

CSE 4/521 – Introduction to Operating Systems  
Summer 2018  
Homework 4

*Total points: 30*

*Submission deadline: Aug 13<sup>th</sup>, 2018 (Inclass)*

*Submission guidelines: One submission per individual*

*'Homework Buffer days' tally is carried over from the previous homework.*

*Please note the academic integrity policy at: <http://academicintegrity.buffalo.edu/policies>*

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**Mass-Storage Structure:**

1. Explain why SSTF scheduling tends to favor middle cylinders over the innermost and outermost cylinders? (2)
2. Is disk scheduling, other than FCFS scheduling, useful in a single-user environment? Explain your answer. (2)
3. What are the tradeoffs involved in rereading code pages from the file system versus using swap space to store them? (2)
4. Elementary physics states that when an object is subjected to a constant acceleration  $a$ , the relationship between distance  $d$  and time  $t$  is given by  $d = (0.5)at^2$ . Suppose that, during a seek, the disk accelerates the disk arm at a constant rate for the first half of the seek, then decelerates the disk arm at the same rate for the second half of the seek. Assume that the disk can perform a seek to an adjacent cylinder in 1 millisecond and a full-stroke seek over all 5000 cylinders in 18 milliseconds.
  - a. The distance of a seek is the number of cylinders over which the head moves. Explain why the seek time is proportional to the square root of the seek distance.
  - b. Write an equation for the seek time as a function of the seek distance. This equation should be of the form  $t = x + y\sqrt{L}$ , where 't' is the time in milliseconds and 'L' is the seek distance in cylinders.
  - c. Calculate the total seek time for each of the schedules (FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK). Determine which schedule is the fastest (has the smallest total seek time).
  - d. The percentage speedup is the time saved divided by the original time. What is the percentage speedup of the fastest schedule over FCFS?  
The queue of pending requests, in FIFO order is:  
2069 1212 2296 2800 544 1618 356 1523 4965 3681  
The head is at cylinder 2150 and the previous request was at 1805. (8)

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**File-System Implementation:**

1. Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file? (2)
2. Consider a file system that uses inodes to represent files. Disk blocks are 8KB in size, and a pointer to a disk block requires 4 bytes. This file system has 12 direct disk blocks, as well as single, double, and triple indirect disk blocks. What is the maximum size of the file that can be stored in this file system? (3)

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**I/O System:**

1. State three advantages of placing functionality in a device controller, rather than in the kernel. State three disadvantages. (3)
2. What are the various kinds of performance overhead associated with servicing an interrupt? (3)
3. Write (in pseudocode) an implementation of virtual clocks, including the queueing and management of timer requests for the kernel and applications. Assume that the hardware provides three timer channels. (5)