Date:
Name 1:
Name 2:

Assume you have a relation R(a,b,c). Suppose the blocks can hold either 10 records (tuples) or 99 keys and 100 pointeres (b+trees). Nodes of the index are 70% full (they only contain 69 keys/70 pointers). The relation contains 1 million records. The values of a are expected to be >=0 and < 10^6.

70 fanout

Consider the following two queries:

a) $\sigma_{a=5}R$ — 1 matching record — $1/10^6 = 10^{-6}$ selec.

b) $\sigma_{a>=10{,}000 \text{ and } a < 20{,}000}R$ ⇒ 10,000 matching rec. — $10^4/10^6 = 10^{-2}$ selec.

Every value of a between 1 and 10^6

1. Determine for each query:
   - the number of expected matching records
   - its selectivity

2. Determine, for each of the structures below:
   i) Expected number of leaf blocks of each index
   ii) The expected height of each index
   iii) The average number of disk I/Os needed to answer each query

Assume that nothing is in memory initially, and that the search key is the primary key of the table.

a) The B+tree is dense and the heap is unsorted
b) The B+tree is a sparse.

Redo assuming that a is not a primary key, values of a vary from >=0 and <= 10^5

a) B+ tree dense

$$h = \left\lceil \log_{70} \left[\frac{1}{7} \cdot 10^5 \text{ blocks} \right] \right\rceil$$

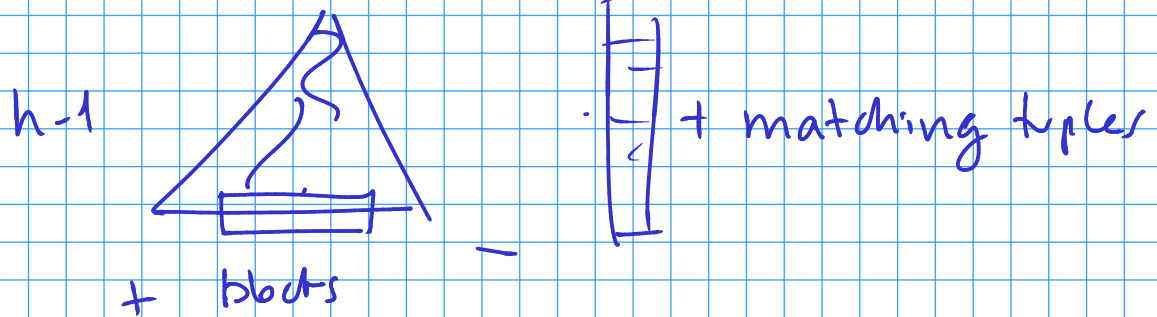
$$= \left\lceil \frac{\log_{10} \left(\frac{1}{7} \cdot 10^5 \text{ blocks} \right)}{\log_{10} 70} \right\rceil$$

Block index $= \frac{10^6}{70} = \frac{1}{7} \cdot 10^5$ blocks.

$h = 3$

For $\sigma_{a=5} R \Rightarrow h + 1 = 4.$

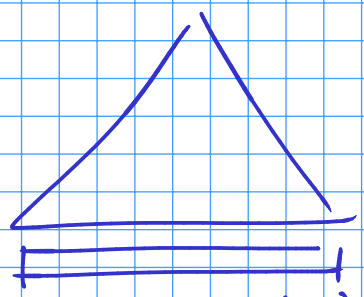
For $\sigma_{a>10k \text{ and } a<20k} R$



$$\text{blocks} = \left\lceil \frac{10^4}{70} \right\rceil = 143$$

$$\text{Cost} = 2 + 143 + 10{,}000 = 10{,}145$$

b) Tree is sparse.

