Sri SAI RAM ENGINEERING COLLEGE

INSTITUTE OF TECHNOLOGY

West Tambaram, Chennai - 44

YEAR	SEM
II	IV

CS 8492

DATABASE MANAGEMENT SYSTEMS

(Common to CSE & IT)

UNIT NO. 1

1.6 RELATIONAL ALGEBRA

1.6.4 Relational Algebra

Relational algebra is a procedural query language. It gives a step by step process to obtain the result of the query. It uses operators to perform queries.

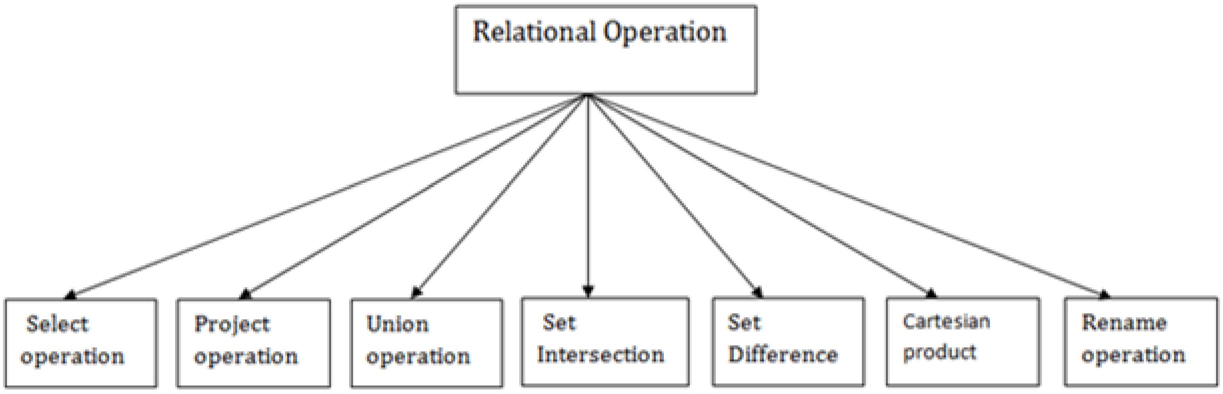
Types of Relational operation

We have divided these operations in two categories:

1. Basic Operations

2. Derived Operations

Basic/Fundamental Operations:



1. Select (σ)

2. Project (∏)

3. Union (∪)

4. Set Difference (-)

5. Cartesian product (X)

6. Rename (ρ)

Derived Operations:

1. Natural Join (⋈)

2. Left, Right, Full outer join (⟕,⟖,⟗)

3. Intersection (∩)

4. Division (÷)

Lets discuss these operations one by one with the help of examples.

Select Operator (σ)

Select Operation:

- The select operation selects tuples that satisfy a given predicate.
- It is denoted by sigma (σ).

Notation: σ p(r)

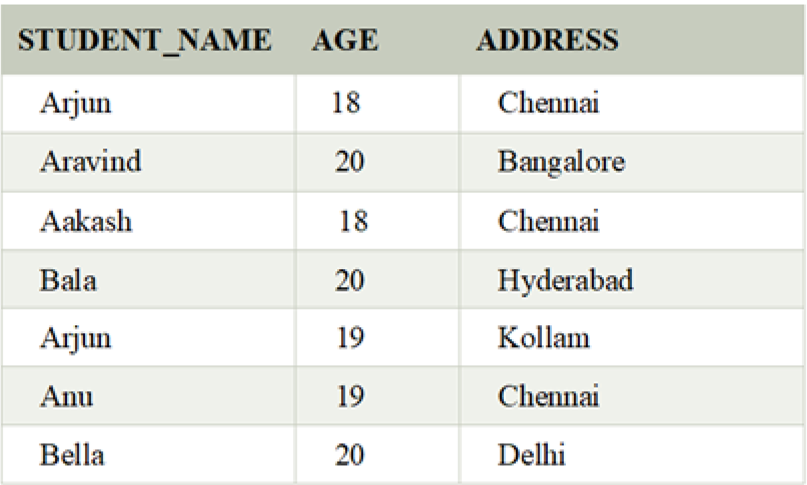
Where:

σ is used for selection prediction

r is used for relation

p is used as a propositional logic formula which may use connectors like: AND OR and NOT. These relational can use as relational operators like =, ≠, ≥, <, >, ≤.

