PostgreSQL Users and Roles Explained: A Complete Guide for Access Control

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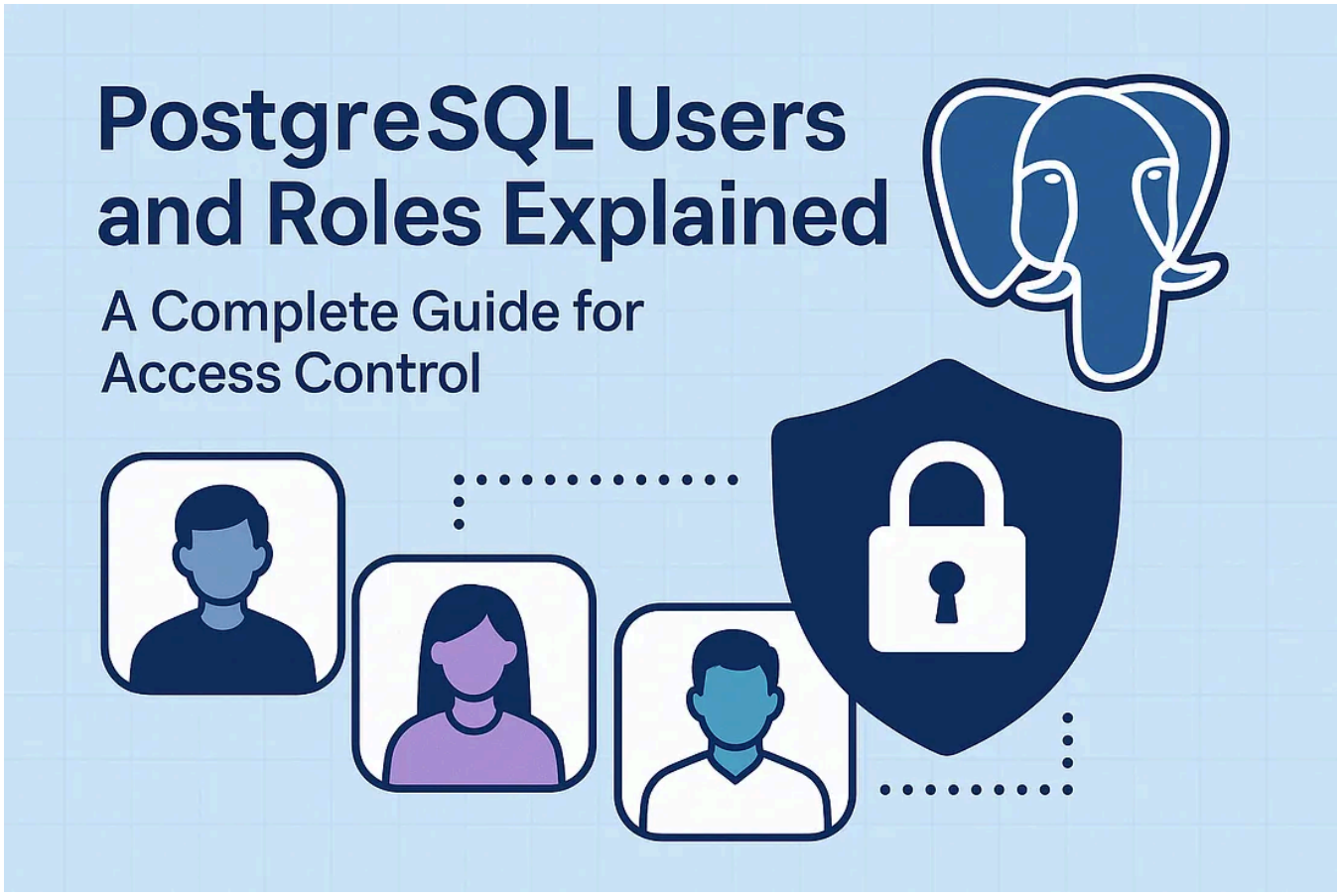

Managing access and permissions is at the heart of any database system — and PostgreSQL offers a highly flexible, powerful model for this: **Users and Roles.**

Whether you're managing a small application or an enterprise-level system, understanding how users and roles work in PostgreSQL is essential for ensuring security, scalability, and efficient privilege management. This guide walks you through everything you need to know — with plenty of real-world SQL examples.

🚀 PostgreSQL Users vs. Roles: What's the Difference?

When working with PostgreSQL, understanding the difference between **users** and **roles** is crucial for managing database security, access control, and permissions effectively. Let's dive deep into how PostgreSQL handles these concepts — and why roles are at the heart of PostgreSQL's flexible permission system.

🔑 The Core Concept

In PostgreSQL, **users** and **roles** are not completely separate entities. Technically, PostgreSQL handles everything as a **role**. The difference lies in whether a role has login privileges or not.

- **User:**
  A role **with login privileges**. This is an account that can connect to the database using a username and password.
- **Role:**
  A broader concept that can represent users, groups, or collections of privileges. Roles can be granted to other roles, allowing flexible management of permissions.

🔧 How PostgreSQL Uses Roles Internally

PostgreSQL simplifies its permission model by merging the concepts of users and groups into roles. When you create a user, you're actually creating a role with the ability to log in.

