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SQL Developer for VS Code

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Preface

This guide provides usage information about Oracle SQL Developer for VS Code.

Audience

This guide is intended for those using the Oracle SQL Developer extension in Visual Studio Code.

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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1

Changes in Release 26.1 for *SQL Developer for VS Code*

The new features in this release are:

- Support for Kerberos Authentication
  See Kerberos Authentication
- Managing Data Import
  See Configuring and Managing Data Import
- Editor for Views and Indexes
  See Creating or Editing a View and Creating or Editing an Index

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2

Getting Started

Oracle SQL Developer for VS code is a new, more powerful version of Oracle SQL Developer desktop that is now freely available as an extension in Visual Studio Code. In the first release, you can browse, edit, and delete objects, run SQL statements and scripts, edit and run PL/SQL code, and manipulate and export data.

You can connect to any target Oracle Database schema using standard Oracle Database authentication. Once connected, you can perform operations on objects in the database.

Topics:

- Installing Oracle SQL Developer for VS Code
- Connecting to Your Database

2.1 Installing Oracle SQL Developer for VS Code

Oracle SQL Developer for VS code is available for all major platforms.

Perform the following steps to install Oracle SQL Developer for VS Code:

> **Note**
>
> After installing it the first time, the SQL Developer extension for VS Code is automatically updated as new versions become available.

1. Click the **Extensions** icon in the Activity Bar on the left side or use the **View**: **Extensions** command (Ctrl+Shift+X).
2. In the Extensions pane, in the Search field, enter **SQL Developer**.

   SQL Developer appears as one of the search results.
3. In the result entry, click **Install**.

   SQL Developer appears in the left pane under INSTALLED along with a SQL Developer icon in the left side bar.
4. Click the icon to open SQL Developer. In the left pane, Connections and SQL Snippets appear.

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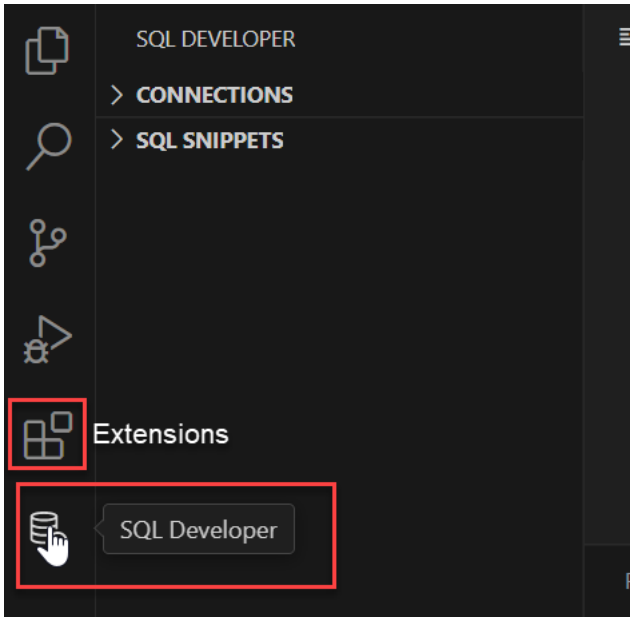


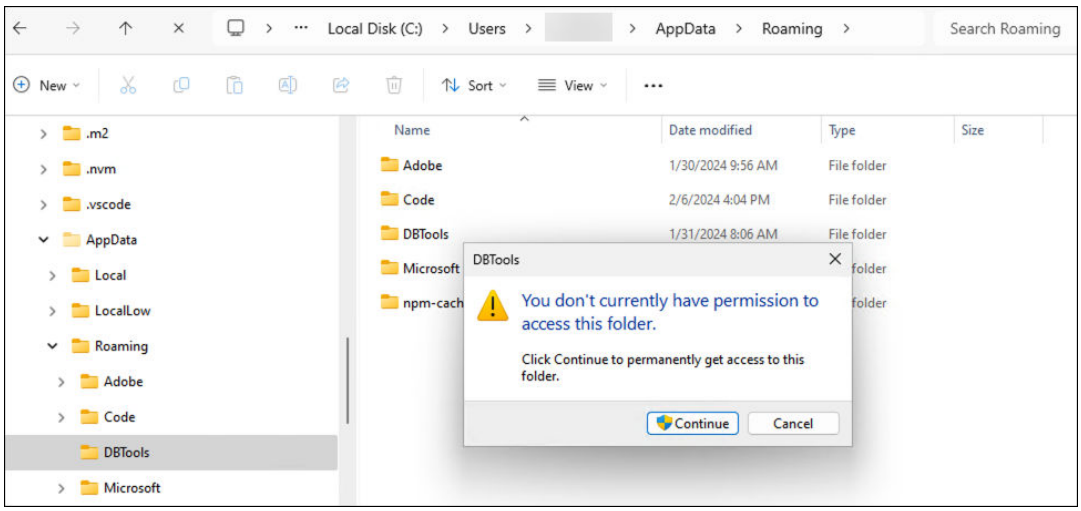
2.1.1 File Permissions for User Accounts in Windows Domain

If there are both local and domain accounts for a user in Windows, the directory is assigned to the local account, creating inaccessible secure storage for the domain account. That is, a DBTools directory owned by the local user is created in the domain user's `AppData\Roaming` location.

To resolve this issue:

1. Uninstall SQL Developer for VS Code release 23.4.0.
2. Remove the DBTools directory.

   As the domain user, if you try to open `<domain-user>/AppData/Roaming/DBTools`, you will get an error message.



To resolve this, do one of the following:

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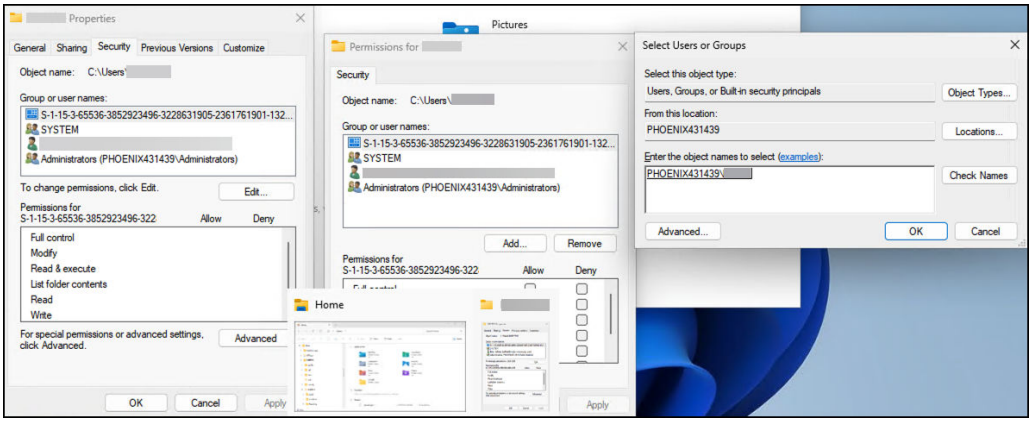
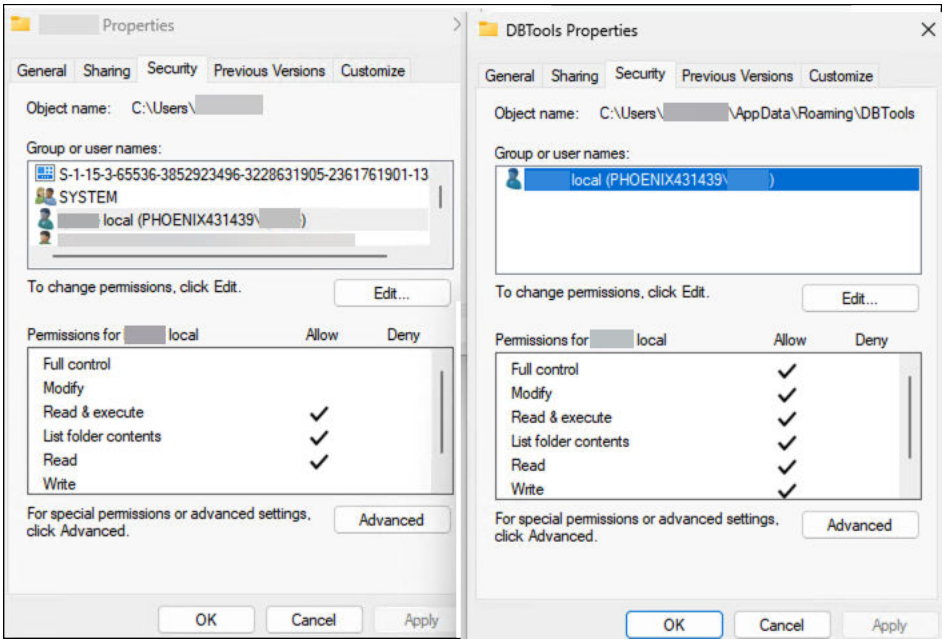
- If you are also an administrator, you are prompted for access, then you can delete the directory before installing a new version.
- If you are not an administrator, contact an administrator who can help to delete the directory.
- If you know both local and domain passwords, provide local account access to your domain user directory.



Ignore any errors as the focus is on the path to `AppData\Roaming\DBTools`.

Permissions are as shown in the following figure:



Log in as local user and navigate to `<domain user>\AppData\Roaming`, and then delete DBTools.

Log in as domain user and remove local account access to the domain account home directory.

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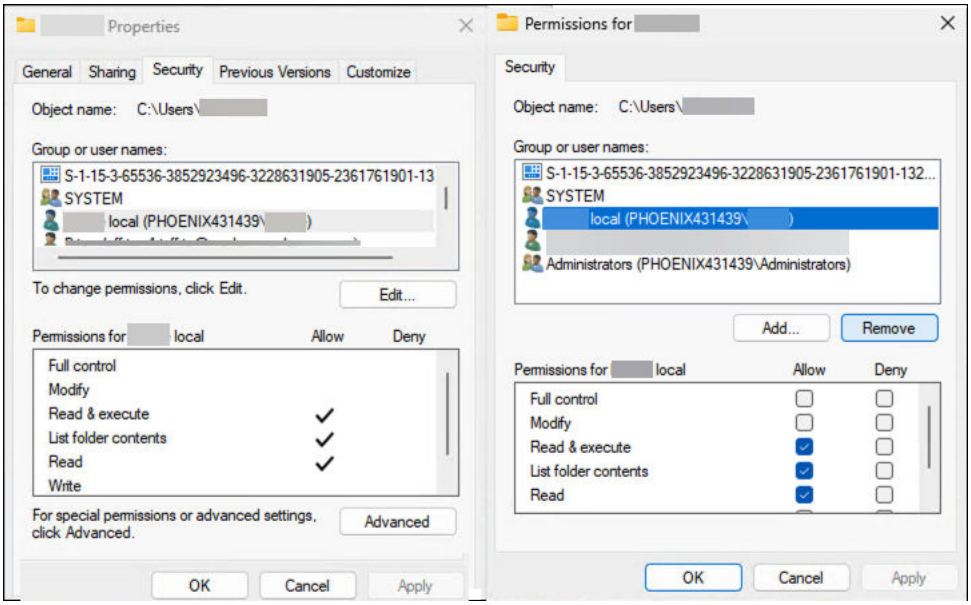

3. Install SQL Developer for VS Code release 23.4.1.

2.2 Connecting to Your Database

A connection is a SQL Developer object that specifies the necessary information for connecting to a specific database as a specific user of that database. You must have at least one database connection (existing or created) to use SQL Developer for VS Code.

You can connect to any target Oracle database schema using standard Oracle database authentication. Once connected, you can perform operations on objects in the database.

The actions that you can perform for connections are:

- **Add**: To create a new connection. Click the **Add** icon next to Connections, enter the connection information and click **Connect**. For more information, see Creating a Connection.
- **Edit**: To edit an existing connection. In the Connections panel, right-click the connection name and select **Edit**. Change any connection information except the connection name, and click **Save** or **Connect**.
- **Clone**: To create a new connection when one or more connections already exist. In the Connections panel, select an existing connection, right-click and click **Clone**. Change the Connection name to the desired name, edit other connection information as needed, and click **Save** or **Connect** to create the new connection.
- **Refresh**: To update the connection to include any changes that were made. Click the Refresh icon next to the connection name to refresh the connection.
- **Open SQL Worksheet**: To open a SQL Worksheet pane for the connection. Right-click the connection name, and select **Open SQL Worksheet**. See Using the SQL Worksheet
- **Open SQLcl**: To start the SQLcl command line in the Terminal tab for the opened database connection. Right-click the connection name, and select **Open SQLcl**.
- **Reconnect**: To reconnect to a connection where the session has been terminated. Right-click the name in the Connections panel, and select **Reconnect**.
- **Disconnect**: To disconnect from the current connection. Right-click the name in the Connections panel, and select **Disconnect**.

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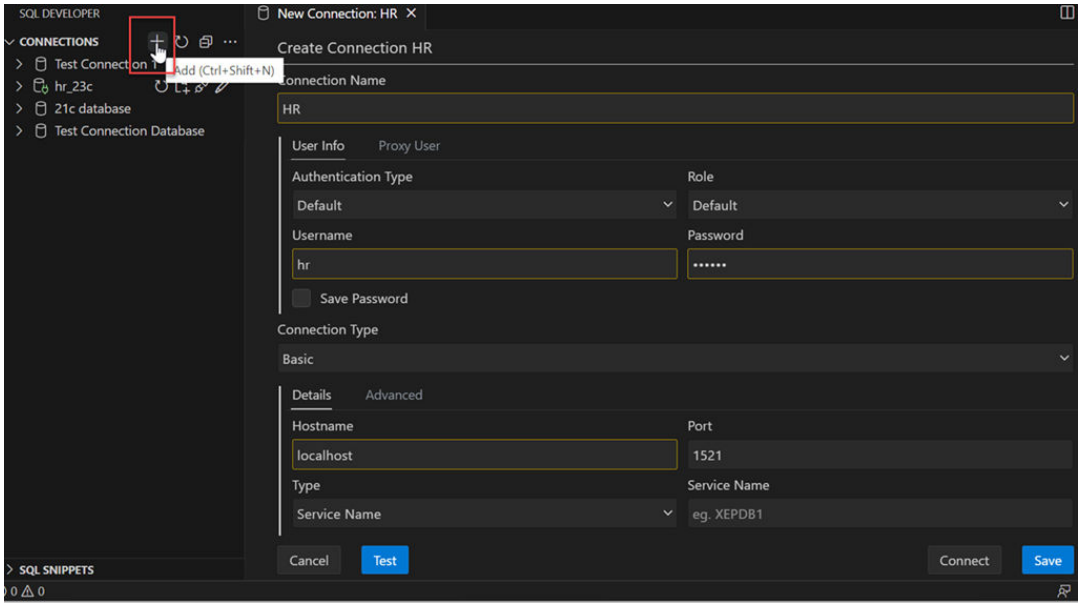
- **Delete**: To delete a connection (that is, delete it from SQL Developer, not merely disconnect from the current connection), right-click the connection name in the Connections panel display and select **Delete**. Deleting a connection does not delete the user associated with that connection.

2.2.1 Creating a Connection

Perform the following steps to create a new connection:

1. In the Connections panel, click the **Add** icon.

   The Create Connection pane appears.



2. Enter the fields as follows:

   Connection Name: An alias for a connection to the database using the information that you enter. (The connection name is not stored in the database, and the connection is not a database object.) Suggestion: Include the database name (SID) and user name in the connection name. Example: personnel_joe for connecting to the personnel database as user Joe.

   User Info Tab

   - **Role**: The set of privileges to be associated with the connection. For a user that has been granted the SYSDBA system privilege, you can specify a connection that includes the privilege.
   - **Username**: Name of the database user for the connection. This user must have sufficient privileges to perform the tasks that you want to perform while connected to the database, such as creating, editing, and deleting tables, views, and other objects.
   - **Password**: Password associated with the specified database user.
   - **Save Password**: If this option is checked, the password is saved with the connection information, and you will not be prompted for the password on subsequent attempts to connect using this connection.
   - **Connection Type**: Select Basic, TNS, Cloud Wallet, or Custom JDBC URL. The display of fields changes to reflect any change in connection type. For any Oracle

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connection type, there is an **Advanced** tab that you can use to set custom JDBC properties.

- **Basic Connection Type**
  - **Hostname**: Host system for the Oracle database.
  - **Port**: Listener port.
  - **Type**: Database name.
  - **Service Name**: Network service name of the database (for a remote database connection over a secure connection).
- **TNS Connection Type**
  - **Network Alias**: Oracle Net alias for the database.
  - **TNS File Location**: Displays the directory where your TNSNAMES.ORA file is located. Click the **Edit in Settings** link to add or change the location.
  - **Connect Identifier**: Oracle Net connect identifier.
- **Cloud Wallet Connection Type**

  This connection type is relevant for Oracle Cloud connections that use Oracle Wallet.
  - **Configuration File**: Client credentials zip file downloaded from the Cloud service console.
  - **Service**: Service name in the client credentials file. This field is automatically prefilled after the client credential file is selected.
  - **Proxy** tab: Cloud Wallet connections support a custom proxy.
- **Custom JDBC Connection Type**
  - **Custom JDBC URL**: URL for connecting directly from Java to the database, it overrides any other connection type specification. If you are using TNS or a naming service with the OCI driver, you must specify this information: Example:

    ```
    jdbc:oracle:thin:scott/@localhost:1521:orcl
    ```

    Note that in this example, the "/" is required, and the user will be prompted to enter the password.

3. Click **Test** to test the database connection before opening it.
4. Click **Save** to save the connection details, or click **Connect** to open the connection.

2.2.2 Entra ID Authentication

This section enables you to connect to an Oracle Database that is configured for Entra ID (Azure AD) authentication, using the SQL Developer Extension for VS Code.

You will learn how to set up the necessary tools, configure authentication, and establish a secure connection to your database.

Install the Azure SDK

Open a SQLcl terminal inside VS Code.

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The Azure SDK is a set of JAR files required by the JDBC thin driver to enable connections to databases using Entra ID authentication. The SQL Developer extension provides a simple command to install this SDK:

```
sdk install jdbc-azure
```

Once installation is complete, restart VS Code to load the newly installed JAR files.

Set up the `tnsnames.ora` Entry

Add a new entry to your `tnsnames.ora` file with the necessary parameters for Entra ID authentication:

```
PDB1 =
  (DESCRIPTION=
    (ADDRESS=(PROTOCOL=TCPS)(HOST=xxxxx)(PORT=0000))
    (SECURITY=
      (SSL_SERVER_DN_MATCH=TRUE)
      (WALLET_LOCATION=SYSTEM)
      (TOKEN_AUTH=AZURE_INTERACTIVE)
      (TENANT_ID=xxxxx)
      (CLIENT_ID=xxxxx)
      (AZURE_DB_APP_ID_URI=xxxxx)
    )
    (CONNECT_DATA=
      (SERVER=DEDICATED)
      (SERVICE_NAME=pdb1)
    )
  )
```

- **PROTOCOL**: Must be set to `TCPS` to ensure a secure connection for token transmission.
- **HOST**: Specify the database host.
- **PORT:** Specify the database port.
- **SSL_SERVER_DN_MATCH** (optional): Enforces server-side certificate validation through distinguished name (DN) matching.
- **WALLET_LOCATION**: Use `SYSTEM` for public CA-signed certificates, or specify a local path if using a self-signed or private CA. When connecting to an OCI database that uses a wallet (such as Autonomous Database), ensure that it points to the extracted wallet location.
- **TOKEN_AUTH**: Set to `AZURE_INTERACTIVE` for Entra ID authentication.
- **TENANT_ID**: Set to `AZURE_INTERACTIVE` for Entra ID authentication.
- **CLIENT_ID**: Specify the registered Entra ID web application for the database client.
- **AZURE_DB_APP_ID_URI**: Specify the URI of the registered Entra ID web application of the database server.

Create the Connection

Create a new connection using the SQL Developer Extension as you would for a standard TNS connection. The username and password are not required, as authentication will be completed through an interactive browser login prompted by the extension.

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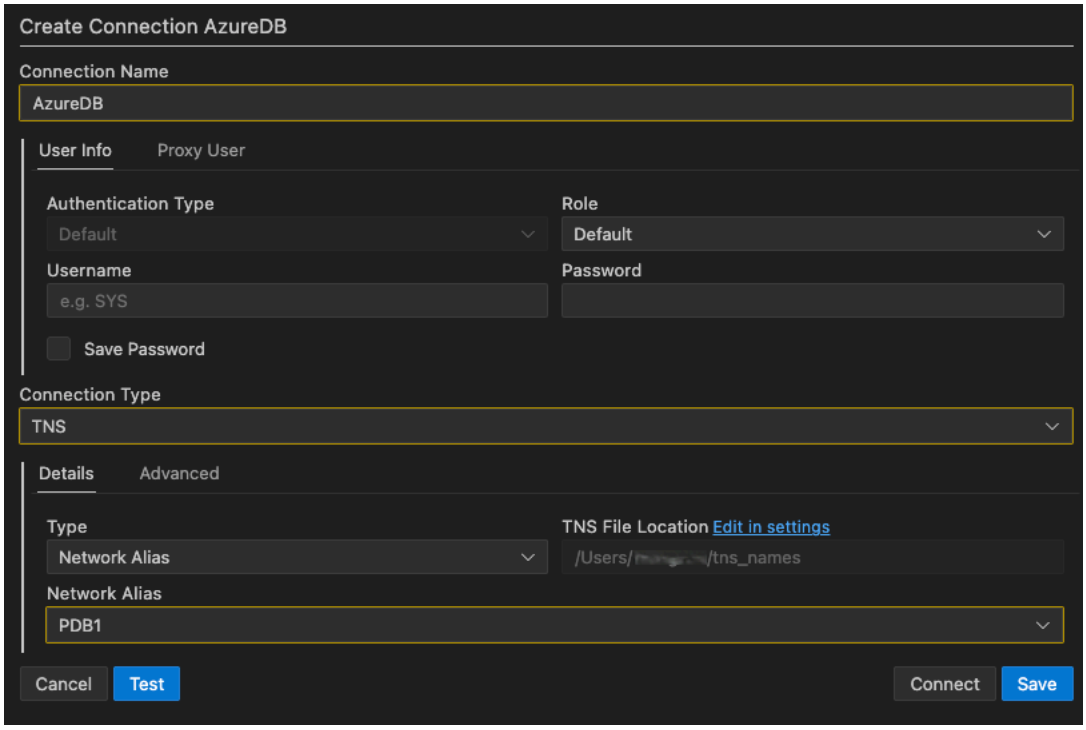

Once you open your connection, a browser window will launch prompting you to sign in with your Entra ID credentials. After you successfully authenticate, an authentication successful screen will be displayed. You can then close the browser and return to VS Code to proceed with your database connection.

2.2.3 Kerberos Authentication

This section explains how to use Kerberos authentication with the SQL Developer Extension for VS Code on Windows, supporting two Kerberos credential sources:

- **MSLSA (Windows LSA)**: This is Windows' native Kerberos credential store, where tickets are kept in memory by the Local Security Authority (LSA).
- **MIT Kerberos**: This method uses a file-based Kerberos configuration and credential cache.

VS Code Extension Settings

To open the settings, click the **Extensions** icon in the Activity Bar on the left side, locate Oracle SQL Developer Extension for VS Code, click **Manage**, and then select **Settings**. In the Settings window, select **Database Connections** from the left pane.

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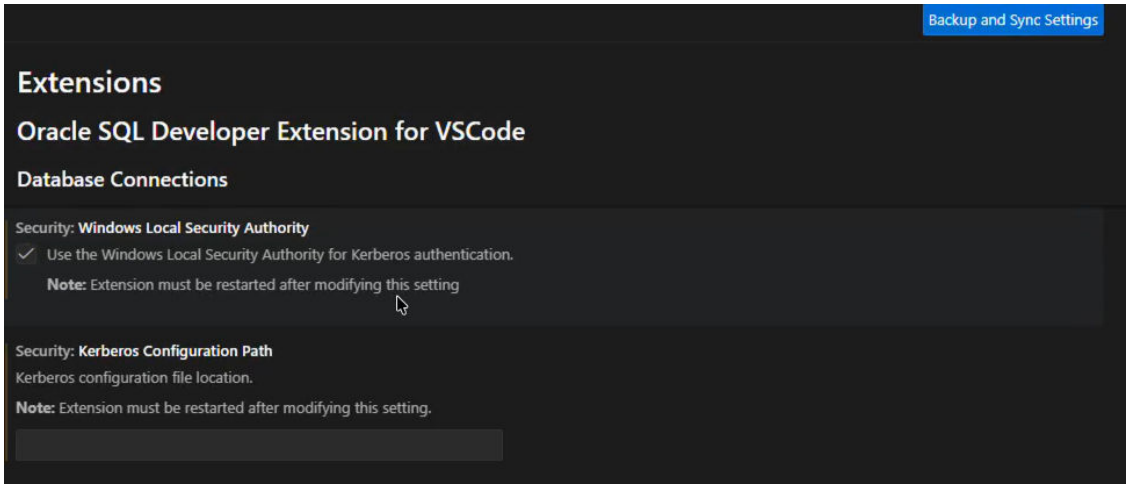

Choosing the Kerberos Mode (MSLSA/MIT)

The Kerberos mode is controlled by two settings that are mutually exclusive. After changing either setting, you must restart the extension for changes to take effect.

- **Security: Windows Local Security Authority**
  This setting enables MSLSA-based Kerberos authentication on Windows. When the **Use the Windows Local Security Authority for Kerberos authentication** checkbox is selected, the extension uses the Windows Local Security Authority (LSA) credential store to obtain the Kerberos ticket needed to perform the authentication.
- **Security: Kerberos Configuration Path**
  This setting specifies the location of the Kerberos configuration file (for example, krb5.conf) used when **Security: Windows Local Security Authority** is not enabled. When a valid path is provided, the extension uses it to get the Kerberos configuration needed to create the connection.

Creating or Editing Connections for Kerberos

To configure a Kerberos connection, ensure the connection definition indicates Kerberos is enabled by setting the following Advanced property. This property is required for both MSLSA and MIT Kerberos connections.

```
oracle.net.authentication_services = (KERBEROS5)
```

The extension uses the presence of `KERBEROS5` to treat the connection as Kerberos-based. For Kerberos connections, the username and password fields can be left empty because authentication is performed using existing Kerberos credentials. This applies to Custom JDBC, TNS, and Wallet connection types.

MIT Kerberos (File-Based) Connection

When using MIT Kerberos-style (file-based) authentication, two additional configuration items are required beyond what is typically needed for an MSLSA Kerberos connection:

- Set **Security: Kerberos Configuration Path** to the location of your Kerberos configuration file (for example, `krb5.conf`).
- In the connection's Advanced properties, add `oracle.net.kerberos5_cc_name` to point to the local Kerberos ticket cache file (for example, a `krb5.cc` cache).

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This property is used in addition to enabling Kerberos through `oracle.net.authentication_services = (KERBEROS5)`. Together, these settings ensure the connection uses the file-based Kerberos configuration and ticket cache rather than Windows LSA credentials.

SQLCL Support

All Kerberos functionality supported by the VS Code extension is also supported when launching and using SQLcl, so Kerberos-authenticated sessions work seamlessly without requiring users to re-enter connection details. The solution supports opening SQLcl by:

- Right-clicking a saved connection and selecting **Open SQLcl**
- Connecting from an in-IDE SQLcl terminal using `connect -name <connection_name>`
- Connecting from an external OS terminal using the SQLcl executable with a named connection:

```
sql -nolog
connect -name <connection_name>
```

For MSLSA on Windows, the external scenario introduces an additional `-mslsa` flag to start SQLcl in native Kerberos mode. For example:

```
sql -nolog -mslsa
connect -name <connection_name>
```

For MIT Kerberos, SQLcl continues to work using the configured file-based Kerberos settings. In all cases (except for the optional `-mslsa` flag on Windows), SQLcl should rely on the already-stored connection definition and require no extra parameters.

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3

Using SQL Developer for VS Code

This chapter covers the following topics:

Topics:

- Understanding AI Enrichment
- Working with Database Objects
- Working with JSON-Relational Duality Views
- Managing JavaScript Modules
- Managing MLE Environments
- Entering and Modifying Data
- Using the SQL Notebook
- Using the SQL Worksheet
- Running Functions and Procedures
- Debugging PL/SQL Objects
- Using Folders to Organize Connections
- Using Filters
- Using Preferences
- Using Drag and Drop for Code Generation

3.1 Understanding AI Enrichment

AI Enrichment enables you to enhance your database by systematically adding, refining, and optimizing schema, table, and column metadata.

With this feature, you can assign clear, meaningful labels and comprehensive descriptions to database objects including tables and columns. By using annotations to declare the intent of your data, you can make your database more understandable and AI-ready for LLMs and natural language querying. This enrichment enables LLMs to generate more accurate, context-aware SQL queries.

3.1.1 Enabling AI Enrichment for a Schema

To view enrichment opportunities for your schema and take action, you must first enable the AI enrichment feature.

This is a one-time process that sets up your schema by creating the necessary objects to store the enrichment metadata.

To enable the feature:

1. In the **Connections** panel, expand your database connection tree, and click the **AI Enrichment** folder.

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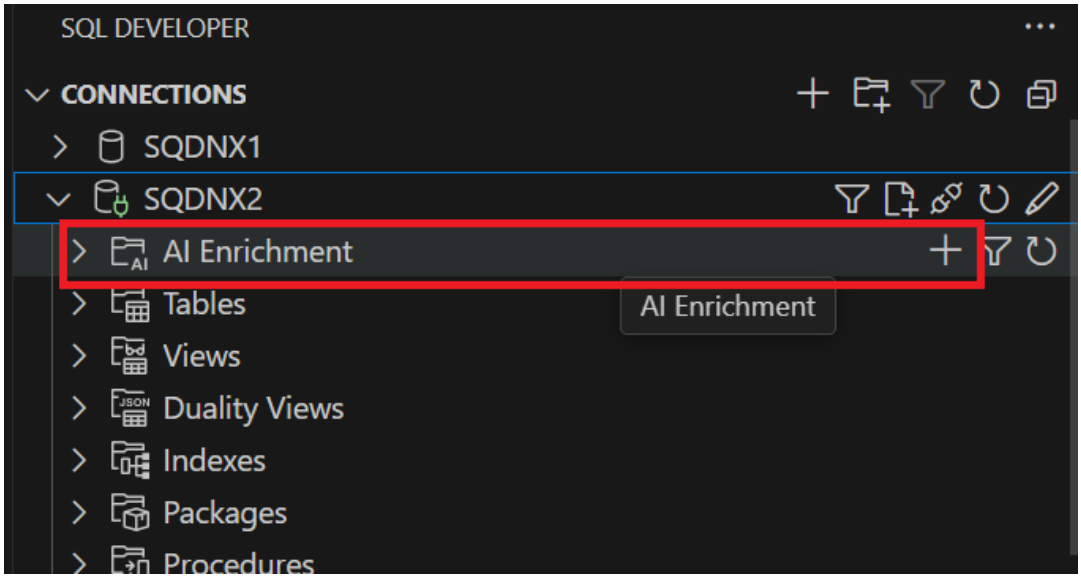
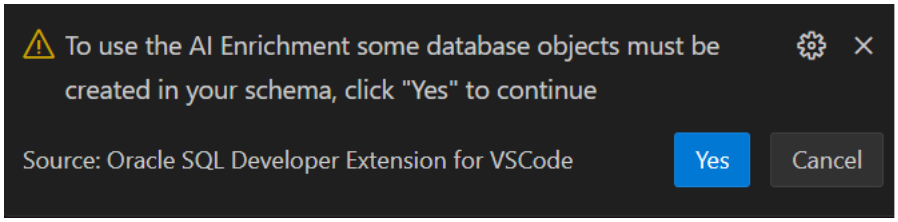


2. In the dialog box that appears, click **Yes** to confirm the creation of AI enrichment objects.



The AI enrichment feature is now available for your schema.

> **Note**
>
> Do not use AI Enrichment on SYS or SYSTEM schemas, as the creation of AI Enrichment objects in a SYS-level schema may fail due to potential conflicts during installation.

3.1.2 Required User Privileges for AI Enrichment

To successfully install and use the AI Enrichment feature, the following database privileges are required:

- CREATE VIEW
- CREATE TABLE
- CREATE SEQUENCE
- CREATE PROCEDURE

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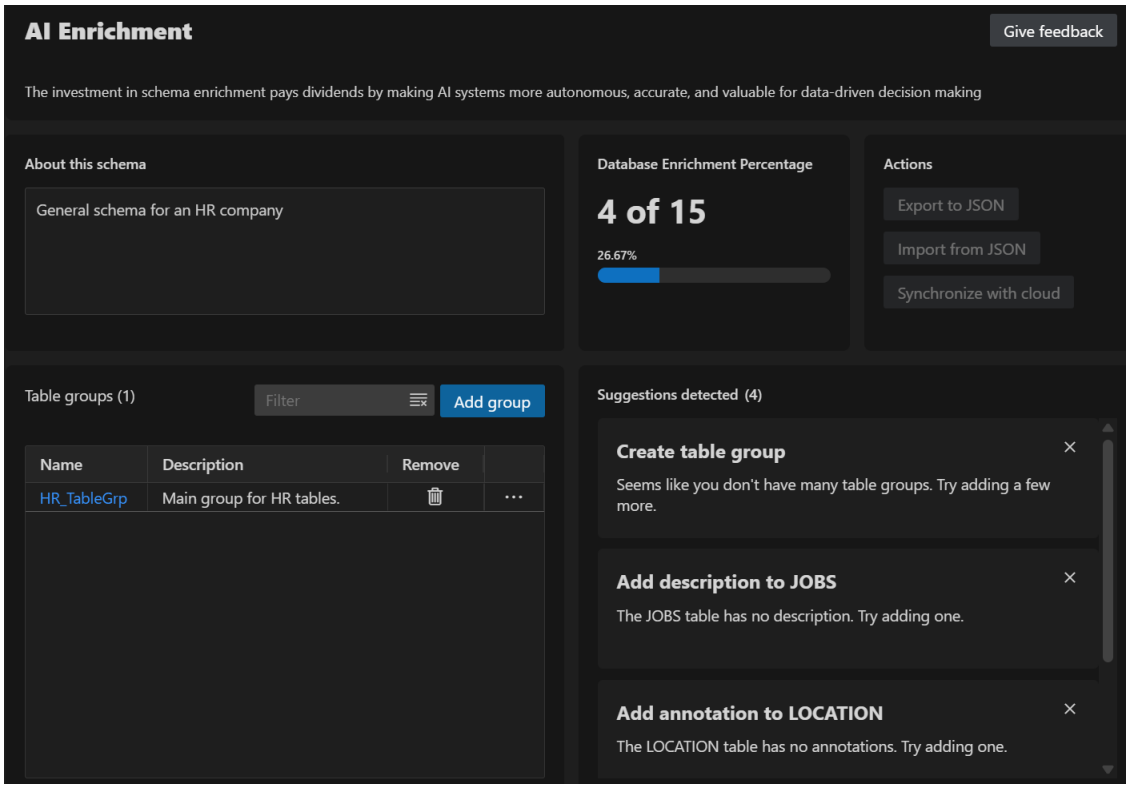
> **Note**
>
> The user must also have sufficient quota in the tablespace.

3.1.3 Introduction to the AI Enrichment Dashboard

The AI Enrichment dashboard provides a consolidated view of database schema, allowing you to monitor and manage schema enrichment activities in one place. With this dashboard, you can easily track the progress of annotations and enrichment across tables and columns, helping ensure completeness throughout your schema.

To open the AI Enrichment dashboard:

In the **Connections** panel, expand your database connection and click **+** on the **AI Enrichment** node. Alternatively, right-click the **AI Enrichment** node and select **AI Enrichment Dashboard**.



