PostgreSQL

References

- W3Schools

Tools needed

- PostgreSQL
- DBeaver
- Installation

Tutorial

Introduction

- **Definition**: PostgreSQL is an **open-source relational database management system** (RDBMS) that uses and extends SQL for querying and managing data.

- **Key Features**:

  - Stores data in **tables** (rows & columns).
  - Supports **SQL** (Structured Query Language).
  - Allows **advanced data types** (JSON, arrays, etc.).
  - Can handle **complex queries** and **large datasets**.
  - Supports **transactions** with ACID compliance (Atomicity, Consistency, Isolation, Durability).

- **Cross-platform**: Works on Windows, macOS, Linux.

- **Example**:

  ```
  SELECT version();
  ```

  Returns the installed PostgreSQL version.

psql Shell

- **Definition**: A **command-line tool** for interacting with PostgreSQL databases.

- **Usage**:

  - Connect to a database.
  - Run SQL commands directly.
  - Manage users, databases, and permissions.

- **Start**:

1. Open terminal / command prompt.
2. Type `psql -U username -d dbname` (replace with your details).

- **Example**:

```
\l        -- list all databases
\c test   -- connect to 'test' database
SELECT * FROM employees;
```

pgAdmin

- **Definition**: A **graphical user interface (GUI)** for managing PostgreSQL.
- **Usage**:
  - Create, edit, and delete databases using menus.
  - Write and run SQL queries in a built-in editor.
  - View tables, schemas, and query results visually.
- **When to use**: Easier for beginners or for database visualization compared to typing commands in psql.

CREATE TABLE

- **Definition**: SQL command used to **create a new table** in a PostgreSQL database.

- **Syntax**:

```
CREATE TABLE table_name (
    column1 datatype constraints,
    column2 datatype constraints,
    ...
);
```

- **Notes**:

  - **datatype**: Defines the type of data (e.g., `INTEGER`, `TEXT`, `DATE`).
  - **constraints**: Rules like `PRIMARY KEY`, `NOT NULL`, `UNIQUE`.

- **Example**:

```
CREATE TABLE employees (
    id SERIAL PRIMARY KEY,
    name TEXT NOT NULL,
    salary NUMERIC(8,2),
    hire_date DATE
);
```

- **Result**: Creates a table named **employees** with 4 columns.

INSERT INTO

- **Definition**: SQL command to **add new rows** (records) into a table.
- **Syntax (Single Row)**:

```sql
INSERT INTO table_name (column1, column2, ...)
VALUES (value1, value2, ...);
```

  - You can omit the column list if inserting values for **all columns in order**.

- **Example (Single Row)**:

```sql
INSERT INTO employees (name, salary, hire_date)
VALUES ('John Doe', 50000.00, '2025-08-11');
```

INSERT INTO (Multiple Rows)

- **Definition**: Insert **more than one row** in a single `INSERT` statement.
- **Syntax (Multiple Rows)**:

```sql
INSERT INTO table_name (column1, column2, ...)
VALUES
    (value1a, value2a, ...),
    (value1b, value2b, ...),
    (value1c, value2c, ...);
```

- **Example (Multiple Rows)**:

```sql
INSERT INTO employees (name, salary, hire_date)
VALUES
    ('Ali Hassan', 45000.00, '2025-08-11'),
    ('Sara Mohamed', 47000.00, '2025-08-11'),
    ('Omar Khaled', 52000.00, '2025-08-11');
```

- **Tip**: Use single quotes `' '` for text and dates, no quotes for numbers.

SELECT

- **Definition**: SQL command used to **retrieve data** from a table.

- **Syntax**:

  ```
  SELECT column1, column2, ...
  FROM table_name;
  ```

  - Use to select **all columns**.

- **Example 1** (specific columns):

  ```
  SELECT name, salary
  FROM employees;
  ```

- **Example 2** (all columns):

  ```
  SELECT *
  FROM employees;
  ```

- **Tip**: You can combine `SELECT` with other clauses like `WHERE`, `ORDER BY`, and `LIMIT` to filter and sort results.

ALTER TABLE

- **Definition**: SQL command used to **change the structure** of an existing table.
- **Common Uses**:

  1. **Add a column**

     ```
     ALTER TABLE table_name
     ADD column_name datatype;
     ```

     Example:

     ```
     ALTER TABLE employees
     ADD department TEXT;
     ```

  2. **Drop (remove) a column**

     ```
     ALTER TABLE table_name
     DROP COLUMN column_name;
     ```

Example:

```sql
ALTER TABLE employees
DROP COLUMN department;
```

3. **Rename a column**

```sql
ALTER TABLE table_name
RENAME COLUMN old_name TO new_name;
```

Example:

```sql
ALTER TABLE employees
RENAME COLUMN name TO full_name;
```

4. **Change a column's data type**

```sql
ALTER TABLE table_name
ALTER COLUMN column_name TYPE new_datatype;
```

Example:

```sql
ALTER TABLE employees
ALTER COLUMN salary TYPE NUMERIC(10,2);
```

UPDATE

- **Definition**: SQL command used to **modify existing rows** in a table.
- **Syntax**:

```sql
UPDATE table_name
SET column1 = value1, column2 = value2, ...
WHERE condition;
```

  - The `WHERE` clause specifies **which rows** to update.
  - Without `WHERE`, **all rows** will be updated.

- **Example 1** (update specific row):

```sql
UPDATE employees
SET salary = 60000.00
WHERE name = 'John Doe';
```

- **Example 2** (update multiple columns):

```sql
UPDATE employees
SET salary = 65000.00, department = 'IT'
WHERE id = 3;
```

- **Example 3** (update all rows – be careful):

```sql
UPDATE employees
SET department = 'General';
```

DELETE

- **Definition**: SQL command used to **remove rows** from a table.
- **Syntax**:

```sql
DELETE FROM table_name
WHERE condition;
```

  - The `WHERE` clause specifies **which rows** to delete.
  - Without `WHERE`, **all rows** will be deleted.

- **Example 1** (delete specific row):

```sql
DELETE FROM employees
WHERE id = 2;
```

- **Example 2** (delete based on condition):

```sql
DELETE FROM employees
WHERE salary < 40000.00;
```

- **Example 3** (delete all rows – be careful):

  ```sql
  DELETE FROM employees;
  ```

DROP TABLE

- **Definition**: SQL command used to **delete an entire table** and all of its data permanently.
- **Syntax**:

  ```sql
  DROP TABLE table_name;
  ```

- **Example**:

  ```sql
  DROP TABLE employees;
  ```

- **Notes**:
  - Once dropped, the table **cannot be recovered** unless you have a backup.
  - You can use `IF EXISTS` to avoid an error if the table does not exist:

    ```sql
    DROP TABLE IF EXISTS employees;
    ```

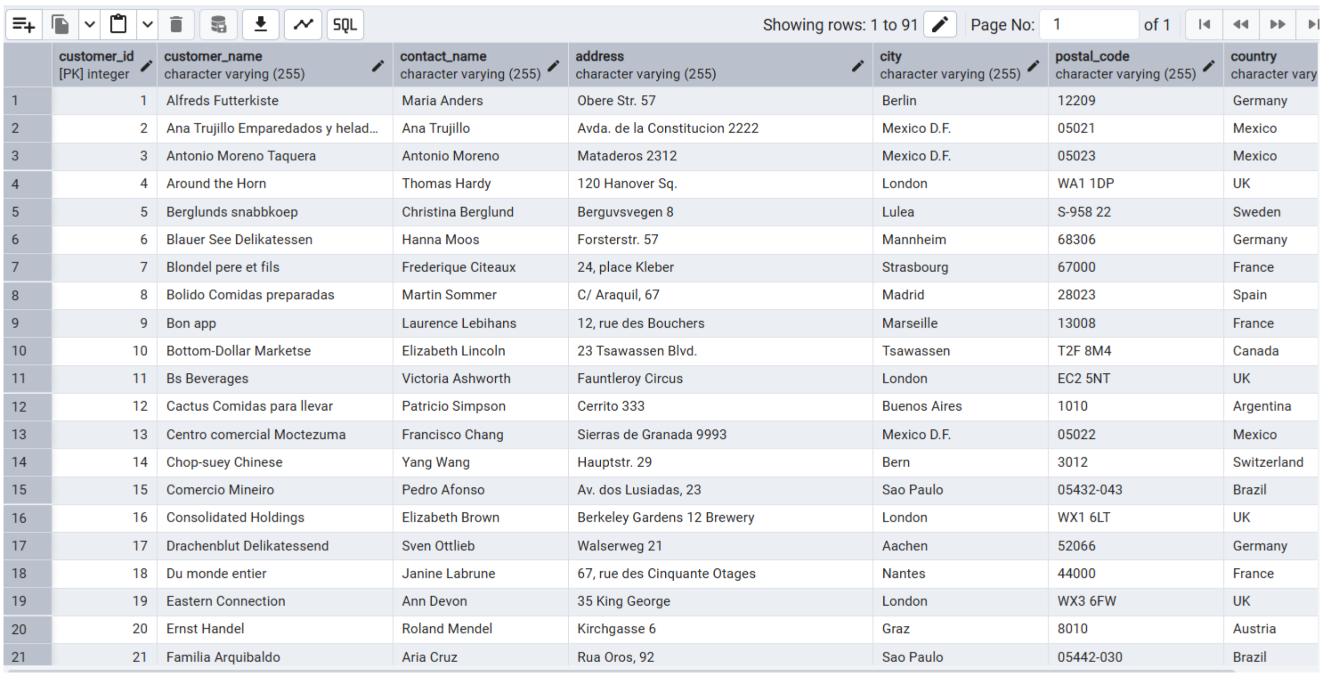
Example Database

you can find the database here

PostgreSQL - Create Demo Database

It contains the following tables:

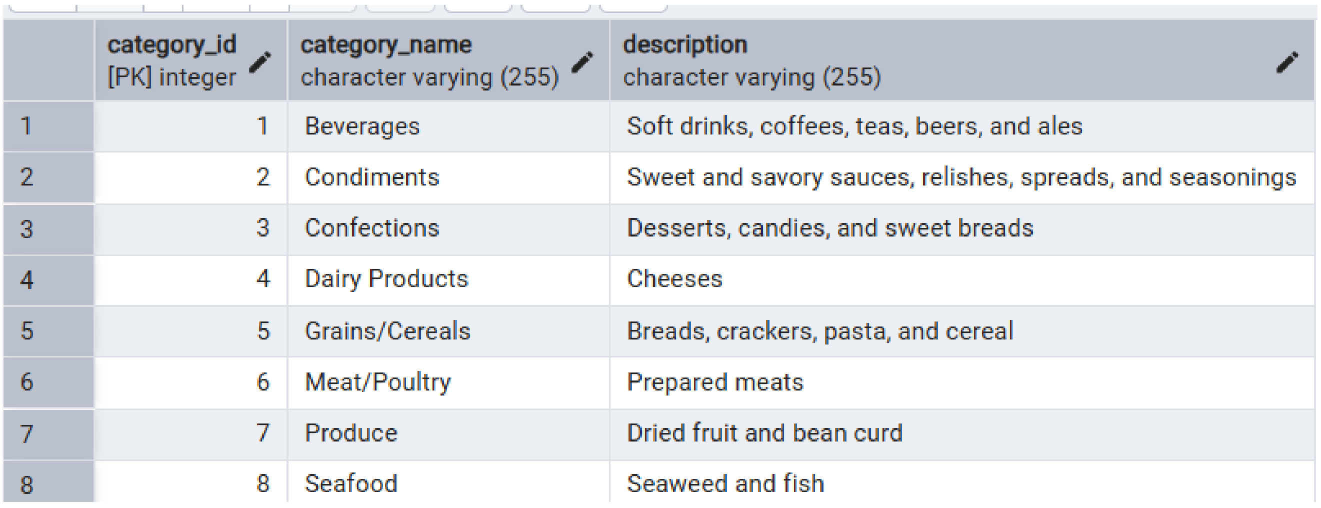
1. customers



Showing rows: 1 to 91 | Page No: 1 of 1

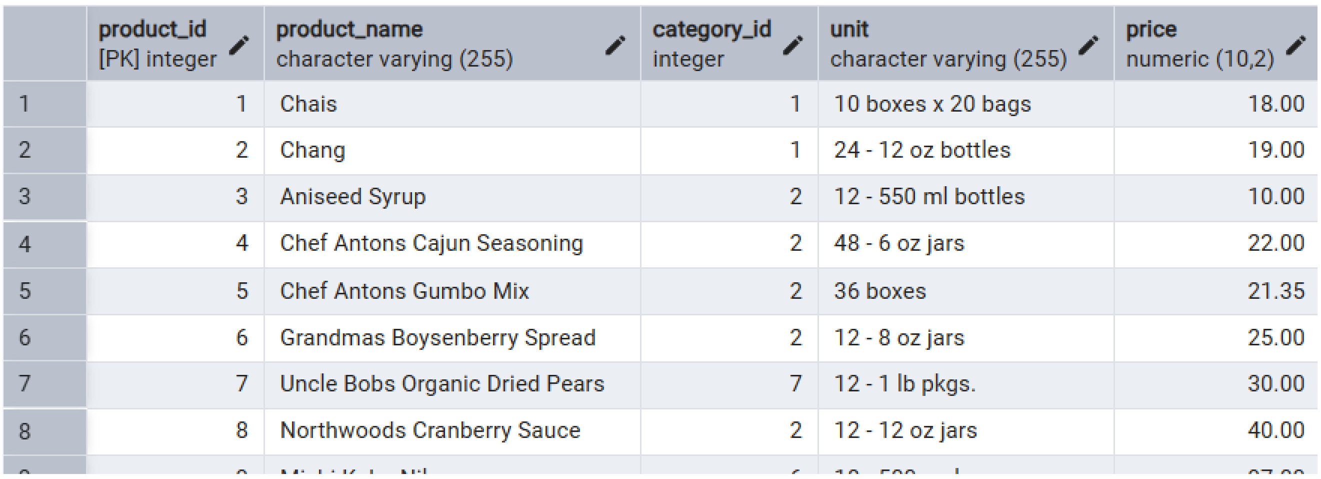
	customer_id [PK] integer	customer_name character varying (255)	contact_name character varying (255)	address character varying (255)	city character varying (255)	postal_code character varying (255)	country character vary
1	1	Alfreds Futterkiste	Maria Anders	Obere Str. 57	Berlin	12209	Germany
2	2	Ana Trujillo Emparedados y helad...	Ana Trujillo	Avda. de la Constitucion 2222	Mexico D.F.	05021	Mexico
3	3	Antonio Moreno Taquera	Antonio Moreno	Mataderos 2312	Mexico D.F.	05023	Mexico
4	4	Around the Horn	Thomas Hardy	120 Hanover Sq.	London	WA1 1DP	UK
5	5	Berglunds snabbkoep	Christina Berglund	Berguvsvegen 8	Lulea	S-958 22	Sweden
6	6	Blauer See Delikatessen	Hanna Moos	Forsterstr. 57	Mannheim	68306	Germany
7	7	Blondel pere et fils	Frederique Citeaux	24, place Kleber	Strasbourg	67000	France
8	8	Bolido Comidas preparadas	Martin Sommer	C/ Araquil, 67	Madrid	28023	Spain
9	9	Bon app	Laurence Lebihans	12, rue des Bouchers	Marseille	13008	France
10	10	Bottom-Dollar Marketse	Elizabeth Lincoln	23 Tsawassen Blvd.	Tsawassen	T2F 8M4	Canada
11	11	Bs Beverages	Victoria Ashworth	Fauntleroy Circus	London	EC2 5NT	UK
12	12	Cactus Comidas para llevar	Patricio Simpson	Cerrito 333	Buenos Aires	1010	Argentina
13	13	Centro comercial Moctezuma	Francisco Chang	Sierras de Granada 9993	Mexico D.F.	05022	Mexico
14	14	Chop-suey Chinese	Yang Wang	Hauptstr. 29	Bern	3012	Switzerland
15	15	Comercio Mineiro	Pedro Afonso	Av. dos Lusiadas, 23	Sao Paulo	05432-043	Brazil
16	16	Consolidated Holdings	Elizabeth Brown	Berkeley Gardens 12 Brewery	London	WX1 6LT	UK
17	17	Drachenblut Delikatessend	Sven Ottlieb	Walserweg 21	Aachen	52066	Germany
18	18	Du monde entier	Janine Labrune	67, rue des Cinquante Otages	Nantes	44000	France
19	19	Eastern Connection	Ann Devon	35 King George	London	WX3 6FW	UK
20	20	Ernst Handel	Roland Mendel	Kirchgasse 6	Graz	8010	Austria
21	21	Familia Arquibaldo	Aria Cruz	Rua Oros, 92	Sao Paulo	05442-030	Brazil

