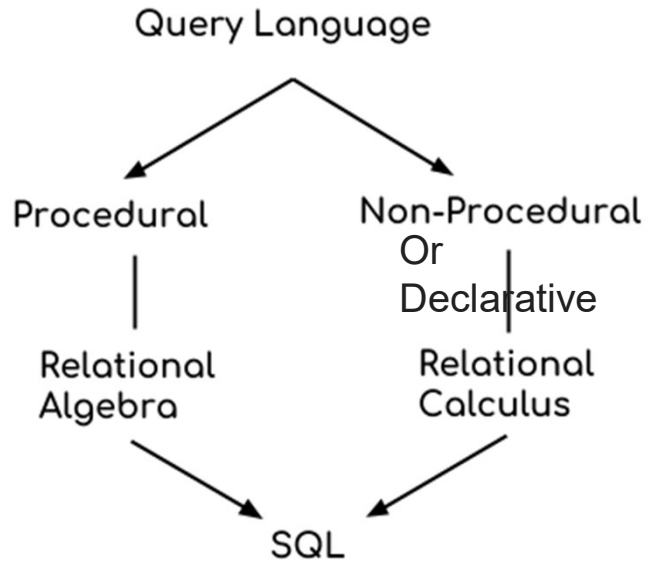
Relational Query Languages

Query language is a language which is used to retrieve information from a database.



Procedural: Information is retrieved from the database by specifying the sequence of operations to be performed.

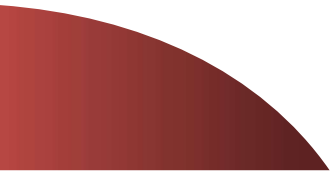
Non-procedural: Information is retrieved from the database without specifying the sequence of operation to be performed. Users only specify what information is to be retrieved.

Relational calculus is a non-procedural query language in which information is retrieved from the database without specifying sequence of operation to be performed.

Relational calculus is of two types which are as follows −

- Tuple calculus
- Domain calculus

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.

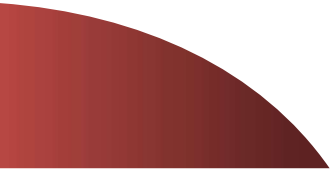
Relational algebra consists of a set of operations that take one or two relations as an input and produces a new relation as output.

The query language ‘Relational Algebra’ defines a set of operations on relations.

Users tell what data to be retrieved from database and how to retrieve it.

It uses operators to perform queries. An operator can be either **unary** or **binary**.

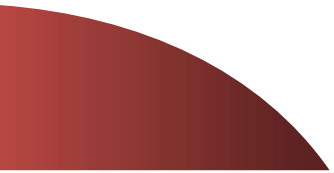
Relational Algebra Operations



Operator	Description
Selection (Unary)	Display particular rows/records/tuples from a relation
Projection (Unary)	Display particular columns from a relation
Joins	Combine data or records from two or more tables 1. Natural Join / Inner Join 2. Outer Join 1. Left Outer Join 2. Right Outer Join 3. Full Outer Join
Cross Product	Multiply each tuples of both relations
Set Operators	Combine the results of two queries into a single result. 1. Union 2. Intersection 3. Minus / Set-difference
Division	Divides one relation by another
Rename (Unary)	Rename a column or a table

Relational Algebra Operations

Selection Operator



Selection Operator

- Symbol: σ (Sigma)
- Notation: $\sigma_{condition}$ (Relation)
- Operation: **Selects tuples** from a relation that **satisfy a given condition**.
- Operators: =, <> (≠), <, >, <=, >=, Λ (AND), V (OR)

Example Display the detail of students belongs to "CE" Branch.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	9

Answer $\sigma_{Branch='CE'}$ (Student)

Output

RollNo	Name	Branch	SPI
101	Raju	CE	8
104	Meet	CE	9

Selection Operator [$\sigma_{condition}$ (Relation)]

Example Display the detail of students belongs to "CE" Branch and having SPI more than 8.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	9

Answer $\sigma_{Branch='CE' \wedge SPI>8}$ (Student)

Output

RollNo	Name	Branch	SPI
104	Meet	CE	9

Selection Operator [$\sigma_{condition}$ (Relation)]

Example Display the detail of students belongs to either “CI” or “ME” Branch.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	9

Answer $\sigma_{Branch='CI' \ V \ Branch='ME'}$ (Student)

Output

RollNo	Name	Branch	SPI
102	Mitesh	ME	9
103	Nilesh	CI	9

Selection Operator [$\sigma_{condition}$ (Relation)]

Example Display the detail of students whose SPI between 7 and 9.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	9

Answer $\sigma_{SPI>7 \wedge SPI<9}$ (Student)

Output

RollNo	Name	Branch	SPI
101	Raju	CE	8

Exercise

- Write down the relational algebra for the student table.
  - Display the detail of students whose RollNo is less than 104.
  - Display the detail of students having SPI more than 8.
  - Display the detail of students belongs to “CE” Branch having SPI less than 8.
  - Display the detail of students belongs to either “CE” or “ME” Branch.
  - Display the detail of students whose SPI between 6 and 9.

