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.

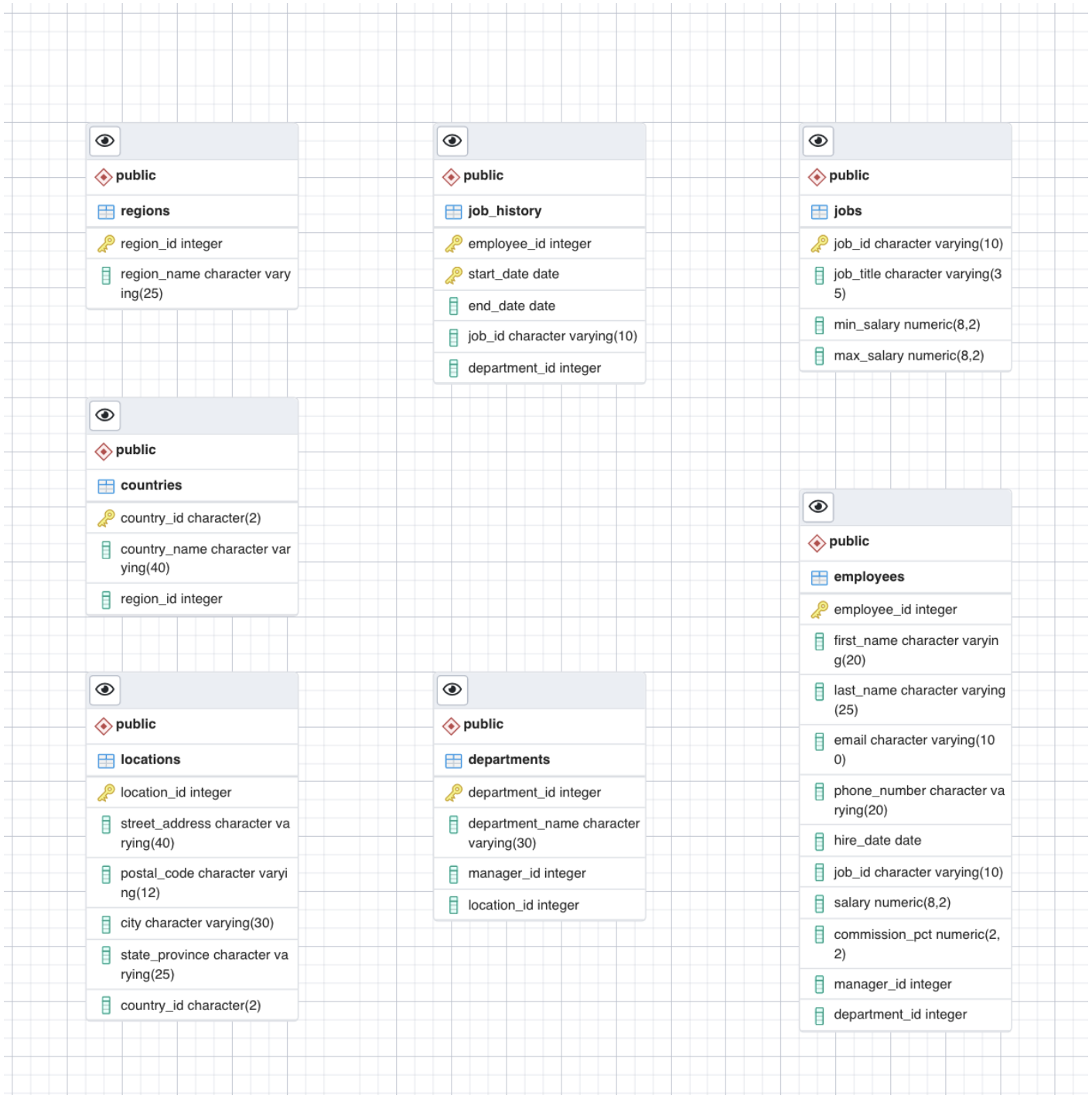
To complete this lab you will utilize the PostgreSQL relational database service available as part of IBM Skills Network Labs (SN Labs) Cloud IDE. SN Labs is a virtual lab environment used in this course.

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, so 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*.

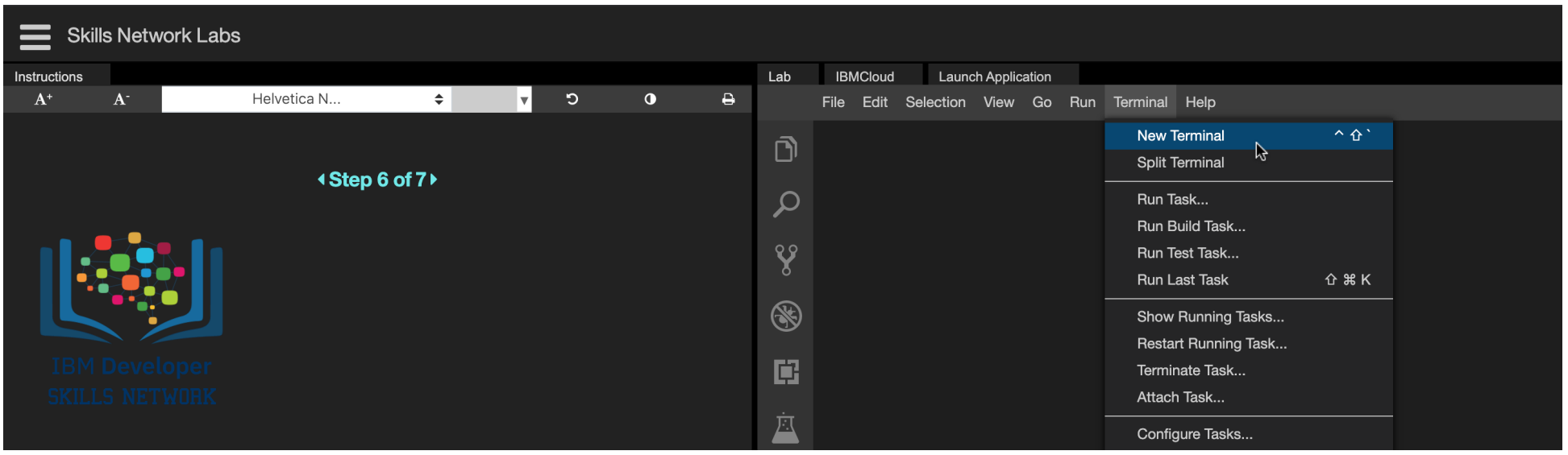
Example Exercise

In this example exercise through different tasks, first you will 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 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.

1. Go to **Terminal > New Terminal** to open a terminal from the side-by-side launched Cloud IDE.



2. Start a PostgreSQL service session in the Cloud IDE using the command below in the terminal. Find your PostgreSQL service session password from the highlighted location of the terminal shown in the image below. Note down your PostgreSQL service session password because you may need to use it later in the lab.

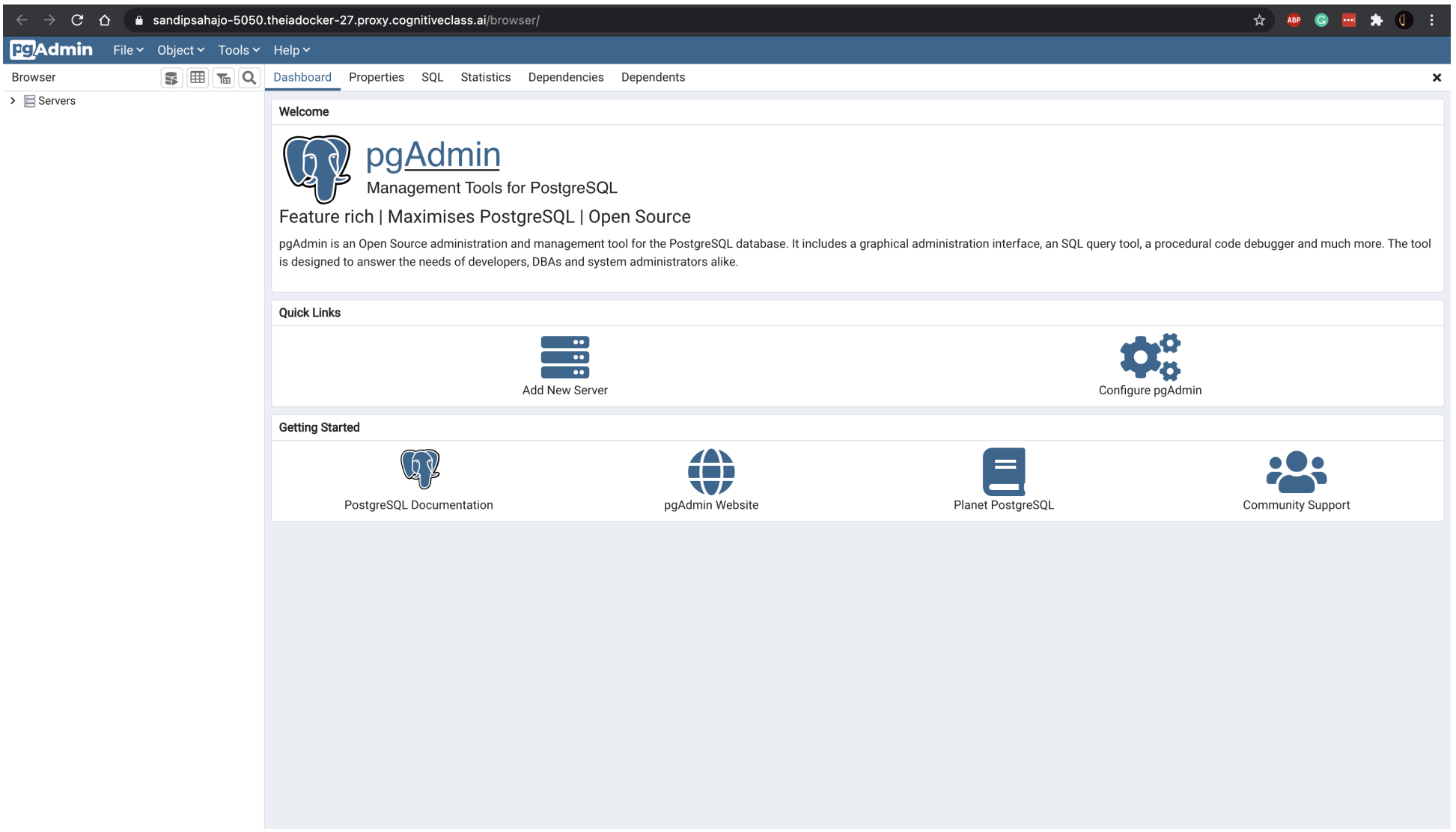
```
start_postgres
```

```
theia@theiadocker-sandipsahajo:/home/project$ start_postgres
Starting your Postgres database....
This process can take up to a minute.

Postgres database started, waiting for all services to be ready....
 [/]
Your Postgres database is now ready to use and available with username: postgres password: MTQ5NTItc2FuZGlw

You can access your Postgres database via:
 • The Browser with pgadmin
   • URL: https://sandipsahajo-5050.theiadocker-27.proxy.cognitiveclass.ai/browser/
   • Database Password: MTQ5NTItc2FuZGlw
 • CommandLine: psql --username=postgres --host=localhost
theia@theiadocker-sandipsahajo:/home/project$
```

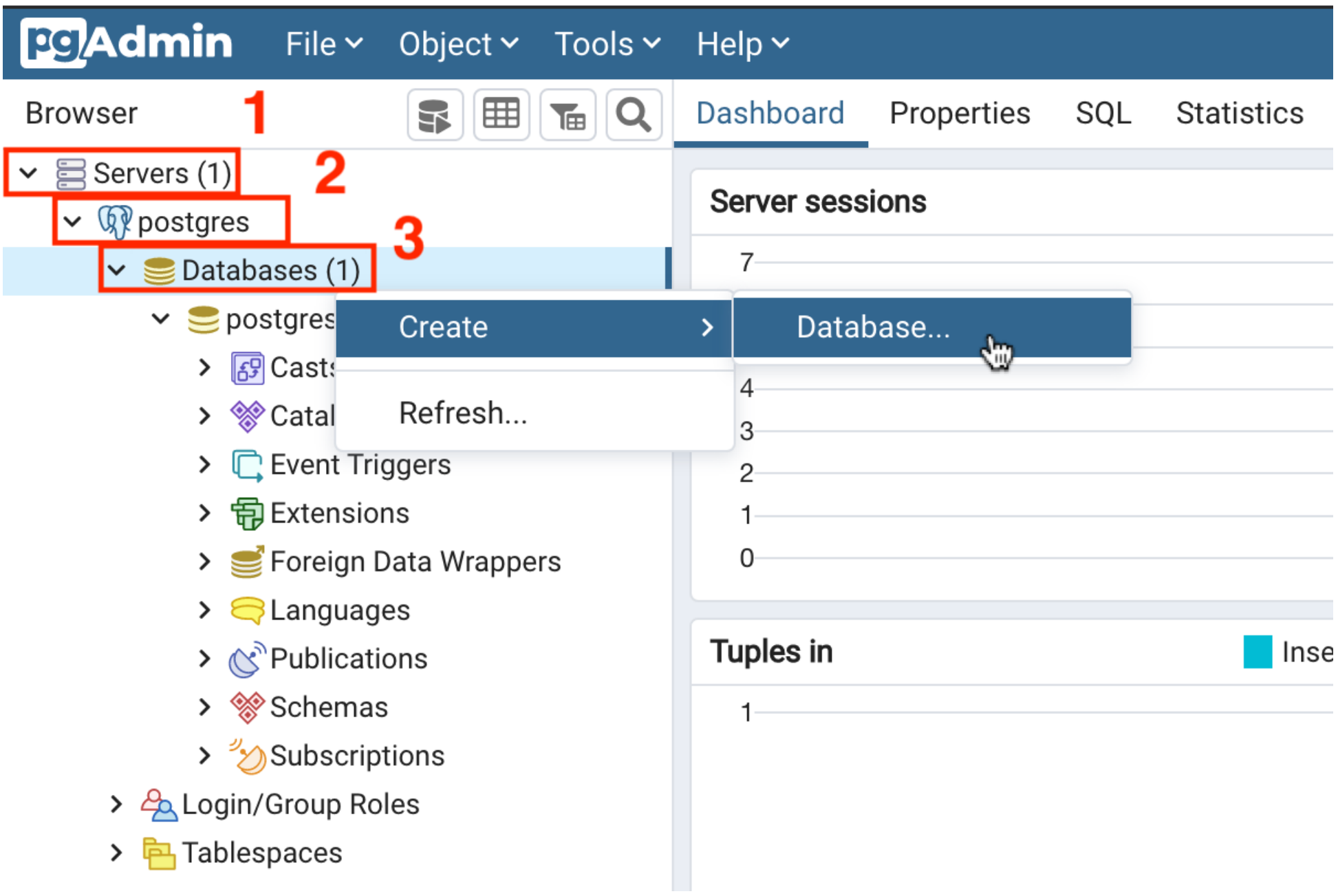
3. Copy your pgAdmin weblink from the highlighted location of the terminal shown in the image below and paste it to a new tab of your web browser.