1. categories



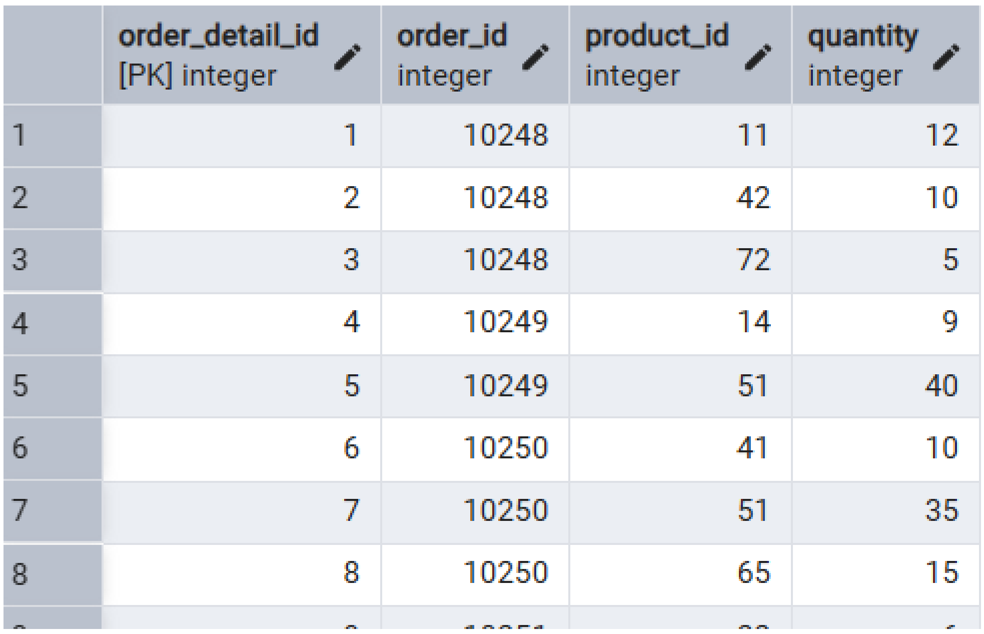
	category_id [PK] integer	category_name character varying (255)	description character varying (255)
1	1	Beverages	Soft drinks, coffees, teas, beers, and ales
2	2	Condiments	Sweet and savory sauces, relishes, spreads, and seasonings
3	3	Confections	Desserts, candies, and sweet breads
4	4	Dairy Products	Cheeses
5	5	Grains/Cereals	Breads, crackers, pasta, and cereal
6	6	Meat/Poultry	Prepared meats
7	7	Produce	Dried fruit and bean curd
8	8	Seafood	Seaweed and fish

1. Products



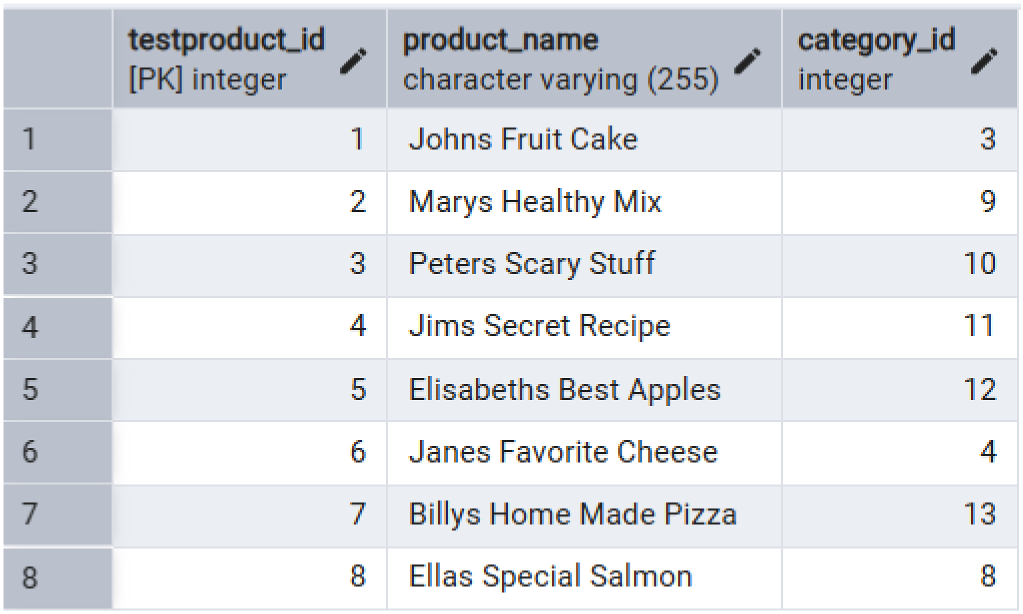
	product_id [PK] integer	product_name character varying (255)	category_id integer	unit character varying (255)	price numeric (10,2)
1	1	Chais	1	10 boxes x 20 bags	18.00
2	2	Chang	1	24 - 12 oz bottles	19.00
3	3	Aniseed Syrup	2	12 - 550 ml bottles	10.00
4	4	Chef Antons Cajun Seasoning	2	48 - 6 oz jars	22.00
5	5	Chef Antons Gumbo Mix	2	36 boxes	21.35
6	6	Grandmas Boysenberry Spread	2	12 - 8 oz jars	25.00
7	7	Uncle Bobs Organic Dried Pears	7	12 - 1 lb pkgs.	30.00
8	8	Northwoods Cranberry Sauce	2	12 - 12 oz jars	40.00

1. order_details



	order_detail_id [PK] integer	order_id integer	product_id integer	quantity integer
1	1	10248	11	12
2	2	10248	42	10
3	3	10248	72	5
4	4	10249	14	9
5	5	10249	51	40
6	6	10250	41	10
7	7	10250	51	35
8	8	10250	65	15

1. testproducts



	testproduct_id [PK] integer	product_name character varying (255)	category_id integer
1	1	Johns Fruit Cake	3
2	2	Marys Healthy Mix	9
3	3	Peters Scary Stuff	10
4	4	Jims Secret Recipe	11
5	5	Elisabeths Best Apples	12
6	6	Janes Favorite Cheese	4
7	7	Billys Home Made Pizza	13
8	8	Ellas Special Salmon	8

Operators in the WHERE Clause

Used to filter rows based on specific conditions in a `SELECT`, `UPDATE`, or `DELETE` statement.

