Operating Systems, Spring 2014

Final

2:10pm $\sim$ 3:50pm, Tuesday, June 24, 2014

INSTRUCTIONS:

1. This is a *closed-book* exam.
2. Try to solve all of the problems.
3. Try to give short answers. (Hint: An answer need not always be longer than the question.)
4. No cheating.
5. Please hand in both the exam sheet and the answer sheet.

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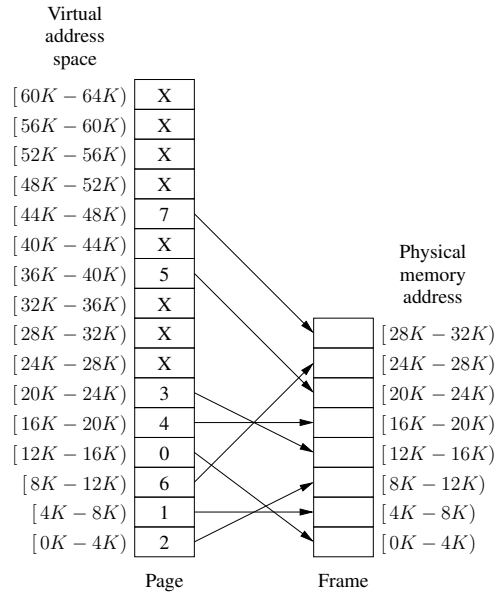
1. Assume a page reference string for a process with m frames (initially all empty). The page reference string has length n with p distinct page numbers occurring in it. For any page-replacement algorithms,
   (a) (10%) What is a lower bound on the number of page faults?
   (b) (10%) What is an upper bound on the number of page faults?
2. Given a UNIX i-node with ten direct blocks and three levels of indirect blocks (i.e., a single, a double, and a triple) and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions.
   (a) (10%) What would be the size of the smallest file allowed in bytes?
   (b) (10%) What would be the size of the largest file allowed in bytes?
3. A disk has 10000 cylinders, each with 10 tracks of 512 blocks. A seek takes 1 ms per cylinder moved. If no attempt is made to put the blocks of a file close to each other, two blocks that are logically consecutive (i.e., follow one another in the file) will require an average seek, which takes 6 ms. If, however, the operating system makes an attempt to cluster related blocks, the mean interblock distance can be reduced to 2 cylinders and the seek time reduced to 200 μs. Assuming that the rotational latency is 3 ms and the transfer time is 10 μs per block, answer the following questions.
   (a) (10%) How long does it take to read a 200 block randomly placed file?
   (b) (10%) How long does it take to read a 200 block clustered file?
4. (10%) A small computer has 8 page frames, each containing a page. The page frames contain virtual pages A, C, G, H, B, L, N, and D in that order. Their respective load times were 18, 23, 5, 7, 32, 19, 3, and 8. Their reference bits are 1, 0, 1, 1, 0, 1, 1, and 1 and their modified bits are 1, 1, 1, 0, 0, 0, 1, and 1, respectively. Which page will the second chance page replacement algorithm replace?
5. (10%) A computer whose processes have 1024 pages in their address spaces keeps its page tables in memory. The overhead required for reading a word from the page table is 600 nsec. To reduce this overhead, the computer has a TLB, which holds 32 (page, frame) pairs and can do a lookup in 100 nsec. What hit rate is needed to reduce the mean overhead to 200 nsec?

6. Using the page mapping depicted below,



give the physical address corresponding to each of the following virtual addresses:

(a) (10%) 2049

(b) (10%) 8193