

CS 471 – Operating Systems
Fall 2004
Examination II
Points: 150
November 20, 2004
Time: 8:30-11:30 AM
CLOSED BOOK

Turning in this exam under your name confirms your continued support for the honor code of Old Dominion University and further indicates that you have neither received nor given assistance in completing it.

Name: _____ UID: _____
Unix account: _____

Question#	Points	
	Maximum	Obtained
1	25	
2	25	
3	25	
4	25	
5	25	
6	25	
Total:	150	
Letter Grade:		

Question 1.

- a. Given the following page-reference string, determine the number of page faults that would occur with optimal page replacement, assuming 3 frames. There were no pages in the frames initially. Reference string: 4,3,2,6,5,4,3,4,1,2,3,4,2

- b. Referring to Figure 1 below, answer the following questions.
 - i. Why does the CPU utilization increase as degree of multiprogramming (DM) is increased from 0 to 7?
 - ii. How do you explain the slight deterioration of CPU utilization for 7 to 10 of DM?
 - iii. Why does CPU utilization decrease drastically for 10 to 13 (of DM)?
 - iv. What is this phenomenon called?

- c. Consider a demand-paged memory system with a paging disk with an average access and transfer time of 10 milliseconds. Addresses are translated through a page table in main memory, with an access time of 50 microseconds per memory access. In addition, an associative memory with an access time of 5 microsecond is added to make the access to page tables faster. If 65% of accesses are in the associative memory, and of the remaining only 20% (or 7% of the total) cause page faults, determine the effective memory access time.

Question 2.

- a. Consider a file currently consisting of 100 blocks (numbered as block 0..99). Assuming that the FCB (File control block) is already in memory, determine the number of disk I/O operations (In terms of number of read block and write block operations) required for contiguous allocation strategy in the following three cases (Note: Treat the three cases as independent). **SHOW YOUR WORK.**
- i. A block (already in memory) is added after block 75.
 - ii. The block 30 is removed.
 - iii. The 89th block is accessed.
- b. Answer (a) assuming indexed allocation (instead of contiguous allocation). Assume that the directory is already in the main memory.

- c. What different types of techniques may be used to improve the efficiency and performance of a disk-based file system? Explain.

Question 3.

- a. Suppose a file with 150 blocks is spread over 150 random sectors (connected using a link list) of a disk (with each block on a single sector). If average seek time for any random cylinder access is 2 milliseconds, average rotational latency is 1 millisecond, and time to read and transfer 1 sector is 0.1 milliseconds, determine the total time to execute the following requests (i) A single request to read logical file sectors 35 thru 45 (ii) Update value in logical sector 77 of the file.
- b. Suppose a disk drive has 8000 cylinders (0..7999). The drive is currently serving a request at cylinder 4999, and the previous request at 2100. The queue of pending requests, in FIFO order, is: 375, 5600, 5, 8900, 3788. Starting from the current position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the three pending requests using SCAN scheduling algorithm.

- c. Suppose a disk rotates at 5000 RPM, has a sector size of 2048 bytes, and holds 1000 sectors per track. If average seek time is 2 milliseconds, and an average data request is for 9096 bytes, determine (i) Sustained bandwidth (in Mbytes/sec), and (ii) Effective bandwidth (in Mbytes/sec).

Question 4.

- [illegible]

- c. What are the advantages of stateless server over stateful server? What are the disadvantages?

Question 5.

- a. In a distributed transaction T , node N_1 acts as the coordinator as well as a participating node. Other participating nodes are N_2 , N_3 , N_4 , N_5 , and N_6 . Explain
- i. What are the consequences (related to T) if N_3 fails immediately after it sent "yes" message to N_1 in phase 2?
 - ii. What are the consequences (related to the T) if node N_3 fails before it even receives "prepare" message from N_1 ?
 - iii. What is the effect of node N_1 's failure before it could send "prepare" message to all participating nodes?
 - iv. What is the effect of node N_1 's failure after it receives "yes" message from all nodes, but prior to sending a "commit" message?

- b. Given the space-diagram of three processes and their interactions, determine whether or not the following happen-before relations are valid. (For each, state VALID or INVALID).

Seq.	Relation	Valid/Invalid
1.	E1→E8	
2.	E3→E5	
3.	E7→E14	
4.	E5→E13	
5.	E4→E10	
6.	E6→E12	

- c. What are the advantages of majority protocol over nonreplicated scheme? What are the disadvantages? Explain using an example.

Question 6.

- [illegible]

- c. Briefly explain how SSL is used to enable two computers to communicate securely.