Introduction to Relational Algebra

Title:
What is Relational Algebra?

Content:

- A procedural query language used to query relational databases.
- Operates on **relations** (tables) and produces new relations as results.
- It serves as the theoretical foundation for SQL.

Key Points:

- Composed of a set of operators.
- Provides a formal framework for manipulating relational data.

Basic Operators in Relational Algebra

Title:
Basic Operators

Content:

- **Selection (σ):**
  Filters rows based on a condition.

- **Projection (π):**
  Extracts specific columns.

- **Union (∪):**
  Combines results of two relations, removing duplicates.

- **Set Difference (−):**
  Returns rows in the first relation but not in the second.

- **Cartesian Product (×):**
  Combines every row of one relation with every row of another.

Selection (σ) Operator

Title:
Selection Operator (σ)

Content:

- **Definition:**
  Filters rows based on a condition (predicate).

- **Syntax:**
  σ_condition(Relation)

- **Example:** σ_age > 30(Employees)

- **Result:**
  Returns all employees older than 30 years.

Projection (π) Operator

Title:
Projection Operator (π)

Content:

- **Definition:**
  Extracts specific columns from a relation.

- **Syntax:**
  π_column1, column2, ...(Relation)

- **Example:** π_name, salary(Employees)

- **Result:**
  Returns the names and salaries of all employees.

Union (∪) Operator

Title:
Union Operator (∪)

Content:

- **Definition:**
  Combines two relations that have the same set of attributes, eliminating duplicates.

- **Syntax:**
  Relation1 ∪ Relation2

- **Example:** Employees ∪ Contractors

- **Result:**
  Returns all unique rows from both employees and contractors.

Set Difference (−) Operator

Title:
Set Difference Operator (−)

Content:

- **Definition:**
  Returns rows in the first relation but not in the second.

- **Syntax:**
  Relation1 − Relation2

- **Example:** Employees − RetiredEmployees

- **Result:**
  Returns all employees who are not retired.

Cartesian Product (×) Operator

Title:
Cartesian Product Operator (×)

Content:

- **Definition:**
  Combines each row of one relation with each row of another.

- **Syntax:**
  Relation1 × Relation2

- **Example:** Employees × Departments

- **Result:**
  Returns every combination of an employee with a department.

Advanced Operators in Relational Algebra

Title:
Advanced Operators

Content:

- **Rename (ρ):**
  Renames attributes or relations.

- **Intersection (∩):**
  Finds common rows between two relations (also can be written as (Relation1 − (Relation1 − Relation2))).

- **Join (⋈):**
  Combines rows from two relations based on a condition (like matching keys).

Join (⋈) Operator

Title:
Join Operator (⋈)

Content:

- **Definition:**
  Combines two relations based on a matching condition, typically using a foreign key relationship.

- **Syntax:**
  Relation1 ⋈ Condition Relation2

- **Example:** Employees ⋈ Employees.DepartmentID = Departments.DepartmentID Departments

- **Result:**
  Returns a combined relation of employees with their respective departments.

Conclusion

Title:
Summary of Relational Algebra

Content:

- Relational Algebra is foundational in querying relational databases.
- It uses a small set of powerful operators to perform operations on data.
- Each operator can be combined to create complex queries.

Takeaway:
It serves as the basis for SQL and offers a formal method for database manipulation.
