

## Hands-on Lab: Database Design using ERDs



Estimated time needed: 45 minutes

In this lab, you will learn how to design a database by creating an entity relationship diagram (ERD) in the PostgreSQL database service using the pgAdmin graphical user interface (GUI) tool. First, you will create an ERD of a database. Next, you will generate and execute an SQL script to create the database schema from its ERD. Finally, you will load the created database schema with data.

### Software used in this lab

In this lab, you will use [PostgreSQL Database](#). PostgreSQL is a Relational Database Management System (RDBMS) designed to efficiently store, manipulate, and retrieve data.



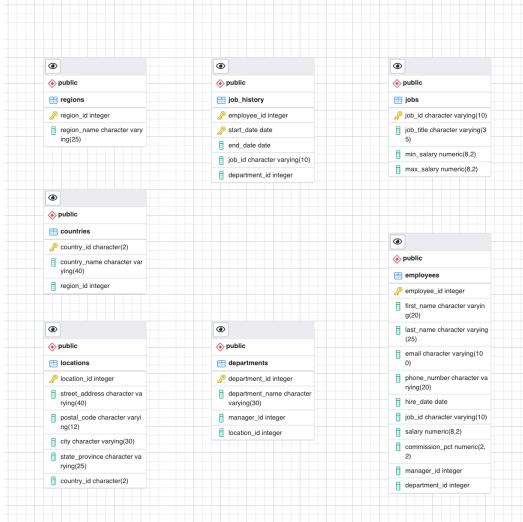
To complete this lab, you will utilize the PostgreSQL relational database service available as part of IBM Skills Network Labs (SN Labs) Cloud IDE. SN Labs is a virtual lab environment used in this course.

### Database used in this lab

The HR database used in this lab comes from the following source: [HR Sample Database](#) [Copyright 2021 - Oracle Corporation].

You will use a modified version of the database for the lab. To follow the lab instructions successfully, please use the database provided with the lab, rather than the database from the original source.

The following ERD shows the tables of the HR database:



### Objectives

After completing this lab, you will be able to use pgAdmin with PostgreSQL to:

- Create an ERD of a database.
- Generate and execute an SQL script from an ERD to create a schema.
- Load the database schema with data.

This lab is divided into two exercises, *Example Exercise* and *Practice Exercise*.

### Example Exercise

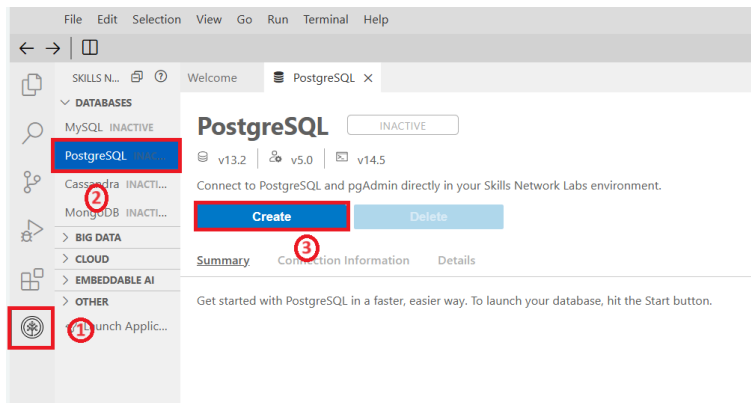
In this example exercise, you will first create a partial ERD of the HR database. Next, you will generate and execute an SQL script to create the partial schema of the HR database from its ERD. Finally, you will load the created database schema with data by using the Restore feature.

### Task A: Create an Entity Relationship Diagram (ERD) of a database

In this task of the Example Exercise, you will create a partial ERD of the HR database.

To get started with this lab, launch PostgreSQL using the Cloud IDE. You can do this by following these steps:

1. Click the Skills Network extension button on the left side of the window.
2. Open the DATABASES menu and click **PostgreSQL**.
3. Click **Create**. PostgreSQL may take a few moments to start.



4. Note down your PostgreSQL service session password because you may need to use it later in the lab.
5. Click the pgAdmin button in the same window where you started PostgreSQL.
6. You will see the pgAdmin GUI tool.


← → ↻ 🏠 [sandipsahajo-5050.theiadocker-27.proxy.cognitiveclass.ai/browser/](https://sandipsahajo-5050.theiadocker-27.proxy.cognitiveclass.ai/browser/)

**pgAdmin** File ▾ Object ▾ Tools ▾ Help ▾

Browser Servers

Dashboard Properties SQL Statistics Dependencies Dependents

### Welcome




# pgAdmin

Management Tools for PostgreSQL

Feature rich | Maximises PostgreSQL | Open Source


pgAdmin is an Open Source administration and management tool for the PostgreSQL database. It is designed to answer the needs of developers, DBAs and system administrators alike.

#### Quick Links




Add New Server

#### Getting Started



PostgreSQL Documentation



pgAdmin Website

7. In the tree-view, expand **Servers** > **postgres** > **Databases**. Enter your PostgreSQL service session password if prompted during the process. Right-click on **Databases** and go to **Create** > **Database**. Type **HR** as the name of the database and click **Save**.

**pgAdmin** File ▾ Object ▾ Tools ▾ Help ▾

Browser Servers (1) postgres Databases (1)

1 2 3

postgres

- Cast
- Catal
- Event Triggers
- Extensions
- Foreign Data Wrappers
- Languages
- Publications
- Schemas
- Subscriptions
- Login/Group Roles
- Tablespaces

Create > Database...

