Oracle Database 10*g*: Administration Workshop I

Volume II • Student Guide

D17090GC31

Edition 3.1

December 2008

D57299

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Preface

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Before You Begin This Course

Before you begin this course, you should have the following qualifications:

- Working experience with SQL

How This Course Is Organized

Oracle Database 10g: Administration Workshop I is an instructor-led course featuring lecture and hands-on exercises. Online demonstrations and written practice sessions reinforce the concepts and skills introduced.

Suggested Next Courses

Oracle Database 10g: Administration Workshop II (D17092GC30)

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Related Publications

Oracle Publications

Title	Part Number
Oracle Database 2 Day DBA 10g Release 2 (10.2)	B14196-01
Oracle Database Administrator's Guide 10g Release 2 (10.2)	B14231-01
Oracle Database Backup and Recovery Basics 10g Release 2 (10.2)	B14192-01
Oracle Database Concepts 10g Release 2 (10.2)	B14220-01
Oracle Database Licensing Information 10g Release 2 (10.2)	B14199-01
Oracle Database Net Services Administrator's Guide 10g Release 2 (10.2)	B14212-01
Oracle Database Net Services Reference 10g Release 2 (10.2)	B14213-01
Oracle Database New Features Guide 10g Release 2 (10.2)	B14214-01
Oracle Database Performance Tuning Guide 10g Release 2 (10.2)	B14211-01
Oracle Database PL/SQL Packages and Types Reference 10g Release 2 (10.2)	B14258-01
Oracle Database PL/SQL User's Guide and Reference 10g Release 2 (10.2)	B14261-01
Oracle Database Recovery Manager Quick Start Guide 10g Release 2 (10.2)	B14193-01
Oracle Database Recovery Manager Reference 10g Release 2 (10.2)	B14194-01
Oracle Database Security Guide 10g Release 2 (10.2)	B14266-01
Oracle Database SQL Quick Reference 10g Release 2 (10.2)	B14195-01
Oracle Database SQL Reference 10g Release 2 (10.2)	B14200-01

Additional Publications

- System release bulletins
- Installation and user guides
- *read.me* files
- International Oracle Users Group (IOUG) articles
- *Oracle Magazine*

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Typographic Conventions

Typographic Conventions in Text

Convention	Element	Example
Bold	Emphasized words and phrases in Web content only	To navigate within this application, do **not** click the Forward and Back buttons.
Bold italic	Glossary term (if there is a glossary)	The ***algorithm*** inserts the new key.
Brackets	Key names	Press [Enter].
Caps and lowercase	Buttons, check boxes, application triggers, windows	Click the Executable button. Select the Can't Delete Card check box. Assign a When-Validate-Item trigger to the ORD block. Open the Master Schedule window.
Angle brackets	Menu paths	Select File > Save.
Commas	Key sequences	Press and release the following keys one at a time: [Alt], [F], [D]
Courier new, case sensitive (default is lowercase)	Code output, directory names, file names, passwords, path names, user input, usernames	Code output: `debug.set ('I', 300);` Directory: `bin` (DOS), `$FMHOME` (UNIX) File name: Locate the `init.ora` file. Password: Use `tiger` as your password. Path name: Open `c:\my_docs\projects`. User input: Enter `300`. Username: Log in as `HR`.
Initial cap	Graphics labels (unless the term is a proper noun)	Customer address (*but* Oracle Payables)
Italic	Emphasized words and phrases, titles of books and courses, variables	Do *not* save changes to the database. For further information, see *Oracle Database SQL Reference 10g Release 1(10.1).* Enter *`user_id`*`@us.oracle.com`, where *`user_id`* is the name of the user.

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Typographic Conventions (continued)

Typographic Conventions in Text (continued)

Convention	Element	Example
Quotation marks	Interface elements with long names that have only initial caps; lesson and chapter titles in cross-references	Select "Include a reusable module component" and click Finish. This subject is covered in the lesson titled, "Working with Objects."
Uppercase	SQL column names, commands, functions, schemas, table names, database trigger names	Use the `SELECT` command to view information stored in the `LAST_NAME` column of the `EMPLOYEES` table.

Typographic Conventions in Code

Convention	Element	Example

Lowercase	Column names, table names, database trigger names	`SELECT last_name`
		`FROM employees;`
		
		CREATE OR REPLACE TRIGGER `secure_employees`

	Passwords	`CREATE USER scott` `IDENTIFIED BY tiger;`
	PL/SQL objects	`items.DELETE(3);`
Lowercase italic	Syntax variables	`CREATE ROLE` *`role`*
Uppercase	SQL commands and functions	`SELECT first_name` `FROM employees;`

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Typographic Conventions (continued)

Typographic Conventions in Navigation Paths

This course uses simplified navigation paths, such as the following example, to direct you through Oracle applications.

Example:

Invoice Batch Summary

(N) Invoice > Entry > Invoice Batches Summary (M) Query > Find (B) Approve

This simplified path translates to the following:

1. (N) From the Navigator window, select Invoice > Entry > Invoice Batches Summary.
2. (M) From the menu, select Query > Find.
3. (B) Click the Approve button.

Notation:

(N) = Navigator	(I) = Icon
(M) = Menu	(H) = Hyperlink
(T) = Tab	(B) = Button

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16

Performing Database Recovery

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Objectives

After completing this lesson, you should be able to recover from the loss of a:

- **Control file**
- **Redo log file**
- **Data file**

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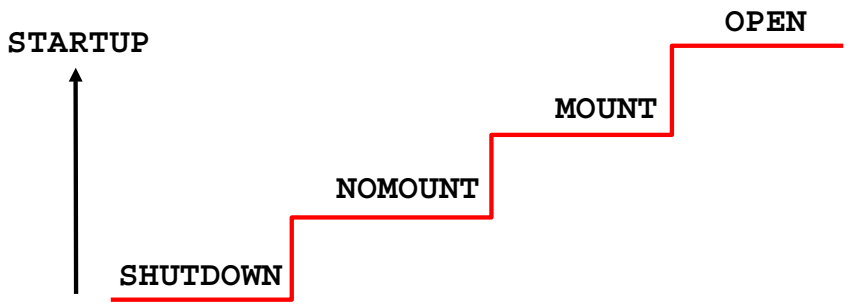
Opening a Database

To open a database:

- **All control files must be present and synchronized**
- **All online data files must be present and synchronized**
- **At least one member of each redo log group must be present**



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Opening a Database

As a database moves from the shutdown stage to being fully open, it performs internal consistency checks. The stages are:

- `NOMOUNT`: In order for an instance to reach the `NOMOUNT` (also known as `STARTED`) status, the instance must read the initialization parameter file. No database files are checked while the instance enters the `NOMOUNT` state.
- `MOUNT`: As the instance moves to the `MOUNT` status, it checks whether all control files listed in the initialization parameter file are present and synchronized. If even one control file is missing or corrupt, the instance returns an error (noting the missing control file) to the administrator and remains in the `NOMOUNT` state.
- `OPEN`: When the instance moves from the `MOUNT` state to the `OPEN` state, it:
  - Checks whether all redo log groups known to the control file have at least one member present. Any missing members are noted in the alert log.

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Opening a Database (continued)

- Verifies that all data files known to the control file are present unless they have been taken offline. Offline files are not checked until the administrator tries to bring them online. The administrator may take a data file offline and open the instance as long as the data file does not belong to the `SYSTEM` or `UNDO` tablespaces. If any files are missing, an error noting the first missing file is returned to the administrator and the instance remains in the `MOUNT` state. When the instance finds files that are missing, only the first file causing a problem appears in the error message. To find all files that need recovery, the administrator can check the `v$recover_file` dynamic performance view to get a complete list of the files that need attention:

```
SQL> startup
ORACLE instance started.
Total System Global Area  171966464 bytes
Fixed Size                   775608 bytes
Variable Size             145762888 bytes
Database Buffers           25165824 bytes
Redo Buffers                 262144 bytes
Database mounted.
ORA-01157: cannot identify/lock data file 4 - see DBWR
trace file
ORA-01110: data file 4:
'/oracle/oradata/orcl/users01.dbf'
SQL> SELECT name, error
  2  FROM v$datafile
  3  JOIN v$recover_file
  4  USING (file#);
NAME                                ERROR
----------------------------------- ------------------
/oracle/oradata/orcl/users01.dbf    FILE NOT FOUND
/oracle/oradata/orcl/example01.dbf  FILE NOT FOUND
```

- Verifies that all data files that are not offline or read-only are synchronized with the control file. If necessary, instance recovery is automatically performed. However, if a file is out of synchronization to the extent that it cannot be recovered by using the online redo log groups, then the administrator must perform media recovery. If any files require media recovery, an error message noting the first file requiring recovery is returned to the administrator and the instance remains in the `MOUNT` state:

```
ORA-01113: file 4 needs media recovery
ORA-01110: data file 4:
'/oracle/oradata/orcl/users01.dbf'
```

  Again, `v$recover_file` gives a complete list of files that need attention. Files that are present and which need media recovery are listed, but no error message is displayed .

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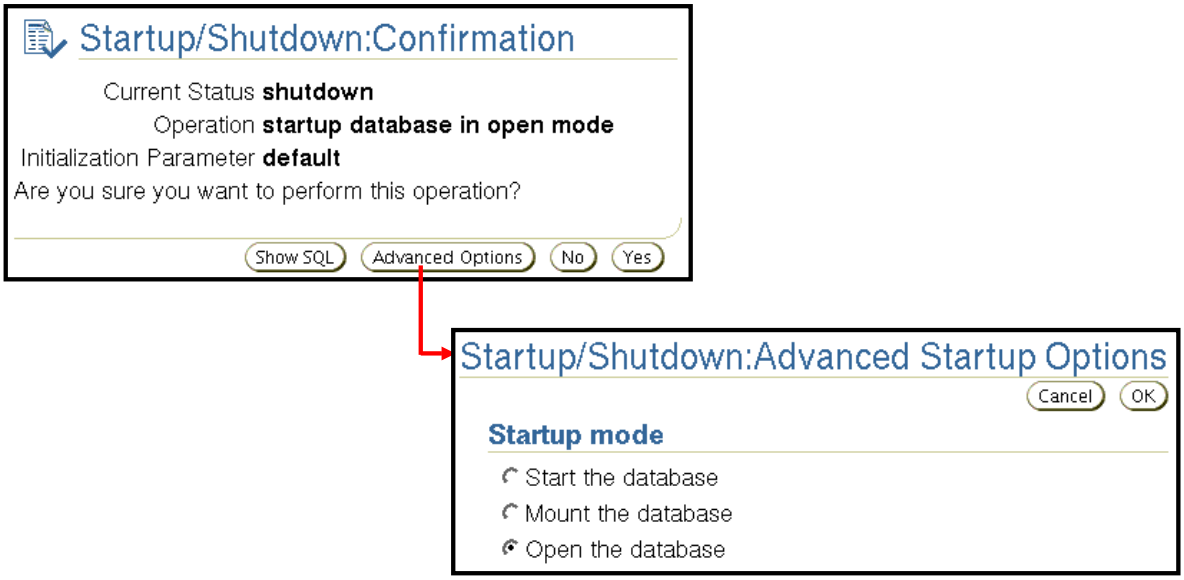
Changing Instance Status

Use Database Control to alter the instance's status.



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Changing Instance Status

When starting the instance, the default start mode is `OPEN`. You may choose to start the instance in some other mode, or problems with the database may force you to start the instance in another mode. The Advanced Startup Options properties page enables you to select a state other than `OPEN` when starting the instance and to alter the state if the instance has already started in another mode. You may also use SQL commands to modify an instance's status:

```
SQL> STARTUP NOMOUNT
ORACLE instance started.

Total System Global Area  188743680 bytes
Fixed Size                   778036 bytes
Variable Size             162537676 bytes
Database Buffers           25165824 bytes
Redo Buffers                 262144 bytes

SQL> ALTER DATABASE MOUNT
Database altered.

SQL> ALTER DATABASE OPEN
```

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Keeping a Database Open

After the instance is open, it fails in the case of the loss of:

- **Any control file**
- **A data file belonging to the system or undo tablespaces**
- **An entire redo log group. As long as at least one member of the group is available, the instance remains open.**

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Keeping a Database Open

After an instance is open, media failure that causes the loss of a control file, loss of an entire redo log group, or loss of a data file belonging to the `SYSTEM` or `UNDO` tablespaces causes the instance to fail.

In many cases, the failed instance does not completely shut down, but is unable to continue to perform work. Recovering from these types of media failures must be done with the database down, and so the administrator must use the `SHUTDOWN ABORT` command before beginning recovery efforts.

The loss of data files belonging to other tablespaces does not cause instance failure, and the database can be recovered while open, with work continuing in other tablespaces.

These errors can be detected by inspecting the alert log file.

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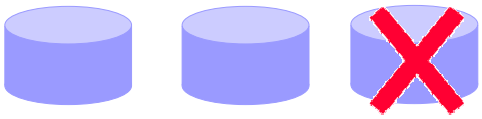
Loss of a Control File

If a control file is lost or corrupted, the instance normally aborts, at which time you must perform the following steps:

1. **Shut down the instance, if it is still open.**
2. **Restore the missing control file by copying an existing control file.**
3. **Start the instance.**



Control files

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Loss of a Control File

Recovering from the loss of a control file (as long as at least one control file remains) can be accomplished by performing the following steps:

1. If the instance has not already failed, shut it down by using `SHUTDOWN ABORT`.
2. Copy one of the remaining control files to the missing file's location. If the media failure is due to the loss of a disk drive or controller, copy one of the remaining control files to some other location and update the instance's parameter file to point to the new location. Alternatively, you can delete the reference to the missing control file from the initialization parameter file. Remember that Oracle recommends having *at least* two control files at all times.
3. Start the instance.

Recovering from the loss of all control files is covered in *Oracle Database 10g: Administration Workshop II*.

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Loss of a Redo Log File

If a member of a redo log file group is lost, as long as the group still has at least one member, then:

- **The normal operation of the instance is not affected.**
- **You receive a message in the alert log notifying you that a member cannot be found.**
- **You can restore the missing log file by dropping the lost redo log member and adding a new member.**
- **If the group with the missing log file has been archived, you can clear the log group to re-create the missing file.**

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Loss of a Redo Log File

Recovering from the loss of a single redo log group member should not affect the running instance. To perform this recovery, perform the following steps:

1. Determine whether there is a missing log file by examining the alert log.
2. Restore the missing file by first dropping the lost redo log member:

   ```
   SQL> ALTER DATABASE DROP LOGFILE MEMBER 'redo01a.log';
   ```

   Then add a new member to replace the lost redo log member:

   ```
   SQL> ALTER DATABASE ADD LOGFILE MEMBER 'redo01a.log'
   TO GROUP 2;
   ```

   Note: If you are using OMF for your redo log files and you use the above syntax to add a new redo log member to an existing group, that new redo log member file will not be an OMF file. If you want to ensure that the new redo log member is an OMF file, the easiest recovery option would be to create a new redo log group and then drop the redo log group that had the missing redo log member.
3. If the media failure is due to the loss of a disk drive or controller, rename the missing file.

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Loss of a Redo Log File (continued)

4. If the group has already been archived, or if you are in `NOARCHIVELOG` mode, you may choose to solve the problem by clearing the log group to re-create the missing file or files. Select the appropriate group and select the Clear Logfile action. You can also clear the affected group manually with the following command:

```
SQL> ALTER DATABASE CLEAR LOGFILE GROUP #;
```

Note: Database Control does not allow you to clear a log group that has not been archived. Doing so breaks the chain of redo information. If you must clear an unarchived log group, you should *immediately* take a full backup of the whole database. Failure to do so may result in a loss of data if another failure occurs. To clear an unarchived log group, use the following command:

```
SQL> ALTER DATABASE CLEAR UNARCHIVED LOGFILE GROUP #;
```

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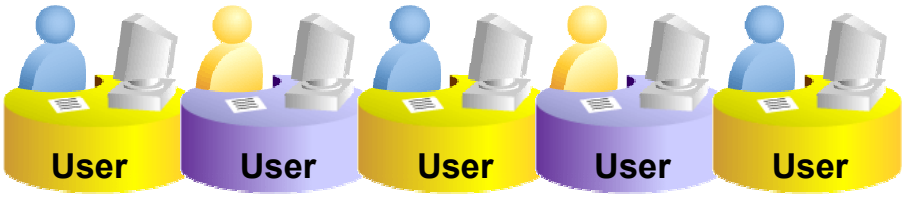
Loss of a Data File in NOARCHIVELOG Mode

If the database is in NOARCHIVELOG mode, and any data file is lost, perform the following tasks:

1. **Shut down the instance if it is not already down.**
2. **Restore the entire database, including all data and control files, from the backup.**
3. **Open the database.**
4. **Have users reenter all changes made since the last backup.**



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Loss of a Data File in NOARCHIVELOG Mode

The loss of *any* data file from a database in NOARCHIVELOG mode requires complete restoration of the database, including control files and all data files.

With the database in NOARCHIVELOG mode, recovery is possible only up to the time of the last backup. So users must reenter all changes made since that backup. For this type of recovery, perform the following tasks:

1. Shut down the instance if it is not already down.
2. Click Perform Recovery on the Maintenance properties page.
3. Select Whole Database as the type of recovery.

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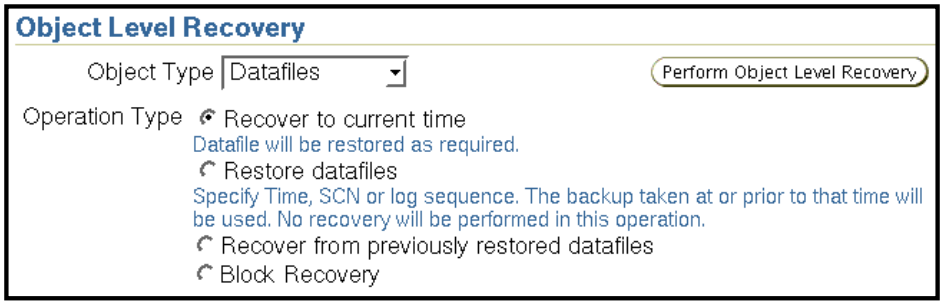
Loss of a Noncritical Data File in ARCHIVELOG Mode

If a data file is lost or corrupted, and that file does not belong to the SYSTEM or UNDO tablespace, then restore and recover the missing data file.



Users

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Loss of a Noncritical Data File in ARCHIVELOG Mode

With the database in ARCHIVELOG mode, the loss of any data file not belonging to the SYSTEM or UNDO tablespaces only affects objects that are in the missing file. The rest of the database remains available for users to continue work. To restore and recover the missing data file, perform the following steps:

1. Click Perform Recovery on the Maintenance properties page.
2. Select "Datafiles" as the recovery type, and select "Restore to current time."
3. Add all data files that need recovery.
4. Determine whether you want to restore the files to the default location or (if a disk or controller is missing) to a new location.
5. Submit the RMAN job to restore and recover the missing files.

Because the database is in ARCHIVELOG mode, recovery up to the time of the last commit is possible and users are not required to reenter any data.

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Loss of a System-Critical Data File in ARCHIVELOG Mode

If a data file is lost or corrupted, and that file belongs to the SYSTEM or UNDO tablespace:

1. **The instance may or may not shut down automatically. If it does not, use SHUTDOWN ABORT to bring the instance down.**
2. **Mount the database**
3. **Restore and recover the missing data file**
4. **Open the database**

Users

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Loss of a System-Critical Data File

Data files belonging to the SYSTEM tablespace or containing UNDO data are considered system critical. A loss of one of these files requires the database to be restored from the MOUNT state (unlike other data files that may be restored with the database open). To perform this recovery, perform the following steps:

1. If the instance is not already shut down, shut it down.
2. Mount the database.
3. Click Perform Recovery on the Maintenance properties page.
4. Select “Datafiles” as the recovery type, and select “Restore to current time.”
5. Add all data files that need recovery.
6. Determine whether you want to restore the files to the default location or (if a disk or controller is missing) to a new location.
7. Submit the RMAN job to restore and recover the missing files.
8. Open the database. Users are not required to reenter data because the recovery is up to the time of the last commit.

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Summary

In this lesson, you should have learned how to recover from the loss of a:

- **Control file**
- **Redo log file**
- **Data file**

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Practice Overview: Performing Database Recovery

This practice covers recovering from the loss of a:

- **Control file**
- **Redo log file**
- **Noncritical data file**
- **System-critical data file**

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17

Performing Flashback

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Objectives

After completing this lesson, you should be able to:

- Describe Flashback Database
- Restore the table content to a specific point in the past with Flashback Table
- Recover from a dropped table
- View the contents of the database as of any single point in time with Flashback Query
- See versions of a row over time with Flashback Versions Query
- View transaction history or a row with Flashback Transaction Query

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Flashback Technology: Benefits

> Overview
Database
Table
Drop
Query
Versions
Transaction

- The Flashback technology is a revolutionary advance in recovery.
- Traditional recovery techniques are slow.
  - The entire database or a file (not just the incorrect data) has to be restored.
  - Every change in the database log must be examined.
- Flashback is *fast*.
  - Changes are indexed by row and by transaction.
  - Only the changed data is restored.
- Flashback commands are *easy*.
  - No complex multiple-step procedures are involved.

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Flashback Technology: Benefits

The Oracle Database 10*g* architecture leverages the unique technological advances in the area of database recovery from the loss of data due to human errors. The Flashback technology provides a set of new features to view and rewind data back and forth in time.

The Flashback technology revolutionizes recovery by simply operating on the changed data. The time it takes to recover from the error is equal to the amount of time it takes to make the error. When applicable, the Flashback technology provides significant benefits over media recovery in terms of ease of use, availability, and restoration time.

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When to Use the Flashback Technology

Object Level	Scenario Examples	Flashback Technology	Uses	Affects Data
Database	Truncate table; Undesired multitable changes made	Database	Flashback logs	True
Table	Drop table	Drop	Recycle bin	True
	Update with the wrong `WHERE` clause	Table	Undo data	True
	Compare current data with data from the past	Query	Undo data	False
	Compare versions of a row	Version	Undo data	False
Tx	Investigate several historical states of data	Transaction	Undo data	False

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When to Use the Flashback Technology

The Flashback technology must be used when a logical corruption occurs in the Oracle database, and you need to recover data quickly and easily. As with human errors, it is difficult to identify the objects and rows that are affected by an erroneous transaction. With the Flashback technology, you can diagnose how errors are introduced into the database, and then you can repair the damage. You can view the transactions that have contributed to specific row modifications, view the entire set of versions of a given row during some time period, or just view data as it appeared at a specific time in the past. The table in the slide shows typical uses of the Flashback technology.

Flashback Database uses the flashback logs to perform flashback. Flashback Drop uses the recycle bin. All others use undo data.

Not all flashback features modify the database. Some are simply methods to query other versions of data. Those are tools for you to use to investigate a problem and aid in recovery. The results of those flashback queries can help you perform one of these two things:

- Determine which type of database-modifying flashback operation to perform to fix the problem
- Feed the result set of these queries into an `INSERT`, `UPDATE`, or `DELETE` statement that enables you to easily repair the erroneous data.

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Flashing Back Any Error

- **Flashback Database brings the database to an earlier point in time by undoing all changes made since that time.**
- **Flashback Table recovers a table to a point in time in the past without having to restore from a backup.**
- **Flashback Drop restores accidentally dropped tables.**

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Flashing Back Any Error

Oracle Database 10*g* introduces expanded database flashback capabilities. If a major error occurs that makes unisolated changes, such as a batch job being run twice in succession, then you can request a flashback operation that quickly recovers the entire database to a previous point in time. This eliminates the need to restore backups and perform a point-in-time recovery. In addition to flashback operations at the database level, it is also possible to flash back a single table or recover a table dropped in error.

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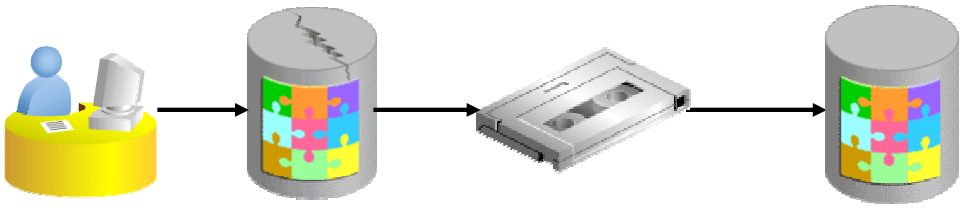
Flashback Database: Overview

The Flashback Database operation:

- **Works like a rewind button for the database**
- **Can be used in cases of logical data corruptions made by users**



Users generate errors. → **The database is corrupted.** → **You "press the rewind button."** → **The database is "rewound."**

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Flashback Database: Overview

With Flashback Database, you can quickly bring your database to an earlier point in time by undoing all the changes that have taken place since that time. This operation is fast because you do not need to restore backups. You can use this feature to undo changes that have resulted in logical data corruptions.

If you have experienced a loss of media or physical corruption in your database, then you must use traditional recovery methods.

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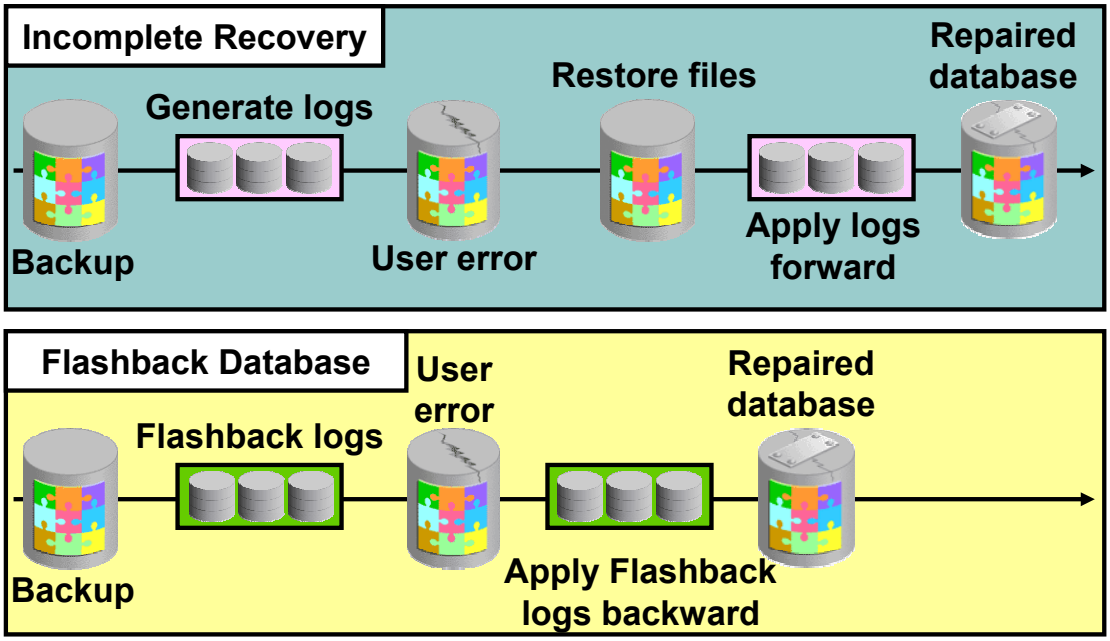
Flashback Database: Reducing Restore Time



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Flashback Database: Reducing Restore Time

Flashback Database is faster than the traditional point-in-time recovery that uses restored files and redo log files. As a database grows in size, the length of time required to restore all the data files to perform a traditional point-in-time recovery becomes prohibitive. With Flashback Database, the time to recover a database is now proportional to the number of changes that need to be backed out (and not to the size of the database) because you do not have to restore data files.

Flashback Database is implemented by using a type of log file called Flashback Database logs. The Oracle database periodically logs “before images” of data blocks in the Flashback Database logs. Block images can be reused to quickly back out the data file changes to any time at which flashback logs are captured just before the desired target time. Then, changes from the redo log files are applied to fill in the gap. The Flashback Database logs are automatically created and managed in the flash recovery area.

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Flashback Database: Considerations

- When the Flashback Database operation completes, the database must be opened by using one of these methods:
  - In read-only mode to verify that the correct target time or SCN has been used
  - With the `RESETLOGS` parameter to allow for updates
- The opposite of flash back is recover.

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Flashback Database: Considerations

In situations where you cannot use the Flashback Database feature, you must use an incomplete recovery operation to return the database to a specific time. After the Flashback Database operation is complete, you can open the database in read-only mode to verify that the correct target time or system change number (SCN) has been used. If not, you can flash back the database again or perform a recovery to roll forward the database. So, to undo a Flashback Database operation, you must recover the database forward.

Note: The flashback retention target is not an absolute guarantee that flashback is available. If space is needed for required files in the flash recovery area, then flashback logs may be deleted automatically.

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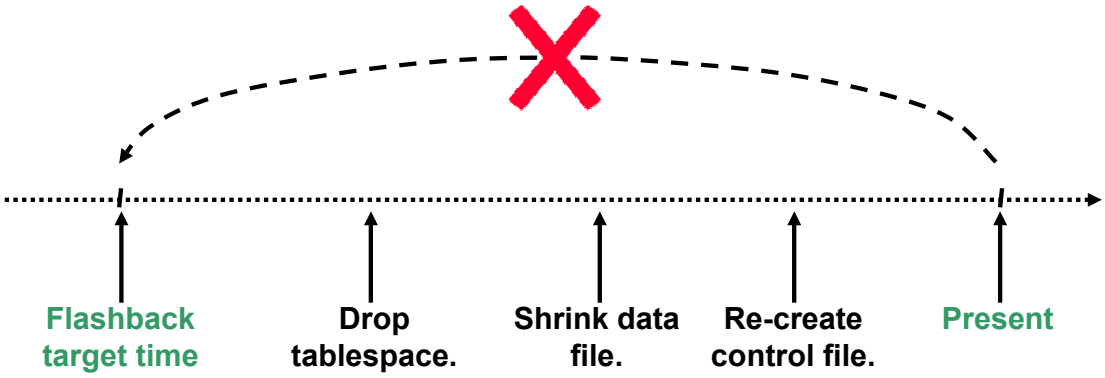
Flashback Database: Limitations

You cannot use Flashback Database in the following situations:

- **The control file has been restored or re-created.**
- **A tablespace has been dropped.**
- **A data file has been shrunk.**



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Flashback Database: Limitations

You cannot use Flashback Database to recover a data file that has been dropped since the Flashback target time. The dropped data file is added to the control file and marked offline, but it is not flashed back. Flashback Database cannot flash back a data file if it has been shrunk since the Flashback target time. Any such data files must be taken offline before performing the flashback operation.

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Enabling Flashback Database

☑ Enable Flashback Database - flashback logging can be used for fast database point-in-time recovery*

The flash recovery area must be set to enable flashback logging. When using flashback logs, you may recover your entire database to a prior point-in-time without restoring files. Flashback is the preferred point-in-time recovery method in the recovery wizard when appropriate.

Specify how far back you wish to flash the database in the future

Flashback Retention Time 24 Hours

Current size of the flashback logs(GB) **n/a**

Lowest SCN in the flashback data **n/a**

Flashback Time **n/a**

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Enabling Flashback Database

Flashback Database can be enabled in Enterprise Manager, using the Recovery Settings link on the Maintenance tabbed page. Turn on the checkmark in the Flash Recovery region of the page, and specify the retention time, which is how far back in the past you want to be able to flash back the database to.

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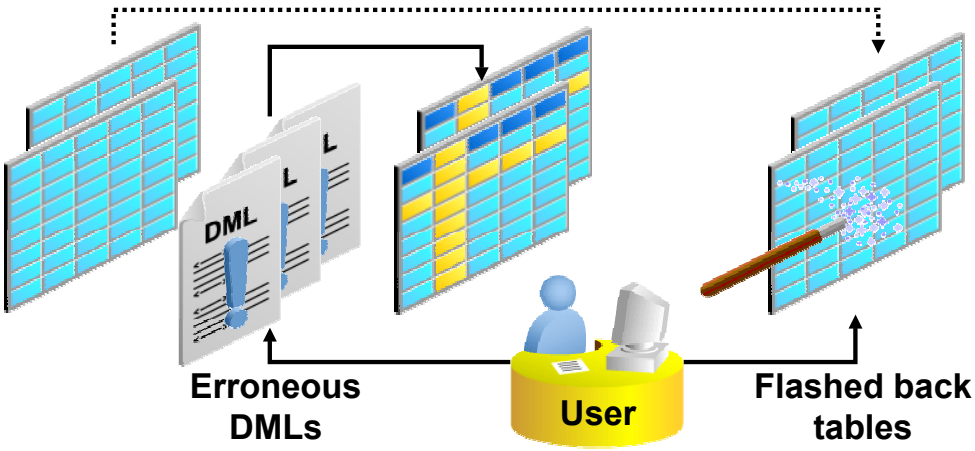
Flashback Table: Overview

Overview
Database
> Table
Drop
Query
Versions
Transaction

- Flashback Table recovers tables to a specific point in time.
- Flashback Table is an in-place operation.
- The database stays online.



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Flashback Table: Overview

Using Flashback Table, you can recover a set of tables to a specific point in time without having to perform traditional point-in-time recovery operations.

A Flashback Table operation is done in-place, while the database is online, by rolling back only the changes that are made to the given tables and their dependent objects.

A Flashback Table statement is executed as a single transaction. All tables must be flashed back successfully, or the entire transaction is rolled back.

Note: You can use Flashback Versions Query and Flashback Transaction Query to determine the appropriate flashback time.

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Flashback Table

- **Using Flashback Table, you can recover a table or tables to a specific point in time without restoring a backup.**
- **Data is retrieved from the undo tablespace to perform a Flashback Table operation.**
- **The `FLASHBACK` object privilege and the `FLASHBACK ANY TABLE` system privilege can be granted to allow a non-owner of a table to flashback that table.**
- **Row movement must be enabled on the table that you are performing the flashback operation on.**

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Flashback Table

With Flashback Table, you can recover a table or tables to a specific point in time without restoring a backup. When you use this feature, the data in tables and their associated objects (indexes, constraints, triggers, and so on) is restored. The data used to satisfy a Flashback Table request is retrieved from the undo tablespace.

You can use Flashback Versions Query and Flashback Transaction Query to determine the appropriate flashback time. For more information about using these features, refer to *Oracle Database Concepts*.

Flashback Table provides a way for users to easily and quickly recover from accidental modifications without a database administrator's (DBA's) involvement. You may grant the `FLASHBACK` object privilege to other users for a specific table to allow them to flashback that table. There is also the `FLASHBACK ANY TABLE` system privilege that allows a user to flashback any table.

You can use Enterprise Manager to flash back a table. The wizard guides you through the process.

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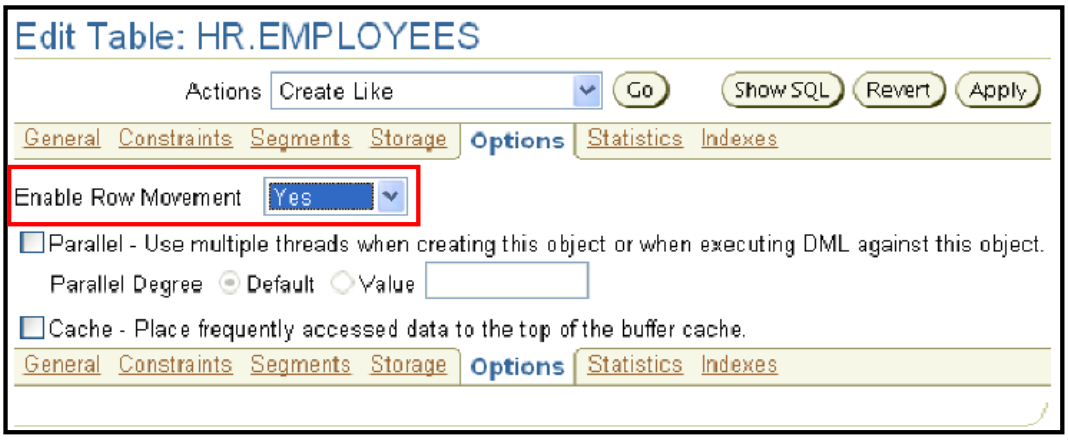
Enabling Row Movement on a Table




```
ALTER TABLE employees ENABLE ROW MOVEMENT;
```

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Enabling Row Movement on a Table

You must enable row movement on a table to be able to flash back the table. When you enable row movement, the Oracle server can move a row in the table. You can use Enterprise Manager to enable row movement.

Using Enterprise Manager, you can enable row movement on a table by performing the following steps:

1. Select Tables in the Schema region on the Administration property page. Enter the schema name to search for the table, and click Go.
2. Click the table name of the table for which you want to enable row movement. You are now on the View Table page.
3. Click Edit, which takes you to the Edit Table page.
4. Click the Options tab, where you can change the Enable Row Movement setting for the table.
5. Set Enable Row Movement to Yes, and click Apply.
   The update confirmation message is displayed.

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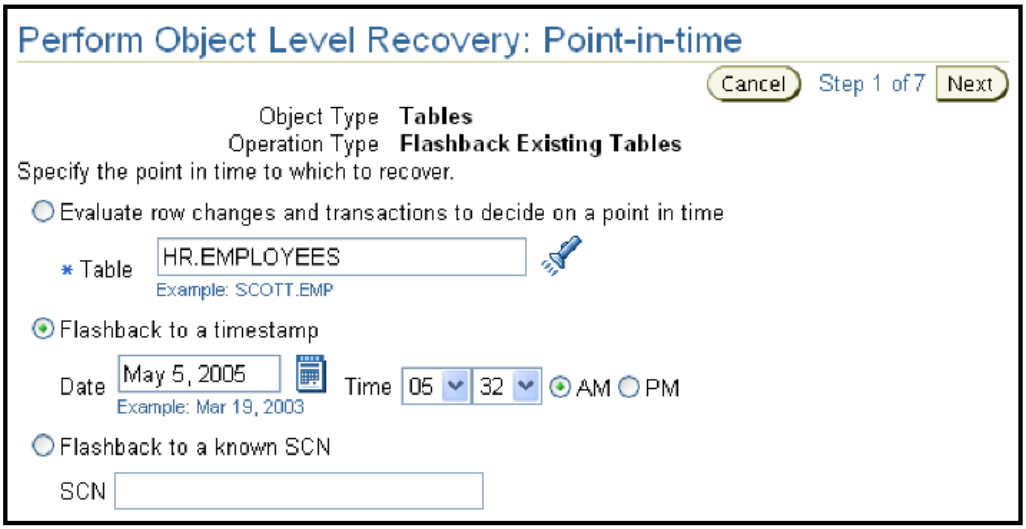
Performing Flashback Table




```
FLASHBACK TABLE hr.employees TO TIMESTAMP
TO_TIMESTAMP('2005-05-05 05:32:00',
'YYYY-MM-DD HH24:MI:SS');
```

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Performing Flashback Table

You can flash back a table through Enterprise Manager by performing the following steps:

1. Select Perform Recovery in the Backup/Recovery region on the Maintenance property page. The Perform Recovery page appears.
2. In the Object Level Recovery region, select Tables from the Object Type drop-down list.
3. Select Flashback Existing Tables as the Operation Type. Click Perform Object Level Recovery. The “Perform Object Level Recovery: Point-in-time” page is displayed.
4. Select “Flashback to a timestamp” or “Flashback to a known SCN” and then specify a time stamp or SCN to flash back to, and click Next.
5. Click Add Tables to add tables to the list for the flashback operation. Click Next.
6. The Dependency Options page appears if there are dependent tables. Select the desired option for dealing with dependent tables. Typically, you would choose “Cascade” to ensure a consistent flashback. Click Next.

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Performing Flashback Table (continued)

7. The “Perform Object Level Recovery: Review” page appears. Review the information and click Submit. The Confirmation page appears.

Note: You can also flash back tables from the Tables link in the Schema region of the Administration page.

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Flashback Table: Considerations

- The `FLASHBACK TABLE` command executes as a single transaction, acquiring exclusive DML locks.
- Statistics are not flashed back.
- Current indexes and dependent objects are maintained.
- Flashback Table operations:
  - Cannot be performed on system tables
  - Cannot span DDL operations
  - Generate undo and redo data

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Flashback Table: Considerations

- The entire `FLASHBACK TABLE` statement is executed within a single transaction. All or none of the specified tables are flashed back.
- Flashback Table acquires exclusive data manipulation language (DML) locks on all the tables that are specified in the statement over the period of time when the operation is in progress.
- Statistics of impacted objects are not flashed back.
- All existing indexes are maintained. Dropped indexes are not re-created. Dependent on-commit materialized views are also maintained automatically.
- A `FLASHBACK TABLE` statement is written to the alert log file.
- Tables specified in the `FLASHBACK TABLE` statement are flashed back, provided that none of the table constraints are violated. If any constraints are violated during flashback execution, the operation is aborted and the tables are left in the same state as they were just before the `FLASHBACK TABLE` statement invocation.
- You cannot perform Flashback Table to a particular time that is older than the time of the execution of a data definition language (DDL) operation that altered the structure of or shrunk a table that would be involved in the flashback operation. This restriction does not apply to DDL statements that only change storage attributes of the tables.
- Flashback Table cannot be performed on system tables, remote tables, and fixed tables.

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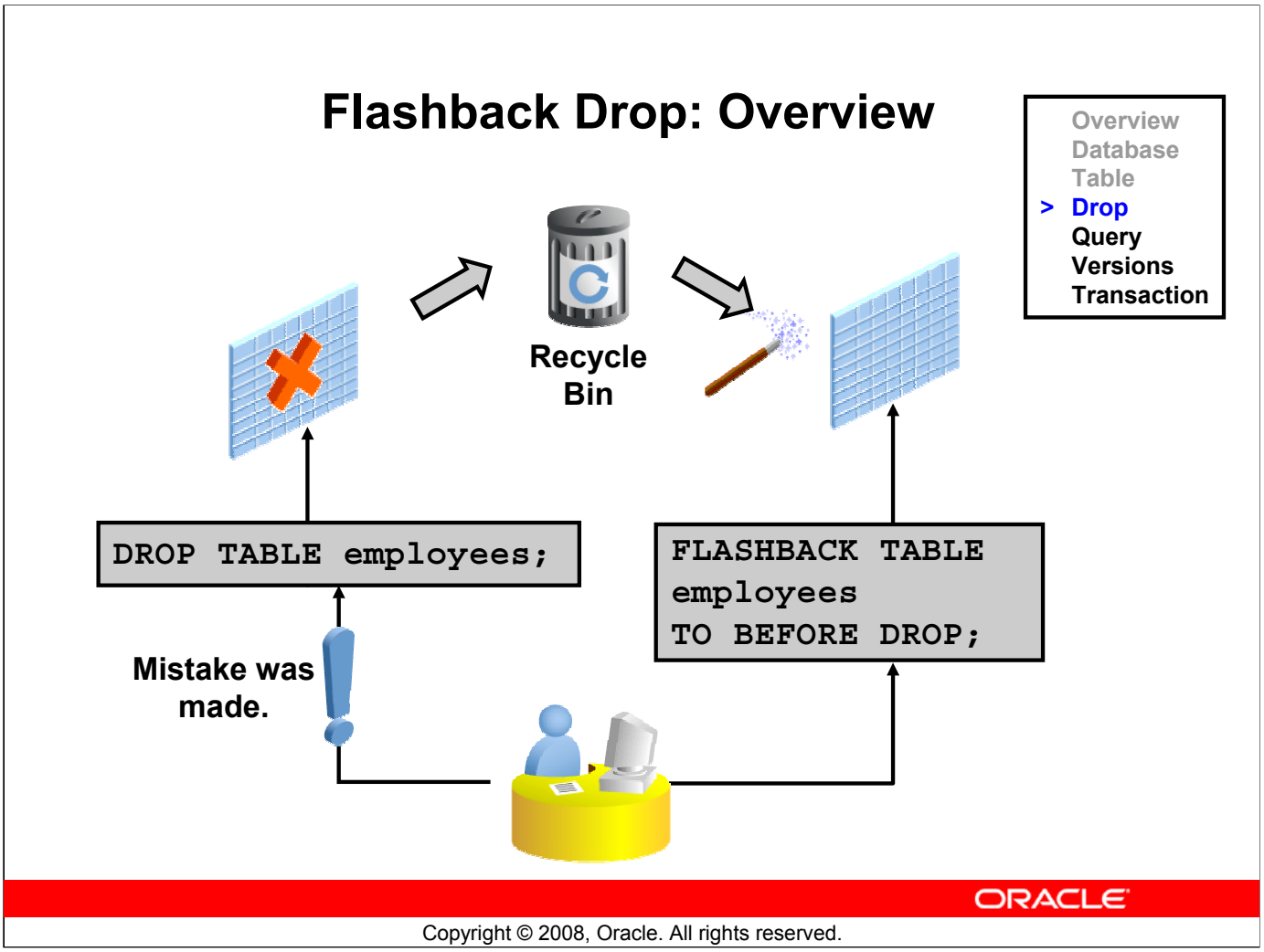

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Flashback Drop: Overview

With the Flashback Drop feature, you can undo the effects of a `DROP TABLE` statement without resorting to the traditional point-in-time recovery. This is made possible because of the recycle bin, which can be queried via the `DBA_RECYCLEBIN` view.

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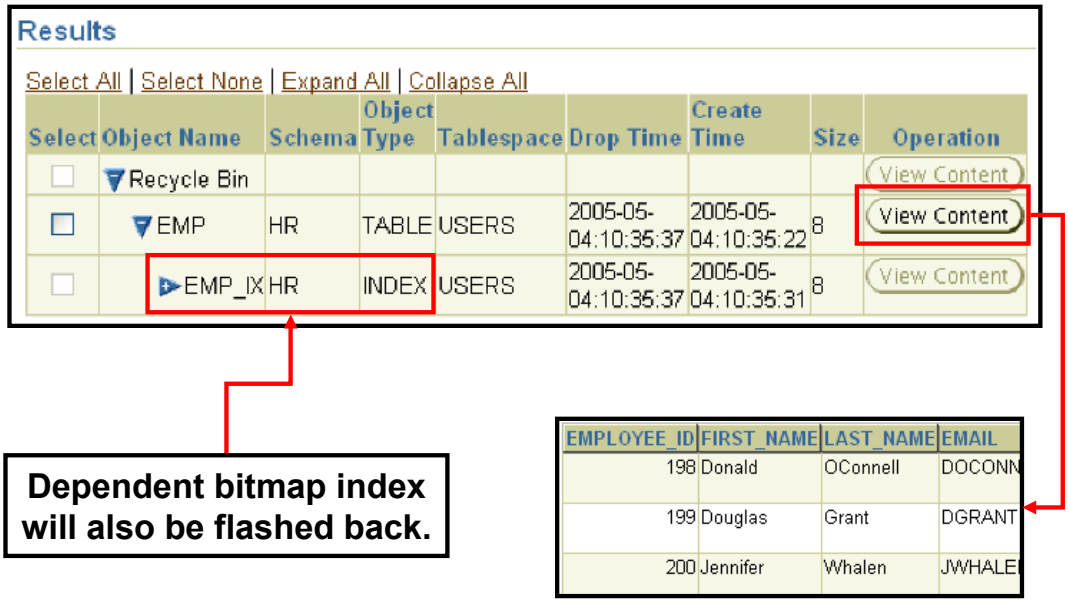
Flashing Back Dropped Tables Through Enterprise Manager



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Flashing Back Dropped Tables Through Enterprise Manager

To flash back dropped tables with the Database Control Console, select Perform Recovery in the Backup/Recovery region of the Maintenance page. Select Tables for the Object Type in the Type region, and choose Flashback Dropped Tables in the Operation Type region. After this is done, click Perform Object Level Recovery.

You should now see the "Perform Object Level Recovery: Dropped Objects Selection" page, where you can select dropped tables from the recycle bin. You can also query the content of dropped tables by clicking View Content. Select the tables that you want to recover, and click Next.

The "Perform Object Level Recovery: Rename" page appears, where you can rename the table if a table with the same name currently exists in the same schema. Click Next to continue. On the "Perform Object Level Recovery: Review" page, you can review the details of your operation as well as display the corresponding SQL statements. After you are ready, click Submit. You should now see the Confirmation page. Click OK to go back to the Maintenance page.

Note: You can also flash back dropped tables from the Tables link of the Schema region of the Administration page. On the Tables page, click the Recycle Bin button.

