# CS2310 Modern Operating System Exercises Spring 2023

## Exercise 4: Storage System

**Due date: Mar. 31, 2023**

1. Consider a disk queue with requests for I/O to blocks on cylinders 23, 89, 132, 42, 187. The head is initially at cylinder number 100. Assume we are going inwards (i.e., towards 0). The cylinders are numbered from 0 to 199. Calculate the total head movement (in number of cylinders) incurred while servicing these requests. Please apply FCFS, SSTF, SCAN, C-SCAN, and C-LOOK, respectively.

2. File System Implementation

1) Suppose a file system is constructed using blocks of 32 bytes each. The storage blocks of a file are stored in an I-node. Assume that an I-node needs a block of storage. The I-node structure is as follows:

| | |
|---|---|
| 0 | File Size |
| 1 | Direct block |
| 2 | Direct block |
| 3 | Direct block |
| 4 | Direct block |
| 5 | Single-indirect |
| 6 | Double-indirect |
| 7 | Triple-indirect |

Let's consider a file containing 252 bytes of data. Assume that blocks are organized in a logical order starting from 0. Available/free blocks include 15-17, 40-46, 65-70, and 115-148. Draw a block diagram showing the structure of the I-node and the blocks that are allocated.

2) What will the state of the system look like after 416 additional bytes are appended to the file (draw a block diagram showing the structure of the I-node and the blocks that are allocated)?

3) What is the maximum file size supported by the above I-node?

4) Suppose that a single-platter and single-side hard disk is used to store the file system. There are 20 tracks logically numbered from 0 to 19. Each track contains 8 blocks. Specifically, track 0 holds blocks 0-7, track 1 holds blocks 8-15, so on and so forth. We assume that all the I/O requests are for the above file in the disk queue, and the block access sequence is shown as follows.

0, 1, 2, 6, 7, 8, 9, 13, 20, 16, 17, 18, 11, 12, 10, 3, 4, 14, 15, 19, 5

Here, each number *i* indicates the *i*th block in the file. The I/O requests may be from the same process or from multiple processes. We assume that there is no strict requirement on the sequence for serving the I/O requests, but the index block(s) must be read before reaching the data blocks.

Please draw the disk scheduling diagram when First-Come, First-Served

(FCFS) scheduling algorithm is used, and calculate the total head movement distance. Suppose that the head just finished serving an I/O request at track 10. Note that the index blocks are buffered once accessed.

**Hint:** You have to translate the sequence of block accesses to a sequence of track accesses first. Please be aware that a single block access may be translated into multiple track accesses.