Oracle® SQLcl

User's Guide

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Preface

This guide provides usage information about Oracle SQLcl (SQL Developer Command Line), a Java-based command-line interface for Oracle AI Database.

Audience

This guide is intended for those using Oracle SQLcl.

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 26.3 for *Oracle SQLcl User's Guide*

The new features and enhancements in this release are:

- Support for AI Enrichment through the new ANNOTATION command for adding, managing, reporting, and generating metadata annotations for database objects.

  See AI Enrichment Using the Annotation Command

- Introduces the MODEL command for configuring OCI Generative AI chat and embedding models, ingesting local documents into Oracle vector tables, and deleting previously ingested document vectors.

  See Using the Model Command for Retrieval-Augmented Generation

- DIFF now supports DDL and DML filters to control which database objects and table data are exported and compared.

  See DIFF

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2

Using Oracle SQLcl

Oracle SQLcl (SQL Developer Command Line) is a Java-based command-line interface for Oracle Database. Using SQLcl, you can execute SQL and PL/SQL statements interactively or as as a batch file. SQLcl provides inline editing, statement completion, command recall, and also supports existing SQL*Plus scripts.

Oracle SQLcl is available for download from Oracle Technology Network.

> **Note**
>
> - To run SQLcl , you need to install Oracle Java 17 or 21. If the Java version is less than 11, then the SQLcl installation fails with the following error message: `Error: A JNI error has occurred, please check your installation and try again Exception in thread "main" java.lang.UnsupportedClassVersionError:.` Check the Java version using the`java -version` command.
> - On Windows, Java is searched for in the following directories:
>   - For SQLcl (sql.exe): `..\..\jdk\jre\bin;%JAVA_HOME%\bin;%PATH%;%ORACLE_HOME%\jdk\jre\bin`
>   - For SQLcl installed with Oracle Database: `%JAVA_HOME%\bin;%PATH%;..\jdk\jre\bin;%ORACLE_HOME%\jdk\jre\bin`
> - If the Java file is not found in those directories, Java is searched for in the registry, the minimum version (version more than or equal to) being 17.0.5.
> - JavaScript is not included with Oracle Java 14 and later versions. It is recommended to download and install GraalVM, and then install JavaScript on GraalVM by using the command `gu install js` (see Getting Started with GraalVM JavaScript).

This chapter contains the following topics:

- Starting and Leaving SQLcl
- Starting Up and Shutting Down a Database
- Entering and Executing Commands
- Manipulating SQL, SQLcl, and PL/SQL Commands
- Defining Parameters in SQLcl Scripts Using the ARGUMENT Command
- Formatting Query Results
- Configuring Thick Driver Support for SQLcl
- Connecting to a Database
- Loading a File
- Using the OCI Command for Oracle Cloud Infrastructure REST APIs

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2.1 Starting and Leaving SQLcl

> **Note**
>
> **Startup and Login Scripts**
>
> When you start SQLcl, it looks for a `startup.sql` script. This script is run only once during the program's runtime.
>
> For every connection, SQLcl looks for a `login.sql` file. This file is run for every connection created.
>
> The `Show Login` command displays the location of the `login.sql` file and verifies whether the file exists or not.

Logging In and Logging Out

Use the following commands to log in to and out of SQLcl.

```
SQL [[option] [logon | /NOLOG] [start]]
```

where *option* has the following syntax:

```
-H[ELP] | -V[ERSION] | [ [-C[OMPATIBILITY] x.y[.z]]] [-L[OGON]] [-NOLOGINTIME] [-
R[ESTRICT] {0|1|2|3|4}] [-S[ILENT]]
```

where *logon* has the following syntax:

```
{username[/password] [@connect_identifier] | /} [AS {SYSASM |SYSBACKUP |SYSDBA |
SYSDG |SYSOPER |SYSRAC |SYSKM}] [edition=value]
```

and where *start* has the following syntax:

```
@{url | file_name[.ext]} [arg ...]
```

```
{EXIT | QUIT} [SUCCESS | FAILURE | WARNING | n | variable | :BindVariable]
[COMMIT | ROLLBACK]
```

Commits or rolls back all pending changes, logs out of Oracle, terminates SQLcl and returns control to the operating system.

```
{QUIT | EXIT} [SUCCESS | FAILURE | WARNING | n | variable | :BindVariable]
[COMMIT | ROLLBACK]
```

Commits or rolls back all pending changes, logs out of Oracle, terminates SQLcl and returns control to the operating system.

Setting JVM Options

To set an Oracle Java Virtual Machine (JVM) option in SQLcl, use the following environment variable:

```
JAVA_TOOL_OPTIONS
```


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The following example shows in Windows, how to change the user interface language in SQLcl to Spanish (es):

```
c:\SQLDev\sqlcl\20.2\sqlcl\bin>SET JAVA_TOOL_OPTIONS=-Duser.language=es
c:\SQLDev\sqlcl\20.2\sqlcl\bin>sql hr/oracle
Picked up JAVA_TOOL_OPTIONS: -Duser.language=es
SQLcl: Versiя 20.2 Production en mar. ago. 25 15:37:58 2020
Copyright (c) 1982, 2020, Oracle. Todos los derechos reservados.
Last Successful login time: Mar Ago 25 2020 15:38:01 -04:00
Conectado a:
Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit Production

Se ha encontrado login.sql en el CWD. El acceso a la DB estß restringido para
login.sql.
Ajuste SQLPATH para incluir la ruta y activar la funcionalidad completa.
SQL>
```

The following example shows how to change the user interface language in SQLcl to French (fr), and also increase the maximum memory available to SQLcl (-Xmx800m):

```
c:\SQLDev\sqlcl\20.2\sqlcl\bin>SET JAVA_TOOL_OPTIONS=-Duser.language=fr -
Xmx800m
c:\SQLDev\sqlcl\20.2\sqlcl\bin>sql hr/oracle
Picked up JAVA_TOOL_OPTIONS: -Duser.language=fr -Xmx800m
SQLcl : version 20.2 Production sur mar. aoѵt 25 15:57:21 2020
Copyright (c) 1982, 2020, Oracle. Tous droits rΘservΘs....
```

2.1.1 About Restrict Levels in SQLcl

For enhanced security, Oracle SQLcl provides a restrict option that allows you to disable certain commands that interact with the operating system.

This option is useful for preventing potentially unsafe operations, such as running host commands or scripts from untrusted sources.

Explore the available restrict levels in SQLcl, commands restricted at each level, and best practices for applying these restrictions.

- The RESTRICT Option
- Commands Restricted by Level
- Best Practices for Applying Restrictions

2.1.1.1 The RESTRICT Option

SQLcl defines five restrict levels, ranging from most restrictive (4) to unrestricted (0). Each level permits or denies specific categories of commands.

For information on commands restricted at each level, see Commands Restricted by Level.

Syntax

```
SQL -R[ESTRICT] {0|1|2|3|4}
```

Options

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Restrict Level	Access	Description
4	Most restrictive	Blocks all commands from level 1 to 4. This includes host commands, scripting, and configuration changes. For the full list, see Restricted Commands at Level 4.
3	Highly restrictive	Disables running external script files in SQLcl. Blocks level 1 to 3 commands (such as `@@`, `save`, `edit`) while allowing level 4 commands.
2	Moderately restrictive	Prevents saving generated SQLcl content to external files. Blocks level 1 and level 2 commands (such as `save`, `edit`, and so on) while allowing level 4 and level 3 commands.
1	Minimally restrictive	Prevents execution of host (OS-level) commands. Blocks level 1 commands (such as `edit` and `host`) while allowing level 2 to 4 commands.
0	Unrestricted	Allows all commands, including host and script execution. This is the default restrict level.

2.1.1.2 Commands Restricted by Level

Review the commands SQLcl disables at each restrict level.

- Restricted Commands at Level 4
- Restricted Commands at Level 3
- Restricted Commands at Level 2
- Restricted Commands at Level 1

Restricted Commands at Level 4

- accept
- alias
- append
- archive
- attribute
- break
- bridge
- btitle
- cd
- change
- clear
- cloudstorage
- column

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- compute
- connmgr
- copy
- datapump
- del
- drivers
- exit
- find
- format
- history
- info
- input
- list
- load
- loadqueryfile
- migrateadvisor
- net
- oci
- oradebug
- oerr
- password
- pause
- ping
- pwd
- quit
- recover
- repeat
- rollback
- run
- script
- secret
- set _12.1_longident
- set _12.1_pdb
- set _prelim
- set arraysize
- set autocommit
- set autodblink
- set autoprint

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- set classicmode
- set clear
- set cloudconfig
- set closecursor
- set cmdsep
- set colsep
- set compatibility
- set concat
- set datapump
- set desc
- set document
- set editfile
- set editor
- set embedded
- set encoding
- set exitcommit
- set flagger
- set flush
- set heads
- set heat
- set hidden
- set highlighting
- set history
- set linenumbers
- set linesize
- set load
- set loadformat
- set loglevel
- set long
- set longc
- set longchunksize
- set maxdata
- set maxrows
- set maxspoolrowstruncate
- set net
- set newpage
- set noverwrite
- set null

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- set num
- set numf
- set parameterpolicy
- set pause
- set printtheme
- set property
- set secureliteral
- set securedcol
- set socksproxy
- set space
- set sqlco
- set sqlformat
- set sqlpluscompatibility
- set sqlprefix
- set sqlt
- set statementcache
- set statusbar
- set suffix
- set tab
- set termout
- set tnsadmin
- set trimout
- set trims
- set truncate
- set wallet
- set wrap
- set xquery
- set xmlformat
- set xmloptimizationcheck
- show array
- show autocommit
- show autoprint
- show autorecovery
- show btitle
- show buffer
- show colsep
- show commandline
- show con_name

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- show connection
- show encodings
- show encoding
- show endbuft
- show endbuftoken
- show flagger
- show heading
- show headsep
- show instance
- show internalerrors
- show java
- show jdbc
- show linesize
- show lno
- show locale
- show login
- show loboffset
- show long
- show longchunksize
- show newpage
- show nls
- show null
- show numformat
- show numwidth
- show pagesize
- show pause
- show pno
- show prelim
- show recsep
- show recsepchar
- show registry
- show release
- show repfooter
- show repheader
- show securedcol
- show spool
- show spparameter
- show sqldev

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- show sqldev2
- show sqlprompt
- show suffix
- show systemout
- show termout
- show toplevel
- show trimout
- show trimspool
- show ufi
- show urls
- show wrap
- show xquery
- show xmloptimization
- show xmloptimizationcheck
- unload
- vault
- version
- whenever
- which
- xquery

Restricted Commands at Level 3

- @@
- @
- get
- start

Restricted Commands at Level 2

- save
- spool
- store

Restricted Commands at Level 1

- edit
- host (!, $)

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2.1.1.3 Best Practices for Applying Restrictions

For optimal security and control in your SQLcl environment, adhere to the following best practices. These recommendations ensure you apply the appropriate restrictions, balancing system protection with operational flexibility.

- **Use the highest restrict level for enhanced security**
  For most production or secure environments, you should use the highest restrict level (4) to minimize security risks.
- **Lower restrictions for specific needs**
  Only lower the restrict level when you have a specific need to run commands that are otherwise blocked. For instance, if you need to run installation scripts, you could temporarily lower the restrict level to one (1) and revert it to a higher level after the task is complete.
- **Use level zero (0) with caution**
  The restrict level zero (0) provides full administrative freedom and can be useful for development or in isolated, trusted environments. However, you should use it with caution due to the potential security implications of allowing host command execution.

2.2 Defining Parameters in SQLcl Scripts Using the ARGUMENT Command

The `ARGUMENT` command enables you to define SQL*Plus parameters that are passed to SQLcl scripts. This command adds a `DEFINE` for the parameter if the parameter does not exist.

Parameters are passed by position to scripts where they are assigned a number starting with one for each position. Therefore, to supply a value for parameter 1, use argument 1 [options]; for parameter 2, use argument 2 [options], and so on. See Passing Parameters through the START Command in the *Oracle SQL*Plus User's Guide* for more information.

Syntax

```
argument|arg OPTIONS
```

Use the `SET PARAMETERPOLICY` command to control parameter retention. The parameter retention applies to all parameters whether defined using this command or not.

When `SET PARAMETERPOLICY` is `SHARE` (default), defined variables retain their values until you:

- Enter a new `DEFINE` command referencing the variable.
- Enter an `UNDEFINE` command referencing the variable.
- Enter an `ACCEPT` command referencing the variable.
- Reference the variable in the `NEW_VALUE` or `OLD_VALUE` clause of a `COLUMN` command and then reference the column in a `SELECT` command.
- Exit SQLcl.

When `SET PARAMETERPOLICY` is `ISOLATE`:

- Parameter settings are saved and undefined at the start of the script.
- On return from the script, the saved parameters are restored.

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- Parameter settings in called scripts do not affect the containing script.

The `SET PARAMETERPOLICY` command must be specified before the script is called. If `SET PARAMETERPOLICY` is set to `ISOLATE` within a script, parameters are removed on return. Parameters cannot be reset as the values were not saved at the start of the script.

Options

Option	Description
Required	
`arg_num`	The position of the parameter relative to 1.
`action {default|prompt}`	The argument action to take when a parameter is not already defined. • `prompt`: Prompts the user for the parameter value and sets it. • `default`: Sets the default value.
`action_value`	The value to specify for the parameter or the string for prompting the user for the value. Values containing spaces must be enclosed in double quotes.
Optional	
`comment {comment}`	Associate a comment with the parameter. {comment} - Associate the comment value specified with the parameter.
`comment_value`	The comment to associate with the parameter. Values containing spaces must be enclosed in double quotes.

Examples

Example 1 - The following example uses the `ARGUMENT` command to define two parameters in a script (script.sql).

```
script.sql:
prompt 'Give value for 1 or prompt for it: &1'
prompt 'Give value for 99 or prompt for it: &99'

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0
SQL> arg 99 default 99_set
/* 99 shared with script.sql */

SQL> @script.sql
Enter value for 1: x
'Give value for 1 or prompt for it: x'
'Give value for 99 or prompt for it: 99_set'
SQL> exit
Disconnected from Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 -
Production
Version 19.3.0.0.0
```


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Example 2 - The following example illustrates how the `SET PARAMETERPOLICY ISOLATE` is used to redefine parameters every time the script is called.

```
SQL> set parameterpolicy isolate
SQL> arg 99 default 99_set
/* 99 is not passed to the script, so prompted for */

SQL> @script.sql
Enter value for 1: x2
'Give value for 1 or prompt for it: x2'
Enter value for 99: x99
'Give value for 99 or prompt for it: x99'
/* 99 restored - set back to the original value when script.sql finishes */

SQL> define 99
DEFINE 99              = "99_set" (CHAR)
```

2.3 Starting Up and Shutting Down a Database

Starting up and shutting down a database requires DBA privileges.

`STARTUP` *`db_options`* | *`cdb_options`* | *`upgrade_options`*

where *`db options`* has the following syntax:

`[FORCE] [RESTRICT] [PFILE=`*`filename`*`] [QUIET] [ MOUNT [`*`dbname`*`] | [ OPEN [`*`open_db_options`*`] [`*`dbname`*`] ] | NOMOUNT ]`

where *`open_db_options`* has the following syntax:

`READ {ONLY | WRITE [RECOVER]} | RECOVER`

where *`cdb_options`* has the following syntax:

`root_connection_options` | *`pdb_connection_options`*

where *`root_connection_options`* has the following syntax:

`PLUGGABLE DATABASE `*`pdbname`*` [FORCE] | [RESTRICT] [ OPEN {`*`open_pdb_options`*`}]`

where *`pdb_connection_options`* has the following syntax:

`[FORCE] | [RESTRICT] [ OPEN {`*`open_pdb_options`*`}]`

where *`open_pdb_options`* has the following syntax:

`READ WRITE | READ ONLY`

and where *`upgrade_options`* has the following syntax:

`[PFILE=`*`filename`*`] {UPGRADE | DOWNGRADE} [QUIET]`

Starts an Oracle Database instance with several options, including mounting and opening a database.

`SHUTDOWN [ABORT | IMMEDIATE | NORMAL | TRANSACTIONAL [LOCAL]]`

Shuts down a currently running Oracle instance, optionally closing and dismounting a database.

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2.4 Entering and Executing Commands

Use the following commands to execute and collect timing statistics on SQL commands and PL/SQL blocks:

`/ (slash)`

Executes the most recently executed SQL command or PL/SQL block which is stored in the SQL buffer. Does not list the command. Use slash (/) at the command prompt or line number prompt in SQLcl command line.

`EXEC[UTE] statement`

Executes a single PL/SQL statement or runs a stored procedure.

`R[UN]`

Lists and executes the most recently executed SQLcl command or PL/SQL block which is stored in the SQL buffer. The buffer has no command history list and does not record SQLcl commands.

`TIMI[NG]`

Timing is only available as a switch.

Use the following command to access the help system:

`HELP | ? [topic]`

Accesses the command-line help system. Enter `HELP INDEX` or `? INDEX` for a list of topics. You can view the Oracle Database Library at http://www.oracle.com/technology/documentation.

Use the following command to execute operating system commands:

`HO[ST] [command]`

Executes an operating system command without leaving SQLcl. Enter `HOST` without command to display an operating system prompt. You can then enter multiple operating system commands.

With some operating systems, you can use another character instead of HOST such as "!" (UNIX) and "$" (Windows). See the Oracle installation and user's manuals provided for your operating system for details.

You can use the `_RC` variable to return the exit status of the command executed with HOST.

> **Note**
>
> When connecting to a database using bequeath protocol (where a client connection is passed directly to a dedicated server process without going through the listener), the `_RC` variable is not automatically updated. Set `bequeath_detach=yes` in the sqlnet.ora configuration file to update the `_RC` variable.

Use the following command to recall the history of SQLcl commands:

`HISTORY [index | FULL | USAGE | SCRIPT | TIME | CLEAR (SESSION)?] | FAILS`

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- Use the Up and Down arrow keys to navigate through history items at the prompt.
- Use the `HISTORY` command to print the history contents.
- History is limited to the last 100 statements.
- `SET HISTORY LIMIT N` allows you to change the default limit, where *`N`* is the maximum number.
- History is retained between SQLcl sessions.
- By default, the `SHOW`, `HISTORY`, `CONNECT`, and `SET` commands are not saved in history.
- `SET HISTORY FILTER` allows you to set the commands that should not be recorded in history.

2.5 Manipulating SQL, SQLcl, and PL/SQL Commands

Use the following commands to edit SQL commands and PL/SQL blocks:

`A[PPEND] text`

Adds specified text to the end of the current line in the SQL buffer. To separate *`text`* from the preceding characters with a space, enter two spaces. To append *`text`* that ends with a semicolon, end the command with two semicolons (a single semicolon is interpreted as a command terminator).

`C[HANGE] sepchar old [sepchar [new [sepchar]]]`

Changes first occurrence of *`old`* on the current line of the SQL buffer. The buffer has no command history list and does not record SQLcl commands. You can use any non-alphanumeric character such as "/" or "!" as a *`sepchar`*. You can omit the space between `CHANGE` and the first *`sepchar`*.

`DEL [n | n m | n * | n LAST | * | * n | * LAST | LAST]`

Deletes one or more lines of the SQL buffer ("*" indicates the current line). You can omit the space between `DEL` and *`n`* or `*`, but not between `DEL` and `LAST`. Enter `DEL` with no clauses to delete the current line of the buffer. The buffer has no command history list and does not record SQLcl commands.

`I[NPUT] [text]`

Adds one or more new lines of text after the current line in the SQL buffer. The buffer has no command history list and does not record SQLcl commands.

`L[IST] [n | n m | n * | n LAST | * | * n | * LAST | LAST]`

Lists one or more lines of the most recently executed SQL command or PL/SQL block which is stored in the SQL buffer. Asterisk (`*`) indicates the current line. You can omit the space between `LIST` and *`n`* or `*`, but not between `LIST` and `LAST`. Enter `LIST` with no clauses to list all lines.

In SQLcl, you can also use ";" to list all the lines in the SQL buffer. The buffer has no command history list and does not record SQLcl commands.

Use the following commands to run scripts:

`@ { url | file_name[.ext] } [arg ...]`

Runs the SQLcl statements in the specified script. The script can be called from the local file system or a web server. You can pass values to script variables in the usual way.

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`@@ { url | file_name[.ext] } [arg ...]`

Runs the SQLcl statements in the specified script. This command is almost identical to the `@` command. It is useful for running nested scripts because it has the additional functionality of looking for the specified script in the same path or *`url`* as the calling script.

`REPEAT <iterations> <sleep>`

Repeats the current SQL in the buffer at the specified times with sleep intervals. The maximum sleep interval is 120 seconds.

`SCRIPT <script file>`

Runs the SQLcl statements in the specified script.

`STA[RT] { url | file_name[.ext] } [arg ...]`

Runs the SQLcl statements in the specified script. The script can be called from the local file system or a web server. You can pass values to script variables in the usual way.

Use the following commands to create and modify scripts:

`ED[IT] [file_name[.ext]]`

Invokes an operating system text editor on the contents of the specified file or on the contents of the SQL buffer. To edit the buffer contents, omit the file name.

The DEFINE variable _EDITOR can be used to set the editor to use. In SQLcl, _EDITOR can be set to any editor that you prefer. *`Inline`* will set the editor to be the SQLcl editor. This supports the following shortcuts:

- `^R` - Run the current buffer
- `^W` - Go to top of buffer
- `^S` - Go to bottom of buffer
- `^A` - Go to start of line
- `^E` - Go to end of line

`FORMAT`

- `FORMAT BUFFER` - formats the script in the SQLcl Buffer
- `FORMAT RULES <filename>` - Loads SQLDeveloper Formatter rules file to formatter
- `FORMAT FILE <input_file> <output_file>`

`GET file_name[.ext] [LIST | NOLIST]`

Loads a SQL statement or PL/SQL block from a file into the SQL buffer. The buffer has no command history list and does not record SQLcl commands.

`REM[ARK]`

Begins a comment in a script. The REMARK command must appear at the beginning of a line, and the comment ends at the end of the line (a line cannot contain both a comment and a command). SQLcl does not interpret the comment as a command.

`SAV[E] [FILE] file_name[.ext] [CRE[ATE] | REP[LACE] | APP[END]]`

Saves the contents of the SQL buffer in a script. The buffer has no command history list and does not record SQLcl commands.

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```
STORE {SET} file_name[.ext] [CRE[ATE] | REP[LACE] | APP[END]]
```

Saves attributes of the current SQLcl environment in a file.

```
WHENEVER OSERROR {EXIT [SUCCESS | FAILURE | n | variable | :BindVariable] [COMMIT
| ROLLBACK] | CONTINUE [COMMIT | ROLLBACK | NONE]}
```

Performs the specified action (exits SQLcl by default) if an operating system error occurs (such as a file writing error).

```
WHENEVER SQLERROR {EXIT [SUCCESS | FAILURE | WARNING | n | variable
| :BindVariable] [COMMIT | ROLLBACK] | CONTINUE [COMMIT | ROLLBACK | NONE]}
```

Performs the specified action (exits SQLcl by default) if a SQL command or PL/SQL block generates an error.

Use the following commands to write interactive commands:

```
ACC[EPT] variable [NUM[BER] | CHAR | DATE | BINARY_FLOAT | BINARY_DOUBLE]
[FOR[MAT] format] [DEF[AULT] default] [PROMPT text | NOPR[OMPT]] [HIDE]
```

Reads a line of input and stores it in a given substitution variable.

```
DEF[INE] [variable] | [variable = text]
```

Specifies a substitution variable and assigns a CHAR value to it, or lists the value and variable type of a single variable or all variables.

```
PAU[SE] [text]
```

Displays the specified text then waits for the user to press RETURN.

```
PRO[MPT] [text]
```

Sends the specified message or a blank line to the user's screen.

```
UNDEF[INE] variable ...
```

Deletes one or more substitution variables that you defined either explicitly (with the DEFINE command) or implicitly (with a START command argument).

Use the following commands to create and display bind variables:

```
PRINT [variable ...]
```

Displays the current values of bind variables, or lists all bind variables.

Use the following symbols to create substitution variables and parameters for use in scripts:

```
&n
```

Specifies a parameter in a script you run using the START command. START substitutes values you list after the script name as follows: the first for &1, the second for &2, and so on.

```
&user_variable, &&user_variable
```

Indicates a substitution variable in a SQL or SQLcl command. SQLcl substitutes the value of the specified substitution variable for each substitution variable it encounters. If the substitution variable is undefined, SQLcl prompts you for a value *each* time an "&" variable is found, and the *first* time an "&&" variable is found.

```
. (period)
```


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Terminates a substitution variable followed by a character that would otherwise be part of the variable name.

2.6 Formatting Query Results

Use the following commands to format, store and print your query results.

BRE[AK] [ON *report_element* [*action* [*action*]]] ...

Specifies where changes occur in a report and the formatting action to perform, such as:

- suppressing the display of duplicate values for a given column
- skipping a line each time a given column value changes
- printing computed figures each time a given column value changes or at the end of the report

Enter BREAK with no clauses to list the current BREAK definition.

Where *report_element* has the following syntax:

{*column* | *expression* | ROW | REPORT}

and where *action* has the following syntax:

[SKI[P] *n* | [SKI[P]] PAGE] [NODUP[LICATES] | DUP[LICATES]]

BTI[TLE] [*printspec* [*text* | *variable*] ...] | [ON | OFF]

Places and formats a title at the bottom of each report page, or lists the current BTITLE definition. Use one of the following clauses in place of *printspec*:

```
BOLD
CE[NTER]
COL n
FORMAT text
LE[FT]
R[IGHT]
S[KIP] [n]
TAB n
```

CL[EAR] *option* ...

Resets or erases the current value or setting for the specified option.

Where *option* represents one of the following clauses:

```
BRE[AKS]
BUFF[ER]
COL[UMNS]
COMP[UTES]
CONTEXT
SCR[EEN]
SQL
TIMI[NG]
```

COL[UMN] [{*column* | *expr*} [*option* ...]]

Specifies display attributes for a given column, such as:

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- text for the column heading
- alignment for the column heading
- format for NUMBER data
- wrapping of column data

Also lists the current display attributes for a single column or for all columns.

Where *option* represents one of the following clauses:

```
ALI[AS] alias
CLE[AR]
ENTMAP {ON | OFF}
FOR[MAT] format
HEA[DING] text
JUS[TIFY] {L[EFT] | C[ENTER] | R[IGHT]}
LIKE {expr | alias}
NEWL[INE]
NEW_V[ALUE] variable
NOPRI[NT] | PRI[NT]
NUL[L] text
OLD_V[ALUE] variable
ON | OFF
WRA[PPED] | WOR[D_WRAPPED] | TRU[NCATED]
```

> **Note**
>
> Currently only `NEW_V[ALUE]` variable syntax is supported.

Enter `COLUMN [{column |expr} FORMAT format]` where the *format* element specifies the display format for the column.

To change the display format of a NUMBER column, use `FORMAT` followed by one of the elements in the following table:

Element	Examples	Description
, (comma)	`9,999`	Displays a comma in the specified position.
. (period)	`99.99`	Displays a period (decimal point) to separate the integral and fractional parts of a number.
$	`$9999`	Displays a leading dollar sign.
0	`0999` `9990`	Displays leading or trailing zeros (0).
9	`9999`	Displays a value with the number of digits specified by the number of 9s. Value has a leading space if positive, a leading minus sign if negative. Blanks are displayed for leading zeros. A zero (0) is displayed for a value of zero.

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Element	Examples	Description
B	B9999	Displays blanks for the integer part of a fixed-point number when the integer part is zero, regardless of zeros in the format model.
C	C999	Displays the ISO currency symbol in the specified position.
D	99D99	Displays the decimal character to separate the integral and fractional parts of a number.
EEEE	9.999EEEE	Displays a value in scientific notation (format must contain exactly four "E"s).
G	9G999	Displays the group separator in the specified positions in the integral part of a number.
L	L999	Displays the local currency symbol in the specified position.
MI	9999MI	Displays a trailing minus sign after a negative value. Displays a trailing space after a positive value.
PR	9999PR	Displays a negative value in <angle brackets>. Displays a positive value with a leading and trailing space.
RN rn	RN rn	Displays uppercase Roman numerals. Displays lowercase Roman numerals. Value can be an integer between 1 and 3999.
S	S9999 9999S	Displays a leading minus or plus sign. Displays a trailing minus or plus sign.
TM	TM	Displays the smallest number of decimal characters possible. The default is TM9. Fixed notation is used for output up to 64 characters, scientific notation for more than 64 characters. Cannot precede TM with any other element. TM can only be followed by a single 9 or E.
U	U9999	Displays the dual currency symbol in the specified position.

`COMP[UTE] [`*`function`* `[LAB[EL]` *`text`*`] ... OF {`*`expr`* `|` *`column`* `|` *`alias`*`} ...ON {`*`expr`* `|` *`column`* `|` *`alias`* `| REPORT | ROW} ...]`

In combination with the `BREAK` command, calculates and prints summary lines using various standard computations. It also lists all COMPUTE definitions. The following table lists valid functions. All functions except NUMBER apply to non-null values only. COMPUTE functions are always executed in the following sequence AVG, COUNT, MINIMUM, MAXIMUM, NUMBER, SUM, STD, VARIANCE.

Function	Computes	Applies to Datatypes
AVG	Average of non-null values	NUMBER
COU[NT]	Count of non-null values	All types
MIN[IMUM]	Minimum value	NUMBER, CHAR, NCHAR, VARCHAR2 (VARCHAR), NVARCHAR2 (NCHAR VARYING)
MAX[IMUM]	Maximum value	NUMBER, CHAR, NCHAR, VARCHAR2 (VARCHAR), NVARCHAR2 (NCHAR VARYING)

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Function	Computes	Applies to Datatypes
NUM[BER]	Count of rows	All types
SUM	Sum of non-null values	NUMBER
STD	Standard deviation of non-null values	NUMBER
VAR[IANCE]	Variance of non-null values	NUMBER

`SET SQLFORMAT {csv | html | xml | json | ansiconsole | insert | loader | fixed | default}`

Outputs reports in various formats. The `ansiconsole` option formats and resizes data according to the column widths, for easier readability. The `json` option returns a query in JSON format.

`SET SQLFORMAT DELIMITED <delimiter> <left enclosure> <right enclosure>` allows you to set a custom delimited format.

`SET SQLFORMAT JSON-FORMATTED` returns a query in well formatted JSON output.

`SPO[OL] [filename[.ext] [CRE[ATE] | REP[LACE] | APP[END]] | OFF | OUT]`

Stores query results in a file, or optionally sends the file to a printer. `OFF` stops spooling. `OUT` stops spooling and sends the file to your computer's default printer. Enter `SPOOL` with no clauses to list the current spooling status. If no file extension is given, the default extension, *`.lst`* or *`.lis`*, is used.

`TTI[TLE] [printspec [text | variable] ...] | [ON | OFF]`

Places and formats a specified title at the top of each report page, or lists the current TTITLE definition. The old form of TTITLE is used if only a single word or a string in quotes follows the TTITLE command.

Where *`printspec`* represents one or more of the following clauses:

```
BOLD
CE[NTER]
COL n
FORMAT text
LE[FT]
R[IGHT]
S[KIP] [n]
TAB n
```

2.7 Configuring Thick Driver Support for SQLcl

By default, SQLcl uses the thin Java Database Connectivity (JDBC) driver for connections to Oracle databases. This section describes how to configure your environment to use the thick JDBC driver.

The configuration and validation varies by platform.

- Requirements for Using the Thick Driver
- Linux and macOS Configuration
- Windows Configuration

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2.7.1 Requirements for Using the Thick Driver

To enable the thick driver, you must specify the location to a client installation that includes the necessary native libraries.

You can use either a full Oracle client or database installation, or an instant client installation. The client installation must be version 23 or later.

2.7.2 Linux and macOS Configuration

To use SQLcl with the thick driver on Linux or macOS, you must set the `ORACLE_HOME` environment variable to point to either the root directory of the installation (for client or database installations) or the instant client directory.

The SQLcl launch script uses this environment variable to configure the session for thick driver access. The script verifies if your client installation meets the minimum version requirement. If a valid installation is detected, SQLcl enables and defaults to the thick driver for connections. If the installed client version doesn't meet the requirement, the script displays an error message, and SQLcl falls back to using the thin driver.

The launch script automatically makes the native libraries from a valid client installation available to SQLcl. You don't have to configure the `PATH`, `LD_LIBRARY_PATH`, or `DYLD_LIBRARY_PATH` variables.

2.7.3 Windows Configuration

To use SQLcl with the thick driver on Windows, you must set the `ORACLE_HOME` environment variable to point to either the root directory of the installation (for client or database installations) or the instant client directory.

SQLcl does not support setting the `ORACLE_HOME` variable in the Windows registry.

> **Note**
>
> The Windows configuration process does not verify the client installation version. If you use a client version below the minimum requirement, you may encounter runtime errors.

You must also ensure that the Windows `PATH` environment variable contains the correct location of the native Windows libraries. For specific guidance on setting the `PATH` variable, consult the installation guide or readme file for your client installation.

2.8 Connecting to a Database

Learn how to connect to a database, manage persistent connections, and work with connections in the OCI Database Tools Service.

- About the `CONNECT` Command
- Working with Persistent Connections
- Working with Connections in the Database Tools Service

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> **Note**
>
> When connecting to a database using a predefined connection string, always enclose the entire string in double quotes. This ensures the string is interpreted correctly across all platforms, even when it contains spaces or special characters.
>
> **Sample command that may cause issues**
>
> ```
> sql myuser@(description= (address=(protocol=tcp)(host=<host>)
> (port=1521)))
> ```
>
> **Recommended command format with a connection string**
>
> ```
> sql myuser@"(description= (address=(protocol=tcp)(host=<host>)
> (port=1521)))"
> ```

2.8.1 About the CONNECT Command

Use the CONNECT command to connect to a database.

The options specified automatically determine the kind of connection required, such as whether it is a traditional client-server connection or a wallet-based cloud connection. You can override this by using options that specify a particular connection type. For example, specify -wallet to use the wallet connection type.

The connection types supported in SQLcl are:

- KERBEROS
- NAME
- OCI
- ORACLE
- OREST
- RADIUS
- SOCKS
- THIRD
- WALLET

For more information, see the CONNECT command.

2.8.2 Working with Persistent Connections

You can manage persistent connections with the Connection Manager (CONNMGR) command.

Persistent connections are referenced by a connection name. Connections may store a user name. If a user name is stored, a password may also be stored. Passwords are stored in a secure wallet. If a password is not stored, it is provided when prompted to create the connection. A stored connection may describe a connection in a variety of formats, including basic host name, port and service name values or a TNS name and a cloud configuration.

To add a stored connection, see NAME Connection Type .

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To save a stored connection, see the options `-save`, `-savepwd`, and `-replace` in CONNECT.

For more information about the Connection Manager command, see CONNMGR.

2.8.3 Working with Connections in the Database Tools Service

You can use the Connection Manager (`CONNMGR`) command with the `-OCI` option to work with connection definitions stored in the Database Tools Service. This allows you to browse connections available in your Oracle Cloud Infrastructure (OCI) tenancy and import them as local, named SQLcl connections, simplifying how you connect to Oracle Databases in OCI.

Learn how to use the OCI configuration commands and the `CONNMGR` command to import a Database Tools connection into your local store and connect to an Oracle Database in OCI.

- Configuring the OCI Profile
- Listing Available Database Tools Connections
- Showing Details of a Specific Connection
- Importing a Database Tools Connection
- Connecting to a Database Using an Imported Connection

2.8.3.1 Configuring the OCI Profile

To import and connect to a Database Tools connection using the SQLcl connection store, you must a select a valid OCI profile. SQLcl uses the **DEFAULT** profile unless another is selected. Additionally, you must select a region to access OCI services. The region generally comes from the profile, but you can change it using the `OCI REGION` command.

Listing Available Profiles

List available profiles and view the current default profile (marked with *).

```
oci profile
```

Example

```
oci profile
Configured Profiles:
     UKWEST
     PERSONAL
     PHOENIX
    *DEFAULT
```

Setting the Required Profile

Use the following command to set the profile.

```
oci profile <profile_name>
```

Example

```
oci profile UKWEST
```


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Setting the Required Region

Use the following command to set the region.

```
oci region <region_name>
```

Example

```
oci region uk-cardiff-1
```

2.8.3.2 Listing Available Database Tools Connections

Use the `CONNMGR LIST` command with the `-OCI` option to list the Database Tools connections that are available to you within your OCI tenancy, across all accessible containers.

Syntax

```
connmgr list -oci
```

Example

```
connmgr list -oci

Display Name        OCID
------------------- ------------------------------------------------------
DB23c-Free          ocid1.databasetoolsconnection.ocl.uk-london-1.xxxxx
DBTools-ATP-Conn    ocid1.databasetoolsconnection.ocl.uk-london-1.yyyyy
```

2.8.3.3 Showing Details of a Specific Connection

Use the `CONNMGR SHOW` command with the `-OCI` option to display detailed information of a specific Database Tools connection. The command looks up the connection by its display name, in a case-insensitive manner.

Syntax

```
connmgr show -oci <display_name>
```

Example

```
connmgr show -oci DB23c-Free

Property          Value
----------------- ------------------------------------------------------
Display Name      DB23c-Free
OCID              ocid1.databasetoolsconnection.ocl.uk-london-1.xxxxx
Compartment OCID  ocid1.compartment.oc1..zzzzz
Type              ORACLE_DATABASE
```


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2.8.3.4 Importing a Database Tools Connection

Use the `CONNMGR IMPORT` command with the `-OCI` option to import a connection definition from the Database Tools Service into your local SQLcl connection store.

Specify the display name of the connection to import.

Syntax

```
connmgr import -oci <display_name>
```

Example

```
connmgr import -oci DB23c-Free

Connection 'DB23c-Free' saved.
```

2.8.3.5 Connecting to a Database Using an Imported Connection

After importing a connection, you can connect to it using the standard `CONNECT` (or `CONN`) command.

SQLcl uses the stored connection definition, including its OCID and the OCI profile information captured at the time of import, to establish the connection. The currently-active OCI profile in your SQLcl session is not used for connecting to an already imported connection.

Example

```
connect DB23c-Free
Connected.
```

2.9 Loading a File

Use the `LOAD` command in SQLcl to load a comma-separated value file from a local directory or cloud storage location into a table.

2.9.1 LOAD Command

Loads a comma-separated value (csv) file from a local directory or cloud storage location into a table.

Syntax

```
LOAD [TABLE] [schema.]table_name { <file-specification> | <cloud-storage-
specification> }
[NEW | SHOW | SHOW_DDL | CREATE |CREATE_DDL]
```

where

[*schema*.]*table_name* identifies the table to load. If the schema is omitted, the table for the connected user schema is loaded.

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file-specification has the following syntax:

```
{ <fully-qualified-file-name> | <file-name> }
```

- *fully-qualified-file-name*: Identifies the full path to the file to load.
- *file-name*: Identifies the file to load. The file must be located in the default path.

cloud-storage-specification has the following syntax:

```
{ CLOUDSTORAGE | CS | CLOUD_STORAGE } [ <url> | <qualified-name> ]
```

- *url*: Complete URL for the cloud storage file if a default cloud storage URL is not set using the Cloud Storage command.
- *qualified-name*: Name of the object, optionally qualified by the namespace and bucket. The qualified name combined with the URL specified by the Cloud Storage command must fully identify the object URL. If *url* and *qualified-name* are omitted, the default Cloud Storage URL must be set to the object.

`NEW` creates a table and loads data.

`[SHOW | SHOW_DDL]` executes the DDL generation phase and shows the DDL.

`[CREATE | CREATE_DDL]` executes the DDL generation phase and creates the table.

Use `SET LOAD` and `SET LOADFORMAT` to specify properties for DDL analysis and generation.

Create table DDL generation pre-scans the data file to determine column properties. Use `SET LOAD SCAN` <*n*> to specify the number of rows to scan for DDL. 100 is the default. To turn off scanning, set to 0.

Use `SET LOAD COL_SIZE` to change column sizes that are generated. Use `SET LOAD MAP_NAMES` to map file column names to table column names.

For more information about the Cloud Storage command, see Using Cloud Storage.

The defaults for the file format are:

- The columns are delimited by a comma and may optionally be enclosed in double quotes.
- Lines are terminated with standard line terminators for Windows, UNIX or Mac.
- File is encoded UTF8.

The default load:

- Processes with 50 rows per batch.
- If AUTOCOMMIT is set in SQLcL, a commit is done every 10 batches.
- The load is terminated if more than 50 errors are found.

Use `SET LOADFORMAT` options for reading the file (delimiter, enclosures).

Use `SET LOAD` options for loading the data (rows per batch, date formats).

Example

The following example shows how to load a file from local storage into a table.

```
--Create Table "countries"
create table countries(countries_id NUMBER(5),countries_name VARCHAR2(40));
```


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```
Table COUNTRIES created

--Load file COUNTRIES_DATA_TABLE.csv in local storage to "countries" table
load countries C:\Users\JDOE\SQLcl\COUNTRIES_DATA_TABLE.csv

format csv

column_names on
delimiter ,
enclosure_left "
enclosure_right "
encoding UTF8
row_limit off
row_terminator default
skip_rows 0
skip_after_names

--Number of rows processed: 30
--Number of rows in error:
0 - SUCCESS: Load processed without errors

--Check the number of rows in countries table
select count(*) from countries;

COUNT(*)
---------
30
```

The following example shows how to load data into a new table EMP.

```
load emp empfile.csv new

--Create new table and load data into table HR.EMP

csv
column_names on
delimiter ,
enclosures ""
encoding UTF8
row_limit off
row_terminator default
skip_rows 0
skip_after_names

#INFO DATE format detected: RRRR-MM-DD


CREATE TABLE HR.EMP
 (
  EMPLOYEE_ID NUMBER(5),
  FIRST_NAME VARCHAR2(26),
  LAST_NAME VARCHAR2(26),
  EMAIL VARCHAR2(26),
  PHONE_NUMBER VARCHAR2(26),
  HIRE_DATE DATE,
```


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```
  JOB_ID VARCHAR2(26),
  SALARY NUMBER(9, 2),
  COMMISSION_PCT VARCHAR2(26),
  MANAGER_ID NUMBER(5),
  DEPARTMENT_ID NUMBER(5)
 )
;

#INFO Table created
#INFO Number of rows processed: 21
#INFO Number of rows in error: 0
#INFO Last row processed in final committed batch: 21
SUCCESS: Processed without errors
```

The following example shows how to create a new table from a local file.

```
load emp1 empfile.csv create_ddl

--Create new table HR.EMP1

csv
column_names on
delimiter ,
enclosures ""
encoding UTF8
row_limit off
row_terminator default
skip_rows 0
skip_after_names
batch_rows 50
batches_per_commit 10
clean_names transform
column_size rounded
commit on
date_format
errors 50
map_column_names off
method insert
timestamp_format
timestamptz_format
locale English United States
scan_rows 100
truncate off
unknown_columns_fail on

--Pre-scans the date format
#INFO DATE format detected: RRRR-MM-DD

CREATE TABLE SYSTEM.EMP1
 (
  EMPLOYEE_ID NUMBER(5),
  FIRST_NAME VARCHAR2(26),
  LAST_NAME VARCHAR2(26),
  EMAIL VARCHAR2(26),
  PHONE_NUMBER VARCHAR2(26),
```


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```
  HIRE_DATE DATE,
  JOB_ID VARCHAR2(26),
  SALARY NUMBER(9, 2),
  COMMISSION_PCT VARCHAR2(26),
  MANAGER_ID NUMBER(5),
  DEPARTMENT_ID NUMBER(5)
 )
;

#INFO Table created
SUCCESS: Processed without errors
```

2.9.1.1 SET LOAD Command

`SET LOAD` enables you to set options for loading data when using the `LOAD` command.

Syntax

```
SET LOAD default | [options...]
```

where

`default` means load method properties return to default values.

options represents the following:

- `BATCH_ROWS|BATCHROWS <number_of_rows>`

  Data loading is done in batches. Specifies the number of rows to include in each batch.

- `BATCHES_PER_COMMIT|BATCHESPERCOMMIT <batches_per_commit>`

  Commit after processing *number_of_batches*. If the number is equal to 0, commit happens at the end of the load. If the number is greater than or equal to 0, `COMMIT ON` is set.

- `CLEAN_NAMES [ TRANSFORM | TRANSFORM128 | QUOTE | QUOTE128 | UNIQUE ]`

  Identifies the rule for making table and column names compliant with database identifiers. Names are cleaned before they are mapped to provide consistency with previous releases. If both `CLEAN_NAMES` and `MAP_COLUMN_NAMES` are used, then clean names should be specified.

  The standard identifiers are:

  – No longer than 30 or 128 characters.
  – Not a reserved word.
  – Starts with a letter and contains only letters, digits, or one of _$#.
  – Uppercase
  – Names that do not comply must be quoted. Length rules always apply.

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> **Note**
>
> Data that is enclosed in quotes will have quotes in the header row removed before names are cleaned.

`TRANSFORM (default)`

Indicates that names are transformed as follows:

- Names are in uppercase.
- If the name starts and ends with the quote character, the quotes are removed.
- Names that are reserved words are appended with a dollar sign ($).
- Names that start with a number or special character is prefixed with an X.
- Spaces and hyphens are replaced with underscores (_). $ and # characters are retained.
- Special characters other than $ and # is replaced with the number sign (#).
- Names are truncated to 30 or 128 characters depending on database MAX_STRING_SIZE.
- After names are cleaned, non-unique names within the column set are appended with a unique sequence number. If truncation is required, the sequence number is maintained.

`TRANSFORM (default)`

Applies all transform rules. Names may be 128 characters.

`QUOTE`

Quote non-compliant names and shorten to 30 or 128 characters depending on database MAX_STRING_SIZE.

`QUOTE128`

Quote non-compliant names. Names may be 128 characters.

`UNIQUE`

Compatibility option with previous releases of load service. Names that are not unique within the column set are appended with a unique sequential number. Truncation is not provided.

- `COLUMN_SIZE|COLUMNSIZE|COLSIZE {ACTUAL|ROUND|ROUNDED|MAX|MAXIMUM}`

  Create table column size strategy.

  `ACTUAL` uses the largest size found during the scan.

  `ROUND|ROUNDED` uses a size a little larger than the largest size found during the scan.

  `MAX|MAXIMUM` uses the database maximum size for the data type that was detected.

- `COMMIT {ON|OFF}`

  Enable or disable data commits.

- `DATE|DATE_FORMAT|DATEFORMAT format_mask`

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The format of all DATE data type columns loaded. Specify no format_mask or DEFAULT to use database default.

For DATE columns, if format is not set and `SCAN_ROWS = 0`, the data is not scanned for a valid mask.

`ERRORS {`*`number_of_rows`*` | UNLIMITED}|-1`: Indicates the number of error rows allowed.

If this number is exceeded, the load will be terminated.

-1 and UNLIMITED indicate no error limit.

All rows in a batch may be in error if any row fails.

- `LOCALE { <language country> | DEFAULT | "" }`

  Specify locale language and optionally country.

  `DEFAULT|""` : Set to default locale.

- `MAP_COLUMN_NAMES|MAPCOLUMNNAMES|MAPNAMES { OFF| (<file-col-name>=<table-col-name>,...) }`

  Provide a mapping from the column names specified in the file to column names in the table.

- `METHOD INSERT`

  Method to use for data loads.

- `SCAN_ROWS|SCANROWS|SCAN <1-5000>`

  Identify the number of rows to scan for create table generation. Default is 100 rows.

- `TIMESTAMP|TIMESTAMP_FORMAT|TIMESTAMPFORMAT`

  The format of all TIMESTAMP data type columns being loaded. Specify no format_mask or DEFAULT to use database default. For TIMESTAMP columns, if format is not set and SCAN_ROWS not equal to 0, the data is scanned for a valid mask.

- `TIMESTAMPTZ|TIMESTAMPTZ_FORMAT|TIMESTAMPTZFORMAT`

  The format of all TIMESTAMPTZ data type columns being loaded. Specify no format_mask or DEFAULT to use database default. For TIMESTAMPTZ columns, if format is not set and SCAN_ROWS not equal to 0, the data is scanned for a valid mask.

- `TRUNCATE {OFF|ON}`

  Truncate ON truncates the table before loading

- `UNKNOWN_COLUMNS_FAIL|UNKNOWNCOLUMNSFAIL|UNKNOWNFAIL {ON|OFF}`

  `ON`: Terminates the load if any columns in the file do not map to a column in the table.

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OFF: Allows the load to proceed when columns in the file do not map to a column in the table.

2.9.1.2 SET LOADFORMAT Command

SET LOADFORMAT enables you to set format properties for loading data when using the LOAD command.

Syntax

```
SET LOADFORMAT [ default|csv|delimited|html|insert|json|json-formatted|loader|
t2|xml] [options...]
```

where

- default: Load format properties return to default values.
- csv: Comma-separated values.
- delimited : (csv synonym) Delimited format, comma separated values by default.
- html : Hypertext Markup Language. For the UNLOAD command only.
- insert : SQL insert statements. For the UNLOAD command only.
- json : JavaScript Object Notation. For the UNLOAD command only.
- json-formatted : Pretty-formatted JSON. For the UNLOAD command only.
- loader : Oracle SQL Loader format. For the UNLOAD command only.
- t2 : T2 Metrics. For the UNLOAD command only.
- xml : Extensible Markup Language. For the UNLOAD command only.

options represent the following clauses:

- COLUMN_NAMES|COLUMNNAMES|NAMES {ON|OFF}: Header row with column names.
- DELIMITER {separator}: Delimiter separating fields in the record.
- DOUBLE [OFF] : (Import only) Embedded right enclosures are doubled. OFF indicates embedded right enclosures are not doubled and embedded right enclosures can lead to unexpected results.
- ENCLOSURES {enclosures|OFF} : Optional left and right enclosures.
  - OFF indicates no enclosures
  - If 1 character is specified, sets left and right enclosures to this value.
  - If 2 or more characters are specified, sets left to the first character, right to the second character and ignores the remaining characters.
  - To set multiple character enclosures, use Set ENCLOSURE_LEFT and ENCLOSURE_RIGHT.
- ENCODING {encoding|OFF|""}: Encoding of load file. OFF and "" reset to default encoding for environment.
- LEFT|ENCLOSURE_LEFT|ENCLOSURELEFT {enclosure|OFF}: Set a 1 or more character left enclosure. If no ENCLOSURE_RIGHT is specified, it is used for both left and right. OFF indicates no enclosures.

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- RIGHT|ENCLOSURE_RIGHT|ENCLOSURERIGHT {enclosure|OFF}: Set a 1 or more character right enclosure. OFF indicates no right enclosure.
- ROW_LIMIT|ROWLIMIT|LIMIT} {number_of_rows|OFF|""}: Maximum number of rows to read, including the header. OFF and "" set to not limit.
- SKIP|SKIP_ROWS|SKIPROWS {number_of_rows|OFF|""}: Number of rows to skip.
- [[SKIP_AFTER_NAMES|SKIPAFTERNAMES|AFTER]|[SKIP_BEFORE_NAMES|SKIPBEFORENAMES|BEFORE]]: Skip the rows before or after the (header) Column Names row.
- TERM|ROW_TERMINATOR {terminator|""|DEFAULT|CR|CRLF|LF}: Character(s) indicating end of row. If the file contains standard line end characters, the line_end does not need to be specified.
  - "" or DEFAULT specifies the default (any standard terminator) for the LOAD command.
  - "" or DEFAULT specifies the environment default for the UNLOAD command.
  - CRLF specifies WINDOWS terminator, generally for the UNLOAD command.
  - LF specifies UNIX terminator, generally for the UNLOAD command.
  - CR specifies MAC terminator, generally for the UNLOAD command.

Examples

```
SQL> set loadformat delimited
7369,"SMITH","CLERK",7902,17-DEC-80,800,,20,5555555555554444

SQL> set loadformat delimited enclosures <> line_end {eol}
7369,<SMITH>,<CLERK>,7902,17-DEC-80,800,,20,5555555555554444{eol}

SQL> set loadformat default (restore default settings)
7369,"SMITH","CLERK",7902,17-DEC-80,800,,20,5555555555554444
```

2.10 Using the OCI Command for Oracle Cloud Infrastructure REST APIs

Starting from SQLcl release 20.2, you can call Oracle Cloud Infrastructure (OCI) REST APIs using the OCI command.

> **See Also**
>
> Oracle Cloud Infrastructure API Documentation

Prerequisites

To use the OCI command, you need to first set the OCI profile for authentication and access.

For more information about how to set up the required SSH keys and configure your Oracle Cloud Infrastructure Software Development Kits, see Setup and Prerequisites in the *Oracle Cloud Infrastructure Documentation*.

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To list profiles contained in the OCI configuration file at `~/.oci/config`, enter:

```
oci profile
```

To set the profile name as "demo", enter:

```
oci profile demo
```

From SQLcl release 23.3, if you have a DEFAULT OCI profile installed, it is loaded when starting SQLcl.

Two Syntax Formats

There are two syntax formats available for using the OCI command.

Specify Target

In the first syntax format, the target is specified completely in the OCI command:

```
oci <host> <method> [file-to-send-as-body] <request-target>
```

where

method is GET, PUT or DELETE.

request-target is the path to the namespace, bucket or object on *host*.

Examples

To delete the emp.csv file from testing-bucket:

```
oci objectstorage.us-ashburn-1.oraclecloud.com delete /n/abc123/b/testing-
bucket/o/emp.csv
```

To list the contents of testing-bucket:

```
oci objectstorage.us-ashburn-1.oraclecloud.com get /n/abc123/b/testing-
bucket/o/
```

To put the emp.csv file into testing-bucket:

```
oci objectstorage.us-ashburn-1.oraclecloud.com put ./emp.csv /n/abc123/b/
testing-bucket/o/emp.csv
```

To get the emp.csv file from testing-bucket:

```
oci objectstorage.us-ashburn-1.oraclecloud.com get /n/abc123/b/testing-
bucket/o/emp.csv
```

Specify Target using Cloud Storage Command

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In the second syntax format, the target is a complete or partial URL to the location, which is set using the Cloud Storage command (cs):

```
oci <method> [file-to-send-as-body] <qualifier>
```

where

method is GET, PUT or DELETE.

qualifier is the cloud storage namespace or bucket. *qualifier* is appended to the location specified on the set Cloud Storage command and must form the complete URL to the namespace, bucket, or object used by the *method*.

For more information about the Cloud Storage command, see Using Cloud Storage.

Examples

To delete emp.csv from testing-bucket:

```
cs objectstorage.us-ashburn-1.oraclecloud.com
oci delete /n/abc123/b/testing-bucket/o/emp.csv
```

To list contents of testing-bucket:

```
--Using the OCI Command (oci get)

cs objectstorage.us-ashburn-1.oraclecloud.com/n/abc123/b/testing-bucket/o/
oci get

--Using the Cloud Storage Command (cs listo)

cs objectstorage.us-ashburn-1.oraclecloud.com/n/abc123/b/testing-bucket/o/
cs listo
```

To put emp.csv into testing-bucket:

```
cs objectstorage.us-ashburn-1.oraclecloud.com/n/abc123/b/testing-bucket
oci put ./emp.csv /o/emp.csv
```

To get emp.csv from testing-bucket:

```
cs objectstorage.us-ashburn-1.oraclecloud.com/n/abc123/b/testing-bucket
oci get /o/emp.csv
```


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3

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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- Configuring Restrict Levels for the SQLcl MCP Server
- Example Use Cases and Prompts
- Monitoring the SQLcl MCP Server

3.1 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.

3.2 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 have 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.
- **schema-information**: Provides detailed insights about the currently connected schema.
- **context_retrieve**: Retrieves relevant document context from compatible SQLcl RAG vector tables. Before using this tool, configure an embedding model and ingest documents using `model ingest`. For information about preparing documents and using retrieval in a

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RAG (Retrieval-Augmented Generation) workflow, see Using MODEL with Retrieval-Augmented Generation..

- **annotation_generate**: Creates annotations for tables and columns.
- **skill_sync**: Updates the set of available skills.
- **request_status**: Checks the current status of a previously submitted asynchronous request.

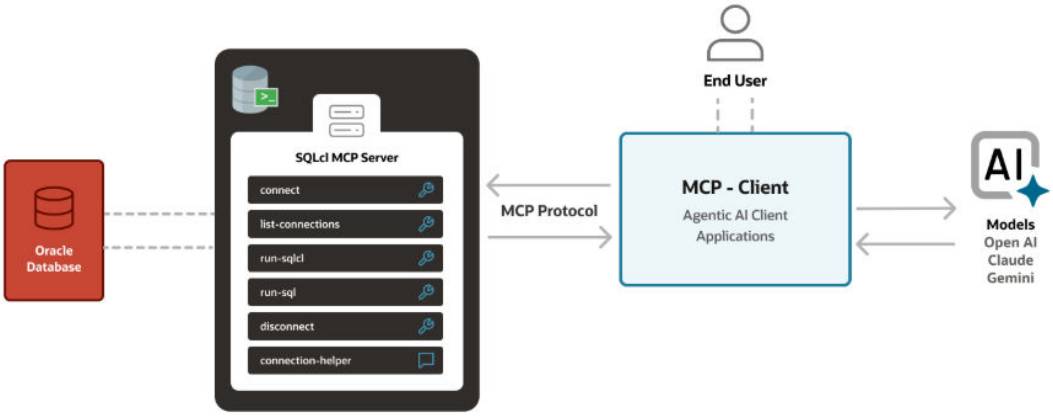
3.3 How the SQLcl MCP Server Works

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.

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:



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3.4 Preparing Your Environment

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

- Installing the Required Software
- Configuring Database Connections

> **Note**
>
> You can also access the SQLcl MCP Server through Oracle SQL Developer for VS Code. For related setup instructions, see Preparing Your Environmentin *Oracle SQL Developer for VS Code User's Guide*.

3.4.1 Installing the Required Software

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

- Oracle SQLcl, version 25.2.0 or higher
- Oracle Java Runtime Environment (JRE), version 17 or 21

3.4.2 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.

To create an MCP-compatible saved connection, execute a command similar to the following example:

```
SQL> conn -save cline_mcp -savepwd User123/pass123@//databaseserver:1521/orcl
Name: cline_mcp
Connect String: //databaseserver:1521/orcl
User: User123
Password: ******
Connected.
SQL>
```


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3.5 Starting and Managing the SQLcl MCP Server

The SQLcl MCP Server is designed to be launched and managed automatically through an MCP client application.

Configure your preferred client, such as Claude Desktop or Cline, to start the server when required. Once configured, the MCP client autonomously handles server startup, manages its life cycle, and ensures clean termination upon session completion, while enabling Oracle Database operations through natural conversations. To configure an MCP client, you must specify the server's location in your client.

> **Note**
>
> If you already use GitHub Copilot in VS Code, you can readily access the SQLcl MCP Server through SQL Developer for VS Code. No configuration is necessary as SQL Developer for VS Code automatically sets up the server for Copilot. You can simply create a database connection and begin asking questions with Copilot.
>
> To use the server with SQL Developer for VS Code and Copilot, see Starting and Managing the SQLcl MCP Server in *Oracle SQL Developer for VS Code User's Guide*

The following topics provide specific instructions for configuring two popular MCP clients.

- Configuring Claude Desktop
- Configuring Cline in VS Code

3.5.1 Configuring Claude Desktop

Follow these steps to configure Claude Desktop for SQLcl MCP Server. After configuration, Claude Desktop automatically manages the SQLcl MCP Server, allowing you to perform Oracle Database operations through your conversations with Claude.

1. Install Claude Desktop. See Installing Claude for Desktop.
2. Download the configuration file.
   a. Open Claude Desktop, click **Menu**, select **File**, and then click **Settings**.
   b. In the Settings window, click the **Developer** tab.
   c. Click **Edit Config** to download the configuration file (`claude_desktop_config.json`) to your computer.
3. Edit the configuration file.

   Open the `claude_desktop_config.json` file in a text editor, and add a JSON configuration snippet in the following format. Replace `PATH/bin/sql` with the absolute path of your SQLcl installation, and save the configuration file.

Example 3-1 Add the `TNS_ADMIN` environment variable when using `tnsnames.ora` for database connections

```
{
  "mcpServers": {
    "sqlcl": {
      "command": "PATH/bin/sql",
```


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```
      "args": ["-mcp"],
      "env" : {"TNS_ADMIN" : "/PATH"}
    }
  }
}
```

Verify the configuration.

Click **Search and tools** in the prompt box. You see the SQLcl MCP Server tools listed and enabled. If necessary, restart Claude Desktop for changes to take effect.

3.5.2 Configuring Cline in VS Code

Cline is an open-source AI coding assistant for Visual Studio Code (VS Code) that supports MCP. Follow these steps to configure Cline for SQLcl MCP Server.

1. Download and install VS Code. See Download Visual Studio Code.
2. Install the Cline extension.
   a. Open VS Code, and click **Extensions** on the sidebar.
   b. Enter `cline` in the search field. When it appears, click **Install**, then click **Trust Publisher and Install** to proceed.

   The extension is installed and appears on the sidebar.
3. Configure API keys and select your preferred AI model.

> **Note**
>
> This step details API configuration for the first installation of Cline. After installation, you can update the API key or model anytime by clicking **Settings** in the top-right corner of the Cline extension view.

   a. Click **Cline** on the sidebar.
   b. Click **Use your own API key**.
   c. Select your API provider, enter related details, and click **Let's go!**

      The API Configuration page opens.
   d. In the **Model** field, select the required AI model, and click **Save**.
4. Add the SQLcl MCP Server to Cline.
   a. With the **Cline** extension selected on the sidebar, click **Manage MCP Servers** below the prompt box.
   b. In the resulting dialogue, click **Settings**.

      The MCP Servers page opens, with the **Installed** tab selected.
   c. Click **Configure MCP Servers**.

      The `cline_mcp_settings.json` file opens in the VS Code editor.

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d. In the settings file, add a JSON configuration snippet in the following format. Replace `PATH/bin/sql` with the absolute path of your SQLcl installation, and press **Ctrl+S** on your keyboard to save the file.

```
{
   "mcpServers": {
    "sqlcl": {
            "command": "PATH/bin/sql",
            "args": ["-mcp"],
            "disabled": false
        }
    }
}
```

You'll now see the SQLcl MCP Server and its tools listed on the MCP Servers page.

e. Click **Done** on the MCP Servers page.

5. If necessary, restart VS Code for changes to take effect.

3.6 Configuring Restrict Levels for the SQLcl MCP Server

Use the restrict levels available in SQLcl to control which commands can be executed with the SQLcl MCP Server.

To learn about the available restrict levels in SQLcl, see About Restrict Levels in SQLcl.

By design, when you start the SQLcl MCP Server, it defaults to the most restrictive level, that is , level 4. This level prohibits running host commands, scripts, and other potentially sensitive operations. You can adjust this setting to allow specific command sets, which helps you enable new functionality in a controlled way.

To set the restrict level, edit your server configuration file and add the `-R` argument, followed by the level number (0, 1, 2, or 3), to the `args` array.

Example 3-2 Default configuration

If you do not specify an `-R` flag, the server defaults to level 4, the most restrictive level. This default configuration is represented as follows:

```
{
  "mcpServers": {
    "sqlcl": {
      "command": "PATH/bin/sql",
      "args": ["-mcp"]
    }
  }
}
```

Example 3-3 Allow scripts but restrict host commands

To allow script execution (@, @@) but block host commands, set the restrict level to one (1).

```
{
  "mcpServers": {
    "sqlcl": {
      "command": "PATH/bin/sql",
```


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```
      "args": ["-R","1","-mcp"]
    }
  }
}
```

Example 3-4 Allow all commands

To run the server with full access, set the restrict level to zero (0).

```
{
  "mcpServers": {
    "sqlcl": {
      "command": "PATH/bin/sql",
      "args": ["-R","0","-mcp"]
    }
  }
}
```

3.7 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 3-1 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*

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Table 3-1 (Cont.) Natural Language Prompts for Oracle Database Operations

Operation	Description	Complexity	Example Prompt to Client
Monitoring performance	Analyze query performance and receive optimization suggestions.	Advanced	*Show me which queries are running slow today and provide optimization tips*

3.8 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
- Monitoring Through Your Client
- Assessing Server Health Through Performance

3.8.1 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 terminal to confirm server readiness. Here's an example server message on startup:

```
SQL>./sql -mcp
---------- MCP SERVER STARTUP ----------
MCP Server started successfully on Fri Jun 13 13:52:13 WEST 2025
Press Ctrl+C to stop the server
---------------------------------------
```

3.8.2 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:

```
SQL> SELECT ID, MCP_CLIENT, MODEL, END_POINT_TYPE, END_POINT_NAME, LOG_MESSAGE
  2*      FROM DBTOOLS$MCP_LOG;
```


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```
   ID MCP_CLIENT    MODEL               END_POINT_TYPE    END_POINT_NAME
LOG_MESSAGE
_____ _____________ ___________________ _________________ ___________________
_____________________________
    3 Claude        claude-sonnet-4     tool              connect
Connect to HR
    4 Claude        claude-sonnet-4     tool              run-sql
select /* LLM in use is Claude Sonnet 4 */ * from employees
    5 Claude        claude-sonnet-4     tool              run-sqlcl
info employees
    6 Claude        claude-sonnet-4     tool              disconnect
Disconnect from HR

SQL>
```

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;
```

3.8.3 Monitoring Through Your Client

Your MCP client provides the most direct way to monitor server activity.

For example, in an application like Claude Desktop, the log files capture detailed information about the server's operations, including:

- Connection events
- Tool executions
- Query results
- Error messages

Always check your client's logs first when you need to troubleshoot an issue.

3.8.4 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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4

AI Enrichment Using the Annotation Command

The `annotation` command enables you to add, manage, and generate metadata annotations for database objects directly in SQLcl.

Annotations are additional metadata that describe objects in your schema. A common example is a `DESCRIPTION` annotation on a table or column. These descriptions make a schema easier to understand, document, search, and use with AI workflows or large language models (LLMs). The command supports both manually created annotations and LLM-assisted annotations.

For complete syntax and options for the `annotation` command and its subcommands, see ANNOTATION in the SQLcl Command Reference.

Topics:

- About Annotations
- Prerequisites
- Supported Object Types
- Set Up AI Enrichment
- Work with Annotations
- Organize Objects into Groups
- Generate an Annotation Report
- Generate Annotations with AI
- Inspect Enrichment Status

4.1 About Annotations

An annotation is a label-value pair that provides information about a database object.

The label identifies the type of information stored in the annotation. For example, `DESCRIPTION` can identify descriptive information, while `SECURITY` can identify security-related information. Labels are user-defined, so it is recommended to use names that are clear and consistent.

The value contains the information associated with the label. For example, a `SALARY` column in an `EMPLOYEE` table might have a `DESCRIPTION` annotation with the value `"Employee base monthly salary before taxes and with no bonuses."`

4.2 Prerequisites

Before you begin, you must ensure the following:

- You have a valid connection to a database schema, with the default privileges required to create objects and run PL/SQL procedures.
- You have run `annotation install` once in the database to install the AI Enrichment metadata package.

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- For `annotation auto-annotate`, you have configured a SQLcl LLM chat model by using the `model` command. If no LLM is configured, `annotation auto-annotate` fails and does not generate descriptions for tables and columns.

  For more information about the `model` command, see Using the Model Command for Retrieval-Augmented Generation.

4.3 Set Up AI Enrichment

The setup commands are `install` and `status`.

Install

The `install` command installs the AI Enrichment package in the connected database.

Syntax

```
annotation install
```

This creates the metadata objects used to store annotations and groups.

Check Installation Status

The `status` command checks whether the AI Enrichment package is installed.

Syntax

```
annotation status
```

4.4 Work with Annotations

Use the following commands to add, get, edit, and delete metadata annotations on database objects.

Syntax

```
annotation <command> [options]
```

4.4.1 Add an Annotation

This command enables you to add a new annotation to an object. An object can have multiple annotations using different labels.

Syntax

```
annotation annotate
-type <object-type>
-name <object-name>
-label <annotation-label>
-value <annotation-value>
[-debug]
[-verbose]
```


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For descriptions of all options, see ANNOTATION.

Example

```
annotation annotate -type 'TABLE COLUMN' -name SHOTS.PEAK_BALL_SPEED_KMH
-label DESCRIPTION -value 'Maximum ball speed in kilometers per hour recorded
after the shot was taken'
```

This adds a `DESCRIPTION` annotation to the `PEAK_BALL_SPEED_KMH` column in the `SHOTS` table.

4.4.2 Get an Annotation

This command enables you to read the value of an existing annotation.

Syntax

```
annotation get-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
[-debug]
[-verbose]
```

Example

```
annotation get-annotation -type 'TABLE COLUMN'
-name SHOTS.PEAK_BALL_SPEED_KMH -label DESCRIPTION
```

This returns the `DESCRIPTION` annotation attached to the `PEAK_BALL_SPEED_KMH` column in the `SHOTS` table.

4.4.3 Edit an Annotation

This command enables you to replace the value of an existing annotation.

Syntax

```
annotation edit-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
-value <new-annotation-value>
[-debug]
[-verbose]
```

Example

```
annotation edit-annotation -type 'TABLE COLUMN' -name
SHOTS.PEAK_BALL_SPEED_KMH
-label DESCRIPTION -value 'Maximum ball speed in kilometers per hour recorded
right after the shot was taken'
```


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This updates the existing DESCRIPTION annotation on the PEAK_BALL_SPEED_KMH column in the SHOTS table.

4.4.4 Delete an Annotation

Use this command to remove an existing annotation from an object by using its label, object name, and object type.

Syntax

```
annotation delete-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
[-debug]
[-verbose]
```

Example

```
annotation delete-annotation -type 'TABLE COLUMN'
-name SHOTS.PEAK_BALL_SPEED_KMH -label DESCRIPTION
```

This removes the DESCRIPTION annotation from the PEAK_BALL_SPEED_KMH column in the SHOTS table. It does not delete the column, the table, or any other annotations attached to that object.

4.5 Organize Objects into Groups

Groups enable you to organize related database objects under a shared name.

A group is metadata managed by the AI Enrichment package. It does not create, modify, or delete database objects. Instead, a group provides a logical association between multiple database objects, allowing users to organize related objects based on a common area, business meaning, or other user-defined criteria.

For example, a group named MATCH_ANALYTICS could contain tables such as MATCHES, PLAYERS, SHOTS, and PASSES.

4.5.1 Create a Group

Use this command to create a new group.

Syntax

```
annotation add-group -group <group-name>
[-debug] [-verbose]
```

Example

```
annotation add-group -group MATCH_ANALYTICS
```

This creates a group named MATCH_ANALYTICS.

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4.5.2 List Groups

Use this command to list the groups that have been created.

Syntax

```
annotation list-groups
```

This lists the available annotation groups.

4.5.3 Add an Object to a Group

Use this command to add a database object to a group.

Syntax

```
annotation add-to-group -group <group-name>
-type <object-type> -name <object-name>
```

For descriptions of all options, see ANNOTATION.

Example

```
annotation add-to-group -group MATCH_ANALYTICS
-type TABLE -name SHOTS
```

This adds the `SHOTS` table to the `MATCH_ANALYTICS` group.

4.5.4 Remove an Object from a Group

Use this command to remove an object from a group.

Syntax

```
annotation remove-from-group -group <group-name>
-type <object-type> -name <object-name>
[-debug] [-verbose]
```

Example

```
annotation remove-from-group -group MATCH_ANALYTICS
-type TABLE -name SHOTS
```

This removes the `SHOTS` table from the `MATCH_ANALYTICS` group. Note that the `SHOTS` table is not changed.

4.5.5 Delete a Group

Use this command to delete a group.

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Syntax

```
annotation delete-group -group <group-name>
[-debug] [-verbose]
```

Example

```
annotation delete-group -group MATCH_ANALYTICS
```

This example deletes the `MATCH_ANALYTICS` group metadata. It does not delete the database objects that were in the group, and it does not delete annotations from those objects.

4.6 Generate an Annotation Report

This command generates a Markdown report containing all tables and their column annotations.

Syntax

```
annotation report -output <output-file>
```

The `-output` option is required. It specifies the path to the Markdown file that SQLcl creates.

Examples

```
annotation report -output match-annotations.md
```

```
annotation report -output /path/to/match-annotations.md
```

These examples create a Markdown file named `match-annotations.md` containing the current table and associated column annotations.

This report is useful for reviewing the documentation stored with the schema, sharing annotations, or searching for annotations associated with a specific object outside the CLI.

> **Note**
>
> SQLcl does not overwrite an existing report file. Therefore, if a file with the specified name already exists, specify a different file name or delete the existing file before generating the report.

4.7 Generate Annotations with AI

By default, SQLcl selects the most referenced tables in the current schema and checks the tables and their columns for missing `DESCRIPTION` annotations. SQLcl then builds the schema context, sends it to the configured LLM, and stores the generated descriptions as annotations. Objects that already have a `DESCRIPTION` annotation are skipped.

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Syntax

```
annotation auto-annotate {OPTIONS}
```

For descriptions of all options, see ANNOTATION.

Topics:

- Workflow for AI-Assisted Annotation
- Generate Descriptions Using the Default Selection
- Generate Descriptions for Specific Tables and Filters
- Exclude Tables After Selection
- Provide Guidance and Reference Files

4.7.1 Workflow for AI-Assisted Annotation

The following workflow diagram explains AI-assisted annotation, where SQLcl selects tables, checks for missing descriptions, and uses a configured chat model to generate annotations.