Student

RollNo	Name	Branch	SPI
101	Raj	CE	6
102	Meet	ME	8
103	Harsh	EE	7
104	Punit	CE	9

- Write down the relational algebra for the employee table.
  - Display the detail of all employee.
  - Display the detail of employee whose Salary more than 10000.
  - Display the detail of employee belongs to “HR” Dept having Salary more than 20000.
  - Display the detail of employee belongs to either “HR” or “Admin” Dept.
  - Display the detail of employee whose Salary between 10000 and 25000 and belongs to “HR” Dept.

Employee

EmpID	Name	Dept	Salary
101	Nilesh	Sales	10000
102	Mayur	HR	25000
103	Hardik	HR	15000
104	Ajay	Admin	20000

Relational Algebra Operations
Projection Operator

Projection Operator

- Symbol: ∏ (Pi)
- Notation: ∏ *attribute set* (Relation)
- Operation: **Selects specified attributes** of a relation.
- It **removes duplicate tuples** (records) from the result.

Example Display RollNo, Name and Branch of all students. **Answer** ∏ *RollNo, Name, Branch* (Student)

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	9

Output

RollNo	Name	Branch
101	Raju	CE
102	Mitesh	ME
103	Nilesh	CI
104	Meet	CE

Exercise

- Write down the relational algebra for the student table.
  - Display RollNo, Name and SPI of all students.
  - Display Name and SPI of all students.
  - Display the Name of all students.
  - Display the Name of all branches.

Student

RollNo	Name	Branch	SPI
101	Raj	CE	6
102	Meet	ME	8
103	Harsh	EE	7
104	Punit	CE	9

- Write down the relational algebra for the employee table.
  - Display EmpID with Name of all employee.
  - Display Name and Salary of all employee.
  - Display the Name of all employee.
  - Display the Name of all departments.

Employee

EmpID	Name	Dept	Salary
101	Nilesh	Sales	10000
102	Mayur	HR	25000
103	Hardik	HR	15000
104	Ajay	Admin	20000

Combined Projection & Selection Operation

Example Display RollNo, Name & Branch of "ME" Branch students.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	7

What if $\sigma_{Branch='ME'}(\prod_{RollNo,\ Name,\ Branch}(Student))$

Although it will give same result
But It is not applicable in all scenarios

Step-1 $\sigma_{Branch='ME'}(Student)$

Output-1

RollNo	Name	Branch	SPI
102	Mitesh	ME	9

Answer $\prod_{RollNo,\ Name,\ Branch}(\sigma_{Branch='ME'}(Student))$

Output-2

RollNo	Name	Branch
102	Mitesh	ME

Combined Projection & Selection Operation

Example Display Name of all students from "ME" Branch.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	7

What if $\sigma_{Branch='ME'}(\prod_{Name}(Student))$ 

You can't apply the condition further!

Name
Raju
Mitesh
Nilesh
Meet

Step-1 $\sigma_{Branch='ME'}(Student)$

Output-1

RollNo	Name	Branch	SPI
102	Mitesh	ME	9

Answer $\prod_{Name}(\sigma_{Branch='ME'}(Student))$

Output-2

Name
Mitesh

Combined Projection & Selection Operation

Example Display Name, Branch and SPI of students whose SPI is more than 8.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	7

Step-1 $\sigma_{SPI>8}$ (Student)

Output-1

RollNo	Name	Branch	SPI
102	Mitesh	ME	9
103	Nilesh	CI	9

Answer $\prod_{Name, Branch, SPI} (\sigma_{SPI>8}$ (Student))

Output-2

Name	Branch	SPI
Mitesh	ME	9
Nilesh	CI	9

Combined Projection & Selection Operation

Example Display Name, Branch and SPI of students who belongs to "CE" Branch and SPI is more than 7.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	7

Step-1 $\sigma_{Branch='CE' \wedge SPI>7}$ (Student)

Output-1

RollNo	Name	Branch	SPI
101	Raju	CE	8

Answer $\prod_{Name, Branch, SPI} (\sigma_{Branch='CE' \wedge SPI>7}$ (Student))

Output-2

Name	Branch	SPI
Raju	CE	8

Combined Projection & Selection Operation

Example Display Name of students along with their Branch who belong to either "ME" Branch or "CI" Branch.