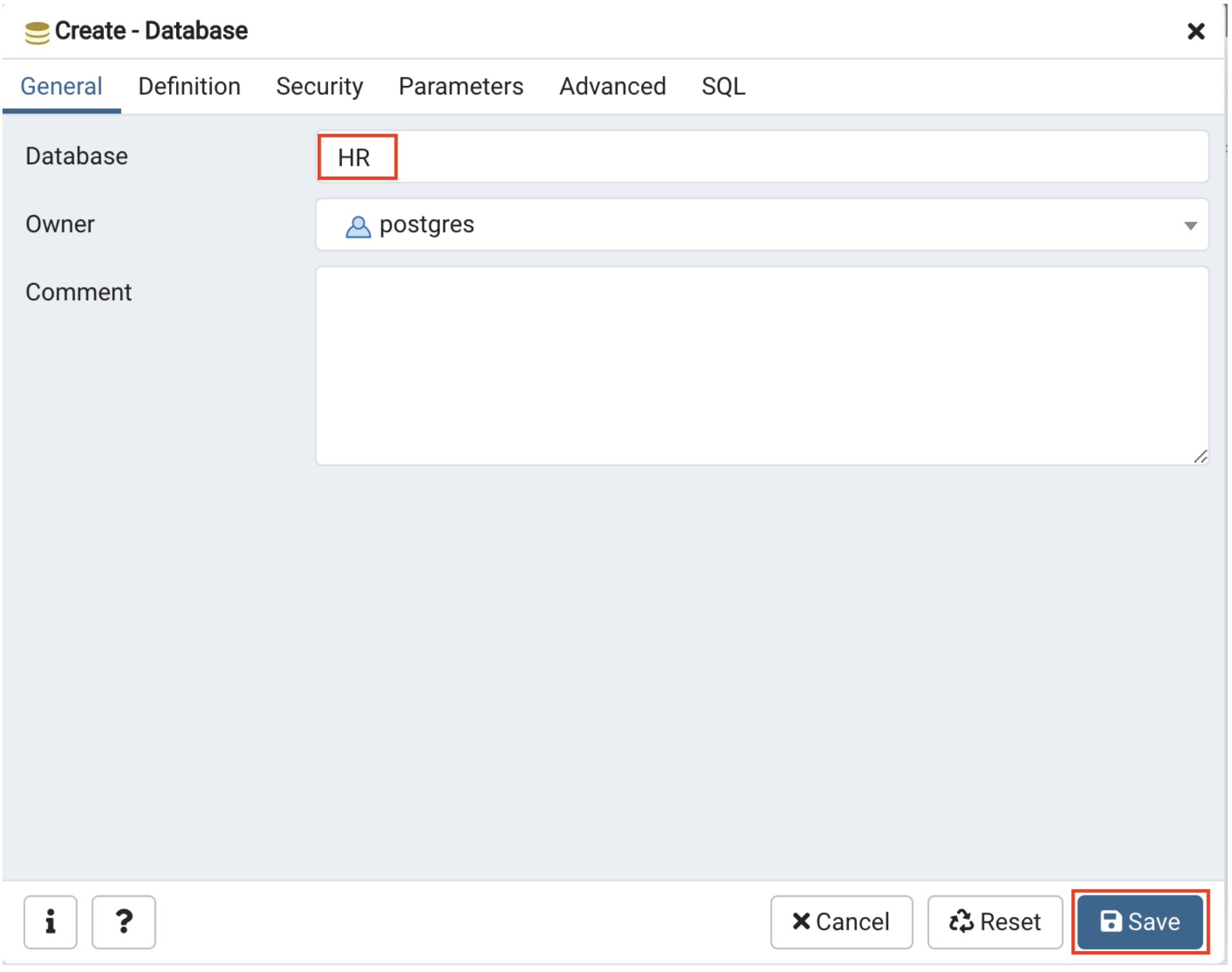
```
theia@theiadocker-sandipsahajo:/home/project$ start_postgres
Starting your Postgres database....
This process can take up to a minute.

Postgres database started, waiting for all services to be ready....
 [/]
Your Postgres database is now ready to use and available with username: postgres password: MTQ5NTItc2FuZGlw

You can access your Postgres database via:
 • The Browser with pgadmin
   • URL: https://sandipsahajo-5050.theiadocker-27.proxy.cognitiveclass.ai/browser/
   • Database Password: MTQ5NTItc2FuZGlw
 • CommandLine: psql --username=postgres --host=localhost
theia@theiadocker-sandipsahajo:/home/project$
```

4. You will see the pgAdmin GUI tool.

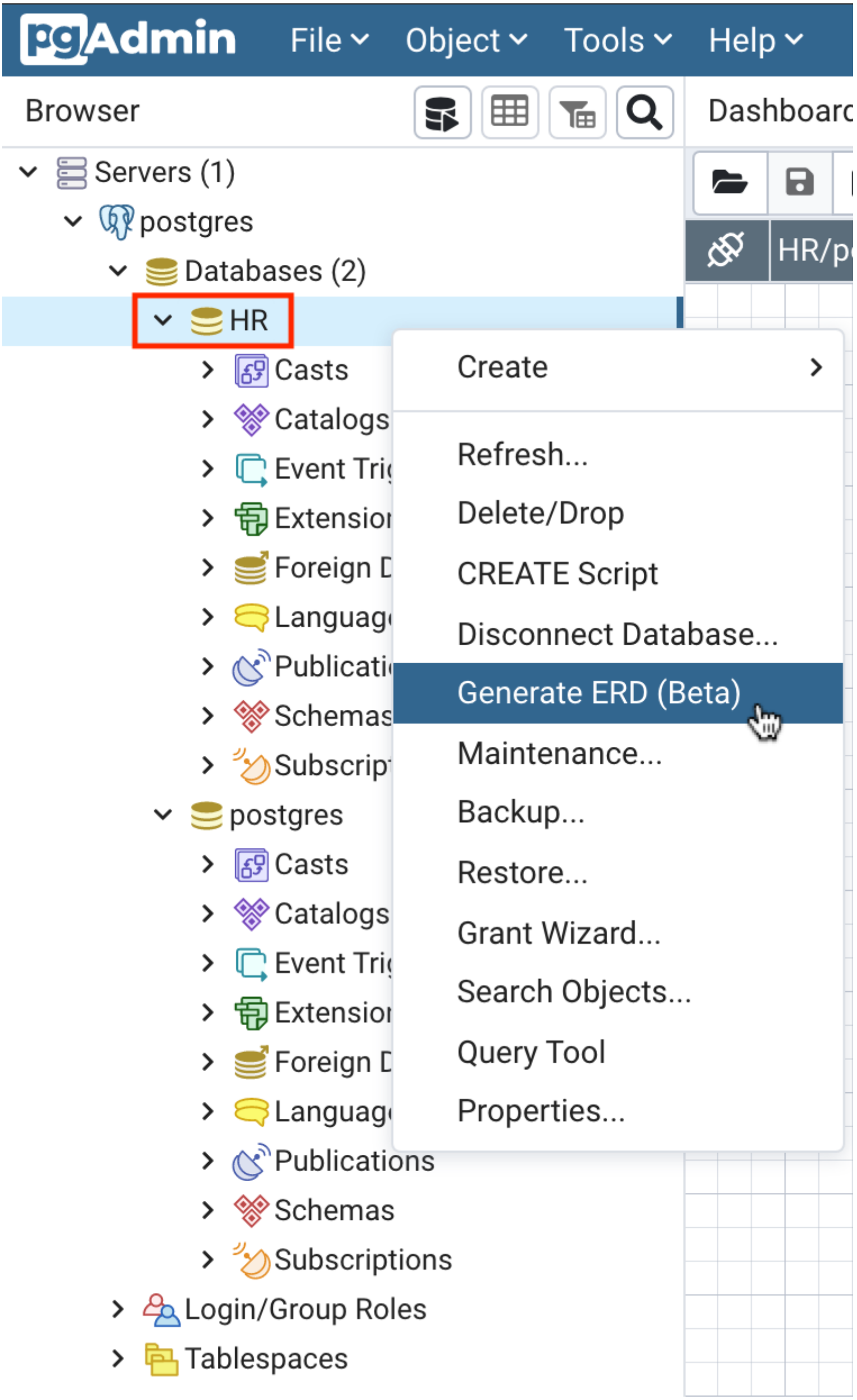


5. In the tree-view, expand **Servers** > **postgres** > **Databases**. Enter your PostgreSQL service session password if prompted during the process. Right-click on **Databases** and go to **Create > Database**. Type **HR** as name of the database and click **Save**.

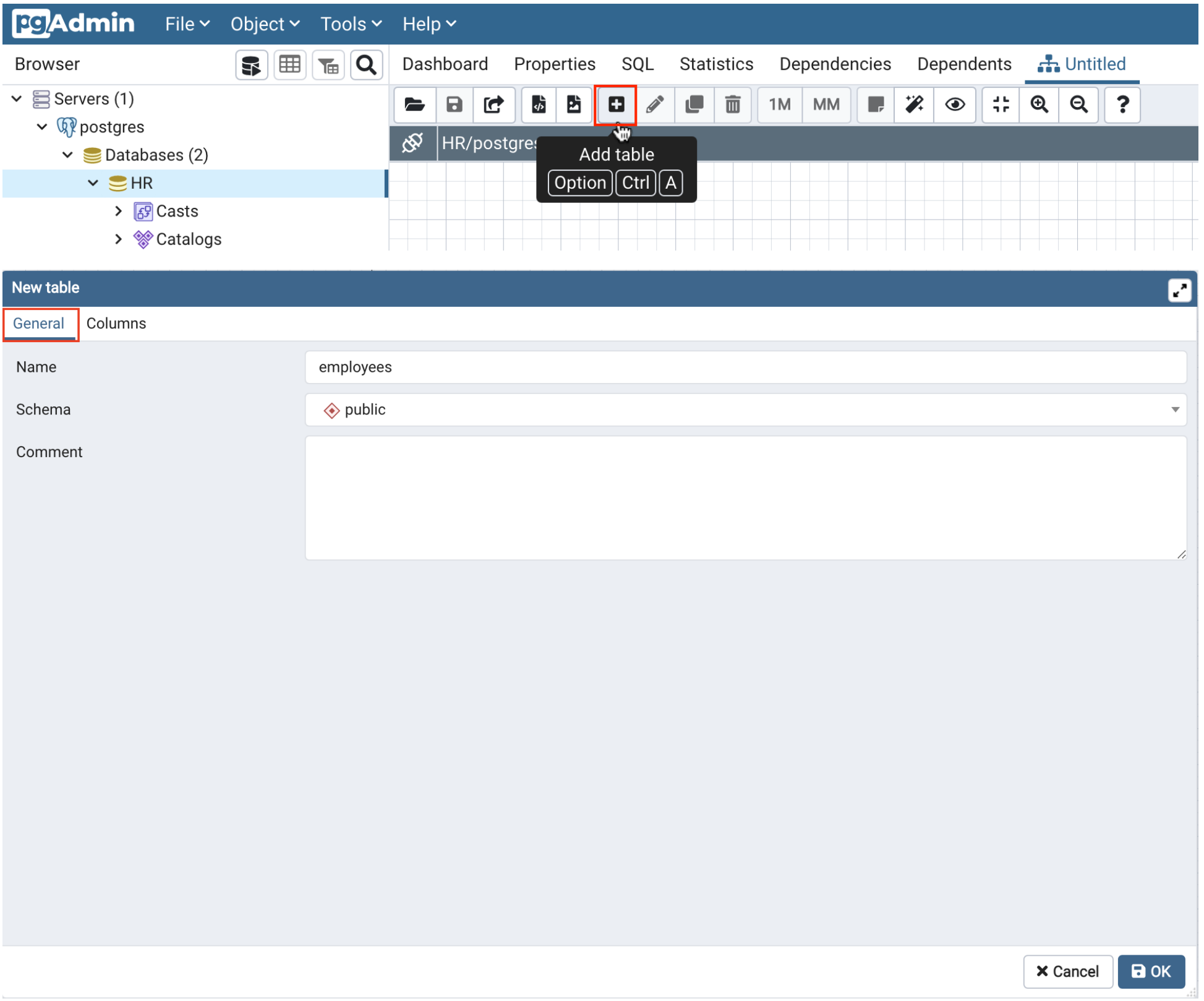




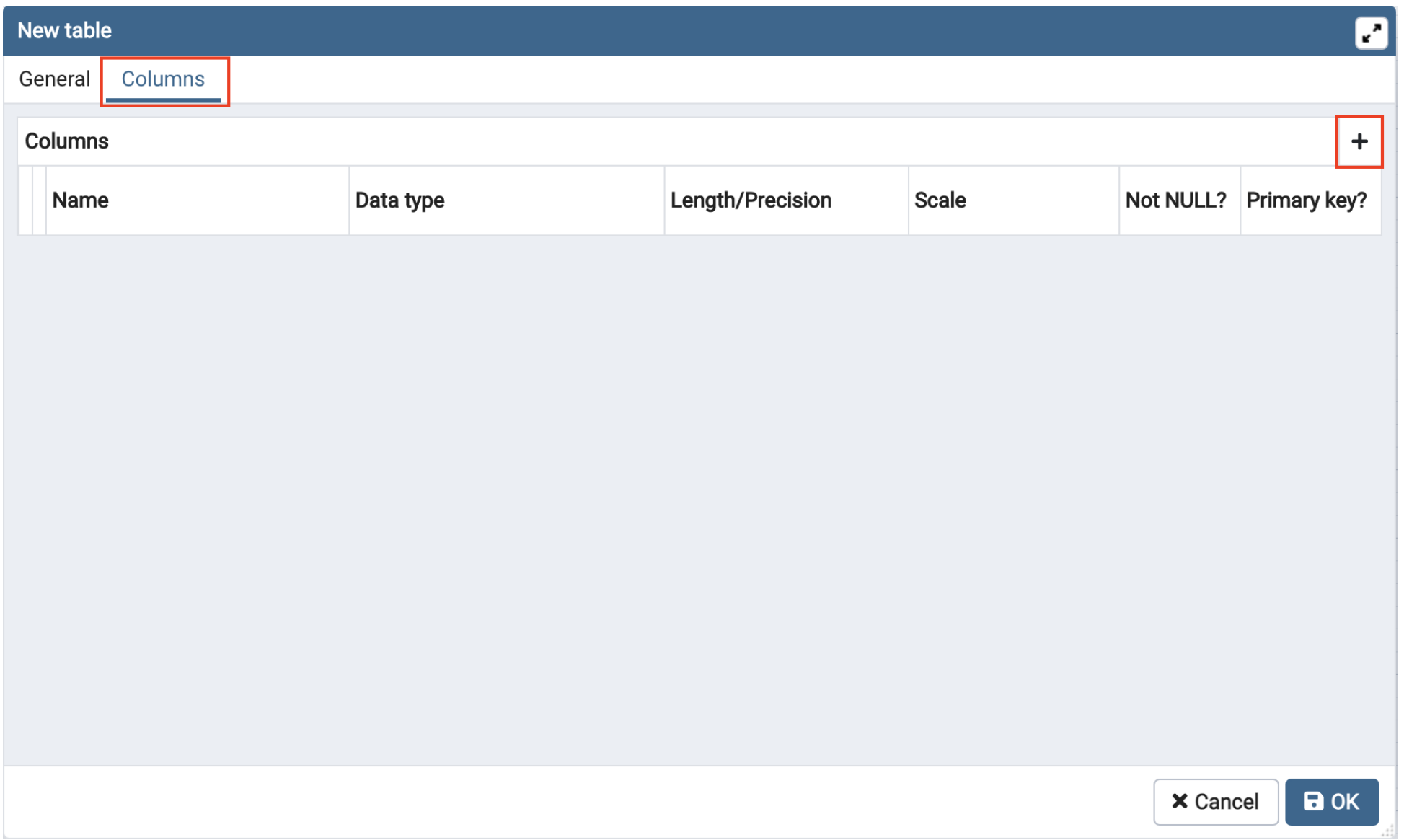
6. In the tree-view, expand **HR**. Right-click on **HR** and select **Generate ERD (Beta)**.



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



8. Switch to the **Columns** tab and click the **Add new row** button 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?
	employee_id	integer			Yes	Yes
	first_name	character varying	20		No	No
	last_name	character varying	25		Yes	No
	email	character varying	100		Yes	No
	phone_number	character varying	20		No	No
	hire_date	date			Yes	No
	job_id	character varying	10		Yes	No
	salary	numeric	8	2	Yes	No
	commission_pct	numeric	2	2	No	No
	manager_id	integer			No	No
	department_id	integer			No	No

Cancel OK

9. Similarly, create entity diagrams for the other three tables following steps 7 and 8:

▼ [Click here] Create an entity diagram for the jobs table

> Click **Add table** icon. On the **General** tab, in the **Name** box, type **jobs** as name of the table. Don't click **OK**. Switch to tab **Columns** and click the **Add new row** button to add the necessary column placeholders. Now enter the **jobs** table definition information as shown in the image below to create its entity diagram. Then click **OK**.