Refresh...

#### Server sessions

7
4
3
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#### Tuples in

1
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Create - Database

×

General

Definition

Security

Parameters

Advanced

SQL

Database

HR

Owner

postgres

Comment

i

?

✕ Cancel

↺ Reset

💾 Save

8. In the tree-view, expand **HR**. Right-click on **HR** and select **Generate ERD (Beta)**.

pgAdmin

File

Object

Tools

Help

Browser

Dashboard

Servers (1)

postgres

Databases (2)

HR

Cast

Catalog

Event Trigger

Extension

Foreign Data Wrapper

Language

Publication

Schema

Subscription

postgres

Cast

Catalog

Event Trigger

Extension

Foreign Data Wrapper

Language

Publication

Schema

Subscription

Login/Group Roles

Tablespaces

Create

Refresh...

Delete/Drop

CREATE Script

Disconnect Database...

Generate ERD (Beta)

Maintenance...

Backup...

Restore...

Grant Wizard...






Search Objects...

Query Tool









Properties...

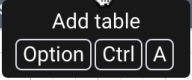
9. Click **Add table**. On the **General** tab, in the **Name** box, type **employees** as the name of the table. Don't click **OK**, proceed to the next step.

**pgAdmin** File ▾ Object ▾ Tools ▾ Help ▾

Browser     Dashboard Properties SQL Statistics Dependencies Dependents  Untitled

▾ Servers (1)  
▾ postgres  
▾ Databases (2)  
▾ HR  
    > Casts  
    > Catalogs


   1M MM     

HR/postgres 

**New table**

**General** Columns

Name

Schema  public

Comment

10. Switch to the **Columns** tab and click **Add new row** to add the necessary column placeholders. Now enter the **employees** table definition information as shown in the image below to create its entity diagram. Then click **OK**.

New table

General Columns

Columns +

	Name	Data type	Length/Precision	Scale	Not NULL?	Primary key?

✕ Cancel
OK

New table

General Columns

Columns

		Name	Data type	Length/Precision	Scale	No
		employee_id	integer			
		first_name	character varying	20		
		last_name	character varying	25		
		email	character varying	100		
		phone_number	character varying	20		
		hire_date	date			
		job_id	character varying	10		
		salary	numeric	8	2	
		commission_pct	numeric	2	2	
		manager_id	integer			
		department_id	integer			

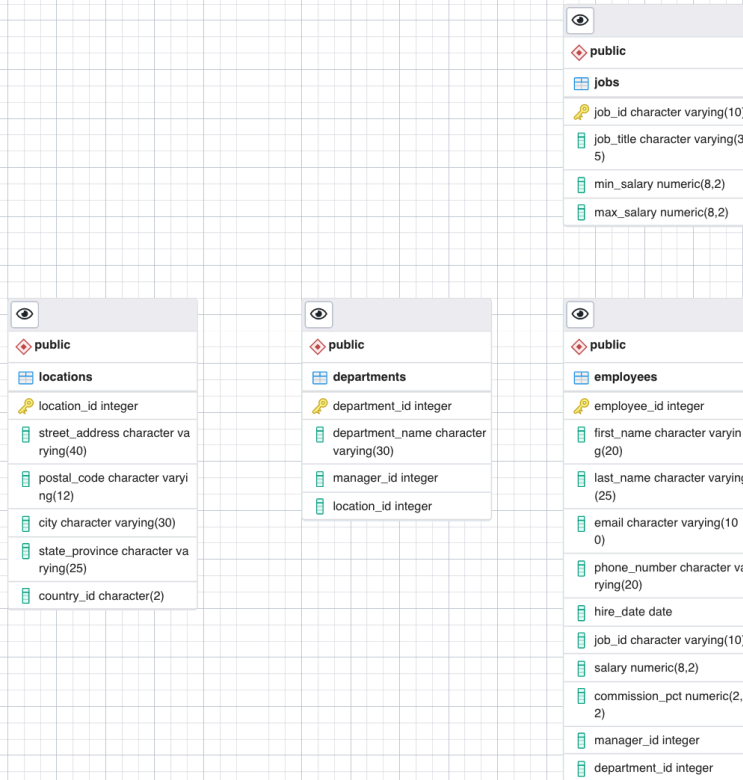
11. Similarly, create entity diagrams for the other three tables following steps 9 and 10:

- ▶ [\[Click here\]](#) Create an entity diagram for the jobs table
- ▶ [\[Click here\]](#) Create an entity diagram for the departments table
- ▶ [\[Click here\]](#) Create an entity diagram for the locations table