For example: Student Relation

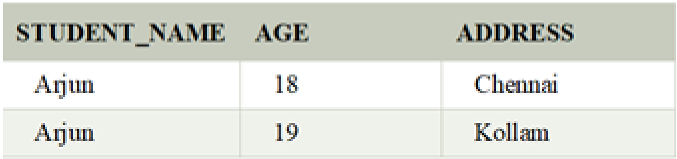


STUDENT_NAME	AGE	ADDRESS
Arjun	18	Chennai
Aravind	20	Bangalore
Aakash	18	Chennai
Bala	20	Hyderabad
Arjun	19	Kollam
Anu	19	Chennai
Bella	20	Delhi

Input:

σ STUDENT_NAME="Arjun" (STUDENT)

Output:



STUDENT_NAME	AGE	ADDRESS
Arjun	18	Chennai
Arjun	19	Kollam

2. Project Operation (∏):

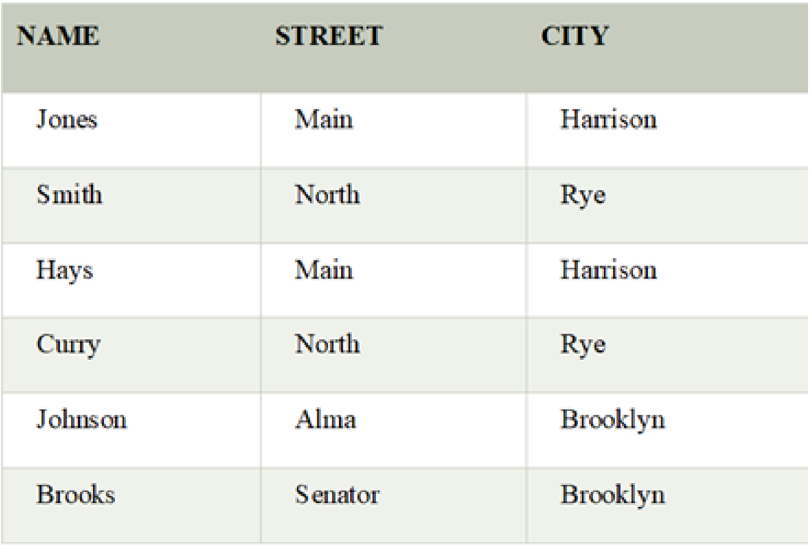
- This operation shows the list of those attributes that we wish to appear in the result. Rest of the attributes are eliminated from the table.
- It is denoted by ∏.

Notation: ∏ A1, A2, An (r)

Where

A1, **A2**, **A3** is used as an attribute name of relation **r**.

Example: CUSTOMER RELATION

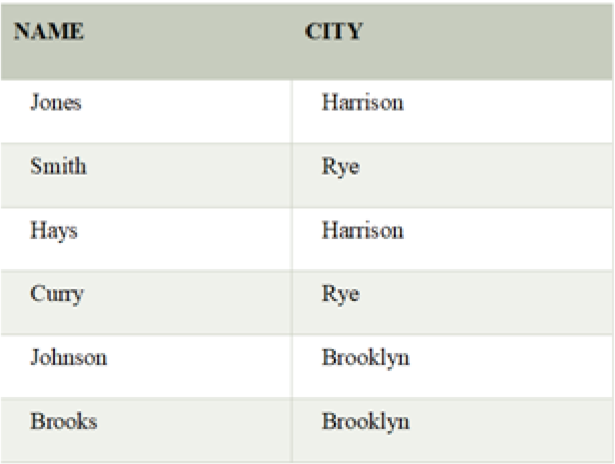


NAME	STREET	CITY
Jones	Main	Harrison
Smith	North	Rye
Hays	Main	Harrison
Curry	North	Rye
Johnson	Alma	Brooklyn
Brooks	Senator	Brooklyn

Input:

∏ NAME, CITY (CUSTOMER)

Output:



NAME	CITY
Jones	Harrison
Smith	Rye
Hays	Harrison
Curry	Rye
Johnson	Brooklyn
Brooks	Brooklyn

3. Union Operation (∪):

- Suppose there are two tuples R and S. The union operation contains all the tuples that are either in R or S or both in R & S.
- It eliminates the duplicate tuples. It is denoted by ∪.