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Flashback Drop: Considerations

- **Flashback Drop does not work for tables that:**
  - **Reside in the `SYSTEM` tablespace**
  - **Use fine-grained auditing or Virtual Private Database**
  - **Reside in a dictionary-managed tablespace**
  - **Have been purged, either by manual purging or automatic purging under space pressure**
- **The following dependencies are not protected:**
  - **Bitmap-join indexes**
  - **Materialized view logs**
  - **Referential integrity constraints**
  - **Indexes dropped before tables**

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Flashback Drop: Considerations

Flashback Drop only works for tables in non-`SYSTEM`, locally managed tablespaces (LMT). However, dependent objects that reside in dictionary-managed tablespaces are flashed back as part of the flashback operation of the LMT-dwelling parent object. Tables with fine-grained auditing (FGA) or Virtual Private Database (VPD) policies defined on them are not eligible for a Flashback Drop operation. Also, you cannot flash back a dropped table if it has been purged. It could have been purged manually with the `PURGE` statement or automatically as the result of a need for space for other objects in the tablespace.

When you perform Flashback Drop on a table, all objects dependent on that table are also flashed back from the recycle bin. There are exceptions to this: Bitmap-join indexes, referential integrity constraints, and materialized view logs are not flashed back, even though their parent table is.

Note: If you drop an index before its associated table, recovery of the index is not supported when you flash back the dropped table.

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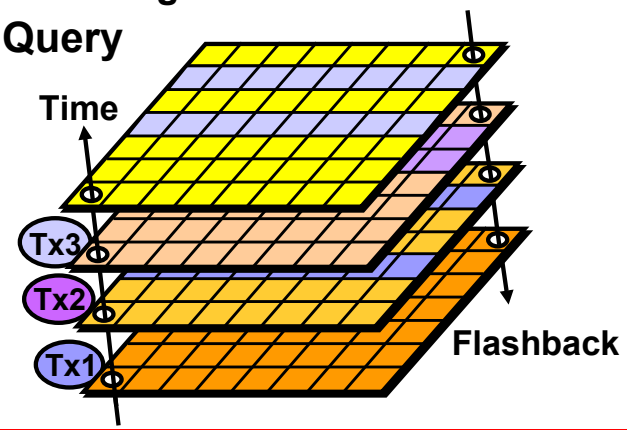
Flashback Time Navigation

Overview
Database
Table
Drop
> Query
Versions
Transaction

- **Flashback Query**
  - **Query all data at a specified point in time.**
- **Flashback Versions Query**
  - **See all versions of a row between two times.**
  - **See the transactions that changed the row.**
- **Flashback Transaction Query**
  - **See all changes made by a transaction.**



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Flashback Time Navigation

The Flashback technology offers the capability to query past versions of schema objects, query historical data, and perform change analysis. Every transaction logically generates a new version of the database. With the Flashback technology, you can navigate through these versions to find an error and its cause:

- **Flashback Query:** Query all data as it existed at a specific point in time.
- **Flashback Versions Query:** See all versions of rows between two times and the transactions that changed the row.
- **Flashback Transaction Query:** See all changes made by a transaction.

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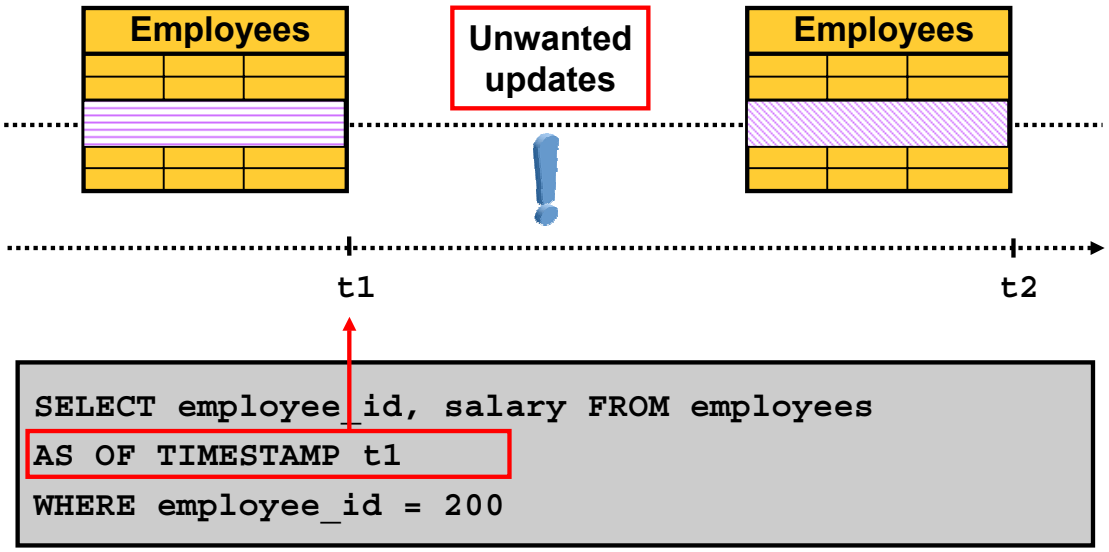
Flashback Query: Overview



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Flashback Query: Overview

With the Flashback Query feature, you can perform queries on the database as of a certain time. By using the `AS OF` clause of the `SELECT` statement, you can specify the time stamp for which to view the data. This is useful for analyzing a data discrepancy.

Note: The `AS OF` clause can be followed by either `TIMESTAMP` or `SCN`.

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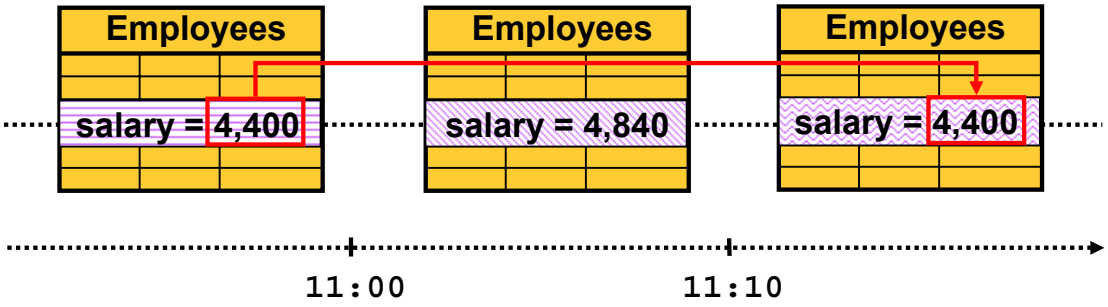
Flashback Query: Example




```
UPDATE employees SET salary =
     (SELECT salary FROM employees
     AS OF TIMESTAMP TO_TIMESTAMP
    ('2005-05-04 11:00:00', 'yyyy-mm-dd hh24:mi:ss')
     WHERE employee_id = 200)
WHERE employee_id = 200
```

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Flashback Query: Example

If a raise has been erroneously given to a particular employee recently, you can update the salary again, assigning the salary provided by a subquery that returns the flashed back value.

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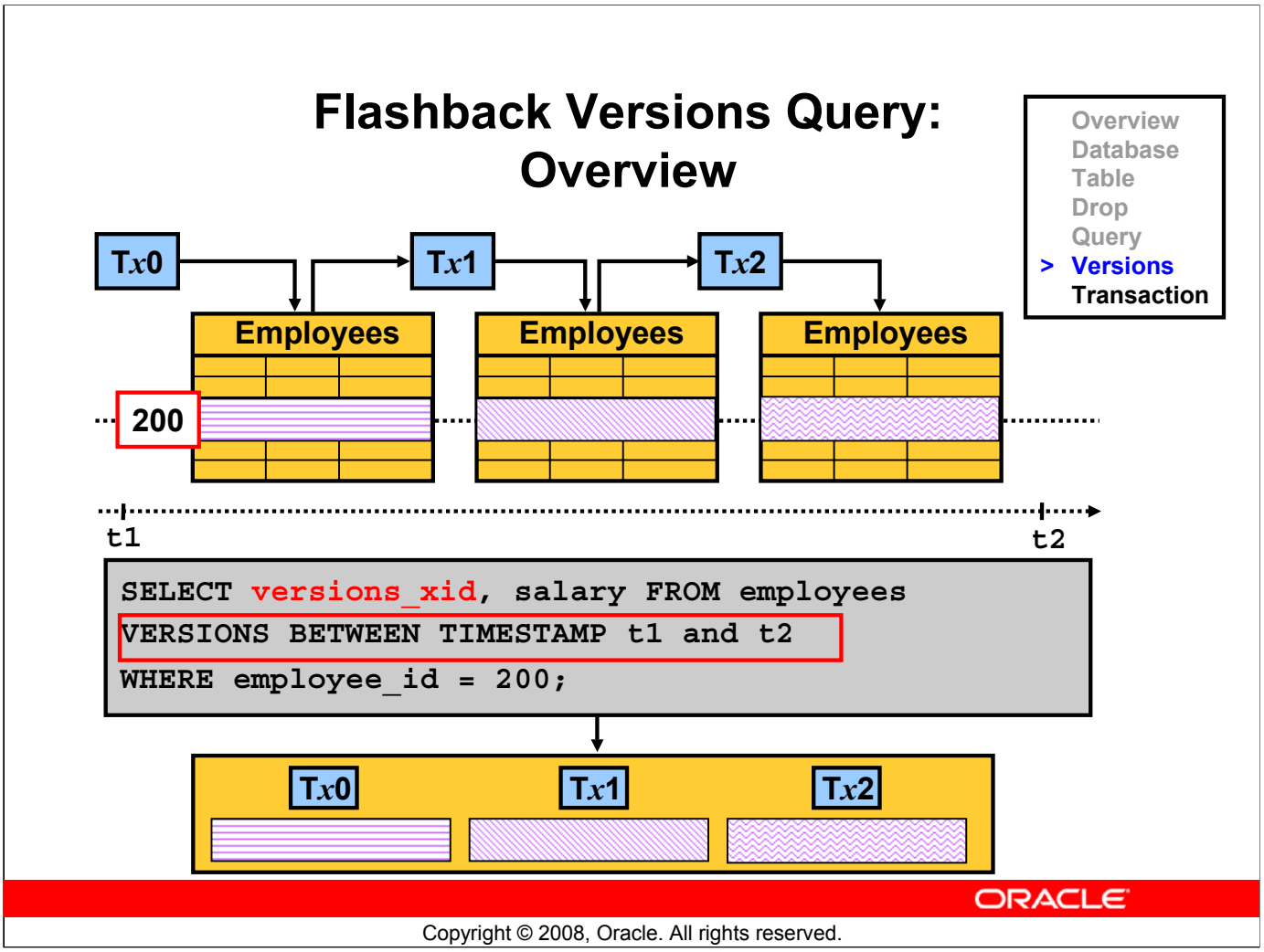

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Flashback Versions Query: Overview

With the Flashback Query feature, you can perform queries on the database as of a certain time span or range of user-specified system change numbers (SCNs). The Flashback Versions Query feature enables you to use the `VERSIONS` clause to retrieve all the versions of the rows that exist between two points in time or two SCNs.

The rows returned by Flashback Versions Query represent a history of changes for the rows across transactions. Flashback Versions Query retrieves only committed occurrences of the rows. Uncommitted row versions within a transaction are not shown. The rows returned also include deleted and subsequently reinserted versions of the rows.

You can use Flashback Versions Query to retrieve row history. It provides you with a way to audit the rows of a table and retrieve information about the transactions that affected the rows. You can then use the returned transaction identifier either to perform transaction mining by using LogMiner or to perform a Flashback Transaction Query, which is covered later in this lesson.

Note: In the example, `VERSIONS_XID` is a pseudocolumn that returns the transaction identifier of the corresponding version of a row.

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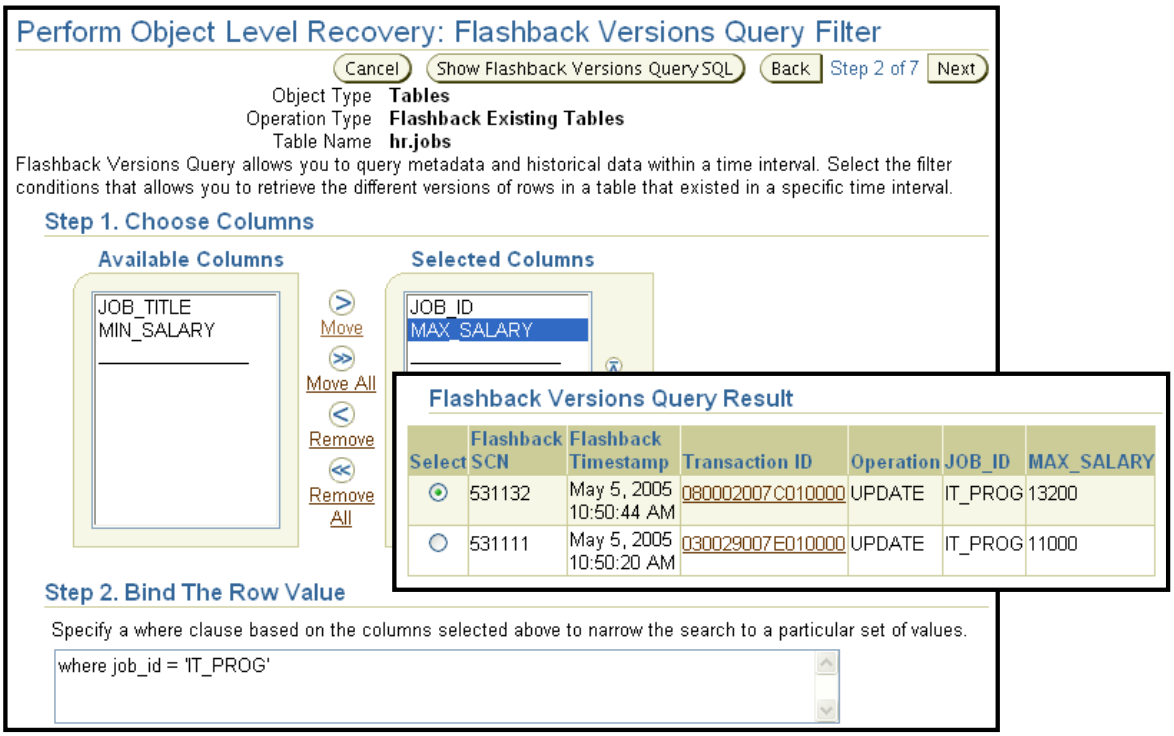
Flashback Versions Query Through Enterprise Manager



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Flashback Versions Query Through Enterprise Manager

Flashback Versions Query can also be performed through Enterprise Manager. On the Maintenance page, select Perform Recovery.

On the Perform Recovery page, select Tables for the Object Type and select Flashback Existing Tables for the Operation Type. Click Perform Object Level Recovery. On the "Perform Object Level Recovery: Point-in-Time" page, select "Evaluate row changes and transactions to decide on a point in time," and specify the name of the target table.

Select the columns that you want to view in the Available Columns box, and then enter a search clause in the Bind The Row Value box. Select "Show all row history," and then click Next.

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Flashback Versions Query: Considerations

- The `VERSIONS` clause cannot be used to query:
  - External tables
  - Temporary tables
  - Fixed tables
  - Views
- The `VERSIONS` clause cannot span DDL commands.
- Segment shrink operations are filtered out.

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Flashback Versions Query: Considerations

The `VERSIONS` clause cannot be used to query the following special tables:

- External tables
- Temporary tables
- Fixed tables

You cannot use the `VERSIONS` clause to query a view. However, a view definition can use the `VERSIONS` clause.

The `VERSIONS` clause in a `SELECT` statement cannot produce versions of rows across the DDL statements that change the structure of the corresponding tables. This means that the query stops producing rows after it reaches a time in the past when the table structure was changed.

Certain maintenance operations, such as a segment shrink, may move table rows across blocks. In this case, the version query filters out such phantom versions because the row data remains the same.

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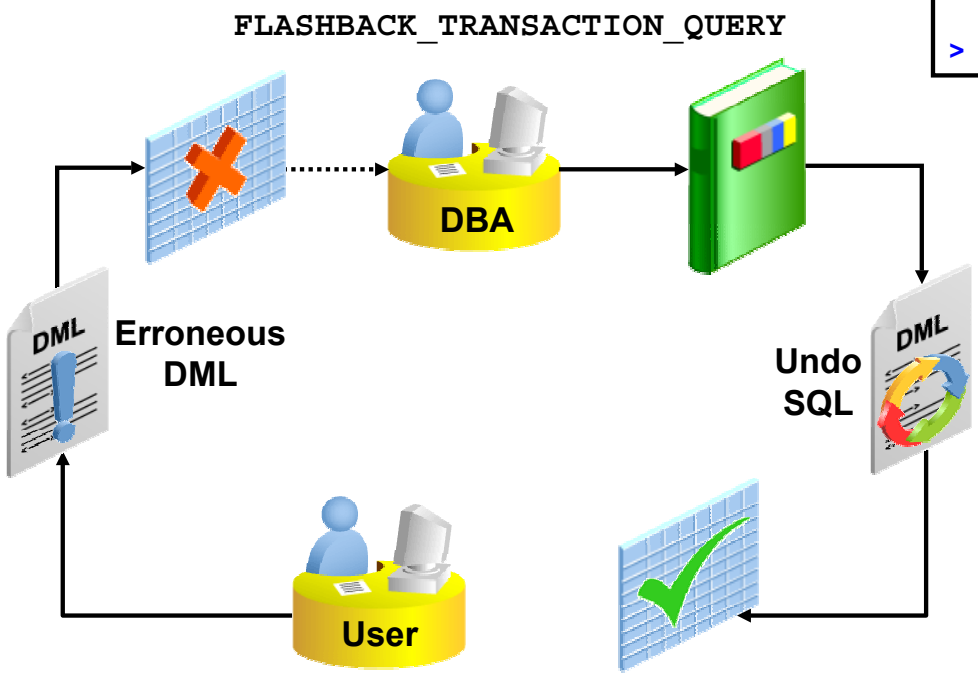
Flashback Transaction Query: Overview

- Overview
- Database
- Table
- Drop
- Query
- Versions
- > Transaction



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Flashback Transaction Query: Overview

Flashback Transaction Query is a diagnostic tool that you can use to view changes made to the database at the transaction level. This enables you to diagnose problems in your database and perform analysis and audits of transactions.

You can use the `FLASHBACK_TRANSACTION_QUERY` view to determine all the necessary SQL statements that can be used to undo the changes made either by a specific transaction or during a specific period of time.

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Flashback Transaction Query Through Enterprise Manager

Flashback Versions Query Result

Select	Flashback SCN	Flashback Timestamp	Transaction ID	Operation	JOB_ID	MIN_SALARY
◉	489358	Aug 5, 2005 11:54:29 AM	090003002D010000	UPDATE	AD_PRES	30000
○	489347	Aug 5, 2005 11:54:11 AM	0A001C00CF000000	UPDATE	AD_PRES	25000
○	489318	Aug 5, 2005 11:53:17 AM	08001100 2010000	UPDATE	AD_PRES	22000

Choose SCN: Transaction Details

OK

Transaction ID **0A001C00CF000000**
User **HR**
Commit SCN **489348**
Commit Time **Aug 5, 2005 12:00:00 AM**

Operation	Table Owner	Table Name	Undo SQL
UPDATE	HR	JOBS	update "HR"."JOBS" set "MIN_SALARY" = '22000' where ROWID = 'AAAMg1AAFAAAABIAAA';
UPDATE	HR	EMPLOYEES	update "HR"."EMPLOYEES" set "SALARY" = '4400' where ROWID = 'AAAMg3AAFAAAABUAAC';

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Flashback Transaction Query Through Enterprise Manager

This feature is used in conjunction with the Flashback Versions Query feature with the help of the Perform Recovery Wizard. On the "Perform Object Level Recovery: Choose SCN" page, click the corresponding Transaction ID link in the Flashback Versions Query Result region.

In the example in the slide, a Flashback Versions Query is performed on the `JOBS` table to retrieve the three versions of the `JOBS` row for `JOB_ID` = '`AD_PRES`'. Then, one of the transaction IDs is clicked, showing all the changes that were part of that transaction. Notice that, besides the `JOBS` table update, there was also an update to the `EMPLOYEES` table in that transaction.

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Flashback Transaction Query: Considerations

- DDLs are seen as dictionary updates.
- Dropped objects appear as object numbers.
- Dropped users appear as user identifiers.

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Flashback Transaction Query: Considerations

- Within the database, DDL operations are nothing but a series of space management operations and changes to the data dictionary. Flashback Transaction Query on a transaction underlying a DDL displays the changes made to the data dictionary.
- When Flashback Transaction Query involves tables that have been dropped from the database, the table names are not reflected. Instead, object numbers are used.
- If the user who executed a transaction is dropped, Flashback Transaction Query of that transaction displays the corresponding user ID only, and not the username.

Note: When there is not enough undo data for a specific transaction, a row with a value of `UNKNOWN` in the `OPERATION` column of `FLASHBACK_TRANSACTION_QUERY` is returned.

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Summary

In this lesson, you should have learned how to:

- Describe Flashback Database
- Restore the table content to a specific point in the past with Flashback Table
- Recover from a dropped table
- View the contents of the database as of any single point in time with Flashback Query
- See versions of a row over time with Flashback Versions Query
- View transaction history or a row with Flashback Transaction Query

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Practice Overview: Using Flashback

This practice covers the following topics:

- **Using Flashback to recover a dropped table**
- **Performing Flashback Versions Query**

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Moving Data

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Objectives

Directory Obj.
SQL*Loader
Data Pump
- Export
- Import
External Table

After completing this lesson, you should be able to do the following:

- Describe available ways for moving data
- Create and use directory objects
- Use SQL*Loader to load data from a non-Oracle database (or user files)
- Explain the general architecture of Data Pump
- Use Data Pump Export and Import to move data between Oracle databases
- Use external tables to move data via platform-independent files

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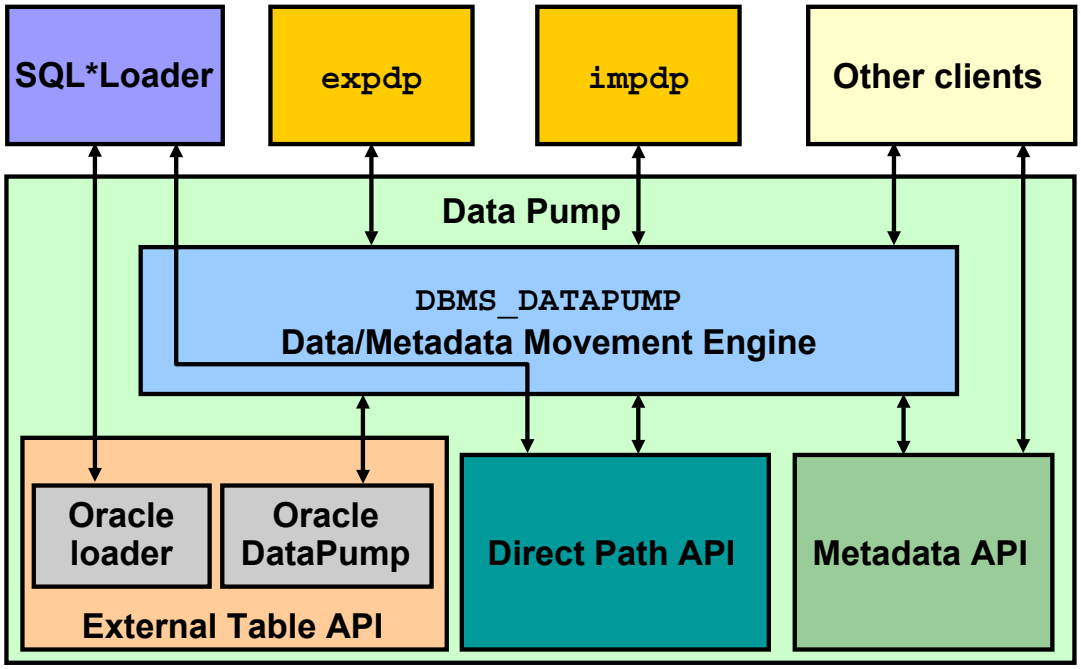
Moving Data: General Architecture



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Moving Data: General Architecture

This is a block diagram of the major functional components:

- **DBMS_DATAPUMP:** This package embodies the API for high-speed export and import utilities for bulk data and metadata movement.
- **Direct Path API (DPAPI):** Oracle Database 10*g* supports a direct path API interface that minimizes data conversion and parsing at both unload and load time.
- **DBMS_METADATA:** This package is used by worker processes for all metadata unloading and loading. Database object definitions are stored using XML rather than SQL.
- **External Table API:** With the ORACLE_DATAPUMP and ORACLE_LOADER access drivers, you can store data in external tables (that is, in platform-independent files). The SELECT statement reads external tables as though they were stored in an Oracle database.
- **SQL*Loader:** The **SQL*Loader** client has been integrated with external tables, thereby providing automatic migration of loader control files to external table access parameters.
- **expdp** and **impdp:** The **expdp** and **impdp** clients are thin layers that make calls to the DBMS_DATAPUMP package to initiate and monitor Data Pump operations.
- **Other clients:** They are applications, such as Database Control, replication, transportable tablespaces, and user applications, that benefit from this infrastructure. SQL*Plus may also be used as a client of DBMS_DATAPUMP for simple status queries against ongoing operations.

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Directory Object: Overview

Schema

Database Objects

Tables
Indexes
Views
Synonyms
Sequences
Database Links
Directory Objects
Reorganize Objects

Directory Objects

Search

Object Name

Go

By default, the search returns all uppercase matches beginning with the string you entered. To run an exact or case-sensitive match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

Selection Mode Single

Create

Edit View Delete Actions Create Like Go

Select	Name	Path
◉	ADMIN_DIR	/ade/aime_10.2_lnx_push/oracle/md/admin
○	DATA_FILE_DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/sales_history/
○	DATA_PUMP_DIR	/u01/app/oracle/product/10.2.0/db_1/rdbms/log/
○	LOG_FILE_DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/log/
○	MEDIA_DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/product_media/
○	SUBDIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/order_entry//2002/Sep
○	WORK_DIR	/ade/aime_10.2_lnx_push/oracle/work
○	XMLDIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/order_entry/

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Directory Object: Overview

Directory objects are logical structures that represent a physical directory on the server's file system. They contain the location of a specific operating system directory. This directory object name can be used in Enterprise Manager, so you do not need to hard-code directory path specifications. Therefore, you get greater file management flexibility. Directory objects are owned by the `SYS` user. Directory names are unique across the database because all the directories are located in a single name space (that is, `SYS`).

Directory objects are required when you specify file locations for Data Pump because it accesses files on the server rather than on the client.

In Enterprise Manager, select Administration > Directory Objects.

To edit or delete a directory object, select the directory object and click the appropriate button.

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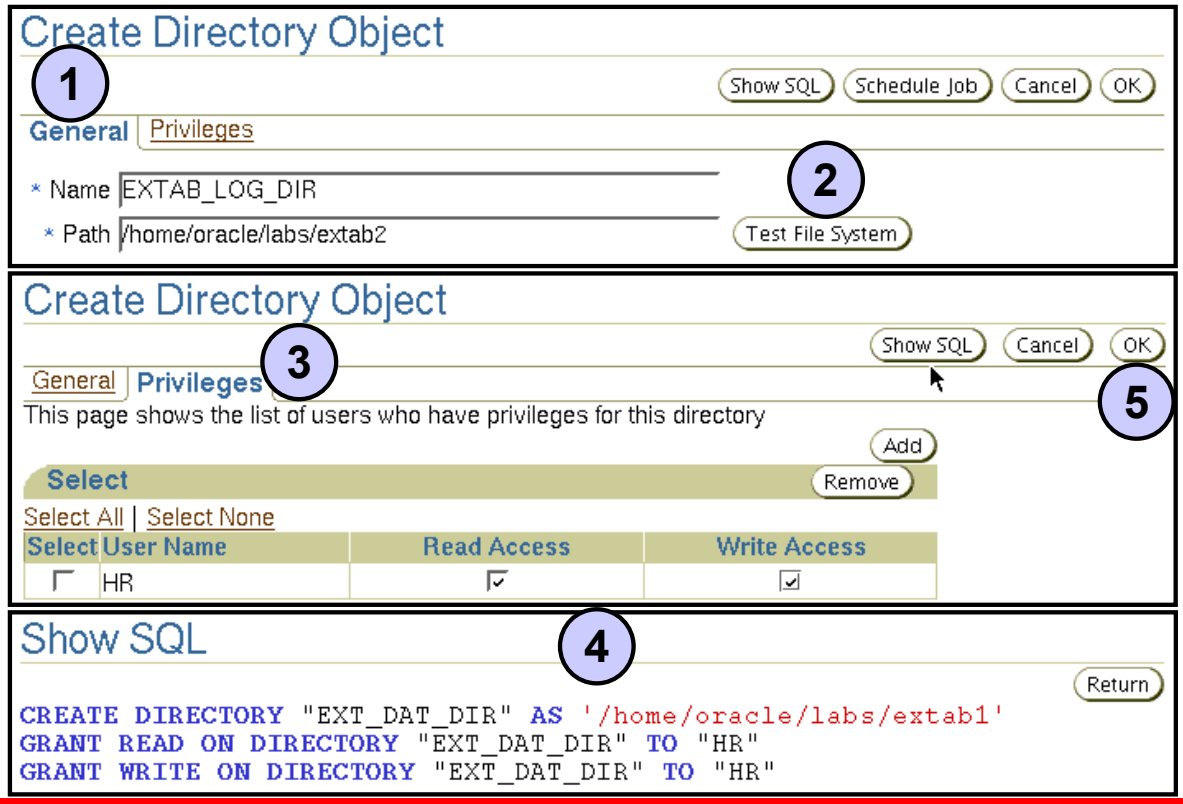
Creating Directory Objects



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Creating Directory Objects

1. On the Directory Objects page, click the Create button.
2. Enter the name of the directory object and the OS path to which it maps. OS directories should be created before they are used. You can test this by clicking the "Test File System" button. For the test, provide the host login credentials (that is, the OS user who has privileges on this OS directory).
3. Permissions for the directory objects are not the same as the OS permissions on the physical directory on the server file system. You can manage user privileges on individual directory objects. This increases the level of security and gives you granular control over these objects. On the Privileges tabbed page, click Add to select the user to which you give read or write privileges or both.
4. Click Show SQL to view the underlying statements.
5. Click OK to create the object.

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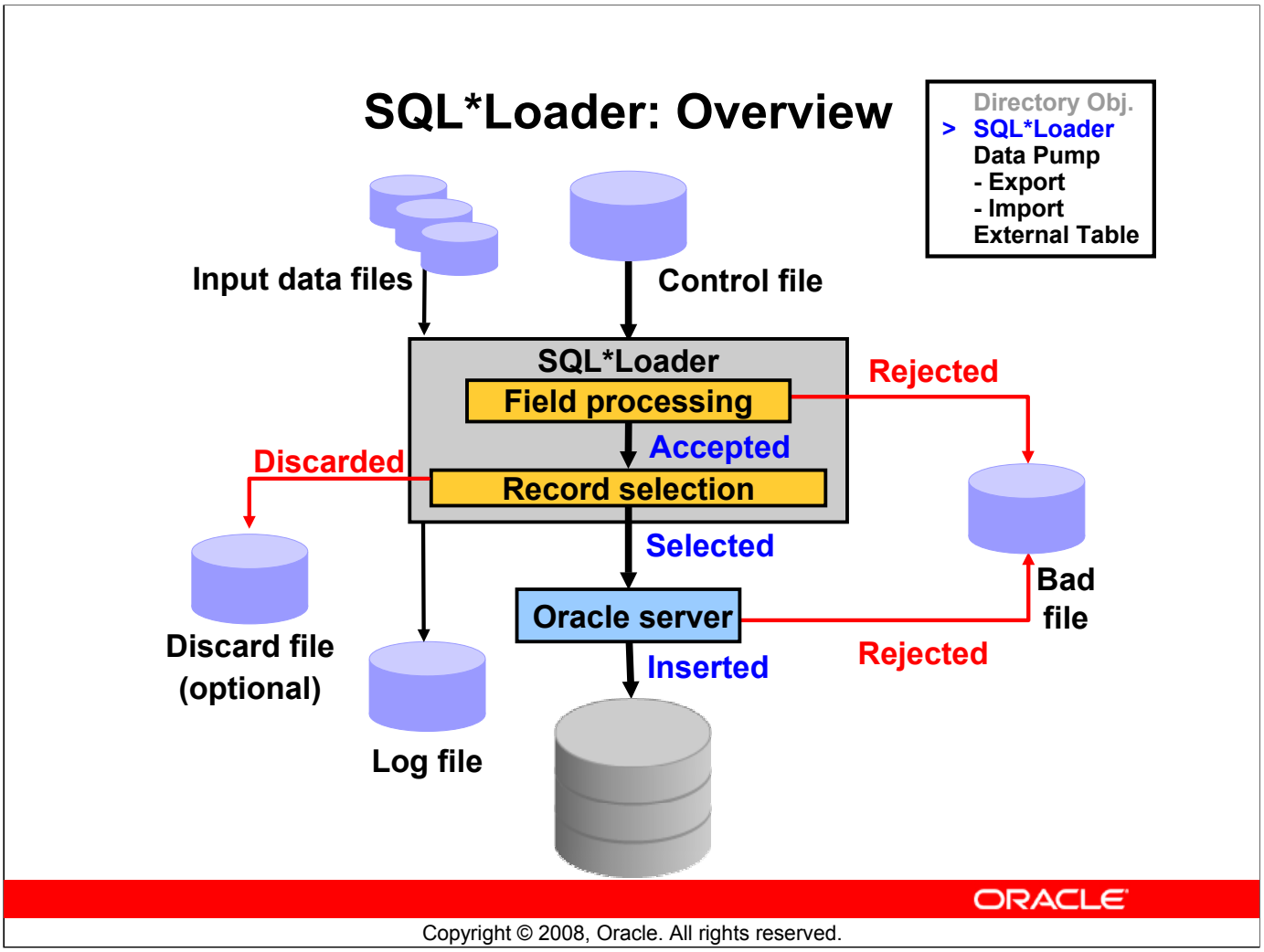

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SQL*Loader: Overview

SQL*Loader loads data from external files into tables of an Oracle database. It has a powerful data parsing engine that puts little limitation on the format of the data in the data file. The files that are used by SQL*Loader are as follows:

Input data files: SQL*Loader reads data from one or more files (or operating system–equivalents of files) that are specified in the control file. From SQL*Loader's perspective, the data in the data file is organized as records. A particular data file can be in fixed record format, variable record format, or stream record format. The record format can be specified in the control file with the `INFILE` parameter. If no record format is specified, the default is stream record format.

Control file: The control file is a text file that is written in a language that SQL*Loader understands. The control file indicates to SQL*Loader where to find the data, how to parse and interpret the data, where to insert the data, and so on. Although not precisely defined, a control file can be said to have three sections.

- The first section contains sessionwide information, for example:
  - Global options, such as the input data file name, and records to be skipped.
  - `INFILE` clauses to specify where the input data is located
  - Data to be loaded

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SQL*Loader: Overview (continued)

- The second section consists of one or more `INTO TABLE` blocks. Each of these blocks contains information about the table (such as the table name and the columns of the table) into which the data is to be loaded.
- The third section is optional and, if present, contains input data.

Log file: When SQL*Loader begins execution, it creates a log file. If it cannot create a log file, execution terminates. The log file contains a detailed summary of the load, including a description of any errors that occurred during the load.

Bad file: The bad file contains records that are rejected, either by SQL*Loader or by the Oracle database. Data file records are rejected by SQL*Loader when the input format is invalid. After a data file record is accepted for processing by SQL*Loader, it is sent to the Oracle database for insertion into a table as a row. If the Oracle database determines that the row is valid, then the row is inserted into the table. If the row is determined to be invalid, then the record is rejected and SQL*Loader puts it in the bad file.

Discard file: This file is created only when it is needed, and only if you have specified that a discard file should be enabled. The discard file contains records that are filtered out of the load because they do not match any record-selection criteria specified in the control file.

For more information about SQL*Loader, refer to the *Oracle Database Utilities* documentation.

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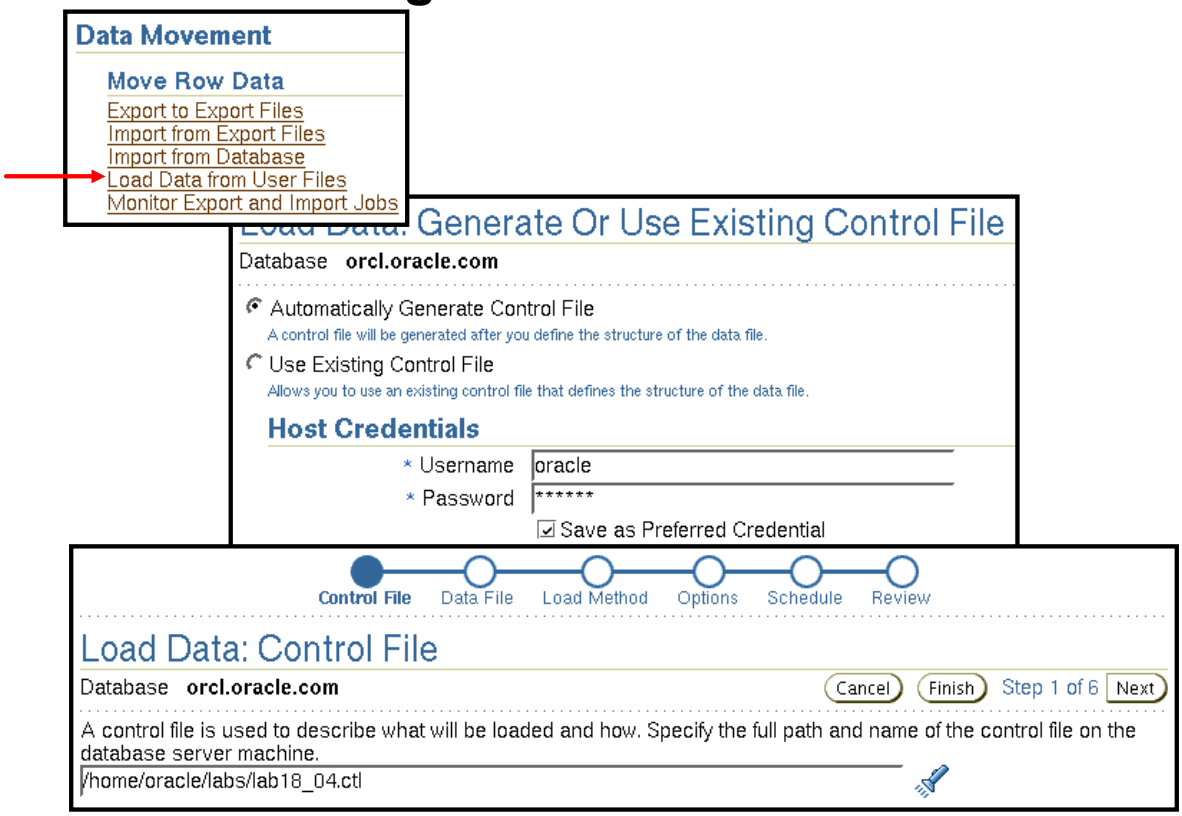
Loading Data with SQL*Loader



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Loading Data with SQL*Loader

Use the Load Data from User Files Wizard to load data from a flat file into an Oracle database. To display the wizard, select Enterprise Manager Maintenance > Data Movement > Move Row Data > Load Data from User Files. The wizard guides you through the required steps.

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SQL*Loader Control File

The SQL*Loader control file instructs SQL*Loader about:

- **Location of the data to be loaded**
- **The data format**
- **Configuration details:**
  - **Memory management**
  - **Record rejection**
  - **Interrupted load handling details**
- **Data manipulation details**

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SQL*Loader Control File

The SQL*Loader control file is a text file that contains data definition language (DDL) instructions. DDL is used to control the following aspects of a SQL*Loader session:

- Where SQL*Loader finds the data to load
- How SQL*Loader expects that data to be formatted
- How SQL*Loader is being configured (including memory management, selection and rejection criteria, interrupted load handling, and so on) as it loads the data
- How SQL*Loader manipulates the data being loaded

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SQL*Loader Control File (continued)

```
1   -- This is a sample control file
2 LOAD DATA
3 INFILE 'SAMPLE.DAT'
4 BADFILE 'sample.bad'
5 DISCARDFILE 'sample.dsc'
6 APPEND
7 INTO TABLE emp
8 WHEN (57) = '.'
9 TRAILING NULLCOLS
10 (hiredate SYSDATE,
          deptno POSITION(1:2) INTEGER EXTERNAL(3)
       NULLIF deptno=BLANKS,
          job POSITION(7:14) CHAR TERMINATED BY WHITESPACE
          NULLIF job=BLANKS "UPPER(:job)",
          mgr POSITION(28:31) INTEGER EXTERNAL
          TERMINATED BY WHITESPACE, NULLIF mgr=BLANKS,
       ename POSITION(34:41) CHAR
          TERMINATED BY WHITESPACE "UPPER(:ename)",
          empno POSITION(45) INTEGER EXTERNAL
          TERMINATED BY WHITESPACE,
          sal POSITION(51) CHAR TERMINATED BY WHITESPACE
          "TO_NUMBER(:sal,'$99,999.99')",
          comm INTEGER EXTERNAL ENCLOSED BY '(' AND '%'
          ":comm * 100"
    )
```

The explanation of a sample control file by line numbers is as follows:

1. Comments can appear anywhere in the command section of the file, but they must not appear within the data. Precede any comment with two hyphens. All text to the right of the double hyphen is ignored, until the end of the line.
2. The `LOAD DATA` statement indicates to SQL*Loader that this is the beginning of a new data load. If you are continuing a load that has been interrupted in progress, use the `CONTINUE LOAD DATA` statement.
3. The `INFILE` keyword specifies the name of a data file containing data that you want to load.
4. The `BADFILE` keyword specifies the name of a file into which rejected records are placed.
5. The `DISCARDFILE` keyword specifies the name of a file into which discarded records are placed.
6. The `APPEND` keyword is one of the options that you can use when loading data into a table that is not empty. To load data into a table that is empty, use the `INSERT` keyword.
7. The `INTO TABLE` keyword enables you to identify tables, fields, and data types. It defines the relationship between records in the data file and tables in the database.
8. The `WHEN` clause specifies one or more field conditions that each record must match before SQL*Loader loads the data. In this example, SQL*Loader loads the record only if the 57th character is a decimal point. That decimal point delimits dollars and cents in the field and causes records to be rejected if `SAL` has no value.
9. The `TRAILING NULLCOLS` clause prompts SQL*Loader to treat any relatively positioned columns that are not present in the record as null columns.
10. The remainder of the control file contains the field list, which provides information about column formats in the table that is being loaded.

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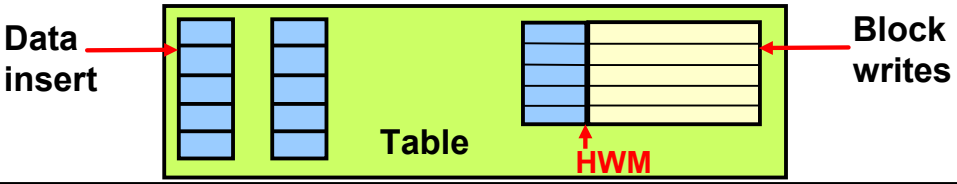
Loading Methods



Conventional Load	Direct Path Load
Uses `COMMIT`	Uses data saves (faster operation)
Always generates redo entries	Generates redo only under specific conditions
Enforces all constraints	Enforces only `PRIMARY KEY`, `UNIQUE`, and `NOT NULL`
Fires `INSERT` triggers	Does not fire `INSERT` triggers
Can load into clustered tables	Does not load into clusters
Allows other users to modify tables during load operation	Prevents other users from making changes to tables during load operation

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Comparing Direct and Conventional Path Loads

Method of Saving Data

Conventional path loads use SQL processing and a database `COMMIT` operation for saving data. The insertion of an array of records is followed by a `COMMIT` operation. Each data load may involve several transactions.

Direct path loads use data saves to write blocks of data to Oracle data files. This is why the direct path loads are faster than the conventional ones. The following features differentiate a data save from `COMMIT`:

- During a data save, only full database blocks are written to the database.
- The blocks are written after the high-water mark (HWM) of the table.
- After a data save, the high-water mark (HWM) is moved.
- Internal resources are not released after a data save.
- A data save does not end the transaction.
- Indexes are not updated at each data save.

Note: Direct path and parallel direct path loads are so similar regarding DML activities that they are not separated in this comparison.

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Comparing Direct and Conventional Path Loads (continued)

Logging Changes

Conventional path loading generates redo entries similar to any DML statement. When using a direct path load, redo entries are not generated if:

- The database is in `NOARCHIVELOG` mode
- The database is in `ARCHIVELOG` mode, but logging is disabled. Logging can be disabled by setting the `NOLOGGING` attribute for the table or by using the `UNRECOVERABLE` clause in the control file.

Enforcing Constraints

During a conventional path load, all enabled constraints are enforced in the same way that they are during any DML operation.

During direct path loads, the constraints are handled as follows:

- `NOT NULL` constraints are checked when arrays are built.
- `FOREIGN KEY` and `CHECK` constraints are disabled, and they can be enabled at the end of the load by using the appropriate commands in the control file. The `FOREIGN KEY` constraints are disabled because they reference other rows or tables, and the `CHECK` constraints are disabled because they may use SQL functions. If only a small number of rows are to be inserted into a large table, then use conventional loads.
- `PRIMARY KEY` and `UNIQUE` constraints are checked during and at the end of the load, and they may be disabled if they are violated.

Firing the `INSERT` Triggers

The `WHILE INSERT` triggers are fired during conventional loads; they are disabled before a direct path load and reenabled at the end of the load. They may remain disabled if a referenced object is not accessible at the end of the run. Consider using conventional path loads to load data into tables with the `INSERT` triggers.

Loading into Clustered Tables

Direct Loads cannot be used to load rows into clustered tables. Clustered tables can be loaded with conventional path loads only.

Locking

While a direct path load is in progress, other transactions cannot make changes to the tables that are being loaded. The only exception to this rule is when several parallel direct load sessions are used concurrently.

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Data Pump: Overview

Directory Obj.
SQL*Loader
> Data Pump
- Export
- Import
External Table

As a server-based facility for high-speed data and metadata movement, Data Pump:

- **Is callable via `DBMS_DATAPUMP`**
- **Provides the following tools:**
  - `expdp`
  - `impdp`
  - **Web-based interface**
- **Provides data access methods:**
  - **Direct path**
  - **External tables**
- **Detaches from and reattaches to long-running jobs**
- **Restarts Data Pump jobs**

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Data Pump: Overview

Data Pump enables very high-speed data and metadata loading and unloading of Oracle databases. The Data Pump infrastructure is callable via the `DBMS_DATAPUMP` PL/SQL package. Thus, custom data movement utilities can be built by using Data Pump.

Oracle Database 10*g* provides the following tools:

- Command-line export and import clients called `expdp` and `impdp` respectively
- A Web-based export and import interface that is accessible from Database Control

Data Pump automatically decides the data access methods to use; these can be either direct path or external tables. Data Pump uses direct path load and unload when a table's structure allows it and when maximum single-stream performance is desired. However, if there are clustered tables, referential integrity constraints, encrypted columns, or a number of other items, Data Pump uses external tables rather than direct path to move the data.

The ability to detach from and reattach to long-running jobs without affecting the job itself enables you to monitor jobs from multiple locations while they are running. All stopped Data Pump jobs can be restarted without loss of data as long as the metainformation remains undisturbed. It does not matter whether the job is stopped voluntarily or involuntarily due to a crash.

Note: Data Pump is an integral feature of Oracle Database 10*g* and is, therefore, available in all configurations. However, parallelism is available in Enterprise Edition only.

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Data Pump: Benefits

- Fine-grained object and data selection
- Explicit specification of database version
- Parallel execution
- Estimation of the export job space consumption
- Network mode in a distributed environment
- Remapping capabilities during import
- Data sampling and metadata compression

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Data Pump: Benefits

The EXCLUDE, INCLUDE, and CONTENT parameters are used for fine-grained object and data selection.

You can specify the database version for objects to be moved (using the VERSION parameter) to create a dump file set that is compatible with a previous release of the Oracle database that supports Data Pump.

You can use the PARALLEL parameter to specify the maximum number of threads of active execution servers operating on behalf of the export job.

You can estimate how much space an export job would consume (without actually performing the export) by using the ESTIMATE_ONLY parameter.

Network mode enables you to export from a remote database directly to a dump file set. This can be done by using a database link to the source system.

During import, you can change the target data file names, schemas, and tablespaces.

In addition, Oracle Database 10*g* enables you to specify a percentage of data to be sampled and unloaded from the source database when performing a Data Pump export. This can be done by specifying the SAMPLE parameter.

You can use the COMPRESSION parameter to indicate whether the metadata should be compressed in the export dump file so that it consumes less disk space. If you compress the metadata, it is automatically uncompressed during import.