The AI Enrichment Dashboard is divided into following key sections:

- **About this schema**: Allows you to enter the high-level description for the schema. For more information, see High-Level Schema Description.
- **Table groups**: Allows you to logically group related tables and displays the existing groups in the schema. For example, all tables related to Human Resources can be grouped into an HR table group. For more information, see Managing Table Groups.
- **Database Enrichment Percentage**: Allows you to view the percentage completion of AI Enrichment in your schema. If none of the schema objects (tables or columns) are annotated, the enrichment percentage will be 0%. As more tables and columns within the schema are enriched, this percentage increases accordingly. This metric helps you track

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progress and measure how extensively enrichment has been applied within a given schema.

- **Suggestions detected**: Displays helpful hints and recommended next steps to guide users in maximizing the effectiveness of schema enrichment.

3.1.4 High-Level Schema Description

The first step in schema enrichment is to add a high-level description for your schema.

You can use this section to explain the purpose of your schema and clearly communicate its role and structure within your database. Adding this description helps users and tools quickly understand the business context, objectives, and key entities represented by the schema.

In the AI Enrichment dashboard, add a clear and concise description in the **About this schema** section. For example, for a Human Resources (HR) schema, you can enter a description as follows:

```
This schema manages core HR data including employees, departments, roles,
payroll, and benefits to support workforce management and reporting.
```

3.1.5 Managing Table Groups

The table groups enables you to logically group related tables. With this, you can provide a common description for all the tables in the group, which in turn facilitates the enrichment functionality.

3.1.5.1 Creating a Table Group

Perform the following steps to create a new table group:

1. On the AI Enrichment dashboard, click **Add group** in the **Table groups** section.

   The **Create Table Group** slider appears:

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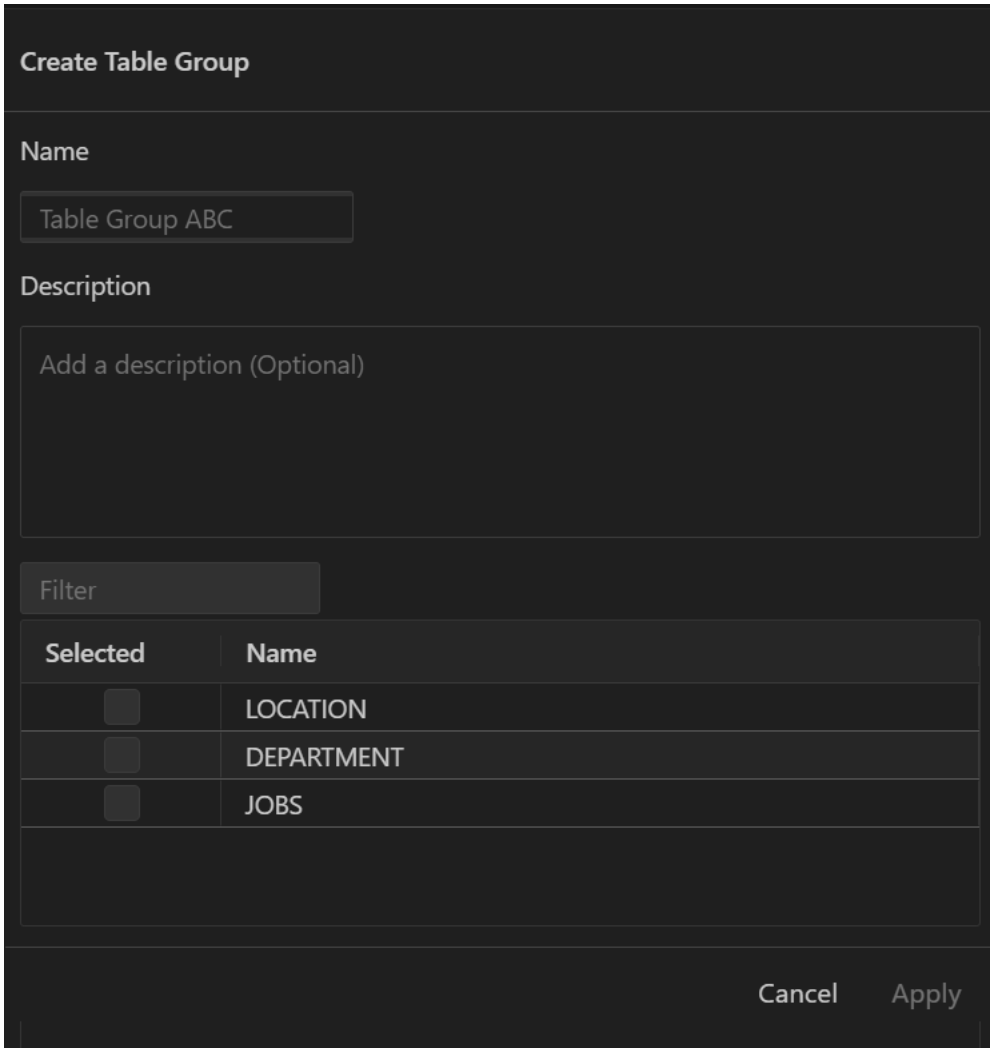

2. Enter a name and description for the table group.
3. Select the checkboxes for the tables that you want to include in this group.
4. Click **Apply**.

The new group is now displayed under the **Table group** panel on the dashboard.

3.1.5.2 Adding a Description to a Table Group

You can add a summary to a table group to clarify the purpose of its tables.

Perform the following steps to add a natural language description to a table group:

1. In the AI Enrichment dashboard, locate the **Table groups** section.
2. Click the **Description** cell of a table group.
3. In the **Set description** slider, enter a description and click **Save**.

You can also add a description in the table group's view by accessing it through any of these actions:

- Click a table group link in the **Table groups** section of the AI Enrichment dashboard.
- Select a table group under the **AI Enrichment** node in the **Connections** panel.

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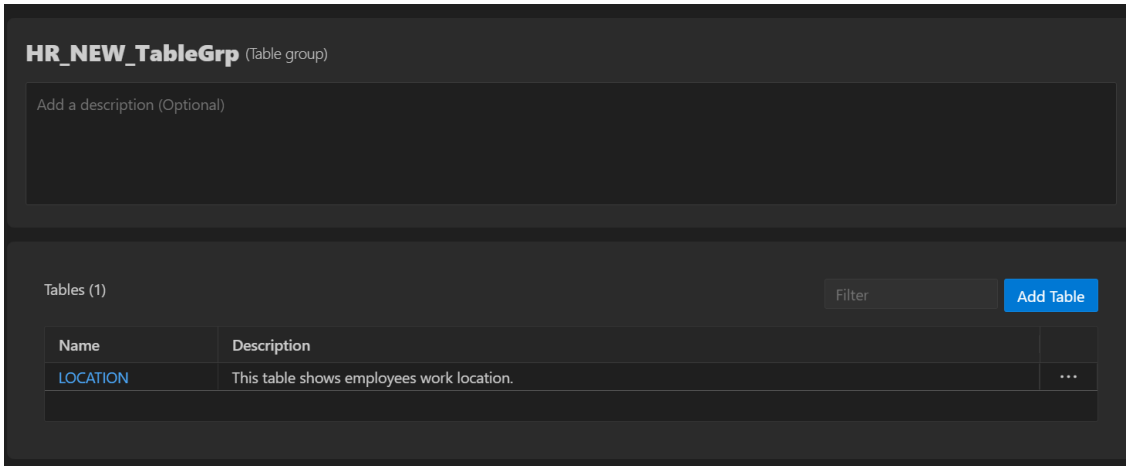


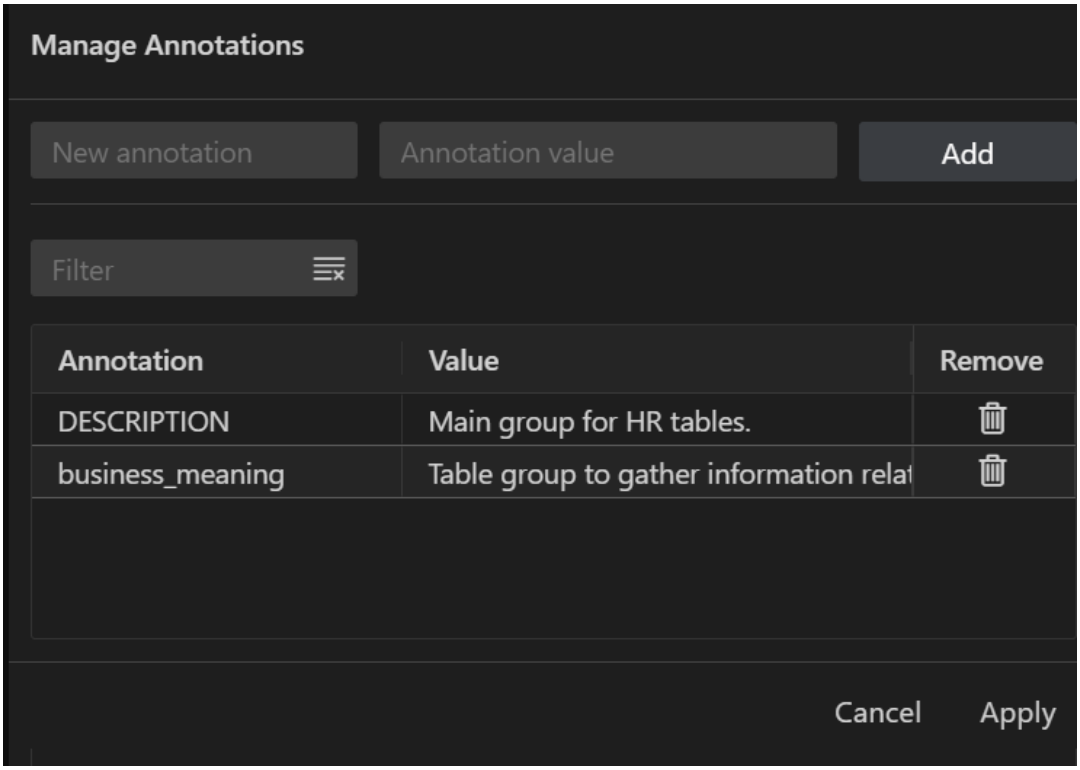
3.1.5.3 Adding Annotations for a Table Group

In addition to providing a description for a table group, you can also include additional annotations to further clarify the table group's purpose.

Perform the following steps to add and edit annotations for a table group:

1. In the AI Enrichment dashboard, locate the **Table groups** section.
2. Click **...** next to a table group name.

   The **Manage Annotations** slider appears.



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3. To define an annotation, enter a key-value pair in the **New annotation** and **Annotation value** fields respectively.
4. Click **Add**, and then click **Apply**.

   The new annotation is added to the table.

   To edit an annotation, re-open the **Manage Annotations** slider, edit the value, and then click **Apply** to save the changes.

3.1.5.4 Adding an Existing Table to a Table Group

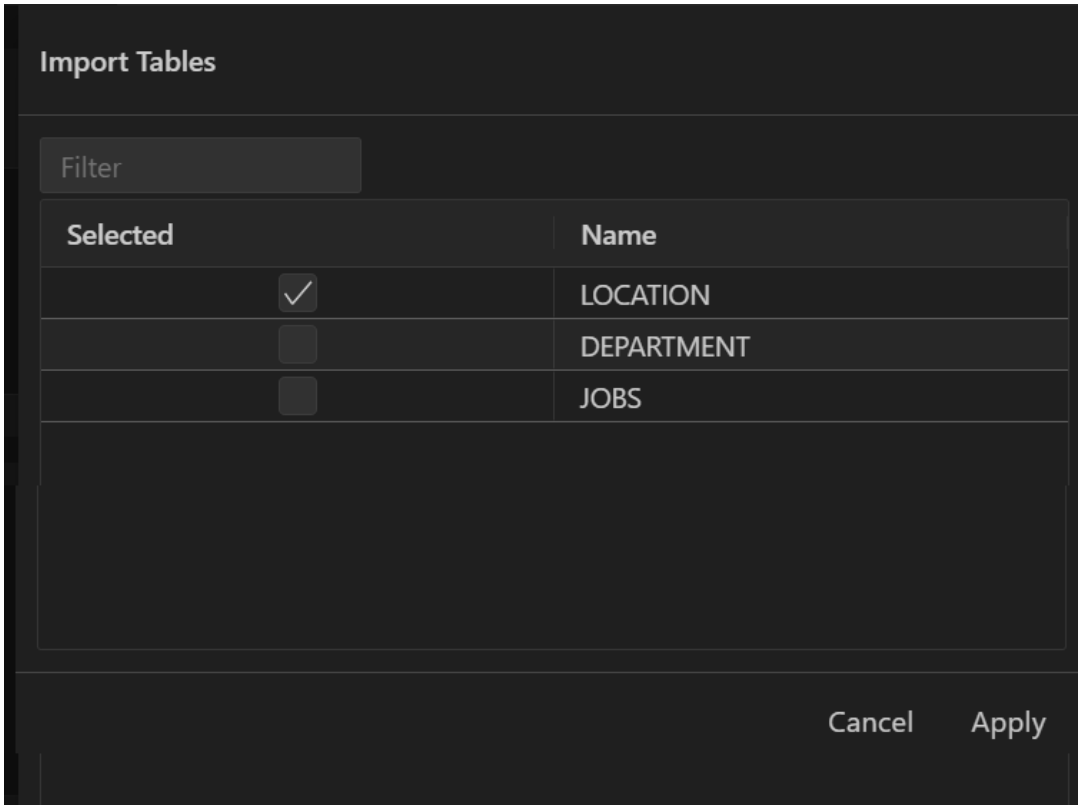
From the table group view, you can also include new tables in the selected table group.

Perform the following steps to add an existing table to a table group:

1. On the AI Enrichment dashboard, click a table group link in the **Table groups** section.

   Alternatively, select a table group under the **AI Enrichment** node in the **Connections** panel.

   You are navigated to the table group view.
2. Click **Add Table**.



3. In the **Import Tables** slider, select the checkboxes next to the tables you want to include in the group.
4. Click **Apply**.

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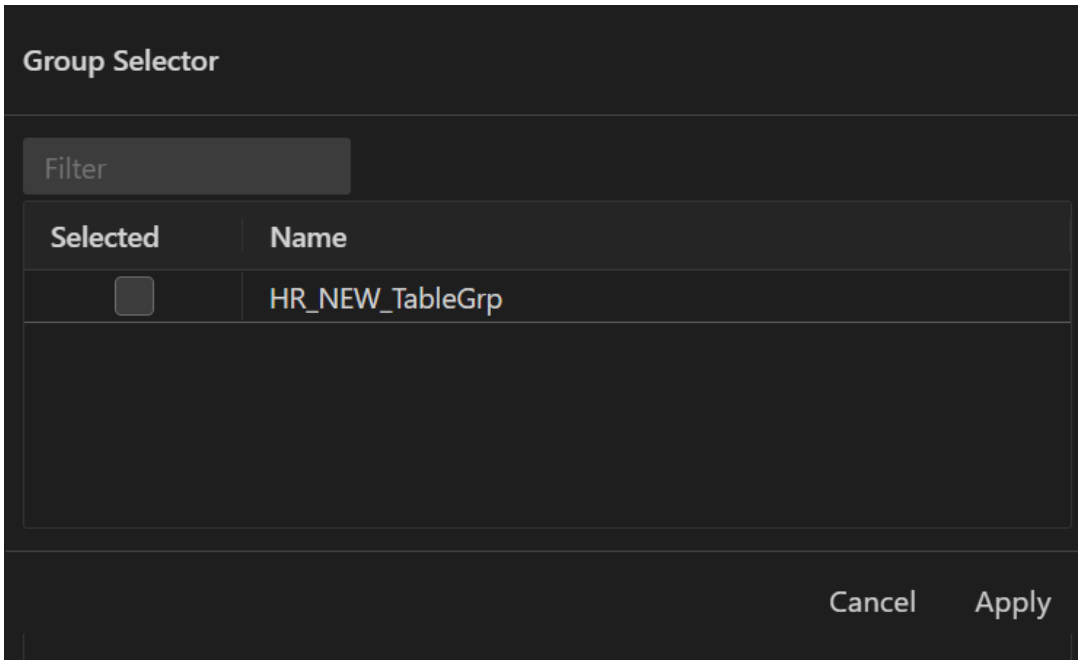
3.1.5.5 Assigning a Table to Multiple Groups

A single table can belong to multiple logical groups, reflecting its role in different business contexts.

Perform the following steps to add a table to different groups:

1. Navigate to the table's view using any of the following actions:
   - On the AI Enrichment dashboard, click a table group link in the **Table groups** section, then click a table link in the **Tables** section.
   - Select a table under the **AI Enrichment** node in the **Connections** panel.
2. Select the **Table Groups** tab and click **Add Table Group**.

   The **Group Selector** slider appears.



3. Select the checkboxes next to the table groups you wish to add your table to.
4. Click **Apply**.

3.1.6 Enriching Tables

After creating groups, you can add more granular details to the individual tables within them.

3.1.6.1 Adding a Description to a Table

You can provide a descriptive summary for a table to clarify the purpose of the table.

Perform the following steps to add a natural language description to a table:

1. On the AI Enrichment dashboard, click a table group link in the **Table groups** section. Alternatively, select a table group under the **AI Enrichment** node in the **Connections** panel.

   You are navigated to the table group view.

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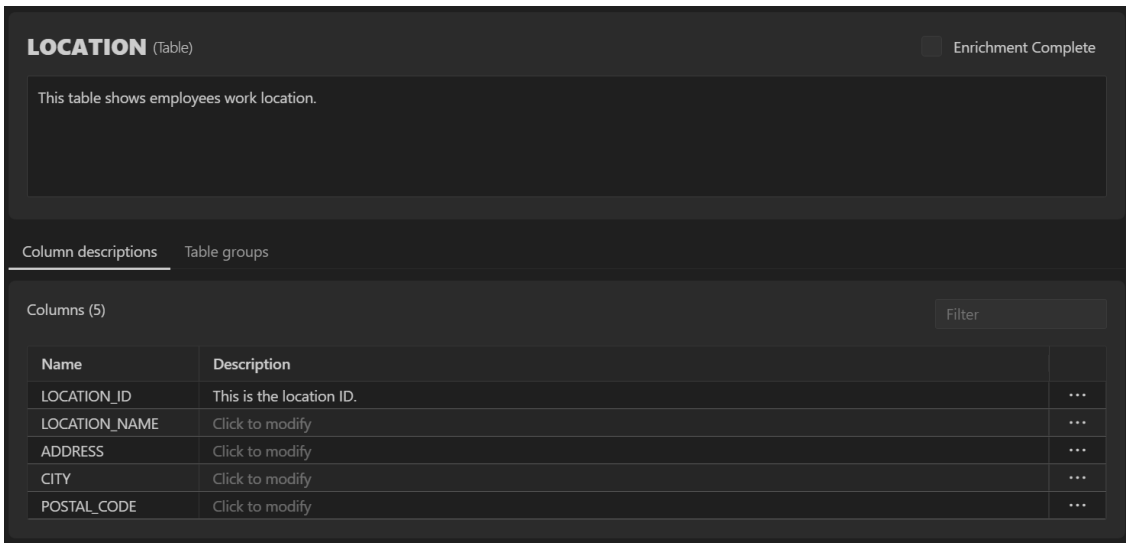
2. In the **Tables** section, click the **Description** cell of a table.
3. In the **Set description** slider, enter the description and click **Save**.

You can also add a description in the table's view by accessing it through any of these actions:

- Click a table link in the table group view.
- Select a table under the **AI Enrichment** node in the **Connections** panel.



> **Note**
>
> Select the **Enrichment Complete** checkbox to mark a table as fully annotated, even if some columns are not annotated. This results in the table and its columns being included in the **Database Enrichment Percentage** displayed on the AI Enrichment dashboard.

3.1.6.2 Adding Annotations for a Table

In addition to providing a description for a table, you can also include additional annotations to further clarify the table's purpose.

Perform the following steps to add and edit annotations for a table:

1. On the AI Enrichment dashboard, click a table group link in the **Table groups** section.

   Alternatively, select a table group under the **AI Enrichment** node in the **Connections** panel.

   You are navigated to the table group view.
2. In the **Tables** section, click **...** next to the table name.

   The **Manage Annotations** slider appears.

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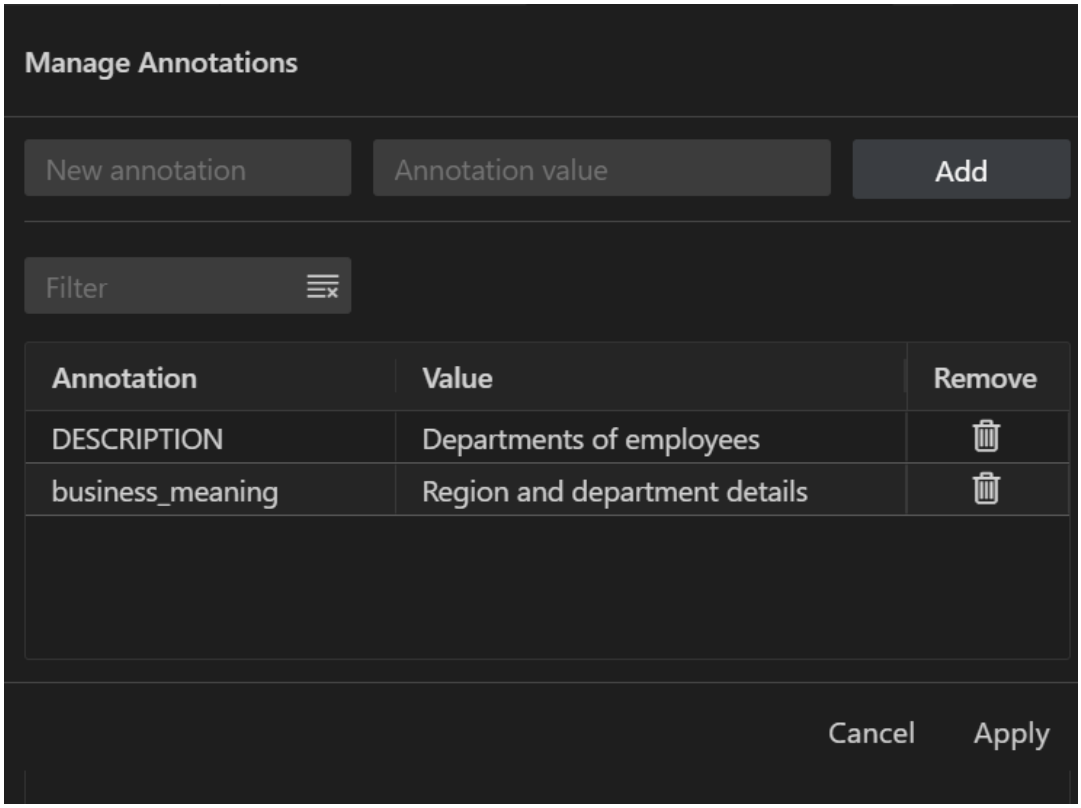

3. To define an annotation, enter a key-value pair in the **New annotation** and **Annotation value** fields respectively.
4. Click **Add**, and then click **Apply**.

   The new annotation is added to the table.

   To edit an annotation, re-open the **Manage Annotations** slider, edit the value, and then click **Apply** to save the changes.

3.1.7 Enriching Columns

For the highest level of detail, you can enrich individual columns within a table.

3.1.7.1 Adding a Description to a Table Column

You can add a descriptive summary to table columns to clarify their purpose.

Perform the following steps to add a natural language description to a table column:

1. Navigate to the table's view using any of the following actions:
   - On the AI Enrichment dashboard, click a table group link in the **Table groups** section, then click a table link in the **Tables** section.
   - Select a table under the **AI Enrichment** node in the **Connections** panel.

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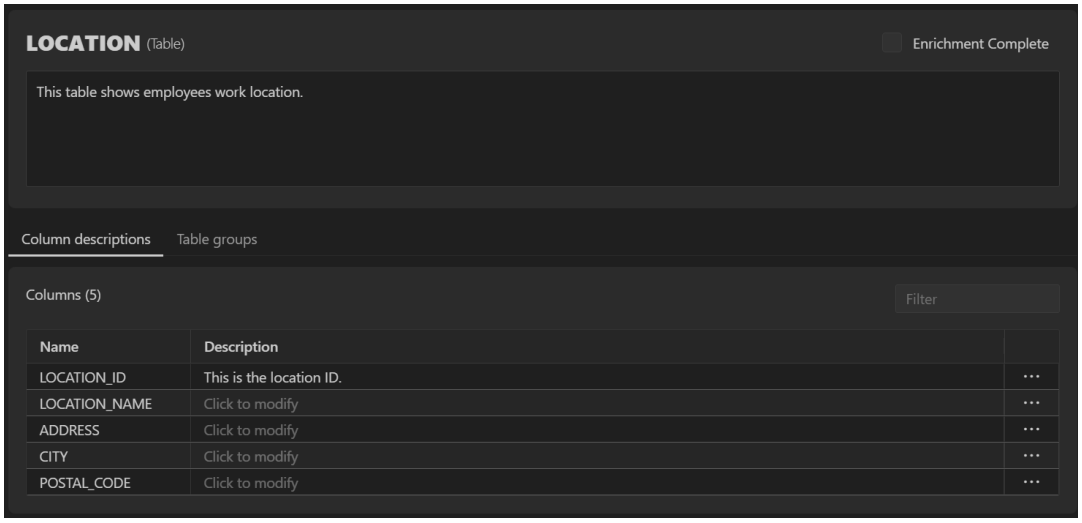

2. In the **Columns** section, click the **Description** cell of a column.
3. In the **Set description** slider, enter the description and click **Save**.

3.1.7.2 Adding Annotations for a Table Column

In addition to providing a description for a column, you can also include additional annotations to further clarify the column's purpose.

Perform the following steps to add and edit annotations for a column:

1. Navigate to the table's view using any of the following actions:
   - On the AI Enrichment dashboard, click a table group link in the **Table groups** section, then click a table link in the **Tables** section.
   - Select a table under the **AI Enrichment** node in the **Connections** panel.
2. In the **Columns** section, click **...** next to a column.

   The **Manage Annotations** slider appears.

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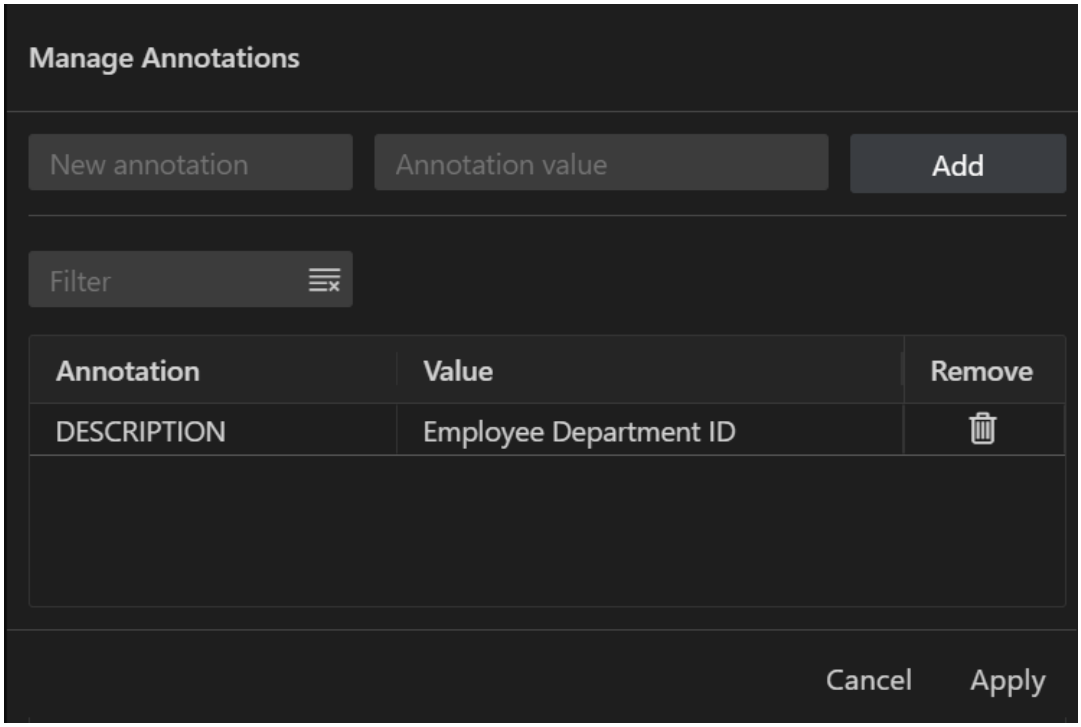

3. To define an annotation, enter a key-value pair in the **New annotation** and **Annotation value** fields respectively.
4. Click **Add**, and then click **Apply**.

   The new annotation is added to the column.
   To edit an annotation, re-open the **Manage Annotations** slider, edit the value, and then click **Apply** to save the changes.

3.2 Working with Database Objects

The SQL Developer for VS code interface uses the left side for navigation to find and select objects, and the right side to display information about selected objects.

In the Connections panel, you can browse, edit and delete objects.

To search for an object within an object type, for example, a specific table, click **Tables** and type the name of the object. Even as you type, objects matching the letters entered are highlighted.

Click a database object to open it in the right panel. A tabular display of the object's properties are displayed. In the following figure, click the SQL tab to see the corresponding SQL source code for the COUNTRIES table.

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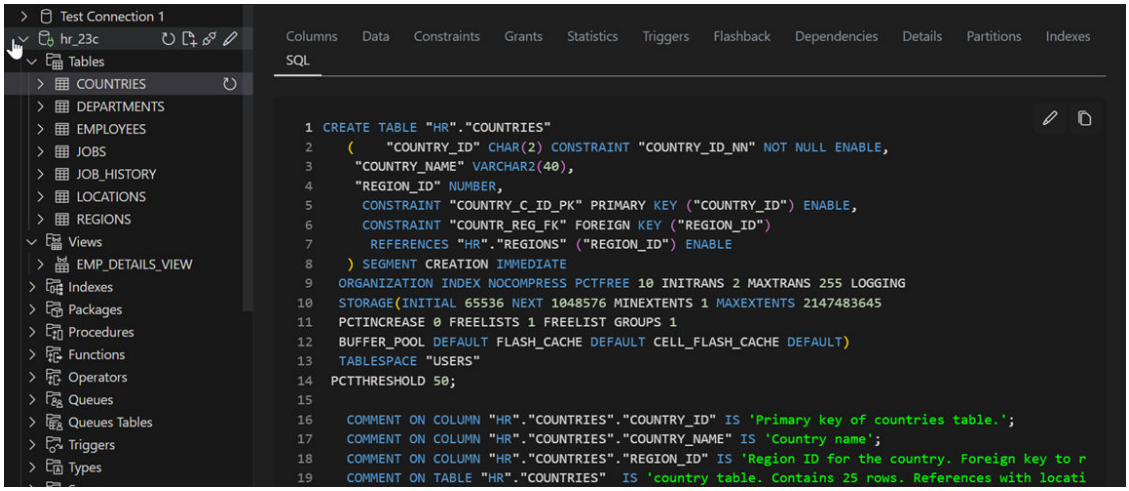

The object types available are:

- Tables
- Views
- Duality Views
- Indexes
- Functions
- Procedures
- Packages
- Triggers
- Types
- Sequences
- Synonyms (Public and Private)
- Other Users

3.2.1 Tables

You can perform the following operations on a table by right-clicking the table name in the Connections navigator and selecting an item from the menu:

- **Open**: Opens the table in the right panel.
- **Table**: Table actions include Rename, Copy (create a copy using a different name), Drop (delete the table), Truncate (delete existing data without affecting the table definition), Lock (set the table lock mode: row share, exclusive, and so on), Comment (descriptive comment explaining the use or purpose of the table), Parallel (change the default degree of parallelism for queries and DML on the table), No Parallel (specify serial execution), Count Rows (return the number of rows), and Generate Table API (generate statements for a PL/SQL procedure to perform operations on the table).
- **Column**: Column actions include Comment (descriptive comment about a column), Add, Drop, Rename and Normalize.

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- **Index**: Options include Create (create an index on specified columns), Create Text (create an Oracle Text index on a column), Create Text (create a function-based index on a column), and Drop.
- **Constraint**: Options include Enable or Disable Single, Drop (delete a constraint), Add Check (add a check constraint), Add Foreign Key, and Add Unique.
- **Statistics**: Options include Gather Statistics (compute exact table and column statistics and store them in the data dictionary) and Validate Structure (verifies the integrity of each data block and row, and for an index-organized table also generates the optimal prefix compression count for the primary key index on the table). Statistics are used by the Oracle Database optimizer to choose the execution plan for SQL statements that access analyzed objects.
- **Storage**: Options include Shrink Table (shrink space in a table, for segments in tablespaces with automatic segment management) and Move Table (to another tablespace). The Shrink Table options include Compact (only defragments the segment space and compacts the table rows for subsequent release, but does not readjust the high water mark and does not release the space immediately) and Cascade (performs the same operations on all dependent objects of the table, including secondary indexes on index-organized tables).
- **Trigger**: Options include Create, Create PK from Sequence (create a before-insert trigger to populate the primary key using values from a specified sequence), Enable or Disable All, Enable or Disable Single, and Drop (delete the trigger).

You can perform the following operations on a column in a table by right-clicking the column name in the Connections navigator and selecting an item from the menu:

- **Rename**: Renames the column.
- **Drop**: Deletes the column (including all data in that column) from the table.
- **Comment**: Adds a descriptive comment about the column.
- **Encrypt** (for Oracle Database Release 10.2 and higher, and only if the Transparent Data Encryption feature is enabled for the database): Displays a dialog box in which you specify a supported encryption algorithm to be used for encrypting all data in the column. Current data and subsequently inserted data are encrypted.
- **Decrypt** (for Oracle Database Release 10.2 and higher, and only if the Transparent Data Encryption feature is enabled for the database): Decrypts data in the column that had been encrypted, and causes data that is subsequently inserted not to be encrypted.
- **Normalize**: Creates a new table using the distinct values in the specified column. You must specify names for the new table and its primary key column, as well as a sequence name and trigger name.

3.2.2 Views

You can perform the following operations on a view by right-clicking the view name in the Connections panel and selecting an item from the menu:

- **Open**: Opens the view in the right pane.
- **Edit**: Opens the view for editing in the right pane.
- **Rename**: Renames the view.
- **Drop**: Deletes the view.

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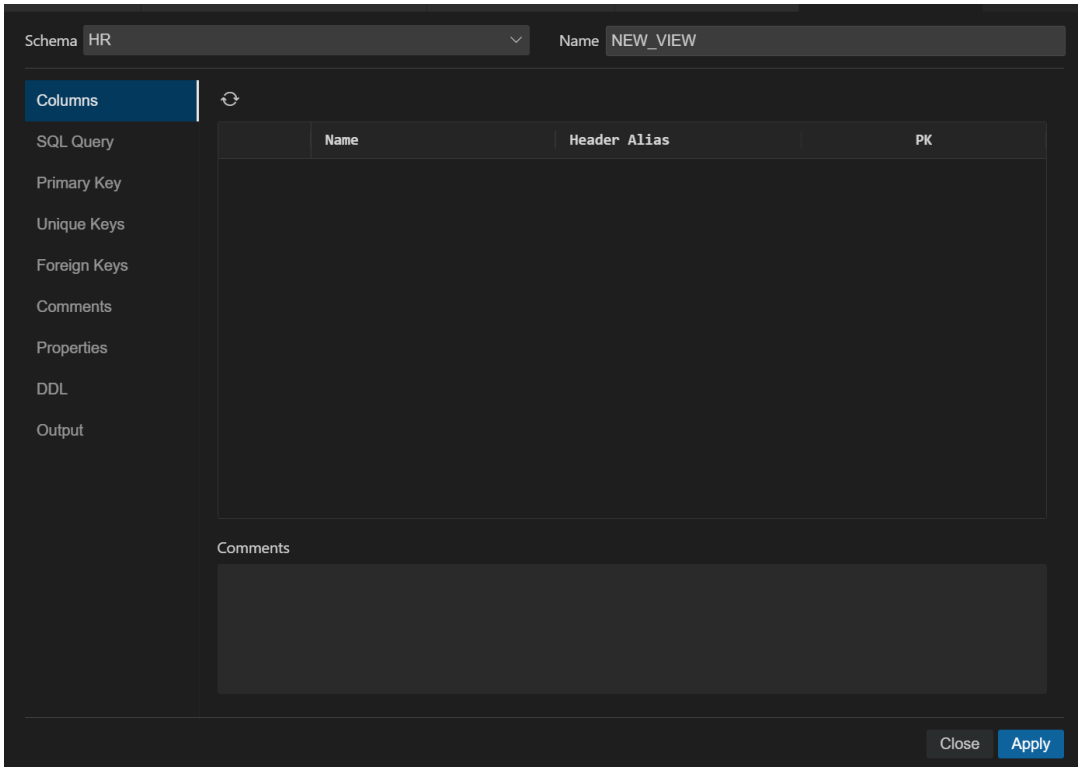
- **Compile**: Recompiles the view, to enable you to locate possible errors before runtime. You may want to recompile a view after altering one of its base tables to ensure that the change does not affect the view or other objects that depend on it.
- **Comment**: Allows you to enter additional information about the view.