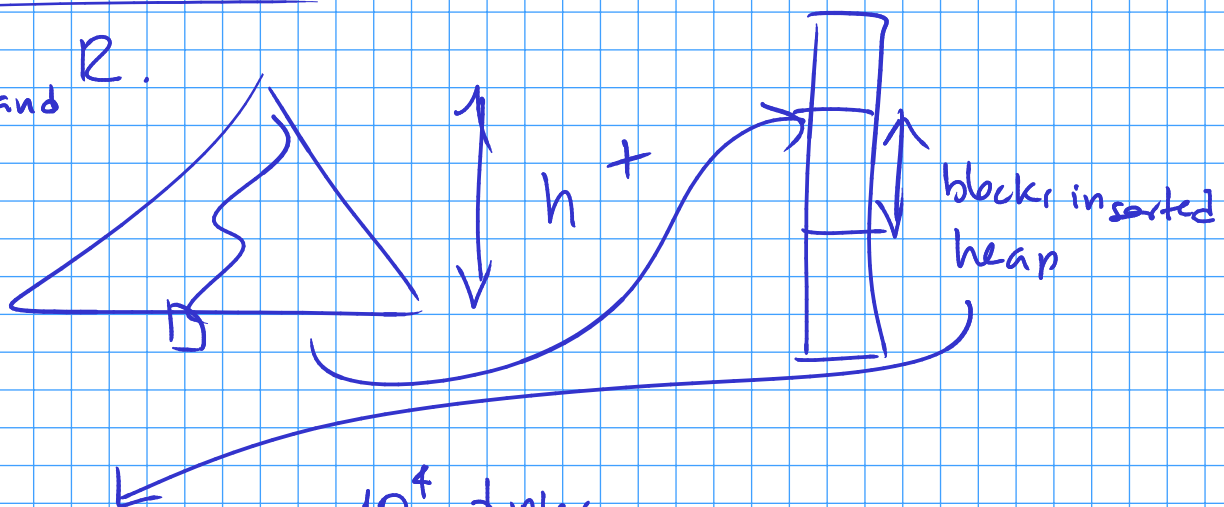


$$\#\text{blocks index} = \frac{B(R)}{70} = \frac{10^5}{70}$$

$$h = \left\lceil \log_{70} \frac{10^5}{70} \right\rceil = \left\lceil \frac{\log_{10}\left(\frac{10^5}{70}\right)}{\log_{10} 70} \right\rceil = \lceil 1.70 \rceil = 2.$$

$\sigma_{a=5} R \Rightarrow h+1 = 3.$

$\sigma_{a \geq 10k \text{ and } a \leq 20k} R.$



$$\text{blocks in heap} = \frac{10^4 \text{ tuples}}{10 \text{ tuples/block}} = 1{,}000 \text{ block.}$$

Cost = 1002 blocks

$\sigma_{a=s}\ R$ a not primary key.

Indexes will be the same

matching tuples $\underline{\underline{10}}$ (each value is repeated 10 times).

Cost = h + 10 = 13

(10 blocks found in one block of index

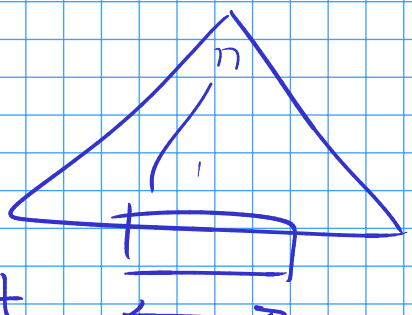
Sparse index 10 tuples can be found in one block of heap (most likely 2 if they don't start in the beginning of block

Cost = h + 1 or h + 2

= 3 or 4.

$\sigma_{a>=10k \text{ and } a<20k}\ R$. $\Rightarrow 10^5$ tuples would match.

Dense:



h-1 + matching tuple. 10^5

+

block index

block index = $\frac{10^5 \text{ tuples}}{70}$

Cost = $h-1+\frac{10^5}{70}+10^5$

$= 2 + \frac{10^5}{70} + 10^5$

Sparse index

h + # blocks in heap.

$$\text{Cost} = h + \frac{10^5}{10} = 2 + 10^4 = 10,002 \text{ blocks.}$$