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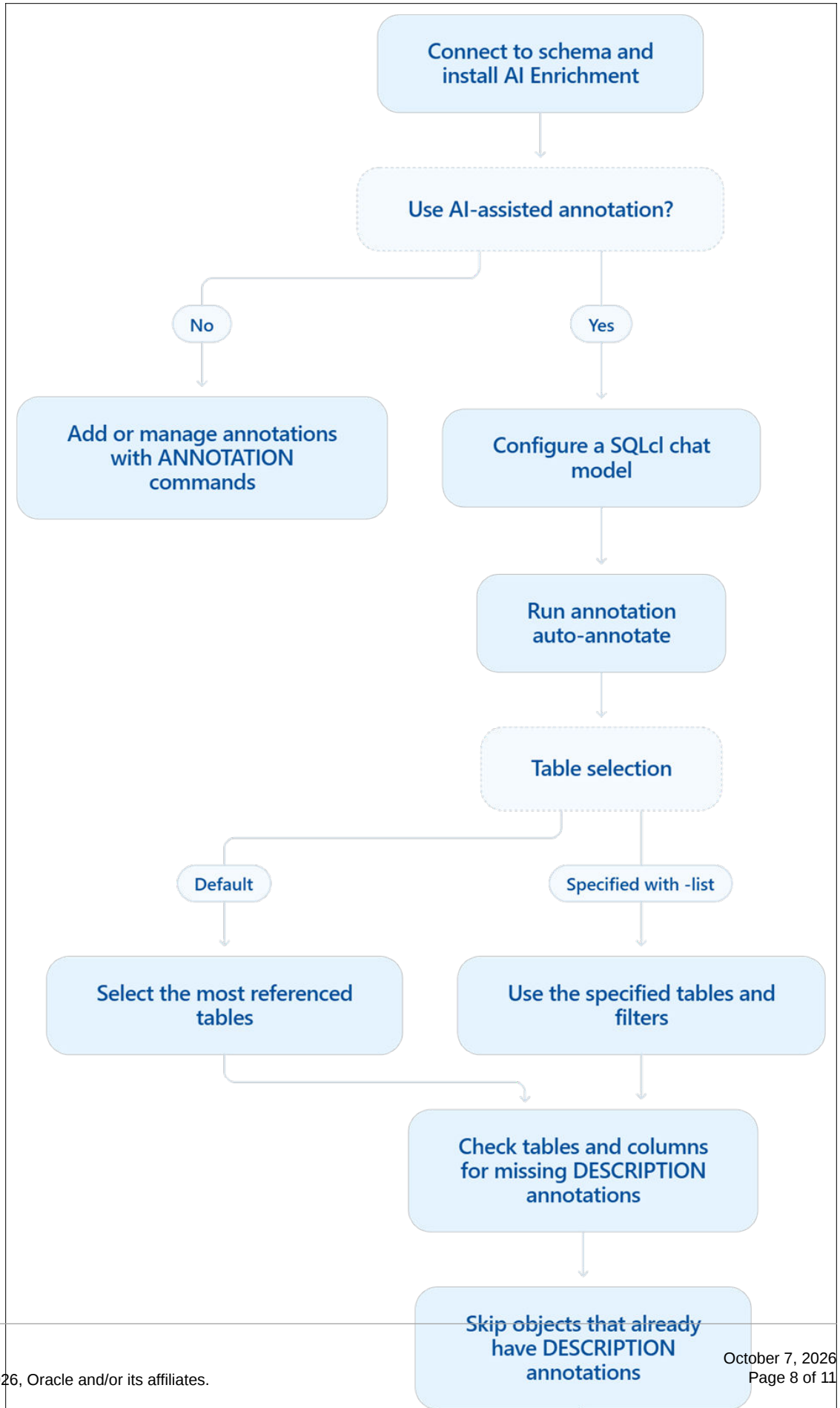
Figure 4-1 Workflow for AI-Assisted Annotation



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4.7.2 Generate Descriptions Using the Default Selection

When the `-list` option is not specified, SQLcl selects the most referenced tables in the current schema. A table is considered more referenced when other tables point to it through foreign keys. For each selected table, SQLcl generates missing `DESCRIPTION` annotations for the table and its columns.

Example

```
annotation auto-annotate
```

4.7.3 Generate Descriptions for Specific Tables and Filters

Use the `-list` option to specify the tables for which to generate annotations. When specified, this option overrides the default table selection and supports SQL-like filters for selecting multiple tables.

Examples

```
annotation auto-annotate -list SHOTS,PASSES,PLAYERS
```

This considers only the `SHOTS`, `PASSES`, and `PLAYERS` tables.

```
annotation auto-annotate -list 'SHOTS,MATCH_%'
```

This considers `SHOTS` and all tables starting with `MATCH_`.

4.7.4 Exclude Tables After Selection

Use the `-ignore-list` option to ignore tables from the default selection or from a table pattern supplied with `-list`. If a table is selected in `-list` and then ignored in `-ignore-list`, it is ignored.

Examples

```
annotation auto-annotate -ignore-list AUDIT_LOG,TEMP_IMPORT
```

This removes `AUDIT_LOG` and `TEMP_IMPORT` from the selected table set.

```
annotation auto-annotate -list 'SHOTS,MATCH_%' -ignore-list 'MATCH_DURATION'
```

This adds `SHOTS` and all tables starting with `MATCH_`, then removes `MATCH_DURATION` from the selected tables.

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4.7.5 Provide Guidance and Reference Files

Use the `-prompt` option to add instructions to the LLM.

```
annotation auto-annotate -list SHOTS -prompt 'Use concise descriptions for
football analytics users. Add explanations for mathematical formulas for how
numerical values are calculated'
```

This tells the LLM to keep the generated descriptions concise and focused on the football analytics context, with explanations of mathematical formulas.

For longer guidance, use a prompt file:

```
annotation auto-annotate -prompt-file annotation-guidance.md
```

For extra schema or business context, use reference files or URLs:

```
annotation auto-annotate -reference file.md,https://site.oracle.com/
schemadoc.pdf
```

The `-list`, `-ignore-list`, `-prompt`, `-prompt-file`, and `-references` options can be combined.

4.8 Inspect Enrichment Status

The commands covered in this section are `list tables`, `statistics` and `most referenced tables`.

List Tables

This command lists tables in the current schema.

Syntax

```
annotation list-tables
```

This is useful for listing tables that are not part of the installed AI Enrichment package.

Statistics

This command shows the enrichment progress.

Syntax

```
annotation stats
```

This shows general information such as which objects have a `DESCRIPTION` annotation, the count of enriched objects, and the progression, with a percentage, of annotated or enriched schema objects.

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Most Referenced Tables

This command lists tables ranked by the number of foreign key references from other tables.

Syntax

```
annotation most-referenced-tables
```

This helps identify central tables in the schema. By default, `annotation auto-annotate` selects these tables when no objects are specified. Because they are referenced most by other objects, they are often useful candidates for annotation.

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5

Using the Model Command for Retrieval-Augmented Generation

The SQLcl `model` command configures OCI Generative AI models, prepares local documents for semantic search, and manages documents that have been ingested into Oracle vector tables.

For the complete syntax and available options, see MODEL in the SQLcl Command Reference.

The `model` command configures the models and prepares the document knowledge base used in a RAG workflow. The SQLcl MCP `context_retrieve` tool can then retrieve relevant context from the ingested documents.

Topics:

- Prerequisites
- Configure Models
- Ingest Documents
- Remove an Ingested Document
- Use Ingested Documents with the SQLcl MCP Server

5.1 Prerequisites

Before using the `model` command, ensure that the following prerequisites are met:

- For `model ingest` and `model delete`, connect SQLcl to an Oracle Database that supports the Oracle AI Vector Search features and Vector Database APIs required by these commands. See Overview of Oracle Vector AI Search
- Ensure that the connected database user has the privileges required to create and use vector tables and indexes, and to execute the required vector database APIs.
- Ensure that you have access to the required OCI Generative AI model and compartment. See OCI Generative AI Models
- Ensure that the OCI identity used by SQLcl has permission to invoke the selected model. See IAM Policies for Generative AI.
- Ensure that files supplied to `model ingest` are accessible and readable by the SQLcl process.

5.1.1 OCI Authentication

The `model` command supports OCI profile authentication and instance principal authentication.

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To use an OCI profile, select the profile before configuring a model:

```
SQL> OCI PROFILE <profile-name>
```

By default, SQLcl reads OCI profiles from the following configuration file:

```
~/.oci/config
```

To use a different OCI configuration file, specify the `-config-path` option when configuring the model.

If you do not select an OCI profile, SQLcl uses instance principal authentication. In this case, SQLcl must run on an OCI resource that is configured to use instance principals and has the required IAM policies to access OCI Generative AI. For more information about IAM policies, see IAM Policies for OCI Generative AI.

The compartment OCID is required when configuring either model. The selected OCI profile or instance principal must be able to access the compartment and invoke the requested model.

For more information, see Configuring the OCI Profile.

5.1.2 Local Configuration File

SQLcl stores model configuration in:

```
~/.dbtools/sqlcl/model_config.json
```

The file is created automatically after the first successful `model config` command. It stores the configured chat-model and embedding-model settings.

5.2 Configure Models

Configure the chat model and embedding model separately.

The chat model is used for answer generation. The embedding model is used for document ingestion and semantic retrieval. Use the same embedding-model configuration for ingestion and retrieval. The chat model is used when retrieved context is supplied to an AI model to generate a response.

5.2.1 Configure the Chat Model

The chat-model configuration identifies the OCI Generative AI chat model that can be used for answer generation.

Syntax

```
MODEL CONFIG CHAT-MODEL -model-name <model-id>
-serving-type <ON-DEMAND|DEDICATED> -compartment-id <compartment-ocid>
[-config-path <oci-config-file>] [-debug] [-verbose]
```


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SQLcl determines the chat-model integration from the specified model name. Model names containing `cohere` use the OCI Cohere integration. Other model names use the generic OCI Generative AI integration.

Examples

- Configure an on-demand chat model:

```
SQL> MODEL CONFIG CHAT-MODEL -compartment-id
"ocid1.compartment.oc1..example"
-model-name "cohere.command-r-plus" -serving-type ON-DEMAND
```

- For a dedicated deployment, specify the dedicated endpoint identifier and set the serving type to DEDICATED:

```
SQL> MODEL CONFIG CHAT-MODEL -compartment-id
"ocid1.compartment.oc1..example"
-model-name "<dedicated-endpoint-ocid>" -serving-type DEDICATED
```

5.2.2 Configure an Embedding Model

The embedding model generates vectors during document ingestion and semantic retrieval.

The embedding model converts document content and retrieval queries into vector embeddings.

> **Note**
>
> Use the same embedding-model configuration for both document ingestion and semantic retrieval to ensure that document content and retrieval queries are represented consistently.

Syntax

```
MODEL CONFIG EMBEDDING-MODEL -model-name <model-id>
-serving-type <ON-DEMAND|DEDICATED> -compartment-id <compartment-ocid>
[-config-path <oci-config-file>] [-debug] [-verbose]
```

Example

- To configure an embedding model

```
SQL> MODEL CONFIG EMBEDDING-MODEL
-model-name "openai.text-embedding-3-large"
-serving-type ON-DEMAND
-compartment-id "ocid1.compartment.oc1..example"
```


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5.2.3 View the Saved Model Configuration

Model configuration is stored in:

```
~/.dbtools/sqlcl/model_config.json
```

The file is created automatically by the first successful `MODEL CONFIG` command.

To display the saved configuration, use the following command:

```
SQL> MODEL CONFIG -list
```

5.3 Ingest Documents

MODEL INGEST reads a file or recursively scans a directory, creates embeddings using the configured embedding model, and stores the document chunks in the specified Oracle vector table.

Syntax

```
MODEL INGEST -path <file-or-directory>
-table <vector-table> [-debug] [-verbose]
```

5.3.1 Prerequisites

Before running `model ingest`, ensure the following:

- Configure an embedding model by using `MODEL CONFIG EMBEDDING-MODEL`.
- Connect SQLcl to the target Oracle Database.
- Ensure that the specified path is readable.
- Ensure that the connected database user can create or use the target vector table and vector index.

> **Note**
>
> The chat model is not required for ingestion.

5.3.2 Supported File Types for Model Ingest

`model ingest` supports the following file types:

File Type	Parser	Description
PDF	Apache PDFBox	Extracts text from PDF documents.

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File Type	Parser	Description
DOC, DOCX	Apache POI	Extracts content from Microsoft Word documents.
XLS, XLSX	Apache POI	Extracts content from Microsoft Excel workbooks.
PPT, PPTX	Apache POI	Extracts content from Microsoft PowerPoint presentations.
TXT, MD	Text parser	Processes the file as plain text.

When `-path` specifies a directory, SQLcl scans the directory and its subdirectories for supported files. Unsupported files are ignored.

5.3.3 Ingest Workflow

For each `model ingest` operation, SQLcl:

1. Verifies that the specified file or directory exists.
2. Loads the saved embedding model configuration.
3. Creates the target vector table and HNSW (Hierarchical Navigable Small World) vector index if they do not already exist.
4. Verifies that the target table is compatible with the configured embedding model.
5. Processes the specified file or, if a directory is specified, the supported files in that directory and its subdirectories.
6. Computes a hash for each document and skips documents that have already been ingested into the target table.
7. Extracts the document content and metadata.
8. Divides the content into smaller chunks.
9. Generates a vector embedding for each chunk.
10. Stores the chunks, vector embeddings, and document metadata in the target vector table.
11. Commits the operation.

SQLcl uses the document content hash to detect documents that have already been ingested. Running the same command again skips documents whose content is already present in the target table.

If an operation fails, SQLcl rolls back the current transaction and restores the connection's original auto-commit setting.

5.3.4 Duplicate Detection and Model Compatibility Checks

SQLcl uses the document's content hash to detect documents that have already been ingested. Duplicate detection uses the selected target table and the document content hash, it does not rely on the file name alone. If the contents of a file change, the document hash typically changes, allowing the modified file to be ingested as a new document.

The embedding-model configuration used for ingestion must match the model fingerprint recorded for the target vector table. If the embedding model or another configuration value that affects its fingerprint changes, use a separate vector table.

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SQLcl creates and maintains the compatibility metadata. Users do not normally set these values manually.

5.3.5 Examples

Configure the embedding model before the first ingest:

```
SQL> MODEL CONFIG EMBEDDING-MODEL -model-name "cohere.embed-english-v3.0"
-serving-type ON-DEMAND -compartment-id "ocid1.compartment.oc1..example"

SQL> model ingest -path "./knowledge-base" -table HR_DOCS -verbose
```

Ingest one document:

```
SQL> MODEL INGEST -path "./knowledge-base/guide.pdf" -table HR_DOCS
```

Recursively ingest supported files:

```
SQL> MODEL INGEST -path "./knowledge-base" -table HR_DOCS -verbose
```

Running the command again checks the stored document hashes and skips documents that have already been ingested into `HR_DOCS`.

5.4 Remove an Ingested Document

Use `model delete` to remove vectors associated with a previously ingested document.

`model delete` removes the document chunks, vector embeddings, and associated metadata from the specified vector table. It does not delete the original file from the local file system.

Syntax

```
MODEL DELETE -file-path <file>
-table <vector-table> [-debug] [-verbose]
```

The source file must still exist and must be a regular file. SQLcl calculates the content hash of the file and uses it to identify and remove the corresponding document data from the specified vector table.

Example

```
MODEL DELETE -file-path "./knowledge-base/guide.pdf"
-table HR_DOCS
```

> **Note**
>
> If the file has changed since it was ingested, SQLcl might not find a matching document. If the document was not ingested into the specified table, SQLcl reports that no matching document was found.

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5.5 Use Ingested Documents with the SQLcl MCP Server

`model ingest` can be used with SQLcl MCP retrieval capabilities to implement a retrieval-augmented generation workflow.

5.5.1 Retrieval Workflow

`model ingest` prepares the knowledge base. The `context_retrieve` MCP tool searches that knowledge base and returns relevant document context.

The tool uses the same embedding-model configuration that was used during ingestion. It returns context to the MCP client. it does not generate the final answer or modify the vector tables.

A typical workflow is:

1. Configure an embedding model.
2. Ingest one or more documents into an Oracle vector table.
3. Send a semantic query from an MCP client.
4. `context_retrieve` embeds the query.
5. The tool searches compatible SQLcl RAG vector tables.
6. The tool returns relevant document context.
7. The MCP Client provides the context to the configured chat model.

RAG Retrieval Workflow

```
Prepare the Knowledge Base

Local Documents
      ↓
MODEL INGEST
      ↓
Embedding Model
      ↓
Oracle Vector Table
(chunks and embeddings)

      ↓
Retrieve Relevant Context

User Query
      ↓
context_retrieve
      ↓
Embed Query + Search Compatible
SQLcl RAG Vector Tables
      ↓
Relevant Document Context

      ↓
Generate a Response
```


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```
MCP Client
      ↓
Chat Model
      ↓
Generated Response
```

5.5.2 Vector Table Compatibility for Retrieval

The MCP server searches only SQLcl RAG vector tables that are compatible with the active embedding model.

A compatible table contains the following metadata:

Metadata	Required Value
purpose	sqlcl-rag
model_fingerprint	Fingerprint of the active embedding model.
vector_dimension	Vector dimension of the active embedding model.

The MCP tool discovers matching tables through the database vector APIs. It searches each table and combines the returned document chunks into one text result. Each table can contribute up to seven results, subject to the configured minimum similarity score of 0.7.

The tool returns context to the MCP client. It does not return the final answer and does not modify the vector tables.

If no compatible table is found, the tool reports that no tables matched the active embedding-model fingerprint. If compatible tables are found but the search returns no chunks, the tool reports that no retrieval context was found.

For more information about semantic retrieval from an MCP client, see Using the Oracle SQLcl MCP Server.

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6

Running SQLcl as a Scheduler Daemon

Learn how to run SQLcl as a background scheduler daemon to automate and manage jobs.

Topics:

- About the SQLcl Scheduler Daemon
- Managing the Scheduler Daemon
- Scheduling Daemon Jobs
- Monitoring with Log Files
- Using a Unix Service to Manage Daemons

6.1 About the SQLcl Scheduler Daemon

You can run SQLcl as a scheduler daemon process. Based on a schedule file, the daemon automatically schedules and executes jobs using a cron-based schedule. This allows you to automate recurring tasks without maintaining an active SQLcl session.

The daemon is designed to be user-specific. Only one daemon instance is allowed per operating system user. This means you can start the daemon only once when you're logged in as a specific user. To start the daemon again, you must stop the currently running instance or use the `restart` command. The options to manage the daemon are integrated directly into the SQL command that's used to launch SQLcl.

> **Note**
>
> This feature is currently not supported on Windows systems.

6.2 Managing the Scheduler Daemon

You can manage the life cycle of the daemon using the `-daemon` option with the `sql` command.

Starting the Daemon

You can start the daemon only if it is not already running.

Command

```
sql -daemon start
```

Example

```
sql -daemon
start
```


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```
Starting SQLcl daemon...
INFO Mon Jun  9 00:09:38 +01 2025: Daemon started with PID 1666
```

Stopping the Daemon

To stop the daemon, it must currently be running.

Command

```
sql -daemon stop
```

Example

```
sql -daemon
stop
INFO Mon Jun  9 00:11:08 +01 2025: Daemon stopped, process with PID 1666 has
been killed
```

Restarting the Daemon

To stop and then immediately start the daemon in a single operation, use the `restart` command. This is useful for applying configuration changes that are not subject to live reloading.

Command

```
sql -daemon restart
```

Example

```
sql -daemon
restart
INFO Mon Jun  9 00:14:09 +01 2025: Daemon stopped, process with PID 2372 has
been killed
Starting SQLcl daemon...
INFO Mon Jun  9 00:14:13 +01 2025: Daemon started with PID 2464
```

Checking the Daemon Status

Use this command to check if the daemon is running for the current user.

Command

```
sql -daemon status
```

Example

```
sql -daemon
status
INFO Mon Jun  9 00:15:39 +01 2025: Daemon is running (PID 2464)
```


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6.3 Scheduling Daemon Jobs

The daemon's behavior is controlled by a YAML configuration file that defines the jobs to be scheduled.

The name of this YAML file or the schedule file is `scheduler.yaml`. The SQLcl daemon reads this file to load and schedule jobs.

Learn about the schedule file's location, its structure, and how the daemon actively monitors the file to reload jobs.

- Schedule File Location
- Schedule File Structure
- Live Reload of Jobs

6.3.1 Schedule File Location

The Database Tools (`dbtools`) home directory contains the schedule file.

The schedule file location is:

```
${HOME}/.dbtools/schedules/scheduler.yaml
```

When the daemon is started for the first time, it automatically creates the schedule file at this location, with a commented-out sample job.

Default content on first run:

```
cat ~/.dbtools/schedules/
scheduler.yaml

jobs:
# - name: job-example
#   cron: 0/2 * * * * ? *
#   connection: named-conn-example
#   payload: "@/path/to/script.sql arg1 arg2 arg3"
```

6.3.2 Schedule File Structure

The `scheduler.yaml` file contains a top-level key (`jobs`) that points to a list of job definitions.

Each job entry in a `jobs` list is an object with the following keys:

- **name** *(Required)*: A unique identifier for the job. This name is also used for the job's log file.
- **cron** *(Required)*: A Quartz-compatible cron expression with seven fields (from seconds to year) that defines the schedule.
  Examples of schedules defined using cron expressions:
  - **0 15 10 ? * *** — Runs at 10:15 AM every day.
  - **0 0/5 14 * * ?** — Runs every 5 minutes starting at 2:00 PM and ending at 2:55 PM, every day.

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  - **0 0/5 14,18 * * ?** — Runs every 5 minutes starting at 2:00 PM and ending at 2:55 PM, AND runs every 5 minutes starting at 6:00 PM and ending at 6:55 PM, every day.

- **connection** *(Optional)*: A saved SQLcl connection (for example, a connection created using `conn -save <name> -savepwd`).
  Using a saved connection allows the job to run without interactive password prompts. If omitted, the job runs without a database connection (`/nolog`).
- **payload** *(Required)*: A valid SQL, PL/SQL, or SQLcl-specific command or script to be executed by the daemon.
  Payload examples:
  - **Inline SQL or SQLcl command:** Useful for simple, single-line operations.

    ```
    payload: desc employees
    ```

  - **Script file with arguments:** Useful for enhancing reusability and flexibility across use cases.

    ```
    payload: "@/path/to/generate_report.sql 2024 Q1"
    ```

    Notice the quotes around the string starting with `@`. Using this string without quotes causes a syntax error because the `@` character is reserved for future use according to the YAML specification.
  - **Multiline payload using YAML literal block:** Ideal for longer SQL or PL/SQL scripts defined directly in YAML.

    ```
    payload: |
      BEGIN
        DBMS_OUTPUT.PUT_LINE('Job started');
        -- Add more PL/SQL logic here
      END;
      /
    ```

6.3.3 Live Reload of Jobs

The daemon actively monitors the `scheduler.yaml` file for changes.

When the file is modified and saved, the daemon performs the following actions without requiring a restart:

- Calculates a checksum of each job definition to detect changes.
- Adds new jobs if any.
- Reschedules jobs that were modified.
- Unschedules jobs that were removed.
- Leaves unchanged jobs as is.

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6.4 Monitoring with Log Files

The SQLcl daemon includes a built-in reporting system for job execution events, scheduler lifecycle events, and configuration issues. It records key events and errors in log files to help you debug and monitor scheduled jobs.

Learn about log formats, log file locations, and their descriptions.

- Log Formats
- Log File Locations
- Log File Descriptions

6.4.1 Log Formats

The log files have a semi-structured format, where each log line contains tokens enclosed in `[]` and separated by ` - ` (a hyphen surrounded by spaces) for better readability and parsing.

Logs are generated in two primary formats, one for informational entries and another for error entries. However, key events like job scheduling or job completion have unique, dedicated formats.

- **Informational messages:** This format is used for general messages, such as job started, scheduler started, and so on.

  ```
  [timestamp] - [STATUS] - [MESSAGE: <message>]
  ```

- **Error reports:** This format is used for error messages, such as job failed, scheduler start failed, and so on.

  ```
  [timestamp] - [STATUS] - [ERROR: <error-message>]
  ```

  In the above formats, the `STATUS` field classifies the type of log event, and the `MESSAGE` or `ERROR` field provides the details.

- Special formats for key events.
  - **Job scheduling (SCHEDULE_JOB):** This format is used to indicate that a job has been successfully scheduled for execution.

    ```
    [timestamp] - [SCHEDULE_JOB] - [JOB: <job-name>] - [JOB_LOG: <full-log-file-path>]
    ```

  - **Job completion (COMPLETED):** This format is used to indicate that a job has successfully completed execution.

    ```
    [timestamp] - [COMPLETED] - [JOB_RESULT: <output returned by running the job>]
    ```

    If the output spans multiple lines, it's wrapped in the following way:

    ```
    [timestamp] - [COMPLETED] - [JOB_RESULT:
        line 1 of output
    ```


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```
    line 2 of output
]
```

- **Schedule file events:** This format is used to indicate the changes that can occur to the schedule file (`scheduler.yaml`), such as `SCHEDULE_FILE_LOADED`, `SCHEDULE_FILE_VALIDATED`, and `SCHEDULE_FILE_ERROR`.

  ```
  [timestamp] - [STATUS] - [SCHEDULE_FILE: <schedule-file-path>]
  ```

6.4.2 Log File Locations

The Database Tools (`dbtools`) home directory contains the log files.

The log files path is:

```
${HOME}/.dbtools/schedules/
```

The SQLcl daemon uses the following directory structure for log files:

```
~/.dbtools/schedules
├─── logs
│    ├─── job-<job-name>.log
│    └─── jobs.log
├─── pid
├─── scheduler.log
└─── scheduler.yaml
```

6.4.3 Log File Descriptions

Each log file of the SQLcl daemon has a distinct purpose. For example, one file records daemon lifecycle logs while another captures scheduling logs of jobs, and so on.

The daemon contains the following log files:

- Daemon Life Cycle Logs (`scheduler.log`)
- Shared Job Scheduling Logs (`jobs.log`)
- Per-Job Execution Logs (`job-<job-name>.log`)

> **Note**
>
> Log rotation is not supported, so these log files may grow over time.

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6.4.3.1 Daemon Life Cycle Logs (`scheduler.log`)

The `scheduler.log` file records high-level events related to the daemon's life cycle, such as startup, shutdown, and failures.

Table 6-1 Statuses reported in life cycle logs

Status	Description	Example
`STARTED`	Indicates the scheduler has started successfully and is ready to begin scheduling jobs.	`[2025-05-06 09:00:00] - [STARTED] - [MESSAGE: SQLcl daemon started]`
`STOPPED`	Indicates the scheduler has been stopped and the job scheduling has ceased.	`[2025-05-06 09:00:00] - [STOPPED] - [MESSAGE: SQLcl daemon stopped]`
`STARTUP_FAILED`	Indicates the scheduler has failed to start. The message provides the reason.	`[2025-05-06 09:00:00] - [STARTUP_FAILED] - [ERROR: <error-message>]`
`SHUTDOWN_FAILED`	Indicates the scheduler has failed to shut down cleanly. The message provides the reason.	`[2025-05-06 18:35:00] - [SHUTDOWN_FAILED] - [ERROR: <error-message>]`

6.4.3.2 Shared Job Scheduling Logs (`jobs.log`)

The `jobs.log` file logs events that affect all jobs, such as updates to the schedule file, validations, and job scheduling actions.

Table 6-2 Statuses reported in shared-job scheduling logs

Status	Description	Example
`SCHEDULE_FILE_LOADED`	Indicates the schedule file was successfully loaded and serialized, and jobs are available for scheduling.	`[2025-05-06 10:00:00] - [SCHEDULE_FILE_LOADED] - [SCHEDULE_FILE: /Users/<username>/.dbtools/schedules/scheduler.yaml]`

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Table 6-2 (Cont.) Statuses reported in shared-job scheduling logs

Status	Description	Example
SCHEDULE_FILE_ERROR	Indicates the schedule file is invalid due to missing fields or malformed content.	[2025-05-06 10:00:00] - [SCHEDULE_FILE_ERROR] - [ERROR: <error-message>]
SCHEDULE_FILE_VALIDATED	Indicates the schedule file is valid and the system can proceed to schedule jobs.	[2025-05-06 10:00:00] - [SCHEDULE_FILE_VALIDATED] - [SCHEDULE_FILE: /Users/<username>/.dbtools/schedules/scheduler.yaml]
SCHEDULE_JOB	Indicates a job has been successfully scheduled. The log shows the job's name and its dedicated log file path.	[2025-05-06 18:35:00] - [SCHEDULE_JOB] - [JOB: test] - [JOB_LOG: /Users/<username>/.dbtools/schedules/logs/job-test.log]
JOB_SCHEDULE_FAILED	Indicates a job failed to be scheduled due to an invalid cron expression or internal error.	[2025-05-06 18:35:00] - [JOB_SCHEDULE_FAILED] - [ERROR: <error-message>]

6.4.3.3 Per-Job Execution Logs (job-<job-name>.log)

Each job has its own dedicated log file, recording only that job's activity. This facilitates isolating and debugging job-specific behavior.

Table 6-3 Statuses reported in individual job logs

Status	Description	Example
RUNNING	Indicates the job has started executing. This confirms that the job's scheduled time has arrived and a resource has been allocated to run it.	[2025-05-06 10:00:00] - [RUNNING] - [MESSAGE: Job execution started]

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Table 6-3 (Cont.) Statuses reported in individual job logs

Status	Description	Example
COMPLETED	Indicates the job has completed successfully. The job's output is included in the log.	[2025-05-06 10:00:00] - [COMPLETED] - [RESULT: Name Null? Type ------------ -------- ------------ COUNTRY_ID NOT NULL CHAR(2) COUNTRY_NAME VARCHAR2(40) REGION_ID NUMBER]
FAILED	Indicates the job failed to complete due to errors like a missing connection or script failure. The reason is included in the log.	[2025-05-06 10:00:00] - [FAILED] - [ERROR: Unknown connection test]

6.5 Using a Unix Service to Manage Daemons

When SQLcl is installed using the RPM package, it includes a `systemd` service (named `sql-scheduler`) to centrally manage SQLcl scheduler daemons for multiple users. This service manages daemons of all users belonging to a specific Unix group.

When you install SQLcl using the RPM package, the following user and group configurations are performed:

- A Unix group named `sql-scheduler` is created if one doesn't exist on the system.
- The `oracle` user account is created if it doesn't exist. Additionally, it is added to the `sql-scheduler` group.

If you add any other user to the `sql-scheduler` group, their scheduler daemon is automatically managed by the `systemd` service.

When a user is part of this group, the user's daemon starts automatically on system boot (if the service is enabled) and stops cleanly on system shutdown.

> **Note**
>
> The `systemd` service manages only the users in the `sql-scheduler` group. Other users must manage their daemon manually using the `sql -daemon` commands.

Explore the following topics for information on using this Unix service and accessing in-product support resources.

- Managing the Service as the Root User

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- In-Product Help

6.5.1 Managing the Service as the Root User

After installing the SQLcl RPM package and ensuring all the required users are in the `sql-scheduler` group, a privileged user (like `root`) can manage the service to centrally control starting and stopping daemons for the users.

This example demonstrates managing the service as the `root` user to control the scheduler daemon for the `oracle` user.

Check the `oracle` User's Group

Confirm that the `oracle` user is part of the `sql-scheduler` group.

```
[root@oracledb23ia ~]$ groups oracle
oracle : oracle oinstall .... sql-scheduler
```

Check the `sql-scheduler` Service Status

Confirm that the `sql-scheduler` service is installed.

```
[root@oracledb23ia ~]$ systemctl status sql-scheduler
   sql-scheduler.service - SQLcl scheduler services
   Loaded: loaded (/etc/systemd/system/sql-scheduler.service; disabled;
vendor preset: disabled)
   Active: inactive (dead)

Jun 09 13:02:57 oracledb23ia.localdomain systemd[1]: Started SQLcl scheduler
services.
```

Start the Service

Run the `sql-scheduler` service to start the scheduler daemon for all users in the `sql-scheduler` group (in this case, just the `oracle` user).

```
[root@oracledb23ia ~]$ systemctl start sql-scheduler
[root@oracledb23ia ~]$ systemctl status sql-scheduler
   sql-scheduler.service - SQLcl scheduler services
   Loaded: loaded (/etc/systemd/system/sql-scheduler.service; disabled;
vendor preset: disabled)
   Active: active (running) since Mon 2025-06-09 13:39:06 CST; 2min 29s ago
  Process: 3832 ExecStart=/usr/bin/bash -c /etc/init.d/sql-scheduler start
(code=exited, status=0/SUCCESS)
 Main PID: 3938 (java)
    Tasks: 0 (limit: 36046)
   Memory: 64.0K
   CGroup: /system.slice/sql-scheduler.service
```


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Check the Service Logs

Use the `journalctl` command to view the service logs. All related logs, schedule configuration files, and runtime data for the `oracle` user are placed in the following location: `/home/oracle/.dbtools/schedules`.

```
[root@oracledb23ia ~]# journalctl -a -f -u sql-scheduler

Jun 09 13:31:57 oracledb23ia.localdomain systemd[1]: sql-scheduler.service:
Succeeded.
Jun 09 13:31:57 oracledb23ia.localdomain systemd[1]: Stopped SQLcl scheduler
services.
Jun 09 13:39:02 oracledb23ia.localdomain systemd[1]: Starting SQLcl scheduler
services...
Jun 09 13:39:02 oracledb23ia.localdomain bash[3842]: Starting the SQLcl
Scheduler Daemon.
Jun 09 13:39:02 oracledb23ia.localdomain bash[3849]: Starting the SQLcl
Scheduler Daemon for user oracle.
.....
```

Stop the Service

Stop the scheduler daemon for managed users (for example, the `oracle` user).

```
[root@oracledb23ia ~]# systemctl stop sql-scheduler
[root@oracledb23ia ~]# journalctl -a -f -u sql-scheduler

Jun 09 13:39:04 oracledb23ia.localdomain bash[4065]: The SQLcl Scheduler
Daemon has started correctly.
Jun 09 13:39:06 oracledb23ia.localdomain systemd[1]: Started SQLcl scheduler
services.
Jun 09 14:07:24 oracledb23ia.localdomain systemd[1]: Stopping SQLcl scheduler
services...
Jun 09 14:07:24 oracledb23ia.localdomain bash[4497]: Stopping the SQLcl
Scheduler Daemon.
Jun 09 14:07:24 oracledb23ia.localdomain bash[4504]: Stopping SQLcl Scheduler
Daemon for user oracle
```

6.5.2 In-Product Help

For YUM or RPM installations, you can view the SQL and scheduler-service manual pages available in the product for additional information.

The Service Manual Page

```
man sql-scheduler.service
```

The SQL Manual Page

```
man sql
```


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7

Using Liquibase

This chapter covers the Liquibase feature in SQLcl. It has the following topics:

- About Liquibase in SQLcl
- Requirements for Using Liquibase
- Supported Types
- Supported Liquibase Commands in SQLcl
- Using SQLcl Liquibase Functionality with Open-Source Liquibase
- Dynamic Object Transformation with SQLcl Liquibase and `DBMS_METADATA` Oracle Database Package
- Liquibase Open-Source Changesets with SQLcl Liquibase
- DATABASECHANGELOG_DETAILS VIEW
- ChangeSets in Liquibase
- Tips for Liquibase Settings
- Important 23.4 Update with Liquibase Changelog Files
- Examples Using Liquibase

7.1 About Liquibase in SQLcl

Liquibase is an open-source database-independent library for tracking, managing and applying database schema changes.

For an understanding of the major concepts in Liquibase, see Major Concepts.

> **Note**
>
> Liquibase is not available in SQLcl that is part of the SQL Developer installation. To use this feature, you need to download the standalone SQLcl offering.

The Liquibase feature in SQLcl enables you to execute commands to generate a changelog for a single object or for a full schema (changeset and changelogs). You can process these objects manually using SQLcl or through any of the traditional Liquibase interfaces.

With the Liquibase feature in SQLcl, you can:

- Generate and execute single object changelogs
- Generate and execute schema changesets with object dependencies
- Automatically sort a changeset during creation based on object dependencies
- Record all SQL statements for changeset or changelog execution, as it is generated
- Provide full rollback support for changesets and changelogs automatically

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7.2 Requirements for Using Liquibase

The two important aspects for using the Liquibase functionality are capturing and deploying objects in an Oracle database.

Capture Objects

To capture an object or a schema, you must have SQLcl with the Liquibase plug-in available.

You can only capture objects from the schema you are connected to in SQLcl. You also need write permission on the directory in which you save the files.

If you are capturing an entire schema, the user you are connected to must have the privilege to create a table. The DATABASECHANGELOG_EXPORT table is created internally to gather object details and sort them correctly. The created object is automatically excluded from the capture process and destroyed upon capture completion.

Deploy Objects

Liquibase uses the DATABASECHANGELOG table to track the changesets that have been run. The DATABASECHANGELOGLOCK table ensures that only one instance of Liquibase is running at a time. The DATABASECHANGELOG_ACTIONS table tracks the object state and the SQL statements executed during deployment.

- **SQLcl**

  Deploying changes to any database through SQLcl requires the privilege to create a table. You must have necessary permissions to create any object type through the change that you are deploying.

- **Liquibase**

  If you use Liquibase directly to deploy changesets, you need:

  – the extension installed in your Liquibase environment. Add the following jar files from `sqlcl/lib` and `sqlcl/lib/ext` folders to the `liquibase/lib` folder:

    * `dbtools-liquibase.jar`
    * `dbtools-apex.jar`
    * `guava-with-lf.jar`
    * `xmlparserv2_sans_jaxp_services.jar`
    * `dbtools-common.jar`

  – the privileges to create a table and a package.

    The minimum privileges required when using Liquibase in SQLcl are:

    * `create session`
    * `create table`
    * `create procedure`
    * `quota unlimited on [default tablespace]`, where quota is set as required in your database administration.

  – to update your properties file by adding the following line:

    ```
    change-exec-listener-class:
    liquibase.changelog.visitor.OracleActionChangeListener
    ```


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7.3 Supported Types

DDL types use create or replace syntax. A snapshot of the object is taken before applying the change so automatic rollback to the last known state is supported.

SXML types support automatic alter generation with automatic rollback support.

DDL types have their own change type.

- CONSTRAINT
- DIMENSION
- DIRECTORY
- FUNCTION
- JOB
- OBJECT_GRANT
- PACKAGE_BODY
- PACKAGE_SPEC
- PROCEDURE
- PUBLIC_SYNONYM
- REF_CONSTRAINT
- SYNONYM
- TRIGGER
- TYPE BODY
- TYPE SPEC

SXML types share the SXML change type.

- AQ_QUEUE
- AQ_QUEUE_TABLE
- AQ_TRANSFORM
- ASSOCIATION
- AUDIT
- AUDIT_OBJ
- CLUSTER
- CONTEXT
- DB_LINK
- DEFAULT_ROLE
- FGA_POLICY
- JOB
- LIBRARY
- MATERIALIZED_VIEW

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- MATERIALIZED_VIEW_LOG
- OPERATOR
- PROFILE
- PROXY
- REFRESH_GROUP
- RESOURCE_COST
- RLS_CONTEXT
- RLS_GROUP
- RMGR_CONSUMER_GROUP
- RMGR_INTITIAL_CONSUMER_GROUP
- RMGR_PLAN
- RMGR_PLAN_DIRECTIVE
- ROLE
- ROLLBACK_SEGMENT
- SEQUENCE
- TABLE
- TABLESPACE
- TRIGGER XS_ACL
- TRUSTED_DB_LINK
- USER
- VIEW
- XMLSCHEMA
- XS_ACL_PARAM INDEX
- XS_DATA_SECURITY
- XS_ROLE
- XS_ROLESET
- XS_ROLE_GRANT
- XS_SECURITY_CLASS
- XS_USER

7.4 Supported Liquibase Commands in SQLcl

You can invoke the Liquibase commands in SQLcl with `liquibase` or `lb`.

The SQLcl Liquibase commands that were initially launched in SQLcl release 19.2 has deprecated. The SQLcl plug-in has been updated to synchronize with the new command format introduced by Liquibase.

Syntax

```
Liquibase|lb COMMAND {OPTIONS}
```


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To see the help for Liquibase in SQLcl, type :

```
help Liquibase
```

To only view the examples in help, type:

```
help liquibase examples
```

For more information about the SQLcl Liquibase commands, see LIQUIBASE.

7.5 Using SQLcl Liquibase Functionality with Open-Source Liquibase

SQLcl Liquibase with Oracle Database provides extended functionality to the Liquibase experience compared to the vanilla Liquibase client. This includes dynamically altering tables using Liquibase and SQLcl-exclusive Liquibase commands, such as generating specialized snapshots for:

- A comprehensive schema (`generate-schema`)
- Oracle REST Data Service (ORDS) objects (`generate-ords-module` and `generate-ords-schema`)
- Oracle APEX objects (`generate-apex`)

By default, the Liquibase client does not include this enhanced functionality or enable you to read the specialized changelogs generated by SQLcl Liquibase.

You can add the functionality to read these specialized changelogs to the Liquibase client by copying certain jar files from SQLcl and updating your Liquibase properties file. The steps to do this are demonstrated using the following example:

1. Connect to your Oracle Database and start the SQLcl command-line interface. The example database has a few sample tables that you can view.

   ```
   SQL> select table_name from user_tables;

   TABLE_NAME
   _______________
   REGIONS
   LOCATIONS
   DEPARTMENTS
   JOBS
   EMPLOYEES
   JOB_HISTORY
   COUNTRIES

   7 rows selected.
   ```

2. Create a table `Fruits`. This will serve as an example table to track.

   ```
   SQL> create table fruits (id number(1,0), type varchar2(50), price number,
   constraint fruits_pk primary key (id));
   ```


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```
Table FRUITS created.
```

The table is added to the list of sample tables.

```
SQL> select table_name from user_tables;

TABLE_NAME
_____________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
FRUITS
COUNTRIES

8 rows selected.
```

3. Generate a changelog for the `Fruits` table.

```
SQL> lb generate-object -object-type table -object-name fruits;

--Starting Liquibase at 13:43:52 (version 4.15.0 #0 built at 2022-08-19
14:45+000)

Changelog created and written to file fruits_table.xml

Operation completed successfully.
```

4. Delete the `Fruits` table so that you can run some tests generating it with the changelog created.

```
SQL> drop table fruits;

SQL> select table_name from user_tables;

TABLE_NAME
_____________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
COUNTRIES

7 rows selected.
```

5. Switch to the vanilla Liquibase open-source command line client, which you can download from Liquibase's website.
6. You must provide the credentials of the Oracle Database that you are connected to in SQLcl for the vanilla Liquibase client. Create a `liquibase.properties` file from a blank

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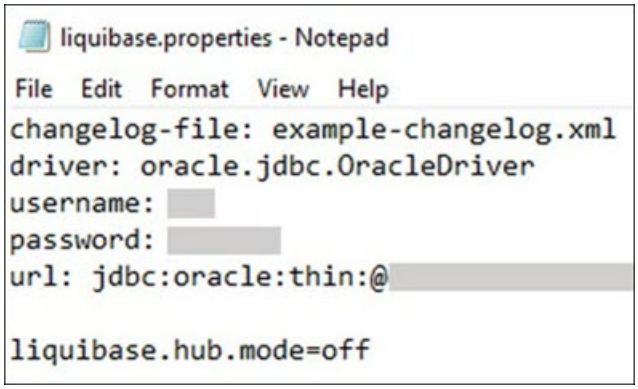
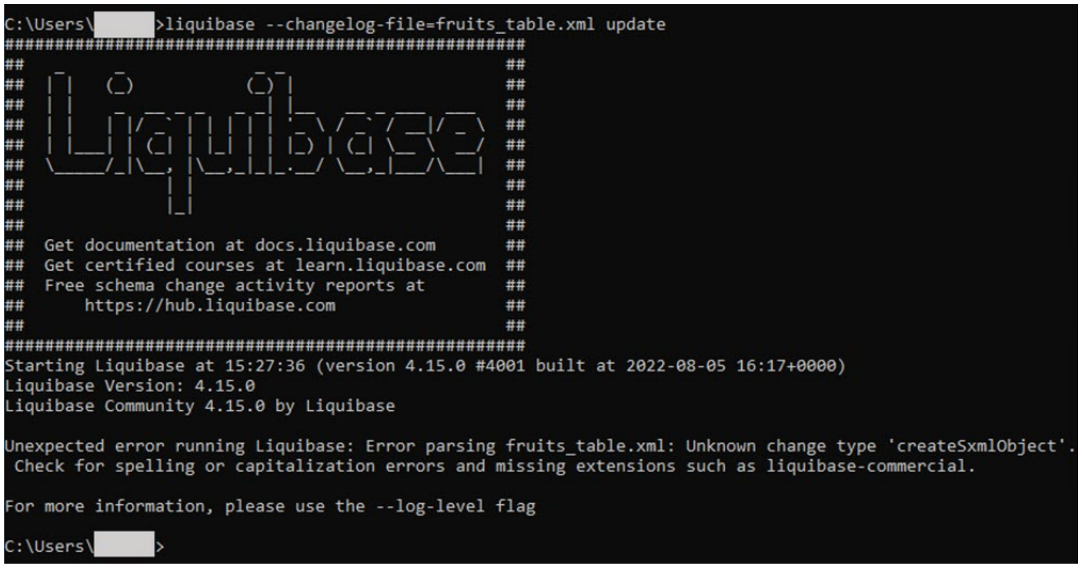
text file. In this example, the `liquibase.properties` file is created in `C:\Users\` [*username*] folder on a Windows system. The following figure shows the properties file used in this example. For more information about providing database credentials for Liquibase, see Specifying Properties in a Connection Profile.



7. Copy and paste the `fruits_table.xml` changelog file created earlier from your SQLcl bin folder to the folder location of your `liquibase.properties` file (in this case, C:\Users\ [username]). To keep your changelog files in a different location, specify the path to the file location in the changelog-file field of your `liquibase.properties` file.
8. Run the update command.

```
>liquibase --changelog-file=fruits_table.xml update
```



The update fails because the SQLcl specialized changelog is an unsupported format in the vanilla Liquibase client.

The next step is to add the functionality to read the changelogs of your SQLcl Liquibase in your vanilla Liquibase client so that you can run the changelog.

9. Copy five jar files from the `lib` and `lib/ext` folders in your SQLcl folder and add them to the `lib` folder of your vanilla Liquibase client (`liquibase/lib`):

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- `dbtools-liquibase.jar` (`sqlcl/lib/ext`)
- `dbtools-apex.jar` (`sqlcl/lib/ext`)
- `guava-with-lf.jar` (`sqlcl/lib`)
- `xmlparserv2_sans_jaxp_services.jar` (`sqlcl/lib`)
- `dbtools-common.jar` (`sqlcl/lib`)

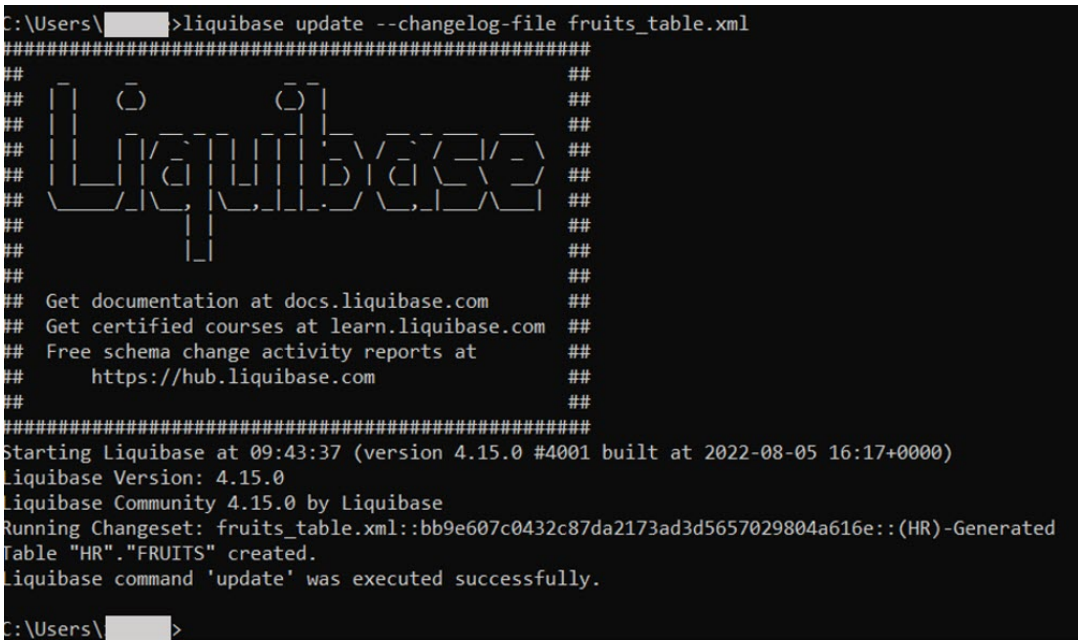
10. Update your `liquibase.properties` file by adding the following line:

```
change-exec-listener-class:
liquibase.changelog.visitor.OracleActionChangeListener
```

You can now read SQLcl Liquibase changelogs in your vanilla Liquibase client.

11. Run the SQL Liquibase changelog in the vanilla Liquibase client.

```
>liquibase update --changelog-file fruits_table.xml
```



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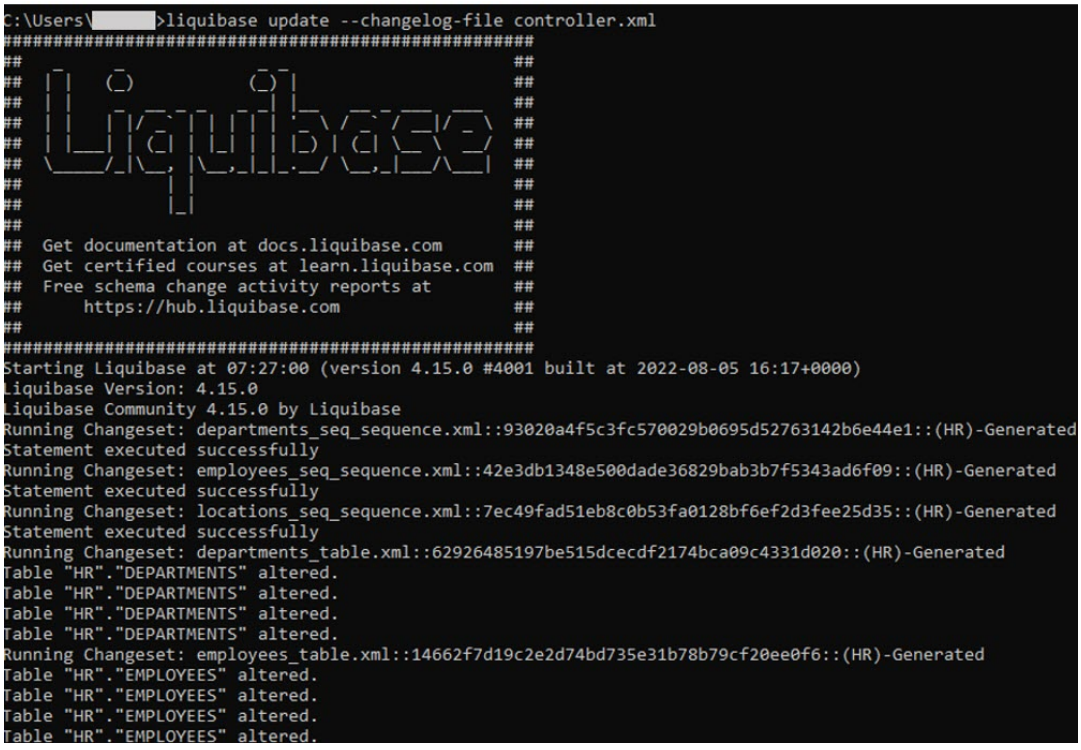
In another command-line window connected to SQL and your database, you can check if the table has been successfully created.

```
SQL> select table_name from user_tables;

TABLE_NAME
_______________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
COUNTRIES
DATABASECHANGELOGLOCK
DATABASECHANGELOG
FRUITS
COUNTRIES

10 rows selected.
```

With this functionality added to your vanilla Liquibase client, you can also read changelogs for other changelog types such as Oracle Rest Data Services (ORDS), Oracle APEX, and full database schemas along with Oracle SQLcl scripts.



7.6 Dynamic Object Transformation with SQLcl Liquibase and DBMS_METADATA Oracle Database Package

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Oracle supplies many packages, which are automatically installed with Oracle Database, that extend database functionality. One of these packages, `DBMS_METADATA`, provides a way to retrieve metadata from the database dictionary as XML or SQL Data Definition Language (DDL) statements, and to submit the XML to recreate the object.

Oracle SQLcl Liquibase uses the `DBMS_METADATA` package to generate and execute specialized changelogs that transform the state of the database objects dynamically. This is a feature not available in the Liquibase open-source client. By using SQLcl-exclusive Liquibase commands such as `generate-schema`, a complete Oracle database schema can be updated. This includes altering tables and other objects already present according to the changelog's specification. In open-source Liquibase, if the `update` command is run for a changelog mentioning a table that is pre-existing, it will fail. This is because open-source Liquibase is incapable of altering pre-exising objects.

SQLcl Liquibase's specialized changelogs generated from commands such as `generate-schema` and `generate-object` use the SXML data format from the `DBMS_METADATA` package to execute these dynamic updates. SXML is an XML representation of object metadata that looks like a direct translation of SQL DDL into XML.

This section demonstrates this concept using a few examples. For these example, a Windows-based operating system is used.

Example 1

Connect to an Oracle database with SQLcl release 22.3. The one featured in this example includes a few sample tables. The tables that are going to be used for this example are employees and departments.

```
SQL> select table_name from user_tables;

TABLE_NAME
_____________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
HIRE_DATE
PERSON_COLLECTION
COUNTRIES

9 rows selected.
```

1. Generate a schema of the database state using SQLcl Liquibase.

   ```
   SQL> lb generate-schema
   ```


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```
SQL> lb generate-schema
--Starting Liquibase at 15:59:29 (version 4.15.0 #0 built at 2022-08-19 14:45+0000)


Export Flags Used:

Export Grants           false
Export Synonyms         false

[Method loadCaptureTable]:
        [Type - TYPE_SPEC]:                      451 ms
        [Type - TYPE_BODY]:                      247 ms
        [Type - SEQUENCE]:                       205 ms
        [Type - DIRECTORY]:                      112 ms
        [Type - CLUSTER]:                       1473 ms
        [Type - TABLE]:                        25672 ms
```

2. Switching over to another command-line window, use the open-source Liquibase client to generate a changelog of the database state. Because generate-schema is a SQLcl-exclusive command that uses extended functionality, the open-source Liquibase client must use the `generate-changelog` command.

> **Note**
>
> You can download the open-source Liquibase client from the Liquibase website.

```
>liquibase --changelog-file=sql_test.xml generate-changelog
```

```
:\Users\      >liquibase --changelog-file=sql_test.xml generate-changelog
##################################################
#                                                ##
#  Get documentation at docs.liquibase.com       ##
#  Get certified courses at learn.liquibase.com  ##
#  Free schema change activity reports at        ##
#      https://hub.liquibase.com                 ##
#                                                ##
##################################################
tarting Liquibase at 17:01:32 (version 4.15.0 #4001 built at 2022-08-05 16:17+0000)
iquibase Version: 4.15.0
iquibase Community 4.15.0 by Liquibase
EST PRACTICE: The changelog generated by diffChangeLog/generateChangeLog should be inspected for correctness and comple
eness before being deployed. Some database objects and their dependencies cannot be represented automatically, and they
may need to be manually updated before being deployed.
enerated changelog written to C:\Users\      \sql_test.xml
iquibase command 'generate-changelog' was executed successfully.

:\Users\      >
```

The database state is now captured in both SQLcl Liquibase and the open-source Liquibase client.

3. In the SQLcl command-line window, make a few changes to the database.

```
SQL>alter table employees add height number;
Table EMPLOYEES altered.

SQL>alter table employees add mood varchar2(50);
Table EMPLOYEES altered.
```


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```
SQL>alter table departments add happiness varchar2(50);
Table DEPARTMENTS altered.
```

View these column additions in the database.

```
SQL> select * from departments;
SQL> select * from employees;
```

```
SQL> select * from departments;

   DEPARTMENT_ID DEPARTMENT_NAME          MANAGER_ID    LOCATION_ID HAPPINESS
_______________ ______________________ ______________ ______________ ______________
              10 Administration                  200           1700
              20 Marketing                       201           1800
              30 Purchasing                      114           1700
              40 Human Resources                 203           2400
              50 Shipping                        121           1500
              60 IT                              103           1400
              70 Public Relations                204           2700
              80 Sales                           145           2500
```

```
SQL> select * from employees;

   EMPLOYEE_ID FIRST_NAME    LAST_NAME    EMAIL       PHONE_NUMBER    HIRE_DATE    JOB_ID          SALARY    COMMISSION_PCT    MANAGER_ID    DEPARTMENT_ID    HEIGHT MOOD
_____________ ____________ ____________ ___________ ____________ ____________ ___________ ___________ ____________ ____________ ____________ ____________ _______ _____
          198 Donald       OConnell     DOCONNEL    650.507.9833    21-JUN-99    SH_CLERK          2600                          124               50
          199 Douglas      Grant        DGRANT      650.507.9844    13-JAN-00    SH_CLERK          2600                          124               50
          200 Jennifer     Whalen       JWHALEN     515.123.4444    17-SEP-87    AD_ASST           4400                          101               10
          201 Michael      Hartstein    MHARTSTE    515.123.5555    17-FEB-96    MK_MAN           13000                          100               20
          202 Pat          Fay          PFAY        603.123.6666    17-AUG-97    MK_REP            6000                          201               20
          203 Susan        Mavris       SMAVRIS     515.123.7777    07-JUN-94    HR_REP            6500                          101               40
          204 Hermann      Baer         HBAER       515.123.8888    07-JUN-94    PR_REP           10000                          101               70
          205 Shelley      Higgins      SHIGGINS    515.123.8080    07-JUN-94    AC_MGR           12000                          101              110
          206 William      Gietz        WGIETZ      515.123.8181    07-JUN-94    AC_ACCOUNT        8300                          205              110
          100 Steven       King         SKING       515.123.4567    17-JUN-87    AD_PRES          24000                                           90
          101 Neena        Kochhar      NKOCHHAR    515.123.4568    21-SEP-89    AD_VP            17000                          100               90
          102 Lex          De Haan      LDEHAAN     515.123.4569    13-JAN-93    AD_VP            17000                          100               90
          103 Alexander    Hunold       AHUNOLD     590.423.4567    03-JAN-90    IT_PROG           9000                          102               60
          104 Bruce        Ernst        BERNST      590.423.4568    21-MAY-91    IT_PROG           6000                          103               60
```

4. You need to use the Liquibase `update` command to alter the database to the state of the changelogs. This is the database state where employees and departments tables do not have the extra columns added.

   To do that, in the command-line window **not** connected to SQLcl and that was used for running the open-source Liquibase client commands, enter the following command:

```
>liquibase --changelog-file=sql_test.xml update
```

```
C:\Users\[redacted]>liquibase --changelog-file=sql_test.xml update
##################################################
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##                                              ##
##  Get documentation at docs.liquibase.com     ##
##  Get certified courses at learn.liquibase.com ##
##  Free schema change activity reports at      ##
##      https://hub.liquibase.com               ##
##                                              ##
##################################################
Starting Liquibase at 17:20:43 (version 4.15.0 #4001 built at 2022-08-05 16:17+0000)
Liquibase Version: 4.15.0
Liquibase Community 4.15.0 by Liquibase
Running Changeset: sql_test.xml::1663279353479-1::[redacted] (generated)

Unexpected error running Liquibase: Migration failed for changeset sql_test.xml::1663279353479-1::[redacted] (generated):
     Reason: liquibase.exception.DatabaseException: ORA-00955: name is already used by an existing object
 [Failed SQL: (955) CREATE TABLE HR.REGIONS (REGION_ID NUMBER CONSTRAINT REGION_ID_NN NOT NULL, REGION_NAME VARCHAR2(25 BYTE), CONSTRAINT REG_I
D_PK PRIMARY KEY (REGION_ID))]

For more information, please use the --log-level flag

C:\Users\[redacted]>
```


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The update command fails because Liquibase encounters objects already existing in the database such as the tables. This standard version of Liquibase does not handle these objects dynamically.

5. In the SQLcl command-line window, the same step is repeated with SQLcl Liquibase.

   First, examine the SQL that is used to complete the schema update using the `update-sql` command.

```
SQL>lb update-sql -changelog-file controller.xml
```

```
SQL> lb update-sql -changelog-file controller.xml
--Starting Liquibase at 09:59:36 (version 4.15.0 #0 built at 2022-08-19 14:45+0000)

-- Loaded 37 change(s)
-- ******************************************************************************
-- Update Database Script
-- ******************************************************************************
-- Change Log: controller.xml
-- Ran at: 9/16/22, 9:59 AM
-- Against:
-- Liquibase version: 4.15.0
-- ******************************************************************************
```

Examining the output, you see that departments and employees tables are recognized and that you need to drop the extra columns that you created to return to the state in the changelog.

```
-- Changeset departments_table.xml::18f3f88289eddcfc2b16fdae44a17169f8fe0d3f::(HR)-Generated
ALTER TABLE "HR"."DEPARTMENTS" DROP ("HAPPINESS")
/



-- Changeset employees_table.xml::3679094045b7965245949695613df9351c236f3e::(HR)-Generated
ALTER TABLE "HR"."EMPLOYEES" DROP ("HEIGHT")
/
  ALTER TABLE "HR"."EMPLOYEES" DROP ("MOOD")
/
```

In actual use cases that are more complicated, there can often be risks involved with the SQL `drop` command. Examining the SQL code using the `update-sql` command is beneficial for review. Any manual changes can then be made to the changesets and checked as needed.

When you run the update command, the schema is successfully updated and the columns are dropped.

```
SQL> lb update -changelog-file controller.xml
--Starting Liquibase at 68:23:55 (version xml 4.15.0 #0 built at
2022-08-19 14:45+0000)

-- Loaded 38 change(s)
```

Example 2

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This example also explains the same concept, this time adding columns and a table.

For this example, in the database, a table `Activities` has been previously created along with columns `Head_Count` and `Retention` in the `departments` table and `Awards` in the `employees` table.

```
SQL> select * from departments;

  DEPARTMENT_ID DEPARTMENT_NAME          MANAGER_ID    LOCATION_ID    HEAD_COUNT RETENTION
_______________ ______________________ _____________ ______________ _____________ _____________
             10 Administration                   200           1700
             20 Marketing                        201           1800
             30 Purchasing                       114           1700
             40 Human Resources                  203           2400
             50 Shipping                         121           1500
             60 IT                               103           1400
             70 Public Relations                 204           2700
             80 Sales                            145           2500
             90 Executive                        100           1700
            100 Finance                          108           1700
            110 Accounting                       205           1700
            120 Treasury                                       1700
            130 Corporate Tax                                  1700
            140 Control And Credit                             1700
```

```
SQL> select * from employees;

  EMPLOYEE_ID FIRST_NAME    LAST_NAME    EMAIL       PHONE_NUMBER    HIRE_DATE    JOB_ID        SALARY    COMMISSION_PCT    MANAGER_ID    DEPARTMENT_ID    AWARDS
_____________ _____________ ____________ ___________ _______________ ____________ _____________ _________ _________________ _____________ ________________ _____________
          198 Donald        OConnell     DOCONNEL    650.507.9833    21-JUN-99    SH_CLERK         2600                              124               50
          199 Douglas       Grant        DGRANT      650.507.9844    13-JAN-00    SH_CLERK         2600                              124               50
          200 Jennifer      Whalen       JWHALEN     515.123.4444    17-SEP-87    AD_ASST          4400                              101               10
          201 Michael       Hartstein    MHARTSTE    515.123.5555    17-FEB-96    MK_MAN          13000                              100               20
          202 Pat           Fay          PFAY        603.123.6666    17-AUG-97    MK_REP           6000                              201               20
          203 Susan         Mavris       SMAVRIS     515.123.7777    07-JUN-94    HR_REP           6500                              101               40
          204 Hermann       Baer         HBAER       515.123.8888    07-JUN-94    PR_REP          10000                              101               70
          205 Shelley       Higgins      SHIGGINS    515.123.8080    07-JUN-94    AC_MGR          12000                              101              110
          206 William       Gietz        WGIETZ      515.123.8181    07-JUN-94    AC_ACCOUNT       8300                              205              110
          100 Steven        King         SKING       515.123.4567    17-JUN-87    AD_PRES         24000                                               90
          101 Neena         Kochhar      NKOCHHAR    515.123.4568    21-SEP-89    AD_VP           17000                              100               90
          102 Lex           De Haan      LDEHAAN     515.123.4569    13-JAN-93    AD_VP           17000                              100               90
          103 Alexander     Hunold       AHUNOLD     590.423.4567    03-JAN-90    IT_PROG          9000                              102               60
          104 Bruce         Ernst        BERNST      590.423.4568    21-MAY-91    IT_PROG          6000                              103               60
```

Changelogs are generated and the `Activities` table and `Head_count`, `Retention`, and `columns` are deleted so as to showcase using Liquibase to create them.

1. Generate the schema in SQLcl.

   > **Note**
   >
   > Move the changelogs from the previous example to a separate folder to avoid issues.

   ```
   SQL> lb generate-schema
   --Starting Liquibase at 09:33:52 (version 4.15.0 #0 built at 2022-08-19
   14:45+0000)
   ```

2. Switching over to another command-line window to execute commands in the open-source Liquibase client, here also generate a changelog:

   ```
   >liquibase --changelog-file=sql_test2.xml generate-changelog
   ```


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3. In the SQLcl command-line window, delete the `Activities` table and `Head_count`, `Retention`, and `Awards` columns, so that their creation can be demonstrated with the update command.

```
SQL> drop table activities;
Table ACTIVITIES dropped.

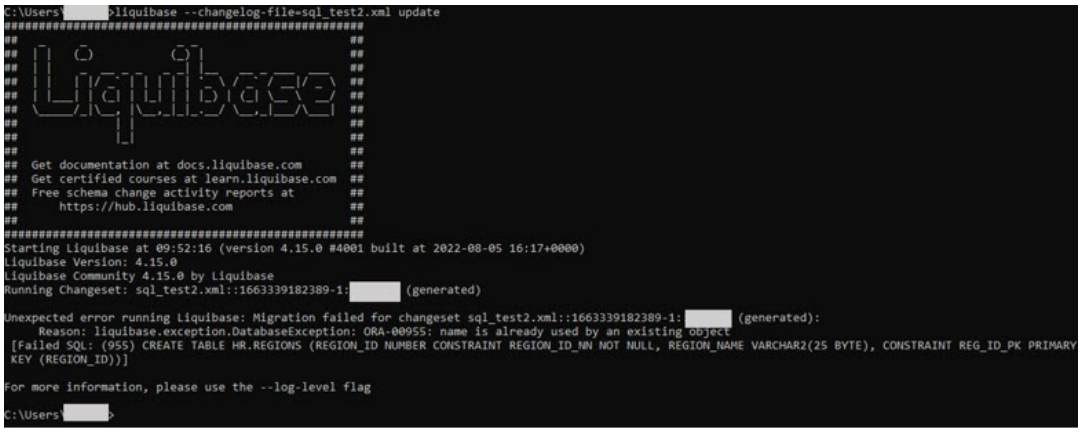
SQL> alter table employees drop column awards;
Table EMPLOYEES altered.

SQL> alter table departments drop column head_count;
Table DEPARTMENTS altered.

SQL> alter table departments drop column retention;
Table DEPARTMENTS altered.
```

4. In the open-source Liquibase command-line window, run the update command.

```
> liquibase --changelog-file=sql_test2.xml update
```



The update fails when Liquibase encounters pre-existing objects.

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5. In the SQLcl command-line window, generate the SQL to examine, then run the update with SQLcl Liquibase .

```
SQL>lb update-sql -changelog-file controller.xml
```

```
SQL> lb update-sql -changelog-file controller.xml
--Starting Liquibase at 09:59:36 (version 4.15.0 #0 built at 2022-08-19 14:45+0000)

-- Loaded 37 change(s)
-- ******************************************************************************
-- Update Database Script
-- ******************************************************************************
-- Change Log: controller.xml
-- Ran at: 9/16/22, 9:59 AM
-- Against:
-- Liquibase version: 4.15.0
-- ******************************************************************************
```

Looking at the SQL output, you can see sections involving the creation of the `Activities` table and SQLcl Liquibase generating the SQL statements to alter the `Departments` and `Employees` table to add the columns.

```
-- Changeset departments_table.xml::62926485197be515dcecdf2174bca09c4331d020::(HR)-Generated
ALTER TABLE "HR"."DEPARTMENTS" ADD ("HEAD_COUNT" NUMBER)
/
  ALTER TABLE "HR"."DEPARTMENTS" ADD ("RETENTION" VARCHAR2(50))
/



-- Changeset employees_table.xml::14662f7d19c2e2d74bd735e31b78b79cf20ee0f6::(HR)-Generated
ALTER TABLE "HR"."EMPLOYEES" ADD ("AWARDS" NUMBER)
/



-- Changeset activities_table.xml::a7941c2352f1cad12cd6e4eadfbd4fc9d1d438d6::(HR)-Generated
CREATE TABLE "HR"."ACTIVITIES"
   (    "ID" NUMBER,
        "NAME" VARCHAR2(50),
        "COST" NUMBER,
        "LOCATION" VARCHAR2(50),
        "DIFFICULTY" VARCHAR2(50)
   ) SEGMENT CREATION DEFERRED
  PCTFREE 10 PCTUSED 40 INITRANS 1 NOCOMPRESS LOGGING
  TABLESPACE "USERS";
```

6. Run the update to see that the table and columns are added.

```
SQL> lb update -changelog-file controller.xml
```


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```
SQL> lb update -changelog-file controller.xml
--Starting Liquibase at 10:05:17 (version 4.15.0 #0 built at 2022-08-19 14:45+0000)

-- Loaded 37 change(s)
Running Changeset: departments_seq_sequence.xml::93020a4f5c3fc570029b0695d52763142b6e44e1::(HR)-Generated
Statement executed successfully
Running Changeset: employees_seq_sequence.xml::42e3db1348e500dade36829bab3b7f5343ad6f09::(HR)-Generated
Statement executed successfully
Running Changeset: locations_seq_sequence.xml::7ec49fad51eb8c0b53fa0128bf6ef2d3fee25d35::(HR)-Generated
Statement executed successfully
Running Changeset: departments_table.xml::62926485197be515dcecdf2174bca09c4331d020::(HR)-Generated
Table "HR"."DEPARTMENTS" altered.
Table "HR"."DEPARTMENTS" altered.
Table "HR"."DEPARTMENTS" altered.
Table "HR"."DEPARTMENTS" altered.
Running Changeset: employees_table.xml::14662f7d19c2e2d74bd735e31b78b79cf20ee0f6::(HR)-Generated
Table "HR"."EMPLOYEES" altered.
Table "HR"."EMPLOYEES" altered.
Table "HR"."EMPLOYEES" altered.
Table "HR"."EMPLOYEES" altered.
Running Changeset: regions_table.xml::52334f421d935229140b0468d06157dd45c20f96::(HR)-Generated
Statement executed successfully
Running Changeset: jobs_table.xml::84d6c14a5af0d22812c689a42e58e6c0cf300c1e::(HR)-Generated
Statement executed successfully
Running Changeset: activities_table.xml::a7941c2352f1cad12cd6e4eadfbd4fc9d1d438d6::(HR)-Generated
Table "HR"."ACTIVITIES" created.
Running Changeset: countries_table.xml::43c08b308b52ef60fc8e8f42f33ebda679f18323::(HR)-Generated
Statement executed successfully
```

```
SQL>select table_name from user_tables;
SQL>select * from employees;
SQL>select * from departments;

SQL> select table_name from user_tables;

TABLE_NAME
_______________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
DATABASECHANGELOG_ACTIONS
DATABASECHANGELOG
ACTIVITIES
COUNTRIES

11 rows selected.
```


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```
SQL> select * from employees;

   EMPLOYEE_ID FIRST_NAME    LAST_NAME    EMAIL       PHONE_NUMBER    HIRE_DATE    JOB_ID          SALARY    COMMISSION_PCT    MANAGER_ID    DEPARTMENT_ID    AWARDS
_____________ ____________ ___________ ___________ ______________ ____________ ___________ ___________ ________________ ____________ ___________ ___________ ________
           198 Donald       OConnell    DOCONNEL    650.507.9833    21-JUN-99    SH_CLERK           2600                              124               50
           199 Douglas      Grant       DGRANT      650.507.9844    13-JAN-00    SH_CLERK           2600                              124               50
           200 Jennifer     Whalen      JWHALEN     515.123.4444    17-SEP-87    AD_ASST            4400                              101               10
           201 Michael      Hartstein   MHARTSTE    515.123.5555    17-FEB-96    MK_MAN            13000                              100               20
           202 Pat          Fay         PFAY        603.123.6666    17-AUG-97    MK_REP             6000                              201               20
           203 Susan        Mavris      SMAVRIS     515.123.7777    07-JUN-94    HR_REP             6500                              101               40
           204 Hermann      Baer        HBAER       515.123.8888    07-JUN-94    PR_REP            10000                              101               70
           205 Shelley      Higgins     SHIGGINS    515.123.8080    07-JUN-94    AC_MGR            12000                              101              110
           206 William      Gietz       WGIETZ      515.123.8181    07-JUN-94    AC_ACCOUNT         8300                              205              110
           100 Steven       King        SKING       515.123.4567    17-JUN-87    AD_PRES           24000                                               90
           101 Neena        Kochhar     NKOCHHAR    515.123.4568    21-SEP-89    AD_VP             17000                              100               90
           102 Lex          De Haan     LDEHAAN     515.123.4569    13-JAN-93    AD_VP             17000                              100               90
           103 Alexander    Hunold      AHUNOLD     590.423.4567    03-JAN-90    IT_PROG            9000                              102               60
           104 Bruce        Ernst       BERNST      590.423.4568    21-MAY-91    IT_PROG            6000                              103               60
```

```
SQL> select * from departments;

   DEPARTMENT_ID DEPARTMENT_NAME          MANAGER_ID    LOCATION_ID    HEAD_COUNT RETENTION
_____________ ________________________ ____________ ____________ ____________ ____________
              10 Administration                  200           1700
              20 Marketing                       201           1800
              30 Purchasing                      114           1700
              40 Human Resources                 203           2400
              50 Shipping                        121           1500
              60 IT                              103           1400
              70 Public Relations                204           2700
              80 Sales                           145           2500
              90 Executive                       100           1700
             100 Finance                         108           1700
             110 Accounting                      205           1700
             120 Treasury                                      1700
             130 Corporate Tax                                 1700
             140 Control And Credit                            1700
```

7.7 Liquibase Open-Source Changesets with SQLcl Liquibase

You can use changesets generated in the open-source Liquibase solution with SQLcl Liquibase. This enables you to carry over previous change management projects to SQLcl to optimize them with your Oracle Database.

