Université d'Ottawa • University of Ottawa

Faculté des sciences
Informatique

Faculty of Science
Computer Science

CSI 2131
FINAL EXAMINATION

Time : 3 Hours
Prof : H. Ural

April 1996


This is a closed book exam.

Calculators are permitted

Give your answers on the questionnaire.

Mark allocation is as follows:

Questions 1, 4, 6, and 7 are 10 marks each.
Questions 2, 3, 5, and 8 are 15 marks each.

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Q1. Suppose that a file with 60,000 fixed length records will be stored on a magnetic tape of 1600 bpi with 0.6 inch interblock gaps. Logical records are 224 bytes and physical records are 2240 bytes. The tape drive speed is 200 ips.

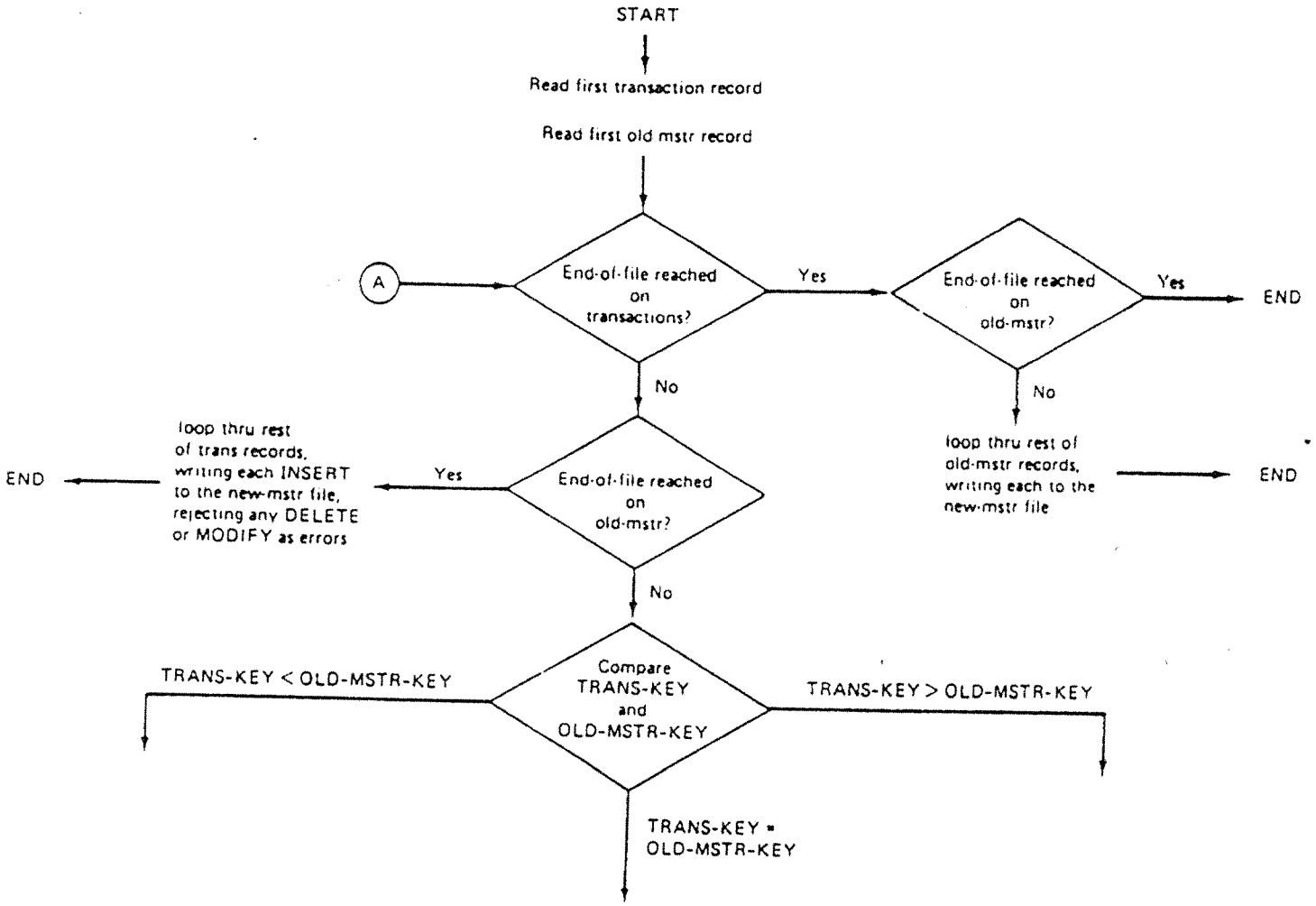
a) What is the nominal recording density?

b) What is the effective recording density?

c) What is the nominal data transmission rate?

d) What is the effective data transmission rate?

