Catalogue Information:

N_R = Number of tuples (records) in Relation R.

B_R = Number of blocks contains in $R\left(\frac{N_R}{F_R}\right)$

S_R = Size of a tuple of R

F_R = Blocking Factor; Number of tuple from R that fit into one block.

$\left[\frac{N_R}{B_R}\right]$

$V(A,R)$ = Number of distinct value for attribute A in R.

$Se(A,R)$ = Selectivity of attribute A

= Avg. number of tuple R satisfy equality condition on A.

$\frac{N_R}{V(A,R)}$

Let's understand with example :

Student

Roll	Name	
1	A	block 1
2	B	
3	C	
4	D	block 2
5	E	
6	F	
7	G	block 3
8	H	
9	I	

2 bytes 8 bytes

$N_R = 9$

$B_R = 3$

l_R = Size of each Records

= 2+8 = 10 bytes

$f_R = \frac{N_R}{B_R} = \frac{9}{3} = 3$,

$V(A,R)$ =

- V (Roll, Student(R)) = 9
- V (Name, ") = 9

R

ID
a
a
b
c

V (ID, R(R) = 3

here; select * from r where Branch='BE'

$S(B,R) = \frac{n_R}{V(B,V)} = \frac{6}{2} = 3$

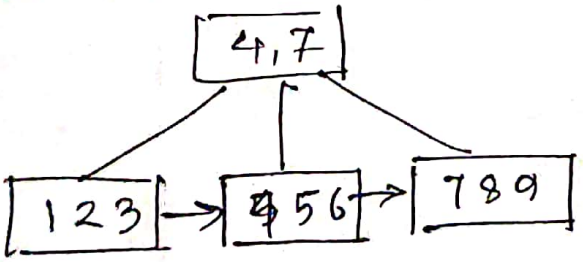
V

Roll	Branch
1	BE
2	BE
3	ME
4	BE
5	ME
6	ME

BE/ME = (3)

Equally dist.

B+ tree



If each value of an attribute have uniform distribution means equal probability. then selection result can be estimated to have

$\frac{n_R}{V(I,R)}$ records.

Query Optimization

Complex conjugation :

S_i = the number of satisfying tuples.

Student

Roll	Branch	G
1	BE	M
2	BE	F
3	ME	M
4	ME	M
5	BE	F
6	BSc	M

$S_{BE} = 3$ | $P[BE] = \frac{3}{6} = \frac{1}{2}$

$S_{MB} = 2$ | $P[MB] = \frac{2}{6} = \frac{1}{3}$

$S_{BSc} = 1$ | $P[BSc] = \frac{1}{6}$

$S_M = 4$ | $P[M] = \frac{4}{6} = \frac{2}{3}$

$S_F = 2$ | $P[F] = \frac{2}{6} = \frac{1}{3}$

Select * from Student
where Branch = 'BE' & Gender = 'F'

$\sigma_{Branch = 'BE' \wedge Gender = 'M'}$ (Student)

$= 6 \times \frac{3}{6} \times \frac{4}{6} = 2$

$\sigma_{Branch = 'BE' \wedge Gender = 'F'}$ (Student)

$= 6 \times \frac{3}{6} \times \frac{2}{6} = \frac{2}{3}$.

Disjunction :

select * from Student
where Branch = "BE" or Gender = "F".

$NR * \left(1 - \left(1 - \frac{S_1}{NR}\right) \times \left(1 - \frac{S_2}{NR}\right) \times \left(1 - \frac{S_3}{NR}\right)\right)$.

$6 * \left(1 - \left(1 - \frac{3}{6}\right) \times \left(1 - \frac{2}{6}\right)\right)$

$= 6 \times \left(1 - \frac{3}{6} \times \frac{4}{6}\right) = 6 \times \left(1 - \frac{1}{3}\right) = \frac{12}{3} = 4.$

$\sigma_{A \le v}$ or $\sigma_{A \ge v}$ cases :

Student

Roll	Marks
1	90
2	62
3	40
4	75
5	82

```
select * from studen
① where marks < 39;
② where marks > 90;
③ where marks < 50;
④ where marks > 80;
```

min(marks) = 40;
max(marks) = 90

for ① & ② the values are out of range. so tuples = 0

for ③

$$\text{tuples} = \frac{\text{value} - \min(R)}{\max(R) - \min(R)} \times \text{no. of (total tuple) value}$$

$$= \frac{50 - 40}{90 - 40} \times 5$$

$$= \frac{10}{50} \times 5 = \frac{10}{10} = 1$$

for ④,

$$\text{tuples} = 5 \times \frac{80 - 40}{90 - 40}$$

$$= 5 \times \frac{40}{50}$$

$$= 4 \text{ Ans}$$

যদি table না দেয়া থাকে তাহলে tuples = NR/2 হবে।

Negation :

select * from Student
where Branch != "BE";

