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CS 162, Fall, 2003 Prof. Alan Jay Smith

Midterm 2, October 29, 2003

1. Define and distinguish the principles of temporal and spatial locality. Give two examples of how the principles of locality are exploited in a computer system.

2. Virtual Memory:

In a computer with 32-bit virtual address (A virtual address specifies a byte number) we subdivide the virtual address into 4 pieces as follows: 8-bit, 4-bit, 8-bit, 12-bit. We use a 3-level page table, such that the first 8 bits are used to index the page table for the first level, 4 bits for the second level, 8 bits for the third level, and 12 bits for the byte within page. Each page table entry is 48 bits, and contains a physical address (42 bits), 3 protection bits, valid, reference and dirty bits. Answer the following questions, showing how you reach the answer. A simple number will not receive any credit.

a. What is the page size in such a system? Explain your answers. (4)

b. How much memory is consumed by the page table, and how much is wasted by internal fragmentation for a process that has 64K of memory starting at address 0? (Don't forget to include internal fragmentation in the page table.) Assume that we don't allocate any page tables that have no valid entries in them. (6)

c. What is an inverted page table? If you use a global (i.e. shared by all processes, with a process ID) inverted page table, and you want to ensure that the page table was never more than 50% full, and the physical memory size is 32 MB, how many entries does the page table have? Why?

3. Disk Scheduling (24)

Suppose you are given a disk with 5000 cylinders (numbered 0 – 4999). Suppose also that the drive is currently servicing cylinder 143, and previously serviced cylinder 125.

Requests to the following cylinders have been made to the disk in the following time sequence order and are all pending. (I.e. they have not been done yet.)

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Consider the following disk arm scheduling algorithms: i) FCFS; ii) SSTF; iii) SCAN; iv) C-SCAN

a. For each of the above algorithms, what is the order in which the requests are serviced for the requests listed above? (8)

b. For each of the above algorithms, what is the order in which the requests are serviced for the requests listed above? (show work) (8)

c. In order to determine which is the "best" arm scheduling algorithm, (in general, not particularly for this problem), what would you consider? (List the factors, in their relative order of importance, and explain their relative importance.) (8)

4. What is the inode table? What is the process open file table? Why do we use both, rather than putting a copy of the inode in the open file table entry? (15)

5. Page Replacement (18)

Given the following reference string:
5 4 3 2 5 4 6 5 4 3 2 6

determine the number of page faults when there are 3 or 4 page frames, for each of LRU, OPT and FIFO replacement.

Show your work.

	3	4
LRU		
FIFO		
OPT		

6. What is a stack algorithm? Prove that LRU is a stack algorithm. Prove that FIFO is not a stack algorithm or prove that OPT is a stack algorithm (your choice). (15)