Table: jobs (public)

General Columns

Name jobs

Schema public

Comment

Cancel OK

Table: jobs (public)

General | Columns

Columns

		Name	Data type	Length/Precision	Scale	Not NULL?	Primary key?
✎	🗑	job_id	character varying	10		Yes	Yes
✎	🗑	job_title	character varying	35		Yes	No
✎	🗑	min_salary	numeric	8	2	No	No
✎	🗑	max_salary	numeric	8	2	No	No

✖ Cancel 💾 OK

▼ [Click here] Create an entity diagram for the departments table

> Click **Add table** icon. On the **General** tab, in the **Name** box, type **departments** as name of the table. Don't click **OK**. Switch to tab **Columns** and click the **Add new row** button to add the necessary column placeholders. Now enter the **departments** table definition information as shown in the image below to create its entity diagram. Then click **OK**.

Table: departments (public)

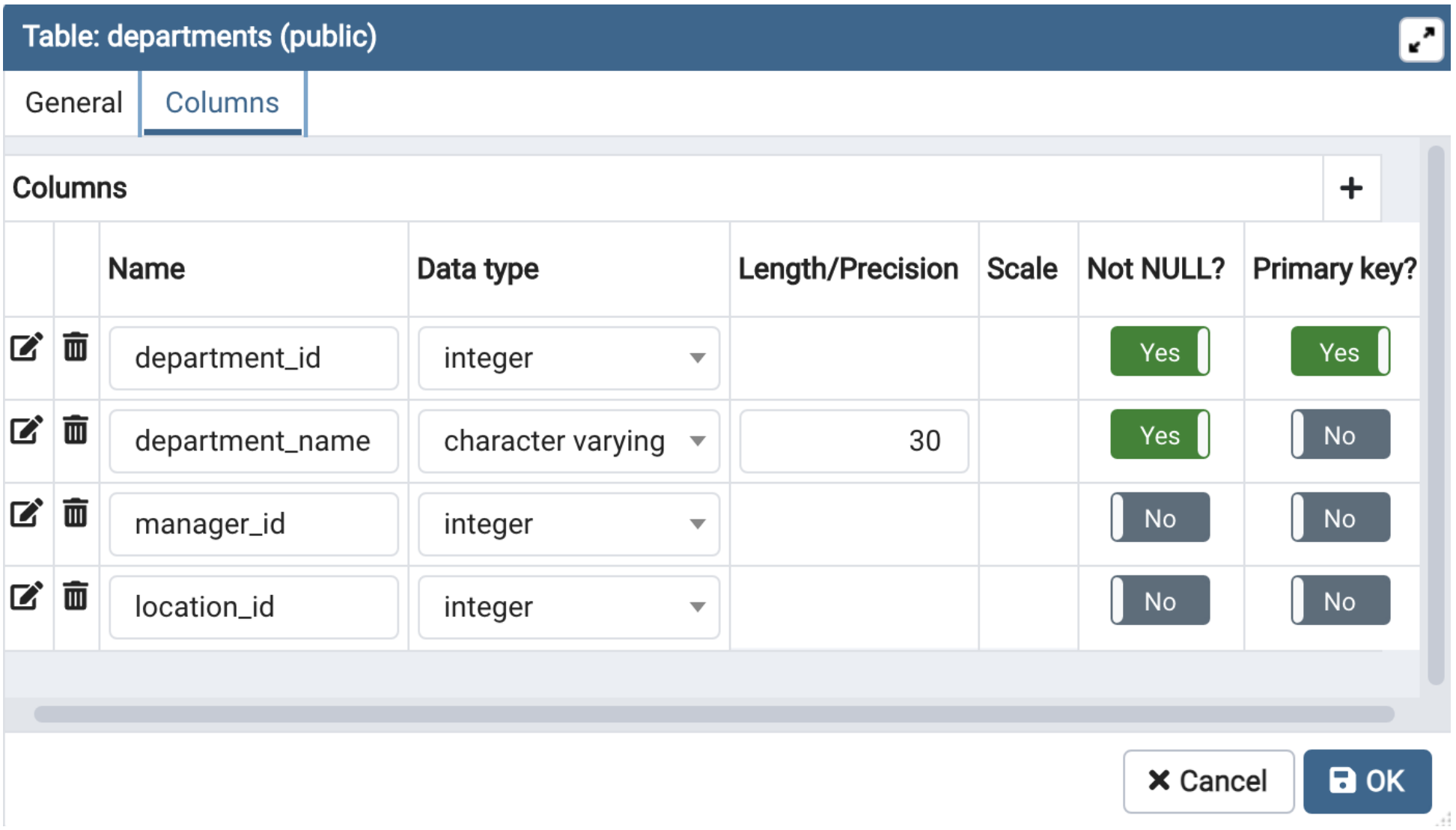
General | Columns

Name: departments

Schema: public

Comment:

✖ Cancel 💾 OK



▼ [Click here] Create an entity diagram for the locations table

> Click **Add table** icon. On the **General** tab, in the **Name** box, type **locations** as name of the table. Don't click **OK**. Switch to tab **Columns** and click the **Add new row** button to add the necessary column placeholders. Now enter the **locations** table definition information as shown in the image below to create its entity diagram. Then click **OK**.

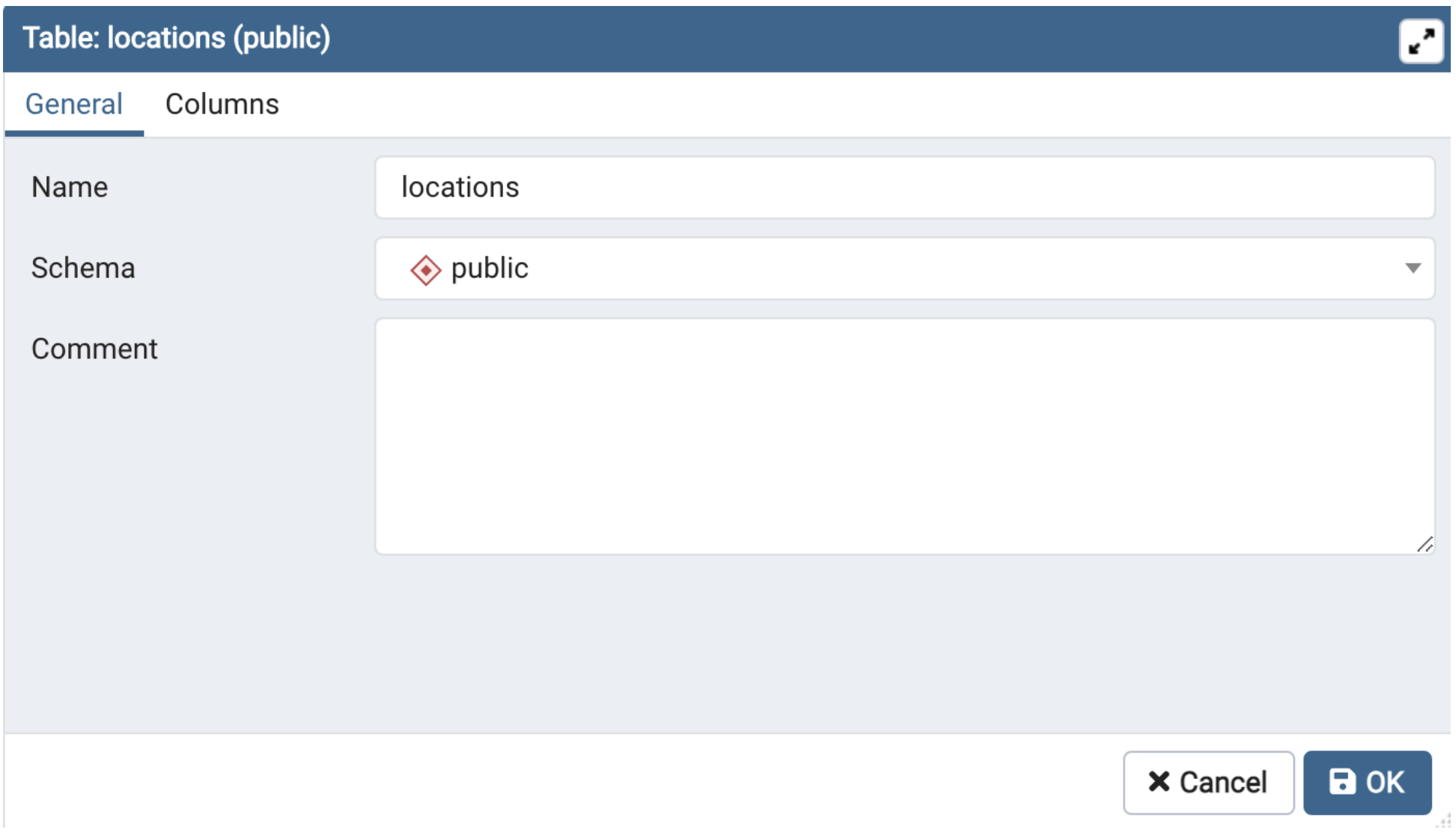


Table: locations (public)

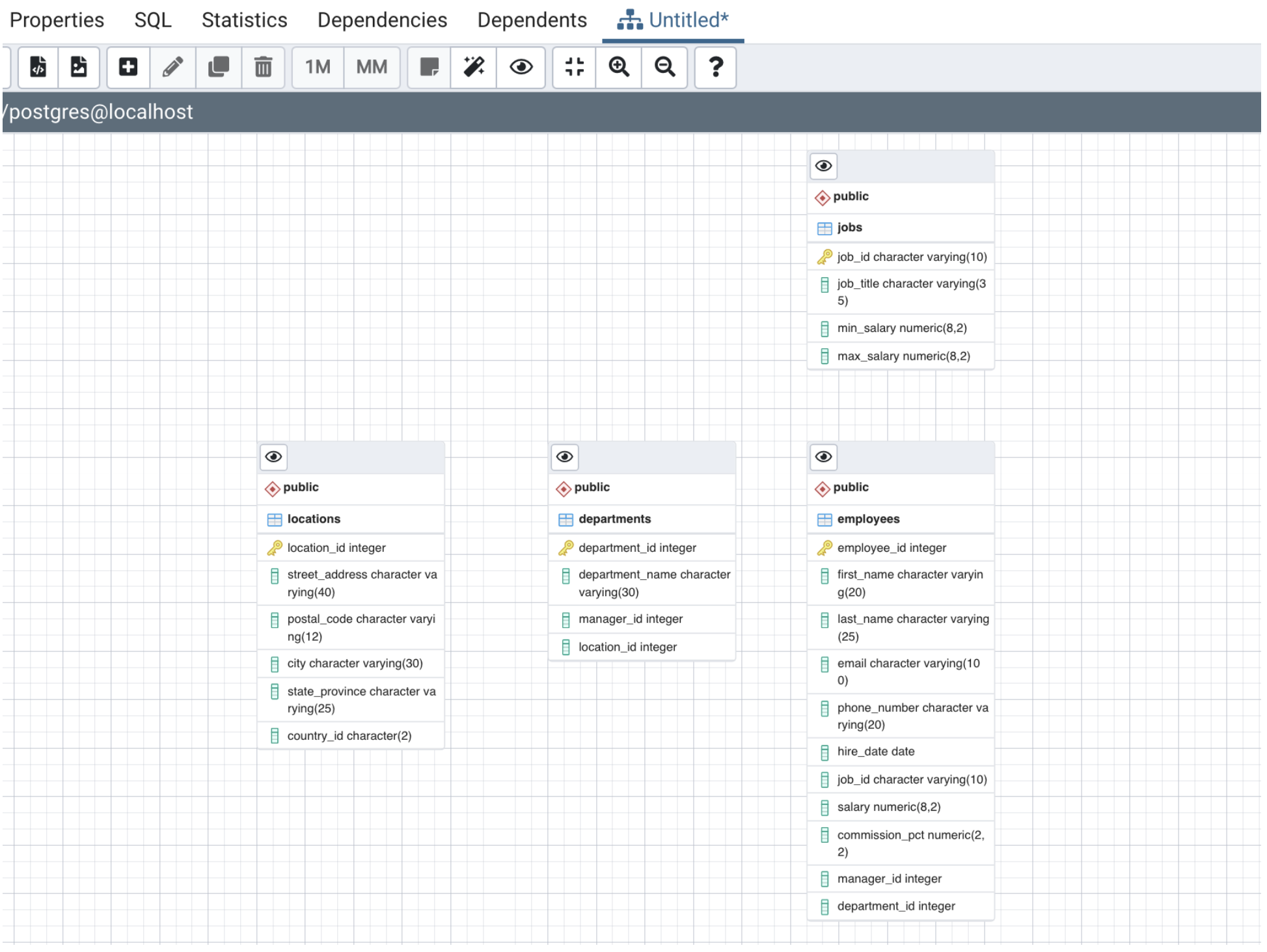
General | Columns

Columns

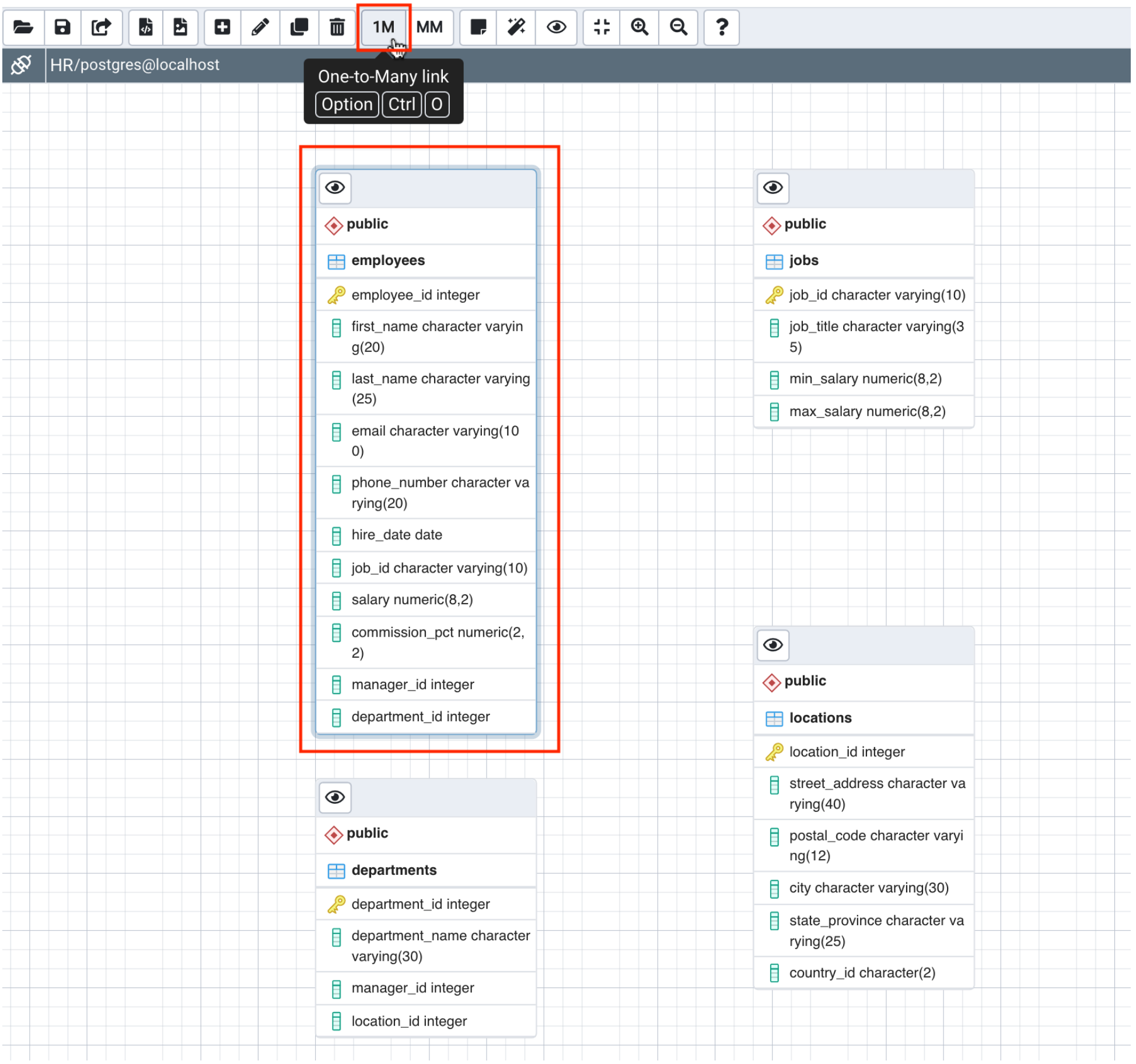
		Name	Data type	Length/Precision	Scale	Not NULL?	Primary key?
✎	🗑	location_id	integer			Yes	Yes
✎	🗑	street_address	character varying	40		No	No
✎	🗑	postal_code	character varying	12		No	No
✎	🗑	city	character varying	30		Yes	No
✎	🗑	state_province	character varying	25		No	No
✎	🗑	country_id	character	2		Yes	No