For example:

```
-- Creating a user (role with login privilege)
CREATE ROLE john LOGIN PASSWORD 'secure_password';
```

```
-- Creating a role without login privilege (useful for grouping
privileges)
CREATE ROLE readonly;
```

Here, `john` is a role with login privileges — in common terms, a user. The `readonly` role is a group of privileges that can be assigned to multiple users.

🎯 Assigning Roles to Users

One of PostgreSQL's most powerful features is its role-based privilege inheritance. You can assign roles to other roles, effectively building a hierarchy of permissions.

Example:

```
-- Grant readonly privileges to john
GRANT readonly TO john;
```

Now, `john` inherits all the privileges of the `readonly` role, making permission management scalable and efficient.

🔒 Why Roles are a Best Practice

✅ Centralized Permission Management:

Instead of assigning individual privileges to each user, you define roles for various job functions or permission sets.

✅ **Simpler Administration:**
Adding or removing a user's access becomes as simple as granting or revoking roles.

✅ **Scalability:**
As your database grows, role-based permissions make it easier to onboard new users or adjust permissions without disrupting other accounts.

👉 **Pro Tip:**
Always plan your role hierarchy carefully when starting a new PostgreSQL project. Well-designed roles save you from permission headaches later!

👤 Users in PostgreSQL: A Deep Dive

In PostgreSQL, **users** are the primary way to control access to your database. Whether you're managing human access or application-level connections, PostgreSQL users represent authenticated identities that can interact with the system.

Although PostgreSQL internally treats **users as roles with login privileges**, it's common practice to refer to them as "users" when discussing connection-level access.

✅ What is a PostgreSQL User?

A PostgreSQL **user** is essentially a role that has permission to **log in** to the database server. This means it can authenticate using a username and password and then perform operations as permitted by its privileges.

Think of a user as:

- A database login identity (for developers, apps, admins)
- A role with the **LOGIN** attribute

✅ Creating a User

You can create a new user with a simple SQL command using the `CREATE USER` statement:

```
CREATE USER myuser WITH PASSWORD 'mypassword';
```

This command:

- Creates a new role named `myuser`
- Enables login with the specified password
- Adds no other privileges by default (e.g., it cannot create databases or roles unless explicitly granted)

🔧 Optional Attributes When Creating Users

You can further customize the user with additional parameters:

```
CREATE USER myuser
WITH PASSWORD 'mypassword'
VALID UNTIL '2025-12-31'
CONNECTION LIMIT 5;
```

- `VALID UNTIL` : Specifies an expiration date for the password.
- `CONNECTION LIMIT` : Restricts the number of concurrent connections for the user.

These settings are helpful for managing security and resource allocation.

✅ Listing Users

To see the list of all users (and other roles), you can use the following command in `psql`:

```
\du+
```

This displays:

- Role names (users and groups)
- Attributes like login capability, superuser status, role creation rights
- Any role memberships (which users are part of which groups)

Example output:

```
Role name | Attributes                  | Member of
-----------+-----------------------------+------------
 myuser    | Login                       | {}
 readonly  | Cannot login                | {}
 admin     | Superuser, Create role...   | {}
```

This is your go-to view for auditing and managing user permissions.

✅ Dropping a User

If a user is no longer needed, you can remove them from the system:

```
DROP USER myuser;
```

However, note:

- You cannot drop a user if they own any database objects (tables, schemas, etc.).

- You may need to reassign ownership or drop dependent objects first.

```
REASSIGN OWNED BY myuser TO another_user;
DROP OWNED BY myuser;
DROP USER myuser;
```

This ensures a clean and safe deletion without leaving orphaned objects behind.

🧠 Quick Recap

Task Command Create a user `CREATE USER myuser WITH PASSWORD 'mypassword';` List users `\du+` Drop a user `DROP USER myuser;`

By managing **users** correctly in PostgreSQL, you lay a strong foundation for secure and organized database access control. As your environment grows, consider assigning users to **roles** to streamline privilege management — but it all starts with understanding the fundamentals of users themselves.

🎭 Roles in PostgreSQL: Grouping Privileges the Smart Way

When it comes to managing access in PostgreSQL, **roles** are the backbone of a scalable and secure permission system. Instead of assigning individual permissions to every user, PostgreSQL encourages the use of roles to **group privileges** and assign them in bulk. This not only simplifies administration but also makes permission management consistent and maintainable.

🔧 What is a Role?

A **role** in PostgreSQL is a flexible concept that can act as:

- A **user** (a role with login capability)
- A **group** (a role without login, used to collect permissions)
- Or both

The real power of roles lies in their ability to **inherit privileges** from other roles, which creates a clean and scalable access control hierarchy.

✅ Creating a Role

To create a role, use the `CREATE ROLE` command:

```
CREATE ROLE myrole;
```

By default, this role **cannot log in**. It's a placeholder for privileges, designed to be granted to users or other roles.

You can think of this like creating a security group in your system — it doesn't do anything by itself but becomes powerful when connected to users.

✅ Granting Privileges to Roles

Once you create a role, you can grant specific database object privileges to it. For example:

```
GRANT SELECT, INSERT, UPDATE, DELETE ON customers TO myrole;
```

This command gives the `myrole` role permission to perform all common operations on the `customers` table. You can repeat this for other tables or specific columns if

needed.

Roles allow you to centralize permission logic — update a role, and all users assigned to it instantly get updated access.

