

Computer Science & IT

Database Management System



Query Languages

Lecture No. 02



By- Vishal Sir

Recap of Previous Lecture



Topic

Query Languages



Topic

Relational algebra



Topic

Basic relational algebra operations



Topics to be Covered



Topic

Derived relational algebra operations



Topic

Join operations

Topic

Division operation



Employee (E) Student (S)

int Chan int Chan

Aadhaar-No.	Ename
123	A
439	A
728	B
385	C

Aadhaar-No.	Sname
430	A
439	A
385	C
400	D

$S \cap E =$

Aadhaar-No.	Sname
439	A
385	C

$E \cup S =$

Aadhaar-No.	Ename
123	A
439	A
728	B
385	C
430	A
400	D

$E - S =$

Aadhaar-No	Ename
123	A
728	B

$S - E =$

Aadhaar-No	Sname
430	A
400	D



Topic : Union, Set difference, Intersection

- ❑ Union ($A \cup B$)- It contains all tuples from both the relations.
{ But no duplicate tuple }
- ❑ Difference ($A - B$)- It contains all the tuples that are contained in the relation A but are not present in the relation B.
$$A - B = \{x \mid x \in A \text{ and } x \notin B\}$$

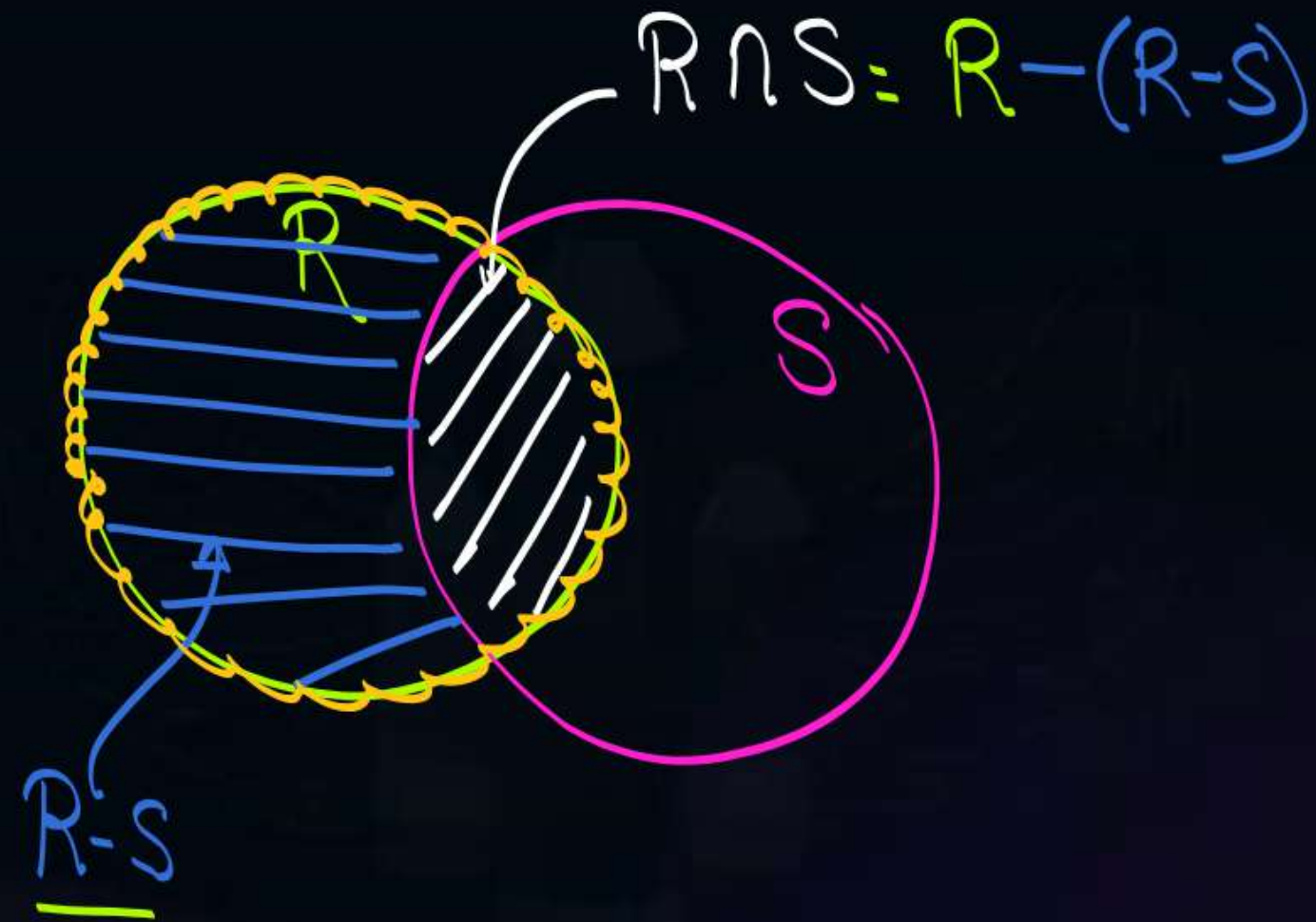
*Note: in general, $A - B \neq B - A$
 $A - B = B - A$ only if $A = B$*
- ❑ Intersection ($A \cap B$)- It contains all the tuples that are contained in both the relations A and B.



