ASSIGNMENT-5

Database Design

Assignment - 5

1. Block size B = 512 bytes
Block pointer P = 6 bytes
Record pointer PR = 7 bytes
r = 3000

a) Record size R = 30 (NAME) + 10 (SSN) + 10 (DEPARTMENTCODE) + 30 (ADDRESS) + 10 (PHONE) + 10 (BIRTHDATE) + 1 (GENDER) + 4 (JOBCODE) + 4 (SALARY) + 1 (Additional byte for deletion marker) = 110
∴ R = 110 bytes

b) Blocking factor bfr = ⌊B div R⌋ = ⌊512 div 110⌋
= 4 records / block
Number of file blocks = ⌈r / bfr⌉ = ⌈3000/4⌉ = 750
= 750 file blocks

c) i) Index blocking factor bfr i = ⌊B div Ri⌋
= ⌊512 div (10+6)⌋ = 32 entries / blocks

ii) Number of first-level index entries = 750
Number of first-level index blocks = ⌈750/32⌉
= 24 index blocks

iii) Number of second-level index entries = 24
Number of second-level index blocks = ⌈24/32⌉
= 1 index block

∴ Number of levels needed = 2

iv) Total number of blocks required = 1+24 = 25

v) Number of block accesses = 3

d) i) Index blocking factor bfr$_i$ = $\lfloor 512 \text{ div } (10+6) \rfloor$
= 32 entries / block

ii) Number of first level index entries = 3000
Number of first level index blocks = $\lceil 3000/32 \rceil$
= 94

iii) Number of second level index entries = 94
Number of second level index blocks = $\lceil 94/32 \rceil$ = 3

Number of third level index entries = 3
Number of third level index blocks = $\lceil 3/32 \rceil$ = 1

∴ Number of levels needed = 3

iv) Total number of blocks = 94 + 3 + 1 = 98

v) Number of block accesses = 4

e) i) Index blocking factor bfr$_i$ = $\lceil 512 \text{ div } (10+6) \rceil$
= 32 entries / block.

ii) Record pointer size = 7 bytes
1 block can store $\lceil 512/7 \rceil$ = 73 pointers / block
3000 employees among 100 departments
Hence each department can be stored in 1 block
∴ 100 blocks for 100 departments.

iii) Number of first level index entries = 100
Number of first level index blocks = $\lceil 100/32 \rceil = 4$

iv) Number of second level index entries = 4
Number of second level index blocks = $\lceil 4/32 \rceil = 1$
∴ Number of levels = 2

v) Number of blocks required = 100 + 4 = 105
Blocks used in extra level of indirection = 100

vi) Number of block accesses = 3 + 30 = 33.

f) i) Index blocking factor bfr i = $\lceil 512/(10+6) \rceil$
= 32 entries/block

ii) Number of first level index entries = 100
Number of first level index blocks = $\lceil 100/32 \rceil = 4$

iii) Number of second level index entries = 4
Number of second level index blocks = $\lceil 4/32 \rceil = 1$
∴ Number of levels = 2

iv) Total number of blocks = 1 + 4 = 5

v) Number of block accesses = 2 + 8 = 10

g) Calculation of order p :-
i) block pointer P = 6 bytes
SSN = 10 bytes

Let number of pointers be p

Then $(p \times 6) + [(p-1) \times 10] \leq 512$

$6p + 10p - 10 \leq 512$

$16p \leq 522$

$Max(p) = 32$

Calculation of p-leaf:

$(Pleaf \times 7) + (Pleaf \times 10) + P \leq 512$

$(17 \times Pleaf) + 6 \leq 512$

$17 Pleaf \leq 506$

$Max(Pleaf) = 29$

ii) Each leaf node will hold $0.69 \times max(pleaf)$

$= 0.69 \times 29 = 20$ record pointers

Number of leaf level blocks = $\lceil 3000/20 \rceil = 150$

iii) Each internal node will hold $0.69 \times 32 = 22$ pointer

$= 21$ values.

Number of first internal level nodes = $\lceil \frac{150}{21} \rceil = 8$

second level require one block

Total = 3 levels.

iv)

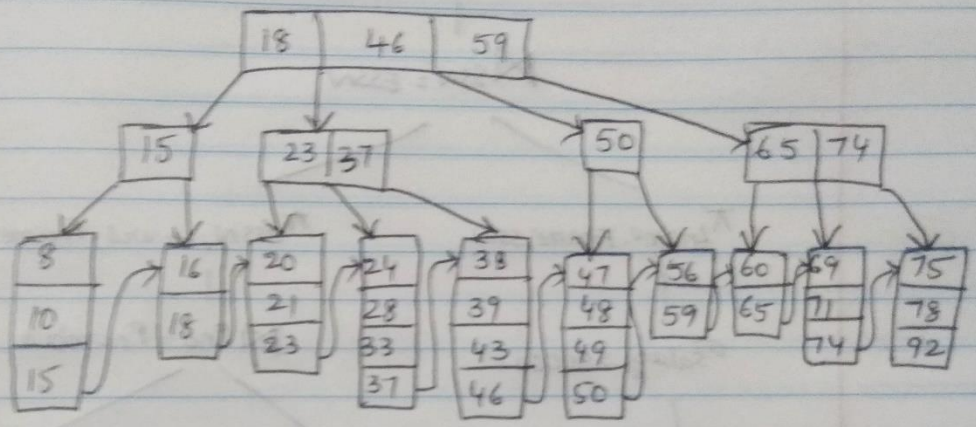
Root	1 node	20 keys	22 pointers
Level1	22 nodes	440 keys	484 pointers
Level2	440 nodes	9680 keys	
		> 3000	