✅ Assigning Roles to Users

Once a role is configured with the desired privileges, you can assign it to users.

```
CREATE USER customer1 WITH PASSWORD 'password1';
GRANT myrole TO customer1;
```

Here's what happens:

- `customer1` becomes a PostgreSQL user.
- By granting `myrole` to `customer1`, the user now inherits all the privileges assigned to `myrole`.

This inheritance is immediate and dynamic — any future changes to `myrole` will automatically apply to `customer1`.

🔄 How Users and Roles Work Together

This relationship — **roles manage permissions**, and **users inherit roles** — allows for elegant and efficient access control.

Benefits:

- 🔁 **Reusable permission sets** across multiple users
- ⚙️ **Centralized updates** — change role once, affect all users
- 🔒 **Cleaner access design** for applications with many users

🔎 Example Scenario: E-Commerce Access Levels

Let's say you're designing an e-commerce system. You want all your customer accounts to have read and write access to the `customers` table — but only to certain columns.

Here's how you can structure it:

```
-- Create a reusable role for all customers
CREATE ROLE customer;
```

```
-- Grant typical privileges to that role
GRANT SELECT, INSERT, UPDATE ON customers TO customer;

-- Create individual users and assign them the role
CREATE USER customer1 WITH PASSWORD 'password1';
GRANT customer TO customer1;

CREATE USER customer2 WITH PASSWORD 'password2';
GRANT customer TO customer2;
```

Now, both `customer1` and `customer2` inherit permissions from the `customer` role. This setup ensures consistency — any changes to `customer`'s privileges will automatically apply to both users.

🧠 Quick Recap

Task Command Create a role `CREATE ROLE myrole;` Grant privileges to a role `GRANT SELECT, INSERT ON table TO myrole;` Assign role to user `GRANT myrole TO username;`

✅ Best Practice

🔑 **Design roles around job functions or access patterns**, not individuals.
Example: `customer`, `admin`, `readonly`, `support_team`

🎯 Then, assign these roles to users. This approach keeps your permission structure flexible, auditable, and future-proof.

📂 The Public Schema and Role in PostgreSQL: Understanding Defaults and Securing Access

When you install PostgreSQL and start working with a fresh database, you'll quickly notice something called the **public schema**. This schema — along with a special **public role** — is created automatically and plays a significant role in how new users interact with the database.

But here's the catch: **if not configured properly, the public schema can be a potential security loophole.** Let's explore what it is, how it works, and how to secure it.

🔍 What is the Public Schema?

In PostgreSQL, a **schema** is a logical container for database objects like tables, views, functions, and sequences. Think of it like a folder that helps organize your database contents.

By default, every PostgreSQL database contains a schema named `public`. This is:

- Automatically created when a new database is initialized
- Accessible by **all users** via the special **`PUBLIC` role**

This means that unless you change it, **any user in the database can create objects inside the `public` schema.** This design simplifies things during development but poses risks in production environments.

👥 What is the PUBLIC Role?

`PUBLIC` is a **special keyword** in PostgreSQL that refers to **all roles (users)** — both existing and future ones. When you grant privileges to `PUBLIC`, you're giving that access to *every user* in the system.

By default, PostgreSQL grants the `CREATE` privilege on the `public` schema to `PUBLIC`, which allows all users to:

- Create tables
- Create functions
- Create any other object in that schema

While convenient, this default behavior can lead to:

- Unintended object creation
- Security risks in shared databases
- Conflicts between users or applications

✅ Viewing the Current Search Path

The **search path** in PostgreSQL determines the order in which schemas are searched when you run a query without explicitly specifying the schema.

To view the current search path:

```
SHOW search_path;
```

Typical output:

```
"$user", public
```

Here's what it means:

- First, PostgreSQL checks for a schema named after the current user (`"$user"`).
- Then, it checks the `public` schema.

If you don't specify the schema when creating a table or querying one, PostgreSQL follows this search order.

✅ How to Secure the Public Schema

To prevent every user from creating objects in the `public` schema, **revoke the default create privilege** from the `PUBLIC` role:

```
REVOKE CREATE ON SCHEMA public FROM PUBLIC;
```

🔐 What This Does:

- It stops users (other than superusers or those explicitly granted privileges) from creating objects in the `public` schema.
- It helps avoid accidental table creation in shared environments.
- It enforces better access control and schema usage practices.

💡 Best Practices

1. **Use dedicated schemas** for each application or user group instead of relying on `public` .
2. **Always revoke `CREATE` from `PUBLIC`** on the public schema in production environments.
3. **Explicitly grant privileges** to specific roles as needed.

Example:

```
-- Create a new schema
CREATE SCHEMA sales;
```

```
-- Grant create/use access to a specific role
GRANT USAGE, CREATE ON SCHEMA sales TO sales_user;
```

This ensures clean separation of concerns and better security.

🧠 Summary Table

Task Command View search path `SHOW search_path;` Revoke create on public schema `REVOKE CREATE ON SCHEMA public FROM PUBLIC;` Secure schema access Use custom schemas + targeted grants

🚨 Final Thoughts

The `public` schema and `PUBLIC` role are powerful defaults that make development easier — but they're **not safe defaults** for production. Taking time to restrict unnecessary access and use schema-based permission models is a critical step toward building secure PostgreSQL environments.

🧱 Creating Read-Only and Read/Write Roles in PostgreSQL

Effective permission management is essential in any production database environment. One of the most powerful practices in PostgreSQL is to create **custom roles** that reflect specific access needs — such as **read-only** for analysts and **read/write** for application users.