3.2.2.1 Creating or Editing a View

Use the View Editor to create or modify a database view using a form-based UI. The editor helps you define the view query and columns, specify keys and relationships, set properties, and review the generated DDL before applying changes.

1. In the left navigator, expand Connections, expand your connection, and then expand **Views**.
2. Do one of the following:
   - **Create a new view**: Right-click the **Views** node and select **Create View** or click the **+** (Add) icon next to **Views**.
   - **Edit an existing view**: Right-click a view and select **Edit**.

   The View Editor opens in the right pane where you can enter or edit details.



3. At the top of the editor, select the target **Schema** and enter the view name.
4. Select the **SQL Query** tab, and then enter or paste the `SELECT` statement that defines the view.

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> **Note**
>
> When creating a view, enter the SQL query first, and then go to the **Columns** tab and refresh the column list to populate columns from the query. When editing a view, you can update column details directly in the **Columns** tab without going to **SQL Query**, unless you need to change the view definition.

5. Select the **Columns** tab and review the column list. Update the following values as needed: Header Alias, PK, and Comment.
6. Select the **Primary Key** tab to define the key for the view.
   - Enter a key name in the **Name** field.
   - From **Available Columns**, select the column(s) and move them to **Selected Columns** using the arrow buttons.
7. Select the **Unique Keys** tab to define one or more unique key definitions for the view.
   - Click **+ Add** to create a unique key entry. A new unique key is automatically created and added to the list.
   - Click the generated unique key name and rename it as needed
   - Select one or more columns from **Available Columns** and move them to **Selected Columns**.
   - Click **Delete Selected** to remove a unique key entry (if required).
8. Select the **Foreign Keys** tab to define reference relationships for the view.
   - Click **+ Add** to create a foreign key entry. A new foreign key is automatically created and added to the list.
   - Under **Referenced Constraint**, select **Schema** (referenced schema), **Table** (referenced table), **Constraint** (referenced PK/UK constraint), and **On Delete** action, for example, NO ACTION, CASCADE, SET NULL.
   - Under **Associations**, map **Local Column** to **Referenced Column**.
9. Select the **Comments** tab and enter a description for the view.
10. Select the **Properties** tab to set view-level options.
    - Enable or disable the **Force On Create** option to force view creation.
    - Select the **Query Restriction** option for the view. For example, NO RESTRICTION, READ ONLY, CHECK OPTION
11. Select the **DDL** tab to review the generated DDL. Use **Create** or **Update** secondary tabs to view the statements.
12. Click **Apply** to save your changes. You are automatically navigated to the **Output** tab, where you can review success messages or error details.

3.2.3 Duality Views

See Working with JSON-Relational Duality Views

3.2.4 Indexes

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You can perform the following operations on an index by right-clicking the index name in the Connections navigator and selecting an item from the menu:

- **Open**: Opens the index in the right pane.
- **Edit** Opens the index for editing in the right pane.
- **Drop**: Deletes the index.
- **Rebuild**: Recreates the index or one of its partitions or subpartitions. If the index is unusable, a successful rebuild operation makes the index usable. For a function-based index, rebuilding also enables the index; however, if the function on which the index is based does not exist, the rebuild operation fails.
- **Rename**: Changes the name of the index.
- **Make Unusable**: Prevents the index from being used by Oracle in executing queries. An unusable index must be rebuilt, or dropped and re-created, before it can be used again.
- **Coalesce**: Merges the contents of index blocks, where possible, to free blocks for reuse.
- **Compute Statistics**: For a function-based index, collects statistics on both the index and its base table using the DBMS_STATS package. Such statistics will enable Oracle Database to correctly decide when to use the index.
- **Rebuild Index Partition**: Rebuilds a specified index partition.
- **Drop Index Partition**: Drops (deletes) a specified index partition.

3.2.4.1 Creating or Editing an Index

Use the Index Editor to create a new index or modify an existing index on a table. The editor helps you define index properties (name, type, tablespace), choose indexed columns or expressions, and preview the generated DDL before applying changes.

1. In the left navigator, expand Connections, expand your connection, and then expand **Indexes**.
2. Do one of the following:
   - **Create a new index**: Right-click the **Indexes** node and select **Create Index** or click the **+** (Add) icon next to Indexes.
   - **Edit an existing index**: Right-click an index and select **Edit**.

   The Index Editor opens in the right pane, where you can enter or edit details. By default, the **Properties** tab is selected.

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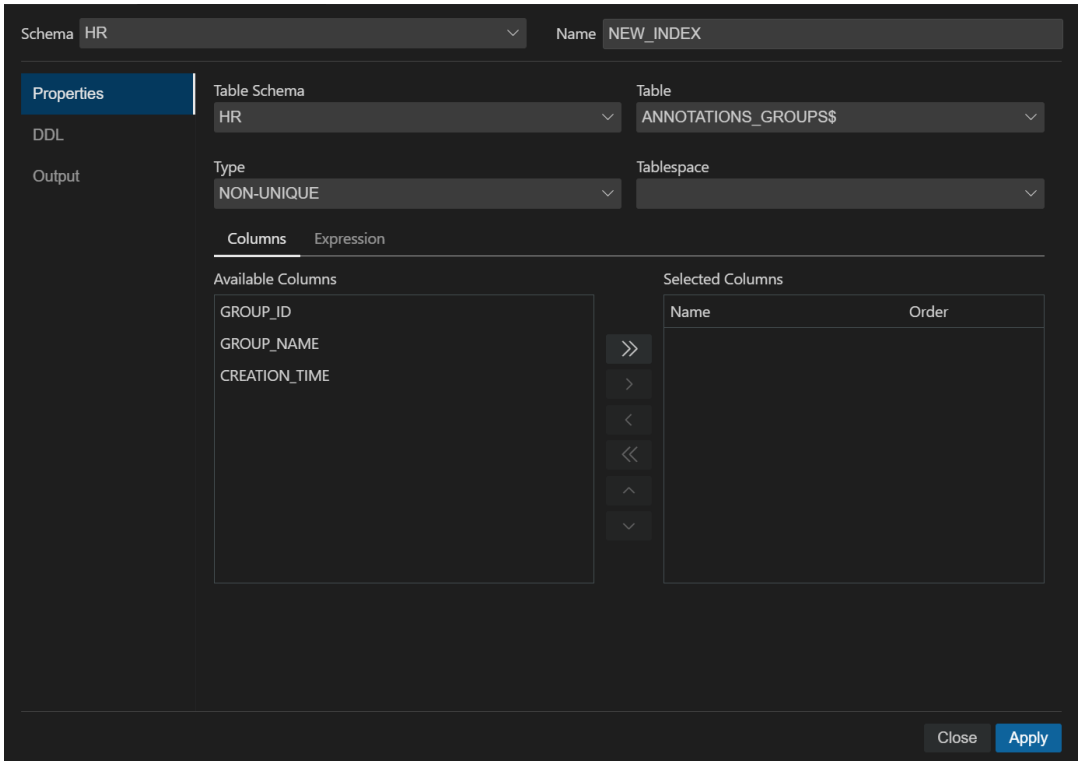

3. At the top of the editor, select the target **Schema** and enter the index name.
4. Define the index settings in the **Properties** tab:
   - **Table Schema**: The schema that owns the table being indexed.
   - **Table**: Select the target table. For example, `COUNTRIES`
   - **Type**: Select the index type. For example, UNIQUE, NON-UNIQUE, BITMAP
   - **Tablespace**: Select where the index will be stored.
   - For standard column-based indexes, select the **Columns** tab.
     From **Available Columns**, select the column(s) and move them to **Selected Columns** using the arrow buttons. For each selected column, set **Order**: ASC or DESC
   - (Optional) For creating an indexed expression, select the **Expression** tab and enter the expression.
5. Select **DDL** and review the generated SQL statement.
6. Click **Apply** to save your changes. You are automatically navigated to the **Output** tab, where you can review success messages or error details.

3.2.5 Packages

You can perform the following operations on a package by right-clicking the package name in the Connections navigator and selecting an item from the menu:

- **Open**: Opens the package in the right pane.
- **Run**: Lets you select a member in the package and run it.
- **Drop Package**: Deletes the package.

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3.2.6 Procedures

You can perform the following operations on a procedure by right-clicking the procedure name in the Connections navigator and selecting an item from the menu:

- **Open**: Displays the procedure text so that you can view and edit it.
- **Run**: Displays the PL/SQL dialog box, and then executes the procedure.
- **Drop**: Deletes the procedure.

3.2.7 Functions

You can perform the following operations on a function by right-clicking the function name in the Connections navigator and selecting an item from the menu:

- **Open**: Opens the function in the right pane.
- **Drop**: Deletes the function.
- **Grant**: Enables you to grant available privileges on the function to selected users.
- **Revoke**: Enables you to revoke available privileges on the function from selected users.

3.2.8 MLE Environments

See Managing MLE Environments

3.2.9 JavaScript Modules

See Managing JavaScript Modules

3.2.10 Triggers

Triggers are stored PL/SQL blocks associated with a table, a schema, or the database, or anonymous PL/SQL blocks or calls to a procedure implemented in PL/SQL or Java. Oracle Database automatically executes a trigger when specified conditions occur.

See Oracle Database 2 Day Developer's Guide

3.2.11 Types

A data type associates a fixed set of properties with the values that can be used in a column of a table or in an argument of a function or procedure. These properties cause Oracle Database to treat values of one data type differently from values of another data type. Most data types are supplied by Oracle, although users can create data types.

See Oracle Database Concepts

3.2.12 Sequences

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Sequences are used to generate unique integers. You can use sequences to automatically generate primary key values.

See Oracle Database 2 Day Developer's Guide

3.2.13 Synonyms (Public and Private)

Synonyms provide alternative names for tables, views, sequences, procedures, stored functions, packages, materialized views, Java class database objects, user-defined object types, or other synonyms. The Connections navigator has a Synonyms node for all synonyms (public and private) owned by the user associated with the specified connection, and a Public Synonyms node for all public synonyms on the database associated with the connection.

See Oracle Database 2 Day Developer's Guide

3.2.14 Other Users

Database users are accounts through which you can log in to the database. In the Connections navigator, you can see the Other Users in the database associated with a connection, but the objects that you are allowed to see for each user are determined by the privileges of the database user associated with the current database connection.

3.3 Working with Tables

This section provides comprehensive guidance on creating, editing, and managing database tables efficiently.

It covers the following topics:

- Using Table Editor
  Learn how to use the **Table Editor** to create new tables or modify existing ones. This topic walks you through specifying columns and constraints, managing keys and indexes, setting storage options, and applying table-level settings, all within an intuitive visual interface.
- Managing Data Import
  Learn how to seamlessly import data into your tables. This topic explains the steps for bringing external data into your database, including mapping columns, handling data formats, and validating imported records to ensure data integrity.

3.3.1 Using Table Editor

The **Table Editor** provides users with an intuitive interface to create and modify database tables efficiently.

Users can define table structures by adding, editing, or deleting columns, specifying data types, and setting constraints such as primary keys and unique keys. Additional options, such as defining indexes, foreign keys, and storage parameters, allow for comprehensive table customization. With straightforward navigation, this feature streamlines the table management process, supporting both new table creation and the modification of existing tables to fit evolving data requirements.

To create a new table, right-click **Tables** in the **Connections** panel and select **Create Table**. The **Table Editor: New** window appears. From the drop-down list, select a **Schema** and enter the table name in the **Name** field. By default, the new table will be named NEW_TABLE.

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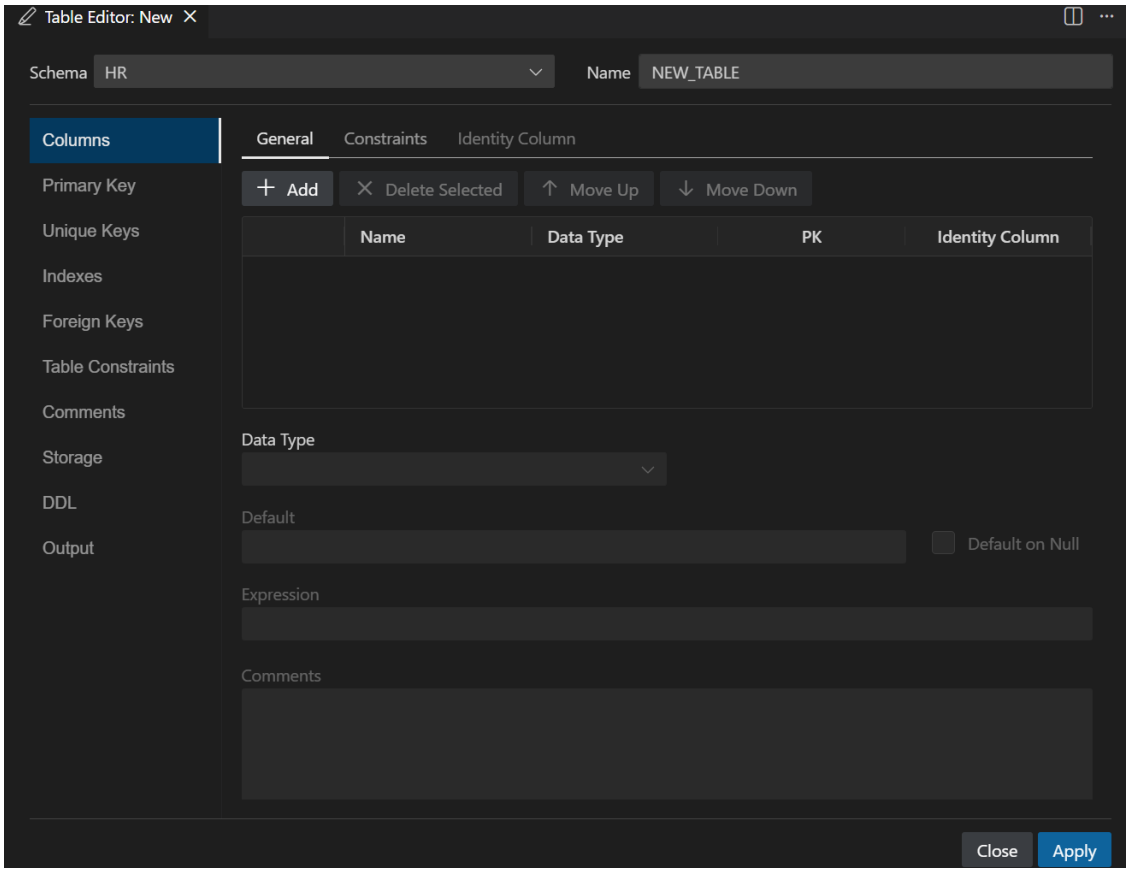
To edit an existing table, right-click the table name in the **Connections** panel and select **Edit**.



You can add or edit the table information in the following sections:

- Columns
- Primary Key
- Unique Keys
- Indexes
- Foreign Keys
- Table Constraints
- Comments
- Storage
- DDL
- Output

3.3.1.1 Columns

In this window, you can specify properties for each column in the table.

By default, the **General** tab is displayed.

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General Tab

In this tab, you can add or delete a column. Click **+ Add** to add a new column or click **X Delete Selected** to delete the selected column. You can also designate a column as a Primary Key by selecting the corresponding **PK** checkbox, or set it as an identity column by selecting the **Identity Column** checkbox. When you select a column from the list, you can customize its properties, such as data type, default value, expression, and comments, using the fields that appear below the column list.

- **Name**: The name of the column. By default, the new column is named as COLUMN_1. You can double-click the column cell to edit its value.
- **Data Type**: Data type of the column. Most of the remaining information depends on the specific type.
- **Size**: For character data, the maximum size of the column data. This field is displayed when VARCHAR2 data type is selected.
- **Units**: For character data, the units represented by the Size: `BYTE` for bytes or `CHAR` for characters. This attribute is important if the database contains data in Unicode format, with multiple bytes for each character. This field is displayed when VARCHAR2 data type is selected.
- **Precision**: For numeric data, the precision (total number of significant digits that can be represented) of the column data. This field is displayed when `NUMBER` data type is selected.
- **Scale**: For numeric data, the scale (number of digits after the decimal point) of the column data. This field is displayed when `NUMBER` data type is selected.
- **Default**: For relevant types, the default value inserted into the column if no value is specified when a row is inserted.
- **Default on Null**: If this option is selected, then the default value is inserted when no value is provided in the column.
- **Expression**: When an expression is specified, the column value is automatically generated according to the logic you provide, rather than being directly entered or modified by users.
- **Comments**: Optional descriptive comment about the column.

Click **Apply** to save your changes.

Constraints Tab

Select the **Constraints** tab to view and edit constraints for your table columns.

- Not Null Constraint
  For each column, select the **Not Null** checkbox if the column should not allow NULL values. You can also provide a custom name for the NOT NULL constraint in the **Not Null Name** field.
- Check Constraint
  To add additional validation rules, select a column and use the **Check Constraint** section to define custom constraints, such as specifying allowed value ranges or patterns. You can enter a constraint name and logic in the provided fields.
- Additional Constraint Options
  At the bottom of the tab, you can further configure constraint behavior by enabling or disabling the constraint, setting it as deferrable, determining if it should be enforced

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immediately, and enabling validation. These options help you control how and when the constraints are applied to your table data.

Click **Apply** to save your changes.

Identity Column Tab

In this tab, you can configure automatic value generation for a specific column, typically used for unique identifiers like primary keys. In this tab, you can specify how the identity values should be generated, including options for the starting value, increment step, minimum and maximum values, caching behavior, cycling, and ordering.

- **Generate**: Options to set whether the value should be provided `BY DEFAULT` or `ALWAYS`.
- **Start With**: Initial value for the column.
- **Increment By**: Step size between generated values.
- **Min Value** -**Max Value**: Allowable range for generated numbers.
- **Cache** and **Cache Size**: Cache causes sequence values are preallocated in cache, which can improve application performance. Cache size indicates the number of sequence values preallocated in cache. `No Cache` causes sequence values not to be preallocated in cache.
- **Cycle**: Indicates whether the sequence wraps around to reuse numbers after reaching its maximum value or its minimum value. If cycling of values is not enabled, the sequence cannot generate more values after reaching its maximum or minimum value.
- **Order**: Indicates whether sequence numbers are generated in the order in which they are requested. If `No Order` is specified, sequence numbers are not guaranteed to be in the order in which they were requested.

Click **Apply** to save your changes.

3.3.1.2 Primary Key

In this window, you can define the primary key constraint for your table, ensuring that each row is uniquely identifiable.

You can configure the following for a primary key:

- **Name**: The name of your primary key constraint.
- **Enabled**: If this option is selected, then the primary key constraint will be enabled.
- **Rely**: If this option is selected, then the constraint can be relied upon.
- **Deferrable**: If this option is selected, then the constraint check can be deferred until the transaction is committed.
- **Initially Immediate**: If this option is selected, then the constraint is enforced immediately.
- **Validate**: If this option is selected, then data in the table must comply with the primary key constraint.
- **Index**: This drop-down list allows you to select an existing index to associate with the primary key constraint.
- **Tablespace**: This drop-down list allows you to select a tablespace for storing the index.
- **Available Columns** and **Selected Columns**: These lists allow you to select one or more columns to be included in the primary key. Select columns from the **Available Columns** list and use the arrow buttons to move them to the **Selected Columns** list.

Once your primary key configuration is complete, click **Apply** to save your changes.

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3.3.1.3 Unique Keys

In this window, you can define unique key constraints for your table, ensuring that the combination of values in the selected columns is always unique for every row. You can add or delete unique key constraints using the **+ Add** and **X Delete Selected** buttons.

You can configure the following for a unique key:

- **Name**: The name of the unique key. You can edit the name by double-clicking the cell.
- **Enabled**: If this option is selected, then the unique key constraint will be enabled.
- **Rely**: If this option is selected, then the constraint can be relied upon.
- **Deferrable**: If this option is selected, then the constraint check can be deferred until the transaction is committed.
- **Initially Immediate**: If this option is selected, then the constraint is enforced immediately.
- **Validate**: If this option is selected, then data in the table must comply with the unique key constraint.
- **Index**: This drop-down list allows you to select an existing index to associate with the unique key constraint.
- **Tablespace**: This drop-down list allows you to select a tablespace for storing the index.
- **Available Columns** and **Selected Columns**: These lists allow you to select one or more columns to be included in the unique key. Select columns from the **Available Columns** list and use the arrow buttons to move them to the **Selected Columns** list.

Once your unique key configuration is complete, click **Apply** to save your changes.

3.3.1.4 Indexes

In this section, you can manage indexes for your table to improve query performance. You can add new indexes or delete existing ones using the **+ Add** and **X Delete Selected** buttons.

You can configure the following for an index:

- **Schema**: The name of the schema under which the index is created.
- **Name**: The name of the index. You can edit the name by double-clicking the cell.
- **Type**: The type of index, such as UNIQUE, NON-UNIQUE, or BITMAP.
- **Tablespace**: Specifies the tablespace where the index is stored.
- **Available Columns** and **Selected Columns**: Select one or more columns to be included in the index. Use the **Available Columns** list and arrow buttons to move columns to the **Selected Columns** list and organize their order.
- **Expression**: Allows you to specify the expression that defines the index logic.

Once your index configuration is complete, click **Apply** to save your changes.

3.3.1.5 Foreign Keys

In this window, you can define foreign key constraints for your table, allowing you to establish relationships between columns in your table and columns in another table. You can add or delete foreign key constraints using the **+ Add** and **X Delete Selected** buttons.

You can configure the following for a foreign key:

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- **Name**: The name of the foreign key constraint. You can edit the name by double-clicking the cell.
- **Enabled**: If this option is selected, then the foreign key constraint will be enabled.
- **Rely**: If this option is selected, then the constraint can be relied upon.
- **Deferrable**: If this option is selected, then the constraint check can be deferred until the transaction is committed.
- **Initially Immediate**: If this option is selected, then the constraint is enforced immediately.
- **Validate**: If this option is selected, then data in the table must comply with the foreign key constraint.
- **Referenced Constraint**: Allows you to select the **Schema**, **Table**, and **Constraint** that you want to reference. You can also specify the **On Delete** action to define the behavior when referenced data is deleted, such as NO ACTION, CASCADE, or SET NULL.
- **Associations**: Allows you to map the **Local Column(s)** in your table to the corresponding **Referenced Column(s)** in the related table.

Once your foreign key configuration is complete, click **Apply** to save your changes.

3.3.1.6 Table Constraints

In this window, you can define table-level constraints, such as check constraints, to enforce complex rules and conditions on your data beyond what can be achieved with column-level constraints. You can add or delete table constraints using the **+ Add** and **X Delete Selected** buttons.

You can configure the following for a table constraint:

- **Name**: The name of the table constraint key. You can edit the name by double-clicking the cell.
- **Enabled**: If this option is selected, then the table constraint will be enabled.
- **Rely**: If this option is selected, then the constraint can be relied upon.
- **Deferrable**: If this option is selected, then the constraint check can be deferred until the transaction is committed.
- **Initially Immediate**: If this option is selected, then the constraint is enforced immediately .
- **Validate**: If this option is selected, then data in the table must comply with the table constraint.
- **Check Condition**: Specify an expression or condition that must be met for all rows in the table. For example, to indicate that the value in a numeric column named `RATING` must be from 1 to 10, you can specify: rating >=1 and rating <= 10.

Once your table constraint configuration is complete, click **Apply** to save your changes.

3.3.1.7 Comments

In this window, you can provide additional descriptive comments about the table.

3.3.1.8 Storage

In this window, you can configure storage-related options for your table to optimize data management and performance.

You can configure the following storage options:

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- **Organization**: The organization type of the table, such as, Heap, Index, or External.
- **Tablespace**: Allows you to select the tablespace for the table.
- **Logging**: Enables or disables logging for the table, which determines whether changes to the table are recorded in the redo log for recovery purposes.
- **Row Archival**: Indicates whether row-level archival is enabled for the table.

Once your storage configuration is complete, click **Apply** to save your changes.

3.3.1.9 DDL

In this window, you can view and manage the Data Definition Language (DDL) statements associated with your table.

The DDL tab displays the SQL code required to create or modify the table structure, including all constraints and relationships. You can switch between the **Create** and **Update** tabs to see scripts for creating the table from scratch or updating it based on the current changes.

Any errors or missing definitions, such as those highlighted in the output, should be addressed before applying changes. Once you have reviewed the DDL statements and ensured they are correct, click **Apply** to implement the changes to your database.

3.3.1.10 Output

In this window, you can view the results of executed operations, including messages, errors, and logs generated when applying changes to the table.

The **Output** tab displays detailed error reports and Oracle error codes if an operation fails, along with references to relevant documentation links for troubleshooting. Any issues or syntax errors encountered during execution are shown here, making it easier to diagnose problems, understand the cause of errors, and take corrective action. Review these messages to resolve any issues before reapplying your changes. Once you have addressed any errors, click **Apply** to save your changes.

3.3.2 Configuring and Managing Data Import

This feature enables importing data from delimited files, such as Comma Separated Values (CSV), Tab Separated Values (TSV), Microsoft Excel (.xls/.xlsx), or other similar formats into your database. You have the flexibility to either create new tables or populate existing ones, with a range of configuration options to suit your data import needs.

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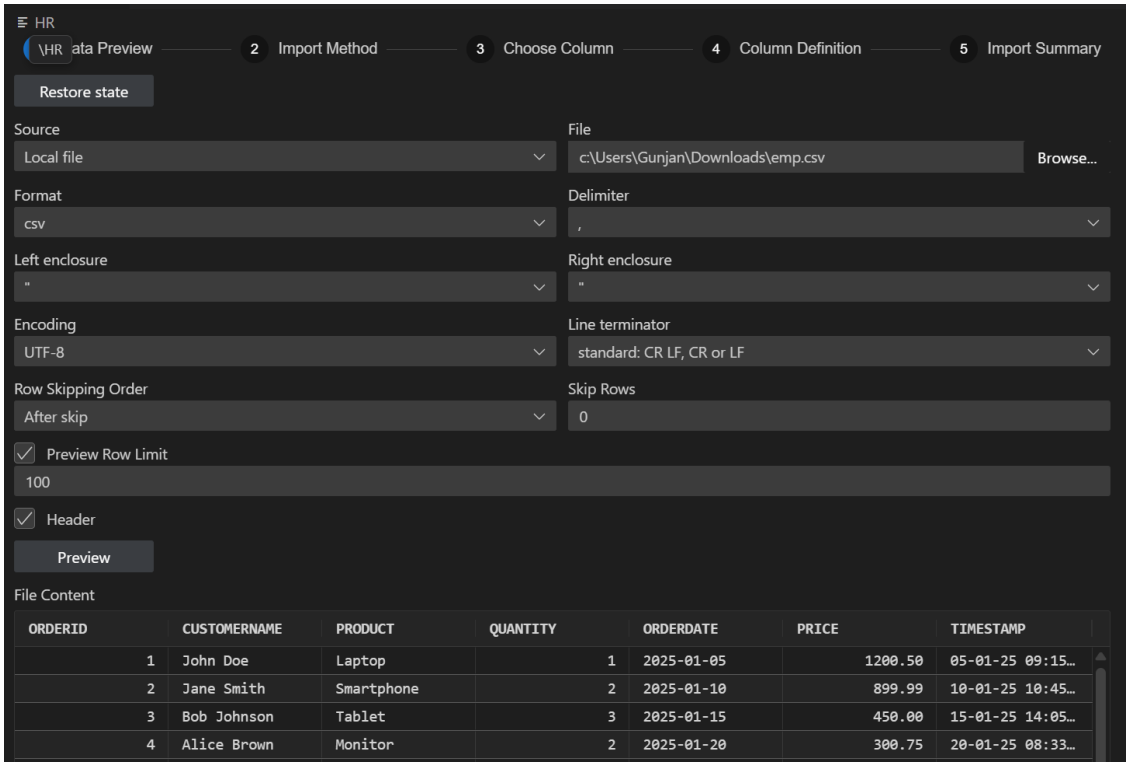

The data import workflow includes the following steps:

1. **Previewing Data**: Review and validate the data from your source file before importing.
2. **Choosing Import Method**: Select how the data will be imported.
3. **Choosing Columns**: Select which columns from the source data should be imported.
4. **Defining Column Metadata**: Specify or adjust column definitions, data types, and other attributes.
5. **Summarizing the Import**: Review a summary of your selections and confirm the import configuration before proceeding.

3.3.2.1 Importing Data into Tables

Perform the following steps to import data into a table:

1. In the **Connections** panel, right-click **Tables** under your database connection and choose **Import** to add data to a new table.

   To import data into an existing table, right-click the corresponding table and select **Import**.

Previewing Data
The **Data Preview** page enables you to specify preferences that affect the preview display of data to be imported.

2. Select your data source. Choose `Local file` to upload from your computer.
3. Click **Browse** and select the file you want to import. For example, CSV, Delimited, Text, Excel 95 - 2003 (.xls), or Excel 2003+ (.xlsx)
4. Modify the following configurations, if required:

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- **Format**: This field is automatically populated based on the file you upload. For example, csv (comma separated value), delimited (delimiter separated value), text (tab separated value), Excel 95 - 2003 (.xls), or Excel 2003+ (.xlsx) .

> **Note**
>
> The configuration options shown on the **Data Preview** page depend on the selected format. For **Excel (.xls/.xlsx)** imports, only **Skip Rows**, **Preview Row Limit**, **Worksheet**, and **Header** are displayed. For **CSV/Delimited/Text** imports, additional options such as **Delimiter**, **Enclosures**, **Encoding**, **Line Terminator**, and **Row Skipping Order** are available.

- **Delimiter**: Select the character that separates columns. For example, , (comma), | (pipe), ; (semicolon), and so on.
- **Left Enclosure**: Select the character that encloses field values. For example, double quote ("), single quote ('), opening parenthesis ((), opening brace ({), and opening bracket ([).
- **Right Enclosure**: Select the character that encloses field values. For example, double quote ("), single quote ('), closing parenthesis ()), closing brace (}), and closing bracket (]).
- **Encoding**: Select the character set used for encoding data to be imported. For example, UTF-8, UTF-16, UTF-16LE, and so on.
- **Line Terminator**: Select the character used for line breaks.
- **Row Skipping Order**: Select whether to skip rows preceding the import or following a certain point.
- **Skip Rows**: Enter the number of initial rows to skip before importing.
- **Preview Row Limit:** Enter the number of rows to preview.
- **Worksheet** (Excel only): Displayed only when you import an Excel file with multiple sheets and click **Preview**. It lists all sheets present in the Excel file. You can select the sheet to import. By default, the first sheet is imported.
- **Header**: Select this checkbox to display headers in the preview.

> **Note**
>
> The **Restore State** button allows you to restore a previously saved import state, reapplying all saved configurations and settings. This feature helps streamline the import process by making it easy to resume or repeat imports with the same parameters.

5. Click **Preview**.

   The content of the uploaded file is displayed in the **File Content** section.

6. Click **Next**.

Choosing Import Method

The **Import Method** page specifies methods for importing data from local files.

7. In the **Import Method** list, select `Insert`.
8. Enter a table name in the **Table Name** field if you are importing data into a new table.

   For import into an existing table, the table name is auto-populated in this field.

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9. To restrict the number of rows for import, select the **Import row limit** checkbox and enter the desired value in the accompanying field.
10. Click **Next**.

Choosing Columns
The **Choose Column** page lets you select the specific column from the data set and arrange them in the order you want.

11. If you want to import specific columns only, select the columns from the **Available Columns** list and use the arrow button to move them to the **Selected Columns** list.

    To change the order of a selected column in the list for the import operation, select it and use the up and down arrow buttons.
12. Click **Next**.

Defining Column Metadata
The **Column Definition** page enables you to specify information about the columns in the database table for data import. If you are deriving the table definition from an external file, you can modify the attributes of any column in the destination table that will be created during the data import process. When importing data into an existing table, the Column Definition step is different from the process used for a new table. Each source column from the imported file must be mapped to a target column that already exists in the table.

13. For each of the columns in **Source Data Columns**, you can modify its attribute as needed.

    These include properties such as name, data type, size/precision, scale, default value, comments, and whether the column should allow null values. The available attribute fields for each column may vary depending on the column data type.
14. Click **Next**.

Summarizing the Import
The **Import Summary** page provides a final overview of your import configuration before you execute the import process.

15. Review all selections and settings to confirm they are correct.

    This summary includes details about your destination connection, the table being loaded, file properties, fields selected for import, and import method options.

    You can use the **Save State** button to save your current import setup. This will capture all your configuration settings, Data Preview options, Import Method selections, Column Selection, and Column Definition options.
16. Click **Finish** to start the import based on the summary settings.

    When importing a file, errors may occur if the data does not match the expected format. For example, if a column defined as `NUMBER` contains a string value. In such cases, the system will notify you and allow you to choose how to proceed. You will be presented with the following options:

    - **Continue**: Skip the row containing the error and proceed with importing the remaining data.
    - **Ignore All**: Ignore all subsequent errors of this type for the rest of the import operation, skipping any problematic rows automatically.
    - **Cancel**: Abort the import process immediately, and no further data will be imported.

    Use **Back** to return and make changes to previous steps. Click **Cancel** to abort the import process.

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3.4 Working with JSON-Relational Duality Views

A JSON-relational duality view exposes data stored in relational database tables as JSON documents. These documents are generated on demand. Duality views organize your data both relationally and hierarchically. This means that applications can access (create, query, modify) the same data as a set of JSON documents or as a set of related tables and columns, and both approaches can be employed at the same time.

For more information about JSON- Relational Duality Views, see *Oracle® Database JSON-Relational Duality Developer's Guide*.

In the SQL Developer extension for VS Code, Duality View is treated as an object type and is available as a separate node in the Connections panel. The tasks that you can perform are:

- Create a duality view using the Duality View Builder.
- Edit a duality view.
- Insert a data record in a duality view.
- Edit a data record in a duality view.
- Display the JSON Data Guide Diagram for a duality view.

3.4.1 Create a Duality View

You can use the Duality View Builder to create a duality view.

> **Note**
>
> The tables used to define a duality view must satisfy certain requirements. If these requirements are not met, an error is raised when you try to create the view.
>
> Also, see Restrictions for JSON-Relational Duality Views.

1. In the Connections panel, right-click the **Duality Views** node and select **Duality View Builder**.

   The Duality View Builder interface appears. It consists of three parts: the diagram panel, the preview panel, and the definition panel. Enter a name for the duality view in the **Name** field on top, and click **Save to File** to save and continue working at a later time.