The following example demonstrates this using the `H2` database available in the open-source download of Liquibase and SQLcl Liquibase:

1. Download the open-source Liquibase client available on the Liquibase website. In your command-line interface, create a project folder and example `H2` database with the following command:

```
>liquibase init project
```

```
C:\Users\[redacted]>liquibase init project
####################################################
##   _     _          _ _                        ##
##  | |   (_)        (_) |                       ##
##  | |    _ __ _ _   _ _| |__   __ _ ___  ___   ##
##  | |   | |/ _ | | | | | '_ \ / _ / __|/ _ \  ##
##  | |___| | (_| | |_| | | |_) | (_| \__ \  __/  ##
##  \_____/_|\__, |\__,_|_|_.__/ \__,_|___/\___|  ##
##              | |                               ##
##              |_|                               ##
##                                                ##
##  Get documentation at docs.liquibase.com       ##
##  Get certified courses at learn.liquibase.com  ##
##  Free schema change activity reports at        ##
##      https://hub.liquibase.com                 ##
##                                                ##
####################################################
Starting Liquibase at 13:47:17 (version 4.15.0 #4001 built at 2022-08-05 16:17+0000)
Liquibase Version: 4.15.0
Liquibase Community 4.15.0 by Liquibase
Setup new liquibase.properties and sample changelog? Enter (Y)es with defaults, yes with (C)ustomization, or (N)o. [Y]:
y
Setting up new Liquibase project in 'C:\Users\[redacted]\.'...
To use the new project files make sure your database is active and accessible by opening a new terminal window to run "liquibase init start-h2",
and then return to this terminal window to run "liquibase update" command.
For more details, visit the Getting Started Guide at https://docs.liquibase.com/start/home.html
Liquibase command 'init project' was executed successfully.

C:\Users\[redacted]>
```


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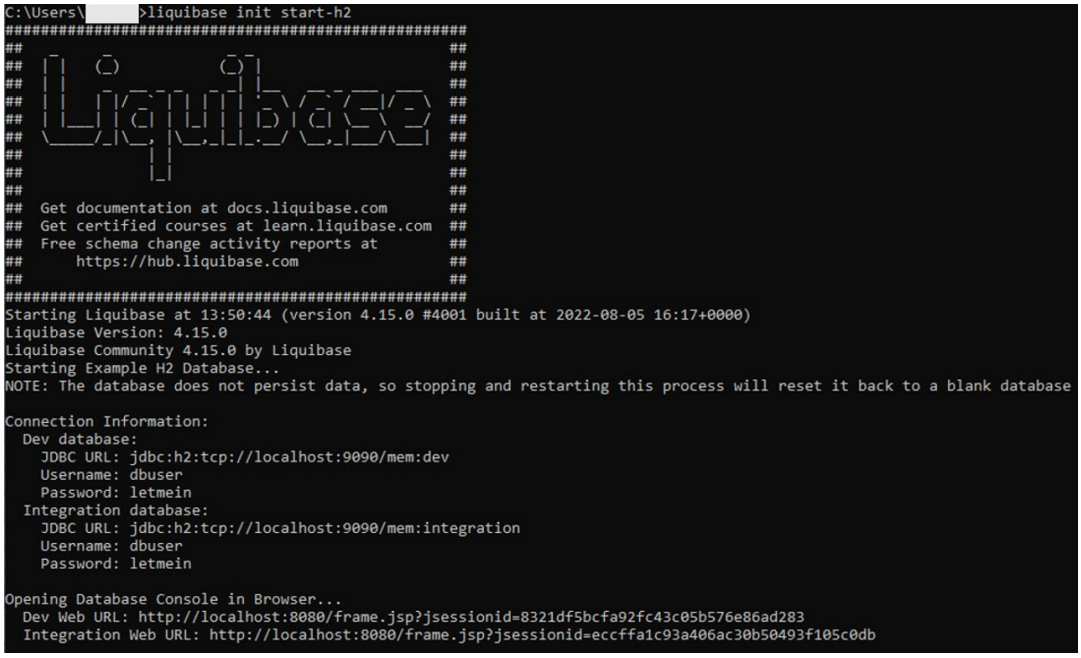
2. Start your H2 database:

```
>liquibase init start-h2
```



This also launches the database console of the empty H2 database in your browser.

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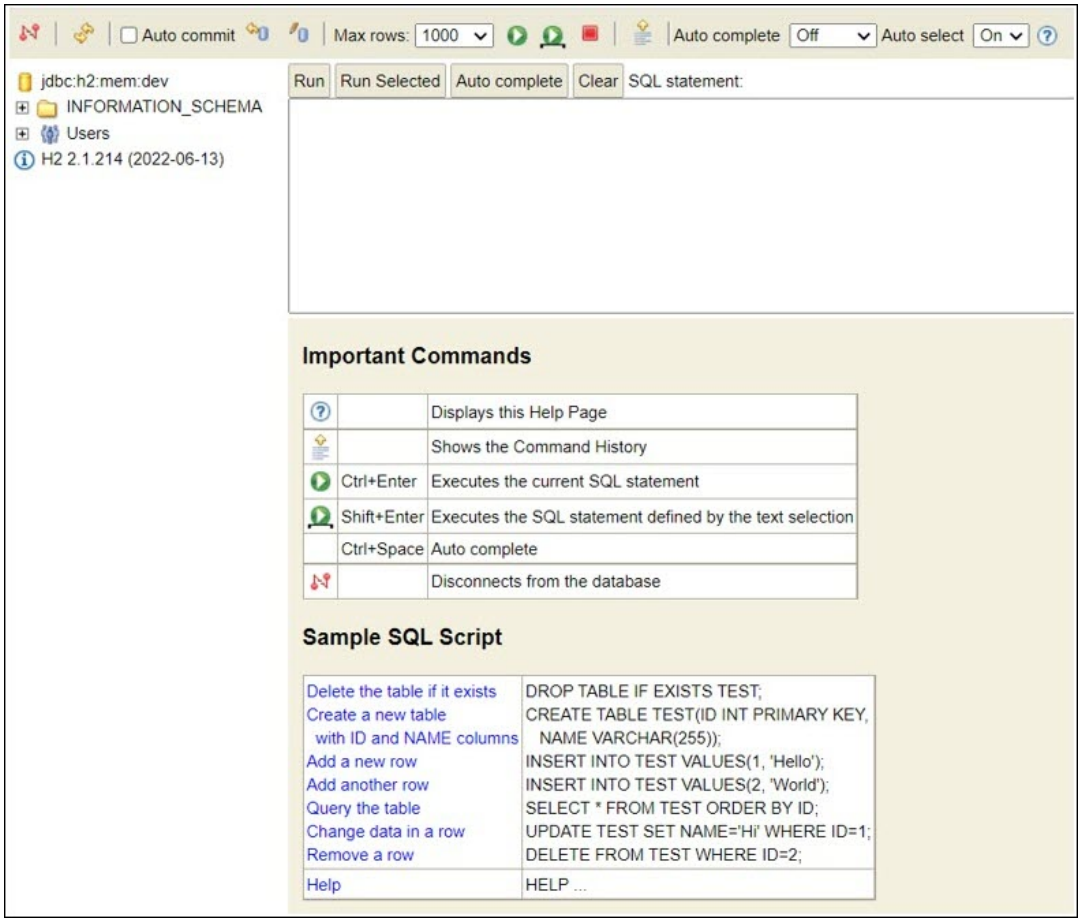
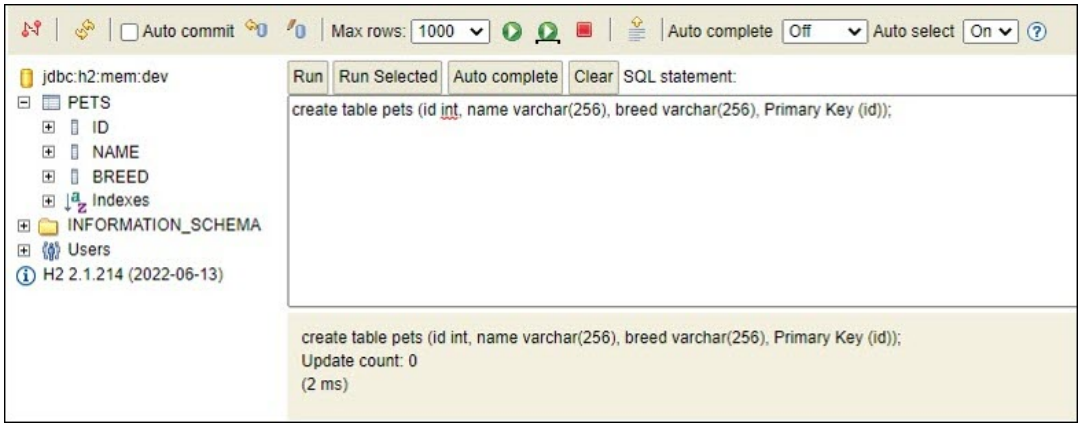


3. In the browser console, create a sample table using the following command and click **Run**:

```
>create table pets (id int, name varchar(256), breed varchar(256), Primary
Key (id));
```



4. Capture this schema consisting of the `Pets` table with a Liquibase changelog.

   Open a new command-line window and generate the changelog:

   ```
   >liquibase --changelog-file=examplepets.xml generate-changelog
   ```

   Name the changelog file as `examplepets.xml`.

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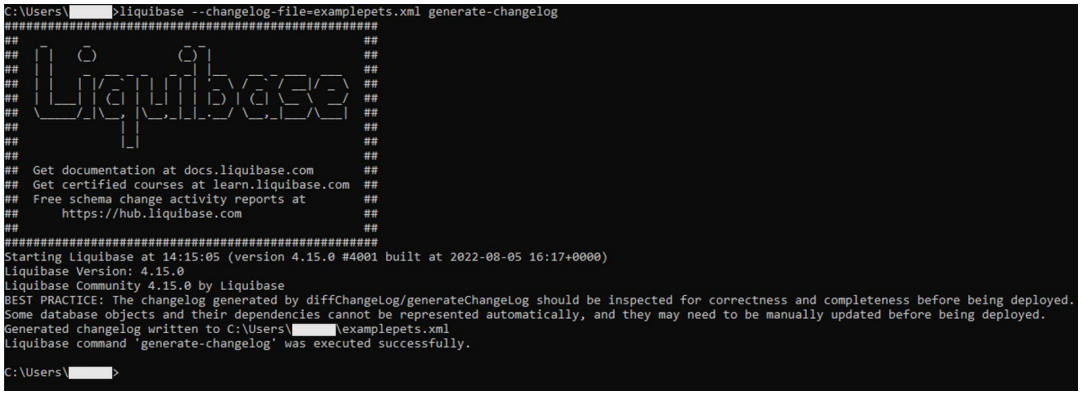

The output shows where the file is saved.

5. Connect to your Oracle Database from the SQLcl 22.3 bin location.

   You can view the tables in your database with the following command. The example database shows a few sample tables.

```
SQL> select table_name from user_tables;

TABLE_NAME
_______________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
COUNTRIES

7 rows selected.
```

6. Copy the `examplepets.xml` changelog file to the SQLcl 22.3 bin folder.
7. In the SQL command-line interface, run the changelog to add the `Pets` table to your database, and check to see that the table is now included in your list.

```
SQL> lb update --changelog-file examplepets.xml
SQL> select table_name from user_tables;
```


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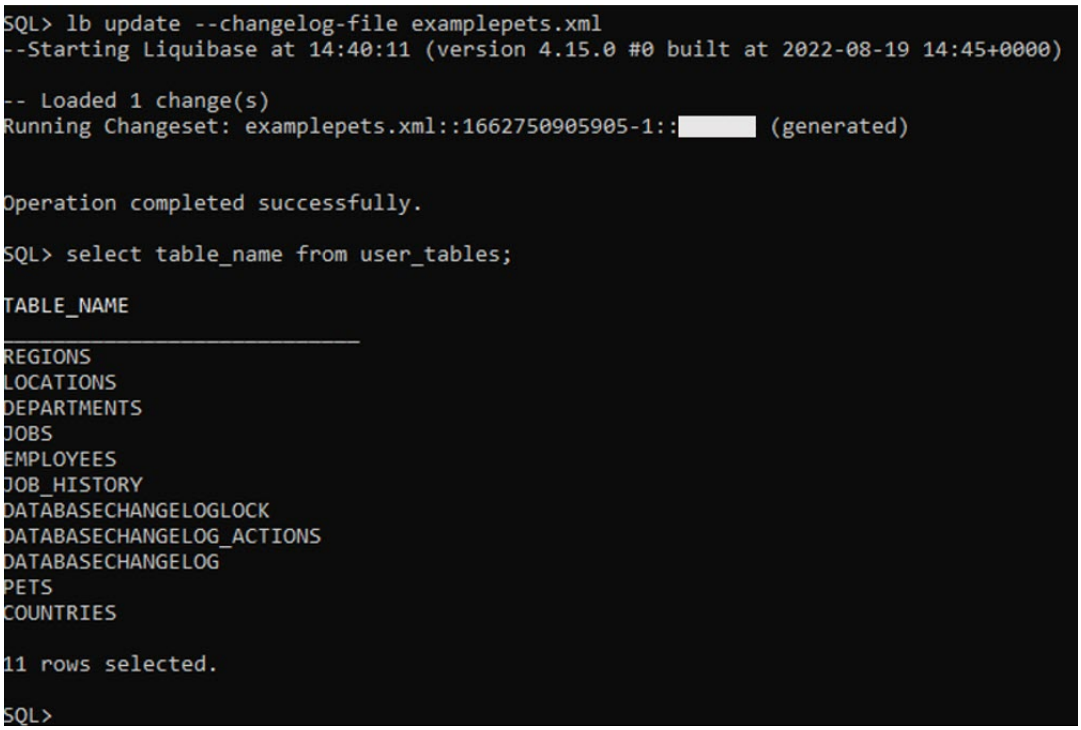

```
SQL> lb update --changelog-file examplepets.xml
--Starting Liquibase at 14:40:11 (version 4.15.0 #0 built at 2022-08-19 14:45+0000)

-- Loaded 1 change(s)
Running Changeset: examplepets.xml::1662750905905-1::[redacted] (generated)


Operation completed successfully.

SQL> select table_name from user_tables;

TABLE_NAME
__________________________
REGIONS
LOCATIONS
DEPARTMENTS
JOBS
EMPLOYEES
JOB_HISTORY
DATABASECHANGELOGLOCK
DATABASECHANGELOG_ACTIONS
DATABASECHANGELOG
PETS
COUNTRIES

11 rows selected.

SQL>
```

7.8 DATABASECHANGELOG_DETAILS VIEW

DATABASECHANGELOG_DETAILS is a view that consolidates information from the DATABASECHANGELOG and DATABASECHANGELOG_ACTIONS tables for easier reporting and troubleshooting.

This view enables a better understanding of the status and work performed by each change applied to the database. The SQL column shows the actual SQL that was run in the database. The SXML column shows the state of the object prior to the change being applied.

Example

```
SQL> desc DATABASECHANGELOG_DETAILS


  Name            Null?         Type
_________________ ___________ _______________
DEPLOYMENT_ID                 VARCHAR2(10)
ID                            VARCHAR2(255)
AUTHOR                        VARCHAR2(255)
FILENAME                      VARCHAR2(255)
SQL                           CLOB
SXML                          CLOB
DATEEXECUTED      NOT NULL    TIMESTAMP(6)
EXECTYPE          NOT NULL    VARCHAR2(10)
MD5SUM                        VARCHAR2(35)
DESCRIPTION                   VARCHAR2(255)
COMMENTS                      VARCHAR2(255)
LIQUIBASE                     VARCHAR2(20)
```


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```
CONTEXTS                       VARCHAR2(255)
LABELS                         VARCHAR2(255)
```

7.9 ChangeSets in Liquibase

The following table lists the changeSets and provides a description for each of them. To learn more about changeSets, see <changeSet> tag.

ChangeSet	Description
CreateOracleConstraint	Creates a constraint from SQL.
CreateOracleDirectory	Creates a directory from SQL.
CreateOracleFunction	Creates a function from SQL.
CreateOracleGrant	Creates a grant from SQL.
CreateOraclePackageBody	Creates a package body from SQL.
CreateOracleJob	Creates a DBMS_Scheduler job from SQL.
CreateOraclePackageSpec	Creates a package specification from SQL.
CreateOracleProcedure	Creates a procedure from SQL.
CreateOraclePublicSynonym	Creates a public synonym from SQL.
CreateOracleRefConstraint	Creates a referential constraint from SQL.
CreateOracleSynonym	Creates a synonym from SQL.
CreateOracleTrigger	Creates a trigger from SQL.
CreateOracleTypeBody	Creates a type body from SQL.
CreateOracleTypeSpec	Creates a type spec from SQL.
CreateSxmlObject	Creates a function from SQL.
DropOracleConstraint	Drops a constraint.
DropOracleFunction	Drops a function.
DropOracleGrant	Drops a grant.
DropOraclePackageBody	Drops a package body.
DropOraclePackageSpec	Drops a package specification.
DropOracleProcedure	Drops a procedure.
DropOracleRefConstraint	Drops a referential constraint.
DropOracleTrigger	Drops a trigger.
DropOracleTypeBody	Drops a type body.
DropOracleTypeSpec	Drops a type specification.
DropOracleSynonym	Drops a synonym.
DropSxmlObject	Drops an SXML object. If the object was created through createSxmlObject, this rolls back the object to the last state. If not created, the object is just dropped. This is primarily used internally for SXML object handling.
RunOracleScript	Executes a SQL script using the SQLcl engine and therefore supports all SQLcl commands. Supports script, file, and URL sources.

7.10 Tips for Liquibase Settings

This section covers the following:

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- How to Exclude Table Properties When Deploying Changelogs to a New Environment
- Create Database Objects in a Schema Different From the Connected Schema

7.10.1 How to Exclude Table Properties When Deploying Changelogs to a New Environment

When capturing tables from one environment and deploying to another, there are certain table properties you may want to exclude from the deployment while creating the table. This may be due to these properties being unavailable or undesired in your target environment, such as:

- Partitioning
- Compression
- Tablespace

SQLcl uses the Data Definition Language (DDL) session settings in the target environment, where the database objects are created or altered in (and not the environment the changelog was generated from), to generate the DDL for the objects. By turning off the DDL settings, you can prevent the corresponding table properties from being included in the table creation.

1. Generate your Liquibase changelog file for the table you want to capture and deploy.

   ```
   liquibase generate-object -object-name [table name] -object-type table
   ```

   As an example, consider the following table:

   ```
   CREATE TABLE "PARTITION_COMPRESSION_TABLESPACE_TEST"
      (    "A" VARCHAR2(20) NOT NULL ENABLE,
           "B" VARCHAR2(20),
           "C" VARCHAR2(20) NOT NULL ENABLE,
           CONSTRAINT "PARTITION_COMPRESSION_TABLESPACE_TEST_PK" PRIMARY KEY
   ("A")
     USING INDEX
     PCTFREE 10 INITRANS 2 MAXTRANS 255 LOGGING
     TABLESPACE "USERS" ENABLE
      ) PCTFREE 0 PCTUSED 40 INITRANS 1 COMPRESS BASIC
     STORAGE( BUFFER_POOL DEFAULT FLASH_CACHE DEFAULT CELL_FLASH_CACHE
   DEFAULT)
     TABLESPACE "USERS"
     PARTITION BY HASH ("C")
    (PARTITION "SYS_P803" SEGMENT CREATION DEFERRED
     COMPRESS BASIC
     TABLESPACE "USERS");
   ```

   The following is an excerpt from the resulting changelog (the partition, compression and tablespace attributes are highlighted):

   ```
   <?xml version="1.0" encoding="UTF-8"?>
   <databaseChangeLog
   xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
   …
          <TABLE_PROPERTIES>
             <HASH_PARTITIONING>
   ```


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```
                <COL_LIST>
                   <COL_LIST_ITEM>
                      <NAME>C</NAME>
                   </COL_LIST_ITEM>
                </COL_LIST>
                <DEFAULT_PHYSICAL_PROPERTIES>
                   <HEAP_TABLE>
                      <SEGMENT_ATTRIBUTES>
                         <PCTFREE>0</PCTFREE>
                         <PCTUSED>40</PCTUSED>
                         <INITRANS>1</INITRANS>
                         <MAXTRANS>255</MAXTRANS>
                         <STORAGE>
                            <BUFFER_POOL>DEFAULT</BUFFER_POOL>
                            <FLASH_CACHE>DEFAULT</FLASH_CACHE>
                            <CELL_FLASH_CACHE>DEFAULT</CELL_FLASH_CACHE>
                         </STORAGE>
                         <TABLESPACE>USERS</TABLESPACE>
                      </SEGMENT_ATTRIBUTES>
                      <COMPRESS>BASIC</COMPRESS>
                   </HEAP_TABLE>
                </DEFAULT_PHYSICAL_PROPERTIES>
                <PARTITION_LIST>
                   <PARTITION_LIST_ITEM>
                      <NAME>SYS_P803</NAME>
                      <SEGMENT_ATTRIBUTES>
                         <SEGMENT_CREATION_DEFERRED></
SEGMENT_CREATION_DEFERRED>
                         <TABLESPACE>USERS</TABLESPACE>
                      </SEGMENT_ATTRIBUTES>
                      <COMPRESS>BASIC</COMPRESS>
                   </PARTITION_LIST_ITEM>
                </PARTITION_LIST>
             </HASH_PARTITIONING>
          </TABLE_PROPERTIES>
       </RELATIONAL_TABLE>
    </TABLE>]]></n0:source>
    </n0:createSxmlObject>
    </changeSet>
    </databaseChangeLog>
```

2. In the environment where you apply the update and generate the table, turn off the following DDL settings:

   ```
   set ddl partitioning off
   set ddl segment_attributes off
   set ddl tablespace off
   ```

   Partitioning turns off the partitioning property, segment_attributes turns off the compression property, and tablespace turns off the tablespace property.

   ```
   SQL> show ddl
   Parameters
   ---------------------------------------------
   BODY                           : ON
   COLLATION_CLAUSE               : NEVER
   ```


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```
CONSTRAINTS                    : ON
CONSTRAINTS_AS_ALTER           : ON
EMIT_SCHEMA                    : ON
FORCE                          : ON
INHERIT                        : ON
INSERT                         : ON
OID                            : ON
PARTITIONING                   : OFF
PRETTY                         : ON
REF_CONSTRAINTS                : ON
SEGMENT_ATTRIBUTES             : OFF
SIZE_BYTE_KEYWORD              : ON
SPECIFICATION                  : ON
SQLTERMINATOR                  : ON
STORAGE                        : ON
TABLESPACE                     : OFF
-----------------------------------------------
End Parameters
```

3. To confirm that these settings are not included in the table generation, use the `liquibase update-sql` command. This command shows you the exact SQL and PL/SQL code that will be run by the `update` command before you execute it.

   ```
   liquibase update-sql -changelog-file
   partition_compression_tablespace_test_table.xml
   ```

   When partitioning, compression, and tablespace settings are turned off, the SQL code looks like the following snippet:

   ```
   -- Changeset
   partition_compression_tablespace_test_table.xml::fb1d77405bcd3cf7d60e555337
   b80ec9555134d7::(HR)-Generated
   CREATE TABLE "PARTITION_COMPRESSION_TABLESPACE_TEST"
      (    "A" VARCHAR2(20) NOT NULL ENABLE,
           "B" VARCHAR2(20),
           "C" VARCHAR2(20) NOT NULL ENABLE,
           CONSTRAINT "PARTITION_COMPRESSION_TABLESPACE_TEST_PK" PRIMARY KEY
   ("A")
     USING INDEX ENABLE
      );
   ```

   The following is an example of the SQL code if partitioning, compression, and tablespace settings were turned on:

   ```
   -- Changeset
   partition_compression_tablespace_test_table.xml::fb1d77405bcd3cf7d60e555337
   b80ec9555134d7::(HR)-Generated
   CREATE TABLE "PARTITION_COMPRESSION_TABLESPACE_TEST"
      (    "A" VARCHAR2(20) NOT NULL ENABLE,
           "B" VARCHAR2(20),
           "C" VARCHAR2(20) NOT NULL ENABLE,
           CONSTRAINT "PARTITION_COMPRESSION_TABLESPACE_TEST_PK" PRIMARY KEY
   ("A")
     USING INDEX
   ```


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```
  PCTFREE 10 INITRANS 2 MAXTRANS 255 LOGGING
  TABLESPACE "USERS"  ENABLE
   ) PCTFREE 0 PCTUSED 40 INITRANS 1 COMPRESS BASIC
  STORAGE(
  BUFFER_POOL DEFAULT FLASH_CACHE DEFAULT CELL_FLASH_CACHE DEFAULT)
  TABLESPACE "USERS"
  PARTITION BY HASH ("C")
(PARTITION "SYS_P803"  SEGMENT CREATION DEFERRED
  COMPRESS BASIC
  TABLESPACE "USERS");
```

4. You can apply the update and create the table by running the `update` command in your target environment. This creates the table as unpartitioned, uncompressed, and uses the tablespace of the target environment (rather than attempting to use the tablespace of the environment the changelog was generated from).

   ```
   liquibase update -changelog-file
   partition_compression_tablespace_test_table.xml
   ```

7.10.2 Create Database Objects in a Schema Different From the Connected Schema

With SQLcl Liquibase, you can make deployments to a different database user schema than the one you are connected to. However, you must have the required permissions for the target user schema.

There are three important parameters related to this for the `liquibase update` command:

- `-output-default-schema|-ouds`
  Controls if the schema is output or not when running the data definition language (DDL) SQL to create or alter your database object.
  - If `-output-default-schema true` is set, the schema is included.

    ```
    create table storefront.merchandise …
    ```

  - If `-output-default-schema false` is set or `-output-default-schema` is not set at all, the schema is not included.

    ```
    create table merchandise …
    ```

  To deploy database objects to a different schema than the connected schema, you must set `-output-default-schema true` so that you can specify the schema you want to create the objects in using `-default-schema-name`.
- `-default-schema-name|-desn`
  If `-output-default-schema true` is set, the `-desn` parameter controls which schema is output.

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Use this parameter to specify the schema in which to create your database objects. For example, if you are connected to test_user and you want to create your table in storefront, your command would be:

```
liquibase update -changelog-file merchandise_table.xml -output-default-
schema true -default-schema-name storefront
```

If `-output-default-schema true` is set and `-default-schema-name` is not set, the schema output is based on the `ownerName` attribute for your changeset in your changelog file.

```
<n0:createSxmlObject objectName="Merchandise" objectType="TABLE"
ownerName="LBUSER" replaceIfExists="false" >
```

If `ownerName` is not set, the schema you are connected to is used.

- `-liquibase-schema-name|-lbsn`
  One of the big advantages of the Liquibase functionality in SQLcl is the ability to track and manage your changes. This is mainly done with the `databasechangelog` tracking tables automatically created and updated in your schema when you run Liquibase.

  `-liquibase-schema-name` allows you to control in which schema you update Liquibase tracking information through the databasechangelog tables.

  This allows you to have use cases such as having a control schema or user that tracks all your Liquibase change information, while applying the database objects themselves to other schemas.

  For example, you are connected to the user or schema storefront and want to create your merchandise table using your merchandise_table.xml changelog file. However, you do not want Liquibase to create your databasechangelog tables in this schema. You want the tracking information to be stored in the pre-existing databasechangelog tables in your schema control_user.

  The following command accomplishes this:

  ```
  liquibase update -changelog-file merchandise_table.xml -liquibase-schema-
  name control_user
  ```

  Note

  Storefront needs to have the permission to write on the `databasechangelog`, `databasechangeloglock`, and `databasechangelog_actions` tables in control_user.

  ```
  GRANT SELECT, INSERT, UPDATE, DELETE ON
  CONTROL_USER.DATABASECHANGELOG TO STOREFRONT;
  GRANT SELECT, INSERT, UPDATE, DELETE ON
  CONTROL_USER.DATABASECHANGELOGLOCK TO STOREFRONT;
  GRANT SELECT, INSERT, UPDATE, DELETE ON
  CONTROL_USER.DATABASECHANGELOG_ACTIONS TO STOREFRONT;
  ```


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7.11 Important 23.4 Update with Liquibase Changelog Files

For cross-schema use, changelog files generated before SQLcl release 23.4 may require regeneration or manual updates. These alterations are necessary only if you are changing schema names between your export and import with pre-23.4 changelogs.

If you do not regenerate your changelogs or make the manual adjustments, then:

- Changelogs containing schema names are applied only to the schema named in them, regardless of provided parameters.
- Changelogs not containing schema names are applied only to the schema you are currently connected to with SQLcl, regardless of provided parameters.

SQLcl release 23.4 introduced a `%USER_NAME%` replacement for the schema name stored in changesets.

There are two types of changes for manually updating your changelogs with the proper `%USER_NAME%` substitution:

- Changelogs with <SCHEMA></SCHEMA> XML element
- Changelogs that use SQL within a CDATA field

For changelogs with the <SCHEMA></SCHEMA> XML element, replace the content inside with `%USER_NAME%`.

In the following code block, the two <SCHEMA> XML elements that appear in this code are highlighted using bold font. These are replaced with `%USER_NAME%`

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
 xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
 xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
 http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
 <changeSet id="5b3935a6b05750a24ac6ebc1c646bc6fe4cb4b40" author="(HR)-
Generated" failOnError="false"   runOnChange="true" runAlways="false"  >
    <n0:createSxmlObject objectName="MERCHANDISE" objectType="TABLE"
ownerName="HR"  replaceIfExists="true" >
        0:source><![CDATA[
<TABLE xmlns="http://xmlns.oracle.com/ku" version="1.0">
<SCHEMA>HR</SCHEMA>
<NAME>MERCHANDISE</NAME>
<RELATIONAL_TABLE>
 <COL_LIST>
  <COL_LIST_ITEM>
   <NAME>ID</NAME>
   <DATATYPE>NUMBER</DATATYPE>
   <IDENTITY_COLUMN>
    <SCHEMA>HR</SCHEMA>
    <GENERATION>ALWAYS</GENERATION>
    <START_WITH>1</START_WITH>
    <INCREMENT>1</INCREMENT>
    <MINVALUE>1</MINVALUE>
    <MAXVALUE>9999999999999999999999999999</MAXVALUE>
```


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```
    <CACHE>20</CACHE>
   </IDENTITY_COLUMN>
…
```

After you do the manual adjustment, this section changes to:

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
  xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
  xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
  http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
  <changeSet id="5b3935a6b05750a24ac6ebc1c646bc6fe4cb4b40" author="(HR)-
Generated" failOnError="false"   runOnChange="true" runAlways="false"  >
    <n0:createSxmlObject objectName="MERCHANDISE" objectType="TABLE"
ownerName="HR"  replaceIfExists="true" >
     <n0:source><![CDATA[
<TABLE xmlns="http://xmlns.oracle.com/ku" version="1.0">
<SCHEMA>%USER_NAME%</SCHEMA>
<NAME>MERCHANDISE</NAME>
<RELATIONAL_TABLE>
   <COL_LIST>
     <COL_LIST_ITEM>
       <NAME>ID</NAME>
       <DATATYPE>NUMBER</DATATYPE>
       <IDENTITY_COLUMN>
       <CHEMA>%USER_NAME%</SCHEMA>
       <GENERATION>ALWAYS</GENERATION>
       <START_WITH>1</START_WITH>
       <INCREMENT>1</INCREMENT>
       <MINVALUE>1</MINVALUE>
       <MAXVALUE>9999999999999999999999999999</MAXVALUE>
       <CACHE>20</CACHE>
       </IDENTITY_COLUMN>
…
```

For changelogs that use SQL within the CDATA field, attach "%USER_NAME%". to the front of all database object references. If a schema name is in these locations, replace it with "%USER_NAME%". Note that there is a period after "%USER_NAME%".

Two examples are shown below, each showing a changelog file before and after the manual adjustment, with the area of adjustment highlighted in bold font in the code block for emphasis.

Example 1

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
<changeSet id="f1b1bf677cf990caa0147f863ea18486cdf23815" author="(LBUSER)-
Generated" failOnError="false" runOnChange="false" runAlways="false" >
```


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```
<n0:createOracleRefConstraint objectName="EMP_JOB_FK"
objectType="REF_CONSTRAINT" ownerName="LBUSER" replaceIfExists="false" >
<n0:source><![CDATA[ALTER TABLE "LBUSER"."EMPLOYEES" ADD CONSTRAINT
"EMP_JOB_FK" FOREIGN KEY ("JOB_ID") REFERENCES "LBUSER"."JOBS" ("JOB_ID")
ENABLE;]]></n0:source>
</n0:createOracleRefConstraint>
</changeSet>
</databaseChangeLog>
```

After you do the manual adjustment, this section changes to:

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
<changeSet id="f1b1bf677cf990caa0147f863ea18486cdf23815" author="(LBUSER)-
Generated" failOnError="false" runOnChange="false" runAlways="false" >
<n0:createOracleRefConstraint objectName="EMP_JOB_FK"
objectType="REF_CONSTRAINT" ownerName="LBUSER" replaceIfExists="false" >
<n0:source><![CDATA[ALTER TABLE "%USER_NAME%"."EMPLOYEES" ADD CONSTRAINT
"EMP_JOB_FK" FOREIGN KEY ("JOB_ID") REFERENCES "%USER_NAME%"."JOBS"
("JOB_ID") ENABLE;]]></n0:source>
</n0:createOracleRefConstraint>
</changeSet>
</databaseChangeLog>
```

Example 2

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
  xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
  xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
  http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
  <changeSet id="2b1ce58fc2f1781ce70d5bb99bf23b6ae8741ff3" author="(TEST9)-
Generated" failOnError="false"   runOnChange="false" runAlways="false"  >
     <n0:createOracleProcedure objectName="P_SQLCLERROR_PROCEDURE"
objectType="PROCEDURE" ownerName="TEST9"  replaceIfExists="false" >
       <n0:source><![CDATA[CREATE OR REPLACE EDITIONABLE PROCEDURE
"TEST9"."P_SQLCLERROR_PROCEDURE" is
begin
null;
end p_sqlclerror_procedure;
/]]></n0:source>
                <n0:createOracleProcedure>
        </changeSet>
</databaseChangeLog>
```


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After you do the manual adjustment, this section appears as follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
  xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
  xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
  http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-latest.xsd">
  <changeSet id="2b1ce58fc2f1781ce70d5bb99bf23b6ae8741ff3" author="(TEST9)-
Generated" failOnError="false"   runOnChange="false" runAlways="false"  >
    <n0:createOracleProcedure objectName="P_SQLCLERROR_PROCEDURE"
objectType="PROCEDURE" ownerName="TEST9"  replaceIfExists="false" >
      <n0:source><![CDATA[CREATE OR REPLACE EDITIONABLE PROCEDURE
"%USER_NAME%"."P_SQLCLERROR_PROCEDURE" is
begin
null;
end p_sqlclerror_procedure;
/]]></n0:source>
          </n0:createOracleProcedure>
         </changeSet>
</databaseChangeLog>
```

7.12 Examples Using Liquibase

Some examples of using the Liquibase functionality for database change management tasks:

- Review SQL
- Capture and Deploy an Object
- Capture and Deploy a Schema
- Execute Custom SQL with RunOracleScript

7.12.1 Review SQL

To review SQL before running maintenance commands:

1. Optionally, set up to save SQL updates.

   ```
    cd <lb-changes-directory>
   spool update.sql
   ```

2. Connect to HR and capture the object.

   ```
   connect <db-connect1-string>
   lb update-sql
   spool off
   ```

7.12.2 Capture and Deploy an Object

To deploy the EMPLOYEES table from HR to HR2:

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1. Set default output path.

   ```
   cd <output-files-path>
   ```

2. Connect to HR and capture the object.

   ```
   connect <db-connect1-string>
   lb generate-object -object-type table -object-name employees
   ```

3. Connect to HR2 and ensure the object does not exist.

   ```
   connect <db-connect2-string>
   drop table employees
   ```

4. Create the object in HR2 and verify that it was created.

   ```
   lb update -changelog-file employees_table.xml
   desc employees
   ```

7.12.3 Capture and Deploy a Schema

To capture HR schema and reproduce it in HR2 schema:

1. Set default output path.

   ```
   cd <output-files-path>
   ```

2. Connect to HR and capture the schema.

   ```
   connect <db-connect1-string>
   lb generate-schema
   ```

3. Setup the HR2 user.

   ```
   connect <db-connect-dba-string>
   drop user hr2 cascade;
   create user hr2 identified by hr2;
   grant connect,resource, create view to hr2;
   alter user hr2 quota unlimited on users;
   alter user hr2 quota unlimited on sysaux;
   ```

4. Create the schema objects deployed from HR in HR2 and verify.

   ```
   lb update -changelog-file controller.xml
   tables
   ```

7.12.4 Execute Custom SQL with RunOracleScript

Create a RunOracleScript changeset to create a table and use PL/SQL variables in the script.

```
<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog
```


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```
   xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:n0="http://www.oracle.com/xml/ns/dbchangelog-ext"
xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
http://www.liquibase.org/xml/ns/dbchangelog/dbchangelog-3.6.xsd">
   <changeSet id="runScriptString" author="jdoe">
<n0:runOracleScript objectName="myScript" ownerName="JDOE"
sourceType="STRING">
<n0:source><![CDATA[
DEFINE table_name = RUNNERSTRING;
create table &&table_name (id number);
]]></n0:source>
    </n0:runOracleScript>
  </changeSet>
</databaseChangeLog>
```


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8

Database Application CI/CD

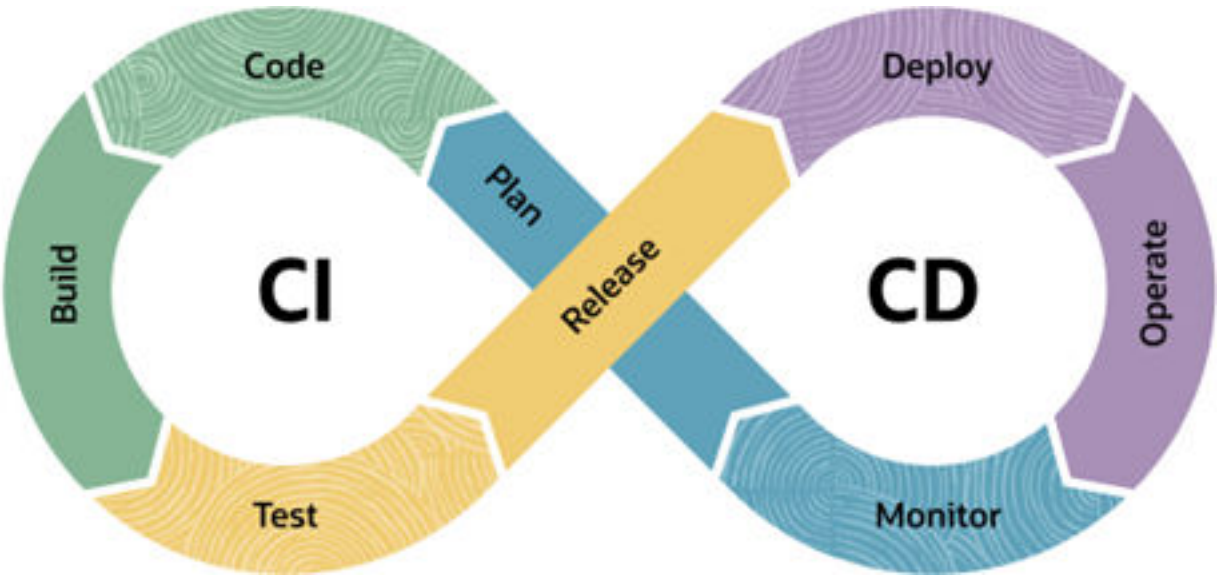
The Oracle SQLcl Projects feature allows users to manage the creation and administration of a database application. It is targeted towards enterprise-level applications that require structured release processes.

This chapter contains the following topics:

- Introduction
- About the Project Command
- Quick Start
- Refining Exports with Filters
- Project Command Usage Examples
- Upgrading SQLcl When Using SQLcl Projects

8.1 Introduction

Database Application Continuous Integration and Continuous Delivery (CI/CD) represents a transformative approach in modern database management and application development. This methodology seamlessly integrates database changes into the development pipeline while ensuring swift and secure deployment to production environments. By combining the rapid feedback mechanisms of Continuous Integration with the streamlined deployment processes of Continuous Delivery, Database CI/CD addresses the critical need for agility and reliability in today's fast-paced software development landscape.



At its core, Database CI/CD aims to:

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- Accelerate time-to-market for new features and updates.
- Maintain a consistently high quality of code and database schema.
- Facilitate immediate issue detection and resolution.
- Ensure that both application and database components are always in a deployable state.

This approach not only enhances development efficiency but also significantly improves the end-user experience through frequent, reliable releases.

The `project` command in Oracle SQLcl is a powerful tool designed to standardize database software versioning and create releasable artifacts, including APEX elements. This command supports a consistent model of development and operations, enabling repeatable builds that can be applied in a specific order.

The key features of SQLcl Projects include:

- Versioned Feature Management: Allows database developers to identify individual changes and create versioned features or issues.
- Release Artifact Creation: Facilitates rolling multiple changes into a single release artifact that can be published for use.
- Ordered Installation: Ensures that artifacts are installable in the correct sequence, taking into account previously installed components in the environment.
- Source Control Integration: Supports creating branches in source control and exporting objects to these branches. Changes are realised using branch diffs and formatted consistently, allowing for easy identification through file checksums.
- Automated Release Packaging: When multiple branches or changes are created, SQLcl Projects can wrap them into a release, automatically setting up the execution of all changesets in the correct order on a target system.

The SQLcl Projects feature represents a significant step towards streamlining database development workflows, enhancing version control, and improving the overall efficiency of database application development and deployment processes.

8.1.1 Database CI/CD Concepts

This section covers the concepts relevant to understanding SQLcl Projects.

- Database Continous Integration (CI) and Database Continuous Delivery (CD)
- Database Project Scaffolding
- Advanced Database Object Explorer
- Automated Database Migration Script Generation
- Building Releasable Artifacts

Database Continous Integration (CI) and Database Continuous Delivery (CD)

Database continuous integration (CI) is the process of frequently integrating database schema and logic changes into application development, aiming to provide immediate feedback on any issues. Database continuous delivery (CD) focuses on quickly and safely deploying those changes to production, ensuring that both application and database code are always in a deployable state. Together, database CI/CD reduces time-to-market and delivers consistent end-user value through frequent, high-quality releases.

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Database Project Scaffolding

When initializing SQLcl Projects (using the `project init` command), SQLcl creates a set of files that are used to manage the creation of files and changelogs.

There are three folders in the initial setup:

- `.dbtools`: This folder contains the following:
  - Project filters that are used by `project export` to filter out objects that will be exported.
    - `ddl.filters`: Defines the filters used to select database objects for DDL generation during project export.
    - `dml.filters`: Defines the filters used to select table data for DML generation during for DML generation.
  - Project format rules that are used to format the code when it is exported.
  - Project configuration settings.
- `src`: This folder is where the exported objects from the database get placed. This is broken down by schema and objects types.
- `dist`: The release artifacts are created in this folder. This folder gets populated by the `project stage` command and the `project release` command compresses its contents to create a release artifact.

```
──.dbtools
│    ├── filters
│    │    └── ddl.filters (previously, project.filters)
     │    └── dml.filters
│    ├── project.config.json
│    └── project.sqlformat.xml
├── dist
│    └── install.sql
└── src
│    └── database
├── .gitignore
└── README.md
```

Advanced Database Object Explorer

One of the main features of SQLcl Projects is exporting database objects to the source control repository. The export includes the SQL needed to create the object and a "snapshot" of the object's metadata. The snapshot is stored as a comment and is prefixed with `sqlcl_snapshot`. It contains the following information:

- Checksum calculated on the exported code
- Object type
- Object name
- Schema name
- SXML representation of the object as exported (see DBMS_METADATA SXML)

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The following path is used for exported objects:

```
src/database/<SCHEMA>/<OBJECT_TYPE>/<OBJECT_NAME>[.sql|.pks|.pkb]
```

For example, a table called `doc` in the `HR` schema, the file path is `src/database/hr/tables/doc.sql`.

```
create table hr.doc (
    id number
);
-- sqlcl_snapshot
{"hash":"d992dceaa87a936e8242bdc81201f93030084ab5","type":"TABLE","name":"DOC"
,"schemaName":"HR","sxml":"<TABLE xmlns=\"http://xmlns.abc.com/ku\"
version=\"1.0\"> <SCHEMA>HR</SCHEMA> <NAME>DOC</NAME>
<RELATIONAL_TABLE><COL_LIST> <COL_LIST_ITEM><NAME>ID</NAME><DATATYPE>NUMBER</
DATATYPE> </COL_LIST_ITEM></COL_LIST><DEFAULT_COLLATION>USING_NLS_COMP</
DEFAULT_COLLATION><PHYSICAL_PROPERTIES> <HEAP_TABLE></HEAP_TABLE></
PHYSICAL_PROPERTIES> </RELATIONAL_TABLE></TABLE>"}
```

Automated Database Migration Script Generation

As developers add changes to the database, they are exported to the branch. Git branches are used to identify changes between units of work. Using the diffs between the branches, the changed files are identified.

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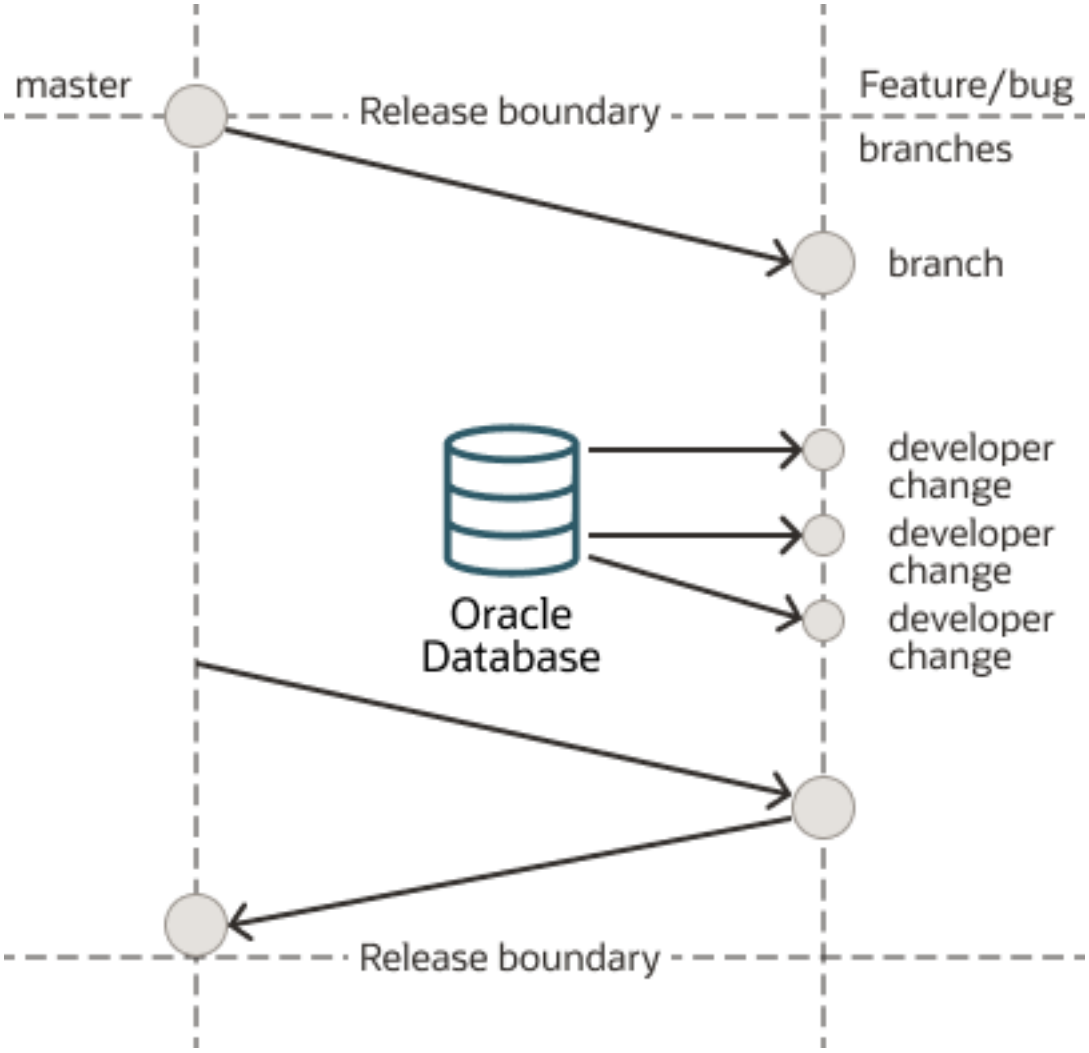

Each object file has a specific checksum and, in some cases, specific SXML for the specification of the object. Using Oracle DBMS_METADATA_DIFF, the SXML files are compared and the DDL to make both objects the same is generated and added to the repository.

Building Releasable Artifacts

To ensure deployment consistency, statements need to run in a particular order. Once a statement is executed, it will never be run again (immutable). Liquibase support, which was introduced in SQLcl to allow users to create changesets for schemas or objects, can be run to install the objects into a database. SQLcl Projects builds on that support to generate changesets for each block of changes on a branch and build those together into a release.

This is achieved by taking the comparison set between branches and generating a hierarchy scaffolding of changelogs that represent the list of comparisons. Then, the comparison set is used to generate the SXML differences, which is then used to generate the DDL for the changes.

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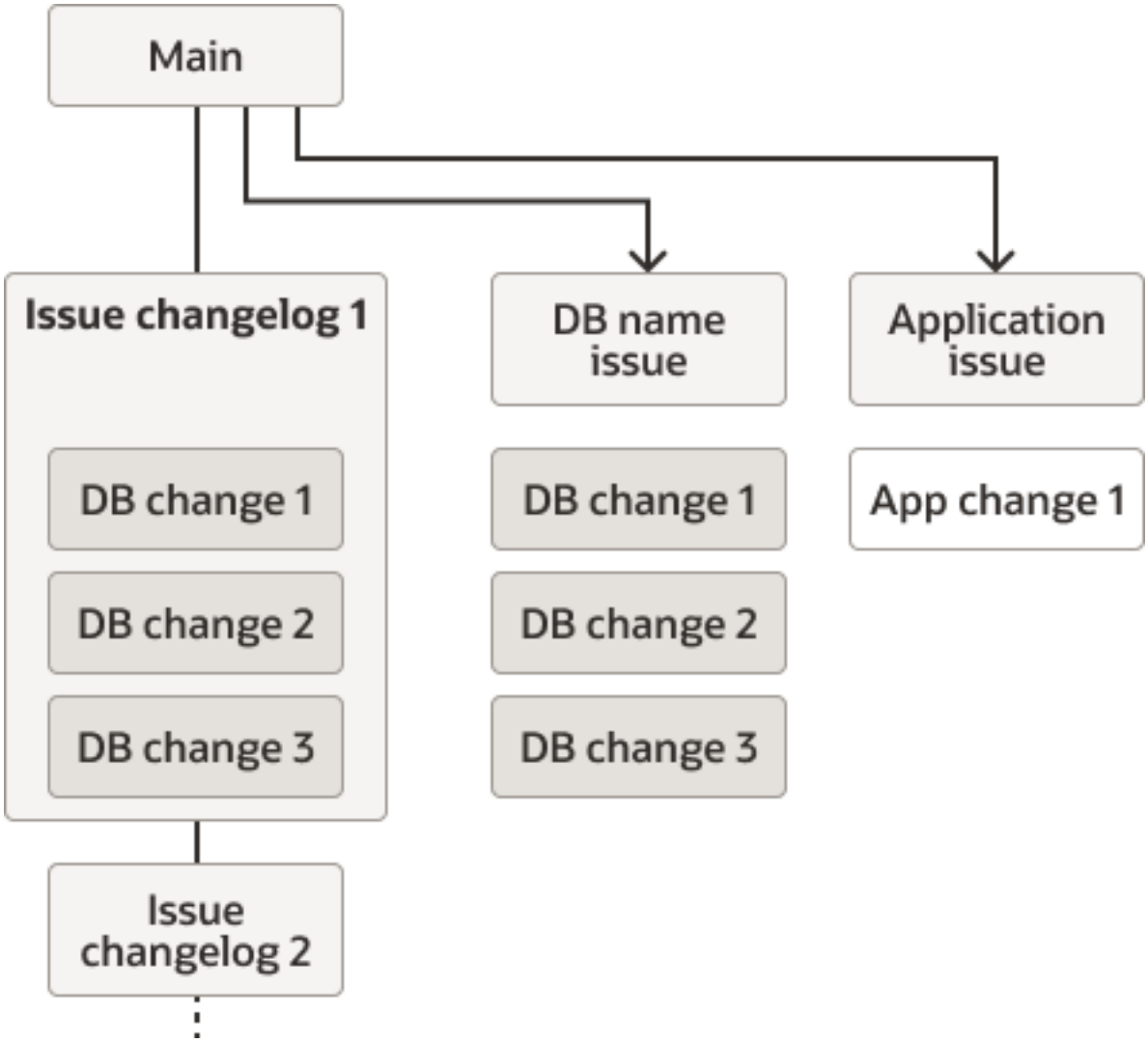

After an export of the changes, the `project stage` command generates the changesets for the differences from the current branch and the main branch.

```
--Example
next
├── release.changelog.xml
└── changes
    └── initial-export
        ├── hr
        │   └── table
        │       └── doc.sql
        └── stage.changelog.xml
```

In this example, there is one table that is exported into doc.sql. This example has been simplified to explain the concept. The `project stage` command compares the contents of the current branch and by default compares it against the base branch of the project. The project

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configuration that controls the base branch is `git.defaultBranch`. This can be shown by using the following command:

```
project config -list -name git.defaultBranch
```

To change it, use the same `config` command with the `-set` option.

```
SQL> project config -list -name git.defaultBranch
 +============================+
 | SETTING NAME      | VALUE  |
 +============================+
 | git.defaultBranch | master |
 +----------------------------+
```

The `project stage` command also has a prescribed format. When the command is run, it creates the following structure:

```
next/changes/<branch_name>
```

In the example, the branch created for the initial export of the `hr.doc` table is called `initial-export`. Each time a new branch is created and the `stage` command is run, there is a new folder underneath `next/changes/<branch_name>`.

In this example, the `doc.sql` file is automatically prefixed with Liquibase-formatted SQL formats and is defined as an individual changeset. `doc.sql` will be referenced in a changelog file.

```
-- Liquibase-formatted sql
-- changeset HR:d992dceaa87a936e8242bdc81201f93030084ab5 stripComments:false
logicalFilePath:initial-export/hr/table/doc.sql
-- sqlcl_snapshot src/database/hr/tables/
doc.sql:null:d992dceaa87a936e8242bdc81201f93030084ab5:create

create table hr.doc (
    id number
);
```

In this example, the stage.changelog.xml references the Liquibase-formatted SQL changeset.

```
--stage.changelog.xml

<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                   xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
                   xsi:schemaLocation="http://www.liquibase.org/xml/ns/
dbchangelog
                      http://www.liquibase.org/xml/ns/dbchangelog/
dbchangelog-4.3.xsd">
<!--BEGIN-->
<include file="hr/table/doc.sql" relativeToChangelogFile="true"/>
<!--END-->
<!--BEGIN CUSTOM-->
```


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```
<!--END CUSTOM-->
</databaseChangeLog>
```

The `next` folder has a `release.changelog.xml` right at the top. This file is referenced again in the `project release` command.

```
--release.changelog.xml

<?xml version="1.0" encoding="UTF-8"?>
<databaseChangeLog xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                   xmlns="http://www.liquibase.org/xml/ns/dbchangelog"
                   xsi:schemaLocation="http://www.liquibase.org/xml/ns/
dbchangelog
                      http://www.liquibase.org/xml/ns/dbchangelog/
dbchangelog-4.3.xsd">
<!--BEGIN CHANGE-->
<include file="changes/initial-export/stage.changelog.xml"
relativeToChangelogFile="true"/>
<!--END CHANGE-->
<!--BEGIN CODE-->
<!--END CODE-->
</databaseChangeLog>
```

When all the changes are created for a release, run the `project release` command to take all files under the `next` folder and move them to a "numbered release" folder.

The final structure is:

```
releases
├── 1.0
│   ├── code
│   │   └── code.changelog.xml
│   ├── release.changelog.xml
│   └── changes
│       └── initial-export
│           ├── _custom
│           ├── hr
│           │   └── table
│           │       └── doc.sql
│           └── stage.changelog.xml
├── main.changelog.xml
├── next
│   └── release.changelog.xml
└── util
    ├── prechecks.sql
    └── recompile.sql
```

To generate a re-runnable artifact, run the `project gen-artifact` command. This creates a file in `artifacts/<projectname>-<version>.zip`. By default, artifacts are not included in the Git repository (To change this, modify the `.gitignore` file).

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The contents of this artifact include:

```
releases/next/release.changelog.xml
releases/1.0/changes/initial-export/stage.changelog.xml
releases/1.0/changes/initial-export/hr/table/doc.sql
releases/1.0/release.changelog.xml
releases/1.0/code/code.changelog.xml
releases/util/recompile.sql
releases/util/prechecks.sql
releases/main.changelog.xml
README.md
install.sql
```

The last part is deploying the artifacts into a production database. The command `project deploy` takes the generated artifact and runs it with SQLcl.

```
SQL> project deploy -file demo-1.0.zip
Starting the migration...
Running Changeset: initial-export/hr/table/
doc.sql::d992dceaa87a936e8242bdc81201f93030084ab5::HR
Table HR.DOC created.
Liquibase: Update has been successful. Rows affected: 1
Installing/updating schemas
--Starting Liquibase at 2024-09-19T09:09:02.326601 (version [local build] #0
built at 2024-08-14 18:40+0000)
Table HR.DOC created.

UPDATE SUMMARY
Run:                          1
Previously run:               0
Filtered out:                 0
-------------------------------
Total change sets:            1

Produced logfile: sqlcl-lb-1726733337322.log
Operation completed successfully.
Migration has been completed.
```

8.1.2 Support for Schema Annotations

Oracle SQLcl Projects include partial support for schema annotations. This allows you to use the `project` command to export and stage database schema objects that have annotations attached to them.

The `project export` Command

The `project export` command fully supports annotations. You can export the following object types that have annotations attached to them:

- Tables
- Views
- Indexes
- Materialized views

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- Domains

The `project stage` Command

The `project stage` command has partial support for annotations.

The following scenarios highlight the current limitations when using the `project stage` command.

Staging Table Alters with Annotation Changes

When you stage a table where the only difference between the source and the target is in the annotations, the `project stage` command doesn't generate any DDL or file for that table.

Staging Domain Alters with Annotations

Staging `ALTER` statements for domains with annotations is not supported. The generated change set contains the following placeholder comment instead of a DDL:

```
/* Liquibase comments here */

/*dbms_metadata_diff does not currently support domains, see Bug 37979876 add
customer id to existing bug to escalate.

old ddl:
/* The old DDL would be here */


new ddl:
/* The new DDL would be here */
```

8.1.3 Support for Jobs

Oracle SQLcl Projects support jobs scheduler objects with some caveats.

Exporting Jobs

The `project export` command exports all job types except for immediate jobs. You can use the command with jobs that have either inline or named programs and schedules. The following examples illustrate how each type is handled.

> **Note**
>
> The project export command includes any job arguments associated with the selected job export. Program arguments are also supported and are included where applicable. This ensures that both scheduler job and program arguments are preserved during export.

- **Inline Program and Schedule:** In this configuration, the job definition includes embedded logic and timing. The export contains all specified attributes and may include additional attributes required for staging.

  ```
  BEGIN
    DBMS_SCHEDULER.CREATE_JOB (
      job_name           => 'my_inline_job',
  ```


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```
    job_type           => 'PLSQL_BLOCK',
    job_action         => '
      BEGIN
        -- your program code here
        -- e.g. call a stored procedure or do some logic
        my_schema.my_proc;
      END;',
    start_date         => SYSTIMESTAMP + INTERVAL '5' MINUTE,
    repeat_interval    => 'FREQ=HOURLY; BYMINUTE=0; BYSECOND=0',
    end_date           => NULL,
    enabled            => TRUE,
    auto_drop          => FALSE,
    comments           => 'Job with inline program and schedule'
  );
END;
/
```

- **Named Program and Schedule:** In this configuration, the job contains predefined program name and schedule name attributes. The export includes these attributes. Additionally, if you'd exported a job that was in an enabled state, the exported Data Definition Language (DDL) includes a `DBMS_METADATA.ENABLE` block at the end. When exporting jobs with named dependencies, SQLcl automatically exports the associated program and schedule objects.

  ```
  BEGIN
    DBMS_SCHEDULER.CREATE_JOB (
      job_name      => 'my_named_job',
      program_name  => 'my_program',
      schedule_name => 'my_schedule',
      enabled       => TRUE,
      comments      => 'Job with named program and schedule'
    );
  END;
  /
  ```

Staging Jobs

The `project stage` command generates DDLs for jobs differently than for other objects. Because jobs require careful handling of their enabled state, the command applies a different mechanism based on a job's status in the source and target branches to generate the DDL. The following table illustrates this mechanism.

Table 8-1 Stage DDL Generation for Jobs

Job State in Main/Master Branch	Job State in Current Branch	Stage Behavior
Disabled	Disabled	Applies changes directly, without disabling or enabling the job.
Enabled	Enabled	Disables the job before changes, and re-enables it after.
Enabled	Disabled	Disables the job before changes.
Disabled	Enabled	Enables the job after changes.

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> **Note**
>
> The term *master or main* branch does not strictly refer to branches named *master* or *main*; rather, it denotes the target branch against which the current branch is being staged.

For drop operations, the `project stage` command generates the appropriate DDLs to remove jobs and other scheduler objects, such as programs and schedules. However, certain attributes may be commented out in the DDL blocks. You should review and uncomment these statements as needed to ensure safe and intentional deletion. Here's an example DDL for dropping a job:

```
-- DROPPING A JOB
/*  Uncomment drop statement after ensuring it is performing the correct
actions
BEGIN
  DBMS_SCHEDULER.DROP_JOB(
   job_name => '"OUSSAMA"."MY_JOB"'
   --force => true -- Uncomment to forcibly drop the job
   --defer => true -- Either choose force or defer!
);
END;
*/
```

Similarly, the `project stage` command generates DDLs for dropping programs and schedules.

8.1.4 Support for Schema Substitution

Oracle SQLcl Projects include support for schema substitution. This enables you to use the `project` command to parameterize hard-coded schema names in database scripts for dynamic environment handling. It involves replacing hard-coded schema names in database scripts with placeholders (parameters). This minimizes manual script changes required to maintain portability across environments (for example, DEV, TEST, PROD).

The `project config` Command

Configure the `stage.substituteSchemas` parameter in `project.config.json`. To enable schema substitution, set `stage.substituteSchemas` to `true`. The default value of this parameters is set to `false` during `PROJECT INIT`. You can update it using the following command:

```
PROJECT CONFIG SET -name stage.substituteSchemas -value true
```

> **Note**
>
> Both `stage.substituteSchemas` and `export.setTransform.emitSchema` must be set to `true` for schema substitution to function correctly.

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The `project stage` Command

When `stage.substituteSchemas` is enabled, executing the `project stage` command generates environment-specific defaults files in the `dist/env`:

- For Liquibase format:
  - File: `dist/env/default.properties`
  - Contents:
    - If schemas are provided: Contains a list of new parameters names: `parameter.schemaName=actualSchemaName`
    - If no schemas are provided: Includes an example entry for reference: `parameter.%SCHEMA_NAME%=%SCHEMA_NAME_VALUE%`
- For SQL format:
  - File: `dist/env/defaultProperties.sql`
  - Contents:
    - If schemas are provided: Contains a list of new parameters: `DEFINE schemaName=schemaName`
    - If no schemas are provided: Includes an example entry for reference: `DEFINE %SCHEMA_NAME%=%SCHEMA_NAME_VALUE%;`

> **Note**
>
> Modifying `stage.substituteSchemas` or `stage.generatedFormat` after the project has been staged may invalidate previously staged artifacts. If changes are made, re-staging the project is necessary to maintain consistency.

The `project deploy` Command

The `project deploy` command includes a `--defaults-file` option, enabling the specification of a custom defaults file during deployment, thereby overriding the generated defaults:

- Liquibase artifacts: Overrides `dist/env/default.properties`.
- SQL artifacts: Overrides `dist/env/defaultProperties.sql`.

8.1.5 Supported Objects and Data Types

The supported database object and data types have been tested to work with the `project export` and `project stage` commands. All types not included in the following list can be added using the `project stage add-custom` command with any custom SQL. For more information about the `add-custom` command, see stage.

Supported database object types are:

- APEX_APP
- AQ_QUEUE
- AQ_QUEUE_TABLE
- CHAINS

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- CONSTRAINT
- CONTEXT
- DUALITY VIEWS
- FUNCTION
- INDEX
- JOB CLASSES
- JOBS
- MATERIALIZED_VIEW
- MLE ENV
- MLE MODULE
- OBJECT_GRANT
- ORDS Modules
- PACKAGE_BODY
- PACKAGE_SPEC
- PROCEDURE
- PROGRAMS
- REF_CONSTRAINT
- ROLE_GRANT
- SCHEDULER GROUPS
- SCHEDULES
- SEQUENCE
- SYNONYM
- SYSTEM_GRANT
- TABLE
- TRIGGER
- TYPE_BODY
- TYPE_SPEC
- USER
- VIEW

Note

- Regarding support for annotations attached to database objects, see Support for Schema Annotations.
- Regarding support for jobs scheduler objects, see Support for Jobs.

8.2 About the Project Command

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The command in SQLcl for Database CI/CD extension is `project`. It contains several sub-commands that are used as part of the process to help developers manage database changes and create serialized transactions.

All `project` sub-commands support `-verbose` and `-debug` options, which provide detailed processing information.

Each of the sub-commands are described below.

- **init|in**

  Initializes a new project. This command can be run in a new Git repository or in an existing repository.

  ```
  project init -name demo -makeroot -schemas cicd
  ```

  This command creates a project in the current working directory called `demo` under a new folder called `demo`. Several folders are created under the project directory including a configuration directory under `.dbtools`.

  This folder and the files under it should be added and committed to the Git repository.

- **config|cfg**

  Enables you to view and manage your project configuration properties.

  This command allows you to look at the current configuration that is used by each of the `project` commands. The files for the configuration are stored under the `.dbtools` folder. In the configuration, there are a number of settings that can be configured.

  ```
  project config -list
  ```

  This command lists all the configured options. Most of these options have defaults, which are used in the absence of the parameter. You can see the defaults by using the `-verbose` option with `project config -list`.

  You can set configuration items by using the following command:

  ```
  project config set -name <configitem> -value <value> -type <value-type>
  ```

  Any invalid configurations are flagged at runtime when a `project` command is used.

- **export|ex**

  Exports database objects into your repository.

  As a rule, when exporting from the database, a new branch is created. This branch is used when using the `stage` command to compare with previous branches to generate the DDL statements. You can run the following command in the project to export the objects owned by the schemas identified in the `project init` command.

  ```
  project export
  ```

  You can also choose to export a specific schema, or even an object.

  In the configuration files, there is a specific file for filtering objects that can be modified to clearly identify the correct objects to export.

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Export supports normal database objects supported by DBMS_METADATA and also APEX applications. See the DBMS_METADATA: Object Types table in *Oracle Database PL/SQL Packages and Types Reference*.

- **stage|st**
  Creates Liquibase changelogs or changesets for all source files and custom SQL files.

  The `stage` command is used along with the `export` command. This command takes the current branch and compares it to the base branch and generates the changelogs that will apply those changes to a database. The command creates a folder in a specific format with a `dist` folder.

  ```
  src
  dist -
       -releases
       -next
           - <stage files>
  ```

  The `stage` command can also be used to add other custom changesets as part of the change. This generates a file to add SQL and SQLcl commands with a Liquibase SQL changeset header. This file will be added to the changelog hierarchy automatically.

- **release|re**
  Moves the current set of work into a release state and starts a new body of work.

  The `release` command takes the contents of the dist/next folder and renames it to a given version number.

  ```
  project release -version 1.0
  ```

  And then creates a new `next` folder under dist.

  Once code has been moved into a release it should never be modified. As such, it is recommended that the `release` command should only be run once the following criteria have been met:

  – `project verify` has successfully ran.
  – Test the release against various systems:
    * Build system: This confirms that all DDL and code compiles correctly.
    * Test system (with data): Confirms that no data integrity issues (For example: Making a column `not null` only to find out it has `null` values).

  To test a pre-release build, run `project gen-artifact` and use a version name such as `-version 1.0.0-test`. This also includes everything in the `next` folder.

- **gen-artifact|ga**
  Generates an artifact representing the current state of your project.
- **deploy|dp**
  Deploys the artifact on a target database.
- **verify|v**
  Provides the means to test various aspects of your project (snapshots, changes, overall project).

8.3 Quick Start

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This section introduces the SQLcl Projects feature using a simple setup and list of tasks. The quick start covers:

- How to initialize a new project (for an application with a single schema called `demo`) .
- Work to be done as part of a sprint:
  - Ticket-1
    - Create the standard sample `dept` and `emp` tables
    - Load the tables with sample data
  - Ticket-2
    - Add a new column named `email` to the `emp` table
    - Add a new function named get_display_name
- How to complete a release, and then generate and deploy an artifact.

Topics

- Prerequisites
- Assumptions
- Project Setup
- Ticket-1
- Ticket-2
- Final Steps

8.3.1 Prerequisites

This Quick Start has the following prerequisites:

- You must create two databases, `DEV` and `PROD`, with the `demo` schema pre-created. You need to connect as the `demo` user from SQLcl.

```
create user demo identified by demo;
grant resource to demo;
grant connect to demo;
grant create view to demo;
alter user demo quota unlimited on system;
```

- You require two named connections in SQLcl: `demo-dev` and `demo-prod`. The following examples show how to add and manage named connections in SQLcl.

```
-Add a new named connection
-Note: -savepwd is an optional parameter to save the password.
SQL> conn -savepwd -save demo-dev demo/demo@//myserver.com:1521/mypdb

-List current connections
SQL> connmgr list

-To connect to a named connection
SQL> conn -name demo-dev
```


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8.3.2 Assumptions

This quick start assumes the following:

- A Git project named `demo-project` is used.
  All work in the repository is "local" only, a remote server (such as, Github or Gitlab) is not needed for this demo.
- The term ticket (or issue) refers to a unit of work, typically tracked in a system such as Jira.
- SQLcl can run operating system level commands using the `host` command.
  - For example, `host date` prints the system date.
  - A shortcut for the host command is `!<cmd>`. For example, `!date` is the equivalent of `host date`.
  - This demo uses a lot of `host` commands. To avoid exiting and entering SQLcl each time, the `!` shortcut is used to execute them directly within SQLcl.

8.3.3 Project Setup

Create a Git repository.

> **Note**
>
> This demo uses a local Git repository. In most cases, a clone from a remote Git repository is used as a starting point.

```
-Create and go into new folder
mkdir demo-project
cd demo-project

-Start SQLcl
sql /nolog

-Initialize git repo
SQL> !git init --initial-branch=main
```

Initialize the repository for SQLcl Projects.

```
-The schema that is used for this demo is called "demo".

SQL> project init -name demo_project -schemas demo

------------------------
PROJECT DETAILS
------------------------
Project name:    demo_project
Schema(s):       DEMO
Directory:       /private/tmp/demo-project
Connection name:
Project root:    demo-project
```


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```
Your project has been successfully created

-Root folder now looks like:
- .
- ├──── .dbtools
- │     ├──── filters
- │     │     └──── project.filters
- │     ├──── project.config.json
- │     └──── project.sqlformat.xml
- ├──── dist
- │     └──── install.sql
- └──── src
- │     └──── database
- ├──── .gitignore
- └──── README.md

-Add and commit the initial files to the repository

SQL> !git add --all
SQL> !git commit -m "initial"

[main (root-commit) 5fa6ebd] initial
 9 files changed, 188 insertions(+)
 create mode 100644 .dbtools/filters/project.filters
 create mode 100644 .dbtools/project.config.json
 create mode 100644 .dbtools/project.sqlformat.xml
 create mode 100644 .gitignore
 create mode 100644 README.md
 create mode 100644 dist/install.sql
```

8.3.4 Ticket-1

In practice, most development is done as part of a ticket in a project management system, such as Jira or GitHub. In this section, `ticket-1` is created and has the following requirements:

1. Create `emp` and `dept` tables.
2. Add the initial data.

In the following steps, you will:

1. Create and check out a Git branch named `ticket-1`.
2. Create the tables in the database schema.
3. Export the objects from the schema to the project's `src` folder.
4. Register the changes in the project's `dist` folder.
   - Changes are detected automatically by comparing the feature branch to the main branch.
   - Changes are created in the next release as part of `ticket-1`.
   - Changes are captured as Liquibase changelogs/sets.
5. Add a custom script to load the initial data for the `emp` and `dept` tables.
6. Commit and merge changes to complete the ticket.