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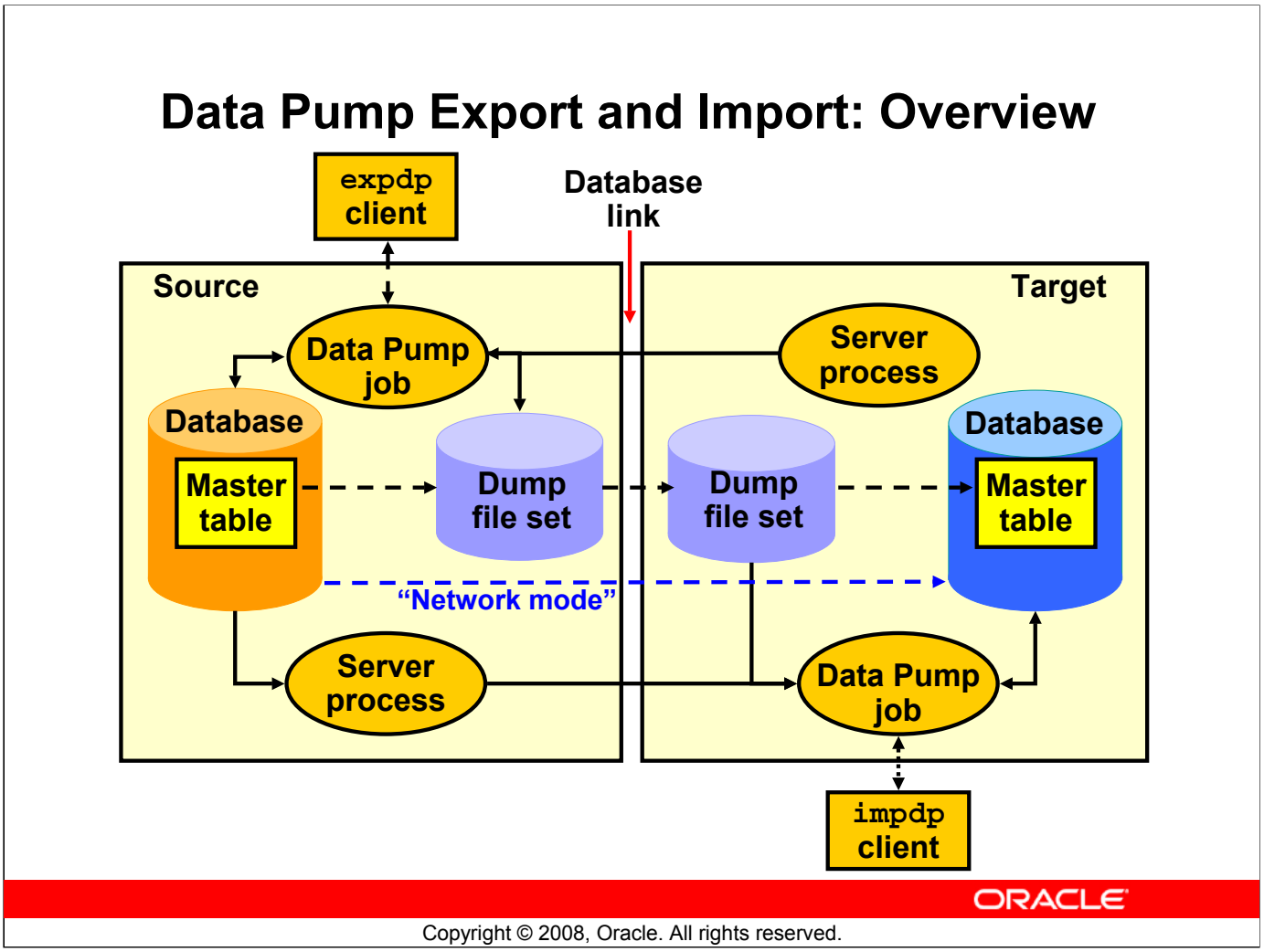

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Data Pump Export and Import: Overview

Data Pump Export is a utility for unloading data and metadata into a set of operating system files called dump file sets. Data Pump Import is used to load metadata and data stored in an export dump file set into a target system.

The Data Pump API accesses its files on the server rather than on the client.

These utilities can also be used to export from a remote database directly to a dump file set, or to load the target database directly from a source database with no intervening files. This is known as network mode. This mode is particularly useful to export data from a read-only source database.

At the center of every Data Pump operation is the master table (MT), which is a table created in the schema of the user running the Data Pump job. The MT maintains all aspects of the job. The MT is built during a file-based export job and is written to the dump file set as the last step. Conversely, loading the MT into the current user's schema is the first step of a file-based import operation and is used to sequence the creation of all objects imported.

Note: The MT is the key to Data Pump's restart capability in the event of a planned or unplanned stopping of the job. The MT is dropped when the Data Pump job finishes normally.

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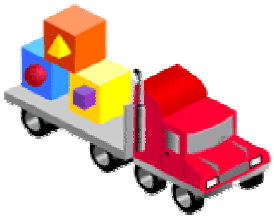
Data Pump Utility: Interfaces and Modes

- **Data Pump Export and Import interfaces:**
  - **Command line**
  - **Parameter file**
  - **Interactive command line**
  - **Database Control**
- **Data Pump Export and Import modes:**
  - **Full**
  - **Schema**
  - **Table**
  - **Tablespace**
  - **Transportable tablespace**



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Data Pump Utility: Interfaces and Modes

You can interact with Data Pump Export and Import by using one of the following interfaces:

- The command-line interface enables you to specify most of the export parameters directly on the command line.
- The parameter file interface enables you to specify all command-line parameters in a parameter file. The only exception is the `PARFILE` parameter.
- The interactive-command interface stops logging to the terminal and displays the export or import prompts, where you can enter various commands. This mode is enabled by pressing [Ctrl] + [C] during an export operation that is started with the command-line interface or the parameter file interface. Interactive-command mode is also enabled when you attach to an executing or stopped job.
- You can also access the Web interface. On the Database Control home page, click the Maintenance tab, and then select one of the following links from the Utilities region: Export to Files, Import from Files, or Import from Database.

Data Pump Export and Import provide different modes for unloading and loading different portions of the database. The mode is specified on the command line by using the appropriate parameter.

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Fine-Grained Object Selection

Directory Obj.
SQL*Loader
Data Pump
> - Export
- Import
External Table

Content

What to Export from the Source Database
- All — Export both metadata and data
- Data Only — Export only table row data
- Metadata Only — Export only database object definitions

Export Content
- Include All Objects
- Include Only Objects Specified Below
- Exclude Only Objects Specified Below

Objects to Include or Exclude

Select	Object Type	Object Name Expression
	No items found	

Add Another Row

Object Name Expression example: "IN('EMP','DEPT')" or, to include every object except those of a particular type not beginning with PRO, select EXCLUDE with an expression of "NOT LIKE 'PRO%'"

Flashback

Export read-consistent view of data
- As the specified System Change Number (SCN)
  - SCN 699783
- As the SCN which most closely matches the specified time
  - Date June 6, 2005
  - Time 12 00 AM PM

Query

Specify SELECT statement predicate clauses to be applied to tables being exported. If a Table Name is not supplied for a particular Predicate Clause, the Predicate Clause is applied to (and must make sense for) all tables being exported.

Select	Predicate Clause	Table Name
	No items found	

Add

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Fine-Grained Object Selection

The Data Pump job can include or exclude virtually any type of object.

The `EXCLUDE` parameter enables any database object type to be excluded from an export or import operation. The optional name qualifier enables you to have finer selectivity within each object type that is specified. Examples:

```
EXCLUDE=VIEW
EXCLUDE=PACKAGE
EXCLUDE=INDEX:"LIKE 'EMP%'"
```

The `INCLUDE` parameter includes only the specified object types and objects in an operation. Syntax:

```
INCLUDE  = object_type[:"name_expr"]
```

The `CONTENT` parameter enables you to request for the current operation, only the metadata, only the data, or both. Syntax:

```
CONTENT = ALL | METADATA_ONLY | DATA_ONLY
```

The `QUERY` parameter operates in a similar manner as the original export utility, with two significant enhancements: It can be qualified with a table name so that it applies to only that table, and it can be used during import as well. Example:

```
QUERY=hr.employees:"WHERE department_id in (10,20) and salary
< 1600 ORDER BY department_id"
```

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Advanced Feature: Sampling

- **Task: Create test data.**
- **Method: Specify a percentage of data to be sampled and unloaded from the source database.**

Example to unload 44% of the `HR.EMPLOYEES` table:

```
SAMPLE="HR"."EMPLOYEES":44
```

Example to unload 30% of the entire export job (because no table name is specified):

```
expdp hr/hr DIRECTORY=DATA_PUMP_DIR
DUMPFILE=sample1.dmp SAMPLE=30
```

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Advanced Feature: Sampling

With the `SAMPLE` parameter, you can specify a percentage of data to be sampled and unloaded from the source database when performing a Data Pump export.

Syntax:

```
SAMPLE=[[schema_name.]table_name:]sample_percent
```

Range for *`sample_percent`*: `.000001` to (but not including) `100`

Sample percentage indicates the likelihood that a block of rows will be included.

Note: The `SAMPLE` parameter is not valid for network exports.

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Export Options: Files

Schemas Options Files Schedule Review

Export: Options

Database orcl.oracle.com Cancel Finish Back Step 2 of 5 Next

Maximum Number of Threads in Export Job 1

This option allows you to make tradeoffs between resource consumption and elapsed time. Parallelism is only available in Enterprise Edition.

Estimate Disk Space

Calculates an estimate of how much disk space the export job will consume (in bytes). The estimate is for table row data only and does not include metadata.

Blocks

Estimate will be calculated by multiplying the number of database blocks used by the target objects times the appropriate block sizes. This method will provide the quickest rough estimate.

Statistics

Estimate will be calculated using per-table statistics. This method will provide the most accuracy if all target tables have been recently analyzed.

Estimate Disk Space Now

Calculate the estimate of space that will be consumed without actually performing the export operation. This may take a few minutes.

Optional File

Generate Log File

Directory Object DATA_PUMP_DIR Create Directory Object

Log File hrexp.log

Show Advanced Options

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Export Options: Files

There are three types of files that are managed by Data Pump jobs:

- Dump files for data and metadata that is to be moved
- Log files for messages
- SQL files for the output of a `SQLFILE` operation

Because Data Pump is server based and not client based, Data Pump files are accessed relative to Oracle directory paths. Absolute paths are not supported for security reasons.

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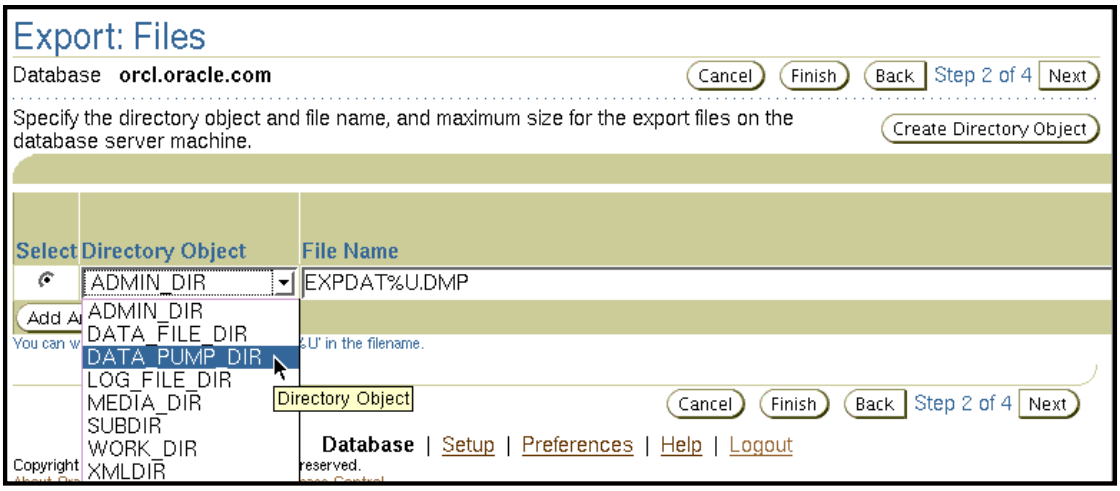
Data Pump File Locations



The order of precedence of file locations:

- **Per-file directory**
- **The `DIRECTORY` parameter**
- **The `DATA_PUMP_DIR` environment variable**
- **`DATA_PUMP_DIR` directory object**

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Data Pump File Locations

The slide shows you the order of precedence used by Data Pump clients to locate these files:

- Per-file directory objects may be specified for each dump file, log file, and SQL file. If specified, they are separated from the file name by a colon (:).
- The Data Pump Export and Import clients provide a `DIRECTORY` parameter, which specifies the name of a directory object. These directory objects describe the location in which the files are accessed.
- You can alternatively define an environment variable, `DATA_PUMP_DIR`, to specify the directory object name rather than use the `DIRECTORY` parameter. The Data Pump clients look for this environment variable if no explicit directory object is specified.
- There is a default directory object created for every database. This directory object is named `DATA_PUMP_DIR`. Access to the `DATA_PUMP_DIR` directory is granted automatically to the `EXP_FULL_DATABASE` and `IMP_FULL_DATABASE` roles.

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Data Pump File Locations (continued)

- You do not need to create a directory object manually before using Data Pump Export. There is a default directory object created for every database, whether newly created or upgraded by a script on UNIX or Windows platforms. This directory object is named `DATA_PUMP_DIR`. Access to the `DATA_PUMP_DIR` directory is granted automatically to the `EXP_FULL_DATABASE` and `IMP_FULL_DATABASE` roles. The `DATA_PUMP_DIR` directory is created in one of the following locations:
  - `<ORACLE_BASE>/admin/ORACLE_SID`
  - `<ORACLE_HOME>/admin/ORACLE_SID`

  The exact directory path specification for `DATA_PUMP_DIR` varies, depending on the value of the `ORACLE_BASE` and `ORACLE_HOME` system environment variables and on the existence of the `DATA_PUMP_DIR` subdirectory. If `ORACLE_BASE` is defined on the target system, then that value is used. Otherwise, the value of `ORACLE_HOME` is used. If, for some reason, the `DATA_PUMP_DIR` subdirectory is not found, the following default path is used: `ORACLE_HOME/rdbms/log`.

Note: In all cases, you must have the appropriate access privileges to the directory object for the operation attempted. For export, you need write access for all files; for import, you need read access for dump files and write access for log files and SQL files.

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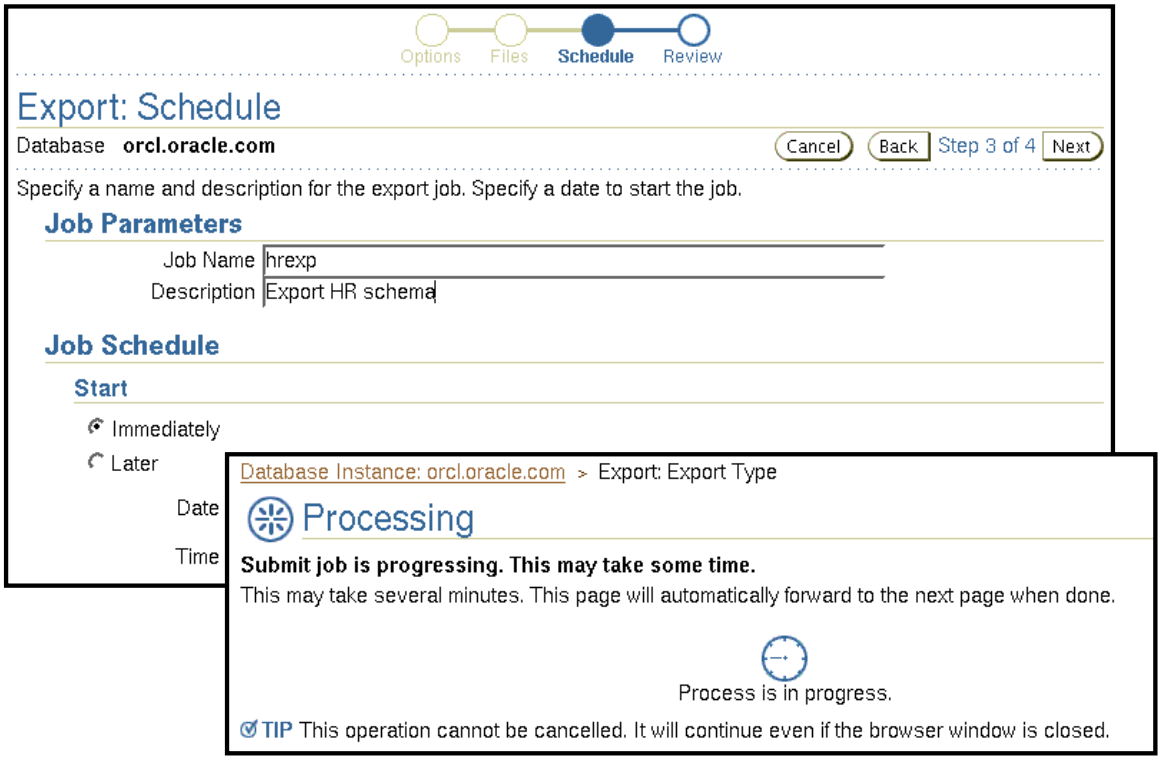
Scheduling and Running a Job



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Scheduling and Running a Job

Data Pump jobs (created through this wizard) are scheduled as repeatable jobs by Enterprise Manager Database Control.

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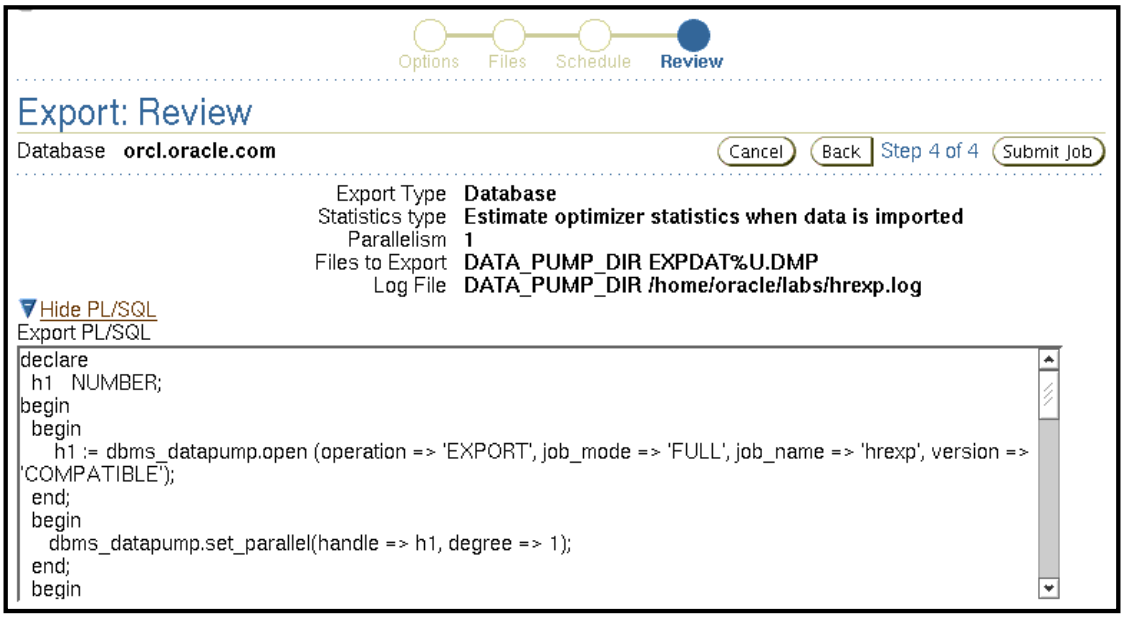
Data Pump File Naming and Size



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Data Pump File Naming and Size

The `DUMPFILE` parameter specifies the names and (optionally) directories of disk-based dump files. Multiple file specifications may be provided as a comma-separated list or in separate `DUMPFILE` parameter specifications. File names may contain the substitution variable `%U`, which implies that multiple files may be generated. `%U` is expanded in the resulting file names into a two-character, fixed-width, monotonically increasing integer starting at `01`. If no `DUMPFILE` is specified, `expdat.dmp` is used by default. By default, created dump files are autoextensible.

If `FILESIZE` is specified, each file is `FILESIZE` bytes in size and nonextensible. If more dump space is required and a template with `%U` has been supplied, then a new file is automatically created with `FILESIZE` bytes; otherwise, the client receives a message to add a new file.

If a template with `%U` is specified, the number of files initially created is equal to the `PARALLEL` parameter.

Preexisting files that match the resulting file names are not overwritten; they result in an error and cause the job to be aborted.

Note: If multiple dump file templates are provided, then they are used to generate dump files in a circular fashion.

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Data Pump Import

Directory Obj.
SQL*Loader
Data Pump
- Export
> - Import
External Table

Import: Files

Database orcl.oracle.com

Database Version of Files to Import 10g or later Go

Changing the version affects attributes below. Note: if the files were produced using the original 'exp' command, select "Prior to 10g" regardless of the database version.

Files

Specify the directory name and file name of the import files on the database server machine. Create Directory Object

Remove

Select	Directory Object	File Name
◉	DATA_PUMP_DIR	EXPDAT%U.DMP

Add Another Row

You can wildcard a set of dump files using '%U' in the filename.

Import Type

◉ Entire files
○ Schemas
Allows you to choose one or more schemas and to import the objects in those schemas.
○ Tables
Allows you to choose one or more tables to import from a selected schema.
○ Tablespace
Allows you to import the tables from one or more selected tablespaces. Note: the tablespaces themselves will not be imported and must exist in the database.

Host Credentials

* Username oracle
* Password **********
☐ Save as Preferred Credential

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Data Pump Import

Data Pump Import is a utility for loading an export dump file set into a target system. The dump file set is made up of one or more disk files that contain table data, database object metadata, and control information. The files are written in a proprietary, binary format. During an import operation, the Data Pump Import utility uses these files to locate each database object in the dump file set.

You can interact with Data Pump Import by using a command line, a parameter file, or an interactive-command mode:

- You can use the `impdp` command and specify parameters directly on the command line.
- You can enter command-line parameters in a file (the `PARFILE` parameter is excluded because parameter files cannot be nested).
- In interactive-command mode, the current job continues running, but logging to the terminal is stopped and the Import prompt is displayed. You can, for example, attach additional jobs to an executing or stopped job.

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Data Pump Import: Transformations

You can remap:

- **Data files by using `REMAP_DATAFILE`**
- **Tablespaces by using `REMAP_TABLESPACE`**
- **Schemas by using `REMAP_SCHEMA`**

```
REMAP_DATAFILE = 'C:\oradata\tbs6.f':'/u1/tbs6.f'
```

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Data Pump Import: Transformations

Because object metadata is stored as XML in the dump file set, it is easy to apply transformations when DDL is being formed during import. Data Pump Import supports several transformations:

- `REMAP_DATAFILE` is useful when moving databases across platforms that have different file-system semantics.
- `REMAP_TABLESPACE` allows objects to be moved from one tablespace to another.
- `REMAP_SCHEMA` provides the old `FROMUSER` /`TOUSER` capability to change object ownership.

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Data Pump Import: Transformations

Using TRANSFORM, you can also :

- **Exclude from tables and indexes:**
  - **STORAGE and TABLESPACE clauses**
  - **STORAGE clause only**
- **Re-create object identifiers of abstract data types**
- **Change extent allocations and file size**

```
TRANSFORM =
SEGMENT_ATTRIBUTES|STORAGE|OID|PCTSPACE:{y|n|v}[:object type]
```

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Data Pump Import: Transformations (continued)

The TRANSFORM parameter enables you to alter the object creation DDL for specific objects or for all applicable objects being loaded. Specify the TRANSFORM parameter as shown in the slide. The following are possible options:

- SEGMENT_ATTRIBUTES: If the value is specified as Y, segment attributes (physical attributes, storage attributes, tablespaces, and logging) are included.
- STORAGE: If the value is specified as Y, the STORAGE clauses are included.
- OID: You can use this parameter to determine whether the object ID (OID) of abstract data types is reused or created anew. If the value is specified as N, then the generation of the export OID clause for object types is suppressed. This is useful when you need to duplicate schemas across databases by using export and import, but you cannot guarantee that the object types will have identical OID values in those databases.
- PCTSPACE: You can use the PCTSPACE parameter to reduce the amount of space required for tablespaces by performing a shrink operation on tablespace storage allocation. The value supplied for this transformation must be a number greater than zero. It represents the percentage multiplier used to alter extent allocations and the size of data files.

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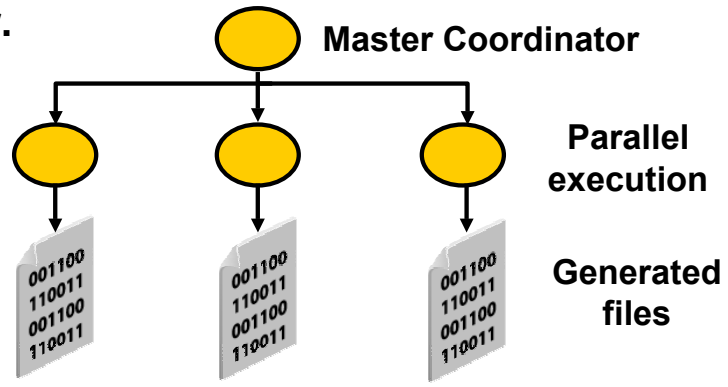
Data Pump: Performance Consideration

Maximizing job performance with the `PARALLEL` parameter.



Example:

```
expdp hr/hr FULL=y
DUMPFILE=dp_dir1:full1%U.dmp, dp_dir2:full2%U.dmp
FILESIZE=2G PARALLEL=3
LOGFILE=dp_dir1:expfull.log JOB_NAME=expfull
```

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Data Pump: Performance Consideration

You can improve throughput of a job with the `PARALLEL` parameter. The parallelism setting is enforced by the master process, which allocates work to be executed to worker processes that perform the data and metadata processing within an operation. These worker processes operate in parallel. In general, the degree of parallelism should be set to more than twice the number of CPUs on an instance. To maximize parallelism, you must supply at least one file for each degree of parallelism. If there are not enough dump files, the performance will not be optimal because multiple threads of execution will be trying to access the same dump file. The degree of parallelism can be reset at any time during a job.

The example in the slide shows a full database export. All data and metadata in the database will be exported. Dump files (`full101.dmp`, `full201.dmp`, `full102`.dmp, and so on) will be created in a round-robin fashion in the directories pointed to by the `dp_dir1` and `dp_dir2` directory objects. For best performance, these should be on separate I/O channels. Each file will be up to 2 gigabytes in size, as necessary. Initially, up to three files will be created. More files will be created, if needed. The job and master table have the same name: `expfull`. The log file will be written to `expfull.log` in the `dp_dir1` directory.

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Performance Initialization Parameters

- **Performance of Data Pump can be affected by:**
  - `DISK_ASYNCH_IO=TRUE`
  - `DB_BLOCK_CHECKING=FALSE`
  - `DB_BLOCK_CHECKSUM=FALSE`
- **The following should be set high to allow for maximum parallelism:**
  - `PROCESSES`
  - `SESSIONS`
  - `PARALLEL_MAX_SERVERS`
- **The following should be sized generously:**
  - `SHARED_POOL_SIZE`
  - `UNDO_TABLESPACE`

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Performance Initialization Parameters

You can try using the parameters (shown in the slide) to improve performance, although the effect may not be the same on all platforms.

Additionally, the `SHARED_POOL_SIZE` and `UNDO_TABLESPACE` initialization parameters should be generously sized. The exact values will depend upon the size of your database.

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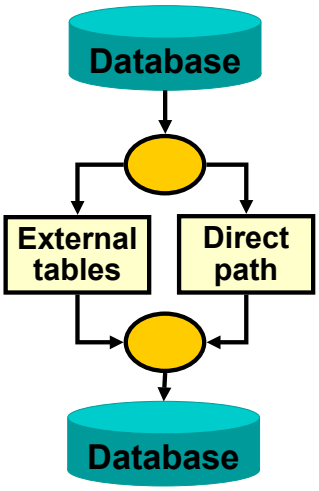
Data Pump Access Path: Considerations

One of the following access paths is automatically selected by Data Pump:

- **Direct path**
- **External tables, if data includes:**
  - **Encrypted columns**
  - **Clustered tables**
  - **Different partition at unload and load time, and others (see Notes)**



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Data Pump Direct Path: Considerations

Data Pump automatically selects the most appropriate access method for each table.

Data Pump uses direct path load and unload when a table's structure allows it and when maximum single-stream performance is desired.

Data Pump uses external tables, if any of the conditions exist:

- Tables with fine-grained access control enabled in insert and select modes
- Domain index, which exists for a LOB column
- Tables with active triggers defined
- Global index on partitioned tables with a single-partition load
- `BFILE` or opaque type columns
- Referential integrity constraint
- `VARRAY` columns with an embedded opaque type

Note: Because both methods support the same external data representation, data that is unloaded with one method can be loaded using the other method.

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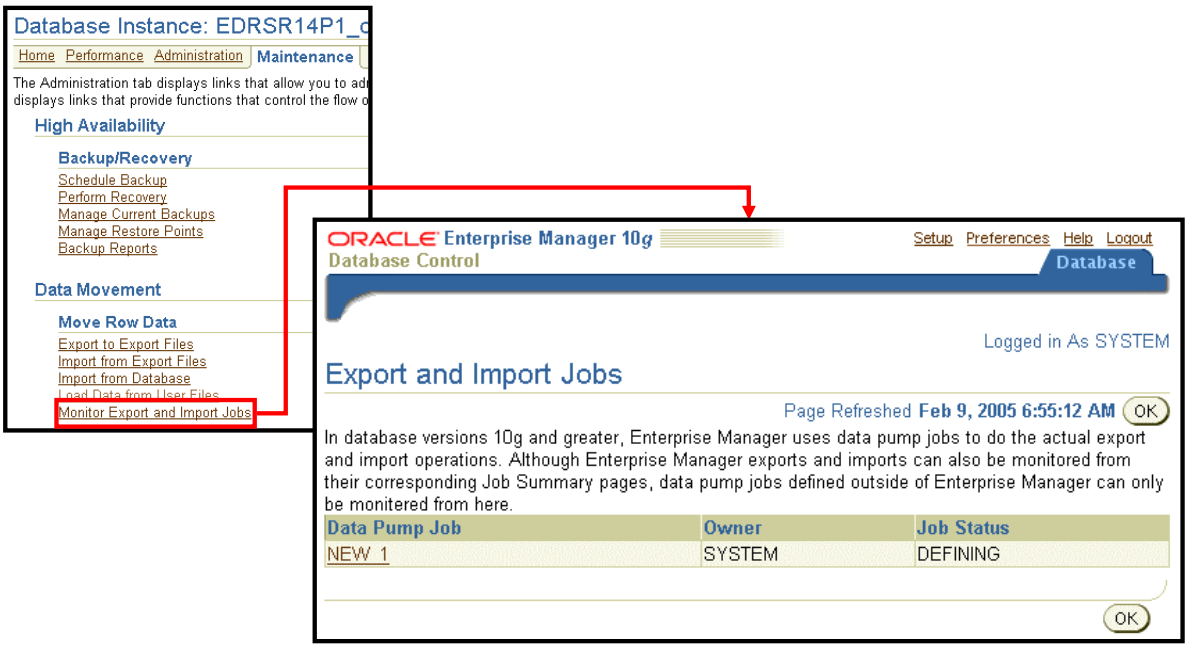
Using Enterprise Manager to Monitor Data Pump Jobs



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Using Enterprise Manager to Monitor Data Pump Jobs

You can use the Enterprise Manager graphical user interface (GUI) to monitor all Data Pump jobs, including those created by using the `expdp` or `impdp` command-line interfaces or by using the `DBMS_DATAPUMP` package.

You can view the current status of the job and also change the status to `EXECUTE`, `STOP`, or `SUSPEND`.

To access the Export and Import Jobs page, click the Monitor Export and Import Jobs link in the Move Row Data region of the Maintenance page.

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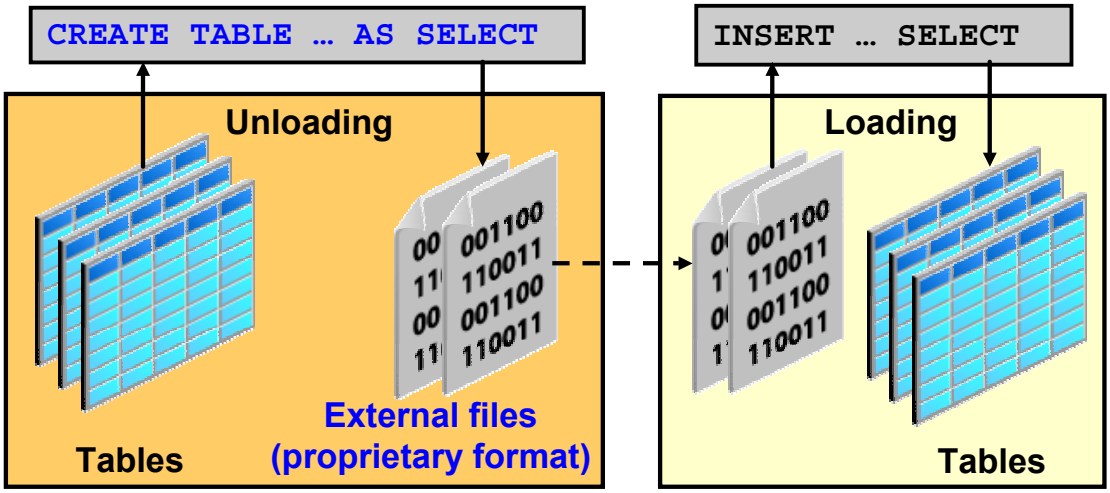
External Table Population

Directory Obj.
SQL*Loader
Data Pump
- Export
- Import
> External Table

- Unloading of data to external files with the `ORACLE_DATAPUMP` access driver
- No modifications of external tables



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External Table Population

An "external table" is composed of proprietary format (that is, Direct Path API) flat files that are operating system independent. As data is extracted from the Oracle database and "unloaded" into files, it is transparently converted from its Oracle internal representation into an equivalent Oracle native external representation (that is, DPAPI).

You may use the `CREATE TABLE AS SELECT` command to populate an external table. After an external table has been created and populated, no rows may be added, updated, or deleted from the external table. Any attempt to modify the data in the external table fails. An external table may not have indexes.

The Data Pump access driver enables the unloading and loading operations for external tables.

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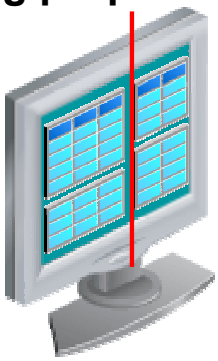
Using External Tables

- **Data can be used directly from the external file or loaded into another database.**
- **Resulting files can be read only with the `ORACLE_DATAPUMP` access driver.**
- **You can combine generated files from different sources for loading purposes.**

From Oracle Database



From External File

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Using External Tables

The data files created for the external table can be moved and used as the data files for another external table in the same database or different database. They can be read only by the `ORACLE_DATAPUMP` access driver. You can choose whether your applications should directly access external tables with the `SELECT` command, or if the data should first be loaded into a target database.

Data files populated by different external tables can all be specified in the `LOCATION` clause of another external table. This provides an easy way of aggregating data from multiple sources. The only restriction is that the metadata for all the external tables must be exactly the same.

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External Table Population with ORACLE_DATAPUMP

```
CREATE TABLE emp_ext
  (first_name, last_name, department_name)
ORGANIZATION EXTERNAL
  (
    TYPE ORACLE_DATAPUMP
    DEFAULT DIRECTORY ext_dir
    LOCATION ('emp1.exp','emp2.exp','emp3.exp')
  )
PARALLEL
AS
SELECT e.first_name,e.last_name,d.department_name
FROM   employees e, departments d
WHERE  e.department_id = d.department_id AND
       d.department_name in
                      ('Marketing', 'Purchasing');
```

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External Table Population with ORACLE_DATAPUMP

This example shows you how the new external table population operation can help to export a selective set of records resulting from the join of the EMPLOYEES and DEPARTMENTS tables.

Because the external table can be large, you can use a parallel populate operation to unload your data to an external table. As opposed to a parallel query from an external table, the degree of parallelism of a parallel populate operation is constrained by the number of concurrent files that can be written to by the access driver. There is never more than one parallel execution server writing into one file at a particular point in time.

The number of files in the LOCATION clause must match the specified degree of parallelism because each input/output (I/O) server process requires its own file. Any extra files that are specified are ignored. If there are not enough files for the specified degree of parallelism, the degree of parallelization is lowered to match the number of files in the LOCATION clause.

Note: For more information about the ORACLE_DATAPUMP access driver parameters, see the *Oracle Database Utilities* guide.

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External Table Population with ORACLE_LOADER

```
CREATE TABLE extab_employees
                 (employee_id       NUMBER(4),
                  first_name        VARCHAR2(20),
                  last_name         VARCHAR2(25),
                  hire_date         DATE)
ORGANIZATION EXTERNAL
    ( TYPE ORACLE_LOADER DEFAULT DIRECTORY extab_dat_dir
      ACCESS PARAMETERS
      ( records delimited by newline
        badfile extab_bad_dir:'empxt%a_%p.bad'
        logfile extab_log_dir:'empxt%a_%p.log'
        fields terminated by ','
        missing field values are null
    ( employee_id, first_name, last_name,
     hire_date char date_format date mask "dd-mon-yyyy"))
    LOCATION ('empxt1.dat', 'empxt2.dat') )
    PARALLEL  REJECT LIMIT UNLIMITED;
```

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External Table Population with ORACLE_LOADER

The ORACLE_LOADER access driver uses the SQL*Loader syntax to create external tables.

The example shown in the slide assumes that three directory objects (extab_dat_dir, extab_bad_dir, and extab_log_dir) are created and mapped to existing OS directories, to which the user is granted access.

Tip: If you have a lot of data to load, enable PARALLEL for the load operation:

```
ALTER SESSION ENABLE PARALLEL DML;
```

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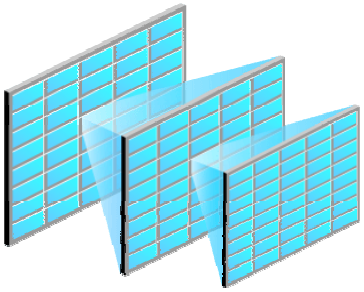
Data Dictionary

View information about external tables in:

- `[DBA| ALL| USER]_EXTERNAL_TABLES`
- `[DBA| ALL| USER]_EXTERNAL_LOCATIONS`
- `[DBA| ALL| USER]_TABLES`, and others



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Data Dictionary

`[DBA| ALL| USER]_EXTERNAL_TABLES` list the specific attributes of external tables in the database.

`[DBA| ALL| USER]_EXTERNAL_LOCATIONS` list the data sources for external tables.

`[DBA| ALL| USER]_TABLES` describe relational tables in the database.

`[DBA| ALL| USER]_TAB_COLUMNS` describe the columns of tables, views, and clusters in the database.

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Summary

In this lesson, you should have learned how to:

- Describe available ways for moving data
- Create and use directory objects
- Use SQL*Loader to load data from a non-Oracle database (or user files)
- Explain the general architecture of Data Pump
- Use Data Pump Export and Import to move data between Oracle databases
- Use external tables to move data via platform-independent files

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Practice Overview: Moving Data

This practice covers the following topics:

- **Using the Data Pump Export Wizard to select database objects to be exported**
- **Monitoring a Data Pump Export job**
- **Using the Data Pump Import Wizard to import tables in your database**
- **Using the Load Data Wizard to load data into your database**
- **Loading data by using the command line**

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Appendix A

Practices

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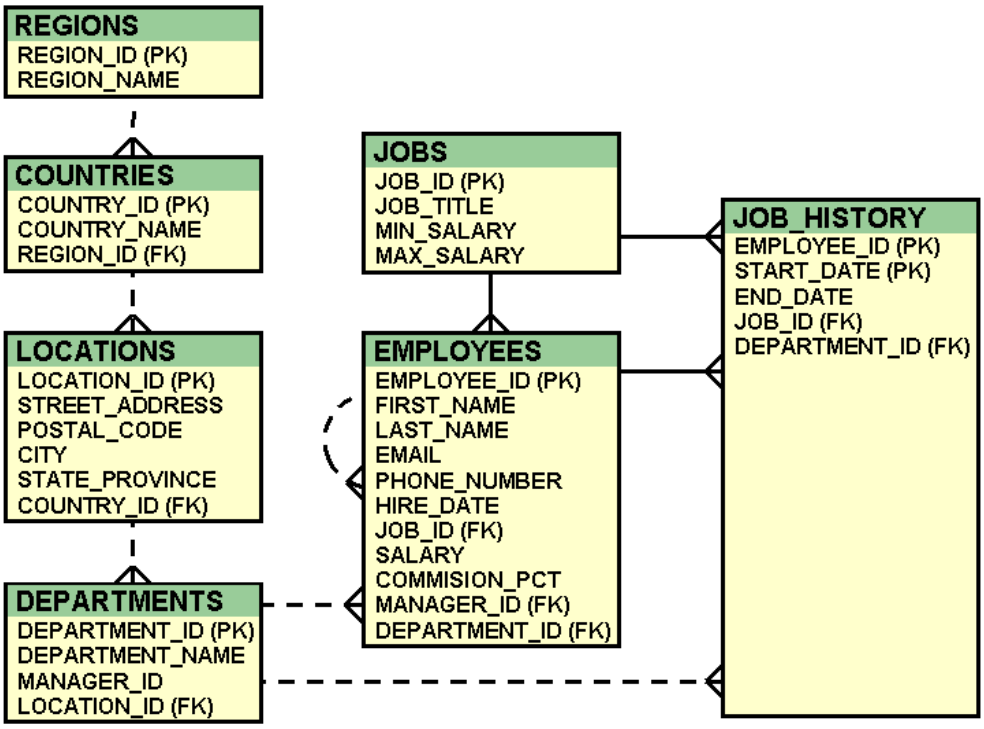
Practice Sessions: Overview

The HR schema:



Data Definition Language (DDL) Scripts

DDL scripts can be used to create the initial HR schema.

Table Definitions

```
PROMPT Creating Table 'REGIONS'
CREATE TABLE REGIONS
 (REGION_ID FLOAT(53) NOT NULL
 ,REGION_NAME VARCHAR2(25)
 )
/

PROMPT Creating Table 'JOBS'
CREATE TABLE JOBS
 (JOB_ID VARCHAR2(10) NOT NULL
 ,JOB_TITLE VARCHAR2(35) NOT NULL
 ,MIN_SALARY NUMBER(10,0)
 ,MAX_SALARY NUMBER(10,0)
 )
/

PROMPT Creating Table 'LOCATIONS'
CREATE TABLE LOCATIONS
 (LOCATION_ID NUMBER(5,0) NOT NULL
 ,STREET_ADDRESS VARCHAR2(40)
 ,POSTAL_CODE VARCHAR2(12)
 ,CITY VARCHAR2(30) NOT NULL
 ,STATE_PROVINCE VARCHAR2(25)
 ,COUNTRY_ID CHAR(2)
 )
/

PROMPT Creating Table 'JOB_HISTORY'
CREATE TABLE JOB_HISTORY
 (EMPLOYEE_ID NUMBER(10,0) NOT NULL
 ,START_DATE DATE NOT NULL
 ,END_DATE DATE NOT NULL
 ,JOB_ID VARCHAR2(10) NOT NULL
 ,DEPARTMENT_ID NUMBER(5,0)
 )
/

PROMPT Creating Table 'DEPARTMENTS'
CREATE TABLE DEPARTMENTS
 (DEPARTMENT_ID NUMBER(5,0) NOT NULL
 ,DEPARTMENT_NAME VARCHAR2(30) NOT
NULL
 ,MANAGER_ID NUMBER(10,0)
 ,LOCATION_ID NUMBER(5,0)
 )
/
```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Practice Sessions: Overview (continued)

```
PROMPT Creating Table 'EMPLOYEES'
CREATE TABLE EMPLOYEES
 (EMPLOYEE_ID NUMBER(10,0) NOT NULL
 ,FIRST_NAME VARCHAR2(20)
 ,LAST_NAME VARCHAR2(25) NOT NULL
 ,EMAIL VARCHAR2(25) NOT NULL
 ,PHONE_NUMBER VARCHAR2(20)
 ,HIRE_DATE DATE NOT NULL
 ,JOB_ID VARCHAR2(10) NOT NULL
 ,SALARY NUMBER(8,2)
 ,COMMISSION_PCT NUMBER(2,2)
 ,MANAGER_ID NUMBER(10,0)
 ,DEPARTMENT_ID NUMBER(5,0)
 )
/

PROMPT Creating Table 'COUNTRIES'
CREATE TABLE COUNTRIES
 (COUNTRY_ID CHAR(2) NOT NULL
 ,COUNTRY_NAME VARCHAR2(40)
 ,REGION_ID FLOAT(53)
 )
/
```

Constraint Definitions

```
PROMPT Creating Primary Key on
'REGIONS'
ALTER TABLE REGIONS
 ADD (CONSTRAINT
PK__REGIONS__76CBA758 PRIMARY KEY
  (REGION_ID))
/

PROMPT Creating Primary Key on 'JOBS'
ALTER TABLE JOBS
 ADD (CONSTRAINT PK__JOBS__023D5A04
PRIMARY KEY
  (JOB_ID))
/

PROMPT Creating Primary Key on
'LOCATIONS'
ALTER TABLE LOCATIONS
 ADD (CONSTRAINT
PK__LOCATIONS__7B905C75 PRIMARY KEY
  (LOCATION_ID))
/

PROMPT Creating Primary Key on
'JOB_HISTORY'
ALTER TABLE JOB_HISTORY
 ADD (CONSTRAINT
PK__JOB_HISTORY__0AD2A005 PRIMARY KEY
  (EMPLOYEE_ID
  ,START_DATE))
/

PROMPT Creating Primary Key on
'DEPARTMENTS'
ALTER TABLE DEPARTMENTS
 ADD (CONSTRAINT
PK__DEPARTMENTS__7E6CC920 PRIMARY KEY
  (DEPARTMENT_ID))
/

PROMPT Creating Primary Key on
'EMPLOYEES'
ALTER TABLE EMPLOYEES
 ADD (CONSTRAINT
PK__EMPLOYEES__0425A276 PRIMARY KEY
  (EMPLOYEE_ID))
/

PROMPT Creating Primary Key on
'COUNTRIES'
ALTER TABLE COUNTRIES
 ADD (CONSTRAINT
PK__COUNTRIES__78B3EFCA PRIMARY KEY
  (COUNTRY_ID))
/

PROMPT Creating Unique Key on
'EMPLOYEES'
ALTER TABLE EMPLOYEES
 ADD (CONSTRAINT
UQ__EMPLOYEES__0519C6AF UNIQUE
  (EMAIL))
/

PROMPT Creating Check Constraint on
'JOB_HISTORY'
ALTER TABLE JOB_HISTORY
 ADD (CONSTRAINT
CK__JOB_HISTORY__0EA330E9 CHECK
(END_DATE > START_DATE))
/
```


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Practice Sessions: Overview (continued)

```
PROMPT Creating Check Constraint on
'EMPLOYEES'
ALTER TABLE EMPLOYEES
 ADD (CONSTRAINT
CK__EMPLOYEES__SALAR__08EA5793 CHECK
(SALARY > 0))
/


PROMPT Creating Foreign Key on
'LOCATIONS'
ALTER TABLE LOCATIONS ADD (CONSTRAINT
 FK__LOCATIONS__COUNT__7C8480AE
FOREIGN KEY
  (COUNTRY_ID) REFERENCES COUNTRIES
  (COUNTRY_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'JOB_HISTORY'
ALTER TABLE JOB_HISTORY ADD
(CONSTRAINT
 FK__JOB_HISTO__DEPAR__0BC6C43E
FOREIGN KEY
  (DEPARTMENT_ID) REFERENCES
DEPARTMENTS
  (DEPARTMENT_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'JOB_HISTORY'
ALTER TABLE JOB_HISTORY ADD
(CONSTRAINT
 FK__JOB_HISTO__JOB_I__0DAF0CB0
FOREIGN KEY
  (JOB_ID) REFERENCES JOBS
  (JOB_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'JOB_HISTORY'
ALTER TABLE JOB_HISTORY ADD
(CONSTRAINT
 FK__JOB_HISTO__EMPLO__0CBAE877
FOREIGN KEY
  (EMPLOYEE_ID) REFERENCES EMPLOYEES
  (EMPLOYEE_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'DEPARTMENTS'
ALTER TABLE DEPARTMENTS ADD
(CONSTRAINT
 FK__DEPARTMEN__LOCAT__7F60ED59
FOREIGN KEY
  (LOCATION_ID) REFERENCES LOCATIONS
  (LOCATION_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'EMPLOYEES'
ALTER TABLE EMPLOYEES ADD (CONSTRAINT
 FK__EMPLOYEES__MANAG__07F6335A
FOREIGN KEY
  (MANAGER_ID) REFERENCES EMPLOYEES
  (EMPLOYEE_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'EMPLOYEES'
ALTER TABLE EMPLOYEES ADD (CONSTRAINT
 FK__EMPLOYEES__JOB_I__07020F21
FOREIGN KEY
  (JOB_ID) REFERENCES JOBS
  (JOB_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'EMPLOYEES'
ALTER TABLE EMPLOYEES ADD (CONSTRAINT
 FK__EMPLOYEES__DEPAR__060DEAE8
FOREIGN KEY
  (DEPARTMENT_ID) REFERENCES
DEPARTMENTS
  (DEPARTMENT_ID) ON DELETE CASCADE)
/

PROMPT Creating Foreign Key on
'COUNTRIES'
ALTER TABLE COUNTRIES ADD (CONSTRAINT
 FK__COUNTRIES__REGIO__79A81403
FOREIGN KEY
  (REGION_ID) REFERENCES REGIONS
  (REGION_ID) ON DELETE CASCADE)
```

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Practice 2: Installing the Oracle Database Software

Background: In the practices of this course, you assume the role of a database administrator (DBA). The operating system (OS) accounts on your computer are:

- The `oracle` user with a password of `oracle`
- The `root` user with a password of `oracle`

The system administrator has set up the OS so that it is ready for the installation, and the installation media is staged at `/stage/Disk1`. Perform the following tasks as the default `oracle` OS user, unless otherwise indicated.

