

## EXERCISES ON STORAGE MEDIA

(Elmasri & Navathe “Fundamentals of Database Systems”, 6<sup>th</sup> edition)

### 17.27.

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.

- What is the total capacity of a track, and what is its useful capacity (excluding interblock gaps)?
- How many cylinders are there?
- What are the total capacity and the useful capacity of a cylinder?
- What are the total capacity and the useful capacity of a disk pack?
- Suppose that the disk drive rotates the disk pack at a speed of 2400 rpm (revolutions per minute); what are the transfer rate ( $t_r$ ) in bytes/msec and the block transfer time ( $t_{bt}$ ) in msec? What is the average rotational delay ( $t_{rd}$ ) in msec? What is the bulk transfer rate?
- Suppose that 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?
- Calculate the average time it would take to transfer 20 random blocks, and compare this with the time it would take to transfer 20 consecutive blocks using double buffering to save seek time and rotational delay.

### 17.28.

A file has  $r=20,000$  STUDENT records of fixed length. Each record has the following fields: Name (30 bytes), Ssn (9 bytes), Address (40 bytes), PHONE (10 bytes), Birth\_date (8 bytes), Sex (1 byte), Major\_dept\_code (4 bytes), Minor\_dept\_code (4 bytes), Class\_code (4 bytes, integer), and Degree\_program (3 bytes). An additional byte is used as a deletion marker. The file is stored on the disk whose parameters are given in Exercise 17.27.

- Calculate the record size  $R$  in bytes.
- Calculate the blocking factor  $bfr$  and the number of file blocks  $b$ , assuming an unspanned organization.
- Calculate the average time it takes to find a record by doing a linear search on the file if (i) the file blocks are stored contiguously, and double buffering is used; (ii) the file blocks are not stored contiguously.
- Assume that the file is ordered by Ssn; by doing a binary search, calculate the time it takes to search for a record given its Ssn value.

### 17.29.

Suppose that only 80 percent of the STUDENT records from Exercise 17.28 have a value for Phone, 85 percent for Major\_dept\_code, 15 percent for Minor\_dept\_code, and 90 percent for Degree\_program; and suppose that we use a variable-length record file. Each record has a 1-byte field type for each field in the record, plus the 1-byte deletion marker and a 1-byte end-of-record marker. Suppose that we use a

spanned record organization, where each block has a 5-byte pointer to the next block (this space is not used for record storage).

- Calculate the average record length  $R$  in bytes.
- Calculate the number of blocks needed for the file.

**17.30.**

Suppose that a disk unit has the following parameters: seek time  $s=20$  msec; rotational delay  $rd=10$  msec; block transfer time  $btt=1$  msec; block size  $B=2400$  bytes; interblock gap size  $G=600$  bytes. An EMPLOYEE file has the following fields: Ssn, 9 bytes; Last\_name, 20 bytes; First\_name, 20 bytes; Middle\_init, 1 byte; Birth\_date, 10 bytes; Address, 35 bytes; Phone, 12 bytes; Supervisor\_ssn, 9 bytes; Department, 4 bytes; Job\_code, 4 bytes; deletion marker, 1 byte. The EMPLOYEE file has  $r=30,000$  records, fixed-length format, and unspanned blocking. Write appropriate formulas and calculate the following values for the above EMPLOYEE file:

- The record size  $R$  (including the deletion marker), the blocking factor  $bfr$ , and the number of disk blocks  $b$
- Calculate the wasted space in each disk block because of the unspanned organization.
- Calculate the transfer rate  $tr$  and the bulk transfer rate  $btr$  for this disk unit.
- Calculate the average number of block accesses needed to search for an arbitrary record in the file, using linear search.
- Calculate in msec the average time needed to search for an arbitrary record in the file, using linear search, if the file blocks are stored on consecutive disk blocks and double buffering is used.
- Calculate in msec the average time needed to search for an arbitrary record in the file, using linear search, if the file blocks are not stored on consecutive disk blocks.
- Assume that the records are ordered via some key field. Calculate the average number of block accesses and the average time needed to search for an arbitrary record in the file, using binary search