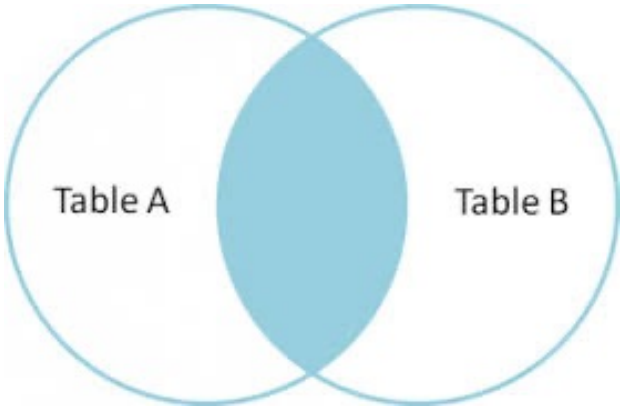
Relational Algebra Operations
Natural Join / Inner Join

Natural Join / Inner Join

- Symbol: ⋈
- Notation: *Relation-1 (R1)* ⋈ *Relation-2 (R2)* **OR** *Algebra-1* ⋈ *Algebra-2*
- Operation: Natural join will **retrieve consistent data** from multiple relations.
  - It **combines records** from different relations that **satisfy a given condition**.

Steps performed in Natural Join	
Steps	**Description**
Step – 1	It performs Cartesian Product
Step – 2	Then it deletes inconsistent tuples
Step – 3	Then it removes an attribute from duplicate attributes



Natural Join / Inner Join Example

Example Perform Natural Join between Student and Result.

Answer (Student) ⋈ (Result)

Student

RNo	Name	Branch
101	Raju	CE
102	Mitesh	ME

Result

RNo	SPI
101	8
103	9

Output

RNo	Name	Branch	SPI
101	Raju	CE	8

To perform a Natural Join there must be **one common attribute (column)** between two relations.

Steps performed in Natural Join

Step:1 Perform Cross Product

Student.RNo	Name	Branch	Result.RNo	SPI
101	Raju	CE	101	8
101	Raju	CE	103	9
102	Mitesh	ME	101	8
102	Mitesh	ME	103	9

Step:2 Removes inconsistent tuples

Student.RNo	Name	Branch	Result.RNo	SPI
101	Raju	CE	101	8

Step:3 Removes an attribute from duplicate

RNo	Name	Branch	SPI
101	Raju	CE	8

Natural Join / Inner Join Example

Example Perform Natural Join between Branch and Faculty.

Answer (Branch) ⋈ (Faculty)

Branch

BID	BName	HOD
1	CE	Shah
2	ME	Patel

Faculty

FID	FName	BID
101	Raj	1
103	Meet	2

Output

BID	Bname	HOD	FID	FName
1	CE	Shah	101	Raj
2	ME	Patel	103	Meet

To perform a Natural Join there must be **one common attribute (column)** between two relations.

Write down query for the following tables/relations

- Relations
  - Student (Rno, Sname, Address, City, Mobile)
  - Department (Did, Dname)
  - Academic (Rno, Did, SPI, Backlog)
  - Guide (Rno, PName, Fid)
  - Faculty (Fid, Fname, Subject, Did, Salary)

Example List the name of students with their department name and SPI of all student belong to "CE" department.

Answer $\prod_{Sname,\ Dname,\ SPI} (\sigma_{Dname='CE'} (Student \bowtie (Department \bowtie Academic)))$

Example Display the name of students with their project name whose guide is "A. J. Shah".

Answer $\prod_{Sname,\ Pname} (\sigma_{Fname='A.J.Shah'} (Student \bowtie (Guide \bowtie Faculty)))$

Exercise: Write down relational algebra for the following tables/relations

- Relations
  - Student (Rno, Sname, Address, City, Mobile)
  - Department (Did, Dname)
  - Academic (Rno, Did, SPI, CPI, Backlog)
  - Guide (Rno, PName, Fid)
  - Faculty (Fid, Fname, Subject, Did, Salary)
- List the name of students with their department name having backlog 0.
- List the name of faculties with their department name and salary having salary more than 25000 and belongs to “CE” department.
- List the name of all faculties of “CE” and “ME” department whose salary is more than 50000.
- Display the students name with their project name of all “CE” department’s students whose guide is “Z.Z. Patel”.
- Display the name of faculties with their department name who belongs to “CE” department and tough “CPU” subject having salary more than 25000.
- List the name of students with their department name doing project “Hackathon” under guide “I. I. Shah”.

Relational Algebra Operations
Outer Join

Outer Join

- In **natural join some records are missing**, if we **want that missing records** than we have to **use outer join**.

Three types of Outer Join		
Sr.	**Outer Join**	**Symbol**
1.	Left Outer Join	
2.	Right Outer Join	
3.	Full Outer Join	

To perform a Outer Join there must be **one common attribute (column)** between two relations.