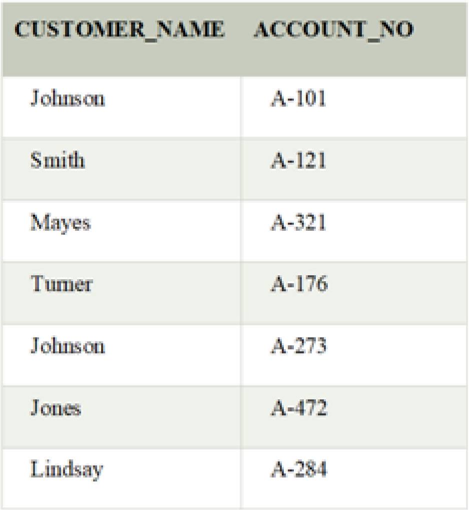
Notation: R ∪ S

A union operation must hold the following condition:

- R and S must have the attribute of the same number.
- Duplicate tuples are eliminated automatically.

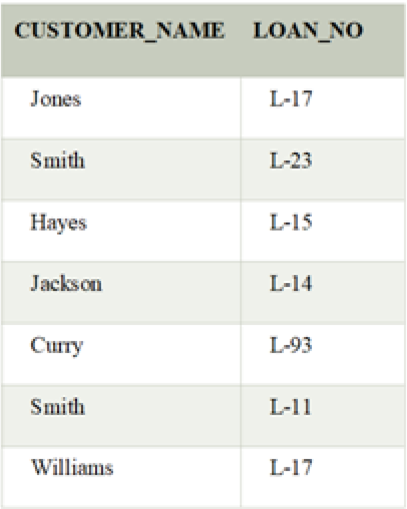
Example:

DEPOSITOR RELATION



CUSTOMER_NAME	ACCOUNT_NO
Johnson	A-101
Smith	A-121
Mayes	A-321
Tumer	A-176
Johnson	A-273
Jones	A-472
Lindsay	A-284

BORROW RELATION

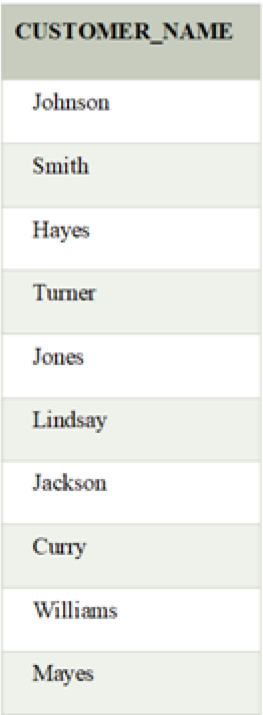


CUSTOMER_NAME	LOAN_NO
Jones	L-17
Smith	L-23
Hayes	L-15
Jackson	L-14
Curry	L-93
Smith	L-11
Williams	L-17

Input:

∏ CUSTOMER_NAME (BORROW) ∪ ∏ CUSTOMER_NAME (DEPOSITOR)

Output:



CUSTOMER_NAME
Johnson
Smith
Hayes
Turner
Jones
Lindsay
Jackson
Curry
Williams
Mayes

4. Set Intersection (∩):

- Suppose there are two tuples R and S. The set intersection operation contains all tuples that are in both R & S.
- It is denoted by intersection ∩.

Notation: R ∩ S

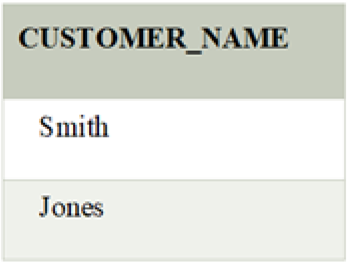
Example:

Using the above DEPOSITOR table and BORROW table

Input:

∏ CUSTOMER_NAME (BORROW) ∩ ∏ CUSTOMER_NAME (DEPOSITOR)

Output:



CUSTOMER_NAME
Smith
Jones

5. Set Difference (-):

- Suppose there are two tuples R and S. The set intersection operation contains all tuples that are in R but not in S.
- It is denoted by intersection minus (-).

