Operating Systems, Spring 2013

Final

2:10pm $\sim$ 3:50pm, Tuesday, June 18, 2013

INSTRUCTIONS:

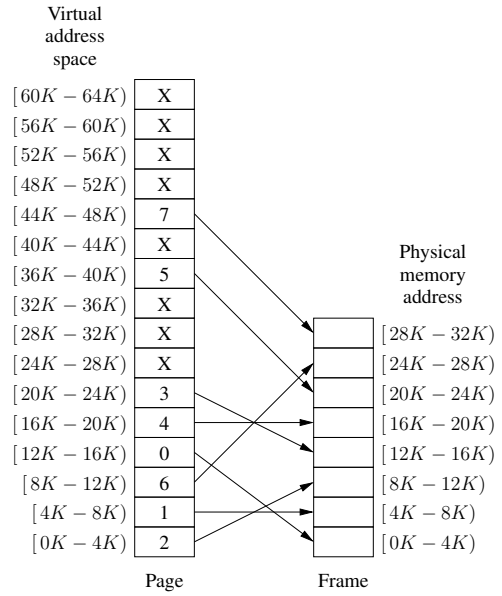
1. This is a *closed-book* exam.
2. Try to solve all of the problems.
3. Try to give short answers. (Hint: An answer need not always be longer than the question.)
4. No cheating.
5. Please hand in both the exam sheet and the answer sheet.

---

1. Given an i-node with *ten* direct blocks and *three* levels of indirect blocks and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions. *(Hint: you may assume all the meta-information for a file has been read into the main memory and forget about the case where some buffers may need to be written back to disk first.)*
   (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?
2. Assume a page reference string for a process with m frames (initially all empty). The page reference string has length p with n 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?
3. (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?
4. Disk requests come in to the driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 5 msec per cylinder moved. How much seek time is needed for
   (a) (10%) Closest cylinder next, and
   (b) (10%) Elevator algorithm (initially moving upward).

   In all cases, the arm is initially at cylinder 20.
5. (10%) A computer has 4 GB of RAM allocated in units of 64 KB. How many KB are needed if a bit map is used to keep track of free memory?
6. (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?

7. Using the page mapping depicted below,



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

(a) (5%) 2048

(b) (5%) 8192