3612ICT/7204ICT

Workshop Exercise 2

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)?

(b) How many cylinders are there?

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

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

(e) Suppose disk rotation speed is 2400 rotations/minute. What is the average rotation delay in ms?

(f) Suppose Average seek time =30ms, Block transfer time = 1ms

How much time is needed for reading 20 random blocks?

2.- Consider a disk with block size B=512 bytes. A block pointer is P=6 bytes long, and a record pointer is PR =7 bytes long. A file has r=30,000 EMPLOYEE records of fixed-length. Each record has the following fields: NAME (30 bytes), SSN (9 bytes), DEPARTMENTCODE (9 bytes), ADDRESS (40 bytes), PHONE (9 bytes), BIRTHDATE (8 bytes), SEX (1 byte), JOBCODE (4 bytes), SALARY (4 bytes, real number). An additional byte is used as a deletion marker.

(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.

(c) Suppose the file is ordered by the key field SSN and we want to construct a primary index on SSN. Calculate (i) the index blocking factor bfr i; (ii) the number of first-level index entries and the number of first-level index blocks; (iii) the number of levels needed if we make it into a multi-level index; (iv) the total number of blocks required by the multi-level index; and (v) the number of block accesses needed to search for and retrieve a record from the file--given its SSN value--using the primary index.

(d) Suppose the file is not ordered by the key field SSN and we want to construct a

secondary index on SSN. Repeat question (c) for the secondary index and compare with the primary index.

(e) Suppose the file is not ordered by the non-key field DEPARTMENTCODE and we want to construct a secondary index on DEPARTMENTCODE using block pointers pointing to blocks of record pointers (as in the example on slide 19). Assume there are 1000 distinct values of DEPARTMENTCODE, and that the EMPLOYEE records are evenly distributed among these values. Calculate (i) the index blocking factor bfr i; (ii) the number of blocks needed by the level of indirection that stores record pointers; (iii) the number of first-level index entries and the number of first-level index blocks; (iv) the number of levels needed if we make it a multi-level index; (v) the total number of blocks required by the multi-level index and the blocks used in the extra level of indirection; and (vi) the approximate number of block accesses needed to search for and retrieve all records in the file having a specific DEPARTMENTCODE value using the index.

(f) Suppose the file is ordered by the non-key field DEPARTMENTCODE and we want to construct a clustering index on DEPARTMENTCODE that uses block anchors (every new value of DEPARTMENTCODE starts at the beginning of a new block). Assume there are 1000 distinct values of DEPARTMENTCODE, and that the EMPLOYEE records are evenly distributed among these values. Calculate (i) the index blocking factor bfr i ; (ii) the number of first-level index entries and the number of first-level index blocks; (iii) the number of levels needed if we make it a multi-level index; (iv) the total number of blocks required by the multi-level index; and (v) the number of block accesses needed to search for and retrieve all records in the file having a specific DEPARTMENTCODE value using the clustering index (assume that multiple blocks in a cluster are either contiguous or linked by pointers).

2. 3.- 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 (9 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. Disk block size = 512bytes

   (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.

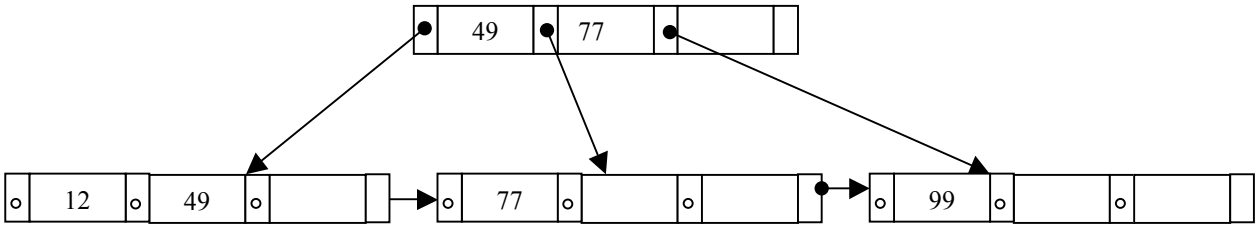
   (c) What is the average number of I/O operations for linear search?

   (d) Assume the file is ordered by SSN; calculate the number of I/O operations it takes to search for a record given its SSN value by doing a binary search.

4.-

a) Consider the B^+tree structure shown below. This is a B^+tree of degree (N) = 4 and $N_{leaf} = 3$. (Each internal node has between n/2 and n pointers.)

Insert **this sequence** of Keys: 98, 97, 78, 79, 76, 75 and 50.



b) Explain the sequence of operations that occur when the above Tree (after insertions) is used to locate the record with a key of 78?

c) **Show the process of** deleting the keys 49, 99, 75, 76, 97 from the B+ tree obtained in step a).