Tutorial 3

Question 1 Consider a disk with the following characteristics:
- Block size B = 512 bytes,
- Number of blocks per track = 20,
- Number of tracks per surface = 400.
- A disk consists of 15 double-sided platters.

A. What is the total capacity of a track?

B. How many cylinders are there?

C. What is the total capacity of a cylinder?

D. What is the total capacity of a disk?

E. Suppose the disk drive rotates the disk at a speed of 3000 rpm (revolutions per minute):
   a. What is the transfer rate in bytes/msec?
   b. What is the block transfer time (btt) in msec?
   c. What is the average rotational delay (rd) in msec?

F. Suppose the average seek time is 30 msec. How much time does it take (on the average) in msec to locate and transfer a single block given its block address?

G. Calculate the average time it would take to transfer 20 random blocks and compare it with the time it would take to transfer 20 consecutive blocks.

Question 2 A file has N = 20000 STUDENT records of fixed-length. Each record has the following fields:

> NAME (30 bytes), SSN (9 bytes), ADDRESS (40 bytes), PHONE (9 bytes), BIRTHDATE (8 bytes), SEX (1 byte), MAJORDEPTCODE (4 bytes), MINORDEPTCODE (4 bytes), CLASSCODE (4 bytes), and DEGREEPROGRAM (3 bytes)

An additional byte is used as a deletion marker. The file is stored on a disk with block size B = 512 bytes.

A. Calculate the record size R in bytes.

B. Calculate the blocking factor bfr and the number of file blocks b assuming an unspanned organization.

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Answers for Question 1 are given below:

A. Total capacity of a track = 20 * 512 = 10240 bytes = 10.24 Kbytes.

B. Number of cylinders = number of tracks = 400.

C. Total cylinder capacity = 15 * 2 * 20 * 512 = 307200 bytes = 307.2 Kbytes.

D. Total capacity of a disk = 15 * 2 * 400 * 20 * 512 = 122.88 Mbytes.

E. The disk drive rotates the disk at a speed of 3000 rpm:

   a. Transfer rate (tr) = (total track size in bytes)/(time for one disk revolution in msec) = (10240) / ((60 * 1000) / (3000)) = 10240 / 20 = 512 bytes/msec.

   b. Block transfer time (btt) = B / tr = 512 / 512 = 1 msec.

   c. Average rotational delay (rd) = (time for one disk revolution in msec) / 2 = 20 / 2 = 10 msec.

F. Average time to locate and transfer a block = s + rd + btt = 30+10+1 = 41 msec.

G. Time to transfer 20 random blocks = 20 * (s + rd + btt) = 20 * 41 = 820 msec.

   Time to transfer 20 consecutive blocks using cylinder-based organization = s + rd + 20*btt = 30 + 10 + (20*1) = 60 msec.

Answers for Question 2 are given below:

A. Record size R = (30 + 9 + 40 + 9 + 8 + 1 + 4 + 4 + 4 + 3) + 1 = 113 bytes.

B. Blocking factor bfr = floor (B / R) = floor (512 / 113) = 4 records per block.

   Number of file blocks b assuming an unspanned organization = N / bfr = 20000 / 4 = 5000 blocks.