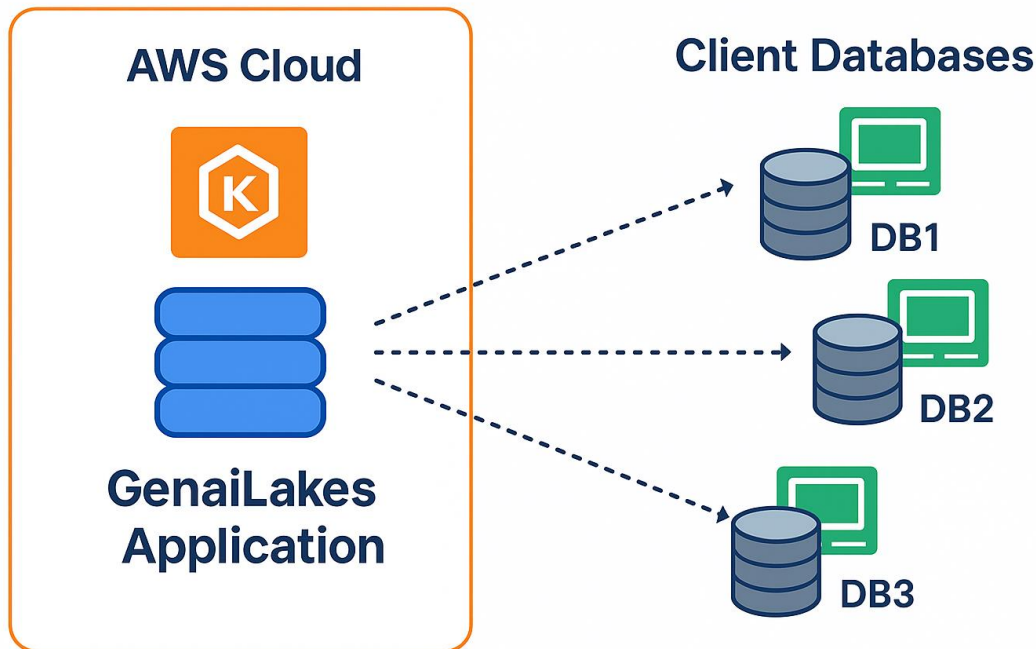


Multiple Tenant Databases



Project Overview

- GenAILakes is a **secure, scalable, and cost-effective** application designed to manage **multiple tenant databases** across different AWS environments. It enables each client to have **their own isolated PostgreSQL database** (hosted on AWS VMs) while providing **centralized application control, secure credential storage, and automated backup/restore** processes.
- With this architecture, businesses can ensure **data security, tenant isolation, and high availability**, while still benefiting from a **single, unified application interface**.

Architecture Overview

Components Used:

- **AWS EC2 (2 Virtual Machines)** – Each hosting PostgreSQL databases.
- **AWS S3 Bucket** – Stores automated and on-demand backups for quick recovery.
- **AWS Secrets Manager** – Securely stores and retrieves tenant database credentials.
- **AWS IAM** – Manages user roles, permissions, and security policies.
- **pgAdmin4 (Local)** – Centralized database administration from a local machine.

Flow:

1. **GenAllakes Application** connects to the appropriate tenant database (DB1, DB2, ...) based on the client.
2. **Tenant credentials** are securely fetched from AWS Secrets Manager.
3. **Automated backups** are stored in AWS S3, with on-demand restore capability.
4. **pgAdmin4** allows centralized monitoring and administration.

Main Aim of the Project:

To provide a **single application** that can **securely manage multiple client databases** across AWS environments with:

- **Tenant isolation** for security and compliance.
- **Automated & on-demand backups** for disaster recovery.
- **Centralized control** for easier management and scalability.

This architecture is ideal for **multi-client SaaS products, data platforms, and enterprise services** that require **separate databases per customer**.

Key Features:

- **Multi-Tenant Isolation** – Each client has their own **PostgreSQL** database to ensure no data leakage.
- **Secure Credential Storage** – Uses **AWS Secrets Manager** to protect database credentials.
- **Automated & On-Demand Backups** – AWS S3 stores versioned backups with restore capability.
- **High Availability** – Spread across multiple AWS VMs for redundancy.
- **Centralized Administration** – Manage all tenant databases via **pgAdmin4** from a single interface.
- **Scalable Architecture** – Easily add new tenants without affecting existing ones.

Benefits (Pros)

- **Security** – Credentials and data are stored securely using AWS Cloud.
- **Scalability** – Add or remove tenants quickly without downtime.
- **Disaster Recovery** – S3 backup and restore ensures business continuity.
- **Performance Isolation** – One tenant's workload does not impact another's.

Why Tenant Databases Are Important

Tenant databases are **the backbone** of secure, multi-tenant applications. They:

- Ensure **data isolation**, preventing one client from accessing another's data.
- Allow **customized configurations** for each client (indexes, extensions, optimizations).

- Improve **performance predictability**, as queries are not competing across tenants.
- Simplify **compliance audits** by maintaining separate database instances.

Example Use Cases

- **SaaS Platforms** – One app, multiple clients, each with its own database.
- **HR & Payroll Systems** – Each company's employee data is isolated.
- **Healthcare Data Management** – Separate patient data per hospital or clinic.
- **Educational Portals** – Different schools/universities have separate datasets.

AWS EC2 Virtual Machines:

The image displays two screenshots of the AWS Management Console, specifically the EC2 Instances page, illustrating a multi-tenant database architecture across different AWS regions.

Top Screenshot (Asia Pacific (Mumbai) Region):

- URL:** `https://ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#Instances:v=3;$case=tags:true%5C,client:false;$regex=tags:false%5C,client:...`
- Instance List:**

Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Database1	i-0c5771c924871c465	Running	t2.micro	2/2 checks passed	View alarms
- Instance Details (i-0c5771c924871c465):**
 - Instance ID:** i-0c5771c924871c465
 - Public IPv4 address:** 15.206.92.94
 - Private IPv4 addresses:** 172.31.137.1

