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16.37.

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:

a. Calculate the record size R (including the deletion marker), the blocking factor bfr, and the number of disk blocks.

➔ Given,

- Block size (B) = 2400 bytes
- Seek time (s) = 20 msec
- Rotational delay (rd) = 10 msec
- Record (r) = 30000 records
- Block transfer time (btt) = 1 msec
- Inter block gap size (G) = 600 bytes
- Now,
  - Record size (R) = (9+20+20+1+10+35+12+9+4+4+1) bytes = **125 bytes**
  - Blocking factor (bfr) = floor(B/R) = floor (2400/125) = **19 records per block**
  - Number of disk blocks(b) = ceiling(r/bfr) =ceiling (30000/19) = **1579 blocks**

b. Calculate the wasted space in each disk block because of the unspanned organization.

➔ Wasted space in each disk block = B – (R * Bfr) = 2400 – (125 * 19) = **25 bytes**

c. Calculate the transfer rate tr and the bulk transfer rate btr for this disk unit (see Appendix B for definitions of tr and btr).

➔ Transfer rate (tr) = B/btt = 2400 / 1 = **2400 bytes/msec**

➔ Bulk transfer rate (btr) = tr * (B/(B+G)) = 2400 * (2400 / (2400 + 600)) = **1920 bytes / msec**

d. Calculate the average number of block accesses needed to search for an arbitrary record in the file, using linear search.

➔ Average number of block accesses = number of disk blocks(b)/ 2 = 1579/2 = **790 blocks**

e. 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.

➔ The average time to read n consecutive blocks = s + rd + (n * (B/btr))
- n = ceiling(b/2) = 790 blocks,
  - Time = 20 + 10 + (790 * (2400/1920)) = **1017.5 msec**

f. Calculate in msec the average time needed to search for an arbitrary record in the file, using linear search, if the blocks are not stored on consecutive disk blocks.

➔ The average time needed to search n blocks = n * (s +rd + btt)
- n = ceiling(b/2) = 790 blocks,
  - Time = (790)*(20+10+1) = **24490 msec**

g. 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.

➔ The average number of block accesses = ceiling ($\log_2 b$) = ceiling($\log_2 1579$) = **11**.

➔ The average time using binary search = ceiling($\log_2 b$) *(s+rd+btt)
= ceiling($\log_2 1579$) * (20+10+1) = 11 * 31 = **341 msec**

16.35.

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 16.37.

➔ Given,
- r = 20000
- Block size (B) = 2400 bytes
- Bulk transfer rate (btr) = 1920 bytes/msec
- Block transfer time (btt) = 1 msec

a. Calculate the record size R in bytes

→ Record size (R) = (30+9+40+10+8+1+4+4+4+3)+1 = **114 bytes**

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

→ Blocking factor (bfr) = floor (B/R) = floor(2400/114) = **21 records per block**

→ number of file blocks (b) = ceiling(r/bfr) = ceiling(20000/21) = **953 blocks**

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

(i) The file blocks are stored contiguously, and double buffering is used.

→ Time to read n consecutive blocks = s + rd + (n* (B/btr)),

Where n = ceiling (b/2) = ceiling(953/2) = 477 blocks

a. Time = 20 + 10 + (477 * (2400/ 1920)) = **626.25 msec**

(ii) The file blocks are not stored contiguously.

→ Time to seek n blocks = n * (s+rd +btt),

Where n = ceiling (953/2) = 477 blocks

a. Time = 477 * (20 + 10 + 1) = **14787 msec**

d. 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.

→ Time = ceiling ($\log_2 b$) * (s+rd+btt)

= ceiling ($\log_2 953$)*(20+10+1)

= 10*31 = **310 msec**