By creating dedicated roles for different use cases, you ensure security, consistency, and scalability across your PostgreSQL ecosystem.

🔍 Why Use Read-Only or Read/Write Roles?

- **Read-Only Role:** Ideal for users who only need to view data — such as data analysts, business intelligence tools, or auditors. These roles **cannot modify** any data.
- **Read/Write Role:** Perfect for application components or users who need to read from and write to the database — like CRUD operations in APIs or back-office apps.

Instead of assigning granular permissions to individual users, you define **standardized roles**, then assign users to those roles. This keeps your access control clean and manageable.

✅ Creating a Read-Only Role

Here's how you can create a read-only role in PostgreSQL and grant it the necessary privileges:

```
-- Step 1: Create the read-only role
CREATE ROLE readonly;
```

```
-- Step 2: Allow the role to connect to the database
GRANT CONNECT ON DATABASE demodb TO readonly;

-- Step 3: Grant access to the schema (but not object creation)
GRANT USAGE ON SCHEMA public TO readonly;

-- Step 4: Allow the role to select from all existing tables
GRANT SELECT ON ALL TABLES IN SCHEMA public TO readonly;

-- Step 5: Ensure future tables also inherit SELECT privilege
ALTER DEFAULT PRIVILEGES IN SCHEMA public GRANT SELECT ON TABLES TO
readonly;
```

🔒 What this configuration does:

- `CONNECT` : Enables the role to log into `demodb` .

- `USAGE` : Allows access to the `public` schema, without object creation rights.
- `SELECT` : Grants read-only access to all current tables.
- `ALTER DEFAULT PRIVILEGES` : Ensures all **future** tables in the schema will also be readable by `readonly` .

This is extremely useful for **reporting dashboards**, **data exports**, and **readonly replicas**.

✅ Creating a Read/Write Role

For users or services that need full data access — both read and write — you can create a read/write role as follows:

```
-- Step 1: Create the read/write role
CREATE ROLE readwrite;
```

```
-- Step 2: Allow the role to connect to the database
GRANT CONNECT ON DATABASE demodb TO readwrite;

-- Step 3: Grant access to and creation within the schema
GRANT USAGE, CREATE ON SCHEMA public TO readwrite;

-- Step 4: Grant full CRUD access to all existing tables
GRANT SELECT, INSERT, UPDATE, DELETE ON ALL TABLES IN SCHEMA public
TO readwrite;

-- Step 5: Set default privileges for future tables
ALTER DEFAULT PRIVILEGES IN SCHEMA public
GRANT SELECT, INSERT, UPDATE, DELETE ON TABLES TO readwrite;
```

🛠️ What this setup allows:

- Full access to existing and future tables within the `public` schema.
- The ability to create objects (tables, functions, etc.) in the schema.
- Ideal for internal apps, automation tools, or backend microservices that require full interaction with the data.

🧠 Summary Table

Role Type Permissions Use Case `readonly` `CONNECT`, `USAGE`, `SELECT` Reporting, dashboards, auditing `readwrite` `CONNECT`, `USAGE`, `CREATE`, `SELECT`, `INSERT`, `UPDATE`, `DELETE` Full-access apps, API users, backend services

✅ Best Practice

- Use **dedicated roles** for each type of access (e.g., `readonly`, `readwrite`, `admin`).
- Assign these roles to users instead of giving direct object privileges.
- Always include `ALTER DEFAULT PRIVILEGES` to ensure future-proof access control.

🔄 Role Assignment Example

```
-- Assign a user to the read-only role
GRANT readonly TO analyst_user;
```

```
-- Assign a user to the read/write role
GRANT readwrite TO backend_user;
```

This model keeps your database secure, organized, and easy to manage — especially as the number of users and applications grows.

🔐 Managing User Permissions in PostgreSQL: A Role-Based Approach

In PostgreSQL, the most effective way to manage user access is through a **role-based permission system**. Instead of assigning privileges directly to individual users, you

define roles with specific privileges and **assign or revoke roles** as needed. This strategy scales beautifully — whether you're managing a few users or thousands.

Let's explore how to manage user permissions in PostgreSQL efficiently and securely.

✅ Assigning Roles to Users

Once you've created a role (like `readonly` or `readwrite`), you can assign it to users. This grants the user all permissions associated with that role.

```
CREATE USER demouser1 WITH PASSWORD 'secret_passwd';
GRANT readonly TO demouser1;
```

In this example:

- `demouser1` is a user with login privileges.
- By granting the `readonly` role, the user inherits all the permissions defined under `readonly`, such as `SELECT` access on tables.

This model decouples **permission logic** from individual user accounts and keeps things organized.

✅ Revoking Roles from Users

Need to revoke access? You can just remove the role assignment:

```
REVOKE readwrite FROM demouser1;
```

This command **instantly removes** all permissions associated with `readwrite` from `demouser1`, without having to revoke each privilege manually.

✅ Checking Granted Roles

To audit role assignments and verify who has what access, use this query:

```
SELECT
    r.rolname,
    ARRAY(
        SELECT b.rolname
        FROM pg_catalog.pg_auth_members m
        JOIN pg_catalog.pg_roles b ON (m.roleid = b.oid)
        WHERE m.member = r.oid
    ) as memberof
FROM pg_catalog.pg_roles r
ORDER BY 1;
```

📃 Output Example:

rolname member of demouser1 {readonly} backendapp {readwrite}

This makes it easy to **track access levels** across your database.