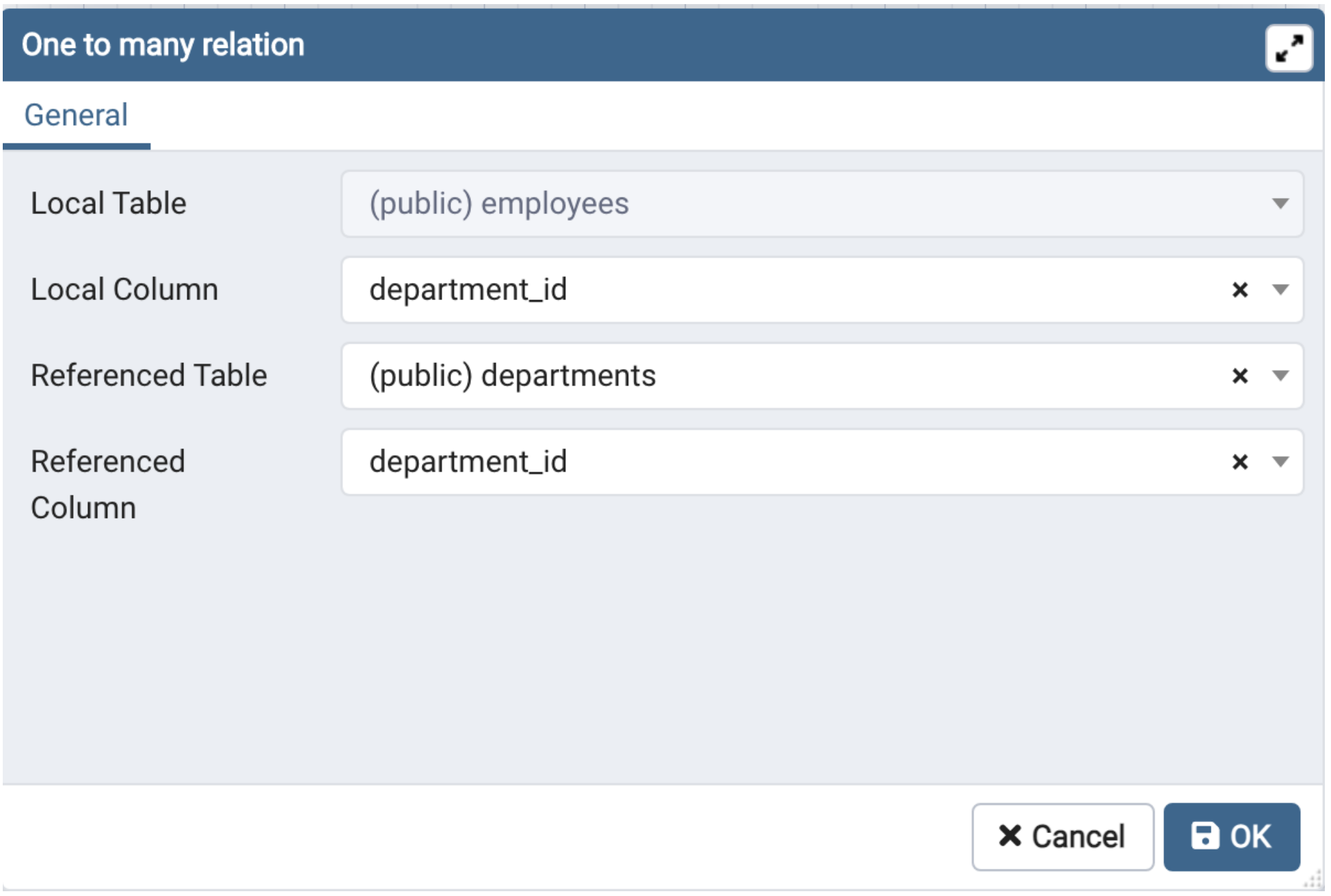
✖ Cancel | OK

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



11. Next you will create relationships between the entities by adding foreign keys to the tables. Select the entity diagram **employees** and click the **One-to-Many link** button. 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**.

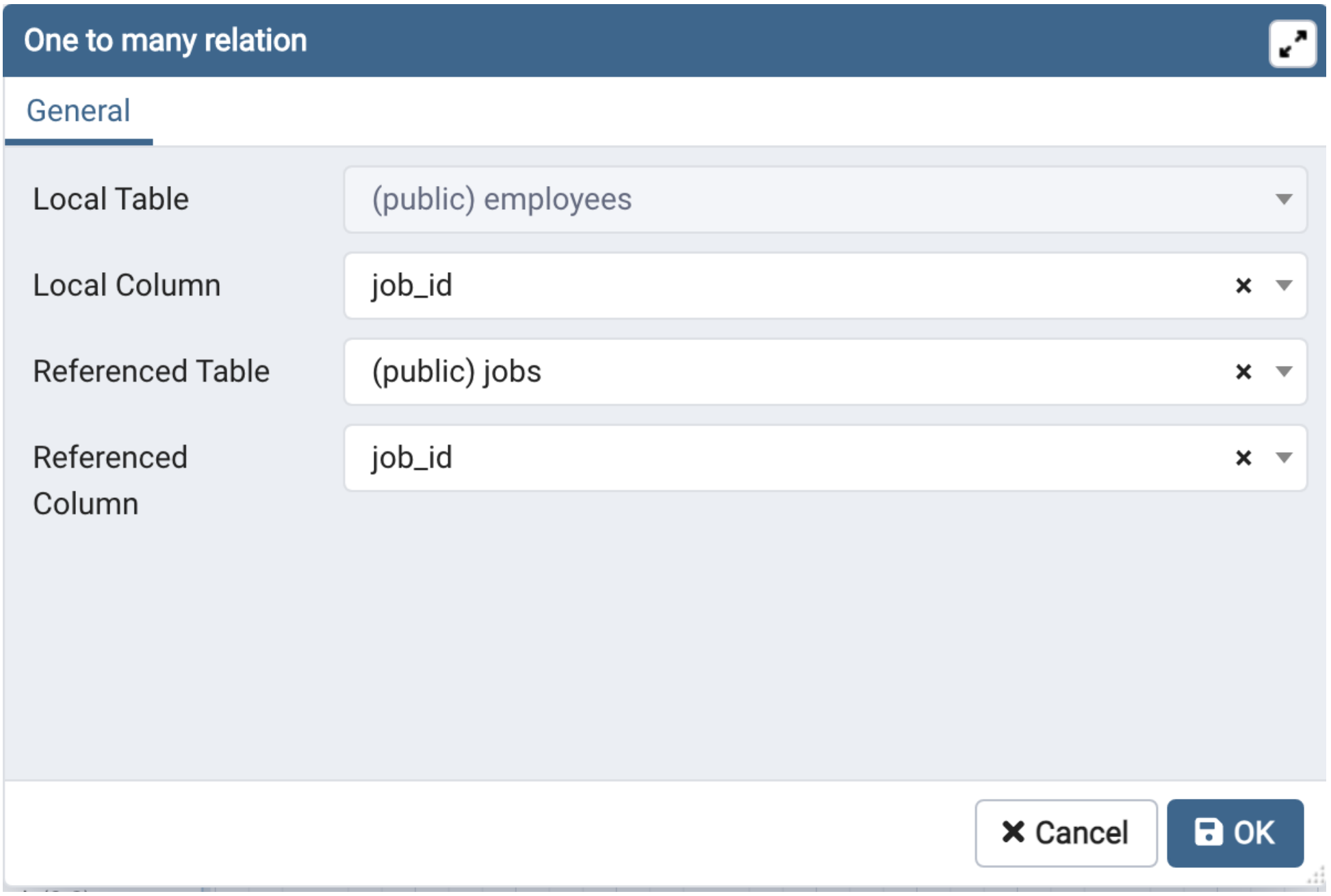

1M
MM
HR/postgres@localhost
One-to-Many link
Option Ctrl O
public
employees
employee_id integer
first_name character varying(20)
last_name character varying(25)
email character varying(100)
phone_number character varying(20)
hire_date date
job_id character varying(10)
salary numeric(8,2)
commission_pct numeric(2,2)
manager_id integer
department_id integer
public
jobs
job_id character varying(10)
job_title character varying(35)
min_salary numeric(8,2)
max_salary numeric(8,2)
public
departments
department_id integer
department_name character varying(30)
manager_id integer
location_id integer
public
locations
location_id integer
street_address character varying(40)
postal_code character varying(12)
city character varying(30)
state_province character varying(25)
country_id character(2)



12. Similarly, create the other relationships between the tables following the instructions in step 11:

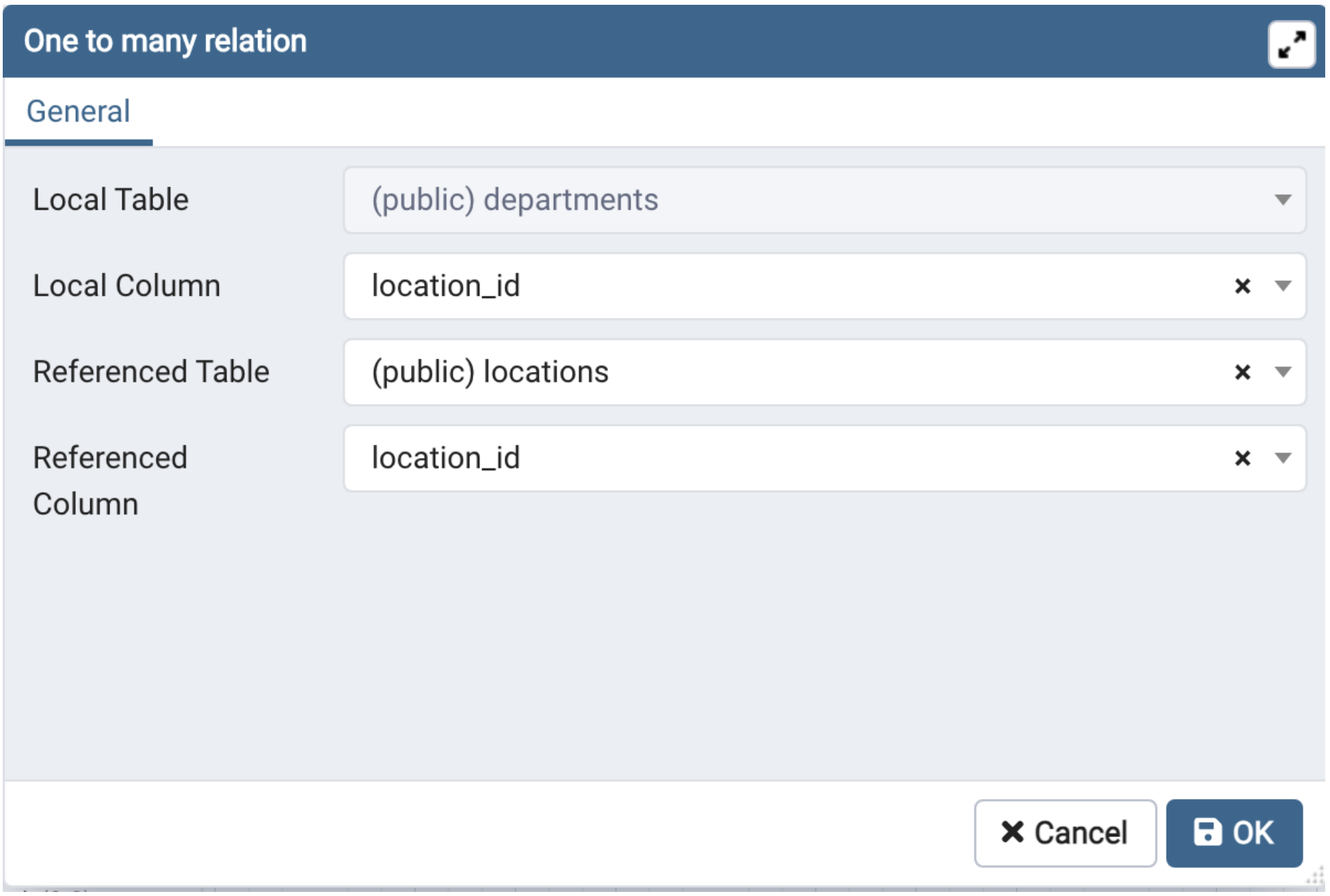
▼ [Click here] Create a relationship between employees and jobs

> Select the entity diagram **employees** and click the **One-to-Many link** button. 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**.



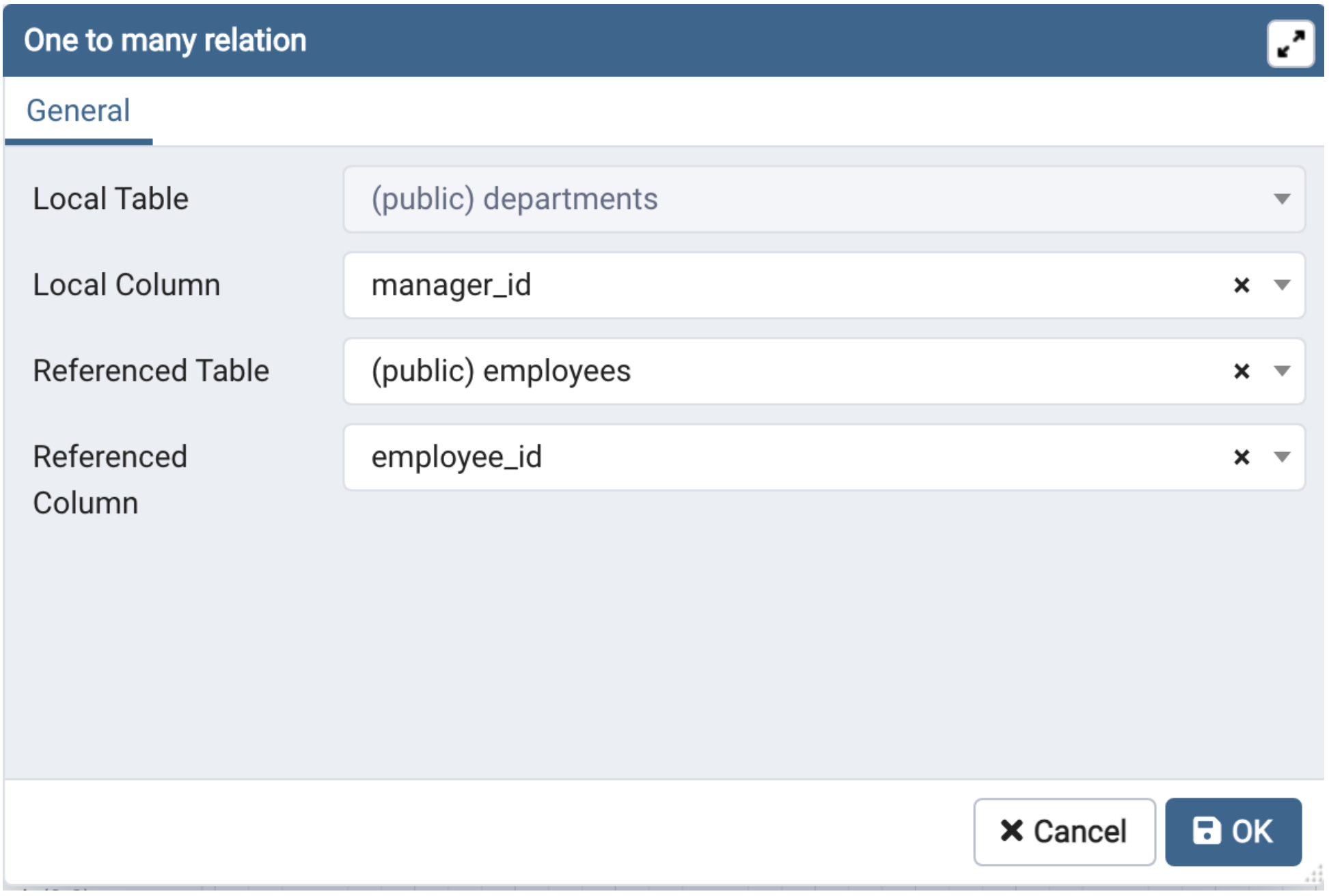
▼ [Click here] Create a relationship between departments and locations

> Select the entity diagram **departments** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **departments** table as shown in the image below to create the relationship. Then click **OK**.