Topic : Intersection

Intersection is a derived relational algebra operation,
it is derived using "Set difference" operation

$$R \cap S = R - (R - S)$$





Topic : Rename (ρ)

Rename operation can be used to rename attribute of the relation, name of the relation or both.

❑ Renaming a relation:

Rename op

$\rho_{\text{FinalYrStudents}}(\text{Students})$

Name of relation

New name for relation

❑ Renaming attributes:

$\rho_{(SID, Sname)}(\text{Students})$

❑ Renaming both:

$\rho_{\text{FinalYrStudents}}(SID, Sname)(\text{Students})$

Student

Student-id	Name-of-Student

$\Rightarrow \rho_{\text{Final-yr-student}}(\text{Student}) \Rightarrow$

Final-yr-student

Student-id	Name-of-Student



$\rho_{(\text{Sid}, \text{Sname})}(\text{Student})$

New name
for 1st
attribute

Student

Sid	Sname

New name for
2nd
attribute

$\rho_{\text{Final-yr-student}(\text{Sid}, \text{Sname})}(\text{Student})$

Final-yr-student

Sid	Sname



Topic : Basic Relational Algebra operators

1. Projection(π)
2. Selection (σ)
3. Cross Product (\times)
4. Union (U)
5. Set Difference ($-$)
6. Rename (ρ)



Topic : Derived Relational Algebra operators

1. Intersection (\cap) ✓
2. Join Operations (" \bowtie ")
3. Division Operation (\div)



Topic : Join Operations

Join operations are used to join relational tables based on some condition.

Cross Product \equiv Cross Join

↓
In cross join, we join all tuples of first relation with all tuples of second relation.



Topic : Types Join Operations

Broadly join operations are classified into two types:

- (1) Inner join
- (2) Outer join

1) Inner join { In inner join we only select the tuples from both the relation that satisfied "join Condition" }

- a. Theta join
- b. Equi join
- c. Natural join

2) Outer join { We may also select the tuples from one or both the relation that did not satisfy the "join Condition" }

- a. Left outer join
- b. Right outer join
- c. Full outer join



Topic : Inner join



Inner join, includes only those tuples that satisfy the
matching criteria.
"Condition"



Topic : Theta join

Conditional Join



The general case of JOIN operation is called a Theta join. It is denoted by symbol θ

- Theta join can use any condition in the selection criteria.

$<, >, \leq, \geq, =, \underbrace{< >}_{\text{Not equal}}$

$R_1 \bowtie_{\theta} R_2$

θ can be any Condition

eg:

Student	
Sid	Sname
2	A
4	B
3	A

Employee	
Eid	Ename
2	B
4	A
5	B

Student \bowtie Employee
 (Student.Sid < Employee.Eid)
 join condition "0"
 This join condⁿ can be any condⁿ.