🗄 Full Permission Management Example

Here's a consolidated setup, perfect for enterprise environments where you want fine-grained, secure, and scalable user access:

```
-- 🔒 Step 1: Revoke default public access
REVOKE CREATE ON SCHEMA public FROM PUBLIC;
REVOKE ALL ON DATABASE demodb FROM PUBLIC;
```

```
-- 📘 Step 2: Create and configure a read-only role
CREATE ROLE readonly;
```

```
GRANT CONNECT ON DATABASE demodb TO readonly;
GRANT USAGE ON SCHEMA myschema TO readonly;
GRANT SELECT ON ALL TABLES IN SCHEMA myschema TO readonly;
ALTER DEFAULT PRIVILEGES IN SCHEMA myschema
GRANT SELECT ON TABLES TO readonly;

-- 🛠️ Step 3: Create and configure a read/write role
CREATE ROLE readwrite;
GRANT CONNECT ON DATABASE demodb TO readwrite;
GRANT USAGE, CREATE ON SCHEMA myschema TO readwrite;
GRANT SELECT, INSERT, UPDATE, DELETE ON ALL TABLES IN SCHEMA
myschema TO readwrite;
ALTER DEFAULT PRIVILEGES IN SCHEMA myschema
GRANT SELECT, INSERT, UPDATE, DELETE ON TABLES TO readwrite;

-- 🔄 Step 4: Handle sequence permissions (for auto-increment IDs,
etc.)
GRANT USAGE ON ALL SEQUENCES IN SCHEMA myschema TO readwrite;
ALTER DEFAULT PRIVILEGES IN SCHEMA myschema
GRANT USAGE ON SEQUENCES TO readwrite;
```

🧠 Why This Works:

- Users assigned `readonly` can only view data.
- Users with `readwrite` can perform full CRUD operations and even create new tables or sequences.
- Revoking public access ensures tight security from the beginning.

🔎 Why Use Roles?

PostgreSQL's role-based system provides several advantages:

✅ Centralized Permission Control

Define once, apply everywhere.

✅ Scalability

Manage hundreds or thousands of users effortlessly by grouping permissions.

✅ Security & Auditing

Know exactly who has access to what. Simplifies internal audits and compliance checks.

✅ Faster Onboarding/Offboarding

Assign or revoke roles in one step — no manual permission juggling.

🧩 Final Thoughts

PostgreSQL's role-based permission system is one of the most powerful features for database administrators and developers alike. By structuring access through well-defined roles, you maintain security, simplify operations, and scale effortlessly with your growing user base.

🚀 Conclusion

PostgreSQL gives you full flexibility to build a permission system that fits your business needs, whether you're running SaaS platforms, financial systems, or internal applications.

Mastering users and roles is **not optional** — it's your first step toward building a secure, scalable PostgreSQL environment.

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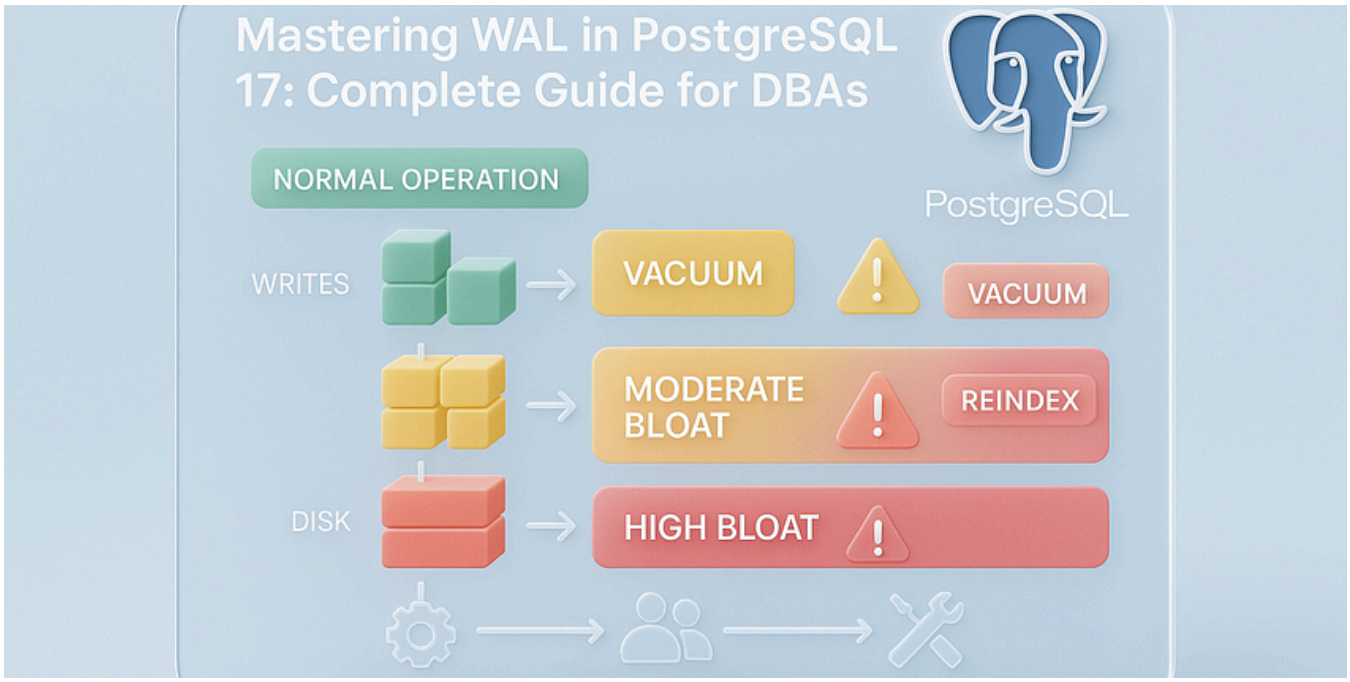

