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**CS443 - 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.

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

**Total track capacity formula is (block size + interblock size) \* blocks per track. Thus, block size is 512, interblock size is 128 and blocks per track is 20. (512 + 128) \* 20 = 12,800 bytes. The formula for useful capacity is Useful Track Capacity = (block size \* blocks per track). Thus, the calculations are as follows: (512 \* 20) = 10,240 bytes.**

1. How many cylinders are there?

**There are 400 cylinders since the number of tracks per surface is equal to 400.**

1. What is the total capacity and the useful capacity of a cylinder?

**A disk pack consists of 15 double-sided disks, knowing this, we do 15 x 2, to get us 30 cylinders per track. Now, we must calculate the total cylinder capacity. The formula for this is: Total Cylinder Capacity = Cylinders Per Track \* Total Track Capacity. Thus, what we get is: Total Cylinder Capacity = 30 \* 12,800 = 384,000 bytes. Now, we must calculate the useful capacity of a cylinder. This is done via the following formula: Useful Cylinder Capacity = Cylinders Per Track \* Useful Track Capacity. Thus, the calculations are as follows: Useful Cylinder Capacity = 30 \* 10,240 = 307,200 bytes.**

1. What is the total capacity and the useful capacity of a disk pack?

**The total disk capacity formula is: Total Disk Capacity = Number of Tracks Per Surface \* Total Cylinder Capacity. This gets us 400 \* 384,000 = 153,600,000 bytes. The Useful Capacity of a Disk Pack formula is: Useful Disk Capacity = Number of Tracks Per Surface \* Useful Cylinder Capacity. Thus, the calculations will be: Useful Disk Capacity = 400 \* 307,200 = 122,880,000 bytes.**

1. 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)?

**The Transfer Rate in bytes/msec is: 12,800 bytes / (60\*1,000 / 2,400) = 512 bytes/ms**

**The Block Transfer Time is: block size / transfer rate = 512 / 512 = 1 ms**

**The Average Rotational Delay (rd) is 60,000 / (2 \* 2,400) = 12.5 ms**

**The Bulk Transfer Rate (btr) is: (512/(512+ 128)) \* 512 = 409.6 bytes/ms**

1. 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?

**It takes (30 + 12.5 + 1) = 43.5 ms to locate and transfer a single block given its block address.**

1. 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 on cylinder).

**The average time to transfer 20 random blocks when it is not on the same cylinder:**

**20 \* (30 + 12.5 + 1) = 870 ms.**

**The average time to transfer 20 consecutive blocks (all in one cylinder) is:**

**30 + 12.5 + (20\*1) = 62.5 ms**

**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.

1. Calculate the record size R in bytes.

**The record size R in bytes is: 30 + 9 + 40 + 10 + 8 + 1 + (4 \*3) + 3 + 1 = 114 bytes**

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

**Blocking factor calculation is: Floor((512/114)) = Floor(4.49) -> 4**

**The number of file blocks b is 200,000/4 = 50,000 blocks.**

1. 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

**Contiguous block formula: s + rd + (k \* btt) msec, so 30 + 12.5 + ((50,000/2) \* 1) = 25,042.5 ms.**

* 1. if the file blocks are not stored contiguously.

**Noncontiguous block formula: k \* (s + rd + btt) msec**

**(50,000/2) \* (30 + 12.5 + 1) = 1,087,500 ms**

1. 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.

**If the file is ordered by SSN, we know that the file blocks are not stored contiguously. Thus, we use Noncontiguous block formula: k \* (s + rd + btt) msec.**

**So, the answer is: Ceiling((log2(50,000)) \* (30 + 12.5 + 1) = 679.02-> 680 msec.**