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Media Engineering and Technology
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Data Bases II, Spring 2017
Practice Assignment 1

Part One: Practical Problems

Exercise 1-1

For the given dummy relation below, called "Fiction_Character", do each of the following:

a) Page the relation appropriately assuming a page can hold two records, or four key-pointer pairs
b) Construct primary, secondary, dense, sparse, and multi-level indices; briefly explain what data columns can be chosen for each type of index
c) In case of a dense primary index is constructed, show the steps of:
   i. Inserting a tuple given as follows,:

Minnie	Mouse	123 Fantasy Way	Anaheim	72

   ii. Deleting record number 3
   iii. Updating Tweety's age to be 29

Char_ID	First Name	Last Name	Address	City	Age
1	Mickey	Mouse	123 Fantasy Way	Anaheim	73
2	Bat	Man	321 Cavern Ave	Gotham	54
3	Wonder	Woman	987 Truth Way	Paradise	39
4	Donald	Duck	555 Quack Street	Mallard	65
5	Bugs	Bunny	567 Carrot Street	Rascal	58
6	Wiley	Coyote	999 Acme Way	Canyon	61
7	Cat	Woman	234 Purrfect Street	Hairball	32
8	Tweety	Bird	543	Itotltaw	28

-Figure 1.1: Fiction_Character Relation-

Solution: (In-Class Activity)