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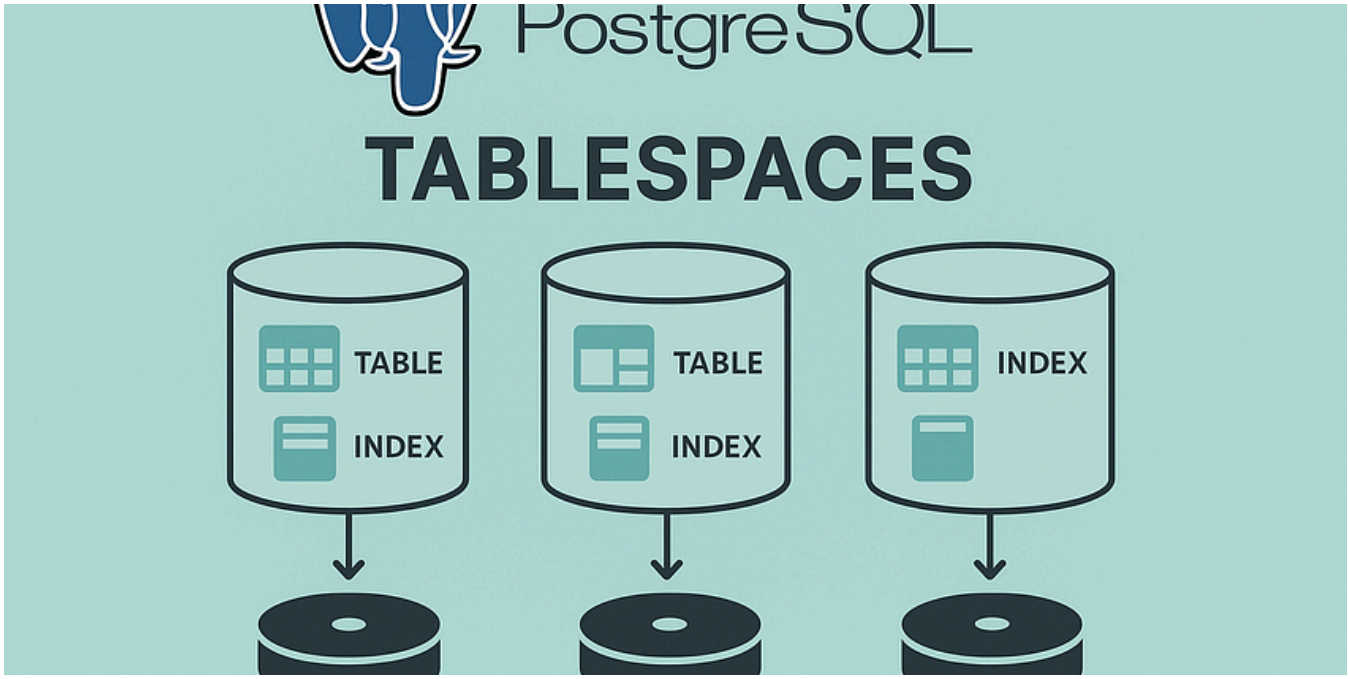

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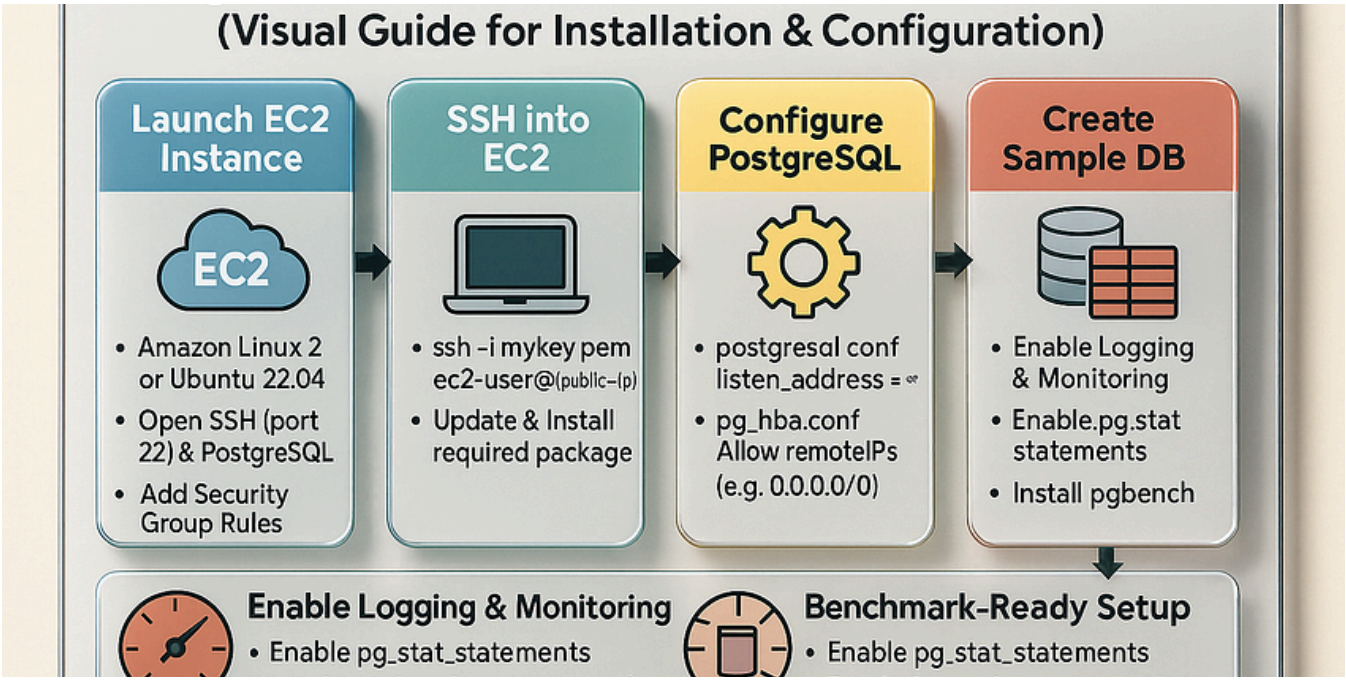