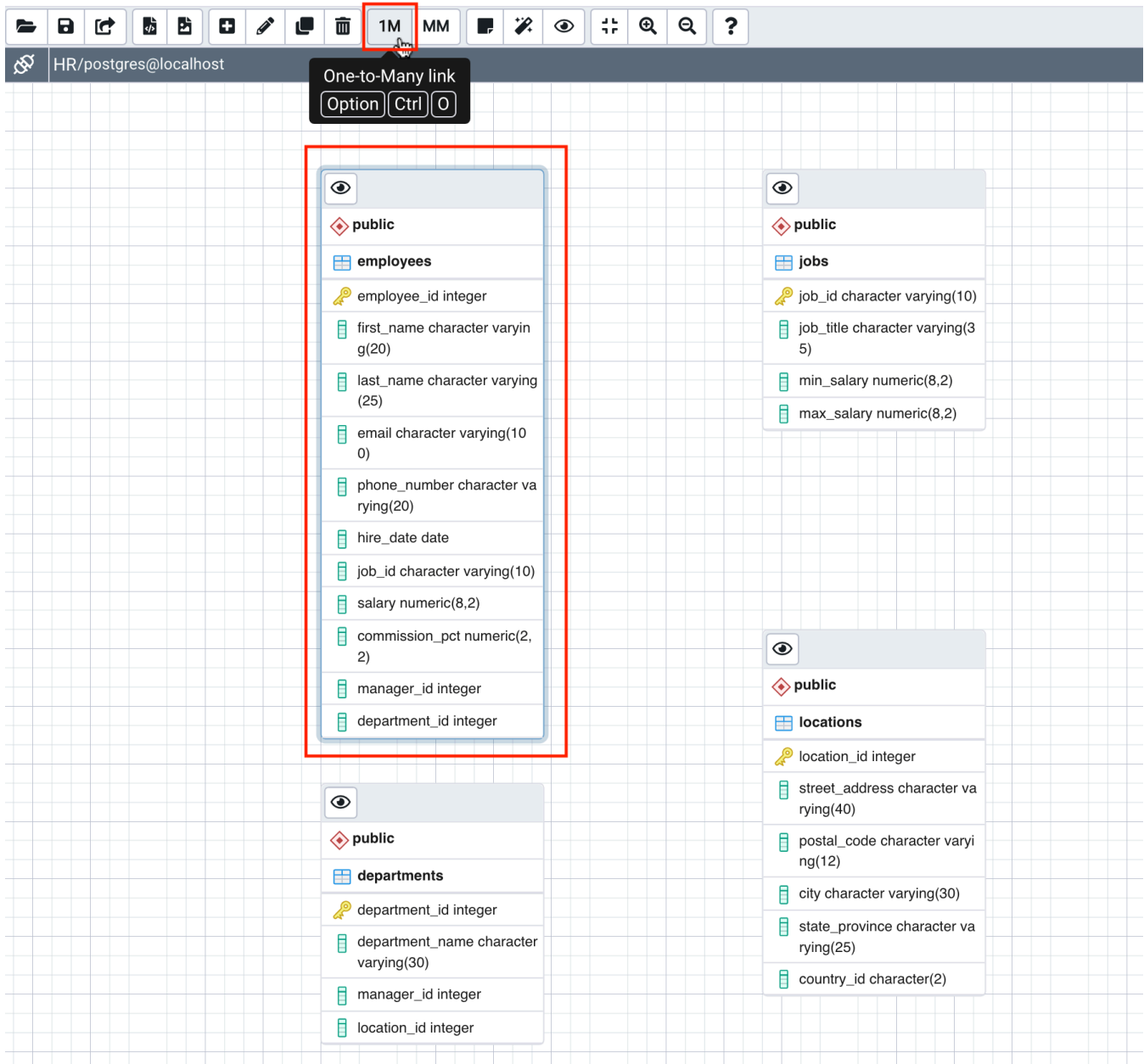
12. After creating all four entity diagrams, the entities of the ERD are complete.



/postgres@localhost



13. Next, you will create relationships between the entities by adding foreign keys to the tables. Select the entity diagram **employees** and click **One-to-Many link**. Now enter the definition information for a foreign key on the **employees** table as shown in the image below to create the relationship. Then click **OK**.



**One to many relation**

**General**

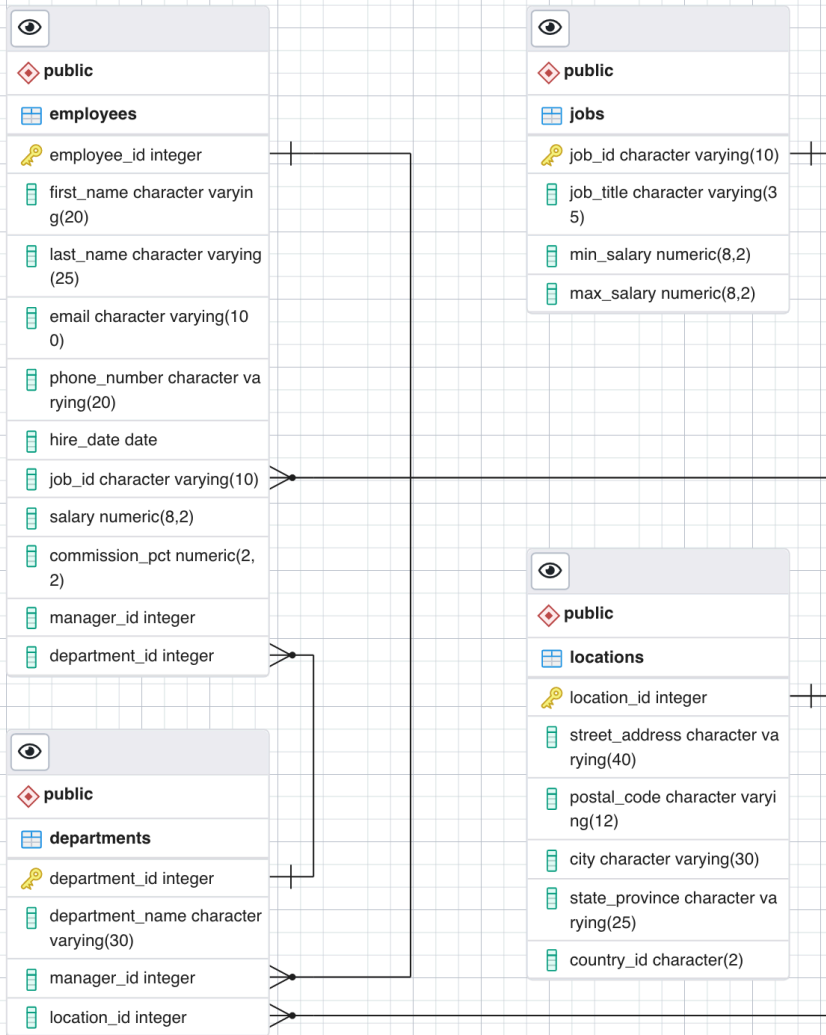
Local Table	(public) employees
Local Column	department_id
Referenced Table	(public) departments
Referenced Column	department_id