Operator	Meaning	Example
`=`	Equal to	`WHERE salary = 50000`
`<`	Less than	`WHERE age < 30`
`>`	Greater than	`WHERE age > 40`
`<=`	Less than or equal to	`WHERE age <= 25`
`>=`	Greater than or equal to	`WHERE age >= 60`
`<>`	Not equal to	`WHERE city <> 'Cairo'`

Operator	Meaning	Example
`!=`	Not equal to	`WHERE city != 'Giza'`
`LIKE`	Match a pattern (case sensitive)	`WHERE name LIKE 'A%'`
`ILIKE`	Match a pattern (case insensitive)	`WHERE name ILIKE 'a%'`
`AND`	Logical AND	`WHERE age > 20 AND salary > 30000`
`OR`	Logical OR	`WHERE city = 'Cairo' OR city = 'Giza'`
`IN`	Value in a list	`WHERE department IN ('HR', 'IT')`
`BETWEEN`	Value in a range	`WHERE age BETWEEN 25 AND 35`
`IS NULL`	Value is NULL	`WHERE hire_date IS NULL`
`NOT`	Negates a condition	`WHERE name NOT LIKE 'A%'`

SELECT DISTINCT

- **Definition**: Returns only **unique values** from a column, removing duplicates.
- **Syntax**:

```sql
SELECT DISTINCT column1, column2, ...
FROM table_name;
```

- **Example**:

```sql
SELECT DISTINCT country FROM customers;
```

→ Lists each department only once.

COUNT(DISTINCT)

- **Definition**: Counts the **number of unique (distinct) values** in a column.
- **Syntax**:

```sql
SELECT COUNT(DISTINCT column_name)
FROM table_name;
```

- **Example**:

```
SELECT count(DISTINCT country) FROM customers;
```

→ Returns how many different departments exist.

ORDER BY

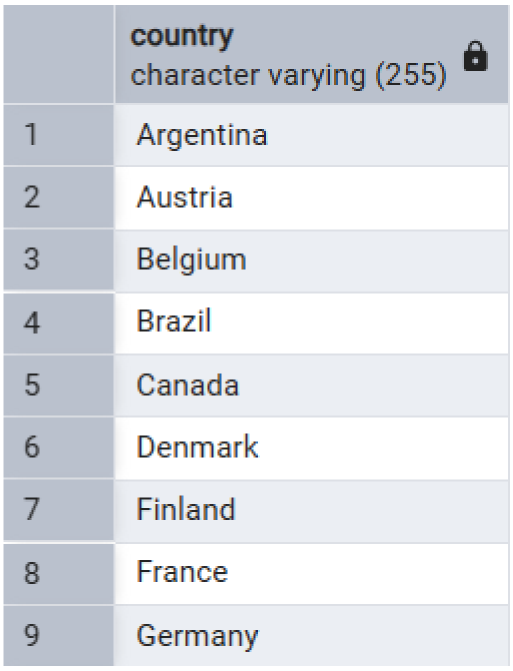
- **Definition**: Used to **sort the result set** of a query in ascending or descending order. It works with numbers and words
- **Syntax**:

```
SELECT column1, column2, ...
FROM table_name
ORDER BY column_name [ASC|DESC];
```

  - `ASC` = Ascending (default).
  - `DESC` = Descending.

- **Example 1** (ascending):

```
SELECT DISTINCT country
FROM customers
ORDER BY country;
```

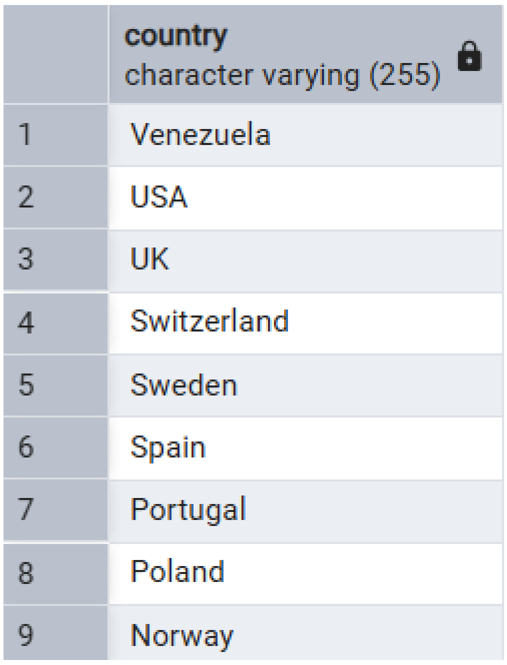


	country character varying (255)
1	Argentina
2	Austria
3	Belgium
4	Brazil
5	Canada
6	Denmark
7	Finland
8	France
9	Germany

- **Example 2** (descending):

```
```

```sql
SELECT DISTINCT country
FROM customers
ORDER BY country DESC;
```