Use the Oracle Universal Installer (OUI) to begin your software installation of the Enterprise Edition of Oracle Database 10*g* Release 2. This is a "Basic Installation" of the Oracle software.

After installing the software, execute the `lab_02_05.sh` script, which creates a listener for you.

Note: Completing this practice is critical for all following practice sessions.

Your Tasks

1. Install the Oracle database software as the `oracle` user. Navigate to the `/stage/Disk1` directory, and start the OUI by entering `./runInstaller`.

2. Select your installation method by entering and accepting the following settings:

Object	**Setting**
Installation Method	Basic Installation
Database Home Location	`/u01/app/oracle/product/10.2.0/db_1`
Installation Type	Enterprise Edition
UNIX DBA Group	`oinstall`
Create Starter Database	*Deselected*
Inventory Directory	`/u01/app/oracle/oraInventory`

3. After entering the initial settings, OUI checks product-specific prerequisites for you. When these checks are finished, install the Oracle software.

   Estimated installation time is 10–15 minutes. However, varying environments can greatly influence this estimate.

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Practice 2: Installing the Oracle Database Software (continued)

4. When the Execute Configuration scripts page appears, follow the instructions on that page, accept the default for the local `bin` directory, and then finish your installation with OUI.

   Make a note of your End of Installation URLs. You will use them in later practice sessions.

   *i*SQL*PlusURL:_____

   *i*SQL*Plus DBA URL:_____

   Optionally, review the product inventory, and then exit.

5. Execute the `lab_02_05.sh` script, which is in the `/home/oracle/labs` directory. This script uses the `netca` utility to create a listener for you. If you create your first database with OUI (as part of your installation), then OUI invokes the network configuration assistant, which creates the first listener for you. For more details on listeners, see the lesson titled "Configuring the Oracle Network Environment."

   You see an activity log, which should end with a success message. If not, resolve any errors that might have occurred.

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Practice 3: Creating an Oracle Database

Background: You are about to begin creating your first Oracle database. You anticipate that several similar databases will be needed in the near future. Therefore, you decide to create your `ORCL` database, as well as a database template and the database creation scripts. Locate the scripts in the `/home/oracle/labs` directory (which is the directory that you use most often throughout this course).

Note: Completing the database creation is critical for all following practice sessions.

Your Tasks

1. Start the Database Configuration Assistant (DBCA) by entering `dbca` in a terminal window.

2. Begin the `ORCL` database creation. Use the General Purpose database template. Review the template's details and answer the following questions.

   Question 1: How many control files are created?

   _____

   Question 2: Would it maximize database availability to multiplex them?

   _____

   Question 3: How many redo log groups are created?

   _____

   Question 4: Would it maximize database availability to mirror them?

   _____

   _____

   Question 5: What is the database block size (`db_block_size`)?

   _____

   Question 6: What is the value of Sample Schemas?

   _____

   Note: You will change this setting later in this practice to create and unlock the `HR` sample schema.

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Practice 3: Creating an Oracle Database (continued)

Question 7: What is the template default for the Database Character Set?

_____

Note: You will change this setting later in this practice to use a Unicode database character set.

3. Create the `ORCL` database, as well as the `ORCL` template and the database generation scripts.

   Create a database with the following settings:

Object	**Setting**
Global Database Name	`orcl.oracle.com`
SID	`orcl`
Configuration	Configure the Database with Enterprise Manager
Database Management	Use Database Control for Database Management
Enable Email Notifications	*deselect*
Enable Daily Backup	*deselect*
Password for All Accounts	`oracle`
Storage Options	File System
File Location	Use Oracle-Managed Files
Recovery Configuration	Specify Flash Recovery Area
Enable Archiving	*deselect*
Database Content	Sample Schemas enabled
Initialization Parameters Memory	Custom and Automatic Shared Memory Management
Character Sets	Use Unicode (AL32UTF8)
Creation Options:	Select all: - Create Database - Save as a Database Template (optional) - Generate Database Creation Scripts (optional)
Template Name	`orcl`
Description	`ORCL Database template`
Destination Directory	`/home/oracle/labs`

   Review and confirm options and parameters, such as `Sample Schemas (true)`, `db_block_size (8KB)`, `sga_target (270MB)`, `undo_management (AUTO)`, and `Database Character Set (AL32UTF8)`.

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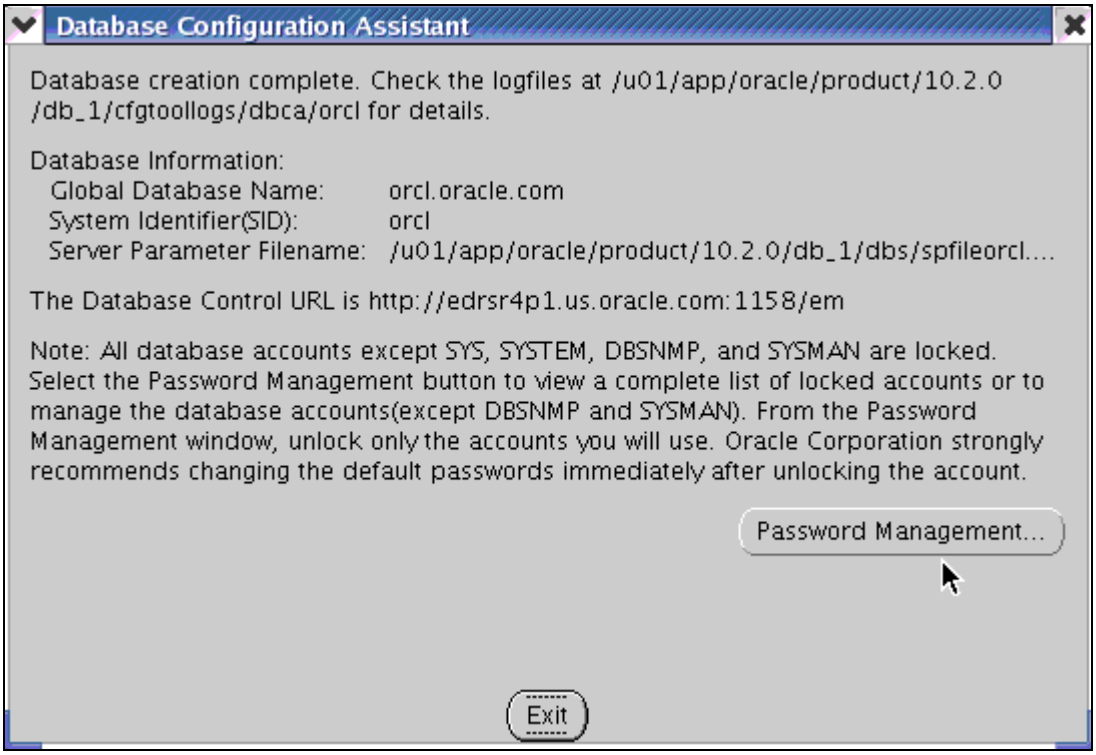
Practice 3: Creating an Oracle Database (continued)

The DBCA displays the progress of the various installation steps. When the database itself has been created, the DBCA displays essential information about the database. Make note of this information. The Database Control URL will be used in several of the following practice sessions.



Unlock the HR user with HR as password.

You completed your task to create a database and (optionally) a database template and database generation scripts.

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Practice 4: Managing the Oracle Instance

Background: You have just installed the Oracle software and created a database. You want to ensure that you can start and stop the database and see the application data.

Your Tasks

1. Invoke Enterprise Manager with Mozilla and the `oracle` profile. Enter the URL that you wrote down in Practice 3, and log in as the `SYS` user with the `oracle` password and `SYSDBA` as "Connect As." Which port number does this database use? You noted this in Practice 3.

   _____

   The first time you log in after installing the software, the "Oracle Database 10*g* Licensing Information" page appears. Acknowledge this information.

2. View the initialization parameters (Navigation aid: Adminstration > All Initialization Parameters). Set the `JOB_QUEUE_PROCESSES` parameter to `15`. What SQL statement is run to do this?

   _____

3. *Question:* What is the significance of a check in the Dynamic column?

   _____

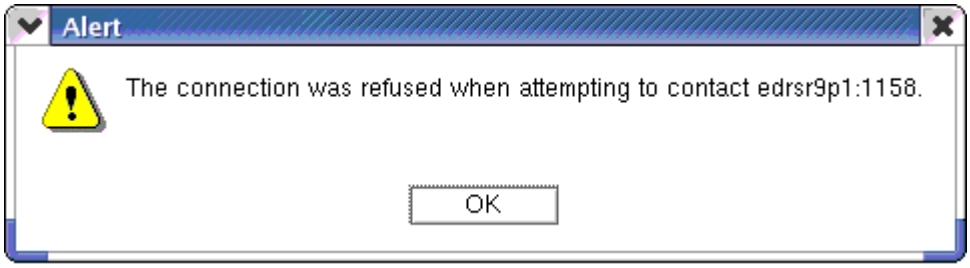
4. Shut down the database instance by using Enterprise Manager.

   For Host Credentials, enter `oracle` as Username and `oracle` as Password.

   Question: What SQL is executed to shut down the database instance?

   _____

   If you click Refresh during the shutdown operation, you may see the following error: Click **OK** and continue to refresh. The error will resolve itself.



   Click **OK** and continue to click Refresh. Note that the Status of the instance is now "Down."

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Practice 4: Managing the Oracle Instance (continued)

5. When you note that the Status of the instance is "Down," use SQL*Plus to verify that you are **not** able to connect as the `HR` user.

6. Use Enterprise Manager to restart the database instance with the `oracle` host credentials.
   Question: What SQL is run to accomplish the database startup?

   _____

7. In the alert log, view the phases that the database went through during startup. (Navigation aid: Database > Alert Log Content).
   Question: What are the database instance startup phases?

   _____

8. Test access to *i*SQL*Plus for your HR application developers. (Navigation aid: Database > iSQL*Plus). Use the `Normal` role, `hr` username and password, and the default setting as Connect Identifier. If there is an error accessing *i*SQL*Plus, then start the isqlplus process using the `isqlplusctl start` command at the OS prompt, and then reattempt. After connecting, select the contents of the `EMPLOYEES` table.

   When you have finished reviewing the information, log out of *i*SQL*Plus and close the *i*SQL*Plus window.

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Practice 5: Managing Database Storage Structures

Background: You need to create a new tablespace for the `INVENTORY` application. You also need to create a database user that is not as privileged as the `SYS` user.

Your Tasks

1. Enter `./lab_05_01.sh` to run a script that creates the `DBA1` user. It is located at `/home/oracle/labs`. The password for `DBA1` is `oracle`. Leave the command shell window open. You will use it again later.

2. Use the Setup link in the top-right corner of Enterprise Manager (EM) to define the `DBA1` user as one who can perform administrative tasks in EM. Use the following settings:

Object	Setting
Name	`dba1`
Password	`Oracle`
Confirm Password	`Oracle`
Super Administrator	*Selected*

   When the non-SYS user is configured, log out as `SYS` user and log in as `DBA1` user. Use the `DBA1` user to perform the rest of these tasks, unless otherwise indicated.

3. Using Enterprise Manager, view information about the `EXAMPLE` tablespace (Navigation aid: Administration > Tablespaces). Answer the following questions about it:

   Question 1: What percentage of free space can be used up before the Warning threshold is reached?

   _____

   Question 2: How many segments are there in the `EXAMPLE` tablespace? (Navigation aid: "Show Tablespace Contents" Actions drop-down list selection).

   _____

   Question 3: Which index in the `EXAMPLE` tablespace takes up the most space? (Navigation aid: Search type "INDEX")

   _____

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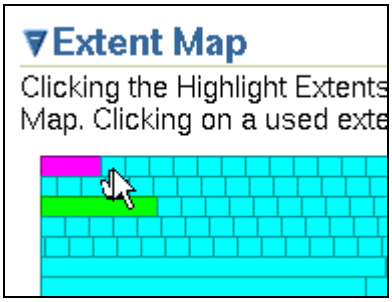
Practice 5: Managing Database Storage Structures (continued)

Question 4: Which segment is stored physically first in the tablespace? That is, which one is stored right after the tablespace header?

Look at all extent types on the Extent Map. Note the extent just to the right of the tablespace header extent.



Scroll to the top of the page again, and note the segment that is being pointed to.

_____

4. Create a new, locally managed tablespace (LMT) called `INVENTORY` (Navigation aid: Administration > Tablespaces). Use the following specifications:

Object	**Setting**
Tablespace name	`INVENTORY`
Extent Management	Locally Managed
Type	Permanent
Status	Read Write
Use Bigfile tablespace	*deselected*
Data File Name	`inventory01.dbf`
File Size	`5 MB`
Extent Allocation	Automatic
Segment Space Management	Automatic
Enable Logging	*selected*

Review the SQL that will be run to create this tablespace.

Note: The `INVENTORY` tablespace will be used in later practice sessions during this class.

5. Run the `lab_05_05.sql` script to create and populate a table (called `X`) in the `INVENTORY` tablespace. What error do you eventually see?

_____

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Practice 5: Managing Database Storage Structures (continued)

6. Go to the Enterprise Manager window and define space for 50 MB in the tablespace instead of 5 MB, while keeping the same single data file in the tablespace. What is the `ALTER` statement that is executed to make this change?

   _____

7. Go back to the terminal window and run the `lab_05_07.sql` script that drops the table and reexecutes the original script that previously returned the space error.

   Note that the same number of row inserts are attempted, and there is no error because of the increased size of the tablespace.

8. In a terminal window, run the `lab_05_08.sql` script to clean up the tablespace for later practice sessions.

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Practice 6: Administering User Security

Background: You need to create a user account for Jenny Goodman, the new human resources department manager. There are also two new clerks in the human resources department, David Hamby and Rachel Pandya. All three of them must be able to log in to the `ORCL` database, select data from, and update records in the `HR.EMPLOYEES` table. The manager also needs to be able to insert and delete new employee records. Ensure that if the new users forget to log out at the end of the day, they will automatically be logged out after 15 minutes. You also need to create a new user account for the inventory application that you are installing.

Your Tasks

1. **Mandatory:** Review and run the `lab_06_01.sh` script (located in the `/home/oracle/labs` directory) to create the `INVENTORY` schema user, which you will use in the next practice.

2. Create a profile named `HRPROFILE`, allowing 15 minutes idle time (Navigation aid: Administration > Profiles). Optionally, review the underlying SQL statement.

3. Set the `RESOURCE_LIMIT` initialization parameter to TRUE, so that your profile limits will be enforced time (Navigation aid: Administration > All Initialization Parameters).

4. Use EM to create the role named `HRCLERK` that has permission to select from and update the `HR.EMPLOYEES` table (Navigation aid: Administration > Roles). Review your underlying SQL statement:

```
CREATE ROLE "HRCLERK" NOT IDENTIFIED
GRANT SELECT ON "HR"."EMPLOYEES" TO "HRCLERK"
GRANT UPDATE ON "HR"."EMPLOYEES" TO "HRCLERK"
```

5. Use EM to create the role named `HRMANAGER` that has permissions to insert into and delete from the `HR.EMPLOYEES` table. Grant the `HRCLERK` role to the `HRMANAGER` role. Review your underlying SQL statement:

```
CREATE ROLE "HRMANAGER" NOT IDENTIFIED
GRANT DELETE ON "HR"."EMPLOYEES" TO "HRMANAGER"
GRANT INSERT ON "HR"."EMPLOYEES" TO "HRMANAGER"
GRANT "HRCLERK" TO "HRMANAGER"
```

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Practice 6: Administering User Security (continued)

6. Use EM to create an account for David Hamby, a new HR clerk (Navigation aid: Administration > Users). Use the following specifications:

Object	Setting
Name	DHAMBY
Profile	HRPROFILE
Password Authentication	*selected*
Password	newuser
Expire Password now	*selected*
Roles	CONNECT and HRCLERK

7. Use EM to create an account for Rachel Pandya, another new HR clerk. Repeat the steps from step 6 with RPANDYA as the username.

8. Use EM to create an account for Jenny Goodman, the new HR manager. Repeat the steps from step 6 with JGOODMAN as the username and selecting the HRMANAGER role instead of the HRCLERK role. Review your underlying SQL statement:

```
CREATE USER "JGOODMAN" PROFILE "HRPROFILE" IDENTIFIED BY "*******" PASSWORD
EXPIRE ACCOUNT UNLOCK
GRANT "CONNECT" TO "JGOODMAN"
GRANT "HRMANAGER" TO "JGOODMAN"
```

9. Test the new users in SQL*Plus. Connect to the ORCL database as the DHAMBY user. Use oracle as the new password. Select the row with EMPLOYEE_ID=197 from the HR.EMPLOYEES table. Then, attempt to delete it. (You should get the "insufficient privileges" error.)

10. Repeat the delete attempt as the JGOODMAN user. After deleting the row, issue a rollback, so that you still have the original 107 rows.

    Question 1: Where was the row stored after deletion?

    _____

    Question 2: When you created the new users, you did not select a default or temporary tablespace. What determines the tablespaces that the new users will use?

    _____

    Question 3: You did not grant the CREATE SESSION system privilege to any of the new users, but they can all connect to the database. Why?

    _____

11. Review the lab_05_01.sql script and the lab_05_01.txt log file that it generated when you created the DBA1 user.

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Practice 6: Administering User Security (continued)

12. Use SQL*Plus to connect to the `ORCL` database as the `RPANDYA` user. Change the password to `oracle`. (You must change the password, because this is the first connection as `RPANDYA`.) Leave `RPANDYA` connected during the next lesson or at the end of the day. `HRPROFILE` specifies that users whose sessions are inactive for more than 15 minutes will automatically be logged out. Verify that the user was automatically logged out by trying to select from the `HR.EMPLOYEES` table again.

```
ERROR at line 1:
ORA-02396: exceeded maximum idle time, please connect again
```

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Practice 7: Managing Schema Objects

Background: You need to create schema objects for the new inventory application. Work as `DBA1` user in the `SYSDBA` role for your `ORCL` database.

Your Tasks

1. Return to the Enterprise Manager browser session, or invoke EM as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

2. In the `INVENTORY` tablespace, create the `PRODUCT_MASTER` table in the `INVENTORY` schema. The specifications of the table are:

   `PRODUCT_ID` number(7). This is the primary key field. (Constraint name: `PK_INV`)
   `PRODUCT_NAME` varchar2(50) with a Not NULL constraint
   `CODE` varchar2(10) with a Not NULL constraint
   `REORDER_THRESHOLD` number(5) with a check constraint ensuring that the number is always greater than zero (Constraint name: `CHK_REORDER`)
   `COST` number(5,2)
   `PRICE` number(5,2)

3. In the `INVENTORY` tablespace, create the `PRODUCT_ON_HAND` table in the `INVENTORY` schema. You have been given the `lab_07_03.sql` script to create the table, but there is a problem with it (*intentionally created to enhance your learning experience*). Fix the problem, and run the script. If you cannot find the error right away, then go ahead and run the original script in SQL*Plus to see the error message. This helps you discover and solve the problem. The specifications of the table are:

   `PRODUCT_ID` number(7). This field should have a foreign key constraint linking it to the `PRODUCT_ID` field in the `PRODUCT_MASTER` table.
   `QUANTITY` number(5)
   `WAREHOUSE_CITY` varchar2(30)
   `LAST_UPDATE` date

4. In the `INVENTORY` tablespace, create the `OBSOLETE_PRODUCTS` table in the `INVENTORY` schema. This table definition is very much like that of the `PRODUCT_MASTER` table, so you can use Enterprise Manager's ability to "Define Using SQL" rather than using "Column Specification." The specifications of the table are:

   `PRODUCT_ID` number(7). This is the primary key field.
   `PRODUCT_NAME` varchar2(50) with a Not Null constraint
   `CODE` varchar2(20) with a Not Null constraint
   `COST` number(5,2)
   `PRICE` number(5,2)

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Practice 7: Managing Schema Objects (continued)

5. In the `INVENTORY` tablespace, create an index called `OBS_CODE` on the `CODE` column of the `OBSOLETE_PRODUCTS` table in the `INVENTORY` schema. Choose an appropriate index type: either B-tree or Bitmap. Explain the reason for your choice.

   Question: Which type of index is appropriate, and why?

   _____

   _____

6. In the `INVENTORY` tablespace, create an index called `PROD_NAME_CODE` on the combined `PRODUCT_NAME` and `CODE` columns of the `PRODUCT_MASTER` table. Use the `lab_07_06.sql` script *(which contains an error, intentionally created to enhance your learning experience*). Correct the error and run the script. If you cannot find the error right away, then run the original script in SQL*Plus to see the error message. This will help you discover and solve the problem.

7. In the `INVENTORY` tablespace, use SQL*Plus to create a combined index on the `PRODUCT_ID` and `QUANTITY` columns of the `PRODUCT_ON_HAND` table. The index name should be `POH_PROD_ID_QTY`.

8. You receive an update for the inventory application that requires you to add two columns to the `PRODUCT_MASTER` table. Add a column called `PRIMARY_SOURCE` of the data type `varchar2(50)`. Add another column called `SECONDARY_SOURCE` of the data type `varchar2(50)`. What is the SQL that executes to do this?

   _____

   _____

9. You receive another update for the inventory application. This change request instructs you to drop the `OBSOLETE_PRODUCTS` table and add the `OBSOLETED` column to the `PRODUCT_MASTER` table, with data type `DATE`. Do this using EM. What clause is added to the end of the `DROP TABLE` statement to also remove the table constraints?

   _____

10. Another change request to the inventory application instructs you to create a view called `WAREHOUSE_VW` (Navigation aid: Administration > Views). The view is in the `INVENTORY` schema and displays (in this order):

    - The name of the product
    - The amount of "product on hand"
    - The warehouse city name

    You will have to join two tables together to create this view.

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Practice 7: Managing Schema Objects (continued)

11. You receive a notice from developers that there is a certain type of query that will be run very frequently, and they want to be sure that it runs in less than one second. You need to run the query and see how it performs. First, run the `lab_07_11_a.sql` script to generate some test data of the volume indicated in the request. Then, run the query in the `lab_07_11_b.sql` script several times to see the average run time. Note that it takes several seconds to run each time. Create a function-based index on the `CODE` column that will improve the performance of this query.

12. Use *i*SQL*Plus to identify the data dictionary view name that you would use to list all constraints that the `INVENTORY` user can see. What is the view name?

    _____

13. How many indexes are owned by the `INVENTORY` user? You are looking for database objects owned by the `INVENTORY` user, so you know that the data dictionary view begins with the "`USER_`" prefix. The view name is `USER_INDEXES`.

    _____

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Practice 8: Managing Data and Concurrency

Background: The Help desk just received a call from Susan Mavris, an HR representative, complaining that the database is "frozen." Upon questioning the user, you find that she was trying to update John Chen's personnel record with his new phone number, but when she entered the new data, her session froze and she could not do anything else. SQL script files are provided for you in the `/home/oracle/labs` directory.

Your Tasks

1. Make an uncommitted update to the row in question by running the `lab_08_01.sql` script. Do not worry if the session seems to "hang"—this is the condition you are trying to create.

2. Make an attempt to update the same row in a separate session by running, in a separate terminal window, the `lab_08_02.sql` script. Make sure you see the message "Update is being attempted now" before moving on.

3. Using the **Blocking Sessions** link on the Performance page, detect which session is causing the locking conflict.

4. What was the last SQL statement that the blocking session executed?

5. Resolve the conflict in favor of the user who complained, by killing the *blocking* session. What SQL statement resolves the conflict?

   _____

6. Return to the SQL*Plus command window, and note that `SMAVRIS`'s update has now completed successfully. It may take a few seconds for the success message to appear.

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Practice 9: Managing Undo Data

Background: A new version of your application will include several reports based on very long-running queries. Configure your system to support these reports.

Your Tasks

1. Use the Undo Advisor to calculate the amount of undo space required to support a report that takes two days to run, on the basis of an analysis period of the last seven days. (Navigation aid: Administration > Advisor Central > Undo Management > Undo Advisor).

   Question: What does the analysis recommend as "Required Tablespace Size for New Undo Retention"?

   _____

2. Resize the undo tablespace to support the retention period required by the new reports (or 1 GB, whichever is smaller). Do this by increasing the size of the existing data file.

   Question: What are the two ways to add space to a tablespace?

   _____

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Practice 10: Implementing Oracle Database Security

Background: You have just been informed of suspicious activities in the `HR.JOBS` table in your `ORCL` database. All maximum salaries seem to fluctuate in a strange way. You decide to enable standard database auditing and monitor data manipulation language (DML) activities in this table.

Log in as the `DBA1` user (with `oracle` password, connect as `SYSDBA`) and perform the necessary tasks either through Enterprise Manager Database Control or through SQL*Plus. All scripts for this practice are in the `/home/oracle/labs` directory.

Your Tasks

1. Use Enterprise Manager to enable database auditing. Set the `AUDIT_TRAIL` parameter to `XML`. This setting should be stored in the SPFILE.

2. Because you changed a static parameter, you must restart the database. Do so by running the `lab_10_02.sh` script.

   Continue with the next step when you see that the database is restarted and the script has exited out of SQL*Plus.

3. Back in Enterprise Manager, select `HR.JOBS` as the audited object and `DELETE`, `INSERT`, and `UPDATE` as **Selected Statements**. Gather audit information by session. (Navigation aid: Administration > Audit Settings).

4. Provide input for the audit, by executing the `lab_10_04.sh` script. This script creates the `AUDIT_USER` user, connects to SQL*Plus as this user, and multiplies the values in the `MAX_SALARY` column by `10`. Then, the `HR` user connects and divides the column values by `10`. Finally, the `AUDIT_USER` user is dropped again.

5. In Enterprise Manager, review the audited objects. Use the **Audited Objects** tab.

6. Undo your audit settings for `HR.JOBS`, disable database auditing, and then restart the database by using the `lab_10_06.sh` script.

7. Maintain your audit trail: Because you are completely finished with this task, delete all audit files from the `/u01/app/oracle/admin/orcl/adump` directory.

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Practice 11: Configuring the Oracle Network Environment

Background: Users need to connect to your `ORCL` database. Work with them to enable connections by using different methods. Ensure that users can use connect-time failover to take advantage of a backup listener.

Your Tasks

1. Make a copy of your `listener.ora` and `tnsnames.ora` files. They are in the `$ORACLE_HOME/network/admin` directory.

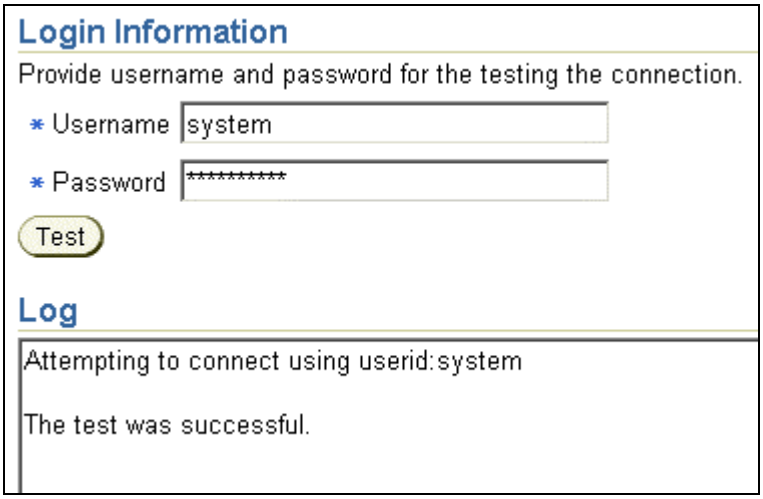
2. Navigate to the Net Services Administration page. Start by clicking the **Listener** link on the Database home page.

3. Modify your local Names Resolution file so that you can connect to another database. (Navigation aid: Listener link > Net Services Administration > Administer > Local Naming). Use the following information to define the connection:

Object	Setting
Connection name	`Testorcl`
DB ID Method	`SID`
SID value	`Orcl`
Protocol	TCP/IP
Port	`1521`
Host	IP or name of other student's computer

4. In Enterprise Manager, test access to your partner's `ORCL` database as the **`system`** user with the **`oracle`** password by using the **`testorcl`** Local Naming.

   The Processing page displays status information. Then, it is followed by a success message. *If you receive any errors or warnings, resolve them.*



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Practice 11: Configuring the Oracle Network Environment (continued)

5. Test your changes to the network configuration by using SQL*Plus or *i*SQL*Plus. Again, use: `system/oracle@testorcl`. To see your partner's information, select the `instance_name` and `host_name` columns from the `v$instance` table. You should see your partner's host name.

6. Create a `LISTENER2` listener to support connect-time failover. Use port 1561 for this listener. First, log out of Enterprise Manager and run the `lab_11_06.sh` script to configure the `NetProperties` file. (Navigation aid: Listener link > Net Services Administration > Administer > Listeners). Use the **Static Database Registration** tab on the Create Listener page to connect the listener to your database. Use the following information:

Object	**Setting**
Listener name	`LISTENER2`
Host	`<your computer's name>`
Service name	`orcl`
Protocol	TCP/IP
Port	`1561`
SID	`orcl`
Oracle Home Directory	`/u01/app/oracle/product/10.2.0/db_1`

7. Start the `LISTENER2` listener.

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Practice 12: Proactive Maintenance

Background: You want to proactively monitor your `ORCL` database so that common problems can be fixed before they affect users. This practice session invents some issues so that you can familiarize yourself with the tools that are available. First, execute scripts to set up your Automatic Database Diagnostic Management (ADDM) environment.

Your Tasks

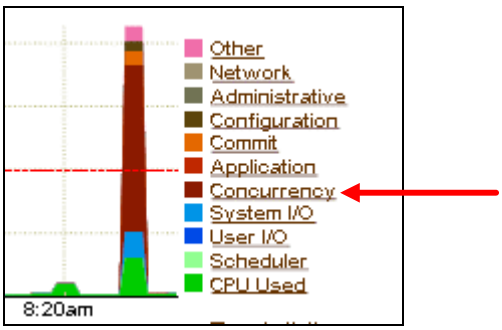
1. Create a new locally managed tablespace called `TBSADDM`. Its `addm1.dbf` data file is 50 MB. Ensure that the `TBSADDM` tablespace does not use Automatic Segment Space Management (ASSM). Execute the `lab_12_01.sh` script to perform these tasks.

2. Create a new `ADDM` user, identifed by `ADDM`. Assign the `TBSADDM` tablespace as default tablespace. Assign the `TEMP` tablespace as temporary tablespace. Grant the following roles to the `ADDM` user: `CONNECT`, `RESOURCE`, and `DBA`. Execute the `lab_12_02.sh` script to perform these tasks.

3. Use the `DBMS_ADVISOR` package to set the database activity time to 30 minutes. As an `ADDM` user, drop and create the `ADDM` table and gather statistics for this table. Create a snapshot in Automatic Workload Repository (AWR). Execute the `lab_12_03.sh` script to perform these tasks.

4. Create activity to be analyzed. Execute the `lab_12_04.sh` script to perform these tasks.

5. In Enterprise Manager, review the Performance page as a user connected as `SYSDBA`. View performance data in real time with a 15-seconds refresh cycle. After a while, you should see a spike on the "Average Active Sessions" graph. This is your activity to be analyzed. Looking at the graph, you can already determine that this instance is suffering from concurrency problems. If this is the first time that you accessed the Performance page, you need to accept the Adobe license agreement. Follow the directions in the pop-up window to accept the agreement.



Note: Depending on when you run the workload, you may see differences between your graph and the one provided as a possible solution.

After the spike is finished, execute the `lab_12_05.sh` script. This script forces the creation of a new snapshot and gathers statistics on your `ADDM` table.

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Practice 12: Proactive Maintenance (continued)

6. Look at the **Performance Analysis** findings in order of their impact. There are several access paths to this information.

   Looking at the Performance Analysis section, you see that the first finding (in the SQL Tuning Recommendations category) has a 100% impact on the system. So your first impluse is to look at this finding in more detail. However, looking at this SQL statement does not yet help you to understand the concurrency problem of your database.

   Research the next finding under Schema Recommendations: **Read and write contention of database blocks was consuming significant database time**. Here, you are advised to use the Automatic Segment Space Management (ASSM) feature for your `ADDM` table.

7. To implement the recommendation, you must re-create the object. Create a new locally managed tablespace, called `TBSADDM2` with a 50 MB data file, called `addm2_1.dbf`. Ensure that the `TBSADDM2` tablespace uses the the ASSM feature. Then, execute the `lab_12_07.sh` script to drop the `ADDM` table, to re-create it in the new tablespace, to gather statistics and to take a new snapshot.

8. Execute your workload again by running the `lab_12_08.sh` script. (The `lab_12_08.sh` script is identical to the `lab_12_04.sh` script.)

9. In Enterprise Manager, review the Performance page as a user connected as `SYSDBA`. View performance data in real time with a 15-seconds refresh cycle. After a while, you should see a spike on the "Average Active Sessions" graph.

   Note: Depending on when you run the workload, you may see differences between your graph and the one provided as a possible solution.

   After the spike is finished, execute the `lab_12_09.sh` script. (The `lab_12_09.sh` script is identical to the `lab_12_05.sh` script.) This script forces the creation of a new snapshot and gathers statistics on your `ADDM` table.

10. Review the Performance Analysis on the Database home page. View the information for this last ADDM task.

    You see that there are no longer any schema-related recommendations. By moving the `ADDM` table to the locally managed `TBSADDM2` tablespace, which uses the Automatic Autoextend Segment feature, you obviously fixed the root cause of this problem.

11. To not affect other practice session, execute the `lab_12_11.sh` script to clean up your environment.

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Practice 13: Performance Management

Background: Users are complaining about slower-than-normal performance for operations involving the human resources and order-entry applications. When you question other members of the DBA staff, you find that maintenance was recently performed on some of the tables belonging to the `HR` schema. You need to troubleshoot and make changes as appropriate to resolve the performance problems. SQL script files are provided for you in the `/home/oracle/labs` directory. Other directories are individually named.

Your Tasks

1. Log in to SQL*Plus as the `DBA1` user and perform maintenance on tables in the `HR` schema by running the `lab_13_01.sql` script.

2. You get calls from HR application users saying that a particular query is taking longer than normal to execute. The query is in the `lab_13_02.sql` script. As the HR user, run it.

3. Using Enterprise Manager (EM), locate the `HR` session in which the above statement was just executed, and view the execution plan for that statement. (Navigation aid: Performance > Search Sessions).

4. Using EM, check to see the status of the `EMPLOYEE` table's index on `EMPLOYEE_ID`. See if it is `VALID`. (Navigation aid: Administration > Indexes).

5. Now that you have seen one index with a non-`VALID` status, you decide to check all indexes. Using SQL*Plus, as the `HR` user, find out which `HR` schema indexes do not have `STATUS` of `VALID`. To do this, you can query a data dictionary view with a condition on the `STATUS` column.

6. Using EM, reorganize all the indexes in the `HR` schema that are marked as `UNUSABLE`.

7. Return to the SQL*Plus session where the `HR` user is logged in, and run the `lab_13_07.sql` script to execute the same kind of query. Then, repeat the steps to see the plan of the last SQL statement executed by this session, to see if the plan has changed.

8. What is the difference in execution plans, and why?

   _____

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Practice 13: Performance Management (continued)

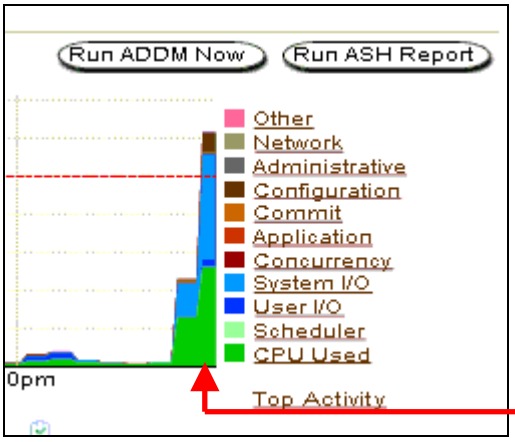
9. Simulate a working load on your instance by running the `lab_13_09.sql` script as the `DBA1` user. Note the SID value for task 10.

   _____

   This script takes about 20 minutes to complete. So, run it in a separate terminal window and continue with this practice exercise while it runs.

   Note: Because this script generates a fairly heavy load in terms of CPU and disk I/O, you will notice that response time for Database Control is slower.

   Use EM to view overall instance performance and answer the following questions:



Wait to see the beginning of a spike in the **Average Active Sessions** graph before proceeding.

   Question 1: In the **Average Active Sessions** graph, which are the two main categories that active sessions are waiting for?

   _____

   Question 2: In the Configuration category of waits, what is one of the contributors to the wait time? Click **Configuration** to see the graph.

   _____

   Question 3: Review the **Physical Writes** on the **Instance Disk I/O** graph. Determine which process is doing the most writing to the disk.

   _____

   Question 4: Review the **Top Activity** under **Additional Monitoring Links**. Which SQL statement is causing the most waits?

   _____

10. Kill the session that is generating the load. Use the SID value from step 9 in Enterprise Manager's **Search Sessions** link on the **Performance** tab to locate and kill the session.

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Practice 14: Backup and Recovery Concepts

Background: Your `ORCL` database is ready to move from test or development into production. Configure your database to reduce the chances of failure or data loss.

Your Tasks

1. Verify that you have two control files to ensure redundancy. (Navigation aid: Administration > Control Files).

   Question 1: How would you add another control file if you needed to?

   _____

   _____

   _____

   _____

   _____

2. Check how many members each redo log group has. Ensure that there are at least two redo log members in each group. In what directory or directories are the redo log files stored?

   _____

   _____

   Note: In a production database, you want to ensure that the two members are on different hard drives, preferably with different disk controllers, to minimize the risk of any single hardware failure destroying an entire log group.

3. You notice that, for each log group, the `Archived` column has a value of `No`. This means that your database is not retaining copies of redo logs to use for database recovery, and in the event of a failure, you will lose all data since your last backup. Place your database in `ARCHIVELOG` mode, so that redo logs will be archived.

   In the OS, create a new directory `/u01/app/oracle/archive` as the destination for the redo log files. In Enterprise Manager, verify that Log Archive Filename Format contains `%t`, `%s`, and `%r`.

   Notice that the database is preconfigured to save archived logs to the Flash Recovery Area by default (Archive Log Destination 10).

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Practice 14: Backup and Recovery Concepts (continued)

4. Configure redundant archive log destinations—one to the Flash Recovery Area and the other to `/u01/app/oracle/archive/`. Do not forget the trailing slash. Leave **Quota** blank.

   Optionally, review the underlying SQL statement:

   Show SQL

   ```
   ALTER SYSTEM SET log_archive_dest_1 =
   "LOCATION=/u01/app/oracle/archive/ OPTIONAL REOPEN=300" SCOPE=BOTH
   ALTER SYSTEM SET log_archive_dest_10 =
   "LOCATION=USE_DB_RECOVERY_FILE_DEST OPTIONAL REOPEN=300" SCOPE=BOTH
   ```

   When prompted, restart your database with `oracle` Host Credentials and the `SYS` user.

   Now that your database is in `ARCHIVELOG` mode, it will continually archive a copy of each online redo log file before reusing it for additional redo data.

   Note: Remember that this consumes space on the disk and that you must regularly back up older archive logs to some other storage.

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Practice 15: Performing Database Backups

Background: Your database is ready to move from development and test into production. Ensure that your database is configured so that recovery is possible without loss of data.

Your Tasks

1. What is the difference between a backup set and an image copy?

   _____

2. What is the destination of any disk backups that are done?

   _____

3. Test making a backup to disk, as a backup set, with `oracle` for Host Credentials. (Navigation aid: Maintenance > Backup Settings)

4. Back up your entire database, without archived logs, while the database is open for user activity. This backup should be the base for an incremental backup strategy (Navigation aid: Maintenance > Schedule Backup).

   Question: What prerequisite *must* be met to create a valid backup of a database without shutting it down?

   _____

   Use the following specifications to perform the backup:

Object	**Setting**
Object(s)	Whole Database
Host Credentials Username	`oracle`
Host Credentials Password	`oracle`
Backup Type	Full Backup
Use as the base of an incremental backup strategy	*selected*
Backup Mode	Online Backup
Backup Location	Disk
Disk Backup Location	Flash Recovery Area
Also backup all archived logs on disk	*deselected*
Schedule	*Defaults selected*

   Submit and monitor the job. This backup takes approximately 15 minutes to complete.

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Practice 15: Performing Database Backups (continued)

5. Schedule nightly disk-based incremental online backups for your whole database, without archived logs `backup` (Navigation aid: Maintenance > Schedule Backup). Schedule it for 11:00 p.m.. The schedule should be in effect indefinitely.

   Use the following specifications:

Object	**Setting**
Object(s)	Whole Database
Host Credentials Username	`oracle`
Host Credentials Password	`oracle`
Backup Type	Incremental Backup (Level 1)
Use as the base of an incremental backup strategy	*selected*
Backup Mode	Online Backup
Also backup all archived logs on disk	*deselected*
Backup Location	Disk – Flash Recovery Area
Job Name	`Nightly_Backup`
Job Description	*Default selected*
Start	Later
Time	11:00 p.m.
Repeat	Interval
Frequency	1 Days

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Practice 16: Performing Database Recovery

Background: Many failures of the Oracle database can be traced to some sort of media failure, such as disk or controller failure. Recover your database from a variety of simulated media failures. SQL script files are provided for you in the `/home/oracle/labs` directory. If needed, use appendix C for Linux and appendix D for SQL syntax. Note that where OS file names are mentioned, your system may possibly have different file names than shown here.

Your Tasks

1. Recover from the loss of a control file.

   a) As the `DBA1` user, run the `lab_16_01_a.sql` script to prepare some procedures to be called by the rest of this practice.

   b) Now run the `lab_16_01_b.sql` script. This script deletes one of your control files.

   c) The Help desk begins receiving calls saying that the database appears to be down. Troubleshoot and recover as necessary. Use Enterprise Manager's Database page to attempt to start up the database, and use SQL*Plus, if needed.

   d) The startup of the instance fails with Enterprise Manager, and you can get no other information to explain the failure. So use the command-line tools.

      - Connect to the instance with SQL*Plus `as sysdba` and check the current status of the instance.

      - Attempt to mount the database.

   e) The instance cannot move to the mount stage because it cannot find one of the control files. Check the last 10 rows of the alert log to see which control file is the problem.

   f) The control file in the Flash Recovery Area is missing. Restore the missing control file by copying the existing control file, and then mount and open the database.

   Question 1: Why did you have to use two commands to move the instance state from NOMOUNT to OPEN?

   _____

   _____

   Question 2:Why did you use operating system commands to restore the control file instead of using Oracle Recovery Manager?

   _____

   _____

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Practice 16: Performing Database Recovery (continued)

2. Recover from the loss of an application data file.

   a) Start a SQL*Plus session as the `DBA1` user, and run the `lab_16_02.sql` script. This script deletes one of your application data files.

   b) The Help desk has received a call from a user who is unable to access the `COUNTRIES` table in the `HR` application schema. Count the rows in the table to see whether there is a problem.

   c) Troubleshoot and recover as necessary. The error message suggests that the data file for the `EXAMPLES` tablespace is corrupt or missing. Using operating system commands, verify that there is a problem with the file.

   d) Recover the data file to the current time, specifying the missing data file to be recovered. (Navigation aid: Maintenance > Perform recovery > Object Type > Datafiles).

   e) Verify that the `COUNTRIES` table is now accessible.

3. Recover from the loss of a system data file.

   a) *Question 3*: Why is recovery from the loss of a system data file or a data file belonging to an undo tablespace different from recovering an application data file?

   _____

   _____

   b) As `SYSDBA`, run the `lab_16_03.sql` script. This script deletes the system data file.

   c) In Enterprise Manager, review the Database home page. The database is shut down, so you click **Startup** to try to open it.

      - Enter the host credentials as `oracle` and `oracle` for the host **Username** and **Password**, and enter `DBA1` and `oracle` for the database credentials, and then click **OK**.

   d) This command will fail with the database left in the `MOUNT` state, because there is a data file missing from the `SYSTEM` tablespace.

   e) Recover the missing data file.

   f) Open the database.

   g) Verify that the database is open and operating normally, by logging into EM as `DBA1/oracle, as SYSDBA`, and reviewing the Database home page.

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Practice 17: Performing Flashback

Background: You decide to gain hands-on experience in some of the flashback functionality. To avoid impacting other users, you will first copy the `DEPARTMENTS` table of the `HR` schema to `DEPARTMENTS2`.

Your Tasks

1. Log in to SQL*Plus as `DBA1` user and create a new `HR.DEPARTMENTS2` table based on the `HR.DEPARTMENTS` table. Count the rows in the `DEPARTMENTS2` table. There should be 27 rows.

2. Drop the `HR.DEPARTMENTS2` table, and then verify that it has indeed been dropped.

3. Use the `FLASHBACK TABLE` command to restore the table. Count the rows in the `DEPARTMENTS2` table.

4. Run the `lab_17_04.sql` script to insert three rows into the `HR.DEPARTMENTS2` table by using three separate transactions. The new rows have `DEPARTMENT_ID` values of `280`, `290`, and `300`.

5. Use Enterprise Manager to perform flashback to the version of the table where only the first of the three new rows is present (with `DEPARTMENT_ID` = 280). (Navigation aid: Maintenance > Perform Recovery). First, evaluate row changes to decide on a point in time. Limit your analysis to the new rows just added: where `department_id >= 280`. If you receive an error while performing the flashback, you may need to enable row movement on the table. See the next step. Use the following specifications:

Object	Setting
Object Type	Tables
Operation Type	Flashback Existing Tables
Evaluate row changes and transactions to decide on a point in time	*selected*
Table	`HR.DEPARTMENTS2`
Choose Columns > Selected Columns	`DEPARTMENT_ID`
Bind The Row Value	`where department_id >= 280`

Review the Flashback Versions Query Result.

Flashback Versions Query Result

Select	Flashback SCN	Flashback Timestamp	Transaction ID	Operation	DEPARTMENT_ID
◉	6800080	Jun 9, 2005 5:15:32 PM	0A002B00A6030000	INSERT	300
○	6800061	Jun 9, 2005 5:15:15 PM	03002400CB030000	INSERT	290
○	6800049	Jun 9, 2005 5:14:53 PM	05000600FA030000	INSERT	280

Select the row with the `DEPARTMENT_ID = 290` and continue your flashback operation. Review the SQL statement that you are about to execute and submit your operation.

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Practice 17: Performing Flashback (continued)

6. You find that the operation fails because row movement is not enabled for the table. You may recall from the lesson that row movement must be enabled for this feature to work.

   Enable row movement (Navigation aid: Administration > Tables). Review the underlying SQL statement:

```
ALTER TABLE "HR"."DEPARTMENTS2" ENABLE ROW MOVEMENT
```

   After the table modification is confirmed, you can perform the flashback operation.

   Repeat step 5 to perform the version flashback of the table. Because row movement has been enabled, it should succeed this time.

   Then, in SQL*Plus, count the rows of the `HR.DEPARTMENTS2` table to confirm the flashback operation. Note that there is only one additional row now, not three. Then, display the rows where `DEPARTMENT_ID >= 280`. Note that only one of the original three is remaining.

```
SQL> select count(*) from hr.departments2;

  COUNT(*)
----------
        28

SQL> select * from hr.departments2 where department_id >= 280;

DEPARTMENT_ID DEPARTMENT_NAME                MANAGER_ID LOCATION_ID
------------- ------------------------------ ---------- -----------
          280 DUMMY1

SQL>
```

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Practice 18: Moving Data

Background: In the recent past, you received a number of questions about the HR schema. To analyze them, without interfering in the daily activities, you decide to use the Data Pump Wizard to export the HR schema to file. When you perform the export, you are not sure into which database you will be importing this schema.