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Steps

1. Connect to the the `demo-dev` server.

```
SQL> conn -name demo-dev
Connected.
```

2. Create a new branch called `ticket-1`.

```
SQL> !git checkout -b ticket-1
Switched to a new branch 'ticket-1'
```

3. Create database objects.

```
SQL> create table dept(
     deptno     number(2,0),
     dname      varchar2(14),
     loc        varchar2(13),
     constraint pk_dept primary key (deptno)
);

Table DEPT created.

SQL> create table emp(
     empno      number(4,0),
     ename      varchar2(10),
     job        varchar2(9),
     mgr        number(4,0),
     hiredate   date,
     sal        number(7,2),
     comm       number(7,2),
     deptno     number(2,0),
     constraint pk_emp    primary key (empno),
     constraint fk_deptno foreign key (deptno) references dept (deptno)
);

Table EMP created.

SQL> create index idx_emp_deptno on emp(deptno);
Index IDX_EMP_DEPTNO created.
```

4. Export all the objects to the `src` folder.

```
SQL> project export

The current connection //myserver.com:1521/mypdb DEMO will be used for all
operations
*** INDEXES ***
*** TABLES ***
*** REF_CONSTRAINTS ***
------------------------------
TABLE                          2
REF_CONSTRAINT                 1
INDEX                          1
------------------------------
```


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```
Exported 4 objects
Elapsed 20 sec
```

The `src` folder now contains all the scripts required to recreate the objects in the `demo` schema.

The changes in the `src` folder are used to detect changes that need to be added to the `dist` folder for each release.

The folder structure looks as follows:

```
└──
src
    └──
database
        └──
demo
            ├──
indexes
            │   └──
idx_emp_deptno.sql
            ├──
ref_constraints
            │   └──
fk_deptno.sql
            └──
tables
                ├──
dept.sql
                └── emp.sql
```


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Add and commit the newly created `src` files.

> **Note**
>
> It is very important to commit all `src` changes because only committed changes are used to determine changes for `dist/release`.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-1: Added dept emp tables, and get_display_name
function"

[ticket-1 812db72] TICKET-1: Added dept emp tables, and get_display_name
function
 4 files changed, 44 insertions(+)
 create mode 100644 src/database/demo/indexes/idx_emp_deptno.sql
 create mode 100644 src/database/demo/ref_constraints/fk_deptno.sql
 create mode 100644 src/database/demo/tables/dept.sql
 create mode 100644 src/database/demo/tables/emp.sql
```

5. Generate the scripts and Liquibase changelogs for the current ticket.

   This happens in the background where the changes in `branches/ticket-1/src` are compared against `branches/main/src`.

```
SQL> project stage
Stage successfully completed, please review and commit your changes to
repository
```

The `dist` folder now becomes as follows:

> **Note**
>
> - All current work is stored in the `releases/next` folder. After a release is ready, this folder is converted to a release number and a new or empty `next` folder is created.
> - Changelogs work as follows: `main.changelog.xml` references `next/release.changelog.xml`, which references `ticket-1/stage.changelog.xml`, which references all the files that are part of `ticket-1`.

```
├── dist
│   ├── install.sql
│   ├── releases
│   │   ├── main.changelog.xml
│   │   └── next
│   │       ├── changes
│   │       │   └── ticket-1
│   │       │       ├── _custom
│   │       │       ├── demo
│   │       │       │   ├── index
│   │       │       │   │   └── idx_emp_deptno.sql
```


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```
│    │        │        │    ├─── ref_constraint
│    │        │        │    │    └─── fk_deptno.sql
│    │        │        │    └─── table
│    │        │        │        ├─── dept.sql
│    │        │        │        └─── emp.sql
│    │        │        └─── stage.changelog.xml
│    │        │
│    │        └─── release.changelog.xml
│    └─── utils
│        ├─── prechecks.sql
│        └─── recompile.sql
```

6. Add and commit the files.

   It is recommended to review all generated files before adding to the repository.

```
SQL> !git add --all
SQL> !git status

On branch ticket-1
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   dist/releases/main.changelog.xml
        new file:   dist/releases/next/changes/ticket-1/demo/index/
idx_emp_deptno.sql
        new file:   dist/releases/next/changes/ticket-1/demo/
ref_constraint/fk_deptno.sql
        new file:   dist/releases/next/changes/ticket-1/demo/table/dept.sql
        new file:   dist/releases/next/changes/ticket-1/demo/table/emp.sql
        new file:   dist/releases/next/changes/ticket-1/stage.changelog.xml
        new file:   dist/releases/next/release.changelog.xml
        new file:   dist/utils/prechecks.sql
        new file:   dist/utils/recompile.sql

SQL> !git commit -m "TICKET-1: Added dept emp tables"

[ticket-1 261cceb] TICKET-1: Added dept emp tables
 10 files changed, 396 insertions(+)
 create mode 100644 dist/releases/main.changelog.xml
 create mode 100644 dist/releases/next/changes/ticket-1/demo/index/
idx_emp_deptno.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/
ref_constraint/fk_deptno.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/table/dept.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/table/emp.sql
 create mode 100644 dist/releases/next/changes/ticket-1/stage.changelog.xml
 create mode 100644 dist/releases/next/release.changelog.xml
 create mode 100644 dist/utils/prechecks.sql
 create mode 100644 dist/utils/recompile.sql
```

7. Add sample data for each table using a custom .sql file.

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Use the `project stage add-custom` command to generate custom files, as it auto-generates all the Liquibase-header information.

```
SQL> project stage add-custom -file-name dept-data.sql
SQL> project stage add-custom -file-name emp-data.sql
```

The custom files now appear in `dist` under the `_custom` folder.

```
├─── dist
│    ├─── releases
│    │    └─── next
│    │         ├─── changes
│    │         │    └─── ticket-1
│    │         │         ├─── _custom
│    │         │         │         ├─── dept-data.sql
│    │         │         │         └─── emp-data.sql
```

The following command displays the contents of `dept-data.sql`.

```
SQL> !cat dist/releases/next/changes/ticket-1/_custom/dept-data.sql
(For Windows, use !type .\dist\releases\next\changes\ticket-1\_custom\dept-
data.sql)

-- liquibase formatted sql
-- changeset SqlCl:f56fcfec11f7d7cb99d74403a0c2727a765ddb99
stripComments:false logicalFilePath:ticket-1/_custom/dept-data.sql
-- sqlcl_snapshot dist/releases/next/changes/ticket-1/_custom/dept-
data.sql:null:null:custom
```

8. Add the sample data for each file.

   In `dist/releases/next/changes/ticket-1/_custom/dept-data.sql`, copy and paste the following statements to the end of the file and then save the file.

```
insert into demo.dept values(10, 'ACCOUNTING', 'NEW YORK');
insert into demo.dept values(20, 'RESEARCH', 'DALLAS');
insert into demo.dept values(30, 'SALES', 'CHICAGO');
insert into demo.dept values(40, 'OPERATIONS', 'BOSTON');
```

   In `dist/releases/next/changes/ticket-1/_custom/emp-data.sql`, copy and paste the following statements to the end of the file and then save the file.

```
insert into demo.emp values( 7839, 'KING', 'PRESIDENT', null,
to_date('17-11-1981','dd-mm-yyyy'), 5000, null, 10);
insert into demo.emp values( 7698, 'BLAKE', 'MANAGER', 7839,
to_date('1-5-1981','dd-mm-yyyy'), 2850, null, 30);
insert into demo.emp values( 7782, 'CLARK', 'MANAGER', 7839,
to_date('9-6-1981','dd-mm-yyyy'), 2450, null, 10);
insert into demo.emp values( 7566, 'JONES', 'MANAGER', 7839,
to_date('2-4-1981','dd-mm-yyyy'), 2975, null, 20);
insert into demo.emp values( 7788, 'SCOTT', 'ANALYST', 7566, to_date('13-
JUL-87','dd-mm-rr') - 85, 3000, null, 20);
insert into demo.emp values( 7902, 'FORD', 'ANALYST', 7566,
to_date('3-12-1981','dd-mm-yyyy'), 3000, null, 20);
```


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```
insert into demo.emp values( 7369, 'SMITH', 'CLERK', 7902,
to_date('17-12-1980','dd-mm-yyyy'), 800, null, 20);
insert into demo.emp values( 7499, 'ALLEN', 'SALESMAN', 7698,
to_date('20-2-1981','dd-mm-yyyy'), 1600, 300, 30);
insert into demo.emp values( 7521, 'WARD', 'SALESMAN', 7698,
to_date('22-2-1981','dd-mm-yyyy'), 1250, 500, 30);
insert into demo.emp values( 7654, 'MARTIN', 'SALESMAN', 7698,
to_date('28-9-1981','dd-mm-yyyy'), 1250, 1400, 30);
insert into demo.emp values( 7844, 'TURNER', 'SALESMAN', 7698,
to_date('8-9-1981','dd-mm-yyyy'), 1500, 0, 30);
insert into demo.emp values( 7876, 'ADAMS', 'CLERK', 7788, to_date('13-
JUL-87', 'dd-mm-rr') - 51, 1100, null, 20);
insert into demo.emp values( 7900, 'JAMES', 'CLERK', 7698,
to_date('3-12-1981','dd-mm-yyyy'), 950, null, 30);
insert into demo.emp values( 7934, 'MILLER', 'CLERK', 7782,
to_date('23-1-1982','dd-mm-yyyy'), 1300, null, 10);
```

9. Run each file to ensure that the data is loaded into the table.

```
SQL> @dist/releases/next/changes/ticket-1/_custom/dept-data.sql
SQL> @dist/releases/next/changes/ticket-1/_custom/emp-data.sql
SQL> commit;

Commit complete.
```

10. Add and commit the new custom files.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-1: data files"

[ticket-1 ac2488d] TICKET-1: data files
 3 files changed, 33 insertions(+)
 create mode 100644 dist/releases/next/changes/ticket-1/_custom/dept-
data.sql
 create mode 100644 dist/releases/next/changes/ticket-1/_custom/emp-
data.sql
```

11. To highlight the order of operations that have automatically been managed, enter the following command:

```
SQL> !cat dist/releases/next/changes/ticket-1/stage.changelog.xml

<?xml version="1.0" encoding="UTF-8"?><databaseChangeLog xmlns:xsi="http://
www.w3.org/2001/XMLSchema-instance"
                                                    xmlns="http://
www.liquibase.org/xml/ns/dbchangelog"

xsi:schemaLocation="http://www.liquibase.org/xml/ns/dbchangelog
                                                       http://
www.liquibase.org/xml/ns/dbchangelog/dbchangelog-4.3.xsd">
<include file="demo/tables/dept.sql" relativeToChangelogFile="true"/>
<include file="demo/tables/emp.sql" relativeToChangelogFile="true"/>
<include file="demo/indexes/idx_emp_deptno.sql"
relativeToChangelogFile="true"/>
<include file="demo/ref_constraints/fk_deptno.sql"
relativeToChangelogFile="true"/>
```


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```
<include file="_custom/dept-data.sql" relativeToChangelogFile="true"/>
<include file="_custom/emp-data.sql" relativeToChangelogFile="true"/></
databaseChangeLog>
```

`Ticket-1` is now complete.

12. Merge the changes into the `main` branch.

    This is done through a Merge Request or a Pull Request (depending on your Git provider). Since this is a local repository, you can only merge directly into `main`.

```
SQL> !git checkout main

Switched to branch 'main'

SQL> !git merge "ticket-1"

Updating f9660ae..ac2488d
Fast-forward
 dist/releases/main.changelog.xml                                    |
9 +++++++
 dist/releases/next/changes/ticket-1/_custom/dept-data.sql        |  11 +++
+++++
 dist/releases/next/changes/ticket-1/_custom/emp-data.sql         |  20 +++
++++++++++++
 dist/releases/next/changes/ticket-1/demo/index/idx_emp_deptno.sql     |
8 ++++++
 dist/releases/next/changes/ticket-1/demo/ref_constraint/fk_deptno.sql |
9 +++++++
 dist/releases/next/changes/ticket-1/demo/table/dept.sql               |
13 ++++++++++
 dist/releases/next/changes/ticket-1/demo/table/emp.sql                |
18 ++++++++++++++
 dist/releases/next/changes/ticket-1/stage.changelog.xml               |
16 ++++++++++++
 dist/releases/next/code/code.changelog.xml                            |
8 ++++++
 dist/releases/next/release.changelog.xml                              |
11 ++++++++
 dist/utils/prechecks.sql                                              |
81 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 dist/utils/recompile.sql                                              |
225 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++
 src/database/demo/indexes/idx_emp_deptno.sql                          |
7 ++++++
 src/database/demo/ref_constraints/fk_deptno.sql                       |
8 ++++++
 src/database/demo/tables/dept.sql                                     |
12 +++++++++
 src/database/demo/tables/emp.sql                                      |
17 ++++++++++++++
 16 files changed, 473 insertions(+)
 create mode 100644 dist/releases/main.changelog.xml
 create mode 100644 dist/releases/next/changes/ticket-1/_custom/dept-
```


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```
data.sql
 create mode 100644 dist/releases/next/changes/ticket-1/_custom/emp-
data.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/index/
idx_emp_deptno.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/
ref_constraint/fk_deptno.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/table/dept.sql
 create mode 100644 dist/releases/next/changes/ticket-1/demo/table/emp.sql
 create mode 100644 dist/releases/next/changes/ticket-1/stage.changelog.xml
 create mode 100644 dist/releases/next/release.changelog.xml
 create mode 100644 dist/utils/prechecks.sql
 create mode 100644 dist/utils/recompile.sql
 create mode 100644 src/database/demo/indexes/idx_emp_deptno.sql
 create mode 100644 src/database/demo/ref_constraints/fk_deptno.sql
 create mode 100644 src/database/demo/tables/dept.sql
 create mode 100644 src/database/demo/tables/emp.sql
```

8.3.5 Ticket-2

Now that the first ticket is complete, work can start on `TICKET-2`. The purpose of this ticket is to highlight the automated DDL management along with soft objects (that is, re-runnable objects such as packages, views, and so on) creation.

TICKET-2 has the following requirements:

1. Add a new column `emp.email`.
2. Add a new function `get_display_name`.

The steps are:

1. Create and check out a Git branch called `ticket-2`.
2. Alter the `emp` table and add the new column in the database.
3. Export the `emp` table. This will show the new table structure in the `src/.../tables/emp.sql` file.
4. Run the `project stage` command to register the alter table statements.
5. Create a new function, `get_display_name`, in the database and run `project export`.
6. Rerun the `project stage` command to include the `get_display_name` function.
7. Commit and merge changes to complete the ticket.

Steps

1. Create the `ticket-2` branch.

   ```
   SQL> !git checkout -b ticket-2
   Switched to a new branch 'ticket-2'
   ```

2. Make the table changes to the development database.

   ```
   SQL> alter table emp add email varchar2(255);
   Table EMP altered.
   ```

3. Run the `project export` command to get the latest version of the table.

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> **Note**
>
> Use the `-o` argument to only export the `demo.emp` table.

```
SQL> project export -o emp

The current connection //myserver.com:1521/mypdb DEMO will be used for all
operations
*** INDEXES ***
*** TABLES ***
*** REF_CONSTRAINTS ***
------------------------------
TABLE                          1
REF_CONSTRAINT                 1
INDEX                          1
------------------------------
Exported 3 objects
Elapsed 13 sec
```

4. Run the `git diff` command to show what was changed in the `src/database/demo/tables/emp.sql` file.

> **Note**
>
> Because the column name is changed, the whole file is marked as changed to add additional spacing.

Only the logical changes are listed below to show the real differences. The diff highlights that the new column (email) is added.

```
!git --no-pager diff src/database/demo/tables/emp.sql

-    deptno   number(2, 0)
+    deptno   number(2, 0),
+    email    varchar2(255 byte)
```

5. Add and commit changes, which is required before running the `project stage` command.

   This happens in the background where the changes in `branches/ticket-1/src` are compared against `branches/main/src`.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-2: Added emp.email"

[ticket-2 a3e7508] TICKET-2: Added emp.email
 1 file changed, 3 insertions(+), 2 deletions(-)
```


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6. Run `project stage` to automatically generate the `alter table` statement required to add the email column.

```
SQL> project stage
Stage successfully completed, please review and commit your changes to
repository
```

The following files have been added:

```
├─── dist
│    ├─── releases
│    │    └─── next
│    │         ├─── changes
│    │         │    └─── ticket-2
│    │         │         │    └─── _custom
│    │         │         ├─── demo
│    │         │         │    └─── table
│    │         │         │         └─── emp.sql
│    │         │         └─── stage.changelog.xml
```

7. The output of `dist/releases/next/changes/ticket-2/demo/table/emp.sql` is shown below.

It automatically detected the modification in the emp table and generated the correct `alter` statement.

```
SQL> !cat dist/releases/next/changes/ticket-2/demo/table/emp.sql

-- liquibase formatted sql
-- changeset DEMO:cffad61078f4afbd0680bfacbe818e5f089ce535
stripComments:false logicalFilePath:ticket-2/demo/table/emp.sql
-- sqlcl_snapshot src/database/demo/tables/
emp.sql:1d12b2ddb0fe34a061ad35dc1990fc3d84d5a676:9c26d3ba57756671939cf399cb
7e96ae0d3ac84e:alter

alter table demo.emp add (
    email varchar2(255)
)
/
```

8. Add and commit changes.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-2: emp.email alter commands"

[ticket-2 582cd63] TICKET-2: emp.email alter commands
 3 files changed, 20 insertions(+)
 create mode 100644 dist/releases/next/changes/ticket-2/demo/table/emp.sql
 create mode 100644 dist/releases/next/changes/ticket-2/stage.changelog.xml
```

9. Create a new function called `get_display_name`. This highlights how the source code can automatically be managed with SQLcl Projects.

```
SQL> create or replace function get_display_name(p_ename in emp.ename%type)
return varchar2
```


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```
as
begin
    return initcap(p_ename);
end get_display_name;
/

Function GET_DISPLAY_NAME compiled
```

10. Similar to table changes, running a `project export` command detects supported object changes.

```
SQL> project export

*** FUNCTIONS ***
*** INDEXES ***
*** TABLES ***
*** REF_CONSTRAINTS ***
------------------------------
TABLE                         2
REF_CONSTRAINT                1
INDEX                         1
FUNCTION                      1
------------------------------
Exported 5 objects
Elapsed 14 sec
```

11. Add and commit followed by `project stage` to add to the release.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-2: added get_display_name"

[ticket-2 7cf60a4] TICKET-2: added get_display_name
 1 file changed, 10 insertions(+)
 create mode 100644 src/database/demo/functions/get_display_name.sql

SQL> project stage
Stage successfully completed, please review and commit your changes to
repository
```

The function was added to the `dist/next` folder under a common `code` folder and not `ticket-2`.

This is done because re-runnable code (packages, functions, and so on) may be modified multiple times within a sprint. In most cases, it only needs to be compiled once.

```
SQL> !git status
On branch ticket-2
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   dist/releases/next/release.changelog.xml
```


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12. Add and commit the `dist` changes.

```
SQL> !git add --all
SQL> !git commit -m "TICKET-2: dist changes for get_display_name"

[ticket-2 706fdb9] TICKET-2: dist changes for get_display_name
 3 files changed, 13 insertions(+)
 create mode 100644 dist/releases/next/code/demo/function/
get_display_name.sql
```

13. Now that all work on `ticket-2` is complete, merge back to `main`.

```
SQL> !git checkout main
 Switched to branch 'main'

SQL> !git merge "ticket-2"

Updating d6abe9d..706fdb9
Fast-forward
 dist/releases/next/changes/ticket-2/demo/table/emp.sql     |  8 ++++++++
 dist/releases/next/changes/ticket-2/stage.changelog.xml    | 11 ++++++++++
+
 dist/releases/next/code/code.changelog.xml                 |  1 +
 dist/releases/next/code/demo/function/get_display_name.sql | 11 ++++++++++
+
 dist/releases/next/release.changelog.xml                   |  2 ++
 src/database/demo/functions/get_display_name.sql           | 10 ++++++++++
 src/database/demo/tables/emp.sql                           |  5 +++--
 7 files changed, 46 insertions(+), 2 deletions(-)
 create mode 100644 dist/releases/next/changes/ticket-2/demo/table/emp.sql
 create mode 100644 dist/releases/next/changes/ticket-2/stage.changelog.xml
 create mode 100644 dist/releases/next/code/demo/function/
get_display_name.sql
 create mode 100644 src/database/demo/functions/get_display_name.sql
```

8.3.6 Final Steps

After the sprint is complete, the following needs to be done:

- Generate a release (`project release`)
  - The `release` command renames the `dist/next` folder to the release name (in the following example, 1.0.0) and then generates a new (empty) `dist/next folder` ready for the next sprint's changes.
- Generate an artifact (`project gen-artifact`)
  - `gen-artifact` creates a zip file that contains a single install.sql file, which points to all the different sub-folders in the `dist` folder. In this example, it only contains one folder (1.0.0). Over time, the artifact will contain additional releases, as this is what allows Liquibase to upgrade from any point in time.
- Deploy the artifact (`project deploy`).
  - The `deploy` command takes an artifact and upgrades an environment to the latest version. For example, if the artifact includes versions 1-10 and the current environment

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is on version 8, the installer auto-detects the current state and only runs the changes related to version 9 and version 10.

8.3.6.1 Generate Release 1.0.0

Generating a release:

- Moves the contents of `dist/next` to the name of the release. For example, if generating release 1.0.0, then dist/next > dist/1.0.0.
- Create a new `dist/next` folder that is open for the next set of work for the next release.

1. Generate release 1.0.0

```
SQL> project release -version 1.0.0
Process completed successfully
```

The `dist` folder now looks like below. Note the `dist/next` folder has been emptied and there is a new "fresh" release.changelog.xml.

```
├─── dist
│    ├─── README.md
│    ├─── install.sql
│    ├─── releases
│    │    ├─── 1.0.0
│    │    │    ├─── changes
│    │    │    │    ├─── main
│    │    │    │    │    ├─── _custom
│    │    │    │    │    └─── stage.changelog.xml
│    │    │    │    ├─── ticket-1
│    │    │    │    │    ├─── _custom
│    │    │    │    │    │    ├─── dept-data.sql
│    │    │    │    │    │    └─── emp-data.sql
│    │    │    │    │    ├─── demo
│    │    │    │    │    │    ├─── index
│    │    │    │    │    │    │    └─── idx_emp_deptno.sql
│    │    │    │    │    │    ├─── ref_constraint
│    │    │    │    │    │    │    └─── fk_deptno.sql
│    │    │    │    │    │    └─── table
│    │    │    │    │    │         ├─── dept.sql
│    │    │    │    │    │         └─── emp.sql
│    │    │    │    │    └─── stage.changelog.xml
│    │    │    │    └─── ticket-2
│    │    │    │         ├─── _custom
│    │    │    │         ├─── demo
│    │    │    │         │    └─── table
│    │    │    │         │         └─── emp.sql
│    │    │    │         └─── stage.changelog.xml
│    │    │    ├─── code
│    │    │    │    ├─── code.changelog.xml
│    │    │    │    └─── demo
│    │    │    │         └─── function
│    │    │    │              └─── get_display_name.sql
│    │    │    └─── release.changelog.xml
│    │    ├─── main.changelog.xml
```


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```
|   |   └── next
|   |       └── release.changelog.xml
```

2. Add the changed files and commit.

```
SQL> !git add --all
SQL> !git add .
SQL> !git commit -m "release 1.0.0"

[main 5e1ac12] release 1.0.0
 16 files changed, 25 insertions(+), 4 deletions(-)
 create mode 100644 dist/releases/1.0/changes/main/stage.changelog.xml
 rename dist/releases/{next => 1.0}/changes/ticket-1/code/_custom/dept-
data.sql (100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/code/_custom/emp-
data.sql (100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/demo/index/
idx_emp_deptno.sql (100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/demo/ref_constraint/
fk_deptno.sql (100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/demo/table/dept.sql
(100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/demo/table/emp.sql
(100%)
 rename dist/releases/{next => 1.0}/changes/ticket-1/stage.changelog.xml
(100%)
 rename dist/releases/{next => 1.0}/changes/ticket-2/demo/table/emp.sql
(100%)
 rename dist/releases/{next => 1.0}/changes/ticket-2/stage.changelog.xml
(100%)
 rename dist/releases/{next => 1.0}/code/code.changelog.xml (100%)
 rename dist/releases/{next => 1.0}/code/demo/function/
get_display_name.sql (100%)
 create mode 100644 dist/releases/1.0/release.changelog.xml
```

3. (Optional) Git tag the release.

```
!git tag release-1.0.0
```

At this point, the `dist/release/next` folder is ready for the next set of work for the new release.

8.3.6.2 Generate an Artifact

An artifact contains all the releases that enable the deployment to automatically detect the instance's current version and the releases to run through to update to the latest version. SQLcl generates the artifact as a zipped file. By default, this file is not included in the Git repository because it is a binary file that can become large over time.

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> **Note**
>
> - To generate the artifact before creating an official release, use the following command:
>
>  ```
>  project gen-artifact -version <test-version>
>  ```
>
> This allows you to test deployments without creating a permanent release version.
> - Artifacts must be stored in an artifact repository such as JFrog's Artifactory.

Generate the artifact as follows:

```
SQL> project gen-artifact -version 1.0.0
Your artifact has been generated demo_project-1.0.0.zip
```

The artifact directory now contains the following artifact:

```
├─── artifact
│    └─── demo_project-1.0.0.zip
```

By default, the artifact directory is included in the .gitignore file and not added to the repository. It is a best practice to move these to an artifact repository (for example, JFrog).

8.3.6.3 Deploy to PROD

Use the artifact that was generated in the previous step and run the `deploy` command on a different database. The following steps deploy the artifact on the `demo-prod` connection.

1. Connect to the production server.

   ```
   SQL> connect -name demo-prod
   ```

2. Deploy on the Prod server.

   ```
   SQL> project deploy -file artifact/demo_project-1.0.0.zip

   Starting the migration...
   Running Changeset: ticket-1/demo/table/
   dept.sql::1e18b33eb500d4ccf3880f65c0d06846c793c509::DEMO
   Running Changeset: ticket-1/demo/table/
   emp.sql::1d12b2ddb0fe34a061ad35dc1990fc3d84d5a676::DEMO
   Running Changeset: ticket-1/demo/ref_constraint/
   fk_deptno.sql::55dee6178861d12324b4e858b5465b7f4c1a4fcd::DEMO
   Running Changeset: ticket-1/demo/index/
   idx_emp_deptno.sql::ab1f05f1b3b979156e8b2c8e1608231ae86a14c5::DEMO
   Running Changeset: ticket-1/_custom/dept-
   data.sql::f56fcfec11f7d7cb99d74403a0c2727a765ddb99::SqlCl
   Running Changeset: ticket-1/_custom/emp-
   data.sql::113b7d3b31e5ae089898777aaa7f556ff6f8dbf7::SqlCl
   Running Changeset: ticket-2/demo/table/
   emp.sql::cffad61078f4afbd0680bfacbe818e5f089ce535::DEMO
   ```


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```
Running Changeset: ../demo/function/
get_display_name.sql::4c4e98c47aeddbc5ca84a31d8ab7e1c066296976::DEMO
Liquibase: Update has been successful. Rows affected: 26
Installing/updating schemas
--Starting Liquibase at 2024-11-05T17:00:18.968636 (version [local build]
#0 built at 2024-08-14 18:40+0000)

UPDATE SUMMARY
Run:                          8
Previously run:               0
Filtered out:                 0
-------------------------------
Total change sets:            8

Produced logfile: sqlcl-lb-1730851216381.log
Operation completed successfully.
Migration has been completed
```

8.4 Refining Exports with Filters

When using the `project export` command, you can apply SQL filters to precisely control which database objects are included in the export. This allows you to fine-tune the process, ensuring that you generate the Data Definition Language (DDL) only for the objects you need.

Learn how these filters work and how you can customize them for your projects.

Topics:

- About Filters and Their Types
- Creating and Managing Project Filters
- Advanced Filtering Techniques
- How Filters Are Applied
- Debugging Applied Filters
- Common Use Cases

8.4.1 About Filters and Their Types

A SQL filter is a SQL expression, or predicate, that is applied to the data dictionary queries during the export process. It provides a condition that determines whether a specific database object is included or not.

Oracle SQLcl supports two types of filters during export:

- Internal Filters
- Project Filters

Internal Filters

Internal filters are built-in and are always applied to the export process. You cannot modify or disable these filters. They automatically exclude system-level schemas and objects that are not relevant for a typical project export.

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For example, the following internal filters exclude secondary objects and objects owned by `SYS` or `PUBLIC`:

```
and (Dba_objects.secondary = 'N') --<-- sqlcl internal.fixed.filters
and (Dba_objects.owner not in ('SYS', 'PUBLIC')) --<-- sqlcl
internal.fixed.filters
```

Project Filters

Project filters are custom filters that you create to refine the selection of database objects for your specific needs. You can create filters to exclude temporary development objects, include only specific APEX applications, or filter objects by name patterns.

For example, the following export filter excludes objects by a name pattern:

```
object_name not like 'DBTOOLS$%'
```

The following filter excludes Oracle Machine Learning or Data Mining-generated tables:

```
not (object_type = 'TABLE' and object_name like 'DM$%')
```

This filter exports a specific APEX application:

```
application_id in (200, 300)
```

8.4.2 Creating and Managing Project Filters

You create and manage project (or custom) filters within a specific directory.

To get started, locate the `project.filters` file within your project's `.dbtools/filters/` directory. This is the primary file for custom filters. It contains a comma-separated list of predicates specifying the filters to apply. You can edit this file to add all your custom filter conditions.

For better organization, you can create new files with the `.filters` extension inside the `.dbtools/filters/` folder. This allows you to group related filters into separate files. As long as a file has the `.filters` extension, SQLcl will automatically read it and apply the filters in it during the export. SQLcl reads and applies every `.filters` file located in this directory.

8.4.3 Advanced Filtering Techniques

For more granular control, you can use the `export_type` and `object_type` columns in your filters.

- Filtering Using the `export_type` Column
- Filtering Using the `object_type` Column

8.4.3.1 Filtering Using the `export_type` Column

The `export_type` is a special pseudo-column that you can use to filter database objects by their category. It enables selective exporting of specific object types, including those not present in the underlying dictionary view.

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The available export types are listed at the beginning of the `project.filters` file for easy reference.

Here is the complete list of export types you can use:

- ALL_OBJECTS
- ALL_INDEXES
- ALL_TRIGGERS
- ALL_SYNONYMS
- ALL_COL_COMMENTS
- ALL_TAB_COMMENTS
- ALL_TAB_PRIVS
- ALL_MVIEW_LOGS
- ALL_QUEUE_TABLES
- ALL_QUEUES
- ALL_DEPENDENCIES
- ALL_USERS
- APEX_APPLICATIONS
- ORDS_SCHEMA
- USER_SYS_PRIVS
- USER_ROLE_PRIVS

Here are a few examples of filters defined using export types.

Example 8-1 Excluding ORDS

This filter example uses the `ORDS_SCHEMA` export type to exclude Oracle REST Data Services (ORDS) from the export:

```
export_type != 'ORDS_SCHEMA'
```

Example 8-2 Exporting APEX applications

This filter example uses the `APEX_APPLICATION` export type to export only APEX applications:

```
export_type = 'APEX_APPLICATION'
```

8.4.3.2 Filtering Using the `object_type` Column

You can use the `object_type` column to filter database objects by their type (for example, a table or view).

This is useful when you need to exclude all objects of a certain type or name. If you are unsure of an object's type, you can identify it by querying the database directly.

To get a distinct list of all object types in the database, run the following query:

```
select distinct object_type from all_objects;
```


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Based on the results, you can then write a filter to exclude specific types (for example, `MLE_MODULE` and `MLE_ENVIRONMENT`) from your export.

Here are a few examples of filters defined using object types.

Example 8-3 Excluding MLE objects

This filter example excludes `MLE_MODULE` and `MLE_ENVIRONMENT` object types from your export:

```
object_type not in ('MLE_MODULE', 'MLE_ENVIRONMENT')
```

Example 8-4 Excluding tables

This filter excludes all table objects:

```
object_type != 'TABLE'
```

Example 8-5 Excluding specific views

This example excludes a specific view by name:

```
not (object_type = 'VIEW' and object_name ='EMP_V')
```

8.4.4 How Filters Are Applied

During the export process, filters refine the selection of database objects by injecting conditions directly into the SQL queries running against the database's dictionary views. In essence, each filter acts as a `WHERE` clause, modifying the queries for views to ensure only the desired data is retrieved.

The process works as follows:

1. **Syntax validation:** First, SQLcl parses each filter to ensure it is a valid SQL predicate. If any filter has a syntax error, the export process halts immediately and returns an error message.
2. **Scope assessment:** SQLcl determines the scope of each filter depending on how you have referenced the column name within it. You can use either qualified or non-qualified column names.
   - **Non-qualified filters:** A non-qualified filter applies to all dictionary views that contain the specified column. This is useful for applying a broad condition across many object types.

     For example, the following filter applies to all views that have an `owner` column, such as `ALL_OBJECTS`, `ALL_TABLES`, `APEX_APPLICATIONS`, and so on.

     ```
     owner = 'HR'
     ```

   - **Qualified filters:** A qualified filter (`view_name.column_name`) applies only to the specific dictionary view you name. This gives you precise, targeted control.

     For example, the following filter applies only to the `ALL_OBJECTS` view.

     ```
     all_objects.object_name = 'EMPLOYEES'
     ```


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3. **Query execution:** After determining each filter's scope, SQLcl injects the filters into the relevant dictionary queries. Subsequently, it validates the filters against the dictionary queries.
   - If a filter is invalid or conflicts with the associated query, the export process halts immediately and returns an error message.
   - If filters are valid, SQLcl executes the final, modified queries to export only the data that matches your conditions.

Here's an example that demonstrates how a simple filter is applied.

Example 8-6 Filtering objects by name prefix

To export only objects whose names start with `HR_`, you could use the following non-qualified filter:

```
object_name like 'HR_%'
```

This filter targets all dictionary views containing the `object_name` column, such as `ALL_OBJECTS`, `ALL_INDEXES`, `ALL_TRIGGERS`, and so on. During the export process, SQLcl modifies the queries on each relevant view to include this filter, ensuring only objects with names starting with `HR_` are selected.

For instance, the query against the `ALL_OBJECTS` view becomes:

```
select * from all_objects where object_name like 'HR_%';
```

The same filtering logic applies to other views like `ALL_INDEXES`, `ALL_TRIGGERS`, and any other view containing the `object_name` column, maintaining consistent and targeted data retrieval across the export.

8.4.5 Debugging Applied Filters

If an export does not produce the expected results, you can debug the filtering process by adding the `-debug` flag to the `project export` command.

The debug output displays the final SQL queries that were executed, allowing you to see how your custom filters and the internal filters were applied.

In the debug output, internal and project (or custom) filters are commented differently, which helps you see exactly how each filter affects the final query.

Example 8-7 An internal filter in a debug output

```
and (Dba_objects.secondary = 'N') --<-- sqlcl internal.fixed.filters
```

Example 8-8 A project filter in a debug output

```
and (not (object_type = 'VIEW' and object_name ='DATABASECHANGELOG_DETAILS'))
--<-- project.filters
```


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8.4.6 Common Use Cases

Here are some practical examples of how you can use filters to refine your exports.

Excluding Development-Only Objects

In a development environment, you may create temporary objects for testing. To prevent these from being included in your production-ready exports, you can adopt a naming convention, such as using a `DEV_ONLY_` prefix.

You can then apply the following filter to exclude such objects:

```
object_name NOT LIKE 'DEV_ONLY_%'
```

When you run the `project export` command with this filter, it ensures that objects like `DEV_ONLY_TEMP_TABLE` are not included in the export, keeping it clean and ready for production.

Filtering Unwanted Grants

If you use a framework like utPLSQL, the `project export` command typically includes GRANT statements from the framework's schema (for example, UT3) that you may not require in your project source.

To exclude these grants, you can define a filter on the `grantor` column:

```
grantor != 'UT3'
```

When you run the `project export` command with this filter, any grants from the UT3 user are omitted, preventing them from being written to your `src/database` folder.

Excluding DML

By default, the `dml.filters` setting contains the following filter:

```
export_type != 'TABLES_DML'
```

This filter excludes `TABLES_DML` objects from export. If you change the comparison operator from `!=` to `=` or remove the filter, the project export and stage commands generate DML in addition to DDL.

8.5 Project Command Usage Examples

Get hands-on guidance about the Project command through these examples.

The examples in this section make assumptions around connections and source schemas, and depend on having the connections created.

8.5.1 Single Schema

This example consists of a single development schema and a single production schema. After it is created, the production schema includes objects from the development schema and the Liquibase changelog objects.

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Overview

1. Create a SQLcl database project.
2. Initialize a git repository in the database project and commit initial files to the main branch.
3. Create a new branch called `base-release`, run `project export` to export the objects from the connection `hr-dev` and commit the files to the branch.
4. Run `project stage` to compare the branch `base-release` to the `main` branch and generate the changelogs for installing the base release.
5. Run `project release` to move the development code to a versioned release called 1.0.
6. Run `project gen-artifact` to create a deployable zip file of the release called `<projectname>-<version>.zip`.
7. Connect to the production schema and deploy the artifact with `project deploy` command.

Connection Definitions

`hr-dev`: This is the connection to use as a development schema.

`hr-prod`: This is the connection to use as the production schema.

Development Connection and Objects

In the development schema, install the objects for the `HR sample schema`. These objects are available on Github. Clone the `oracle-samples/db-samples-schemas` repository.

In this example, an `hr` user is set up with the password `oracle`.

```
$> git clone git@github.com:oracle-samples/db-sample-schemas.git
$> cd db-sample-schemas/human_resources
$> sql <SYSTEM_USER>/<SYSTEMPASSWORD>@<DATABASE_URL>

SQL> @hr_install
Thank you for installing the Oracle Human Resources Sample Schema.
This installation script will automatically exit your database session
at the end of the installation or if any error is encountered.
The entire installation will be logged into the 'hr_install.log' log file.

Enter a password for the user HR: ******
Enter a tablespace for HR [USERS]:
Do you want to overwrite the schema, if it already exists? [YES|no]: YES
Old HR schema has been dropped.
******  Creating REGIONS table ....
******  Creating COUNTRIES table ....
******  Creating LOCATIONS table ....
******  Creating DEPARTMENTS table .....
******  Creating JOBS table ....
******  Creating EMPLOYEES table ....
******  Creating JOB_HISTORY table ....
******  Creating EMP_DETAILS_VIEW view ...
******  Creating indexes ...
******  Adding table column comments ...

****** Populating REGIONS table ....
****** Populating COUNTRIES table ....
```


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```
****** Populating LOCATIONS table ....
****** Populating DEPARTMENTS table ....
****** Populating JOBS table ....
****** Populating EMPLOYEES table ....
****** Populating JOB_HISTORY table ....

Installationverification
_____________________________
Verification:

Table             provided    actual
_____________ ____________ _________
regions                  5         5
countries               25        25
departments             27        27
locations               23        23
employees              107       107
jobs                    19        19
job_history             10        10
```

Create the connection in Oracle SQL Developer extension for VSCode or Oracle SQLcl.

```
SQL> connect -save hr-dev -savepwd hr/oracle@localhost/freepdb1
Name: hr-dev
Connect String: localhost/freepdb1
User: hr
Password: ******
Connected.
SQL> connect -name hr-dev
Connected.
```

Use a login.sql file to customise the login experience. Set up the user, database, project, git status, and current working directory.

```
--login.sql
set sqlformat ansiconsole
set sqlprompt "@|red _USER|@@@|green _O_RELEASE|@@|blue   ≤ >|@"
set statusbar default editmode linecol git project cwd
set statusbar on
```

Steps

1. Create a SQLcl database project.

   Choose a directory to create the project and run the `project init` command.

   ```
   SQL> project init -name demo -schemas hr -makeroot
   ------------------------
   PROJECT DETAILS
   ------------------------
   Project name:    demo
   Schema(s):       HR
   Directory:       /Users/abc/sandbox/projects/demo
   Connection name: hr-dev
   ```


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```
Config Only:     false
Project root     demo
Your project has been successfully created.
```

This command creates the project and the `makeroot` option creates a project folder.

2. Initialize the Git repository.

   In the project directory, initialize a Git repository and commit the initial files to the main branch. The main branch is called `main`. On commit, it is important to use the Conventional Commits standard for commit messages so that it is useful on release to identify features, bugs, chores and other types. The code block shows Git running in SQLcl using the host command denoted by the `!` character preceding the Git command. This character allows the user to run any command available on the host shell.

   ```
   SQL>cd demo
   SQL>pwd
   /Users/abc/sandbox/projects/demo
   SQL> !git init --initial-branch=main
   Initialized empty Git repository in /Users/abc/sandbox/projects/demo/.git/
   SQL> !git add .
   SQL> !git commit -m "chore: initializing repository with default project
   files"
   [main (root-commit) 6cc2434] chore: initializing repository with default
   project files
    8 files changed, 145 insertions(+)
    create mode 100644 .dbtools/filters/project.filters
    create mode 100644 .dbtools/project.config.json
    create mode 100644 .dbtools/project.sqlformat.xml
    create mode 100644 .gitignore
    create mode 100644 dist/README.md
    create mode 100644 dist/install.sql
    create mode 100644 src/README.md
    create mode 100644 src/database/README.md
   ```

   In the `demo` folder, there are several folders and files:

   - `.dbtools`: Contains the configuration files for the project.
   - `src`: Contains the source files exported from the schema.
   - `dist`: Contains the generated install files and releases.
   - `artifact`: Contains the zip files generated for a release.

3. Create the `base-release` branch and commit exported files.

   Create a branch in Git called `base-release` and check it out. Run `project export` to export the objects from the hr-dev connection.

   ```
   SQL> !git checkout -b base-release
   Switched to a new branch 'base-release'
   SQL> project export
   The current connection localhost/freepdb1 HR will be used for all
   operations.
   *** INDEXES ***
   *** PROCEDURES ***
   *** SEQUENCES ***
   ```


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```
*** TABLES ***
*** TRIGGERS ***
*** VIEWS ***
*** COMMENTS ***
*** REF_CONSTRAINTS ***
--------------------------------
TABLE                           6
PROCEDURE                       2
REF_CONSTRAINT                 10
CREATE_USER                     1
TRIGGER                         2
SEQUENCE                        3
INDEX                          11
VIEW                            1
COMMENT                         7
--------------------------------
Exported 43 objects.
Elapsed  13 sec.
SQL>!git status
On branch base-release
Untracked files:
  (use "git add <file>..." to include in what will be committed)
    src/database/hr/
SQL>!git add src
SQL>!git status
On branch base-release
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
    new file:   src/database/hr/comments/countries.sql
...
    new file:   src/database/hr/comments/regions.sql
    new file:   src/database/hr/create_users/create_user.sql
    new file:   src/database/hr/indexes/dept_location_ix.sql
...
    new file:   src/database/hr/indexes/loc_state_province_ix.sql
    new file:   src/database/hr/procedures/add_job_history.sql
    new file:   src/database/hr/procedures/secure_dml.sql
    new file:   src/database/hr/ref_constraints/countr_reg_fk.sql
...
    new file:   src/database/hr/ref_constraints/loc_c_id_fk.sql
    new file:   src/database/hr/sequences/departments_seq.sql
    new file:   src/database/hr/sequences/employees_seq.sql
    new file:   src/database/hr/sequences/locations_seq.sql
    new file:   src/database/hr/tables/countries.sql
...
    new file:   src/database/hr/tables/regions.sql
    new file:   src/database/hr/triggers/secure_employees.sql
    new file:   src/database/hr/triggers/update_job_history.sql
    new file:   src/database/hr/views/emp_details_view.sql

!git commit -m "chore: base export of hr schema"
[base-release b481c41] chore: base export of hr schema
 44 files changed, 609 insertions(+)
 create mode 100644 src/database/hr/comments/countries.sql
 ...
 create mode 100644 src/database/hr/comments/regions.sql
```


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```
create mode 100644 src/database/hr/create_users/create_user.sql
create mode 100644 src/database/hr/indexes/dept_location_ix.sql
...
create mode 100644 src/database/hr/indexes/loc_state_province_ix.sql
create mode 100644 src/database/hr/procedures/add_job_history.sql
create mode 100644 src/database/hr/procedures/secure_dml.sql
create mode 100644 src/database/hr/ref_constraints/countr_reg_fk.sql
...
create mode 100644 src/database/hr/ref_constraints/loc_c_id_fk.sql
create mode 100644 src/database/hr/sequences/departments_seq.sql
...
create mode 100644 src/database/hr/sequences/locations_seq.sql
create mode 100644 src/database/hr/tables/countries.sql
...
create mode 100644 src/database/hr/tables/regions.sql
create mode 100644 src/database/hr/triggers/secure_employees.sql
create mode 100644 src/database/hr/triggers/update_job_history.sql
create mode 100644 src/database/hr/views/emp_details_view.sql
```

4. Use `project stage` to create changelogs for installing the base release.

   Run the `project stage` command to compare the `base-release` branch to the main branch and generate the changelogs for installing the base release.

```
SQL> project stage
Stage successfully created, please review and commit your changes to
repository.
SQL> !git status
On branch base-release
Untracked files:
  (use "git add <file>..." to include in what will be committed)
    dist/releases/
SQL> !find dist/releases/next
dist/releases/next
dist/releases/next/changes
dist/releases/next/changes/base-release
dist/releases/next/changes/base-release/code
dist/releases/next/changes/base-release/code/_custom
dist/releases/next/changes/base-release/stage.changelog.xml
dist/releases/next/changes/base-release/hr
dist/releases/next/changes/base-release/hr/ref_constraint
dist/releases/next/changes/base-release/hr/ref_constraint/dept_loc_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/emp_job_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/jhist_job_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/jhist_dept_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/loc_c_id_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/countr_reg_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/emp_dept_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/jhist_emp_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/dept_mgr_fk.sql
dist/releases/next/changes/base-release/hr/ref_constraint/
emp_manager_fk.sql
dist/releases/next/changes/base-release/hr/table
dist/releases/next/changes/base-release/hr/table/jobs.sql
dist/releases/next/changes/base-release/hr/table/departments.sql
dist/releases/next/changes/base-release/hr/table/regions.sql
```


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```
dist/releases/next/changes/base-release/hr/table/countries.sql
dist/releases/next/changes/base-release/hr/table/employees.sql
dist/releases/next/changes/base-release/hr/table/job_history.sql
dist/releases/next/changes/base-release/hr/table/locations.sql
dist/releases/next/changes/base-release/hr/index
dist/releases/next/changes/base-release/hr/index/emp_name_ix.sql
dist/releases/next/changes/base-release/hr/index/jhist_department_ix.sql
dist/releases/next/changes/base-release/hr/index/emp_manager_ix.sql
dist/releases/next/changes/base-release/hr/index/emp_department_ix.sql
dist/releases/next/changes/base-release/hr/index/loc_country_ix.sql
dist/releases/next/changes/base-release/hr/index/jhist_employee_ix.sql
dist/releases/next/changes/base-release/hr/index/jhist_job_ix.sql
dist/releases/next/changes/base-release/hr/index/loc_city_ix.sql
dist/releases/next/changes/base-release/hr/index/dept_location_ix.sql
dist/releases/next/changes/base-release/hr/index/emp_job_ix.sql
dist/releases/next/changes/base-release/hr/index/loc_state_province_ix.sql
dist/releases/next/changes/base-release/hr/sequence
dist/releases/next/changes/base-release/hr/sequence/departments_seq.sql
dist/releases/next/changes/base-release/hr/sequence/locations_seq.sql
dist/releases/next/changes/base-release/hr/sequence/employees_seq.sql
dist/releases/next/release.changelog.xml
dist/releases/next/code
dist/releases/next/code/code.changelog.xml
dist/releases/next/code/hr
dist/releases/next/code/hr/trigger
dist/releases/next/code/hr/trigger/update_job_history.sql
dist/releases/next/code/hr/trigger/secure_employees.sql
dist/releases/next/code/hr/comment
dist/releases/next/code/hr/comment/jobs.sql
dist/releases/next/code/hr/comment/departments.sql
dist/releases/next/code/hr/comment/regions.sql
dist/releases/next/code/hr/comment/countries.sql
dist/releases/next/code/hr/comment/employees.sql
dist/releases/next/code/hr/comment/job_history.sql
dist/releases/next/code/hr/comment/locations.sql
dist/releases/next/code/hr/procedure
dist/releases/next/code/hr/procedure/secure_dml.sql
dist/releases/next/code/hr/procedure/add_job_history.sql
dist/releases/next/code/hr/view
dist/releases/next/code/hr/view/emp_details_view.sql
```

5. Run `project release` to complete the release.

   Run the `project release` command to move the development code to a versioned release called 1.0.

```
SQL> project release -version 1.0 -verbose
Creating a release version 1.0 for the current body of work

Updated change:dist/releases/main.changelog.xml
Moved folder "dist/releases/next" to "dist/releases/1.0"
Created file:  dist/releases/next
Created change:dist/releases/next/release.changelog.xml
Created change:dist/releases/next/release.changelog.xml
Process completed successfully
```


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This moves all changes in the `next` folder to the `1.0` folder under releases.

```
--Cropped Tree Structure
SQL> !tree
.
├─── demo
│    ├─── README.md
│    ├─── dist
│    │    ├─── install.sql
│    │    └─── releases
│    │         ├─── 1.0
│    │         │    ├─── code
│    │         │    ├─── release.changelog.xml
│    │         │    └─── changes
│    │         │         └─── base-release
│    │         │              ├─── code
│    │         │              │     ...
│    │         │              ├─── hr
│    │         │              │     ...
│    │         │              └─── stage.changelog.xml
│    │         ├─── main.changelog.xml
│    │         ├─── next
│    │         │    └─── release.changelog.xml
│    │         └─── util
│    │              ├─── prechecks.sql
│    │              └─── recompile.sql
│    └─── src
│         ├─── README.md
│         └─── database
│              ├─── README.md
│              └─── hr
│                   ...
```

6. Run `project deploy` to install the artifact into a database.

   Connect to the production schema and deploy the artifact with the `project deploy` command.

   ```
   connect -name production-connection
   SQL> project deploy -file artifact/demo-1.0.zip -verbose
   Check database connection...
   Extract the file name: demo-1.0
   Artifact decompression in progress...
   Artifact decompressed: /var/folders/35/v7k4b96d1d9b61mm93bgjjnr0000gn/T/
   e6b3d0f0-92d5-4fde-b82c-37ea9ec419c58326209255710673404
   Starting the installation...
   ```

7. Check the installed schema to check the installed objects.

   ```
   SQL> connect hr/<password>
   Connected.
   SQL> tables

   TABLES
   ------------------------------
   COUNTRIES
   ```


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```
DATABASECHANGELOG_ACTIONS
DATABASECHANGELOG
DATABASECHANGELOGLOCK
DEPARTMENTS
DOC
EMPLOYEES
JOB_HISTORY
JOBS
LOCATIONS
REGIONS
```

The migrated tables are listed along with the management tables for Liquibase.

8.5.2 Administrator Exports HR to Production Schema

In this example, the steps are the same as in Single Schema, except for the deploy (step 7), which is done in this case as an administrator. All objects that are created need to be prefaced with the schema name. This can be added on export by setting the following configuration item:

```
project config set -name export.setTransform.emitSchema -value true
```

Run the `project deploy` command.

```
SQL> connect adminuser/oracle@database
SQL> drop user hr cascade;
SQL> grant connect,resource, dba to hr identified by oracle;
SQL> project deploy -file artifact/demo-1.0.zip -verbose
Check database connection...
Extract the file name: demo-1.0
Artifact decompression in progress...
Artifact decompressed: /var/folders/35/v7k4b96d1d9b61mm93bgjjnr0000gn/T/
e6b3d0f0-92d5-4fde-b82c-37ea9ec419c58326209255710673404
Starting the installation...
```

After the installation, the main difference in objects is where the Liquibase tables exist.

```
SQL> show user
USER is "ABC"
SQL> tables

TABLES
_____________________________
DATABASECHANGELOG_ACTIONS
DATABASECHANGELOG
DATABASECHANGELOGLOCK

SQL> connect hr/oracle
Connected.
SQL> tables

TABLES
_____________________________
```


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```
COUNTRIES
DEPARTMENTS
DOC
EMPLOYEES
JOB_HISTORY
JOBS
LOCATIONS
REGIONS
```

8.6 Upgrading SQLcl When Using SQLcl Projects

With the SQLcl Projects feature, a structured approach is required to upgrade SQLcl so as to minimize disruption and ensure consistency across the team. This section describes the process for upgrading SQLcl when using SQLcl Projects, along with key considerations for timing and implementation.

8.6.1 When to Upgrade

The best approach for upgrading SQLcl is to wait until the end of a sprint when all work is completed. This ensures:

- No active development is disrupted.
- Team members are aware of the upgrade and can plan accordingly.
- The transition to the new SQLcl version is smooth and consistent.

Before starting, notify the team about the SQLcl upgrade and ensure that they stop working with SQLcl in the repository until the process is complete.

You can upgrade SQLcl even if there is work in progress that crosses sprint boundaries. However, you must modify the process described in the next section to suit your requirement.

8.6.2 Upgrade Process

To upgrade SQLcl, do the following:

1. Create a feature branch for the upgrade.

   Branch off from `main` (or the equivalent stable branch) and create a feature branch dedicated to the SQLcl version update. This keeps the upgrade isolated from ongoing development and allows for review before merging.

2. Update the project configuration.

   Modify the `sqlcl.version` property in the project configuration (found in `.dbtools/project.config.json`) to reflect the new version of SQLcl. This ensures that team members are using the intended version after the upgrade is complete.

3. Refresh `src/database`.

   SQLcl Projects is handled differently based on the version of SQLcl. This means you need to ensure that `src/database` is aligned with the new version.

   The recommended approach:

   - Delete `src/database` completely.

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- Re-export the project using the updated version of SQLcl.

This is a significant step because it ensures all definitions and configurations are regenerated according to the new SQLcl behavior.

Discuss with the team to find out if any project-specific considerations may affect this step. For example, if you are using a shared Development Database and there is a feature crossing sprint boundaries that is not ready for export, consider alternatives such as starting up a temporary database, running the installer there, and then exporting from that database.

4. Merge the branch to `main`.

   After the update is complete, merge the feature branch back into `main`.

   At this point:

   - The upgrade is officially complete.
   - The team must download the correct SQLcl version before starting new work.
   - New feature branches are created using the updated SQLcl version.

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9

APEXlang Support in SQLcl

APEXlang is a domain-specific language used to define Oracle APEX applications as source files. It enables you to manage APEX applications as code, supporting version control, validation, and automated deployment workflows. For more information, see APEXlang in the *Oracle APEX* documentation.

SQLcl supports APEXlang with a set of commands that support the full application lifecycle, including generation, export, validation, and import.

APEXlang commands are used to create and manage application source files. These files can be included into a SQLcl project, where `Projects` commands are used to organize, package, and deploy the application as part of a larger database project.

Topics:

- Prerequisites
- Commands Overview
- Common Workflows
- APEXlang Project Structure
- APEXlang Command Reference

9.1 Prerequisites

Before using APEXlang commands, ensure:

- SQLcl release 26.1 or later is installed.
- Oracle APEX release 26.1 or later is available.
- A valid database connection is established.
- You have the required privileges to access the APEX workspace and schema.

9.2 Commands Overview

This section describes the SQLcl APEX commands that support APEXlang. For detailed information about each command, see APEXlang in the SQLcl Command Reference chapter.

Command	Description
generate	Creates starter APEXlang project files.
export	Exports an existing APEX application as APEXlang source.
validate	Compiles and validates APEXlang source files.
import	Compiles and imports APEXlang source into the database.

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generate

The `generate` command creates starter application files that can be used as a foundation for development. These templates can be compiled and imported into APEX, and are intended to be customized by the user.

When a database connection is present, SQLcl determines the appropriate version automatically.

export

The `export` command supports APEXlang as an export type, allowing existing APEX applications to be converted into APEXlang code. This command converts an Oracle APEX application into APEXlang source files in `.apx` format.

validate

The `validate` command compiles APEXlang input and reports any errors. If no issues are found, a success message is displayed.

Supported inputs include a directory, zip file, or a single APEXlang file containing the entire application.

The APEXlang compiler is used to compile APEXlang source files as part of the validate and import operations.

import

The `import` command compiles APEXlang input and executes the resulting PL/SQL using the current database connection.

Compilation errors are reported with file name, line, column, and message details. If successful, the application is created or updated.

Supported inputs include a directory, zip file, or a single APEXlang file containing the entire application.

9.3 Common Workflows

Creating a New Application

1. Generate starter files:

   ```
   apex generate -alias customer-portal
   ```

2. Modify the generated files.
3. Validate the source:

   ```
   apex validate -input ./customer-portal
   ```

4. Import the application:

   ```
   apex import -input ./customer-portal
   ```


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Converting an Existing Application to APEXlang

1. Export the application:

   ```
   apex export -applicationid 105 -exptype APEXLANG
   ```

2. Modify the exported files.
3. Validate the source:

   ```
   apex validate -input ./f105
   ```

4. Import the application:

   ```
   apex import -input ./f105
   ```

9.4 APEXlang Project Structure

APEXlang applications use a standardized project structure to organize application files, deployment settings, and compiler metadata.

This structure enables:

- consistent application exports
- automated validation and deployment
- version control integration
- environment-specific configuration management

The following sections describe the directory layout, deployment configuration files, and internal metadata used by SQLcl and the APEXlang compiler.

9.4.1 Directory Structure

APEXlang applications use a defined directory structure to ensure consistency and support deployment and metadata management.

- Application files are placed in a parent directory using the application's alias property.
- Deployment configuration files are stored in the `deployments/` directory.
- The hidden `.apex/` directory contains internal metadata or configuration files that should not be modified.

  An example of the directory structure:

```
.
└── <app-alias>/
    ├── pages/
    │   ├── p00001.apx
    │   ├── p00002.apx
    │   └── ...
    ├── shared_components/
    │   ├── lists.apx
    │   └── ...
```


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```
├─── supporting_objects/
├─── deployments/
│    └─── default.json
├─── .apex/
│    └─── apexlang.json
├─── application.apx
└─── page_groups.apx
```

SQLcl Projects Directory Structure

To maintain consistency across SQLcl `APEX` and `Projects` commands, APEX application directories in SQLcl Projects follow this structure:

```
f<appId>/<app-alias>/
```

As part of this change, the SQLcl `Projects` command includes logic during database export to remove the previous directory structure automatically.

Example:

```
.
├─── .dbtools/
│    ├─── project.config.json
│    └─── ...
├─── artifact/
├─── dist/
└─── src/
     └─── database/
          ├─── mySchema/
          │    └─── apex_apps/
          │         └─── f100/
          │              ├─── f100.sql
          │              └─── brookstrut/
          │                   ├─── pages/
          │                   │    ├─── p00001.apx
          │                   │    ├─── p00002.apx
          │                   │    └─── ...
          │                   ├─── shared_components/
          │                   │    ├─── lists.apx
          │                   │    └─── ...
          │                   ├─── supporting_objects/
          │                   ├─── .apex/
          │                   │    └─── apexlang.json
          │                   ├─── deployments/
          │                   │    └─── default.json
          │                   ├─── page_groups.apx
          │                   └─── application.apx
          └─── sys/
               └─── ...
```


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9.4.2 Deployment File

APEXlang uses a deployment file to define application and workspace settings used during validation and import. It provides default values such as application ID, workspace, and other import settings. These values can be overridden using command options.

Deployment files are generated during `apex export` or created when running `apex generate`.

Example

```
{
  "app": {
    "id": 1020,
    "name": "Customer Portal",
    "alias": "customer-portal",
    "databaseSession": {
      "parsingSchema": "CUST_PORTAL_APP"
    },
    "availability": {
      "buildStatus": "runAndBuild"
    },
    "runtime": {
      "logging": true,
      "debugging": false
    },
     "proxy": {
      "proxyServer": "proxy.corp.example.com",
      "noProxyDomains": "localhost,internal.example.com"
    },
     "staticFiles": {
      "appFilesPath": "/u01/apex/apps/customer-portal/files",
      "apexFilesPath": "/u01/apex/shared/files"
    }
  },
  "workspace": {
    "name": "CUSTOMER_PORTAL"
  },
  "theme": {
    "advanced": {
      "filePrefix": "i"
    }
  }
}
```

Property Descriptions

The deployment file defines values used during validation and import.

Property	Description
app.id	Specifies the target Application ID to use when importing the application.
app.name	Defines the display name of the application.
app.alias	Sets the unique alias used in application URLs.

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Property	Description
app.databaseSession.parsingSchema	Identifies the database schema used to parse and execute the application.
app.availability.buildStatus	Controls application availability. Supported values: `runAndBuild` (application is editable and runnable) and `runOnly` (application is runtime-only).
app.runtime.logging	Enables page view logging for the application.
app.runtime.debugging	Enables application debugging.
app.proxy.proxyServer	Specifies the proxy server used for outbound network requests.
app.proxy.noProxyDomains	Lists domains that bypass the configured proxy server.
app.staticFiles.appFilesPath	Defines the file system or URL path for application-specific static files.
app.staticFiles.apexFilesPath	Defines the path for shared APEX static resources (images, JavaScript, CSS).
workspace.name	Specifies the target workspace into which the application is imported.
theme.advanced.filePrefix	Sets the file prefix used by the application theme for resolving static resources.

Property Resolution Order

When the same property is defined in multiple sources, APEXlang resolves the value by using a defined order of precedence.

The following sections describe how this resolution process applies to specific property groups.

Application ID Resolution

APEXlang determines the application ID using the following order of precedence:

1. Use the application ID provided through a command option.
2. Use the `app.id` value from a deployment file specified through a command option.
3. Use the application ID defined in the APEX session.
4. Use the `app.id` value from the default deployment file in the input path.
5. Generate an available application ID using the database connection.

Workspace Resolution

APEXlang determines the workspace by using the following order of precedence:

- Use the workspace or workspace ID provided through a command option.
- Use the workspace defined in the APEX session.
- Use the `workspace.name` value from a deployment file specified through a command option.
- Use the `workspace.name` value from the default deployment file in the input path.
- Query the workspace using the database connection.

All Other Property Resolution

All other deployment properties are resolved using the following order of precedence:

- Use the value provided through an associated command option.
- Use the value defined in the APEX session, if supported.

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- Use the property value from a deployment file specified through a command option.
- Use the property value from the default deployment file in the input path.
- If no value is found, the property is not set.

9.4.3 Hidden Configuration Directory

The hidden `.apex/` directory contains internal metadata and configuration files used by APEXlang. These files are managed automatically and generally should not be modified manually. Changes to these files may cause unexpected behavior.

The primary file in this directory is `.apex/apexlang.json`. This file stores the internal configuration used by the APEXlang compiler.

Property	Description
mmdVersion	Specifies the version of the MMD (meta meta data) that the APEXlang source files are compatible with. This value is used to initialize the APEXlang compiler. If not specified, the compiler uses the latest supported version. This value must not be modified manually.

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10

Using Cloud Storage

SQLcl supports Oracle Cloud Infrastructure (OCI) Object Storage for loading, unloading, and managing objects in Cloud Storage.

You can authenticate using either:

- An OCI profile, which supports both on-premises and Oracle Cloud databases.
- A DBMS_CLOUD credential, which is available for Oracle Cloud databases.

The following operations are supported with both authentication methods:

- Upload, download, preview, and delete objects in Cloud Storage.
- Load database objects from Cloud Storage.
- Unload database tables to Cloud Storage.

Table 10-1 Accessing cloud storage

Using OCI	Using `DBMS_CLOUD`
Can access on-premises database and cloud database.	Can access cloud database only.
List compartments, buckets and objects, and view some of the contents of an object in Cloud Storage.	Set a default Cloud Storage URL, list objects, and view some of the contents of an object in Cloud Storage.
Require an OCI profile for authentication and access as a prerequisite step.	Authentication is done using existing OCI or Swift credentials.

Topics

- Using DBMS_CLOUD Authentication
- Configuring Cloud Storage
- Using the Cloud Storage Command
- Examples

See Also

- Loading a File
- Using the OCI Command for Oracle Cloud Infrastructure REST APIs

10.1 Using DBMS_CLOUD Authentication

You can access cloud storage using the `DBMS_CLOUD` Credential command. Presently, the `DBMS_CLOUD` Credential supports Oracle Cloud database.

With the `DBMS_CLOUD` Credential command (`dbcc`), you can:

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- Create a credential using Swift, OCI credentials, or an existing OCI profile.
- Enable, disable, update, and drop a credential.
- List the credentials.
- Set the default credential.

Create a Credential

To create authentication using the Swift credential, use the following command:

```
dbcc create <new-credential-name> user <username> pass <password>
```

To create authentication using the OCI credential, use the following command:

```
dbcc create <new-credential-name> fingerprint <fingerprint> user_ocid <user-
id> tenancy_ocid <tenancy-id> private_path <path-to-private-key>
```

To create authentication using OCI profile, use the following command:

```
dbcc create <new-credential-name> profile <oci-profile-name>
```

Enable, Disable, Update, and Drop a Credential

To enable a credential, use the following command:

```
dbcc enable <credential-name>
```

To disable a credential, use the following command:

```
dbcc disable <credential-name>
```

To update a credential, use the following command:

```
dbcc update <credential-name> <attribute> <value>
```

where `<attribute> : [user_ocid] [tenancy | tenancy_id] [key_path | private_key_path] [print | fingerprint]`

To drop a credential, use the following command:

```
dbcc drop <credential-name>
```

List the Credentials

To display a list of available credentials, use the following command:

```
dbcc list
```


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Set the Default Credential

To set **mycred** as the default credential, use the following command:

```
dbcc mycred
```

To find help on the dbcc command, use the following command:

```
help dbccred
```

An Example to Create and Set a DBMS_CLOUD Credential

The following example details the steps to create and set different types of DBMS_CLOUD credentials.

```
--Set the path to the Wallet zip file on your system
SQL> set cloudconfig <path-to-Wallet-file>
Operation is successfully completed.

--Supply the database user name, password and the database service name
provided in the tnsnames.ora
SQL> connect admin/<password>@adw20200526_high
Connected.

--Set Cloud Storage URL to the bucket
SQL> set cloudstorage uri https://objectstorage.us-ashburn-1.example.com/n/
test/b/example
DBMS_CLOUD Credential: Not Set
OCI Profile: Not Set
Transfer Method: Not Set
URI as specified: https://objectstorage.us-ashburn-1.example.com/n/test/b/
example

--create CREDENTIAL using Swift authentication
SQL> dbcc create swiftcred user <username> pass <password>
Credential SWIFTCRED created.
DBMS_CLOUD Credential set to SWIFTCRED.
Transfer method set to DBMS_CLOUD.

--create CREDENTIAL using OCI authentication
SQL> dbcc create ocicred fingerprint ec:98:83:**:**:**:b5
     user_ocid ocid1.user.oc1......**g4xoca
     tenancy_ocid ocid1.tenancy.oc1.....a**3n3a
     private_path C:\\Users\\test\\.oci/freedb_api_key.pem
Credential OCICRED created.
DBMS_CLOUD Credential set to OCICRED.
Transfer method set to DBMS_CLOUD.

--create CREDENTIAL using an existing OCI profile called freedb
--If profile name is not passed as a parameter, it takes the default
   OCI profile details which is already set.
SQL> dbcc create profcred profile [freedb]
Credential PROFCRED created.
```


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```
DBMS_CLOUD Credential set to PROFCRED.
Transfer method set to DBMS_CLOUD.
```

10.2 Configuring Cloud Storage

Cloud Storage configuration is managed through the `set cloudstorage` and `show cloudstorage` commands.

You can configure:

Command	Description
`set/show cloudstorage uri`	Sets or shows the default Cloud Storage URI.
`set/show cloudstorage transfer`	Sets or displays the transfer method (OCI or DBMS_CLOUD).
`set/show cloudstorage credential`	Sets or displays the DBMS_CLOUD credential.
`show cloudstorage profile`	Displays the current OCI profile.

> **Note**
>
> PROFILE is display-only. Cloud Storage operations automatically use the current OCI profile selected for the session. Cloud Storage does not maintain a separate profile setting. To view the active profile, use `show cloudstorage profile`.
>
> For more information about the `set/show cloudstorage` commands, see the inline SQLcl help.

Examples

```
set cloudstorage uri https://objectstorage...
set cloudstorage transfer oci
set cloudstorage transfer dbms_cloud
set cloudstorage credential my_credential
show cloudstorage
```

10.3 Using the Cloud Storage Command

You can invoke the Cloud Storage command in SQLcl with `cloudstorage` or `cloud_storage` or `cs`.

The `cloudstorage` command performs cloud storage operations such as listing, uploading, downloading, previewing, and deleting objects.

The `cloudstorage` command uses the current Cloud Storage settings by default. Individual commands can override the configured URI by using the -uri option.

For a list of the Cloud Storage command options in SQLcl, enter:

```
help cs
```


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Listing Resources

Lists compartments, buckets, or objects.

```
cs list {{-compartment|-c} [compartment] | {-bucket|-b} <compartment> | {-
object|-o} [bucket]} [-uri|-u <uri>]
```

Specify one of the following: `-compartment`, `-bucket` or `-object`. These options are mutually exclusive.

- `-bucket` requires a compartment.
- `-object` accepts an optional bucket.

If no bucket is supplied, SQLcl uses the bucket from the current cloudstorage URI.

Examples:

```
cs list -compartment
cs list -compartment my_compartment
cs list -bucket my_compartment
cs list -object
cs list -object my_bucket
```

Deleting Objects

```
cs delete [-uri|-u <uri>] <object>
```

Downloading Objects

```
cs get [-dbdirectory|-dir <directory>] [-uri|-u <uri>] <object>
```

Uploading Objects

```
cs put [-qualifier|-q <object>] [-dbdirectory|-dir <directory>] [-uri|-u
<uri>] <file>
```

Previewing Objects

```
cs peek [-position|-pos <position>] [-size|-sz <size>] [-uri|-u <uri>]
<object>
```

Add URI Override

Each `cloudstorage` action command supports `-uri` and `-u` to temporarily override the configured Cloud Storage URI.

> **Note**
>
> The `-uri` option overrides the configured Cloud Storage URI for the current command only. The configured URI remains unchanged.

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Example:

```
cs get -uri https://objectstorage... my_object

cs put -uri https://objectstorage... my_file
```

10.4 Examples

This section provides some examples:

- Load a Cloud Storage File into a Table
- Unload Table Data into Cloud Storage
- List Compartments, Buckets, and Objects
- Load a Local File into Cloud Storage using the PUT command
- Get a File from Cloud Storage using the GET Command
- Delete a File in Cloud Storage using the DELETE Command
- Grant a `DBMS_CLOUD` Credential to Another User

Load a Cloud Storage File into a Table

The following example shows how to load a cloud storage file into a database table:

Use Case 1: When using the `DBMS_CLOUD` authentication scheme, the `DBMS_CLOUD` credential is set and transfer method is set to `dbms_cloud`.

```
--Set the DBMS_CLOUD credential
SQL> SET CLOUDSTORAGE TRANSFER DBMS_CLOUD
SQL> SET CLOUDSTORAGE CREDENTIAL swiftcred

--Set Cloud Storage URI to the bucket
SQL> SET CLOUDSTORAGE URI https://objectstorage.us-ashburn-1.example.com/n/
test/b/example

DBMS_CLOUD Credential: SWIFTCRED
OCI Profile: Not Set
Transfer Method: dbms_cloud
URI as specified: https://objectstorage.us-ashburn-1.example.com/n/test/b/
example
```

Use Case 2: When using the OCI Profile authentication scheme, the OCI profile is set and transfer method is set to `oci`.

```
--Set the OCI profile
--The current OCI profile is automatically reused by Cloud Storage operations.
--Set Cloud Storage URI to the bucket
SQL> SHOW CLOUDSTORAGE PROFILE



--Create Table "locations"
SQL> create table locations(location_id NUMBER(5),location_name VARCHAR2(40));
```


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```
Table LOCATIONS created

--Load data from LOCATIONS_DATA_TABLE.csv in cloud storage into "locations"
table of the schema for the current user
SQL> load locations cs /o/LOCATIONS_DATA_TABLE.csv

format csv

column_names on
delimiter ,
enclosure_left "
enclosure_right "
encoding UTF8
row_limit off
row_terminator default
skip_rows 0
skip_after_names

--Number of rows processed: 50
--Number of rows in error: 0
--Last row processed in final committed batch: 50
0 - SUCCESS: Load processed without errors

SQL> select count(*) from locations;

COUNT(*)
---------
50

--Load data from LOCATIONS_DATA_TABLE.csv in your current local folder into
"locations" table
  of the schema for the current user
SQL> load locations cs LOCATIONS_DATA_TABLE.csv
```

Unload Table Data into Cloud Storage

The following example shows how to unload data from the `locations` table into cloud storage. The data is unloaded to the cloud storage location and is named `LOCATIONS_DATA_TABLE.csv`.