Notation: R - S

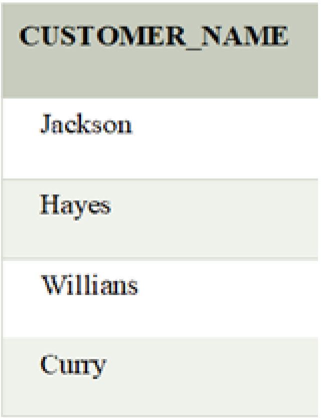
Example:

Using the above DEPOSITOR table and BORROW table

Input:

∏ CUSTOMER_NAME (BORROW) - ∏ CUSTOMER_NAME (DEPOSITOR)

Output:



CUSTOMER_NAME
Jackson
Hayes
Willians
Curry

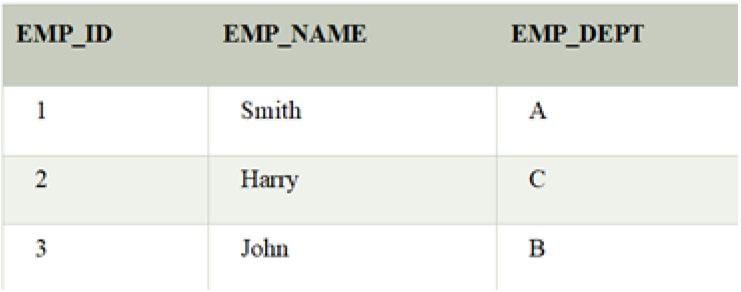
6. Cartesian product (X)

- The Cartesian product is used to combine each row in one table with each row in the other table. It is also known as a cross product.
- It is denoted by X.

Notation: E X D

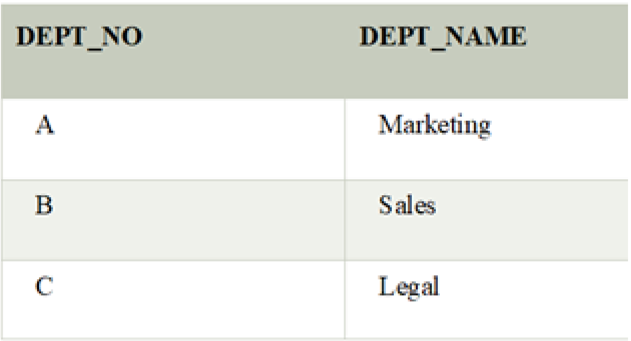
Example:

EMPLOYEE



EMP_ID	EMP_NAME	EMP_DEPT
1	Smith	A
2	Harry	C
3	John	B

DEPARTMENT

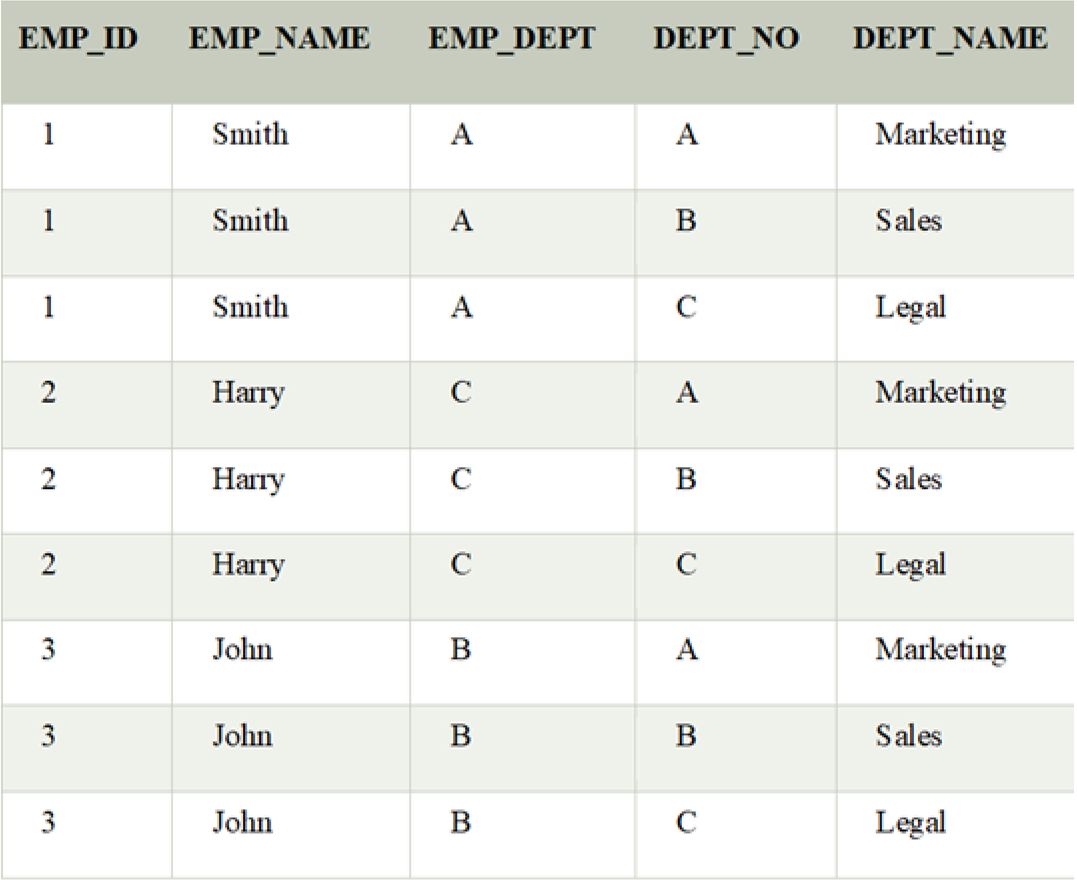


DEPT_NO	DEPT_NAME
A	Marketing
B	Sales
C	Legal

Input:

EMPLOYEE X DEPARTMENT

Output:



EMP_ID	EMP_NAME	EMP_DEPT	DEPT_NO	DEPT_NAME
1	Smith	A	A	Marketing
1	Smith	A	B	Sales
1	Smith	A	C	Legal
2	Harry	C	A	Marketing
2	Harry	C	B	Sales
2	Harry	C	C	Legal
3	John	B	A	Marketing
3	John	B	B	Sales
3	John	B	C	Legal

7. Rename Operation (ρ):

The rename operation is used to rename the output relation. It is denoted by **rho** (ρ).

Example: We can use the rename operator to rename STUDENT relation to STUDENT1.

ρ(STUDENT1, STUDENT)

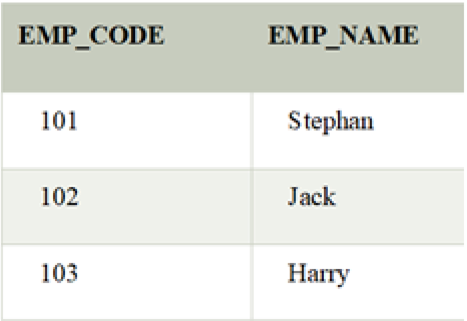
DERIVED OPERATIONS

Join Operations:

A Join operation combines related tuples from different relations, if and only if a given join condition is satisfied. It is denoted by ⋈.

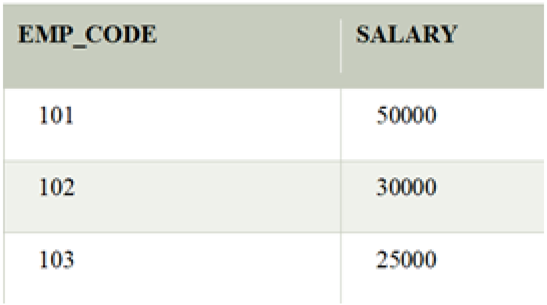
Example:

EMPLOYEE



EMP_CODE	EMP_NAME
101	Stephan
102	Jack
103	Harry

SALARY

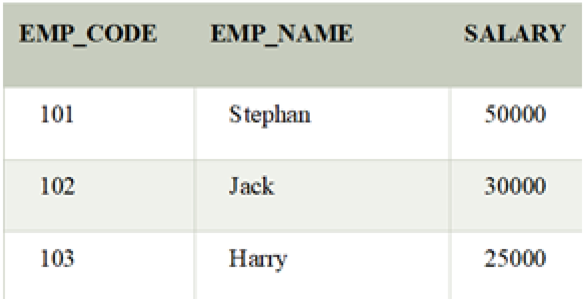


EMP_CODE	SALARY
101	50000
102	30000
103	25000

Operation:

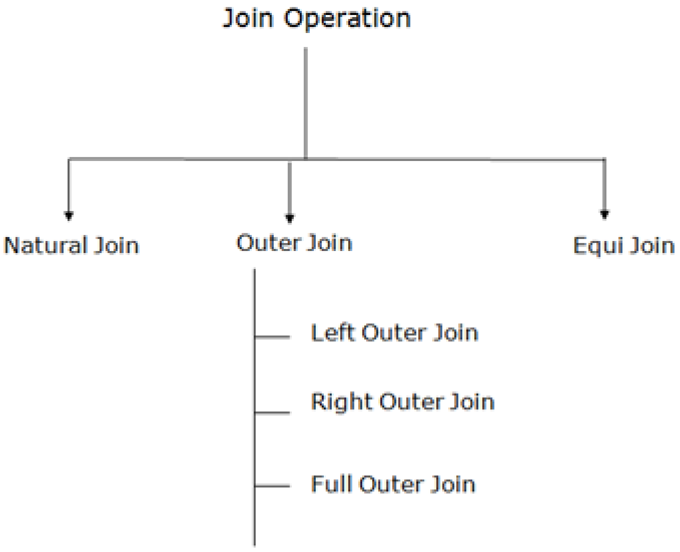
(EMPLOYEE ⋈ SALARY)

