

Relational Algebra

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- Relational algebra is a collection of operations used to manipulate relations (tables).
- Each Operator of relational algebra takes either one or two relations as its input and produces a new relation as its output.
- In Relational algebra, user has to specify what information is required from the database and what are the steps or procedures performed on the database to obtain the required information.

Types of Relational Operators



(i) Traditional Set Operators

- Union
- Intersection
- Difference
- Cartesian Product



(ii) Special Operators

- Selection
- Projection
- Join
- Division

(i) Traditional Set Operators:-

These include Union, Intersection, Difference, Cartesian Product. All of these operations are binary operations which means that operation applies to pair of Relations.

(ii) Union :- The Union operations contains all the tuples that are either R1 or R2 or both.

→ It is denoted by U.

Example:-

R1			R2		
Name	Age	Sex	Name	Age	Sex
A	20	M	D	20	F
C	21	M	A	20	M
B	21	F	E	21	F

R3 = R1 U R2

NAME	AGE	SEX
A	20	M
C	21	M
B	21	F
D	20	F
E	21	F

(2) Intersection:- The intersection operations contains all tuples that are both in R1 and R2.

→ It is denoted by intersection \cap .

→ Notation: $R1 \cap R2$.

Example

R1			R2		
Name	Age	Sex	Name	Age	Sex
A	20	M	D	20	F
C	21	M	A	20	M
B	21	F	E	21	F

$R3 = R1 \cap R2$

Name	Age	Sex
A	20	M

(3) Difference:- The difference between two relations between R1 and R2 ($R1$ MINUS $R2$), is the set of all records or tuples belongs to R1 and not to R2.

→ It is denoted by minus (-).

→ Notation: $R1 - R2$

Example -

R1

R2

Name	AGE	Sex
A	20	M
C	21	M
B	21	F

Name	AGE	SEX
D	20	F
A	20	M
E	21	F

R3 = R1 - R2

Name	AGE	Sex
C	21	M
B	21	F

(IV) Cartesian Product :- The Cartesian Product is used to combine each row in one table with each row in the other table.

→ It is also known as cross product.

→ It is denoted by X.

Example

R1 =

Name	Age	Sex
A	20	M
C	21	M

R2 =

Name	Age	Sex
D	20	F
E	21	F

R3 = R1 X R2

Name	Age	Sex	Name	Age	Sex
A	20	M	D	20	F
C	21	M	D	20	F
A	20	M	E	21	F
C	21	M	E	21	F

(2) Special Operators :-

The special relational operators are :-

- (i) Selection (Unary Operation)
- (ii) Projection (Unary Operation)
- (iii) Join
- (iv) Division

(i) Selection :- The select operation selects a subset of tuples or records from a relation.

→ It is Unary operator.

→ It is denoted by sigma (σ).

→ Notation :- $\sigma \langle \text{select condition} \rangle \langle \text{relation} \rangle$

Example R

Name	Age	Sex
A	20	M
M	21	F
B	20	F
F	19	M
A	20	F
R	21	F
C	21	M

$R_1 = \sigma (\text{Age} = 20) (R)$

Name	Age	Sex
A	20	M
B	20	F
A	20	F

(iii) Projection :- It contains a subset of columns of a table and eliminates any duplicate rows that may result.

→ It is a Unary operation.

→ Notation :- $\langle \text{attribute list} \rangle (\text{relation})$

Example:

$R1 = \pi (\text{Name, Sex}) (R)$

R =

Name	Age	Sex
A	20	M
M	21	F
B	20	F
F	19	M
A	20	F

→

Name	Sex
A	M
M	F
B	F
F	M
A	F

(iii) Join :- The Join operation concatenates two relations based on a joining condition.

→ It is denoted by a join symbol (\bowtie)

→ Notation :-

$R \bowtie \langle \text{join condition} \rangle S$

R1

R2

FirstName	LastName
A	Mary
B	John
C	Ann

LastName	Sex
Ann	F
John	M
Mary	F
Bill	M

$$R3 = R1 \text{ (LastName = LastName) } R2$$

FirstName	LastName	LastName	Sex
A	Mary	Mary	F
B	John	John	M
C	Ann	Ann	F

(IV) Division: - The division operator divides a relation R_1 of degree $(n+m)$ by a relation R_2 of degree m and produces a relation of degree n .

→ The formal notation for a division operation is \div .

Name	Sex
A	M
B	F
A	F
C	F
D	M
C	M

Sex
M
F

$$R3 = R1 \div R2$$

Name
A
C