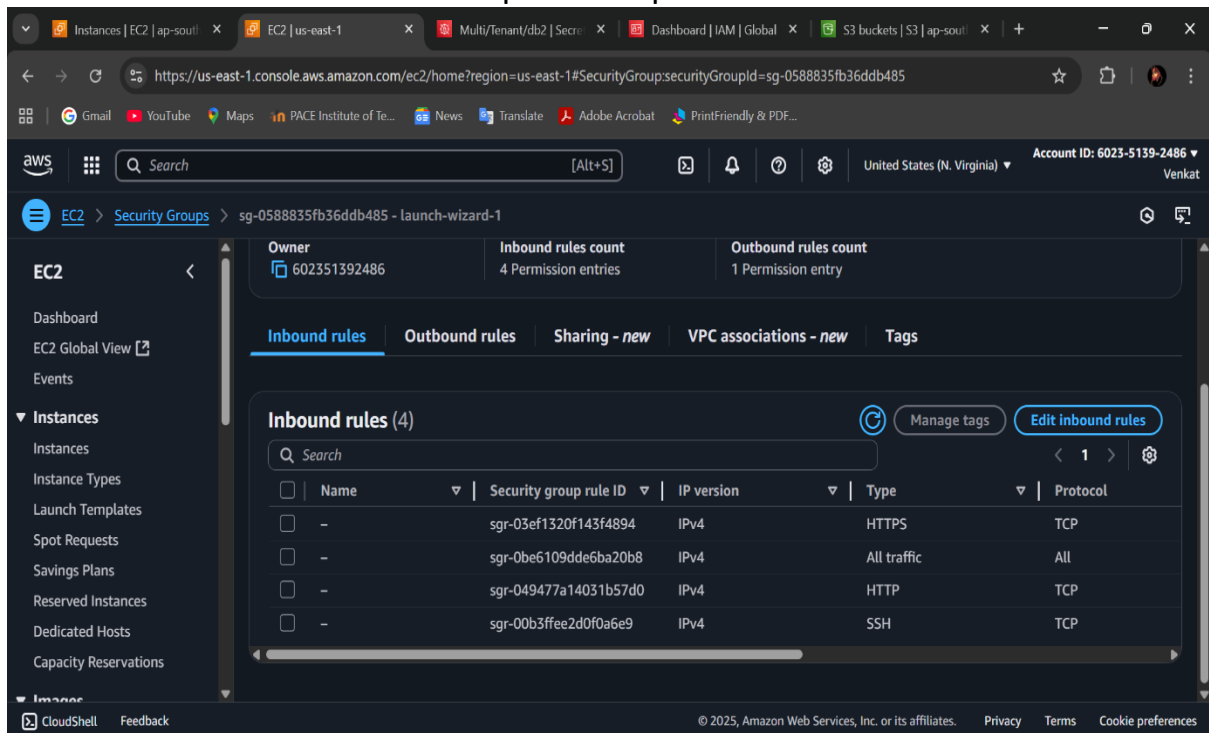
Bottom Screenshot (United States (N. Virginia) Region):

- URL:** `https://us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#Instances:v=3;$case=tags:true%5C,client:false;$regex=tags:false%5C,client:...`
- Instance List:**

Name	Instance ID	Instance state	Instance type	Status check	Alarm status
Database2	i-0fa84f171305b629f	Running	t2.micro	2/2 checks passed	View alarms
- Instance Details (i-0fa84f171305b629f):**
 - Instance ID:** i-0fa84f171305b629f
 - Public IPv4 address:** 54.197.2.231
 - Private IPv4 addresses:** 172.31.21.9

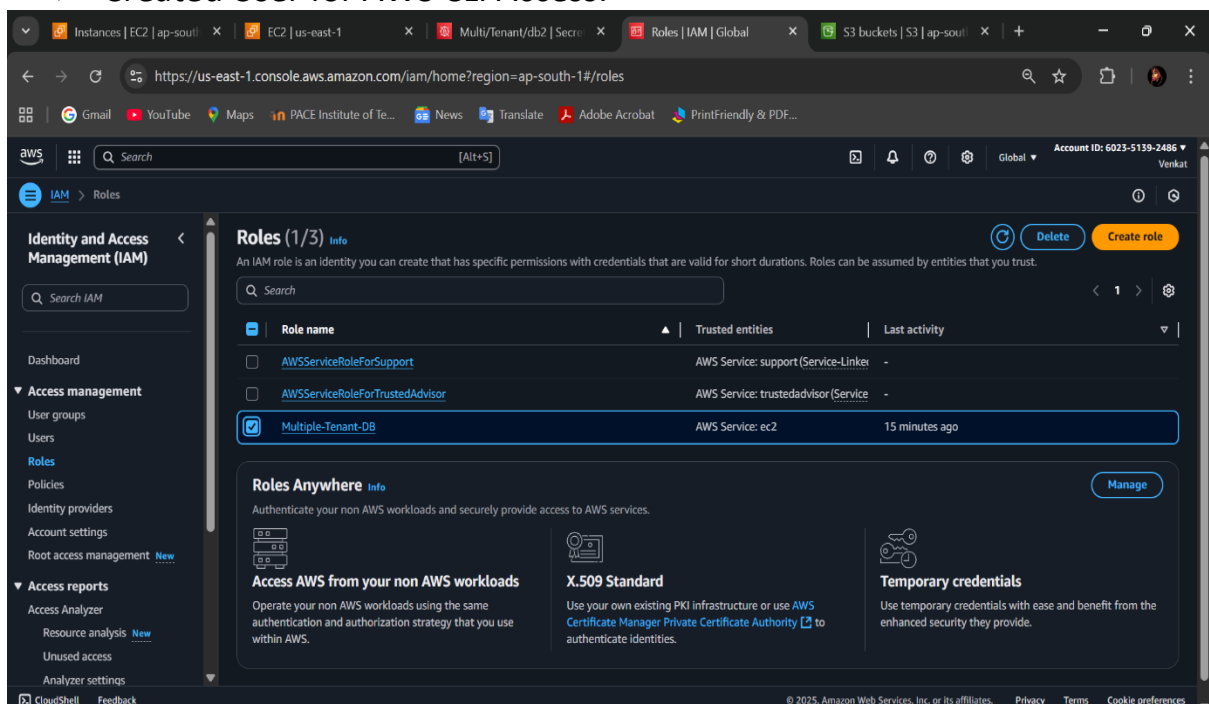
Security Groups:

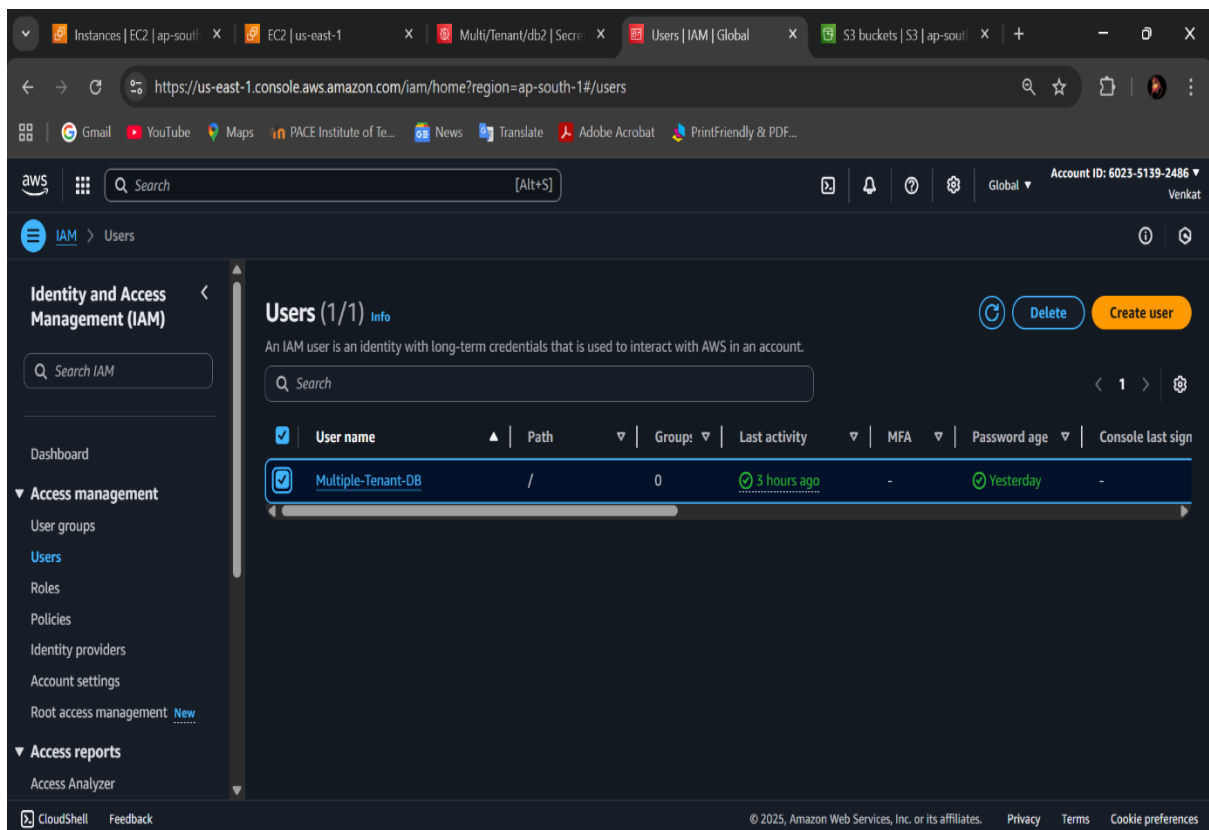
- Security Groups Created for testing purpose (Allowed All Traffic) in the Production we can allow Specific required Ports.



Identity and Access Management (IAM):

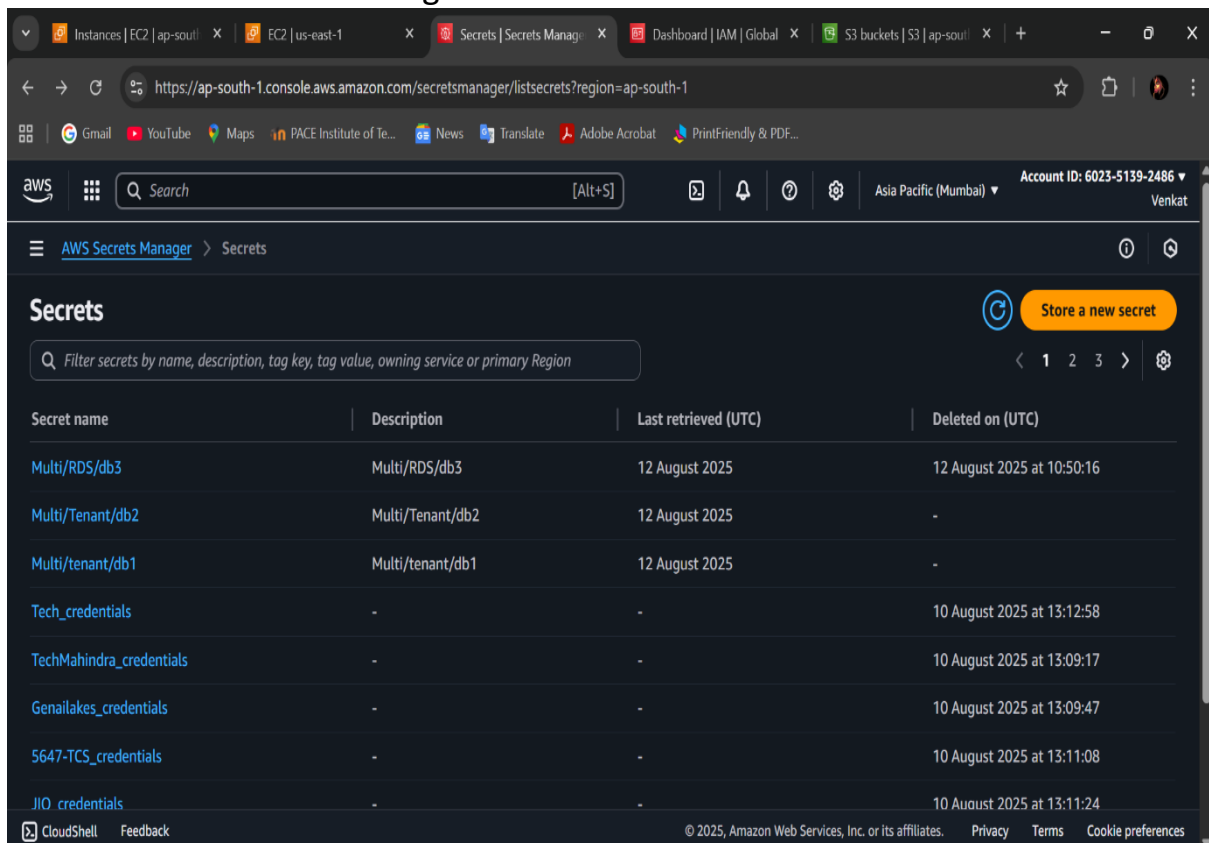
- Created IAM Role for Allowed the permissions for S3 Bucket and Secret Manager.
- Attach the IAM Roles to your EC2 Virtual machines.
- Created User for AWS CLI Access.





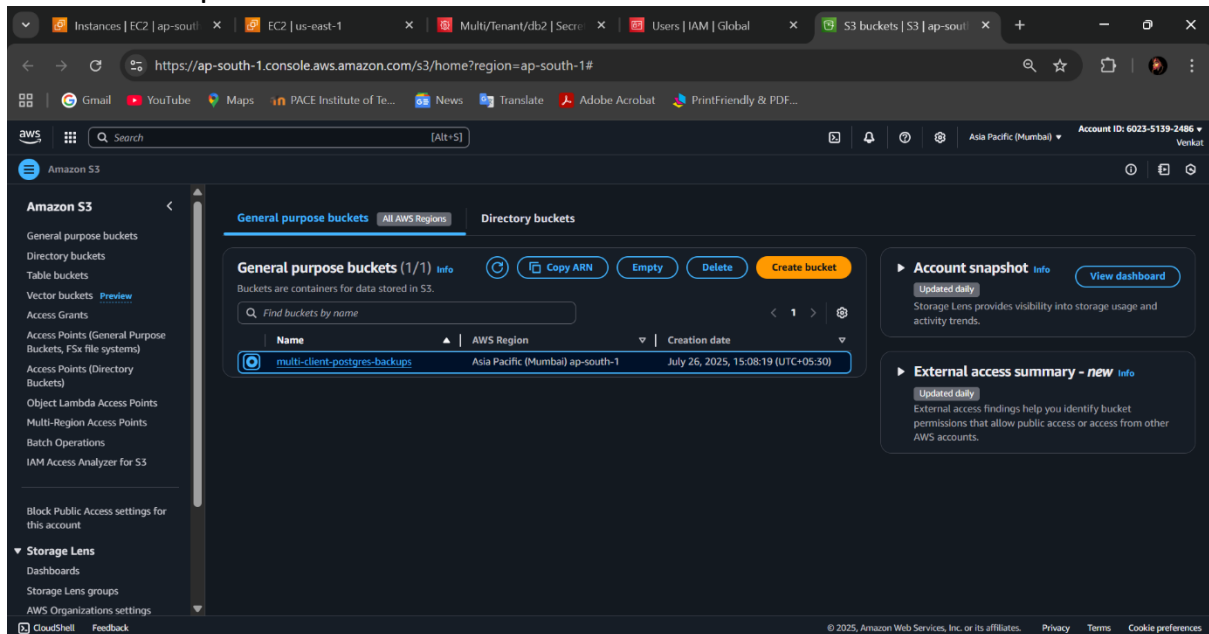
Secret Manager:

➤ Created Secret Manager to store the Tenants Credentials



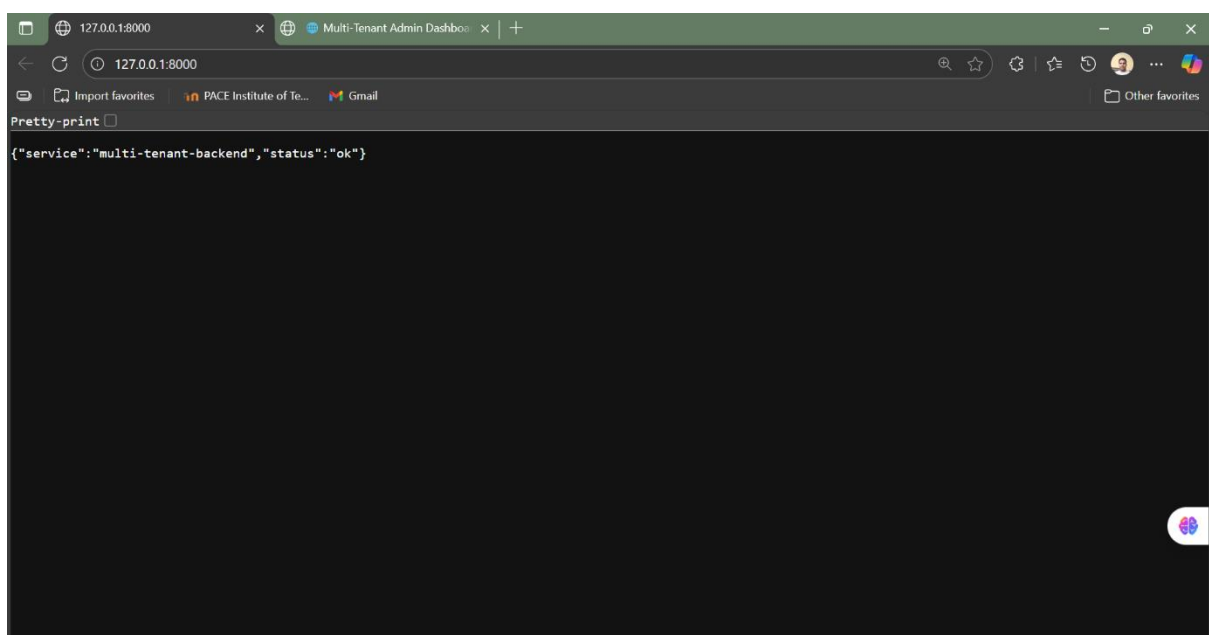
S3 Bucket:

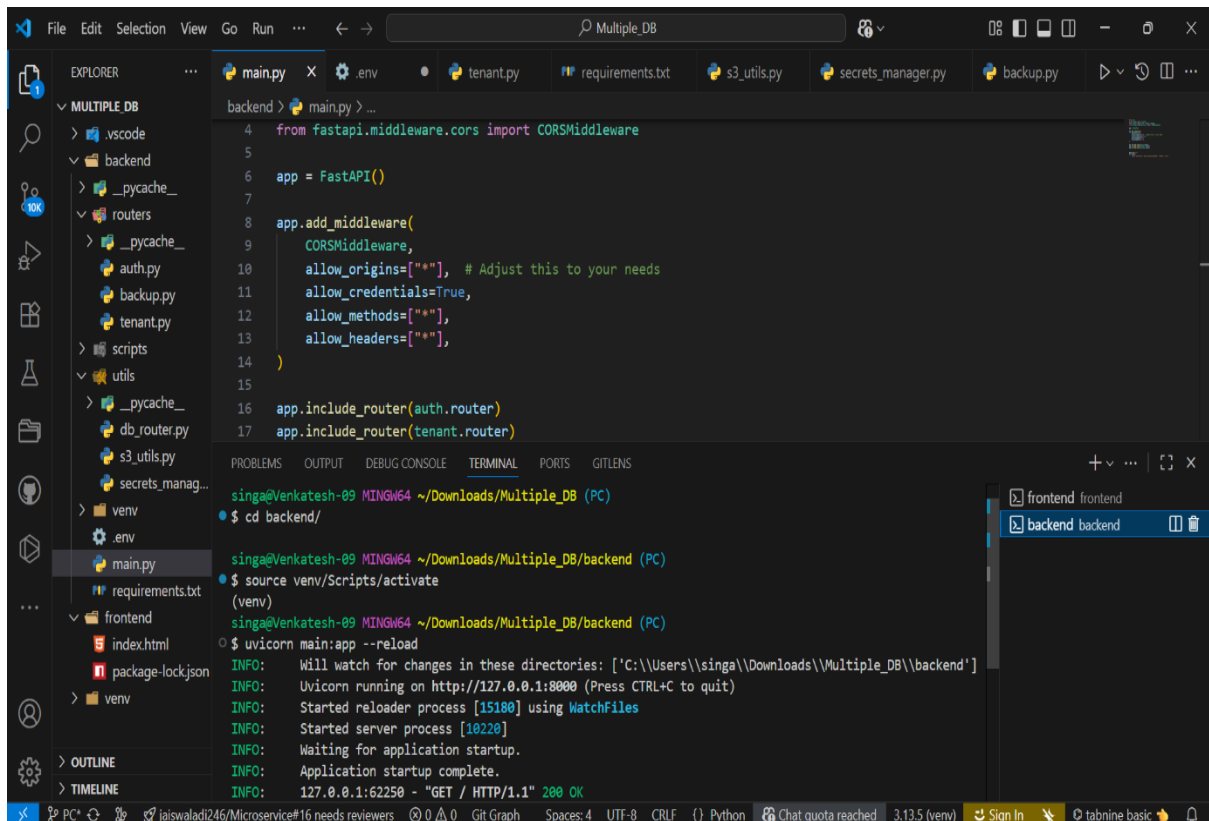
- Created S3 Bucket for to store the Tenants data for Backups & Restore if we required.