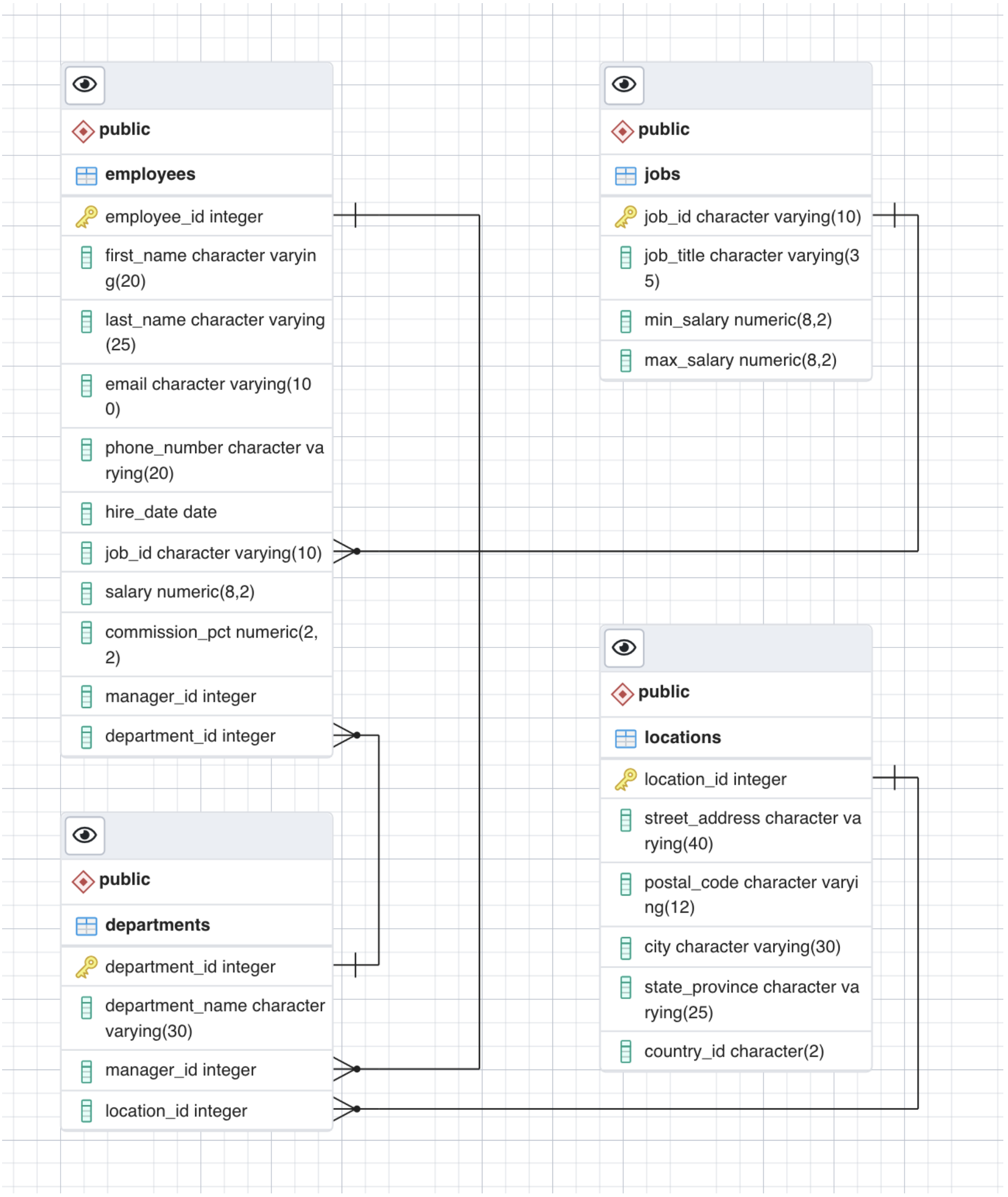


▼ [Click here] Create a relationship between departments and employees

> Select the entity diagram **departments** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **departments** table as shown in the image below to create the relationship. Then click **OK**.



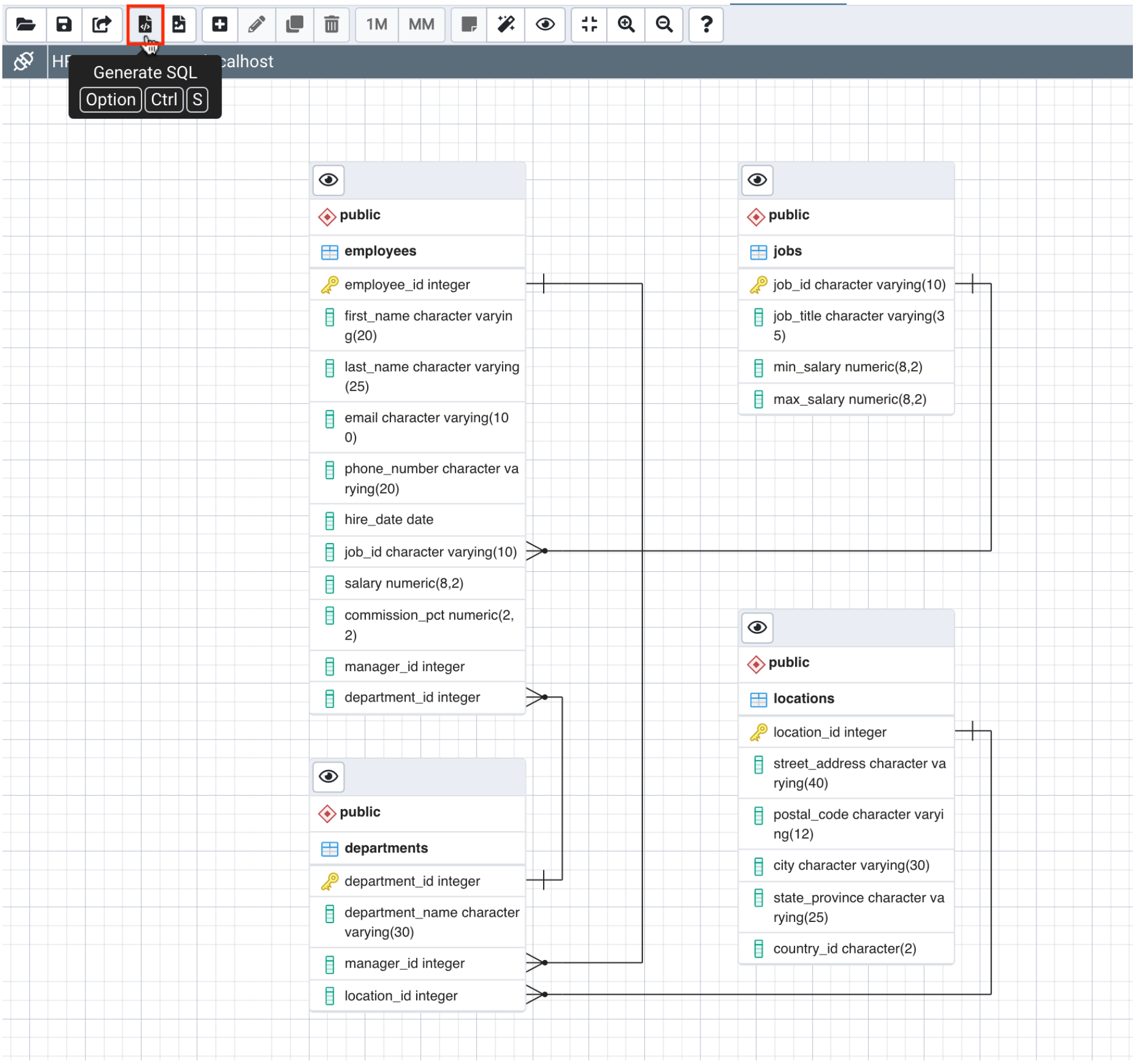
13. After creating all four relationships, you have completed the ERD for this exercise. Proceed to Task B.



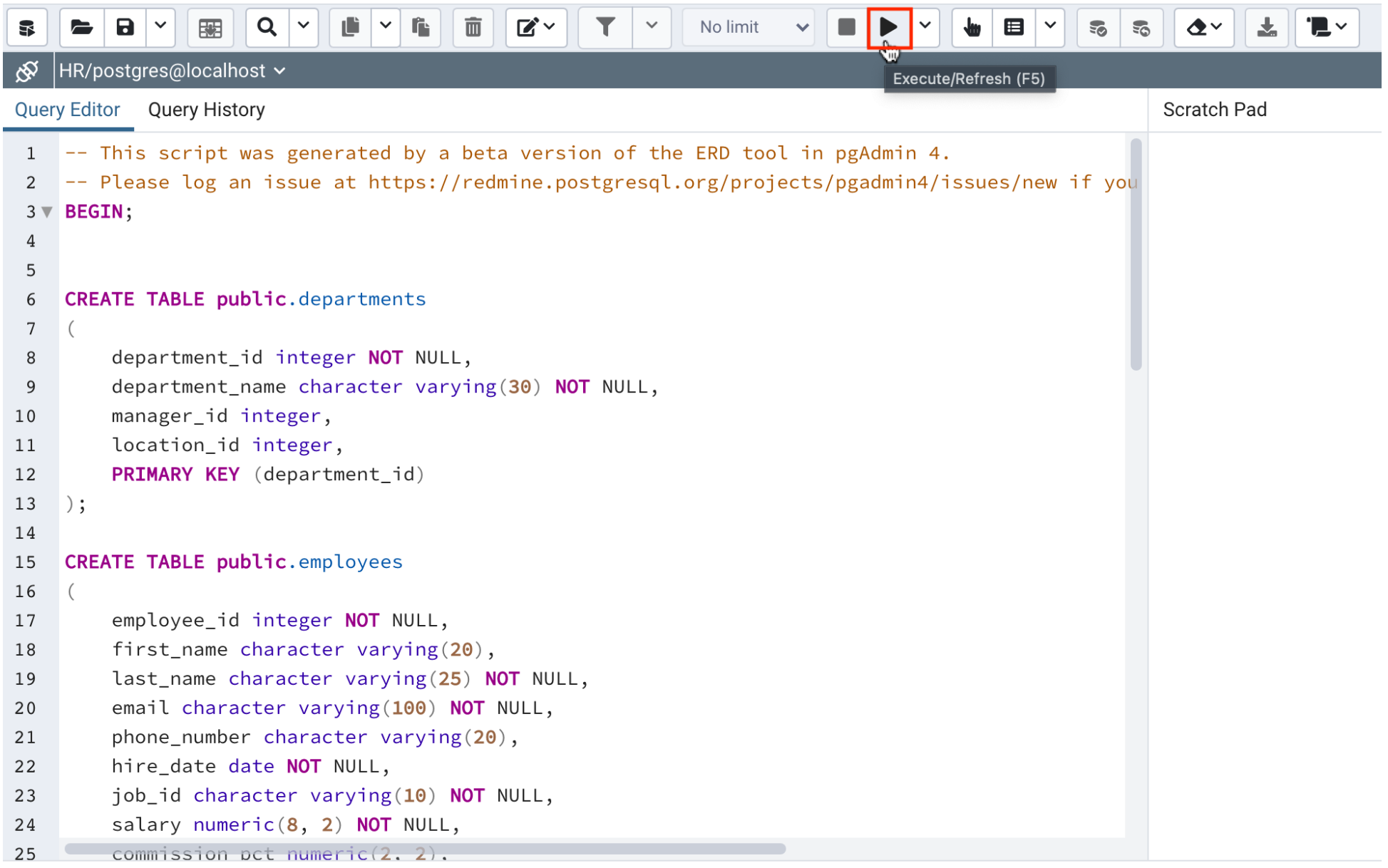
Task B: Generate and execute SQL script from ERD to create schema

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

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



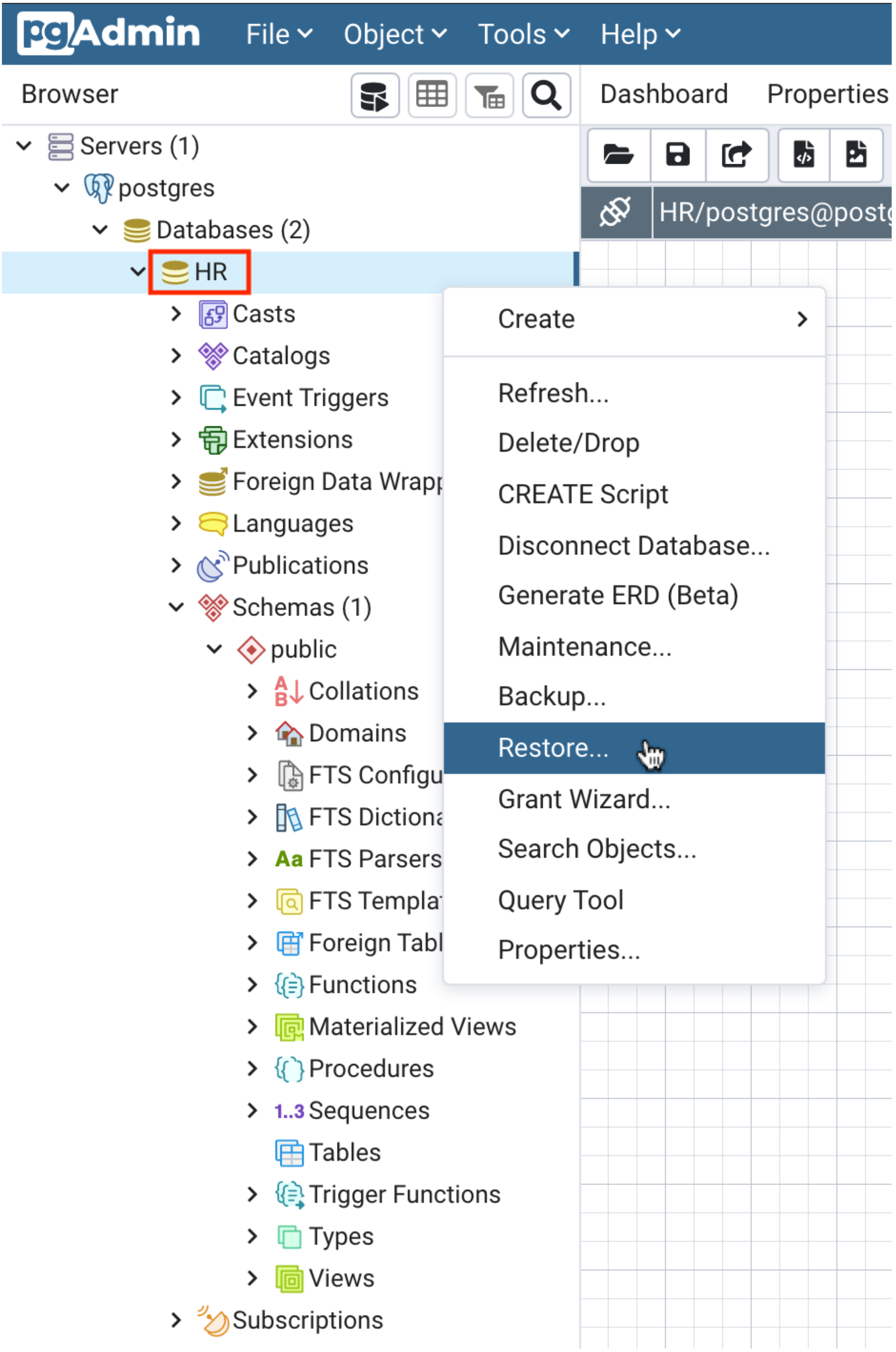
2. A new Query Editor window will open containing a SQL script generated from the ERD. Click the **Execute/Refresh** button to run the script. Proceed to Task C.