```
--Set Cloud Storage URI to the bucket
SQL> SET CLOUDSTORAGE URI https://objectstorage.us-
ashburn-1.oraclecloud.com/n/test/b/example

--Specify delimiter as | and terminator as <eol>
SQL> set loadformat delimiter | term <eol> csv

--Unload locations table into cloud storage
SQL> unload locations cs

DBMS_CLOUD Credential: SWIFTCRED            --Using DBMS_CLOUD authentication
OCI Profile: Not Set
Transfer Method: dbms_cloud
URI as specified: https://objectstorage.us-ashburn-1.oraclecloud.com/n/test/b/
example/o/
Final URI: https://objectstorage.us-ashburn-1.oraclecloud.com/n/test/b/
example/o/
```


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```
format csv

column_names on
delimiter |
enclosure_left "
enclosure_right "
encoding UTF8
row_terminator <eof>

** UNLOAD Start ** at 2020.09.10-17.08.34
Export Separate Files to https://objectstorage.us-ashburn-1.oraclecloud.com/n/
test/b/example
DATA TABLE LOCATIONS
File Name: LOCATIONS_DATA_TABLE.csv
Number of Rows Exported: 23
** UNLOAD End ** at 2020.09.10-17.08.39

-- Show file contents
SQL> cs peek /o/LOCATIONS_DATA_TABLE.csv

"LOCATION_ID"|"LOCATION_NAME"<eof>01|"California"<eof>02|"Alaska<eof>03|"Flori
da"<eof>04|"Texas"<eof>05|"Virginia"<eof>
06|"Louisiana"<eof>07|"Massachusetts"<eof>08|"Arkansas"<eof>09|"Oregon"<eof>10
|"Hawaii"<eof>11|"Maryland"<eof>
12|"Pennsylvania"<eof>13|"Colorado<eof>14|"Michigan"<eof>15|"Minnesota"<eof>16
|"Ohio"<eof>17|"Maine"<eof>18|"Arizona"<eof>
19|"Missouri"<eof>20|"Vermont"<eof>21|"Kansas"<eof>22|"Nevada"<eof>23|"Illinoi
s"
```

List Compartments, Buckets, and Objects

The following example shows how to list compartments, buckets, and objects in cloud storage:

> **Note**
>
> When using `DBMS_CLOUD` credential, you can only list the objects in the bucket. `DBMS_CLOUD` transfer method does not support listing compartments and buckets.

```
cs https://objectstorage.us-ashburn-1.oraclecloud.com/n/test

--Lists the compartments in the namespace
SQL> cs list -compartment

COMP_APEX
dbtst
old
ords
pdf-fn-compartment
sandbox
sqldev

--Lists the compartments in the compartment sqldev
```


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```
SQL> cs list -compartment sqldev

sqldev1

--Lists the buckets in the compartment sqldev
SQL> cs list -bucket sqldev

example
test

--Lists the objects in the bucket transfer
SQL> cs list -object example

COUNTRIES_DATA_TABLE.csv
DEPARTMENTS_DATA_TABLE.csv
REGIONS_DATA_TABLE.csv
LOCATIONS_DATA_TABLE.csv

--Displays the first 2000 characters of LOCATIONS_DATA_TABLE file
SQL> cs peek /o/LOCATIONS_DATA_TABLE.csv
```

> **Note**
>
> When using the DBMS_CLOUD transfer method, only object listing is supported. Listing compartments and buckets is supported only with OCI transfer.

Load a Local File into Cloud Storage using the PUT command

The following example shows how to load a local file into cloud storage using the `CS PUT` command and the Cloud Storage command:

```
--Set Cloud Storage URI to the bucket
SQL> SET CLOUDSTORAGE URI https://objectstorage.us-
ashburn-1.oraclecloud.com/n/test/b/example

--Put an object from local directory into cloud storage
SQL> cs put -q myemployees.csv C:\Users\JDOE\EMPLOYEES_DATA_TABLE.csv

Put C:\\Users\\JDOE\\EMPLOYEES_DATA_TABLE.csv copied
        to https://objectstorage.us-ashburn-1.oraclecloud.com/n/test/b/
example/o/myemployees.csv

--List the objects in the bucket
SQL> cs list -object

COUNTRIES_DATA_TABLE.csv
DEPARTMENTS_DATA_TABLE.csv
REGIONS_DATA_TABLE.csv
LOCATIONS_DATA_TABLE.csv
myemployees.csv
```


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Get a File from Cloud Storage using the GET Command

The following example shows how to get a file from cloud storage using the `CS GET` command and the Cloud Storage command:

```
--Set Cloud Storage URI to the bucket
SQL> SET CLOUDSTORAGE URI https://objectstorage.us-
ashburn-1.oraclecloud.com/n/test/b/example/o/

--Set the local directory
SQL> cd C:\\Users\JDOE\\TempCS

--Get the myemployees.csv file from cloud storage
SQL> cs get myemployees.csv

Get Object https://objectstorage.us-ashburn-1.oraclecloud.com/n/test/b/
example/o/myemployees.csv
copied to C:\Users\JDOE\TempCSemployees.csv
```

Delete a File in Cloud Storage using the DELETE Command

The following example shows how to delete a file in cloud storage using the `CS DELETE` command and the Cloud Storage command:

```
--Set Cloud Storage URI to the bucket
SQL> SET CLOUDSTORAGE URI https://objectstorage.us-
ashburn-1.oraclecloud.com/n/test/b/example/o/

--Set the local directory
SQL> cd C:\\Users\JDOE\\TempCS

--Delete the myemployees.csv file in cloud storage
SQL> cs delete myemployees.csv

Deleted Object
https://objectstorage.us-ashburn-1.oraclecloud.com/n/test/b/example/o/
myemployees.csv
```

Grant a `DBMS_CLOUD` Credential to Another User

The following example shows how to create and grant a `DBMS_CLOUD` credential to another user:

```
-- Create a DBMS_CLOUD credential using oci-profile
SQL> dbcc create jdoecred profile freedb

DBMS_CLOUD Credential: JDOECRED
OCI Profile: Not Set
Transfer Method: dbms_cloud
URI as specified: https://objectstorage.us-ashburn-1.example.com/n/test/b/
example

-- Grant jdoecred to user jdoe
SQL> grant all on jdoecred to jdoe;
```


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```
-- Connect to the Cloud instance as jdoe
SQL> connect jdoe/********@adw20200526_high

-- Create a synonym for jdoecred
SQL> create synonym mycred for admin.jdoecred;

-- Set the transfer method using the synonym mycred
SQL> SET CLOUDSTORAGE TRANSFER DBMS_CLOUD
SQL> SET CLOUDSTORAGE CREDENTIAL mycred

-- User can now list the objects in the Cloud Storage 'test' bucket
because jdoe.mycred exists (as synonym)
SQL> cs list -object
```

Override the Configured URI

The following example lists objects in the default cloud storage bucket and then lists objects in another bucket by overriding the configured URI.

```
SQL> set cloudstorage uri https://objectstorage.us-
ashburn-1.oraclecloud.com/n/example_namespace/b/default_bucket/o/
SQL> set cloudstorage transfer oci
SQL> cs list -object
SQL> cs list -object -uri https://objectstorage.us-
ashburn-1.oraclecloud.com/n/example_namespace/b/other_bucket/o/
```


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11

Using Data Pump

You can import and export data and metadata using Data Pump. Data Pump is made available in SQLcl using the PL/SQL package, `DBMS_DATAPUMP`.

You can do the following:

- Export one or more schemas.
- Import one or more schemas with the `remap schema` option.
- Use `DATAPUMP` export and import for Oracle Database and Oracle Autonomous AI Database Cloud Services.
- Use database directory or Oracle Object Store for dump files, which can be optionally encrypted.
- Perform parallel processing of dump files.
- Filter objects by object types or names.
- Use the `SET DATAPUMP` command to set defaults and save them with the `STORE` command.
- Use the Cloud Storage feature to put or get from the database directory.

Topics

- Getting Started
- Data Pump Command Syntax and Arguments
- Use Cases
- Tips and Troubleshooting

11.1 Getting Started

The following sections provide information needed to get started with the `DATAPUMP` command in SQLcl.

11.1.1 Prerequisites

To use `DATAPUMP` in SQLcl, you need to know the following:

- When you are the logged-in user that is exporting or importing:
  - You must have the appropriate system privileges or adequate user space resource on the tablespace.
  - If you do not have the `DBA` or `PDB_DBA` role, you need access to the Oracle Directory for importing or exporting your own schema.

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For example:

```
grant read, write on directory DATA_PUMP_DIR to dpumpnotdba;
```

- When using other schemas:
  - See Required Roles to learn about the required roles for data pump import and export operations.
  - You must have permissions for the tablespace to import.
- If you are unable to use Data Pump, you can instead load a file using Loading a File.
- To connect to an Autonomous AI Database:
  - Download the wallet file for the Oracle Cloud connection. See Download Client Credentials.

    For importing to Autonomous, see Cloud Premigration Advisor Tool (CPAT).
- To use object storage from Oracle Database:
  - See Using the Cloud Storage Command and Setup and Prerequisites in the *Oracle Cloud Infrastructure Documentation*.
  - You must install an OCI profile configuration file.
  - The OCI profile must be set using `OCI PROFILE <name>` or `CS OCI <profile>`.
  - You can copy dump files to object storage as the last step of an export using the `-copycloud` option on the data pump export.
  - You can copy dump files from object storage as the first step of an import using the `-copycloud` option on the data pump import.
  - You can copy dump files between cloud storage and Oracle Directories using the Cloud Storage command (put and get).
- To use object storage from Autonomous AI Database:
  - See Using DBMS_CLOUD Authentication.
  - You must set the credential for object storage using Cloud Storage, `SET DATAPUMP` or `DATAPUMP` command.
  - You can export dump files directly to object storage without using a database directory.
  - You can import dump files directly from object storage without using a database directory.
  - You cannot write log files directly to object storage but you can copy them to cloud storage using the Cloud Storage command.
- The Time Zone File version is shown during export. The dump file can only be imported into a database with the same (or later) time zone file version.
- Transparent and Dual encryption modes require Transparent Data Encryption (TDE). If TDE is not available, you can use only password encryption.

11.1.2 Usage

The `DATAPUMP` command creates and submits data pump jobs using the DBMS_DATAPUMP package.

- For importing to Autonomous, see Cloud Premigration Advisor Tool (CPAT).

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- You can have different hardware, operating systems, character sets, time zones, and versions in the source and target databases.
- All object types and data types existing in Oracle Database release 11g and later versions are supported.
- You can transfer and filter data and metadata.
- You can transform schema names, tablespace names, and metadata at import time.
- You can unload and load data in an Oracle proprietary format.
- You can encrypt dump files to ensure your data is secure. You can use transparent if available on the database or use password as the encryption mode.
- You can filter the import or export process to limit the objects types and objects included.

Export

Data Pump export is used to unload metadata and data into a dump file, which can be stored in an Oracle Directory or object storage.

- If a schema or list of schemas is not provided, the current schema is exported.
- If a directory or object storage and a credential are not provided, the dump file is stored in `DATA_PUMP_DIR`.
- Job name is created as `ESQL_<n>`, if one is not provided.
- If a dump file name is not provided, the dump file is stored as `<jobname>.DMP`.
- If a log file name is not provided, the log file is stored as `<jobname>.LOG`.

Import

Data Pump import is used to load metadata and data from a previously exported dump file, which was stored in an Oracle Directory or object storage.

- If a schema or list of schemas is not provided, all the objects in the dump file are imported (`FULL` import by default). You can use a filter to limit the number of objects imported.
- If a database directory or object storage and a credential are not provided, the dump file is stored in `DATA_PUMP_DIR`.
- Job name is created as `ISQL_<n>`, if one is not provided.
- If a dump file name is not provided, the dump file is stored as `<jobname>.DMP`.
- If a log file name is not provided, the log file is stored as `<jobname>.LOG`.

11.2 Data Pump Command Syntax and Arguments

You can invoke the Data Pump command using `dp` or `datapump`.

Syntax

```
dp help [examples|syntax] | export [<optional-argument>,...] | import
[<optional-argument>,...] |
```

To see the help description for data pump in SQLcl, type:

```
dp help
```


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To quickly view the syntax and exclude other details, type:

```
dp help syntax
```

To only view the examples in help, type:

```
dp help examples
```

<*optional argument*>: The following table describes the possible optional arguments along with default values for each of them.

Table 11-1 Optional Arguments

File Argument	Description	Default
-credential, -c	Credential for dump file access in Oracle Object Store.	As specified in the Cloud Storage command
-directory,-d	Default database directory for reading and writing dump and log files.	`DATA_PUMP_DIR`
-dumpdirectory,-dd	Database directory for dump file.	-directory if specified or `DATA_PUMP_DIR`
-dumpfile,-f	<*file-name*>[,…] Dump file name(s) when using database directory. You can specify multiple files whether parallelism is enabled or not. The number of files specified must be at least as large as the degree of parallelism.	<*jobname*><*n*>.DMP

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Table 11-1 (Cont.) Optional Arguments

File Argument	Description	Default
-dumpuri,-u	[<*uri*>[,...] | <*qualified-name*>[,...]] <*uri*>: Complete URI for the Oracle Object Store file if a default is not set on Cloud Storage command. <*qualifier*>: Name of the object, optionally qualified by the namespace and the bucket. The qualified name concatenated to the URI specified on Cloud Storage command must fully identify the object URI. Credential must be set for direct read/write access to Oracle Object Store from Autonomous AI database. For -copycloud between database directory and Oracle Object Store, OCI PROFILE must be set. You can specify multiple URIs whether parallelism is enabled or not. The number of files specified should be at least as large as the degree of parallelism.	Default object name is <*jobname*>.DMP
-logdirectory,-ld	Database directory for log file.	-directory if specified or DATA_PUMP_DIR
-logfile,-lf	Log file name in the database directory.	<*jobname*><*n*>.LOG

Table 11-2 Command Arguments

Command Argument	Description	Default
-noexec,-ne	[TRUE | FALSE] TRUE: Validate and generate the PL/SQL, but do not execute it.	FALSE
-verbose,-ve	[TRUE | FALSE] TRUE: Show additional diagnostic output.	FALSE

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Table 11-3 Common Arguments

Common Argument	Description	Default
-copycloud,-cc	`[TRUE | FALSE]` `TRUE`: Copy the dump file between database directory and Oracle Object Store. For export, copy the dump file from the database directory to Oracle Object Store after the data pump job completes. For import, copy the dump file from Oracle Object Store to the database directory before the data pump job starts. Set the `OCI PROFILE` using `OCI` command or `CLOUDSTORAGE` command. Set the cloud storage URI using the `CLOUDSTORAGE` command, `SET DATAPUMP` command or `DATAPUMP` command.	FALSE
-encryptionpassword,-enp	<*password*> If password is not specified, a prompt for the password is given. For export, the dump files are encrypted using the password. For import, the same password used for export is provided.	None
-excludeexpr,-ex	<*object_type_expression*> Specify an expression identifying an object type or set of object types to exclude from the job. Example:`-excludeexpr "IN ('GRANT','INDEX','TRIGGER')"`	None
-excludelist,-el	<*object-type*>[,...] Specify a comma-separated-value list of object types to exclude from the job. Example:`-excludelist GRANT,INDEX,TRIGGER`	None
-includeexpr,-ix	<*object_type_expression*> Specify an expression identifying an object type or set of object types to include in the job. Only matching object types and their dependents are included in the job. Use -excludelist or -excludeexpr to exclude dependent objects. Example: `-includeexpr "IN ('TABLE','VIEW')"`	None

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Table 11-3 (Cont.) Common Arguments

Common Argument	Description	Default
-includelist,-il	<*object_type*>[,...] Specify a comma-separated-value list of object types to include in the job. Only matching object types and their dependents are included in the job. Use -excludelist or -excludeexpr to exclude dependent objects. Example: `-includelist TABLE,VIEW`	None
-includemetadata,-im	`[TRUE | FALSE]` `TRUE`: Include metadata in the job.	TRUE
-includerows,-ir	`[TRUE | FALSE]` `TRUE`: Include data in the job.	TRUE
-jobname,-j	Name for the data pump job. Job name is appended with a data pump generated number, unless it ends with a number. jobname<*n*> is used when submitting the data pump job and as a default name for dump and log file names or object names.	`ESQL_`<*n*> | `ISQL_`<*n*> where *n* is a data pump generated number.
-nameexpr,-nx	{<*object-type*>=<*name-expression*>}[;...] For specified object type, provide an expression identifying a set of object names to include in the job. Example: `-nameexpr TABLE="IN ('EMPLOYEES', 'DEPARTMENTS')";PROCEDURE="IN ('ADD_JOB_HISTORY','SECURE_DML')"`	None
-namelist,nl	{<*object-type*>=<*name*>[,...]}[;...] For specified object type, provide a comma-separated-value list of objects to include in the job. Example: `-namelist TABLE=employees,departments;PROCEDURE=add_job_history,secure_dml`	None
-parallel,-p	<*degree_integer*> Adjusts the degree of parallelism within a job allowing multiple processes simultaneously. Specify the same number of files as the degree or some processes may remain idle.	1

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Table 11-3 (Cont.) Common Arguments

Common Argument	Description	Default
-schemas,-s	*<schema>[,...]* - The schema or list of schemas to process. For example: `-schemas schema1,schema2`	For export, schema for the current connection. For import, the default is FULL and all objects in the dump file are imported.
-version,-v	{*<nn.n>* | `COMPATIBLE` | `LATEST`} *<nn.n>*: A specific database version, for example, 11.0.0. When exporting from Oracle Database 11g release 2 (11.2.0.3) or later into an Oracle Database 12 c Release 1 (12.1), specify a value of 12 to allow all existing database features, components, and options to be exported. This applies to a multitenant container database (CDB) or a non-CDB. `COMPATIBLE`: Uses the metadata version from the database compatibility level and the compatibility release level for the feature. `LATEST`: The version of the metadata corresponds to the database version.	COMPATIBLE
-wait,-w	`[TRUE | FALSE]` `TRUE`: Wait for the data pump job to finish and show summary results. `FALSE`: Submit the data pump job without waiting and without showing results.	TRUE

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Table 11-4 Export Only Arguments

Export-Only Arguments	Description	Default
-compression,-cm	{ALL | DATA_ONLY | METADATA_ONLY | NONE} Indicates if compression is needed for user data and metadata. ALL: Compress user data and metadata. DATA_ONLY: Compress only user data. METADATA_ONLY: Compress only metadata. NONE: Do not compress user data or metadata.	METADATA_ONLY
-estimate,-e	{BLOCKS | STATISTICS} Specifies the estimate method for the size of the tables. It should be performed before starting the job. BLOCKS: Estimate is calculated using the count of blocks allocated to the user tables. STATISTICS: Estimate is calculated using the statistics for each table. If no statistics are available for a table, BLOCKS is used.	
-encryption,-en	{ALL | DATA_ONLY | ENCRYPTED_COLUMNS_ONLY | METADATA_ONLY | NONE} Specifying any encryption option will turn on encryption if you do not specify -encryption NONE.	NONE, or ALL if any other encryption option is specified.
-encryptionalgorithm,-ena	{AES128 | AES192 | AES256} Identifies the cryptographic algorithm to use.	AES128
-encryptionmode,-enm	{DUAL | PASSWORD | TRANSPARENT} Identifies the types of security used for encryption and decryption. PASSWORD encrypts the dump files using the provided password. TRANSPARENT enables encryption if the Oracle Encryption Wallet is available. DUAL enables import using the Oracle Encryption Wallet or the password. When using DUAL, -encryptionpassword must be specified.	TRANSPARENT, or PASSWORD if -encryptionpassword is specified.

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Table 11-4 (Cont.) Export Only Arguments

Export-Only Arguments	Description	Default
-filesize,-fs	{<*n*>{B | KB | MB | GB | TB}} Limit for the size of files.	500 MB
-flashbackscn,-fb	[TRUE | FALSE] TRUE: Use consistent database content based on system change number (SCN) at the start time of execution.	FALSE
-reusefile,-r	[TRUE | FALSE] TRUE: Replace existing dump file(s) with a new file.	TRUE

Table 11-5 Import Only Arguments

Import-Only Arguments	Description	Default
-columnencryption,-ce	[TRUE | FALSE] TRUE: Include column encryption clause on table metadata. FALSE Omit column encryption clause.	TRUE if supported by database
-objectid,-oid	[TRUE | FALSE] TRUE: Assign the exported OID. FALSE: Assign a new OID	TRUE
-remapschemas,-rs	*{<oldSchema>=<newSchema>[, …]}* <oldSchema> objects in the job are moved to <newSchema>. Example: oldschema1=newschema1,oldschema2=newschema2.	Not Applicable
-remaptablespaces,-rt	*{<oldTablespace>=<newTablespace>[,…]}* <oldTablespace> storage segment in the job is relocated to <newTablespace>. Example: oldtablespace1=newtablespace1, oldtablespace2=newtablespace2	Not Applicable
-segmentattributes,-sa	[TRUE | FALSE] TRUE: Include segment attributes clauses (physical attributes, storage attributes, tablespace, logging).	TRUE
-skipunusableindexes,-sui	[TRUE | FALSE] TRUE : Rows are inserted into tables having unusable indexes.	TRUE

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Table 11-5 (Cont.) Import Only Arguments

Import-Only Arguments	Description	Default
-storage,-st	`[TRUE | FALSE]` `TRUE`: Include storage clauses.	TRUE
-tableexists,-te	`{APPEND | REPLACE | SKIP | TRUNCATE}` Action to take if table exists during import. `APPEND`: New rows are added to the existing rows in the table. `REPLACE`: Before creating the new table, the old table is dropped. `SKIP`: The preexisting table is left unchanged. `TRUNCATE`: Rows are removed from a preexisting table before inserting rows from the import.	SKIP when `-includemetadata true`, otherwise APPEND action is taken if table exists during import.
-tablecompression,-tc	`[TRUE | FALSE]` `TRUE`: The table compression clause is included if supported. `FALSE`: The table has the default compression for the tablespace.	TRUE

11.3 Use Cases

The following use cases illustrate how to use the `DATAPUMP` command to import and export data.

Use Case 1

Copy tables, views and functions in current schema from database to database.

1. Export the current schema into DATA_PUMP_DIR.
2. Import the schema from DATA_PUMP_DIR.

```
-- Export the current schema into DATA_PUMP_DIR
SQL> connect <db-connect1-string>
SQL> dp export -dumpfile my_dump.dmp -includelist table,view,function

-- Import from DATA_PUMP_DIR
SQL> connect <db-connect2-string>
SQL> dp import -dumpfile my_dump.dmp
```

Use Case 2

Copy current schema from database to Autonomous AI Database. Encryption is done using prompt for password.

1. Set up for Oracle access to Oracle Object Store using an OCI profile.

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2. Export current schema into an encrypted dump file in DATA_PUMP_DIR and copy it to the CS bucket using profile.
3. Import encrypted file from Oracle Object Store using credential.

```
-- Set up for Oracle access to Oracle Object Store using an OCI profile
SQL> oci profile my-profile
SQL> cs https://swiftobjectstorage.us-ashburn-1.oraclecloud.com/v1/abc123/
testing-bucket/

-- Export current schema into an encrypted dump file in DATA_PUMP_DIR and
copy it to the CS bucket using profile
SQL> connect <db-connect-string>
SQL> dp export -copycloud -dumpfile my_dump.dmp -encryptionpassword

-- Import encrypted file from Oracle Object Store using credential
SQL> set cloudconfig <wallet>
SQL> connect <cloud-connect-string>
SQL> dp import -dumpuri /o/my_dump.dmp -encryptionpassword -c SWIFTCRED
```

Use Case 3

Copy multiple schemas from database to Autonomous AI Database with remap schemas.

1. Set up for Oracle access to Oracle Object Store using an OCI profile.
2. Export schemas into database directory and copy to cloud.
3. Import from Oracle Object Store using credential. Remap the schemas.

```
-- Set up for Oracle access to Oracle Object Store using an OCI profile
SQL> oci profile my-profile
SQL> cs https://swiftobjectstorage.us-ashburn-1.oraclecloud.com/v1/abc123/
testing-bucket/

-- Export schemas into database directory and copy to cloud
SQL> connect <db-connect-string>
SQL> dp export -schemas dpumptest1,dpumptest11 -dumpfile DPUMPTEST1_11.DMP -cc

-- Import from Oracle Object Store using credential. Remap the schemas
SQL> set cloudconfig <wallet>
SQL> connect <cloud-connect-string>
SQL> dp import -dumpuri /o/DPUMPTEST1_11.DMP -c SWIFTCRED -rs
dpumptest1=dpumptest2,dpumptest11=dpumptest21
```

Use Case 4

Copy multiple schemas from database to Autonomous AI Database with remap tablespace using OCI profile only.

1. Set up for Oracle access to Oracle Object Store using an OCI profile.
2. Export the current schema into DATA_PUMP_DIR and copy it to the CS bucket using profile.

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3. Copy from Oracle Object Store into directory and import from directory. Remap the tablespace.

```
-- Set up for Oracle access to Oracle Object Store using an OCI profile
SQL> oci profile my-profile
SQL> cs https://swiftobjectstorage.us-ashburn-1.oraclecloud.com/v1/abc123/
testing-bucket/

-- Export the current schema into DATA_PUMP_DIR and copy it to the CS bucket
using profile
SQL> connect <db-connect-string>
SQL> dp export -copycloud

-- Copy from Oracle Object Store into directory and import from directory.
Remap the tablespace.
SQL> set cloudconfig <wallet>
SQL> connect <cloud-connect-string>
SQL> dp import -copycloud -dumpuri /o/ESQL_<n>.DMP -rt DATA=USERS
```

Use Case 5

Copy current schema from database to Autonomous AI Database using parallel processors.

1. Set up for Oracle access to Oracle Object Store using an OCI profile.
2. Export the current schema into DATA_PUMP_DIR and copy all files to the CS bucket using profile.
3. Import from Oracle Object Store using credential.

```
-- Set up for Oracle access to Oracle Object Store using an OCI profile
SQL> oci profile my-profile
SQL> cs https://swiftobjectstorage.us-ashburn-1.oraclecloud.com/v1/abc123/
testing-bucket/

-- Export the current schema into DATA_PUMP_DIR and copy all files to the CS
bucket using profile
SQL> connect <db-connect-string>
SQL> dp export -copycloud -parallel 3 -dumpfile
my_dump1.dmp,my_dump2.dmp,my_dump3.dmp

-- Import from Oracle Object Store using credential
SQL> set cloudconfig <wallet>
SQL> connect <cloud-connect-string>
SQL> dp import -dumpuri /o/my_dump1.dmp,/o/my_dump2.dmp,/o/my_dump3.dmp -c
SWIFTCRED
```

11.4 Tips and Troubleshooting

The `DATAPUMP` command builds PL/SQL that uses the `DBMS_DATAPUMP` package to execute exports and imports.

- Preview the PL/SQL and Parameters
  - Use the `-noexec` option to validate the export or import. This option shows the generated PL/SQL and parameters but does not submit the job for execution.

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- Get additional information about the command processing
  - Use the `-verbose` option to see additional diagnostic information.
  - This option also provides queries that you can copy to view the last line of the log and percentage completed.
- View the job log
  - When using the `-wait` option, the log is written to the console.
  - When using `-wait false`, you can copy the log to object storage if you cannot see files in the directory.
  - When using `-wait false`, you can view the log file with the following code block for Oracle Database release 12.2 and later versions:

    ```
    var c clob;
    set long 32000
    begin select to_clob(BFILENAME('DATA_PUMP_DIR','ESQL_<n>.LOG')) into :c
    from dual; end;
    /
    print c
    ```

- When importing or exporting as the logged-in user, it is recommended not to use the `SYS` role.
- Inserting a row into a table confirms you have quota on the tablespace. If you do not have quota, you see the following error after you run a DATAPUMP command: **ORA-31626: job does not exist**.

  The following code snippet illustrates this problem:

  ```
  *** Error with DataPump command

  grant connect, resource, create session to user1 identified by user1;
  grant read on directory DATA_PUMP_DIR to user1;
  grant write on directory DATA_PUMP_DIR to user1;

  SQL> connect <db-connect-string>
  Connected

  SQL> datapump export -schemas user1

  Datapump Command Start ** at 2022.03.10-15.51.28
  Initiating DATA PUMP
  DATABASE TIME ZONE: VERSION:32 CON_ID:0
  Log
  Location: DATA_PUMP_DIR:ESQL_1614.LOG
  ORA-31626: job does not exist
  ORA-06512: at "SYS.DBMS_SYS_ERROR", line 79
  ORA-06512: at "SYS.DBMS_DATAPUMP", line 1849
  ORA-06512: at "SYS.DBMS_DATAPUMP", line 6869
  ORA-06512: at line 25

  ** Datapump Command End ** at 2022.03.10-15.51.30
  SQL> exit

  ***Resolve Error by Granting Tablespace Quota to User
  Connected to:
  ```


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```
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> alter user user1 quota 128M on users;
Grant succeeded.

SQL> connect <db-connect-string>
Connected.

SQL> datapump export -schemas user1

** Datapump Command Start ** at 2022.03.10-15.54.15
Initiating DATA PUMP
DATABASE TIME ZONE: VERSION:32 CON_ID:0
Log Location: DATA_PUMP_DIR:ESQL_1616.LOG
Starting "USER1"."ESQL_1616":
Processing object type SCHEMA_EXPORT/TABLE/TABLE_DATA
Processing object type SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/
INDEX_STATISTICS
Processing object type SCHEMA_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Processing object type SCHEMA_EXPORT/PRE_SCHEMA/PROCACT_SCHEMA
Processing object type SCHEMA_EXPORT/TABLE/TABLE
Processing object type SCHEMA_EXPORT/TABLE/COMMENT
Processing object type SCHEMA_EXPORT/TABLE/INDEX/INDEX
Master table "USER1"."ESQL_1616" successfully loaded/unloaded
******************************************************************************
***
Dump file set for USER1.ESQL_1616 is:
  /opt/oracle/admin/DB193C/dpdump/D9C3824B6E651CA4E053020014C3358C/
ESQL_1616.DMP
Job "USER1"."ESQL_1616" successfully completed at Thu Mar 10 15:54:52 2022
elapsed 0 00:00:33
DataPump Operation Status 'COMPLETED'
Jobname = ESQL_1616
** Datapump Command End ** at 2022.03.10-15.54.56
```


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12

Using the Cloud Premigration Advisor Tool

The Cloud Premigration Advisor Tool (CPAT) helps you evaluate an existing Oracle database for compatibility with Oracle Autonomous AI Database before migration. CPAT identifies potential user actions, prioritizes their importance, and suggests resolutions. Oracle recommends using CPAT to accelerate your migration to Oracle Cloud.

For more information, see Cloud Premigration Advisor Tool in *Oracle Database Utilities*.

Also, see CPAT Analyzes Databases for Suitability of Cloud Migration (Doc ID 2758371.1) in My Oracle Support.

You can use SQLcl to run CPAT by using the `MIGRATEADVISOR` command.

Topics:

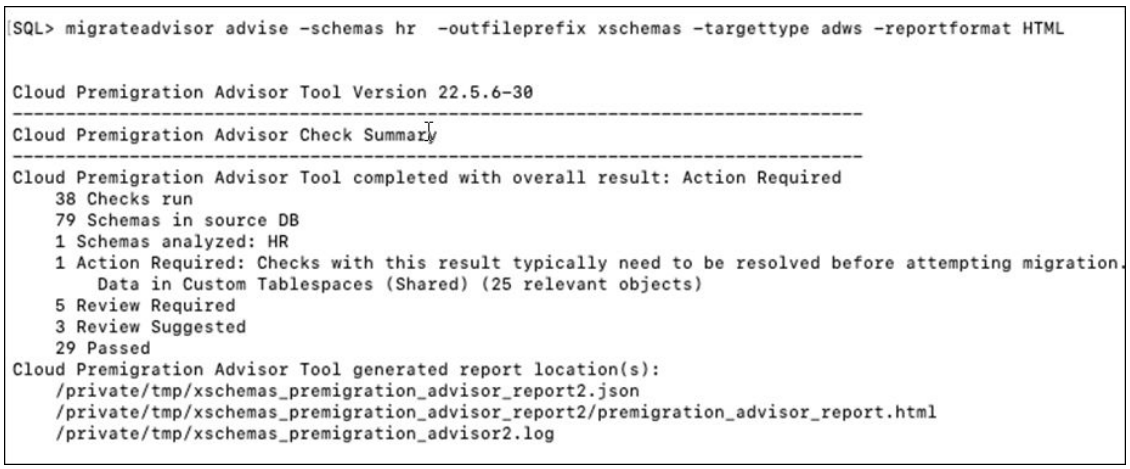
- Overview
- Prerequisites
- About the MIGRATEADVISOR Command
- Examples
- Tips and Troubleshooting

12.1 Overview

Using the `MIGRATEADVISOR` command in SQLcl, you can:

- Analyze an Oracle database to a generic autonomous type or specific instance, and create reports identifying actions recommended for successful migration to Oracle Cloud. A report can be generated in HTML, text or JSON format.
- Optionally, generate a target properties file that will provide more details specific to an autonomous instance.

The following image shows a CPAT report in HTML format.



```
SQL> migrateadvisor advise -schemas hr  -outfileprefix xschemas -targettype adws -reportformat HTML


Cloud Premigration Advisor Tool Version 22.5.6-30
---------------------------------------------------------------------------
Cloud Premigration Advisor Check Summary
---------------------------------------------------------------------------
Cloud Premigration Advisor Tool completed with overall result: Action Required
    38 Checks run
    79 Schemas in source DB
    1 Schemas analyzed: HR
    1 Action Required: Checks with this result typically need to be resolved before attempting migration.
        Data in Custom Tablespaces (Shared) (25 relevant objects)
    5 Review Required
    3 Review Suggested
    29 Passed
Cloud Premigration Advisor Tool generated report location(s):
    /private/tmp/xschemas_premigration_advisor_report2.json
    /private/tmp/xschemas_premigration_advisor_report2/premigration_advisor_report.html
    /private/tmp/xschemas_premigration_advisor2.log
```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CPAT Concepts

The source analysis in CPAT is done generically for different cloud types:

- ATPS (Autonomous Transaction Processing on Shared Infrastructure)
- ATPD (Autonomous Transaction Processing on Dedicated Infrastructure)
- ADWS (Autonomous Data Warehouse on Shared Infrastructure)
- ADWD (Autonomous Data Warehouse on Dedicated Infrastructure)
- Default (Oracle Database)

The source analysis consists of a series of tests that are executed as SQL Statements. The scope of the tests fall into three categories:

- **SCHEMA**: Checks that are only applicable to data within schemas. For example, tables are checked for usage of deprecated and desupported features.
- **INSTANCE**: Checks that are only applicable to the database instance as a whole. For example, certain parameters and values in the `V$PARAMETER` table are checked.
- **UNIVERSAL**: Checks that are always run.

The source analysis can run in FULL mode, SCHEMA MODE or FULL SCHEMA mode.

- **FULL**: (Default) Executes all applicable checks in all appropriate schemas. SCHEMA, INSTANCE, and UNIVERSAL scope checks are executed.
- **SCHEMA**: Executes all applicable checks for schemas specified on the command line and UNIVERSAL checks. INSTANCE scope checks are not executed.
- **SCHEMA FULL**: Executes all applicable checks for schemas specified on the command line and UNIVERSAL and INSTANCE checks.

12.2 Prerequisites

The prerequisites for using the `migrateadvisor` command are:

- Oracle Database 11g Release 2 and later versions are supported.
- The `PROPERTIES` command is available only if the connected user is granted the `SELECT ANY DICTIONARY` privilege.
- The `ADVISE` command is available only if the connected user is granted:
  - the `SELECT ANY DICTIONARY` privilege
  - the `SELECT` privilege to access `SYSTEM.DUM$COLUMNS` and `SYSTEM.DUM$DATABASE`

> **Note**
>
> You need access to the DUM$ tables only if the source and target character sets indicate that Oracle Database Migration Assistant for Unicode (DMU) is needed.

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12.3 About the MIGRATEADVISOR Command

You can run the CPAT command in SQLcl using `ma` or `migrateadvisor`.

This command inclues the following sub-commands:

- **Properties**: Generates a target properties file for Oracle or Autonomous AI Database that provides instance-specific analysis.
- **Advise**: Analyzes the database and produce reports containing information to assist in a successful migration.
- **Info**: Shows version information for CPAT.

Syntax

```
migrateadvisor help [examples|syntax] |
advise {{-targettype,-t} {ATPS|ATPD|ADWS|ADWD|DEFAULT} } [<-optional-
argument>,...] |
properties [<optional-argument>,...] |
info
```

The following table lists the required and optional arguments for `advise`.

Argument	Description	Default
Required		
-targettype,-t	`(ATPS|ATPD|ADWS|ADWD|DEFAULT}` The type of target database to analyze for migration.	None
Optional		

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Argument	Description	Default
-analysisprops,-a	*<propertyFile>* The path and name of a properties file. **Note** The full path is optional. If the full path is not specified, `cd <path>` is used as the root. If `cd <path>` is not specified, then the launch path is used as the root. A properties file that was created using the properties sub-command while connected to the target database.	None
-excludeschemas,-x	*<schema>*[,...] The schema or comma-separated-value list of schemas to exclude from analysis.	None
-full, -f	`[TRUE:FALSE]` Execute the full set of tests.	FALSE when -schemas is not specified, otherwise the default is TRUE

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Argument	Description	Default
-maxrelevantobjects,-m	<*maxRelevantObjects*> The maximum number of "relevant objects" to be included in all reports. This option overrides -maxtextdatarows for TEXT reports.	Include all objects
-maxtextdatarows,-n	<*maxTextDataRows*> Relevant object rows to be included in text reports (does not apply to JSON reports).	-maxrelevantobjects if specified, otherwise all relevant objects are included.
-migrationmethod,-mm	`{DATAPUMP|DATAPUMP_DBLINK|GOLDENGATE}[,...]` A comma-separated-value list of methods or tooling that will be used to do the migration. Example: DATAPUMP, GOLDENGATE	DATAPUMP
-outdir,-o	<*directory*> Identifies location for log and report files.	Current SQLcl directory
-outfileprefix,-p	<*outFilePrefix*> A prefix to the standard base file name of "premigration_advisor_report".	No prefix
-reportformat,-r	`{HTML|JSON|TEXT}[,...]` Specify one or more <reportFormats> where <reportFormat> is HTML, JSON, or TEXT.	HTML
-schemas,-s	<*schema*>[,...] The schema or comma separated value list of schemas to analyze. Example: schema1, schema2	All schemas
-sqltext,-q	Include SQL query used for checks in TEXT reports.	Do not include sql text in TEXT reports. Ignored for JSON reports.
-verbose,-ve	`[TRUE|FALSE]` TRUE shows additional diagnostic output.	FALSE

The following table lists the optional arguments for `properties`.

Argument	Description	Default
-outdir,-o	<*directory*> Identifies location for log and report files.	Current SQLcl directory

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Argument	Description	Default
-outfileprefix,-p	*<outFilePrefix>* A prefix to the standard base file name of "premigration_advisor_report".	No prefix

12.4 Examples

The following examples illustrate how to use the `MIGRATEADVISOR` command.

Example 1

Generate the target properties file for Autonomous AI Database.

```
-- Set default directory
SQL> cd <directory>
-- Connect to target
SQL> set cloudconfig <config-file>
SQL> connect <autonomous-connect-string>
-- Generate the properties file
SQL> migrateadvisor properties -outfileprefix cloud
```

Example 2

Create the HTML Advisor report for a single schema using target properties.

```
-- Set default directory
SQL> cd <directory>
-- Connect to source
SQL> connect <database-connect-string>
-- Generate the report
SQL> migrateadvisor advise -schemas hr -outfileprefix hr -targettype adws -
analysisprops <propertyFile>
```

Example 3

Create the HTML Advisor report for the full database using target properties.

```
-- Set default directory
SQL> cd <directory>
-- Connect to source
SQL> connect <database-connect-string>
-- Generate the report
SQL> migrateadvisor advise -outfileprefix fulldb -targettype adws -
analysisprops <propertyFile>
```

Example 4

Create the JSON Advisor report excluding schemas.

```
-- Set default directory
SQL> cd <directory>
```


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```
-- Connect to source
SQL> connect <database-connect-string>
-- Generate the report
SQL> migrateadvisor advise -excludeschemas hr,sales -outfileprefix xschemas -
targettype adws -reportformat json
```

Example 5

Create the HTML Advisor report for multiple schemas including instance tests.

```
-- Set default directory
SQL> cd <directory>
-- Connect to source
SQL> connect <database-connect-string>
-- Generate the report
SQL> migrateadvisor advise -schemas hr,sales -full -outfileprefix fullmulti -
targettype adws -analysisprops <propertyFile>
```

Example 6

Create HTML Advisor report for a single schema for migration to an Oracle database with target properties.

```
-- Set default directory
SQL> cd <directory>
-- Connect to target
SQL> connect <database-connect-string>
-- Generate the properties file
SQL> migrateadvisor -gettargetproperties -outfileprefix cloud
-- Connect to source
SQL> connect <database-connect-string>
-- Generate the report
SQL> migrateadvisor advise -schemas hr -outfileprefix ora -targettype adws -
analysisprops <propertyFile>
```

12.5 Tips and Troubleshooting

Some points to note are:

- If the source is an Autonomous AI Database, running the `ADVISE` command is not a supported use of CPAT and the result may be unpredictable.
- The `PROPERTIES` and `ADVISE` commands require that the connected user has the `SELECT ANY DICTIONARY` privilege.

  If you do not have the `SELECT ANY DICTIONARY` privilege, you see the following error:

  ```
  SQL> grant connect, resource, unlimited tablespace to jdoe identified by
  jdoe;
  Grant succeeded.

  SQL> connect jdoe/jdoe
  Connected.
  ```


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```
SQL> migrateadvisor advise -schemas hr -outfileprefix pre -targettype adws
-reportformat json

CPAT-1004: SQL error while initializing premigration application.
ORA-00942: table or view does not exist

--Ensure the JDBC connection information is correct. See the log file for
more details.

Additional Information: 255: Internal error - please contact support.
**Exception** : /Users/xyz/pre_premigration_advisor_report.json

Log file contains:
Caused by: Error : 942, Position : 20, Sql = SELECT VERSION FROM
V$INSTANCE,
OriginalSql = SELECT VERSION FROM V$INSTANCE,
Error Msg = ORA-00942: table or view does not exist
```


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13

Using the PGQL Plug-in

Property Graph Query Language (PGQL) is a graph pattern-matching query language for the property graph data model. The PGQL plug-in enables execution and translation of PGQL statements from the command line in SQLcl.

The PGQL plug-in for SQLcl is available with Oracle Graph Server and Client Release 20.3 and later releases.

> **See Also**
>
> Property Graph Query Language for more information about PGQL.

This chapter covers the following topics:

- Downloading and Installing
- About PGQL Commands
- Examples

13.1 Downloading and Installing

You can download the plug-in either from Oracle Software Delivery Cloud (search for "Oracle Graph Server and Client") or from Oracle Graph Server and Client Downloads.

To install the PGQL plug-in for SQLcl, you need to unzip the downloaded plug-in into the `lib/ext/pgql` directory of your local SQLcl installation. Note that you need to create the `pgql` folder in `lib/ext` if it does not already exist.

To upgrade to a newer version of the PGQL plug-in, remove all the files from `lib/ext/pgql` and then unzip the files of the newer version of the plug-in into `lib/ext/pgql`.

13.2 About PGQL Commands

To run PGQL statements against a database, start SQLcl and then turn on PGQL mode by using the following command:

```
pgql auto on;
```

After PGQL mode is turned on, all subsequent SELECT, INSERT, UPDATE, DELETE, CREATE, and DROP statements are considered as PGQL statements.

You can also provide different arguments when turning on PGQL mode:

```
pgql auto on [args]
```


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The possible arguments are:

- `schema <schema_name>`: Make queries run against graphs owned by the specified schema.
- `graph <graph_name>`: Make queries run against the specified graph.
- `execute`: Turn on PGQL execution.
- `executeonly`: Turn on PGQL execution and do not show PGQL-to-SQL translation.
- `translate`: Show PGQL-to-SQL translation.
- `translateonly`: Show PGQL-to-SQL translation and turn off PGQL execution.
- `parallel <parallel>`: Run (or translate) PGQL queries using the specified parallel value.
- `dynamic_sampling <dynamic_sampling>`: Run (or translate) PGQL queries using the specified dynamic sampling value.

By default, the `schema` and `graph` values are not set, PGQL execution is turned on, and PGQL to SQL translation is turned off. The default value for `parallel` is 0, and the default value for `dynamic_sampling` is 6.

To run SQL statements again, turn PGQL mode off:

```
pgql auto off;
```

To reset all parameters to their default values, turn PGQL mode off and then turn on again.

13.3 Examples

This section provides some examples:

- Turn On PGQL Mode
- Create a Property Graph and Execute a Query
- Define a Graph Parameter
- Show SQL Translation Using Parallel Value 2
- Turn Off PGQL Mode

Turn On PGQL Mode

This example turns PGQL mode on. The PGQL prompt appears when PGQL is enabled.

```
SQL> pgql auto on;

PGQL Auto enabled for graph=[null], execute=[true], translate=[false]
PGQL>
```

Create a Property Graph and Execute a Query

This example creates a property graph and executes a query against the newly created "scott_hr" graph.

```
PGQL> CREATE PROPERTY GRAPH scott_hr
  2    VERTEX TABLES (
  3      emp KEY(empno) LABEL Employee
```


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```
  4        PROPERTIES ARE ALL COLUMNS EXCEPT ( deptno ),
  5      dept KEY(deptno) LABEL Department
  6        PROPERTIES ( deptno, dname )
  7    )
  8    EDGE TABLES (
  9      emp AS works_for
 10         KEY(empno)
 11        SOURCE KEY ( empno ) REFERENCES emp
 12        DESTINATION KEY ( deptno ) REFERENCES dept
 13        NO PROPERTIES
 14    )
 15    OPTIONS(PG_PGQL);

Graph created

PGQL> column name format a15;
PGQL> SELECT e.ename AS name
  2  FROM MATCH (e:Employee) ON scott_hr
  3  ORDER by e.ename
  4  LIMIT 4;

NAME
---------------
ADAMS
ALLEN
BLAKE
CLARK
```

Define a Graph Parameter

You can define a `graph` parameter to run all PGQL queries against a particular graph. This example sets `graph` to `scott_hr`. Note that the query does not need an ON clause.

```
PGQL> pgql auto on graph scott_hr;

PGQL Auto enabled for graph=[SCOTT_HR], execute=[true], translate=[false]

PGQL> column department format a20;
PGQL> column employees format a10;
PGQL> SELECT d.dname AS department, COUNT(e) AS employees
  2  FROM MATCH (e:Employee) -[:works_for]-> (d:Department)
  3  GROUP BY d
  4  ORDER BY employees
  5* LIMIT 3;

DEPARTMENT           EMPLOYEES
-------------------- ----------
ACCOUNTING           3
RESEARCH             5
SALES                6
```


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Show SQL Translation Using Parallel Value 2

This example shows the SQL translation of a PGQL query using a parallel value of 2. Note that the SQL translation has a hint using the defined parallel value.

```
SQL> pgql auto on translateonly parallel 2;

PGQL Auto enabled for graph=[null], execute=[false], translate=[true]
PGQL> SELECT id(n) FROM MATCH (n) ON scott_hr;
SELECT /*+ parallel(2) */ * FROM(SELECT 7 AS "id(n)$T",
to_nchar(T0$0.VID,'TM9','NLS_Numeric_Characters=''.,''') AS "id(n)$V",
T0$0.VID AS "id(n)$VN",
to_timestamp_tz(null) AS "id(n)$VT"
FROM "SCOTT".SCOTT_HRVD$ T0$0);
```

Turn Off PGQL Mode

This example shows how to turn PGQL mode off.

```
PGQL> pgql auto off;

PGQL Auto disabled
SQL>
```


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14

SQLcl Command Reference

This chapter covers the following sections:

- AQ (Advanced Queuing)
- AWR
- BACKGROUND
- BLOCKCHAIN_TABLE
- CERTIFICATE
- CODESCAN
- CONNECT
- CONNMGR
- DG (Data Guard)
- DIRS, PUSHD and POPD
- IMMUTABLE_TABLE
- LIQUIBASE
- MDB
- MLE
- MODELER
- PROJECT
- REST
- SDK
- SET *system_variable value*
- SHOW *option*
- SODA

14.1 ANNOTATION

The `annotation` command adds, retrieves, modifies, deletes, and generates metadata annotations for database objects. It also provides commands for managing annotation groups, generating annotation reports, and viewing annotation statistics.

For information about annotations, prerequisites, and workflows for creating and managing annotations, see AI Enrichment Using the Annotation Command.

Syntax

```
annotation <command> [options]
```


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Supported Subcommands

Subcommand	Description
install	Installs the AI Enrichment package in the connected database.
status	Checks whether the AI Enrichment package is installed.
annotation	Adds an annotation to a database object.
get-annotation	Retrieves an existing annotation.
edit-annotation	Modifies the value of an existing annotation.
delete-annotation	Deletes an annotation from a database object.
add-group	Creates an annotation group.
list-groups	Lists annotation groups.
add-to-group	Adds a database object to a group.
remove-from-group	Removes a database object from a group.
delete-group	Deletes a group.
report	Generates a Markdown report of tables and column annotations.
auto-annotate	Uses a configured LLM to generate missing `DESCRIPTION` annotations.
list-tables	Lists tables in the current schema.
stats	Displays annotation statistics.
most-referenced-tables	Lists tables ranked by inbound foreign key references.

14.1.1 Annotation Subcommands

For a description of the options, see the **Add an Annotation** section.

Add an Annotation

This command enables you to add a new annotation to an object. An object can have multiple annotations using different labels.

Syntax

```
annotation annotate
-type <object-type>
-name <object-name>
-label <annotation-label>
-value <annotation-value>
[-debug]
[-verbose]
```

Options

Option	Required	Description
-type <object-type>	Yes	The type of object being annotated. For example, `TABLE` or `TABLE COLUMN`.
-name <object-name>	Yes	The object name. For a table, use the table name. For a table column, use `TABLENAME.COLUMNNAME`.

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Option	Required	Description
-label <annotation-label>	Yes	The annotation label. For example, `DESCRIPTION`.
-value <annotation-value>	Yes	The annotation text stored under the label.
-debug	No	Enables debugging information.
-verbose	No	Enables verbose output.

For a list of object types supported, see Supported Object Types.

Get an Annotation

Use `annotation get-annotation` to read the value of an existing annotation.

Syntax

```
annotation get-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
[-debug]
[-verbose]
```

Edit an Annotation

Use `annotation edit-annotation` to replace the value of an existing annotation.

Syntax

```
annotation edit-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
-value <new-annotation-value>
[-debug]
[-verbose]
```

Delete an Annotation

Use `annotation delete-annotation` to remove an existing annotation from an object by using its label, object name, and object type.

Syntax

```
annotation delete-annotation
-type <object-type>
-name <object-name>
-label <annotation-label>
[-debug]
[-verbose]
```


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14.1.1.1 Supported Object Types

The AI Enrichment extension supports the following object types:

Category	Supported Types
Tables	Table, Table Column, Table Partition, Table Subpartition
Views	View, View Column, Materialized View, Materialized View Column
PL/SQL	Package, Package Procedure, Package Function, Procedure, Function
Other	Database, Schema, Group

14.1.2 Group Subcommands

For a description of the options, see the **Add an Object to a Group** section.

Create a Group

Use `annotation add-group` to create a new group.

Syntax

```
annotation add-group -group <group-name>
[-debug] [-verbose]
```

List Groups

Use `annotation list-groups` to list the groups that have been created.

Syntax

```
annotation list-groups
[-debug] [-verbose]
```

Add an Object to a Group

Use `annotation add-to-group` to add a database object to a group.

Syntax

```
annotation add-to-group -group <group-name>
-type <object-type> -name <object-name>
[-debug] [-verbose]
```

Parameter	Required	Description
-group <group-name>	Yes	The group name.
-type <object-type>	Yes	The type of object being added to the group. For example, `TABLE` or `TABLE COLUMN`.

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Parameter	Required	Description
-name <object-name>	Yes	The object name. For a table, use the table name. For a table column, use `TABLENAME.COLUMNNAME`.

Remove an Object from a Group

Use `annotation remove-from-group` to remove an object from a group.

Syntax

```
annotation remove-from-group -group <group-name>
-type <object-type> -name <object-name>
[-debug] [-verbose]
```

Delete a Group

Use `annotation delete-group` to delete a group.

Syntax

```
annotation delete-group -group <group-name>
[-debug] [-verbose]
```

14.1.3 Auto-Annotate

This command generates `DESCRIPTION` annotations for `TABLE` and `TABLE COLUMN` objects.

Syntax

```
annotation auto-annotate {OPTIONS}
```

Options

Option	Description
-prompt <prompt>	Additional user guidance to consider after the built-in annotation rules.
-prompt-file <prompt-file>	File containing additional user guidance to consider after the built-in annotation rules.
-reference <references>	Provide one or more comma-separated reference files containing business or domain context.
-list <list>	Annotate the specified comma separated list of tables. Table names may include % wildcards.
-ignore-list <ignore-list>	Exclude the specified comma separated list of tables from being annotated. % wildcards are supported.
-debug	Show diagnostic information.
-verbose	Show additional processing information.

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> **Note**
>
> `auto-annotate` generates `DESCRIPTION` annotations only for `TABLE` and `TABLE COLUMN` targets. You can manually add annotations to other supported object types, but `auto-annotate` does not generate annotations for those objects.

14.2 APEXlang

The available commands are:

- generate
- export
- validate
- import

14.2.1 generate

This command generates starter APEXlang application files. The generated application can be modified, validated, and imported into Oracle APEX.

APEX provides starter application template files compatible with the APEXlang compiler for the target APEX version. SQLcl generates these files in the current directory or a specified target directory.

- If files already exist in the target directory, they are overwritten.
- If the `-force` option is used, the existing directory is removed and the files are recreated.

Syntax

```
apex generate {options}
```

Parameters

Parameter	Description
-dir <dir> {PATH}	Specifies the output directory. If omitted, the current working directory is used.
-force	If the directory and files already exist at the specified location, using this parameter will remove all existing directory and files.
-name <name> {STRING}	Specifies the application name to use in the generated application files instead of the default. If provided, the starter application files are updated with this name. If omitted, the default application name from the starter template is used.
-workspaceid <workspaceid> {INTEGER}	Specifies the workspace ID used to retrieve the corresponding workspace name for inclusion in the generated default deployment file. Requires a database connection.

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Parameter	Description
-workspace <workspace> {STRING}	Specifies the workspace name to use for the generate, validate, or import commands when multiple workspaces are available in the current connection. If a workspace ID is also provided, it takes precedence over this option.
-id <id> {INTEGER}	Specifies the application ID to include in the generated default deployment file.
-alias <alias> {STRING}	Specifies the application alias to use in the generated application files instead of the default.
-schema <schema> {STRING}	Specifies the parsing schema to include in the generated default deployment file.

Examples

- Create starter application files in the current directory:

```
apex generate
```

- Create starter application files in a specified directory with a custom name:

```
apex generate -name "Hello World" -dir ./projects
```

14.2.2 export

This command exports an existing Oracle APEX application.

APEXlang is a new export format for generating application source files in APEXlang structure.

This command requires a database connection.

Note the following when exporting in APEXlang format to a location that already contains the source files:

- If the `-force` option is not used, the existing files will be overwritten by the exported files.
- The existing default deployment file is handled differently:
  - It is merged with the exported default deployment file.
  - Existing properties are preserved.
  - Only new properties from the exported file are added.

Syntax

```
apex export -applicationid <id> [options]
```

New Parameters

Parameter	Description
Required -applicationid <applicationid> {INTEGER}	Specifies the application ID to export.

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Parameter	Description
-dir <dir> {PATH}	Specifies the output directory for generated files. If the directory is not specified, it defaults to the current working directory.
-force	If the directory and files already exist at the specified location, using this parameter will remove the existing directory and files. If the `-components` parameter is also used, only the component files will be removed.
-exptype <exptype> {APEXLANG|SQL...}	Specifies the export format: • APEXLANG exports the application as APEXlang source files and directories. • SQL exports the application as a PL/SQL installation script.
-expcomments	Exports developer comments. This option is deprecated for APEX 26.1 and later, as comments are included in exports by default. To exclude comments, use the `disable-exp-comments` option. A warning is displayed if this option is used with APEX 26.1 or later.
-disable-exp-comments	Excludes comments in the export for APEX 26.1 and later. For earlier APEX versions, use the `expcomments` option instead. A warning is displayed if this option is used with APEX versions earlier than 26.1.

Examples

- Export the application to the current directory:

```
apex export -applicationid 105 -exptype APEXLANG
```

- Export the application to the specified directory:

```
apex export -applicationid 105 -dir ./projects
```

14.2.3 validate

This command validates APEXlang source by compiling it and reporting any syntax or compilation errors.

- This command does not require a database connection.
- If no input is specified, the current directory is used.
- Before compilation, the command checks for the presence of APEXlang files.
- If a default or specified deployment file is present, its values are applied during execution and may affect validation.
- The MMD version defined in `.apex/apexlang.json` determines which APEXlang compiler version is used and may affect validation. For more information about the .apex/ directory, see Hidden Configuration Directory.

  If the file or the MMD version property is not found, the latest compiler version is used.

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- If a database connection is available, SQLcl may retrieve additional information from the database to support compilation.

Syntax

```
apex validate [options]
```

Parameters

Parameter	Description
-input <input> {PATH}	Specifies the path to the APEXlang input. This can be a directory, a zip file, or a single APEXlang file containing the entire application. If provided, the specified path is used as input. If omitted, the current directory is used. When using a single file as input, it must contain the entire application.
-workspaceid <workspaceid> {INTEGER}	Specifies the workspace ID to use when multiple workspaces are available in the connection.
-workspace <workspace> {STRING}	Specifies the workspace name to use for the validate or import command when multiple workspaces are available in the current connection. If a workspace ID is also provided, it takes precedence over this option.
-deployment <deployment> {STRING}	Specifies the path to the deployment file to use for import. If only a filename is provided, the file is looked up in the `deployments/` directory within the application context (either the current directory or the specified input path). If a full or relative path is provided, that path is used directly to locate the file.
-debug	Enables debug output. Displays detailed information about values retrieved or read from the deployment file that are used during compilation.

Examples

- Validate using the current directory as input:

  ```
  apex validate
  ```

- Validate a specific directory:

  ```
  apex validate -input ./projects/Brookstrut
  ```

14.2.4 import

The `import` command compiles the APEXlang input and executes the resulting PL/SQL to create or update an APEX application.

- This command requires a database connection.

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- Deployments/default.json is used to store deployment configurations. Some values can be overriden by user-provided SQLcl command options. SQLcl prepends PL/SQL blocks to the compiled output to apply these values during import. For more information, see Attributes Manipulated by APEX_APPLICATION_INSTALL.
  - If deployments/default.json exists in the source input, that will be used by default.
  - If override options are provided (for example, `-workspaceid`, `-applicationid`), they take precedence over the deployment file.
  - If no deployment file is present and insufficient options are provided, some values may be inferred from the database connection.
  - If required information cannot be determined, the command will return an error or prompt for the missing values.
- If no input path is specified, the current directory is used.

Syntax

```
apex import [options]
```

Parameters

Parameter	Description
-input <input> {PATH}	Specifies the path to the APEXlang input. This can be a directory, a zip file, or a single APEXlang file containing the entire application. If provided, the specified path is used as input. If omitted, the current directory is used. When using a single file as input, it must contain the entire application.
-deployment <deployment> {STRING}	Specifies the path to the deployment file to use for import. If only a filename is provided, the file is looked up in the `deployments/` directory within the application context (either the current directory or the specified input path). If a full or relative path is provided, that path is used directly to locate the file.
-debug	Enables debug output. Displays detailed information about values retrieved or read from the deployment file that are used during compilation.

Optional Override Parameters

These parameters override values defined in the deployment file or APEXlang files. They are useful for creating a duplicate of an application for testing or deploying the application to a different workspace.

Parameter	Description
-workspace <workspace> {STRING}	Specifies the workspace name to use for the validate or import command when multiple workspaces are available in the current connection. If a workspace ID is also provided, it takes precedence over this option.

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Parameter	Description
-workspaceid <workspaceid> {INTEGER}	Specifies the APEX workspace ID where the application will be imported. If omitted, the workspace defined in the deployment file is used. If no deployment file or workspace value is available, the workspace is determined from the current database connection.
-id <id> {INTEGER}	Specifies the APEX application ID to use for the import. If omitted, the application ID defined in the deployment file is used. If no deployment file or application ID is available, a new application ID is generated based on the current database connection.
-name <name> {STRING}	Specifies the APEX application name to use for the import. If omitted, the application name defined in the APEXlang code or deployment file is used.
-alias <alias> {STRING}	Specifies the APEX application alias to use for the import. If omitted, the application alias defined in the APEXlang code or deployment file is used.
-schema <schema> {STRING}	Specifies the APEX application schema to use for the import. If omitted, the application schema defined in the APEXlang code or deployment file is used.
-image-prefix <image-prefix> {STRING}	Specifies the APEX application image prefix to use for the import. If omitted, the image prefix defined in the APEXlang code or deployment file is used.
-proxy <proxy> {STRING}	Specifies the APEX application proxy to use for the import. If omitted, the application proxy defined in the APEXlang code or deployment file is used.

Examples

- Import using the current directory as input:

```
apex import
```

- Import the application with overridden values (for example, a different ID and name):

```
apex import -input ./projects/Brookstrut -id 105 -name "Burner App"
```


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14.3 AQ (Advanced Queuing)

The AQ command in SQLcl enables you to access the Oracle Database Advanced Queuing functionality to create queues and queue tables, enqueue and dequeue messages, add and remove subscribers, and manage transactional event queues (TxEventQ).

Prerequisites

This command requires the ADMIN role.

You must have some working knowledge of Advanced Queuing and Transactional Event Queues and be familiar with the concepts, which are explained in the *Oracle Database Advanced Queuing and Transactional Event Queues User's Guide*.

Supported Commands

You can run Advanced Queuing commands in SQLcl using `aq`.

To view the help information for Advanced Queuing, enter `aq help`.

- Create a Queue Table
- Alter a Queue Table
- Drop a Queue Table
- Create a Queue
- Alter a Queue
- Drop a Queue
- Create a Sharded Queue
- Alter a Sharded Queue
- Drop a Sharded Queue
- Create an Exception Queue
- Create a Transactional Event Queue
- Alter a Transactional Event Queue
- Drop a Transactional Event Queue
- Create an EQ Exception Queue
- Start a Queue
- Stop a Queue
- Add a Subscriber
- Alter a Subscriber
- Remove a Subscriber
- Enqueue
- Dequeue

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Example

The following example uses Advanced Queuing commands in SQLcl to create a queue, start the queue, add a subscriber to the queue, enqueue a message and then dequeue it.

```
--Create a queue named demo2 with multiple consumers and payload type JSON
SQL> aq createteq -name demo2 -mul true -pt JSON

--Show the queue properties
SQL> select name, qid, queue_type, enqueue_enabled, dequeue_enabled, sharded,
queue_category, recipients from user_queues;

--Start the queue demo2
SQL> aq startq -name demo2
SQL> select name, qid, queue_type, enqueue_enabled, dequeue_enabled, sharded,
queue_category, recipients from user_queues;

--Add subscriber named Bob to queue demo2
SQL> aq add subscriber -queue demo2 -name bob;

--Enqueue message "hello" to queue demo2
SQL> aq enq -name demo2 -p {"message":"hello"};

--Commit the message (send)
SQL> commit;

--Dequeue from queue demo2 by subscriber named Bob using NEXT_MESSAGE
navigation after waiting for 2 seconds
SQL> aq deq -name demo2 -nav NEXT_MESSAGE -consumer_name bob -wait 2;
```

14.3.1 Create a Queue Table

Syntax

```
AQ CREATE QUEUE TABLE/CREATEQT -n[ame] table_name
  [-pay[load_type] {JSON | RAW | [schema.]type_name}]
  [-sto[rage_clause] string]
  [-sort[_list] string]
  [-mul[tiple_consumers] {NO | YES}]
  [-com[ment] string]
  [-primary[_instance] number]
  [-secondary[_instance] number]
  [-secure {YES | NO}]
  [-repl[ication_mode] {NONE | REPLICATION}]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue table to create.	-
`-payload_type,-pt`	`[OBJECT NAME|TYPE NAME|JSON]` Type of the user data stored.	JSON

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Parameter	Description	Default
`-storage_clause,-sto`	<storage_clause>Storage parameter. The storage parameter is included in the CREATE TABLE statement when the queue table is created. The storage parameter can be made up of any combinations of the following parameters: PCTFREE, PCTUSED, INITRANS, MAXTRANS, TABLESPACE, LOB, and a table storage clause.	NULL
`-sort_list,-sort`	*<sort_list>* The columns to be used as the sort key in ascending order. This parameter has the following format: 'sort_column_1,sort_column_2' The allowed column names are priority, enq_time, and commit_time.	ENQ_TIME
`-multiple_consumers,-mul`	`[TRUE|FALSE]` TRUE: Queues created in the table can only have one consumer for each message. FALSE: Queues created in the table can have multiple consumers for each message.	False
`-comment,-c`	*<comment>* User-specified description of the queue table.	NULL
`-primary_instance,-primary`	*<primary_instance>* The primary owner of the queue table. Queue monitor scheduling and propagation for the queues in the queue table are done in this instance.	0
`-secondary_instance,-secondary`	*<secondary_instance>* The queue table fails over to the secondary instance if the primary instance is not available.	0
`-secure,-sec`	`[TRUE|FALSE]` TRUE: Use the queue table for secure queues. Secure queues are queues for which AQ agents must be associated explicitly with one or more database users.	False
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

14.3.2 Alter a Queue Table

Syntax

```
AQ ALTER QUEUE TABLE/ALTERQT -n[ame] table_name
  [-com[ment] string]
  [-primary[_instance] number]
  [-secondary[_instance] number]
  [-repl[ication_mode] {NONE | REPLICATION}]
```


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Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue table to alter.	-
`-comment,-c`	<*comment*> User-specified description of the queue table.	NULL
`-primary_instance,-primary`	<*primary_instance*> The primary owner of the queue table. Queue monitor scheduling and propagation for the queues in the queue table are done in this instance.	0
`-secondary_instance,-secondary`	<*secondary_instance*> The queue table fails over to the secondary instance if the primary instance is not available.	0
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

14.3.3 Drop a Queue Table

Syntax

```
AQ DROP QUEUE TABLE/DROPQT -n[ame] table_name
  [-for[ce] {NO | YES}]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue table to drop.	-
`-force,-f`	`[TRUE|FALSE]` TRUE: All queues in the table are stopped and dropped automatically. FALSE: The operation does not succeed if there are any queues in the table.	False

14.3.4 Create a Queue

Syntax

```
AQ CREATE QUEUE/CREATEQ -n[ame] queue_name
  -tab[le_name] [schema.]table_name
  [-type {NORMAL | EXCEPTION}]
  [-max[_retries] number]
  [-retry[_delay] number]
  [-retention[_time] number]
  [-com[ment] string]
```


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Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to create.	-
`-table_name,-tab`	`[schema].`<*table_name*> Name of the queue table that will contain the queue.	-
`-type,-t`	`[0:NORMAL QUEUE|1:EXCEPTION QUEUE]` Specifies whether the queue being created is an exception queue or a normal queue.	0:NORMAL QUEUE
`-max_retries,-max`	<*max_retries number*> A message is moved to an exception queue if RETRY_COUNT is greater than MAX_RETRIES. RETRY_COUNT is incremented when the application issues a rollback after executing the dequeue.	5
`-retry_delay,-retry`	<*retry_delay number*> Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	0
`-comment,-c`	<*comment*> User-specified description of the queue table.	NULL
`-retention_time,-rtime`	<*retention_time number*> `[-1:INFINITE]` means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0

14.3.5 Alter a Queue

Syntax

```
AQ ALTER QUEUE/ALTERQ -n[ame] queue_name
  [-max[_retries] number]
  [-retry[_delay] number]
  [-retention[_time] number]
  [-com[ment] string]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to alter.	-

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Parameter	Description	Default
`-max_retries,-max`	*<max_retries number>* A message is moved to an exception queue if RETRY_COUNT is greater than MAX_RETRIES. RETRY_COUNT is incremented when the application issues a rollback after executing the dequeue.	NULL - current value will not be altered.
`-retry_delay,-retry`	*<retry_delay number>* Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	NULL - current value will not be altered.
`-retention_time,-rtime`	*<retention_time number>* `[-1:INFINITE]` means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0
`-comment,-c`	*<comment>* User-specified description of the queue table.	NULL

14.3.6 Drop a Queue

Syntax

```
AQ DROP QUEUE/DROPQ -n[ame] queue_name
```

Parameters

Parameter	Description	Default
`-name,-n`	*<name>* Name of a queue to drop.	-

14.3.7 Create a Sharded Queue

Syntax

```
AQ CREATE SHARDED QUEUE/CREATESQ -n[ame] queue_name
  [-sto[rage_clause] string]
  [-mul[tiple_consumers] {NO | YES}]
  [-max[_retries] number]
  [-com[ment] string]
  [-pay[load_type] {JSON | RAW | [schema.]type_name}]
  [-retry[_delay] number]
  [-retention_time number]
  [-sort[_list] {PRIORITY,ENQ_TIME | ENQ_TIME}]
  [-cache[_hint] {AUTO | UNCACHED | CACHED }]
```


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```
[-retention_type string]
[-repl[ication_mode] NONE]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue table to create.	-
`-storage_clause,-sto`	<storage_clause>Storage parameter. The storage parameter is included in the CREATE TABLE statement when the queue table is created. The storage parameter can be made up of any combinations of the following parameters: PCTFREE, PCTUSED, INITRANS, MAXTRANS, TABLESPACE, LOB, and a table storage clause.	NULL
`-multiple_consumers,-mul`	[TRUE|FALSE] TRUE: Queues created in the table can only have one consumer for each message. FALSE: Queues created in the table can have multiple consumers for each message.	False
`-comment,-c`	<*comment*> User-specified description of the queue table.	NULL
`-payload_type,-pt`	[OBJECT NAME|TYPE NAME|JSON|JMS] Type of the user data stored.	JMS
`-retry_delay,-retry`	<*retry_delay number*> Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	0
`-retention_time,-rtime`	<*retention_time number*> [-1:INFINITE] means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0
`-sort_list,-sort`	<*sort_list*> The columns to be used as the sort key in ascending order. This parameter has the following format: 'sort_column_1,sort_column_2' The allowed column names are priority, enq_time, and commit_time.	PRIORITY,ENQ_TIME
`-cache_hint,-cache`	[1:AUTO|2:CACHED|3:UNCACHED] Specifies a hint to sharded queue whether to cache messages or not. User can specify following: • [1:AUTO]: Message cache does best effort based on available memory. • [2:CACHED]: Message cache will cache messages and give preference to those queues with CACHED hint.	1:AUTO

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Parameter	Description	Default
`-retention_type,-rtype`	`[0: DEQUEUE_TIME]` The retention time starts after a subshard is dequeued by all the subscribers. If a new subscriber seeks back before or to this subshard, then the retention clock is reset.	0:DEQUEUE_TIME
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

14.3.8 Alter a Sharded Queue

Syntax

```
AQ ALTER SHARDED QUEUE/ALTERSQ -n[ame] queue_name
  [-max[_retries] number]
  [-com[ment] string]
  [-retry[_delay] number]
  [-retention_time number]
  [-cache[_hint] {AUTO | UNCACHED | CACHED}]
  [-retention_type string]
  [-repl[ication_mode] NONE]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to alter.	-
`-max_retries,-max`	<*max_retries number*> A message is moved to an exception queue if RETRY_COUNT is greater than MAX_RETRIES. RETRY_COUNT is incremented when the application issues a rollback after executing the dequeue.	NULL - current value will not be altered.
`-comment,-c`	<*comment*> User-specified description of the queue table.	NULL
`-retry_delay,-retry`	<*retry_delay number*> Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	0
`-retention_time,-rtime`	<*retention_time number*> `[-1:INFINITE]` means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0

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Parameter	Description	Default
`-sort_list,-sort`	*<sort_list>* The columns to be used as the sort key in ascending order. This parameter has the following format: 'sort_column_1,sort_column_2' The allowed column names are priority, enq_time, and commit_time.	PRIORITY,ENQ_TIME
`-cache_hint,-cache`	`[1:AUTO|2:CACHED|3:UNCACHED]` Specifies a hint to sharded queue whether to cache messages or not. User can specify following: • [1:AUTO]: Message cache does best effort based on available memory. • [2:CACHED]: Message cache will cache messages and give preference to those queues with CACHED hint.	1:AUTO
`-retention_type,-rtype`	`[0: DEQUEUE_TIME]` The retention time starts after a subshard is dequeued by all the subscribers. If a new subscriber seeks back before or to this subshard, then the retention clock is reset.	0:DEQUEUE_TIME
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

14.3.9 Drop a Sharded Queue

Syntax

```
AQ DROP SHARDED QUEUE/DROPSQ -n[ame] queue_name
  [-for[ce] {NO | YES}]
```

Parameters

Parameter	Description	Default
`-name,-n`	*<name>* Name of a queue table to drop.	-
`-force,-f`	`[TRUE|FALSE]` TRUE: The sharded queue is dropped even if the queue is not stopped. FALSE: The sharded queue is not dropped even if the queue is not stopped.	False

14.3.10 Create an Exception Queue

Syntax

```
AQ CREATE EXCEPTION QUEUE/CREATEEQ -n[ame] queue_name
  -sharded[_queue_name] [schema.]queue_name
```


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Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to create.	NULL
`-sharded_queue_name,-sharded`	`[schema].`<*name*> The name of the sharded queue.	FALSE

14.3.11 Create a Transactional Event Queue

> **Note**
>
> This command is only available for Oracle Database release 21c and later versions.

Syntax

```
AQ CREATE TRANSACTIONAL EVENT QUEUE/CREATETEQ -n[ame] queue_name
  [-sto[rage_clause] string]
  [-mul[tiple_consumers] {NO | YES}]
  [-max[_retries] number]
  [-com[ment] string]
  [-pay[load_type] {JSON | RAW | JMS | [schema.]type_name}]
  [-retry[_delay] number]
  [-retention_time number]
  [-sort[_list] {PRIORITY,ENQ_TIME | ENQ_TIME}]
  [-cache[_hint] {AUTO | UNCACHED | CACHED}]
  [-retention_type string]
  [-repl[ication_mode NONE]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to create.	-
`-storage_clause,-sto`	`<storage_clause>`Storage parameter. The storage parameter is included in the CREATE TABLE statement when the queue table is created. The storage parameter can be made up of any combinations of the following parameters: PCTFREE, PCTUSED, INITRANS, MAXTRANS, TABLESPACE, LOB, and a table storage clause.	NULL
`-multiple_consumers,-mul`	`[TRUE|FALSE]` TRUE: Queues created in the table can only have one consumer for each message. FALSE: Queues created in the table can have multiple consumers for each message.	False

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Parameter	Description	Default
`-max_retries,-max`	*<max_retries number>* A message is moved to an exception queue if RETRY_COUNT is greater than MAX_RETRIES. RETRY_COUNT is incremented when the application issues a rollback after executing the dequeue.	5
`-comment,-c`	*<comment>* User-specified description of the queue table.	NULL
`-payload_type,-pt`	`[OBJECT NAME|TYPE NAME|JSON|JMS]` Type of the user data stored.	JMS
`-retry_delay,-retry`	*<retry_delay number>* Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	0
`-retention_time,-rtime`	*<retention_time number>* `[-1:INFINITE]` means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0
`-sort_list,-sort`	*<sort_list>* The columns to be used as the sort key in ascending order. This parameter has the following format: 'sort_column_1,sort_column_2' The allowed column names are priority, enq_time, and commit_time.	PRIORITY,ENQ_TIME
`-cache_hint,-cache`	`[1:AUTO|2:CACHED|3:UNCACHED]` Specifies a hint to sharded queue whether to cache messages or not. User can specify following: • [1:AUTO]: Message cache does best effort based on available memory. • [2:CACHED]: Message cache will cache messages and give preference to those queues with CACHED hint.	1:AUTO
`-retention_type,-rtype`	`[0: DEQUEUE_TIME]` The retention time starts after a subshard is dequeued by all the subscribers. If a new subscriber seeks back before or to this subshard, then the retention clock is reset.	0:DEQUEUE_TIME
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

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14.3.12 Alter a Transactional Event Queue

> **Note**
>
> This command is only available for Oracle Database release 21c and later versions.

Syntax

```
AQ ALTER TRANSACTIONAL EVENT QUEUE/ALTERTEQ -n[ame] queue_name
  [-max[_retries] number]
  [-com[ment] string]
  [-retry[_delay] number]
  [-retention_time number]
  [-cache[_hint] {AUTO | UNCACHED | CACHED}]
  [-retention_type string]
  [-repl[ication_mode NONE]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to alter.	-
`-max_retries,-max`	<*max_retries number*> A message is moved to an exception queue if RETRY_COUNT is greater than MAX_RETRIES. RETRY_COUNT is incremented when the application issues a rollback after executing the dequeue.	NULL - current value will not be altered.
`-comment,-c`	<*comment*> User-specified description of the queue table.	NULL
`-retry_delay,-retry`	<*retry_delay number*> Delay time, in seconds, before this message is scheduled for processing again after an application rollback.	0
`-retention_time,-rtime`	<*retention_time number*> `[-1:INFINITE]` means the message is retained forever. Number of seconds that a message is retained in the queue table after being dequeued from the queue.	0
`-sort_list,-sort`	<*sort_list*> The columns to be used as the sort key in ascending order. This parameter has the following format: 'sort_column_1,sort_column_2' The allowed column names are priority, enq_time, and commit_time.	PRIORITY,ENQ_TIME

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Parameter	Description	Default
`-cache_hint,-cache`	`[1:AUTO|2:CACHED|3:UNCACHED]` Specifies a hint to sharded queue whether to cache messages or not. User can specify following: • [1:AUTO]: Message cache does best effort based on available memory. • [2:CACHED]: Message cache will cache messages and give preference to those queues with CACHED hint.	1:AUTO
`-retention_type,-rtype`	`[0: DEQUEUE_TIME]` The retention time starts after a subshard is dequeued by all the subscribers. If a new subscriber seeks back before or to this subshard, then the retention clock is reset.	0:DEQUEUE_TIME
`-replication_mode,-repl`	`[0:NONE|1:REPLICATION_MODE]`	0:NONE

14.3.13 Drop a Transactional Event Queue

> **Note**
>
> This command is only available for Oracle Database release 21c and later versions.