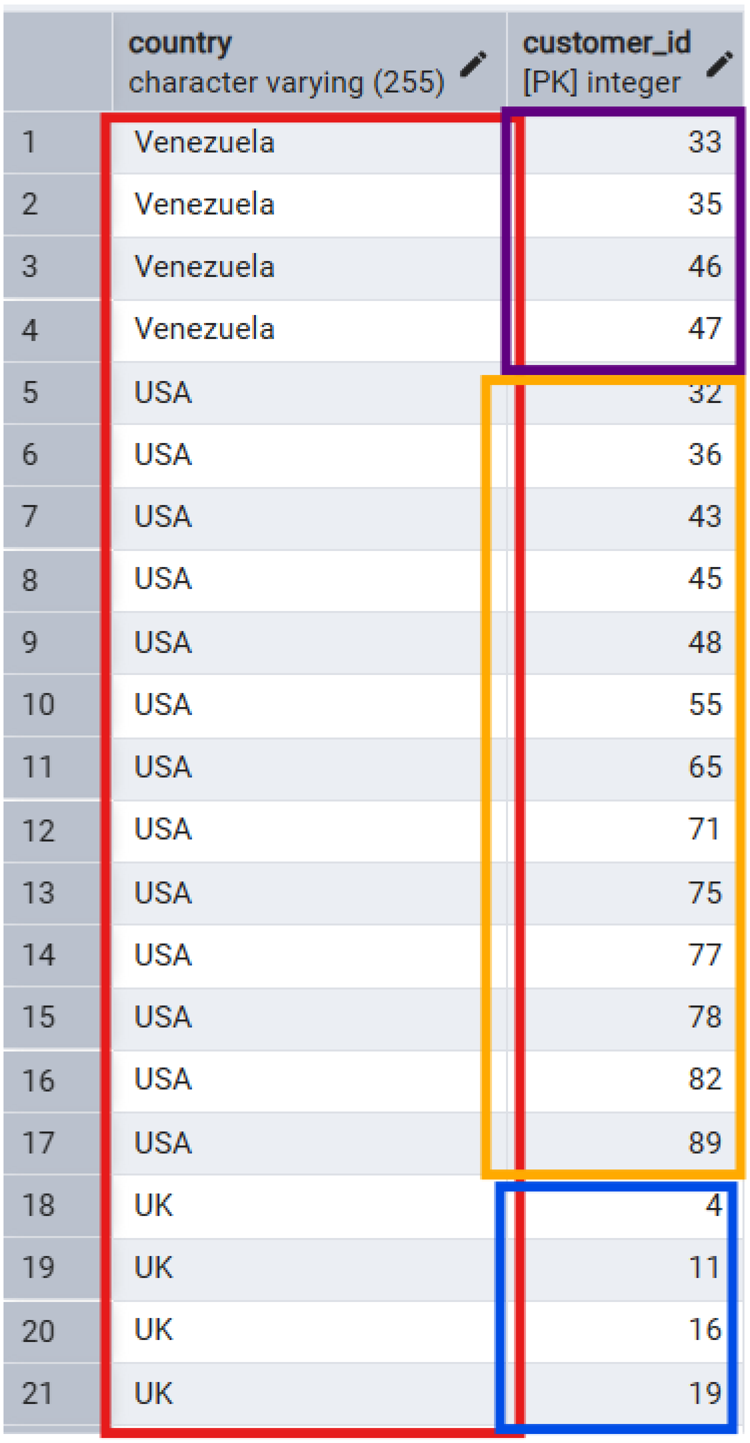


	country character varying (255)
1	Venezuela
2	USA
3	UK
4	Switzerland
5	Sweden
6	Spain
7	Portugal
8	Poland
9	Norway

- **Example 3** (sort by multiple columns):

```sql
SELECT DISTINCT country,customer_id
FROM customers
ORDER BY country DESC,customer_id ASC;
```

- it will sort the output according to country descending, and then sort the columns with same country ascending according to the customer_id



	country character varying (255)	customer_id [PK] integer
1	Venezuela	33
2	Venezuela	35
3	Venezuela	46
4	Venezuela	47
5	USA	32
6	USA	36
7	USA	43
8	USA	45
9	USA	48
10	USA	55
11	USA	65
12	USA	71
13	USA	75
14	USA	77
15	USA	78
16	USA	82
17	USA	89
18	UK	4
19	UK	11
20	UK	16
21	UK	19

OFFSET

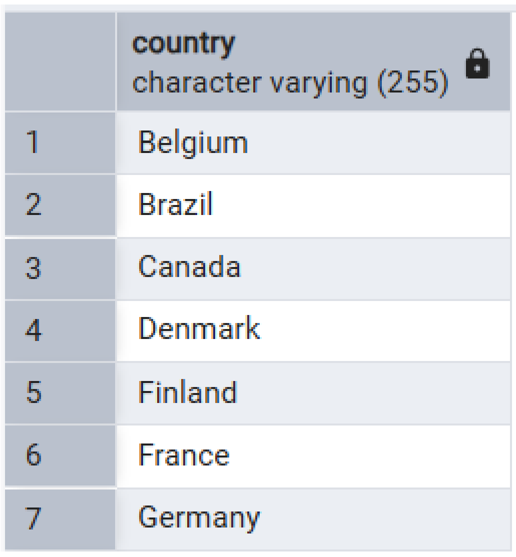
- **Definition**: Skips a specified number of rows before returning results (often used with `LIMIT`).
- **Syntax**:

```sql
SELECT column1, column2, ...
FROM table_name
OFFSET number;
```

- **Example**:

```sql
SELECT DISTINCT country
FROM customers
ORDER BY country ASC
OFFSET 2;
```

→ Skips the first 2 rows, returns the rest(Argentina and Austrilla disabered).

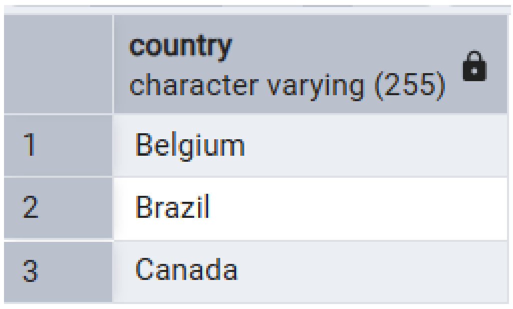


	country character varying (255)
1	Belgium
2	Brazil
3	Canada
4	Denmark
5	Finland
6	France
7	Germany

- **With LIMIT**:

```sql
SELECT DISTINCT country
FROM customers
ORDER BY country ASC
OFFSET 2 LIMIT 3;
```

→ Skips first 2 rows, then returns the next 3 rows **ONLY**.



	country character varying (255)
1	Belgium
2	Brazil
3	Canada

PostgreSQL Aggregate Functions & LIMIT

Function / Clause	Description	Example
`MIN(column)`	Returns the **smallest value** in a column	`SELECT MIN(salary) FROM employees;`

Function / Clause	Description	Example
`MAX(column)`	Returns the **largest value** in a column	`SELECT MAX(salary) FROM employees;`
`COUNT(column)`	Counts **non-NULL values** in a column	`SELECT COUNT(id) FROM employees;`
`SUM(column)`	Returns the **total sum** of values in a column	`SELECT SUM(salary) FROM employees;`
`AVG(column)`	Returns the **average** value of a column	`SELECT AVG(salary) FROM employees;`
`LIMIT number`	Restricts the number of rows returned	`SELECT * FROM employees LIMIT 5;`

LIKE

- **Definition**: Used in a `WHERE` clause to **search for a pattern** in a column (**case-sensitive**).
- Same as **ILIKE** ,but like is key sensitive and **ILIKE** is not key sensitive(look at examples)
- **Wildcards**:
  - `%` → Matches **any sequence** of characters (0 or more).
  - `_` → Matches **a single character**.
- **Syntax**:

```sql
SELECT column1, column2, ...
FROM table_name
WHERE column_name LIKE pattern;
```

- **Examples**:

```sql
-- Starts with 'A'
SELECT country
From customers
WHERE country LIKE 'A%'
-- OR
SELECT country
From customers
WHERE country ILIKE 'a%'

-- Ends with 'n'
SELECT country
From customers
```

```sql
WHERE country ILIKE '%n'

-- OR
SELECT country
From customers
WHERE country LIKE '%N'

-- Contains 'S' either at start, at end or in the middle
SELECT country
From customers
WHERE country ILIKE '%s%'

-- Second letter is 'a'
SELECT country FROM customers
WHERE country LIKE '_a%';
```