Result:



EMP_CODE	EMP_NAME	SALARY
101	Stephan	50000
102	Jack	30000
103	Harry	25000

Types of Join operations:



1. Natural Join:

- A natural join is the set of tuples of all combinations in R and S that are equal on their common attribute names.
- It is denoted by ⋈.

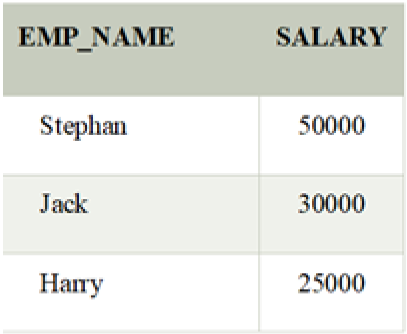
Example:

Let's use the above EMPLOYEE table and SALARY table:

Input:

∏EMP_NAME, SALARY (EMPLOYEE ⋈ SALARY)

Output:



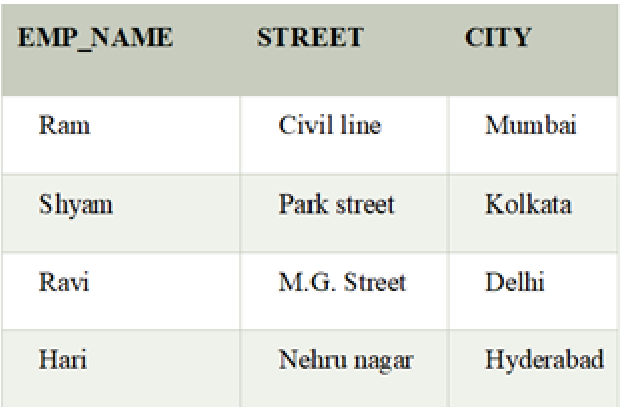
EMP_NAME	SALARY
Stephan	50000
Jack	30000
Harry	25000

2. Outer Join:

The outer join operation is an extension of the join operation. It is used to deal with missing information.

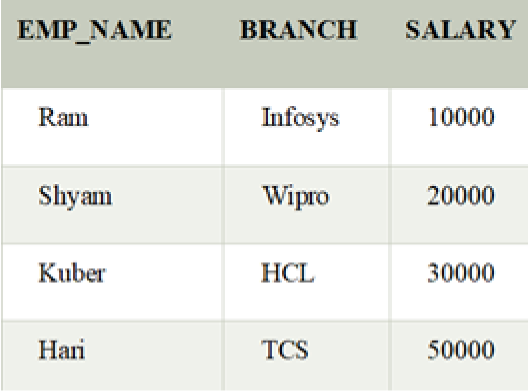
Example:

EMPLOYEE



EMP_NAME	STREET	CITY
Ram	Civil line	Mumbai
Shyam	Park street	Kolkata
Ravi	M.G. Street	Delhi
Hari	Nehru nagar	Hyderabad

FACT_WORKERS

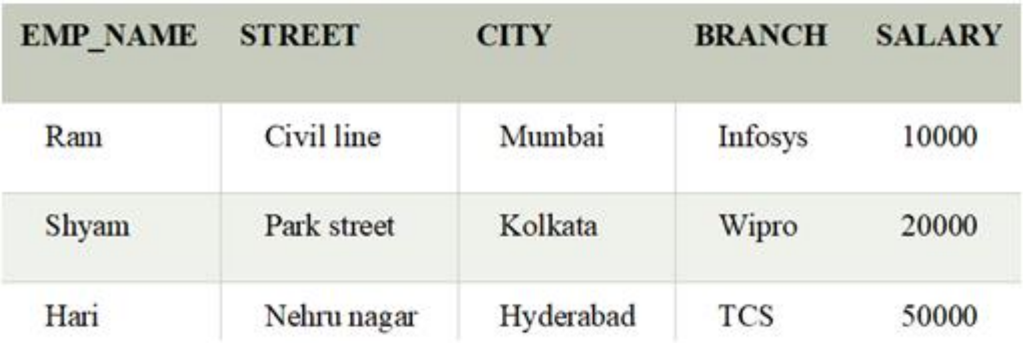


EMP_NAME	BRANCH	SALARY
Ram	Infosys	10000
Shyam	Wipro	20000
Kuber	HCL	30000
Hari	TCS	50000