Student.Sid	Student.Sname	Employee.Eid	Employee.Ename
2	A	4	A
2	A	5	B
4	B	5	B
3	A	4	A
3	A	5	B

π (Student \bowtie Employee)
 Student.Sid < Employee.Eid
 all attributes of Student & Employee } Not distinct }



Topic : Equijoin



An equijoin is a theta join using the equality operator.
In equijoin the condition is always equality condition.

It is a type of theta join. (in which condition is Equality Condⁿ)
need not be on
same or common attribute

eg:

Student	
Sid	Sname
2	A
4	B
3	A

Employee	
Eid	Ename
2	B
4	A
5	B

Student \bowtie Employee
(Student.Sid = Employee.Eid)
Equality Condⁿ
is Equijoin

Student.Sid	Student.Sname	Employee.Eid	Employee.Ename
2	A	2	B
4	B	4	A

π All attributes of Student & all attributes of Employee
($\sigma_{\text{Student.Sid} = \text{Employee.Eid}}$ (Student X Employee))

eg:

Student	
Sid	Sname
2	A
4	B
3	A

Enroll	
Sid	Cid
2	C1
2	C2
3	C2

Using Equijoin,
Common attributes
from both the
relation will
be present in o/p.

Student \bowtie Enroll
(Student.Sid = Enroll.Sid)
Equality Condⁿ
is Equijoin

|||

π (Student \times Enroll)
Student.Sid = Enroll.Sid
All attributes of Student & all attributes of Enroll

Student.Sid	Student.Sname	Enroll.Sid	Enroll.Cid
2	A	2	C1
2	A	2	C2
3	A	3	C2

Note: In theta join (or) Equijoin, we need to specify the join condition explicitly, which is not the case with Natural join.

Note:- In Equijoin Equality condition can be applied on common attributes or different attributes, there is no restriction,
But in Natural join, ① we don't need to specify the join Condⁿ.
② Join Condⁿ is always Equality Condⁿ on all common attributes.



Topic : Natural join (\bowtie)

Natural join is performed based on the equality condition on all common attributes (column) between the relations. The name and type of common attributes must be same.

Additionally, a natural join removes the duplicate columns involved in the equality comparison so only one of each compared column remains

Student (S_{id}, S_{name}) & Enroll (S_{id}, C_{id})

No Common attribute b/w Student & Enroll.

* Natural Join (\bowtie) :-

Natural join is a derived relational algebra opⁿ,
which is derived using three basic relational algebra op^s (i) Cross Product
(ii) selection
(iii) Projection

$R \bowtie S =$ Step 1: Obtain $R \times S$
Step 2: from " $R \times S$ " Select the tuples based on Equality
Condⁿ on all common attributes of R & S .
Step 3: from the output of Step-2,
Project distinct attributes of R & S .

R Natural join S

① $R(A, B, C), S(A, D, E)$

$$R \bowtie S = \pi_{A, B, C, D, E} \left(\sigma_{R.A = S.A} (R \times S) \right)$$

② $R(A, B, C) \text{ \& } S(B, C, D)$

$$R \bowtie S = \pi_{A, B, C, D} \left(\sigma_{\begin{matrix} R.B = S.B \\ \wedge \\ R.C = S.C \end{matrix}} (R \times S) \right)$$

③ $R(A, B, C)$ & $S(D, E)$

$$R \bowtie S = \pi_{A, B, C, D, E} \left(\underbrace{\quad}_{(R \times S)} \right) \equiv R \times S$$

↑
No Common attribute
∴ No selection condition

↳ Hence all tuples of $R \times S$ will be selected.

If there are No Common attributes b/w the relations, then o/p of Natural join will be same as Cross product of these relations

eg:

Student	
Sid	Sname
2	A
4	B
3	A

Employee	
Eid	Ename
2	B
4	A
5	B

Student \bowtie Employee \equiv

Student \times Employee

Because No Common attribute

eg:

Student	
Sid	Sname
2	A
4	B
3	A

Enroll	
Sid	Cid
2	C1
2	C2
3	C2

Student \bowtie Enroll

\equiv

Sid	Sname	Cid
2	A	C1
2	A	C2
3	A	C2

$\pi_{Sid, Sname, Cid} (\sigma_{Student.Sid = Enroll.Sid} (Student \times Enroll))$



Topic : Outer join

In an outer join, along with tuples that satisfy the matching criteria, we also include tuples that do not match the criteria ^(Condition) either from left hand side relation, or from right hand side relation or both.



