# Operating Systems, Spring 2011

Final

1:10pm $\sim$ 2:50pm, Tuesday, June 21, 2011

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**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. Given an $i$-node with eight 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. (20%) A disk has 8000 cylinders, each with 8 tracks of 512 blocks. A seek takes 1 msec 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 5 msec. 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 100 microsec. How long does it take to read a 100 block file in both cases, if the rotational latency is 10 msec and the transfer time is 20 microsec per block?
4. Disk requests come in to the driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 6 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. (20%) A small computer has four page frames. At the first clock tick, the R bits are 0111 (page 0 is 0, the rest are 1). At subsequent clock ticks, the values are 1011, 1010, 1101, 0010, 1010, 1100, 0001, 0101, 1011, and 1101. If the aging algorithm is used with a 5-bit counter, give the values of the four counters after the last ticks.