Buttons: **Cancel** **OK**

12. Similarly, create the other relationships between the tables following the instructions in step 13:

- [Click here] Create a relationship between employees and jobs
- [Click here] Create a relationship between departments and locations
- [Click here] Create a relationship between departments and employees

13. After creating all four relationships, you have completed the ERD for this exercise. Proceed to Task B.

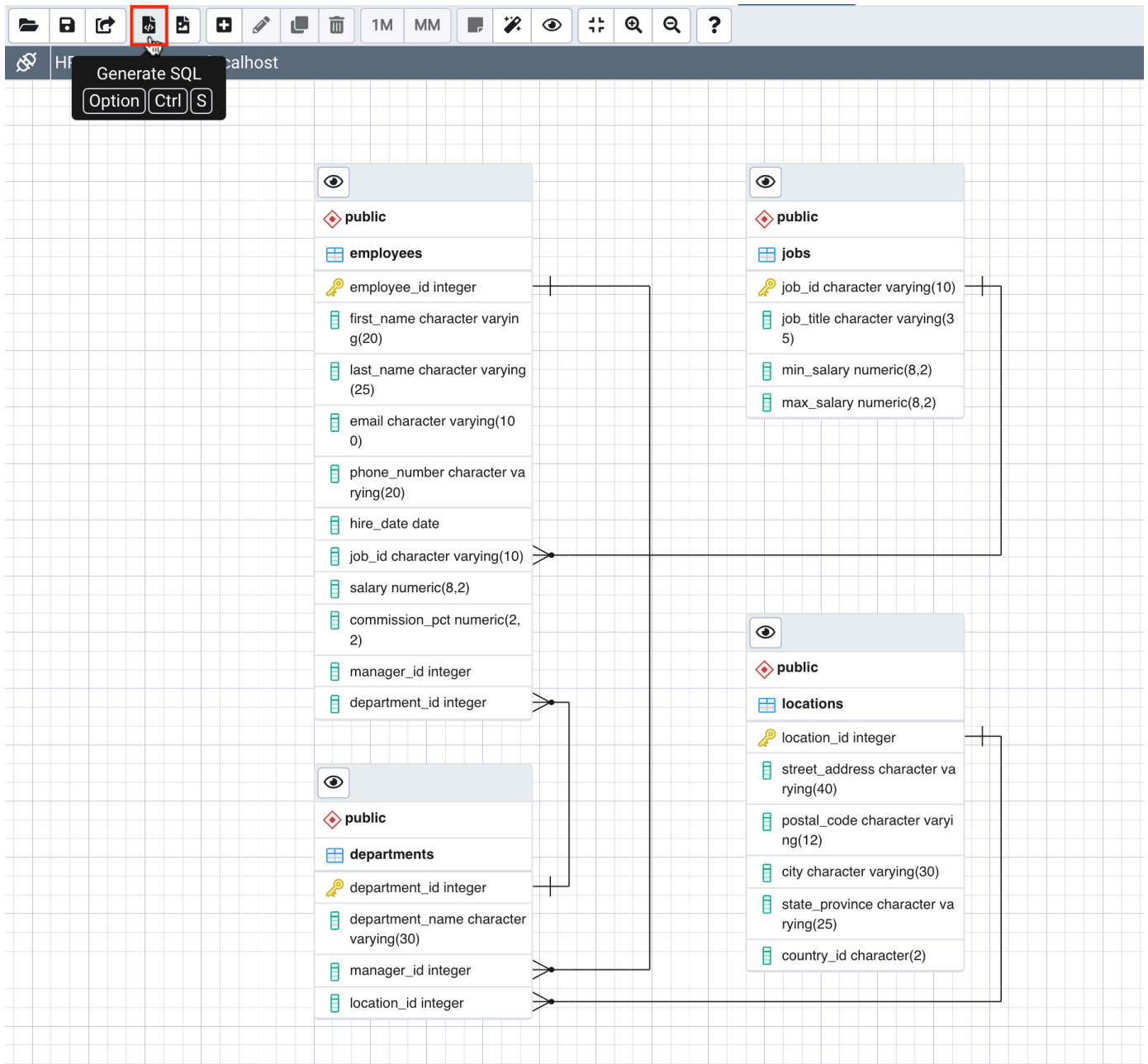


## Task B: Generate and execute SQL script from ERD to create the schema

In this task of the Example Exercise, you will generate and execute a SQL script from the ERD you created in Task A of the Example Exercise.