Diagram Panel

2. From the toolbar, select **Add Root Table**. In the following figure, the table `Employees` is selected.

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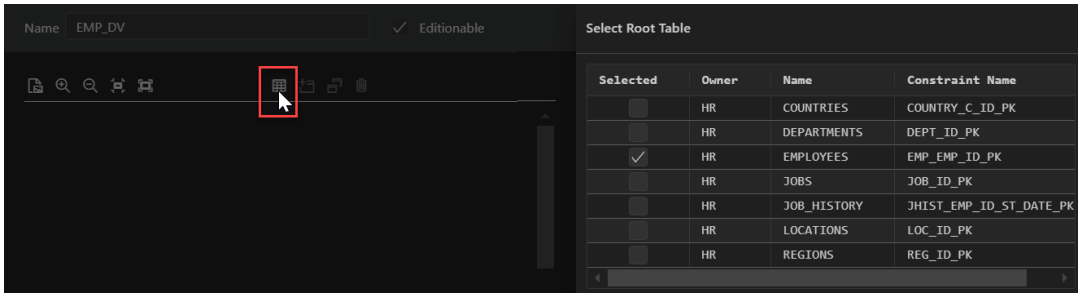
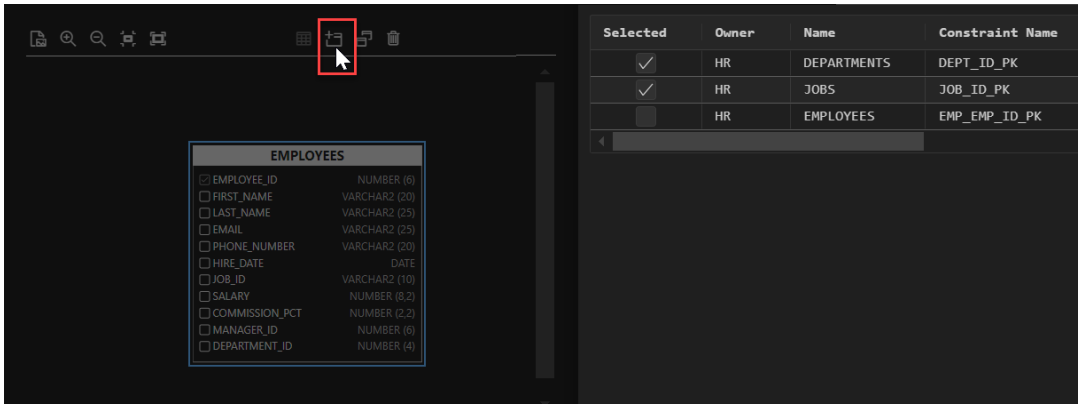


3. In the Select Root Table pane, select the checkbox for the root table that you want, and click **Apply**.

   The selected table appears in the diagram pane. You can zoom in and zoom out and export to SVG format using the icons in the toolbar.

4. You can now select Parent and Child Tables. Select the table in the diagram (when selected, a blue border appears around the table) and from the toolbar, and select **Add Parent Table(s)**. Following this, if you want to add child tables, select the parent table and select **Add Child Table(s)** from the toolbar.

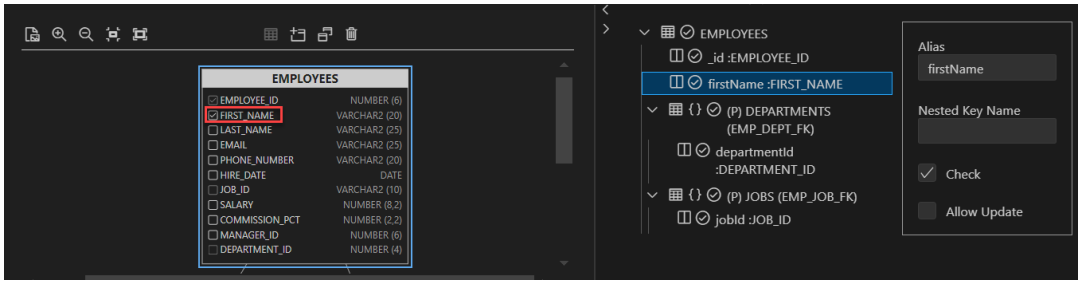
   In the following figure, `Departments` and `Jobs` are selected as parent tables.



Preview Panel

5. You can select additional columns for the table by selecting the appropriate checkbox in the diagram panel. As you select, these changes instantly appear in the preview panel. Select an object in the preview panel to set additional properties such as Alias, Nested Key Name, Allow Update, Allow Insert, Allow Delete, Check, and Filter.

   In the following figure, the `First_Name` column is selected in the diagram panel and it immediately appears in the preview panel. Select `First_Name` in the preview panel to set additional properties such as Nested Key Name, Check and Allow Update.



Definition Panel

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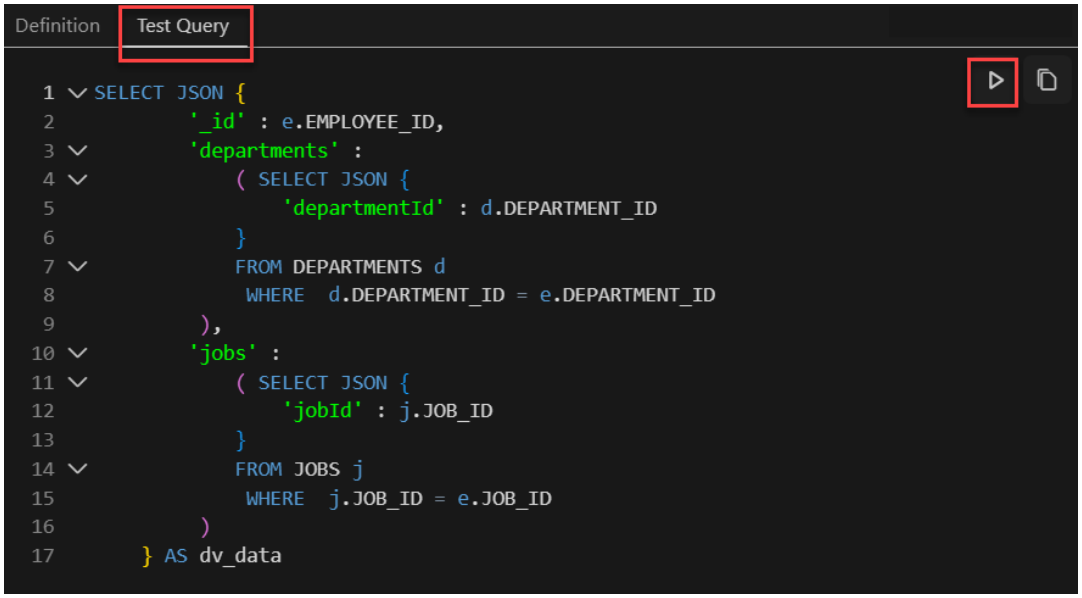
6. In the Definition tab, the duality view definition is automatically generated as a SQL Statement.
7. To test the SELECT statement, select the **Test Query** tab and click the **Run Query** icon.



The output is displayed below the defintion panel.

Create Duality View

8. After confirming the output, you can create the duality view. In the top right corner, click **Create Duality View**.

   To view the newly created duality view, refresh the Connections panel and expand the Duality View node. Click the duality view name to open it in the right panel.

3.4.2 Edit a Duality View

You can use the Duality View Builder to edit a duality view.

1. In the Connections panel, expand the **Duality Views** node, right-click the name of the duality view to edit, and select **Edit**.

   The duality view appears in the Duality View Builder interface.
2. Some of the changes that you can make to the duality view are add or delete tables in the diagram panel, and add columns or set additional properties for objects in the preview panel.

   For more information about how to make these changes, see Create a Duality View.

3.4.3 Insert a Data Record in a Duality View

This section covers the steps to insert a data record in a duality view.

1. In the Connections panel, expand the **Duality Views** node, and then click the duality view name to open it in the right panel.

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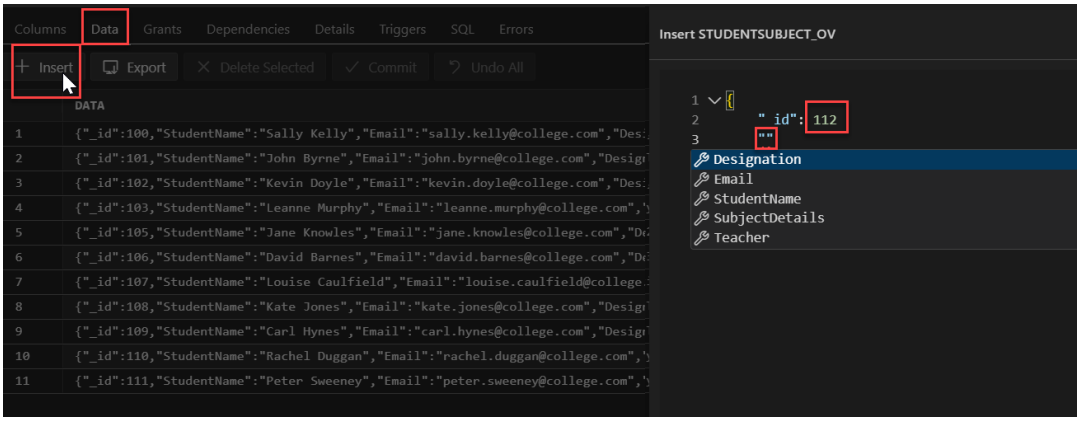
2. Select the **Data** tab.
3. Click **Insert**.
4. In the Insert panel, enter the value for the first property. Press the Enter key to move to the next line. When you enter quotation marks, the available properties that you can choose from are displayed in a list.



If you add any new property that is not part of the schema, an error notification is displayed.

After you complete entering all the details, click **Save**.

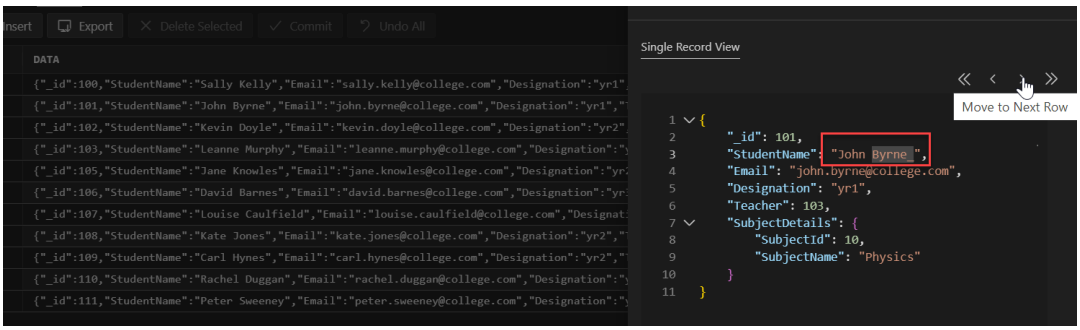
5. Click **Commit** to commit the changes to the database.

3.4.4 Edit a Data Record in a Duality View

This section covers the steps to edit a data record in a duality view.

1. In the Connections panel, expand the **Duality Views** node, and then click the duality view name to open it in the right panel.
2. Select the **Data** tab.
3. Position the cursor on the row that you want to edit, right-click and select **Single Record View**.

   Alternatively, click the **Edit** icon at the end of the row that you want to edit.
4. In the Single Record View panel, click and type to complete the required changes.



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To move to another record, you can use the **move to next row** or **move to previous row** icons.

> **Note**
>
> When using the Single Record View option for a table with a column of JSON data type, note the following:
>
> - In a duality view, the metadata-related fields (such as etag, asof) are not available for editing.
> - For a regular table that has a column of JSON data type, this restriction does not hold and all the fields can be edited.
> - If the result of a SELECT statement in the worksheet is a duality view table or a table with a JSON data type column, then the table remains read-only and cannot be edited.

5. After you have completed all your changes, click **Save**.

   A star symbol (*) appears next to the row number. This indicates that the changes to the row have not yet been committed to the database.

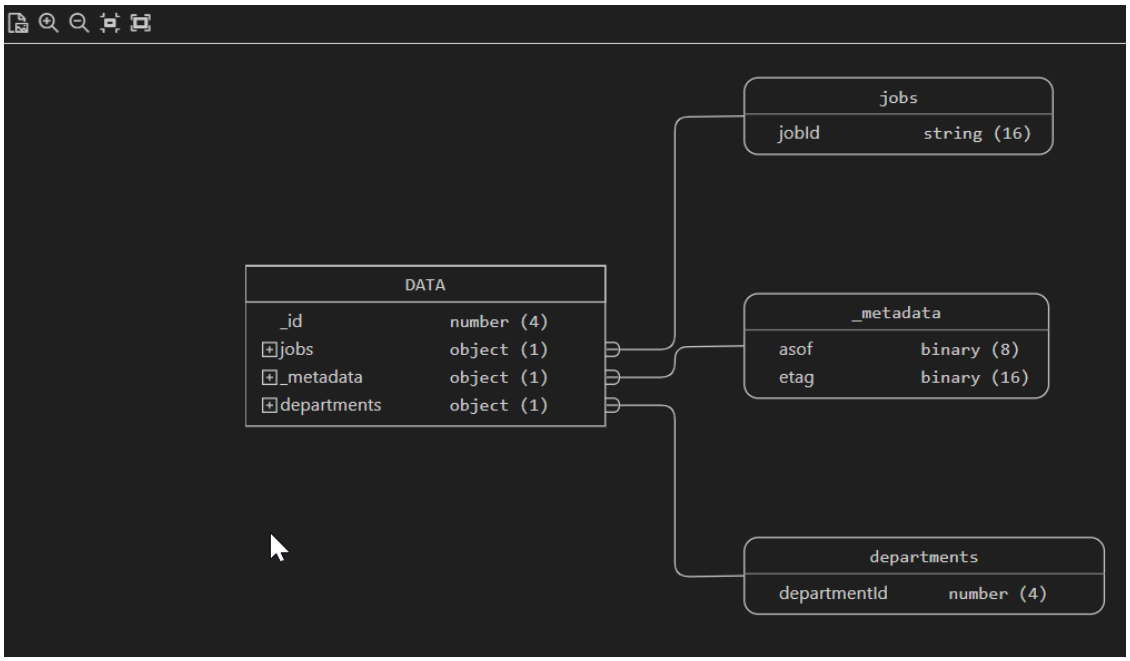
6. Click **Commit** to commit the changes to the database.

3.4.5 Display the JSON Data Guide Diagram for a Duality View

The JSON data guide diagram represents the JSON schema for a duality view.

In the Connections panel, expand the **Duality Views** node, right-click the name of the duality view to edit, and select **Show JSON Data Guide** to display the diagram.

The following figure displays the JSON data guide diagram for the `EMP_DV` duality view that was created in Create a Duality View.



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3.5 Managing JavaScript Modules

The SQL Developer extension for VS Code enables you to access and manage MLE (Multilingual Engine) objects such as MLE modules.

For more information about MLE, see Introduction to Oracle Database Multilingual Engine in the Oracle Database JavaScript Developer's Guide.

SQL Developer for VS Code allows the creation of JavaScript modules as schema objects, assuming the necessary privileges are in place. JavaScript module is a unit of MLE's language code stored in the database as a schema object. You can create, edit and delete JavaScript modules.

The actions available are:

- Create a JavaScript module
- Open a JavaScript module
- Show JavaScript module details
- Compile a JavaScript module
- Drop a JavaScript module

3.5.1 Create a JavaScript Module

To create a JavaScript module:

1. In the Connections panel, click the + icon or right-click **JavaScript Modules** and then click **Create**.

   The **Create** panel appears.
2. In the **MLE Module Name** field, enter a name for the module.

   The SQL pane displays the DDL code for the JavaScript module.
3. Click **Apply**.

   The module is saved and appears in the Connections panel under JavaScript Modules.

3.5.1.1 Example for Create a JavaScript Module

This example demonstrates the creation of the **factorial_mod** JavaScript module.

1. In the Connections panel, click the + icon in the JavaScript Modules node and then click **Create**.
2. In the **MLE Module Name** field, enter **factorial_mod**.
3. Click **Apply**.

   The module appears under **JavaScript Modules** in the Connections panel.
4. In the Connections panel, expand JavaScript Modules, right-click **factorial_mod** and select **Open**.

   The **factorial_mod** module pane appears.

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5. Enter the following JavaScript function:

```
export function factorial(num) {
    if(num < 0) {
        return -1;
    } else if (num == 0) {
        return 1;
    } else {
        return(num * factorial(num-1));
    }
}
```

6. Click the **Compile** icon to save the JavaScript code.

> **Note**
>
> Alternatively, you can save the code by using `ctr + s` or `cmd + s`.

To import a module to an MLE environment, see Example for Create an MLE Environment.

3.5.2 Open a JavaScript Module

To open a JavaScript module:

1. In the Connections panel, select the module name under JavaScript Modules, or right-click the module name and click **Open**.

   If the module is newly created using the Create action in the context menu, the module's content is `//add you code here`.

   You can add code or modify the existing code in the module. If the code has any syntax errors, the errors are underlined and the file's name turns to red. Also, the syntax errors appear in the Problems panel.

2. Click the **Compile** icon to save the code to the database.

   After compiling the module, the result is displayed in the Script Output panel. If the execution finishes with errors, these appear in the Problems panel.

3.5.3 Show JavaScript Module Details

To show details about a selected module, after opening the module, click the **Show Details Panel** icon, which is located right next to the Compile icon.

The Details panel has three tabs: Privileges, Details and Errors.

If there are any errors in the saved module, the line and position column displays the line,position as a link that takes the cursor to the exact location of the syntax error in the module's file.

You can hide the Details panel by clicking the **Hide Details Panel** icon.

3.5.4 Compile JavaScript Module

To compile a selected JavaScript module:

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1. In the Connections panel, select the module to compile, right-click and select **Compile**.

   The Compile panel appears.

2. Click **Apply**.

To compile all MLE modules for the connection, right-click **JavaScript Modules** and select **Compile All**.

To compile all invalid modules for the connection, right-click **JavaScript Modules** and select **Compile All Invalid**.

3.5.5 Delete a JavaScript Module

In the Connections panel, select the module to delete, right-click and select **Drop**. The Drop panel appears. Click **Apply**.

3.6 Managing MLE Environments

MLE environments are schema objects that can be managed in the database. In the SQL Developer extension for VS Code, you can create, edit and delete MLE environments.

For more information about MLE, see Introduction to Oracle Database Multilingual Engine in the *Oracle Database JavaScript Developer's Guide*.

The actions available to you are:

- Create an MLE environment
- Add imports to an MLE environment
- Compile one or all MLE environments
- Delete an MLE environment
- Post-Execution Debugging of MLE JavaScript Modules

3.6.1 Create an MLE Environment

To create an MLE environment:

1. In the Connections panel, for a specific connection, click the + icon in the MLE Environments node and then click **Create**.

   The **Create** pane appears.

2. In the **MLE Environment Name** field, enter a name for the environment.

   The SQL pane displays the DDL code for the new MLE environment.

3. Click **Apply**.

   An empty MLE environment is created and appears in the Connections panel under **MLE Environments**.

3.6.1.1 Example for Create an MLE Environment

This example demonstrates the creation of **myfactorialenv** MLE environment and how to import the **factorial_mod** JavaScript module into this environment.

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1. In the Connections panel, right-click **MLE Environments** and then click **Create**.

   The **Create** panel appears.

2. In the **MLE Environment Name** field, enter a name for the environment, **myfactorialenv**.

   The SQL pane displays the DDL code for the new MLE environment.

3. Click **Apply**.

   An empty myfactorialenv environment is created and appears in the left pane under **MLE Environments**.

4. In the Connections panel, expand MLE Environments, right-click **myfactorialenv** and click **Add Imports**.

   The **Add Imports** pane appears.

5. In **Module Name** field, select the module (**factorial_mod**) to import.

6. In **Import Name** field, enter a name for your import.

7. Click **Apply**.

   To view the imported module, in the Connections panel, right click **myfactorialenv** and select **Open**. Three tabs are displayed for the MLE environment: Errors, Grants and SQL.

   The imported module appears in the **Imports** panel.

3.6.2 Import a Module to an MLE Environment

To import a module for a selected MLE environment:

1. In the Connections panel, right-click the MLE environment name and select **Add Imports**.

   The Add Imports panel appears.

2. In the **Module Name** field, a list of the modules that you have created or have been granted access to appears in the list. Select a module from the list.

3. Enter an **Import Name** for the module.

4. Click **Apply**.

3.6.3 Compile an MLE Environment

To compile an MLE environment, in the Connections panel, right-click the selected environment name and select **Compile**.

To compile all MLE environments for a connection, in the Connections panel, right-click **MLE environments** and select **Compile All**.

To compile all invalid MLE environments, in the Connections panel, right-click **MLE environments** and select **Compile All Invalid**.

3.6.4 Delete an MLE Environment

To delete an MLE environment:

1. In the Connections panel, right-click the selected MLE environment and select **Drop**.

   The Drop panel appears.

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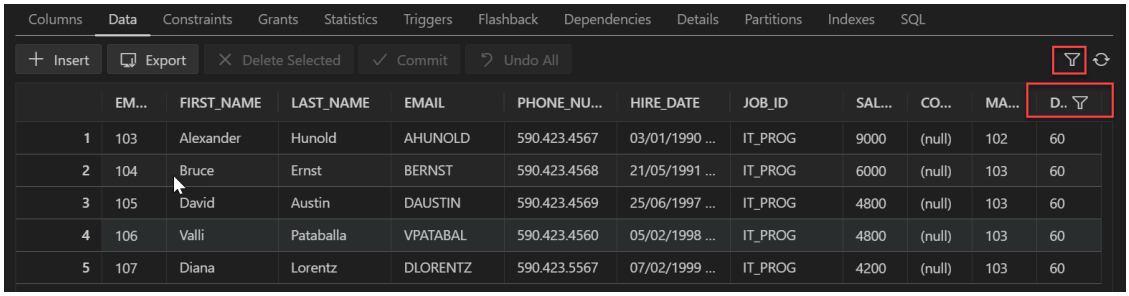
2. Click **Apply**.

3.7 Entering and Modifying Data

You can enter data into tables and views and also edit and delete existing data. To do any of these operations, select the object in the Connections panel, and then click the Data tab in the table detail display. If you click one of the other tabs, Columns, Constraints, Grants, Statistics, Triggers, and so on, you can view the information and perform relevant context menu (right-click) operations.

The following figure shows the Data pane for a table named EMPLOYEES, with a filter applied to show only those employees whose department_id is 60. A filter icon appears next to the department_id column name in the table.



The Data tab provides the following options:

- **Insert** adds an empty row at the beginning of the table, for you to enter new data.
- **Export** enables you to export some or all of the table data to a file or to the system clipboard, in any of the following formats: XML (XML tags and data), CSV (comma-separated values including a header row for column identifiers), SQL Insert (INSERT statements), or SQL Loader (SQL*Loader control file). After you select a format, the Database Export (Unload Database Objects and Data) wizard is displayed.
- **Delete Selected** marks the selected rows for deletion. The actual deletion does not occur until you commit changes.
- **Commit** ends the current transaction and makes permanent all changes performed in the transaction.
- **Undo All** reverts back to the previous state before any changes were made in the current transaction.
- **Filter** icon enables you to add a filter to limit the display of data. Enter the column name, operator and value, and click **Add**. The filter is added below. Add more filters if needed. Click **Apply** to apply the filters.

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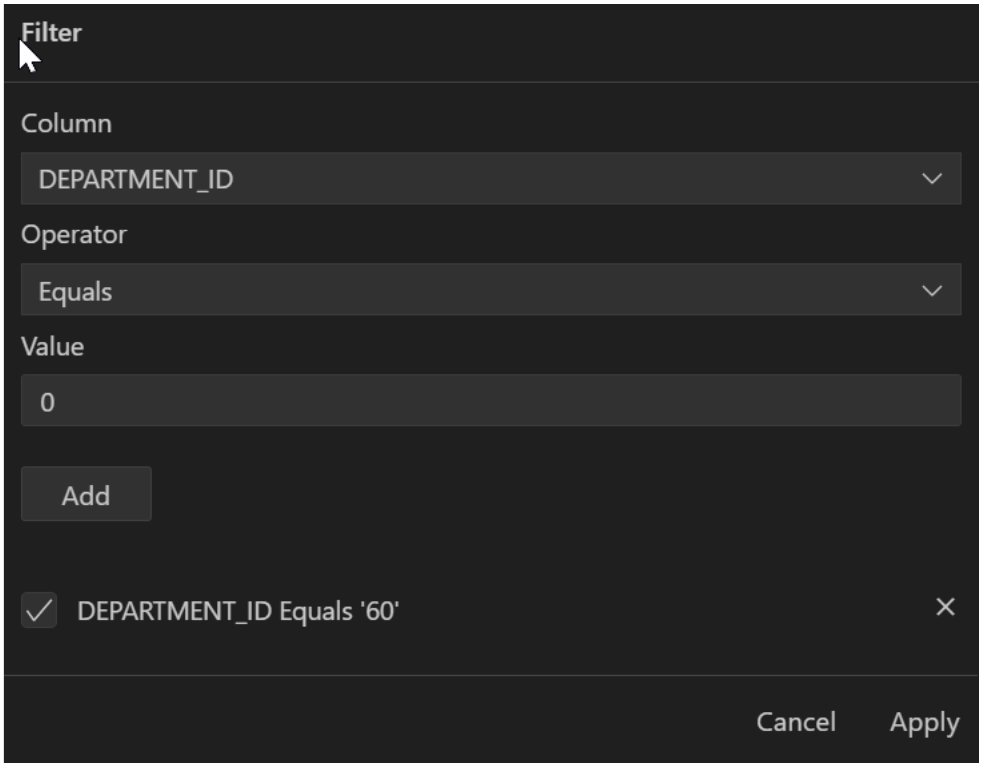

- **Refresh** icon queries the database to update the data display. If a filter is specified, the refresh operation uses the filter.

In the data grid, the context menu (right-click) includes the following commands:

- **Single Record View** displays the Single Record View dialog box, which enables you to edit data for a table or view, one record at a time.
- **Count Rows** displays the number of rows in the table.
- **Export** enables you to export some or all of the table data to a file or to the system clipboard, in any of the following formats: XML (XML tags and data), CSV (comma-separated values including a header row for column identifiers), SQL Insert (INSERT statements), or SQL Loader (SQL*Loader control file). After you select a format, the Database Export (Unload Database Objects and Data) wizard is displayed.

When you right-click a column name, the context menu commands are:

- **Auto-fit All Columns** adjusts the width of all columns according to your specification (by column header, by column data, or best fit).
- **Auto-fit Selected Columns** adjusts the width of the selected columns according to your specification (by column header, by column data, or best fit).
- **Columns** enables you to reorder, hide or show columns.
- **Sort** enables you to sort columns in ascending or descending order.

3.8 Using the SQL Notebook

SQL Notebook is a powerful feature of the SQL Developer Extension for VS Code that offers an alternative to SQL Worksheets that build up a series of queries with Markdown, similar to user defined reports.

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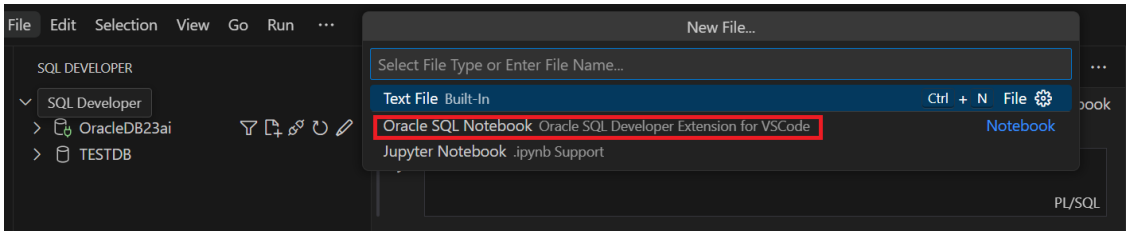
SQL Notebooks use a YAML-based structure, making them both human-readable and machine-parseable. They allow you to create, organize, and run SQL and PL/SQL code in a structured notebook format. You can also create Markdown which help organize reports, group related queries, and add meaningful comments.

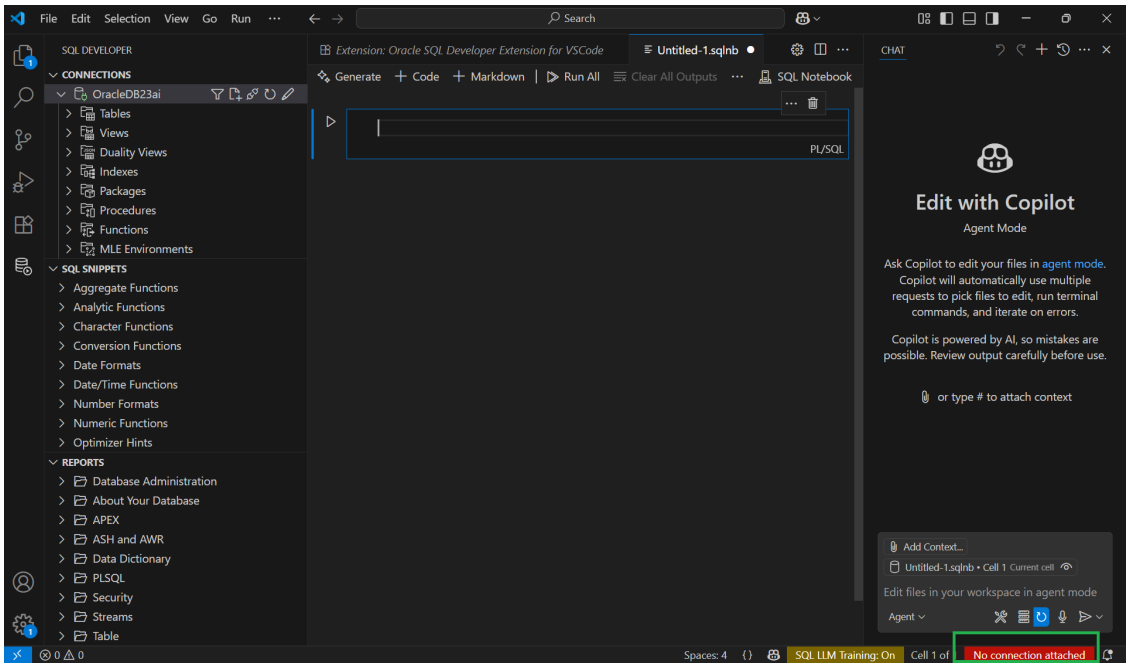
It enables you to run query blocks in a structured notebook format and view the results. You can create a new notebook or edit an existing one.

Open a New SQL Notebook

From the **File** menu, select **New File**, and then select **Oracle SQL Notebook**.



VS Code opens a new SQL Notebook editor with a code cell to enter your query. The default extension of a SQL Notebook is `.sqlnb`. To run a SQL Notebook, you need to attach it to a connection.



Attach a SQL Notebook to a Connection

When a SQL Notebook is opened, it is not attached to any connection by default. You can attach a connection by clicking the connection icon in the lower-right corner of the SQL Notebook editor.

1. In the right pane, click the **No connection attached** label.
   The **Search** box displays the list of available connections.
2. Select a connection.

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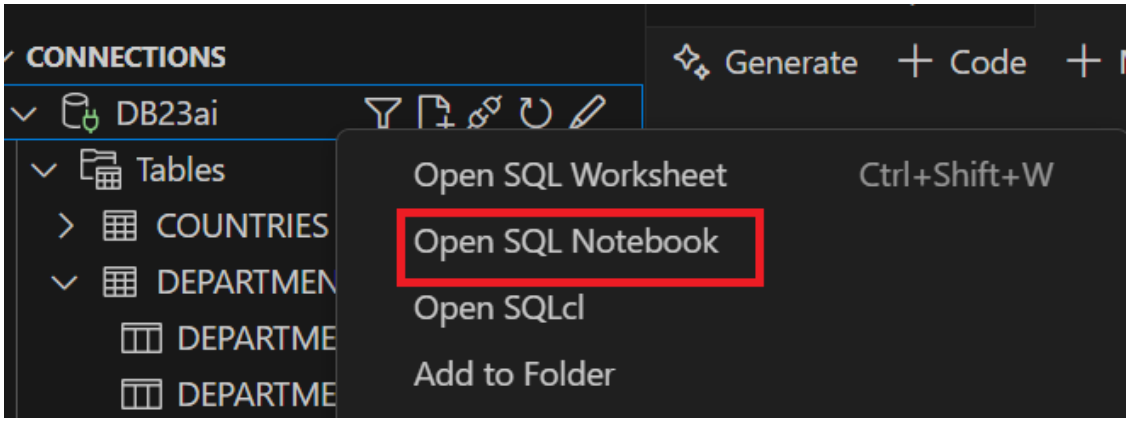
The SQL Notebook is now attached to the selected connection. You see the name of your connection displayed in the lower-right corner.

Alternatively, you can also right-click on the connection name in the left pane and select **Open SQL Notebook**. In this case, the notebook is attached to the dedicated database connection by default.



Save the SQL Notebook

From the **File** menu, select **Save As** or press **Ctrl+Shift+S**. Provide a meaningful file name for the SQL Notebook and save it. The notebook will be saved as an `.sqlnb` file.

Open an Existing SQL Notebook

From the **File** menu, select **Open File** or press **Ctrl+O** . Browse to the file (.sqlnb) and then open it. After the notebook is opened, you need to attach it to a connection again.

The SQL Notebook enables you to perform the following operations using the buttons available in the editor:

- **Code (Ctrl+Enter)** adds a new code cell. It enables you to run one or more SQL statements, PL/SQL statements, and scripts. For more information, see Using the Code Cell.
- **Markdown** adds a new Markdown cell. It enables you to enter markdown-formatted text. For more information, see Using the Markdown Cell.
- **Run All** runs all the cells in the SQL Notebook sequentially.
- **Clear All Outputs** clears all the output.

3.8.1 Using the Code Cell

In the code cell, you can enter one or more SQL, PL/SQL statements, or scripts that you intend to run.

You can run multiple queries sequentially in a single code cell, combine DDL and DML operations, and run setup scripts followed by data queries. You can also use bind variables and substitution variables for dynamic query execution. It also displays detailed output of the script execution.

For multiple statements, each SQL statement must be terminated with either a semicolon or (on a new line), and each PL/SQL statement must be terminated with a slash (/) on a new line. You can drag some kinds of objects such as tables or views from the Connections navigator

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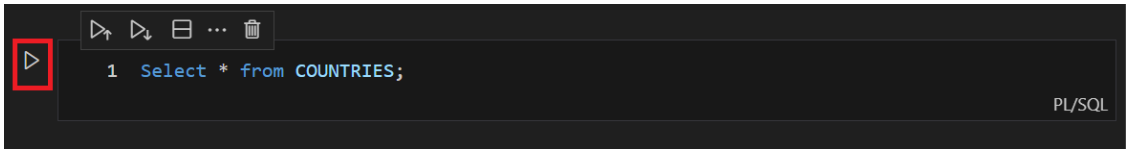
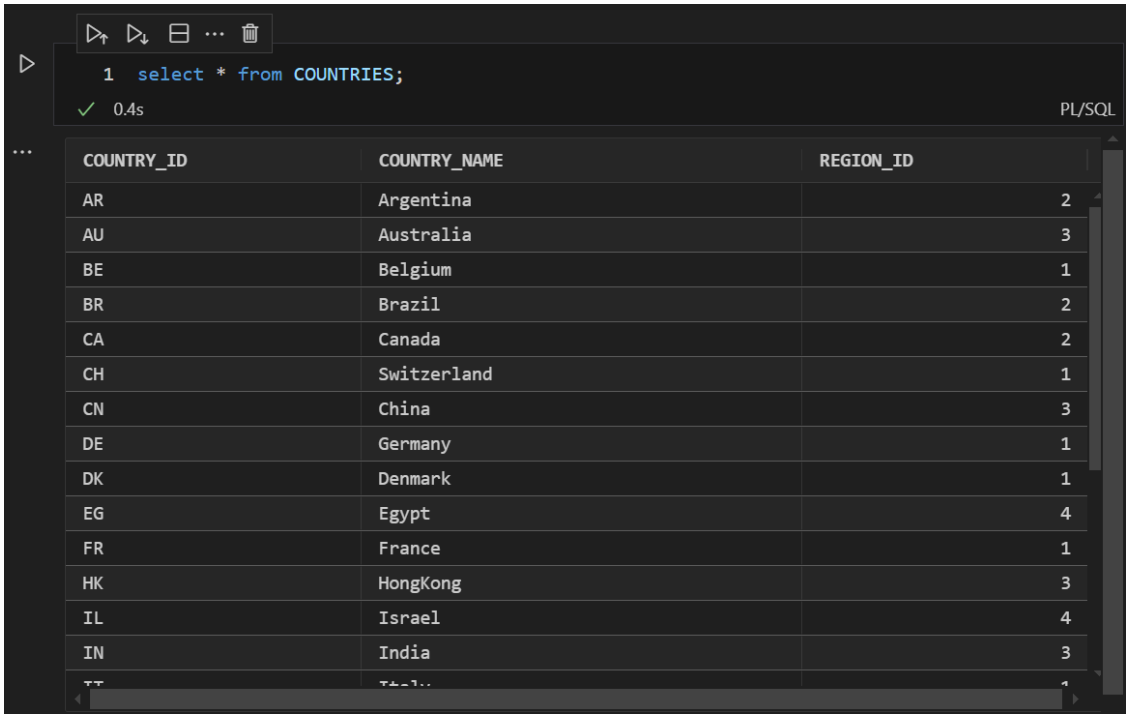
and drop them into the code cell. When you do this, the following options appear: Object Name, Insert, Delete, Update, and Select. If you select **SELECT**, a SELECT statement is constructed with all columns in the table or view. You can then edit the statement.