Topic : Left Outer Join (\bowtie)

$R \bowtie S \equiv$ All tuples of $R \bowtie S$, and tuples from left hand side relation (i.e. 'R') that failed the join condition

R

A	B	C
1	2	3
1	4	5

$R \bowtie S =$

A	B	C	D
1	2	3	4
1	4	5	NULL

} tuple from $R \bowtie S$

S

B	C	D
2	3	4
5	6	9
3	7	8



Topic : Right Outer Join (\bowtie)

$R \bowtie S =$ All tuples of $R \bowtie S$, and the tuples from right hand side relation {i.e.: 'S'}, that failed the join condition

R

A	B	C
1	2	3
1	4	5

S

B	C	D
2	3	4
5	6	9
3	7	8

$R \bowtie S =$

A	B	C	D
1	2	3	4
NULL	5	6	9
NULL	3	7	8

} tuple from $R \bowtie S$



Topic : Full Outer Join (\bowtie)

$R \bowtie S$ - All tuples of $R \bowtie S$, and tuples from both left hand side relation & right hand side relation that failed join condition

R

A	B	C
1	2	3
1	4	5

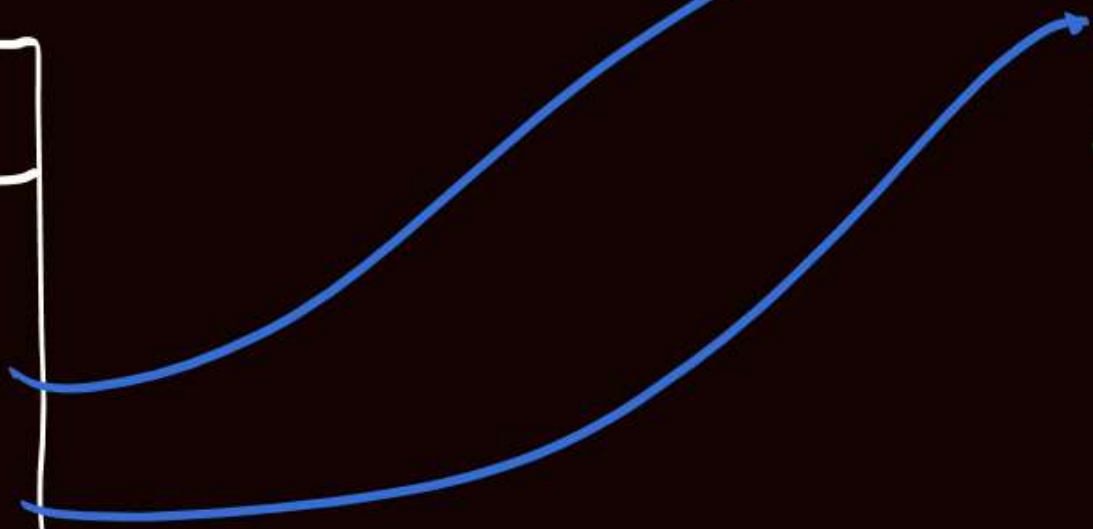
R ~~IMS~~ =

A	B	C	D
1	2	3	4
1	4	5	NULL
NULL	5	6	9
NULL	3	7	8

} from RAS

S

B	C	D
2	3	4
5	6	9
3	7	8



Q: Result of which of the following is super-set of other three

(a) Natural join

(b) Left outer join

(c) Right outer join

☒ (d) Full outer join



Topic : Division (\div)



Division operation is used whenever the query is with respect to every or all.



2 mins Summary



Topic

Derived relational algebra operations ✓

Topic

Join operations ✓

Topic

Division operation

} Next Class

THANK - YOU