IN

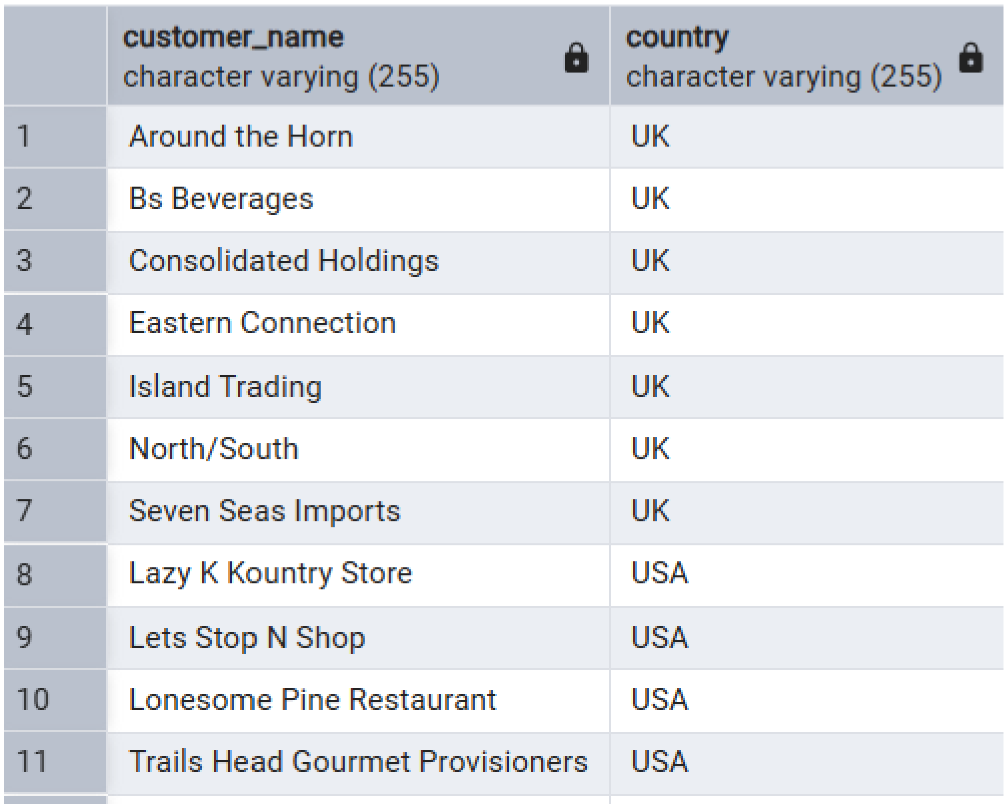
- **Definition**: Checks if a value **matches any value** in a list.
- **Syntax**:

```sql
SELECT column1, column2, ...
FROM table_name
WHERE column_name IN (value1, value2, ...);
```

- **Example**:

```sql
SELECT customer_name ,country
From customers
WHERE country IN('UK','USA')
ORDER BY country;
```

→ Returns customers who live in USA or UK.



	customer_name character varying (255)	country character varying (255)
1	Around the Horn	UK
2	Bs Beverages	UK
3	Consolidated Holdings	UK
4	Eastern Connection	UK
5	Island Trading	UK
6	North/South	UK
7	Seven Seas Imports	UK
8	Lazy K Kountry Store	USA
9	Lets Stop N Shop	USA
10	Lonesome Pine Restaurant	USA
11	Trails Head Gourmet Provisioners	USA

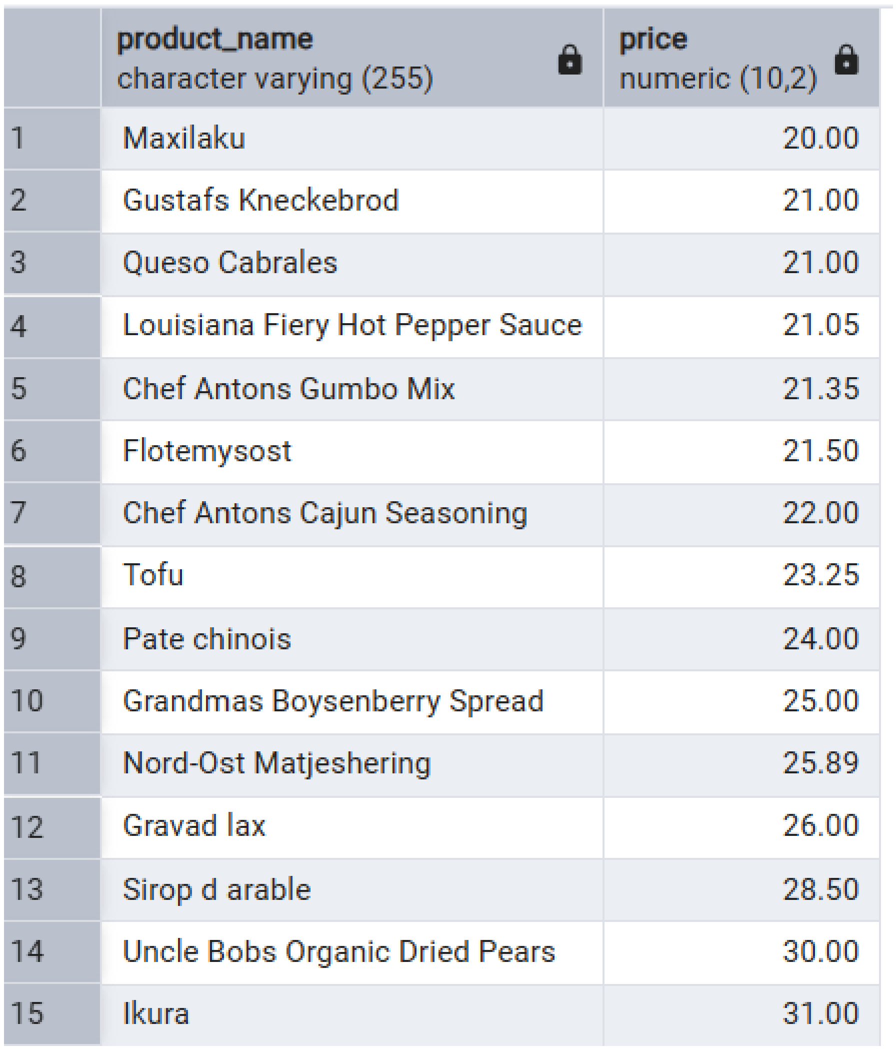
BETWEEN

- **Definition**: Checks if a value is **within a range** (inclusive).
- **Syntax**:

```
SELECT column1, column2, ...
FROM table_name
WHERE column_name BETWEEN value1 AND value2;
```

- **Example**:

```
SELECT product_name,price
FROM products
WHERE price BETWEEN 20 AND 100
ORDER BY price;
```



	product_name character varying (255)	price numeric (10,2)
1	Maxilaku	20.00
2	Gustafs Kneckebrod	21.00
3	Queso Cabrales	21.00
4	Louisiana Fiery Hot Pepper Sauce	21.05
5	Chef Antons Gumbo Mix	21.35
6	Flotemysost	21.50
7	Chef Antons Cajun Seasoning	22.00
8	Tofu	23.25
9	Pate chinois	24.00
10	Grandmas Boysenberry Spread	25.00
11	Nord-Ost Matjeshering	25.89
12	Gravad lax	26.00
13	Sirop d arable	28.50
14	Uncle Bobs Organic Dried Pears	30.00
15	Ikura	31.00

→ Returns products whose price is **≥ 20 and ≤ 30**

- **Tip**: Can be combined with `NOT` to reverse it:

```
WHERE price NOT BETWEEN 20 AND 100
```

AS

- **Definition**: Used to give a **temporary name (alias)** to a column or table in a query.
- **Syntax (Column Alias)**:

```
SELECT column_name AS alias_name
FROM table_name;
```