1. In the **Generate ERD (Beta)** window, click **Generate SQL**.





2. A new Query Editor window will open containing a SQL script generated from the ERD. Click **Execute/Refresh** to run the script. Proceed to Task C.

HR/postgres@localhost

Execute/Refresh (F5)

Query Editor Query History Scratch Pad

```
1 -- This script was generated by a beta version of the ERD tool in pgAdmin 4.
2 -- Please log an issue at https://redmine.postgresql.org/projects/pgadmin4/issues/new if you
3 BEGIN;
4
5
6 CREATE TABLE public.departments
7 (
8     department_id integer NOT NULL,
9     department_name character varying(30) NOT NULL,
10    manager_id integer,
11    location_id integer,
12    PRIMARY KEY (department_id)
13 );
14
15 CREATE TABLE public.employees
16 (
17     employee_id integer NOT NULL,
18     first_name character varying(20),
19     last_name character varying(25) NOT NULL,
20     email character varying(100) NOT NULL,
21     phone_number character varying(20),
22     hire_date date NOT NULL,
23     job_id character varying(10) NOT NULL,
24     salary numeric(8, 2) NOT NULL,
25     commission_pct numeric(2, 2).
26 );
27 COMMIT
```

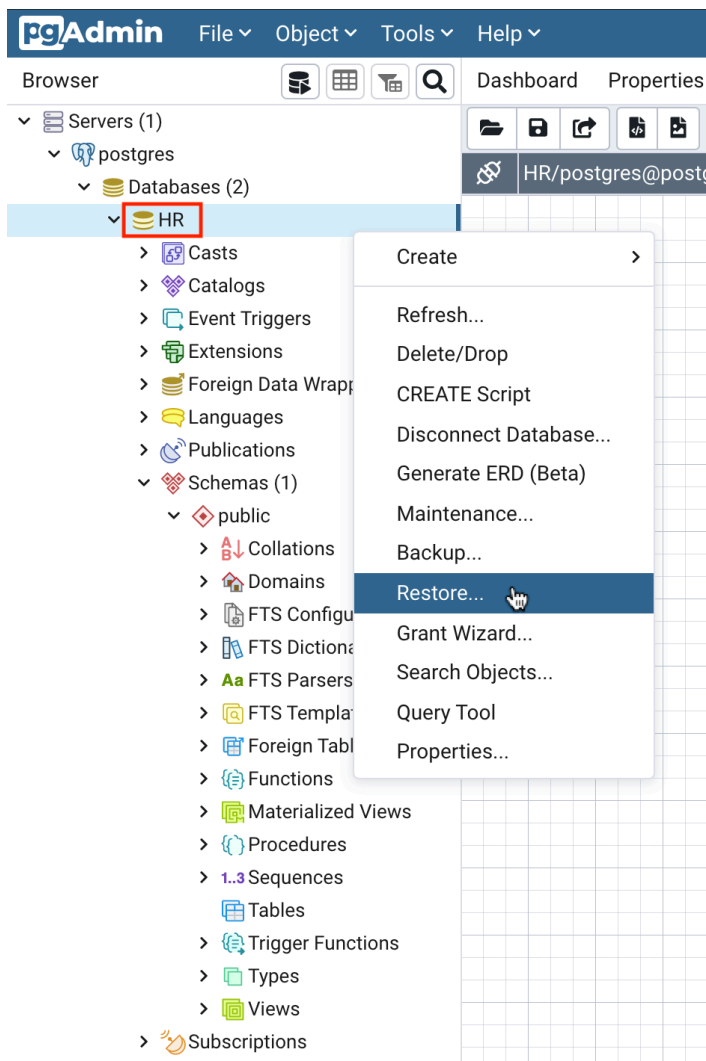
Data Output Explain Messages Notifications

Query returned successfully in 99 msec.

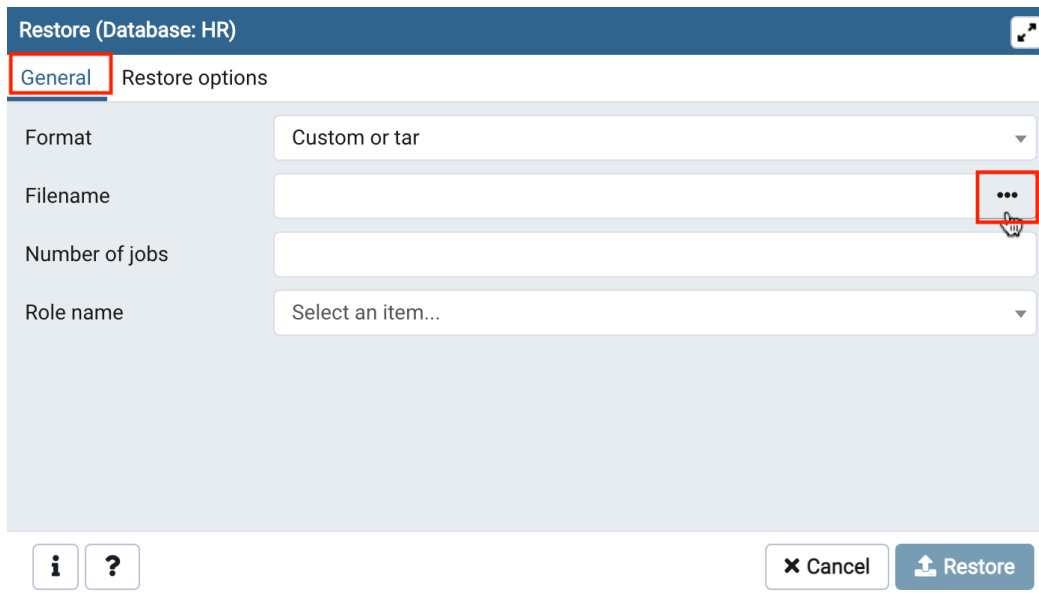
### Task C: Load the database schema with data