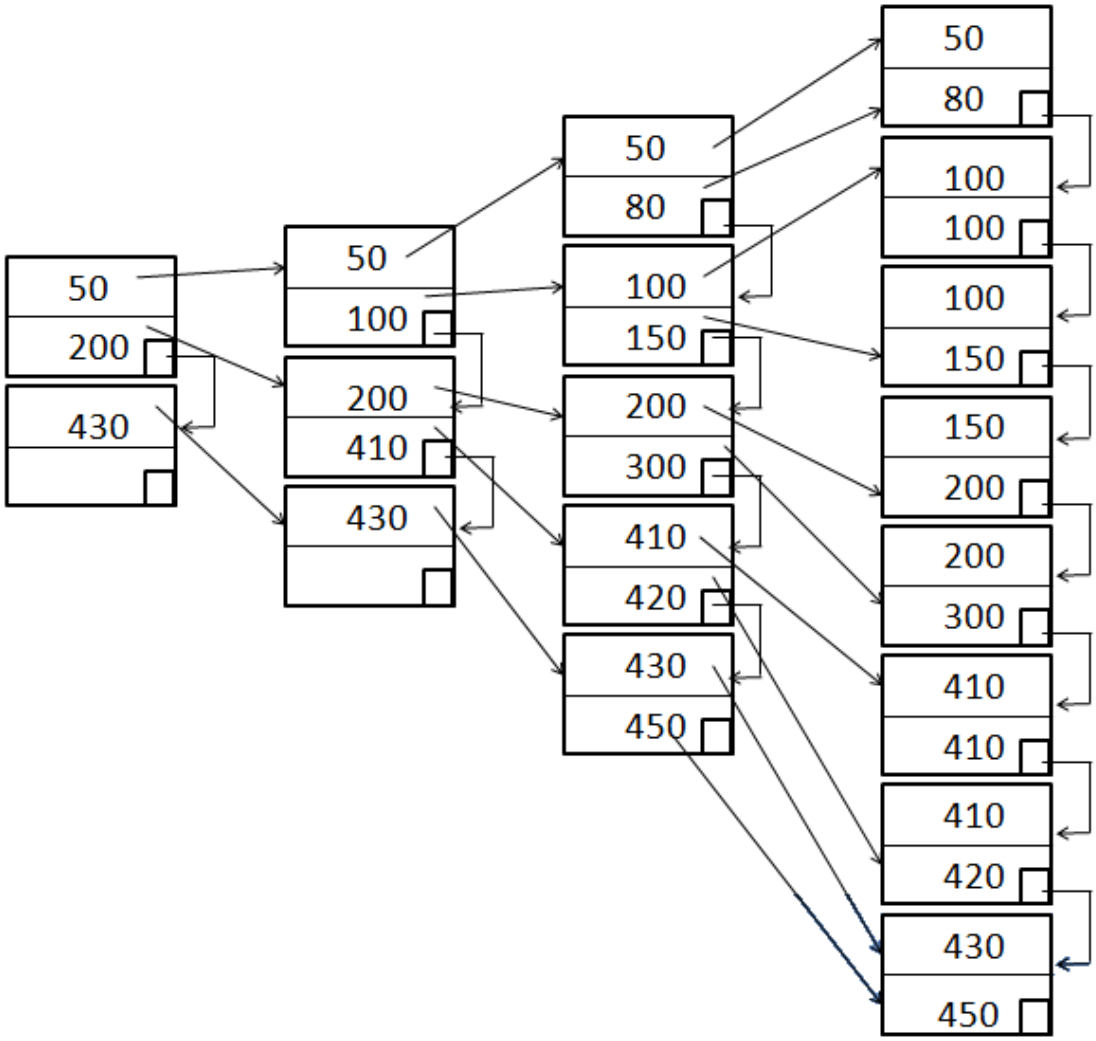
Exercise 1-2

Assume that a page can hold up to two rows. If we have a Table D with 16 rows with the following keys:

D = {50, 80,100, 100, 100, 150, 150, 200, 200, 300, 410, 410, 410, 420, 430,450}

Build a 3-level index on D – one of which must be dense. Clearly explain how you handle duplicates.

Solution:



Part Two: Theoretical Questions

Exercise 1-3 True or False

a) When a sparse index is used, each record must have an entry in the index.

b) Secondary indices are always dense.

c) Considering 2 levels of indices, any of them can be either sparse or dense.

d) You can only use a sparse index if the data file is sorted by the search key, while a dense index can be used for any search key.

e) In multilevel indexes, a primary index created for its first level is classified as the first level of multilevel index.

f) A type of index which is based on any candidate key or a non-key field which may have duplicate values is classified as a primary index.

Solution:

a) False, each block must have an entry in the index.
b) True, because these indexes are for columns other than the one the table is sorted with.
c) False, the first level has to be dense.
d) True, because when a sparse index is used, data in the pages/blocks has to be sorted.
e) False, in multilevel indexes, a primary index created for its first level is classified as the second level of multilevel index.
f) False, a type of index which is based on any candidate key or a non-key field which may have duplicate values is classified as a secondary index.

Part Three: Text Book Questions

Exercise 1-4

Suppose blocks hold either three records, or ten key-pointer pairs. As a function of n "the number of records", how many blocks do we need to hold a data file and:

a) A dense index

b) A sparse index

Solution:

a) For dense index we need a key-pointer pair for each record, and so will need $\frac{n}{10}$ blocks.
For the data, we will need $\frac{n}{3}$ block.
So the total number of blocks is $\frac{13\,n}{30}$.

b) For sparse index we need a key-pointer pair for each of the data block, and so will need $\frac{n}{30}$ blocks.
For the data, we will need $\frac{n}{3}$ blocks.
So the total number of blocks is $\frac{11\,n}{30}$.

Exercise 1-5

Repeat the exercise above if we use as many levels of index as is appropriate, until the final level of index has only one block.

Solution:

a) For dense, we will need $\log_{10} n$ levels. Total number of blocks is:

$$\begin{aligned} & 1 + 10 + 10^2 + 10^3 + \cdots + n \\ &= 1 + 10 + 10^2 + 10^3 + \cdots + 10^{\log_{10} n} \\ &= \sum_{i=0}^{\log_{10} n} 10^i \\ &= \frac{1 - 10^{\log_{10} n}}{1 - 10} \\ &= \frac{1 - n}{-9} \\ &= \frac{n - 1}{9} \end{aligned}$$

Alongside the $\frac{n}{3}$ blocks for the table, the total is

$$\frac{4n - 1}{9}$$

b) For sparse,

$$\begin{aligned} & 1 + 10 + 10^2 + 10^3 + \cdots + \frac{n}{3} \\ &= 1 + 10 + 10^2 + 10^3 + \cdots + 10^{\log_{10} n/3} \\ &= \sum_{i=0}^{\log_{10} n/3} 10^i \\ &= \frac{1 - 10^{\log_{10} n/3}}{1 - 10} \\ &= \frac{1 - \frac{n}{3}}{-9} \\ &= \frac{n - 3}{27} \end{aligned}$$

Alongside the $\frac{n}{3}$ blocks for the table, the total is

$$\frac{10n - 3}{27}$$