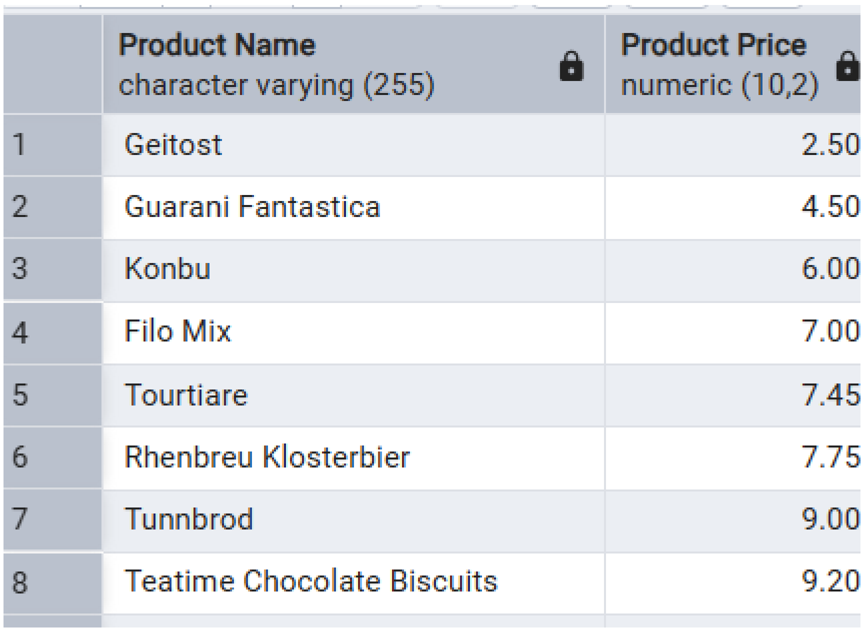
- **Syntax (Table Alias)**:

```
```

```
SELECT t.column_name
FROM table_name AS t;
```

- **Example**:

```
SELECT product_name AS "Product Name",price AS "Product Price"
FROM products
ORDER BY price;
```



	Product Name character varying (255)	Product Price numeric (10,2)
1	Geitost	2.50
2	Guarani Fantastica	4.50
3	Konbu	6.00
4	Filo Mix	7.00
5	Tourtiare	7.45
6	Rhenbreu Klosterbier	7.75
7	Tunnbrod	9.00
8	Teatime Chocolate Biscuits	9.20

→ The result will show columns as Product Name and Product Price.

|| (Concatenation Operator)

- **Definition**: Joins two or more strings together.
- **Syntax**:

```
SELECT column1 || column2
FROM table_name;
```

- **Example**:

```
SELECT name || ' works in ' || department AS employee_info
FROM employees;
```

→ If `name = 'Ali'` and `department = 'IT'`, the result will be **"Ali works in IT"**.

JOIN

A **JOIN** is used to **combine rows from two or more tables** based on a related column between them (usually a **primary key** in one table and a **foreign key** in another).

General Syntax:

```
SELECT columns
FROM table1
JOIN table2
ON table1.column = table2.column;
```

Main Types of JOIN

1. INNER JOIN

- **Meaning**: Returns only rows that have a match in **both tables**.
- **Think of it as**: “Give me only the intersection.”
- **Example**:

  Tables:

  employees

id	name	dept_id
1	Ali	10
2	Sara	20
3	Omar	30

  departments

id	dept_name
10	IT
20	HR

  Query:

```sql
SELECT employees.name, departments.dept_name
FROM employees
INNER JOIN departments
ON employees.dept_id = departments.id;
```

Result: Only Ali and Sara show up (because dept_id 30 has no match in departments).

---

2. LEFT JOIN (or LEFT OUTER JOIN)

- **Meaning**: Returns **all rows from the left table** and the matching rows from the right table. If no match, it shows **NULL**.
- **Think of it as**: “All from left, matches from right if possible.”
- **Example**:

```sql
SELECT employees.name, departments.dept_name
FROM employees
LEFT JOIN departments
ON employees.dept_id = departments.id;
```

Result: Ali (IT), Sara (HR), Omar (NULL).

---

3. RIGHT JOIN (or RIGHT OUTER JOIN)

- **Meaning**: Returns **all rows from the right table** and matching rows from the left table. If no match, it shows **NULL**.
- **Think of it as**: “All from right, matches from left if possible.”
- **Example**:

```sql
SELECT employees.name, departments.dept_name
FROM employees
RIGHT JOIN departments
ON employees.dept_id = departments.id;
```

Result: Ali (IT), Sara (HR) — and if a department exists with no employees, it will appear with NULL for name.

---

4. FULL JOIN (or FULL OUTER JOIN)

- **Meaning**: Returns **all rows when there’s a match in either table**. If there’s no match, it still shows the row with **NULL** in the missing part.

- **Think of it as**: “Everything from both tables, fill blanks with NULL.”
- **Example**:

  ```sql
  SELECT employees.name, departments.dept_name
  FROM employees
  FULL JOIN departments
  ON employees.dept_id = departments.id;
  ```

  Result: All employees + all departments, even if there’s no match.

---

5. CROSS JOIN

- **Meaning**: Combines **every row from the first table with every row from the second** (Cartesian product).
- **Think of it as**: “Every possible combination.”
- **Example**:

  ```sql
  SELECT employees.name, departments.dept_name
  FROM employees
  CROSS JOIN departments;
  ```

  Result: If 3 employees and 2 departments, you get **3 × 2 = 6 rows**.

---

6. SELF JOIN

- **Meaning**: A table joins with **itself** (useful for hierarchical data).
- **Example**:

  Suppose `employees` table has a `manager_id` column pointing to another employee.

  ```sql
  SELECT e.name AS employee, m.name AS manager
  FROM employees e
  LEFT JOIN employees m
  ON e.manager_id = m.id;
  ```

  Result: Shows each employee with their manager’s name.

Summary Diagram

Think of circles as the two tables:

Legend:

Ⓐ = Left Table (table1)

Ⓑ = Right Table (table2)

JOIN Type	Diagram	Meaning	Example Rows Returned
INNER JOIN	○Ⓐ ∩ Ⓑ○	Only rows where Ⓐ and Ⓑ match.	Ali (IT), Sara (HR)
LEFT JOIN	Ⓐ○ + (Ⓐ ∩ Ⓑ)○	All Ⓐ, match from Ⓑ if exists, else NULL.	Ali (IT), Sara (HR), Omar (NULL)
RIGHT JOIN	Ⓑ○ + (Ⓐ ∩ Ⓑ)○	All Ⓑ, match from Ⓐ if exists, else NULL.	Ali (IT), Sara (HR), (NULL, Marketing)
FULL JOIN	Ⓐ○ ∪ Ⓑ○	All rows from both Ⓐ and Ⓑ, matches where possible.	Ali (IT), Sara (HR), Omar (NULL), (NULL, Marketing)
CROSS JOIN	Ⓐ×Ⓑ	Every possible combination of Ⓐ and Ⓑ.	If 3 employees × 2 departments → 6 rows
SELF JOIN	Ⓐ joins to Ⓐ	Table joins to itself (like employees → managers).	Ali → Sara, Sara → Omar

UNION

- **Definition**: Combines the result sets of two or more `SELECT` statements into a single result set.
- **Rules**:
    1. Each `SELECT` must have the same number of columns.
    2. The columns must have compatible data types.
- **By default**: Removes duplicate rows.

Syntax:

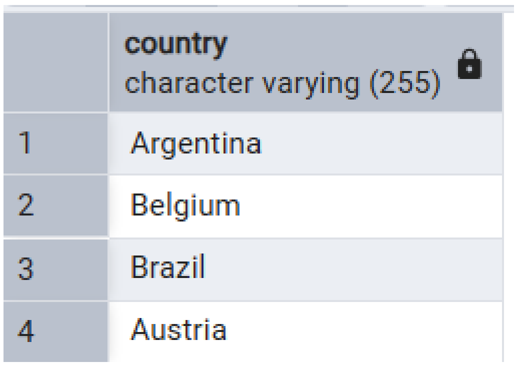
```
SELECT column1, column2, ...
FROM table1
UNION
SELECT column1, column2, ...
FROM table2;
```

Example:

```
SELECT country FROM customers
WHERE country like 'A%'
UNION
```

```
SELECT country FROM customers
WHERE country like 'B%'
```

→ Returns a list of unique countries starts with A and B.



	country character varying (255)
1	Argentina
2	Belgium
3	Brazil
4	Austria

UNION ALL

- Same as `UNION`, but **keeps duplicates**.
- Faster because it doesn't check for duplicates.