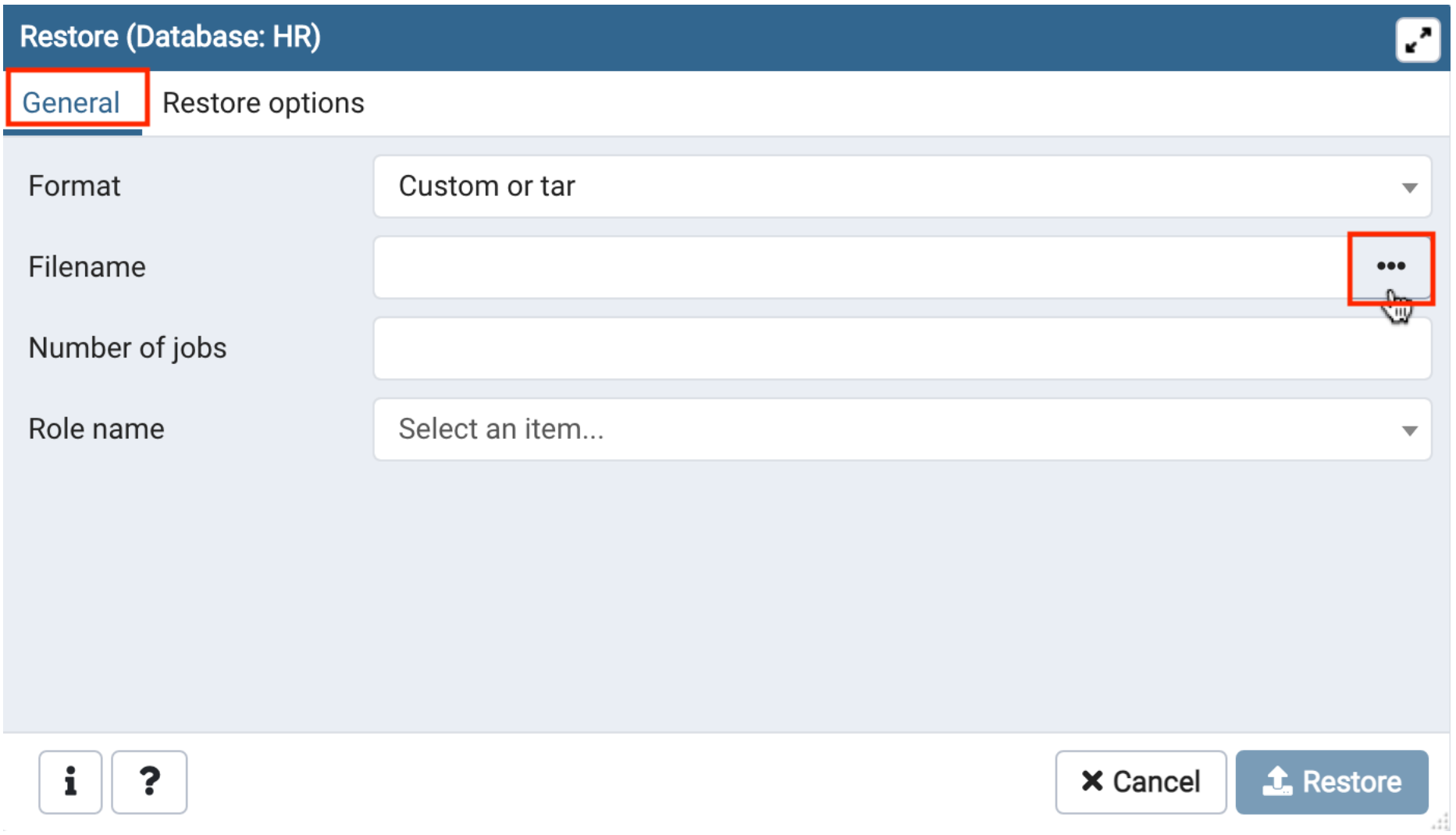
Task C: Load the database schema with data.

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.

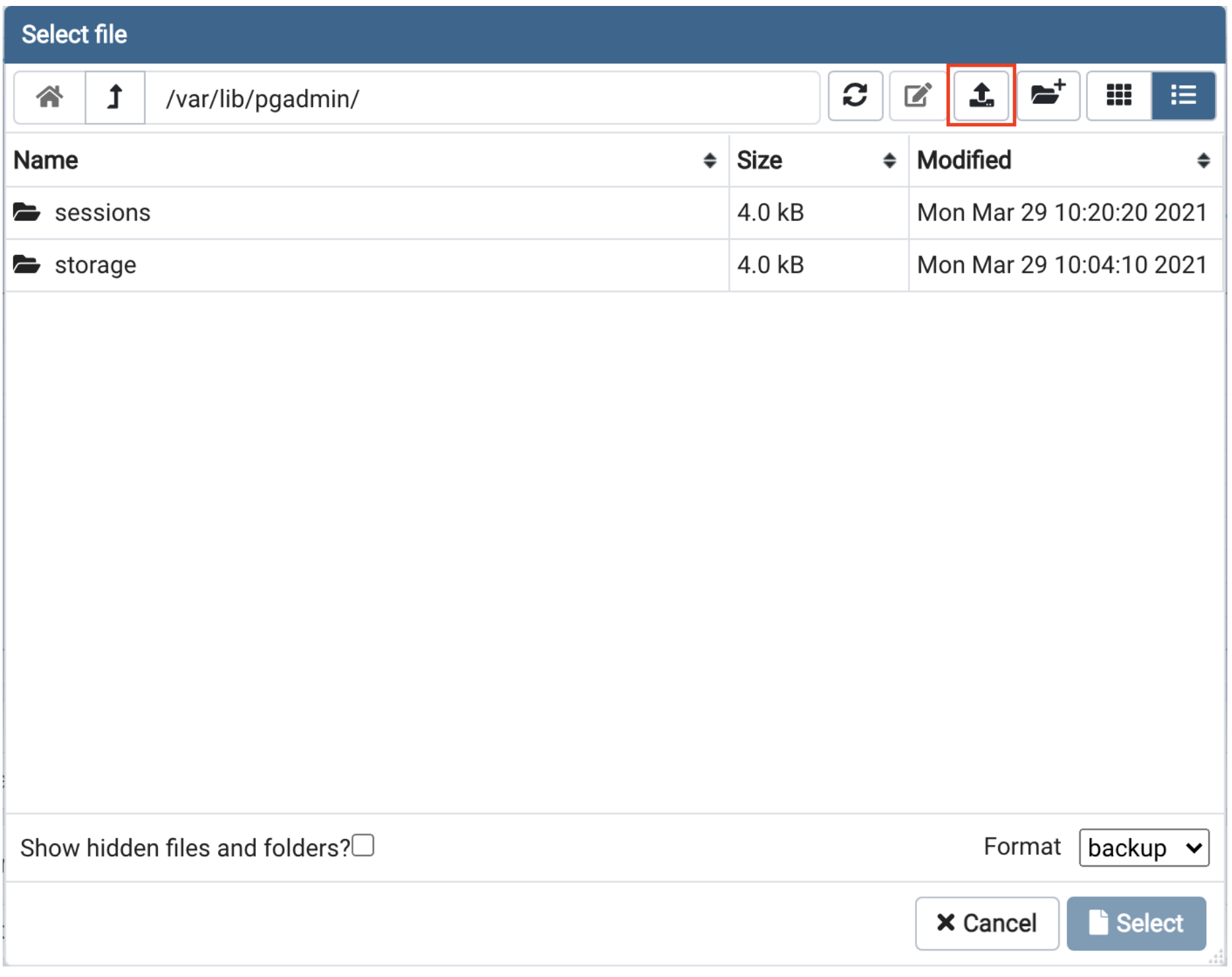
1. Download the **HR_pgsql_dump_data_for_example-exercise.tar** PostgreSQL dump file (containing the partial HR database data) using the link below to your local computer storage.
    - HR_pgsql_dump_data_for_example-exercise.tar
2. Follow the instructions below to import/restore the data:
    - In the tree-view, expand **HR**. Right-click **HR** and click **Restore**.



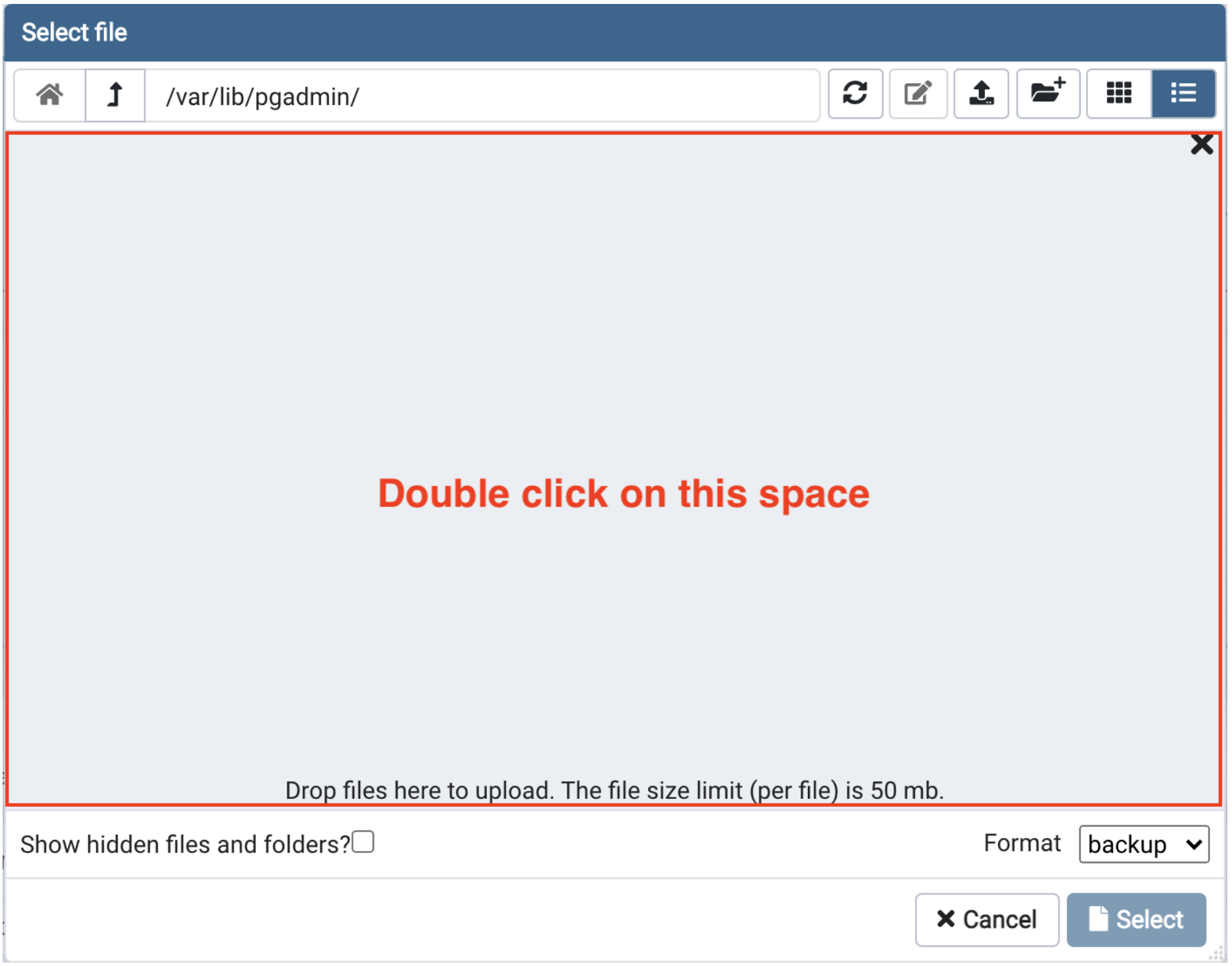
- On the **General** tab, click the **Select file** button by the Filename box.



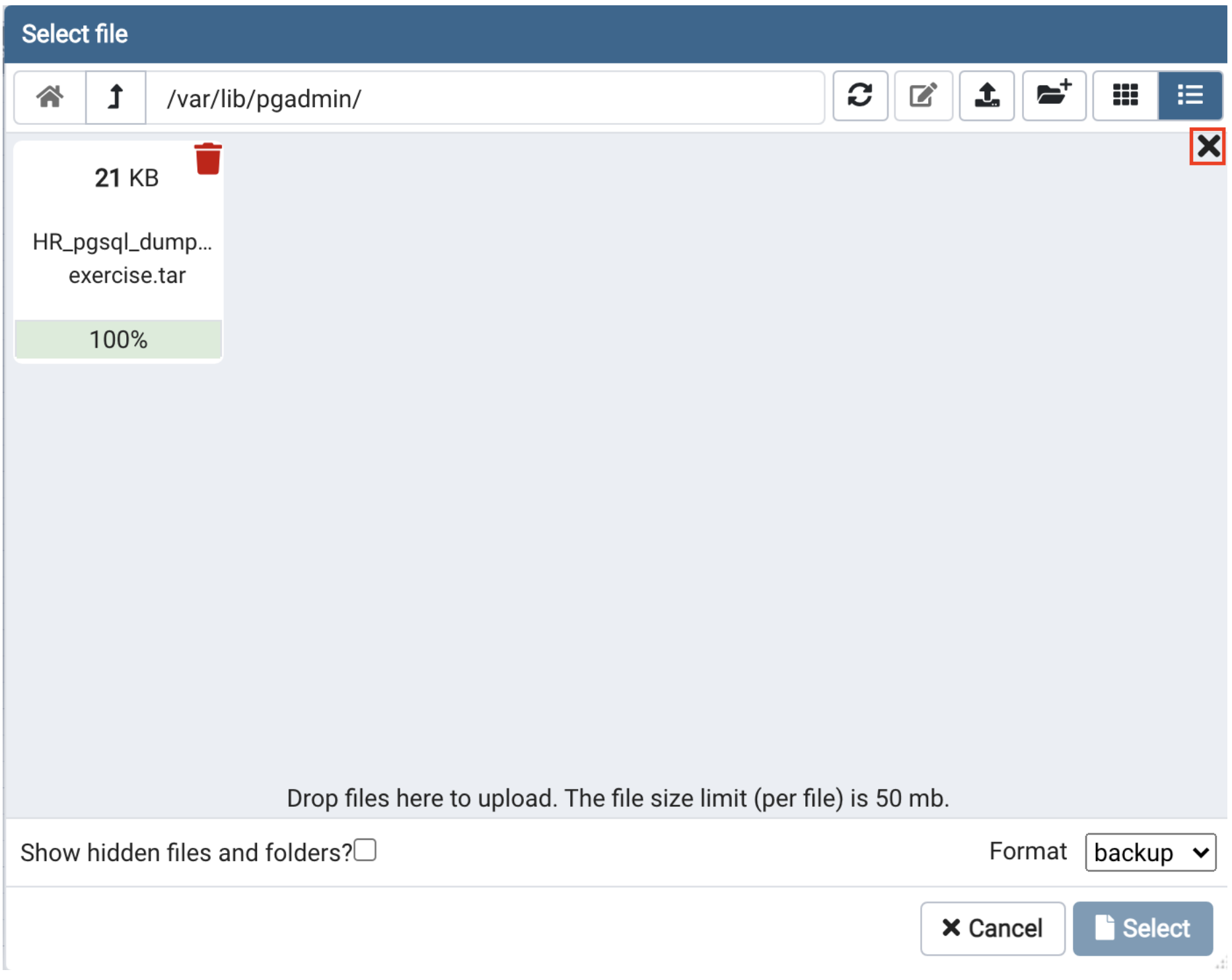
- Click the **Upload File** button.