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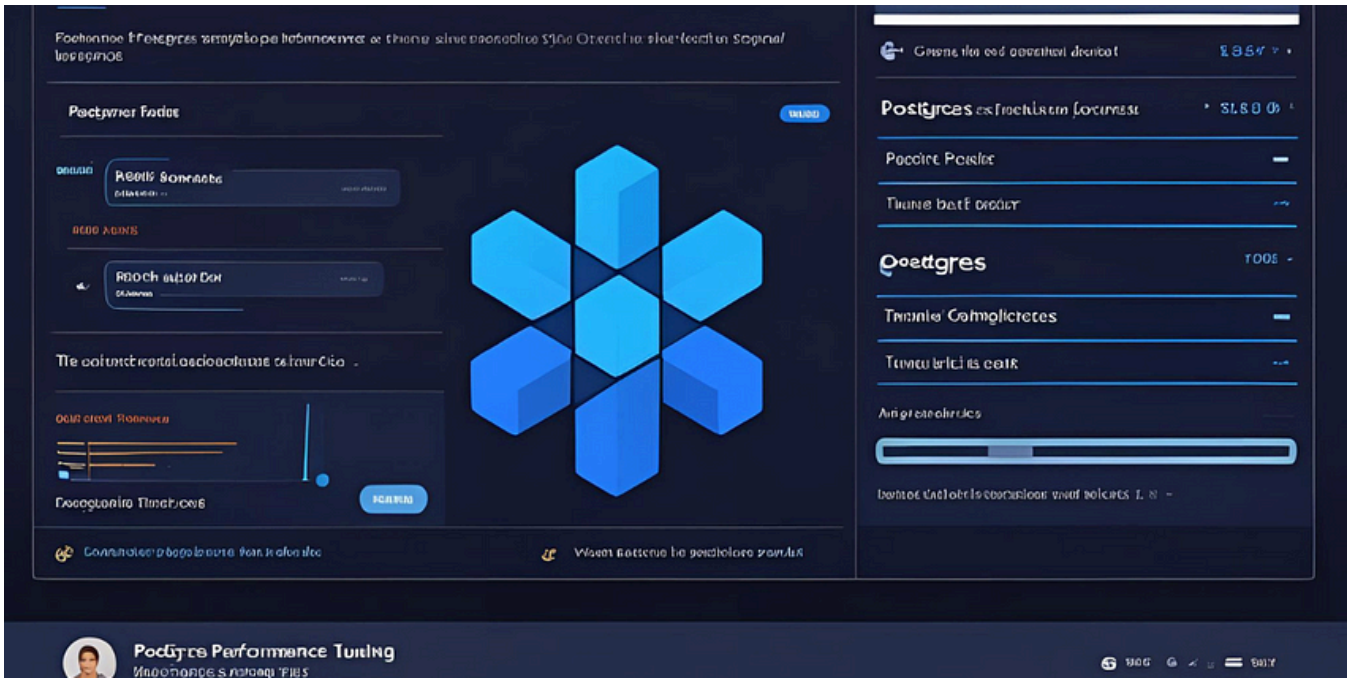

