📌 What is **GRANT** in PostgreSQL?

In PostgreSQL, the **GRANT** command is used to **give permissions (privileges)** to users (roles) on database objects like tables, schemas, or databases.

👉 In simple words: **GRANT = Give access to someone**

🎯 Why do we use GRANT?

We use `GRANT` to:

- 🔐 Control **who can access what**
- 🥷 Allow users to perform actions like:
  - `SELECT` (read data)
  - `INSERT` (add data)
  - `UPDATE` (modify data)
  - `DELETE` (remove data)
- 🛡️ Improve **database security**
- 👥 Support **multi-user environments**

📝 Basic Syntax

```
GRANT privilege(s)
ON object_name
TO role_name;
```

🧩 Common Privileges

Privilege	Meaning
SELECT	Read data
INSERT	Add new rows
UPDATE	Modify existing data
DELETE	Remove rows
ALL	All privileges

☑️ Example

Step 1: Create a user (role)

```
CREATE ROLE trainee WITH LOGIN PASSWORD '1234';
```

Step 2: Grant access to a table

```
GRANT SELECT ON customer TO trainee;
```

👉 Now `trainee` can only **view data** from `customer` table.

🔄 Multiple Privileges Example

```
GRANT SELECT, INSERT, UPDATE
ON customer
TO trainee;
```

👉 Now user can:

- Read
- Add
- Modify data

🌐 Grant on Entire Database

```
GRANT CONNECT ON DATABASE dvdrental TO trainee;
```

👉 Allows user to connect to the `dvdrental` database.

🧠 Important Notes

- You must be **owner or superuser** to grant permissions.
- Permissions can be revoked using `REVOKE`.
- Roles can be users or groups.

🧪 Practical Lab Exercise (Beginner Friendly)

🎯 Objective:

Learn how to control access using GRANT.

◇ Task 1: Create a Role

```
CREATE ROLE student1 WITH LOGIN PASSWORD 'pass123';
```

◇ Task 2: Grant Database Access

```
GRANT CONNECT ON DATABASE dvdrental TO student1;
```

◇ Task 3: Grant Read Access

```
GRANT SELECT ON film TO student1;
```

👉 Test: Login as `student1` and run:

```
SELECT * FROM film;
```

◇ Task 4: Try Restricted Action

```
INSERT INTO film(title) VALUES ('Test Movie');
```

❌ This should fail (no INSERT permission)

◇ Task 5: Grant INSERT Permission

```
GRANT INSERT ON film TO student1;
```

👉 Try INSERT again → ☑ Should work

◇ Task 6: Grant All Permissions

```
GRANT ALL ON film TO student1;
```

◇ Challenge Task 💡

1. Create another role `viewer`
2. Allow only SELECT on `actor` table
3. Block all other operations

📋 Summary

- `GRANT` = Give permission
- Used for **security & access control**
- Works on tables, databases, schemas
- Helps manage **multiple users safely**

Below is a **complete step-by-step real-world university system scenario** showing:

✔ Database creation ✔ Table design ✔ Role creation ✔ GRANT usage (security layer) ✔ Testing access like a real system

