CS & IT ENGINEERING

Database Management System

File Org & Indexing

DPP – 03 Discussion Notes

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01 Question

02 Discussion

Q.1

The order of a leaf node in a B+ tree is the maximum number of (value, data record pointer) pairs it can hold. Given that the block size is 1K bytes, data record pointer is 8 bytes long, the value field is 10 bytes long and a block pointer is 6 bytes, then what is the order of the leaf node?

[MCQ]

A. 53

B. 54

C. 55

D. 56

$P * key + P * R_p + 1 BP \leq Block\ Size$

$P * 10 + P * 8 + 1 \times 6 \leq 1024\ B$

$10P + 8P + 6 \leq 1024$

$18P \leq 1018$

$P \leq \left\lfloor \frac{1018}{18} \right\rfloor = 56$ Ans

Block Size = 1KB = 1024 B, $R_p = 8B$, key = 10, BP = 6 Byte

Ans (D).

Q.2

The order of a node in B tree is defined as the number of pointers it can hold. What is the maximum number of keys that a B tree of order 4 and height 4 can have ? _____ [NAT]

(Assume that the height of a root node is 1)

Ans (255)

ORDER: P

Height / Level	max # Node	max # Bp	max # keys
1 — 0/1	1	P	P-1
2 — 1/2	P	P^2	P(P-1)
3 — 2/3	P^2	P^3	$P^2(P-1)$
4 — 3/4	P^3	P^4	$P^3(P-1)$

Given Question

ORDER[P] = 4

$(4-1) = 3$

$4 \times 3 = 12$

$4^2 \times 3 = 48$

$4^3 \times 3 = 192$

$192 + 48 + 12 + 3 = 255$

Q.3

Given a block can hold either 3 records or 10 key pointers. A database contains P records then how many blocks do we need to hold the data file and the dense index? **[MCQ]**

A. $\frac{P}{30}$

B. $\frac{P}{3}$

C. $\frac{13P}{30}$

D. $\frac{P}{10}$

3 Record Per Block.

Block Factor = 3

Dense Index

#Entries = # Records

(BFi)

To Store Record #Blocks Required $= \frac{P}{3}$

To Store keys, # Block Required $= \frac{P}{10}$

Total #Blocks Required $= \frac{P}{3} + \frac{P}{10} = \frac{10+3}{30} = \frac{13P}{30}$

Ans (C)

Q.4

The order of an internal node in B+ tree index is the maximum number of children it can have. Assume that a child pointer takes 6 bytes, the search field value takes 34 bytes and the blocks size is 2048 bytes. The order of the internal node is _____. **[NAT]**

$C_p / B_p = 6$ Byte keys = 34 Byte, Block size = 2048 Byte

B+ Tree
Internal Node

$$P * B_p + (P-1)\,\text{keys} \le \text{Block size}$$

$$\Rightarrow P \times 6 + (P-1)\,34 \le 2048$$

$$6P + 34P - 34 \le 2048$$

$$40P \le 2082$$

$$P = \left\lfloor \frac{2082}{40} \right\rfloor = 52 \text{ Ans}$$

Ans (52)

Q.5

Assume a disk with block size B = 1024 Bytes, A block pointer is P_B = 12 bytes long and a record pointer is P_R = 18 bytes long. A file has 1,00,000 patients records of size 100 bytes. Suppose the file is ordered by the key field PID and we want to construct a secondary (dense) index on non-key field DeptID (14 bytes), then minimum of how many blocks are required to store index file assuming an unspanned organisation?

[NAT]

A. 3000

B. 3100

C. 3125

D. None of the above

Ans(C)

Block Size = 1024 Byte PR = 18 Byte key = 14 Byte, #records = 100.000

18 + 14 = 32

$$\text{Block factor of Index file} = \left\lfloor \frac{\text{Block Size}}{\text{Index Record size}} \right\rfloor = \left\lfloor \frac{1024}{32} \right\rfloor \Rightarrow \frac{2^{10}}{2^5}$$

⇒ 32 Index entries Per Blocks.

Dense

↳ Total # Index entries = 100.000 (# DB Records)

$$\text{Total \# of Index Blocks} = \left\lceil \frac{100,000}{32} \right\rceil = 3125 \text{ Index Block.}$$

Q.6

The order of a node in B tree is the maximum number of block pointers it can hold. Given that the block size is 2K bytes, data record pointer is 8 bytes long, the search key is 9 bytes long and a block pointer is 5 bytes long. The best possible order of B tree node is 93 Ans

[NAT]

Block size = 2048B
R_p = 8Byte
key = 9B
B_p = 5B

ORDER P: $P * B_p + (P-1)$ keys $+ (P-1)R_p \leq$ Block size

$\Rightarrow P*5 + (P-1)9 + (P-1)8 \leq 2048$

$5P + 9P - 9 + 8P - 8 \leq 2048$

$22P - 17 \leq 2048$

$22P \leq 2065$

$P = \left\lfloor \frac{2065}{22} \right\rfloor = 93$ Ans

Ans (93)

Q.7

The order of a leaf node (P) in a B^+ tree is the maximum number of (value, data record pointer) pairs it can hold. Given that P=36, data record pointer is 8 bytes long, the search field is 6 bytes long and a block pointer is 8 bytes long. The permissible block size is _____ .