Q2. Suppose that the following flowchart will be used to update OLD-MSTR file with respect to the transactions in TRANSACTION file to create NEW-MSTR file. There are three types of trans-rec: INSERT, MODIFY, DELETE. Complete the update process expressed in the flowchart.



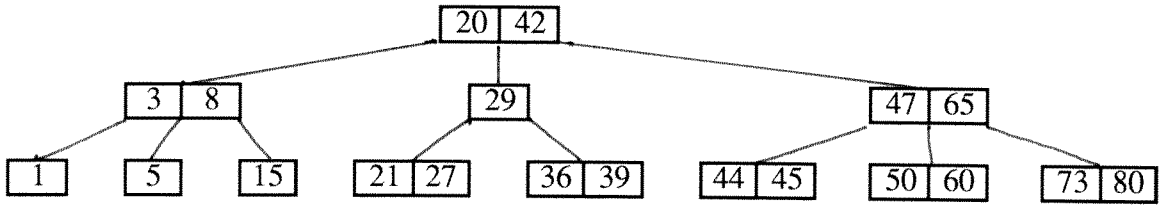
Q3. Suppose that a file containing 250,000 records will be sorted by using POLYPHASE MERGE with k = 4. Since the available RAM is 10,000 records it is required to obtain 25 runs using some internal sort method. These 25 runs are denoted by R1 to R25. Carry out the polyphase merge by showing the contents of each file in each phase and calculate the total number of physical read and write operations needed to perform the polyphase merge when the blocking factor of 100 is used for each file.

(0) ⟶ **Form Runs & Distribute**

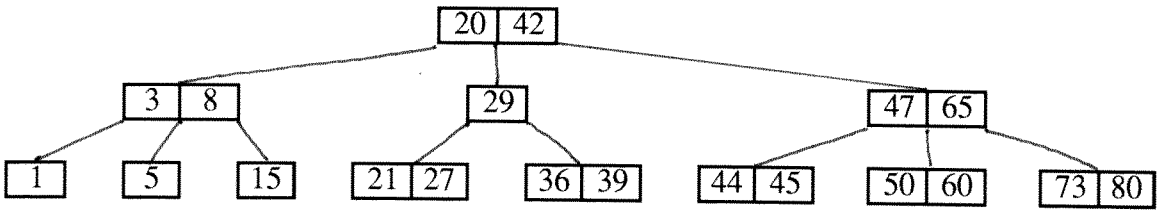
(1)
(2)
(3)
(4)

Q4. Consider the following file of integers which will be used to form runs where each run is a sequence of integers sorted in increasing order. Suppose that the available RAM can only hold three integers. Use replacement selection to form the runs. Show steps.
END of FILE 33, 18, 24, 58, 14, 17, 7, 21, 67, 12, 5, 47, 16 BEGINNING of FILE

Q5. Consider the B-tree of order 3 shown below.




a) Show the resulting tree after inserting keys 7, 37, and 57 into the tree given above.




b) Show the resulting tree after deleting keys 42, 8, and 5 from the tree given above.

Q6. Let the root of a B-tree be at level 1 and the depth of a B-tree be the number of nodes on a path from the root to a leaf. Give expressions of the minimum and maximum depths of a B-tree of order m that has n keys.

Q7. Suppose you have a B*-tree used as an index to an unsorted data file containing n records. In the index, each key is stored together with the RRN of the corresponding record. If at most d nodes (where d is the number of nodes on a path from the root to a leaf) can be stored in RAM at any given time, calculate the minimum and maximum number of disk accesses required to retrieve all records of the data file in sorted order. Assume that each node of the B*-tree can be retrieved in one disk access.

Q8. Consider a file containing students' records is accessed via a hashing technique where
- the hash table consists of buckets of size one.
- the hash function is f(key) = key mod 11.
- the collision resolution method is rehashing using $f_R(key) = 1 + (key \bmod 7)$.

Show the relevant parts of the hash table corresponding to the following key values (i.e., student numbers) inserted into the table in the order shown below:

330521
312937
465236
197844
021821
007720
234782
139265
415583
578591