Syntax

```
AQ DROP TRANSACTIONAL EVENT QUEUE/DROPTEQ -n[ame] queue_name
  [-for[ce] {NO | YES}]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of a queue to drop.	-
`-force,-f`	`[TRUE|FALSE]` TRUE: The sharded queue is dropped even if the queue is not stopped. FALSE: The sharded queue is not dropped even if the queue is not stopped.	FALSE

14.3.14 Create an EQ Exception Queue

Syntax

```
AQ CREATE EQ EXCEPTION QUEUE/CREATEEQEQ -n[ame] queue_name
  -teq[_queue_name] [schema.]queue_name
```


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Parameters

Parameter	Description	Default
-name,-n	<*name*> Name of a queue to create.	NULL
-teq_queue_name,-teq	[schema].<*name*> The name of the transactional event queue.	FALSE

14.3.15 Start a Queue

Syntax

```
AQ START QUEUE/STARTQ -n[ame] queue_name
  [-enq[ueue] {ENABLE | KEEP}]
  [-deq[ueue] {ENABLE | KEEP}]
```

Parameters

Parameter	Description	Default
-name,-n	<*name*> Name of a queue to enable.	NULL
-enqueue,-enq	[TRUE|FALSE] TRUE: Enable ENQUEUE. FALSE: Do not alter the current setting.	TRUE
-dequeue,-deq	[TRUE|FALSE] TRUE: Enable DEQUEUE. FALSE: Do not alter the current setting.	TRUE

14.3.16 Stop a Queue

Syntax

```
AQ STOP QUEUE/STOPQ -n[ame] queue_name
  [-enq[ueue] {DISABLE | KEEP}]
  [-deq[ueue] {DISABLE | KEEP}]
  [-wait {YES | NO}]
```

Parameters

Parameter	Description	Default
-name,-n	<*name*> Name of a queue to disable.	NULL

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Parameter	Description	Default
-enqueue,-enq	[TRUE|FALSE] TRUE: Enable ENQUEUE. FALSE: Do not alter the current setting.	TRUE
-dequeue,-deq	[TRUE|FALSE] TRUE: Enable DEQUEUE. FALSE: Do not alter the current setting.	TRUE
-wait,-w	[TRUE|FALSE TRUE: Wait if there are any outstanding transactions. FALSE: Return immediately either with a success or an error.	TRUE

14.3.17 Add a Subscriber

Syntax

```
AQ ADD SUBSCRIBER/ADDSUB -n[ame] subscriber_name
  -queue[_name] queue_name
  [-subscriber_address string]
  [-subscriber_protocol number]
  [-rule string]
  [-trans[formation] [schema.]name]
  [-queue_to_queue {NO | YES}] t
  [-mode {PERSISTENT | BUFFERED | PERSISTENT_OR_BUFFERED}]
```

Parameters

Parameter	Description	Default
-name,-n	Name of a producer or consumer of a message.	-
-queue_name,-queue	<*name*> Name of a queue.	-
-subscriber_address,-sa	<*subscriber_address*> Protocol-specific address of the recipient. If the protocol is 0, then the address is of the form [schema.]queue[@dblink]. Name of the queue table that will contain the queue.	""
-subscriber_protocol,-sp	<subscriber_protocol> Protocol to interpret the address and propagate the message.	0

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Parameter	Description	Default
`-rule,-r`	<*rule*> A conditional expression based on the message properties, the message data properties and PL/SQL functions. A rule is specified as a Boolean expression using syntax similar to the WHERE clause of a SQL query. You must prefix each attribute with tab.user_data as a qualifier to indicate the specific column of the queue table that stores the payload.	NULL
`-transformation,-trans`	<*transformation*> Specifies a transformation that will be applied when this subscriber dequeues the message.	NULL
`-queue_to_queue,-q2q`	`[TRUE|FALSE]` TRUE: propagation is from queue-to-queue	FALSE
`-mode,-m`	`[1:PERSISTENT|2:BUFFERED|3:PERSISTENT_OR_BUFFERED]` Delivery mode of the messages the subscriber is interested in.	PERSISTENT

14.3.18 Alter a Subscriber

Syntax

```
AQ ALTER SUBSCRIBER/ALTERSUB -n[ame] subscriber_name
  [-subscriber_address string]
  [-subscriber_protocol number]
  -queue[_name] [schema.]queue_name
  [-rule string]
  [-trans[formation] [schema.]name]
```

Parameters

Parameter	Description	Default
`-name,-n`	Name of a producer or consumer of a message.	-
`-queue_name,-queue`	<*name*> Name of a queue.	-
`-subscriber_address,-sa`	<*subscriber_address*> Protocol-specific address of the recipient. If the protocol is 0, then the address is of the form [schema.]queue[@dblink]. Name of the queue table that will contain the queue.	""
`-subscriber_protocol,-sp`	<subscriber_protocol> Protocol to interpret the address and propagate the message.	0

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Parameter	Description	Default
`-rule,-r`	<*rule*> A conditional expression based on the message properties, the message data properties and PL/SQL functions. A rule is specified as a Boolean expression using syntax similar to the WHERE clause of a SQL query. You must prefix each attribute with tab.user_data as a qualifier to indicate the specific column of the queue table that stores the payload.	NULL
`-transformation,-trans`	<*transformation*> Specifies a transformation that will be applied when this subscriber dequeues the message.	NULL

14.3.19 Remove a Subscriber

Syntax

```
AQ REMOVE SUBSCRIBER/REMOVESUB -n[ame] subscriber_name
  [-subscriber_address string]
  [-subscriber_protocol number]
  -queue[_name] [schema.]queue_name
```

Parameters

Parameter	Description	Default
`-name,-n`	Name of a producer or consumer of a message.	-
`-queue_name,-queue`	<*name*> Name of a queue.	-
`-subscriber_address,-sa`	<*subscriber_address*> Protocol-specific address of the recipient. If the protocol is 0, then the address is of the form [schema.]queue[@dblink]. Name of the queue table that will contain the queue.	""
`-subscriber_protocol,-sp`	<subscriber_protocol> Protocol to interpret the address and propagate the message.	0

14.3.20 Enqueue

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Syntax

```
AQ ENQ[UEUE] -n[ame] queue_name
  {
    -pay[load] payload
    |
    -file[name] name
  }
  [-type {JSON | HEX | BINARY}]

  [-vis[ibility] {ON_COMMIT | IMMEDIATE}]
  [-trans[formation] [schema.]name]
  [-mode {PERSISTENT | BUFFERED}]
  [-pri[ority] priority]
  [-del[ay] delay]
  [-exp[iration] expiration]
  [-corr[elation] string]
  [-rec[ipient_list] agents]
  [-exc[eption_queue] name]
  [-sender[_agent] name]
  [-out_msgid string]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of the queue to which this message should be enqueued.	-
`-payload,-p`	Message payload.	-
`-filename,-file`	File to read the message payload.	-
`-payload_type,-pt`	Payload format type.	JSON
`-visibility,-vis`	Specifies the transactional behavior of the enqueue request. Possible settings are: • [2:ON_COMMIT]: The enqueue is part of the current transaction. The operation is complete when the transaction commits. This setting is the default. • [1: IMMEDIATE]: The enqueue operation is not part of the current transaction, but an autonomous transaction which commits at the end of the operation. This is the only value allowed when enqueuing to a non-persistent queue.	2:ON_COMMIT
`-mode,-m`	`[1:PERSISTENT|2:BUFFERED|3:PERSISTENT_OR_BUFFERED]` Delivery mode of the messages the subscriber is interested in.	PERSISTENT
`-priority,-pri`	Specifies the priority of the message. A smaller number indicates higher priority. The priority can be any number, including negative numbers.	1

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Parameter	Description	Default
-comment,-c	<*comment*> User-specified description of the queue table.	NULL
-delay,-del	The delay represents the number of seconds after which a message is available for dequeuing.	0
-expiration,-exp	It determines, in seconds, the duration the message is available for dequeuing.	-1 - NEVER
-correlation,-corr	Specifies the name of the queue into which the message is moved if it cannot be processed successfully.	-
-sender_id,-sid	The application-sender identification specified at enqueue time by the message producer. Sender name is required for secure queues at enqueue time.	-
-out_message_id,-out_msgid	System generated identification of the message. This is a globally unique identifier that can be used to identify the message at dequeue time. A bind variable can also be used as an input to store the message id. (Example: -out_msgid :xyz)	-

14.3.21 Dequeue

Syntax

```
AQ DEQ[UEUE] -n[ame] queue_name
  [-cons[umer] name]
  {
    -pay[load] payload
    |
    -file[name] name
  }
  [-type {JSON | HEX | BINARY}]
  [-deq[ueue]_mode {REMOVE | BROWSE | LOCKED | REMOVE_NODATA}]
  [-nav[igation {NEXT_MESSAGE | NEXT_TRANSACTION | FIRST_MESSAGE}]
  [-vis[ibility] {ON_COMMIT | IMMEDIATE}]
  [-wait number]
  [-msgid string]
  [-corr[elation] string]
  [-cond[ition] string]
  [-trans[formation] [schema.]name]
  [-mode {PERSISTENT | BUFFERED | PERSISTENT_OR_BUFFERED}]
  [-for[mat_enqueue_time] string]
  [-out_msgid string]
  [-out_pri[ority] number]
  [-out_del[ay] number]
  [-out_exp[iration] number]
  [-out_corr[elation] string]
  [-out_attempts number]
```


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```
[-out_exc[eption_queue] name]
[-out_enqueue_time string]
[-out_state string]
[-out_sender_agent name]
[-out_original_msgid string]
[-out_mode string]
```

Parameters

Parameter	Description	Default
`-name,-n`	<*name*> Name of the queue to which this message should be dequeued.	-
`-payload,-p`	Message payload to be written on the console.	-
`-filename,-file`	File to write the message payload.	-
`-payload_type,-pt`	Payload format type.	JSON
`-consumer_name,-cons`	Only those messages matching the consumer name are accessed. If a queue is not set up for multiple consumers, then this field should be set to NULL.	-
`-dequeue_mode,-dm`	Specifies the locking behavior associated with the dequeue. Possible settings are: • [1: BROWSE] : Read the message without acquiring any lock on the message. This specification is equivalent to a select statement. • [2: LOCKED] : Read and obtain a write lock on the message. The lock lasts for the duration of the transaction. This setting is equivalent to a select for update statement. • [3: REMOVE - DEFAULT] : Read the message and delete it. • [4: REMOVE_NODATA] : Mark the message as updated or deleted. The message can be retained in the queue table based on the retention properties.	-
`-navigation,-nav`	Specifies the position of the message that will be retrieved. Possible settings are: • [1: FIRST_MESSAGE:] : Retrieves the first message which is available and matches the search criteria. • [2: NEXT_TRANSACTION] : Skip the remainder of the current transaction group (if any) and retrieve the first message of the next transaction group. • [3: NEXT_MESSAGE - DEFAULT] : Retrieve the next message that is available and matches the search criteria.	-

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Parameter	Description	Default
`-visibility,-vis`	Specifies the transactional behavior of the enqueue request. Possible settings are: • [2:ON_COMMIT]: The enqueue is part of the current transaction. The operation is complete when the transaction commits. This setting is the default. • [1: IMMEDIATE]: The enqueue operation is not part of the current transaction, but an autonomous transaction which commits at the end of the operation. This is the only value allowed when enqueuing to a non-persistent queue.	2:ON_COMMIT
`-deq_wait,-deq_w`	Specifies the wait time if there is currently no message available which matches the search criteria. Possible settings are: • [-1: FOREVER]: Wait forever. This setting is the default. • [0 : NO_WAIT] : Do not wait. • [x] : Wait time in seconds. (x seconds)	
`-correlation,-corr`	Specifies the name of the queue into which the message is moved if it cannot be processed successfully.	-
`-condition,-con`	A conditional expression based on the message properties, the message data properties, and PL/SQL functions.	-
`-message_id, msg_id`	Specifies the message identifier of the message to be dequeued. A bind variable can also be used as an input (Example: -msgid :xyz).	-
`-transformation,-trans`	*<transformation>* Specifies a transformation that will be applied after dequeuing the message.	NULL
`-mode,-m`	`[1:PERSISTENT|2:BUFFERED|3:PERSISTENT_OR_BUFFERED]` Delivery mode of the messages the subscriber is interested in.	PERSISTENT
`-out_message_id,-out_msgid`	System generated identification of the message. This is a globally unique identifier that can be used to identify the message at dequeue time. A bind variable can also be used as an input to store the message id. (Example: -out_msgid :xyz)	-
`-out_priority,-out_pri`	Priority of the message. A smaller number indicates higher priority. A bind variable can also be used as an input to store the priority. (Example: -out_priority :xyz)	-

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Parameter	Description	Default
-out_delay,-out_del	The delay represents the number of seconds after which a message is available for dequeuing. A bind variable can also be used as an input to store the delay. (Example: -out_delay :xyz)	-
-out_expiration,-out_exp	The duration the message is available for dequeuing. A bind variable can also be used as an input to store the expiration. (Example: -out_expiration :xyz)	-
-out_correlation,-out_corr	Correlation identifier of the message to be dequeued. A bind variable can also be used as an input to store the correlation. (Example: -out_correlation :xyz)	-
-out_attempts,-out_att	Number of attempts made to dequeue the message. A bind variable can also be used as an input to store the attempts. (Example: -out_attempts :xyz)	-
-out_exception_queue,-out_exc	Name of the queue into which the message is moved if it cannot be processed successfully. A bind variable can also be used as an input to store the exception queue (Example: -out_exception_queue :xyz)	-
-out_enqueue_time,-out_eqt	The time the message was enqueued. A bind variable can also be used as an input to store the enqueue time. (Example: -out_enqueue_time :xyz)	-
-out_state,-out_st	State of the message at the time of the dequeue. A bind variable can also be used as an input to store the state (Example: -out_state :xyz)	-
-out_sender_id,-out_sid	The application-sender identification specified at enqueue time by the message producer. A bind variable can also be used as an input to store the sender id (Example: -out_sender_id :xyz)	-
-out_mode,-out_m	The delivery mode of the messages. A bind variable can also be used as an input to store the mode (Example: -out_mode :xyz)	-

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14.4 AWR

The `awr` command creates and retrieves automatic workload repository (AWR) reports for the currently connected instance. These reports provide metrics on the database's workload, performance, and resource usage.

Syntax

```
awr <create_snapshot> | <create_report> | <list_snapshots>
<create_snapshot> := create snapshot (bestfit | lite | typical | all)?
<create_report> := create (html | text) <begin-snapshot-id>
<end-snapshot-id>
<list_snapshots> := list snap[shots]
```

where

<*create_snapshot*>: Creates a new snapshot and prints its id. The optional parameter flush-level of the snapshot are (BESTFIT, LITE, TYPICAL, ALL).

<*create_report*>: Creates a new AWR report and writes it to a file called "AWR-<DB_Name>-<PDB_Name>-<Current Timestamp>.[html|txt]" in the current working directory.

<*begin-snapshot-id*>: Provides the beginning snapshot id for the AWR report. By default, the second last snapshot id is taken if no id has been provided.

<*end-snapshot-id*>: Provides the ending snapshot id for the AWR report. By default, the last snapshot id is taken if no id has been provided.

<*list_snapshots*>: Lists the available snapshots in the database.

14.5 BACKGROUND

The `BACKGROUND` command runs the SQLcl command as a background task.

Syntax

```
background|bg {OPTIONS} <commandspec>
```

where <*commandspec*> is the SQLcl command.

Options

Option	Description
-wait4|-w4 <*wait4*>	List of task names to wait for. See Wait4 Command
-taskname|-tn <*taskname*>	Name of the task. To know the task details, use the Jobs Command.

Examples

```
SQL> background apex list
SQL> background -taskname task3 -wait4 task1,task2 apex list
```


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14.5.1 Jobs Command

The `JOBS` command lists the details of jobs that are running in the background.

Syntax

```
jobs|jb {SUBCOMMAND} {OPTIONS}
```

where SUBCOMMAND can be any of the following:

- Cancel: Cancel a running job.
- Logs: Show job logs.
- Delete: Remove jobs from the list.

Options

Option	Description
-id|-i <*id*>	The id of the task.
-taskname|-tn <*taskname*>	Name of the task.

Examples

```
SQL> jobs -id 2
SQL> jobs logs -id 2
SQL> jobs cancel -id 2
```

14.5.1.1 Cancel Jobs

This command cancels a running job.

Syntax

```
 jobs|jb  cancel|c {OPTIONS}
```

Options

Option	Description
-id|-i <*id*>	The id of the task.
-taskname|-tn <*taskname*>	Name of the task.

Examples

```
SQL> jobs cancel -id 2
```

14.5.1.2 Log Jobs

This command shows the log files for jobs.

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Syntax

```
jobs|jb  logs|l {SUBCOMMAND} {OPTIONS}
```

where SUBCOMMAND is:

`delete|d`: Delete logfiles for completed jobs.

Options

Option	Description
-id|-i <*id*>	The id of the task.
-taskname|-tn <*taskname*>	Name of the task.

Examples

```
SQL> jobs logs -id 2
SQL> jobs logs delete
```

14.5.1.3 Delete Jobs

This command removes jobs from the list. This could be either a a specific job, or all jobs, or only if the job is finished.

Syntax

```
jobs|jb  delete|d {OPTIONS}
```

Options

Option	Description
-id|-i <*id*>	The id of the task.
-taskname|-tn <*taskname*>	Name of the task.
-all|-a	Remove all tasks from the list.
-finished|-f	Only remove finished tasks from the list.

Examples

```
SQL> jobs delete -id 2
```

14.5.2 Wait4 Command

Wait for one or more tasks to finish before continuing the job.

Syntax

```
wait4|w4 {OPTIONS} {PARAMETERS}
```

Options

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Option	Description
-delay|-d <*delay*> (0)	Number of milliseconds to wait before continuing with processing.

Parameters

Option	Description
<*tasknames*>	List of task names to wait for.

Examples

```
SQL> wait4 task1,task3
```

14.6 BLOCKCHAIN_TABLE

This command uses an extension of the `DBMS_BLOCKCHAIN_TABLE` PL/SQL package. A blockchain table is an append-only table designed for centralized blockchain applications. V2 blockchain tables support schema evolution, delegate signatures, and countersignatures in addition to the functionality found in V1 blockchain tables. Blockchain tables support only DER encoding for X.509 certificates, not PEM encoding.

Syntax

```
blockchain_table|bl [add_interval_partitioning|addintpartition] |
[countersign_row|countersign] | desc | [delete_expired_rows|del] |
get_bytes_for_row_hash | get_bytes_for_row_signature | get_digest |
get_signed_digest | [sign_row|sign] |
[sign_row_with_countersignature|signandcountersign] | verify_rows |
verify_table | verify_user_chains
```

The following table provides a description of each sub-command.

Sub-Command	Description
add_interval_partitioning | addintpartition	Adds interval partitioning to an existing, non-partitioned, V1 or V2 blockchain table.
countersign_row | countersign	Procures a countersignature on a specified row in a blockchain table.The countersignature is produced by signing the row data content using the table owner's private key stored in the database wallet.
desc	Describes the details of the blockchain table.
delete_expired_rows | del	Deletes some or all expired rows in the blockchain table.
get_bytes_for_row_hash	Returns in row_data the bytes for the particular row identified (a series of meta-data-value, column-data-value pairs in column position order) followed by the hash for the previous row in the chain in the data format specified.

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Sub-Command	Description
get_bytes_for_row_signature	Returns the bytes used to compute a user signature, a delegate signature, or a countersignature. For a user signature or a delegate signature, the command returns in row_data the bytes in the hash in the row without any metadata.
get_digest	Generates and returns a cryptographic hash of the digest for user-specified rows or for a specified blockchain table.
get_signed_digest	Generates and returns the signed digest for user-specified rows (if specified) in a blockchain table using the table owner's private key stored in the database wallet. The particular rows in the digest are specified by the selector parameter. The default value of this field is NULL. The signed_bytes, signed_row_indexes, and schema_certificate_guid are also returned.
sign_row | sign	Provides a signature by the current user on the row content of a previously inserted row.
sign_row_with_countersignature | signandcountersign	Enables the user to request a countersignature from the database. The countersignature is produced by signing the row data content using the table owner's private key stored in the database wallet. This command is an extension of the SIGN_ROW command
verify_rows	Verifies all rows on all applicable system chains for the integrity of the hash column value for rows created in the range of low_timestamp to high_timestamp. Row signatures can be verified as an option.
verify_table	Verifies all rows whose creation-time falls between the minimum value for the row-creation time from begin_bytes_file and the maximum value for row-creation time from end_bytes_file, and returns the number of successfully verified rows.
verify_user_chains	Verifies rows of one or more user chains when the user chains feature is enabled on the blockchain table.

Example

The following example shows different ways to select rows for operations in a blockchain table.

- Use one of the following commands to select a row using positional parameters (instance id, chain id, sequence id).

```
bl countersign_row -tab <TABLE_NAME> -inst <INSTANCE_ID> -ch <CHAIN_ID> -
seq  <SEQUENCE_ID> -countersignalgo <ALGORITHM> -cscg <CERTIFICATE_GUID> -
```


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```
bytes_file  <PATH_TO_FILE>/countersignBytes.txt -csig
<COUNTERSIGNATURE_VARIABLE>


bl get_bytes_for_row_hash -tab <TABLE_NAME> -inst <INSTANCE_ID> -ch
<CHAIN_ID> -seq <SEQUENCE_ID> -uchain <USER_CHAIN>


bl get_bytes_for_row_signature -tab <TABLE_NAME> -inst  <INSTANCE_ID> -ch
<CHAIN_ID> -seq <SEQUENCE_ID> -row_data_file <PATH_TO_FILE>/test2.txt


bl sign_row -tab <TABLE_NAME> -inst <INSTANCE_ID> -ch <CHAIN_ID> -seq
<SEQUENCE_ID> -row_hash <ROW_HASH> -signature_file <PATH_TO_FILE>/
u1r1_sign.dat -cert_guid <CERTIFICATE_GUID> -algo <ALGORITHM>


bl signandcountersign -tab <TABLE_NAME> -inst <INSTANCE_ID> -ch <CHAIN_ID>
-seq <SEQUENCE_ID> -row_hash <ROW_HASH> -signature_file <PATH_TO_FILE>/
u1r11_sign.dat -cert_guid <CERTIFICATE_GUID> -algo <ALGORITHM>
```

- Use one of the following commands to select a row using key column parameters.

```
blockchain_table countersign_row -tab <TABLE_NAME> -kc1name <COLUMN_NAME> -
kc1val <COLUMN_VALUE> -countersignalgo <ALGORITHM> -cscg
<CERTIFICATE_GUID> -bytes_file <PATH_TO_FILE>/countersignBytes.txt -csig
<COUNTERSIGNATURE_VARIABLE>


bl get_bytes_for_row_hash -table_name <TABLE_NAME> -kc1name <COLUMN_NAME> -
kc1val <COLUMN_VALUE>


bl get_bytes_for_row_signature -tab <TABLE_NAME> -kc1name <COLUMN_NAME> -
kc1val <COLUMN_VALUE> -row_data_file <PATH_TO_FILE>/u1r1.dat


bl sign_row -tab <TABLE_NAME> -kc1name <COLUMN_NAME> -kc1val
<COLUMN_VALUE> -signature_file <PATH_TO_FILE>/u1r2_sign.dat -cert_guid
<CERTIFICATE_GUID> -algo <ALGORITHM>


bl signandcountersign -tab  <TABLE_NAME> -kc1name <COLUMN_NAME> -kc1val
<COLUMN_VALUE> -signature_file <PATH_TO_FILE>/u1r12_sign.dat -cert_guid
<CERTIFICATE_GUID> -algo <ALGORITHM>
```

14.6.1 add_interval_partitioning

Adds interval partitioning to an existing, non-partitioned, V1 or V2 blockchain table.

Syntax

```
blockchain_table|bl add_interval_partitioning|addintpartition {OPTIONS}
```

Options

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Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.
`-interval_number|-intnum <interval_number>`	Specifies the interval number that determines how often the database creates partitions for the blockchain table.
`-interval_frequency|-intfreq <interval_frequency>`	Specifies the interval frequency that determines how frequently the database creates partitions for blockchain tables within a specified interval set by the `interval_number` setting. Supported values are `YEAR, MONTH, DAY, HOUR, MINUTE`.
`-first_high_timestamp|-firsthigh <first_high_timestamp>`	Specifies a timestamp that determines the upper boundary of the first partition in the blockchain table.

Example

Partition the `BCTAB1` blockchain table with a daily frequency, beginning on January 23, 2024, at 12:47:29.

```
bl addintpartition -tab "u1.""bctab1""" -intnum 1 -intfreq "DAY" -firsthigh
"23-JAN-24 12.47.29.182463000"
```

14.6.2 countersign_row

Procures a countersignature on a specified row in a blockchain table.The countersignature is produced by signing the row data content using the table owner's private key stored in the database wallet.

Syntax

```
blockchain_table|bl countersign_row|countersign {OPTIONS}
```

Options

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Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case-sensitive, embedded white space, table and schema name must be entered as `"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.
`-instance_id|-inst <instance_id>`	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
`-chain_id|-ch <chain_id>`	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
`-sequence_id|-seq <sequence_id>`	Specifies the position of the row on the specified chain.
Optional	
`-keycol1_name|-kc1name <keycol1_name>`	Specifies the name of the key column.
`-keycol1_value|-kc1val <keycol1_value>`	Specifies the value of the key column.
`-keycol2_name|-kc2name <keycol2_name>`	Specifies the name of the second column in a composite key.
`-keycol2_value|-kc2val <keycol2_value>`	Specifies the value of the second column in a composite key.
`-keycol3_name|-kc3name <keycol3_name>`	Specifies the name of the third column in a composite key.
`-keycol3_value|-kc3val <keycol3_value>`	Specifies the value of the third column in a composite key.
`-countersignature_algorithm|-countersignalgo <countersignature_algorithm>`	Specifies the cryptographic hash algorithm to use for the countersignature. The default value of this field is `DBMS_BLOCKCHAIN_TABLE.SIGN_ALGO_DEFAULT`. If specified, the parameter must be one of the following acceptable string constants: • `RSA_SHA2_256` • `RSA_SHA2_384` • `RSA_SHA2_512`
`-bytes_file <bytes_file>`	Specifies the name of the file that contains the signed countersignature bytes.

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Option	Description
`-countersignature|-csig <countersignature>`	Specifies the digital signature on the bytes returned in `bytes_file`. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-countersign_cert_guid|-cscg <countersign_cert_guid>`	Specifies a unique identifier for the certificate of the blockchain table owner stored in the database that may be used to verify the countersignature. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-content_version <content_version> ('V2_DIGEST')`	Specifies the version of the data contents and layout that are used as input to the countersignature algorithm. Only `V2_DIGEST` is supported in this release.

Example

Countersign the row in the `BCTAB1` blockchain table where COL1 equals 200.

```
bl countersign -tab u1.bctab1 -kc1name "COL1" -kc1val "200"
```

14.6.3 desc

Describes the details of the blockchain table.

Syntax

```
blockchain_table|bl desc {OPTIONS}
```

Option

Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes.

> **Note**
>
> Case-sensitive, embedded white space, table and schema name should be entered as`"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.

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14.6.4 delete_expired_rows

Deletes some or all expired rows in the blockchain table.

Syntax

```
blockchain_table|bl delete_expired_rows|del {OPTIONS}
```

Options

Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case-sensitive, embedded white space, table and schema name should be entered as:`"""Alp_ha""."""Be $a"""`. The parser parses these values as: `"Alp_ha"."Be $a".`
Optional	
`-before_timestamp|-before <before_timestamp>`	Specifies a timestamp to determine deletion of expired rows. Set this parameter according to the NLS_TIMESTAMP_FORMAT or NLS_TIMESTAMP_TZ_FORMAT. The default value for this parameter is NULL. • If the parameter value is `NULL`, all expired rows in the table are deleted. • If the parameter value is not `NULL` and is older than the timestamp calculated based on the current time and the row retention period, then rows with timestamps earlier than the parameter value are deleted. • If the parameter value is not `NULL` and is more recent than the timestamp calculated based on the current time and row retention period, the calculated timestamp is used, resulting in the deletion of all expired rows.
`-rowcount <rowcount>`	Requests the number of rows deleted. This is an OUT parameter option, used for storing the output value of the command in a bind variable.

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Example

Delete expired rows from the BCTAB1 blockchain table where expiry occurred before January 23, 2024, at 11:00 AM, and store the number of deleted rows in the bind variable row_count.

```
blockchain_table delete_expired_rows -table_name """bcta _b1""" -
before_timestamp 23-JAN-23 11.00.00 AM -rowcount ":count1"
```

14.6.5 get_bytes_for_row_hash

Returns in row_data the bytes for the particular row identified (a series of meta-data-value, column-data-value pairs in column position order) followed by the hash for the previous row in the chain in the data format specified.

Syntax

```
blockchain_table|bl get_bytes_for_row_hash {OPTIONS}
```

Options

Option	Description
Required	
-table_name|-tab <table_name>	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case-sensitive, embedded white space, table and schema name should be entered as:"""Alp_ha""."""Be $a""". The parser parses these values as: "Alp_ha"."Be $a".
-instance_id|-inst <instance_id>	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
-chain_id|-ch <chain_id>	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
-sequence_id|-seq <sequence_id>	Specifies the position of the row on the specified chain.
Optional	

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Option	Description
-data_format|-df <data_format>	Specifies the version of the data layout for the hash in the specified row. Must be 1 in this release. By default, the value of this option is set as 1.
-row_data_file <row_data_file>	Specifies the file in which the generated row_data_bytes are saved.
-user_chain|-uchain <user_chain>	Specifies the name of the user chain when the bytes for the cryptographic hash on the user chain are desired. If the option is not specified, the system chain's cryptographic hash bytes are assumed as the desired output.
-keycol1_name|-kc1name <keycol1_name>	Specifies the name of the key column.
-keycol1_value|-kc1val <keycol1_value>	Specifies the value of the key column.
-keycol2_name|-kc2name <keycol2_name>	Specifies the name of the second column in a composite key.
-keycol2_value|-kc2val <keycol2_value>	Specifies the value of the second column in a composite key.
-keycol3_name|-kc3name <keycol3_name>	Specifies the name of the third column in a composite key.
-keycol3_value|-kc3val <keycol3_value>	Specifies the value of the third column in a composite key.
-pdb_guid <pdb_guid>	Specifies the identifier of the pluggable database that inserted the row for a V2 blockchain table. If specified, restricts attention to system chains inserted by the specified pluggable database. It must be NULL for a V1 blockchain table.

Examples

Retrieve the row hash bytes for the row in the BCTAB1 blockchain table identified by INSTANCE_ID = 1, CHAIN_ID = 27, and SEQUENCE_ID = 2.

```
blockchain_table get_bytes_for_row_hash -tab u1.bcTAB1 -inst 1 -ch 27 -seq 2
```

14.6.6 get_bytes_for_row_signature

Returns the bytes used to compute a user signature, a delegate signature, or a countersignature.

For a user signature or a delegate signature, the command returns in row_data the bytes in the hash in the row without any metadata. No other columns are involved, either in the row or in the previous row. For a countersignature, the routine returns in row_data the bytes that are input to the digital signature algorithm that computes a countersignature on the row.

Syntax

```
blockchain_table|bl get_bytes_for_row_signature {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab [table_name]`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case-sensitive, embedded white space, table and schema name should be entered as:`"""Alp_ha""."Be $a"""`. The parser parses these values as: `"Alp_ha"."Be $a".`
One of the following: instance_id or chain_id and sequence_id or keycol1_name and keycol1_value	
`-instance_id|-inst [instance_id]`	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
`-chain_id|-ch [chain_id]`	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
`-sequence_id|-seq <sequence_id>`	Specifies the position of the row on the specified chain.
`-keycol1_name|-kc1name <keycol1_name>`	Specifies the name of the key column.
`-keycol1_value|-kc1val <keycol1_value>`	Specifies the value of the key column.
Optional	
`-data_format|-df <data_format>`	Specifies the version of the data layout for the hash in the specified row. Must be 1 in this release. By default, the value of this option is set as 1.
`-row_data_file <row_data_file>`	Specifies the file in which the generated `row_data_bytes` are saved.
`-keycol2_name|-kc2name <keycol2_name>`	Specifies the name of the second column in a composite key.
`-keycol2_value|-kc2val <keycol2_value>`	Specifies the value of the second column in a composite key.
`-keycol3_name|-kc3name <keycol3_name>`	Specifies the name of the third column in a composite key.
`-keycol3_value|-kc3val <keycol3_value>`	Specifies the value of the third column in a composite key.
`-pdb_guid <pdb_guid>`	Specifies the identifier of the pluggable database that inserted the row for a V2 blockchain table. If specified, restricts attention to system chains inserted by the specified pluggable database. It must be `NULL` for a V1 blockchain table.

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Option	Description
`-type <type>`	The valid values are `USER`, `DELEGATE`, and `COUNTERSIGNATURE`. `DELEGATE` and `USER` may be used interchangeably. The default value is `USER`.

Examples

Retrieve the row signature bytes for the row in the `BCTAB1` blockchain table where COL1 = 100, and store the output in the row data file `u1r1.dat`.

```
bl get_bytes_for_row_signature -tab u1.bctab1 -kc1name "COL1" -kc1val "100" -
row_data_file <PATH_TO_FILE>/u1r1.dat
```

14.6.7 get_digest

Generates and returns a cryptographic hash of the digest for user-specified rows or for a specified blockchain table.

Syntax

```
blockchain_table|bl get_digest {OPTIONS}
```

Options

Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.
`-digest <digest>`	Specifies the output variable containing the hexadecimal representation of the digest. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
Optional	
`-selector <selector>`	Specifies the condition: A WHERE clause without the `WHERE` keyword.

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Option	Description
`-selector_file <selector_file>`	Specifies the name of the file which stores the condition, a WHERE clause without the `WHERE` keyword.
`-bytes_file <bytes_file>`	Specifies the name of the file that contains the digest.
`-digest_file <digest_file>`	Specifies the name of the file that contains the binary representation of the digest. The digest value contains a header followed by an array of row-info.
`-row_data_file <row_data_file>`	Specifies the file in which the generated `row_data_bytes` are saved.
`-row_indexes_file <row_indexes_file>`	Specifies the name of the file that contains the JSON representation of the type `ORABCTAB_ROW_ARRAY_T`.
`-algorithm|-algo <algorithm>`	Specifies the cryptographic hash algorithm to use. The parameter must be one of the following constants: • `SHA2_256` • `SHA2_384` • `SHA2_512`

Examples

Generate a digest for the rows in the `BCTAB1` blockchain table where COL1 = 100 or COL1 = 400, and store the digest in the file `dig.txt`.

```
blockchain_table get_digest -tab u1.bctab1 -selector "COL1=100 OR COL1=400" -
digest_file <PATH_TO_FILE>/dig.txt
```

14.6.8 get_signed_digest

Generates and returns the signed digest for user-specified rows (if specified) in a blockchain table using the table owner's private key stored in the database wallet.

The particular rows in the digest are specified by the selector parameter. The default value of this field is NULL. The `signed_bytes`, `signed_row_indexes`, and `schema_certificate_guid` are also returned.

Syntax

```
blockchain_table|bl get_signed_digest {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha"".""Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a".`
`-digest <digest>`	Specifies the output variable that contains the hexadecimal representation of the signed digest. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-digest_file <digest_file>`	Specifies the name of the file that contains the binary representation of the signed digest.
Optional	
`-selector <selector>`	Specifies the condition: A WHERE clause without the `WHERE` keyword.
`-selector_file <selector_file>`	Specifies the name of the file which stores the condition, a WHERE clause without the `WHERE` keyword.
`-bytes_file <bytes_file>`	Specifies the name of the file that contains the digest that is signed.
`-row_data_file <row_data_file>`	Specifies the file in which the generated `row_data_bytes` are saved.
`-row_indexes_file <row_indexes_file>`	Specifies the name of the file that contains the JSON representation of the type `ORABCTAB_ROW_ARRAY_T`.
`-cert_guid|-cg <cert_guid>`	Specifies the Global Unique Identifier (GUID) for the certificate. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-algorithm|-algo <algorithm>`	Specifies the cryptographic hash algorithm to use. The default value of this field is `DBMS_BLOCKCHAIN_TABLE.SIGN_ALGO_DEFAULT`. If specified, the parameter must be one of the following package constants: • `RSA_SHA2_256` • `RSA_SHA2_384` • `RSA_SHA2_512`

Examples

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Generate a signed digest for the BCTAB1 blockchain table and store the digest in the bind variable hex.

```
blockchain_table get_signed_digest -table_name u1.bctab1 -digest ":hex"
```

14.6.9 sign_row

This command can be used by the current user to provide a signature on the row content of a previously inserted row. The transaction that inserted the row into the blockchain table must be committed before the SIGN_ROW command is executed.

Syntax

```
blockchain_table|bl sign_row|sign {OPTIONS}
```

Options

Option	Description
Required	
-table_name|-tab <table_name>	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as """Alp_ha"".""Be $a""". The parser parses these values as: "Alp_ha"."Be $a".
-cert_guid|-cg <cert_guid>	Specifies the Global Unique Identifier (GUID) for the certificate.
-instance_id|-inst <instance_id>	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
-chain_id|-ch <chain_id>	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
-sequence_id|-seq <sequence_id>	Specifies the position of the row on the specified chain.

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Option	Description
-signature|-sig <signature>	Specifies the bind variable which holds the hexadecimal representation of the user's digital signature on the hash value stored in the row.
-algorithm|-algo <algorithm>	Specifies the algorithm used to create the digital signature. The parameter must be one of the following acceptable string constants: • RSA_SHA2_256 • RSA_SHA2_384 • RSA_SHA2_512
Optional	
-row_hash <row_hash>	Specifies the expected value of the hash in the row to be signed, if non-Null. If NULL, the hash in the row to be signed is not checked. Default value is NULL.
-signature_file <signature_file>	Specifies the file name which holds the binary representation of the user's digital signature on the hash value stored in the row.
-private_key_for_signature|-prvtkey <private_key_for_signature>	Specifies the private key file used to generate a signature using the signature bytes for a particular row. The generated signature is further used for signing a particular row. The private key is cleared out from memory upon signature generation.
-wallet_path|-wallet <wallet_path>	Specifies the location of the Wallet. If `private_key_for_signature` is not provided, the private key is extracted and used from the wallet at the specified path.
-wallet_password|-walletpw <wallet_password>	Specifies the password for accessing the local wallet. The password is cleared upon use and is not retained. If a local wallet password is not provided, a prompt appears for interactive entry.
-wallet_private_key_alias|-walletpvtkeyalias <wallet_private_key_alias>	Specifies the private key for signature generation. If not specified, the system tries to retrieve the private key associated with the provided CERT_GUID from the local wallet.
-wallet_private_key_password|-walletpvtkeypw <wallet_private_key_password>	Specifies the password required to access the private key stored in the specified wallet_path.
-keycol1_name|-kc1name <keycol1_name>	Specifies the name of the key column.
-keycol1_value|-kc1val <keycol1_value>	Specifies the value of the key column.
-keycol2_name|-kc2name <keycol2_name>	Specifies the name of the second column in a composite key.
-keycol2_value|-kc2val <keycol2_value>	Specifies the value of the second column in a composite key.
-keycol3_name|-kc3name <keycol3_name>	Specifies the name of the third column in a composite key.
-keycol3_value|-kc3val <keycol3_value>	Specifies the value of the third column in a composite key.
-data_format|-df <data_format>	Specifies the version of the data layout for the hash in the specified row. Must be 1 in this release. By default, the value of this option is set as 1.
-pdb_guid <pdb_guid>	Specifies the identifier of the pluggable database that inserted the row for a V2 blockchain table. It must be NULL for a V1 blockchain table.

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Option	Description
`-type <type>`	The valid values for type are `USER` and `DELEGATE`. These values may be used interchangeably. The default value is `USER`.

Examples

Sign the row in the `BCTAB1` blockchain table identified by the bind variables `INSTANCE_ID`, `CHAIN_ID`, and `SEQUENCE_ID`, using the certificate ID in the bind variable `CERTID`, the row hash in `ROWHASH`, and the `RSA_SHA2_512` algorithm.

```
blockchain_table sign_row -tab u1.bctab1 -inst ":instid" -ch ":chainid" -seq
":seqid" -row_hash  ":rowhash" -sig ":signature" -cg ":certid" -algo
"RSA_SHA2_512"
```

14.6.10 sign_row_with_countersignature

Enables the user to request a countersignature from the database.

This command is an extension of the `SIGN_ROW` command. The countersignature is produced by signing the row data content using the table owner's private key stored in the database wallet. A row in a blockchain table can be countersigned only if the row belongs to the current epoch for the blockchain table.

Syntax

```
blockchain_table|bl sign_row_with_countersignature|signandcountersign
{OPTIONS}
```

Options

Option	Description
Required	
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes.

> **Note**
>
> Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.

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Option	Description
One of the following is required: instance_id, or chain_id and sequence_id, or keycol1_name and keycol1_value	
`-instance_id|-inst <instance_id>`	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
`-chain_id|-ch <chain_id>`	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
`-sequence_id|-seq <sequence_id>`	Specifies the position of the row on the specified chain.
`-keycol1_name|-kc1name <keycol1_name>`	Specifies the name of the key column.
`-keycol1_value|-kc1val <keycol1_value>`	Specifies the value of the key column.
One of the following: signature, or signature_file, or private_key_for_signature, or wallet_path	
`-signature|-sig <signature>`	Specifies the bind variable which holds the hexadecimal representation of the user's digital signature on the hash value stored in the row.
`-signature_file <signature_file>`	Specifies the file name which holds the binary representation of the user's digital signature on the hash value stored in the row.
`-private_key_for_signature|-prvtkey <private_key_for_signature>`	Specifies the private key file used to generate signature using the signature bytes for a particular row. The generated signature is further used for signing a particular row. The private key is cleared out from memory upon signature generation.
`-wallet_path|-wallet <wallet_path>`	Specifies the location of the local wallet.
`-cert_guid|-cg <cert_guid>`	Specifies the Global Unique Identifier (GUID) for the certificate.
`-algorithm|-algo <algorithm>`	Specifies the algorithm used to create the digital signature. The parameter must be one of the following acceptable string constants: • `RSA_SHA2_256` • `RSA_SHA2_384` • `RSA_SHA2_512`
Optional	
`-row_hash <row_hash>`	Specifies the expected value of the hash in the row to be signed, if `non-Null`. If `NULL`, the hash in the row to be signed is not checked. Default value is `NULL`.
`-wallet_password|-walletpw <wallet_password>`	Specifies the password for accessing the local wallet. The password is cleared upon use and is not retained. If a local wallet password is not provided, a prompt appears for interactive entry.
`-wallet_private_key_alias|-walletpvtkeyalias <wallet_private_key_alias>`	Specifies the private key for signature generation. If not specified, the system tries to retrieve the private key associated with the provided `CERT_GUID` from the local wallet.
`-wallet_private_key_password|-walletpvtkeypw <wallet_private_key_password>`	Specifies the password required to access the private key stored in the specified `wallet_path`.
`-keycol2_name|-kc2name <keycol2_name>`	Specifies the name of the second column in a composite key.

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Option	Description
-keycol2_value|-kc2val <keycol2_value>	Specifies the value of the second column in a composite key.
-keycol3_name|-kc3name <keycol3_name>	Specifies the name of the third column in a composite key.
-keycol3_value|-kc3val <keycol3_value>	Specifies the value of the third column in a composite key.
-data_format|-df <data_format>	Specifies the version of the data layout for the hash in the specified row. Must be 1 in this release. By default, the value of this option is set as 1.
-type <type>	The valid values for type are USER and DELEGATE. These values may be used interchangeably. The default value is USER.
-countersignature_algorithm|-countersignalgo <countersignature_algorithm>	Specifies the cryptographic hash algorithm to use for the countersignature. The default value of this field is DBMS_BLOCKCHAIN_TABLE.SIGN_ALGO_DEFAULT. If specified, the parameter must be one of the following acceptable string constants: • RSA_SHA2_256 • RSA_SHA2_384 • RSA_SHA2_512
-bytes_file <bytes_file>	Specifies the name of the file that contains the signed countersignature bytes.
-countersignature|-csig <countersignature>	Specifies the digital signature on the bytes returned in bytes_file. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
-countersign_cert_guid|-cscg <countersign_cert_guid>	Specifies a unique identifier for the certificate of the blockchain table owner stored in the database that may be used to verify the countersignature. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
-content_version <content_version>	Specifies the version of the data contents and layout that are used as input to the countersignature algorithm. Only V2_DIGEST is supported in this release.
-pdb_guid <pdb_guid>	Specifies the identifier of the pluggable database that inserted the row for a V2 blockchain table. It must be NULL for a V1 blockchain table.

Examples

- Sign and countersign the row in the U1.BCTAB1 blockchain table identified by the bind variables :INST_ID, :CHAIN_ID, and :SEQ_ID, using the row hash :ROWHASH, the certificate ID :CERT_ID2, and the RSA_SHA2_512 algorithm. The signature is generated using the content from the file u1r11_sign.dat.

  ```
  bl signandcountersign -tab u1.bctab1 -inst ":inst_id" -ch ":chain_id" -seq
  ":seq_id" -row_hash ":row_hash" -signature_file
  <PATH_TO_FILE>/u1r11_sign.dat -cert_guid ":cert_id2" -algo "RSA_SHA2_512"
  ```

- Perform signature and countersignature on the row in the U1.BCTAB1 blockchain table identified by :INST_ID,:CHAIN_ID, and :SEQ_ID, using the row hash :ROWHASH, signer certificate ID :CERT_ID2, and returns the countersigner certificate ID :CERT_GUID used for

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countersignature. The RSA_SHA2_512 algorithm is used for both signing and countersigning. The signature is generated using the file u1r11_sign.dat, and the countersignature is provided in hex format using :CSIG and the binary format using countersignBytes.txt.

```
blockchain_table sign_row_with_countersignature -tab u1.bctab1 -inst
":inst_id" -ch ":chain_id" -seq ":seq_id" -row_hash ":row_hash" -
signature_file
<PATH_TO_FILE>/u1r11_sign.dat -cert_guid ":cert_id2" -algo "RSA_SHA2_512" -
cscg ":cert_guid" -bytes_file <PATH_TO_FILE>/countersignBytes.txt -csig
":csig"
-countersignalgo "RSA_SHA2_512"
```

- Sign and countersign the row in the U1.BCTAB1 blockchain table where COL1 = 1200, using the certificate ID :CERT_ID2 and the RSA_SHA2_512 algorithm. The signature is generated from the file u1r12_sign.dat.

```
bl signandcountersign -tab u1.bctab1 -kc1name "COL1" -kc1val "1200" -
signature_file <PATH_TO_FILE>/u1r12_sign.dat -cert_guid ":cert_id2" -algo
"RSA_SHA2_512"
```

14.6.11 verify_rows

Verifies all rows on all applicable system chains for the integrity of the hash column value for rows created in the range of low_timestamp to high_timestamp. Row signatures can be verified as an option. An appropriate exception is triggered if the integrity of chains is compromised.

Syntax

```
blockchain_table|bl verify_rows {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha"".""Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.
Optional	
`-low_timestamp|-low <low_timestamp>`	Specifies the low end of the time range. If specified, the low end of the time range is used for verifying rows. The default value is `NULL`. Use double quotes to enclose the value. **Note** The `low_timestamp` should be specified as per the NLS_TIMESTAMP_FORMAT or NLS_TIMESTAMP_TZ_FORMAT.
`-high_timestamp|-high <high_timestamp>`	. Specifies the high end of the time range. If specified, the high end of the time range is used for verifying rows. The default value is `NULL`. Use double quotes to enclose the value. **Note** The `high_timestamp` should be specified as per the NLS_TIMESTAMP_FORMAT or NLS_TIMESTAMP_TZ_FORMAT.

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Option	Description
`-instance_id|-inst <instance_id>`	Specifies the instance that inserted the row. If specified, this limits the operation to rows inserted by the given instance.
`-chain_id|-ch <chain_id>`	Specifies the chain containing the row. If specified, this limits operation to rows assigned to the specified chain. By default, there are 32 chains in each instance, and they are numbered from 0 to 31.
`-rowcount <rowcount>`	Specifies the number of rows verified. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-skip_user_signature|-skipuser`	Specifies true or false for `SKIP_USER_SIGNATURE`. The default value is `FALSE`. • If `SKIP_USER_SIGNATURE` is specified (set to true), the blockchain `verify_rows` SQLcl command bypasses the validation of user signature if it is present on any row. • If `SKIP_USER_SIGNATURE` is not specified (set to false), the hash and user signature are both verified for any row if they are present, otherwise only the hash is verified.
`-skip_delegate_signature|-skipdlg`	Specifies true or false for `SKIP_DELEGATE_SIGNATURE`. The default value is `FALSE`. • If `SKIP_DELEGATE_SIGNATURE` is specified (set to true), the blockchain `verify_rows` SQLcl command bypasses the validation of delegate signature if it is present on any row. • If `SKIP_DELEGATE_SIGNATURE` is not specified (set to false), the hash and delegate signature are both verified for any row if they are present, otherwise only the hash is verified.
`-skip_countersignature|-skipctr`	Specifies true or false for `SKIP_COUNTERSIGNATURE`. The default value is `FALSE`. • If `SKIP_COUNTERSIGNATURE` is specified (set to true), the blockchain `verify_rows` SQLcl command bypasses the validation of countersignature if it is present on any row. • If `SKIP_COUNTERSIGNATURE` is not specified (set to false), the hash and countersignature are both verified for any row if they are present, otherwise only the hash is verified.
`-pdb_guid <pdb_guid>`	Specifies the identifier of the pluggable database that inserted the rows for a V2 blockchain table. It must be `NULL` for a V1 blockchain table.

Examples

Verify the integrity of all rows in the `BCTAB1` blockchain table.

```
blockchain_table verify_rows -table_name u1.bctab1
```


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14.6.12 verify_table

Verifies signatures and system chains for all rows where the creation time falls between the minimum value for the row-creation time from `begin_bytes_file` and the maximum value for row-creation time from `end_bytes_file`. The `OUT` parameter row count returns the number of successfully verified rows.

Syntax

```
blockchain_table|bl verify_table {OPTIONS}
```

Options

Option	Description
Required	
`-end_bytes_file <end_bytes_file>`	Specifies a digest populated by a call to either PL/SQL API's (`GET_SIGNED_BLOCKCHAIN_DIGEST`, `GET_SIGNED_BLOCKCHAIN_DIGEST_FOR_SELECTED_ROWS`, `GET_BLOCKCHAIN_DIGEST`, or `GET_BLOCKCHAIN_DIGEST_FOR_SELECTED_ROWS`) or by executing SQLcl command (blockchain_table get_digest or get_signed_digest command).
`-begin_bytes_file <begin_bytes_file>`	Specifies a digest populated by a call to either PL/SQL API's (`GET_SIGNED_BLOCKCHAIN_DIGEST`, `GET_SIGNED_BLOCKCHAIN_DIGEST_FOR_SELECTED_ROWS`, `GET_BLOCKCHAIN_DIGEST`, or `GET_BLOCKCHAIN_DIGEST_FOR_SELECTED_ROWS`) or by executing SQLcl command (blockchain_table get_digest or get_signed_digest command) before the `end_bytes_file` is populated.
Optional	
`-rowcount <rowcount>`	Specifies the number of rows verified. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-skip_user_signature|-skipuser`	Specifies true or false for `SKIP_USER_SIGNATURE`. The default value is `FALSE`. • If `SKIP_USER_SIGNATURE` is specified (set to true), the blockchain `verify_table` SQLcl command bypasses the validation of user signature if it is present on any row. • If `SKIP_USER_SIGNATURE` is not specified (set to false), the hash and user signature are both verified for any row if they are present, otherwise only the hash is verified.

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Option	Description
`-skip_delegate_signature|-skipdlg`	Specifies true or false for `SKIP_DELEGATE_SIGNATURE`. The default value is `FALSE`. • If `SKIP_DELEGATE_SIGNATURE` is specified (set to true), the blockchain `verify_table` SQLcl command bypasses the validation of delegate signature if it is present on any row. • If `SKIP_DELEGATE_SIGNATURE` is not specified (set to false), the hash and delegate signature are both verified for any row if they are present, otherwise only the hash is verified.
`-skip_countersignature|-skipctr`	Specifies true or false for `SKIP_COUNTERSIGNATURE`. The default value is `FALSE`. • If `SKIP_COUNTERSIGNATURE` is specified (set to true), the blockchain `verify_table` SQLcl command bypasses the validation of countersignature if it is present on any row. • If `SKIP_COUNTERSIGNATURE` is not specified (set to false), the hash and countersignature are both verified for any row if they are present, otherwise only the hash is verified.

Examples

Verify the digests defined by the end bytes file `latest.txt` and the begin bytes file `prev1.txt`, and store the count of verified rows in the bind variable `rowcount`.

```
blockchain_table verify_table -end_bytes_file <PATH_TO_FILE>/latest.txt -
begin_bytes_file <PATH_TO_FILE>/prev1.txt -rowcount ":temp"
```

14.6.13 verify_user_chains

Verifies rows of one or more user chains when the user chains feature is enabled on the blockchain table.

Syntax

```
blockchain_table|bl verify_user_chains {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the blockchain table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as : `"""Alp_ha"".""Be $a"""`. The parser parses these values as: `"Alp_ha"."Be $a".`
`-user_chain|-uchain <user_chain>`	Specifies the name of the row version given when the blockchain table was created.
Optional	
`-rowcount <rowcount>`	Specifies the number of rows verified. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
`-keycol1_value|-kc1val <keycol1_value>`	Specifies the value of the key column.
`-keycol2_value|-kc2val <keycol2_value>`	Specifies the value of the second column in a composite key.
`-keycol3_value|-kc3val <keycol3_value>`	Specifies the value of the third column in a composite key.
`-low_timestamp|-low <low_timestamp>`	Specifies the low end of the time range. If specified, the low end of the time range is used for verifying rows. The default value is `NULL`. Use double quotes to enclose the value. **Note** The `low_timestamp` should be specified as per NLS_TIMESTAMP_FORMAT or NLS_TIMESTAMP_TZ_FORMAT.

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Option	Description
`-high_timestamp|-high <high_timestamp>`	Specifies the high end of the time range. If specified, the high end of the time range is used for verifying rows. The default value is `NULL`. Use double quotes to enclose the value. **Note** The `high_timestamp` should be specified as per NLS_TIMESTAMP_FORMAT or NLS_TIMESTAMP_TZ_FORMAT.
`-skip_user_signature|-skipuser`	Specifies true or false for `SKIP_USER_SIGNATURE`. The default value is `FALSE`. • If `SKIP_USER_SIGNATURE` is specified (set to true), the blockchain `verify_user_chains` SQLcl command bypasses the validation of user signature if it is present on any row. • If `SKIP_USER_SIGNATURE` is not specified (set to false), the hash and user signature are both verified for any row if they are present, otherwise only the hash is verified.
`-skip_delegate_signature|-skipdlg`	Specifies true or false for `SKIP_DELEGATE_SIGNATURE`. The default value is `FALSE`. • If `SKIP_DELEGATE_SIGNATURE` is specified (set to true), the blockchain `verify_user_chains` SQLcl command bypasses the validation of delegate signature if it is present on any row. • If `SKIP_DELEGATE_SIGNATURE` is not specified (set to false), the hash and delegate signature are both verified for any row if they are present, otherwise only the hash is verified.
`-skip_countersignature|-skipctr`	Specifies true or false for `SKIP_COUNTERSIGNATURE`. The default value is `FALSE`. • If `SKIP_COUNTERSIGNATURE` is specified (set to true), the blockchain `verify_user_chains` SQLcl command bypasses the validation of countersignature if it is present on any row. • If `SKIP_COUNTERSIGNATURE` is not specified (set to false), the hash and COUNTERSIGNATURE are both verified for any row if they are present, otherwise only the hash is verified.
`-pdb_guid <pdb_guid>`	Specifies the identifier of the pluggable database that inserted the rows for a V2 blockchain table. It must be `NULL` for a V1 blockchain table.

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Examples

Verify the rows of BCTAB1_COL2 user chain in the BCTAB1 blockchain table.

```
bl verify_user_chains -tab u1.bctab1 -uchain "bctab1_col2"
```

14.7 CERTIFICATE

Use the certificate command to add and delete X.509 certificates. This command uses an extension of the DBMS_USER_CERTS PL/SQL package. The DBMS_USER_CERTS PL/SQL package uses ADD_CERTIFICATE and DROP_CERTIFICATE subprograms to add and delete X.509 certificates which are used for signature verification for blockchain tables by the current user.

The sub-commands are:

- Add
- Add_Copy
- Drop
- List

14.7.1 Add

Adds an X.509 certificate.

> **Note**
>
> - Pass the full path of the cert_file on the client machine.
> - The certificates should be present on the client machine.

Syntax

```
certificate add {OPTIONS}
```

Options

Option	Description
Required	
-cert_file | -cf <cert_file>	Specifies the X.509 certificate (saved as a file) used for signature verification of blockchain tables.
Optional	
-cert_guid | -cg <cert_guid>	Specifies the Global Unique Identifier (GUID) for the certificate. This is an OUT parameter option, used for storing the output value of the command in a bind variable.
-wallet_path | -wallet <wallet_path>()	Specifies the location of the wallet. If `cert_file` is not provided, the certificate is extracted from the specified wallet and added to the user_certs$ table.

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Option	Description
`-wallet_password | -walletpwd <wallet_password>()`	Specifies the password of the local wallet. The password is removed upon use and is not retained. If a wallet password is not provided, then you are prompted to enter the password.
`-wallet_certificate_alias |-walletcertalias <wallet_certificate_alias>()`	Specifies the alias of the certificate to be added.

Example

```
SQL> certificate add -cf <PATH_TO_FILE>/u2_cert.der
```

14.7.2 Add_Copy

Copies an X.509 certificate from one pluggable database to another while retaining its original GUID.

> **Note**
>
> - Pass the full path of the cert_file on the client machine.
> - The certificates should be present on the client machine.

Syntax

```
certificate add_copy {OPTIONS}
```

Options

Option	Description
Required	
`-cert_file | -cf <cert_file>`	Specifies the X.509 certificate (saved as a file) used for signature verification of blockchain tables.
`-cert_guid | -cg <cert_guid>`	Specifies the Global Unique Identifier (GUID) for the certificate.
Optional	
`-username | -uname <username>`	Specifies the user name. If specified, the certificate is added to the schema associated with the mentioned user name.

Example

```
SQL> certificate add_copy -cf <PATH_TO_FILE>/u2_cert.der -cg <ORIGINAL_GUID> -
uname "u1"
```


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14.7.3 Drop

Drops a certificate. This is used for signature verification of blockchain tables.

Syntax

```
certificate drop {OPTIONS}
```

Options

Option	Description
Required	
`-cert_guid | -cg <cert_guid>`	Specifies the Global Unique Identifier (GUID) for the certificate.

Example

```
SQL> certificate drop -cg ":cg"
```

14.7.4 List

Lists all previously added certificates that can be used for signature verification of blockchain tables.

Syntax

```
certificate list|ls
```

Example

```
SQL> certificate list
```

14.8 CODESCAN

Identifies issues with the code using the Trivadis Coding Guidelines, which is available on GitHub.

Syntax

```
codescan { -path dir | -format {json|text} | -ignore ruleNo | -output file | -
settings file }
```

where

- `-path` checks SQL, PLS and PLB files in the directory for SQL Best Practice violations and generates a report of the issues found.

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- `-format` formats the output as structured JSON. For example:

```
[ {"file": "/private/tmp/tst.sql", "warnings": [
                {line:35, pos:15, ruleNo:"G-1050",
                 msg:"Avoid using literals in your code" },...]... ].
```

- `-output` saves the report in a new file.
- `-ignore` skips specified rule checks.
- `-settings` imports CODESCAN settings from the JSON file. Currently, only the ignore attribute is supported, example, `{"ignored":["G-1050", "G-4010"]}`.

Set Codescan

Controls warning messages that are triggered for SQLcl command line code quality issues.

Syntax

```
set codescan {ON | OFF}
```

where `ON` turns on warnings for SQL and PL/SQL best practice violations. The default is `OFF`.

Example

```
SQL>set codescan on
SQL>BEGIN
    BEGIN
        null;
    END;
 END;
/

SQL best practice warning (1,7): G-1010: Try to label your sub blocks

PL/SQL procedure successfully completed.
```

14.9 CONNECT

Connection types in SQLcl:

- KERBEROS
- NAME
- OCI
- ORACLE
- OREST
- RADIUS
- SOCKS
- THIRD
- WALLET

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14.9.1 KERBEROS Connection Type

Connect to a database using Kerberos authentication. The connection spec parameter has the following form:

```
[/][@<url>]
```

> **Note**
>
> Only Kerberos connections using [/][@<url>] are supported in SQLcl. Active Directory is not supported.

See Enabling Kerberos Authentication in *Oracle Database Security Guide* for more information about Kerberos authentication in Oracle Database.

Options

Option	Description
-kerberos, ker	Specifies a KERBEROS connection type.
-krb5_config, krb5c	Specifies a non-default Kerberos configuration file. This property is specified only when SQLcl is started. These can be passed in by using the relevant -D system property name or environmental variables.
-krb5ccname, krb5cc	Specifies a non-default Kerberos credential file.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Example

To connect to a database using KERBEROS:

```
SQL> CONNECT -kerberos /@myhost:1521/myservice
```

See Also:

Support for Kerberos for troubleshooting information

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14.9.2 NAME Connection Type

Connect to a database using a stored connection definition. Stored connections are identified using a unique connection name. For more information about stored connections, see CONNMGR.

Options

Option	Description
-name, n	Specifies a connection type using a stored connection definition.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Examples

To connect using a stored connection:

```
SQL> CONNECT -name my_connection
```

To connect using a stored connection as a different user:

```
SQL> CONNECT -name myuser/mypassword@my_connection
```

or

```
SQL> CONNECT -name myuser@my_connection
```

14.9.3 OCI Connection Type

Connect to a database using OCI. Before connecting to OCI, it is necessary to specify the profile to use. For example, `OCI PROFILE frankfurt`.

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Options

Option	Description
-oci	Specifies an OCI connection type.
-rest, rt	Specifies that the connection should be established using REST.
-proxy, p	Specifies the network proxy to use.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<ocid>	Provides the OCID of a connection definition in the OCI Database Tools Service. It has the following format: `ocid1.databasetoolsconnection.<id>` When connecting with the `ocid` parameter, the `-oci` flag is optional.
<display_name>	Provides the display name of a connection definition in the OCI Database Tools Service. When connecting with the `display_name` parameter, the `-oci` flag is required. **Note** Unlike OCIDs, display names don't have to be unique. If more than one Database Tools Connection is available with the name you specify, you'll see an error.

Example 1

Connecting using the `ocid` parameter:

```
SQL> CONNECT ocid1.databasetoolsconnection.oc1.xxxyyyyzz.aabbccd
```

Example 2

Connecting using the `display_name` parameter:

```
SQL> CM SHOW -OCI admin@adbusw-jfk-conn
Name: admin@adbusw-jfk-conn
OCID: ocid1.databasetoolsconnection.oc1.us-
example-1.amaaaaaaihuofcibbbbbbbrcvsrefyccccccc4uuyprrwgidzwa
```


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```
Type: ORACLE
Username: admin
Connection String: (description= (retry_count=20)(retry_delay=3)
(address=(protocol=tcps)(port=1522)(host=adb.us-example-1.oraclecloud.com))
(connect_data=(service_name=gc652b60e5e551c_adbusw_low.adb.oraclecloud.com))
(security=(ssl_server_dn_match=yes)))

SQL> CONNECT -OCI admin@adbusw-jfk-conn
Connected.
```

14.9.4 Oracle Connection Type

Connect to a database using Oracle Relational Database Management System.

The connection spec parameter has the following form:

```
<username>[/<password>][@<url>][as <role>][edition= <edition>]
```

where

- <username> may be <proxyuser>[<username>] if a proxy user is required. Note that the brackets around user name are required syntax.
- The <url> can take either of the following forms:

  ```
  //<host>:<port>/<service>
  <host>:<port>/<service>
  ```

  or it may be a TNS name or an LDAP specification.

Options

Option	Description
-oracle, o	Specifies an Oracle connection type.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

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Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Example

To connect using EZCONNECT:

```
SQL> CONNECT myuser/passwd@myhost:1521/myservice
```

14.9.5 OREST Connection Type

Connect to a database using REST. The connection spec parameter has the form:

```
<username>[/<password>][@<url>][as <role>][edition= <edition>]
```

The <url> can take the form:

```
http://<host>:<port>/ords/<schema>
```

Options

Option	Description
-orest, or	Specifies a connection type that uses REST.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Example

To connect using REST:

```
SQL> CONNECT myuser/passwd@http://myhost:9213/ords/myschema
```


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14.9.6 RADIUS Connection Type

Connect to a database using RADIUS authentication. The connection spec parameter has the form:

```
[<username>][/<password>][@<url>]
```

RADIUS can also be configured to authenticate using <*number*> from two-factor authenication:

```
[<username>]/[<password>][<number from device or command>][<@url>]
```

> **Note**
>
> Challenge response two-factor authentication for RADIUS is not supported in this release.

See Configuring RADIUS Authentication in *Oracle Database Security Guide* for more information about RADIUS authentication.

Options

Option	Description
-radius, rad	Specifies a RADIUS connection type.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<*connectionspec*>	Provides the connection specification for the target database.

Example

To connect using RADIUS:

```
SQL> CONNECT -radius myuser/passwd@myhost:1521/myservice
```


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See Also:

- Support for RADIUS for troubleshooting information

14.9.7 SOCKS Connection Type

Connect to a database using a SOCKS proxy. Before connecting, set up the proxy process on the local machine by using the `ssh` command. For example:

```
ssh -N -D 127.0.0.1:1087
opc@123.456.789.120.
```

The connection spec parameter has the form:

```
[<username>][/<password>][@<url>]
```

Options

Option	Description
-socks|s	Specifies a SOCKS connection type.
-socksproxy|sp	Specifies the socks proxy.
-cloudconfig, cc	Specifies the wallet to establish the connection.
-proxy, p	Specifies the network proxy to use.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Example

To set the SOCKS and wallet properties and then connect:

```
SQL> SET socksproxy socks5h://localhost:1080
 SQL> SET cloudconfig mywallet.zip
 SQL> CONNECT myuser/passwd@mycloudtns
```


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Alternatively, do it using one command:

```
SQL> CONNECT -socksproxy socks5h://localhost:1080 -cloudconfig mywallet.zip
  myuser/passwd@mycloudtns
```

14.9.8 THIRD Connection Type

Connect to a third-party database. You need to add the appropriate driver jar to `<sqlcl-root>/lib/drivers/`. For example, for MYSQL you can download `mysql-connector-java-8.0.30.jar`.

The connection spec parameter is specific to the database but generally takes the form:

```
<username>[/<password>]@jdbc:<dbtype>://<host>:<port>
```

Options

Option	Description
-third, t	Specifies a THIRD connection type.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<connectionspec>	Provides the connection specification for the target database.

Example

To connect to MySQL:

```
SQL> CONNECT myuser/passwd@jdbc:mysql://myhost:9906
```

14.9.9 WALLET Connection Type

Connect to a database using a wallet. The connection spec parameter has the form:

```
[<username>][/<password>][@<url>]
```


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Options

Option	Description
-wallet, w	Specifies a WALLET connection type.
-cloudconfig, cc	Specifies the wallet to establish the connection.
-proxy, p	Specifies the network proxy to use.
-user, u	Specifies the user name. This is an alternative to providing it in the connection spec parameter.
-password, pw	Specifies the password. This is an alternative to providing it in the connection spec parameter.
-url	Specifies the URL. This is an alternative to providing it in the connection spec parameter.
-role, r	Specifies the database role. This is an alternative to providing it in the connection spec parameter.
-edition, ed	Specifies the Oracle database edition. This is an alternative to providing it in the connection spec parameter.
-verbose, v	Requests output of diagnostic information about the connection.

Parameters

Parameter	Description
<*connectionspec*>	Provides the connection specification for the target database.

Example

To set the wallet property and then connect:

```
SQL> SET cloudconfig mywallet.zip
SQL> CONNECT myuser/passwd@mycloudtns
```

Alternatively, do it using one command:

```
SQL> CONNECT -cloudconfig mywallet.zip myuser/passwd@mycloudtns
```

14.10 CONNMGR

Use the Connection Manager (`CONNMGR`) command to work with persistent connections and connections stored in the OCI Database Tools Service.

It contains the following subcommands:

- Clone
- Import
- Export
- List
- Show
- Test

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14.10.1 Clone Connections

Clones an existing connection. By default, the credentials stored with the original connection are used for the new connection. To change the user name, the `-user` option can be used. If the user changes, a password prompt is displayed unless the `-nopwd` option is used

Syntax

```
connmgr|cm clone {OPTIONS} {PARAMETERS}
```

Options

Option	Description	Default
-original, -o	The name of the source connection being cloned.	Required
-nopwd	Whether to create the connection without a stored password.	-
-user, -u	The user name to store with the connection. If no user name is specified, you may be prompted to provide one when using the connection, depending on the authentication configuration.	-

Parameters

Parameter	Description
<name>	The name of the connection. Connection names are case-sensitive.

Example

To clone an existing connection:

```
SQL> CONNMGR CLONE -original original_name newname
SQL> CONNMGR CLONE -original original_name -user newuser newname
```

14.10.2 Export Connections

Exports one or more connections to an encrypted archive file for backup or transfer to another system. Passwords and credentials are encrypted using the specified key.

Use this command to:

- Export all stored connections
- Export specific connections
- Export connections from a specific folder (including subfolders)

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Syntax

```
connmgr|cm export {OPTIONS}
```

Options

Option	Description
Required	
`-key`	The public name of a secret that protects the encryption key used to encrypt passwords in the file. **Note** If the encryption key is invalid, the connections are imported with the passwords removed.
Optional	
`-folder <folder>`	Specifies the folder (including sub folders) from which to export all connections.
`-all-connections|-a|-all`	Exports all stored connections.
`-overwrite|-o`	Overwrites an existing export file if it exists.
`-preserve-folders|-p`	Preserves the current folder hierarchy so connections are exported with the same structure.

Example 1

To export all connections to a file:

```
SQL> CONNMGR EXPORT -key mykey -all-connections connections.backup
```

Example 2

To export specific connections:

```
SQL> CONNMGR EXPORT -key mykey conn1 conn2 conn3 my_connections
```

Example 3

To export all connections from a folder:

```
SQL> CONNMGR EXPORT -key mykey -folder /prod prod_backup
```

Example 4

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To overwrite an existing export file:

```
SQL> CONNMGR EXPORT -key mykey -overwrite -all-connections
      connections.backup
```

14.10.3 Import Connections

Imports one or more connections to the common connection store .

Use this command to import connections from:

- JSON files exported from SQL Developer. These may include encrypted passwords and credentials. If passwords are encrypted, provide the encryption key (stored as a secret) or enter it when prompted. Alternatively, you can strip passwords during import and provide them later when connecting.
- Encrypted archive files exported via CONNMGR EXPORT. The encryption key is required to import.
- Oracle Cloud Infrastructure Database Tools service. Imports a reference to a cloud-based connection; the connection name is stored locally, while credentials, connect string, and other details are retrieved from the Database Tools service as needed.

When importing connections with encrypted passwords, the encryption key is required to decrypt the passwords. The encryption key may be provided with the import command by first securing it with a secret. For more information about using a secret, see SECRET Command. If no key is provided with the import command, a prompt is displayed to request the key.

The passwords can be removed from imported connections by specifying the `-strip_passwords` option.

Syntax

```
connmgr|cm import {OPTIONS} {PARAMETERS}
```

Options

Option	Description
`-duplicates | d | dups`	`{ignore|rename|replace}` Indicates how to handle imported connections whose names match an existing connection. • `IGNORE`: Skips the duplicate connections. • `RENAME`: Renames the duplicate connections by appending a unique number to the end of the name. • `REPLACE`: Replaces the existing connection with the new connection.

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Option	Description
`-key`	The public name of a secret that protects the encryption key used to encrypt passwords in the file. **Note** If the encryption key is invalid, the connections are imported with the passwords removed.
`-strip_passwords | s | strip`	Indicates that encrypted passwords be stripped from imported connections.
`-oci`	Accesses the Database Tools connections that are available to you within your OCI tenancy.
`-list-contents|-l|-list`	Lists the connections contained in the archive without importing them.
`-folder|-f <folder>`	Imports connections into the specified folder instead of the root folder.

Parameters

Parameter	Description
Required	
<import-location>	A JSON file (from SQL Developer), an encrypted archive (from CONNMGR EXPORT), or the `DisplayName` of a DatabaseTools Service connection when used with -oci
Optional	
path	A single file or directory containing one or more connections to import. If the path is an archive file, the archive is checked for a single connection definition. If the path is a JSON file, it is checked for legacy connection definitions. If the path is a directory, it is checked for more archives containing connection definitions.
<display_name>	The display name of a connection in the OCI Database Tools Service. **Note** This parameter is applicable only when using the `-oci` option.

Example 1

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To create a secret for the encryption key and specify the secret name when importing connections from a file, enter:

```
SQL> SECRET SET mySecret <encryption key>
  SQL> CONNMGR IMPORT -KEY mySecret myconns.json
```

Example 2

To import a connection from the OCI Database Tools Service, enter:

```
SQL> CONNMGR IMPORT -OCI DB23c-Free
```

Example 3

To import connections from a legacy JSON file:

Example 4

To import connections from an encrypted archive:

```
 SQL> CONNMGR IMPORT -KEY mySecret connections.backup
```

Example 5

To list connections in an archive without importing:

```
SQL> CONNMGR IMPORT -KEY mySecret -LIST connections.backup
```

Example 6

To import connections into a specific folder:

```
SQL> CONNMGR IMPORT -KEY mySecret -FOLDER /imported connections.backup
```

Example 7

To import connections, renaming duplicates:

```
SQL> CONNMGR IMPORT -KEY mySecret -DUPLICATES RENAME connections.backup
```

Example 8

To import with passwords stripped:

```
SQL> CONNMGR IMPORT -STRIP-PASSWORDS myconns.json
```

14.10.3.1 SECRET Command

This command is used to securely store secret values in memory. The Connection Manager (`connmgr`) commands enable the use of the secret name to identify secure values such as passwords and encryption keys. Using the secret name in this way ensures that secure values

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are not displayed on the command line and do not persist in command history. Secure values cannot be retrieved with the SECRET command.

Syntax

```
secret {SUBCOMMAND}
```

where the subcommands are:

- Set
- List
- Unset

Set

Sets a name for a secret value. The secret name can be used with commands that support secure values.

Syntax

```
secret set {PARAMETERS}
```

Parameters

Parameter	Description
secret_name	The public name that can be used to represent a secure value.
secret_value	The protected secret value that is associated with the secret name.

List

Lists the currently stored secret names.

Syntax

```
secret list
```

Unset

Removes the secret value for the secret name.

Syntax

```
secret unset <secret_name>
```

where secret_name is the public name used to represent a secret value.

Example

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Set a name for a secret value and use it to import connections.

