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# Problem 1

1 Disk Capacity :

= 2 x number of platters x no of tracks x sectors x bytes per sector

= 2 x 5 x 8000 x 512

= 8519680000

i.e. 7.93 ~ 8 GB

2 Disk capacity in terms of number of blocks it can hold

= 2 * 5 * 8000 * 208 * 512 / (8 * 1024)

= 1040000

3 Minimum, maximum, and average time needed to read one block from the disk? You need to divide the time into its three components (seek, rotation latency, transfer).

1KB = 1024 bytes

8kB = 8 * 1024 = 8192 bytes

8192 bytes block = 16 sectors

Transfer time = 0.05 * 16 = 0.8

3.1 Minimum Time(Best Case) = 0.05 * 16 = 0.8 ms

Disk makes 1 rotation in (1/90 sec) = 11.1 Moving across all tracks = (1ms+16ms)

3.2 Maximum Time = 17ms +11.1 + 0.8 = 28.9ms

3.3 Average Time= 9.5 + 5.5(half rotation) + 0.8 = 15.85ms

4

4.1 8KB = 8 * 1024

= 8192 bytes Each record

= 128 bytes

= 8192/128

= 64 records/block

4.2 File size = 100000 * 128

= 12800000 bytes Records

= 12800000/8192

= 1563 blocks

4.3 Sectors = 512 bytes

hence, 12800000/512 = 25000 sectors

5 Seek time = 1ms warm up + 1 ms 500 tracks

= 1 + 0.002 ms 100 tracks

= 1 + 0.2

= 1.2 ms

Rotational latency = 5400 rpm = 1/90sec = 11.1

Half = 5.5ms

Transfer time = 0.8

To read 10 blocks = 10*0.8

= 8 Disk delay

= seek + rotation + transfer

= 1.2 + 5.55 + 8 = 14.75

6 Since we have 5 platters 10 blocks can be aligned.

7 To maximize sequential read performance, we should organize the blocks so that they are stored on the same cylinder. This means that we need to ensure that the blocks B1, B2, B3, and so on, are placed on tracks that are at the same radial position across all platters.

We can divide the 40,000 tracks into cylinders, with each cylinder containing tracks of the same radial position from each platter. We will have a total of 8,000 cylinders (5 platters x 8,000 tracks per platter).

Place blocks B1, B2, B3, etc., sequentially on the same cylinder. The block size is 8KB, so we can place multiple blocks on one cylinder.

If we have 8KB blocks, and each track can hold 512 bytes, we can place 16 blocks on a single track. Then, we would place blocks B1 to B16 on the first cylinder, B17 to B32 on the second cylinder, and so on.

**Seek Time**: Warm-up time: 1 ms, Seek time per cylinder: 1 ms for 500 tracks (as specified)

The number of cylinders required to read the entire file is determined by the number of blocks and the number of blocks per cylinder. We have 40,000 tracks (cylinders) and 16 blocks per cylinder, so we would need 2,500 cylinders to read all the blocks sequentially.

**Rotational Delay**: The disk rotates at 5400 RPM, which means it takes 1 / (5400 / 60) = 11.11 ms to complete one revolution. On average, we would have to wait half of the rotation time, so the average rotational delay is 11.11 ms / 2 = 5.56 ms.

**Transfer Time**: Reading one sector takes 0.05 ms.

The size of each block is 8KB, which is 16 sectors.

**Total time** = Warm-up time + Seek time + Rotational delay + Transfer time

= 1 ms + (2,500 cylinders * 1 ms) + 5.56 ms + (16 sectors * 0.05 ms)

=1 ms + 2,500 ms + 5.56 ms + 0.8 ms

**Total time = 2,507.36 ms or 2.51 seconds**

# Problem 2

Given,

ID (4 bytes),

Name (25 bytes),

age (4 bytes),

DoB (10 bytes),

gender (1 Byte),

Address (60 bytes),

state (2 bytes).

1 #For 4 byte boundaries (rounding up nearest multiple of 4)

ID = 4 bytes

Name = 25 bytes ~ 28 Bytes

Age = 4 bytes

DOB = 12 bytes

Gender = 1 ~ 4 bytes

Address = 60 bytes

State = 2 ~ 4 bytes

Size = 116 + header

= 116 + 8

= 124 bytes

2 #For 8 byte boundaries (rounding up nearest multiple of 8)

ID = 8 bytes

Name = 32 bytes

Age = 8 bytes

DOB = 16

Gender = 8

Address = 64

State = 8

Size = 144 + header

= 144 + 8

= 152 bytes

3 Number of Records in a 4KB Disk Block:

A 4KB disk block is 4,096 bytes in size, and 64 bytes are used for the block header.

For 4-Byte Boundaries:

Records per block (4-byte alignment) = (4,096 - 64) / 111 = 36.32 ≈ 36 records

For 8-Byte Boundaries:

Records per block (8-byte alignment) = (4,096 - 64) / 123 = 32.78 ≈ 32 records