Homework 4 for CSE153 (Winter 22)

Due: Monday March 14 (no extensions/slack days)

Optional – if submitted, will replace your worst homework

Instructions:

* Be brief in your answers. You will be graded for correctness, not on the length of your answers.

* Make sure to write legibly. Incomprehensible writing will be assumed to be incorrect.

*At our discretion, we may sample-grade the homeworks. The choice any problems that may not be graded is not pre-determined.

I. Consider that requests to read the following set of logical block numbers are enqueued to be serviced from a disk that has 100 logical blocks laid out sequentially from block 0 to block 99.

$\{1, 22, 14, 72, 86, 32, 11,\ 66, 45, 80\}$

Assume that the seek time in moving the disk arm head from logical block i to block j is proportional to $|i – j|$. Given that the arm head is currently positioned at block 75 and is in the midst of moving in the direction towards block 0, what is the sequence in which the enqueued blocks will be read with the i) SSTF, ii) SCAN, and iii) C-SCAN algorithms (picks up requests on way down only)?   (3 points)

II. Consider a file system that uses a structure similar to an i-node with the following differences. If the file size is less than 100 bytes, the data is stored directly in the i-node. If it is larger, there are 6 direct links (point to a data block), 1 single-indirect links, 2-double indirect links and 1 triple indirect link.

(a) What is the largest file size that can be indexed in this system without using the triple indirect link? Assume the block size is 1024 bytes. (2 points)

(b) How many blocks (including index blocks) are needed to address a file of size 100 bytes, 10000 bytes, 100Kbytes, and 10Mbytes? (4 points)

(c) (2 points) What happens if you increase the size of the file in (a) by one block? How many total additional blocks are needed?

(d) (2 points) Explain two <u>specific</u> scenarios of problems that happen if the system crashes in the middle of part (c). What is their effect?

IV. Consider a disk on which the rate at which it can read sequentially laid out data is 100 MBps. Average seek time on the disk is 6 milliseconds and that the disk rotates at 5400 RPM. Assume all indexing blocks (directory/i-node) are cached in memory; you only have to account for the data block accesses. Assume that sequentially placed data fits in consecutive tracks so that no additional seek or rotational delays are incurred if they do not fit in a single track.

(1) If the block size used by the file system is 1 KB and all blocks are randomly distributed across the disk, how long will it take for an application to read a file of size 256 MB?   (2 point)

(2) Repeat 1, assuming that the blocks were allocated contiguously. (2 point)