In the end, you find out that the only database for which management approves an import, is the ORCL database. So, you perform the import with the Data Pump Wizard, remapping the HR schema to a newly created HR_TEST schema in the HR_TEST tablespace. To follow best practice guidelines, you also decide to create a DP user who will be a DBA performing Data Pump jobs. For your convenience in class, the creation of the DP user is included in the lab_18_01.sql script. SQL scripts are in the /home/oracle/labs directory. However, there is one step missing.

Then you receive two data load requests for which you decide to use SQL*Loader.

Your Tasks

1. Review the lab_18_01.sql script, which creates the HR_TEST tablespace, the HR_TEST_ROLE role, and the HR_TEST and DP users. Note the passwords for these users.

   HR_TEST password: _____

   DP password: _____

   Which additional step do you need to perform to allow the DP user access to Enterprise Manager as Administrator?

   _____

2. Execute the lab_18_02.sh script. Then, perform the required step to make the DP user an EM administrator.

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Practice 18: Moving Data (continued)

3. Log in to Enterprise Manager as the `DP` user in the `Normal` role and export the `HR` schema (Navigation aid: Maintenance > Export to Export Files). Use the following specifications:

Object	**Setting**
Username	`oracle`
Password	`oracle`
Save as Preferred Credential	*selected*
Export: Schemas	`HR`
Export Options: Directory Objects	`DATA_PUMP_DIR`
Log File	`hrexp.log`
Export Files: Directory Objects	`DATA_PUMP_DIR`
File Name	`HREXP%U.DMP`
Export Schedule: Job Name	`hrexp`
Description	`Export HR schema`
Job Start Time	Immediate

Review the PL/SQL that the Export Wizard helped you to create and submit the job. A processing message appears, and then a success message. If not, resolve any errors, which may have occurred.

Note: Please wait, not only for the job to be created, but also for the job to complete execution. (It may take two minutes.)

4. As the `DP` user, import the exported `HR` schema back into the `ORCL` database, remapping it to the previously created `HR_TEST` schema. (Navigation aid: Maintenance > Import from Export Files). Use the following import specifications:

Object	**Setting**
Import Files: Directory Objects	`DATA_PUMP_DIR`
File Name	`HREXP%U.DMP`
Import Type	`Schemas`
Host credentials	`oracle`

The Data Pump Wizard reads the specified import file and gives you a success message. If not, resolve any errors that may have occurred.

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Practice 18: Moving Data (continued)

Use the following import remapping specifications:

Object	Setting
Re-Map Schemas: Source Schema	`HR`
Re-Map Schemas: Destination Schema	`HR_TEST`
Re-Map Tablespaces: Destination Tablespace	`HR_TEST`
Import Options: Directory Objects	`DATA_PUMP_DIR`
Log file	`hrimport.log`
Import Schedule: Job Name	`hrimp`
Description	`Import HR schema for test purposes`
Start	Later
Time	Enter a time between 2 and 5 minutes from now (to give yourself time for submitting and monitoring the job)

(Navigation aid: Maintenance > Monitor Export and Import Jobs) Monitor the job while it is executing.

Optional, as this requires quick action: Suspend and resume the job.

In the end, you want to see that your job executed 100% without any errors.

Verify the import succeeded by viewing the log file.

```
$ cat </u01/app/oracle/product/10.2.0/db_1/rdbms/log/hrimport.log
```

Note: You may see an error saying that the hr_test object already exists. This is because that user existed when you did the export, and still exists. This is not a problem.

Select data from tables in the `hr_test` schema, for verification of the import.

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Practice 18: Moving Data (continued)

5. As the `DP` user, load data into the `PRODUCT_MASTER` table by using SQL*Loader via Enterprise Manager Database Control. (Navigation aid: Maintenance > Load Data from User Files). Use the following loading specifications:

Object	**Setting**
Use Existing Control File	*selected*
Username	`oracle`
Password	`oracle`
Save as Preferred Credential	*selected*
Load Data Control File Name	`/home/oracle/labs/lab_18_05.ctl`
Data File: Provide the full path and name on the database server machine	*selected*
Data File Name	`/home/oracle/labs/lab_18_05.dat`
Load Method	Conventional Path
Load Data Options: Log File Name	`/home/oracle/labs/lab_18_05.log`
Load Data Schedule: Job Name	`lab_18_05`
Description	`Load data into the PRODUCT_MASTER table`
Start	Immediately

   Submit your job and confirm your results by viewing your `lab_18_05.log` file.

6. As the `INVENTORY` user, load data into the `PRODUCT_ON_HAND` table by using SQL*Loader command line. (Enter the command in continuation, without pressing [Enter] before reaching the end of the command: **`sqlldr userid=inventory/verysecure control=lab_18_06.ctl log=lab-_18_06.log data=lab_18_06.dat`**).

   Confirm your results by viewing your `lab_18_06.log` file in your `/home/oracle/labs` directory.

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Appendix B
Solutions

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Solutions for Practice 2: Installing the Oracle Database Software

Background: In the practices of this course, you assume the role of a database administrator (DBA). The operating system (OS) accounts on your computer are:

- The `oracle` user with a password of `oracle`
- The `root` user with a password of `oracle`

The system administrator has set up the OS so that it is ready for the installation, and the installation media is staged at `/stage/Disk1`. Perform the following tasks as the default `oracle` OS user, unless otherwise indicated.

After installing the software, execute the `lab_02_05.sh` script, which creates a listener for you.

Note: Completing this practice is critical for all following practice sessions.

1. Install the Oracle database software as the `oracle` user. Navigate to the `/stage/Disk1` directory, and start the Oracle Universal Installer (OUI) by entering `./runInstaller`.

   a) Right-click your desktop and select **Open Terminal**, and then enter:

   ```
   $ cd /stage/Disk1
   $ ./runInstaller
   ```

2. Select your installation method for OUI.

   a) On the Installation Method page, select **Basic Installation**, and confirm the following settings:

Object	**Setting**
Database Home Location	`/u01/app/oracle/product/10.2.0/db_1`
Installation Type	Enterprise Edition
UNIX DBA Group	`oinstall`
Create Starter Database	*Deselected*

   Note: Ensure that you deselect the Create Starter Database option.

   b) Click Next.

   c) You are now on the page titled "Specify Inventory directory and credentials." Accept `/u01/app/oracle/oraInventory` as **inventory directory** and `oinstall` as **Operating System group name**. Click **Next**.

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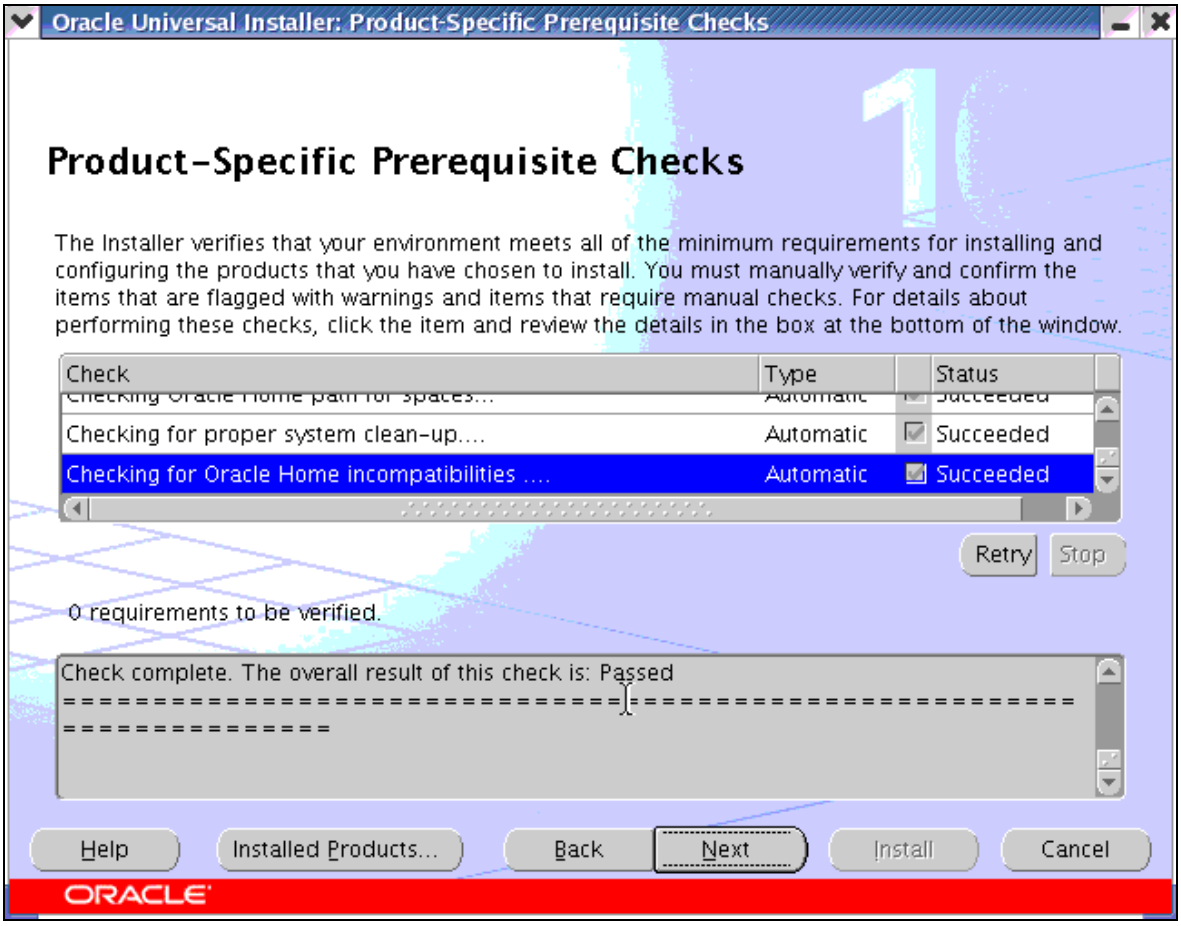
OUI is loading the products list and checking product-specific prerequisites.



d) After OUI has finished its prerequisite checks on the Product-Specific Prerequisite Checks page, click **Next**.

3. When the prerequisite checks are finished, the Summary page is displayed.

   a) Click **Install** to begin your installation.

   Estimated installation time is 10–15 minutes. However, varying environments can greatly influence this estimate.

4. When the "Execute Configuration scripts" page appears, follow the instructions on that page, accept the default for the local `bin` directory, and then finish your installation with OUI.

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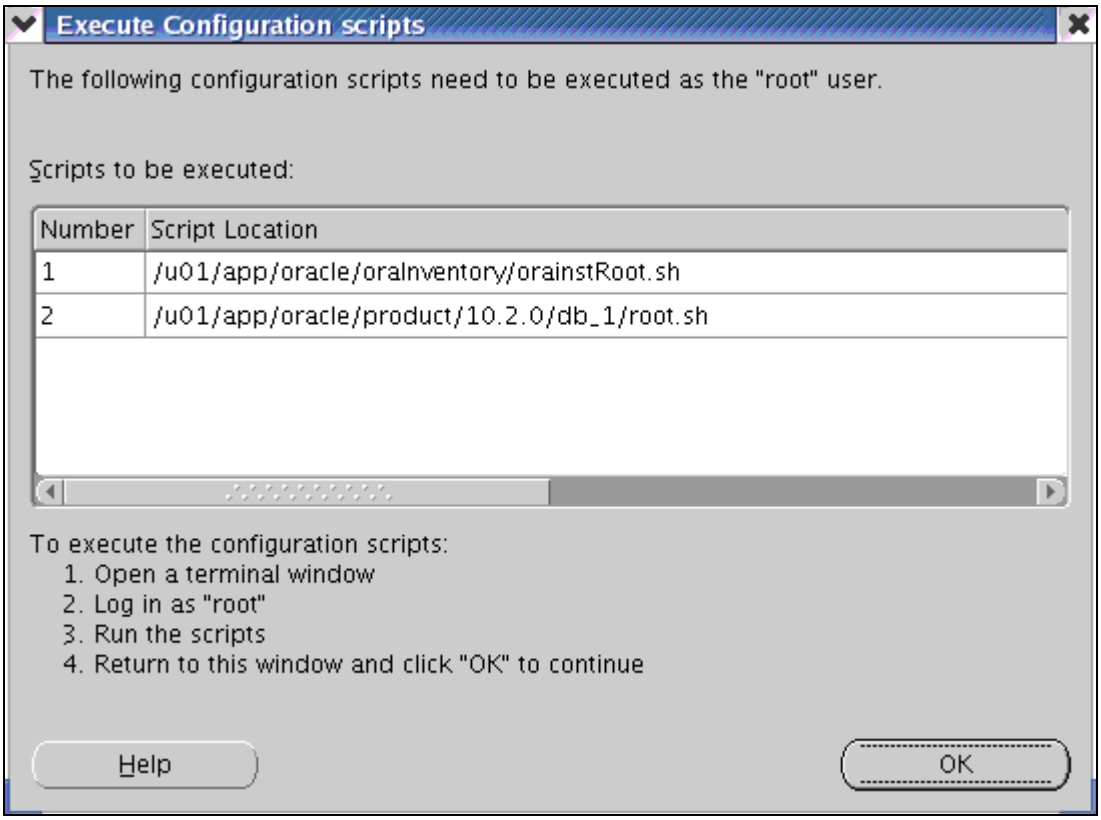

a) Right-click your desktop and select **Open Terminal**.

b) Run the `orainstRoot.sh` and `root.sh` scripts as `root`, and then click **Continue**.

```
$ su
# password: oracle <root password, does not appear on the screen>
# cd /u01/app/oracle/oraInventory
# ./orainstRoot.sh
# cd /u01/app/oracle/product/10.2.0/db_1
# ./root.sh
```

c) Accept the default for the local `bin` directory.

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```
[oracle@EDRSR4P1 oracle]$ su
Password:
[root@EDRSR4P1 oracle]# cd /u01/app/oracle/oraInventory
[root@EDRSR4P1 oraInventory]# ./orainstRoot.sh
Changing permissions of /u01/app/oracle/oraInventory to 770.
Changing groupname of /u01/app/oracle/oraInventory to oinstall.
The execution of the script is complete
[root@EDRSR4P1 oraInventory]# cd /u01/app/oracle/product/10.2.0/db_1
[root@EDRSR4P1 db_1]# ./root.sh
Running Oracle10 root.sh script...

The following environment variables are set as:
    ORACLE_OWNER= oracle
    ORACLE_HOME=  /u01/app/oracle/product/10.2.0/db_1

Enter the full pathname of the local bin directory: [/usr/local/bin]:
   Copying dbhome to /usr/local/bin ...
   Copying oraenv to /usr/local/bin ...
   Copying coraenv to /usr/local/bin ...


Creating /etc/oratab file...
Entries will be added to the /etc/oratab file as needed by
Database Configuration Assistant when a database is created
Finished running generic part of root.sh script.
Now product-specific root actions will be performed.
[root@EDRSR4P1 db_1]#
```

d) Enter **`exit`** to exit the `root` OS user.

e) Close the terminal window, and then click **OK** on the "Execute Configuration scripts" page.

The End of Installation page appears.

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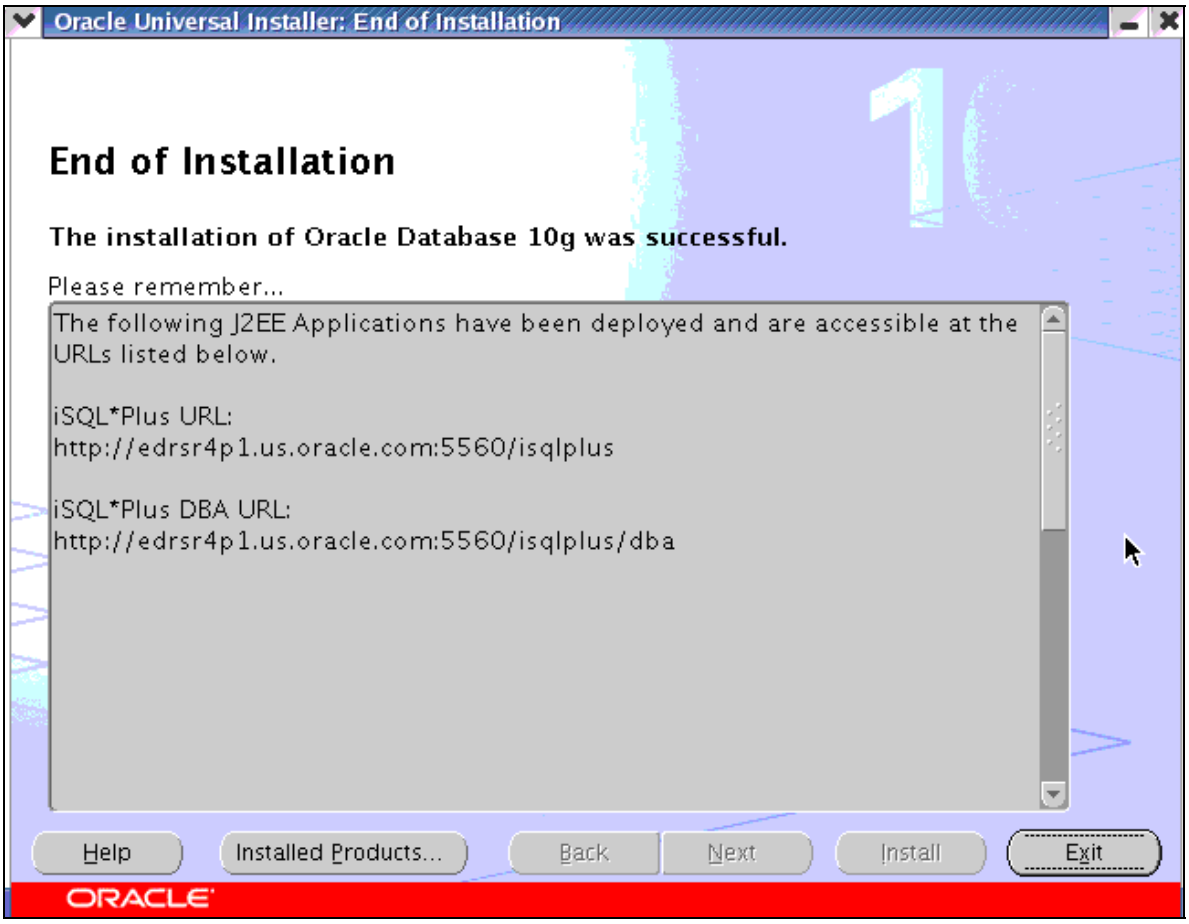

f) Make a note of your URLs. You will use them in later practice sessions.

*i*SQL*Plus URL:_____

*i*SQL*Plus DBA URL:_____

g) Optionally, click **Installed Products**, review the product inventory, then click **Close**.

h) Click **Exit**, and then click **Yes** to leave OUI.

5. Execute the `lab_02_05.sh` script, which is in the `/home/oracle/labs` directory. This script uses the `netca` utility to create a listener for you. If you create your first database with OUI (as part of your installation), then OUI invokes the network configuration assistant, which creates the first listener for you.

   a) In a terminal window, enter:

```
cd /home/oracle/labs
./lab_02_05.sh
```

   You see an activity log, which should end with a success message. If not, resolve any errors that might have occurred.

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Solutions for Practice 3: Creating an Oracle Database

Background: You are about to begin creating your first Oracle database. You anticipate that several similar databases will be needed in the near future. Therefore, you decide to create your `ORCL` database, as well as a database template and the database creation scripts. Locate the scripts in the `/home/oracle/labs` directory (which is the directory that you use most often throughout this course).

After you create the `ORCL` database, you execute the `lab_03_03.sh` script, which creates a listener for you.

Note: Completing the database creation is critical for all following practice sessions.

1. Start the Database Configuration Assistant (DBCA).

   a) Open a terminal window as the `oracle` user; that is, right-click your desktop and select **Open Terminal**.

   b) To start the DBCA, enter:

```
$ dbca
```

2. Begin the `ORCL` database creation. Use the General Purpose database template.

   a) In the DBCA, click **Next** on the Welcome page.

   b) On the Operations page, select **Create a Database,** and then click **Next**.

   c) On the Database Templates page, select **General Purpose,** and then click **Show Details**.

   d) Review the template's details and answer the following questions.

   Question 1: How many control files are created?

   Answer: 3

   Question 2: Would it maximize database availability to multiplex them?

   Answer: Yes. (*This will be done in a later practice.)*

   Question 3: How many redo log groups are created?

   Answer: 3

   Question 4: Would it maximize database availability to mirror them?

   It depends: No, not in class, because there are already three groups and you have only one physical storage device; but yes, if you can put each group on a different physical storage device.

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Question 5: What is the database block size (`db_block_size`)?

Answer: 8 KB

Question 6: What is the value of Sample Schemas?

Answer: Sample Schemas is set to False.

Note: You will change this setting later in this practice to create the `HR` sample schema.

Question 7: What is the template default for the Database Character Set?

Answer: WE8ISO8859P1

Note: You will change this setting later in this practice to use a Unicode database character set.

e) Click **Close** to close the Template Details window.

f) Click **Next**.

3. Create the `ORCL` database, as well as the `ORCL` template and the database generation scripts.

a) On the Database Identification page, enter **`orcl.oracle.com`** as Global Database Name. The SID defaults to the database name **`orcl`**. Click **Next**.

b) On the Management Options page, ensure that the following items are selected:

- Configure the Database with Enterprise Manager
- Use Database Control for Database Management

c) Click **Next**.

d) On the Database Credentials page, select **Use the Same Password for All Accounts** and enter **`oracle`** as Password and Confirm Password. Then, click **Next**.

e) On the Storage Options page, select **File System**, and then click **Next**.

f) On the Database File Locations page, select **Use Oracle-Managed Files**. Accept the default Database Area, and then click **Next**.

g) On the Recovery Configuration page, select **Specify Flash Recovery Area,** and then click **Next**.

h) On the Database Content page, select **Sample Schemas,** and then click **Next**.

i) On the Memory tabbed page of the Initialization Parameters page, select **Custom** and then select **Automatic** for the **Shared Memory Management** setting.

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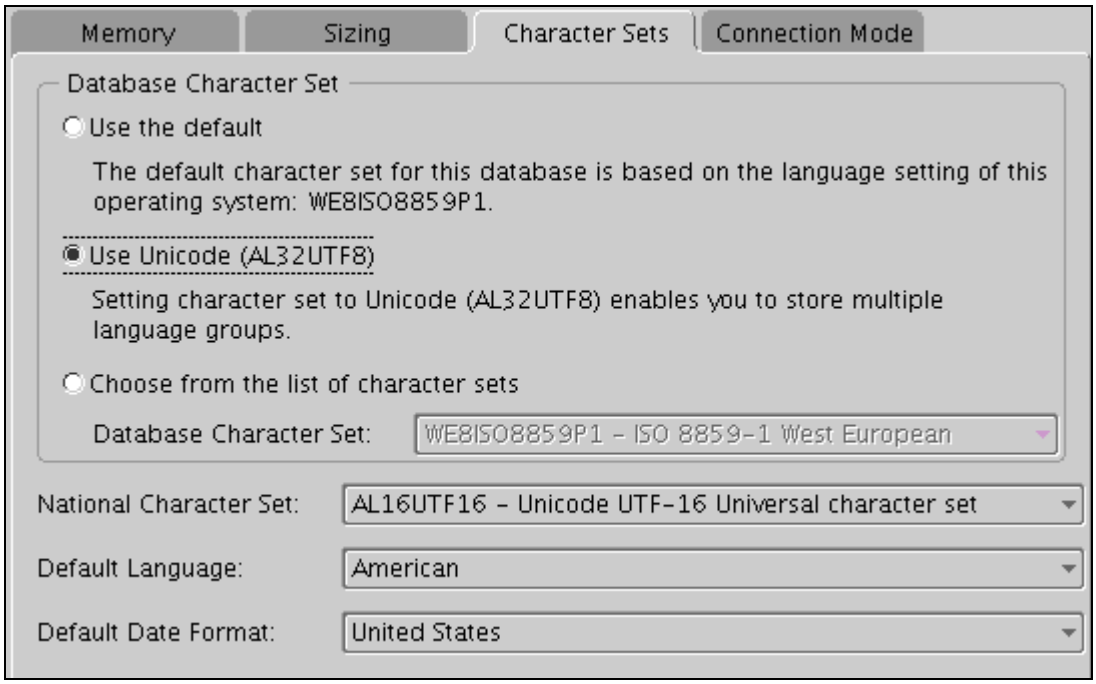
j) On the Initialization Parameters Character Sets tabbed, select **Use Unicode (AL32UTF8)**.



k) Review the Sizing and Connection Mode tabbed pages, but do not change any values. Then, click **Next**.

l) On the Database Storage page, review your file names and locations. Then, click **Next**.

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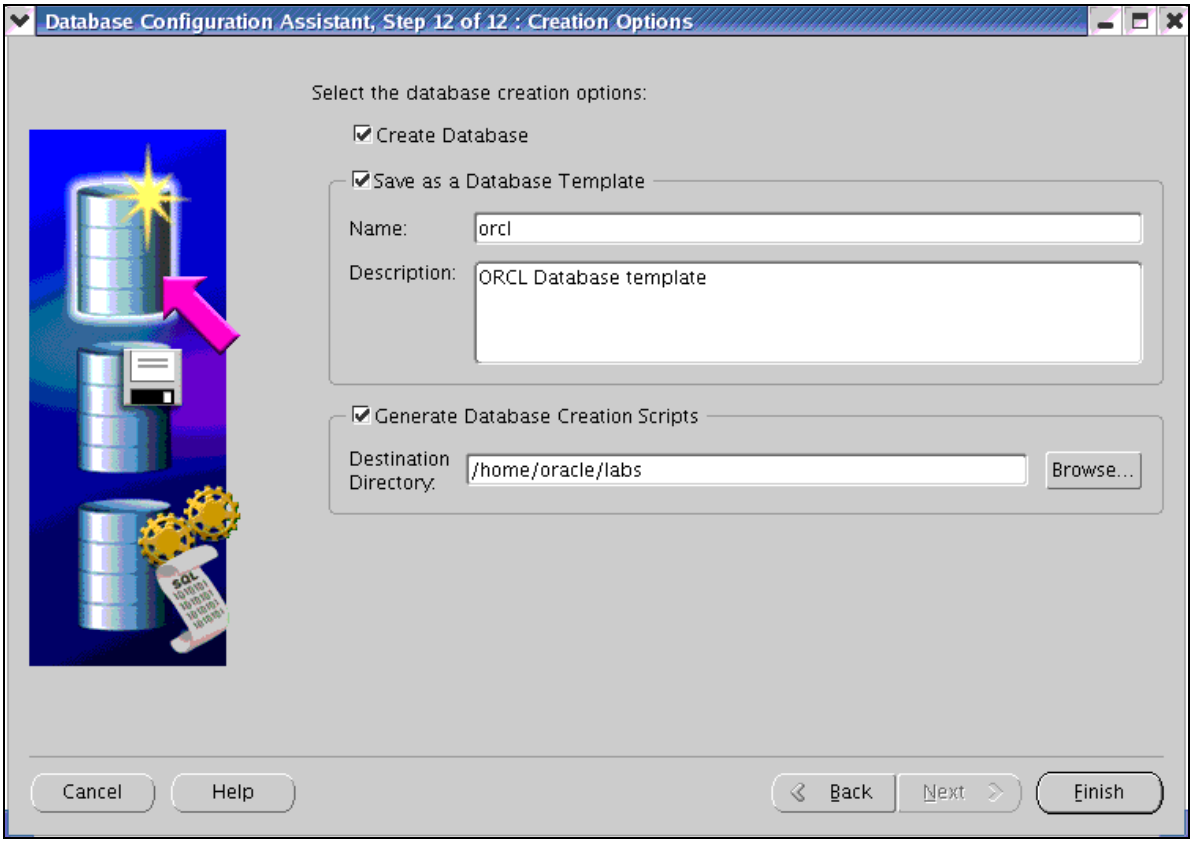
m) On the Creation Options page, select **Create Database**.



n) Optionally, select all creation options and enter `orcl` as **Name** for the database template, `ORCL Database template` as **Description**, and `/home/oracle/labs` as **Destination Directory**. Then, click Finish.

o) The Confirmation page appears. Review options and parameters, such as `Sample Schemas (true)`, `db_block_size (8KB)`, `sga_target (270MB)`, `undo_management (AUTO)`, `Database Character Set (AL32UTF8)`, and then click **OK**.

p) Click **OK** to acknowledge that the template has been created. Then, acknowledge the generation of the database scripts (if you selected those options).

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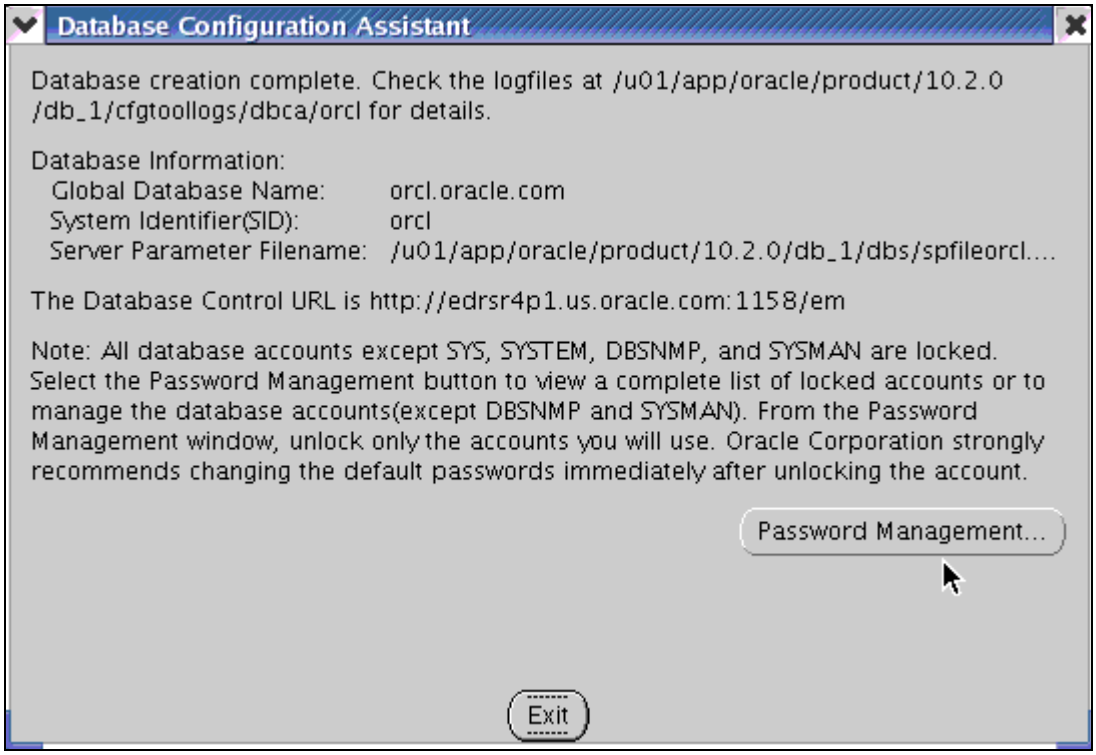
Solutions for Practice 3: Creating an Oracle Database (continued)

q) The DBCA displays the progress of the various installation steps. When the database itself has been created, the DBCA displays essential information about the database. Make note of this information. The Database Control URL will be used in several of the following practice sessions.



r) Click the **Password Management** button.

s) Scroll down the Password Management page until you see the HR User Name.

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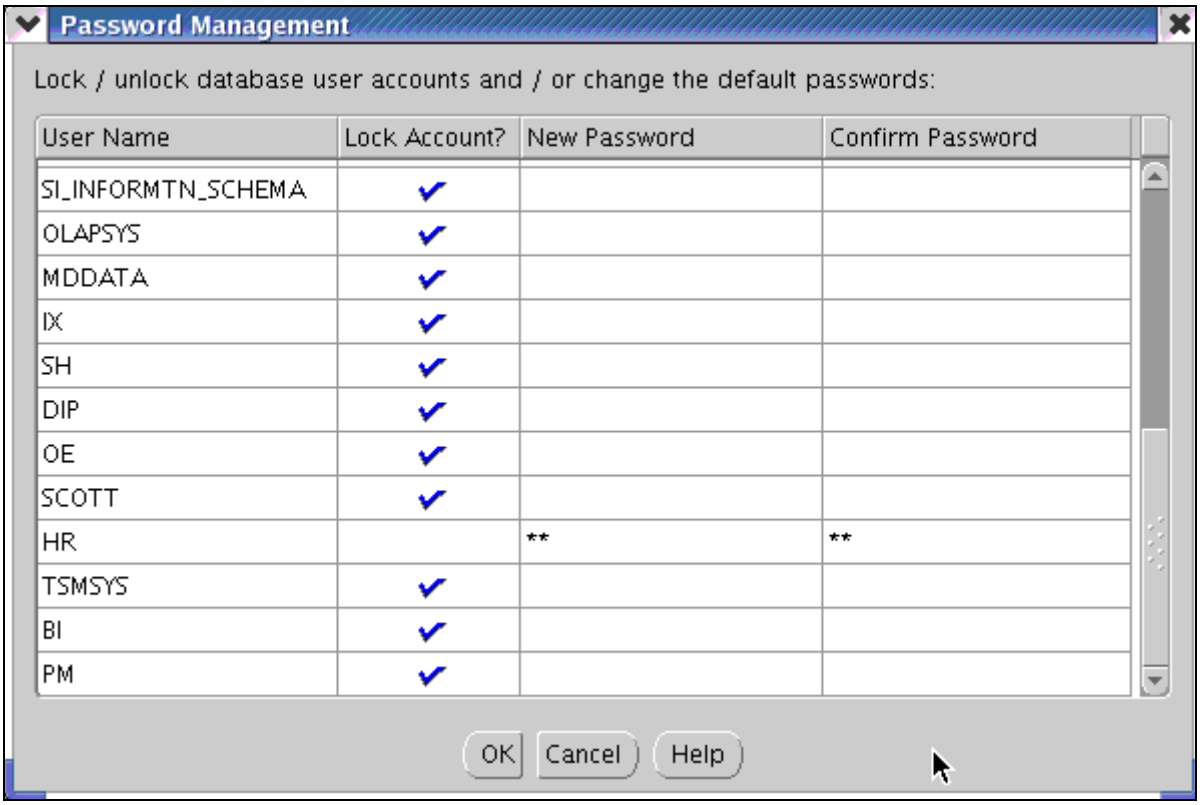
t) Deselect **Lock Account?** and enter **`hr`** as New Password and Confirm Password. Then, click **OK**.



u) Click **Exit** to close the DBCA.

You completed your task to create a database and (optionally) a database template and database generation scripts.

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Solutions for Practice 4: Managing the Oracle Instance

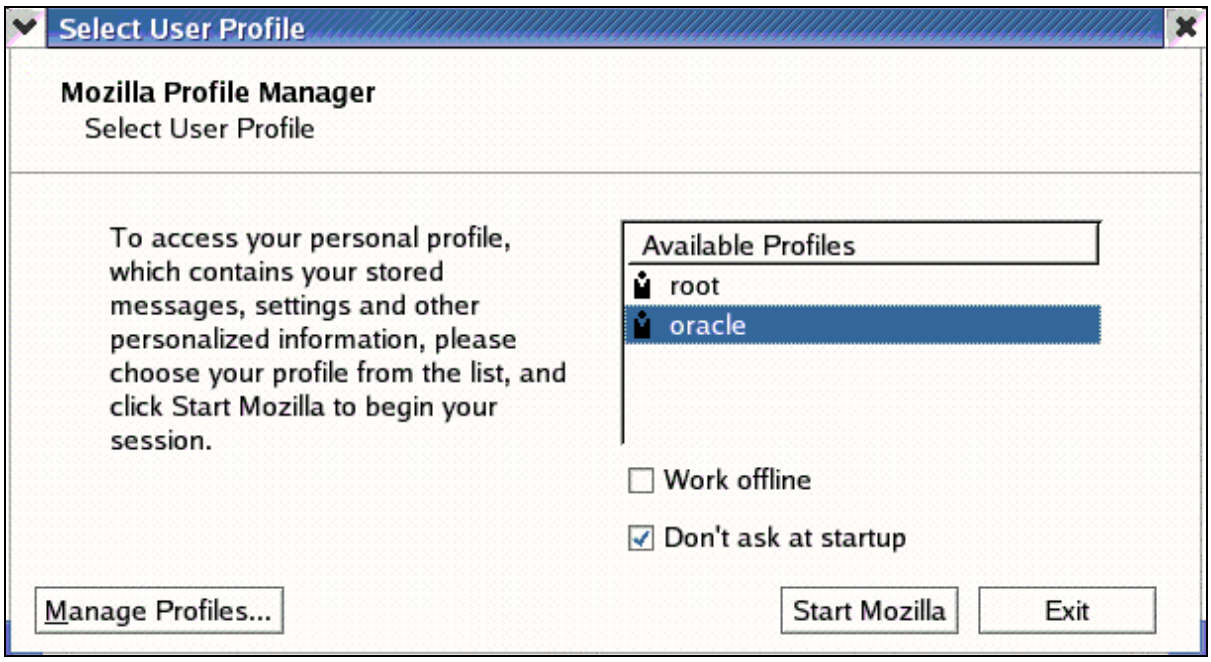
Background: You have just installed the Oracle software and created a database. You want to ensure that you can start and stop the database and see the application data.

1. Invoke Enterprise Manager, and log in as the `SYS` user. Which port number does this database use? You noted this in Practice 3.

   Answer: `1158`

   a) Open a Web browser.

   b) If using Mozilla, the Select User Profile dialog box appears.



   Select **oracle** as the profile, and select **Don't ask at startup**, and then click **Start Mozilla**.

   c) Enter the URL that you wrote down in Practice 3. It has the following format:

   http://*hostname*:*portnumber*/em

   The Oracle Enterprise Manager window appears.

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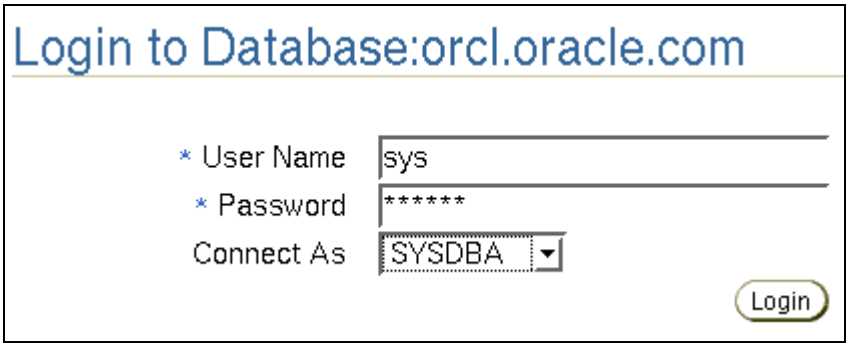
d) Log in by entering `sys` as **User Name** and `oracle` as **Password**, and selecting `SYSDBA` as **Connect As**. Then, click **Login**.



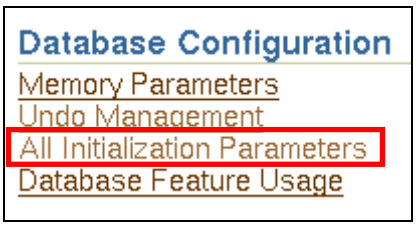
e) You may receive a security warning. In class, deselect **Alert me whenever I submit information that's not encrypted.**, and then click **Continue**.

The first time you log in after installing the software, the Oracle Database 10*g* Licensing Information page appears.

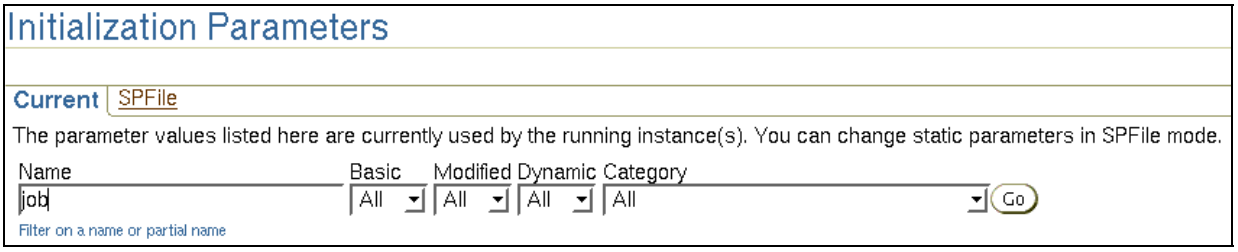
f) To acknowledge this information, click **I agree** at the bottom of the page.

2. View the initialization parameters and set the `JOB_QUEUE_PROCESSES` parameter to `15`. What SQL statement is run to do this?

a) Select **Administration** > Database Administration > Database Configuration > **All Initialization Parameters**.



b) Enter `job` in the **Name** field, and then click **Go**.



c) When the `JOB_QUEUE_PROCESSES` initialization parameter appears, change its value from 10 to 15.

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d) Click **Show SQL** and note the SQL statement that is going to be run.

Show SQL

Return

```
ALTER SYSTEM SET job_queue_processes = 15 SCOPE=MEMORY
```

e) Click **Return**, and then click **Apply**.

3. *Question:* What is the significance of a check in the Dynamic column?

   Answer: A "dynamic" parameter can be modified while the database is active.

4. Shut down the database instance by using Enterprise Manager.

   Question: What SQL is executed to do this?

   a) In the Enterprise Manager browser session, click the **Database** tab.

   b) Click **Shutdown**.

   c) For **Host Credentials**, enter `oracle` as **Username** and `oracle` as **Password**.

   d) Click OK.

   The Startup/Shutdown: Confirmation page appears.

   e) Click **Advanced Options** to see the mode for shutting down, but do not change the mode; it should remain as "Immediate."

   f) Click **Cancel** to return to the previous page.

   g) Click **Show SQL** to view the SQL that is going to be executed to perform the shutdown operation.

   Question: What SQL is executed to do this?

   Answer: `SHUTDOWN IMMEDIATE`

Show SQL

Return

```
SHUTDOWN immediate
```

   h) Click **Return**.

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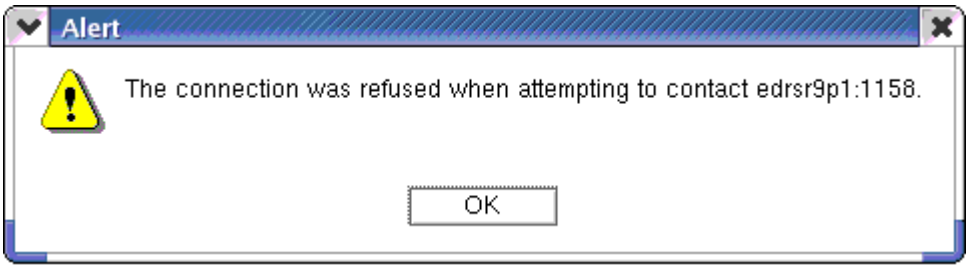
i) Click **Yes** to confirm the shutdown operation.

j) Click Refresh. If you see the following error during the refresh, click **OK** and continue to refresh. The error will resolve itself.



k) Note that the **Status** of the instance is now "Down."

5. Using SQL*Plus, verify that you are not able to connect as the `HR` user to a database that has been shut down.

   a) In the Linux command window, enter the following to attempt to log in to the database:

```
$ sqlplus hr
```

   b) Enter `hr` for the password.

   c) Note the "ORACLE not available" error message.

   d) Press [Ctrl], [D] to exit the username prompt.

6. Use Enterprise Manager to restart the database instance, and then log in as the `SYS` user again.

   Question: What SQL is run to accomplish the database startup?

   a) In Enterprise Manager, click the **Startup** button.

   b) Enter `oracle` for both **Username** and **Password** in the **Host Credentials** region.

   c) Click **OK**.

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d) The Startup/Shutdown: Confirmation page appears. Click **Show SQL** to view the SQL that is about to run.

Question: What SQL is run to accomplish the database startup?

Answer: `STARTUP`

e) Click **Return**.

f) Click **Yes** to confirm the startup operation.

g) The Startup/Shutdown: Activity Information page appears. Wait for the login page to appear, at which time you can log in as `SYS` user with the `oracle` password and the `SYSDBA` privilege.

7. In the alert log, view the phases that the database went through during startup. What are they?

a) Select **Database** > Related Links > **Alert Log Content**.

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b) Scroll toward the bottom of the log and review the phases of the database during startup. Your alert log may look different from this screenshot, based on different system activities.

```
Fri May 20 09:47:26 2005
Database mounted in Exclusive Mode
Completed: ALTER DATABASE   MOUNT
Fri May 20 09:47:26 2005
ALTER DATABASE OPEN
Fri May 20 09:47:26 2005
Thread 1 opened at log sequence 209
  Current log# 1 seq# 209 mem# 0: /u01/app/oracle/oradata/orcl/redo01.log
Successful open of redo thread 1
Fri May 20 09:47:26 2005
MTTR advisory is disabled because FAST_START_MTTR_TARGET is not set
Fri May 20 09:47:26 2005
SMON: enabling cache recovery
Fri May 20 09:47:27 2005
Successfully onlined Undo Tablespace 1.
Fri May 20 09:47:27 2005
SMON: enabling tx recovery
Fri May 20 09:47:27 2005
Database Characterset is AL32UTF8
replication_dependency_tracking turned off (no async multimaster replication found)
Starting background process QMNC
QMNC started with Fri May 20 09:47:30 2005
db_recovery_file_dest_size of 2048 MB is 0.00% used. This is a
user-specified limit on the amount of space that will be used by this
database for recovery-related files, and does not reflect the amount of
space available in the underlying filesystem or ASM diskgroup.
Fri May 20 09:47:33 2005
Completed: ALTER DATABASE OPEN
```

c) Note that the modes the database goes through during startup are `MOUNT` and `OPEN`. Click **OK** to close the alert log.

8. Test access to *i*SQL*Plus for your HR application developers. (Navigation aid: Database > *i*SQL*Plus). Use the `Normal` role, `hr` username and password, and the default setting as Connect Identifier. If there is an error accessing *i*SQL*Plus, then start the isqlplus process using the `isqlplusctl start` command at the OS prompt, and then reattempt. After connecting, select the contents of the `EMPLOYEES` table.

   a) Select **Database** > Related Links > **iSQL*Plus**.

   The *i*SQL*Plus Connection Role page appears.

   b) Notice that the `SYSOPER` and `SYSDBA` roles require special setup and authentication for security reasons. Select **Normal**, and then click **Continue**.

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c) If you see an error message saying that the connection was refused, that means you need to start the supporting process. To do this, enter the `isqplusctl start` command at the OS prompt, and then retry step (b).