Backend:

- python -m venv venv
- source venv/Scripts/activate
- pip install -r requirements.txt
- uvicorn main:app --reload
- Select the URL <http://127.0.0.1:8000>
- You can connect successfully





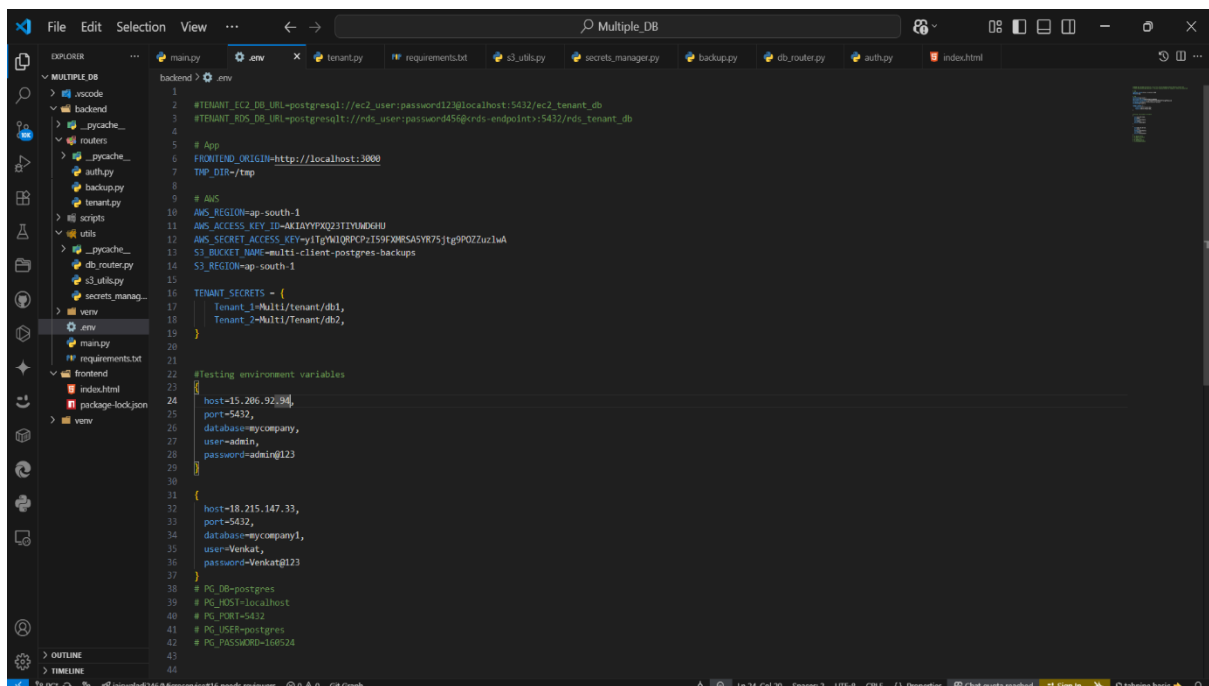
```
backends > main.py > ...
4 from fastapi.middleware.cors import CORSMiddleware
5
6 app = FastAPI()
7
8 app.add_middleware(
9     CORSMiddleware,
10     allow_origins=["*"], # Adjust this to your needs
11     allow_credentials=True,
12     allow_methods=["*"],
13     allow_headers=["*"],
14 )
15
16 app.include_router(auth.router)
17 app.include_router(tenant.router)
```

```
singa@Venkatesh-09 MINGW64 ~/Downloads/Multiple_DB (PC)
$ cd backend/

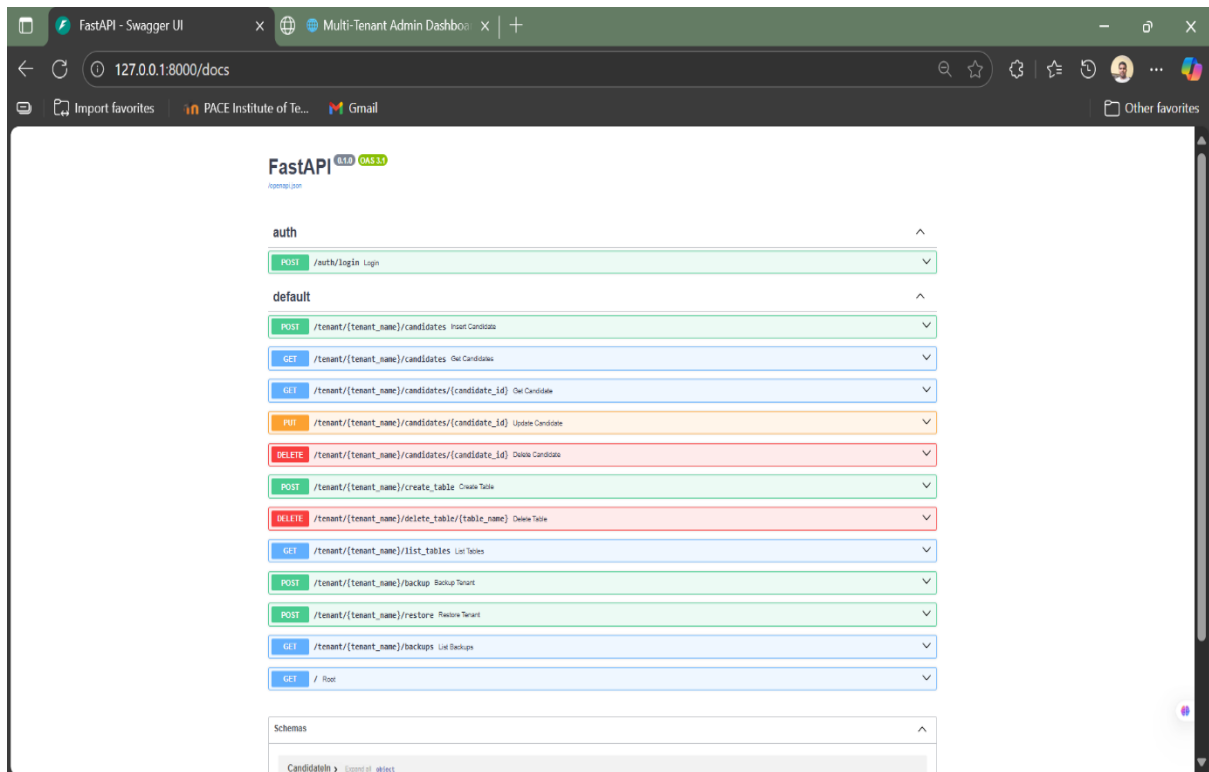
singa@Venkatesh-09 MINGW64 ~/Downloads/Multiple_DB/backend (PC)
$ source venv/Scripts/activate
(venv)
singa@Venkatesh-09 MINGW64 ~/Downloads/Multiple_DB/backend (PC)
$ uvicorn main:app --reload
INFO: Will watch for changes in these directories: ['C:\\Users\\singa\\Downloads\\Multiple_DB\\backend']
INFO: Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
INFO: Started reloader process [15180] using WatchFiles
INFO: Started server process [10228]
INFO: Waiting for application startup.
INFO: Application startup complete.
INFO: 127.0.0.1:62250 - "GET / HTTP/1.1" 200 OK
```