Student

RollNo	Name	Branch	SPI
101	Raju	CE	8
102	Mitesh	ME	9
103	Nilesh	CI	9
104	Meet	CE	7

Step-1 $\sigma_{Branch='ME' \ V \ Branch='CI'}$ (Student)

Output-1

RollNo	Name	Branch	SPI
102	Mitesh	ME	9
103	Nilesh	CI	9

Answer $\prod_{Name,\ Branch}$ ($\sigma_{Branch='ME' \ V \ Branch='CI'}$ (Student))

Output-2

Name	Branch
Mitesh	ME
Nilesh	CI

Exercise

- Write down the relational algebra for the student table.
  - Display Rollno, Name and SPI of all students belongs to “CE” Branch.
  - List the Name of students with their Branch whose SPI is more than 8 and belongs to “CE” Branch.
  - List the Name of students along with their Branch and SPI who belongs to either “CE” or “ME” Branch and having SPI more than 8.
  - Display the Name of students with their Branch name whose SPI between 7 and 9.

Student

RollNo	Name	Branch	SPI
101	Raj	CE	6
102	Meet	ME	8
103	Harsh	EE	7
104	Punit	CE	9

- Write down the relational algebra for the employee table.
  - Display the Name of employee belong to “HR” Dept and having salary more than 20000.
  - Display the Name of all “Admin” and “HR” Dept’s employee.
  - List the Name of employee with their Salary who belongs to “HR” or “Admin” Dept having salary more than 15000.
  - Display the Name of employee along with their Dept name whose salary between 15000 and 30000.

Employee

EmpID	Name	Dept	Salary
101	Nilesh	Sales	10000
102	Mayur	HR	25000
103	Hardik	HR	15000
104	Ajay	Admin	20000

Relational Algebra Operations

Cartesian Product / Cross Product

Cartesian Product / Cross Product

- Symbol: X (Cross)
- Notation: *Relation-1 (R1)* X *Relation-2 (R2)* **OR** *Algebra-1* X *Algebra-2*
- Operation: It will **multiply each tuples** of Relation-1 to each tuples of Relation-2.
  - Attributes of Resultant Relation = Attributes of R1 + Attributes of R2
  - Tuples of Resultant Relation = Tuples of R1 * Tuples of R2

Example Perform Cross Product between Student and Result. **Answer** (Student) X (Result)

Student

RNo	Name	Branch
101	Raju	CE
102	Mitesh	ME

Result

RNo	SPI
101	8
102	9

Output

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

If both relations have some attribute with the same name, it can be distinguished by combing **relation-name.attribute-name**.

Cartesian Product / Cross Product Example

Example Perform Cross Product between Student and Result.

Consider only selected attributes
- Student – RNo, Name and Branch
- Result – RNo, SPI and BL

Student

RNo	Name	Branch	Sem
101	Raju	CE	3
102	Mitesh	ME	5

Result

RNo	SPI	BL	Rank
101	8	1	2
103	9	0	1

Answer $\prod_{RNo,\ Name,\ Branch}$ (Student) X $\prod_{RNo,\ SPI,\ BL}$ (Result)

Output

Student.RNo	Name	Branch	Result.RNo	SPI	BL
101	Raju	CE	101	8	1
101	Raju	CE	103	9	0
102	Mitesh	ME	101	8	1
102	Mitesh	ME	103	9	0

Cartesian Product / Cross Product Example

Example Perform Cross Product between Student and Result.

Consider only selected tuples
- Student – Branch='CE' and Sem=3
- Result – SPI>7 and BL<1

Student

RNo	Name	Branch	Sem
101	Raju	CE	3
102	Mitesh	ME	5
103	Om	CE	3
104	Dhara	CE	5

Result

RNo	SPI	BL	Rank
101	8	1	2
103	9	0	1
105	7	2	3

Answer $\sigma_{Branch='CE' \wedge Sem=3}$ (Student) X $\sigma_{SPI>7 \wedge BL<1}$ (Result)

Output

:.RNo	Name	Branch	Sem	Result.RNo	SPI	BL	Rank
101	Raju	CE	3	103	9	0	1
103	OM	CE	3	103	9	0	1