```
$ isqplusctl start
iSQL*Plus 10.2.0.1.0
Copyright (c) 2003, 2005, Oracle.  All rights reserved.
Starting iSQL*Plus ...
iSQL*Plus started.
```

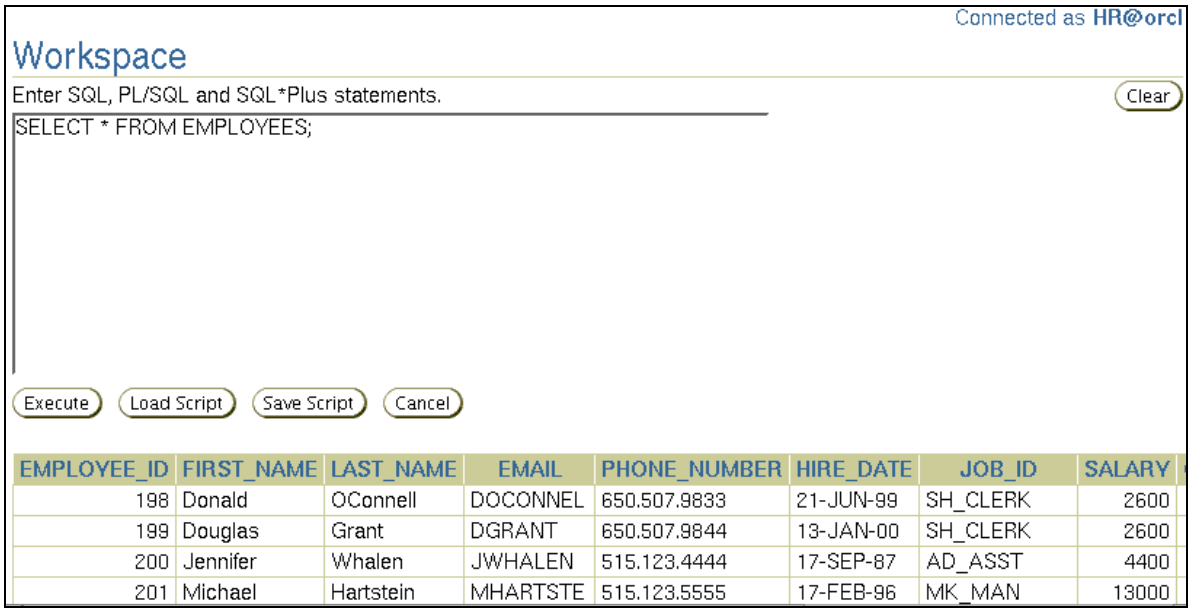
d) On the Login page, enter `hr` as **Username** and **Password** and leave the **Connect Identifier** set to its default value. Click the **Login** button.

The Confirm window appears, with the Password Manager offering to remember this login for you. Click **No**.

e) Enter the following statement in the workspace, and then click the **Execute** button:

```
SELECT * FROM EMPLOYEES;
```

The content of the `EMPLOYEES` table appears in a tabular form.



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY
198	Donald	OConnell	DOCONNEL	650.507.9833	21-JUN-99	SH_CLERK	2600
199	Douglas	Grant	DGRANT	650.507.9844	13-JAN-00	SH_CLERK	2600
200	Jennifer	Whalen	JWHALEN	515.123.4444	17-SEP-87	AD_ASST	4400
201	Michael	Hartstein	MHARTSTE	515.123.5555	17-FEB-96	MK_MAN	13000

f) When you have finished reviewing the information, click **Logout** in the top-right corner of the page.

g) Click X in the top-right window frame to close the *i*SQL*Plus window.

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Solutions for Practice 5: Managing Database Storage Structures

Background: You need to create a new tablespace for the `INVENTORY` application. You also need to create a database user that is not as privileged as the `SYS` user.

1. Enter `./lab_05_01.sh` to run a script that creates the `DBA1` user. It is located at `/home/oracle/labs`. The password for `DBA1` is `oracle`.

   a) Start a Linux command shell by right-clicking your desktop and selecting **Open Terminal**.

   b) Change the current directory to the `labs` directory by entering:

   ```
   $ cd labs
   ```

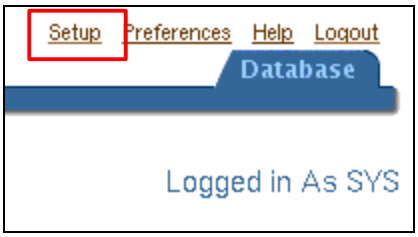
   c) Enter the following command to run the script that creates the `DBA1` user:

   ```
   $ ./lab_05_01.sh
   ```

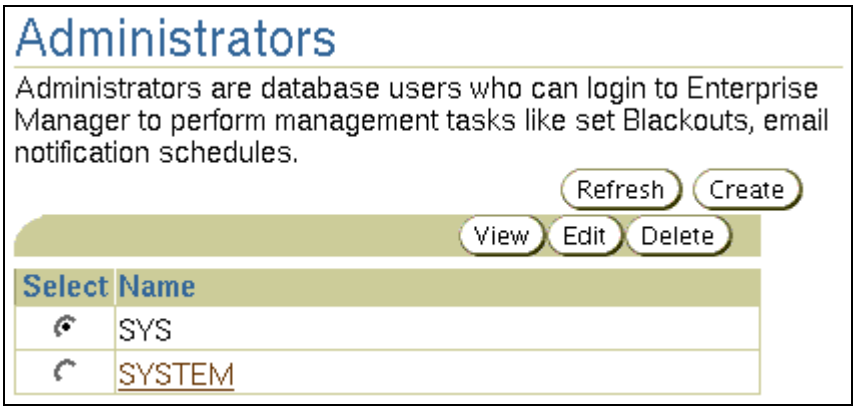
   d) Leave the command shell window open. You will use it again later.

2. Use the Setup link in the top-right corner of Enterprise Manager (EM) to define the `DBA1` user as one who can perform administrative tasks in EM. When the non-SYS user is configured, log out as the `SYS` user and log in as the `DBA1` user. Use the `DBA1` user to perform the rest of these tasks, unless otherwise indicated.

   a) In the far top-right corner of the EM window, click **Setup**.

   b) Click **Create** to add the `DBA1` user to the Administrators list. This will enable the `DBA1` user to perform management tasks by using Enterprise Manager.

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c) Enter `dba1` as **Name**, and `oracle` as **Password** and **Confirm Password**. Leave **Email Address** blank, and leave **Super Administrator** selected, and then click **Finish**.

d) On the Create Administrator: Review page, click **Finish** again.

e) Now that there is a non-`SYS` user, click **Logout** in the top-right corner, and then click **Login**.

f) Enter `DBA1` as **User Name** and `ORACLE` as **Password**, and select `SYSDBA` as **Connect As**. Then, click **Login**.

The first time you log in as a new user, the licensing page appears.

g) To acknowledge this information, click **I agree** at the bottom of the page.

The Database Home page appears.

3. Using Enterprise Manager, view information about the `EXAMPLE` tablespace. Answer the following questions about it:

a) In Enterprise Manager, select **Administration** > Database Administration > Storage > **Tablespaces**.

b) Click the `EXAMPLE` tablespace name.

c) *Question 1:* What percentage of free space can be used up before the Warning threshold is reached?

Answer: 85%

Tablespace Full Metric Thresholds

Space Used (%)

This tablespace is using the database default space used thresholds.

Warning (%) **85**
Critical (%) **97**

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d) From the **Actions** drop-down list, select **Show Tablespace Contents**, and then click **Go**.

e) The Show Tablespace Contents page appears.

Previous 1-10 of 418 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS	TABLE	12,288	27
SH.SUPPLEMENTARY_DEMOGRAPHICS	TABLE	4,096	19
OE.PRODUCT_DESCRIPTIONS	TABLE	[illegible]	[illegible]

f) *Question 2:* How many segments are there in the `EXAMPLE` tablespace?

Answer: 418

g) Select INDEX from the **Type** drop-down list in the Search region, and then click **Go**.

Previous 1-10 of 77 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS_PK	INDEX	1,024	16
OE.PROD_NAME_IX	INDEX	512	8
OE.PRD_DESC_PK	INDEX	320	5

h) *Question 3:* Which index in the `EXAMPLE` tablespace takes up the most space?

Answer: `SH.CUSTOMERS_PK`

Question 4: Which segment is stored physically first in the tablespace? That is, which one is stored right after the tablespace header?

i) Scroll to the bottom of the page, and then click the plus icon to the left of the Extent Map label.

j) After several seconds, the extent map appears. Note that the map legend indicates that pink is the tablespace header.

k) Scroll back to the top of the page, select **All Types** from the **Type** drop-down list, and then click **Go**.

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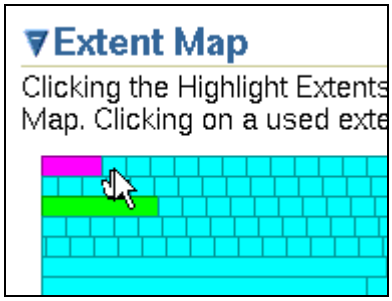
l) Click the extent just to the right of the tablespace header extent.



m) Scroll to the top of the page again, and note the segment that is being pointed to:

○	PM.SYS_LOB0000051820C00004$$	LOBSEGMENT	128	2
○	PM.SYS_LOB0000051819C00015$$	LOBSEGMENT	128	2
➡	HR.REGIONS	TABLE	64	1
○	HR.LOCATIONS	TABLE	64	1

Answer: `HR.REGIONS`

4. Create a new, locally managed tablespace (LMT) called `INVENTORY` of size 5 MB.

Note: The `INVENTORY` tablespace will be used in later practice sessions during this class.

a) In Enterprise Manager, select **Administration** > Database Administration > Storage > **Tablespaces**.

b) Click **Create**.

c) Enter `INVENTORY` as the tablespace name, and verify that **Extent Management** is **Locally Managed**, **Type** is **Permanent**, **Status** is **Read Write**, and **Use Bigfile tablespace** is not selected.

d) Click **Add** in the Datafiles region.

e) On the Add Datafile page, enter `inventory01.dbf` for **File Name**, and `5 MB` as **File Size**.

f) Click **Continue**.

g) Click the **Storage** tab, and verify that **Extent Allocation** is **Automatic**, **Segment Space Management** is **Automatic**, and **Logging** is enabled.

h) Click the **General** tab.

i) Click **Show SQL** to see the SQL that will be run, and then click **Return**.

j) Click **OK**, and a successful Update Message appears.

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5. As the `DBA1` user, run the `lab_05_05.sql` script to create and populate a table (called `X`) in the `INVENTORY` tablespace. What error do you eventually see?

   a) Right-click the desktop and select **Open Terminal** to start a command shell. Then enter:

   ```
   $ cd labs
   ```

   b) Enter the following to run the script:

   ```
   $ sqlplus dba1/oracle @lab_05_05.sql
   ```

   c) Note that there is eventually an error ORA-01653 stating that the table cannot be extended. There is not enough space to accommodate all of the rows to be inserted.

   ```
   1024 rows created.

   SQL> insert into x select * from x
     2  /
   insert into x select * from x
   *
   ERROR at line 1:
   ORA-01653: unable to extend table DBA1.X by 128 in tablespace INVENTORY


   SQL> commit
     2  /

   Commit complete.
   ```

6. Go to the Enterprise Manager window and define space for 50 MB in the tablespace instead of 5 MB, while keeping the same single data file in the tablespace. What is the `ALTER` statement that is executed to make this change?

   a) Select **Administration** > Database Administration > Storage > **Tablespaces**.

   b) Select the `INVENTORY` tablespace, and then click **Edit**.

   c) In the **Datafiles** region, click **Edit**.

   d) Change **File Size** from 5 MB to 50 MB.

   e) Click **Continue** to return to the General tabbed page.

   f) Click **Show SQL** to see the SQL that will be run. Note that it is an `ALTER DATABASE` statement. Click **Return**.

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Show SQL

Return

```
ALTER DATABASE DATAFILE
'/u01/app/oracle/oradata/ORCL/datafile/inventory01.dbf'
RESIZE 50M
```

g) Click **Apply**.

7. Go back to the terminal window and run the `lab_05_07.sql` script. It drops the table and reexecutes the original script that previously returned the space error.

   a) Go to the SQL*Plus window.

   b) Enter the following to run the script:

```
$ sqlplus dba1/oracle @lab_05_07.sql
```

   c) Note that the same number of row inserts are attempted, and there is no error because of the increased size of the tablespace.

8. In an terminal window, run the `lab_05_08.sql` script to clean up the tablespace for later practice sessions.

   a) Enter the following to run the script:

```
$ sqlplus dba1/oracle @lab_05_08.sql
```

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Solutions for Practice 6: Administering User Security

Background: You need to create a user account for Jenny Goodman, the new human resources department manager. There are also two new clerks in the human resources department, David Hamby and Rachel Pandya. All three of them must be able to log in to the `ORCL` database, select data from, and update records in the `HR.EMPLOYEES` table. The manager also needs to be able to insert and delete new employee records. Ensure that if the new users forget to log out at the end of the day, they will automatically be logged out after 15 minutes. You also need to create a new user account for the inventory application that you are installing.

1. **Mandatory task:** Review and run the `lab_06_01.sh` script (located in the `/home/oracle/labs` directory) to create the `INVENTORY` user, which you will use in the next practice.

   a) In a terminal window, enter:

```
cd /home/oracle/labs
more lab_06_01.sh
./lab_06_01.sh
```

2. Create a profile named `HRPROFILE`, allowing 15 minutes idle time.

   a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   b) Select **Administration** > Schema > Users & Privileges > **Profiles**.

   c) Click the **Create** button.

   d) Enter **`HRPROFILE`** in the **Name** field.

   e) Enter **`15`** in the **Idle Time (Minutes)** field.

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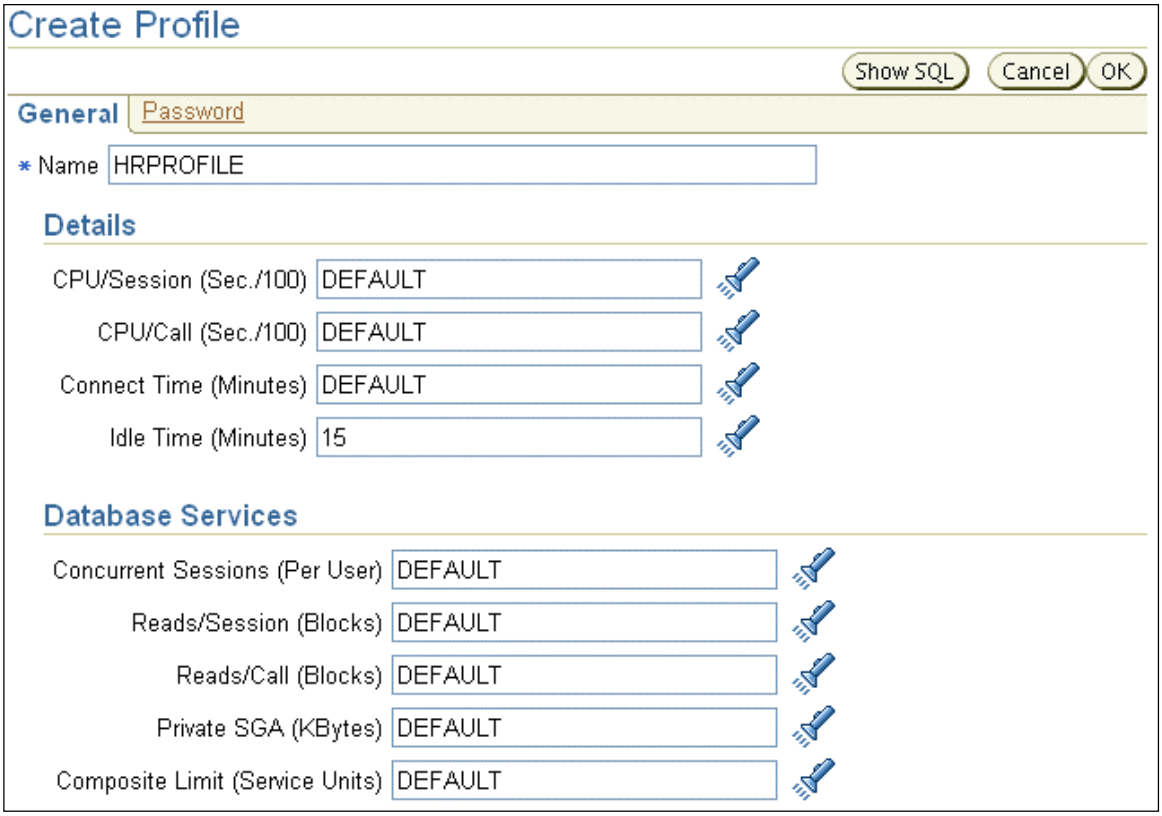

f) Leave all the other fields set to DEFAULT.

g) Click the **Password** tab, and review the Password options, which are currently all set to DEFAULT.

h) Optionally, click the **Show SQL** button, review your underlying SQL statement, and then click **Return**.

i) Finally, click **OK** to create your profile.

3. Set the `RESOURCE_LIMIT` initialization parameter to TRUE so that your profile limits will be enforced.

   a) Select **Administration** > Database Administration > Database Configuration > **All Initialization Parameters**.

   b) Enter **`RESOURCE_LIMIT`** in the **Filter** field, and then click **Go**.

   c) Select **TRUE** from the **Value** drop-down list, and then click **Apply**.

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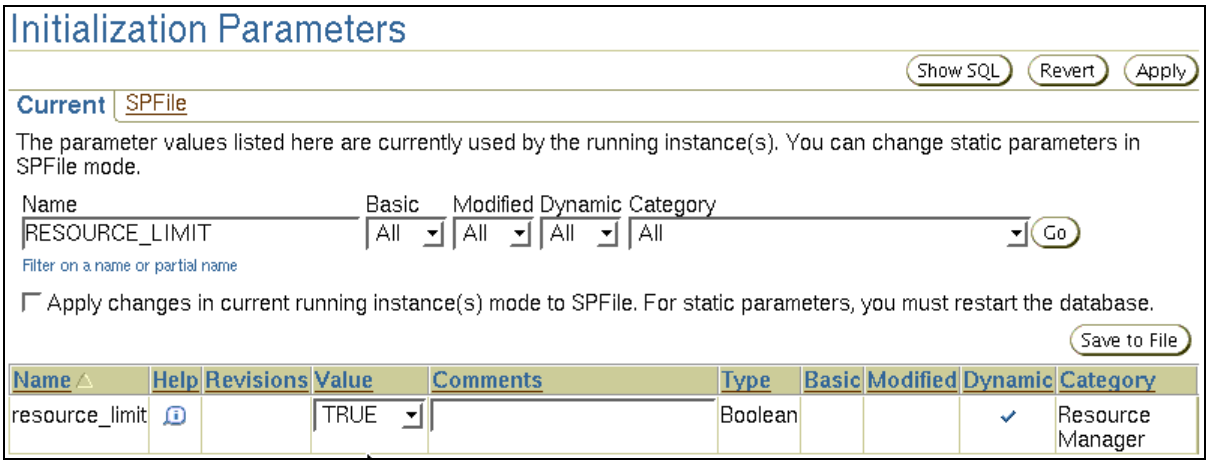

4. Create the role named `HRCLERK` with `SELECT` and `UPDATE` permissions on the `HR.EMPLOYEES` table.

   a) Select **Administration** > Schema > Users & Privileges > **Roles**.

   b) Click the **Create** button at the top-right of the page.

   c) Enter **`HRCLERK`** in the **Name** field. This role is not authenticated.

   d) Click **Object Privileges**.

   e) Select **Table** from the **Select Object Type** drop-down list, and then click **Add**.

   f) Enter **`HR.EMPLOYEES`** in the **Select Table Objects** field.

   g) Move the `SELECT` and `UPDATE` privileges to the **Selected Privileges** box. Click **OK**.

   h) Click the **Show SQL** button, and review your underlying SQL statement.

```
CREATE ROLE "HRCLERK" NOT IDENTIFIED
GRANT SELECT ON "HR"."EMPLOYEES" TO "HRCLERK"
GRANT UPDATE ON "HR"."EMPLOYEES" TO "HRCLERK"
```

   i) Click **Return**, and then click **OK** to create the role.

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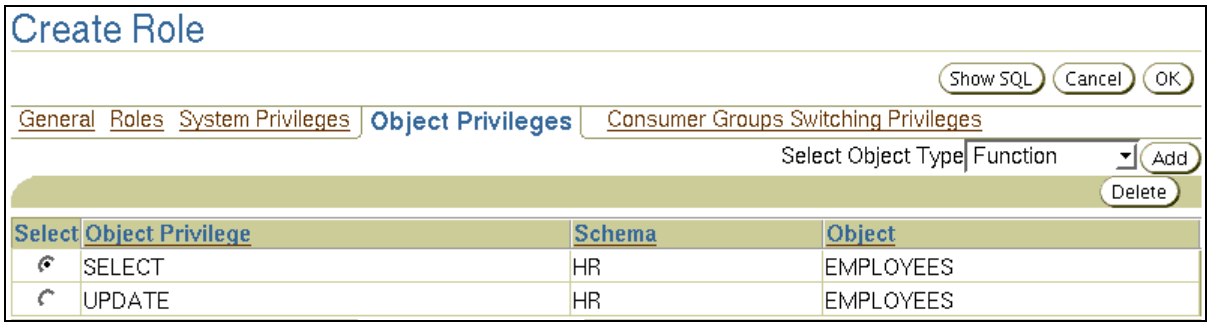


5. Create the role named `HRMANAGER` with `INSERT` and `DELETE` permissions on the `HR.EMPLOYEES` table. Grant the `HRCLERK` role to the `HRMANAGER` role.

   a) Select **Administration** > Schema > Users & Privileges > **Roles**.

   b) Click **Create**.

   c) Enter **`HRMANAGER`** in the **Name** field. This role is not authenticated.

   d) Click **Object Privileges**.

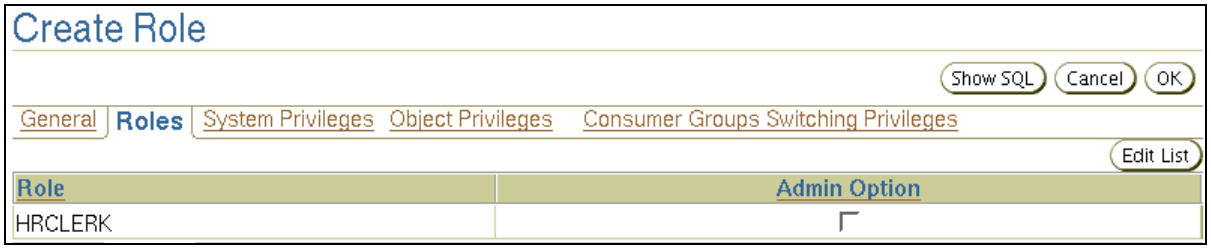
   e) Select **Table** from the **Select Object Type** drop-down list, and then click **Add**.

   f) Enter **`HR.EMPLOYEES`** in the **Select Table Objects** field.

   g) Move the `INSERT` and `DELETE` privileges to the **Selected Privileges** box. Click **OK**.

   h) Click **Roles**, and then click **Edit List**.

   i) Move the `HRCLERK` role into the **Selected Roles** box, and then click **OK**.



   j) Click the **Show SQL** button, and review your underlying SQL statement.

```
CREATE ROLE "HRMANAGER" NOT IDENTIFIED
GRANT DELETE ON "HR"."EMPLOYEES" TO "HRMANAGER"
GRANT INSERT ON "HR"."EMPLOYEES" TO "HRMANAGER"
GRANT "HRCLERK" TO "HRMANAGER"
```

   k) Click **Return**, and then click **OK** to create the role.

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6. Create an account for David Hamby, a new HR clerk.

   a) Select **Administration** > Schema > Users & Privileges > **Users**.

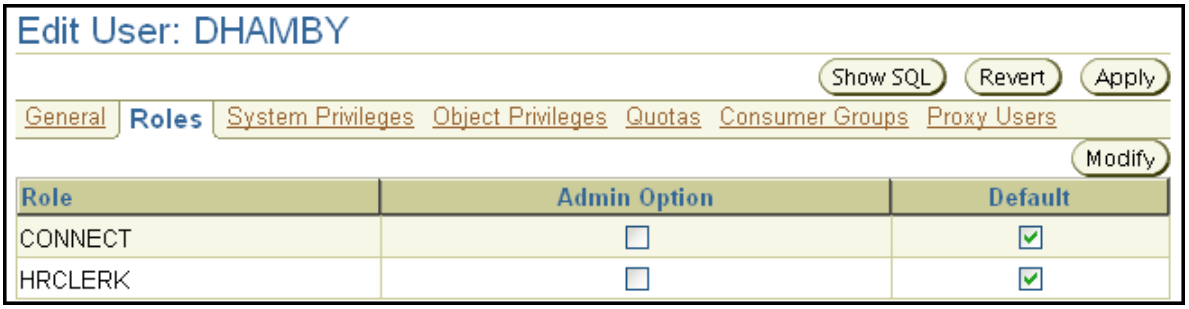
   b) Click **Create**, and enter **`DHAMBY`** in the Name field.

   c) Select **`HRPROFILE`** for the Profile.

   d) Select Password Authentication, and enter **`newuser`** as password. Enter it into the **Confirm Password** field also. Select the **Expire Password now** check box so that David will have to change the password the first time he logs in.

   e) Click **Roles**. Notice that the `CONNECT` role has automatically been assigned to the user.

   f) Add the `HRCLERK` role by clicking **Edit List** and moving the `HRCLERK` role into the **Selected Roles** box. Click **OK** to close the Modify Roles window.



   g) Click **OK** again to create the user.

7. Create an account for Rachel Pandya, another new HR clerk. Repeat the steps under step 6 with `RPANDYA` as the username.

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Solutions for Practice 6: Administering User Security (continued)

8. Create an account for Jenny Goodman, the new HR manager. Repeat the steps under step 6 with JGOODMAN as the username and selecting the HRMANAGER role instead of the HRCLERK role.

   a) Click the **Show SQL** button and review your underlying SQL statement.

```
CREATE USER "JGOODMAN" PROFILE "HRPROFILE" IDENTIFIED BY "*******" PASSWORD
EXPIRE ACCOUNT UNLOCK
GRANT "CONNECT" TO "JGOODMAN"
GRANT "HRMANAGER" TO "JGOODMAN"
```

   b) Click **Return**, and then click **OK** to create the user.

9. Test the new users in SQL*Plus. Connect to the ORCL database as the DHAMBY user. Use oracle as the new password. Select the row with EMPLOYEE_ID=197 from the HR.EMPLOYEES table. Then, attempt to delete it. (You should get the "insufficient privileges" error.)

   a) In a terminal window, enter:

```
sqlplus dhamby/newuser
```

   or if you are already in SQL*Plus, use the CONNECT command. If you reconnect as dhamby in SQL*Plus, the login and change-of-password session looks like this:

```
SQL> CONNECT dhamby/newuser

ERROR:
ORA-28001: the password has expired

Changing password for dhamby
New password: oracle     <<<Password does not appear on screen
Retype new password: oracle     <<<Password does not appearon screen
Password changed

Connected to:
Oracle Database 10g Enterprise Edition Release 10.2.0.1.0 - Production
With the Partitioning, OLAP and Data Mining options

SQL>
```

   b) Select the salary for EMPLOYEE_ID=197 from the HR.EMPLOYEES table.

```
SQL> SELECT salary FROM hr.employees WHERE EMPLOYEE_ID=197;

          SALARY
      ----------
            3000
```


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c) Now attempt to delete the same record from the `hr.employees` table.

```
SQL> DELETE FROM hr.employees WHERE EMPLOYEE_ID=197;
DELETE FROM  hr.employees WHERE EMPLOYEE_ID=197
               *
ERROR at line 1:
ORA-01031: insufficient privileges
```

10. Repeat the delete attempt as the `JGOODMAN` user. After deleting the row, issue a rollback, so that you still have the original 107 rows.

a) Connect to the `ORCL` database as the `JGOODMAN` user.

```
SQL> connect jgoodman/newuser
ERROR:
ORA-28001: the password has expired
<Change the password as shown above>
```

b) Select the row with `EMPLOYEE_ID=197` from the `HR.EMPLOYEES` table.

```
SQL> SELECT salary FROM hr.employees WHERE EMPLOYEE_ID=197;

     SALARY
   ----------
      3000
```

c) Now delete the same row from the `HR.EMPLOYEES` table.

```
SQL> DELETE FROM  hr.employees WHERE EMPLOYEE_ID=197;

1 row deleted.
```

d) Roll back the delete operation (because this was just a test).

```
SQL> rollback;

Rollback complete.
```

e) Confirm that you still have 107 rows in this table.

```
SQL> SELECT COUNT(*) FROM hr.employees;

  COUNT(*)
----------
       107

SQL>
```

Question 1: Where was the row stored after deletion?

Answer: It was stored in the Undo tablespace.

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Question 2: When you created the new users, you did not select a default or temporary tablespace. What determines the tablespaces that the new users will use?

Answer: The system-defined default permanent and temporary tablespaces

Question 3: You did not grant the `CREATE SESSION` system privilege to any of the new users, but they can all connect to the database. Why?

Answer: Because Enterprise Manager automatically assigns the `CONNECT` role to the new users, and `CREATE SESSION` is contained within that role

11. Review the `lab_05_01.sql` script and the `lab_05_01.txt` log file that it generated when you created the `DBA1` user.

    a) Double-click the **oracle's Home** icon on your desktop.

    b) Navigate to the **`labs`** directory.

    c) Double-click the **`lab_05_01.sql`** file, and review its content.

    d) When you have finished reviewing the file, click the **Up** icon to return to the `labs` directory.

    e) Now, double-click the **`lab_05_01.txt`** file, which was created when you executed the `lab_05_01.sql` file.

    f) When you have finished reviewing the file, click the X (Close Window) icon.

12. Use SQL*Plus to connect to the `ORCL` database as the `RPANDYA` user. Change the password to `oracle`. (You must change the password, because this is the first connection as `RPANDYA`.) Leave `RPANDYA` connected during the next lesson or at the end of the day. `HRPROFILE` specifies that users whose sessions are inactive for more than 15 minutes will automatically be logged out. Verify that the user was automatically logged out by trying to select from the `HR.EMPLOYEES` table again.

```
ERROR at line 1:
ORA-02396: exceeded maximum idle time, please connect again
```

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Solutions for Practice 7: Managing Schema Objects

Background: You need to create schema objects for the new inventory application. Work as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

1. Return to the Enterprise Manager browser session, or invoke EM as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

2. In the `INVENTORY` tablespace, create the `PRODUCT_MASTER` table in the `INVENTORY` schema. The specifications of the table are:

   `PRODUCT_ID` number(7). This is the primary key field. (Constraint name: `PK_INV`)
   `PRODUCT_NAME` varchar2(50) with a Not NULL constraint
   `CODE` varchar2(10) with a Not NULL constraint
   `REORDER_THRESHOLD` number(5) with a check constraint ensuring that the number is always greater than zero (Constraint name: `CHK_REORDER`)
   `COST` number(5,2)
   `PRICE` number(5,2)

   a) Select **Administration** > Schema > Database Objects > **Tables**.

   b) Click **Create**.

   c) Leave the default table type to be **Standard, Heap Organized permanent**, and then click **Continue**.

   d) Enter `PRODUCT_MASTER` as table name and set **Schema** to `INVENTORY`, and leave the Tablespace setting as the default for the user, which is `INVENTORY`.

   e) Enter the first five columns' information (including Data Type, Size, Scale, and Not NULL); but no constraints yet.

   f) Click **Add 5 Table Columns**, and then enter the last column, `PRICE`, along with its type and size.

   g) Click the **Constraints** tab.

   h) Set the drop-down list value to `PRIMARY`, and then click **Add**.

   i) Give the constraint a name by entering `PK_INV` in the **Name** field.

   j) Double-click PRODUCT_ID in the left list to move it to the right list, to make it alone the primary key. Then, click **Continue**.

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k) Set the constraint type drop-down list value to CHECK, and then click **Add**.

l) Enter `CHK_REORDER` for the name of the check constraint.

m) Enter "`reorder_threshold > 0`" (without the quotation marks) in the **Check Condition** field.

Definition

Name CHK_REORDER

* Check Condition reorder_threshold > 0

Attributes

☐ Disabled

☐ Deferrable - In subsequent transactions this allows constraint checking to be deferred until the end of the transaction.

☐ Initially Deferred - Set the default deferred behavior to check constraints at the end of a transaction.

☑ Validate - Check to ensure all existing data meets the constraint criteria.

☐ Do not enforce the constraint (RELY) - Constraint is not used to enforce data integrity. It is used to express the relationship between tables and views.

n) Leave the Attributes settings at their default settings, and then click **Continue**.

o) Your constraint list should now look like this:

Select	Name	Type	Table Columns	Disabled	Deferrable	Initially Deferred	Validate	RELY
○	PK_INV	PRIMARY	PRODUCT_ID	NO	NO	NO	YES	NO
◉	CHK_REORDER	CHECK		NO	NO	NO	YES	NO

p) Click **OK** to create the table. If you receive errors, correct them, and then click **OK** again.

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3. In the `INVENTORY` tablespace, create the `PRODUCT_ON_HAND` table in the `INVENTORY` schema. You have been given the `lab_07_03.sql` script to create the table, but there is a problem with it (*intentionally created to enhance your learning experience*). Fix the problem, and run the script. If you cannot find the error right away, then go ahead and run the original script in SQL*Plus to see the error message. This helps you discover and solve the problem. The specifications of the table are:

   `PRODUCT_ID` number(7). This field should have a foreign key constraint linking it to the `PRODUCT_ID` field in the `PRODUCT_MASTER` table.
   `QUANTITY` number(5)
   `WAREHOUSE_CITY` varchar2(30)
   `LAST_UPDATE` date

   a) Edit the `lab_07_03.sql` in the `/home/oracle/labs` directory. It has an error in it. If you can spot the error, make the change to correct it. Run the script to create the table by entering this on the OS command line:

```
$ sqlplus dba1/oracle @lab_07_03.sql
```

   b) The error in the script is that "`(PRODUCT_ID)`" is missing after "`FOREIGN KEY`." So, add "`(PRODUCT_ID)`".

```
SQL> CREATE TABLE INVENTORY.PRODUCT_ON_HAND
  2  (
  3  PRODUCT_ID NUMBER(7),
  4  QUANTITY NUMBER(5),
  5  WAREHOUSE_CITY VARCHAR2(30),
  6  LAST_UPDATE DATE,
  7    CONSTRAINT FK_PROD_ON_HAND_PROD_ID
  8      FOREIGN KEY REFERENCES
  9      INVENTORY.PRODUCT_MASTER (PRODUCT_ID) VALIDATE
 10  )
 11  /
    FOREIGN KEY REFERENCES
                *
ERROR at line 8:
ORA-00906: missing left parenthesis
```

(PRODUCT_ID)

   c) Remove the `prompt` commands:

```
prompt  There is an error in this statement. It will not
prompt  run successfully unless fixed.
```

   d) Run the script. The table should be created without error.

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4. In the `INVENTORY` tablespace, create the `OBSOLETE_PRODUCTS` table in the `INVENTORY` schema. This table definition is very much like that of the `PRODUCT_MASTER` table, so you can use Enterprise Manager's ability to "Define Using SQL" rather than using "Column Specification." The specifications of the table are:

   PRODUCT_ID number(7). This is the primary key field.
   PRODUCT_NAME varchar2(50) with a Not Null constraint
   CODE varchar2(20) with a Not Null constraint
   COST number(5,2)
   PRICE number(5,2)

   a) In Enterprise Manager, select **Administration** > Schema > Database Objects > **Tables**.

   b) Click **Create**.

   c) Leave the default setting for **Table Organization**, and then click **Continue**.

   d) Enter `OBSOLETE_PRODUCTS` for **Name**.

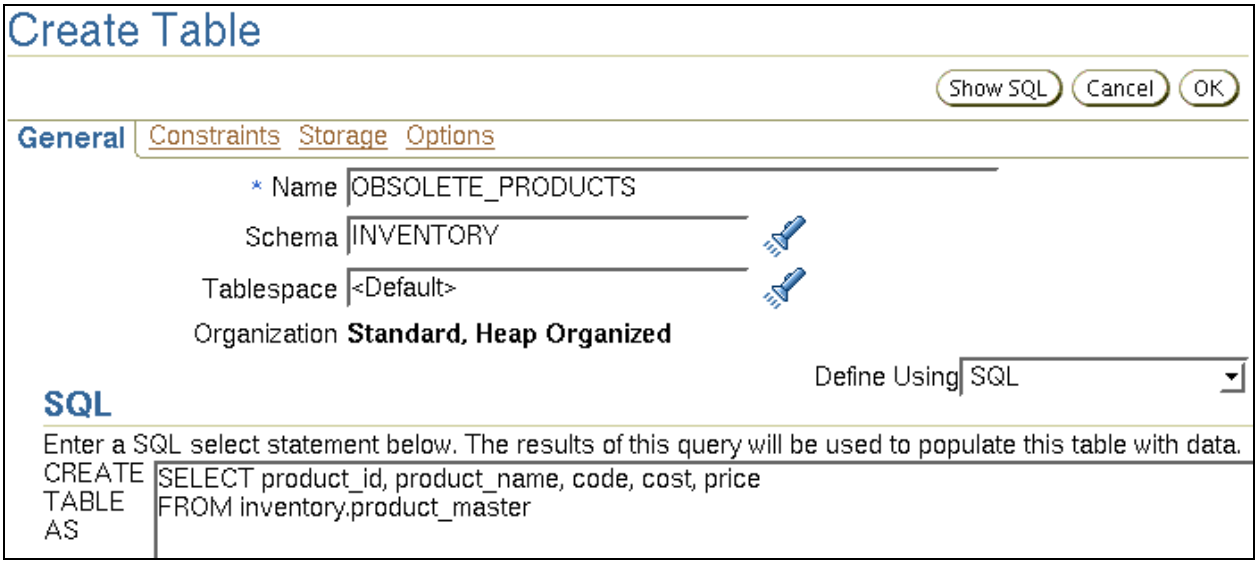
   e) Enter `INVENTORY` for **Schema**.

   f) Leave the Tablespace setting as the default for this schema.

   g) Set the **Define Using** drop-down list to **SQL**.

   h) In the SQL region, enter the following statement:

```
SELECT product_id, product_name, code, cost, price
FROM inventory.product_master
```



   i) Click **OK** to create the table.

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5. In the `INVENTORY` tablespace, create an index called `OBS_CODE` on the `CODE` column of the `OBSOLETE_PRODUCTS` table in the `INVENTORY` schema. Choose an appropriate index type: either B-tree or Bitmap. Explain the reason for your choice.

   a) *Question:* Which type of index is appropriate, and why?

   Answer: B-tree, because the `CODE` column can contain many different values, not just a small, finite set.

   b) Select **Administration** > Schema > Database Objects > **Indexes**, and the click **Create**.

   c) Enter `OBS_CODE` as **Name**.

   d) Enter `INVENTORY` as **Schema**.

   e) Enter `INVENTORY.OBSOLETE_PRODUCTS` as **Table Name**.

   f) Click **Populate Columns**. The column names have been filled into the table. If your browser prompts you to remember entered values, click **No**.

   g) Enter an `ORDER` value of `1` for the `CODE` column.

Table Columns

Column Name	Data Type	Sorting Order	Order
PRODUCT_ID	NUMBER	ASC	
PRODUCT_NAME	VARCHAR2	ASC	
CODE	VARCHAR2	ASC	1
COST	NUMBER	ASC	
PRICE	NUMBER	ASC	

Add Column Expression

   h) Click **Show SQL**, confirm the SQL statement looks like the statement below, and then click **Return**.

```
CREATE INDEX "INVENTORY"."OBS_CODE" ON
"INVENTORY"."OBSOLETE_PRODUCTS" ("CODE")
```

   i) Click **OK** to create the index.

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6. In the `INVENTORY` tablespace, create an index called `PROD_NAME_CODE` on the combined `PRODUCT_NAME` and `CODE` columns of the `PRODUCT_MASTER` table. Use the `lab_07_06.sql` script *(which contains an error, intentionally created to enhance your learning experience*). Correct the error and run the script. If you cannot find the error right away, then run the original script in SQL*Plus to see the error message. This will help you discover and solve the problem.

   a) Edit the `lab_07_06.sql` in the `/home/oracle/labs` directory. It has an error in it. If you can spot the error, make the change to correct it.

```
There is an error in this script.
Correct the error to have the index
created successfully.
create composite index inventory.prod_name_code
       *
ERROR at line 1:
ORA-00901: invalid CREATE command
```

Remove this

   The corrected statement is:

```
create index inventory.prod_name_code
on inventory.product_master(product_name,code)
```

   b) Remove the `prompt` commands:

```
prompt  There is an error in this script.
prompt  Correct the error to have the index
prompt  created successfully.
```

   c) Run the script to create the index by entering the following on the OS command line:

```
$ sqlplus dba1/oracle @lab_07_06.sql
```

   d) The error in the script is that it should not have the word "`COMPOSITE`". Delete the word, run the script, and the index should be created without error.

7. In the `INVENTORY` tablespace, use SQL*Plus to create a combined index on the `PRODUCT_ID` and `QUANTITY` columns of the `PRODUCT_ON_HAND` table. The index name should be `POH_PROD_ID_QTY`.

   a) At the SQL*Plus prompt, enter the following command:

```
SQL> create index inventory.poh_prod_id_qty on
inventory.product_on_hand(product_id, quantity);
```


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8. You receive an update for the inventory application that requires you to add two columns to the `PRODUCT_MASTER` table. Add a column called `PRIMARY_SOURCE` of the data type `varchar2(50)`. Add another column called `SECONDARY_SOURCE` of the data type `varchar2(50)`. What is the SQL that executes to do this?

   a) Select **Administration** > Schema > Database Objects > **Tables**.

   b) Enter `INVENTORY` in the **Schema** field, and then click **Go**.

   c) Select the `PRODUCT_MASTER` table, and then click **Edit**.

   d) Enter `PRIMARY_SOURCE` in the **Name** field under `PRICE`, and set **Data Type** to `VARCHAR2`, and **Size** to `50`.

   e) Enter `SECONDARY_SOURCE` in the next available **Name** field, and set **Data Type** to `VARCHAR2`, and **Size** to `50`.

   f) Click **Show SQL**.

```
ALTER TABLE "INVENTORY"."PRODUCT_MASTER"
ADD ( "PRIMARY_SOURCE" VARCHAR2(50),
"SECONDARY_SOURCE" VARCHAR2(50))
```

   g) Click **Return**, and then click **Apply**.

9. You receive another update for the inventory application. This change request instructs you to drop the `OBSOLETE_PRODUCTS` table and add the `OBSOLETED` column to the `PRODUCT_MASTER` table, with data type `DATE`. Do this using EM. What clause is added to the end of the `DROP TABLE` statement to also remove the table constraints?

   a) Select **Administration** > Schema > Database Objects > **Tables**.

   b) Enter `INVENTORY` in the **Schema** field, and then click **Go**.

   c) Select the `OBSOLETE_PRODUCTS` table, and then click **Delete With Options**.

   d) Keep the default settings for performing `DROP`, and then click **Show SQL** to see the `CASCADE CONSTRAINTS` option.

```
DROP TABLE "INVENTORY"."OBSOLETE_PRODUCTS" CASCADE CONSTRAINTS
```

   e) Click **Return**, and then click **Yes**.

   f) Select the `PRODUCT_MASTER` table, and then click **Edit**.

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g) In the first empty **Name** field, enter `OBSOLETED`, and set **Data Type** to `DATE`.

h) Click **Apply**.

10. Another change request to the inventory application instructs you to create a view called `WAREHOUSE_VW` (Navigation aid: Administration > Views). The view is in the `INVENTORY` schema and displays (in this order):

- The name of the product
- The amount of "product on hand"
- The warehouse city name

You will have to join two tables together to create this view.

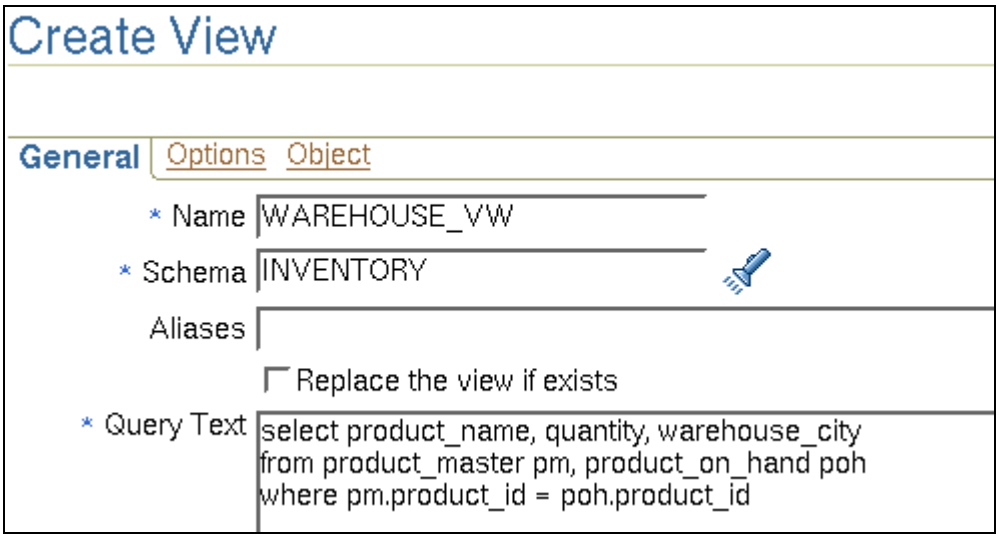
a) Select **Administration** > Schema > Database Objects > **Views**.

b) Click **Create**.

c) Enter `WAREHOUSE_VW` in the **Name** field, and `INVENTORY` in the **Schema** field.

d) Enter the following in the **Query Text** field:

```
select product_name, quantity, warehouse_city
from product_master pm, product_on_hand poh
where pm.product_id = poh.product_id
```



e) Click **OK**.

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11. You receive a notice from developers that there is a certain type of query that will be run very frequently, and they want to be sure that it runs in less than one second. You need to run the query and see how it performs. First, run the `lab_07_11_a.sql` script to generate some test data of the volume indicated in the request. Then, run the query in the `lab_07_11_b.sql` script several times to see the average run time. Note that it takes several seconds to run each time. Create a function-based index on the `CODE` column that will improve the performance of this query.

    a) Right-click the desktop and select **Open Terminal**. Then enter the following at the command prompt to populate the table with test data. This will take three to five minutes to run.

    ```
    $ cd /home/oracle/labs
    $ sqlplus dba1/oracle @lab_07_11_a.sql
    ```

    b) Enter the following on the command line to run the test query.

    ```
    SQL> @lab_07_11_b.sql
    ```

    c) Enter / (a slash), and press [Enter] to run it again. Repeat this several times until you establish an average run time. It should take several seconds each time.

    d) Select **Administration** > Schema > Database Objects > **Indexes**.

    e) Click **Create**.

    f) Enter `CODE_FUNC` in the **Name** field.

    g) Enter `INVENTORY` in the **Schema** field.

    h) Enter `INVENTORY.PRODUCT_MASTER` in the **Table Name** field.

    i) Click **Populate Columns**.

    j) Click **Add Column Expression**.

    k) Enter `upper(substr(code,5,2))` in the newly added empty **Column Name** field.

    l) Enter `1` in the **Order** field beside the expression that you just entered.

    m) Click **Show SQL** to confirm that the SQL statement looks like this:

    ```
    CREATE INDEX "INVENTORY"."CODE_FUNC" ON "INVENTORY"."PRODUCT_MASTER"
    (upper(substr(code,5,2)))
    ```


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n) Click **Return**.

o) Click **OK**.

p) Return to the SQL*Plus command line and run the benchmark query a few more times. Note that the execution time is greatly reduced.

12. Use *i*SQL*Plus to identify the data dictionary view name that you would use to list all constraints that the `INVENTORY` user can see.

a) In the Enterprise Manager browser session, select **Database** > Related Links > **iSQL*Plus**.

The *i*SQL*Plus Connection Role page appears.

b) Select **Normal**, and then click **Continue**.

c) On the Login page, enter `inventory` as **Username** and `verysecure` as the **Password**, leave the **Connect Identifier** set to its default value, and then click **Login**.

The Confirm window appears, with the Password Manager offering to remember this login for you. Click **No**.

d) You are looking for things that the `INVENTORY` user has access to. So, you must use a view with the `ALL_` prefix. You can assume that the name of the view that shows constraint information begins with "`ALL_CON`." In the *i*SQL*Plus Workspace, enter:

```
SELECT * FROM dictionary
WHERE table_name like 'ALL_CON%'
ORDER BY table_name;
```

e) Click the **Execute** button.

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Connected as **HR@orcl**

Workspace

Enter SQL, PL/SQL and SQL*Plus statements. Clear

```
SELECT * FROM dictionary
WHERE table_name like 'ALL_CON%'
ORDER BY table_name;
```

Execute Load Script Save Script Cancel

TABLE_NAME	COMMENTS
ALL_CONSTRAINTS	Constraint definitions on accessible tables
ALL_CONS_COLUMNS	Information about accessible columns in constraint definitions
ALL_CONS_OBJ_COLUMNS	List of types an object column or attribute is constrained to in the tables accessible to the user
ALL_CONTEXT	Description of all active context namespaces under the current session

f) Review the returned rows. One of them has the `COMMENTS` value "Constraints definitions on accessible tables." The object name is `ALL_CONSTRAINTS`.

13. How many indexes are owned by the `INVENTORY` user? You are looking for database objects owned by the `INVENTORY` user, so you know that the data dictionary view begins with the "`USER_`" prefix. The view name is `USER_INDEXES`.

a) In the *i*SQL*Plus Workspace, enter:

```
SELECT * FROM user_indexes;
```

b) Click the **Execute** button.

How many indexes are owned by the `INVENTORY` user?

Answer: 4

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Connected as **INVENTORY@orcl**

Workspace

Enter SQL, PL/SQL and SQL*Plus statements. Clear

```
SELECT * FROM user_indexes;
```

Execute Load Script Save Script Cancel

INDEX_NAME	INDEX_TYPE	TABLE_OWNER	TABLE_NAME	TABL
CODE_FUNC	FUNCTION-BASED NORMAL	INVENTORY	PRODUCT_MASTER	TABL
PROD_NAME_CODE	NORMAL	INVENTORY	PRODUCT_MASTER	TABL
PK_INV	NORMAL	INVENTORY	PRODUCT_MASTER	TABL
POH_PROD_ID_QTY	NORMAL	INVENTORY	PRODUCT_ON_HAND	TABL

c) Note that there are four rows returned.

d) Log out of *i*SQL*Plus by clicking **Logout** in the top-right corner of the window. Then, close the window by clicking **x** (Close icon) in the top-right corner.

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Solutions for Practice 8: Managing Data and Concurrency

Background: The Help desk just received a call from Susan Mavris, an HR representative, complaining that the database is "frozen." Upon questioning the user, you find that she was trying to update John Chen's personnel record with his new phone number, but when she entered the new data, her session froze and she could not do anything else. SQL script files are provided for you in the `/home/oracle/labs` directory.

1. Make an uncommitted update to the row in question by running the `lab_08_01.sql` script. Do not worry if the session seems to "hang"—this is the condition you are trying to create.

   a) Enter the following to run the script. When the script completes executing, you will see a note stating that an uncommitted update has been made.