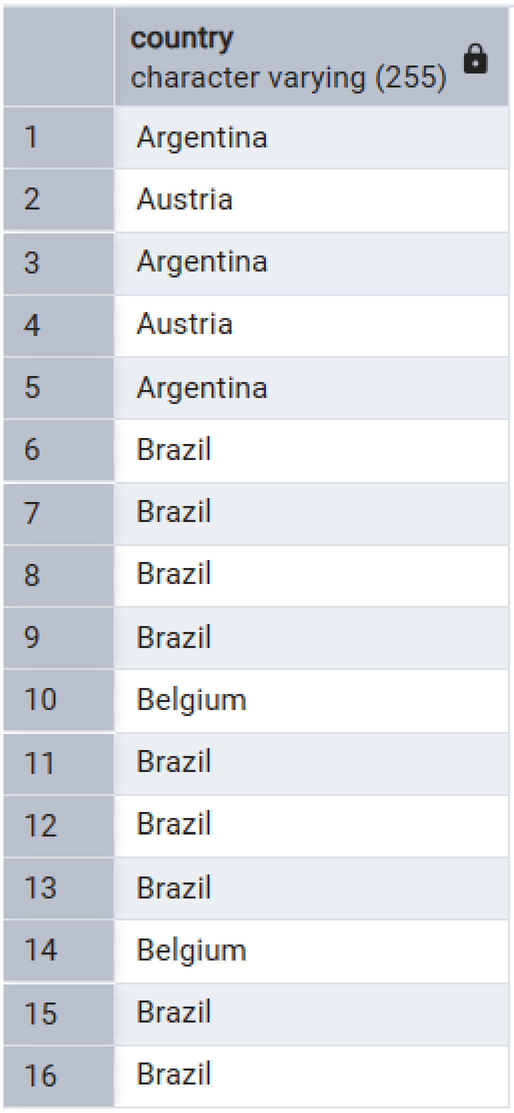
Syntax:

```
SELECT column1, column2, ...
FROM table1
UNION ALL
SELECT column1, column2, ...
FROM table2;
```

Example:

```
SELECT country FROM customers
WHERE country like 'A%'
UNION ALL
SELECT country FROM customers
WHERE country like 'B%'
```

→ Returns all countries including duplicates.



	country character varying (255)
1	Argentina
2	Austria
3	Argentina
4	Austria
5	Argentina
6	Brazil
7	Brazil
8	Brazil
9	Brazil
10	Belgium
11	Brazil
12	Brazil
13	Brazil
14	Belgium
15	Brazil
16	Brazil

HAVING

- **Definition**: Filters groups of rows after `GROUP BY` is applied.
- Similar to `WHERE`, but `WHERE` filters **before** grouping, `HAVING` filters **after** grouping.
- Usually used with **aggregate functions**.

Syntax:

```sql
SELECT column_name, AGGREGATE_FUNCTION(column_name)
FROM table_name
GROUP BY column_name
HAVING condition;
```

Example:

```sql
SELECT department, COUNT(*) AS total_employees
FROM employees
GROUP BY department
HAVING COUNT(*) > 5;
```

→ Returns only departments with more than 5 employees.

Tip:

- `WHERE` → works on individual rows.
- `HAVING` → works on grouped results.

EXISTS

- **Definition**: Checks if a subquery returns **any rows**.
- Returns **TRUE** if the subquery has at least one row, otherwise **FALSE**.

Syntax:

```sql
SELECT column1, column2, ...
FROM table_name
WHERE EXISTS (subquery);
```

Example:

```sql
SELECT department
FROM departments d
WHERE EXISTS (
    SELECT 1
    FROM employees e
    WHERE e.dept_id = d.id
);
```

→ Returns departments **that have at least one employee**.

Notes:

- Often used with correlated subqueries (where the subquery depends on the outer query).
- `SELECT 1` is common inside `EXISTS` because only the existence of rows matters, not their values.

ANY

- **Definition**: Compares a value to **each value** returned by a subquery and returns `TRUE` if the comparison is `TRUE` for **at least one** of them.
- Works with comparison operators: `=`, `<`, `>`, `<=`, `>=`, `<>`.

Syntax:

```
SELECT column1, column2, ...
FROM table_name
WHERE column_name operator ANY (subquery);
```

Example:

```
SELECT name, salary
FROM employees
WHERE salary > ANY (
    SELECT salary
    FROM employees
    WHERE department = 'HR'
);
```

→ Returns employees whose salary is **greater than at least one** salary in the HR department.

Tip:

- `> ANY` = greater than **minimum** value from subquery.
- `< ANY` = less than **maximum** value from subquery.

ALL

- **Definition**: Compares a value to **every value** returned by a subquery.
- Returns `TRUE` only if the comparison is `TRUE` for **all** values in the subquery.
- Works with comparison operators: `=`, `<`, `>`, `<=`, `>=`, `<>`.

Syntax:

```
SELECT column1, column2, ...
FROM table_name
WHERE column_name operator ALL (subquery);
```

Example:

```
SELECT name, salary
FROM employees
WHERE salary > ALL (
    SELECT salary
    FROM employees
    WHERE department = 'HR'
);
```

→ Returns employees whose salary is **greater than the highest salary** in the HR department.

Tip:

- `> ALL` = greater than **maximum** value from subquery.
- `< ALL` = less than **minimum** value from subquery.

CASE

- **Definition**: Allows conditional logic in SQL queries (like `IF...ELSE` in programming).
- Returns a value based on specified conditions.

Syntax:

```
SELECT column1,
       CASE
           WHEN condition1 THEN result1
           WHEN condition2 THEN result2
           ELSE result_default
       END AS alias_name
FROM table_name;
```

Example:

```
SELECT name, salary,
       CASE
           WHEN salary > 5000 THEN 'High'
           WHEN salary BETWEEN 3000 AND 5000 THEN 'Medium'
           ELSE 'Low'
       END AS salary_level
FROM employees;
```

→ Categorizes employees as **High**, **Medium**, or **Low** salary level.

Notes:

- `CASE` stops checking once a condition is met.
- Can be used in `SELECT`, `ORDER BY`, `GROUP BY`, etc.

Constraints

- **Definition**: Rules applied to table columns to limit the type of data that can be inserted.

- Helps maintain **data integrity**.

Constraint	Description	Example
NOT NULL	Column cannot have `NULL` values.	`name VARCHAR(50) NOT NULL`
UNIQUE	All values in the column must be unique.	`email VARCHAR(100) UNIQUE`
PRIMARY KEY	Uniquely identifies each row. (Only one per table, combines `NOT NULL` + `UNIQUE`.)	`id SERIAL PRIMARY KEY`
FOREIGN KEY	Links to a primary key in another table.	`FOREIGN KEY (dept_id) REFERENCES departments(id)`
CHECK	Ensures values meet a condition.	`CHECK (age >= 18)`
DEFAULT	Sets a default value if none is provided.	`status VARCHAR(20) DEFAULT 'active'`

Example:

```sql
CREATE TABLE employees (
    id SERIAL PRIMARY KEY,
    name VARCHAR(50) NOT NULL,
    email VARCHAR(100) UNIQUE,
    age INT CHECK (age >= 18),
    dept_id INT,
    status VARCHAR(20) DEFAULT 'active',
    FOREIGN KEY (dept_id) REFERENCES departments(id)
);
```