```
SQL> secret set my_name myEncryptionKey
secret my_name stored
SQL> connmgr import -encryption_key my_name conns.json
```

14.10.4 List Connections

Lists the names of the connections.

Syntax

```
cnnmgr|cm list {OPTIONS}
```

Options

Option	Description
-oci	Accesses the Database Tools connections that are available to you within your OCI tenancy.

Example 1

To list the names of the connections in the local connection store, enter:

```
SQL> CONNMGR LIST
```

Example 2

To list the Database Tools connections that are available within your OCI tenancy, enter:

```
SQL> CONNMGR LIST -OCI
```

14.10.5 Show Connections

Shows the details for a connection, including the connection URL and the user name (if stored). Additional details are displayed depending on the stored connection description.

Syntax

```
connmgr|cm show {OPTIONS} {PARAMETERS}
```

Options

Option	Description
-oci	Accesses the Database Tools connections that are available to you within your OCI tenancy.

Parameters

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Parameter	Description
<name>	The name of the connection. Connection names are case-sensitive.
<display_name>	The display name of a connection in the OCI Database Tools Service.

Example 1

To show details for `MyConnection`, enter:

```
SQL> CONNMGR SHOW MyConnection
```

Example 2

To show details for the `DB23c-Free` connection in the OCI Database Tools Service, enter:

```
SQL> CONNMGR SHOW -OCI DB23c-Free
```

14.10.6 Test Connections

Tests a connection definition.

Opens and closes a test connection. This test connection does not affect the current SQLcl connection. The credentials stored with the connection are used for the test. If no password is stored, the user is prompted for the password. If the `-user` option is used, the provided user is tested instead. A password will need to be provided when prompted.

Syntax

```
connmgr|cm test {OPTIONS} {PARAMETERS}
```

Options

Option	Description
-user, -u	Specify a user name instead of using the one stored with the connection definition. Case-sensitive user names are quoted to preserve case.

Parameters

Parameter	Description
<name>	The name of the connection. Connection names are case-sensitive.

Example

To test the connection `MyConnection` for user name `SCOTT`:

```
SQL> CONNMGR TEST MyConnection
SQL> CONNMGR TEST -USER SCOTT MyConnection
```


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14.11 DIFF

Use this command to compare two Oracle Database schemas and generate an artifact file containing the necessary changes to synchronize them. This is especially useful for CI/CD workflows, and the final output can be deployed anywhere as needed.

The `diff` command connects to both schemas, exports their objects, compares them, and generates the SQL changes required to make the source schema match the target schema. It packages these changes into a deployable ZIP artifact that can be deployed by using the PROJECT DEPLOY command. The artifact can be deployed directly or extracted to review its contents before deployment.

The `-source` and `-target` options accept either a saved SQLcl connection name or a connection string, such as an Easy Connect string or a JDBC URL.

Prerequisites
Before using the `diff` command, ensure that:

- SQLcl can connect to both the source and target schemas.
- The source schema is available through either a saved SQLcl connection or the `-source` connection string.
- The target schema is specified with the `-target` option, or you are already connected to it in SQLcl.
- The users have the required privileges to read and export the schema objects being compared.
- You have write access to the artifact output directory.
- Git is installed and available on the system path, because the command uses temporary project worktrees internally.
- The SQLcl Project extension is installed and available to deploy the generated artifact.

Syntax

```
diff|di -source <source> [-target <target>] [-artifact-out <directory>] [-
generate-rollback] [-project-dir <directory>] [-parallel-exports] [-log] [-
verbose] [-debug]
```

Options

Option	Type	Required	Description
`-source`	String (connection name or connection string)	Yes	The source connection to compare. Specify a saved SQLcl connection name, an Easy Connect string, or a JDBC URL. The generated forward artifact contains the changes required to make the source schema match the target schema.

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Option	Type	Required	Description
`-target`	String (connection name or connection string)	No	The target connection to compare against. Specify a saved SQLcl connection name, an Easy Connect string, or a JDBC URL. If you omit this option, SQLcl uses the current connection as the target.
`-artifact-out`	String (path to a directory)		The directory where SQLcl writes the generated ZIP artifact. If you omit this option, SQLcl writes the artifact to the current working directory.
`-generate-rollback`	Flag	No	Generate a rollback artifact to move the target schema back toward the source schema.
`-project-dir`	String (path to a directory)	No	Reuse an existing SQLcl project instead of creating a temporary project.
`-parallel-exports`	Flag	No	Export the source and target schemas at the same time. This can reduce runtime.
`-log`	Flag	No	Write command output to `diff.log` in the artifact output directory.
`-verbose`	Flag	No	Print additional progress messages.
`-debug`	Flag	No	Print exception details and stack traces for troubleshooting.
`-objects`	String (List)	No	Comma separated DDL object names or patterns to export. Only matching objects are exported.
`-exclude-objects`	String (List)	No	Comma separated DDL object names or patterns to exclude from export.
`-types`	String (List)	No	Comma separated DDL object types or patterns to export. All objects matching the types are exported.
`-exclude-types`	String (List)	No	Comma separated DDL object types or patterns to exclude from export.

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Option	Type	Required	Description
`-dml`	String (List)	No	Comma separated table names whose data is exported and compared. Only these tables receive DML comparison.
`-exclude-dml`	String (List)	No	Comma separated table names whose data must not be exported or compared. All other table data is included.
`-objects-file`	String (Path to a directory)	No	File containing comma or newline separated DDL object names or patterns to export. Only matching objects are exported.
`-exclude-objects-file`	String (Path to a directory)	No	File containing comma or newline separated DDL object names or patterns to exclude from export.
`-types-file`	String (Path to a directory)	No	File containing comma or newline separated DDL object types to export. All objects matching the types are exported.
`-exclude-types-file`	String (Path to a directory)	No	File containing comma or newline separated DDL object types to exclude from export.
`-dml-file`	String (Path to a directory)	No	File containing comma or newline separated table names whose data is exported and compared. Only these tables receive DML comparison.
`-exclude-dml-file`	String (Path to a directory)	No	File containing comma or newline separated table names whose data must not be exported or compared.

Filtering Processed Objects

Use filters to control which objects and table data `diff` exports before comparing the source and target schemas. Filtering can reduce the size of the generated artifact and limit it to the changes that you want to review or deploy.

`diff` provides two types of filters:

- **DDL filters** control which database object definitions, such as tables, views, and materialized views, are exported and compared.
- **DML filters** control which table data is exported and compared.

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DDL Filters

- Use `-objects` to include only specific named objects:

  ```
  diff -source dev_conn -target test_conn -objects EMPLOYEES,DEPARTMENTS
  ```

  This command exports and compares only objects named `EMPLOYEES` or `DEPARTMENTS`.
- Use `-types` to include only specific object types:

  ```
  diff -source dev_conn -target test_conn -types TABLE,VIEW
  ```

  This command exports and compares only tables and views.
- When you specify both `-objects` and `-types`, an object must match both filters:

  ```
  diff -source dev_conn -target test_conn
  -objects EMPLOYEES,DEPARTMENTS -types TABLE
  ```

  This command exports `EMPLOYEES` and `DEPARTMENTS` only if they are tables. For example, a view named `EMPLOYEES` is not exported.
- When an option contains multiple values, an object can match any of the specified values. For example:

  ```
  -objects EMPLOYEES,DEPARTMENTS
  ```

  This option includes objects named `EMPLOYEES` or `DEPARTMENTS`.
- Use `-exclude-objects` to exclude matching objects from the selected objects:

  ```
  diff -source dev_conn -target test_conn -types TABLE,VIEW
  -exclude-objects AUDIT_%
  ```

  This command exports tables and views except objects with names that begin with `AUDIT_`.

DML Filters

DML filters apply only to table data. They do not affect which object definitions are exported by the DDL filters.

- Use `-dml` to include data from specific tables:

  ```
  diff -source dev_conn -target test_conn -dml EMPLOYEES,DEPARTMENTS
  ```

  This command exports and compares data only from the `EMPLOYEES` and `DEPARTMENTS` tables.
- Use `-exclude-dml` to exclude data from specific tables:

  ```
  diff -source dev_conn -target test_conn -exclude-dml AUDIT_LOG
  ```

  This command exports and compares data from all eligible tables except `AUDIT_LOG`.

Combining DDL and DML Filters

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DDL and DML filters operate independently.

For example:

```
diff -source dev_conn -target test_conn -types TABLE -dml EMPLOYEES
```

This command exports the DDL for all tables but exports table data only for `EMPLOYEES`. Therefore, changes to the `EMPLOYEES` table definition and its data can both appear in the generated artifact.

Using the Artifact
After the artifact is generated, SQLcl creates a deployable ZIP file in the specified output directory (or the current working directory if `-artifact-out` is omitted). Deploy the artifact using the SQLcl Project extension:

```
project deploy -file /path/to/diff_SOURCE_TARGET_artifact.zip
```

The ZIP file does not need to be extracted before deployment.

Deploying the artifact applies the changes required to make the source schema match the target schema.

Reviewing the Artifact
Each artifact generated by the `diff` command is structured so that you can easily audit, review and understand the changes it will apply. This review might be important in minimizing the risk of unexpected changes in production environments.

Artifact Structure

```
├─── env
│    ├─── defaultProperties.sql
│    └─── undefineDefaultProperties.sql
├─── install.sql
├─── releases
│    ├─── main.changelog.sql
│    └─── next
│         ├─── changes
│         │    └─── target_<schema_name>
│         │         └─── stage.changelog.sql
│         │         └─── <object_type>
│         │              └─── <object_name>
│         └─── release.changelog.sql
└─── utils
     ├─── prechecks.sql
     └─── recompile.sql
```

The artifact contains the following key files and directories:

- `env/defaultProperties.sql` and `env/undefineDefaultProperties.sql` define and clear environment properties used during deployment. These files are included by default as part of the SQLcl Project structure but are not used by the `diff` command.
- `install.sql` is the main entry point for deploying the artifact. By default, it invokes the main changelog and includes optional precheck and recompilation scripts. These optional scripts are commented out. Uncomment them if you want to run the prechecks or recompilation during deployment.

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- `releases` contains the project structure that represents the schema differences.
- `main.changelog.sql` is the main script that invokes the object-level change scripts required to synchronize the source schema with the target schema.
- `releases/next/changes/target_<schema_name>` contains the generated object-level changes. The changes are organized by object type, with one SQL file per object. For example:
  - /table/EMPLOYEE.sql
  - /view/EMPLOYEE_VIEW.sql

These files contain the SQL statements that implement the schema differences and form the core of the generated artifact.

To review the artifact and the changes:

- Find the artifact ZIP file generated by the `diff` extension in the specified output directory.
- If you want to browse the files directly, extract the contents of the ZIP file to a review directory.
- Navigate to the `/releases/next/changes/target_<schema_name>` directory.
- Browse the folders categorised by object type (TABLE, VIEW, PROCEDURE).
- Examine each object-level change file, such as `TABLE/EMPLOYEES.sql`.
- For each change file, compare the SQL statements with the current definitions in your source and target schemas as needed to verify or understand the differences.

Examples

- Compare the `dev_conn` and `test_conn` schemas and generate a deployment artifact in the `/tmp/schema-diff` directory.

  ```
  diff -source dev_conn -target test_conn -artifact-out /tmp/schema-diff
  ```

- Compare the `dev_conn` and `test_conn` schemas and generate both a forward deployment artifact and a rollback artifact in the `/tmp/schema-diff directory`.

  ```
  diff -source dev_conn -target test_conn -artifact-out /tmp/schema-diff -
  generate-rollback
  ```

- Compare the `dev_conn` and `test_conn` schemas using the SQLcl project located at `/path/to/project` and generate the deployment artifact in the `/tmp/schema-diff` directory.

  ```
  diff -source dev_conn -target test_conn -project-dir /path/to/project -
  artifact-out /tmp/schema-diff
  ```

14.12 DG (Data Guard)

Enables you to manage Oracle Data Guard broker for Oracle Database release 21c and later versions.

See Data Guard Commands in *Oracle Data Guard Broker* for information about Data Guard commands and parameters.

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14.13 DIRS, PUSHD and POPD

With these commands, you can view and work with the directory stack (a list of recently-visited directories) and change the current working directory in Linux and other Unix type operating systems.

- `dirs`: Displays the list of currently saved directories.
- `pushd`: Adds directories to the stack.
- `popd`: Removes directories from the stack.

Refer to the SQLcl command-line help for more information about these commands.

14.14 IMMUTABLE_TABLE

This command uses an extension of the `DBMS_IMMUTABLE_TABLE` PL/SQL package.

Immutable tables are read-only tables that protect data against unauthorized modification. These tables also prevent against accidental data modifications that may be caused by human errors. The `DBMS_IMMUTABLE_TABLE` PL/SQL package enables you to delete the expired rows in an immutable table and add interval partitioning.

The sub-commands are:

- Add Interval Partitioning
- Delete Expired Rows
- Describe Table

14.14.1 Add Interval Partitioning

Adds interval partitioning to an existing, non-partitioned, V1 or V2 immutable table.

Syntax

```
immutable_table|im add_interval_partitioning|addintpartition {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the immutable table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha""."Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a"`.
`-interval_number|-intnum <interval_number>`	Specifies the interval number that determines how often the database creates partitions for the immutable table.
`-interval_frequency|-intfreq <interval_frequency>`	Specifies the interval frequency that determines how frequently the database creates partitions for immutable tables within a specified interval set by the `interval_number` setting. Supported values are `YEAR, MONTH, DAY, HOUR, and MINUTE`.
`-first_high_timestamp|-firsthigh <first_high_timestamp>`	Specifies a timestamp that determines the upper boundary of the first partition in the immutable table.

14.14.2 Delete Expired Rows

Deletes some or all of the expired rows from the immutable table. This command does not commit if the database release is 19c or 21c. This command commits if the database release is at least 23ai.

Syntax

```
immutable_table|im delete_expired_rows|del {OPTIONS}
```

Options

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the immutable table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes. **Note** Case sensitive, embedded white space table and schema name should be entered as `"""Alp_ha"".""Be $a"""`. The parser parses these values as `"Alp_ha"."Be $a".`
Optional	
`-before_timestamp|-before <before_timestamp>`	Specifies a timestamp to determine deletion of expired rows. Set this parameter according to the NLS_TIMESTAMP_TZ_FORMAT or NLS_TIMESTAMP_FORMAT. The default value for this parameter is NULL. • If the parameter value is NULL, all expired rows in the table are deleted. • If the parameter value is not NULL and is older than the timestamp calculated based on the current time and the row retention period, then rows with timestamps earlier than the parameter value are deleted. • If the parameter value is not NULL and is more recent than the timestamp calculated based on the current time and row retention period, the calculated timestamp is used, resulting in the deletion of all expired rows.
`-rowcount <rowcount>`	Requests the number of rows deleted. This is an OUT parameter option, used for storing the output value of the command in a bind variable.

14.14.3 Describe Table

Describes the details of the specified immutable table.

Syntax

```
immutable_table|im desc {OPTIONS}
```

Option	Description
Required	

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Option	Description
`-table_name|-tab <table_name>`	Specifies a name for the immutable table. The name can be preceded by the respective schema name. To specify a case-sensitive schema or table name, enclose the entire name in double quotes and then enclose the individual names in double, double quotes.

14.15 KEYMAP

The keymap command manages SQLcl editor key bindings for the inline command editor.

Use this command to:

- View current key bindings
- Bind keys to editor actions
- Remove bindings
- Detect terminal key sequences
- Reset keymaps to defaults
- Find keys associated with an action
- Export and import keymap configurations

The keymap command is available only in interactive SQLcl sessions.

Syntax

```
keymap list [emacs|vicmd|viins|visual] [-bound|-unbound] [filter]
keymap bind <mode> (<key>|-detect) <action-id>
keymap unbind <mode> <key>
keymap detect [<key>]
keymap reset [emacs|vicmd|viins|visual|all]
keymap keys <action-id> [mode]
keymap export [<file>]
keymap import <file>
```

Parameters

Parameter	Description
mode	Editor mode to inspect or modify. Valid values are emacs, vicmd, viins, visual.
key	Key sequence in SQLcl/JLine notation, such as ^R, ^[a, or ^[[A.
action-id	Widget or action to bind. Use `keymap list -unbound` to view available unbound actions.
filter	Limits `keymap list` output to entries whose displayed key, action, or description matches the filter text.
file	File path used for export or import operations.

Subcommands

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- **Keymap List**

  Displays current bindings for the specified editor mode.

  If no mode is specified, SQLcl displays the bindings for the active editor family. Key bindings apply only to the editor mode in which they are defined.

  – When SQLcl uses **Emacs** editing, bindings for macs are displayed.

  – When SQLcl uses **vi** editing, bindings for vicmd, viins, and visual are displayed.

  By default, only bound actions are displayed.

  Options

  – `-bound`: Displays bound actions

  – `-unbound`: Displays actions that do not have a key binding in the selected mode.

  You can specify both options together.

  Examples

  ```
  keymap list
  keymap list viins
  keymap list viins -unbound
  keymap list viins history
  ```

- **KEYMAP bind**

  Binds a key sequence to an action in the selected mode.

  ```
  keymap bind <mode> (<key>|-detect) <action-id>
  ```

  If you specify `-detect`, SQLcl prompts you to press a key sequence and binds the detected sequence to the specified action.

  Examples

  ```
  keymap bind viins ^o cl-run-immediately
  keymap bind emacs ^r history-incremental-search-backward
  keymap bind viins -detect cl-run-immediately
  keymap unbind viins ^o
  ```

- **KEYMAP unbind**

  Removes the current binding for the specified key in the selected editor mode.

- **KEYMAP detect**

  Displays the JLine key representation of a key sequence and shows the current binding for that sequence by mode. If no key is supplied, SQLcl prompts:

  ```
  Press key sequence to detect
  ```

  Examples

  ```
  keymap detect
  keymap detect ^r
  ```

- **KEYMAP reset**

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Restores one editor mode or all editor modes to the default key bindings established when SQLcl initialized.

Examples

```
keymap reset viins
keymap reset all
```

- **KEYMAP keys**

  Displays the key or keys currently bound to an editor action.

  Optionally, you can limit the search to a single editor mode.

- **KEYMAP export**

  Exports key bindings to a JSON file.

  If no file is specified, SQLcl writes the export to:

  ```
  ~/.dbtools/sqlcl/keymap.json
  ```

  The exported file stores raw JLine key sequences rather than the display format shown by `keymap list`.

  For example:

  – Command output may display a key as `^[[A`

  – The exported JSON stores the same key as `\u001B[A`

  Using raw JLine sequences ensures that exported keymaps can be imported without losing terminal-specific key information.

  Examples

  ```
  keymap export
  keymap export ~/team-keymap.json
  keymap import ~/team-keymap.json
  ```

- **KEYMAP import**

  Imports key bindings from a JSON file and applies them to the current SQLcl session.

Loading Keymap Configuration

The default export file is also the default keymap configuration file loaded during SQLcl startup.

```
~/.dbtools/sqlcl/keymap.json
```

During startup, SQLcl:

- Initializes built-in default keymaps.
- Captures the baseline used by `keymap reset`.
- Loads `~/.dbtools/sqlcl/keymap.json` if present.
- Applies the imported bindings on top of defaults.

As a result, exporting key bindings to the default location automatically makes them available in future SQLcl sessions.

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14.16 LIQUIBASE

Database Diff Commands

New Command	Description
diff	Writes description of differences between two databases to standard out.
diff-changeLog	Adds any differences between the databases specified to a changelog. Can append in any of the supported changelog formats.

Database Rollback Commands

New Command	Description
rollback	Rolls back the database to the state it was in when the tag was applied.
rollback-sql	A helper command that produces the raw SQL Liquibase would run when using the rollbackByTag command.
rollback-to-date	Rolls back the database to the state it was in at the given date/time.
rollback-to-date-sql	A helper command that allows you to inspect the SQL Liquibase will run while using the rollback-to-date command.
rollback-count	Rolls back the last <value> changesets.
rollback-count-sql	Writes SQL to roll back the last <value> changesets to STDOUT.
future-rollback-sql	Writes SQL to roll back the database to the current state after the changes in the changelog have been applied.
future-rollback-count-sql	Generates the SQL that Liquibase would use to sequentially revert the number of changes associated with undeployed changesets, which are added to a changelog file.
future-rollback-from-tag-sql	Produces the raw SQL Liquibase would need to roll back all undeployed changes made up to the specified tag.

Database Snapshot Commands

New Command	Description
data	Generate changelogs for the data.
generate-apex-object	Generate apex objects from a database
generate-controlfile	Generate an empty control file that you can use to start a new changelog.
generate-db-object	Generate database objects from a database
generate-ords-module, generate-ords-schema	Generate ords objects from a database
generate-schema	Generate all supported objects in a schema and controller file.

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New Command	Description
generate-changelog	Generate a changelog from a database when adding Liquibase to a new project. This is synonymous with snapshot with the exception of saving the output as XML in the changelog.
snapshot	Gathers the current database schema and displays that information to STDOUT. With options, can save the schema in JSON format, and that JSON snapshot can serve as a comparison database.
update-to-tag-sql	A helper command that inspects the SQL code Liquibase will run when using the update-to-tag <tag> command.

Database Update Commands

New Command	Description
update	Updates the database to the current version.
update-sql	A helper command that enables you to inspect the SQL code that Liquibase will run when using the update command.
update-count	Applies the next <value> changesets.
update-count-sql	Writes SQL to apply the next <value> changesets to STDOUT.
update-testing-rollback	Updates the database, then rolls back changes before updating again.
update-to-tag	Applies sequential changes to your database from the newest changeset to the changeset with the tag you specified and applied earlier.
update-to-tag-sql	A helper command that inspects the SQL code Liquibase will run when using the update-to-tag <tag> command.

Documentation Commands

New Command	Description
db-doc	Generates Javadoc-like documentation based on current database and changelog.

Maintenance Commands

New Command	Description
calculate-checksum	Calculates and prints a checksum for the changeset with the specified id in the following format: filepath::id::author.
changelog-sync	Marks all changes as executed in the database.
changelog-sync-sql	Writes SQL to mark all changes as executed in the database to STDOUT.
changelog-sync-to-tag	Marks all undeployed changesets from your changelog up to and including the specified tag as executed in your database.
changelog-sync-to-tag-sql	Produces the raw SQL that Liquibase would run when using the changelog-sync-to-tag command to mark all undeployed changesets associated with the specified tag as executed in your database.

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New Command	Description
clear-checksums	Removes current checksums from database. On next update changesets that have already been deployed will have their checksums recomputed, and changesets that have not been deployed will be deployed.
drop-all	Drops all database objects owned by the user.
list-locks	Lists who currently has locks on the database changelog.
mark-next-changeset-ran	Mark the next changeset as executed in the database.
mark-next-changeset-ran-sql	Inspects the SQL Liquibase will run while using the mark-next-changeset-ran command.
release-locks	Releases all locks on the database changelog.
tag	"Tags" the current database state for future rollback.
tag-exists	Checks whether the given tag already exists.
unexpected-changesets	Produces a list of changesets that were run in the database but do not exist in the current changelog.
validate	Checks the changelog for errors.

Status Commands

New Command	Description
history	Lists all deployed changesets and their deploymentIds.
status	Outputs the count (or list, if --verbose) of changesets that have not been deployed.

14.16.1 calculate-checksum

Calculates and prints a checksum for the changeset with the given ID in the format `filepath::id::author.`.

Syntax

```
Liquibase|lb calculate-checksum|cac {OPTIONS}
```

The calculate-checksum command is typically used to compute an MD5 checksum, which serves as a unique identifier for the changeset. As a result, you can see whether the changeset has been changed and whether it has to be deployed differently. The MD5SUM column in the `DATABASECHANGELOG` table contains a checksum of the changeset and any change made in the changeset will result in a different checksum.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-changeset-identifier|-chi`	Changeset ID identifier of form filepath::id::author.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-

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Option	Description	Default
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Calculate a checksum for changeset:

```
SQL> lb calculate-checksum --changelog-file countries_table.xml --changeset-
identifier
countries_table.xml::382e51cedfbfc7ba59568dd09dcd4e110b9fbeca::(USER)-
Generated
SQL> liquibase calculate-checksum changelog.oracle.sql::myID_123::Steve
```

14.16.2 changelog-sync

Marks all changes as executed in the database.

Syntax

```
Liquibase|lb changelog-sync|chs {OPTIONS}
```

Uses include:

- Creating a new baseline database.
- Excluding objects from a database.

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- Marking a change as executed. The change was created manually.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Mark changes as executed in the database:

```
-- Set default output path
SQL> cd <output-files-path>
```


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```
-- Connect to target and execute command
SQL> connect <db-connect-string>
SQL> lb changelog-sync -changelog-file countries_table.xml
```

14.16.3 changelog-sync-sql

Output the raw SQL used by Liquibase when running changelogsync.

Syntax

```
Liquibase|lb changelog-sync-sql|chss {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-

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Option	Description	Default
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

Example

Generate SQL to mark changes as executed in the database:

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target and execute command
SQL> connect <db-connect-string>
SQL> lb changelog-sync-sql -changelog-file countries_table.xml -outputfile
countries_synch.sql
```

14.16.4 changelog-sync-to-tag

Marks all undeployed changesets as executed starting from the top of the changelog file and moving down up to and including the tag.

Syntax

```
Liquibase|lb changelog-sync-to-tag|chstt {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta <tag>`	The tag to be used during the execution of command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-

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Option	Description	Default
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Mark changes as executed in the database up to and including tag.

```
cd <lb-changes-directory>
-- Edit changelog file and add tagDatabase entries for versions.
-- Execute command using a tag specified in tagDatabase in the changelog file.
SQL> lb changelog-sync-to-tag -tag version1 -changelog-file controller.xml
```

14.16.5 changelog-sync-to-tag-sql

Output the raw SQL used by Liquibase when running changelogSyncToTag.

Syntax

```
Liquibase|lb changelog-sync-to-tag-sql|chstts {OPTIONS}
```


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Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta <tag>`	The tag to be used during the execution of the command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

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Example

Mark changes as executed in database up to and including tag.

```
cd <lb-changes-directory>
-- Edit changelog file and add tagDatabase entries for versions.
-- Execute command using a tag specified in tagDatabase in the changelog file.
SQL> lb changelog-sync-to-tag-sql -tag version1 -changelog-file
controller.xml -outputfile synch.sql
```

14.16.6 clear-checksums

Clears all checksums and nullifies the MD5SUM column of the `DATABASECHANGELOG` table so that they will be recomputed on the next database update.

Syntax

```
Liquibase|lb clear-checksums|clc {OPTIONS}
```

Options

Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn <default-schema-name>`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn <liquibase-schema-name>`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn <liquibase-tablespace-name>`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

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Option	Description	Default
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Clear checksums:

```
-- Connect to target and execute command.
SQL> connect <db-connect-string>
SQL> clear-checksums
```

14.16.7 data

Generate changelogs for the data. Creates a changelog for data from all objects or as filters are specified.

Syntax

```
Liquibase|lb data|da {OPTIONS}
```

Options

Option	Description	Default
`-data-output-directory|-daod <data-output-directory>`	Directory to write data to, only applicable when <DIFF_TYPE> includes data.	-
`-database-changelog-table-name|-dactn <database-changelog-table-name>`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn <default-schema-name>`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-exclude-objects|-exo <exclude-objects>`	Objects to exclude from diff.	-
`-include-objects|-ino <include-objects>`	Objects to include in diff.	-
`-include-schema|-ins <include-schema>`	If true, the schema is included in generated changesets.	False
`-include-tablespace|-int <include-tablespace>`	Include the tablespace attribute in the changelog.	False
`-liquibase-schema-name|-lbsn <liquibase-schema-name>`	Schema to use for Liquibase objects.	-

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Option	Description	Default
`-liquibase-tablespace-name|-lbtn <liquibase-tablespace-name>`	Tablespace to use for Liquibase objects.	
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf <output-file>`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in directory. This will not affect other files.	-
`-schemas|-sc <schemas>`	Schemas to include operation.	-
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files. Multiple paths can be specified by separating them with commas.	-
`-secure-parsing|-scp <secure-parsing>`	Keep functionality from file parsers which could be used insecurely. Examples include (but not limited to) disabling remote XML entity support.	True

14.16.8 db-doc

Generates JavaDoc documentation for the existing database and changelogs.

Syntax

```
Liquibase|lb db-doc|dbd {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf <changelog-file>`	The root changelog file.	-
`-output-directory|-oud <output-directory>`	The directory where the documentation is generated.	-
Optional		
`-database-changelog-table-name|-dactn <database-changelog-table-name>`	Name of table to use for tracking change history.	-

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Option	Description	Default
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn <default-schema-name>`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn <liquibase-schema-name>`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn <liquibase-tablespace-name>`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp <secure-parsing>`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds <output-default-schema>`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Generate db documentation:

```
-- Set default output path
SQL> cd <output-files-path>
-- Generate doc
SQL> lb db-doc -output-directory ./dbdoc -changelog-file controller.xml
```

14.16.9 diff

Compare two databases.

Syntax

```
Liquibase|lb diff|di {OPTIONS}
```


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Options

Option	Description	Default
Required		
`-reference-password|-rep`	The reference database password.	-
`-reference-url|-reur`	The JDBC reference database connection URL.	-
`-reference-username|-reu`	The reference database username.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-diff-types|-dit`	Types of objects to compare.	catalogs, tables, views, columns, indexes, foreignkeys, primarykeys, uniqueconstraints, data, storedprocedures, sequences{catalogs| tables| views| columns| indexes| foreignkeys| primarykeys| uniqueconstraints| data| storedprocedures| sequences}
`-exclude-objects|-exo <exclude-objects>`	Objects to exclude from diff.	-
`-include-objects|-ino <include-objects>`	Objects to include in diff.	-
`-include-schema|-ins <include-schema>`	If true, the schema will be included in generated changesets.	False
`-include-tablespace|-int <include-tablespace>`	Include the tablespace attribute in the changelog.	False
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-overwrite-files|-ovf`	Overwrite any existing files in directory. This will not affect other files.	-

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Option	Description	Default
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files. Specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-reference-default-schema-name|-redsn`	The reference default schema name to use for the database connection.	-
`-schemas|-sc`	Schemas to include operation.	-

Examples

```
Compare two databases and spool output.


-- Set default output path
SQL> cd <output-files-path>
SQL> spool diff.sql
-- Connect to target database
SQL> connect <db-connect-string>
-- Compare to a reference database
SQL> lb diff -reference-url <reference-db-url> -reference-username <reference-
db-user> -reference-password <reference-db-password>
SQL> spool off
```

Compare tables, indexes and views between two databases.

```
-- Set default output path
SQL> cd <output-files-path>
SQL> spool diff.sql
-- Connect to comparison database
SQL> connect <db-connect-string>
-- Compare to a reference database
SQL> lb diff -diff-types tables,indexes,views -reference-url <db-url>
-reference-username <db-user> -reference-password <db-password>
```

14.16.10 diff-changeLog

Compare two databases to produce changesets and write them to a changelog file.

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Syntax

```
Liquibase|lb diff-changelog|dic {OPTIONS}
```

Options

Option	Description	Default
Required		
`-reference-password|-rep`	The reference database password.	-
`-reference-url|-reur`	The JDBC reference database connection URL.	-
`-reference-username|-reu`	The reference database username.	-
`-changelog-file|-chf`	The generated root changelog file containing deployable changesets to resolve the differences between two databases.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-diff-types|-dit`	Types of objects to compare	catalogs, tables, views, columns, indexes, foreignkeys, primarykeys, uniqueconstraints, data, storedprocedures, sequences{catalogs| tables| views| columns| indexes| foreignkeys| primarykeys| uniqueconstraints| data| storedprocedures| sequences}
`-exclude-objects|-exo`	Objects to exclude from diff	-
`-include-objects|-ino`	Objects to include in diff	-
`-include-schema|-ins`	If true, the schema is included in generated changesets.	False
`-include-tablespace|-int`	Include the tablespace attribute in the changelog	False
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-

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Option	Description	Default
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-schemas|-sc`	Schemas to include in diff	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Examples

Create changelog to synchronize two databases.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target database
SQL> connect <db-connect-string>
-- Compare to a reference database and create a changelog to synchronize them
SQL> lb diff-changelog  -changelog-file diff.xml -reference-url <db-url> -
reference-username <db-user> -reference-password <db-password>
```

Create changelog to synchronize table excluding employees between two databases.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to comparison database
SQL> connect <db-connect-string>
-- Compare tables to a reference database
SQL> lb diff-changelog -changelog-file diff.xml -diffTypes=tables -exclude-
objects employees -reference-url <db-url>
-reference-username <db-user> -reference-password <db-password>
```

14.16.11 drop-all

Drops all database objects owned by the user.

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Syntax

```
Liquibase|lb drop-all|dra {OPTIONS}
```

Options

Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-force|-f <force>`	**Required** for Liquibase 4.27.0+ only. If you use an earlier version, this parameter is optional. Indicates that you intend to use this feature. If you specify `-force=true`, the command executes. If you omit the parameter or specify `-force=false`, the command does not execute.	False
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

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Option	Description	Default
`-schemas|-sc`	Schemas to include operation.	-

Example

To drop all database objects owned by the user, enter:

```
SQL> lb drop-all
```

14.16.12 future-rollback-count-sql

Generates SQL that is used to sequentially revert the specified number of undeployed changes.

Syntax

```
Liquibase|lb future-rollback-count-sql|furcs {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-count|-cu`	The number of changes to roll back.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	False
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-

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Option	Description	Default
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true, they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

Example

Generate SQL to roll back the specified number of undeployed changes.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Generate SQL to roll back 1 undeployed change
SQL> lb future-rollback-count-sql -count 1 -changelog-file controller.xml
```

14.16.13 future-rollback-from-tag-sql

Generates SQL to revert future undeployed changes up to the specified tag.

Syntax

```
Liquibase|lb future-rollback-from-tag-sql|furfts {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta`	Generic 'tag to apply action to'.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-

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Option	Description	Default
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true, they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

Example

Generate SQL to roll back undeployed changes to tag.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Generate SQL to roll back 1 undeployed change
SQL> lb future-rollback-count-sql -count 1 -changelog-file controller.xml
-- Edit changelog file and add tagDatabase entries for versions
-- Generate SQL to roll undeployed changes back to version1
SQL> lb future-rollback-from-tag-sql -tag version1 -changelog-file
controller.xml
```

14.16.14 future-rollback-sql

Generate the raw SQL needed to roll back future undeployed changes.

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Syntax

```
Liquibase|lb future-rollback-sql|furs {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true, they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

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Example

Generate SQL to roll back undeployed changes.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Generate SQL to roll back 1 undeployed change
SQL> lb future-rollback-count-sql -count 1 -changelog-file controller.xml
-- Generate SQL to rollback all undeployed changes
SQL> lb future-rollback-sql -changelog-file controller.xml
```

14.16.15 generate-apex-object

Generates the changeset for an APEX object.

Syntax

```
Liquibase|lb generate-apex-object|geao {OPTIONS}
```

Options

Option	Description	Default
`-applicationid|-api`	ID for application to be exported.	-
`-changesby|-chb`	Expects string parameter. Limit -list values to changes by the given user.	-
`-changessince|-chs`	Expects date parameter (YYYY-MM-DD). Limit -list values to changes since the given date.	-
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-debug|-de`	{true|false} Enable debug output.	-
`-deploymentsystem|-desy`	Deployment system for exported feedback.	-
`-dir|-di`	Save all files in the given directory. Example: `-dir some/sub/directory`	-
`-exporiginalids|-dxoi`	Export will not emit ids as they were when the application was imported.	-
`-runalways|-ra`	{true|false} Set runAlways attribute to true in changelog.	False
`-expaclassignments|-exacl`	Export ACL user role assignments.	-
`-expcomments|-exco`	Export developer comments.	-
`-expcomponents|-exc`	-	-

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Option	Description	Default
-expfeedback|-exfe	Export team development feedback for all workspaces or identified by -workspaceid.	-
-expfeedbacksince|-exfs	Export team development feedback since date in the format YYYYMMDD.	-
-expfiles|-exfi	Export all workspace files identified by -workspaceid.	-
-expirnotif|-exir	Export all interactive report notifications.	-
-expminimal|-exmi	Only export workspace definition, users, and groups.	-
-expnosubscriptions|-exns	Do not export references to subscribed components.	-
-exppubreports|-exre	Export all user saved public interactive reports.	-
-expsavedreports|-exsr	Export all user saved interactive reports.	-
-expsupportingobjects|-exso	Pass (Y)es, (N)o or (I)nstall to override the default.	-
-expteamdevdata|-exte	Export team development data for all workspaces or identified by -workspaceid.	-
-exptranslations|-extr	Export the translation mappings and all text from the translation repository	-

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Option	Description	Default
`-exptype|-exty`	Comma delimited list of export types to perform: • APPLICATION_SOURCE: export an APEX application using other parameters passed. • EMBEDDED_CODE: Export code such as SQL, PL/SQL and Javascript. APEX ignores all other options when EMBEDDED_CODE is selected. • CHECKSUM-SH1: Export a SHA1 checksum that is independent of IDs and can be compared across instances and workspaces. • CHECKSUM-SH256: Export an SHA-256 checksum that is independent of IDs and can be compared across instances and workspaces. • READABLE_JSON: Export a readable version of the application metadata in JSON format. • READABLE_YAML: Export a readable version of the application metadata in YAML format.	
`-expworkspace|-exwo`	Export workspace identified by -workspaceid or all workspaces if -workspaceid not specified.	-
`-fail-on-error|-foe`	{true|false} Set failonError attribute to true in changelog.	False
`-instance|-in`	Export all applications.	-
`-skipexportdate|-ked`	Include export date in application export files.	-
`-labels|-la`	Label expression to use for filtering which changes to operate on.	-
`-list|-li`	Lists applications installed in the database.	-
`-log|-lo`	{true|false} Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-nochecksum|-noch`	Overwrite existing files even if the contents have not changed.	-

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Option	Description	Default
-overwrite-files|-ovf	Overwrite any existing files in the directory. This will not affect other files.	=
-split|-sp	{true|false} This makes the export split the files into directories based on the object types.	False
-workspaceid|-woi	Workspace ID to export all applications to or the workspace to be exported.	-

14.16.16 generate-changelog

Writes changelog XML to copy the current state of the database to standard output or a file (uses core Liquibase functionality).

Syntax

```
Liquibase|lb generate-changelog|gec {OPTIONS}
```

Options

Option	Description	Default
-data-output-directory|-daod	Directory to write data to.	-
-database-changelog-table-name|-dactn	Name of table to use for tracking change history.	-
-debug|-de	Enable debug output.	-
-default-schema-name|-desn	The default schema name to use for the database connection.	-
-diff-types|-dit	Types of objects to compare	catalogs, tables, views, columns, indexes, foreignkeys, primarykeys, uniqueconstraints, data, storedprocedures, sequences{catalogs| tables| views| columns| indexes| foreignkeys| primarykeys| uniqueconstraints| data| storedprocedures| sequences}
-exclude-objects|-exo	Objects to exclude from diff	-
-include-objects|-ino	Objects to include in diff	-
-include-schema|-ins	If true, the schema is included in generated changeSets.	False
-include-tablespace|-int	Include the tablespace attribute in the changelog	False
-liquibase-schema-name|-lbsn	Schema to use for Liquibase objects.	-
-liquibase-tablespace-name|-lbtn	Tablespace to use for Liquibase objects.	-

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Option	Description	Default
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf <output-file>`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-schemas|-sc`	Schemas to include in diff	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|cp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

Examples

Generate XML files for a database.

```
-- Set default output path
SQL> cd <output-files-path>
-- Generate xml files
SQL> lb generate-changelog
```

Generate XML files for specific schemas in a database.

```
SQL> lb generate-changelog -schemas hr,sales
```

14.16.17 generate-controlfile

Generates an empty control file that you can use to start a new changelog.

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Syntax

```
Liquibase|lb generate-controlfile {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-debug|-de`	Enable debug output.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-

Example

Generate control file:

```
--Set default output path
SQL> cd <output-files-path>
SQL> lb generate-controlfile
```

14.16.18 generate-db-object

Writes change log XML to copy the current state of the database object to a file.

Syntax

```
lb generate-db-object|geo {OPTIONS}
```

Options

Option	Description	Default
`-database-changelog-table-name|-dactn <database-changelog-table-name>`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output	-
`-default-schema-name|-desn <default-schema-name>`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-fail-on-error|-foe`	Set failonError attribute to true in changelog.	False

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Option	Description	Default
`-liquibase-schema-name|-lbsn <liquibase-schema-name>`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn <liquibase-tablespace-name>`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging	-
`-object-name|-obn`	Name of the object.	-
`-object-type| -obt`	Type of object.	-
`-output-default-schema|-ouds <output-default-schema>`	Control whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-sql|-sq`	Generate a sql file along with the changelog showing the DDL for the object. This sql is not intended to be used for anything other than review.	-
`-replace|-re`	Set replaceIfExists attribute to true in changelog.	-
`-runalways|-ra`	{true|false} Set runAlways attribute to true in changelog.	False
`-runonchange|-rc`	Set runOnChange attribute to true in changelog.	-

Example

Generate the XML file for a specific object.

```
-- Set default output path
SQL> cd <output-files-path>
-- Generate xml files
SQL> liquibase generate-db-object -object-type table -object-name employees
```

14.16.19 generate-ords-module

Generates the code necessary to reproduce a module and all children using the ORDS APIs.

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Syntax

```
Liquibase|lb generate-ords-module|geom {OPTIONS}
```

Options

Option	Description	Default
Required		
`-module-name|-mon`	The module name for which to generate code.	-
Optional		
`-debug|-de`	Enable debug output.	-
`-exclude-enable-schema|-exes`	Dictates whether the enable_schema call will be included in the export.	-
`-exclude-privs|-exp`	Dictates whether privileges will be included in the export.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-

Example

Generate ORDS module object:

```
-- Set default output path
SQL> cd <output-files-path>
-- Generate XML files
SQL> lb generate-ords-module
```

14.16.20 generate-ords-schema

Generates the code necessary to reproduce all modules and children using the ORDS APIs.

Syntax

```
Liquibase|lb generate-ords-schema|geos {OPTIONS}
```

Options

Option	Description	Default
`-debug|-de`	Enable debug output.	-
`-exclude-enable-schema|-exes`	Dictates whether the enable_schema call is included in the export.	-

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Option	Description	Default
`-exclude-privs|-exp`	Dictates whether privileges will be included in the export.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-

14.16.21 generate-schema

Writes changelog XML to copy the current state of the database to files.

Syntax

```
Liquibase|lb generate-schema|ges {OPTIONS}
```

This command uses custom extension functionality. XML files are generated defining the DDL for each object in the database. A controller XML file is created or updated identifying the individual XML files generated. The files are used to deploy using `UPDATE` commands.

Options

Option	Description	Default
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history	DATABASECHANGELOG
`-debug|-de`	Enable debug output.	-
`-fail-on-error|-foe`	{true|false} Set failonError attribute to true in changelog.	False

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Option	Description	Default
`-filter|-fi`	The filter value is the right-hand side of a SQL comparison, that is, a SQL comparison operator (=,!=, and so on) and the value compared against. The value must contain parentheses and quotation marks where appropriate. For example: "IN ('DEPT','EMP')" The filter value is combined with the object attribute corresponding to the object name to produce a WHERE condition in the query that fetches the objects. In the preceding example, objects named DEPT and EMP are retrieved. By default, all named objects of object_type are selected.	-
`-grants|-gr`	Export Object, System and Role grants.	-
`-labels|-la`	Label expression to use for filtering which changes to operate on.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-perform-detail-parse|-pdp`	Setting this flag will cause all functions, procedures and packages to undergo a complete parse to determine dependencies. This addistional processesing will cause the generation to take more time. This flag should only be used when there is a sorting issue in functions, procedures or packages.	-
`-replace|-re`	Set replaceIfExists attribute to true in changelog.	-
`-runalways|-ra`	{true|false} Set runAlways attribute to true in changelog.	False
`-runonchange|-rc`	Set runOnChange attribute to true in changelog.	-
`-split|-sp`	This makes the export split the files into directories based on the object types.	-

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Option	Description	Default
`-sql|-sq`	Generate a SQL file along with the changelog showing the DDL for the object. This SQL is not intended for anything other than review.	-
`-synonyms|-sy`	Export public synonymns.	-

Examples

Generate XML files into separate directories.

```
-- Set default output path
SQL> cd <output-files-path>
-- Generate xml files
SQL> lb generate-schema -split
```

Generate XML files using a filter to include specific object types.

```
SQL> lb generate-schema -filter "IN ('DEPARTMENTS','EMPLOYEES')"
```

14.16.22 history

List all deployed changesets and their deployment ID.

Syntax

```
Liquibase|lb history|hi {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co <contexts>`	Context string to use for filtering the changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la <labels>`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-

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Option	Description	Default
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Show the deployment history.

```
-- Connect to target
SQL> connect <db-connect-string>
SQL> lb history
```

14.16.23 list-locks

List the hostname, IP address, and timestamp of the Liquibase lock record.

Syntax

```
Liquibase|lb list-locks|lil {OPTIONS}
```

The `DATABASECHANGELOGLOCK` table is read to show lock details based on the connection.

Options

Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-

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Option	Description	Default
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files. Specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

14.16.24 mark-next-changeset-ran

Marks the next change you apply as executed in your database.

Syntax

```
Liquibase|lb mark-next-changeset-ran|mancr {OPTIONS}
```

The `mark-next-changeset-ran` command is used when deploy errors occur due to Liquibase not being synchronized with changes made outside of Liquibase.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-

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Option	Description	Default
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

14.16.25 mark-next-changeset-ran-sql

Writes the SQL used to mark the next change you apply as executed in your database.

Syntax

```
Liquibase|lb mark-next-changeset-ran-sql|mancrs {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-

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Option	Description	Default
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true, they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	-
`-output-file|-ouf`	The name of the file to write the output to.	-

14.16.26 release-locks

Remove the Liquibase lock record from the `DATABASECHANGELOG` table.

Syntax

```
Liquibase|lb release-locks|rel {OPTIONS}
```

Options

Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-

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Option	Description	Default
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files. Specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

14.16.27 rollback

Roll back changes made to the database based on the specified tag.

Syntax

```
Liquibase|lb rollback|rb {OPTIONS}
```

The rollback command is used to revert all changes that were made to the database after a defined tag. All deployed changes are rolled back until the tag row in the `DATABASECHANGELOG` table.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-

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Option	Description	Default
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Roll back changes to tag.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update for versions adding new tag for each version
SQL> lb update -changelog-file controller.xml
SQL> lb tag -tag version1
SQL> lb update -changelog-file controller.xml
SQL> lb tag -tag version2
-- Roll back to version1
SQL> lb rollback-sql -tag version1 -changelog-file controller.xml
```

14.16.28 rollback-count

Roll back the specified number of changes made to the database.

Syntax

```
Liquibase|lb rollback-count|rbc {OPTIONS}
```

The `rollback-count` command is used to revert the specified number of changes to the database starting from the most recent changes.

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Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-count|-cu`	The number of changes to apply.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Roll back the specified number of changes.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update for versions adding new tag for each version
SQL> lb update -changelog-file controller.xml
```


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```
SQL> lb update -changelog-file controller.xml
-- Roll back to version1
SQL> lb rollback-count -count 1 -changelog-file controller.xml
```

14.16.29 rollback-count-sql

Generate the SQL to roll back the specified number of changes.

Syntax

```
Liquibase|lb rollback-count-sql|rbcs {OPTIONS}
```

The `rollback-count` command is used to revert the specified number of changes to the database starting from the most recent changes.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-count|-cu`	The number of changes to apply.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-

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Option	Description	Default
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep <search-path>`	Complete list of locations to search for files such as changelog files in. Specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	-

Example

Generate SQL to roll back the specified number of changes.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update for versions
SQL> lb update -changelog-file controller.xml
SQL> lb update -changelog-file controller.xml
-- Roll back to version1
SQL> lb rollback-count-sql -count1 -changelog-file controller.xml
```

14.16.30 rollback-sql

Generate the SQL to roll back changes made to the database after a defined tag.

Syntax

```
Liquibase|lb rollback-sql|rbs {OPTIONS}
```

The SQL will contain all deployed changes being rolled back until the tag row in the `DATABASECHANGELOG` table.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-

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Option	Description	Default
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

Example

Generate SQL to roll back the specified number of changes.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update for versions adding new tag for each version
SQL> lb update -changelog-file controller.xml
SQL> lb tag -tag version1
SQL> lb update -changelog-file controller.xml
SQL> lb tag -tag version2
-- Roll back to version1
SQL> lb rollback-sql -tag version1 -changelog-file controller.xml
```

14.16.31 rollback-to-date

Roll back changes made to the database back to the specified date and time.

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Syntax

```
Liquibase|lb rollback-to-date|rbtd {OPTIONS}
```

The rollback-to-date command is used to revert changes from today's date to the specified date and time..

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-date|-da <date>`	Date to use when determining what changes to apply. Specify the date in the following format and enclose it in quotes: 'YYYY-MM-DD HH:MM:SS'. See Example.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

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Example

Roll back to the specified date and time.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update update on 2025-09-10
SQL> lb update -changelog-file controller.xml
-- Apply update on 2025-09-11
SQL> lb update -changelog-file controller.xml
-- Apply update on 2025-09-12
SQL> lb update -changelog-file controller.xml
-- Roll back to version1
SQL> lb rollback-to-date -date '2025-09-11 00:00:00' -changelog-file
controller.xml
```

14.16.32 rollback-to-date-sql

Generate SQL to roll back changes made to the database back to the specified date and time.

Syntax

```
Liquibase|lb rollback-to-date-sql|rbtds {OPTIONS}
```

The `rollback-to-date-sql` command is used to generate SQL to revert changes from today's date to the specified date and time.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-date|-da <date>`	Date to use when determining what changes to apply. Specify the date in the following format and enclose it in quotes: 'YYYY-MM-DD HH:MM:SS'. See Example.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-

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Option	Description	Default
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-rollback-script|-ros`	Rollback script to execute.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True

Example

Generate SQL to roll back the specified date.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Apply update on 2025-09-10
SQL> lb update -changelog-file controller.xml
-- Apply update on 2025-09-11
SQL> lb update -changelog-file controller.xml
-- Apply update on 2025-09-12
SQL> lb update -changelog-file controller.xml
-- Roll back to version1
SQL> lb rollback-to-date-sql -date '2025-09-11 00:00:00' -changelog-file
controller.xml
```

14.16.33 snapshot

Capture the current state of a target database.

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Syntax

```
Liquibase|lb snapshot|sn {OPTIONS}
```

The snapshot command is used to:

- Review and track changes in your target database
- Compare a previous database state to an online database
- Compare a previous database state to another snapshot

Options

Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-schemas|-sc`	Schemas to include in diff.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-snapshot-format|-snf`	Output format to use (JSON, YAML, or TXT)	-
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

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Example

Generate a snapshot capturing the current state of a database.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target
SQL> connect <db-connect-string>
-- Take a snapshot
SQL> lb snapshot -snapshot-format json -outputfile snaptgt20220901.json
```

14.16.34 status

Generate a list of pending changesets.

Syntax

```
Liquibase|lb status|st {OPTIONS}
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-

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Option	Description	Default
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-verbose|-ve`	Verbose flag	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Report the number of undeployed changesets and identify them.

```
-- Set default output path
SQL> cd <output-files-path>
-- Check the status
SQL> lb status -verbose -changelog-file controller.xml
```

14.16.35 tag

Mark the current database state with the specified tag to use for roll back.

Syntax

```
Liquibase|lb tag|ta {OPTIONS}
```

For example, you can use the tag to mark the current database state for version, release, and so on. The tag is added to the last row in the `DATABASECHANGELOG` table.

Options

Option	Description	Default
Required		
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-

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Option	Description	Default
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Create initial tag and version tags.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target and add base tag
SQL> connect <db-connect-string>
SQL> lb tag -tag baseversion1
-- Apply update for version adding and add new tag for each version
SQL> lb update -changelog-file controller.xml
SQL> lb tag -tag version1
```

14.16.36 tag-exists

Verify the existence of the specified tag.

Syntax

```
Liquibase|lb tag-exists|tae {OPTIONS}
```

Options

Option	Description	Default
Required		
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-

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Option	Description	Default
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

14.16.37 unexpected-changesets

Generate a list of changesets that have been executed but are not in the current changelog.

Syntax

```
Liquibase|lb unexpected-changesets|unc {OPTIONS}
```

This command detects and compares the changes between the `DATABASECHANGELOG` table and the current changelog and reports:

- Changesets in the `DATABASECHANGELOG` table that do not exist in the current changelog.
- Previously deployed changesets that were deleted from your current changelog.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-

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Option	Description	Default
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def <defaults-file> {FILE}`	Fully qualified path to the properties file you want to use. For example, `defaults-file /tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers, which can be used insecurely. An example is disabling remote XML entity support.	True
`-verbose |-ve`	Verbose flag	True

Example

Report unexpected changesets.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target and run command
SQL> connect <db-connect-string>
SQL> lb unexpected-changesets -changelog-file controller.xml
```


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14.16.38 update

Deploy any changes in the changelog file that have not been deployed.

Syntax

```
Liquibase|lb update|up {OPTIONS}
```

When you run the update command, the changesets in the changelog file are read sequentially. The unique identifiers (file::id::author) in the file are compared to those stored in the `DATABASECHANGELOG` table.

- If the unique identifiers do not exist, Liquibase will apply the changeset to the database.
- If the unique identifiers exist, the MD5Sum of the changeset is compared to the one in the database.

  If they are different, Liquibase will produce an error message that someone has changed it unexpectedly.

  If the status of the runOnChange or runAlways changeset attribute is set to TRUE, Liquibase will re-apply the changeset. Example: <changeSet id="2" author="bob" runAlways="true">

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-

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Option	Description	Default
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-show-summary|-shs <show-summary> {OFF|SUMMARY|VERBOSE}`	Produces a summary list of any changesets skipped and why they were skipped. Valid values are OFF, SUMMARY, and VERBOSE.	SUMMARY
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False
`-override-app-alias|-ovaa`	Override value to be used for the APEX application alias.	-
`-override-app-id|-ovai`	Override value to be used for the APEX application id.	-
`-override-app-schema|-ovas`	Override value to be used for the APEX workspace schema.	-
`-override-app-workspace|-ovaw`	Override value to be used for the APEX application workspace.	-

14.16.39 update-count

Deploy the specified number of changes from the changelog file.

Syntax

```
Liquibase|lb update-count|upc {OPTIONS}
```

The `update-count` command applies changes and updates changesets sequentially, starting from the top of the changelog file until the number specified is reached.

- If the unique identifiers do not exist, Liquibase will apply the changeset to the database.
- If the unique identifiers exist, the MD5Sum of the changeset is compared to the one in the database.

  If they are different, Liquibase will produce an error message that someone has changed it unexpectedly.

  If the status of the runOnChange or runAlways changeset attribute is set to TRUE, Liquibase will re-apply the changeset. Example: <changeSet id="2" author="bob" runAlways="true">

Options

Option	Description	Default
Required		

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Option	Description	Default
`-changelog-file|-chf`	The root changelog file.	-
`-count|-cu`	The number of changes to apply.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|l-`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-show-summary|-shs <show-summary> {OFF|SUMMARY|VERBOSE}`	Produces a summary list of any changesets skipped and why they were skipped. Valid values are OFF, SUMMARY, and VERBOSE.	SUMMARY
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Update database with the specified number of changesets in the changelog file.

```
SQL> cd <lb-changes-directory>
SQL> lb update -changelog-file controller.xml -count 2
```


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14.16.40 update-count-sql

Generate the SQL to deploy the specified number of changes for review before running the update command.

Syntax

```
Liquibase|lb update-count-sql|upcs {OPTIONS}
```

Liquibase uses the raw SQL to apply database changes you have added to the changelog file.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-count|-cu`	The number of changes to apply.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-

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Option	Description	Default
`-secure-parsing|scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

14.16.41 update-sql

Generate the SQL identified in the changelog for review before running the `update` command.

Syntax

```
Liquibase|lb update-sql|ups {OPTIONS}
```

Liquibase uses the raw SQL to apply database changes you have added to the changelog file.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-

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Option	Description	Default
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-override-app-alias|-ovaa`	Override value to be used for the APEX application alias.	-
`-override-app-id|-ovai`	Override value to be used for the APEX application id.	-
`-override-app-schema|-ovas`	Override value to be used for the APEX workspace schema.	-
`-override-app-workspace|-ovaw`	Override value to be used for the APEX application workspace.	-

14.16.42 update-testing-rollback

Updates database, then rolls back changes before updating again. It provides testing of rollback funtionality.

Syntax

```
Liquibase|lb update-testing-rollback|uptr {OPTIONS}
```

Use only when all pending changelogs have been verified as ready to be deployed.

A multi-step operation is used and runs in sequential order:

```
update changeset1; update changeset2; update changeset3\
rollback changeset3; rollback changeset2; rollback changeset1
update changeset1; update changeset2; update changeset3
```

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-

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Option	Description	Default
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	-

14.16.43 update-to-tag

Deploy changes sequentially from the newest changeset up to and including the changeset with the specified tag.

Syntax

```
Liquibase|lb update-to-tag|uptt OPTIONS
```

The update-to-tag command will deploy changes only when you have previously added a tag Database Change Type in your changelog file. You cannot use the update-to-tag command with the reference to a tag created in the `DATABASECHANGELOG` table using the tag command. An update-to-tag-sql should always be run to review the SQL before running update-to-tag.

Options

Option	Description	Default
Required		

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Option	Description	Default
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	-
`-show-summary|-shs <show-summary> {OFF|SUMMARY|VERBOSE}`	Produces a summary list of any changesets skipped and why they were skipped. Valid values are OFF, SUMMARY, and VERBOSE.	SUMMARY
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Update database with the changesets up to and including the changeset with the specified database tag.

```
SQL> cd <lb-changes-directory>
-- Edit changelog file and add tagDatabase entries for versions
-- Execute an update-to-tag using a tag specified in tagDatabase in the
```


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```
changelog file
SQL> lb update-to-tag -tag version1 -changelog-file controller.xml
```

14.16.44 update-to-tag-sql

Generate the SQL from the newest changeset up to and including the changeset with the specified tag.

Syntax

```
Liquibase|lb update-to-tag-sql|uptts {OPTIONS}
```

An update-to-tag-sql should always be run to review the SQL before running update-to-tag The `update-to-tag-sql` command will generate SQL when you have previously added a tag Database Change Type in your changelog file. You cannot use the update-to-tag command with the reference to a tag created in the `DATABASECHANGELOG` table using the tag cde command.

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
`-tag|-ta`	The tag to use during the execution of the command.	-
Optional		
`-contexts|-co`	Context string to use for filtering which changes to operate on.	-
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-labels|-la`	Label expression to use for filtering the changes to operate on.	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-output-default-schema|-ouds`	Control whether names of objects in the default schema are fully qualified or not. If true they are qualified. If false, only objects outside the default schema are fully qualified.	False

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Option	Description	Default
`-output-file|-ouf`	The name of the file to write the output to.	-
`-overwrite-files|-ovf`	Overwrite any existing files in the directory. This will not affect other files.	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True

Example

Update database with the changesets up to and including the changeset with the specified database tag.

```
SQL> cd <lb-changes-directory>
-- Edit changelog file and add tagDatabase entries for version1
SQL> lb update-to-tag-sql -tag version1 -changelog-file controller.xml
```

14.16.45 validate

Validate the changelog for errors that may cause an `UPDATE` to fail.

Syntax

```
Liquibase|lb validate|va {OPTIONS}
```

The following checks are done:

- XML, YAML, JSON, and SQL structure
- Referenced files exist
- Required or prohibited attributes are correct for your database
- Duplicated id, author, and file combinations
- Checksum errors

Options

Option	Description	Default
Required		
`-changelog-file|-chf`	The root changelog file.	-
Optional		
`-database-changelog-table-name|-dactn`	Name of table to use for tracking change history.	-
`-debug|-de`	Enable debug output.	-
`-default-schema-name|-desn`	The default schema name to use for the database connection.	-

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Option	Description	Default
`-defaults-file|-def`	Fully qualified path to the properties file you want to use. Example: `-defaults-file/tmp/liquibase.properties`	-
`-liquibase-schema-name|-lbsn`	Schema to use for Liquibase objects.	-
`-liquibase-tablespace-name|-lbtn`	Tablespace to use for Liquibase objects.	-
`-log|-lo`	Enable logging. Standard logging is `INFO` level (no debug flag). Debug logging is `FINEST` level (both log and debug flag).	-
`-search-path|-sep`	Complete list of locations to search for files such as changelog files. You can specify multiple paths by separating them with commas.	-
`-secure-parsing|-scp`	If true, remove functionality from file parsers that could be used insecurely. An example is disabling remote XML entity support.	True
`-output-default-schema|-ouds`	Controls whether names of objects in the default schema are fully qualified or not. If false, only objects outside the default schema are fully qualified.	False

Example

Validate before running UPDATE.

```
-- Set default output path
SQL> cd <output-files-path>
-- Connect to target and validate
SQL> connect <db-connect-string>
SQL> lb validate -changelog-file controller.xml
```

14.16.46 version

Display version information.

Syntax

```
Liquibase|lb version|ve
```

Options

Option	Description	Default
`-debug|-de`	Enable debug output.	-

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14.17 MDB

The MDB command enables the import of tables and data from MDB (Microsoft Access Database) files into an Oracle database schema.

You can run the MDB command in SQLcl using `mdb`.

To view the help information for MDB, enter `help mdb`.

The following two sub-commands are supported, enabling listing or copying data from a Microsoft Access database file.

List Data

Lists tables or saved queries (views) that exist in the specified MDB file and outputs the list.

Syntax

```
mdb  list {OPTIONS}
```

Options

Option	Description
Required	
`-file|-fi <file>`	Path of the Microsoft Access database file.
Optional	
`-tables|-tabs`	Only the tables that exist in the specified Microsoft Access file.
`-views|-vw`	Only the views or saved queries that are saved in the Microsoft Access database.

Examples

List all tables and saved queries in an MDB file.

```
 mdb list -file mdb_file.mdb
```

Copy Data

Copy tables or views from the Microsoft Access database to the Oracle Database.

Syntax

```
mdb  copy {OPTIONS}
```

Options

Option	Description
Required	
`-file|-fi <file>`	Path of the Microsoft Access database file.
Optional	

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Option	Description
`-tables|-tabs`	Only the tables that exist in the specified Microsoft Access file.
`-views|-vw`	Only the views or saved queries that are saved in the Microsoft Access database.
`-prefix|-pr <prefix>`	Name to add before the table or view table names.
`-table|-tab <table>`	Copy a specific table from MDB file into Oracle Database.
`-mode|-mo <mode> {APPEND|REPLACE|SKIP|TRUNCATE} (REPLACE)`	Specify the mode of operation for handling existing data in the destination table. The available options are: • replace: If the target table exists, drop it, then recreate it and add the new data. • append: Add the new data to the existing data in the target table, if any. • truncate: Clear all existing data in the target table before adding the new data. • skip: If the target table already exists, do nothing. Otherwise, create the table and add the new data.

Examples

Copy all from MDB file to Oracle Database.

```
SQL> mdb copy -file mdb_file.mdb
```

Replace the existing target table by dropping it if it exists, then recreate it and add the data.

```
SQL> mdb copy -table employees -file mdb_file.mdb -mode replace
```

14.18 MLE

Use the MLE command to load JavaScript libraries to the database as MLE modules.

The sub-commands are:

- Create Module
- Alter Module

Prerequisites

This command requires:

- Oracle Database Release 23ai.
- The `CREATE TABLE` privilege is required for the create-module sub-command. If creating a module in another schema, then the `CREATE ANY TABLE` privilege is required.
- System privileges documented in the *Oracle Database JavaScript Developer's Guide*.

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14.18.1 Create Module

Creates an MLE module.

Syntax

```
mle create-module {OPTIONS}
```

Options

Option	Description
Required	
`-filename <filename>`	Specifies the path to a valid JavaScript file.
`-module-name <module>`	Specifies the name of the module to create in the current schema.
Optional	
`-bundler <bundler> {rollup}`	Specifies the name of a supported program that can bundle a JavaScript file with its dependencies. See JavaScript with External Dependencies.
`-bundler-config <bundler-config> {file}`	Specifies the name of a configuration file for the bundler program.
`-if-not-exists`	Creates the module only if it does not exist.
`-language <language>`	Specifies the name of a supported programming language. The default value is JavaScript.
`-metadata <metadata>`	Specifies any valid JSON text that describes the module. This option is mutually exclusive with -metafile.
`-metafile <metafile>`	Specifies the path to a valid JSON file that describes the module. This option is mutually exclusive with -metadata.
`-sbom <sbom> {syft}`	Specifies the name of a supported program that can create a Software Bill of Materials.
`-replace`	Replaces the module if it exists or create one if it does not exist.
`-schema <schema>`	Specifies the name of an alternate schema to own the module.
`–verbose`	Emits additional diagnostic information as the command makes progress.
`–version <version>`	Specifies the version of the programming language.

JavaScript with External Dependencies

The Create Module sub-command can load a JavaScript file that refers to other JavaScript modules. To accomplish this, the MLE command bundles the specified JavaScript file with all its dependencies and uses the external rollup command.

- **Install rollup and syft**

  For bundling external dependencies, install rollup. For SBOM (Software Bill of Materials), install syft. You can use brew install for both.

- **Configuring rollup execution**

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The intended usage for bundling is to bundle a single JavaScript file that has external dependencies. For example, if bundling should exclude one or more external dependencies, then those exclusions would be specified in a configuration file specified with the -bundler-config option. Not all bundling requires a configuration. In any case, the single JavaScript file to bundle is always specified with the -filename option, even if the input filename is specified in the configuration file.

- **Mutated dependency**

  If you create an MLE module using `a.js` that imports `c.js`, then modify `c.js`, and then create another module using `b.js` that also imports `c.js`, you end up with two MLE modules that contain different versions of the same dependency, `c.js`. This issue is known as a *mutated dependency*. To avoid this inconsistency, reorganize the code to create three separate MLE modules (`a.js`, `b.js`, `c.js`) and avoid bundling shared dependencies.

- **Debugging**

  When a bundled JavaScript file is created by the host command (using the -bundler option), the resulting JavaScript file is not an exact representation of what exists on the file system. Therefore, when you attach a debugger to the MLE module's execution, you do not know which external JavaScript file and line number you are viewing.

14.18.2 Alter Module

Change an existing MLE module.

Syntax

```
mle alter-module {OPTIONS}
```

Options

Option	Description
Required	
`-module-name <module>`	The name of the module to change in the current schema.
`-metadata <metadata>`	Any valid JSON text that describes the module. This option is mutually exclusive with -metafile.
`-metafile <metafile>`	The path to a valid JSON file that describes the module. This option is mutually exclusive with -metadata.
Optional	
`-if-exists`	Modify the module only if it exists.
`–verbose`	Emit additional diagnostic information as the command makes progress.
`-schema <schema>`	The name of an alternate schema that owns the module.

Examples

- Modify an existing MLE module by updating the metadata and specifying the module name.

```
SQL> mle alter-module -metadata '{"name":"getOrderTotal",
"version":"1.1"}' -module-name abc
```


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- Display the MLE module metadata.

```
SQL> select metadata from user_mle_modules where module_name = 'ABC'
```

14.19 MODEL

The `model` command configures OCI Generative AI models, ingests documents into Oracle vector tables, and removes vectors associated with ingested documents.

For prerequisites, and workflows, see Using the Model Command for Retrieval-Augmented Generation.

Syntax

```
MODEL CONFIG -list [-debug] [-verbose]
MODEL CONFIG CHAT-MODEL <model-options> [-debug] [-verbose]
MODEL CONFIG EMBEDDING-MODEL <model-options> [-debug] [-verbose]
MODEL INGEST -path <file-or-directory> -table <vector-table> [-debug] [-
verbose]
MODEL DELETE -file-path <file> -table <vector-table> [-debug] [-verbose]
```

Command	Description
`model config -list`	Displays the saved model configuration
`model config chat-model`	Configures the OCI chat model.
`model config embedding-model`	Configures the OCI embedding model.
`model ingest`	Embeds documents into a vector table.
`model delete`	Removes the vectors for one previously ingested document.

See:

- MODEL CONFIG
- MODEL INGEST
- MODEL DELETE

14.19.1 MODEL CONFIG

MODEL CONFIG CHAT MODEL

Syntax

```
MODEL CONFIG CHAT-MODEL -model-name <model-id>
-serving-type <ON-DEMAND|DEDICATED> -compartment-id <compartment-ocid>
[-config-path <oci-config-file>] [-debug] [-verbose]
```

Options

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Option	Required	Description
-model-name |-mn	Yes	OCI model or dedicated endpoint identifier.
-serving-type |-st	Yes	Serving type. Valid values are ON-DEMAND and DEDICATED.
-compartment-id |-ci	Yes	OCID of the OCI compartment containing or providing access to the model.
-config-path |-ocp	No	Path to an OCI configuration file.
-debug |-d	No	Enables diagnostic output.
-verbose |-v	No	Enables informational output.

MODEL CONFIG EMBEDDING MODEL

Syntax

```
MODEL CONFIG EMBEDDING-MODEL -model-name <model-id>
-serving-type <ON-DEMAND|DEDICATED> -compartment-id <compartment-ocid>
[-config-path <oci-config-file>] [-debug] [-verbose]
```

Options

Option	Required	Description
-model-name |-mn	Yes	OCI embedding model or dedicated endpoint identifier.
-serving-type |-st	Yes	Serving type. Valid values are ON-DEMAND and DEDICATED.
-compartment-id |-ci	Yes	OCID of the OCI compartment.
-config-path |-ocp	No	Path to an OCI configuration file.
-debug |-d	No	Enables diagnostic output.
-verbose |-v	No	Enables informational output.

14.19.2 MODEL INGEST

Use `model ingest` to generate vector embeddings for local documents and store the document chunks and their corresponding embeddings in an Oracle vector table.

Syntax

```
MODEL INGEST -path <file-or-directory>
-table <vector-table> [-debug] [-verbose]
```

Options

Option	Required	Description
-path | -fp	Yes	Path to file or directory to ingest.
-table | -tb	Yes	Name of the target vector table.
-debug | -d	No	Enables diagnostic output.

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Option	Required	Description
-verbose | -v	No	Displays scanning, model, and file progress information.

14.19.3 MODEL DELETE

Use `model delete` to remove vectors associated with a previously ingested document.

Syntax

```
MODEL DELETE -file-path <file>
-table <vector-table> [-debug] [-verbose]
```

Options

Option	Required	Description
-file-path |-fp	Yes	Path to the previously ingested file.
-table |-tb	Yes	Vector table containing the document.
-debug |-d	No	Enables diagnostic output.
-verbose |-v	No	Displays deletion progress.

14.20 MODELER

The `MODELER` command provides a command-line interface for Oracle SQL Developer Data Modeler features.

The options available are:

- `modeler help <command>` — Displays help information about the specified modeler command.
- `modeler ddl <parameters>` — Generates the Data Definition Lanaguage statements from the selected Data Modeler design.
- `modeler report <parameters>` — Generates the report from the selected Data Modeler design.

MODELER DDL

Generates the Data Definition Lanaguage statements from the selected Data Modeler design.

Syntax

```
MODELER DDL -design <file> -relmodel <name> [-outputfile <name>]
```

Parameters

Parameter	Description
`-design (d) <file>`	Full path to the design's file name.

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Parameter	Description
`-relmodel (rm) <name>`	Name of the relational model.
`-dbsite (ds) <name>`	(Optional) Name of the physical model database site. If this is not specified, then the default relational database management system site for the provided relational model is used.
`-outputfile (o) <file>`	Full path to the output file for the generated DDL content.
`-systemTypesDir (td) <path>`	Full path to the system types directory.
`-settingsFile (s) <file>`	Full path to the exported Data Modeler settings file.
`-ddlConfigFile (c) <file>`	Full path to the exported DDL configuration file.

Example

```
modeler ddl -design "C:/Designs/SH.dmd" -relmodel "SH" -outputfile "C:/
DDL.sql"
```

MODELER REPORT

Generates the report from the selected Data Modeler design.

