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Lab 4

Question 1:
Consider a disk with the following characteristics: block size B=512 bytes, interblock gap size G=128 bytes, number of blocks per track=20, number of tracks per surface=400. A disk pack consists of 15 double-sided disks.

(a) What is the total capacity of a track and what is its useful capacity (excluding interblock gaps)?

Total Track Capacity = (Block size+ Interblock size) * Blocks per Track

- = (512 + 128) * 20
- = (640) * 20
- = 12,800 bytes

Useful Capacity = Block size * Blocks per Track

- = 512 * 20
- = 10,240 bytes

(b) How many cylinders are there?

The number of cylinders is equal to the number of tracks per surface area. 400 Cylinders.

(c) What is the total capacity and the useful capacity of a cylinder?

15 double-sided disks → 15*2 = 30 Cylinders per Track

Total Cylinder Capacity = Cylinders per Track * Total Track Capacity

- = 30 * 12,800
- = 384,000 bytes

Useful Cylinder Capacity = Cylinders per Track * Useful Capacity

- = 30 * 10,240
- = 307,200 bytes

(d) What is the total capacity and the useful capacity of a disk pack?

Total Disk Capacity = Num of Tracks per Surface * Total Cylinder Capacity

- = 400 * 384,000
- = 153,600,000 bytes

Useful Disk Capacity = Num of Tracks per Surface * Useful Cylinder Capacity

- = 400 * 307,200
- = 122,880,000 bytes

(e) Suppose the disk drive rotates the disk pack at a speed of 2400 rpm (revolutions per minute); what is the transfer rate (tr) in bytes/msec and the block transfer time (btt) in msec? What is the average rotational delay (rd) in msec? What is the bulk transfer rate (btr)?

Transfer rate (tr) in bytes/msec = (size of each Track in Bytes) / (time of one rev in msec)

- = 12,800 / (60 * 1000 / p)
- = 12,800 / (60 * 1000 / 2400)
- = 12,800 / (25)
- = 512 bytes/msec

Block transfer time (btt) in msec = Block Size / Transfer rate

- = 512 / 512
- = 1 msec

Average rotational delay (rd) in msec = (60 * 1000) / (2 * 2400)

- = 60000/ 4800
- = 12.5 msec

Bulk transfer rate = (block size / (block size + gap size)) * transfer rate

- = (B/(B+G)) * tr
- = (512/(512+128)) * 512
- = 409.6 bytes/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?

Let "s" be seek time, "rd" be rotational delay and "btt" be block transfer time

Time is takes Avg = (s + rd + btt) msec
- = (30 + 12.5 + 1) msec
- = 43.5 msec

(g) Calculate the average time it would take to transfer 20 random blocks (may not be on the same cylinder) and compare it with the time it would take to transfer 20 consecutive blocks (all in one cylinder).

Let "k" be the number of blocks, "s" be seek time, "rd" be rotational delay and "btt" be block transfer time.

May not be on the same cylinder = k * (s+rd+btt) msec
- = 20 * (30+12.5+1) msec
- = 870 msec

All in one cylinder = s + rd + (k*btt) msec
- = 30 + 12.5 + (20 * 1) msec
- = 62.5 msec

Question 2:
A file has r=200000 STUDENT records of fixed-length. Each record has the following fields: NAME (30 bytes), SSN (9 bytes), ADDRESS (40 bytes), PHONE (10 bytes), BIRTHDATE (8 bytes), SEX (1 byte), MAJORDEPTCODE (4 bytes), MINORDEPTCODE (4 bytes), CLASSCODE (4 bytes, integer), and DEGREEPROGRAM (3 bytes). An additional byte is used as a deletion marker. The file is stored on the disk whose parameters are given in Question 1.

(a) Calculate the record size R in bytes.

R = NAME + SSN + ADDRESS + PHONE + BIRTHDATE + SEX + MAJORDEPTCODE + MINORDEPTCODE + CLASSCODE + DEGREEPROGRAM + deletion marker

R = 30 + 9 + 40 + 10 + 8 + 1 + 4 + 4 + 4 + 3 + 1
R = 114

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

Blocking factor (bfr) = FLOOR[block size / record size]

- = 512 / 114
- = 4.49 → 4

File blocks b = number of records / blocking factor

- = 200,000 / 4
- = 50,000 blocks

(c) Calculate the average time it takes to find a record by doing a linear search on the file if

1. the file blocks are stored contiguously, and

For linear search on blocks (b), for average we do b/2.
Let "k" = b/2, "s" be seek time, "rd" be rotational delay and "btt" be block transfer time.

Contiguously = s + rd + (k * btt) msec

- = 30 + 12.5 ((50000/2) * 1) msec
- = 25,042.5 msec

2. if the file blocks are not stored contiguously.

For linear search on blocks (b), for average we do b/2.
Let "k" = b/2, "s" be seek time, "rd" be rotational delay and "btt" be block transfer time.

Noncontiguously = k * (s+rd+btt) msec

- = (50000/2) * (30+12.5+1)
- = 25000 * 43.5
- = 1,087,500 msec

(d) Assume the file is ordered by SSN; calculate the time it takes to search for a record given its SSN value by doing a binary search

For binary search on blocks (b), for average we do $\log_2(b)$.
Let "k" = $\log_2(b)$, "s" be seek time, "rd" be rotational delay and "btt" be block transfer time.

Noncontiguously = k * (s+rd+btt) msec

- = ($\log_2(50000)$) * (30+12.5+1)
- = 697.02 msec.