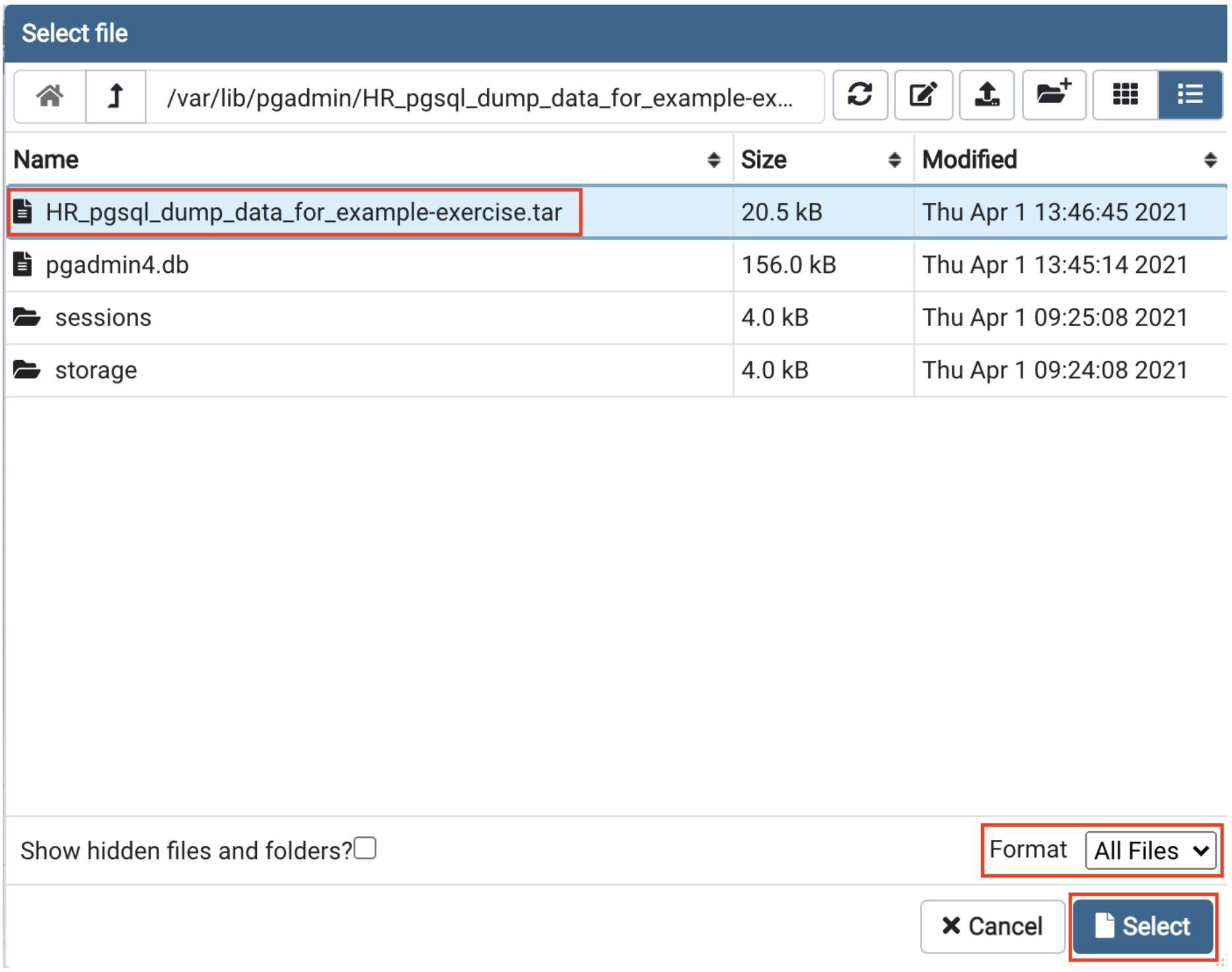
- Double-click on the drop files area and load the **HR_pgsql_dump_data_for_example-exercise.tar** you downloaded earlier from your local computer storage.



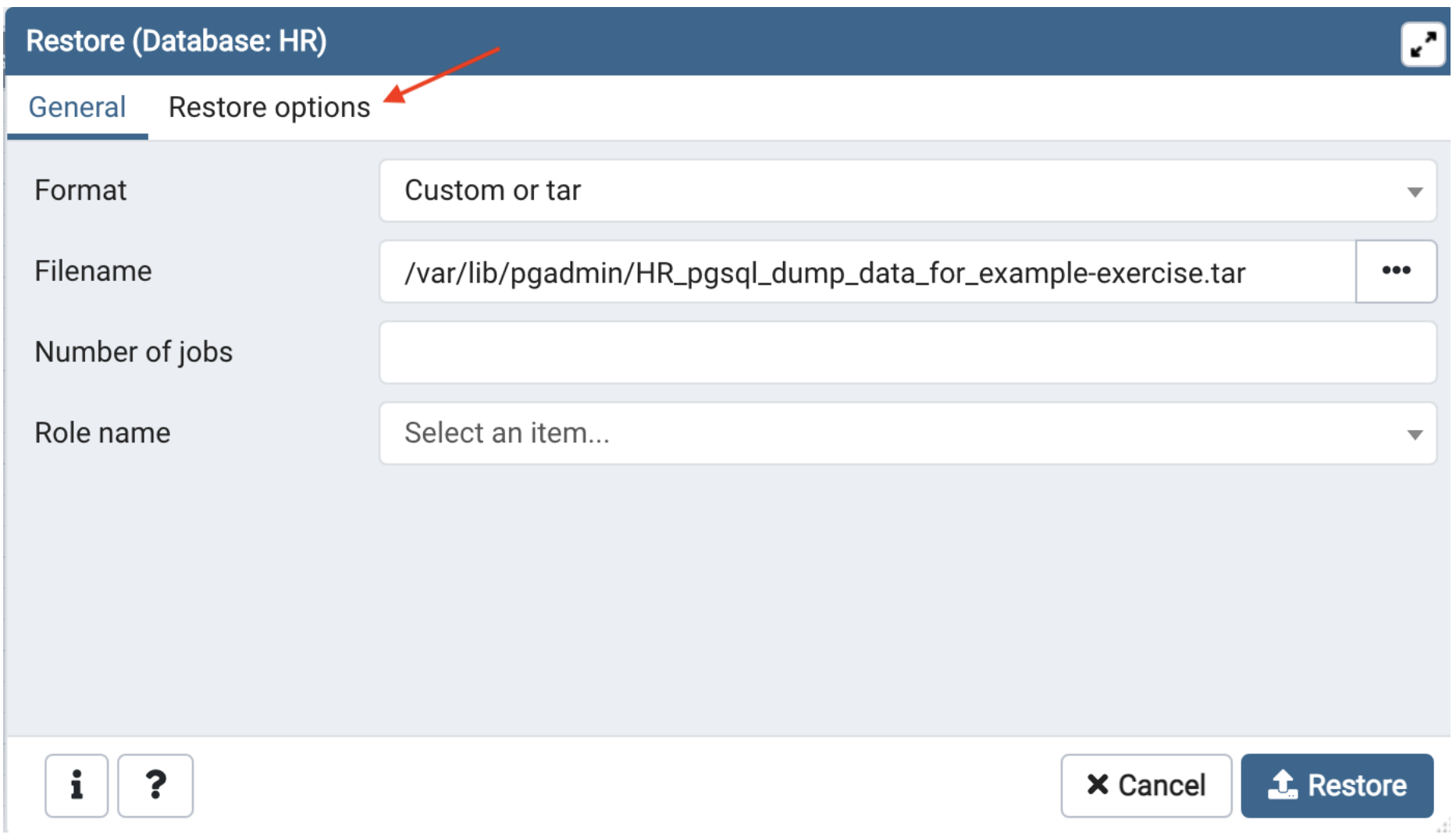
- When the upload is complete, close the drop files area by clicking the **X** button.



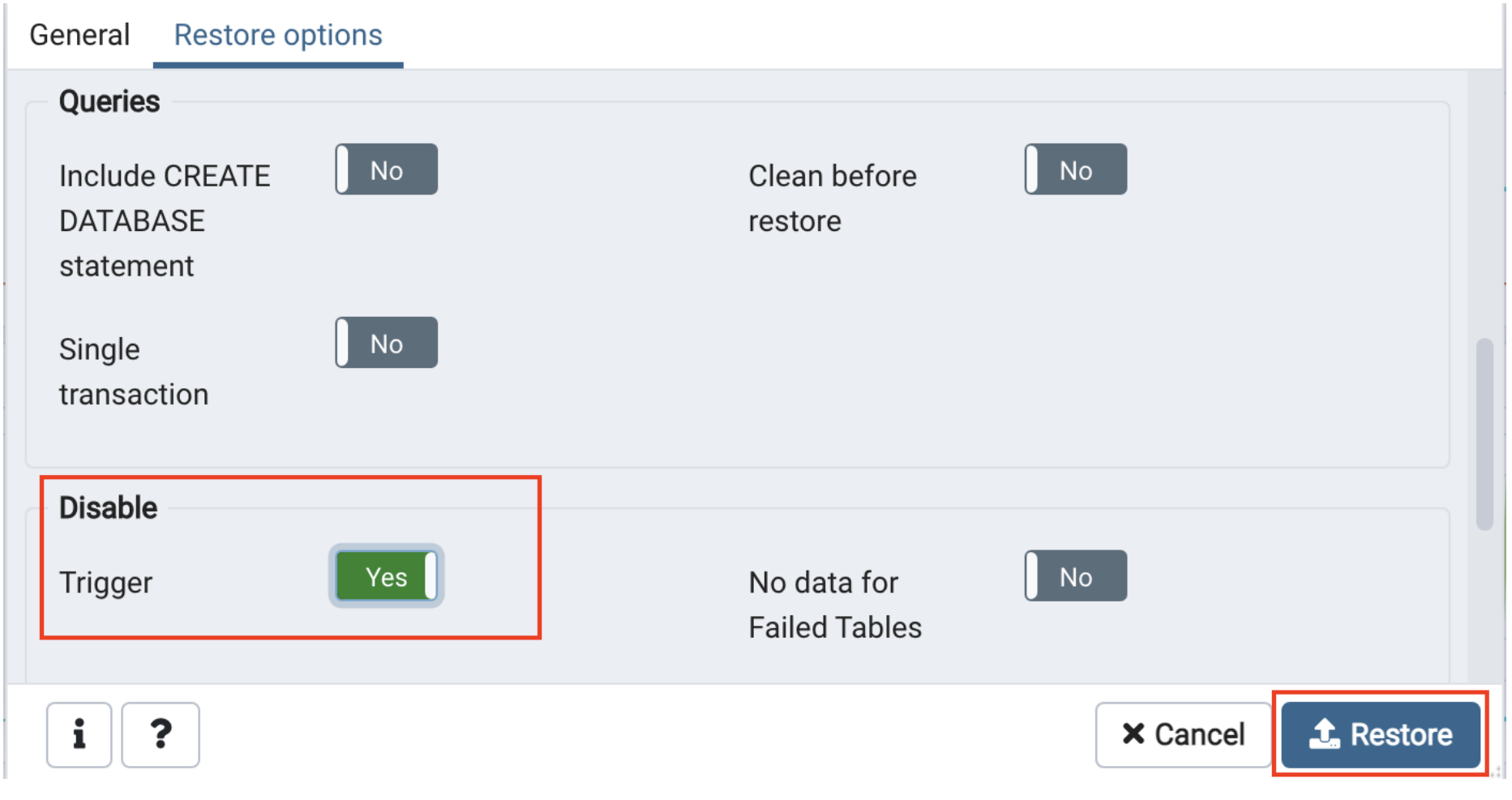
- Make sure Format is set to **All Files**, select the uploaded **HR_pgsql_dump_data_for_example-exercise.tar** file from the list, and then click the **Select** button.



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



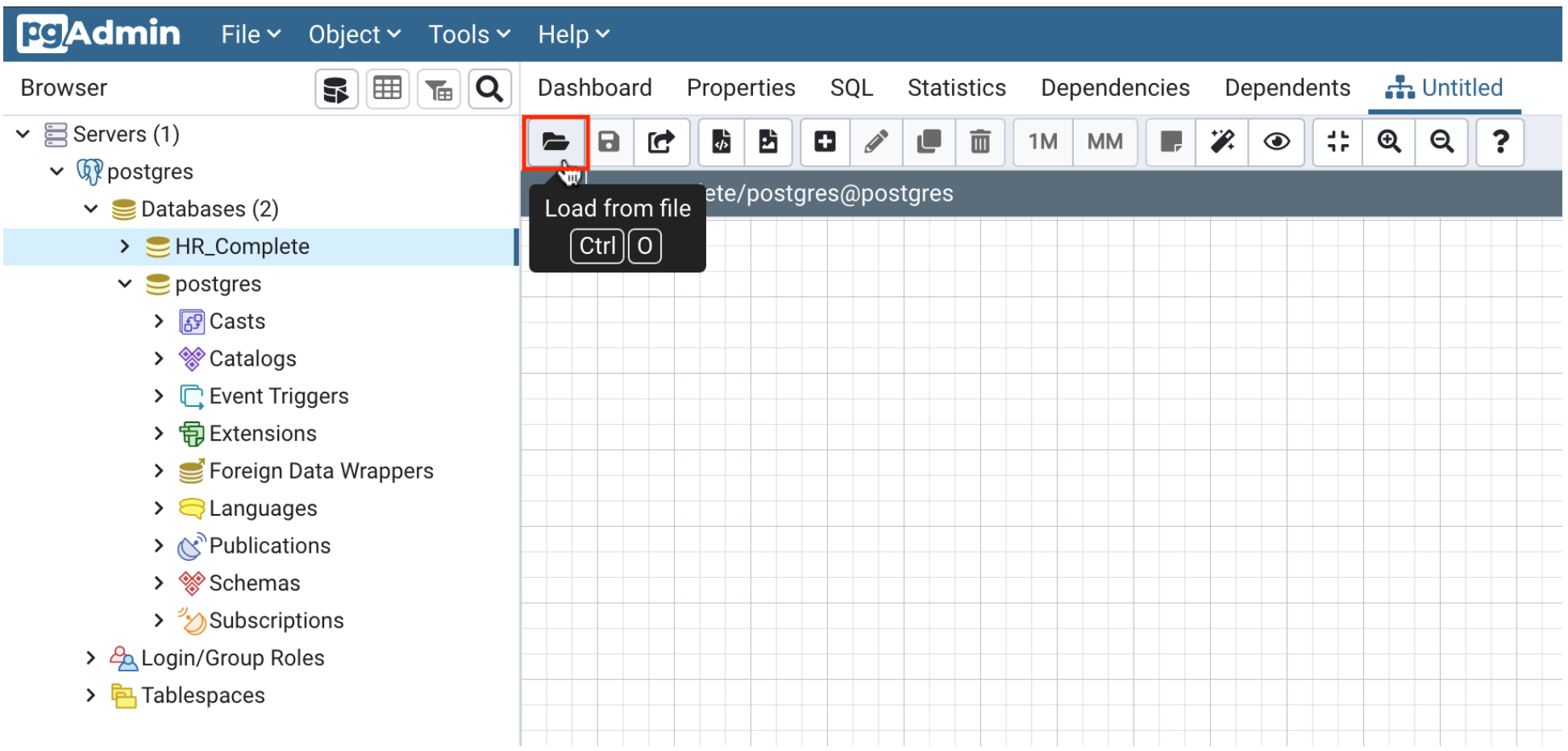
- Under Disable, set the Trigger option to **Yes**. Then click **Restore** button.



