

CSC 139 Operating System Principles

Homework 3

Fall 2019

Posted on Nov. 27, due on Dec. 5 (11:59 pm). Write your own answers. Late submission will be penalized (turn in whatever you have).

Exercise 1. (5%) A machine has 48-bit virtual addresses, 32-bit physical addresses, and the page size is 8 KB. How many entries are needed for one process's page table?

Exercise 2. (5%) A computer with a 32-bit address space uses a two-level page table. Virtual addresses are split into a 9-bit top-level page table field (the directory), an 11-bit second-level page table field, and an offset. How large are the pages and how many are there in the address space?

Exercise 3. (OSC 10.1) (10%) Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs.

Exercise 4. (OSC 9.6) (15%) Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order)? Rank the algorithms in terms of how efficiently they use memory.

Exercise 5. (OSC 10.9) (15%) Consider the following page reference string: 7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1. Assuming demand paging with three frames, how many page faults would occur for the following replacement algorithms?

- LRU replacement
- FIFO replacement
- Optimal replacement

Exercise 6. (OSC 10.40) (20%) In a 1,024-KB segment, memory is allocated using the Buddy system. Using Figure 10.26 in the textbook as a guide, draw a tree illustrating how the following memory requests are allocated:

- Request 6-KB
- Request 250 bytes

- Request 900 bytes
- Request 1,500 bytes
- Request 7-KB

Next, modify the tree for the following releases of memory. Perform coalescing whenever possible:

- Release 250 bytes
- Release 900 bytes
- Release 1,500 bytes

Exercise 8. (OSC 11.13) (18%) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 2150, and the previous request was at cylinder 1805. The queue of pending requests, in FIFO order, is: 2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681. Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?

- FCFS
- SSTF
- SCAN
- LOOK
- C-SCAN
- C-LOOK

Exercise 9. (12%) The blocksize of a filesystem is 2048 bytes. Consider an inode with 8 pointers point to direct blocks, 3 pointers point to single indirect blocks, and 1 pointer points to a double indirect block. If block numbers (disk addresses) take 4 bytes, what is the maximum file size possible? Why? (Hints: Textbook Figure 14.8; Slides 4-4 p18)

Please complete the following survey questions:

1. How much time did you spend on this homework?
2. Rate the overall difficulty of this homework on a scale of 1 to 5 with 5 being the most difficult.
3. Provide your comments on this homework (e.g., amount of work, difficulty, relevance to the lectures, form of questions, etc.)