Syntax

```
MODELER REPORT -design <file> -type <type> [-title <name>] -filename <name> -
outputpath <path>
```

Parameters

Parameter	Description
`-design (d) <file>`	Full path to the design's file name.
`-type (tp)`	Specify the type of report. Available types are: Tables, TableViews, TablesAndViews, Entities, EntityViews, EntitiesAndViews, Domains.
`-filename (f) <name>`	Name of the generated HTML file.
`-outputpath (o) <path>`	Full path to the folder for the generated HTML content. The report file is put in that folder and a "css" sub-directory with the CSS files used is created.
`-relmodel (rm) <name>`	Name of the relational model (for Tables and Table Views only).
`-title (tt) <name>`	(Optional) Title of the report.
`-standardTemplate (st) <name>`	Name of the template for a standard report, defining the set of report sections to include (optional). If this is not specified, all report sections are included.
`-customTemplate (ct) <name>`	(Optional) Name of the template for a custom report.
`-reportConfTemplate (c) <name>`	(Optional) Name of the template that defines the set of objects and subviews to include in the report.
`-companyname (cn) <name>`	(Optional) Name of the company.
`-systemTypesDir (td) <path>`	Full path to the system types directory.

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Parameter	Description
`-settingsFile (s) <file>`	Full path to the exported Data Modeler settings file.

Example

```
modeler report -design "C:/Designs/SH.dmd" -type "Tables" -filename
"SHTablesReport" -outputpath "C:/Reports"
```

14.21 OBJECTSTORAGE

Use the `OBJECTSTORAGE` command to use the Object Storage Service API to manage objects, and related resources.

This command enables you to:

- List objects in a bucket
- Store an object in a bucket
- Retrieve an object from a bucket
- Delete an object from a bucket

The sub-commands are:

- Set
- Object

> **See Also**
>
> - Overview of Object Storage
> - Object Storage Objects

14.21.1 Set

Configures global options used for OCI Object Storage operations. This is used to avoid repeating required options for `object` sub command operations: `GET`, `PUT`, `LIST`, and `DELETE`.

Syntax

```
objectstorage  set {PARAMETERS}
```

Parameters

Parameter	Description
Required	
`<global-option> {BUCKET-NAME|NAMESPACE}`	Provides the option name to set as a default (for example, `BUCKET-NAME` or `NAMESPACE`).
`<value>`	Provides the required value to assign to the chosen global option.

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Example

```
objectstorage set namespace ociNamespace

      objectstorage set bucket-name ociBucketName

      objectstorage object get -object-name someObject.txt -file
   /path/to/output.txt
```

14.21.2 Object

Manages an object in OCI Object Storage.

Syntax

```
objectstorage   object {SUBCOMMAND}
```

Sub-commands

Sub-command	Description
GET	Retrieves an object from the OCI Object Storage.
PUT	Uploads a resource to the OCI Object Storage.
LIST	Lists the objects contained in a bucket in OCI Object Storage.
DELETE	Deletes an object from the OCI Object Storage.

14.21.2.1 LIST

Lists the objects within a bucket in the OCI Object Storage.

Syntax

```
objectstorage list {OPTIONS}
```

Options

Option	Description
Optional	
`-namespace|-ns <namespace>`	Specifies the OCI `namespace`.

> **Note**
>
> Omit this option if you previously specified `objectstorage set namespace <name>` by using the set sub-command.

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Option	Description
`-bucket-name|-bn <bucket-name>`	Specifies the OCI `bucket name` **Note** Omit this option if you previously specified `objectstorage set bucket-name <name>` by using the set sub-command.
`-start <start>`	Specifies the string to use for matching against object names which are lexicographically greater than or equal to specified string.
`-end <end>`	Specifies the string to use for matching against object names which are lexicographically strictly less than this specified string.
`-prefix <prefix>`	Specifies the string to use for matching against the start of object names in a list query.
`-fields <fields>`	Specifies the string to include `size` (object size in bytes), `etag`, `md5`, `timeCreated` (object creation date and time), `timeModified` (object modification date and time), `storageTier` and `archivalState` fields. Specify the values as a comma-separated, case-insensitive list of those field names. For example: `name,etag,timeCreated,md5,timeModified,storageTier,archivalState`. Supported values are: • `name` • `size` • `etag` • `timeCreated` • `md5` • `timeModified` • `storageTier` • `archivalState`
`-limit <limit>`	Specifies the maximum number of results per page, or items to return in a paginated "List".
`-all <all> (false)`	Specifies a flag to indicate to return all object names within the bucket. **Note** If you provide this option, then you cannot provide the `-limit <limit>` option.

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Option	Description
`-client-request-id|-cid <client-request-id>`	Specifies the client request ID to use for tracing.

14.21.2.2 GET

Retrieves an object from the OCI Object Storage.

Syntax

```
objectstorage get {OPTIONS}
```

Options

Option	Description
Required	
`-object-name|-on <object-name>`	Specifies the name of an OCI object within a bucket.
`-file|-f <file>`	Specifies the location of the file to store the object's content.
Optional	
`-etag|-et <etag>`	Specifies the entity tag (`ETag`) to match with the `ETag` of an existing object. If the specified `ETag` matches the `ETag` of the existing object, then the object is downloaded.
`-avoid-etag-match|-aem <avoid-etag-match>`	Specifies the entity tag (`ETag`) to avoid matching while retrieving the objects. Retrieves the object only when `ETag` does not match.
`-client-request-id|-cid <client-request-id>`	Specifies the client request ID to use for tracing.
`-namespace|-ns <namespace>`	Specifies the OCI `namespace`.

> **Note**
>
> Omit this option if you previously specified `objectstorage set namespace <name>` by using the set sub-command.

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Option	Description
`-bucket-name|-bn <bucket-name>`	Specifies the OCI `bucket name`.

> **Note**
>
> Omit this option if you previously specified `objectstorage set bucket-name <name>` by using the set sub-command.

Examples

GET an OCI object to download to the file location:

```
objectstorage object get -namespace ociNamespace -bucket-name
    ociBucketName -object-name someObject.txt -etag
    a1111111-b222-c333-d444-e55555555555 -file /path/to/output.txt
```

GET an OCI object that matches the entity tag (`ETag`) and download to the file location:

```
 objectstorage object get -namespace ociNamespace -bucket-name
    ociBucketName -object-name someObject.txt -etag
    a1111111-b222-c333-d444-e55555555555 -file /path/to/output.txt
```

GET an OCI object that does not match the entity tag (`ETag`) and download to the file location:

```
objectstorage object get -namespace ociNamespace -bucket-name
    ociBucketName -object-name someObject.txt -avoid-etag-match
    a9999999-b888-c777-d444-e66666666666 -file /path/to/output.txt
```

14.21.2.3 PUT

Uploads an object to the OCI Object Storage.

Syntax

```
objectstorage put {OPTIONS}
```

Options

Option	Description
Required	
`-file|-f <file>`	Specifies the location of the file to store the object's content.
Optional	

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Option	Description
`-namespace|-ns <namespace>`	Specifies the OCI `namespace`. **Note** Omit this option if you previously specified `objectstorage set namespace <name>` by using the set sub-command.
`-bucket-name|-bn <bucket-name>`	Specifies the OCI `bucket name` **Note** Omit this option if you previously specified `objectstorage set bucket-name <name>` by using the set sub-command.
`-cache-control|-cc <cache-control>`	Specifies cache-control HTTP header that defines the caching behavior.
`-checksum-algorithm|-csa <checksum-algorithm> {CRC32C|SHA256|SHA384}`	Specifies an additional checksums for the HTTP request body in addition to the default MD5, to enhance object data integrity verification. Supported values are: • `CRC32C` • `SHA256` • `SHA384`
`-checksum-content|-csc <checksum-content>`	Specifies the checksum value corresponding to the selected checksum algorithm (`CRC32C`, `SHA256`, or `SHA384`) for the HTTP request body.
`-client-request-id|-cid <client-request-id>`	Specifies the client request ID to use for tracing.
`-content-disposition|-cd <content-disposition>`	Specifies the optional content-disposition header that defines presentational information for the object
`-content-encoding|-ce <content-encoding>`	Specifies the content-encoding header that defines the content encodings that were applied to the object to upload. Content encoding primarily used to compress a document without losing the identity of its underlying media type.
`-content-language|-cl <content-language>`	Specifies the content-encoding header that defines the content encodings that were applied to the object to upload. The natural language for the intended audience for the resource.
`-content-md5|-cm <content-md5>`	Specifies the Base64-encoded MD5 hash of the request body for object data integrity verification.

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Option	Description
`-content-type|-ct <content-type>`	Specifies the content-type header that defines the standard MIME type format of the object.
`-etag|-et <etag>`	Specifies the ETag to match with the ETag of an existing resource. If the specified ETag matches the ETag of the existing resource, PUT command uploads the resource.
`-object-name|-on <object-name>`	Specifies the name of the OCI object.
`-overwrite|-ow <overwrite> (true)`	Specifies to overwrite an object that already exists with the same object name or file name.
`-storage-tier|-st <storage-tier> {Archive|InfrequentAccess|Standard}`	Specifies the storage tier that the objects should be stored in. If not specified, the objects are stored in the same storage tier as the bucket. The supported values are: • `STANDARD` • `INFREQUENTACCESS` • `ARCHIVE`

Examples

Upload a file to OCI from the file location:

```
objectstorage object put -namespace ociNamespace -bucket-name
      ociBucketName -object-name someObject.txt -file /path/to/myfile.txt
```

Specify the `-checksum-algorithm` and its `-checksum-content`:

```
 objectstorage object put -namespace ociNamespace -bucket-name
      ociBucketName -object-name someObject.txt -checksum-algorithm SHA256
      -checksum-content <SHA256 hash base64 encoding> -file /path/to/
myfile.txt
```

Specify multiple options:

```
objectstorage object put -namespace ociNamespace
      -bucket-nameociBucketName -object-name someObject.txt -file
      /path/to/myfile.txt -cache-control max-age=3600  -content-language en-US
      -content-type text/plain -content-disposition 'attachment;
      filename="example_file.txt"'
```

14.21.2.4 DELETE

Deletes an object from the OCI Object Storage.

Syntax

```
objectstorage delete {OPTIONS}
```

Options

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Option	Description
Required	
`-object-name|-on <object-name>`	Specifies the name of an OCI object within a bucket.
Optional	
`-namespace|-ns <namespace>`	Specifies the OCI `namespace`. **Note** Omit this option if you previously specified `objectstorage set namespace <name>` by using the set sub-command.
`-bucket-name|-bn <bucket-name>`	Specifies the OCI `bucket name`. **Note** Omit this option if you previously specified `objectstorage set bucket-name <name>` by using the set sub-command.
`-etag|-et <etag>`	Specifies the entity tag (`ETag`) to match with the `ETag` of an existing object. If the specified `ETag` matches the `ETag` of the existing object, then the object is deleted.

14.22 ORAPKI

The `orapki` utility is a command-line tool designed to manage public key infrastructure (PKI) components, including wallets and certificate revocation lists. By operating via the command line, it allows these tasks to be seamlessly integrated into scripts, enabling automation of routine PKI maintenance activities.

For more information on `orapki` utility commands , see orapki Utility Commands Summary

14.22.1 ADD

Adds certificate requests and certificates to an Oracle wallet. It also enables you to download the TLS certificate chain from an HTTPS endpoint and add it to an existing Oracle wallet as trusted certificates. This simplifies configuring wallets for endpoints that use certificates not

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already trusted by your environment (for example, endpoints using self-signed certificates or private Certificate Authorities).

Syntax

```
add {OPTIONS}
```

Options

Option	Description
Required	
`-wallet <wallet> {FILE}`	Specifies the location of the Oracle wallet.
Optional	
`-pwd <pwd>`	Specifies the password of the Oracle wallet.
`-dn <dn>`	Specifies the distinguished name of the certificate to add.
`-alias <alias>`	Specifies an alias for the certificate.
`-asym_alg <asym_alg>`	Specifies the asymmetric algorithm to use (RSA or ECC).
`-keysize <keysize>`	Specifies the requested certificate's key size. The key size identifiers are 512, 1024, 2048, 4096, 8192, 16384.
`-eccurve <eccurve>`	Specifies the elliptic curve for ECC algorithms.
`-self_signed`	Specifies that the certificate should be self-signed.
`-validity <validity>`	Specifies the certificate validity measured in days, starting from the current date.
`-valid_from <valid_from>`	Specifies the start date of certificate validity (format: mm/dd/yyyy or yymmdd-hhmmss-z).
`-valid_until <valid_until>`	Specifies the end date of certificate validity (format: mm/dd/yyyy or yymmdd-hhmmss-z).
`-serial_file <serial_file> {FILE}`	Specifies the file location to store or read the serial number for the certificate.
`-serial_num <serial_num>`	Specifies an identification number for the certificate.
`-sign_alg <sign_alg>`	Specifies the signature algorithm that can be used by CA to sign the certificate.
`-addext_ski`	Adds a Subject Key Identifier (SKI) extension to the certificate.
`-addext_ku <addext_ku>`	Adds key usages. The supported keys are: • `digitalSignature` • `nonRepudiation` • `keyEncipherment` • `dataEncipherment` • `keyAgreement` • `keyCertSign` • `cRLSign` • `encipherOnly` • `decipherOnly`
`-addext_basic_cons <addext_basic_cons>`	Adds basic constraints' extension. This extension mentions that the certificate request is CA.
`-pathlen <pathlen>`	Specifies the path length for the basic constraints extension.

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Option	Description
-addext_san <addext_san>	Adds Subject Alternative Name (SAN) extension with DNS, IP, or IPV6 addresses. It only allows adding domain names separated by a comma. For example: DNS:<value1>,DNS:<value2>,DNS:<value3>\n OR DNS:ns1.example.com,DNS:ns2.example.com
-cert <cert> {FILE}	Specifies the certificate location.
-trusted_cert	Specifies that the certificate is a trusted certificate.
-user_cert	Specifies that the certificate is a user certificate.
-auto_login_only	Specifies that the Oracle wallet is in auto-login-only mode.
-trust_flags <trust_flags>	Specifies the trust flags (SERVER_AUTH, CLIENT_AUTH, VALID_PEER, or NULL) to be added to the certificate
-from_uri <from_uri>	Specifies the HTTPS URL of the endpoint whose TLS certificate chain needs to be downloaded and added to the Oracle wallet. The URL must use the https:// scheme, and the port defaults to 443 if not specified.

Examples

Download and add TLS certificates from a public endpoint:

```
SQL> orapki wallet add -wallet /u01/app/oracle/admin/db_wallet -trusted_cert \
     -from_uri https://www.example.com -pwd MySecurePassword
```

Add a self-signed certificate to a wallet:

```
SQL> orapki wallet add -wallet /u01/app/oracle/admin/db_wallet
             -dn "CN=server.in.oracle.com, OU=Support, O=Oracle, L=Jaipur,
            ST=Rajasthan, C=IN"
             -asym_alg RSA -keysize 2048 -self_signed -validity 365 -
addext_ski
            -addext_ku digitalSignature,nonRepudiation,keyEncipherment
```

Add a certificate file to the wallet:

```
 SQL> orapki wallet add -wallet /u01/app/oracle/admin/db_wallet -cert
        /path/to/certificate.pem -pwd MySecurePassword
```


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Add a certificate with SAN extension:

```
SQL> orapki wallet add -wallet /u01/app/oracle/admin/db_wallet -dn
        "CN=example.com" -asym_alg RSA
             -keysize 2048 -addext_san "DNS:example.com,IPV4:192.168.1.1" -pwd
            MySecurePassword
```

14.23 PROJECT

The command in SQLcl for Database CI/CD extension is `project`. It contains several sub-commands that are used as part of the process to help developers manage database changes and create serialized transactions.

Syntax

```
project|proj [init|in] | [export|ex] | [config|cfg] | [gen-artifact|ga] |
[deploy|dp] | [release|re] | [verify|v] | [stage|st]
```

The following table provides a description of each sub-command.

Sub-Command	Description
init|in	Initializes a new project. This command can be run in a new Git repository or in an existing repository.
config|cfg	Enables you to view and manage your project configuration properties. This command allows you to look at the current configuration that is used by each of the `project` commands.
export|ex	Exports database objects into your repository.
stage|st	Creates Liquibase changelogs or changesets for all source files and custom SQL files. The `stage` command is used along with the `export` command.
release|re	Moves the current set of work into a release state and starts a new body of work. The `release` command takes the contents of the dist/next folder and renames it to a given version number, then creates a new `next` folder under dist.
gen-artifact|ga	Generates an artifact representing the current state of your project.
deploy|dp	Deploys the artifact on a target database.
verify|v	Provides the means to test various aspects of your project (snapshots, changes, overall project).

14.23.1 init

Initializes a new project.

Syntax

```
project|proj init|in {OPTIONS}
```

Options

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Option	Description
Required	
`-name|-n <name>`	Specifies a name for the project.
Optional	
`-autoconnect`	Specifies if you want SQLcl to automatically connect to the connection specified in the SQLcl connection name property. If the value is False, you have to manually connect to the specified connection.
`-schemas|-s <schemas>`	Specifies a comma-separated list of schemas to export.
`-directory|-d <directory>`	Specifies the path of the directory where the project should be created. If no path is specified, the project is created in the current directory.
`-connection-name|-con <connection-name>`	Specifies the SQLcl connection name. If you do not provide a connection name and are connecting through a named connection, the system automatically adds that connection name to the `connectionName` configuration property. If no named connection is used, the `connectionName` property remains empty.
`-makeroot|-mr`	Creates a root folder named after the project and stores all files in this directory.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process in the output.

Examples

- Initialize a project with the following details:
  - Project name: apexsb
  - Schemas to export: apexsb_data,apexsb
  - Directory: /workspace/projects/
  - SQLcl connection name: apexsb_conn

```
SQL> project init -name apexsb -schemas apexsb_data,apexsb -d /workspace/
projects -con apexsb_conn
```

14.23.2 export

Exports database objects to your repository.

Syntax

```
project|proj export|ex {OPTIONS}
```

Options

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Option	Description
`-list|-l`	Lists all objects in alphabetical order. The list of objects to export is output based on the current parameters.
`-objects|-o <objects>`	Specifies comma-separated list of objects to export. For example, `HR.COUNTRIES`.
`-schemas|-s <schemas>`	Specifies a comma-separated list of schemas to export. For example, `HR`.
`-threads|-t <threads>`	Specifies the number of concurrent threads to use with cloned JDBC connections for executing `DBMS_METADATA.getDDL`. The default value is five.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Example

Export custom export filters from `.dbtools/filters/project.filters`.

```
SQL> project export -debug -list -objects REGIONS,COUNTRIES -schemas
HR,SCOTT -threads 4
```

14.23.3 config

Enables you to view and manage the project configuration properties.

Syntax

```
project|proj config|cfg {SUBCOMMAND} {OPTIONS}
```

Options

Option	Description
Required	
`-list|-li`	Lists your current configuration settings
Optional	
`-name|-n <name`	Specifies the config parameter name that can be used when filtering or editing.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output .

Examples

List the configuration for the `sqlcl.version` parameter. Use `-verbose` to include default value and description.

```
project config -list -name sqlcl.version -verbose
```


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Sub-Commands

The sub-commands are:

- set: To add or update project configuration parameters.
- delete: To remove a config parameter from the project configuration.

Add or Update a Configuration Parameter

Use the `set` command to add a new configuration parameter or update the existing one.

Syntax

```
project|proj config|cfg set|s {OPTIONS}
```

Options

Option	Description
Required	
`-name|-n <name>`	Specifies the name for the project.
`-value|-va <value>`	Specifies the value that should be assigned to the configuration parameter.
Optional	
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output .

Example

Set the parameter `export.demo.demoComments` to `true`.

```
SQL> project config set -name export.demo.demoComments -value TRUE -verbose
```

Remove Configuration Parameter

Use the `delete` command to remove a configuration parameter from the project configuration.

Syntax

```
project|proj config|cfg  delete|d {OPTIONS}
```

Options

Option	Description
`-name|-n <name>`	Specifies the configuration parameter name that can be used when filtering or editing.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

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14.23.4 gen-artifact

Generates an artifact representing the current state of your project.

Syntax

```
project|proj gen-artifact|ga {OPTIONS}
```

Options

Option	Description
`-name|-n <name>`	Specifies a custom name for the artifact.
`-format|-fo <format>`	Specifies the desired compression format. Supported values are, `zip` or `tgz`.
`-version|-ve <version>`	Specifies the artifact version.
`-force|-f`	Overwrites the artifact if it exists.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Example

Generate an artifact named `R1-1` in `zip` format. The artifact is saved in the artifact folder.

```
SQL> project gen-artifact -name R1 -version 1 -format zip -verbose
```

14.23.5 deploy

Deploys the artifact on a target database.

Syntax

```
project|proj deploy|dp {OPTIONS}
```

Options

Option	Description
Required	
`-file|-fs <file> {FILE}`	Specifies the artifact file location path.
Optional	
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Example

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Extract the artifact file from the specified path. The command executes `@dist/install.sql` and initiates the Liquibase installer on the target database.

```
SQL> project deploy -file /Users/user1/Desktop/project1/artifact/R1-1.zip -
verbose
```

14.23.6 release

Moves the current set of work into a release state and starts a new body of work.

Syntax

```
project|proj release|re {OPTIONS}
```

Options

Option	Description
Required	
`-version|-ve <version>`	Specifies the release version to label the release.
Optional	
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.
`-include|-inc <include>`	Enables to release only the specified changes. In case of multiple changes, specify the comma-delimited list with no spaces between change IDs.

> **Note**
>
> Use either `-include|-inc <include>` or `-exclude|-exc <exclude>`. Both options cannot be used together.

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Option	Description
`-exclude|-exc <exclude>`	Enables to release all except the specified changes. In case of multiple changes, specify the comma-delimited list with no spaces between change IDs. **Note** Use either `-include|-inc <include>` or `-exclude|-exc <exclude>`. Both options cannot be used together.

Examples

Package a unit of work into a release.

```
SQL> project release -version 1.0
```

Release only a hotfix.

```
project release -version 1.0.1-hotfix -include PROJ-102
```

Release everything except a QA change.

```
project release -version 2.0.0 -exclude PROJ-202
```

14.23.7 verify

Tests various aspects of your project (snapshots, changes, and overall project).

Syntax

```
project|proj verify|v {SUBCOMMAND} {OPTIONS}
```

Options

Option	Description
Optional	
`-comparedBranchName|-cbn`	Specifies the branch to compare with the current branch. If you omit the parameter, the default branch is compared with the current branch.

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Examples

```
project verify -cbn mybranch
```

Sub-Commands

The sub-commands are:

- verify-stage: To execute all the verify tests registered for the stage group.
- snapshot: To execute all the verify tests registered for the snapshot group.

Verify Tests for the Stage Group

Use the `verify-stage` command to execute all the verify tests registered for the stage group.

Syntax

```
project|proj verify|v verify-stage|st {OPTIONS}
```

Options

Option	Description
Optional	
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Verify Tests for the Snapshot Group

Use the `snapshot` command to execute all the verify tests registered for the snapshot group.

Syntax

```
project|proj verify|v snapshot|ss {OPTIONS}
```

Options

Option	Description
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

14.23.8 stage

Creates Liquibase changelogs or changesets for all source files and custom SQL files.

It is used along with the `export` command. It can also be used to add other custom changesets as part of the change. This generates a file to add SQL and SQLcl commands with a Liquibase SQL changeset header. This file will be added to the changelog hierarchy automatically.

Syntax

```
project|proj stage|st {SUBCOMMAND} {OPTIONS}
```


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Options

Option	Description
`-branch-name|-bn`	Specifies the branch name for comparison. If not provided, the value from the configuration file (`git.defaultBranch`) is used, with `develop` as the default.
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Examples

Create a new directory under dist/releases/next specifying the branch name.

```
SQL> project stage -branch-name branch1
```

Add a Custom File to Stage

Use the `add-custom` command to add a custom file to stage.

Syntx

```
project|proj stage|st add-custom|ac {OPTIONS}
```

Options

Option	Description
Required	
`-file-name|-fn <file-name>`	Specifies the name for the custom file.
Optional	
`-debug|-de`	Displays the debug information in the output.
`-verbose|-v`	Displays additional details about the current process, in the output.

Example

Add `feature1.sql` custom file.

```
SQL> project stage add-custom -file-name feature1.sql
```

14.24 REST

The REST command enables you to export Oracle REST Data Services 3.x services. This is applicable for Oracle REST Data Services release 3.0.5 or later.

If you have an earlier version of Oracle REST Data Services, you will need to upgrade. See the Installing Oracle REST Data Services section in *Oracle REST Data Services Installation, Configuration, and Development Guide* for details.

The REST command contains the following subcommands:

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List Commands

Command	Description
modules	Lists modules in a schema.
clients	Lists OAuth clients in a schema.
schemas	Lists REST-enabled schemas.
privileges	Lists privileges in a schema.

Export Commands

Command	Description
export module	Exports a REST module by name or prefix.
export client	Exports an OAuth client by name.
export schema	Exports a REST-enabled schema.

Import Command

Command	Description
import	Imports a REST definition form a JSON file.

14.24.1 modules

Lists all modules in the current schema or the specified schema.

Syntax

```
REST modules {OPTIONS}
```

Options

Option	Description
-schema-name	Specifies the name of the schema whose modules are to be listed. If you omit this parameter, the command lists the objects in the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To list modules in the current schema, enter:

```
SQL> REST modules
```

Example 2

To list modules in a schema named `my_other_schema`, enter:

```
SQL> REST modules -schema-name my_other_schema
```


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14.24.2 clients

Lists all OAuth clients in the current schema or the specified schema.

Syntax

```
REST clients {OPTIONS}
```

Options

Option	Description
-schema-name	Specifies the name of the schema whose OAuth clients are to be listed. If you omit this parameter, the command lists the objects in the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To list OAuth clients in the current schema, enter:

```
SQL> REST clients
```

Example 2

To list OAuth clients in a schema named `my_other_schema`, enter:

```
SQL> REST clients -schema-name my_other_schema
```

14.24.3 schemas

Lists all REST-enabled schemas. If you run this command with the ORDS_ADMINISTRATOR_ROLE, it lists all REST-enabled schemas; otherwise, it lists only the current REST-enabled schema.

Syntax

```
REST schemas
```

Example

To list REST-enabled schemas, enter:

```
SQL> REST schemas
```


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14.24.4 privileges

Lists all privileges in the current schema or the specified schema.

Syntax

```
REST privileges {OPTIONS}
```

Options

Option	Description
-schema-name	Specifies the name of the schema whose privileges are to be listed. If you omit this parameter, the command lists the objects in the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To list privileges in the current schema, enter:

```
SQL> REST privileges
```

Example 2

To list privileges in a schema named `my_other_schema`, enter:

```
SQL> REST privileges -schema-name my_other_schema
```

14.24.5 export module

Exports a REST module by name or prefix in the current schema or the specified schema. Requires Oracle REST Data Services (ORDS) **25.1.0 or later**.

Syntax

```
REST export module <item_name> {OPTIONS}
```

Parameters

Parameter	Description
Required	
<item_name>	Specifies the module to export, using either: • The REST module name, for example, `my-module1` or `hr-module`. • The REST module prefix, for example, `/module1/` or `/hr/`.

Options

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Option	Description
-schema-name	Specifies the name of the schema owning the module. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.
-runnable-as-admin	Flag option. When present, generates a script utilizing the ORDS_ADMIN package, allowing object creation in schemas other than the connected schema. When absent, generates a script using the standard ORDS package restricting operations to the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To export a module in the current schema, enter:

```
SQL> REST export module my-module1
```

or

```
SQL> REST export module /module1/
```

Example 2

To export a module in a schema named `my_other_schema` using the standard ORDS package in the output, enter:

```
SQL> REST export module my-module1 -schema-name my_other_schema
```

or

```
SQL> REST export module /module1/ -schema-name my_other_schema
```

Example 3

To export a module in a schema named `my_other_schema` using the ORDS_ADMIN package in the output, enter:

```
SQL> REST export module my-module1 -schema-name my_other_schema -runnable-as-
admin
```

or

```
SQL> REST export module /module1/ -schema-name my_other_schema -runnable-as-
admin
```


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14.24.6 export client

Exports an OAuth client in the current schema or the specified schema. Requires Oracle REST Data Services (ORDS) **25.3.0 or later**.

Syntax

```
REST export client <item_name> {OPTIONS}
```

Parameters

Parameter	Description
Required	
<item_name>	Specifies the name of the OAuth client to export.

Options

Option	Description
-schema-name	Specifies the name of the schema owning the OAuth client. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.
-runnable-as-admin	Flag option. When present, generates a script utilizing the ORDS_ADMIN package, allowing object creation in schemas other than the connected schema. When absent, generates a script using the standard ORDS package restricting operations to the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To export an OAuth client in the current schema, enter:

```
SQL> REST export client client_name
```

Example 2

To export an OAuth client in a schema named `my_other_schema` using the standard ORDS package in the output, enter:

```
SQL> REST export client client_name -schema-name my_other_schema
```

Example 3

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To export an OAuth client in a schema named `my_other_schema` using the ORDS_ADMIN package in the output, enter:

```
SQL> REST export client client_name -schema-name my_other_schema -runnable-as-admin
```

14.24.7 export schema

Exports a full schema. Requires Oracle REST Data Services (ORDS) **25.1.0 or later**.

Syntax

```
REST export schema {OPTIONS}
```

Options

Option	Description
-schema-name	Specifies the name of the schema to export. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.
-runnable-as-admin	Flag option. When present, generates a script utilizing the ORDS_ADMIN package, allowing object creation in schemas other than the connected schema. When absent, generates a script using the standard ORDS package restricting operations to the current schema. The ORDS_ADMINISTRATOR_ROLE is required to use this parameter.

Example 1

To export the current schema, enter:

```
SQL> REST export schema
```

Example 2

To export a schema named `my_other_schema` using the standard ORDS package in the output, enter:

```
SQL> REST export schema -schema-name my_other_schema
```

Example 3

To export a schema named `my_other_schema` using the ORDS_ADMIN package in the output, enter:

```
SQL> REST export schema -schema-name my_other_schema -runnable-as-admin
```


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14.24.8 import

Imports a REST definition form a JSON file.

This command imports a Swagger 2.0 or an OpenAPI 3.0 specification file and generates skeleton calls that can recreate a similar service in ORDS.

Syntax

```
REST import json_file_path
```

Parameters

Parameter	Description
Required	
json_file_path	Provides the absolute path to the json file.

Example

To import a REST definition form a JSON file, enter:

```
SQL> REST import /path/to/file.json
```

14.25 SDK

You can use the SDK command to install SDKs (Software Development Kit) from external cloud providers such as Azure and OCI. This command helps to install external software with all its related dependencies. The SDKs available are `jdbc-oci` and `jdbc-azure`.

Syntax

```
sdk|sd [ [list|l] | [install|i] | [update|u] | [remove|r] ]
```

List

Lists the available SDKs with their available versions and status (installed or not). For an update, this command shows the latest version.

Install

Installs the latest SDK from a cloud provider. The install command has verbose (-verbose) and debug (-debug) modes available.

After the install is over, restart SQLcl. The installed SDKs and its dependencies appear in the created directory under `sqlcl/lib/sdks/[the new sdk]`.

> **Note**
>
> When installing SDKs with the SDK command, the dependencies that are already installed in the classpath with SQLcl are not re-installed.

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Example

```
SQL> sdk install jdbc-oci
Downloading the ojdbc-provider-oci SDK and all its dependencies.
The jdbc-oci SDK is installed successfully, restart SQLcl for changes to take
effect.
```

Update

Updates the selected SDK to the latest version. This command removes and re-installs the SDK and its dependencies

You can also update by using the `sdk install` command on an already installed SDK.

Remove

Deletes the created directory for the SDK installed inside the SDK's directory in the lib folder. The contents of the directory are also deleted.

14.26 SET *system_variable value*

Sets a system variable to alter the SQLcl environment settings for your current session.

For example, to:

- Set the display width for data
- Customize HTML formatting
- Enable or disable printing of column headings
- Set the number of lines per page

Enter a system variable followed by a value as shown below:

```
SET APPI[NFO] {ON | OFF | text}
SET ARRAY[SIZE] {15 | n}
SET AUTO[COMMIT] {ON | OFF | IMM[EDIATE] | n}
SET AUTOP[RINT] {ON | OFF}
SET AUTORECOVERY {ON | OFF]
SET AUTOT[RACE] {ON | OFF | TRACE[ONLY]}
SET BLO[CKTERMINATOR] {. | c | ON | OFF}
SET CLASSIC [ ON | OFF ]
SET CLOUDCONFIG [ -proxy=<proxyhost>:<port> ] <wallet.zip location>
SET CLOUDSTORAGE
SET CMDS[EP] {; | c | ON | OFF}
SET CODESCAN [ON | SQLINJECTION | SQLPERFORMANCE | OFF] (For more details, see the
description at the bottom.)
SET COLSEP {_ | text}
SET CON[CAT] {. | c | ON | OFF}
SET COPYC[OMMIT] {0 | n}
SET COPYTYPECHECK {ON | OFF}
SET DDL [[ PRETTY | SQLTERMINATOR | CONSTRAINTS | REF_CONSTRAINTS |
CONSTRAINTS_AS_ALTER|OID | SIZE_BYTE_KEYWORD | PARTITIONING |
SEGMENT_ATTRIBUTES | STORAGE | TABLESPACE | SPECIFICATION | BODY | FORCE |
INSERT | |INHERIT | RESET] {on|off} ] | OFF ]
```


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```
SET DEF[INE] {& | c | ON | OFF}
SET ECHO {ON | OFF}
SET EDITF[ILE] file_name[.ext]
SET EMB[EDDED] {ON | OFF}
SET ENCODING
SET ERRORD[ETAILS] {OFF | ON | VERBOSE}
SET ERRORL[OGGING] {ON | OFF} [TABLE [schema.]tablename] [TRUNCATE]
[IDENTIFIER identifier]
SET ESC[APE] {\ | c | ON | OFF}
SET ESCCHAR {@ | ? | % | $ | OFF}
SET EXITC[OMMIT] {ON | OFF}
SET FEED[BACK] {6 | n | ON | OFF} [SQL_ID]
SET FLU[SH] {ON | OFF}
SET HEA[DING] {ON | OFF}
SET HEADS[EP] {_| | c | ON | OFF}
SET HISTORY [FAILS [LIMIT [ n | DEFAULT ] ] | NOFAILS |FILTER [DEFAULT
<command list>?|<command list>?] |LIMIT [n|DEFAULT]]
SET LDAPCON
SET LIN[ESIZE] {80 | n}
SET LOAD default [options...]
SET LOADFORMAT [ DEFAULT | CSV | DELIMITED | HTML | INSERT | JSON | JSON-
FORMATTED | LOADER | T2 | XML ] [options...]
SET LONG {80 | n}
SET LONGC[HUNKSIZE] {80 | n}
SET MAXROWS {n>1 | DEFAULT}
SET MAXSPOOLROWSTRUNCATE [ON | OFF | DEFAULT]
SET MDB [[FILE <PATH-OF-MS-DATABASE-FILE>] | [MODE {REPLACE | APPEND |
TRUNCATE | SKIP}] | [PREFIX <PREFIX-VALUE>] | [TABLE <TABLE-NAME-TO-COPY>] |
[TABLES {FALSE|TRUE}] | [VIEWS {FALSE|TRUE}]]
SET NET {ON | OFF | READONLY}
SET NEWP[AGE] {1 | n | NONE}
SET NOVERWRITE {ON | OFF | WARN}
SET NULL text
SET NUMF[ORMAT] format
SET NUM[WIDTH] {10 | n}
SET PAGES[IZE] {14 | n}
SET PARAMETERPOLICY {default | isolate}
SET PAU[SE] {ON | OFF | text}
SET RECSEPCHAR {_| c}
SET SERVEROUT[PUT] {ON | OFF} [SIZE {n | UNL[IMITED]}] [FOR[MAT] {WRA[PPED] |
WOR[D_WRAPPED] | TRU[NCATED]}]
SET SHOW[MODE] {ON | OFF}
SET SQLBL[ANKLINES] {ON | OFF}
SET SQLC[ASE] {MIX[ED] | LO[WER] | UP[PER]}
SET SQLCO[NTINUE] {> | text}
SET SQLFORMAT {csv | html | xml | json | ansiconsole | insert | loader | fixed
| default}
SET SQLPLUSCOMPAT[IBILITY] {x.y[.z]}
SET SQLPRE[FIX] {# | c}
```


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```
SET SQLP[ROMPT] {SQL> | text}
SET SUF[FIX] {SQL | text}
SET T2 METRICDATA NAMESPACE {text}
SET T2 METRICDATA COMPARTMENTID {text}
SET T2 METRICDATA NAME {text}
SET T2 DIMENSIONS RESOURCEID {text}
SET T2 DIMENSIONS REGION {text}
SET T2 METADATA UNIT {text}
SET TAB {ON | OFF}
SET TERM[OUT] {ON | OFF}
SET TI[ME] {ON | OFF}
SET TIMI[NG] {ON | OFF}
SET TRIM[OUT] {ON | OFF}
SET TRIMS[POOL] {ON | OFF}
SET VER[IFY] {ON | OFF}
SET WRA[P] {ON | OFF}
```

```
SET DDL [[ PRETTY | SQLTERMINATOR | CONSTRAINTS | REF_CONSTRAINTS |
CONSTRAINTS_AS_ALTER|OID | SIZE_BYTE_KEYWORD | PARTITIONING | SEGMENT_ATTRIBUTES
| STORAGE | TABLESPACE | SPECIFICATION | BODY | FORCE | INSERT | |INHERIT |
RESET] {on|off} ] | OFF ]
```

Allows you to set the DDL transform option on DBMS_METADATA.

```
SET ENCODING <encoding>
```

Allows you to set the encoding for the current session. Use `SHOW ENCODING` to view the encoding set for the current session. Use SHOW ENCODINGS to list the encodings available on your platform.

```
SET CODESCAN [ON | SQLINJECTION | SQLPERFORMANCE | OFF]
```

Controls warning messages issued for code quality issues. `ON` turns on warnings for possible SQL injection vulnerabilities and SQL performance issues. See SQL Performance Troubleshooting

14.27 SHOW *option*

Shows the value of a SQLcl system variable, or the current SQLcl environment. Enter any system variable set by the SET command in place of *`system_variable`*. SHOW SGA can only be used by a DBA user. Use one of the following terms or clauses in place of *`option`*:

```
system_variable
ALL
BTI[TLE]
CON_ID
CON_NAME
CONNECTION
DDL
EDITION
ENCODING
ENCODINGS
```


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```
ERR[ORS] [ {FUNCTION | PROCEDURE | PACKAGE | PACKAGE BODY | TRIGGER | VIEW |
TYPE | TYPE BODY | DIMENSION | JAVA CLASS} [schema.]name]
INSTANCE
JAVA
JDBC
LNO
NLS
PARAMETER[S] [parameter_name]
PDBS
PNO
RECYC[LEBIN] [original_name]
REL[EASE]
REPF[OOTER]
REPH[EADER]
SGA
SPOO[L]
SPPARAMETER[S] [parameter_name]
SQLCODE
SQLPATH
TNS
TTI[TLE]
USER
```

`SHOW ENCODING`

Shows the encoding which is set for the client.

`SHOW ENCODINGS`

Shows the available encodings for the client.

14.28 SHOW KEYMAP

Use this command to display the key bindings (shortcuts) associated with all supported editor modes (such as `vicmd`, `viins`, `visual`, or `emacs`) in Oracle SQLcl. These shortcuts reflect the default key mappings for each editor mode. It enables you to view which keys are mapped to which functions or actions. To see the default shortcuts for the specific editor mode, you can use filtering by a mode (for example, `show keymap vicmd`). Filtering by mode helps you quickly identify which keys perform specific actions based on the editor style you are using.

Syntax

To display default key mappings for all the supported editor modes:

```
SHOW KEYMAP
```

To see the default key mappings for the specific editor mode by using filtering by a mode:

To display default key mappings for `vicmd` mode:

```
SHOW KEYMAP vicmd
```


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To display default key mappings for `viins` mode:

```
SHOW KEYMAP viins
```

To display default key mappings for `visual` mode:

```
SHOW KEYMAP visual
```

To display default key mappings for `emacs` mode:

```
SHOW KEYMAP emacs
```

14.29 SHOW LEVEL and SHOW SCRIPTS

Oracle SQLcl provides script execution diagnostic commands, `SHOW LEVEL` and `SHOW SCRIPTS`, to help understand and audit the execution context and structure of SQL scripts. These commands offer visibility into which scripts are running, how scripts are nested, and the call order of included scripts. They do not require a database connection and can be used at any time for effective troubleshooting.

`SHOW LEVEL`

Use this command to display the current nesting level of script execution and the file that is currently being executed. The nesting level reflects how many scripts deep you are; each script included within another increases the level by one.

By showing how many scripts deep you are, it lets you know many layers of script calls have been made from the top-level script down to the current one. It gives you clear insight into the execution context. This helps to track the position within nested scripts, understand the depth of script execution, and more easily troubleshoot issues that arise in complex, multi-script environments.

Usage Notes

- Use `SHOW LEVEL` command at key steps in complex scripts to improve log readability.
- Use together with the `PWD` command to display both current script and working directory during execution.

Syntax

```
show level
```

Command Output Examples

When no script is running:

```
SQL> show level
No script is currently active
```


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When running nested scripts:

```
SQL> show level
depth: 3
current: /path/to/nested/script.sql
```

SHOW SCRIPTS

Use this command to display a tree structure of scripts, showing the call order from the top-level script down to the currently running script. This helps visualize script inclusion and nesting during execution.

This tree structure visualization lets you see how scripts are organized and included, revealing the hierarchy and flow between scripts during execution. Such visibility is especially useful in troubleshooting and audits, as it helps you confirm which scripts are involved and how control moves through nested includes or calls. This makes it much easier to navigate, maintain, and debug complex script environments where multiple scripts are interdependent.

Usage Notes

- Execute `SHOW SCRIPTS` to verify script call order and assist with troubleshooting.
- Place `SHOW SCRIPTS` near the start of your top-level script to ensure complete script inclusion logs.

Syntax

```
show scripts
```

Example

```
SQL> show scripts
scripts
├─── main.sql
└─── includes/setup.sql
```

PWDfor Script Execution Context

`PWD` command complements script execution diagnostics by displaying the directory associated with the currently running script. When executed during script execution (even inside nested scripts), it shows the directory context so you know where relative paths resolve.

The PWD command has been enhanced to support script execution mode. Previously, PWD displayed your current working directory at the prompt, regardless of script activity. Now, when you execute a script—or a nested script—PWD shows the directory of the script that is currently being executed. This provides you with precise context for where relative paths will resolve, greatly aiding the debugging and development of complex script environments.

Recommended sequence at the start of included scripts:

```
pwd
show scripts
show level
```

This records the script's directory, stack, and nesting for clear, actionable logs.

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14.30 SODA

SODA allows schemaless application development using the JSON data model. The options are:

- `SODA create <collection_name>` — Create a new collection
- `SODA list` — List all the collections
- `SODA get <collection_name> [-all | -f | -k | -klist] [{<key> | <k1> <k2> ... | <qbe>}]` — List documents the collection. Optional arguments:
  - `all` : list the keys of all docs in the collection
  - `k` : list docs matching the specific <*key*>
  - `klist` : list docs matching the list of keys
  - `f` : list docs matching the <*qbe*>
- `SODA insert <collection_name> <json_str | filename>` — Insert a new document within a collection
- `SODA drop <collection_name>` — Delete existing collection
- `SODA count <collection_name> [<qbe>]` — Count number of documents inside collection. Optional parameter <*qbe*> returns number of matching documents
- `SODA replace <collection_name> <oldkey> <new_{str | doc}>` — Replace one document with another
- `SODA remove <collection_name> [-k | -klist | -f] {<key> | <k1> <k2> ...| <qbe>}` — Remove documents from collection. Optional arguments:
  - `k` : Remove document in collection matching the specific <*key*>
  - `klist` : Remove document in collection matching the list <*key1*> <*key2*> ...
  - `f` : Remove document in collection matching <*qbe*>

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A

List of Unsupported SQL*Plus Commands and Features

Commands

- `REPHEADER`
- `REPFOOTER`
- `TIMING`

The `TIMING` command is replaced by the `SET TIMING` command.

System Variables and Environment Settings through the SET Command

- `describe`
- `flagger`
- `fullcolname`
- `logsource`
- `loboffset`
- `markup`
- `recsep`
- `shiftinout`
- `sqlterminator`
- `underline`
- `xmloptimizationcheck`

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B

About Enhancements to the SQLcl Command-Line Interface

SQLcl release 25.4 includes a significantly improved command-line interface with advanced line editing, intelligent auto-completion, and customizable keyboard shortcuts.

Topics:

- New Commands for SQLcl Interface
- Keyboard Shortcuts
- Help, Configuration and Troubleshooting

B.1 New Commands for SQLcl Interface

The new commands available for the SQLcl command-line interface are:

- Line Number Display
- Enhanced Status Bar
- Intelligent Auto-Pairing
- Personalized Auto-Suggestions

Line Number Display

Command: `SET LINENUMBERS ON|OFF`

Default: ON

Description: Enables line numbers for multi-line SQL statements. This is helpful in navigation, coding and debugging.

Use ON for coding or debugging and OFF for clean output without line numbers.

Enhanced Status Bar

Command: `SET STATUSBAR ON|OFF`

Default: OFF

Description: View or customize status bar components such as edit mode, current line/column, user, and database ID for real-time feedback and and session context.

- EDITMODE: Displays the current edit mode, Emacs, Vicmd or Viins.
- LINECOL: Displays the current line and column numbers.
- USERNAME: Displays the name of the connected database user.
- DBID: Displays the id of the connected database.

Commands available for Status Bar:

- SHOW STATUSBAR: Shows all available components.

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- SET STATUSBAR ON: Enables status bar.
- SET STATUSBAR OFF: Disables status bar.
- SET STATUSBAR ADD ALL: Adds all availablecomponents.
- SET STATUSBAR ADD <comp>..: Adds specific components.
- SET STATUSBAR REMOVE <comp>..: Removes specific components.
- SET STATUSBAR DEFAULT: Shows default status bar components.
- SET STATUSBAR DEFAULT <comp>..: Adds specific components as default.

Troubleshooting: For any rendering issues, run `CLEAR SCREEN` to resolve.

Intelligent Auto-Pairing

Default: Built-in

Description: Automatically inserts matching brackets and quotes to reduce syntax errors and accelerate SQL entry.

Supported character pairs:

- Parenthesis ( )
- Square brackets [ ]
- Curly braces { }
- Single quotes ' '
- Double quotes " "
- Grave accent ` `

Personalized Auto-Suggestions

Command: `SET AUTOSUGGESTIONS ON|OFF`

Default: OFF

Description: Suggests command completions based on prior session history.

As you type, matching commands from your session history appear in gray text. The suggestion updates dynamically with each keystroke.

If this setting is OFF, then TAB completion is used.

Key Differences Between Auto-Suggestions and Tab Completion

-	Auto-Suggestions	Tab Completion
Source	Command history	Database schema
Best For	Repeating queries	Discovering objects
Shows	Complete previous commands	Objects, keywords, functions
When	As you type	Press TAB key

Keyboard Controls

- Right Arrow: Accept suggestion.
- Down Arrow: Ignore suggestion.
- Backspace: Update suggestion by input.

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B.2 Keyboard Shortcuts

The following tables list the shortcut support for both Emacs and Vi editing modes, streamlining navigation, editing, and search.

Navigation

Shortcut	Action	Description	Mode
Ctrl+L	Clear Screen	Refresh and clear the terminal	All
Ctrl+E	Emacs Mode	Switch to Emacs editing	Vi Insert
Ctrl+\ or Esc	Cancel Edit	Clear input line	All
Alt+A	Beginning of Buffer	Jump to the first line	All
Alt+E	End of Buffer	Jump to the last line	All
Ctrl+R	Run Immediately	Execute command without semicolon or slash terminator	All

History and Search Operations

Shortcut	Action	Description	Mode
Alt+R (Option+R)	Search Backward	Search command history backward with real-time matching	All
Alt+<	Beginning of History	Jump to the oldest command	All
Alt+>	End of History	Jump to the most recent command	All

Text Editing Operations

Shortcut	Action	Description	Mode
Ctrl+U	Kill Whole Line	Remove the current line to the kill ring	All
Ctrl+W	Kill Word Backward	Remove the word before the cursor	All
Ctrl+Y	Yank (Paste)	Insert the most recently killed text at cursor position	All
Ctrl+T	Transpose Characters	Swap the two characters before the cursor (typo correction)	Emacs
Ctrl+_	Undo	Undo the last editing operation	Emacs

The kill ring acts as a clipboard that stores deleted text. To retrieve text for repeated pasting, use Ctrl+Y.

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Example:

```
SQL> SELECT * FROM employees WHERE salary > 5000;

-- Press Ctrl+U to kill entire line
SQL> ≤

-- Type new command
SQL> DELETE FROM temp_table;

-- Press Ctrl+Y to paste the killed line
SQL> DELETE FROM temp_table;SELECT * FROM employees WHERE salary > 5000;
```

Shortcut	Action	Description	Mode
Alt+B (Option+B)	Backward Word	Move cursor one word to the left	All
Alt+F (Option+F)	Forward Word	Move cursor one word to the right	All
Alt+C (Option+C)	Capitalize Word	Capitalize the word at cursor position	All
Alt+U (Option+U)	Uppercase Word	Convert the word at cursor to uppercase	All
Alt+L (Option+L)	Lowercase Word	Convert the word at cursor to lowercase	All

Words are delimited by white space and SQL punctuation characters.

```
-- Type SQL keyword in lowercase
SQL> select * from employees;
↑ Position cursor on "select"

-- Press Alt+U to convert to uppercase
SQL> SELECT * from employees;
↑ Keyword now properly formatted
```

Completion Help

Shortcut	Action	Description	Mode
Tab	Complete	Trigger completion menu for the current context	All
Tab Tab	List All Choices	Display all options for current context	All

SQLcl provides intelligent completion from multiple sources:

- Database schema objects (tables, views, sequences, synonyms)
- SQL keywords and reserved words
- SQLcl extensions and commands
- Previously used identifiers from command history

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B.3 Help, Configuration and Troubleshooting

This section covers how to get information about the new commands, ensure pesistent configuration using login scripts, and resolve common issues.

SQLcl Built-in Help

During a SQLcl session, you can type the following commands for more information about commands and settings:

- HELP SET LINENUMBERS: Gives details about using line numbers.
- HELP SET STATUSBAR: Explains configuration options for the status bar.
- HELP SET AUTOSUGGESTIONS: Details about enabling auto-suggestions.

Current Settings

To check the current values or settings in your session, use:

- SHOW LINENUMBERS: Shows if line numbers are enabled.
- SHOW STATUSBAR: Displays current status bar configuration.
- SHOW AUTOSUGGESTIONS: Checks if auto-suggestions are enabled.

Login Scripts

SQLcl supports persistent settings using a login.sql file. This is a script SQLcl automatically runs at startup, if present in:

- Your current working directory or
- Your home directory (`~/login.sql` on UNIX/LINUX/MAC and `%USERPROFILE%\login.sql` on WINDOWS).

Example

Create a login.sql file with your preferred settings:

```
-- Enable enhanced features
SET LINENUMBERS ON
SET STATUSBAR ON
SET AUTOSUGGESTIONS ON

-- Configure display
SET PAGESIZE 50
SET LINESIZE 120

-- Set default formats
SET SQLFORMAT ANSICONSOLE
```

Troubleshooting Common Problems

The following table lists resolutions for common issues.

Problem	Command/Action	Description
Display corruption	CLEAR SCREEN	Refreshes the terminal display

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Problem	Command/Action	Description
History issues	HISTORY -clear (SESSION)?	Clears or resets history
Settings reset	login.sql	Checks for conflicting configurations
Feature not working	SHOW <setting>	Ensures the feature is enabled

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C

SQL Performance Troubleshooting

This appendix provides a list of SQL coding patterns that cause potential performance issues in SQL queries.

- Columns Defined as Literal Constants in Sub-Query Joined Later in Main Query
- Redundant Table in LEFT OUTER JOIN
- Too Many Join Conditions Between Factored WITH Sub Queries
- Data Security Predicates Wrapped Inside Redundant Sub-Query
- Aggregate Functions in Correlated Scalar Sub-query
- Use XMLTYPE Data Type Instead of CLOB
- Large Number of UNION (ALL) Query Blocks in a Single SQL
- Function Calls in WHERE Clause Predicates
- Long CASE Expressions in SELECT and WHERE Clauses
- Long in IN-LISTs in SQL Clauses
- Scalar Sub-Queries with DISTINCT Modifier or ROWNUM Keyword
- Custom PL/SQL Calls in SELECT Clause

Columns Defined as Literal Constants in Sub-Query Joined Later in Main Query

In cases where you have literal constants defined as columns in a single sub-query and later used in joins in the main query, consider passing them as direct filters instead. Refer to the following example of such usage:

```
(SELECT
    ...
    UPPER('HXT') AS DUMMY
    ...
) V1,
(SELECT
    T2.C2 AS C2
 FROM T2
) V2
WHERE
    V1.DUMMY = V2.C2
...
```

The more efficient SQL design is to pass it directly to the main query:

```
(SELECT
    ...
) V1,
(SELECT
    T2.C2 AS C2
```


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```
 FROM T2
) V2
WHERE
 V2.C2 = UPPER('HXT')
...
```

Redundant Table in LEFT OUTER JOIN

Some of Left Outer Joins (LOJ) may be redundant if you join two tables through LOJ but do not select any attributes from the table on the ‘optional’ side of the LOJ. Review the following example:

```
SELECT
  b.book_title,
  b.author,
  b.language
FROM
  books b,
  book_languages l
WHERE
  b.language = l.language (+);
```

The table `BOOK_LANGUAGES` is on the optional side of the OUTER join and no columns from it are in the SELECT clause. The query above is functionally equivalent (that is, it produces the same exact result set) with both the table and LOJ removed:

```
SELECT
    b.book_title,
    b.author,
    b.language
FROM
    books b;
```

Complex SQL queries with redundant OUTER joined tables may result in additional performance overhead during parse time as well as at run time. The optimizer may be unable to eliminate unused outer joined table as outer joins are usually harder to process than the ordinary inner joins. Make sure you carefully validate your functionality to evaluate the impact from removing such joins and tables in your reports.

Too Many Join Conditions Between Factored WITH Sub Queries

When you join two factored WITH sub-queries using too many join conditions, the optimizer may estimate low join cardinality for the respective tables and not choose the best execution plan. Refer to the following example, showing the sub-optimal generated SQL pattern as the result of having too many joins between two factored WITH sub-queries:

```
FROM SAWITH1 D1
  FULL OUTER JOIN SAWITH2 D2
  ON SYS_OP_MAP_NONNULL(D1.c3)   = SYS_OP_MAP_NONNULL(D2.c3)
  AND SYS_OP_MAP_NONNULL(D1.c5)  = SYS_OP_MAP_NONNULL(D2.c5)
  AND SYS_OP_MAP_NONNULL(D1.c12) = SYS_OP_MAP_NONNULL(D2.c12)
  AND SYS_OP_MAP_NONNULL(D1.c14) = SYS_OP_MAP_NONNULL(D2.c14)
  AND SYS_OP_MAP_NONNULL(D1.c11) = SYS_OP_MAP_NONNULL(D2.c11)
  AND SYS_OP_MAP_NONNULL(D1.c2)  = SYS_OP_MAP_NONNULL(D2.c2)
  AND SYS_OP_MAP_NONNULL(D1.c13) = SYS_OP_MAP_NONNULL(D2.c13)
```


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```
  AND SYS_OP_MAP_NONNULL(D1.c15) = SYS_OP_MAP_NONNULL(D2.c15)
  AND SYS_OP_MAP_NONNULL(D1.c9)  = SYS_OP_MAP_NONNULL(D2.c9)
  AND SYS_OP_MAP_NONNULL(D1.c10) = SYS_OP_MAP_NONNULL(D2.c10)
  AND SYS_OP_MAP_NONNULL(D1.c8)  = SYS_OP_MAP_NONNULL(D2.c8)
  AND SYS_OP_MAP_NONNULL(D1.c7)  = SYS_OP_MAP_NONNULL(D2.c7)
  AND SYS_OP_MAP_NONNULL(D1.c18) = SYS_OP_MAP_NONNULL(D2.c18)
  AND SYS_OP_MAP_NONNULL(D1.c21) = SYS_OP_MAP_NONNULL(D2.c21)
  AND SYS_OP_MAP_NONNULL(D1.c4)  = SYS_OP_MAP_NONNULL(D2.c4)
  AND SYS_OP_MAP_NONNULL(D1.c6)  = SYS_OP_MAP_NONNULL(D2.c6)
  AND SYS_OP_MAP_NONNULL(D1.c22) = SYS_OP_MAP_NONNULL(D2.c22)
  AND SYS_OP_MAP_NONNULL(D1.c20) = SYS_OP_MAP_NONNULL(D2.c20)
  AND SYS_OP_MAP_NONNULL(D1.c16) = SYS_OP_MAP_NONNULL(D2.c16)
  AND SYS_OP_MAP_NONNULL(D1.c17) = SYS_OP_MAP_NONNULL(D2.c17)
  AND SYS_OP_MAP_NONNULL(D1.c19) = SYS_OP_MAP_NONNULL(D2.c19)
```

Carefully review all the joins in your SQL logic, and keep them to the bare minimum to address the functional requirements.

Data Security Predicates Wrapped Inside Redundant Sub-Query

Securing data in your reports requires very thorough analysis, and careful coding in your SQL queries. Data Security Predicates (DSP) or security clauses, that you append to ensure secure reporting in your SQLs, could have a performance impact on your SQL execution. For example, if you choose to re-use DSPs from other SQLs that pull in View Object security clauses, you could end up with the pattern described below:

```
(SELECT ...
   FROM T1,
       (SELECT ...
          FROM T2 ...
         WHERE (DSP predicate1) OR (DSP predicate2)
        )
  WHERE ...
```

In this example, table `T2` got secured through two DSP predicates in a separate sub-query. As part of the overall optimization process, Oracle optimizer performs recursive optimization of each inline view (sub query) before optimizing the main query. Such a pattern could affect the query parsing time and possibly produce a less efficient execution plan. Consider using a more efficient pattern rewrite:

```
(SELECT ...
   FROM T1,
        T2, ...
  WHERE (DSP predicate1) OR (DSP predicate2))
        ...
```

Aggregate Functions in Correlated Scalar Sub-query

Aggregate functions such as MAX/MIN/COUNT in scalar subquery can be safely and efficiently replaced by performing alternative rewrites. Refer to the following example:

```
--Sub-optimal pattern:

SELECT t1.c1,
       (SELECT MAX(t2.c2) as maxc2
```


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```
          FROM t2
          WHERE t2.id=t1.id
        ) as c2
FROM t1;

--Optimal pattern:

SELECT t1.c1,
       t2alias.max_c2
FROM t1,
     (SELECT MAX(t2.c2) as max_c2
             T2.id as id
        FROM t2
       GROUP BY t2.id
     ) t2alias
WHERE t2alias.id=t1.id;
```

A scalar sub-query is executed for every row returned by the enclosing query block's row sources (here t1). It means the aggregated MAX is executed as many times as the number of fetched rows in the main query, resulting in slower performance. Moving the aggregated MAX into the FROM clause of the main query will aggregate the data once and speed up the overall query.

> **Note**
>
> If the number of rows returned by the enclosing block (here t1) is moderate/low and the scalar sub-query is correlated on a selective indexed column, then the aggregate operation can be kept inside the correlated scalar sub-query.

Use XMLTYPE Data Type Instead of CLOB

Avoid using CLOB data type for storing XML data. The conversion of CLOB to XML on the fly using XMLTYPE function during report runtime could be very expensive. Instead, consider using XMLTYPE for storing XML documents in the database.

Large Number of UNION (ALL) Query Blocks in a Single SQL

A single SQL with multiple UNION (or UNION ALL) query blocks should be carefully analyzed to consolidate UNIONs into fewer sub-queries. The excessive use of UNIONs is a strong indicator of logic redundancy and SQL complexity. It results in a much larger SQL statement, which would take much longer to parse and execute in the database, as each UNION query block by default is executed serially, one-by-one. Forcing /*+ PARALLEL */ hint would not help to run multiple UNION branches at the same time. The hint /*+ PQ_CONCURRENT_UNION */ could help with parallel UNION branch executions, but it could result in more database workload, especially if the UNION branches have very expensive tables and no selective filters.

In the most cases, the Union branches may be nearly identical with minor differences such as slightly different filters or different expressions on columns in SELECT lists, and so on. Consider reworking multiple-UNION query into a much simpler shape by factoring out one or two common denominator WITH sub-queries and reusing them as per functional requirements. Such an approach results in much less logical reads, lesser database impact and faster query performance. If the same WITH factored sub-query is called more than once, Oracle would ‘materialize’ its result set in a temporary segment and use it throughout the SQL.

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Function Calls in WHERE Clause Predicates

Expressions in WHERE clauses employ filter and join expressions to constrain rows from data sources (tables, views, inline views). When the estimated number of rows after filter/join operation using indexed attributes is low, the optimizer will choose an index to directly access the required data blocks. Applying SQL or PL/SQL functions to columns in filter/join expressions disables index usage and reverts table access to full table scan.

Alternatively, if there is a function-based index (FBI) defined, but filter or join expressions do not use the exact function in the join predicates, the optimizer chooses less optional full table scan as well. For example, the PERSON_NUMBER column in the table PER_ALL_PEOPLE_F is indexed via function-based index (FBI) using UPPER(PERSON_NUMBER). The appropriate use for PERSON_NUMBER in WHERE clause will be UPPER(PERSON_NUMBER). Refer to two separate sections on the recommended use of UPPER and TRUNC in WHERE clauses.

Consider the following example:

```
SELECT * FROM XLA_AE_HEADERS WHERE AE_HEADER_ID = '1511989';
```

There is a unique index defined on the primary key column AE_HEADER_ID, that makes access to desired data very fast and efficient through the INDEX RANGE SCAN operation:

```
-------------------------------------------------------------------------------
--------------------------
| Id  | Operation                           | Name              | Rows  |
Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
--------------------------
|   0 | SELECT STATEMENT                    |                   |     1 |
215 |     4   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| xla_ae_headers    |     1 |
215 |     4   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                  | XLA_AE_HEADERS_U1 |     1
|       |     3   (0)| 00:00:01 |
-------------------------------------------------------------------------------
--------------------------

Predicate Information (identified by operation id):
---------------------------------------------------
   2 - access("AE_HEADER_ID"=1511989)
```

When the function TO_CHAR() is used on AE_HEADER_ID column, the plan changes to:

```
SELECT * FROM XLA_AE_HEADERS WHERE TO_CHAR(AE_HEADER_ID) = '1511989';
-------------------------------------------------------------------------------
------
| Id  | Operation         | Name           | Rows  | Bytes | Cost (%CPU)|
Time     |
-------------------------------------------------------------------------------
------
|   0 | SELECT STATEMENT  |                |     1 |   215 |  5788   (1)|
00:00:01 |
|*  1 |  TABLE ACCESS FULL| xla_ae_headers |     1 |   215 |  5788   (1)|
00:00:01 |
-------------------------------------------------------------------------------
```


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```
------

Predicate Information (identified by operation id):
---------------------------------------------------
   1 - filter(TO_CHAR("AE_HEADER_ID")='1511989')
```

There may be valid cases where SQL or PL/SQL functions in WHERE clause are required by functional design. For example, aggregate functions in WHERE clauses (MAX, MIN, COUNT, AVG,) may be needed for the functional logic. In such cases, ensure you have effective filters on other columns with supporting indexes to ensure optimal performance.

Long CASE Expressions in SELECT and WHERE Clauses

Complex CASE expressions can affect query performance in multiple ways. CASE expressions found in SELECT list are CPU-intensive operations. CASE expressions in WHERE clause (filter and join predicates) may result in incorrect join cardinality estimate and miscalculating the costs. As a result, sub-optimal join method can be selected causing potentially long run time of the query, increasing probability of **ORA-01555** (snapshot too old) error and significant TEMP tablespace usage by the SQL. Carefully inspect your SQL for any large CASE clauses and explore the options to simplify the logic. Refer to the following sub-optimal and rewritten CASE structures:

```
-- Sub-optimal structure:

(CASE WHEN .. THEN
   (CASE WHEN .. THEN
      (CASE WHEN .. THEN
       (...)
      END)
    END)
 ELSE ... END)

-- Rewritten optimal structure:

(CASE WHEN ... THEN
      WHEN ... THEN
      WHEN ... THEN
      ELSE ...
 END)
```

Long in IN-LISTs in SQL Clauses

The option to pass more than one value to SQL through bind parameters makes reports very flexible and versatile. However, if the number of passed values is not limited, it could generate a SQL with very large number of IN-LIST values, possibly hitting the internal Oracle limit of maximum 1,000 IN-LIST values (and get ORA-01795 maximum number of expressions in a list is 1000).

The Oracle optimizer converts IN-list expressions into Boolean OR-expressions. For instance, the following expression: COL_A IN (1, 2, 3) is converted into COL_A = 1 OR COL_A = 2 OR COL_A = 3. Depending on how statistics are collected on a table and its columns, the optimizer may produce incorrect cardinality estimate for that IN-list expression. The more literals are in the IN-LIST, the larger the deviation from the actual cardinality. The incorrect

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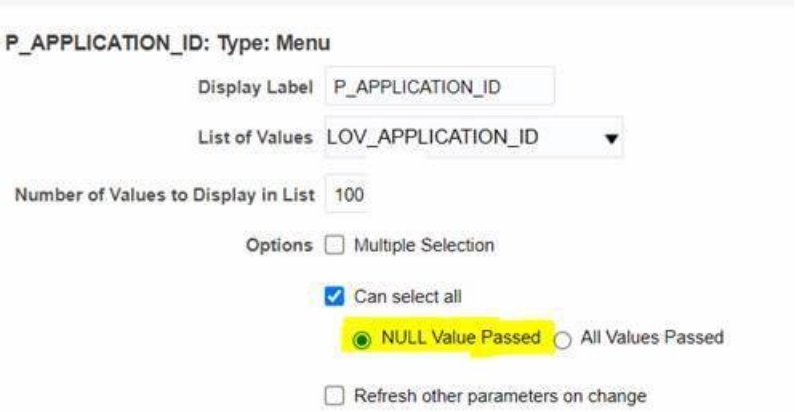
cardinality may cause the optimizer to select less join method. Refer to the following example of long IN-LIST in CASE clause:

```
CASE WHEN d1.c40 NOT IN (
    'CALL',
    'CALL_IB',
    'DEMAND_GENERATION',
    'DEMO',
    'DEMO_IN_PERSON',
    'DISCOVERY',
    'DISCOVERY_PERSON',
    'EMAIL',
    'EMAIL_ELOQUA_ENGAGE',
    'EMAIL_ELOQUA_ENGCAMPAIGN',
    'EMAIL_IB',
    'EMAIL_OUTLOOK',
    'INPERSON_INTRO_MEETING',
    'INPERSON_MEETING',
    'INTRO_MEETING',
    'MANUAL_CALL',
    'MEETING',
    'RESEARCH',
    'SALES_CHAT',
    'SOCIAL_MEDIA',
    'TODO',
    'WORKSHOPS'
    ) THEN ...
```

Carefully design the parameters and lists of values that get passed to reports to avoid generating long IN-LISTs in the SQL queries. Do not create long checklists and an option to check all, as that would lead to generate such IN-clauses and affect performance. To avoid passing ‘all’ and causing the performance with long IN-LISTs, select ‘NULL Value Passed’ when you define the parameters for your data model. Then NULL is passed to the bind variable instead of the long IN-LIST:



Scalar Sub-Queries with DISTINCT Modifier or ROWNUM Keyword

Scalar sub-query is a SQL query block that is used as a column in a SELECT clause. It is called scalar because it must produce exactly one value (a scalar) to use in the main SELECT.

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If a sub-query is written in such a way that it returns more than one row, ORA-01427 exception is raised.

A typical usage pattern of scalar sub-queries is to deliver a single column value by joining a table inside the sub-query to an external table using a unique (primary key) column. That guarantees a single scalar value to be returned by such a sub-query.

If a scalar sub-query produces more than one row, either DISTINCT or ROWNUM may get (wrongly) used as workarounds to enforce a single scalar value. Both workarounds could result in incorrect functionality as well as cause performance overhead, as they get applied as the last step to potentially a very large result set produced by the sub-query.

```
SELECT
    mpm.level_member_id,
    archive.archive_id,
    mat.category_name,
      (
      SELECT DISTINCT category_name
        FROM msc_catalog_categories mcc1
        WHERE mcc1.category_id = mat.parent_category_id
          AND mcc1.parent_category_id IS NOT NULL
      ) cgt_category_name,
...
```

> **Note**
>
> When you design your SQLs with correlated sub-queries in SELECT, ensure that they use index access path, as they get executed once for every single row. If a sub-query employs a full table scan due to the lack of indexes in join predicate, you end up with as many full table scans as the number of fetched rows in the main sub-queries. In that case, you should rewrite it to use the join logic in WHERE clause instead of SELECT.

Custom PL/SQL Calls in SELECT Clause

Use of PL/SQL functions in SELECT clauses could lead to slower SQL performance. The optimizer has no methods to merge the code from PL/SQL functions into the main SQL query, so the functions are called as many times as the number of rows fetched by the main query. The PL/SQL complexity multiplied by a number of its executions could become a major performance factor, often overlooked in SQL optimization.

Refer to the following example, showing the use of such function call, with another SELECT wrapped inside, with both the function and the SELECT invoked once for every fetched row from the main SELECT:

```
SELECT ...
   ff_user_tables_pkg.get_table_value(
     (SELECT l_data_grp.legislative_data_group_id
      FROM   per_legislative_data_groups_vl l_data_grp
      WHERE  l_data_grp.name = 'US'),
     'RETIREMENT_ELIGIBILITY',
     'AGE',
      to_char((months_between(sysdate, pp.date_of_birth) / 12)),
      trunc(sysdate)
```


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```
) l_data_grp_pkg_call,
....
```

Ensure you review the use of such PL/SQL functions, and if their use is required by the functional logic, apply effective filters to reduce the number of fetched rows and the result number of PL/SQL executions for the SQL.

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D.1 ANTLR4 Java Runtime 4.13.2

```
### ANTLR4 Java Runtime

Provider: Terence Parr

Component(s): ANTLR4 Java Runtime

```
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D.5 Apache httpclient5 5.6.4

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Component(s): httpclient5

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D.6 Apache httpcore5 5.4.3

```
### httpcore5

Provider: The Apache Software Foundation

Component(s): httpcore5

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D.7 Apache Mina SSHD-osgi 2.15.0

```
### Mina SSHD-osgi

Provider: The Apache Software Foundation

Component(s): Mina SSHD-osgi

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D.8 Apache Mina SSHD-sftp 2.15.0

```
### Mina SSHD-sftp

Provider: The Apache Software Foundation

Component(s): Mina SSHD-sftp

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D.9 Apache POI 5.5.1

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The initial code for shuffling an array (originally in class
"org.apache.commons.math3.random.RandomDataGenerator", now replaced by
a method in class "org.apache.commons.math3.util.MathArrays") was
inspired from the algorithm description provided in
"Algorithms", by Ian Craw and John Pulham (University of Aberdeen 1999).
The textbook (containing a proof that the shuffle is uniformly random) is
available here:
  http://citeseerx.ist.psu.edu/viewdoc/download;?
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Ecma%20PATENT/
        Patent%20statements%20ok/
ECMA-376%20Edition%202%20Microsoft%20Patent%20Declaration.pdf
    [5] https://www.ecma-international.org/publications/files/ECMA-ST/
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The initial code for shuffling an array (originally in class
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inspired from the algorithm description provided in
"Algorithms", by Ian Craw and John Pulham (University of Aberdeen 1999).
The textbook (containing a proof that the shuffle is uniformly random) is
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D.11 Apache poi-ooxml-lite 5.5.1

```
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Provider: The Apache Software Foundation

Component(s): poi-ooxml-lite

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org.apache.poi:poi-ooxml-lite

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Copyright 2017 Remko Popma

TimeoutBlockingWaitStrategy.java and parts of Util.java
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D.12 Apache SSHD-contrib 2.15.0

```
### sshd-contrib

Provider: The Apache Software Foundation

Component(s): sshd-contrib

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D.14 Apache SSHD-scp 2.15.0

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Component(s): sshd-scp

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D.15 Eclipse Parsson 1.1.9

```
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D.16 Google Guava 33.4.8

```
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Component(s): Guava

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D.17 Jackson Annotations 2.21

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### Jackson Annotations

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Component(s): Jackson Annotations

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# Jackson JSON processor

Jackson is a high-performance, Free/Open Source JSON processing library.
It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has
been in development since 2007.
It is currently developed by a community of developers.

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D.18 Jackson Core 2.21.5

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Provider: FasterXML,LLC

Component(s): Jackson Core

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D.19 Jackson Databind 2.22.2

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Provider: FasterXML, LLC

Component(s): Jackson Databind

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# Jackson JSON processor

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It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has
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# Jackson JSON processor
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D.21 jackson-jr-stree 2.21.5

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This is a Java port of Daniel Lemire's fast_float project.
This project provides parsers for double, float, BigDecimal and BigInteger
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Jackson is a high-performance, Free/Open Source JSON processing library.
It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has
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## FastDoubleParser

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D.22 jakarta.json-api 2.1.3

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D.23 JLine 4.3.1

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### JLine

Provider: Marc Prud'hommeaux

Component(s): JLine

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D.24 json-base 2.5.1

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Component(s): json-base

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D.25 json-flattener 0.17.3

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Provider: Wei-Ming Wu

Component(s): json-flattener

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jackson-databind
jackson-jaxrs-base
jackson-datatype-jsr310
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# Jackson JSON processor

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jakarta.ws.rs-api

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* https://github.com/jakartaee/jaxb-api
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D.30 OCI SDK for Java 3.86.2

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### OCI SDK for Java

Provider: Oracle

Component(s): OCI SDK for Java

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OCI SDK for Java

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D.31 org.eclipse.jgit 7.3.0.202506031305-r

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### Java Git

Provider: Eclipse Foundation

Component(s): Java Git

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D.32 Quartz Job Scheduler 2.5.0

```
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## D.33 slf4j-api 2.0.18

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D.34 slf4j-jdk14 2.0.18

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D.35 StringTemplate 4.3.4

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Component(s): StringTemplate

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D.36 ucanaccess 5.1.5

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D.37 Apache httpcore5-h2

```
Provider: The Apache Software Foundation

Component(s): apache.httpcomponents.core5/httpcore5-h2

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