Bill Yang Due: 2/12/19

Homework 2

CS386D Database Systems Instructor: Daniel Miranker

1 Part A

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8.4.1

Action	No Index	Star Index	Movie Index	Both Indexes
Q_1	100	4	100	4
Q_2	100	100	4	4
I	2	4	4	6
Average	$98p_1 + 98p_2 + 2$	$96p_2 + 4$	$96p_1 + 4$	$6 - 2p_1 - 2p_2$

8.4.2

Indices	Query *v.*	Query *vi.*	Query *vii.*	Insertion	Average
None	50	1	50	2	$48p_1 - p_2 + 48p_3 + 2$
Name	2	1	50	4	$-2p_1 - 3p_2 + 46p_3 + 4$
Class	50	1	50	4	$46p_1 - 3p_2 + 46p_3 + 4$
Launched	50	1	26	4	$46p_1 - 3p_2 + 22p_3 + 4$
Name & Class	2	1	50	6	$-4p_1 - 5p_2 + 44p_3 + 6$
Name & Launched	2	1	26	6	$-4p_1 - 5p_2 + 20p_3 + 6$
Class & Launched	50	1	26	6	$44p_1 - 5p_2 + 20p_3 + 6$
Name & Class & Launched	2	1	26	8	$-6p_1 - 7p_2 + 18p_3 + 8$

Name & Launched is the best combination of indices.

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14.1.1

a) $\lceil \frac{n}{3} \rceil + \lceil \frac{n}{10} \rceil$

$n/3$ blocks are needed to hold the records themselves.

$n/10$ blocks are needed since each record must have an entry in the index, and 10 key-pointer pairs fit in a block.

b) $\lceil \frac{n}{3} \rceil + \lceil \frac{\lceil \frac{n}{3} \rceil}{10} \rceil$

$n/3$ blocks are needed for the records as in part a.

$\frac{n/3}{10}$ are needed for the sparse index since we need a pointer for each block of records. There are $n/3$ blocks of records and 10 key-pointers fit on a block.

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14.2.1 b, c

b)

i)

114705 total blocks

$1000000/10 = 100000$ for the records

$\lceil 1000000/69 \rceil = 14493$ for the leaves

$\lceil 14493/70 \rceil = 208$ for the next layer

$\lceil 208/70 \rceil = 3$ for the next layer

1 for the root

$100000 + 14493 + 208 + 3 + 1 = 114705$ total blocks.

ii)

5, one for each layer of the B-tree and the last one to read the data file.

c)

i)

101472 total blocks

$1000000/10 = 100000$ for the records

$\lceil 100000/69 \rceil = 1450$ for the leaves, pointing to each record block

$\lceil 1450/70 \rceil = 21$ for the next layer

1 for the root

$100000 + 1450 + 21 + 1 = 101472$ total blocks

ii)

4, for the same reason as part b.

14.2.2 b, c

b)

i) 114705.

Only the query type changed, so the total number of blocks remains the same at 114705.

ii)

1018 total accesses.

$\lceil 1000/69 \rceil = 15$, which is the number of blocks in the leaves of the B-tree that the range query spans.

A query for the smallest record will take 4 accesses to blocks in the B-tree.

14 more accesses to blocks will be made to get all the blocks needed in the B-tree for the query.

1000 accesses to the records and data files will need to be made to satisfy the range query.

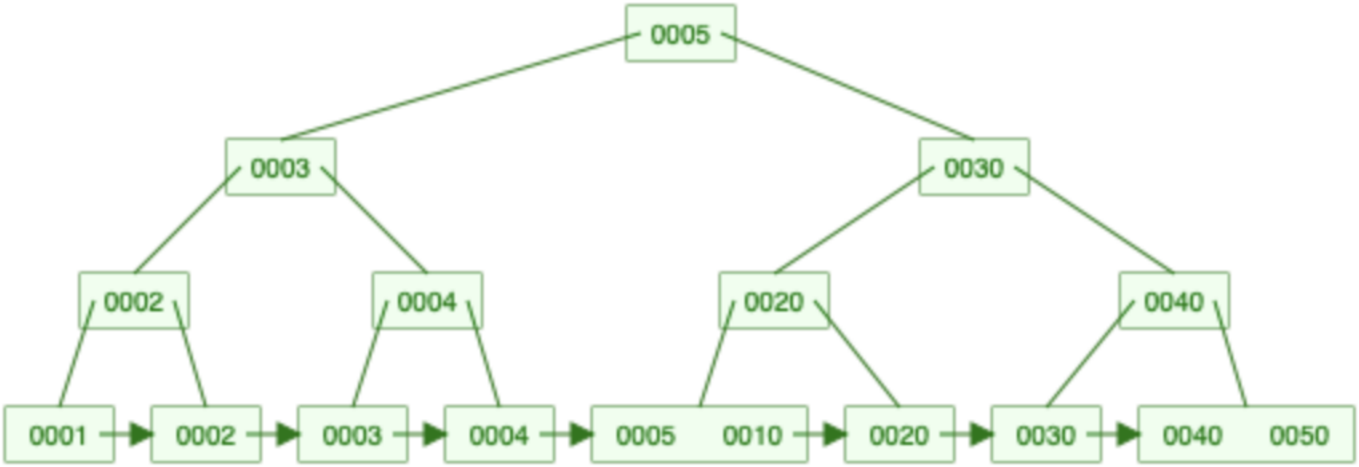
$4 + 14 + 1000 = 1018$ total accesses.

c)

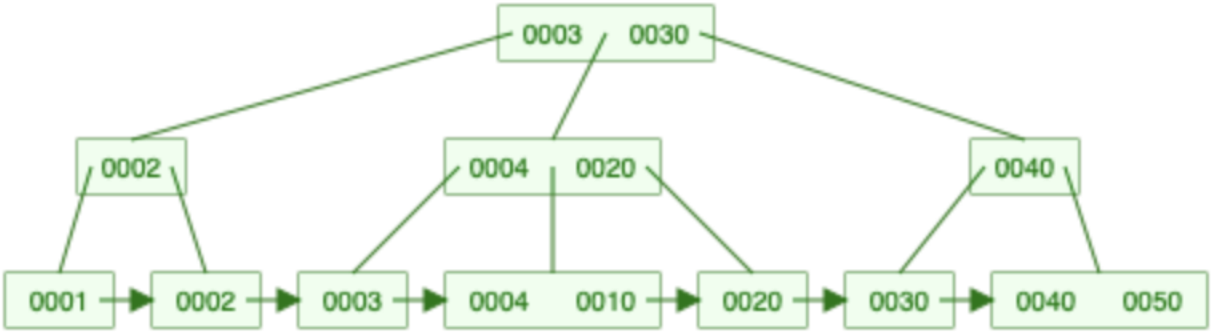
i) 101472.
The total number of blocks remains the same at 101472.
ii)
104 total accesses.
1000/10 = 100 blocks of data need to be accessed.
$\lceil 100/70 \rceil = 2$ leaves in the B-tree need to be accessed to get the pointers to the blocks.
3 accesses to read the smallest element in the query from a leaf in the B-tree.
1 more accesses to blocks in the B-tree to get all the leaves needed, since we still need to access 2 blocks/leaves to get the entire range.
100 accesses to the records and data files for the query.
$3 + 1 + 100 = 104$ total accesses.

2 Part B

Inserts (comma separated) after 10, 20, etc.: 1,2,3,4,5
Final B-Tree (After Last Insert)



Penultimate B-Tree (Before Last Insert)


0003 0030
0002
0004 0020
0040
0001
0002
0003
0004 0010
0020
0030
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