Input:

(EMPLOYEE ⋈ FACT_WORKERS)

Output:



EMP_NAME	STREET	CITY	BRANCH	SALARY
Ram	Civil line	Mumbai	Infosys	10000
Shyam	Park street	Kolkata	Wipro	20000
Hari	Nehru nagar	Hyderabad	TCS	50000

An outer join is basically of three types:

1. Left outer join
2. Right outer join
3. Full outer join

a. Left outer join:

- Left outer join contains the set of tuples of all combinations in R and S that are equal on their common attribute names.
- In the left outer join, tuples in R have no matching tuples in S.
- It is denoted by ⟕

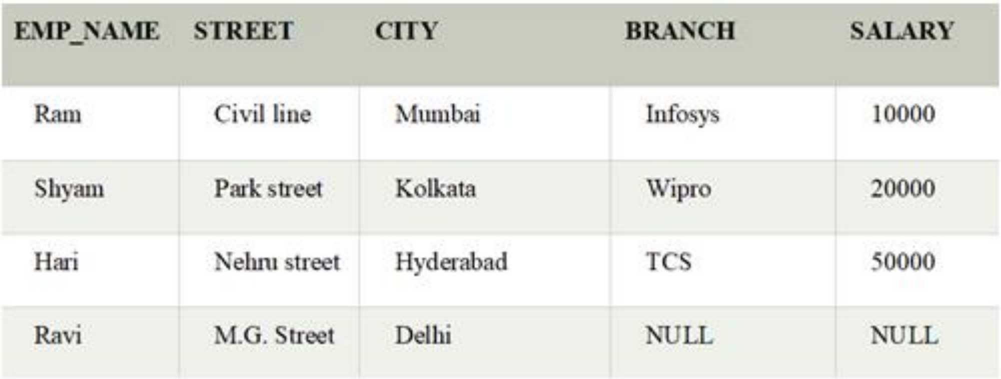
Example:

Using the above EMPLOYEE table and FACT_WORKERS table

Input:

EMPLOYEE ⟕FACT_WORKERS

Output:



EMP_NAME	STREET	CITY	BRANCH	SALARY
Ram	Civil line	Mumbai	Infosys	10000
Shyam	Park street	Kolkata	Wipro	20000
Hari	Nehru street	Hyderabad	TCS	50000
Ravi	M.G. Street	Delhi	NULL	NULL

b. Right outer join:

- Right outer join contains the set of tuples of all combinations in R and S that are equal on their common attribute names.
- In right outer join, tuples in S have no matching tuples in R.
- It is denoted by ⟖

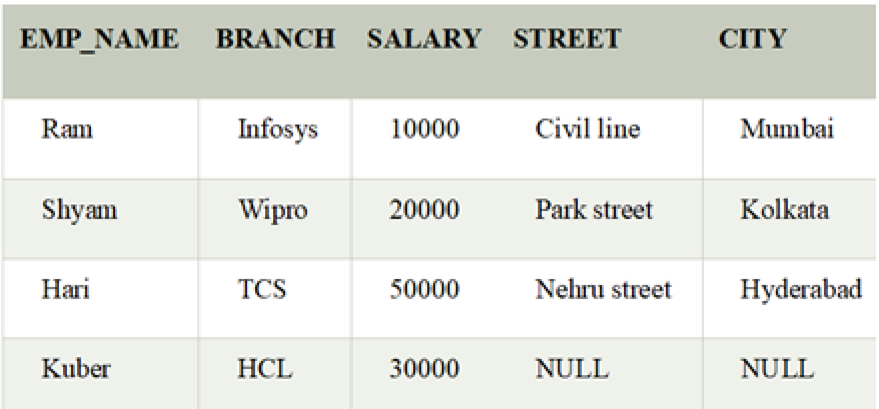
Example:

Using the above EMPLOYEE table and FACT_WORKERS Relation

Input:

EMPLOYEE ⟖FACT_WORKERS

Output:



EMP_NAME	BRANCH	SALARY	STREET	CITY
Ram	Infosys	10000	Civil line	Mumbai
Shyam	Wipro	20000	Park street	Kolkata
Hari	TCS	50000	Nehru street	Hyderabad
Kuber	HCL	30000	NULL	NULL

c. Full outer join:

- Full outer join is like a left or right join except that it contains all rows from both tables.
- In full outer join, tuples in R that have no matching tuples in S and tuples in S that have no matching tuples in R in their common attribute name.
- It is denoted by ⟗

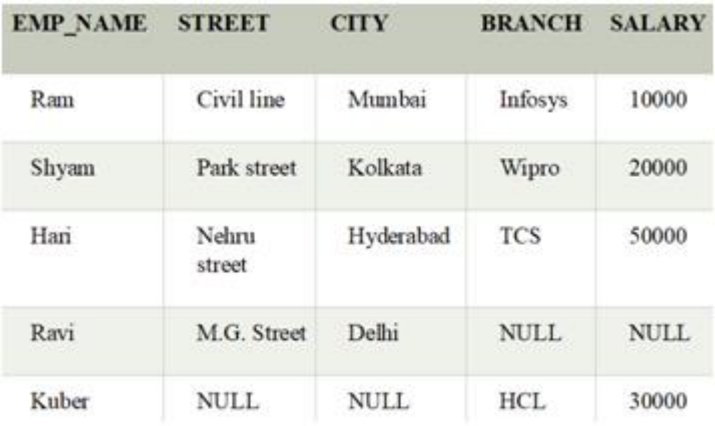
Example:

Using the above EMPLOYEE table and FACT_WORKERS table

Input:

EMPLOYEE ⟗FACT_WORKERS

Output:



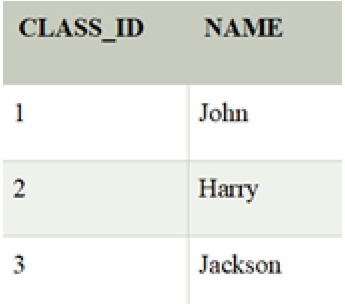
EMP_NAME	STREET	CITY	BRANCH	SALARY
Ram	Civil line	Mumbai	Infosys	10000
Shyam	Park street	Kolkata	Wipro	20000
Hari	Nehru street	Hyderabad	TCS	50000
Ravi	M.G. Street	Delhi	NULL	NULL
Kuber	NULL	NULL	HCL	30000

3. Equi join:

It is also known as an inner join. It is the most common join. It is based on matched data as per the equality condition. The equi join uses the comparison operator(=).

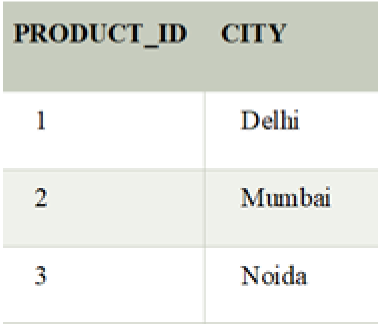
Example:

CUSTOMER RELATION



CLASS_ID	NAME
1	John
2	Harry
3	Jackson

PRODUCT

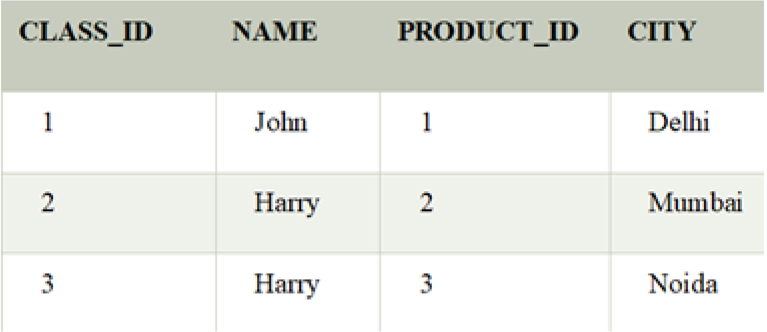


PRODUCT_ID	CITY
1	Delhi
2	Mumbai
3	Noida

Input:

CUSTOMER ⋈ PRODUCT

Output:



CLASS_ID	NAME	PRODUCT_ID	CITY
1	John	1	Delhi
2	Harry	2	Mumbai
3	Harry	3	Noida