Left Outer Join

- Symbol: $\overset{\text{L}}{\bowtie}$
- Notation: *Relation-1 (R1)* $\overset{\text{L}}{\bowtie}$ *Relation-2 (R2)* **OR** *Algebra-1* $\overset{\text{L}}{\bowtie}$ *Algebra-2*
- Operation:
  - Display **all the tuples of the left relation** even through there is no matching tuple in the right relation.
  - For such kind of **tuples having no matching**, the attributes of right relation will be **padded with NULL** in resultant relation.

Example Perform Left Outer Join between Student and Result.

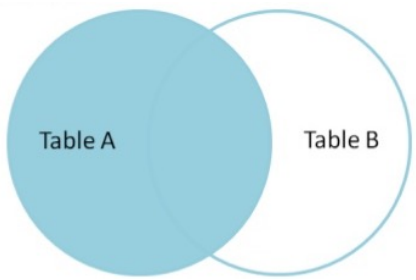
Answer (Student) $\overset{\text{L}}{\bowtie}$ (Result)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI
101	8
103	9



Output

RollNo	Name	Branch	SPI
101	Raj	CE	8
102	Meet	ME	NULL

Exercise What is the output of (Result) $\overset{\text{L}}{\bowtie}$ (Student).

Left Outer Join Example

Example Perform Left Outer Join between Student and Result. (Display RollNo, Name and SPI)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI	BL
101	8	1
103	9	0

Answer $\Pi_{RollNo,\ Name,\ SPI}$ ((Student) $\overrightarrow{\bowtie}$ (Result))

Output

RollNo	Name	SPI
101	Raj	8
102	Meet	**NULL**

Right Outer Join

- Symbol: ⟖
- Notation: *Relation-1 (R1)* ⟖ *Relation-2 (R2)* **OR** *Algebra-1* ⟖ *Algebra-2*
- Operation:
  - Display **all the tuples of right relation** even through there is no matching tuple in the left relation.
  - For such kind of **tuples having no matching**, the attributes of left relation will be **padded with NULL** in resultant relation.

Example Perform Right Outer Join between Student and Result.

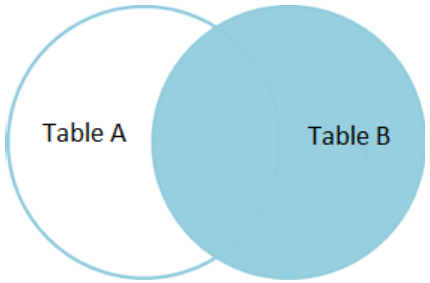
Answer (Student) ⟖ (Result)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI
101	8
103	9



Output

RollNo	Name	Branch	SPI
101	Raj	CE	8
103	**NULL**	**NULL**	9

Exercise What is the output of (Result) ⟖ (Student).

Right Outer Join Example

Example Perform Right Outer Join between Student and Result. (Display RollNo, Name and SPI)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI	BL
101	8	1
103	9	0

Answer $\Pi_{RollNo, Name, SPI}$ ((Student) $\bowtie$ (Result))

Output

RollNo	Name	SPI
101	Raj	8
103	**NULL**	9

Full Outer Join

- Symbol: ⟗
- Notation: *Relation-1 (R1)* ⟗ *Relation-2 (R2)* **OR** *Algebra-1* ⟗ *Algebra-2*
- Operation:
  - Display **all the tuples of both of the relations**. It also pads null values whenever required. (Left outer join + Right outer join)
  - For such kind of **tuples having no matching**, it will be **padded with NULL** in resultant relation.

Example Perform Full Outer Join between Student and Result.

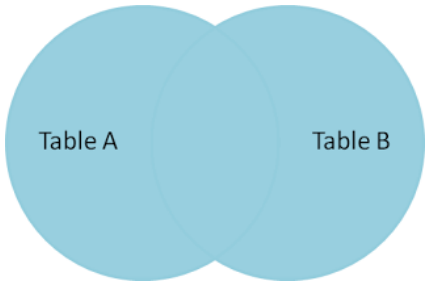
Answer (Student) ⟗ (Result)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI
101	8
103	9



Output

RollNo	Name	Branch	SPI
101	Raj	CE	8
102	Meet	ME	**NULL**
103	**NULL**	**NULL**	9

Exercise What is the output of (Result) ⟗ (Student).

Full Outer Join Example

Example Perform Full Outer Join between Student and Result. (Display RollNo, Name and SPI)

Student

RollNo	Name	Branch
101	Raj	CE
102	Meet	ME

Result

RollNo	SPI	BL
101	8	1
103	9	0

Answer $\Pi_{RollNo,\ Name,\ SPI}$ ((Student) $\overline{\bowtie}$ (Result))

Output

RollNo	Name	SPI
101	Raj	8
102	Meet	**NULL**
103	**NULL**	9