CS4411 Operating Systems Homework 3 (Storage System) Spring 2019

1. **[10 points]** Suppose a hard disk has an average access time of 8ms, a rotational speed of 7200 rpm, and 63 sectors per disk.

   (a) Compute the average time to read a sector.

   (b) Compute the average time to read 10 sectors if they are contiguous (on the same track).

   (c) What is the average time if the 10 sectors are located randomly on the disk?

2. **[10 points]** 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:

   (a) First-Come-First-Serve (FCFS)

   (b) Shortest-Seek-Time-First (SSTF)

   (c) SCAN

   (d) C-SCAN

   (e) LOOK

   (f) C-LOOK

3. **[10 points]** A file currently has 5 blocks, from block 0 to block 4. Assume that its FCB and directory are already in memory. There are a few more assumptions as shown blow:

   - In the contiguous allocation case, the directory entry has a start pointer and a length value.
   - In the linked allocation, a directory entry has a start pointer and an end pointer.
   - In the FAT allocation, the FAT table is in memory and a directory entry has a start pointer to the FAT table.
   - In the case of the indexed allocation, the index block is in memory and is large enough for further expansion.

   How many disk I/O operations (*i.e.*, reads and writes) are required for contiguous, linked, FAT, and indexed (single-level) allocation strategies, if block 2 to be removed. Assume that the directory and index will **not** be written back to disk after this insertion is done.

4. **[10 points]** Suppose a Unix inode has 10 direct disk block pointers, one single indirect block pointer, one double indirect block pointer, and one triple indirect block pointer. For convenience, each index table has $256 = 2^8$ entries and each block has $1\text{K} = 2^{10}$ bytes. What is the maximum size of a Unix file?