No. of Levels = 2

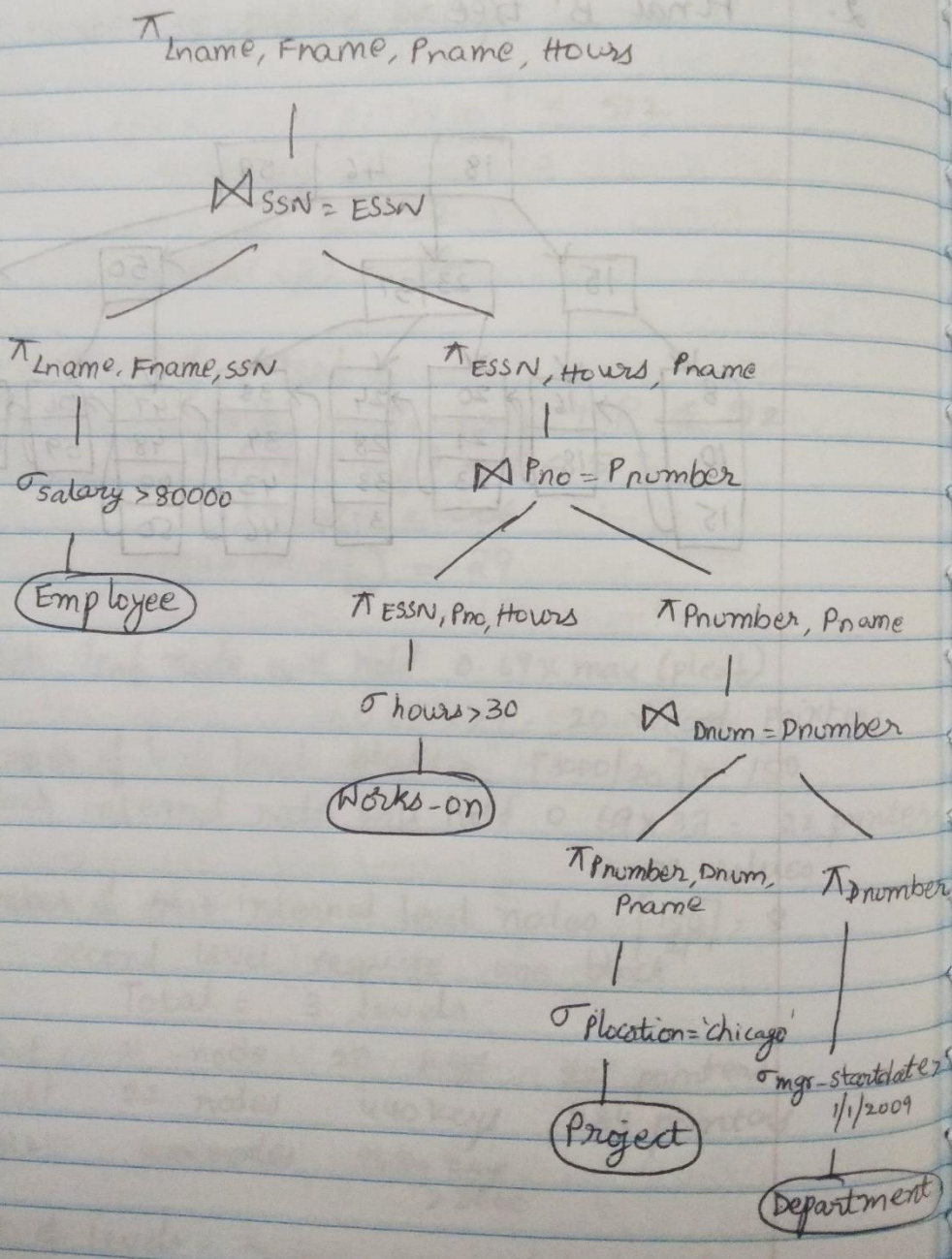
Total block required = 440 + 22 + 1 = 463

v) No. of block access = 3 + 1 = 4

2. Final B^+ tree:



3.


π Lname, Fname, Pname, Hours
⋈ SSN = ESSN
π Lname, Fname, SSN
π ESSN, Hours, Pname
σ Salary > 80000
⋈ Pno = Pnumber
Employee
π ESSN, Pno, Hours
π Pnumber, Pname
σ hours > 30
⋈ Dnum = Dnumber
Works-on
π Pnumber, Dnum, Pname
π Dnumber
σ Plocation = 'Chicago'
σ mgr-startdate > 1/1/2009
Project
Department