In this task of the Example Exercise, you will load the database schema you created in Task B of the Example Exercise with data using the pgAdmin Restore feature.

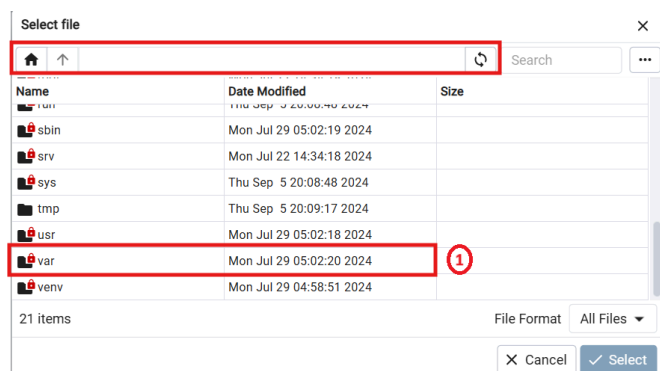
1. Download the [HR\\_pgsql\\_dump\\_data\\_for\\_example-exercise.tar](#) PostgreSQL dump file (containing the partial HR database data) using the link below to your local computer.
  - [HR\\_pgsql\\_dump\\_data\\_for\\_example-exercise.tar](#)
2. Follow the instructions below to import/restore the data:
  - In the tree-view, expand **HR**. Right-click **HR** and click **Restore**.



o On the General tab, click **Select file** by the Filename box.



o Initially make sure the folder details empty and select the var option from the list as shown in the screenshot below. Select var folder.



- Select lib folder.

Select file

/var

Search

Name	Date Modified	Size
cache	Mon Jul 22 14:34:18 2024	
db	Mon Jul 29 05:02:20 2024	
empty	Mon Jul 22 14:34:18 2024	
lib	Mon Jul 29 05:02:26 2024	
local	Mon Jul 22 14:34:18 2024	
lock	Mon Jul 22 14:34:18 2024	
log	Mon Jul 22 14:34:18 2024	
mail	Mon Jul 22 14:34:18 2024	

12 items

File Format All Files

Cancel

Select

- Select pgadmin folder. Here you could notice the folders are locked except the pgadmin folder.

Select file

/var/lib

Search

Name	Date Modified	Size
misc	Mon Jul 22 14:34:18 2024	
pgadmin	Fri Sep 6 01:00:10 2024	
postfix	Thu Sep 5 20:09:12 2024	
sudo	Mon Jul 29 05:02:20 2024	

4 items

File Format All Files

Cancel

Select

- Click Upload File. Now select upload as mentioned here.

Select file

/var/lib/pgadmin

Search

Name	Date Modified	Size
azurecredentialcache	Thu Sep 5 20:08:53 2024	
pgadmin4.db	Fri Sep 6 01:04:34 2024	164.0 kB
sessions	Thu Sep 5 23:43:26 2024	
storage	Thu Sep 5 20:08:53 2024	

4 items

File Format All Files

Cancel

Select

1

...

Rename

Delete

Upload

✓ List View

Grid View

Show Hidden Files

- Double-click on the drop files area and load the **HR\_pgsqli\_dump\_data\_for\_example-exercise.tar** you downloaded earlier on your local computer.

Note: Ensure that you upload the files to this path: /var/lib/pgadmin/

Select file

/var/lib/pgadmin/

Double click on this space

Drop files here to upload. The file size limit (per file) is 50 mb.

Show hidden files and folders?☐

Format backup

Cancel

Select

- o When the upload is complete, close the drop files area by clicking X.

- Ensure **Format** is set to **All Files**, select the uploaded **HR\_pgsql\_dump\_data\_for\_example-exercise.tar** file from the list, and then click **Select**.

The screenshot shows a file selection interface. At the top, there's a title bar 'Select file' and a breadcrumb path '/var/lib/pgadmin/HR\_pgsql\_dump\_data\_for\_example-ex...'. Below this is a table with columns 'Name', 'Size', and 'Modified'. The first row, 'HR\_pgsql\_dump\_data\_for\_example-exercise.tar', is highlighted with a red box. Other files listed are 'pgadmin4.db', 'sessions', and 'storage'. At the bottom right, there's a 'Format' dropdown menu, also highlighted with a red box, showing 'All Files' selected. A 'Select' button is visible at the bottom right.

Name	Size	Modified
HR_pgsql_dump_data_for_example-exercise.tar	20.5 kB	Thu Apr 1 13:46:45 2021
pgadmin4.db	156.0 kB	Thu Apr 1 13:45:14 2021
sessions	4.0 kB	Thu Apr 1 09:25:08 2021
storage	4.0 kB	Thu Apr 1 09:24:08 2021

- Now switch to the **Restore options** tab.