[NAT]

P=36
R_P=8
key=6
B_P=8Byte

B^+ Tree

$P*(key+R_P)+1B_P \le$ Block size

$36*(6+8)+1*8B$

$36*14+8$

512 Byte.

Ans (512 Byte)

Q.8 [NAT]

(Assume that the level of root node is1)

The order of different nodes in B^+ tree/B tree are given as-

2 to P block pointers in root node.

$\left\lceil \frac{P}{2} \right\rceil$ to P block pointers in internal node.

$\left\lceil \frac{P}{2} \right\rceil$-1 to (P-1) keys in leaf node.

Let a and b be

The minimum number of keys in

B tree and B+ tree node of order

P = 5 and level = 5. The value of (a + b) is

$a = 161$

$b = 108$

$a + b = 161 + 108$

$\Rightarrow 269$

Ans (269).

Height/Level	min #Node	min #Bp	min #Keys
0/1	1	2	1
1/2	2	$2\lceil p/2 \rceil$	$2(\lceil p/2 \rceil - 1)$
2/3	$2\lceil p/2 \rceil$	$2\lceil p/2 \rceil^2$	$2\lceil p/2 \rceil (\lceil p/2 \rceil - 1)$
3/4	$2\lceil p/2 \rceil^2$	$2\lceil p/2 \rceil^3$	$2\lceil p/2 \rceil^2 (\lceil p/2 \rceil - 1)$
4/5	$2\lceil p/2 \rceil^3$	$2\lceil p/2 \rceil^4$	$2\lceil p/2 \rceil^3 (\lceil p/2 \rceil - 1)$

$p = 5$

$\lceil p/2 \rceil = \lceil 5/2 \rceil$

$\hookrightarrow 3$

$\lceil p/2 \rceil - 1$

$\Rightarrow 3 - 1$

$= 2$

$1 = 1$

$2 \times 2 = 4$

$2 \times 3 \times 2 = 12$

$2 \times (3 \times 3) \times 2 = 36$

$2 \times (3 \times 3 \times 3) \times 2 = 108$

161

$a = 161$

$b = 108$

$\lceil p/2 \rceil = 3$

$\lceil p/2 \rceil - 1$

$\Rightarrow 2$

In B^+ Tree all keys are available in (Last Level) Leaf Node

Q.9

[NAT]

(Assume that the level of root node is1)

The order of different nodes in B^+ tree/B tree are given as-

2 to P block pointers in root node.

$\left\lceil \frac{P}{2} \right\rceil$ to P block pointer is internal node.

$\left\lceil \frac{P}{2} \right\rceil - 1$ to (P–1) keys in leaf node.

Let a and b be the maximum number of keys in B tree and B^+ tree node of order P = 5 and level = 5. The value of (a +b) is .

Ans (5624)

a = 3124

b = 2500

5624

Height / Level	max #Node	Max #BP	max # keys		
0/1	1	p	(p-1)	4	= 4
1/2	p	p^2	p(p-1)	5×4	= 20
2/3	p^2	p^3	$p^2(p-1)$	5×5×4	= 100
3/4	p^3	p^4	$p^3(p-1)$	5×5×5×4	= 500
4/(5)	p^4	p^5	$p^4(p-1)$	5×5×5×5×4	= 2500

3124

ORDER = (5=p)

(p-1) = 4

B tree: a = 3124

B+ tree: b = 2500 all keys available at (leaf (last level).

Q.10

Consider the keys (1–5000) are going to be interested into a B^+ tree. Assume, all the order are available before insertion. The orders P for B+ tree node is defined as- **[NAT]**

2 to P pointer for root

$\left\lceil \frac{P}{2} \right\rceil$ to P pointer for another node.