.env

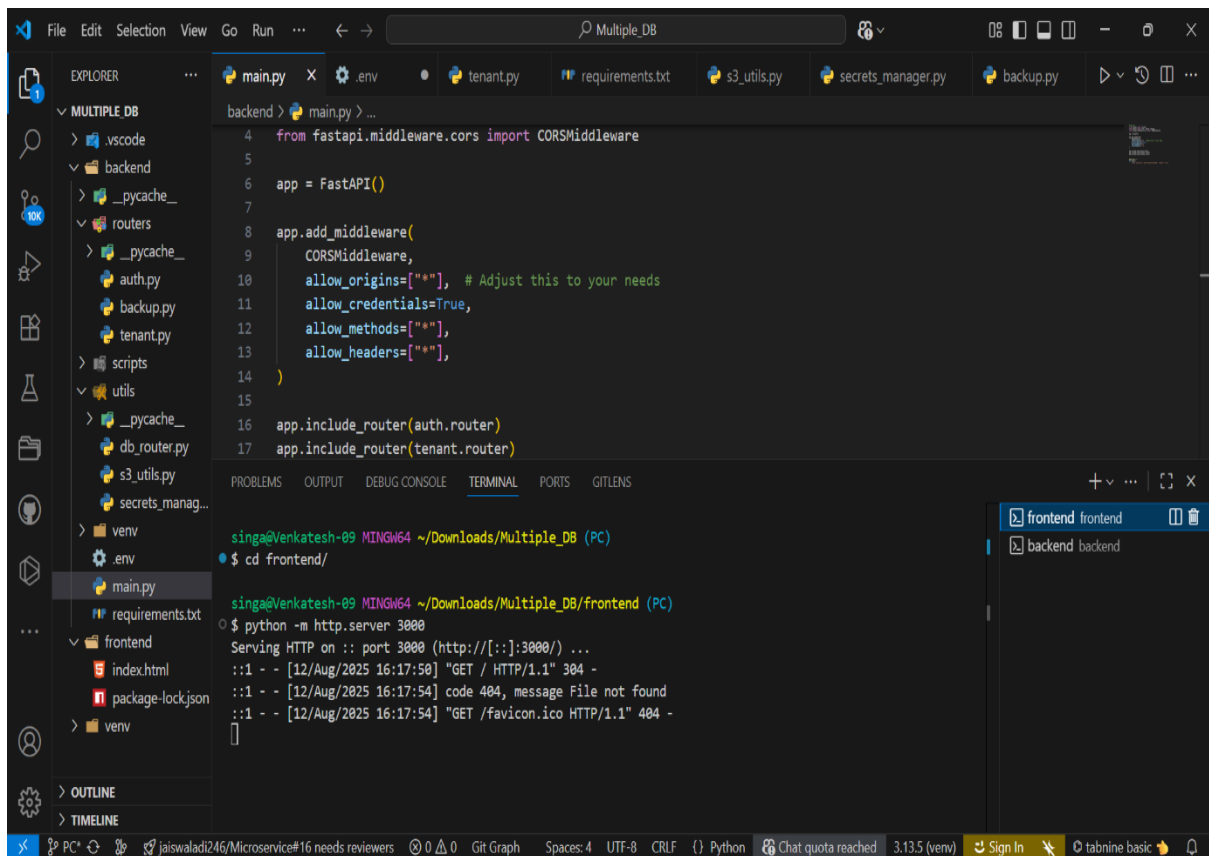
- To store each Tenants Credentials in .env file in the backend so it can fetch the credentials and it will connect/Routes to Correct Tenants Databases.



```
backends > .env
1 #TENANT_IC2_DB_URL=postgres://ec2_user:password123@localhost:5432/ec2_tenant_db
2 #TENANT_RDS_DB_URL=postgres://rds_user:password456@rds-endpoint:5432/rds_tenant_db
3
4 # App
5 FRONTEND_ORIGIN=http://localhost:3000
6 TMP_DIR=/tmp
7
8 # AWS
9 AWS_REGION=ap-south-1
10 AWS_ACCESS_KEY_ID=AKIAIYPPQ23TIYMDGHU
11 AWS_SECRET_ACCESS_KEY=yTgWlQBPcP:159FXHRSASVR75jtg9POZuzlwA
12 S3_BUCKET_NAME=multi-client-postgres-backups
13 S3_REGION=ap-south-1
14
15 TENANT_SECRETS = {
16     Tenant_1=Multi/Tenant/db1,
17     Tenant_2=Multi/Tenant/db2,
18 }
19
20 #Testing environment variables
21
22 host=15.206.92.94,
23 port=5432,
24 database=mycompany,
25 user=admin,
26 password=admin123
27
28 {
29     host=18.215.147.33,
30     port=5432,
31     database=mycompany1,
32     user=Venkat,
33     password=Venkat123
34 }
35
36 # PG_DB=postgres
37 # PG_HOST=localhost
38 # PG_PORT=5432
39 # PG_USER=postgres
40 # PG_PASSWORD=160524
```

Frontend:



Successfully Connected to the Correct Tenant Databases like (DB1 & DB2)

The image displays a web application interface for a Multi-Tenant Admin Panel and a pgAdmin 4 database management tool.

Multi-Tenant Admin Panel:

- Submit Candidate:** A form with fields for Name (Rajasekhar Reddy), Job Role (Azure DevOps Engineer), Email (Sekhar1532@gmail.com), Phone (6301999310), Location (Hyderabad), and Tenant (Tenant_1). A "Submit Candidate" button is at the bottom.
- Backup & Restore:** A section with a "Tenant ID (e.g., tenant_a)" input field and two buttons: "Backup Now" and "Load Backups".
- Notification:** A toast message from "localhost:3000" says "Candidate inserted" with an "OK" button.