Restore (Database: HR)

General Restore options

Format

Custom or tar

Filename

/var/lib/pgadmin/HR\_pgsql\_dump\_data\_for\_example-exercise.tar

Number of jobs

Role name

Select an item...

?

?

Cancel

Restore

Under **Disable**, set the **Trigger** option to **Yes**. Then click **Restore**.

General Restore options

Queries

Include CREATE DATABASE statement

No

Clean before restore

No

Single transaction

No

Disable

Trigger

Yes

No data for Failed Tables

No

?

?

Cancel

Restore

## Practice Exercise

In this practice exercise, first you will finish creating a partially complete ERD for the HR database. Next, you will generate and execute an SQL script to build the complete schema of the HR database from its ERD. Finally, you will load the complete database schema with data by using the Restore feature.

- Download the [HR\\_pgsql\\_ERD\\_for\\_practice-exercise.pgerd](#) ERD file (containing a partial HR database ERD based on the one that you created in Task A of the Example Exercise) below to your local computer.
  - [HR\\_pgsql\\_ERD\\_for\\_practice-exercise.pgerd](#)
- In pgAdmin, create a new database named **HR\_Complete**.
- Open the ERD Tool and use **Load from file** to load the [HR\\_pgsql\\_ERD\\_for\\_practice-exercise.pgerd](#) file.

pgAdmin File Object Tools Help

Browser

Servers (1)

postgres

Databases (2)

HR\_Complete

postgres

Casts

Catalogs

Event Triggers

Extensions

Foreign Data Wrappers

Languages

Publications

Schemas

Subscriptions

Login/Group Roles

Tablespaces

Dashboard

Properties

SQL

Statistics

Dependencies

Dependents

Untitled

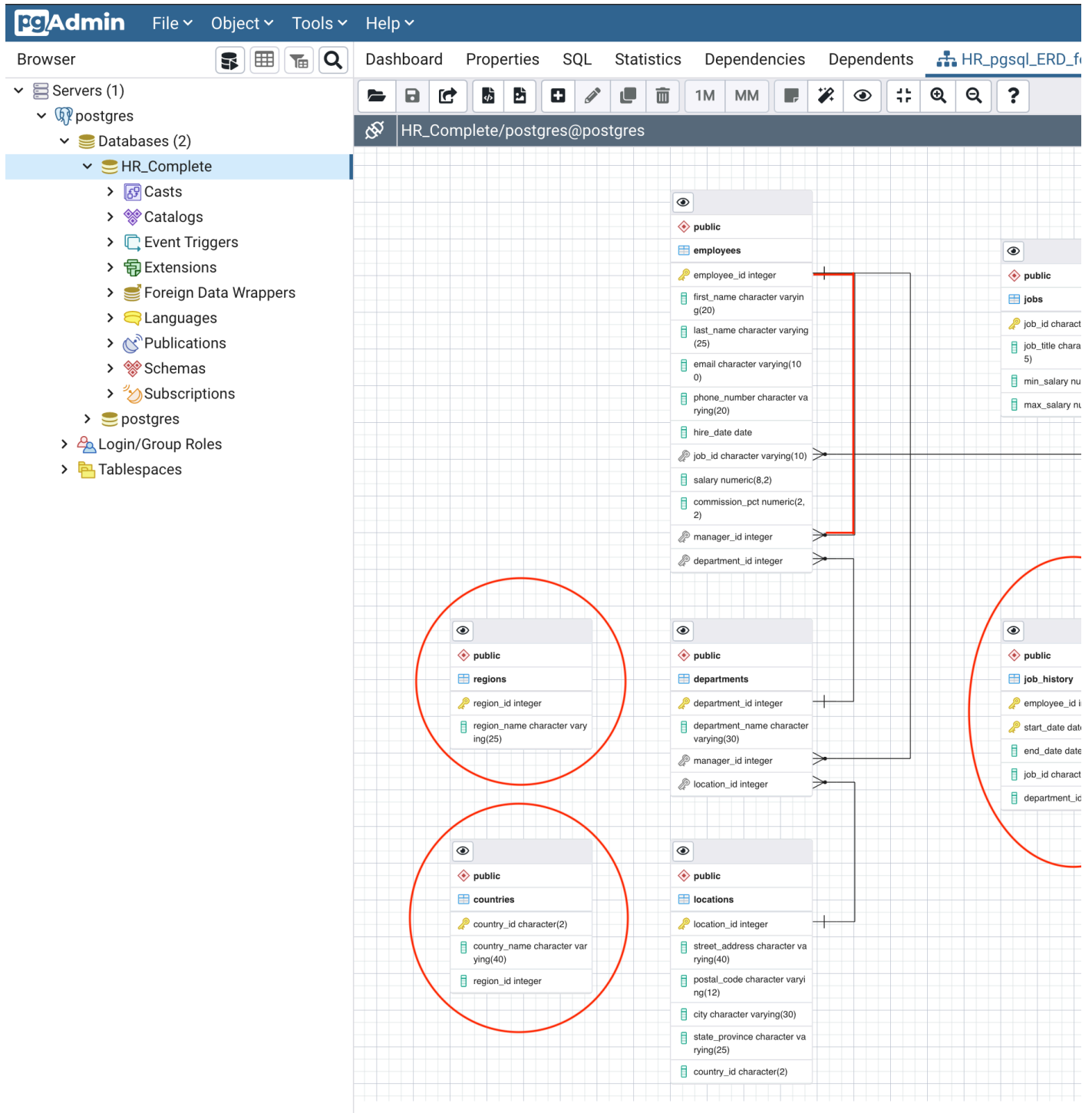
Load from file

Ctrl O

ete/postgres@postgres

Tip: Follow Example Exercise Task C for how to load any file in pgAdmin.