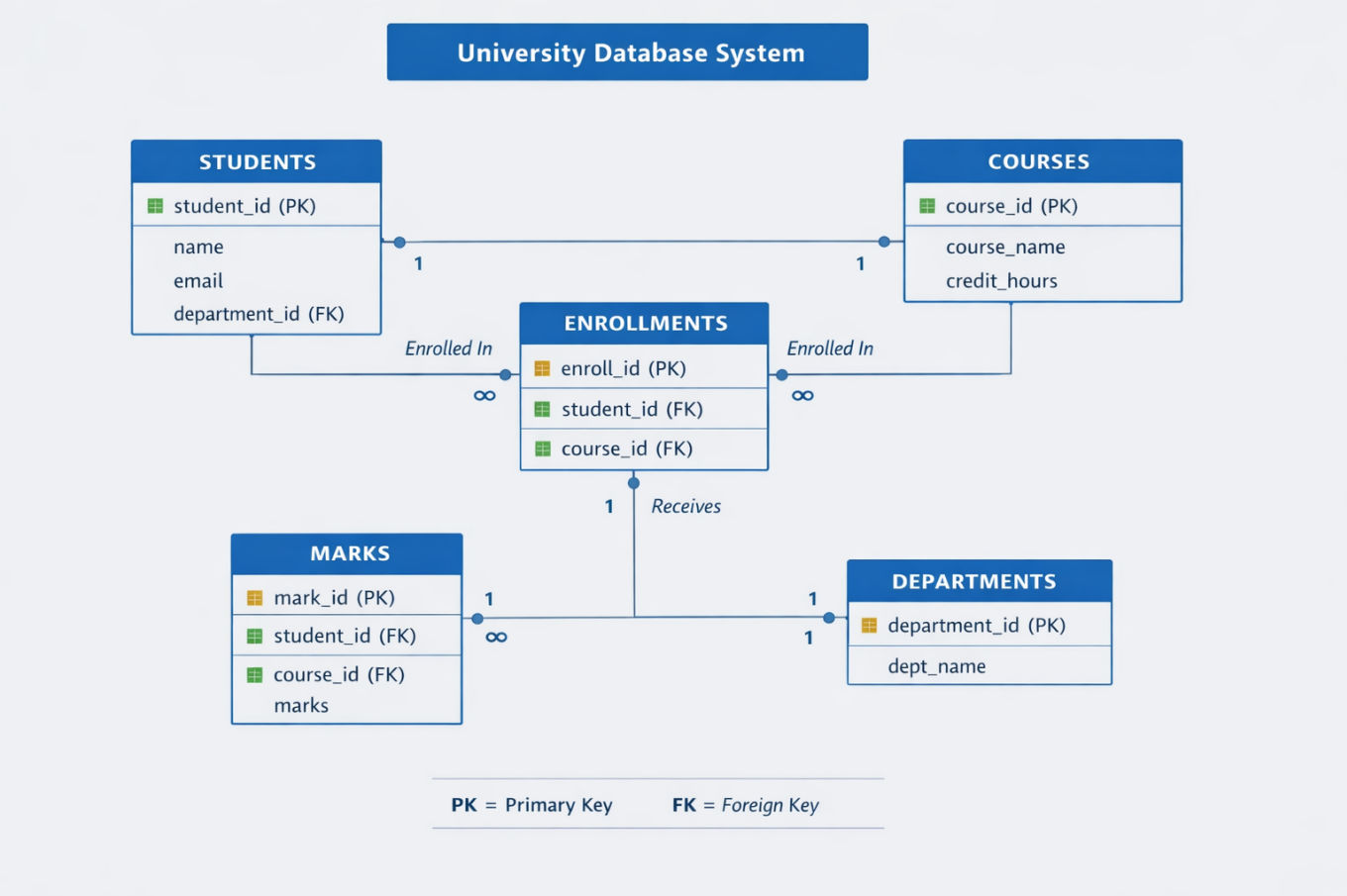
Using PostgreSQL

🎓 University System with GRANT (Step-by-Step Lab)

🏁 Goal

We will build a small **University Database System** where:

- Students can only view data
- Teachers can manage marks
- Admin controls everything using GRANT



ERD Diagram for University Database System

STEP 1: Create Database

```
CREATE DATABASE university_db;
```

Now connect to database:

```
\c university_db
```

STEP 2: Create Main Tables

2.1 Students Table

```
CREATE TABLE students (
    student_id SERIAL PRIMARY KEY,
    name VARCHAR(100),
    department VARCHAR(50),
```

```
    email VARCHAR(100)
);
```

