CS4328: Homework #4

Due on Tuesday, April, 30, 2019

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You may discuss this problem set with other students. However, you must write up your answers on your own. You must also write the names of other students you discussed any problem with. Each problem has a different weight. Please state any assumptions you are making in solving a given problem. Late assignments will not be accepted with prior arrangements. Assignments are due in class.

Problem 1

Consider a simple paging system with the following parameters: 2^{32} bytes of physical memory; page size of 2^{10} bytes; 2^{16} pages of logical address space. Answer the following questions: **[10 pts]**

(a) How many bits are in a logical address?

(b) How many bytes are in frame?

(c) How many bits in the physical address specify a frame?

(d) How many entries in the page table

(e) How many bits in each page table entry? Assume each page table entry includes a valid/invalid bit.

Problem 2

Consider a paging system with page table stored in memory, answer the following **[3 pts each]**:

(a) If a memory reference takes 1.2 microseconds, how long does a paged memory reference take?

(b) If we add 8 associative registers and 75% of all page table references are found in the associative registers, what is the effective memory reference time? Assume that checking a page table entry in the associative registers takes 0.1 microsecond.

Problem 3

Consider the following sequence of page references (each element represents a page number in a virtual memory system):

1 2 3 4 5 2 1 3 3 2 3 4 5 4 5 1 2 3 5

Show how many page faults would occur under each of the following policies:

(a) FIFO. **[3 pts]**

(b) LRU. **[3 pts]**

(c) Optimal. **[3 pts]**

Assume only 3 frames are available and that they were initially empty.

Problem 4

Consider a page reference string for a process with a working set of M frames initially all empty. The page reference string is of length P with N distinct page numbers in it. For any page replacement algorithm, answer the following [**3 pts each**]:

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

(b) What is the upper bound on the number of page faults?

Problem 5

Consider the following requests for tracks that arrived to a hard disk in that order: 98, 183, 37, 122, 14, 124, 65, 67. The hard disk has 200 tracks total and the head is currently positioned on track 53. Answer the following [**3 pts each**]:

(a) What is the average seek length under FIFO scheduling?

(b) What is the average seek length under SSTF scheduling?

(c) What is the average seek length under SCAN scheduling? Assume SCAN goes towards track 0 first and does not use LOOK.