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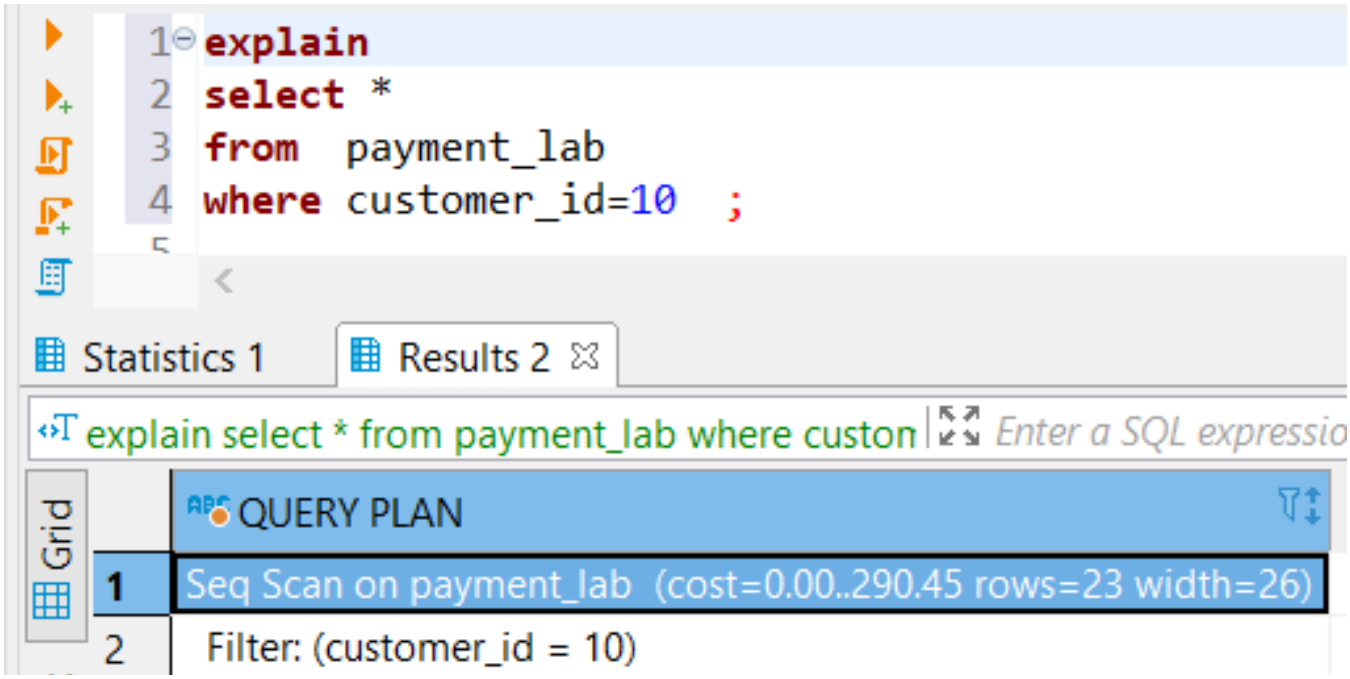

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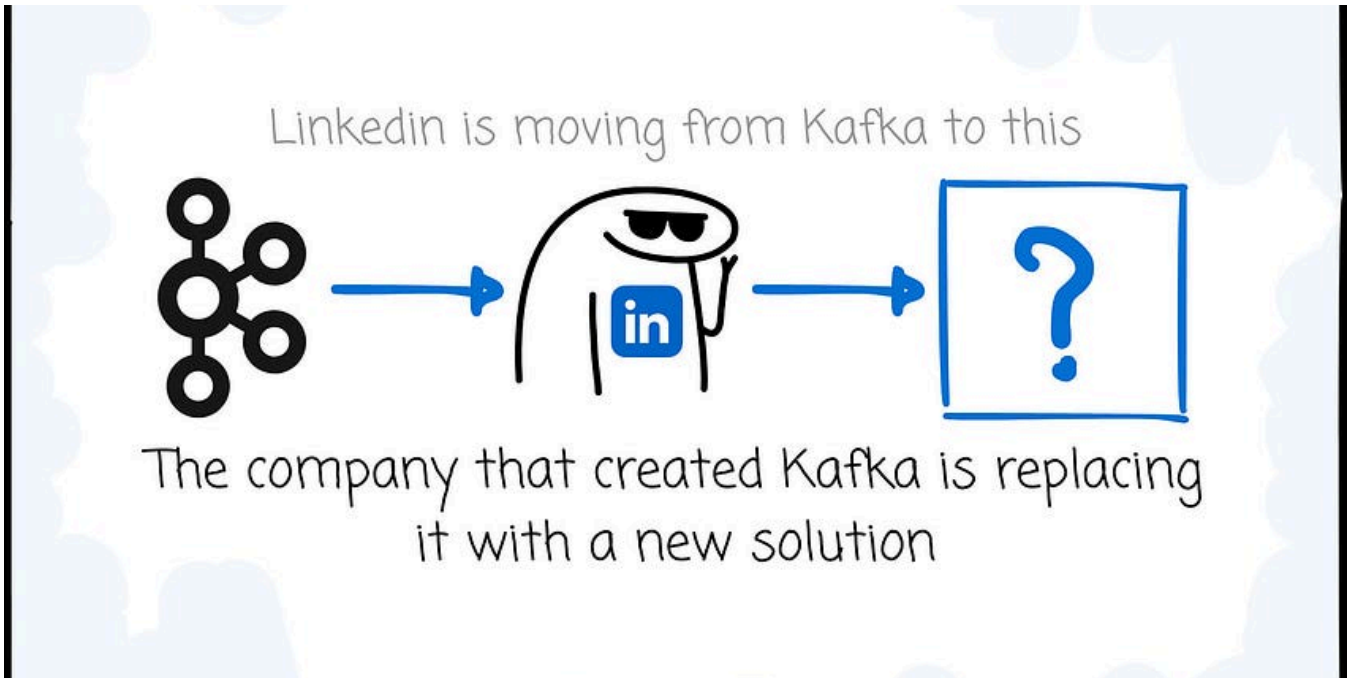

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