum requirement of P1 is 11 tape drives, P2 is 5 tape drives and P3 is 8 tape drives. Currently, P1 is allocated 6 tape drives, P2 is allocated 3 tape drives and P3 is allocated 2 tape drives. Which of the following sequences represent a safe state ? [5 Marks]

- a. How would you specify this protection scheme in UNIX?
- b. Can you suggest another protection scheme that can be used more effectively for this purpose than the scheme provided by UNIX?

Q.8 Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. Find the capacity of the disk pack and the number of bits required to specify a particular sector in the disk. [5 Marks]

Q.9 Consider a disk with 16384 bytes per track having a rotation time of 16 msec and average seek time of 40 msec. What is the time in msec to read a block of 1024 bytes from this disk? [5 Marks]

Q.10 Let the page fault service time be 10ms in a computer with average memory access time being 20ns. If one page fault is generated for every 10^6 memory accesses, what is the effective access time for the memory? [5 Marks]

Q.11 A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1 If optimal page replacement policy is used, how many page faults occur for the above reference string? [5 Marks]

Q.12 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 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. [5 Marks]

Q.13: 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 experimental measured that the average time taken for a memory access in the process is X units. What will be the expression for the page fault rate experienced by the process? [5 Marks]

Q.14 A paging scheme uses a Translation Look-aside Buffer (TLB). A TLB-access takes 10 ns and a main memory access takes 50 ns. What is the effective access time(in ns) if the TLB hit ratio is 90% and there is no page-fault? [3 Marks]

Q.15 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:

- a. What is a lower bound on the number of page faults?
- b. What is an upper bound on the number of page faults? [3 Marks]