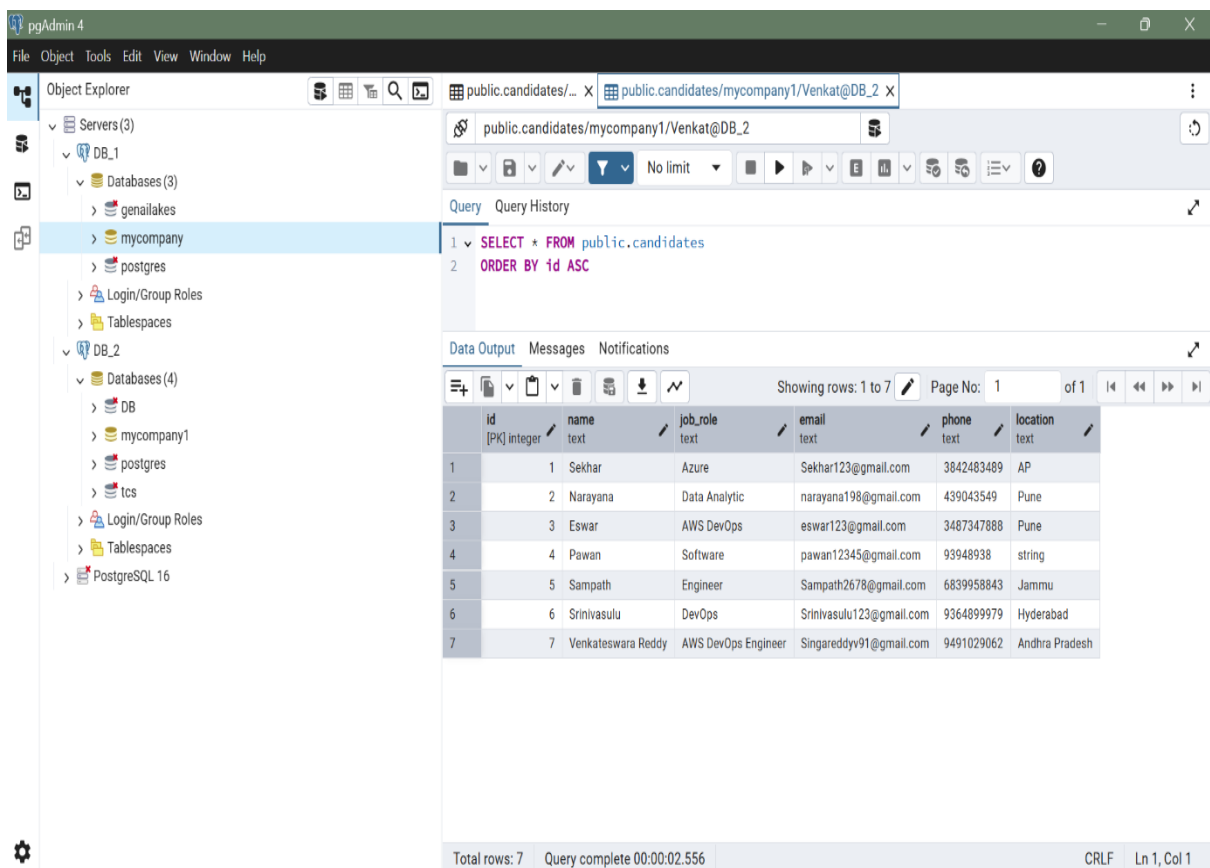
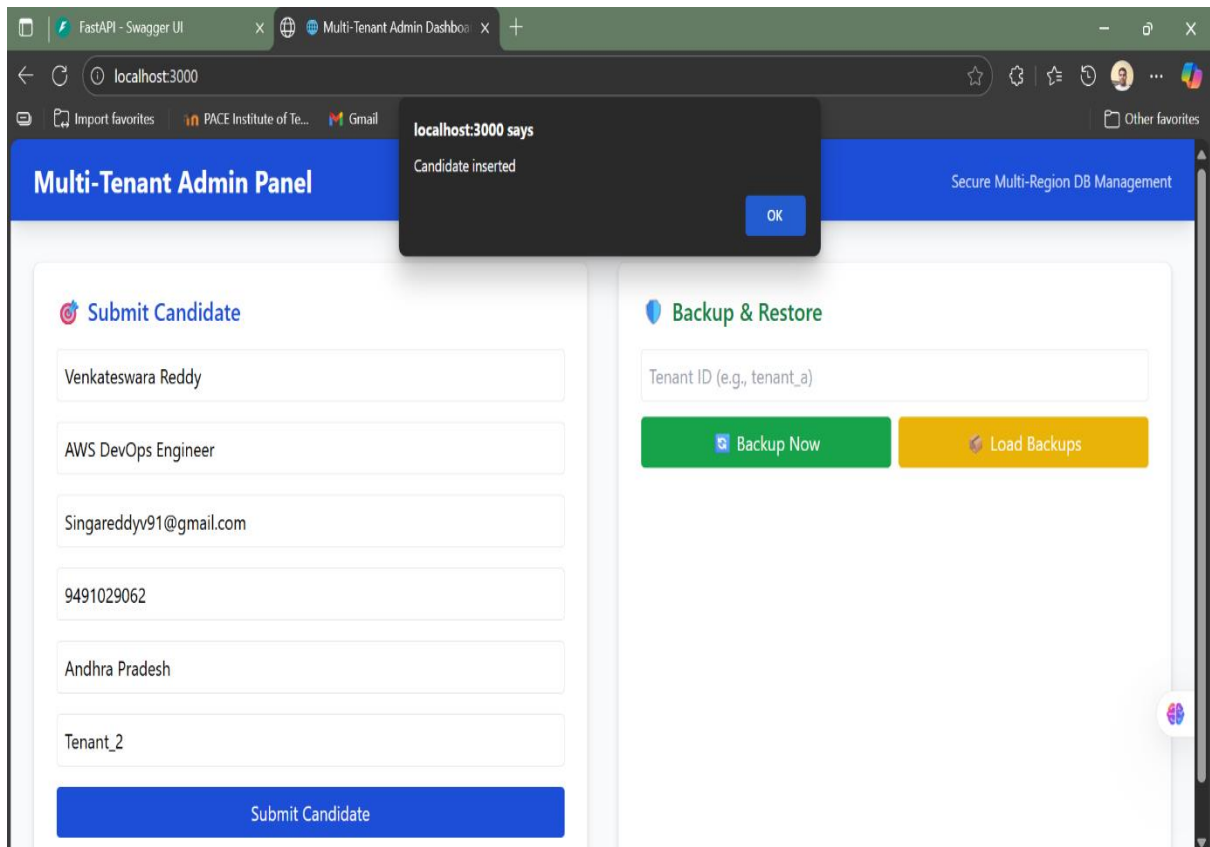
pgAdmin 4:

- Object Explorer:** Shows a tree view of database objects. The "mycompany" database under "DB_1" is selected.
- Query Editor:** Contains the SQL query:

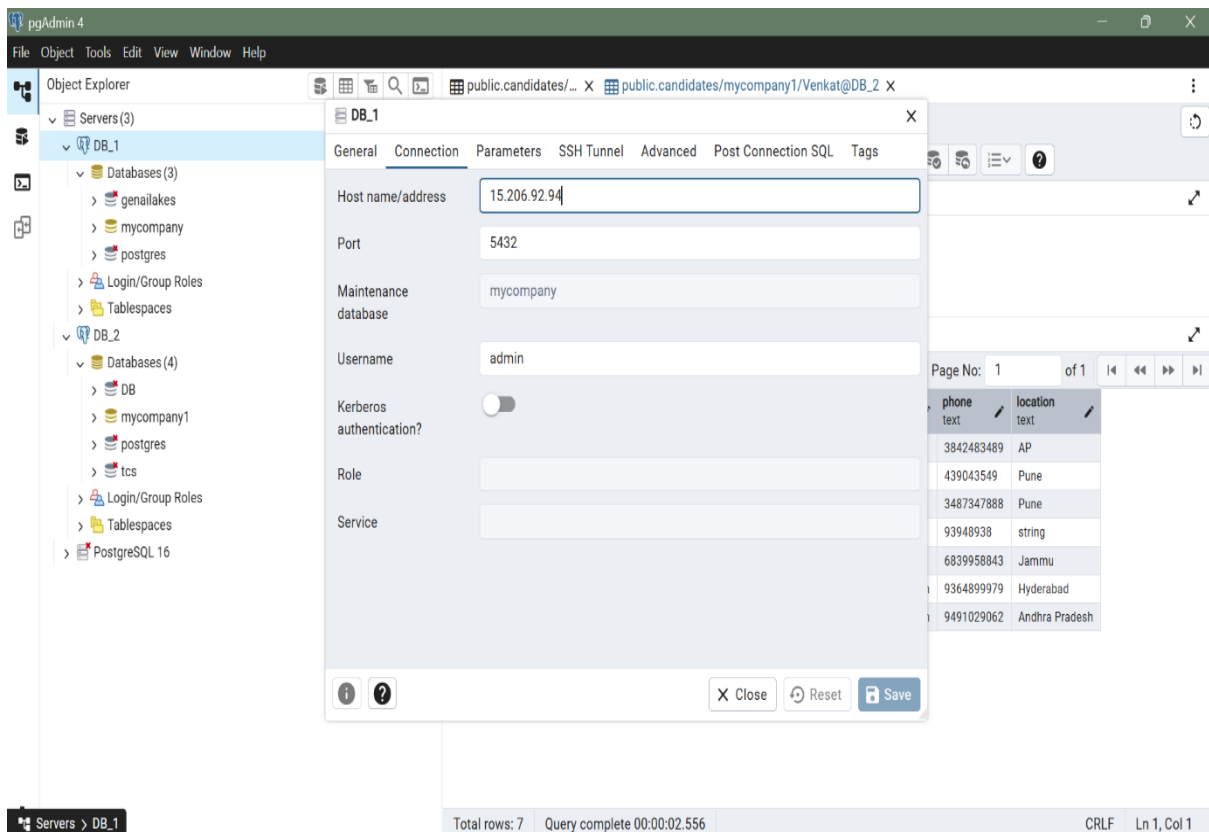
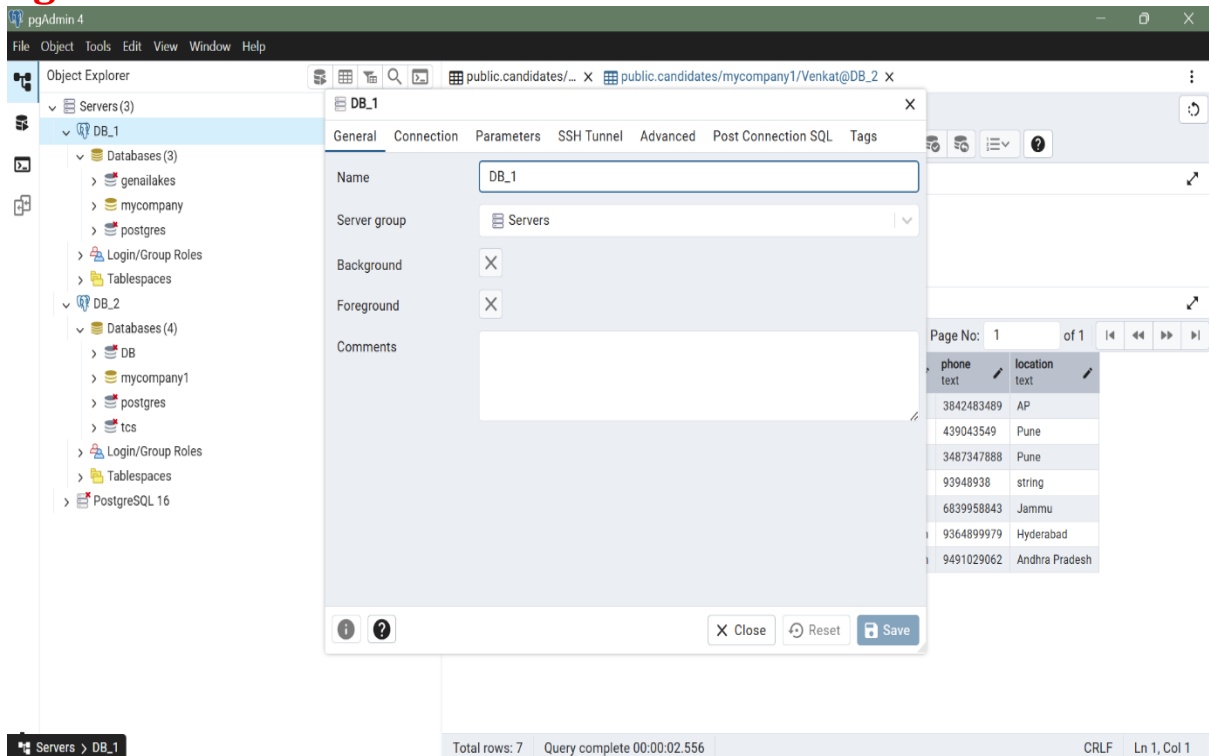
```
SELECT * FROM public.candidates ORDER BY id ASC
```
- Data Output:** Displays the results of the query in a table with 10 rows. The columns are: id, name, job_role, email, phone, and location.

id	name	job_role	email	phone	location
1	Venkatesh	AWS DevOps Engineer	Venkat123@gmail.com	9491029062	Hyderabad
2	string	string	string	string	string
3	Eswar	DATA SCIENCE	eswar123@gmail.com	7897866687	Chennai
4	Venkatesh	data	data123@gmail.com	939459485	Delhi
5	Ramesh	engineer	ramesh123@gmail.com	394398889	Lucknow
6	Rajesh	Data Engineer	Rajesh456@gmail.com	3883437998	Lucknow
7	Kumari	manager	kumari1456@gmail.com	893887490	Chennai
8	Kumari	manager	kumari1456@gmail.com	893887490	Chennai
9	venkatesh	AWS DevOps	singareddy91@gmail.com	9491029062	Mumbai
10	Rajasekhar Reddy	Azure DevOps Engineer	Sekhar1532@gmail.com	6301999310	Hyderabad

Total rows: 10 Query complete 00:00:00.951 CRLF Ln 1, Col 1



Pgadmin4 Centralized Database Connections:



- If you try to Connect to the Another Database, it will Failures due to the Credentials are not included in the (.env file & Secret Manager).

```
File Edit Selection View ... Multiple_DB
EXPLORER
  MULTIPLE_DB
    backend
      .env
      main.py
      requirements.txt
    frontend
      index.html
      package-lock.json
      venv
    venv
      .env
      main.py
      requirements.txt
      scripts
      utils
      db_router.py
      s3_utils.py
      secrets_manag...
      venv

main.py
backend
  .env
  23 {
  24   user=admin,
  25   password=admin@123
  26 }
  27
  28 {
  29   host=18.215.147.33,
  30   port=5432,
  31   database=mycompany1,
  32   user=Venkat,
  33   password=Venkat@123
  34 }
  35
  36 # PG_DB=postgres
  37 # PG_HOST=localhost
  38 # PG_PORT=5432
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