To add a new code cell, click **Code**. Enter the statement that you want to run in the code cell. As you start typing, a context-sensitive pop up window appears to help you auto-complete the code. You can click **Esc** to close the pop up window.

Click **Execute Cell (Ctrl+Alt+Enter)**.

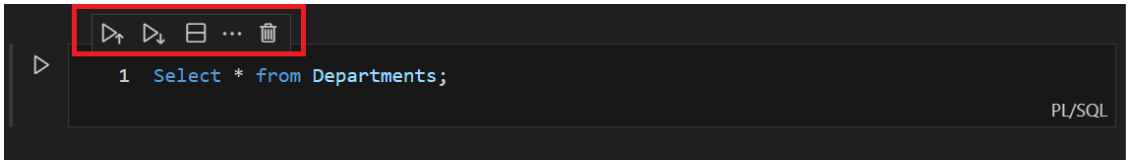


The output is displayed in a grid format:



COUNTRY_ID	COUNTRY_NAME	REGION_ID
AR	Argentina	2
AU	Australia	3
BE	Belgium	1
BR	Brazil	2
CA	Canada	2
CH	Switzerland	1
CN	China	3
DE	Germany	1
DK	Denmark	1
EG	Egypt	4
FR	France	1
HK	HongKong	3
IL	Israel	4
IN	India	3

You can click on column headers to sort the data, drag to resize columns to fit the output, view the full details of a record, and export the output data. The main advantage of SQL Notebooks is that you can run a single code cell, a group of consecutive code cells, or the entire notebook.



The following icons are available on a code cell:

- **Execute Above Cells** runs all the preceding code cells.

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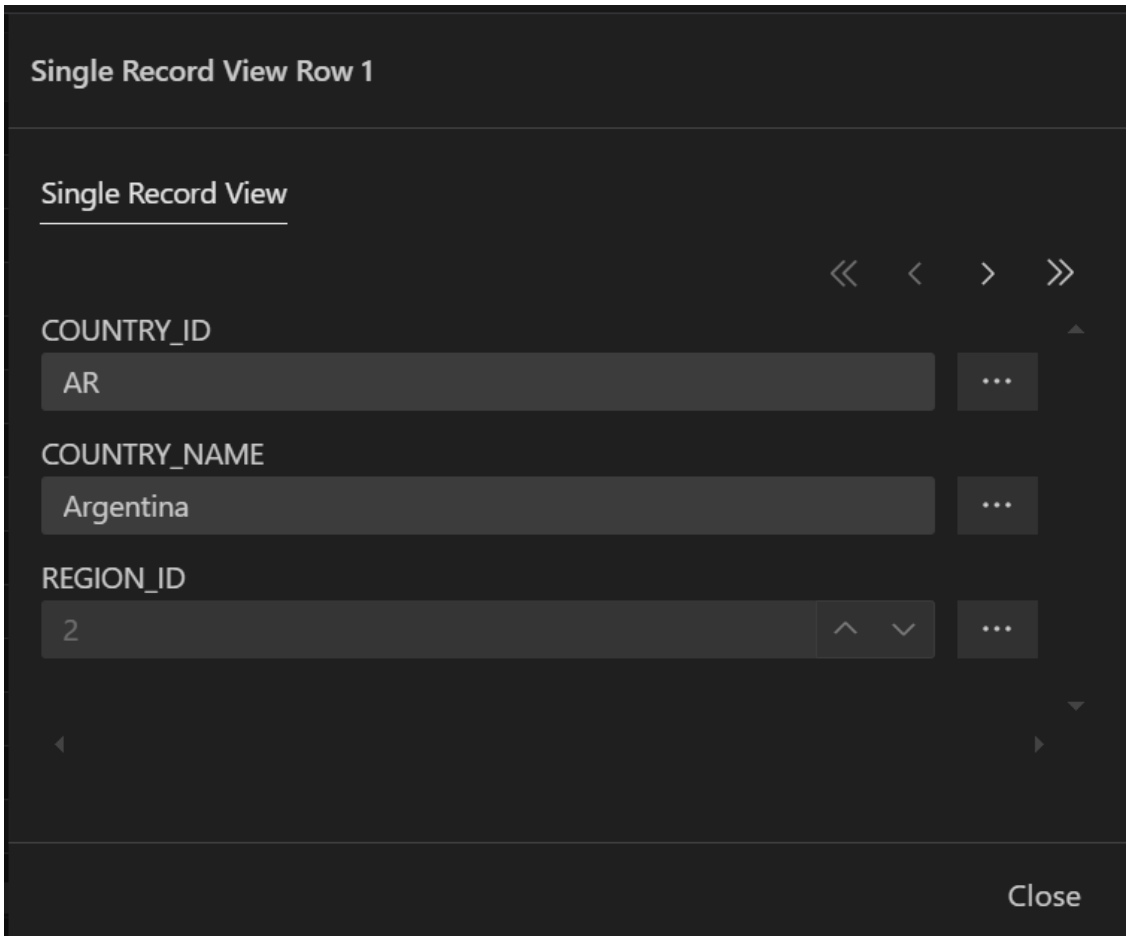
- **Execute Cells and Below** runs the current cell and all code cells below it.
- **Split Cell** splits the current code cell into two separate cells.
- **Delete Cell** deletes the selected code cell.
- **More Actions...** provides additional options to perform common tasks. For more information, see Additional Cell Configuration Options.

3.8.1.1 Viewing Single Record

Right-click on an output row and select **Single Record View** to view its details.

The details of the selected row is displayed:



You can use the **<<**, **<**, **>**, and **>>** buttons to navigate to the first, previous, next, and last records, respectively. Clicking **Close** closes the dialog box.

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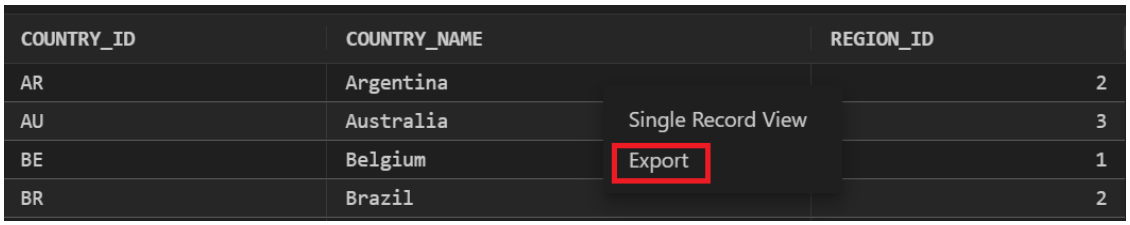
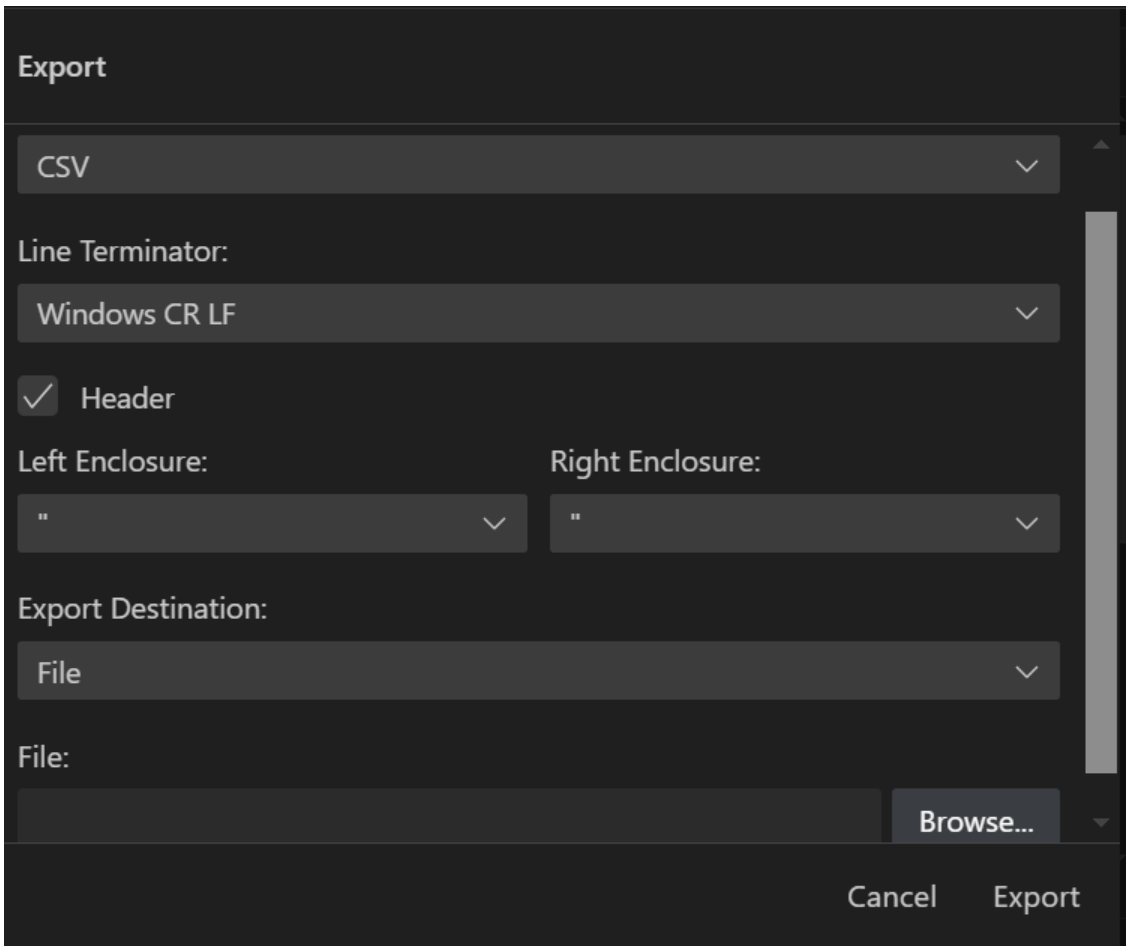
3.8.1.2 Exporting Data

Right-click on the grid and select **Export** to export the output data in multiple formats.



You can choose the desired format for exporting the output by configuring the settings in the **Export** dialog box. Click **Export** to export the output.



The following configurations are available for exporting the output:

- **Format** lists the formats in which the output can be exported. Available options are: CSV, Delimited, Fixed, HTML, Insert, JSON, Text, XML, JSON Formatted, Loader
- **Line Terminator** lists the line terminator options for export. Available options are: Unix/Mac LF, Windows CR LF, CR
- **Header** displays header in the exported output if this check box is selected.

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- **Left Enclosure** displays the available left enclosure options, which include: double quote ("), single quote ('), opening parenthesis ((), opening brace ({), and opening bracket ([).
- **Right Enclosure** displays the available right enclosure options, which include: double quote ("), single quote ('), closing parenthesis ()), closing brace (}), and closing bracket (]).
- **Export Destination** lists the destination for the exported output. Available options are: File, Clipboard
- **File** allows you to browse and select the destination file for exporting the output.

3.8.1.3 Rendering Output as Charts

SQL Notebook Charting enables you to instantly transform query results into interactive visualizations directly within the SQL notebooks. When you run a SQL or PL/SQL statement, the output is displayed in a table format by default. You can now choose to view the output in various chart formats.

To view the output as a chart:

1. On a code cell, click **More Actions (...)**.

   A menu appears with options for additional cell actions.

2. Select the **View as** option.

   A context menu with various chart options is displayed. For more information, see Additional Cell Configuration Options.

3. Select a chart option to view the output in the desired format.

   The following example shows the output as a basic bar chart:

3.8.2 Using the Markdown Cell

In the Markdown cell, you can insert formatted text, explanations, and documentation in a notebook. This helps improve the clarity and readability of notebooks. For example, you can use Markdown to group queries, add comments, and provide descriptions of the code.

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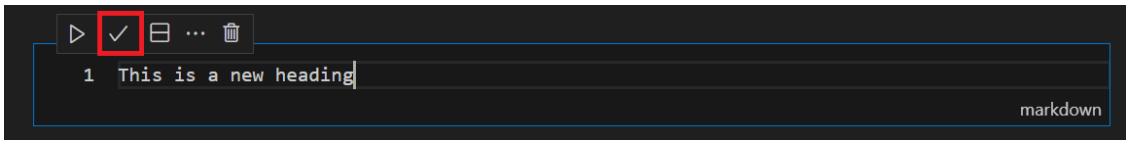
To add a new Markdown cell, click **Markdown**. Enter the markdown-formatted text and click **Stop Editing Cell (Ctrl+Alt+Enter)**.



The output is displayed as:

The following icons are available on a Markdown cell:

- **Run Cells in Section** executes all code cells grouped under a specific Markdown section at once. Markdown headers (for example, # Header1, ## Header2) create sections, and the code cells between them are treated as part of that section.
- **Stop Editing Cell (Ctrl+Alt+Enter)** stops editing the Markdown cell and renders the formatted output.
- **Split Cell (Ctrl+K Ctrl+Shift+\)** splits the current cell into two separate Markdown cells.
- **Delete Cell (Delete)** deletes the selected cell.
- **More Actions...** provides additional options to perform common tasks. For more information, see Additional Cell Configuration Options.

3.8.3 Additional Cell Configuration Options

This section outlines additional actions you can perform on a cell.

Actions for Code and Markdown Cells

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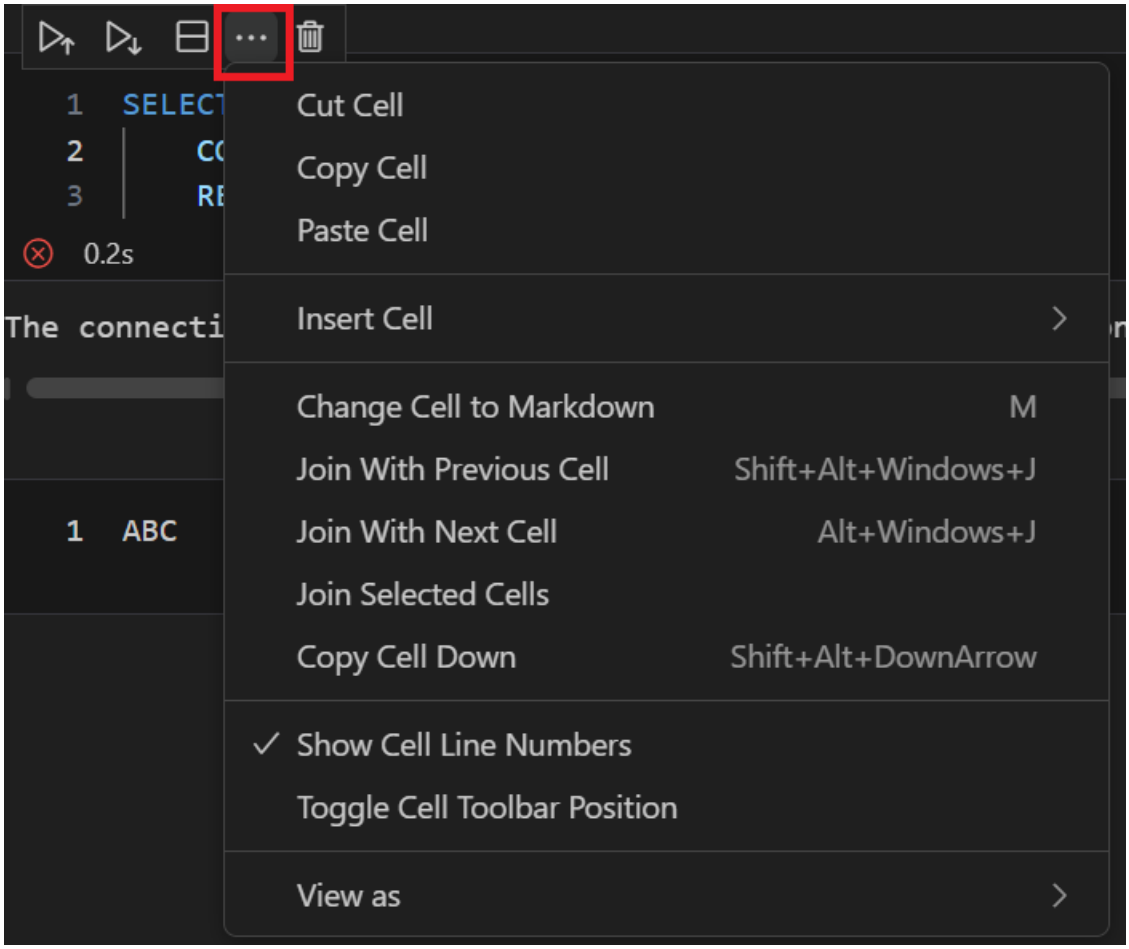

- **Cut Cell** deletes the selected cell and stores its contents for pasting.
- **Copy Cell** copies the selected cell.
- **Paste Cell** pastes the previously cut or copied cell.
- **Insert Cell** inserts a new code or Markdown cell above or below the selected cell.
- **Change Cell to Markdown** changes the selected code cell to a Markdown cell. This option is available only for code cells.
- **Join With Previous Cell (Shift+Alt+Windows+j)** joins the selected cell with the preceding cell.
- **Join With Next Cell (Alt+Windows+j)** joins the selected cell with the next cell.
- **Join Selected Cells** joins the selected cells.
- **Copy Cell Down (Shift+Alt+Down Arrow)** duplicates the selected cell directly below.
- **Show Cell Line Numbers** shows or hides the line numbers in the cell.
- **Toggle Cell Toolbar Position** moves the toolbar to either the upper-left or upper-right corner of the cell.
- **View as** provides the options to view the output of a code cell in different chart formats. These formats are:
  - View as Table
  - View as Basic Bar Chart

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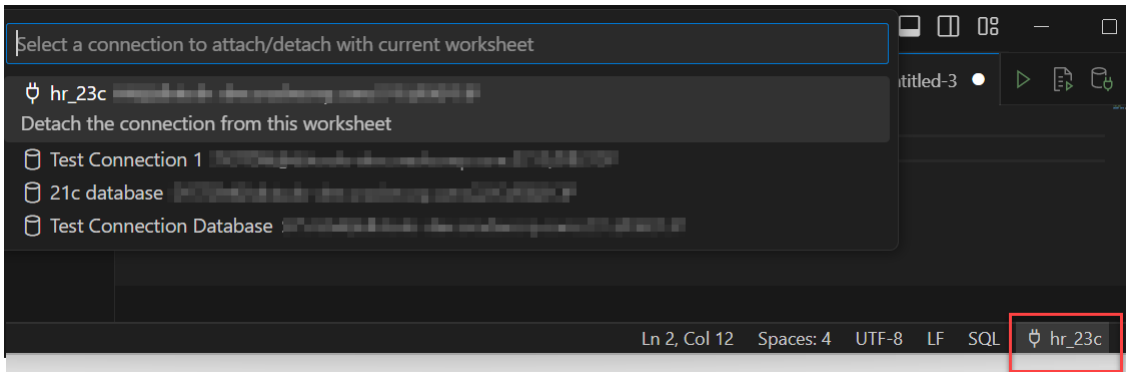
- View as Horizontal Bar Chart
- View as Stacked Bar Chart
- View as Pie Chart
- View as Donut Chart
- View as Nightingale Rose Chart
- View as Basic Line Chart
- View as Smooth Line Chart
- View as Area Line Chart

3.9 Using the SQL Worksheet

You can use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQLcl statements. You can specify any action that can be processed by the database connection associated with the worksheet, such as creating a table, inserting data, creating and editing a trigger, selecting data from a table, and saving that data to a file.

You can display a SQL Worksheet by right-clicking a connection name in the Connections panel and selecting **Open SQL Worksheet**.

When SQL Worksheet is open and if you also have existing SQL files open, you can attach a connection by clicking the connection icon in the lower right corner. Once a connection is associated with your editor or file, you see the name of your connection displayed in the lower right corner.



In the editor, you can enter one or more SQL or statements that you intend to execute. For multiple statements, each non-PL/SQL statement must be terminated with either a semicolon or (on a new line) a slash (/), and each PL/SQL statement must be terminated with a slash (/) on a new line. SQL keywords are automatically highlighted.

You can drag some kinds of objects such as tables or views from the Connections navigator and drop them into the editor pane. When you do this, the following options appear: Object Name, Select, Insert, Delete, Update. If you select SELECT, a SELECT statement is constructed with all columns in the table or view. You can then edit the statement, for example, modifying the column list or adding a WHERE clause.

When you press **Ctrl+Space**, a context-sensitive popup window appears. This provides you with a list of possible completions at the insertion point that you can use to autocomplete code

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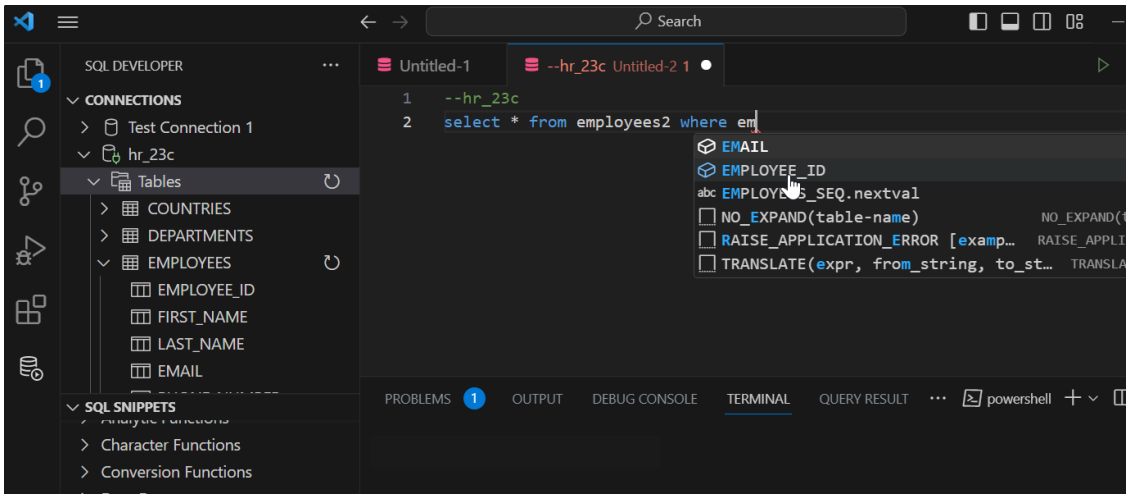
that you are editing. This list is based on the code context at the insertion point. To exit at any time, press **Esc** or continue typing.



SQL Worksheet has the following icons at the top right corner:

- **Run Statement (Ctrl+Enter)** executes the statement at the mouse pointer in the SQL Worksheet. The SQL statements can include bind variables and substitution variables of type VARCHAR2. A pop-up box is displayed for entering variable values. The output is displayed under the Query Result tab in the lower pane.
- **Run Script (F5)** executes all statements in the SQL Worksheet using the Script Runner. The SQL statements can include substitution variables (but not bind variables) of type VARCHAR2. A pop-up box is displayed for entering substitution variable values. The output is displayed under the Script Output tab in the lower pane.
- **Run in SQLcl (Ctrl+Shift+Enter)** executes the statement or script by opening a SQLcl command line session and displaying the output.
- **Explain Plan (F10)** generates the execution plan for the statement (internally executing the EXPLAIN PLAN statement). The results appear under the Explain tab in the lower pane.
- **Attach/Detach Connection** attaches a new connection or detaches the existing connection from the current worksheet.
- **Commit Changes (F11)** commits the changes made to the database.
- **Rollback Changes (F12)** rolls back the changes made to the database.

3.9.1 SQLcl Commands Supported in the SQL Worksheet

The SQL Worksheet supports SQLcl commands. SQLcl commands must be interpreted by the SQL Worksheet before being passed to the database. Any commands that are not supported by the SQL Worksheet are ignored and not passed to the database.

For information about SQLcl commands, you can enter the help command. For information about a specific command or topic, include it as the parameter (for example, help @, help exit, or help reserved words). If the command is not supported, or if there are restrictions or usage notes, the help display includes this information.

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3.9.2 Connection Management

Starting with release 24.1.1, opening a new SQL Worksheet creates a new, dedicated connection to the database. This means that long-running queries in your SQL Worksheet do not block other database requests.

You can control this behaviour using the `Session per attached worksheet` setting in `Preferences`.

1. From the **File** menu, go to **Preferences** and then select **Settings** from the sub-menu.
2. Under **User**, expand **Extensions** and then expand **Oracle SQL Developer Extension for VS Code**.
3. In the right panel, under **Database Connections**, in the **Session per attached worksheet** field, select **off** from the drop-down list to remove this setting.

   The default setting is `on`.

3.9.3 Script Runner

With Script Runner, you have access to commands such as @, @@, CONNECT, EXIT, QUIT, UNDEFINE, WHENEVER, and substitution variables. For example, to run a script named c:\myscripts\mytest.sql, type @c:\myscripts\mytest in the editor, and select the Run Script icon.

The following considerations apply to using the script runner:

- You cannot use bind variables. (However, you can use bind variables of type VARCHAR2, NUMBER, and DATE.)
- For substitution variables, the syntax &&variable assigns a permanent variable value, and the syntax &variable assigns a temporary (not stored) variable value.
- For EXIT and QUIT, commit is the default behavior, but you can specify rollback. In either case, the context is reset, for example, WHENEVER command information and substitution variable values are cleared.
- DESCRIBE works for most, but not all object types.

3.9.4 Explain Plan

The Execute Explain Plan icon generates the execution plan, which you can see by clicking the Explain Plan tab. The execution plan is the sequence of operations that will be performed to execute the statement.

The Explain Plain diagram view is a graphical representation of the contents of `PLAN_TABLE`, which is the default table for the results of the EXPLAIN PLAN statement.

By default, three levels of steps are visible in the diagram. You can use the **+/-** signs at the bottom of each step (available when the step has children) to expand or collapse. To view all steps in the diagram, use **Expand All** in the toolbar.

The diagram also provides the following details:

- Cardinality (number on the arrow to the parent step), which is the number of rows processed

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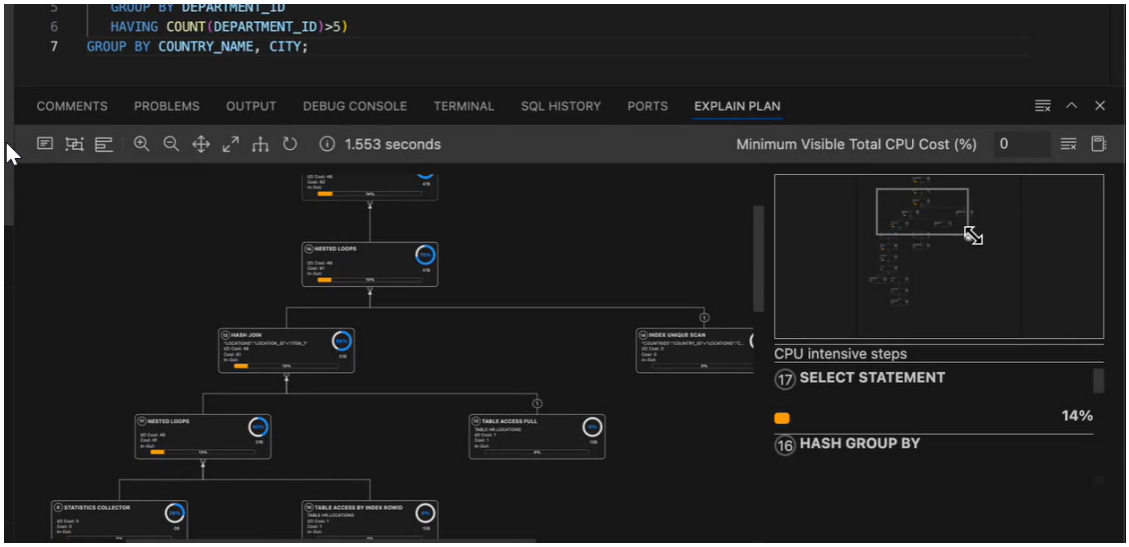
- Operation and options applied in that step
- Execution order, which is the sequential number in the order of execution
- Access predicates CPU cost in percentage (orange bar)
- Total CPU cost for the step in percentage (blue circle)
- Estimated I/O Cost, Bytes processed and Cost metrics



You see a brief description pop-up when you hover over any of the statistics in a step.

The icons in the toolbar are:

- **Text View**: Displays the execution steps in a plain text format.

  For the Text View, you can select the level of detail displayed in explain plan by selecting the appropriate option in Using Preferences.
- **Diagram View**: Displays the execution steps in a flowchart format.
- **Chart View**: Displays data from `PLAN_TABLE` a flame graph.
- **Advanced View**: Displays data from `PLAN_TABLE` in a mixed tabular/tree view.
- **Zoom In, Zoom Out**: If a step is selected in the diagram, clicking the Zoom In icon ensures that it remains at the center of the screen.
- **Fit Screen**: Fits the entire diagram in the visible area.
- **Actual Size**: Sets the zoom factor to 1.
- **Expand All**: Displays all steps in the diagram.
- **Reset Diagram**: Resets the diagram to the initial status, that is, only three levels of steps are displayed.
- **Show Info**: Shows the `SELECT` statement used by the Explain Plan functionality.
- **Min Visible Total CPU Cost(%)**: Defines the threshold to filter steps with total CPU cost equal or more than the provided value.

  Enter a value between 0 and 100. There is no filtering for 0.
- **Plan Notes**: Displays the Explain Plan notes.

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Properties

Double-click or press **Enter** on a selected step to open the Properties slider, which provides more information about that step. See PLAN_TABLE in *Oracle Database Reference* for a description of each property.

The Properties slider shows:

- All information for that step extracted from `PLAN_TABLE` in a tabular format. Nulls are excluded.

  You can select **JSON** to view the properties in JSON format.
- Information from `OTHER_XML` column of `PLAN_TABLE`.

  The information is displayed in JSON format.

Navigation

- Press the **Tab** key to move through the steps in the execution order. The selected step has a blue border around it.

  To move in the reverse direction, press the **Shift + Tab** keys.

  If no step is selected, pressing the **Tab** key selects the step with execution number 1.
- Depending on the zoom level, use horizontal and vertical scrollbars to view different parts of diagram.

  Click the left mouse button and hold it to pan the diagram around up and down.

  Use the icon at the bottom right to scroll to the top of the diagram.

Diagram Navigator

The Diagram Navigator is at the top right corner and represents a smaller copy of the diagram. The rectangle border allows zoom-in and zoom-out operations and moves to show different parts of the diagram.

The diagram navigator shows a list with steps having more than 1% CPU cost in descending order. Click a step in the list to navigate to the same step in the diagram, enabling you to see it in the context of the other steps.

3.9.5 Task Monitor

> **Note**
>
> This feature is available only if you are a user with a Database Administrator role.

The Task Monitor enables you to monitor the progress of all tasks in real time allowing you to effectively manage your time and resources. This is significantly useful for long-running tasks such as large data imports/exports, complex queries, running scripts, or database maintenance tasks. You can prioritize tasks based on their progress and estimated completion time.

The Task Monitor is a tab in the SQL worksheet output panel and displays a list of in-progress and unfinished tasks. Normally completed tasks disappear from the list.

When no tasks are running, the Task Monitor displays the `Nothing to show` message.

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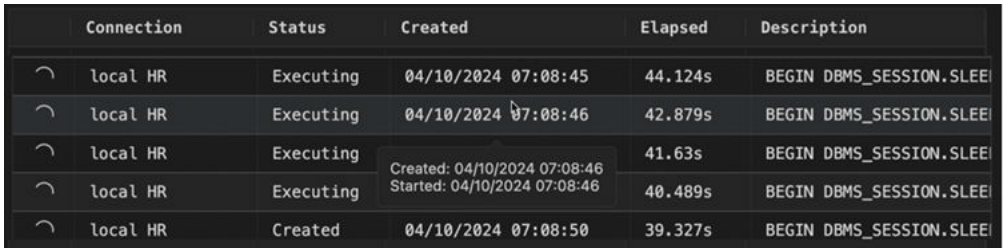

The information displayed for a task consists of the following:

- **Icon**: Visually indicates the status of the task using icons.
- **Connection**: Name of the connection.
- **Status**: Current status of the task.
  - **Waiting**: The task is queued up to execute.

    This only happens if the **Connections Sessions Sharing** option in the Extensions Settings is set to `OFF`.
  - **Created**: The task is created and waiting to be executed.
  - **Executing**: The task is being executed.
  - **Completed**: The task is completed.
  - **Error**: An error occurred when executing the task.
- **Created**: Timestamp of the task creation.

  When hovering over an entry, a popup is displayed with status-related timestamp information (such as Created, Started).
- **Elapsed**: Depends on the status of the task. When the status is Created, Elapsed refers to the time taken to execute since creation. When the status is Executing, the Elapsed time then resets to calculate the time taken to execute the task.
- **Description**: SQL statement or script that forms the task.

To cancel a task, right-click the respective task row and click **Cancel**.

3.9.6 SQL History

You can click the SQL History tab in the lower right pane to view a list of SQL statements and scripts that you have executed, and optionally double-click one or more statements to have them either replace the statements currently on the SQL Worksheet or be added to the statements currently on the SQL Worksheet. The list is at first organized by date, and then by connection name.

The SQL history list will not contain any statement that can include a password. Such statements include (but are not necessarily limited to) CONNECT, ALTER USER, and CREATE DATABASE LINK.

You can control the maximum number of statements in the history by setting the SQL History Limit in Preferences.

When a SQL statement in the SQL History list is selected, it automatically opens the PL/SQL subprogram in the SQL Worksheet pane.

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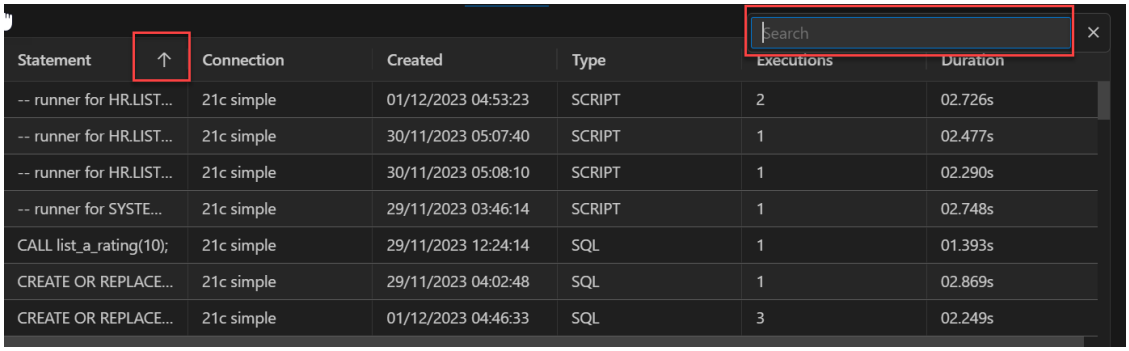
To **sort** the statements in the list, double-click the column header that you want to sort on and the statements are sorted in ascending order. Double-click the header again to sort in descending order. To remove sorting applied to the column, double-click the column header again.