The maximum possible levels in a B^+ tree index for P = 9 is ____6 Ans

(Assume that level of the root node is 1)

Ans (6)

Maximum possible level, if we have min # key in Node =

$\frac{5000}{4}$ = 1250 Node

P = 9

Minimum # keys = $\lceil P/2 \rceil - 1 = \lceil 9/2 \rceil - 1 = 5 - 1 = 4$

Min # BP = $\lceil P/2 \rceil = \lceil 9/2 \rceil = 5$

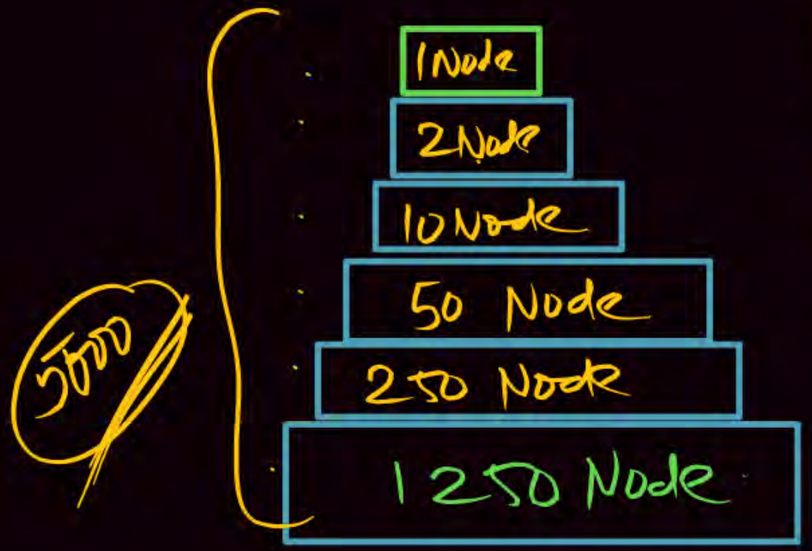
$\lceil \frac{2}{5} \rceil$ = 1 Block

$\lceil \frac{10}{5} \rceil$ = 2 Node

$\lceil \frac{50}{5} \rceil$ = 10 Node

$\lceil \frac{250}{5} \rceil$ = 50 Node

$\lceil \frac{1250}{5} \rceil$ = 250 Node



Q.11 [MCQ]

Consider the following statements:

S_1: In a B+ tree, data pointers are stored only at the leaf nodes of the tree.

S_2: In a B^+ tree, the leaf node has an entry for every value of the search field, along with the data pointer to the record.

Choose the correct statements.

Internal Node $= P*B_P + (P-1)|key \leq B.S$

Leaf $\Rightarrow P*(|key + R_P) + |B_P \leq B.S.$

A. Only S_1 is true

B. Only S_2 is true

C. Both S_1 and S_2 are true

Ans (C).

D. Neither S_1 nor S_2 is true

Q.12

Consider the keys (1– 5000) are going to be interested into a B^+ tree. Assume, all the order are available before insertion. The orders P for B^+ tree node is defined as- **[NAT]**

2 to P pointer for root

$\left\lceil \frac{P}{2} \right\rceil$ to P pointer for another node.

The minimum possible levels in a B+ tree index for P = 9 is 4.

(Assume that level of the root node is 1)

Ans(4)

Minimum #levels ⇒ Maximum Number of keys = (8)

ORDER = P max keys = (P-1)

ORDER = 9 max key = 8

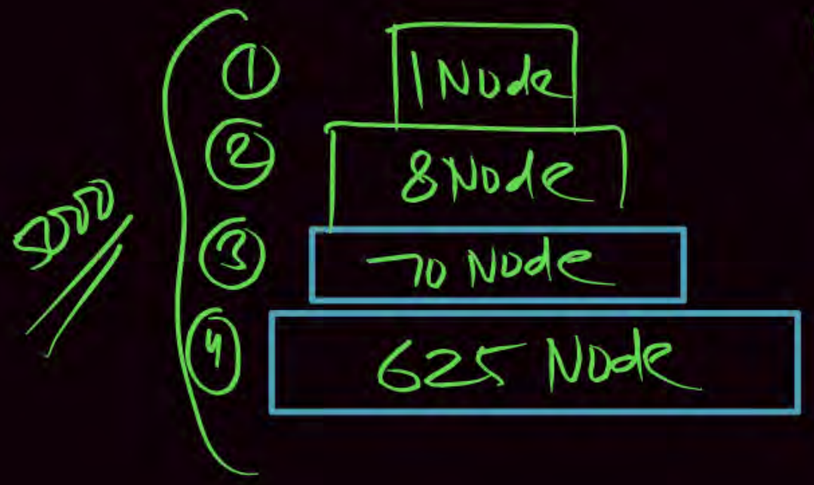
& Maximum B_P = P = (9)

Total # Block Read = $\frac{5000}{8}$ = 625 Node

$\lceil 8/9 \rceil = 1$

$\lceil 70/9 \rceil = 8$

$\lceil 625/9 \rceil = 70$



4 Level Required.


THANK YOU GW
SOLDIERS !