```
$ sqlplus dba1/oracle @lab_08_01.sql
```

```
SQL> show user
USER is "NGREENBERG"
SQL> update hr.employees set phone_number='650.555.1212' where employee_id = 110;

1 row updated.

SQL> prompt User "ngreenberg" made an update and left it uncommitted in this session.
User "ngreenberg" made an update and left it uncommitted in this session.
SQL>
SQL>
SQL>
```

2. Make an attempt to update the same row in a separate session by running, in a separate terminal window, the `lab_08_02.sql` script. Make sure you see the message "Update is being attempted now" before moving on.

   a) Right-click the desktop and select **Open Terminal** to start another command shell. Then enter the following to run the second script.

```
$ sqlplus dba1/oracle @lab_08_02.sql
```

```
Sleeping for 20 seconds to ensure first process gets the lock first.

PL/SQL procedure successfully completed.

Sleep is finished.
Connected.
USER is "SMAVRIS"
Update is being attempted now.
```

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3. Using the **Blocking Sessions** link on the Performance page, detect which session is causing the locking conflict.

   a) In Enterprise Manager, click the Performance page.

   b) The first time you invoke the Performance page, a Software License Agreement is displayed. Press [A] to accept and continue.

   c) Click **Blocking Sessions** in the **Additional Monitoring Links** area.

Blocking Sessions

Page Refreshed May 31, 2005 5:07:44 PM

View Session | Kill Session

Expand All | Collapse All

Select	Username	Sessions Blocked	Session ID	Session Serial Number	SQL Hash Value	Wait Class	Wait Event	P1	P2	P3	Seconds in Wait
	Blocking Sessions										
	NGREENBERG	1	133	1784		Idle	SQL*Net message from client	1650815232	1	0	538
	SMAVRIS	0	158	11895	6smgtv6h8958b	Application	enq: TX - row lock contention	1415053318	327682	540	538

4. What was the last SQL statement that the blocking session executed?

   a) Select the NGREENBERG session, and then click **View Session**.

   b) Click the hash value link named "**Previous SQL**."

Application

Current SQL	None
Current SQL Command	UNKNOWN
Previous SQL	6smgtv6h8958b
Last Call Elapsed Time	21 Minutes, 13 Seconds
SQL Trace	DISABLED
Open Cursors	0
Program	sqlplus@EDRSR9P1 (TNS V1-V3)
Service	SYS$USERS
Current Module	SQL*Plus
Current Action	Unavailable

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c) Note the SQL that was most recently run.

```
Text
update hr.employees set phone_number='650.555.1212'
where employee_id = 110
```

5. Resolve the conflict in favor of the user who complained, by killing the *blocking* session. What SQL statement resolves the conflict?

   a) Click the browser's **Back** button.

   b) Now, on the Session Details: NGREENBERG page, click **Kill Session**.

   c) Leave the Options set to **Kill Immediate**, and then click **Show SQL** to see the statement that is going to be executed to kill the session.

   Note: Your session and serial number are most likely to be different from those shown here.

```
ALTER SYSTEM KILL SESSION '133,1784' IMMEDIATE
```

   d) Click **Return**, and then click **Yes** to carry out the `KILL SESSION` command.

6. Return to the SQL*Plus command window, and note that `SMAVRIS`'s update has now completed successfully. It may take a few seconds for the success message to appear.

```
USER is "SMAVRIS"
Update is being attempted now.

1 row updated.

Update is completed.
SQL>
```

   a) Close all open SQL sessions by entering `exit`, and then close the terminal windows.

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Solutions for Practice 9: Managing Undo Data

Background: A new version of your application will include several reports based on very long-running queries. Configure your system to support these reports.

1. Use the Undo Advisor to calculate the amount of undo space required to support a report that takes two days to run, on the basis of an analysis period of the last seven days.

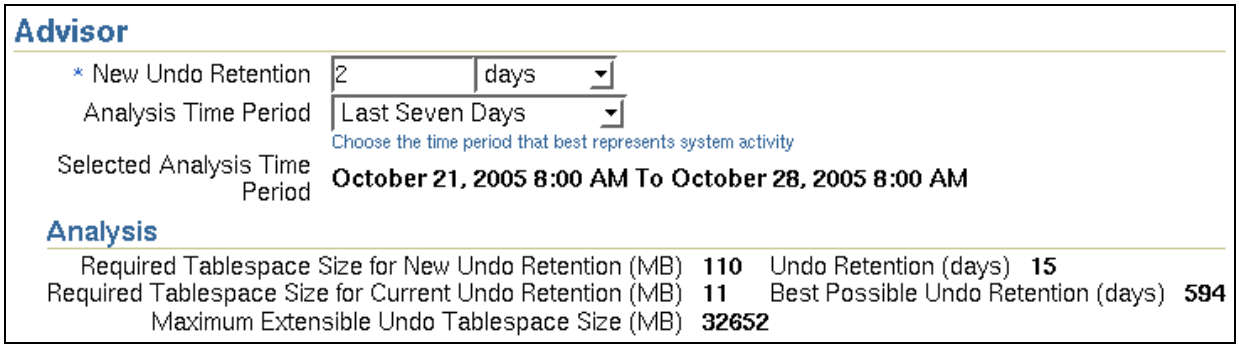
   a) In Enterprise Manager, select **Administration** > Related Links > **Advisor Central**.

   b) Click **Undo Management**.

   c) Click **Undo Advisor**.

   d) In the **New Undo Retention** field, enter `2`. Then select **days** from the drop-down list.

   e) Select Last Seven Days in the **Analysis Time Period** drop-down list. Results of the analysis will be displayed.
   Note: The values that you see are likely to be different from those shown here.



   f) *Question:* What does the analysis recommend as "Required Tablespace Size for New Undo Retention"?

   Answer: 110 MB

   g) Click **OK**.

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Solutions for Practice 9: Managing Undo Data (continued)

2. Resize the undo tablespace to support the retention period required by the new reports (or 1 GB, whichever is smaller). Do this by increasing the size of the existing data file.

   a) Click **Edit Undo Tablespace**.

   b) *Question:* What are the two ways to add space to a tablespace?

   Answer: Add a new data file or increase the size of an existing data file.

   c) To increase the size of the existing data file, select the data file, and then click **Edit**.

   d) Enter the new value from step 1 (f) in the **File Size** field. Round off to the nearest 100 MB (not to exceed 1 GB). Make sure the box for "Automatically extend datafile when full" is not selected. Then, click **Continue**.

   e) Click **Show SQL** to confirm that the SQL statement looks similar to this:

```
ALTER DATABASE DATAFILE
'/u01/app/oracle/oradata/ORCL/datafile/o1_mf_undotbs1_1pzfonlk_.dbf'
RESIZE 200M
ALTER DATABASE DATAFILE
'/u01/app/oracle/oradata/ORCL/datafile/o1_mf_undotbs1_1pzfonlk_.dbf'
AUTOEXTEND OFF
```

   f) Click **Return**, then click **Apply** to implement your change.

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Solutions for Practice 10: Implementing Oracle Database Security

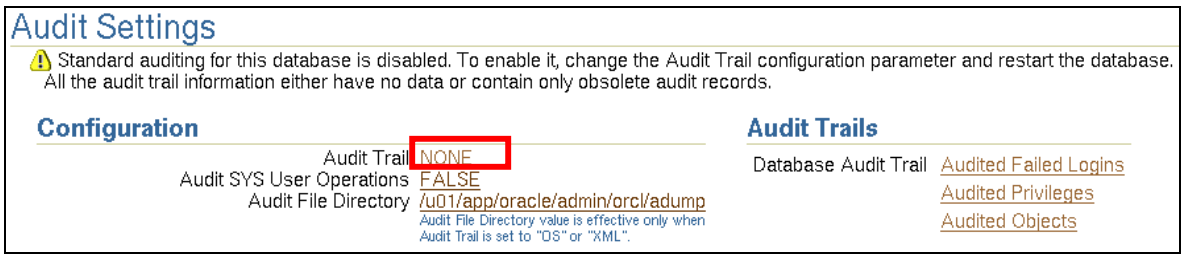
Background: You have just been informed of suspicious activities in the `HR.JOBS` table in your `ORCL` database. All maximum salaries seem to fluctuate in a strange way. You decide to enable standard database auditing and monitor data manipulation language (DML) activities in this table.

Log in as the `DBA1` user (with `oracle` password, connect as `SYSDBA`) and perform the necessary tasks either through Enterprise Manager Database Control or through SQL*Plus. All scripts for this practice are in the `/home/oracle/labs` directory.

1. Use Enterprise Manager to enable database auditing. Set the `AUDIT_TRAIL` parameter to `XML`.

   a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   b) Select **Administration** > Schema > Users & Privileges > **Audit Settings**.



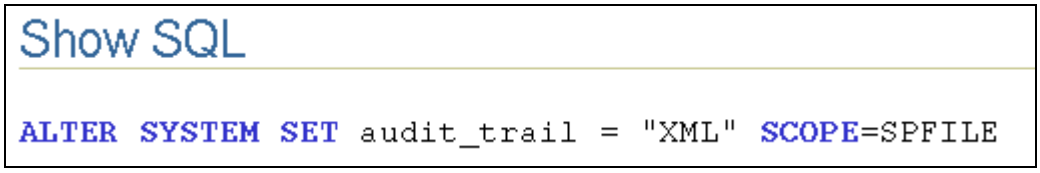
   c) Click the **NONE** link.

   d) On the Initialization Parameters page, click the **SPFile** tab.

   e) Enter `audit` in the **Name** field and then click **Go**.

   f) For the **`audit_trail`** parameter, select the **`XML`** value.

   g) Click **Show SQL**.



   h) Review the statement and then click **Return**.

   i) On the Initialization Parameters page, click **Apply**.

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2. Because you changed a static parameter, you must restart the database. Do so by running the `lab_10_02.sh` script.

   a) In a terminal window, enter:

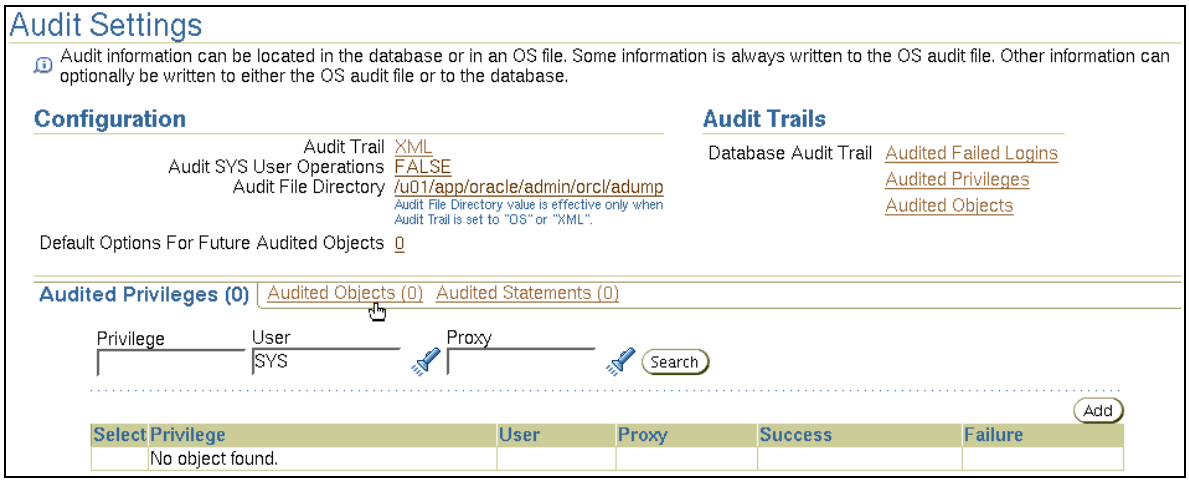
```
cd /home/oracle/labs
./lab_10_02.sh
```

   Continue with the next step when you see that the database is restarted and the script has exited out of SQL*Plus.

3. Back in Enterprise Manager, select `HR.JOBS` as the audited object and `DELETE`, `INSERT`, and `UPDATE` as **Selected Statements**. Gather audit information by session.

   a) Click the Database home page tab to ensure that Enterprise Manager had time to update the status of the database and its agent connections. Because the database has been restarted, you have to log in to EM again as the `DBA1` user.

   b) Then, select **Administration** > Schema > Users & Privileges > **Audit Settings**.

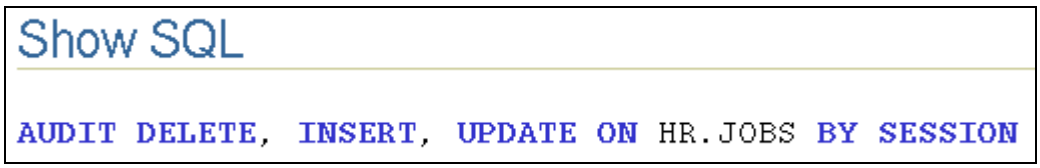


   c) Click the **Audited Objects** tab, and then click the **Add** button.

   d) On the Add Audited Object page, ensure that the **Object Type** is Table, and enter `HR.JOBS` in the **Table** field (or use the flashlight icon to retrieve this table).

   e) Move `DELETE`, `INSERT`, and `UPDATE` into the **Selected Statements** area by double-clicking each of them.

   f) Click **Show SQL**.



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g) Review the statement, and then click **Return**.

h) Click **OK** to activate this audit.

4. Provide input for the audit, by executing the `lab_10_04.sh` script. This script creates the `AUDIT_USER` user, connects to SQL*Plus as this user, and multiplies the values in the `MAX_SALARY` column by `10`. Then, the `HR` user connects and divides the column values by `10`. Finally, the `AUDIT_USER` user is dropped again.

   a) In a terminal window, enter:

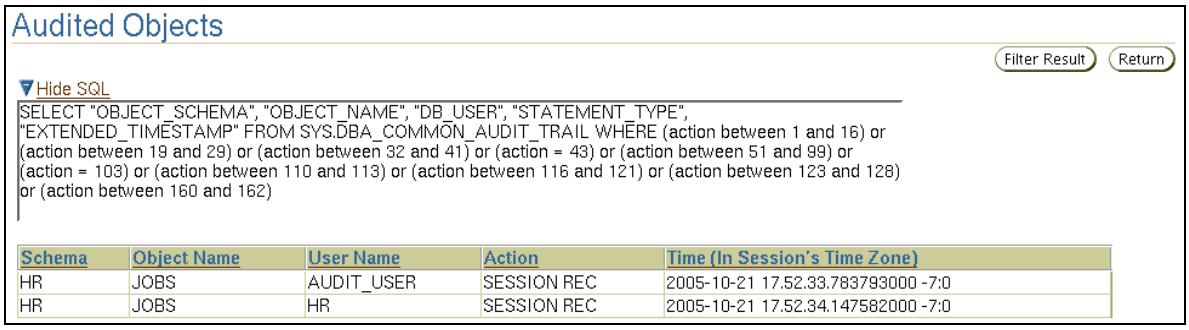
```
cd /home/oracle/labs
./lab_10_04.sh
```

5. In Enterprise Manager, review the audited objects.

   a) Select **Administration** > Schema > Users & Privileges > **Audit Settings**.

   b) Click **Audited Objects** in the **Audit Trails** area, which is on the right side of the page.

   c) On the Audited Objects page, review the collected information, and optionally click **Show SQL**.



Schema	Object Name	User Name	Action	Time (In Session's Time Zone)
HR	JOBS	AUDIT_USER	SESSION REC	2005-10-21 17.52.33.783793000 -7:0
HR	JOBS	HR	SESSION REC	2005-10-21 17.52.34.147582000 -7:0

   d) Click **Return**.

6. Undo your audit settings for `HR.JOBS`, disable database auditing, and then restart the database by using the `lab_10_06.sh` script.

   a) On the Audit Settings page, click the **Audited Objects** tab.

   b) Enter `HR` as **Schema,** and then click **Search**.

   c) Select all three rows, and then click **Remove**.

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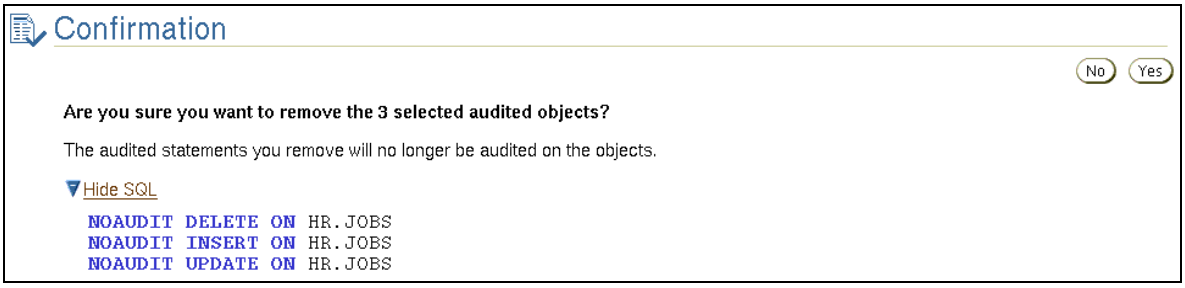
d) On the Confirmation page, click **Show SQL**.



e) Review the statements, then click **Yes** to confirm your removal.

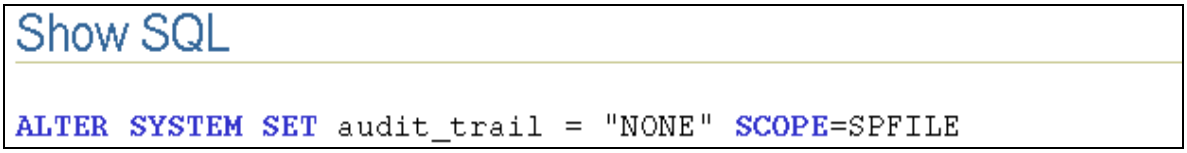
f) On the Audit Settings page, click **XML** in the **Configuration** region.

g) On the Initialization Parameters page, click the **SPFile** tab.

h) On the SPFile page, enter `audit` in the **Name** field, and then click **Go**.

i) For the **`audit_trail`** parameter, select the **`NONE`** value.

j) Click **Show SQL**.



k) Review the statement, and then click **Return**.

l) On the Initialization Parameters page, click **Apply**.

m) Because you changed a static parameter, you must restart the database. Do so by running the `lab_10_06.sh` script. In a terminal window, enter:

```
cd /home/oracle/labs
./lab_10_06.sh
```

7. Maintain your audit trail: Because you are completely finished with this task, delete all audit files from the `/u01/app/oracle/admin/orcl/adump` directory.

a) In a terminal window, enter:

```
cd /u01/app/oracle/admin/orcl/adump
ls
rm -f *
```

b) Close the terminal window.

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Solutions for Practice 11: Configuring the Oracle Network Environment

Background: Users need to connect to your `ORCL` database. Work with them to enable connections by using different methods. Ensure that users can use connect-time failover to take advantage of a backup listener.

1. Make a copy of your `listener.ora` and `tnsnames.ora` files. They are in the `$ORACLE_HOME/network/admin` directory.

   a) In an terminal window, enter `cd $ORACLE_HOME/network/admin` to navigate to the `/u01/app/oracle/product/10.2.0/db_1/network/admin` directory.

   b) Enter `cp listener.ora listener.old` to create a copy of the `listener.ora` file.

   c) Enter `cp tnsnames.ora tnsnames.old` to create a copy of the `tnsnames.ora` file.

   d) Enter `ls -l`, if you want to see the copies and their privileges in your directory.

2. Navigate to the Net Services Administration page. Start by clicking the **Listener** link on the Database home page.

   a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   b) On the Database Instance – Home page, click the **Listener** link in the **General** region.

   c) In the **Related Links** region, click **Net Services Administration**.

3. Modify your local Names Resolution file so that you can connect to another database. Name the connection to a partner's `ORCL` database **`testorcl`**.

   a) On the Net Services Administration page, select **Local Naming** from the Administer drop-down list, and then click **Go**.

   The **Netservices Administration: Host Login** page appears.

   b) If you previously saved the `oracle` username and `oracle` password as preferred credentials for your host login, then they appear on the screen. If not, enter **`oracle`** as Username and Password, select the **Save as Preferred Credential** check box, and then click **Login**.

   c) On the Local Naming page, click **Create** to enter a new network service name.

   d) Enter **`testorcl`** as Net Service Name.

   e) Select **Use SID**, and enter **`orcl`** as SID.

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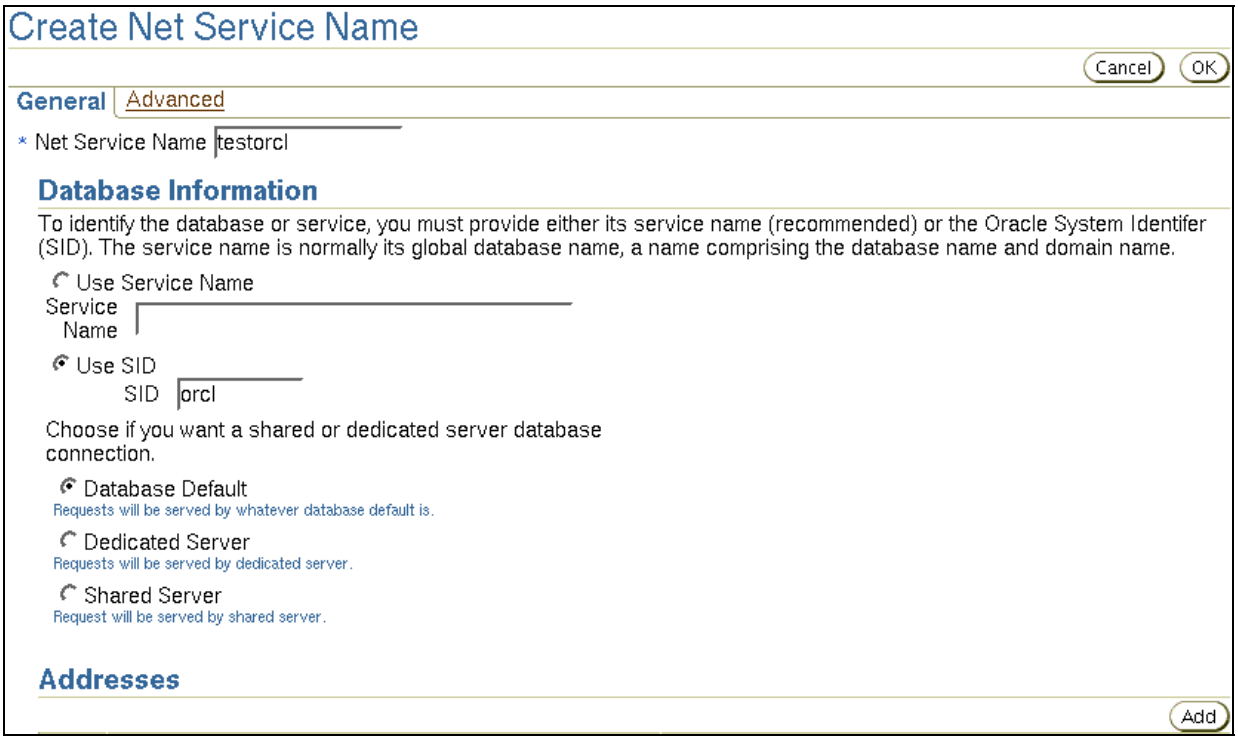
f) Select **Database Default**.

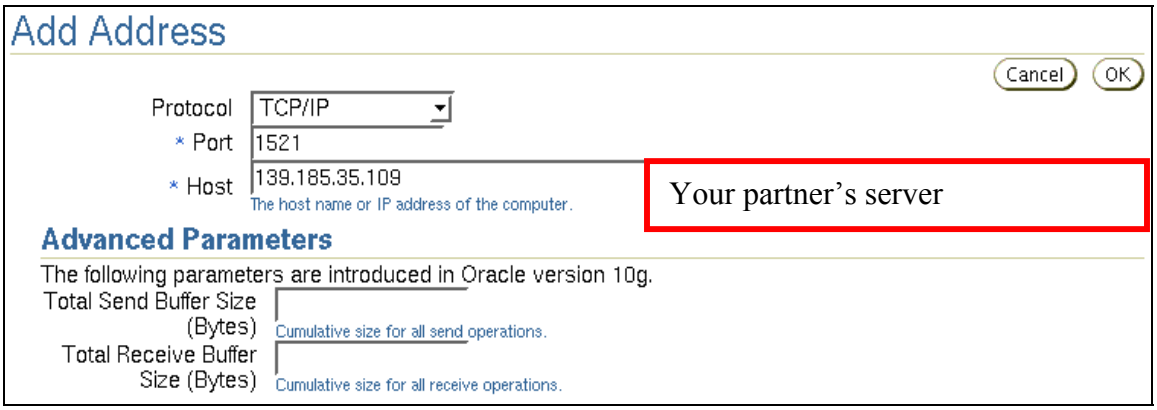


g) Click **Add** in the **Addresses** region.

Click **No** if you are asked, "**Do you want to remember the values you filled in?**"

h) On the Add Address page, select the following values:

- Protocol: **TCP/IP**
- Port: **1521**
- Host: <*Enter the host name or IP address of* ***your partner's computer****. It could be something like* `edrsr9p1.us.oracle.com` *or like* `139.185.35.109`>



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i) Click **OK** to return to the Create Net Service Name properties page.

j) Click **OK**.

The Creation Message appears: Net Service "testorcl" created successfully.

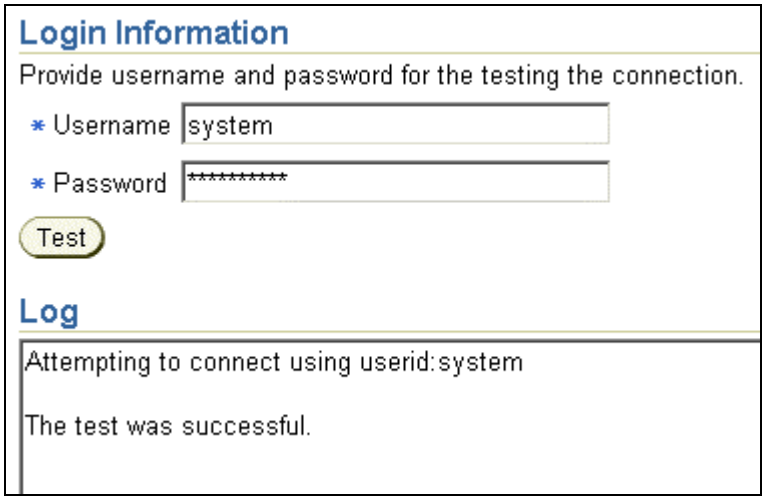
4. In Enterprise Manager, test access to your partner's `ORCL` database as the **`system`** user with the **`oracle`** password by using the **`testorcl`** Local Naming.

   a) Select **`testorcl`** on the Local Naming page, and then click **Test Connection**.

   The "Test Connection To Net Service Name: testorcl" appears.

   b) Enter **`system`** as Username and **`oracle`** as Password, and then click **Test**.

   The Processing page displays status information. Then, it is followed by a success message. *If you receive any errors or warnings, resolve them.*



5. Test your changes to the network configuration by using SQL*Plus or *i*SQL*Plus. Again, use: `system/oracle@testorcl`. To see your partner's information, select the `instance_name` and `host_name` columns from the `v$instance` table.

   a) In an terminal window, enter:

```
sqlplus system/oracle@testorcl
```

   The Oracle SQL*Plus window opens. *If you receive any errors or warnings, resolve them.*

   b) At the SQL> prompt, enter the following command:

```
select instance_name, host_name from v$instance;
```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```
[oracle@EDRSR30P1 oracle]$ sqlplus system/oracle@testorcl

SQL*Plus: Release 10.2.0.0.0 - Beta on Mon May 16 16:38:46 2005

Copyright (c) 1982, 2004, Oracle.  All rights reserved.


Connected to:
Oracle Database 10g Enterprise Edition Release 10.2.0.0.0 - Beta
With the Partitioning, OLAP and Data Mining options

SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
----------------
HOST_NAME
----------------------------------------------------------------
orcl
EDRSR9P1


SQL>
```

You should see your partner's host name.

c) Enter **`exit`** to exit your SQL*Plus session.

6. Create a `LISTENER2` listener to support connect-time failover. Use port 1561 for this listener. First, log out of Enterprise Manager and run the `lab_11_06.sh` script to configure the `NetProperties` file.

   a) Logout of Enterprise Manager.

   b) Run the `lab_11_06.sh` script at the operating system command prompt.

   c) Log in to Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   d) On the Database Instance – Home page, click the **Listener** link in the **General** region.

   e) In the **Related Links** region, click **Net Services Administration**.

   f) On the Net Services Administration page, select **Listeners** from the **Administer** drop-down list, and then click **Go**. Enter host credentials as `oracle` and `oracle` for username and password, and then click **Login**.

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g) On the Listeners page, which gives you an overview of the existing listeners, click the **Create** button.

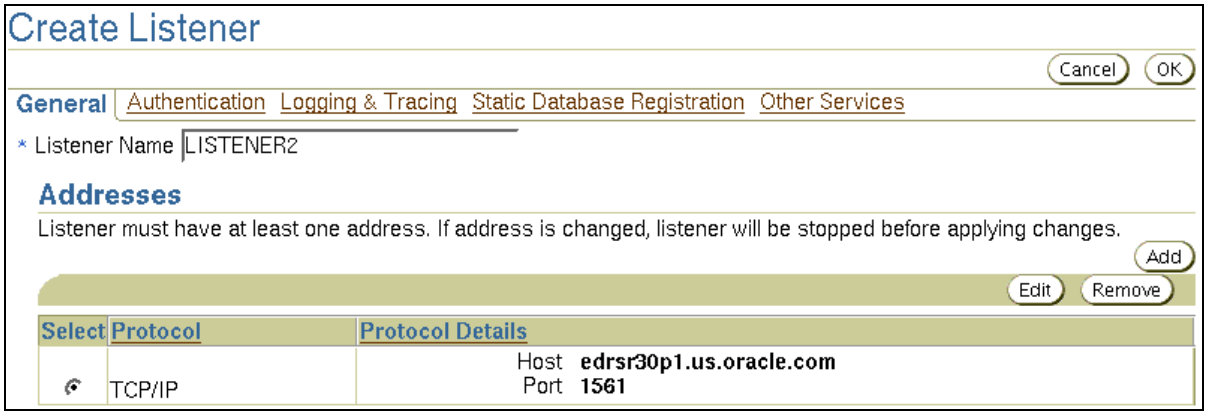
The Create Listener page appears.

h) Enter **`LISTENER2`** as Listener Name, and then click **Add** to add a listener address.

i) Enter or confirm the following values:

- Protocol: `TCP/IP`
- Port: **`1561`**
- Host: <Your computer's host name; for example, `edrsr30p1.us.oracle.com`>

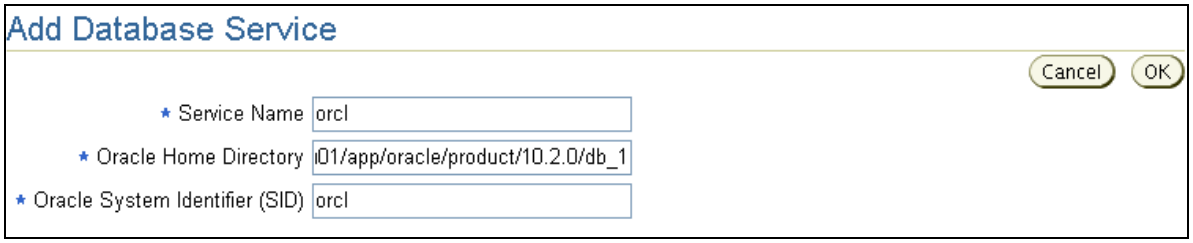
j) Click **OK**.



k) Click the **Static Database Registration** tab, and then click the **Add** button to connect the new listener with your `ORCL` database.

l) Enter the following values:

- Service Name: **`orcl`**
- Oracle Home Directory: **`/u01/app/oracle/product/10.2.0/db_1`**
- Oracle System Identifier (SID): **`orcl`**



m) Click **OK** to add the database service.

n) Click **OK** to create the `LISTENER2` listener.

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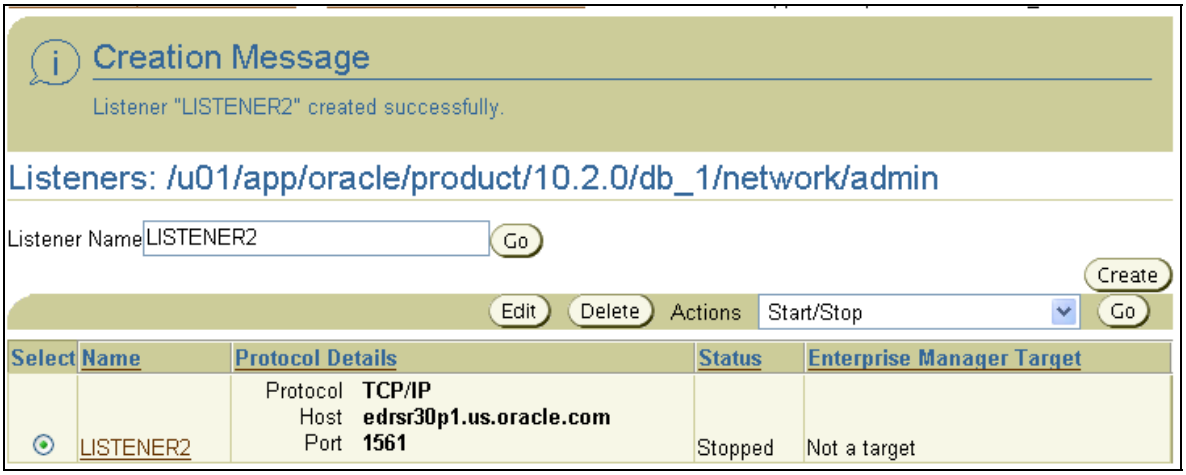

7. Start the `LISTENER2` listener.

   a) Confirm that the **`LISTENER2`** listener and **Start/Stop** Actions are selected, and then click **Go**.

   b) Click **OK** on the Start/Stop page.

   A confirmation message appears with a **View Details** link.

   c) Optionally, click the **View Details** link, review the listener status information, and use the **Back** icon of your browser to return to the previous page.

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Solutions for Practice 12: Proactive Maintenance

Background: You want to proactively monitor your ORCL database so that common problems can be fixed before they affect users. This practice session invents some issues so that you can familiarize yourself with the tools that are available. First, execute scripts to set up your Automatic Database Diagnostic Management (ADDM) environment.

1. Create a new, locally managed tablespace called TBSADDM. Its addm1.dbf data file is 50 MB. Ensure that the TBSADDM tablespace does not use Automatic Segment Space Management (ASSM). Execute the lab_12_01.sh script to perform these tasks.

   a) In a terminal window, enter:

```
cd /home/oracle/labs
./lab_12_01.sh
```

2. Create a new ADDM user, identifed by ADDM. Assign the TBSADDM tablespace as default tablespace. Assign the TEMP tablespace as temporary tablespace. Grant the following roles to the ADDM user: CONNECT, RESOURCE, and DBA. Execute the lab_12_02.sh script to perform these tasks.

   a) In a terminal window, enter:

```
./lab_12_02.sh
```

3. Use the DBMS_ADVISOR package to set the database activity time to 30 minutes. As an ADDM user, drop and create the ADDM table and gather statistics for this table. Create a snapshot in Automatic Workload Repository (AWR). Execute the lab_12_03.sh script to perform these tasks.

   a) In a terminal window, enter:

```
./lab_12_03.sh
```

4. Create activity to be analyzed. Execute the lab_12_04.sh script to perform these tasks.

   a) In a terminal window, enter the following. You may have to press [Enter] after you see that eight PL/SQL procedures have completed, in order to see the command prompt again.

```
./lab_12_04.sh
```

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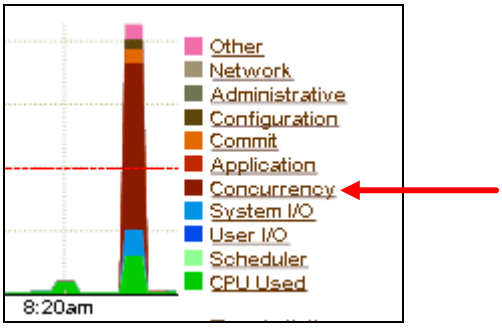
5. In Enterprise Manager, review the Performance page as a user connected as `SYSDBA`. View performance data in real time with a 15-seconds refresh cycle. After a while, you should see a spike on the "Average Active Sessions" graph. This is your activity to be analyzed. Looking at the graph, you can already determine that this instance is suffering from concurrency problems.



Note: Depending on when you run the workload, you may see differences between your graph and the one provided as a possible solution.

After the spike is finished, execute the `lab_12_05.sh` script. This script forces the creation of a new snapshot and gathers statistics on your `ADDM` table.

a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

b) Click the **Performance** tab.

If this is the first time that you accessed the Performance page, you need to accept the Adobe license agreement. Follow the directions in the pop-up window to accept the agreement.

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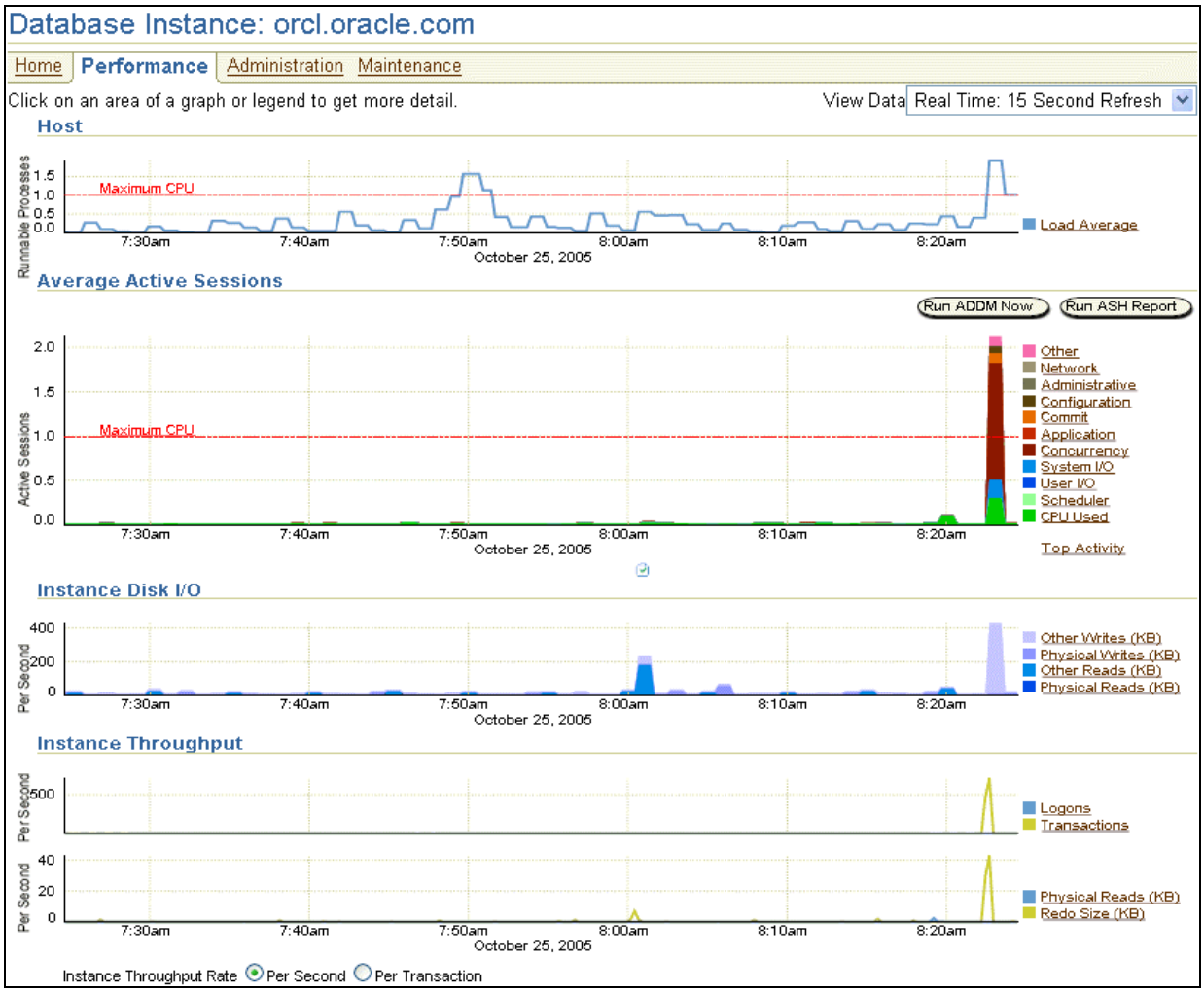
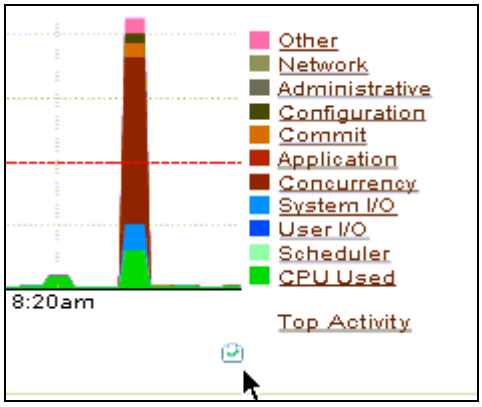


c) After the spike has finished, in a terminal window, enter:

```
./lab_12_05.sh
```



Note: The icon next to the cursor in this screenshot is a shortcut to the Automatic Database Diagnostic Monitor (ADDM) page.

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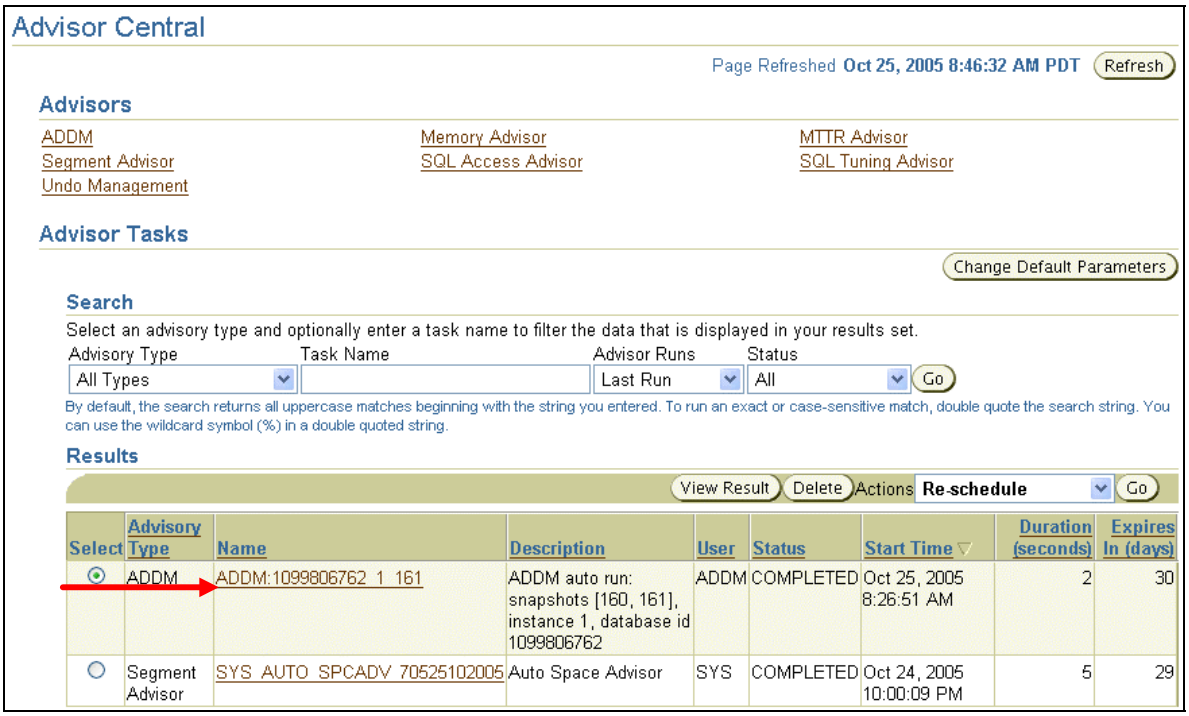
6. Look at the **Performance Analysis** findings in order of their impact. There are several access paths to this information.

   Looking at the Performance Analysis section, you see that the first finding (in the SQL Tuning Recommendations category) has a 100% impact on the system. So your first impluse is to look at this finding in more detail. However, looking at this SQL statement does not yet help you to understand the concurrency problem of your database.

   Research the next finding under Schema Recommendations: **Read and write contention of database blocks was consuming significant database time**. Here you are advised to use the Automatic Segment Space Management (ASSM) feature for your `ADDM` table.

   a) Navigate to the Database home page, and then click **Advisor Central** at the bottom of the page.



   b) Your ADDM task should already be displayed. If not, search for it and display it on this page.

   c) Select the task, and then click the **View Result** button (or alternatively, click the name of the task).

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Performance Analysis

Task Name **ADDM:1099806762_1_161** Time Range **Oct 25, 2005 8:11:00 AM to Oct 25, 2005 8:41:00 AM**

View Snapshots | View Report

Database Time (minutes) **3.2** Period Start Time **Oct 25, 2005 8:00:22 AM PDT** Period Duration (minutes) **26.4**

Task Owner **ADDM** Average Active Sessions **0.1**

Impact (%)	Finding	Recommendations
100	SQL statements consuming significant database time were found.	3 SQL Tuning
25.6	Read and write contention on database blocks was consuming significant database time.	3 Schema
22.4	A hot data block with concurrent read and write activity was found. The block belongs to segment "ADDM.ADDM" and is block 45 in file 6.	1 Application Analysis 1 Schema
13	Wait event "latch: In memory undo latch" in wait class "Concurrency" was consuming significant database time.	1 Application Analysis
12.6	Time spent on the CPU by the instance was responsible for a substantial part of database time.	2 SQL Tuning
5.1	Hard parsing of SQL statements was consuming significant database time.	
3.9	Waits on event "log file sync" while performing COMMIT and ROLLBACK operations were consuming significant database time.	1 Application Analysis 1 Host Configuration
2.4	Database latches in the "Other" wait class were consuming significant database time.	
2.2	Contention on the high watermark (HW) enqueue was consuming significant database time.	

Informational Findings

Looking at the Performance Analysis section, you see that the first finding has a 100% impact on the system. So your first impluse is to look at this finding in more detail.

d) Click the **SQL statements consuming significant database time were found** link.

