CSCI 3278 Homework 3

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13.2.1 parts C, E

Megatron 777 specs:

- 10 surfaces, 100,000 tracks each surface.
- Each track holds 1000 sectors, 1024 bytes each sector.
- 20% of track used for gaps.
- Disk rotates at 10,000 rpm.
- Head moves n tracks in $1 + 0.0002n$ milliseconds.

C) What is the maximum seek time?

Maximum seek time is when the head has moved over every track. Therefore substitute n = 100,000 into $1 + 0.0002n = 1 + 0.0002(100{,}000) =$ **21 milliseconds**.

E) If a block is 65,546 bytes, what is the transfer time of a block?

Following the process from Example 13.2:

- The minimum time to read the 65,546 byte block is the transfer time. This means that the block is on the track over which the head is

positioned already and the first sector of the block might be about to pass under the head.

- Based on the specifications, there are 1024 bytes per sector. Therefore, the block occupies $\frac{65,546}{1024} = 64$ sectors. The head must therefore pass over 64 sectors with 63 gaps in between them.
- The disk rotates at 10,000 rpm meaning that it makes one rotation in $\frac{1}{(10{,}000/60)} = 0.006$ seconds.
- Based on the specifications we know that gaps represent 20% of the circle and sectors the remaining 80%. There are 1000 gaps and 1000 sectors around the circle. Gaps cover 360 x .20 = 72 degrees of arc and sectors cover the remaining 360 - 72 = 288 degrees of arc.
- The total arc covered by 63 gaps and 64 sectors is 72 x 63/1000 + 228 x 64/1000 = 22.968 degrees.
- **The transfer time is thus (22.968/360) x 0.006 = .003828 seconds**.

13.3.1

A) At what time is each request serviced if we use the elevator algorithm (it is permissible to start moving in either direction first).

Figure 13.9 - head starts at 32,000

Cylinder of Requests	First Time Available
8000	0
48000	1
4000	10
40000	20

Megatron 747 Specs: average seek: 6.46 ms, rotational latency: 4.17 ms, transfer time: 0.13 ms, block access = 4.17 + 0.13 = 4.30 ms, seek time = 1 + #tracks/4000.

Following the elevator algorithm:

- 8,000 is the only request so we go down from 32,000.
  Seek time = 1 + (32,000 - 8,000)/4,000 = 7
  Head arrives at t = 0 + 7 = 7 and completes at t = 7 + 4.3 = 11.3
- 4,000 arrived at t = 10 and is in the current direction.
  Seek time = 1 + (8,000 - 4,000)/4,000 = 2
  Head arrives at t = 11.3 + 2 = 13.3 and completes at 13.3 + 4.3 = 17.6
- There are no requests remaining in the current direction so the head reverses direction. While 40,000 has not arrived yet, it will have by the time that the head passes over that track.
  Seek time = 1 + (40,000 - 4,000)/4,000 = 10
  Head arrives at t = 17.6 + 10 = 27.6 (40,000 arrived at t = 20) and completes at t = 27.6 + 4.3 = 31.9
- 48,000 is the only request remaining so the head continues.
  Seek time = 1 + (48,000 - 4,000)/4,000 = 3
  Head arrives at t = 31.9 + 3 = 34.9 and completes at t = 34.9 + 4.3 = 39.2

Results:

Cylinder of Requests	Time Completed
8000	11.3
4000	17.6
40000	31.9
48000	39.2

14.1.1 part A, B

Suppose blocks hold either three records, or ten key-pointer pairs. As a function of n, the number of records, how many blocks do we need to hold a data file and:

A) A dense index?

The data file requires $\frac{n}{3}$ blocks. In a dense index we require one index record per data record and therefore requires $\frac{n}{10}$ blocks.

Total: $\frac{n}{3} + \frac{n}{10} = \frac{10n}{30} + \frac{3n}{30} = \frac{13n}{30}$

B) A sparse index?

The data file still requires $\frac{n}{3}$ blocks. However in a sparse index there is one index record per data block and therefore requires $\frac{n}{3}$ index records, meaning that we have $\frac{n/3}{10} = \frac{n}{30}$ blocks.

Total: $\frac{n}{3} + \frac{n}{30} = \frac{10n}{30} + \frac{n}{30} = \frac{11n}{30}$