To display the **Search** functionality, in the SQL History pane, press **Ctrl+F** (**Cmd+F** for MacOS).



3.9.7 Using Snippets to Insert Code Fragments

Snippets are code fragments, such as SQL functions, Optimizer hints, and miscellaneous PL/SQL programming techniques. Some snippets are just syntax, and others are examples. You can insert and edit snippets when you are using the SQL Worksheet or creating or editing a PL/SQL function or procedure.

Snippets are displayed in the lower part of the Connections panel. Click the Expand icon to view all the available sinppets in each group (such as Aggregate Functions or Character Functions). In most cases, the fragments in each group do not represent all available objects in that logical grouping, or all formats and options of each fragment shown. For complete and detailed information, see the Oracle Database documentation.

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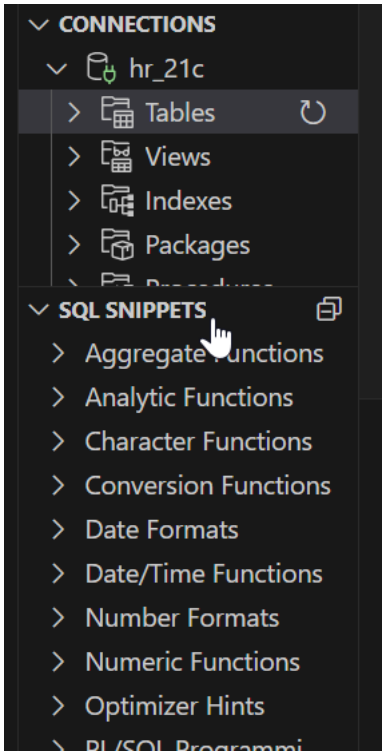

To insert a snippet into your code in a SQL Worksheet or in a PL/SQL function or procedure, drag the snippet from the left bottom pane and drop it into the desired place in your code. Edit the syntax so that the SQL function is valid in the current context.

For example, you could type SELECT and then drag CONCAT(char1, char2) from the Character Functions group. Then, edit the CONCAT function syntax and type the rest of the statement, such as in the following:

```
SELECT CONCAT(title, ' is a book in the library.') FROM books;
```

3.9.8 Reports

Predefined reports are SQL queries that run against the connected database instance.

The Reports feature provides many built-in reports to query and monitor the database and its objects. These reports cover a range of database administration, performance monitoring, and diagnostic needs.

The different types of reports available are Grid, Charts and PL/SQL DBMS_OUTPUT.

Some examples of predefined reports are:

- **Top SQL by Execution Time**: Displays the SQL queries with the highest execution times. Useful for performance tuning.
- **Database Instance Details**: Shows information about the database version, instance name, and startup time.
- **Active Sessions**: Lists currently active sessions along with key metrics like CPU usage and memory allocation.

Prerequisites

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You require a database connection and relevant permissions to access the database views and objects queried by the report.

Accessing a Report

To open a report:

1. Expand the **Reports** panel in the left pane.

   The reports are organized into several categories to help users quickly locate relevant reports such as Database Administration, Data Dictionary, Security and so on.

2. Expand a report category and select a report. You are prompted to select the database connection for which to display the report.

   Some reports may prompt you to select binds (for example, date ranges, schema names) before generating the report. To specify a bind variable, type an entry in the **Value** column and click **Apply**.

User Actions on a Report

For more details if available, you can click on a row in a report to view more details about that entry in a bottom panel.

Click **Open in Worksheet** icon to display the SQL statement used to retrieve the information for a report in a SQL Worksheet pane, where you can view, edit, and run the statement.

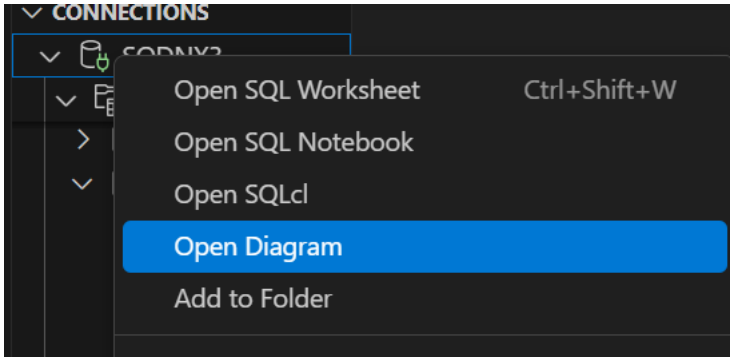
The default options in the context menu for the report table are **Single Record View** and **Export**. Right-click in a report table and select **Export** to export a report to CSV, PDF, HTML or other formats. The context menu might include more options, which are based on the selected report.

3.10 Working with Diagrams

The SQL Developer extension for VS Code allows you to visualize database objects, such as tables, views, and duality views on diagrams.

You can save, export, and reopen these diagrams with ease. Additionally, it allows you to explore dependencies between various database objects and provides a search function to quickly find objects within the diagram.

To open a new diagram, right-click the connection name in the **Connections** panel and select **Open Diagram**.



A diagram window, along with the instructions for working with diagrams, is displayed on the right pane. You can now add objects to this diagram.

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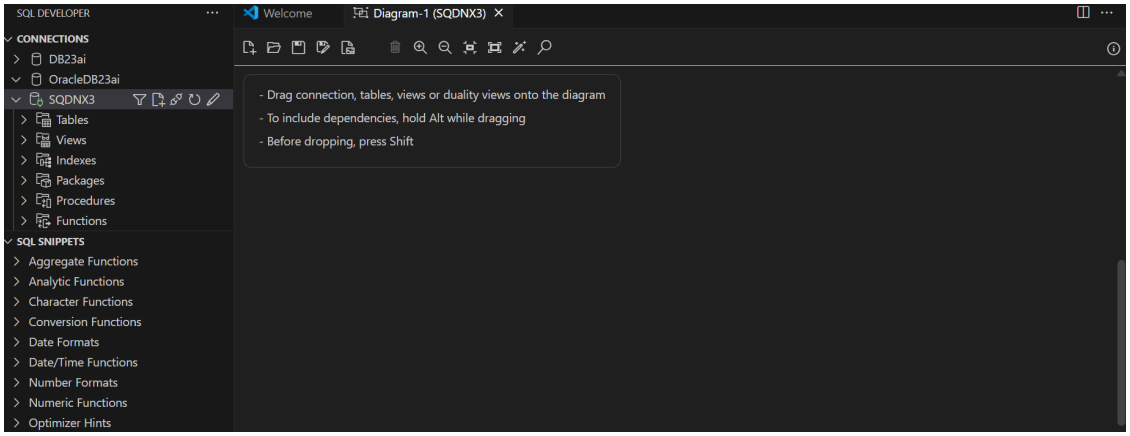

Adding Objects to a Diagram

You can add objects to the diagram using drag-and-drop functionality from the connection folder (node), object type folders, or individual objects. The supported object types for diagrams are Tables, Views, and Duality Views.

Different types of selections cannot be combined in a single drag-and-drop action. Selection is processed according to the following priority: Connection Folder (Node), Object Type Folders (for example, Tables, Views), Individual Objects. If a higher-priority item is selected, any lower-priority items included in the selection will be ignored. For example, if you select both a connection folder and individual tables, only the connection folder will be processed.

Using the Connection Folder (Node)

- Select the connection folder and drag it with your mouse.
- When your cursor is positioned over the diagram, press the **Shift** key once.
  All tables, views, and duality views from the schema associated with the connection will be retrieved and laid out on the diagram.

For example, when you select the entire connection, the required details for all tables, views, and duality views within the schema are retrieved from the database, and the objects are systematically arranged on the diagram.

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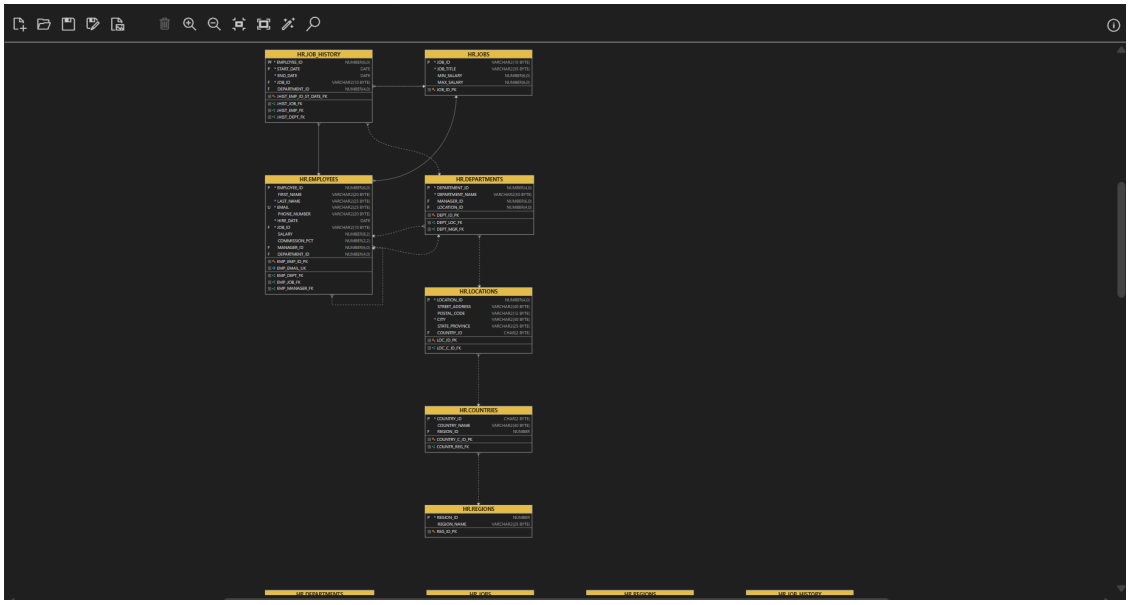
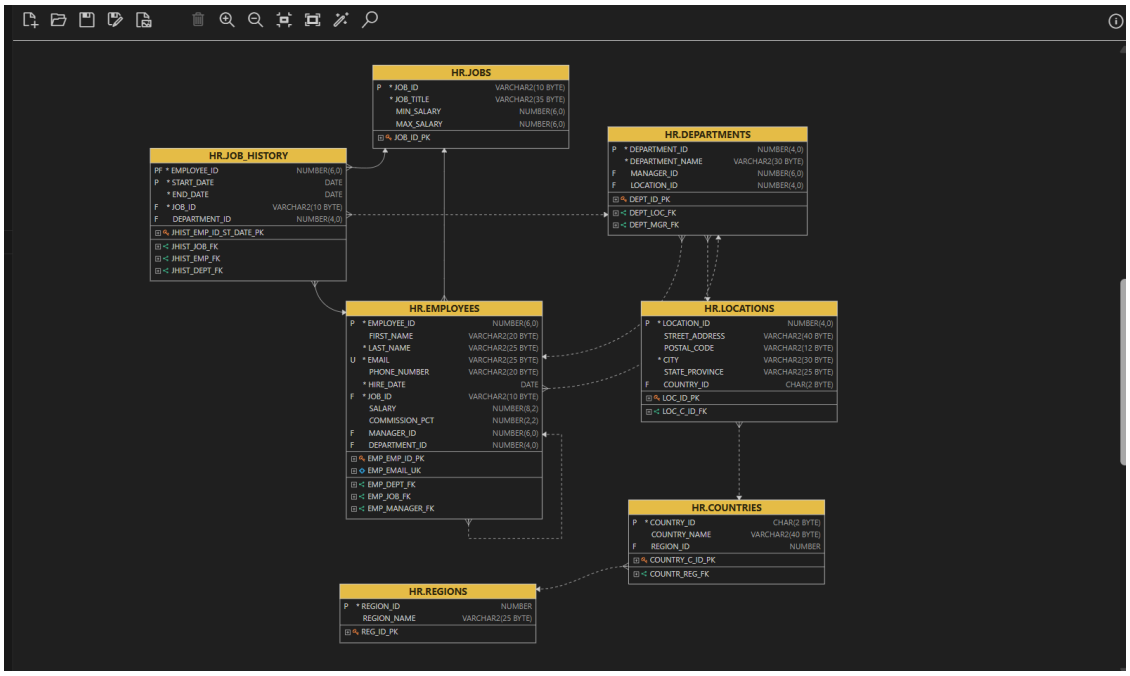


Using Object Type Folders

Supported object type folders include Tables, Views, and Duality Views. You can select type folders from your schema or from the **Other Users** folder (for objects in other schemas). Select one or more type folders from one or multiple schemas and drag them to the diagram, then press the **Shift** key once when the cursor is over the diagram. All objects contained in the selected type folders will be added to the diagram.

For example, if you select the **Tables** folder, drag it to the diagram window, press the **Shift** key, and then release the mouse button to drop it. All the tables will be added to the diagram.



Using a Selection of Supported Objects

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You can select individual supported objects (table, view, duality view) from one or multiple schemas (provided your connection user has access). Drag the selected objects to the diagram and press the **Shift** key once when the cursor is in the diagram area.

Adding Supported Objects with Dependencies

The schema objects can reference other objects as part of their definition. To add objects along with their dependencies, select the objects you wish to add. While dragging to the diagram, hold the **Alt key**. This will add the objects referencing (one level up) and the objects referencing (one level down) by your selection.

> **Note**
>
> To process and include dependencies, ensure you hold the **Alt** key during the drag-and-drop action.

For example, if you want to view the dependencies for the `COUNTRIES` table, hold the **Alt** key while dragging the `COUNTRIES` table. Then press the **Shift** key before dropping the table onto the diagram window. The objects referenced by the selected object, and the objects referencing the selected object will also be added to the diagram.

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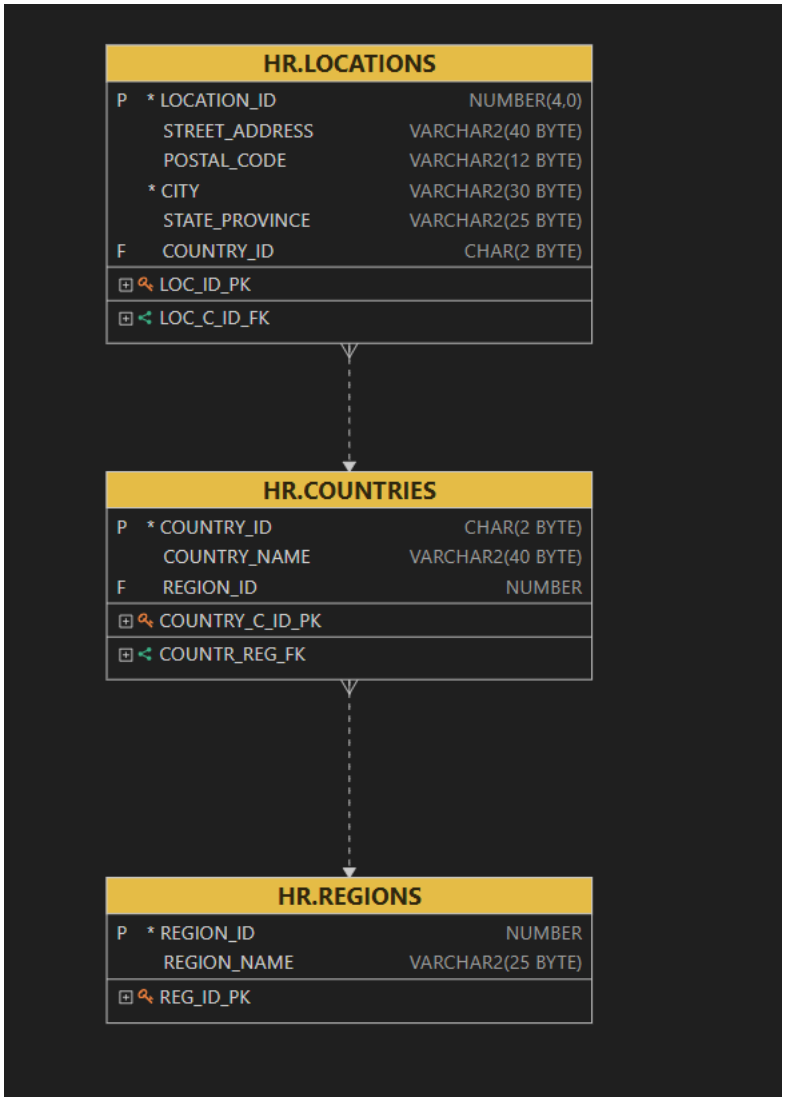

The SQL Developer extension for VS Code allows you to perform the following operations using the buttons available on the toolbar:

- **New Diagram (Shift+Alt+N)** opens a new diagram window.
- **Open Diagram (Shift+Alt+O)** opens a previously saved diagram in the diagram window.
- **Save Diagram (Shift+Alt+S)** saves the diagram. The diagram will be saved as `.dgm` file
- **Save Diagram As...** saves the current diagram under a new name or in a different location.
- **Export Diagram (Shift+Alt+E)** exports the diagram to the SVG format.
- **Remove Object** removes one or more selected objects from the diagram. To select multiple objects, press the **CTRL** key and select the objects.
- **Zoom In** enlarges the diagram to make the details easier to see.
- **Zoom Out** displays less detail, and potentially more objects, in the currently selected diagram.
- **Fit to Screen** makes all relevant objects fit in the window for the currently selected diagram.

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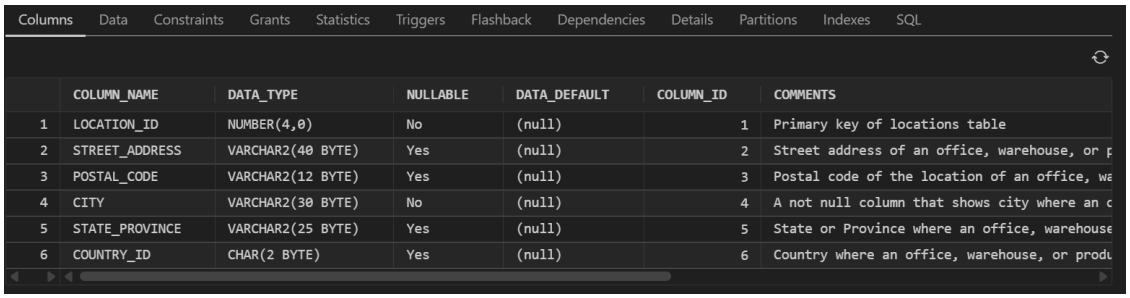
- **Actual Size** displays the diagram at its original size, without any zooming in or out.
- **Auto Layout** rearranges the objects in the diagram to a layout that may be more meaningful and attractive.
- **Search** displays the **Search for Objects** dialog box to search for an object type. Type * to list all the objects of an object type (tables, views, or duality views) in the schema. You can also search by typing a few characters.
- displays the number of tables, views, duality views, and foreign keys in the diagram.

3.10.1 Database Object Details

When you double-click an object in the diagram, you are navigated to the object details window.

For example, double-clicking the `LOCATIONS` table in the diagram will open several tabs with detailed information about the `LOCATIONS` table.

You can select the respective tabs to view details about the object. Selecting the **SQL** tab generates the DDL for the `LOCATIONS` table object.



	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	LOCATION_ID	NUMBER(4,0)	No	(null)	1	Primary key of locations table
2	STREET_ADDRESS	VARCHAR2(40 BYTE)	Yes	(null)	2	Street address of an office, warehouse, or p
3	POSTAL_CODE	VARCHAR2(12 BYTE)	Yes	(null)	3	Postal code of the location of an office, wa
4	CITY	VARCHAR2(30 BYTE)	No	(null)	4	A not null column that shows city where an c
5	STATE_PROVINCE	VARCHAR2(25 BYTE)	Yes	(null)	5	State or Province where an office, warehouse
6	COUNTRY_ID	CHAR(2 BYTE)	Yes	(null)	6	Country where an office, warehouse, or produ

Similarly, you can also view detailed information about views and duality views.

3.10.2 Understanding Diagram Elements

On the diagram window, the objects are represented distinctly, making them easy to identify.

The tables and views are represented with rectangles. The table rectangles have table names displayed on a yellow background, while the view and duality view rectangles have rounded corners and their names are shown on a green background.

The columns are prefixed with `P`, `F`, and `U` to indicate primary, foreign, and unique key constraints, respectively. An asterisk (*) denotes a mandatory column. Optional foreign keys are represented by dashed lines, while mandatory foreign keys are represented by solid lines.

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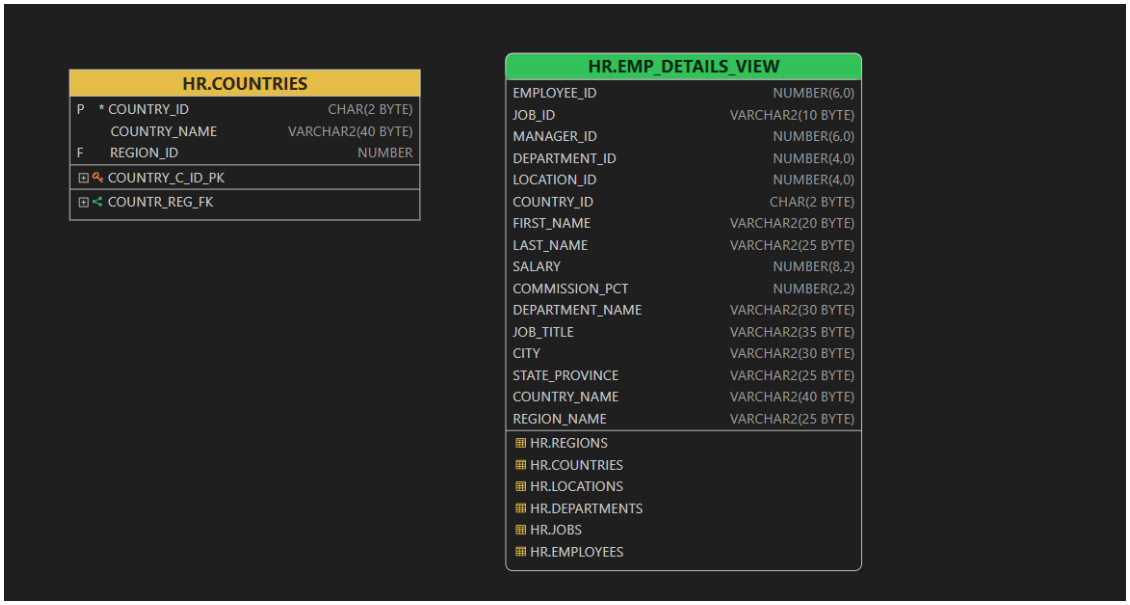

When you click the expand button next to a constraint, it shows the columns that are tied to that specific constraint, helping you understand the structure and relationships in the database schema.

Navigating Through Foreign Key Names

In the diagram window, hold the **Alt** key and click the foreign key name. The diagram will automatically center and highlight the referenced object. This action is available only if the referenced table or view is present on the current diagram.
In the Exported SVG (when viewed in a web browser), clicking the foreign key name will also center and display the referenced object, provided it exists in the diagram.

3.10.3 Searching Objects on the Diagram

The SQL Developer extension for VS Code provides the functionality to search for an object on the schema object diagram.

1. From the toolbar available on the diagram window, click the **Search** icon.

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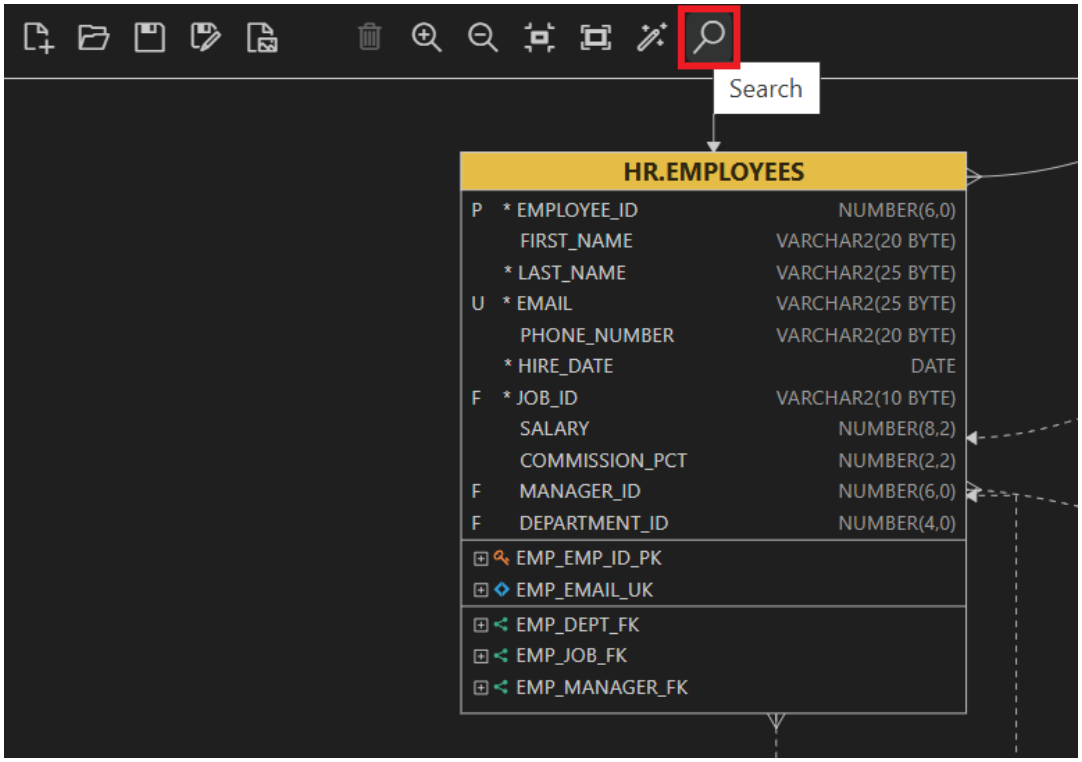

The **Search for Object** dialog box is displayed.

2. In the search box, type the name of the object (table name, view name, or duality view name) you want to search for.

> **Note**
>
> Type * to list all the objects of an object type (tables, views, or duality views) in the schema. You can also search by typing a few characters.

3. Click **Search**.

   The search result are displayed in the grid below. Clicking on an object in the output grid highlights the corresponding object in the diagram.

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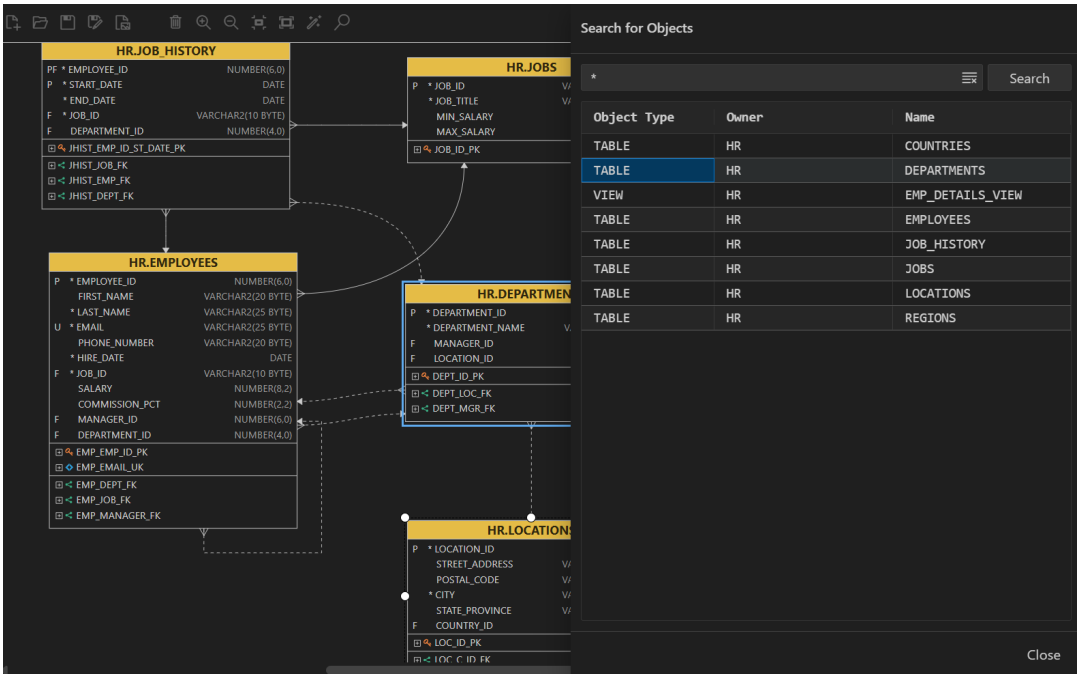

3.11 Running Functions and Procedures

You can open and run PL/SQL subprograms (functions and procedures).

- To open a subprogram, click the name in the Connections panel to open, or right-click and select **Open**.
- To compile a subprogram, open it in the SQL Worksheet, and then select the **Compile** icon in the top right corner.

  To debug a subprogram, open it in the SQL Worksheet, and then select the **Compile for Debug** icon.

  If there are any issues during compilation, these are shown under the Script Output tab in the lower pane.
- To run a subprogram, open it in the SQL Worksheet and then select the **Run** icon. You can then view the PL/SQL code and edit if needed, and then click **Run**. The results are displayed in the Script Output pane below.

The Run, Compile and Compile for Debug icons are also available when opening PL/SQL files with any of the following extensions, KLR, PKB, PKH, PKS, PLB and PLS, from your local device.

In the following figure, the REFCURSOR_FUNCTION is run and the output is displayed below.

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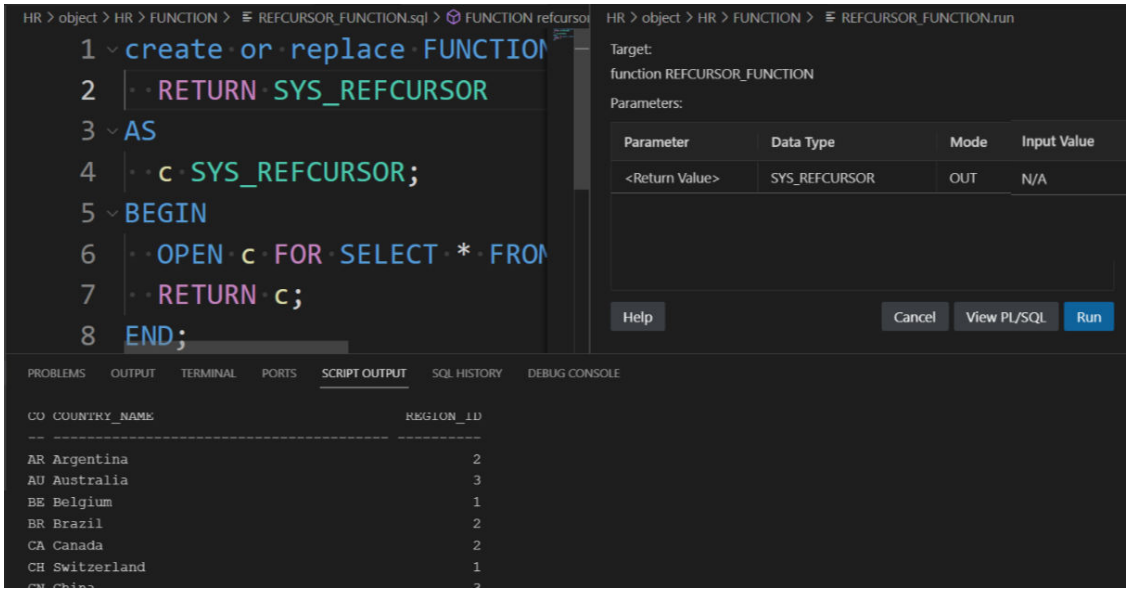

3.12 Debugging PL/SQL Objects

You can debug PL/SQL functions and procedures using the PL/SQL Debugger in SQL Developer for VS Code..

This section covers the following topics:

- Required Debugging Database Privileges
- Understanding Database Debug Sessions
- Debugging a PL/SQL Object

3.12.1 Required Debugging Database Privileges

To debug a PL/SQL object, you must have the following privilege:

```
DEBUG CONNECT SESSION
```

You also need `DEBUG` and `EXECUTE` privileges on `SYS.DBMS_DEBUG_JDWP`, which is the package used to start or stop the debug session.

If the PL/SQL object to debug belongs to you, no further privileges are required.

If the PL/SQL object does not belong to you, then you must be granted `DEBUG` and `EXECUTE` privileges on the PL/SQL object.

3.12.2 Understanding Database Debug Sessions

For a database session, the network connection is initiated by the client (SQL Developer for VS Code) and addressed by the server (Oracle Database). For a database debug session, SQL Developer for VS Code acts as the debug server and listens for connections from the debug client (Oracle Database).

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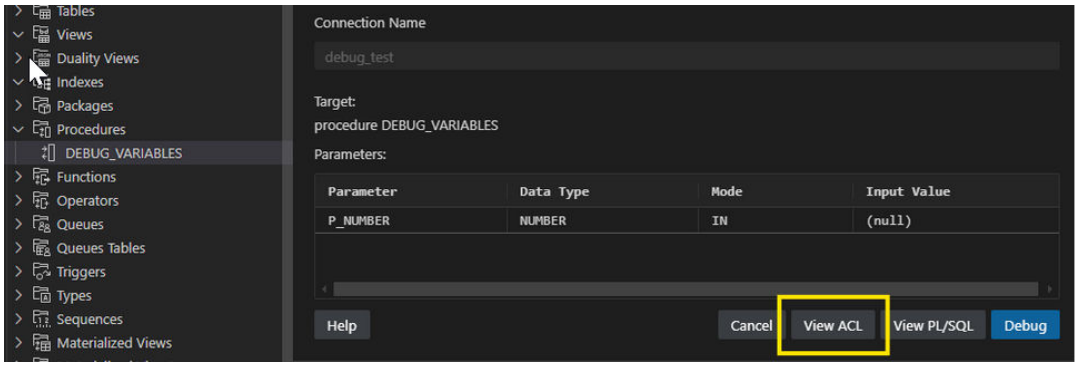
The database must initiate the connection to SQL Developer for VS Code. For this to happen:

- The database must be configured to allow network access from the database to SQL Developer for VS Code. This done by creating an entry in the network access control list (ACL).
- The network ACL must specify the IP address (or host name) and port that SQL Developer for VS Code is using to listen for debug connections.
- There must be a network route from the database to SQL Developer for VS Code. For example, the firewall on the machine where SQL Developer for VS Code is running may need to be configured to allow the incoming connection from Oracle Database. Or if the Oracle Database is running within a Docker container, the container's network configuration may need to be adjusted to create a route between the Docker container and the machine where SQL Developer for VS Code is running.

SQL Developer for VS Code can help you add an entry to the ACL required for the database to connect to SQL Developer for VS Code.

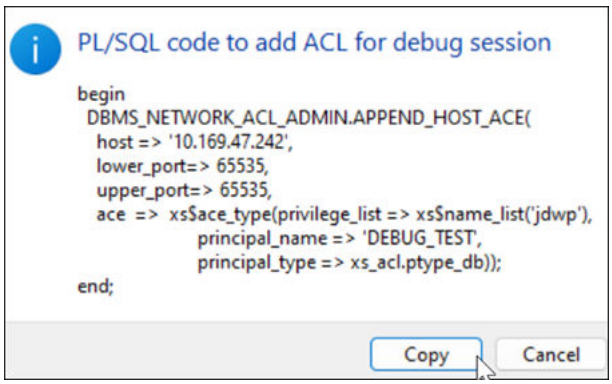
1. From the Connections panel, open the PL/SQL object to debug and click the **Debug** icon in the toolbar at the top of the worksheet editor panel.
2. In the editor pane that appears, click **View ACL**.



3. You are prompted to provide the IP address that the database should use to connect to SQL Developer for VS Code. Choose one of the suggestions or enter your own.

   The PL/SQL code block that is required to add an entry in ACL is shown.

> **Note**
>
> The PL/SQL block must be executed by a user with DBA privileges.