4. You will see the previous four entity diagrams along with relationships that you created in the Example Exercise. You will also see three new entity diagrams for the **job\_history**, **regions**, and **countries** tables and one new relationship within the entity diagram of the **employees** table between *manager\_id* as local column and *employee\_id* as referenced column.

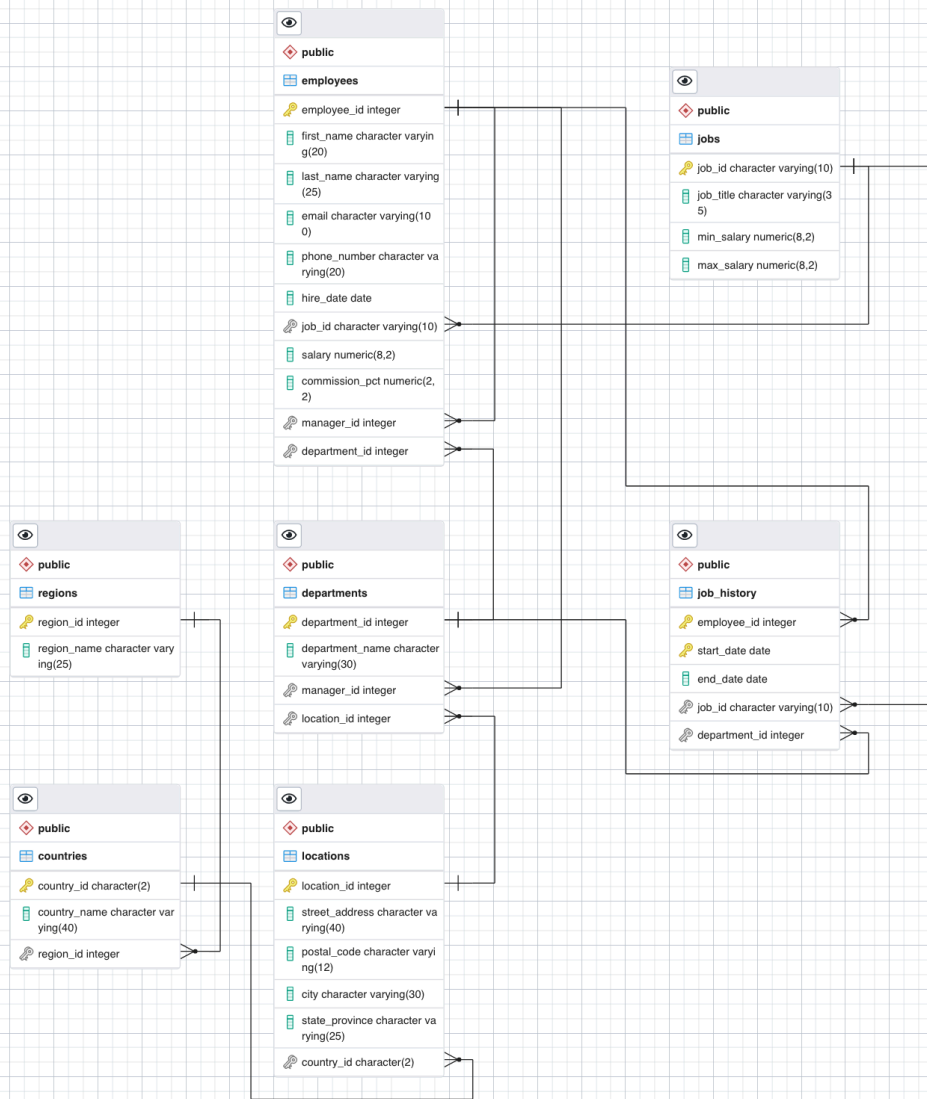


5. Create the remaining relationships between the tables:

- ▶ [Click here] Create a relationship between countries and regions
- ▶ [Click here] Create a relationship between job\_history and departments
- ▶ [Click here] Create a relationship between job\_history and employees
- ▶ [Click here] Create a relationship between job\_history and jobs
- ▶ [Click here] Create a relationship between locations and countries

**Tip:** Follow Example Exercise Task A for how to create relationships between the entities by adding foreign keys to the tables.

6. After creating the remaining relationships, the complete ERD of the HR database will look like the following image:



7. Generate and execute an SQL script from the ERD to create the schema of the **HR\_Complete** database.

**Tip:** Follow Example Exercise Task B.

8. Download the **HR\_psql\_dump\_data.tar** PostgreSQL dump file (containing the complete HR database data) below to your local computer. Use the dump file to restore/import the data to the **HR\_Complete** database.

- [HR\\_psql\\_dump\\_data.tar](#)

**Tip:** Follow Example Exercise Task C.

## Conclusion

Congratulations! You have completed this lab, and you have learned how to create an ERD of a database, generate and execute an SQL script from an ERD to create a schema, and load the database schema with data.

### Author(s)

- [Sandip Saha Joy](#)

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