📓 2.2 Courses Table

```
CREATE TABLE courses (
    course_id SERIAL PRIMARY KEY,
    course_name VARCHAR(100),
    credit_hours INT
);
```

📓 2.3 Enrollments Table

```
CREATE TABLE enrollments (
    enroll_id SERIAL PRIMARY KEY,
    student_id INT REFERENCES students(student_id),
    course_id INT REFERENCES courses(course_id)
);
```

📓 2.4 Marks Table

```
CREATE TABLE marks (
    mark_id SERIAL PRIMARY KEY,
    student_id INT REFERENCES students(student_id),
    course_id INT REFERENCES courses(course_id),
    marks INT
);
```

👥 STEP 3: Create Roles (Users)

🎓 Student Role

```
CREATE ROLE student WITH LOGIN PASSWORD '123';
```

👩‍🏫 Teacher Role

```
CREATE ROLE teacher WITH LOGIN PASSWORD '123';
```

Admin Role

```
CREATE ROLE admin WITH LOGIN PASSWORD 'admin123';
```

STEP 4: Grant Database Access

Allow connection to database

```
GRANT CONNECT ON DATABASE university_db TO student;
GRANT CONNECT ON DATABASE university_db TO teacher;
GRANT CONNECT ON DATABASE university_db TO admin;
```

STEP 5: GRANT Permissions (Core Security)

5.1 Student Permissions (Read Only)

```
GRANT SELECT ON students TO student;
GRANT SELECT ON courses TO student;
GRANT SELECT ON enrollments TO student;
GRANT SELECT ON marks TO student;
```

Students can ONLY VIEW data

Cannot insert/update/delete

5.2 Teacher Permissions

```
GRANT SELECT ON students TO teacher;
GRANT SELECT ON courses TO teacher;
GRANT SELECT ON enrollments TO teacher;
```

Teachers can manage marks:

```
GRANT SELECT, INSERT, UPDATE ON marks TO teacher;
```

5.3 Admin Permissions (Full Control)

```
GRANT ALL PRIVILEGES ON students TO admin;
GRANT ALL PRIVILEGES ON courses TO admin;
GRANT ALL PRIVILEGES ON enrollments TO admin;
GRANT ALL PRIVILEGES ON marks TO admin;
```

STEP 6: Insert Sample Data (Admin Role)

```
INSERT INTO students (name, department, email)
VALUES
('Ali Khan', 'CS', 'ali@uni.edu'),
('Sara Ahmed', 'IT', 'sara@uni.edu');
```

```
INSERT INTO courses (course_name, credit_hours)
VALUES
('Database Systems', 3),
('Web Development', 4);
```

STEP 7: Testing Role Access

Login as Student

```
SELECT * FROM students;
```

✔ Allowed

❌ Try Insert (Should FAIL)

```
INSERT INTO students(name, department, email)
VALUES ('Test Student', 'CS', 'test@uni.edu');
```

```
```

👉 ERROR: permission denied

👩‍🏫 Login as Teacher

✔ View students

```
SELECT * FROM students;
```

✔ Insert marks

```
INSERT INTO marks(student_id, course_id, marks)
VALUES (1, 1, 85);
```

✔ Update marks

```
UPDATE marks
SET marks = 90
WHERE student_id = 1;
```

👨‍💼 Login as Admin

Full control:

```
DELETE FROM students WHERE student_id = 2;
```

✔ Works

🧠 STEP 8: How GRANT Works (Concept)

Think of it like a University Gate System:

Role	Access Level
Student	Read only (library access)
Teacher	Edit marks + view data
Admin	Full control (system owner)

STEP 9: Security Logic (Important)

✔ GRANT = give permission ✔ REVOKE = remove permission ✔ Roles = users or groups

👉 Without GRANT: Users cannot even see tables

FINAL SUMMARY

In this real-world university system:

✔ Database created ✔ Tables designed ✔ Roles created ✔ Permissions assigned using GRANT ✔ Access controlled by role type

---