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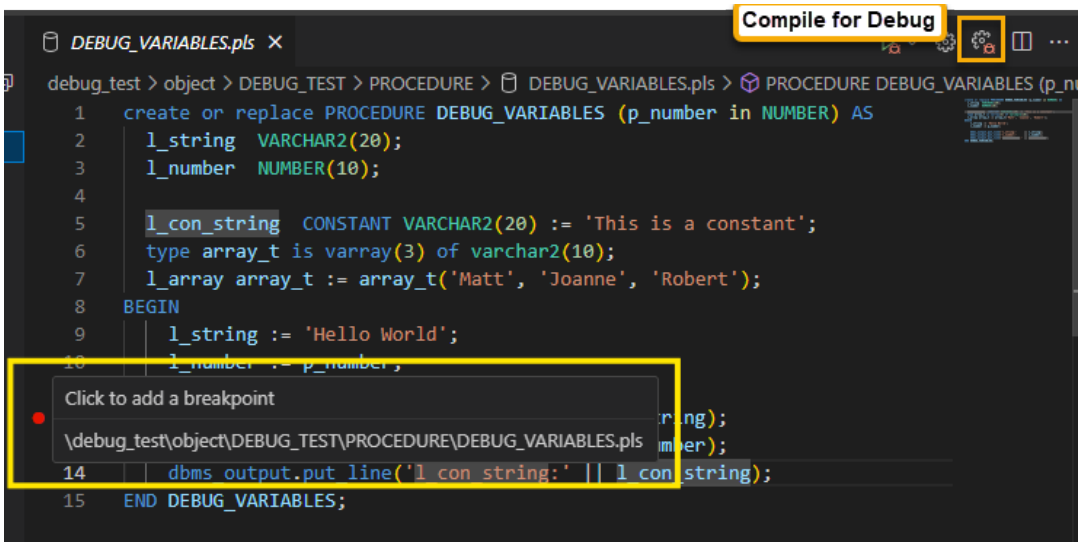
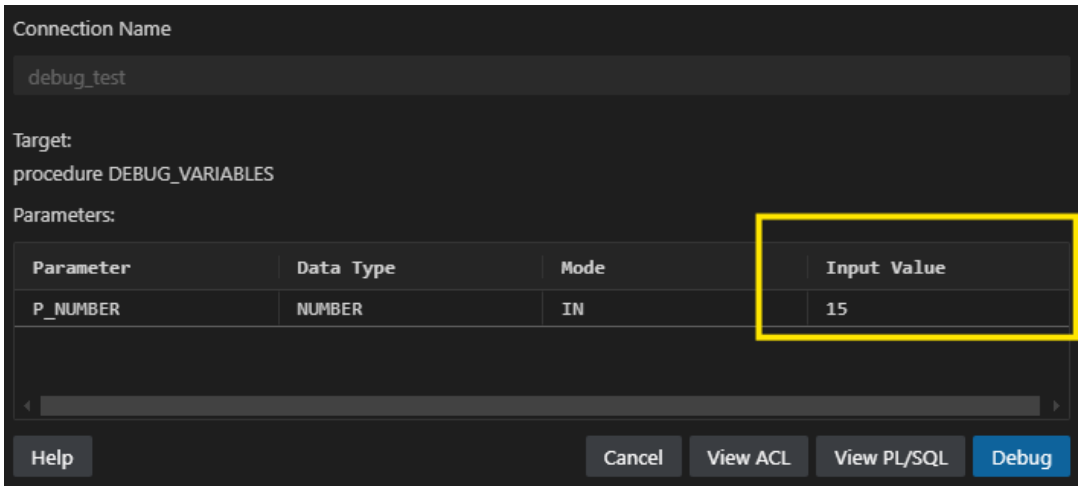
3.12.3 Debugging a PL/SQL Object

This section covers the steps to debug a PL/SQL object.

1. Before debugging a PL/SQL object, it must be compiled with debug symbols that have been generated. Open the PL/SQL object in the PL/SQL editor and click the **Compile for Debug** icon in the PL/SQL Editor toolbar.
2. After a PL/SQL object has been compiled for debugging, you can set breakpoints on any executable line in the PL/SQL object. To configure a breakpoint, in the gutter to the left of the line number, hover till you see a red dot and then click to set the breakpoint.



3. To debug the PL/SQL object, expand the Execute icon and then click **Debug**. In the editor pane that appears, provide values for the arguments required (if any) to invoke the PL/SQL object.



4. Click **Debug**.

   If prompted, confirm the IP address that the database should use to connect to the SQL Developer extension.

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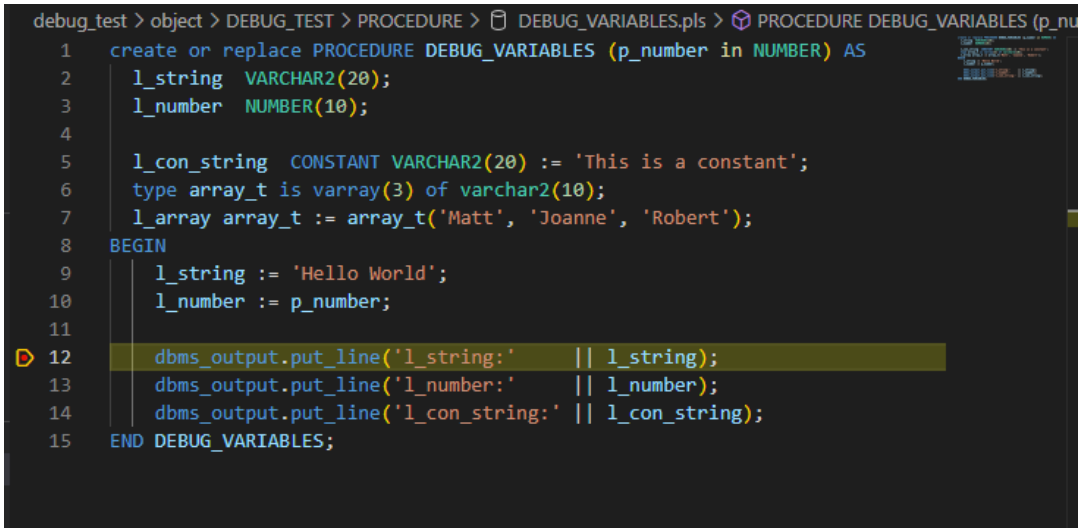
The execution of the PL/SQL object pauses on the first breakpoint encountered.



Using the icons in the Debug toolbar, you can:

- **Step Over**: To move to the next statement.
- **Step Into**: To open and debug the current statement.
- **Continue**: To resume execution.
- **Stop**: To stop debugging,

3.13 Post-Execution Debugging of MLE JavaScript Modules

This feature enables developers to seamlessly troubleshoot and refine their JavaScript code running inside Oracle Database as MLE modules. With this, you gain deep insights into your code's behavior after execution by leveraging familiar debugging workflows.

Post execution debugging allows you to:

- Set breakpoints within your deployed MLE JavaScript modules.
- Initiate and control debugging sessions to inspect code flow.
- Step through code (continue, step in, step out) to analyze logic and execution paths.
- Examine variable values and call stacks to diagnose and resolve issues efficiently.
- Stop or restart debugging sessions for iterative development.

Debugging MLE Module

1. Prepare the MLE function and the invoking script.
   - Ensure your JavaScript function is defined in your MLE module.
   - You need a debug runner file that invokes the function. You can open a new debug runner file containing a sample DBMS_MLE snippet to help invoke the MLE module code for debugging or open an existing debug runner file from your local file system. See About the Debug Runner File.

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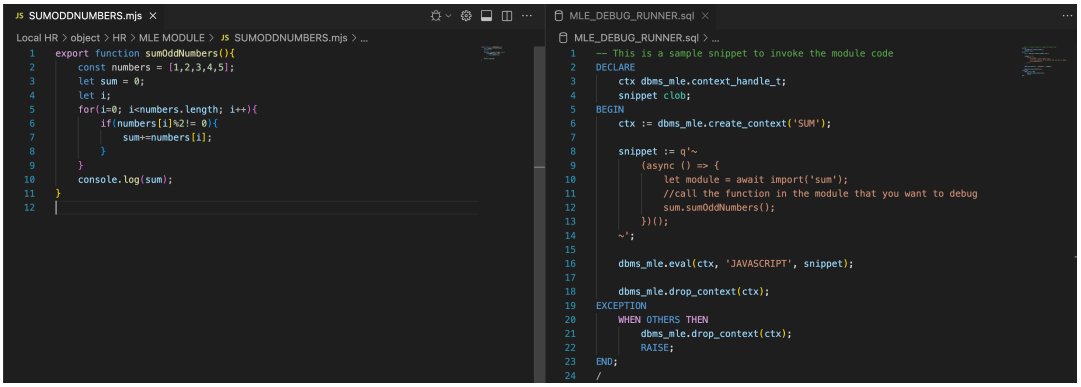
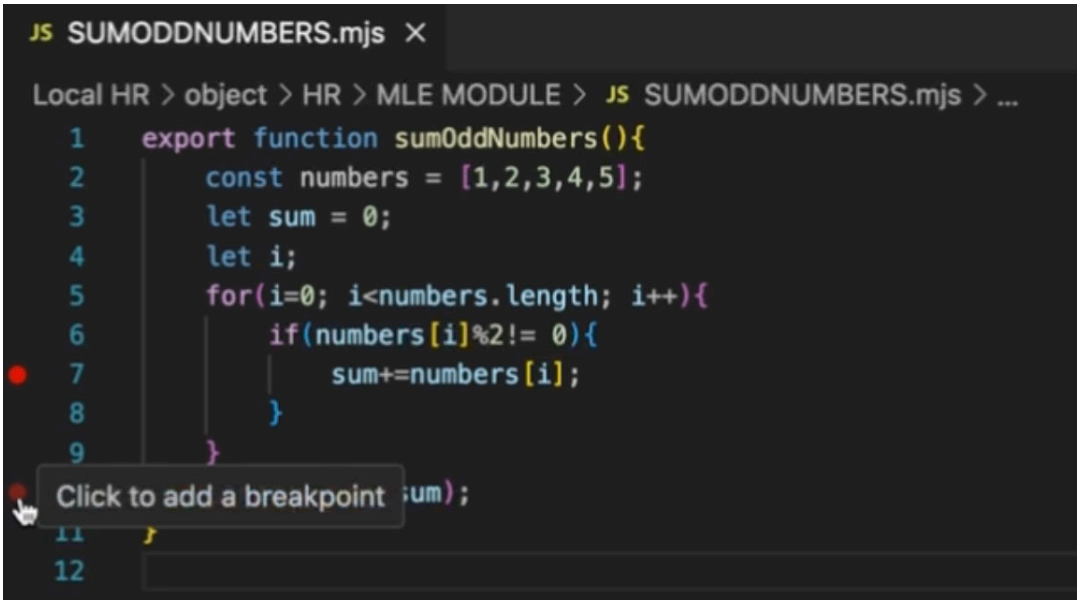


2. Before debugging, set breakpoints in your JavaScript code by clicking in the gutter next to the line numbers.



> **Note**
>
> You must set at least one breakpoint before starting a debug session. Once a debug session is active, you cannot add new breakpoints. To add more, terminate the current debug session, set new breakpoints, then start a new session.

3. With your debug runner file and breakpoints ready, start the debug session using (**Start post-execution debugging**) icon in the toolbar.
Only one debugging session can run at a time.

   The execution will pause at each defined breakpoint. You can inspect variables, view the call stack, and use debug control buttons (continue, step over, step in/out). When all breakpoints are hit or the execution flow ends, the debug session is terminated.

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About the Debug Runner File

The debug runner file, typically a SQL worksheet, contains the logic that initiates debugging of the JavaScript code. This file can be associated with any database connection. Make sure all required database objects (such as the MLE module, environment, procedures, and functions) exist in the current connection. If these objects are missing, execution will fail and an error message will be displayed in the **Script Output** panel (in addition to a warning), because the invoking code is executed in the connection before debugging starts.

Filtering and Breakpoint Management

In the **Breakpoints** panel, all breakpoints from all open modules are listed. Each breakpoint is associated with a specific database connection, which is shown in the file path or context next to the breakpoint.You can filter the list to show breakpoints only for a selected connection, making it easier to focus on relevant modules during your debug session.

If a breakpoint is linked to a different connection than the one currently being used in your debug session, it is automatically disabled. Disabled breakpoints appear grayed out in the list. When you hover over a disabled breakpoint, a tooltip appears explaining the reason for the breakpoint's status.

3.14 Using Real Time SQL Monitor

The Real Time SQL Monitor feature provides a dashboard interface for real-time monitoring of SQL query execution. Users can view long-running and parallel SQL statements, and relevant performance metrics in a single, centralized location.

SQL monitoring is automatically started when:

- a SQL statement runs parallel.
- a SQL statement has consumed at least 5 seconds of CPU or I/O time in a single execution.
- the /*+ MONITOR +*/ hint is used in the execution of a SQL statement.

Prerequisites

Real Time SQL Monitor requires:

- the Oracle Database Tuning Pack.
- the Database Administrator role. You do not require any special database privileges to use this feature to monitor SQL for schema objects that you own. However, to view all monitored SQL in the database, you need the `SELECT_CATALOG_ROLE`.

The Real Time SQL Monitor view consists of a table where each row displays information about a query that is currently executing or has completed executing for a selected database connection.

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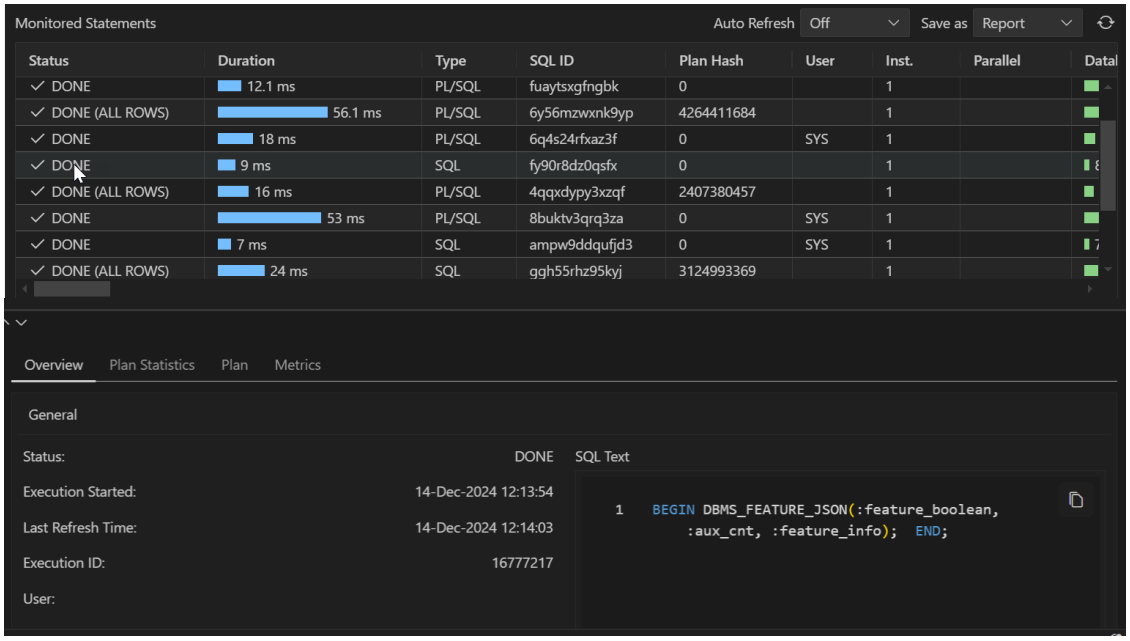

The Monitored Statement table includes the following information:

- **Status**: Current state of the SQL statement execution. For example, a SQL statement that has finished execution shows a `DONE` status.
- **Duration**: The amount of time taken to execute the statement or the amount of time spent waiting before which the statement is executed.
- **Type**: Type of statement (SQL or PL/SQL).
- **SQL ID**: SQL identifier of the monitored statement.
- **User**: Name of user that executes the statement.
- **Parallel**: This column shows how many instances and parallel execution servers are allocated. This is shown in the form of `number of instances | number of parallel servers`.
- **Database Time**: Place the cursor over the database time to see a popup displaying the breakdown of time and wait events.
- **Start Time:** Time when the execution of the SQL statement starts.
- **End Time**: Time when the execution of the SQL statement ends.
- **SQL Text**: SQL statement being monitored.

Accessing Real Time SQL Monitor

Real Time SQL Monitor is available in the context menu (right-click) for a connection. Selecting Real Time SQL Monitor opens a table showing all the statements that are currently being monitored or have been monitored in the past.

Click anywhere on a row to access the following details for the corresponding statement:

- **Overview**: General information about the monitored statement, Time & wait statistics and IO statistics.
- **Plan Statistics**: Explain Plan of the execution of the SQL statement in the form of a table. Each row is a different operation involved in the execution of the SQL statement and it

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shows hierarchy dependency by adding a space at the beginning of the text in the Operation column.

- **Plan**: Explain plan of the execution of the SQL Statement in a tree structure.
- **Metrics**: This entry tracks key performance metrics collected for the execution, including the CPU, Memory used, I/O Throughput and I/O Requests time.

Monitored Statements Table Toolbar

- **Auto Refresh**: Select the time interval (shown in seconds) to refresh the Monitored Statements table.
- **Save as**: Save the detailed information for a selected statement from the Montiored Statements table as a report.
- **Refresh icon**: Update the Monitored Statements table.

3.15 Using Folders to Organize Connections

You can group and store connections using folders in the Connections panel. For example, one folder for connections on your local system, another for connections on the test system, and another for connections on the production system.

You can perform the following actions to manage connection folders:

- **Create a new connection folder**

  In the Connections panel, click the **Add Folder** icon, enter the folder name and press **Enter**.

- **Create a new connection sub-folder**

  In the Connections panel, go to the required folder and then click the **Add Folder** icon, enter the folder name and press **Enter**.

- **Add a connection to a folder**

  Use one of the following methods to add a connection to a folder:

  – For the specific connection, right-click and select **Add to Folder** to select the folder.

  – For the specific connection, drag and drop the connection into the folder.

- **Move a connection out of a folder**

  To move a connection out of a folder, drag and drop it out of the folder into the Connections panel.

- **Rename a connection folder**

  To rename a folder, right-click the folder and select **Rename** to specify the folder name.

- **Delete a connection folder**

  To delete a folder, right-click the folder and select **Delete**.

  An empty folder is immediately deleted. But for a folder with contents or subfolders, a notification to confirm appears before the folder is deleted.

3.16 Using Filters

Filters enable you to control the objects that appear in the Connections navigator display. The filter can be applied on the following:

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- Schema (Connection Tree Node or User Tree Node)
- Object Type (Table,View, Procedure and so on)

To access the Filter pane, right-click a connection node or an object type node (such as Tables) in the Connections navigator and select **Apply Filter**. Use the pane to limit the number of objects of that type that are displayed, according to one or more filter criteria that you specify. For each criterion, specify the following:

- Name (list always includes NAME, other criteria depend on the object type)
- Operator (for example, LIKE)
- Value for comparison (for example EM%)
- Case-sensitive option for character data comparison

For example, to display only tables with names that start with `EM`, specify `NAME`, `LIKE`, and `EM%` (with the percent sign as a wildcard character).

The following attributes are applicable for object type filters.

Ignore Schema Filter (object type node filters): If this option is checked, any filter criterion specified at the connection level is ignored. Only the object type node filter criteria are applied.

Include Synonym (object type node filters): If this option is checked, synonyms for objects of this object type are included.

To add another filter criterion, click the Add (+) icon. To delete a criterion, select it and click the Delete (X) icon. To move a criterion up or down in the list, select it and use the arrow icons.

To apply the filter criteria to the Connections navigator display, click **OK**.

To remove the effects of applying a filter, right-click the object type node in the Connections navigator display and select **Clear Filter**.

3.17 Using Preferences

To modify SQL Developer preferences, from the **File** menu, select **Preferences** and then **Settings**. Under **User**, expand **Extensions** and select **Oracle SQL Developer Extension for VS Code**.

The preferences available are:

Database Connections

- **Tns Configuration Path**: Enter the location of the tnsnames.ora file.
- **Startup Script Path**: Specify the location for the startup script to run when an Oracle database connection is opened. The default location is the default path for scripts.
- **Connections Tree**

  Folders Fetch Size: Specifies the maximum number of rows to be fetched at a time into the data grid display for nodes such as Tables, Views, Materialized Views,

Database NLS

The NLS settings specify values for globalization support parameters, such as the language, territory, sort preference, and date format. These parameter values are used for SQL Developer session operations, such as for statements executed using the SQL Worksheet and for the National Language Support Parameters report. Specifying values in this preferences

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pane does not apply those values to the underlying database itself. To change the database settings, you must change the appropriate initialization parameters and restart the database.

Note that SQL Developer does not use default values from the current system for globalization support parameters; instead, SQL Developer, when initially installed, by default uses parameter values that include the following:

```
NLS_LANG,"ENGLISH"
NLS_TERR,"AMERICA"
NLS_CHAR,"AL32UTF8"
NLS_SORT,"BINARY"
NLS_CAL,"GREGORIAN"
NLS_DATE_LANG,"ENGLISH"
NLS_DATE_FORM,"DD-MM-RR"
```

SQL History

- **History Limit**: Maximum number of statements that can be stored in SQL History.

Telemetry

- **Allow automated usage reporting to Oracle**: Determines whether you consent to usage reporting. If you consent, automated reports can occasionally be sent to Oracle describing the product features in use. No personally identifiable information will be sent and the report will not affect performance.

SQL Worksheet

- **Explain Plan**: Determines the level of details displayed in the Explain Plan.

3.18 Using Drag and Drop for Code Generation

The Drag-and-Drop Code Generation feature simplifies how various programming languages interact with Oracle databases. It enables you to drag and drop database objects into a Java file, which automatically generates the corresponding Java code, including all the logic required to execute queries on the Oracle database.

Additionally, you can drag an entire database connection from the `Connections` panel into your Java file to quickly generate the connection string or complete JDBC API code, streamlining your development process.

3.18.1 Generate Connection Code

When you drag a connection from the **Connections** panel and drop it into a Java file, the feature will automatically generate the necessary code for you. It supports all connection types including Basic, Custom JDBC, Cloud Wallet, and TNS ensuring flexibility for a wide range of Oracle database scenarios.

Perform the following steps to generate the connection code:

1. Open a SQL worksheet and set the language to Java, or open an existing Java file.
2. In the **Connections** panel, locate the desired database connection.
3. Drag the selected connection and drop it into your open Java file.

   A dialog box will appear prompting you to choose a code generation option.
4. Select any of the following code generation options:

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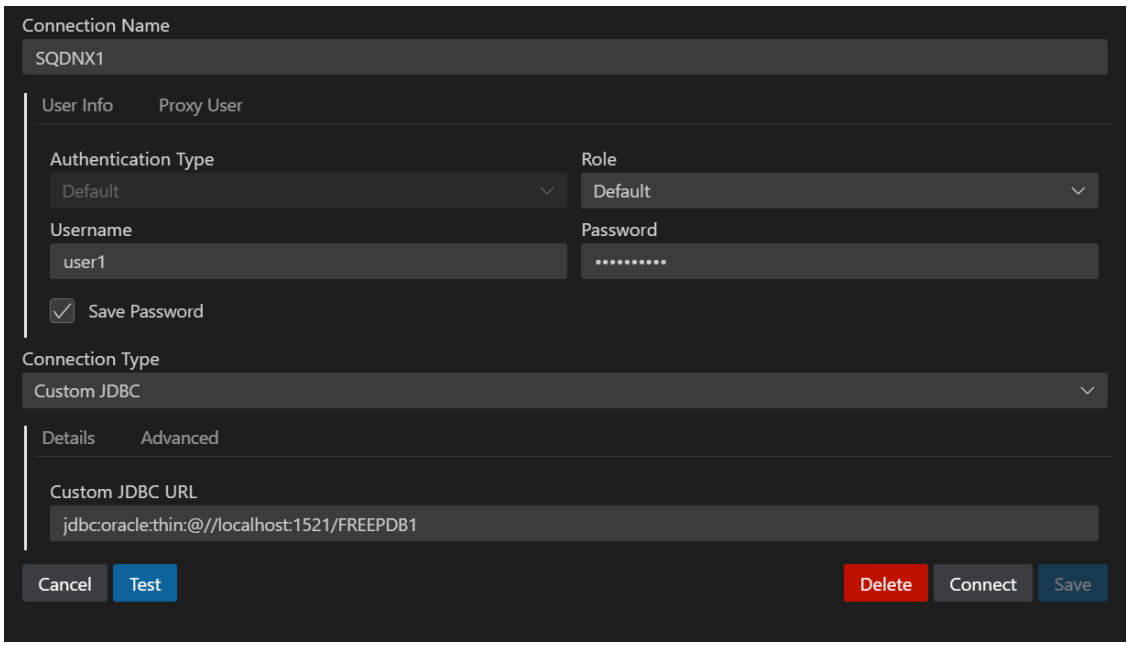
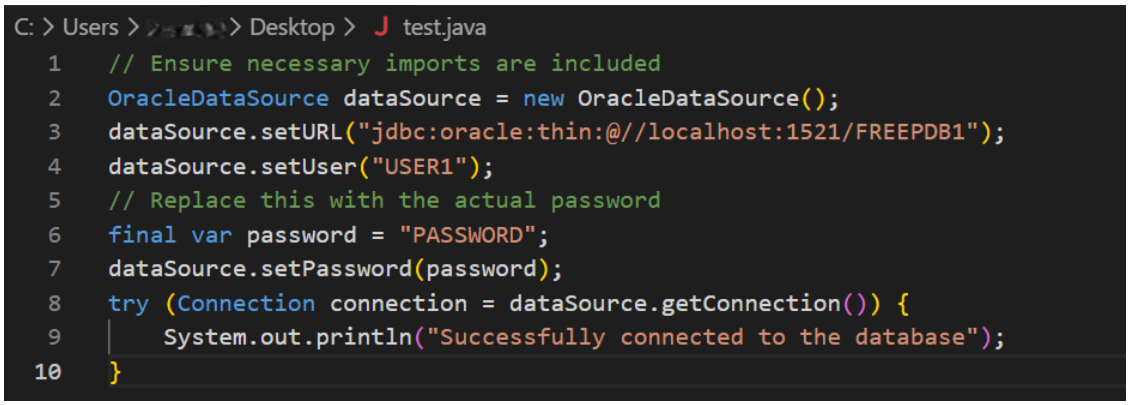
- **Connection String**: Generates the connection string for the dropped connection(s).
- **JDBC**: Generates Java code that enables the user to connect to the dropped connection(s).

The generated code (connection string or full JDBC API code) will automatically appear in your Java file.
You can drag and drop multiple connections to automatically generate code for them at once.

The following examples illustrate a specific connection type configuration and the corresponding auto-generated JDBC code and the connection string after using the drag-and-drop feature. Here is a custom JDBC connection type without any advanced properties specified.



For a selected connection type, such as Custom JDBC, if the code generation option is set to **JDBC**, the corresponding JDBC connection code is automatically generated. This code includes all the relevant details specified in the connection configuration, streamlining the process of connecting to the database.



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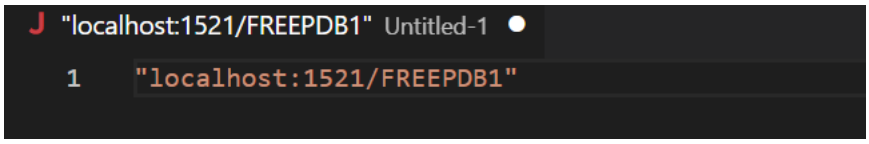
If the code generation option selected is **Connection String**, only the connection string is displayed.



3.18.2 Generate Java Code for Database Objects

When you drag a database object, such as a table, view, duality view, materialized views, and columns from the **Connections** panel and drop it into a Java file, the feature will automatically generate the corresponding Java code. This includes all necessary logic required to execute queries on the Oracle database, streamlining the integration of database operations within your Java application.

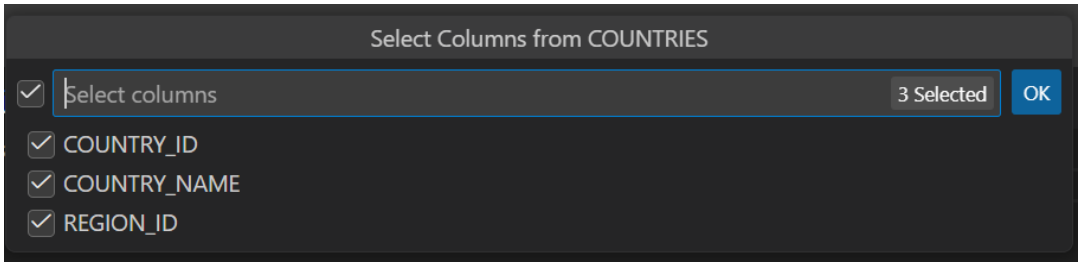
Perform the following steps to generate Java code for database objects:

1. Open a SQL worksheet and set the language to Java, or open an existing Java file.
2. In the **Connections** panel, locate the desired database object.
3. Drag the selected database object and drop it into your open Java file.

   You can select and drag multiple database objects at once to generate comprehensive code for all selected items simultaneously.
4. Select the code generation option as `JDBC`.
5. Select the type of statement to be generated.

   The following options are available:

   - **Object name**: Generates the name of the object.
   - **Insert**:Generates Java code for inserting records into the object.
   - **Delete**: Generates Java code for deleting records from the object.
   - **Update**: Generates Java code for updating records in the object.
   - **Select**: Generates Java code for retrieving records from the object.
   - **Drop**: Generates Java code for removing (dropping) the database object.
   - **Join**: Generate Java code for queries that retrieve data by combining rows from two or more database objects based on related columns. This option is available only when you select multiple database objects.
6. Select columns from the selected object to be included in the generated SQL or Java code for operations, such as, `SELECT`, `INSERT`, `UPDATE`, `DELETE`, or `JOIN`, and then click **OK**.



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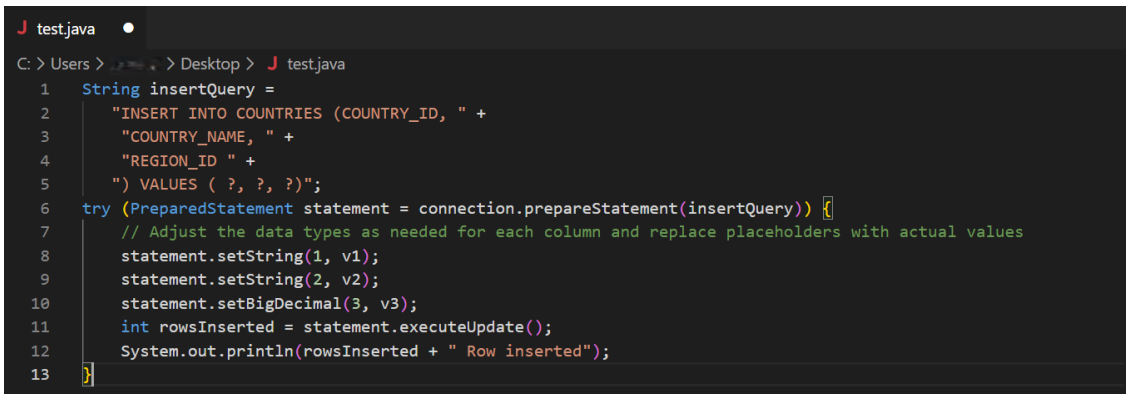
The Java code for the selected database object is generated.

Example 3-1 Generating Java code for inserting data into a table

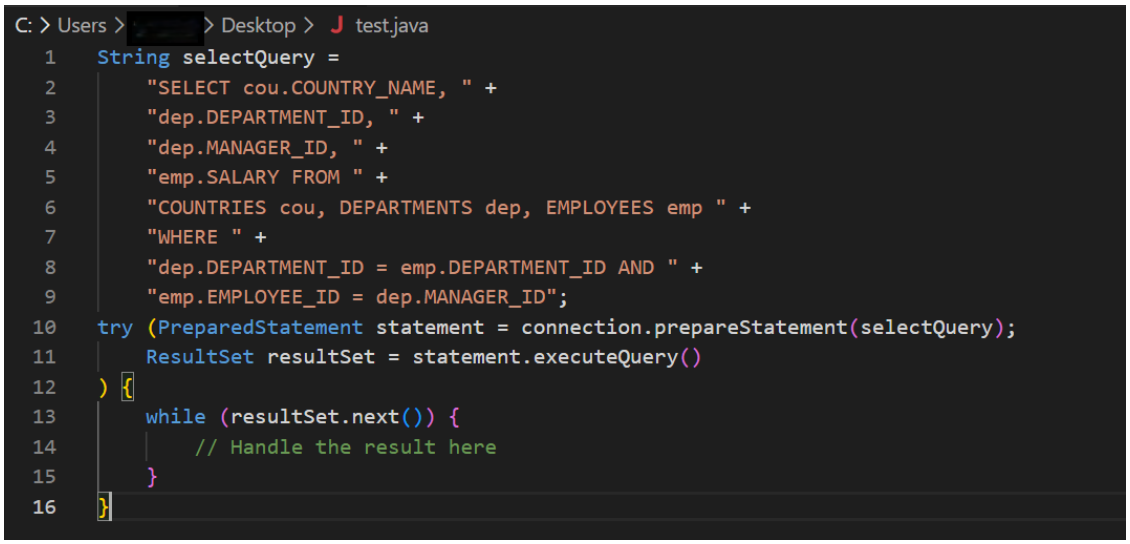
When you drag and drop the `COUNTRIES` table while selecting all the columns and choose the `INSERT` statement option, the following code is generated:



This Java code snippet demonstrates that data is inserted into a database table named `COUNTRIES` using a `PreparedStatement` for safe and efficient database operations. This code inserts values into the `COUNTRY_ID`, `COUNTRY_NAME`, and `REGION_ID` columns. The question marks (?) are placeholders for the values that will be supplied later. The actual values for the placeholders are set using the `.setString()` and `.setBigDecimal()` methods.

Example 3-2 Generating Java code for retriving data spanning multiple related tables

When you drag and drop the `COUNTRIES`, `DEPARTMENTS`, and `EMPLOYEES` tables, select a few columns from each, and choose the `JOIN` statement option, the following code is generated:



Example 3-3 Generating Java code for multiple database objects simultaneously

When you drag and drop the `COUNTRIES` and `DEPARTMENTS` tables, select a few columns from each, and choose the `DELETE` statement option, delete code for each individual table is

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automatically generated. This code deletes records from multiple database tables (`COUNTRIES` and `DEPARTMENTS`) using parameterized SQL delete queries with JDBC's `PreparedStatement`.

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4

Using the Oracle SQLcl MCP Server

The Oracle SQLcl Model Context Protocol (MCP) Server transforms how you interact with the Oracle Database by enabling seamless communication with Artificial Intelligence (AI) applications.

It enables you to perform operations, create reports, and run queries on Oracle Database using natural language through AI-powered interactions. Discover the capabilities of the Oracle SQLcl MCP Server, and learn how to use it with popular MCP clients.

> ⚠ **Caution**
>
> When you grant a large language model (LLM) access to your database, it introduces significant security risks. Because LLMs use the data you input to generate responses, you might inadvertently expose unintended tables or sensitive details.
>
> To mitigate these risks, implement the following safeguards:
>
> - **Assign minimum permissions:** Configure the database user account used by the LLM with the absolute minimum permissions required for its tasks. This approach limits what the LLM can access.
> - **Avoid production database access:** Do not grant LLMs direct access to production databases. Instead, you should use a sanitized, read-only replica or a dedicated data subset.
> - **Audit LLM activity:** Regularly audit the queries executed by the LLM. This helps you detect anomalies or the attempts to access restricted data. To support your auditing efforts, the SQLcl MCP Server provides the following built-in monitoring capabilities:
>   - **Session tracking:** It populates `V$SESSION.MODULE` with the MCP client in use, and `V$SESSION.ACTION` with the LLM's name.
>   - **Activity logging:** It creates a table named `DBTOOLS$MCP_LOG` that records every interaction and SQL execution.
>   - **Query identification:** All LLM-generated queries through the SQLcl MCP Server's tools include the following comment for easy identification in the logs: `/* LLM in use ... */`.
>
> To learn more about monitoring, see Monitoring the SQLcl MCP Server.