$N_R = size(\sigma_\theta(R)) \Rightarrow N_R = size(\sigma_{BE}(St))$

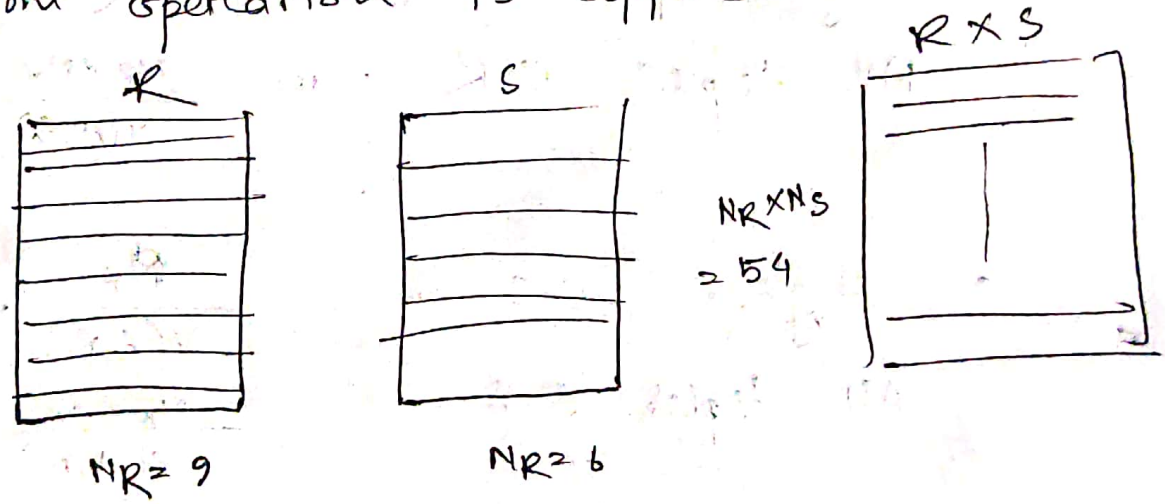
estimate no. of records present in Br.

$= N_R - \frac{N_R}{V(Branch, St)}$

$= 6 - \frac{6}{3} = 6 - 2 = 4$ (Ans)

Join size Estimation :

Determine the size of table after join operation is applied



(1) $R \cap S = \phi$ (No attr. is common).

$\{a,b\} \cap \{c,d\} = \phi$ (a, b, c, d are attr.)

(2) $R \cap S$ = Key of R/S table.

(or)

A record of S (or R) will join with at most one record from R (or S).

যার foreign key ⇒ table ও NR এর সমান join table এর size হবে।

(3) $R \cap S = X$ where X is not key of neither R or S.

R

Roll	Sid
1	S_1
2	S_2
3	S_3
4	S_4

$N_R = 4$

S

Sid	~~Marks~~ Tid
S_1	T_1
S_2	T_2
S_3	T_3

$N_S = 3$

T

Sid	SName
S_1	RM
S_2	Cmm
S_3	Math
S_4	BIO

Rules:

- single tuple ∈ R produces $\frac{N_S}{V(A,S)}$ tuples in RM
  All tuples ∈ R " $\frac{N_R \times N_R}{V(A,S)}$
- single " ∈ S " $\frac{N_R}{V(A,R)}$ " " "
  All tuples ∈ S " $\frac{N_R \times N_S}{V(A,R)}$ " " "

Now, In the given example.

For tuple ∈ R, $A = R \cap S = \{Sid\}$

$$\frac{4 \times 3}{3} = \frac{12}{3} = 4$$

For tuple ∈ S, $\frac{4 \times 3}{4} = \frac{12}{4} = 3.$

Ans = min (4, 3) = 3

* primary key বরাবর খুজলে $\log_2(N_R)$ টাইম লাগে

* কয়টা block Access করব ?

→ formula = ~~tot~~ total blocks + tuple access time within block

$$= \left\lceil \frac{N_R}{V(A,R)} \right\rceil + \log_2\left(\frac{N_R}{F_R}\right)$$

যদি binary search হয়

যদি B+ tree হয়,

Tree height + 1] Primary index, equality on key

Tree height + $\left\lceil \frac{N_R}{V(A,R)} \right\rceil$ হয়

মানে $\sigma_{A=5}$ এমন

Primary index but not equality on key.

time to Access the index (block)

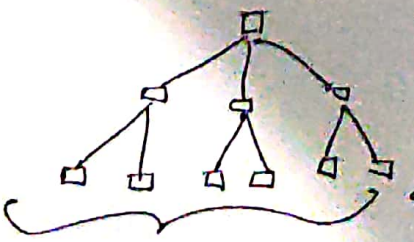
এটা index table থেকে index find করার জন্য

searching index

Access the tuples in the specified index

এটা specified index এ যে tuple আছে সেখানে যাওয়ার জন্য

access the blocks



index table এর leaf node এ যাব (Tree height)

then এখানে tuple খুজব