Practice Exercise

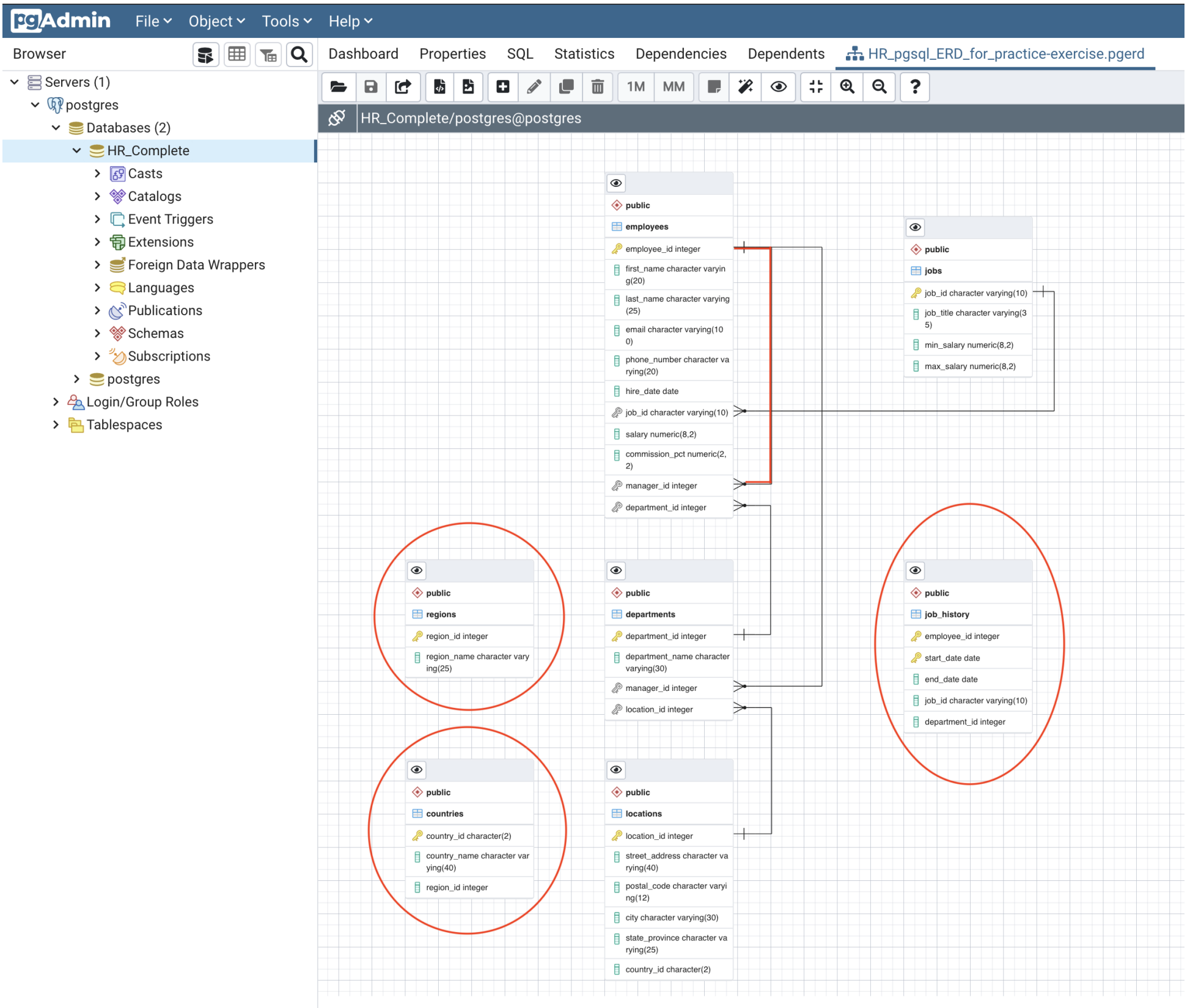
In this practice exercise, first you will finish creating a partially complete ERD for the HR database. Next, you will generate and execute an SQL script to build the complete schema of the HR database from its ERD. Finally, you will load the complete database schema with data by using restore feature.

1. 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 Example Exercise) below to your local computer storage.
    - HR_pgsql_ERD_for_practice-exercise.pgerd
2. In pgAdmin, create a new database named **HR_Complete**.
3. Open the ERD Tool and use the **Load from file** button to load the **HR_pgsql_ERD_for_practice-exercise.pgerd** file.



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

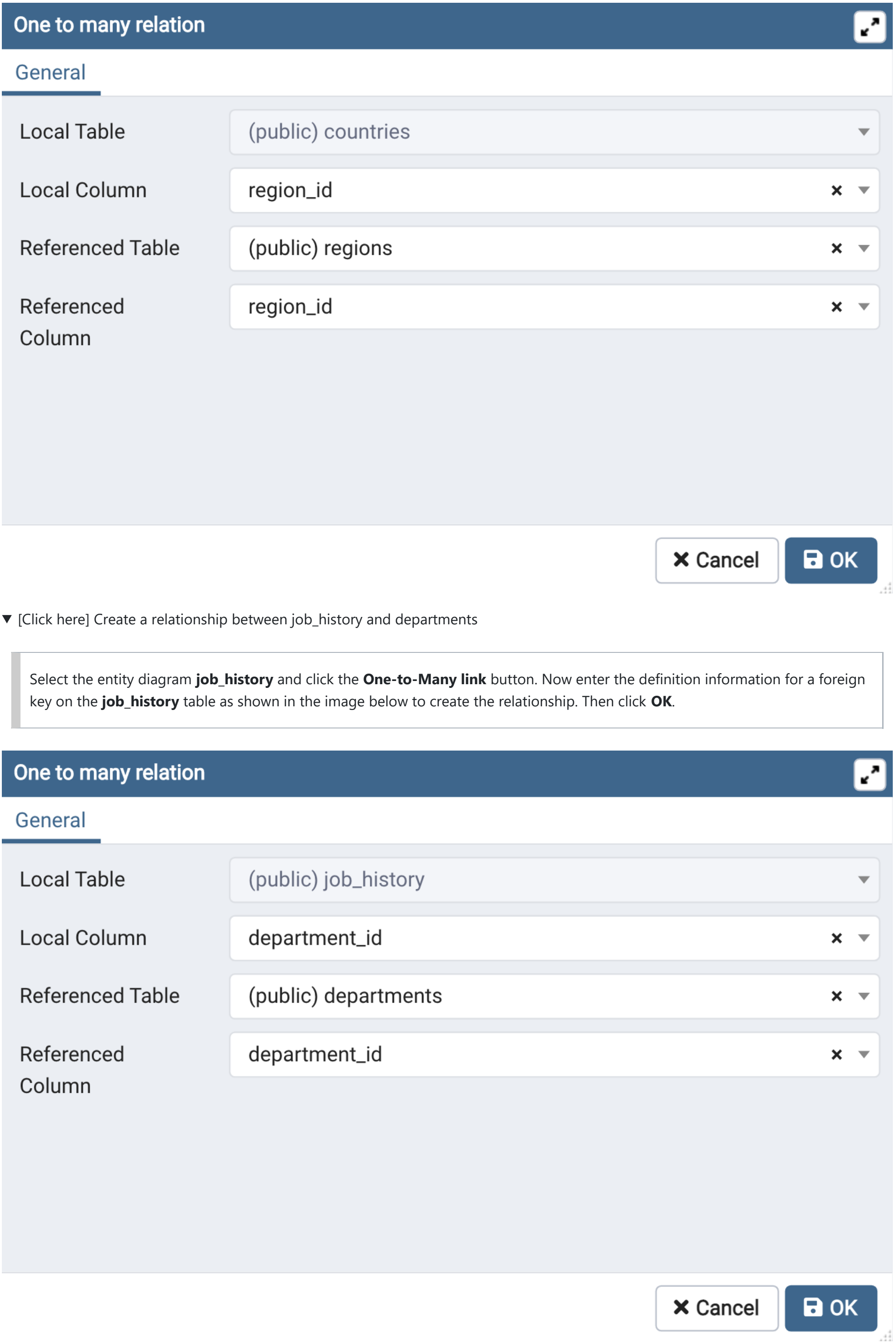
4. You will see the previous four entity diagrams along with relationships that you created in the Example Exercise. You will also see three new entity diagrams for the **job_history**, **regions**, and **countries** tables as well as one new relationship within the entity diagram of the **employees** 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

> Select the entity diagram **countries** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **countries** table as shown in the image below to create the relationship. Then click **OK**.



▼ [Click here] Create a relationship between job_history and departments

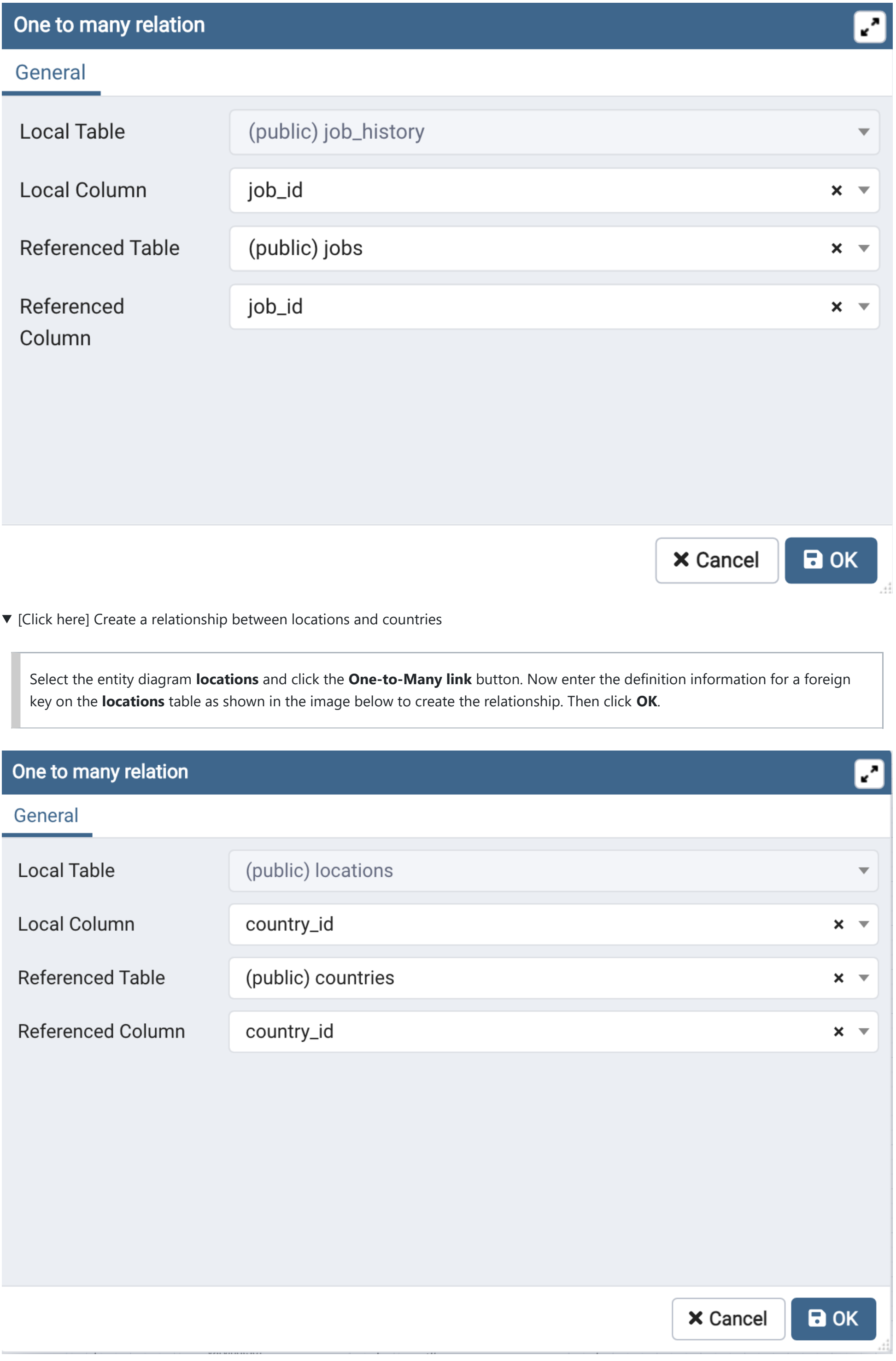
> Select the entity diagram **job_history** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **job_history** table as shown in the image below to create the relationship. Then click **OK**.

▼ [Click here] Create a relationship between job_history and employees

> Select the entity diagram **job_history** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **job_history** table as shown in the image below to create the relationship. Then click **OK**.

▼ [Click here] Create a relationship between job_history and jobs

> Select the entity diagram **job_history** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **job_history** table as shown in the image below to create the relationship. Then click **OK**.

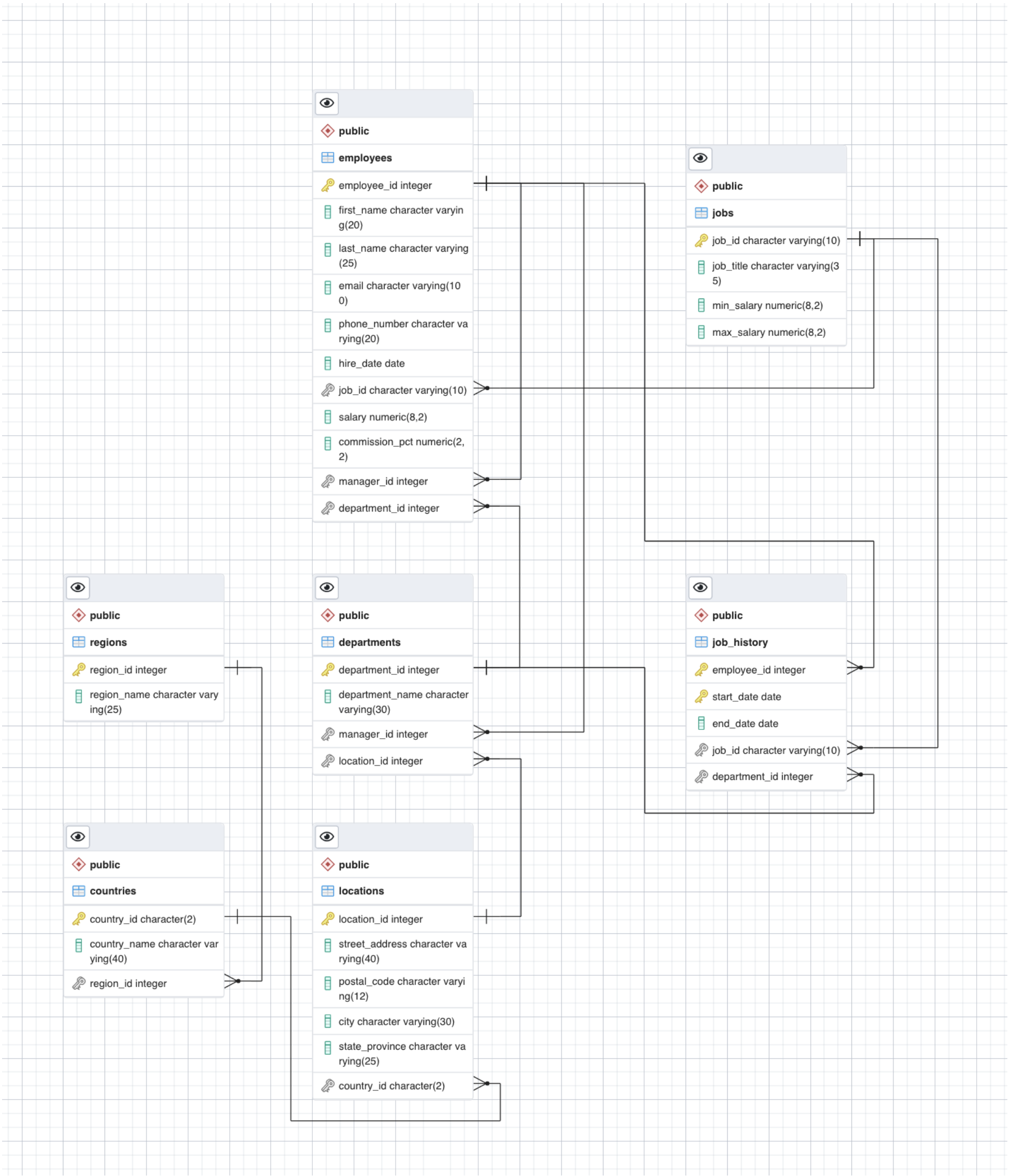


▼ [Click here] Create a relationship between locations and countries

> Select the entity diagram **locations** and click the **One-to-Many link** button. Now enter the definition information for a foreign key on the **locations** table as shown in the image below to create the relationship. Then click **OK**.

> **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_pgsql_dump_data.tar** PostgreSQL dump file (containing the complete HR database data) below to your local computer storage. Use the dump file to restore/import the data to the **HR_Complete** database.

    - HR_pgsql_dump_data.tar

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

Congratulations! You have completed this lab, and you are ready for the next topic.

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Changelog

Date	Version	Changed by	Change Description
2021-03-31	1.0	Sandip Saha Joy	Created initial version