Topics:

- About the SQLcl MCP Server
- About the SQLcl MCP Server Tools
- How the SQLcl MCP Server Works
- Preparing Your Environment
- Starting and Managing the SQLcl MCP Server

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- Example Use Cases and Prompts
- Monitoring the SQLcl MCP Server

4.1 About the SQLcl MCP Server

The Model Context Protocol (MCP) is an open standard that defines a consistent way for applications to provide contextual information to AI models.

MCP standardizes the connection between AI systems and external tools or data sources, such as databases and APIs. To learn more about MCP, see Model Context Protocol.

The SQLcl MCP Server extends Oracle SQLcl to support MCP-based communication. It enables AI applications to interact with Oracle databases using the standardized MCP interface, giving those applications a structured way to discover and use your databases.

By design, the server provides AI applications access to database operations through a defined set of tools. For seamless integration, the server establishes and manages database connections using your preconfigured named or saved SQLcl connections. This allows AI applications to easily and securely access your existing Oracle environments through MCP.

After establishing a connection, an AI client can use natural language to perform the full range of database operations. This includes executing SQL queries, invoking PL/SQL procedures, and running SQLcl-specific commands.

4.2 About the SQLcl MCP Server Tools

The SQLcl MCP Server exposes a set of tools that enhance the way AI applications interact with Oracle databases. By abstracting the SQLcl commands used for various database operations, these tools empower AI models to autonomously manage databases. This allows you to focus on strategic objectives instead of manual command-line interactions.

Additionally, the tools unlock sophisticated workflows through natural language interfaces, enabling AI systems to execute database demonstrations, manage large-scale data migrations, run complex analytical queries, and automate administrative tasks. Ultimately, the SQLcl MCP Server eliminates the need for direct manual input and allows AI applications to independently perform complex database operations that would've required significant technical expertise and effort.

Currently, the SQLcl MCP Server offers the following tools:

- **list-connections:** Discovers and lists all saved Oracle Database connections on your machine.
- **connect:** Establishes a connection to one of your specified named connections.
- **disconnect:** Terminates the current, active Oracle Database connection.
- **run-sql:** Executes standard SQL queries and PL/SQL code blocks against the connected database.
- **run-sqlcl:** Executes SQLcl-specific commands and extensions.

4.3 How the SQLcl MCP Server Works

The SQLcl MCP Server translates conversational AI requests into powerful, context-aware database operations, ensuring the full capabilities, performance, and integrity of the Oracle environments remain intact.

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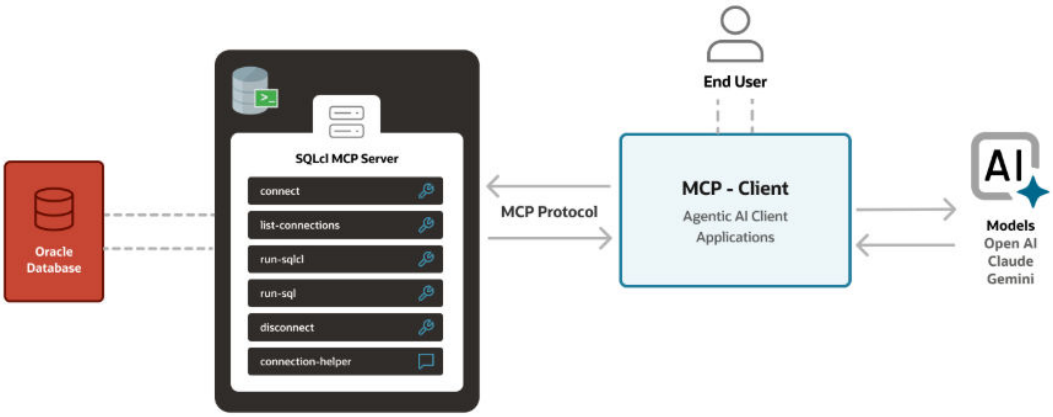
The server workflow is as follows:

1. **User request:** You make a request to an MCP client (for example, Claude Desktop) in natural language, such as "Retrieve all employees hired last month from the HR schema."
2. **MCP client processing:** The MCP client performs the following tasks:
   a. Interprets your request, identifies the intent, and determines the appropriate SQLcl MCP Server tool to invoke.
   b. Calls an AI model, which converts the interpreted request into a corresponding SQL statement.
   c. Issues a structured tool call to the SQLcl MCP Server using the MCP protocol, triggering the execution of the generated SQL statement.
3. **Database operation:** The SQLcl MCP Server receives the request and executes the corresponding SQL query or command through the SQLcl interface against the Oracle Database, using a named or saved connection.
4. **Response formatting and delivery:** SQLcl processes the query and returns the results to the SQLcl MCP Server, which formats the output according to MCP standards and sends it back to the MCP client. Finally, the client presents the information to you in clear, natural language.

The following diagram illustrates the SQLcl MCP Server workflow:



4.4 Preparing Your Environment

Learn about setting up your environment to use the SQLcl MCP Server.

- Installing the Required Software
- Configuring Database Connections

4.4.1 Installing the Required Software

To use the SQLcl MCP Server, you must install the following software on your system:

- Visual Studio Code, version 1.101.0 or higher
- Oracle SQL Developer Extension for VSCode, version 25.2.0 or higher
- GitHub Copilot Chat Extension for VSCode, version 0.28.5 or higher

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4.4.2 Configuring Database Connections

The SQLcl MCP Server relies on the preconfigured connections saved in the connection store, which is in your `~/.dbtools` directory. You can manage these connections using the `connect` and `connmgr` commands.

> **Note**
>
> - For a connection to be accessible to an MCP client, you must save its password. When you create a new connection, use the `-savepwd` flag to store credentials securely.
> - You can also define and manage connections using the Oracle SQL Developer Extension for VS Code.

For information on creating an MCP-compatible connection, see Connecting to Your Database.

4.5 Starting and Managing the SQLcl MCP Server

The SQLcl MCP Server is automatically launched and managed when you start SQL Developer.

After the MCP server is initialized, you can access the tools it provides through the GitHub Copilot Chat Extension in Agent mode. You can interact with the agent using either predefined commands or natural language input. Predefined commands help you perform specific actions quickly, while natural language input allows you to type your requests in plain English, which the agent will understand and respond to accordingly.

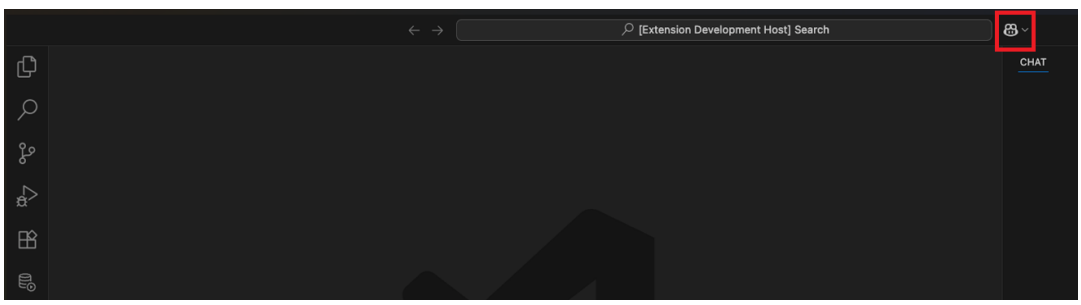
- Accessing SQLcl MCP Server
- Accessing SQLcl MCP Server Tools
- Using the Agent Mode

4.5.1 Accessing SQLcl MCP Server

The SQLcl MCP Server is automatically initialized when you start SQL Developer.

Perform the following steps to access the SQLcl MCP Server:

1. Click the Copilot Chat button.



The **Edit with Copilot** chat window appears in the right pane.

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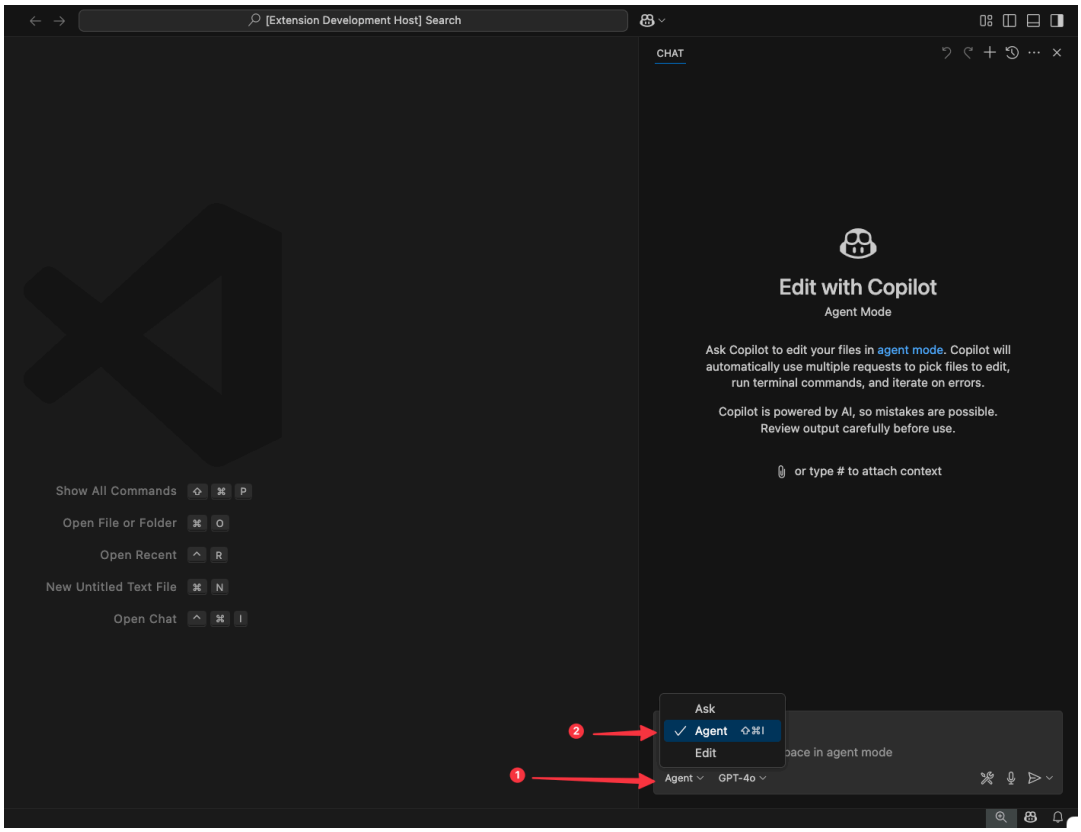
2. From the chat mode drop-down list, select **Agent**.

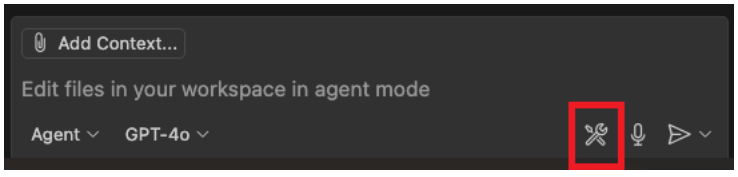


4.5.2 Accessing SQLcl MCP Server Tools

The SQLcl MCP Server provides essential tools for performing basic SQL operations, including connecting to an Oracle database, executing SQL and PL/SQL statements, and retrieving and analyzing results.

Perform the following steps to access the MCP Server tools:

1. Access the SQLcl MCP Server. See Accessing SQLcl MCP Server.
2. In the Copilot chat view, click the tools button to list the available tools.



3. Select or deselect the tools you want to use.

   For more information about SQLcl MCP Server tools, see About the SQLcl MCP Server Tools.

   You can also search for any tool by typing its name in the search box.

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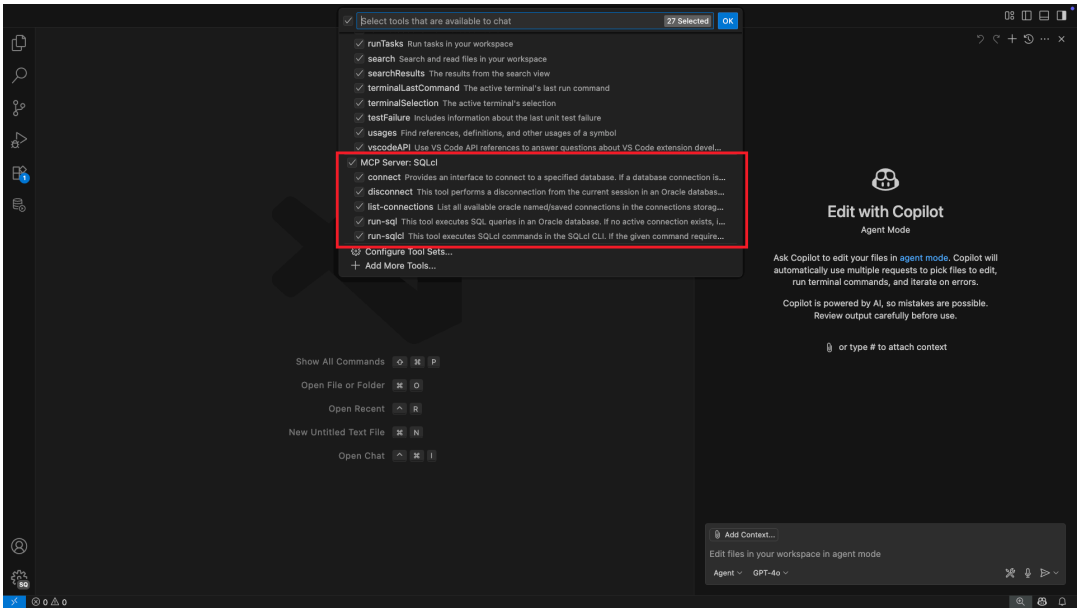
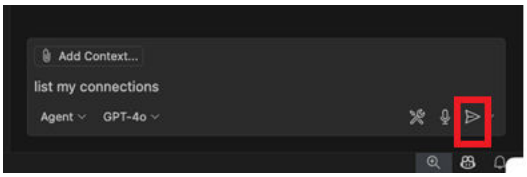


4.5.3 Using the Agent Mode

You can interact with the agent in VS Code by using predefined commands or natural language input. Follow these steps to get started:

1. Open the Chat view. See Accessing SQLcl MCP Server.
2. Enter a predefined command or type a natural language query and click the **Send** button.



Copilot requests confirmation to continue using the tool.

3. Use the **Continue** button's dropdown options to automatically confirm the selected tool for the current session, the workspace, or all future sessions.

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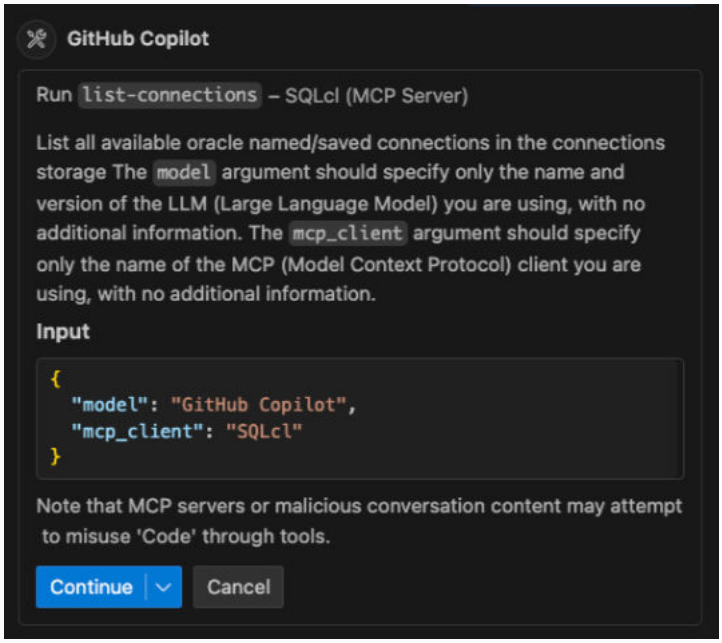
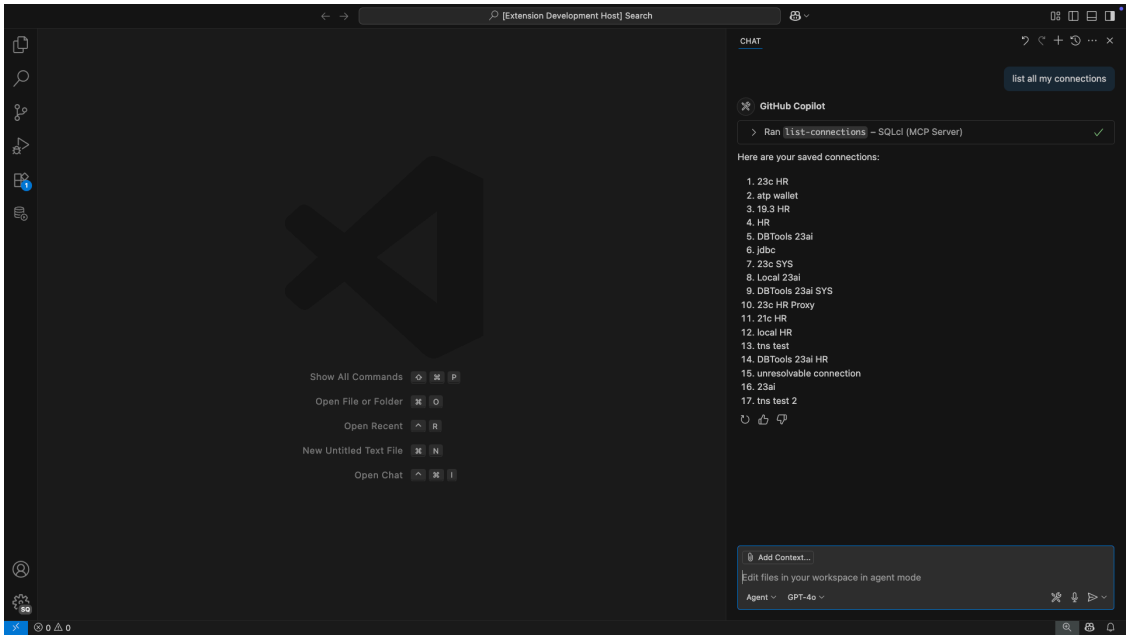
> **Note**
>
> You can click the chevron next to the tool name to view its details and input parameters.



To learn more about Agent mode, see Use Agent Mode in VS Code.

After the task is executed, a green check mark is shown next to the tool, along with the generated result:



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4.6 Example Use Cases and Prompts

Here are a few examples of natural language requests you can use to perform various database operations through an MCP client connected to the SQLcl MCP Server.

Table 4-1 Natural Language Prompts for Oracle Database Operations

Operation	Description	Complexity	Example Prompt to Client
Connecting to databases	Establish database connections with automatic authentication and connection management.	Basic	*Connect to the HR database*
Running simple queries	Run basic SQL queries with readable results.	Basic	*Show me recent orders*, or *Which customers are in California?*
Browsing a database schema	Interactively explore table structures, columns, and relationships.	Basic	*Which tables contain customer information?*, or *Show me the structure of the Orders table*
Checking connection status	Monitor the database session health and connectivity with real-time status reporting.	Basic	*Which database am I currently connected to?*
Performing complex analytical queries	Execute sophisticated analytical operations with hierarchical breakdowns and advanced SQL features.	Advanced	*Show me a hierarchical breakdown of sales by region and product category with year-over-year growth percentages*
Performing multi-environment operations	Coordinate work across development, testing, and production database environments.	Advanced	*Compare the customer counts between our development and production databases*
Managing transactions	Manage complex transactions with capabilities for review and rollback.	Advanced	*Update all customer records in the Northeast region but let me review the changes before committing*
Monitoring performance	Analyze query performance and receive optimization suggestions.	Advanced	*Show me which queries are running slow today and provide optimization tips*

4.7 Monitoring the SQLcl MCP Server

Learn how you can monitor the health, status, and activity of your SQLcl MCP Server.

- Checking Server Status
- Tracking Activity with Logs
- Assessing Server Health Through Performance

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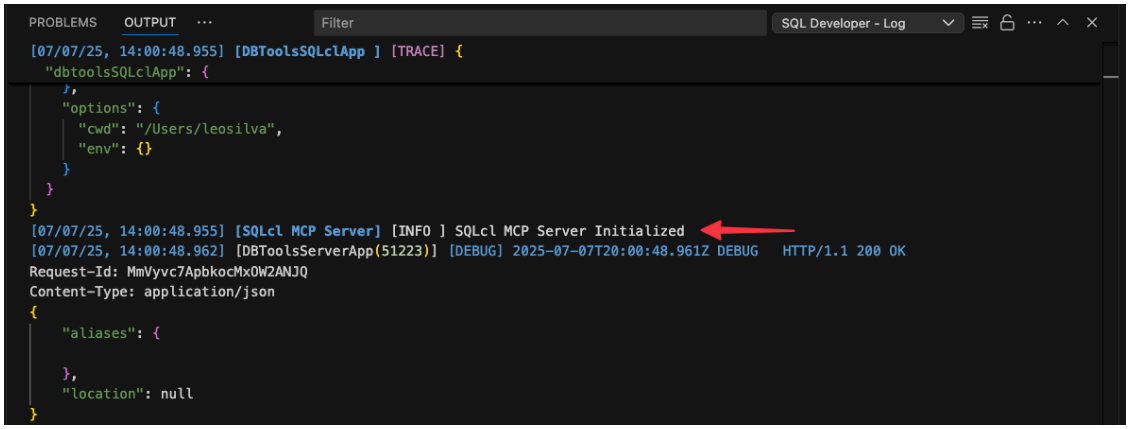
4.7.1 Checking Server Status

When the SQLcl MCP Server starts successfully, it displays a confirmation message with the startup timestamp, indicating it's ready to accept connections from the MCP client.

You can verify this message on the **SQL Developer - Log** output panel to confirm server readiness. Here's an example server message on startup:



4.7.2 Tracking Activity with Logs

The SQLcl MCP Server provides two main ways to track and monitor database operations: a historical audit trail and real-time session monitoring.

Reviewing the Audit Trail

The server automatically records the execution history of every request in the `DBTOOLS$MCP_LOG` table. This table provides a complete audit trail of all database operations the server performs. It captures request details, execution times, and results to help you with analysis and troubleshooting.

To maintain optimal database performance, you should prune the `DBTOOLS$MCP_LOG` table regularly. Consider setting a record limit (for example, 1000 records) and creating an automated cleanup procedure to prevent excessive log accumulation.

To view the audit trail, run a query similar to the following example:

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```
select id,
       mcp_client,
       model,
       end_point_type,
       end_point_name,
       log_message
from dbtools$mcp_log;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS QUERY RESULT SCRIPT OUTPUT SQL HISTORY TASK MONITOR

All rows fetched: 28 in 0.027 seconds

	ID	MCP_CLIENT	MODEL	END_POINT_TYPE	END_POINT_NAME	LOG_MESSAGE
1	24	VS Code	Claude 3.5 Sonnet	tool	connect	Connect to HR
2	25	VS Code	Claude 3.5 Sonnet	tool	run-sql	SELECT /* LLM in use is Claude 3.5 Sonnet */ emplc
3	26	VS Code	Claude 3.5 Sonnet	tool	run-sql	SELECT /* LLM in use is Claude 3.5 Sonnet */ COUNT
4	27	VS Code	Claude 3.5 Sonnet	tool	run-sql	DELETE /* LLM in use is Claude 3.5 Sonnet */ FROM
5	28	VS Code	Claude 3.5 Sonnet	tool	run-sql	COMMIT /* LLM in use is Claude 3.5 Sonnet */;
6	29	VS Code	Claude 3.5 Sonnet	tool	run-sql	COMMIT;
7	30	VS Code	Claude 3.5 Sonnet	tool	run-sql	ROLLBACK;
8	31	VS Code	Claude 3.5 Sonnet	tool	run-sql	COMMIT;
9	21	GitHub Copilot	GitHub Copilot	tool	connect	Connect to HR
10	22	SQLcl	GitHub Copilot	tool	list-connections	Connect to HR
11	23	SQLcl	GitHub Copilot	tool	disconnect	Disconnect from HR
12	36	SQLcl	GitHub Copilot	tool	connect	Connect to HR
13	37	SQLcl	GitHub Copilot	tool	run-sql	SELECT /* LLM in use is GitHub Copilot */ COUNT(*)
14	38	SQLcl	GitHub Copilot	tool	run-sql	INSERT /* LLM in use is GitHub Copilot */ INTO dri
15	39	SQLcl	GitHub Copilot	tool	run-sql	DESCRIBE /* LLM in use is GitHub Copilot */ driver
16	40	SQLcl	GitHub Copilot	tool	run-sql	SELECT /* LLM in use is GitHub Copilot */ column_r
17	41	SQLcl	GitHub Copilot	tool	run-sql	INSERT /* LLM in use is GitHub Copilot */ INTO dri

Monitoring Live Sessions

If you have database administrator (DBA) privileges, you can monitor active MCP connections and operations in real-time. The server integrates with Oracle's `V$SESSION` view, allowing you to use standard Oracle monitoring tools to track current sessions, resource usage, and performance. To see the MCP client information, you can observe the `MODULE` and `ACTION` values in `V$SESSION`.

To view active sessions, query the `V$SESSION` view:

```
select * from V$SESSION;
```

4.7.3 Assessing Server Health Through Performance

You can gauge server health by observing its performance.

- **Normal Operation:** Under normal operation, you should experience consistent response times and smooth database operations.
- **Potential Issues:** If you are experiencing issues, you may notice delayed responses, connection errors, or incomplete results. If these occur, check your client's logs to begin troubleshooting.

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5

Tutorial: Creating Objects for a Small Database

Create objects for a simplified library database, which will include tables for books, patrons (people who have library cards), and transactions (checking a book out, returning a book, and so on).

The tables are deliberately oversimplified for this tutorial. They would not be adequate for any actual public or organizational library.

This tutorial assumes that you have a database connection to a database user that will own the tables and other objects that you create.

The major steps are:

- Create a Table (BOOKS)
- Create a Table (PATRONS)
- Create a Table (TRANSACTIONS)
- Create Two Sequences
- Insert Data into the Tables
- Create a View
- Create a PL/SQL Procedure
- Use the SQL Worksheet for Queries

5.1 Create a Table (BOOKS)

The BOOKS table contains a row for each book in the library. It includes columns of character and number types, a primary key, a unique constraint, and a check constraint.

1. Right-click the connection name, and select **Open SQL Worksheet**.
2. Enter the following statement:

```
CREATE TABLE books (
   book_id VARCHAR2(20),
   title VARCHAR2(50)
      CONSTRAINT title_not_null NOT NULL,
   author_last_name VARCHAR2(30)
      CONSTRAINT last_name_not_null NOT NULL,
   author_first_name VARCHAR2(30),
   rating NUMBER,
   CONSTRAINT books_pk PRIMARY KEY (book_id),
   CONSTRAINT rating_1_to_10 CHECK (rating IS NULL OR
      (rating >= 1 and rating <= 10)),
   CONSTRAINT author_title_unique UNIQUE (author_last_name, title));
```

3. Click the **Run Statement** icon.

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The following notification is displayed in the Script Output pane:

```
Table BOOKS created.
```

5.2 Create a Table (PATRONS)

The PATRONS table contains a row for each patron who can check books out of the library.

1. In the SQL Worksheet, enter the following statement:

```
CREATE TABLE patrons (
   patron_id NUMBER,
   last_name VARCHAR2(30)
      CONSTRAINT patron_last_not_null NOT NULL,
   first_name VARCHAR2(30),
   street_address VARCHAR2(50),
   city_state_zip VARCHAR2(50),
   CONSTRAINT patrons_pk PRIMARY KEY (patron_id));
```

2. Click the **Run Statement** icon.

   The following notification is displayed in the Script Output pane:

```
Table PATRONS created.
```

5.3 Create a Table (TRANSACTIONS)

The TRANSACTIONS table contains a row for each transaction involving a patron and a book (for example, someone checking a book out or returning a book). It includes two foreign key columns.

1. In the SQL Worksheet, enter the following statement:

```
CREATE TABLE transactions (
   transaction_id NUMBER,
   patron_id CONSTRAINT for_key_patron_id
      REFERENCES patrons(patron_id),
   book_id CONSTRAINT for_key_book_id
      REFERENCES books(book_id),
   transaction_date DATE
      CONSTRAINT tran_date_not_null NOT NULL,
   transaction_type NUMBER
      CONSTRAINT tran_type_not_null NOT NULL,
   CONSTRAINT transactions_pk PRIMARY KEY (transaction_id));
```

2. Click the **Run Statement** icon.

   The following notification is displayed in the Script Output pane:

```
Table TRANSACTIONS created.
```


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5.4 Create Two Sequences

Create two sequence objects, which will be used in INSERT statements to generate unique primary key values in the PATRONS and TRANSACTIONS tables.

1. In the SQL Worksheet, enter the following statements:

```
CREATE SEQUENCE patron_id_seq
START WITH 100
INCREMENT BY 1;


CREATE SEQUENCE transaction_id_seq
START WITH 100
INCREMENT BY 1;
```

5.5 Insert Data into the Tables

Add some sample data to the BOOKS, PATRONS, and TRANSACTIONS tables.

1. Copy and paste the following INSERT statements into the SQL Worksheet:

```
INSERT INTO books VALUES ('A1111', 'Moby Dick', 'Melville', 'Herman', 10);
INSERT INTO books VALUES ('A2222', 'Get Rich Really Fast', 'Scammer',
'Ima', 1);
INSERT INTO books VALUES ('A3333', 'Finding Inner Peace', 'Blissford',
'Serenity', null);
INSERT INTO books VALUES ('A4444', 'Great Mystery Stories', 'Whodunit',
'Rodney', 5);
INSERT INTO books VALUES ('A5555', 'Software Wizardry', 'Abugov', 'D.',
10);

INSERT INTO patrons VALUES  (patron_id_seq.nextval,
   'Smith', 'Jane', '123 Main Street', 'Mytown, MA 01234');
INSERT INTO patrons VALUES  (patron_id_seq.nextval,
   'Chen', 'William', '16 S. Maple Road', 'Mytown, MA 01234');
INSERT INTO patrons VALUES  (patron_id_seq.nextval,
   'Fernandez', 'Maria', '502 Harrison Blvd.', 'Sometown, NH 03078');
INSERT INTO patrons VALUES  (patron_id_seq.nextval,
   'Murphy', 'Sam', '57 Main Street', 'Mytown, MA 01234');

INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 100, 'A1111', SYSDATE, 1);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 100, 'A2222', SYSDATE, 2);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 101, 'A3333', SYSDATE, 3);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 101, 'A2222', SYSDATE, 1);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 102, 'A3333', SYSDATE, 1);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 103, 'A4444', SYSDATE, 2);
```


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```
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 100, 'A4444', SYSDATE, 1);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 102, 'A2222', SYSDATE, 2);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 102, 'A5555', SYSDATE, 1);
INSERT INTO transactions
  VALUES (transaction_id_seq.nextval, 101, 'A2222', SYSDATE, 1);
```

2. Click **Run Script**.

5.6 Create a View

Create a view that returns information about patrons and their transactions. This view queries the PATRONS and TRANSACTIONS tables, and returns rows that contain a patron's ID, last name, and first name, along with a transaction and the transaction type. The rows are ordered by patron ID, and by transaction type within patron IDs.

1. Right-click the **Views** node in the schema hierarchy on the left side, and select **Create (simple)**.
2. Enter the following information:
   - **View Name**: Enter **patrons_trans_view**.
   - In **SQL Query**, enter the following statement:

```
SELECT p.patron_id,
       p.last_name,
       p.first_name,
       t.transaction_type,
       t.transaction_date
 FROM patrons p, transactions t
 WHERE p.patron_id = t.patron_id
 ORDER BY p.patron_id, t.transaction_type
```

3. Click **Apply**.

5.7 Create a PL/SQL Procedure

Create a procedure that lists all books with a specified rating. You can then call this procedure with an input parameter (a number from 1 to 10), and the output will be all the titles of all books with that rating.

To create the procedure:

1. Enter the following procedure text:

```
CREATE OR REPLACE
PROCEDURE list_a_rating(in_rating IN NUMBER) AS
  matching_title VARCHAR2(50);
  TYPE my_cursor IS REF CURSOR;
  the_cursor my_cursor;
BEGIN
  OPEN the_cursor
    FOR 'SELECT title
           FROM books
```


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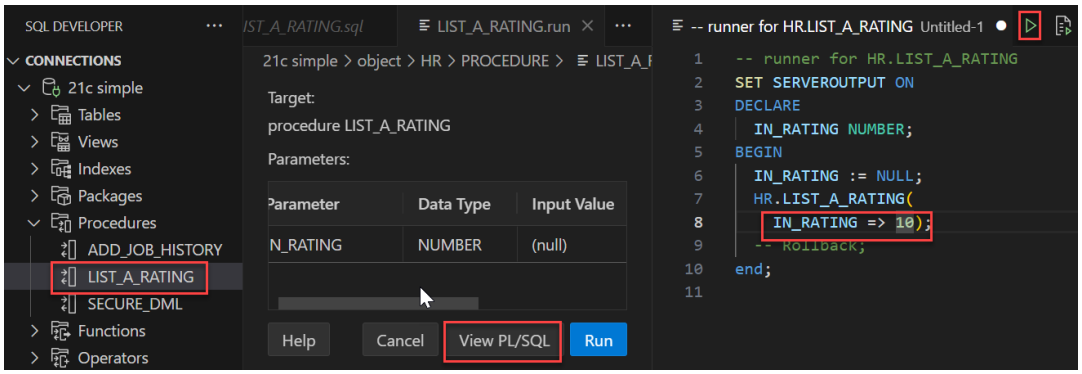
```
        WHERE rating = :in_rating'
    USING in_rating;
  DBMS_OUTPUT.PUT_LINE('All books with a rating of ' || in_rating || ':');
  LOOP
    FETCH the_cursor INTO matching_title;
    EXIT WHEN the_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE(matching_title);
  END LOOP;
  CLOSE the_cursor;
END list_a_rating;
```

2. Click **Run Script**.

   The following notificaton is displayed in the Script Output tab:

   ```
   Procedure LIST_A_RATING compiled
   ```

3. To run this procedure, right-click LIST_A_RATING in the Connections navigator and select **Run**. The parameter and it's properties are displayed.
4. Click **View PL/SQL**.
5. Change IN_RATING => IN_RATING to IN_RATING => **10**, and click **Run Statement**.



   The result is shown in the Script Output pane:

   ```
   All books with a rating of
   10:
   Moby
   Dick
   Software Wizardry
   ```

5.8 Use the SQL Worksheet for Queries

You can use the SQL Worksheet to test SQL statements using a database connection.

1. In the right pane, enter the following statement (the semicolon is optional for the SQL Worksheet):

   ```
   SELECT author_last_name, title FROM books;
   ```

   Notice the automatic highlighting of SQL keywords (SELECT and FROM in this example).

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2. Click the **Run Statement** icon in the SQL Worksheet toolbar. The results of the query are displayed in the Query Result tab under the area in which you entered the SQL statement.
3. Enter (or copy and paste) the following statement:

```
SELECT p.patron_id,
       p.last_name,
       p.first_name,
       t.transaction_type,
       t.transaction_date
  FROM patrons p, transactions t
 WHERE p.patron_id = t.patron_id
 ORDER BY p.patron_id, t.transaction_type;
```

4. Click the **Run Statement** icon in the SQL Worksheet toolbar, and view the results of the query.
5. Click the **Explain Plan** icon in the SQL Worksheet toolbar to see the execution plan (displayed on the Explain tab) that Oracle Database follows to execute the SQL statement. The information includes the optimizer strategy and the cost of executing the statement.

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6
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6.1 @emotion/react 11.14.0

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@babel/generator

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```
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== Dependency
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6.5 ag-grid-react 34.3.1

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6.6 babel-standalone 7.26.2

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6.8 dayjs 1.11.13

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