Performance Finding Details

Database Time (minutes) **3.2** Period Start Time **Oct 25, 2005 8:00:22 AM PDT** Period Duration (minutes) **26.4**

Task Owner **ADDM** Task Name **ADDM:1099806762_1_161** Average Active Sessions **0.1**

Finding **SQL statements consuming significant database time were found.**
Impact (minutes) **3.2**
Impact (%) **100**

Recommendations

Schedule SQL Tuning Advisor

Select All | Select None | Show All Details | Hide All Details

Select	Details	Category	Benefit (%)
	Hide	SQL Tuning	76.5

Action **Tune the PL/SQL block with SQL_ID "8brpf00mu7ubh". Refer to the "Tuning PL/SQL Applications" chapter of Oracle's "PL/SQL User's Guide and Reference"**
SQL Text declare t number; begin for t in 1..2222 loop insert into addm values (Null,'a')...
SQL ID 8brpf00mu7ubh

Rationale **SQL statement with SQL_ID "8brpf00mu7ubh" was executed 8 times and had an average elapsed time of 18 seconds.**

☐	Show	SQL Tuning	58
☑	Show	SQL Tuning	3.5

Findings Path

Expand All | Collapse All

Findings	Impact (%)	Additional Information
SQL statements consuming significant database time were found.	100	

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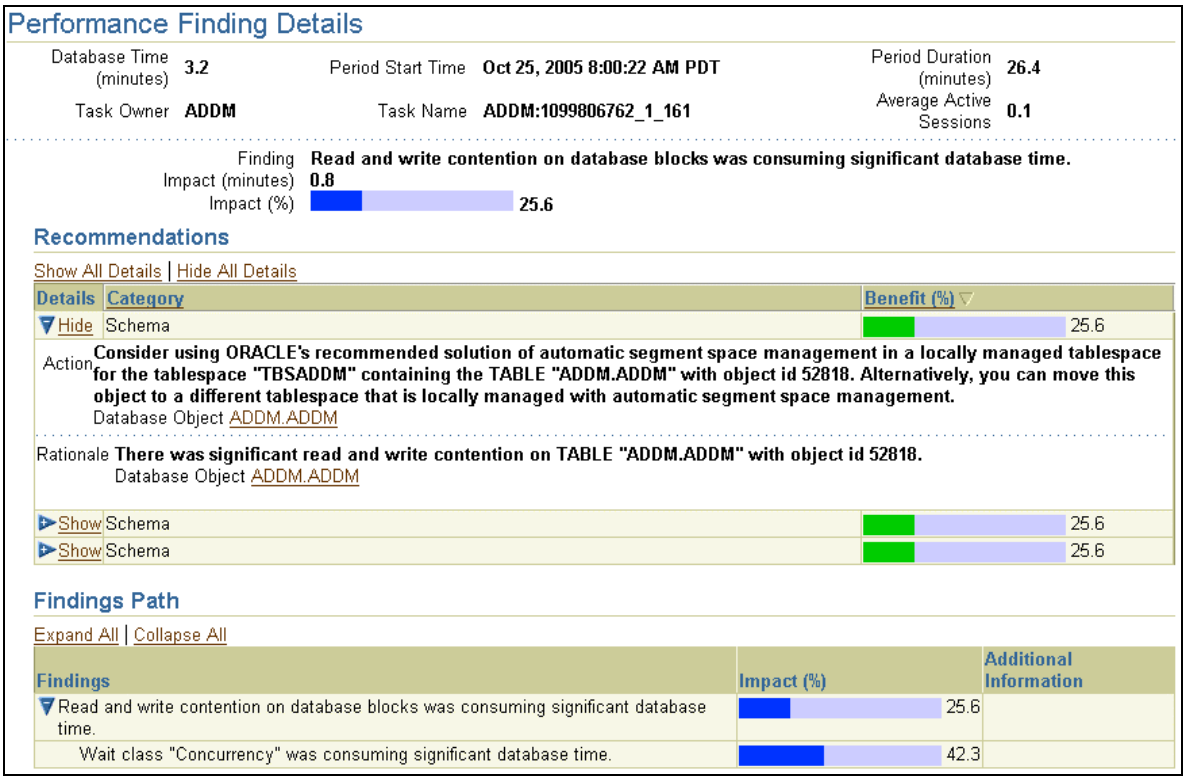
e) Review the recommendations on the Performance Finding Details page. However, looking at this SQL statement does not yet help you to understand the concurrency problem of your database. Click the **Back** icon in your Web browser.

f) On the Automatic Database Diagnostic Monitor (ADDM) page, click the **Read and write contention of database blocks was consuming significant database time** link . This finding appears as type **Schema** under the **Recommendations** heading.



g) You are advised to use the Automatic Segment Space Management feature for your `ADDM` table.

7. To implement the recommendation, you must re-create the object. Create a new, locally managed tablespace, called `TBSADDM2` with a 50 MB datafile, called `addm2_1.dbf`. Ensure that the `TBSADDM2` tablespace uses the the Automatic Segment Space Management feature. Then, execute the `lab_12_07.sh` script to drop the `ADDM` table, to re-create it in the new tablespace, to gather statistics and to take a new snapshot.

a) In Enterprise Manager, select **Administration** > Database Administration > Storage > **Tablespaces**.

b) Click **Create**.

c) Enter `TBSADDM2` as the tablespace name, and verify that **Extent Management** is **Locally Managed**, **Type** is **Permanent**, **Status** is **Read Write**, and **Use Bigfile tablespace** is not selected.

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d) Click **Add** in the **Datafiles** region.

e) On the Add Datafile page, enter `addm2_1.dbf` for **File Name**, and `50 MB` as **File Size**.

f) Click **Continue**.

g) Click the **Storage** tab, and verify that **Extent Allocation** is **Automatic**, **Segment Space Management** is **Automatic**, and **Logging** is enabled.

h) Click the **General** tab.

i) Click **Show SQL** to see the SQL that will be run, and then click **Return**.

j) Click **OK**, and a successful Update Message appears.

k) In a terminal window, enter:

```
./lab_12_07.sh
```

8. Execute your workload again. (The `lab_12_08.sh` script is identical to the `lab_12_04.sh` script.)

   a) In a terminal window, enter the following. You may have to press [Enter] after you see that eight PL/SQL procedures have completed, in order to see the command prompt again.

```
./lab_12_08.sh
```

9. In Enterprise Manager, review the Performance page as a user connected as `SYSDBA`. View performance data in real time with a 15-seconds refresh cycle. After a while, you should see a spike on the "Average Active Sessions" graph.

   Note: Depending on when you run the workload, you may see differences between your graph and the one provided as a possible solution.

   After the spike is finished, execute the `lab_12_09.sh` script. (The `lab_12_09.sh` script is identical to the `lab_12_05.sh` script.) This script forces the creation of a new snapshot and gathers statistics on your `ADDM` table.

   a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   b) Click on the **Performance** tabbed page.

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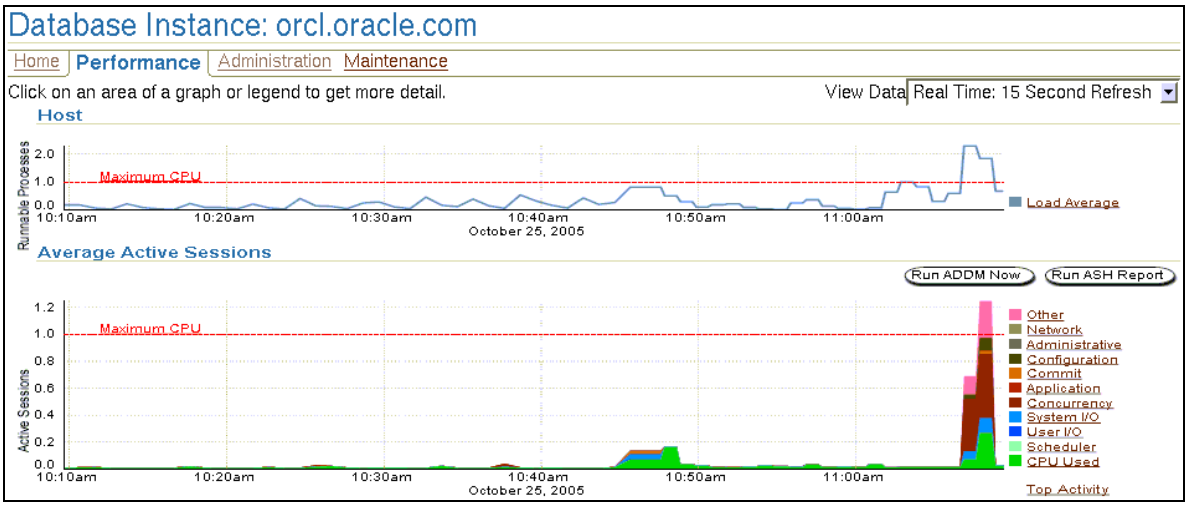


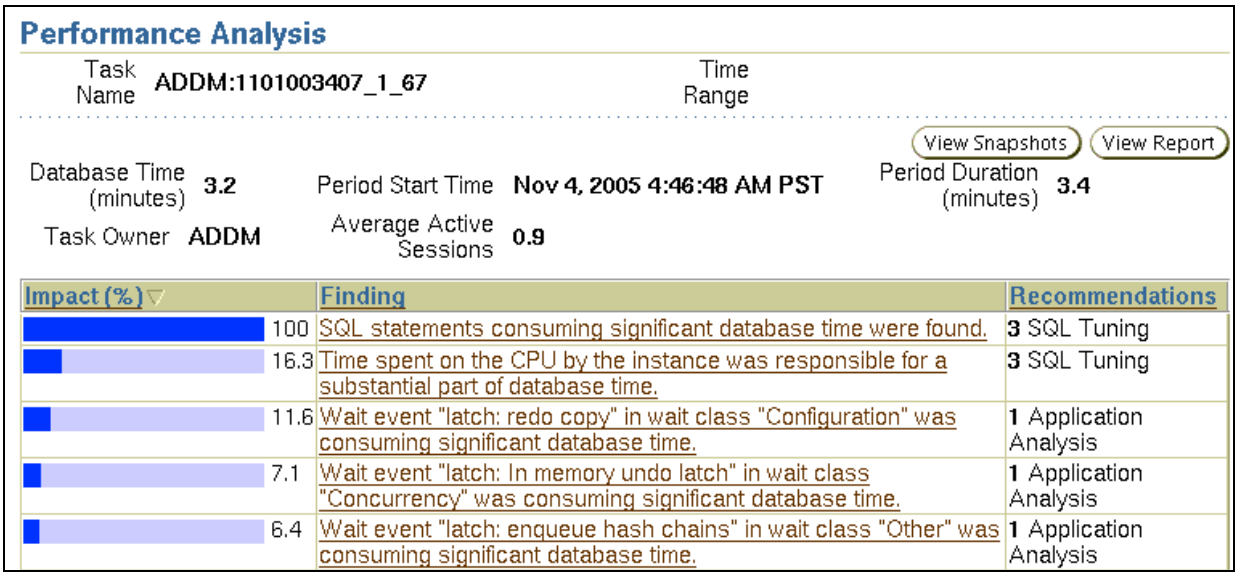
c) After the spike is finished, enter the following in a terminal window:

```
./lab_12_09.sh
```

10. Review the Performance Analysis on the Database home page.

a) Navigate to the Database home page, and then click **Advisor Central** at the bottom of the page.

b) Click the topmost ADDM task name.



You see that there are no longer any schema-related recommendations. By moving the `ADDM` table to the locally managed `TBSADDM2` tablespace, which uses the Automatic Autoextend Segment feature, you obviously fixed the root cause of this problem.

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Solutions for Practice 12: Proactive Maintenance (continued)

11. To not affect other practice session, execute the `lab_12_11.sh` script to clean up your environment.

    a) In a terminal window, enter:

```
./lab_12_11.sh
```

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Solutions for Practice 13: Performance Management

Background: Users are complaining about slower-than-normal performance for operations involving the human resources and order-entry applications. When you question other members of the DBA staff, you find that maintenance was recently performed on some of the tables belonging to the `HR` schema. You need to troubleshoot and make changes as appropriate to resolve the performance problems. SQL script files are provided for you in the `/home/oracle/labs` directory. Other directories are individually named.

1. Log in to SQL*Plus as the `DBA1` user and perform maintenance on tables in the `HR` schema by running the `lab_13_01.sql` script.

   a) Connect to the database as the `DBA1` user and perform some maintenance on the `employees` table by running the `lab_13_01.sql` script.

```
$ cd labs
$ sqlplus dba1/oracle
SQL> @lab_13_01.sql
```

2. You get calls from HR application users saying that a particular query is taking longer than normal to execute. The query is in the `lab_13_02.sql` script. As the HR user, run it.

   a) Enter the following in SQL*Plus , while logged in as the HR user:

```
SQL> @lab_13_02.sql
```

3. Using Enterprise Manager, locate the `HR` session in which the above statement was just executed, and view the execution plan for that statement.

   a) In Enterprise Manager, click **Search Sessions** on the Performance tabbed page.

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b) Change the Filter for the search criteria to "DB User," enter `HR` in the field to the right of that, and then click **Go**.

Database Instance: orcl.oracle.com > Search Sessions Logged in As DBA1

Search Sessions

Search

Specify search criteria

Filter DB User hr Go

For DB User, the search returns all uppercase matches. To run an exact or case-sensitive match, double quote the search string. For other filters, the search returns all case-sensitive matches. You can always use the wildcard symbol (%).

Specify search criteria using WHERE clause Display Columns

Go

(Example: SID > 5 AND USERNAME LIKE 'SCOTT')

Results

SID	DB User	Program	Service	Module	Action	Client	Machine	OS User
159	HR	sqlplus@EDRSR9P1 (TNS V1-V3)	SYS$USERS	SQL*Plus			EDRSR9P1	oracle

c) Click the **SID** number in the **Results** listing.

d) You now see the Session Details page for this session. Click the hash value link to the right of the **Previous SQL** label.

Database Instance: orcl.oracle.com > Top Activity > Session Details: HR (159) Logged in As DBA1

Session Details: HR (159)

Collected From Target **Oct 28, 2005 1:49:13 PM** View Data Real Time: 15 Second Refresh Refresh

Kill Session Enable SQL Trace Disable SQL Trace

General | Activity | Statistics | Open Cursors | Blocking Tree | Wait Event History

Server

Current Status **INACTIVE**
Serial Number **2114**
DB User Name HR
OS Process ID **14577**
Logged On Since **Oct 28, 2005 1:36:20 PM**
Logged On For **12 Minutes, 53 Seconds**
Connection Type **DEDICATED**
Type **USER**
Resource Consumer Group **Unavailable**

Client

OS User Name **oracle**
OS Process ID **14576**
Host **EDRSR9P1**
Terminal **pts/4**
Current Client ID **Unavailable**
Current Client Info **Unavailable**

Application

Current SQL **None**
Current SQL Command **UNKNOWN**
Previous SQL bckcqw5pd108f
Last Call Elapsed Time **12 Minutes, 45 Seconds**
SQL Trace **DISABLED**
Open Cursors 42
Program **sqlplus@EDRSR9P1 (TNS V1-V3)**
Service SYS$USERS
Current Module SQL*Plus
Current Action **Unavailable**

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e) That shows you the SQL Details page for the last SQL statement executed by that session, which is the one in question. Click the **Plan** tab to see the execution plan for the query.

Database Instance: orcl.oracle.com > Top Activity > SQL Details: bckcqw5pd108f Logged in As DBA1

SQL Details: bckcqw5pd108f

Switch to SQL ID [ ] Go View Data [Real Time: Manual Refresh] Refresh Schedule SQL Tuning Advisor

Text

```
select * from hr.employees where employee_id = 200
```

Details

Select the plan hash value to see the details below. Plan Hash Value [1445457117]

Statistics | Activity | **Plan** | Tuning Information

Data Source **Cursor Cache** Capture Time **Oct 28, 2005 1:52:40 PM** Parsing Schema **HR** Optimizer Mode **ALL_ROWS**

Expand All | Collapse All

Operation	Object	Object Type	Order	Rows	Size (KB)	Cost	Time (sec)	CPU Cost	I/O Cost
SELECT STATEMENT			2			3			
TABLE ACCESS FULL	EMPLOYEES	TABLE	1	1	0.066	3	1	57207	3

f) You see in the Operation column that this query is doing a full table scan (TABLE ACCESS FULL). Because you know that the query's condition is an equality comparison on the primary key (`EMPLOYEE_ID`), you decide to investigate the status of the primary key index.

4. Using Enterprise Manager, check to see the status of the `EMPLOYEE` table's index on `EMPLOYEE_ID`. See if it is `VALID`.

   a) Select **Administration** > Schema > Database Objects > **Indexes**.

   b) Select Table Name as the **Search By** value.

   c) Enter `HR` as **Schema Name**.

   d) Enter `employees` for **Object Name**.

   e) Click **Go**, and the list of six indexes appears.

   f) Click the index named `EMP_EMP_ID_PK`.

   g) Click the index link and note that the status of the index is `UNUSABLE`.

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5. Now that you have seen one index with a non-`VALID` status, you decide to check all indexes. Using SQL*Plus, as the `HR` user, find out which `HR` schema indexes do not have `STATUS` of `VALID`. To do this, you can query a data dictionary view with a condition on the `STATUS` column.

   a) Go to the SQL*Plus session where you are still logged in as the `HR` user, and run this query:

```
SQL> select index_name, table_name, status
     from user_indexes where status <> 'VALID';
```

   b) See that the output lists six indexes, all on the `EMPLOYEES` table.

```
SQL> select index_name, table_name, status
  2  from user_indexes where status <> 'VALID';

INDEX_NAME                     TABLE_NAME                     STATUS
------------------------------ ------------------------------ --------
EMP_EMAIL_UK                   EMPLOYEES                      UNUSABLE
EMP_EMP_ID_PK                  EMPLOYEES                      UNUSABLE
EMP_DEPARTMENT_IX              EMPLOYEES                      UNUSABLE
EMP_JOB_IX                     EMPLOYEES                      UNUSABLE
EMP_MANAGER_IX                 EMPLOYEES                      UNUSABLE
EMP_NAME_IX                    EMPLOYEES                      UNUSABLE

6 rows selected.

SQL>
```

6. Using Enterprise Manager, reorganize all the indexes in the `HR` schema that are marked as `UNUSABLE`.

   a) In Enterprise Manager, on the page displaying the `EMP_EMP_ID_PK` index, select **Reorganize** in the **Actions** list, and then click **Go**.

   b) Click **Add**, to add each of the other five indexes to the reorganization operation.

   c) In the Add screen, choose Indexes for the **Type** drop-down list, and enter `hr` in the **Schema** field.

   d) Click **Search**.

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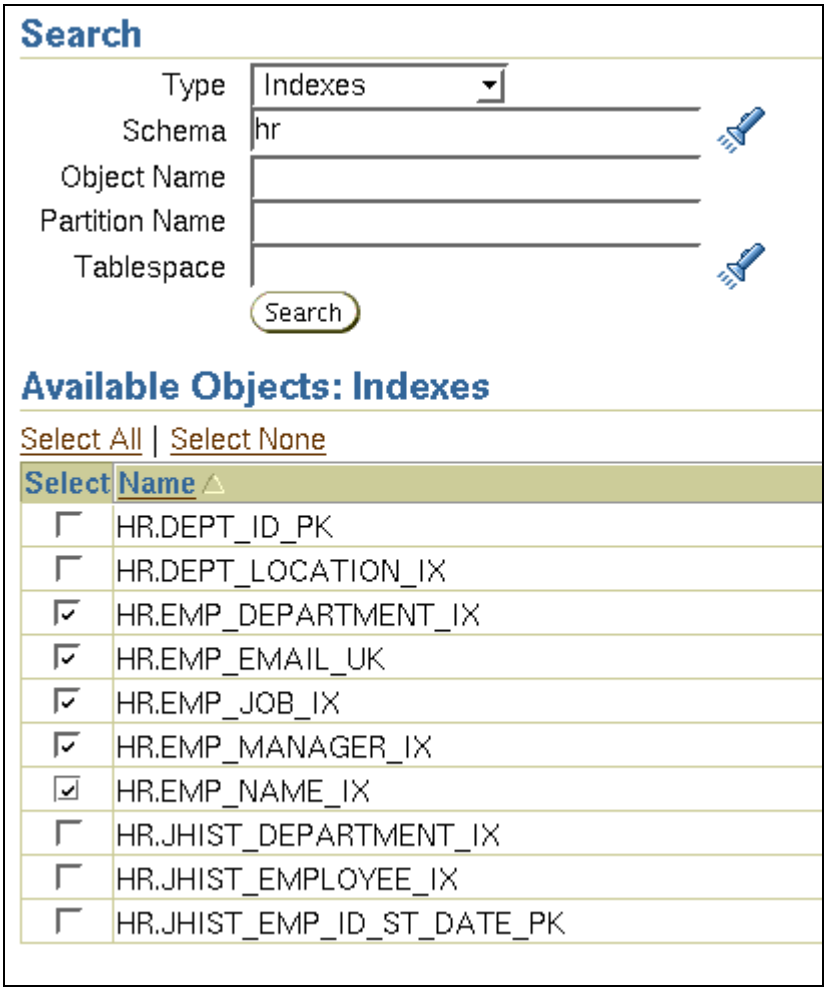
e) Select the five other indexes whose names start with "`EMP_`."



f) Click **OK**.

g) Click **Next**.

h) Keep all the default settings for **Options**, and then click **Next**.

i) Note that there are no problems reported on **Impact Report**, and then click **Next**.

j) On the Schedule page, enter `oracle` and `oracle` for Username and Password under **Host Credentials**.

k) Click **Next**.

l) On the Review page, click **Submit Job**.

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m) After the Confirmation page appears, click the job name to see its status. Click **Reload** on your browser until you see the job has succeeded.

Job Run: REORGANIZE_ORCL.ORACLE.COM_1 at Oct 28, 2005 2:03:27 PM GMT-07:00

Page Refreshed **Oct 28, 2005 2:03:46 PM** Delete Run Edit

Scheduled **Oct 28, 2005 2:03:27 PM GMT-07:00**
Targets **orcl.oracle.com**
Type **Reorganize**
Owner **DBA1**
Description

Executions

Status All Go

A job run is made up of one or more executions. An execution has zero or more targets. The Retry operation will run immediately and may skip steps that are already completed successfully. The Stop and Suspend operations will wait for the current step of a running execution to complete. The Suspend operation will prevent a scheduled execution from running at its scheduled time. A suspended job can be resumed later.

Stop

Select	Targets	Status	Started	Ended	Elapsed Time (seconds)
	orcl.oracle.com	Succeeded	Oct 28, 2005 2:03:29 PM GMT-07:00	Oct 28, 2005 2:03:45 PM GMT-07:00	16

7. Return to the SQL*Plus session where the HR user is logged in, and run the `lab_13_07.sql` script to execute the same kind of query. Then, repeat the steps to see the plan of the last SQL statement executed by this session, to see if the plan has changed.

   a) Enter the following at the SQL*Plus prompt:

```
SQL> @lab_13_07.sql
```

   b) Repeat the tasks listed in step 3. Note that the plan now uses the index.

Operation	Object	Object Type
SELECT STATEMENT		
TABLE ACCESS BY INDEX ROWID	EMPLOYEES	TABLE
INDEX UNIQUE SCAN	EMP_EMP_ID_PK	INDEX (UNIQUE)

   c) Quit the SQL*Plus session.

8. What is the difference in execution plans, and why?

   Answer: The statement execution uses a unique index scan instead of a full table scan, because the index is usable after your index reorganization.

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9. Simulate a working load on your instance by running the `lab_13_09.sql` script as the `DBA1` user. Please note the SID value for task 10.

   Possible answer: 147 (Your answer is most likely a different one).

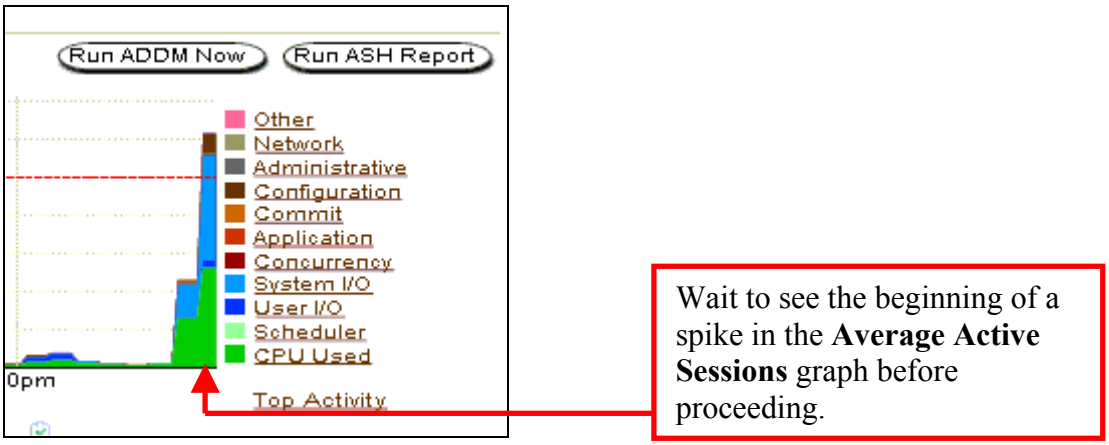
   This script takes about 20 minutes to complete. So, run it in a separate terminal window and continue with this practice exercise while it runs.

   Note: Because this script generates a fairly heavy load in terms of CPU and disk I/O, you will notice that response time for Database Control is slower.

```
$ sqlplus dba1/oracle
SQL> @lab_13_09.sql
```

   a) In Enterprise Manager, navigate to the Performance page, and investigate system performance.

   b) You may need to wait a minute or two to see the effects of the load generation script appear on the graphs.



   Question 1: In the **Average Active Sessions** graph, which are the two main categories that active sessions are waiting for?

   Answer: System I/O and CPU Used

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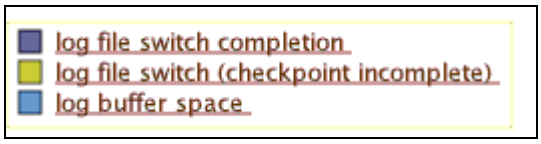
Question 2: In the Configuration category of waits, what is one of the contributors to the wait time? Click Configuration to see the graph.

Answer: Any one of these:



Question 3: Click Back, and then click Physical Writes on the Instance Disk I/O graph. Determine which process is doing the most writing to the disk.

Answer: `DBW0`

c) Click **Back**.

d) Click **Top Activity** in the **Additional Monitoring Links** region.

e) Click the **SQL ID** of the first SQL statement listed in the **Top SQL** region.

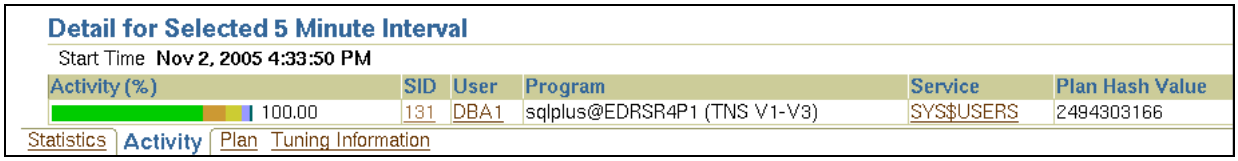
f) See the first SQL statement.

Question 4: What SQL statement is causing the most waits?

Answer: `delete from sh.sales_copy`

10. Kill the session that is generating the load. Use the session ID recorded in step 9. The session ID should be listed at the top of the list on the right side of the page, under the **Top Sessions** region.

    a) Click the SID number for the session ID recorded earlier. This is found under the heading **Detail for Selected 5 Minute Interval.**



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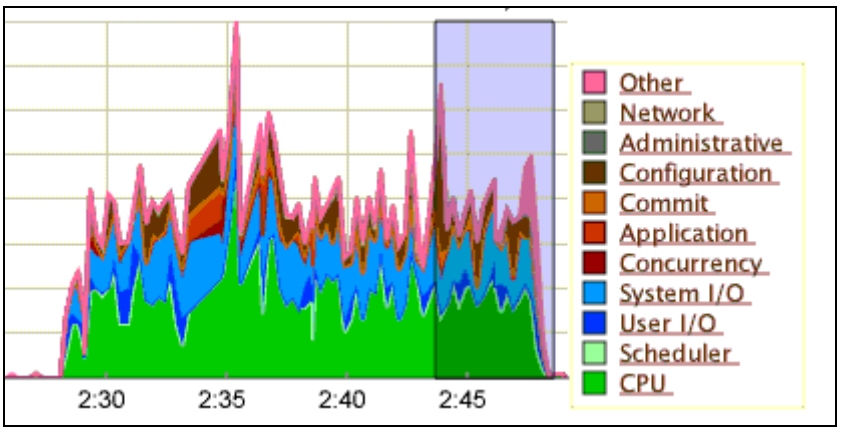
b) On the Session Details page, click **Kill Session**, and then click **Yes** to confirm.

Note: If you remain on this Session Details page long enough for a few automatic refreshes to be done, you may see the following warning, which means you are attempting to refresh information about a session that's already been killed. You can ignore this warning.

c) Click **Top Activity** in the navigation history at the top of the page. Note that the session activity in the database has declined considerably.



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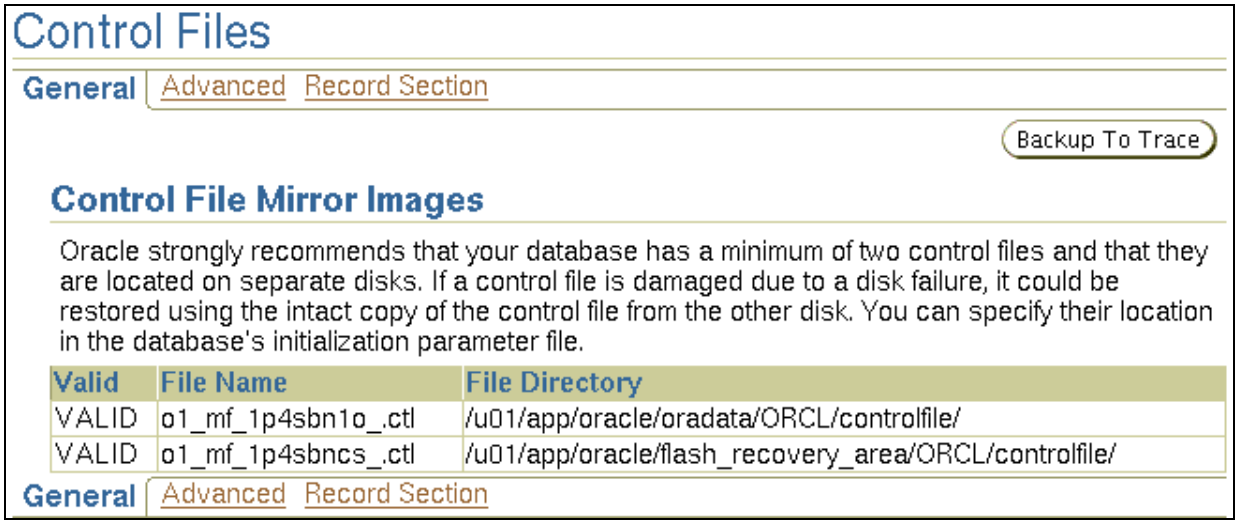
Solutions for Practice 14: Backup and Recovery Concepts

Background: Your `ORCL` database is ready to move from test or development into production. Configure your database to reduce the chances of failure or data loss.

1. Verify that you have two control files to ensure redundancy.

   a) Invoke Enterprise Manager as the `DBA1` user in the `SYSDBA` role for your `ORCL` database.

   b) Select **Administration** > Database Administration > Storage > **Control Files**.



   c) *Question 1:* How would you add another control file if you needed to?

   Answer: Adding a control file is a manual operation. To perform this, you must:

   - Shut down the database
   - Use the operating system to copy an existing control file to the location where you want your new file to be
   - Start the database by using Enterprise Manager. Unlike a normal startup, you would use Advanced Options to select a different startup mode. Select "Start the instance" to leave the instance in the `NOMOUNT` state.
   - Edit the `CONTROL_FILES` initialization parameter to point to the new control file
   - Continue the `STARTUP` database operation until the database is in an open state

   Note: This answer does not apply to an OMF database, as the control files in that case would have to all be recreated.

2. Check how many members each redo log group has. Ensure that there are at least two redo log members in each group. In what directory or directories are the redo log files stored?

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a) Select **Administration** > Database Administration > Storage > **Redo Log Groups**, and note how many members are in the "# of Members" column. There should be two per group.

Selection Mode Single — Create

Edit View Delete Actions **Clear logfile** Go

Select	Group	Status	# of Members	Archived	Size (KB)	Sequence	First Change#
◉	1	Inactive	2	No	51200	26	1408043
○	2	Inactive	2	No	51200	27	1424729
○	3	Current	2	No	51200	28	1452632

b) Select the first group, and then click **Edit** to see the member file names. Note that one member is in directories under the `oradata` directory, and another is in the Flash Recovery Area. Click the browser's **Back** button.

Redo Log Members

Add

Edit Remove

Select	File Name	File Directory
◉	o1_mf_1_1p4sbq1m_.log	/u01/app/oracle/oradata/ORCL/onlinelog/
○	o1_mf_1_1p4sbs8b_.log	/u01/app/oracle/flash_recovery_area/ORCL/onlinelog/

Note: In a production database, you want to ensure that the two members are on different hard drives, preferably with different disk controllers, to minimize the risk of any single hardware failure destroying an entire log group.

3. You notice that, for each log group, the `Archived` column has a value of `No`. This means that your database is not retaining copies of redo logs to use for database recovery, and in the event of a failure, you will lose all data since your last backup. Place your database in `ARCHIVELOG` mode, so that redo logs will be archived.

a) Create a new directory `/u01/app/oracle/archive` as the destination for the redo log files.

- In a terminal window, enter **`cd /u01/app/oracle`**.

- Then, enter **`mkdir archive`**.

- Optionally, enter **`ls -l`** to view your new directory and its OS permissions.

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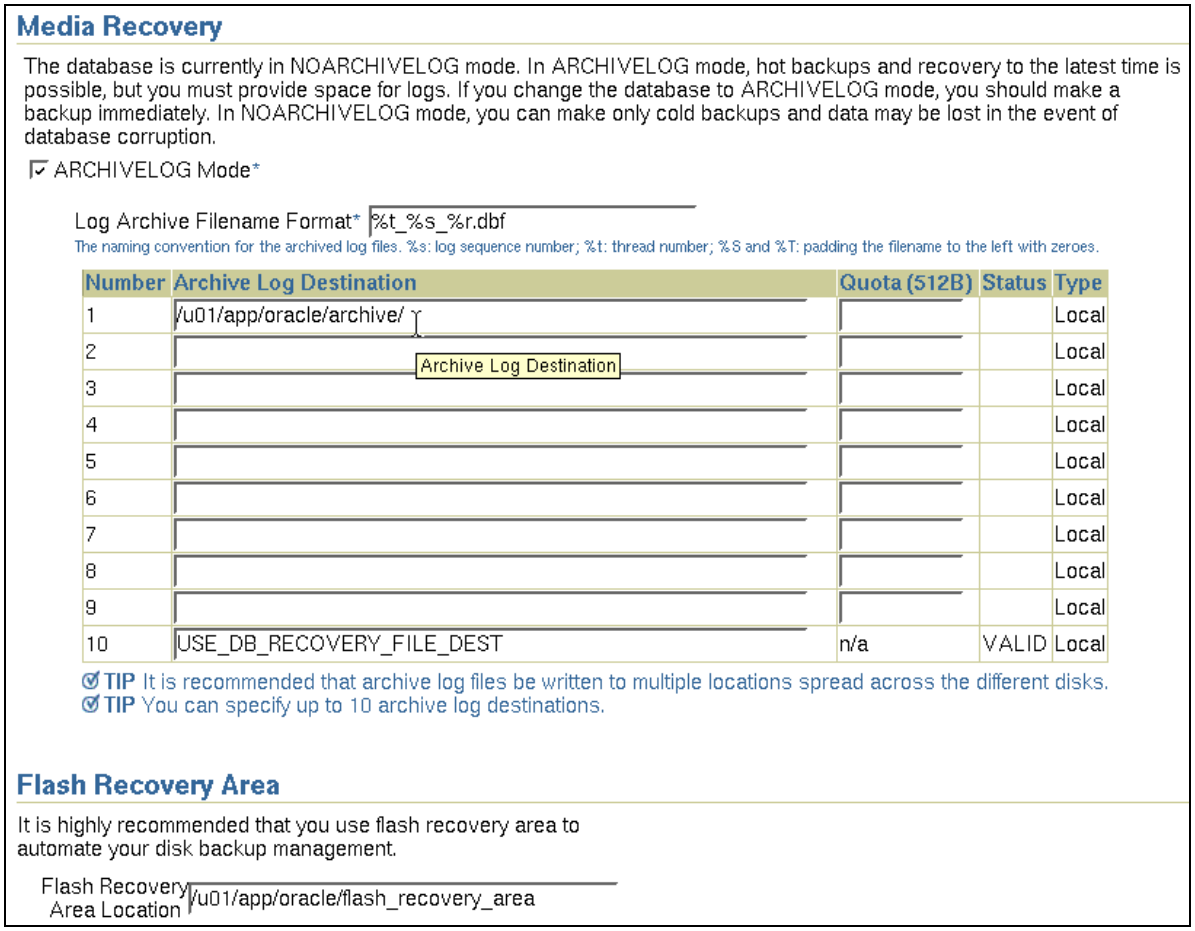
b) In Enterprise Manager, select **Maintenance** > High Availability > Backup/Recovery Settings > **Recovery Settings**.

c) In the **Media Recovery** region, select the **ARCHIVELOG Mode** check box.

d) Verify that Log Archive Filename Format contains `%t`, `%s`, and `%r`.

4. Configure redundant archive log destinations—one to the Flash Recovery Area and the other to `/u01/app/oracle/archive`.



Notice that the database is preconfigured to save archived logs to the Flash Recovery Area by default (Archive Log Destination 10). Add an additional Archive Log Destination so that you will have redundant copies of your log files.

a) In **Archive Log Destination** number 1, enter `/u01/app/oracle/archive/`. The directory path should end with a slash. Leave **Quota** blank.

Note: You must create the directory, if it does not already exist. You already did this in step (3).

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b) Optionally, click **Show SQL**, review the statements, and then click **Return**.

Show SQL

```
ALTER SYSTEM SET log_archive_dest_1 =
"LOCATION=/u01/app/oracle/archive/ OPTIONAL REOPEN=300" SCOPE=BOTH
ALTER SYSTEM SET log_archive_dest_10 =
"LOCATION=USE_DB_RECOVERY_FILE_DEST OPTIONAL REOPEN=300" SCOPE=BOTH
```

c) Click **Apply**. When prompted whether you want to restart the database now, click **Yes**.

Database: orcl > Restart Database:Specify Host and Target Database Credentials Logged in As SYS

Restart Database:Specify Host and Target Database Credentials

Specify the following credentials in order to restart the database.

Host Credentials

Specify the OS user name and password to login to target database machine.

* Username oracle
* Password ******

Database Credentials

Specify the credentials for the target database.
To use OS authentication, leave the user name and password fields blank.

* Username sys
* Password ******
Database orcl
* Connect As SYSDBA
☑ Save as Preferred Credential

Note that you need to login to the database as SYSDBA or SYSOPER in order to restart the database.

d) Enter the credentials to restart the database, and then click **OK**.

e) When asked to confirm, click **Yes** again.

Now that your database is in `ARCHIVELOG` mode, it will continually archive a copy of each online redo log file before reusing it for additional redo data.

Note: Remember that this consumes space on the disk and that you must regularly back up older archive logs to some other storage.

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Solutions for Practice 15: Performing Database Backups

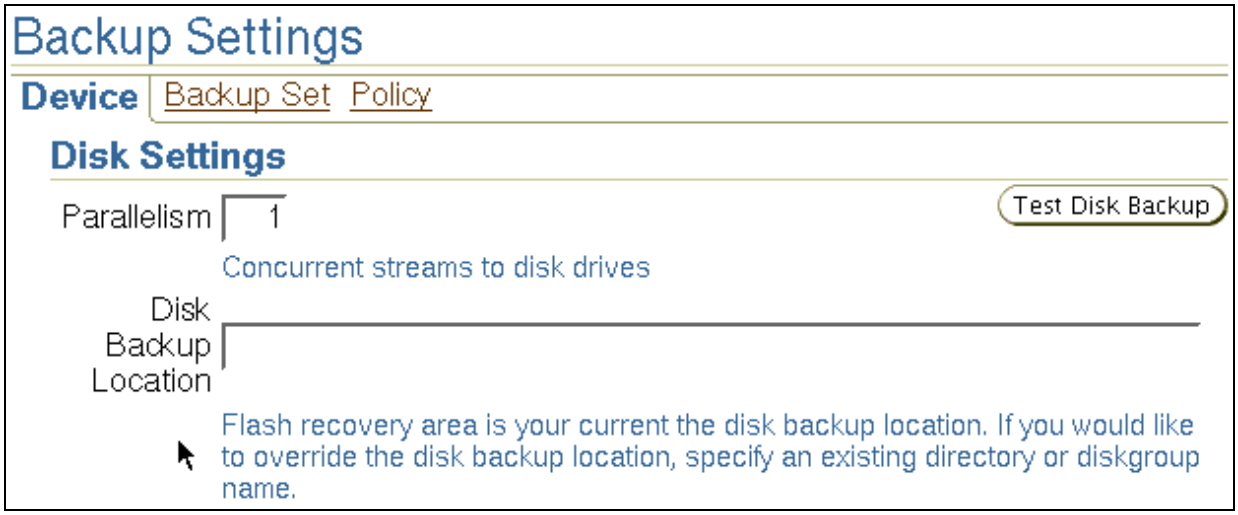
Background: Your database is ready to move from development and test into production. Ensure that your database is configured so that recovery is possible without loss of data.

1. What is the difference between a backup set and an image copy?

   Answer: A backup set contains data and archive log files packed in an Oracle proprietary format. Files must be extracted before use. Image copies are the equivalent of operating system file copies and can be used to restore operations immediately.

2. What is the destination of any disk backups that are done?

   a) In Enterprise Manager, select **Maintenance** > High Availability > Backup/Recovery Settings > **Backup Settings**. Note the message under the Disk Backup Location that says the Flash Recovery Area is the current disk backup location.



3. Test making a backup to disk, as a backup set, with `oracle` for Host Credentials.

   a) Select **Backup Set** as your Disk Backup Type.

   b) Scroll to the bottom and enter `oracle` and `oracle` for **Host Credentials Username** and **Password** for your server.

   c) Click **Test Disk Backup**.

   d) When the test finishes, click **OK**.

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4. Back up your entire database, without archived logs, while the database is open for user activity. This backup should be the base for an incremental backup strategy.

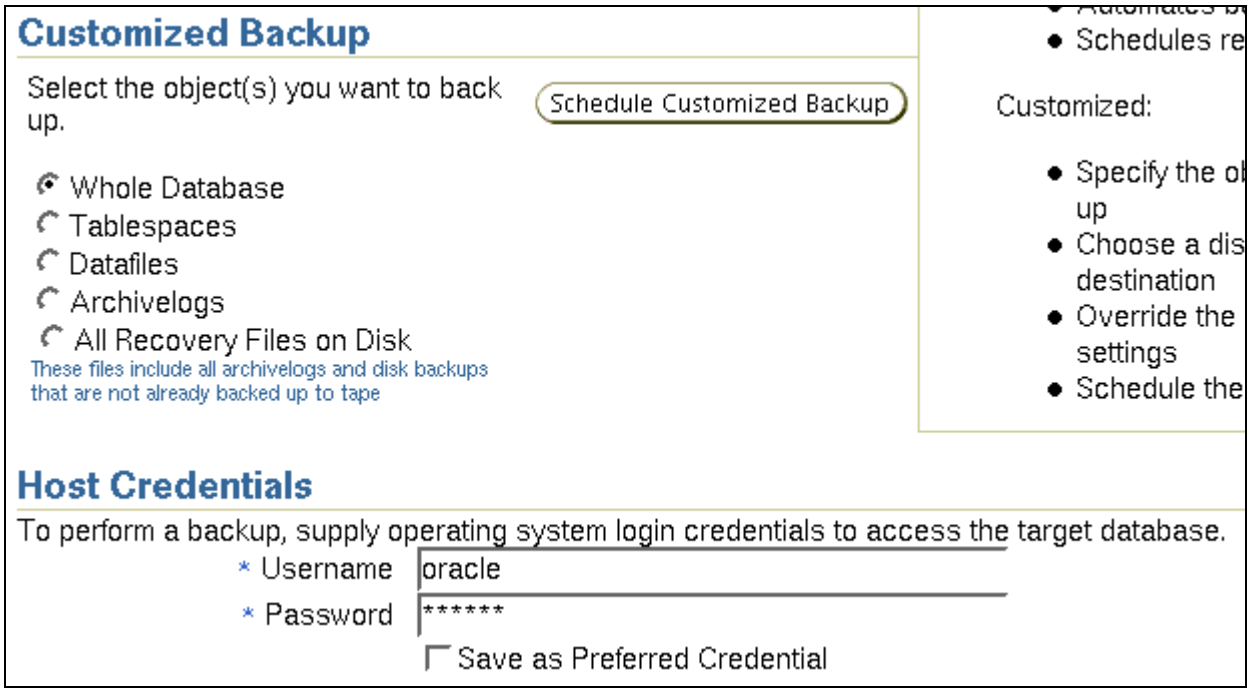
   Question: What prerequisite *must* be met to create a valid backup of a database without shutting it down?

   Answer: The database must be in `ARCHIVELOG` mode. Backups made with the database open but not in `ARCHIVELOG` mode cannot be used for recovery.

   a) Select **Maintenance** > High Availability > Backup/Recovery > **Schedule Backup**.

   b) Select **Whole Database** as the object to be backed up.

   c) Enter `oracle` and `oracle` for **Host Credentials Username** and **Password** for your server.



   d) Click **Schedule Customized Backup**.

   e) Select **Full Backup** for your Backup Type, and select the **Use as the base of an incremental backup strategy** check box.

   f) Select **Online Backup** as Backup Mode.

   g) In the **Advanced** region, deselect the **Also backup all archived logs on disk** check box, and then click **Next** to continue.

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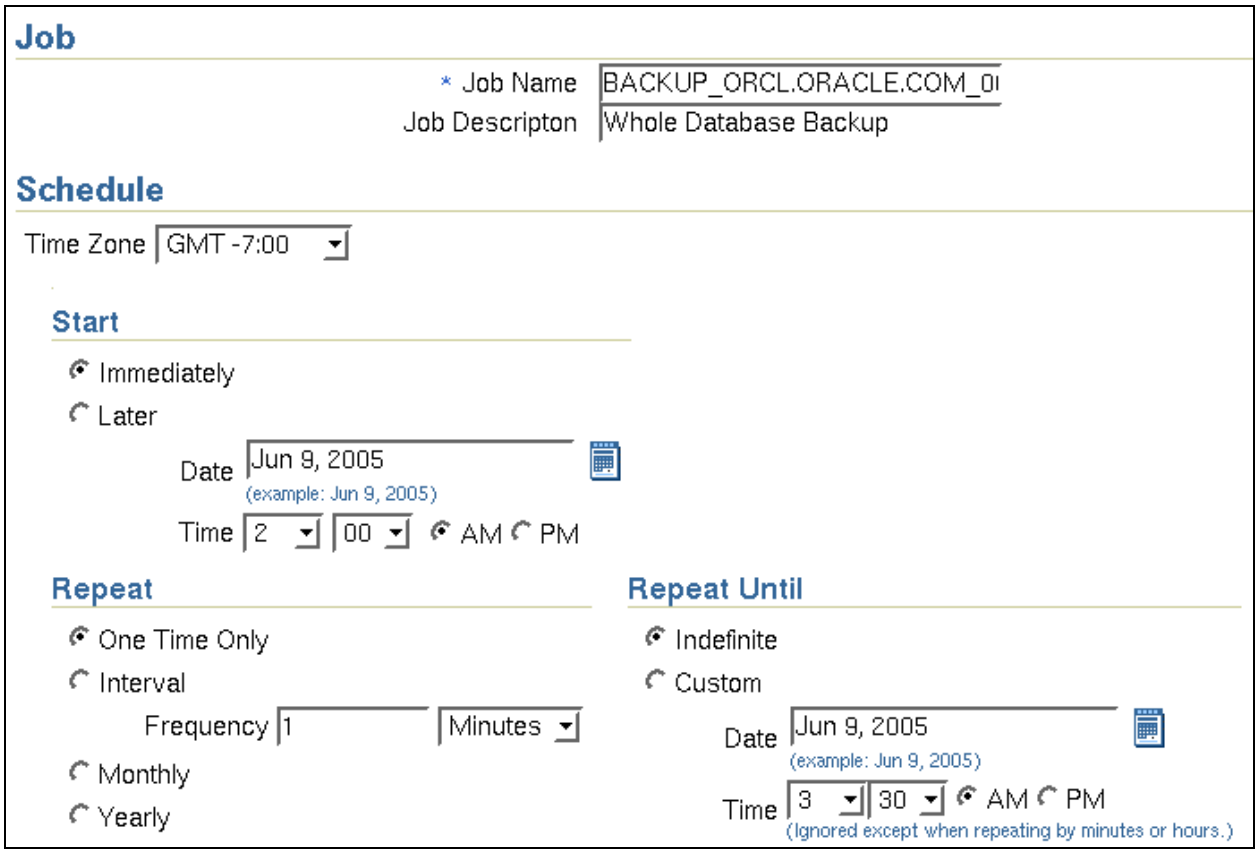
h) Select **Disk** for your backup location (notice that your Disk Backup Location is retained from step [2]). Click **Next** to continue.

i) Accept all the defaults on the Schedule page, and then click **Next** to continue.



j) Click **Submit Job** to perform the online database backup.

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k) Click **View Job** to monitor the status of the backup job. This backup takes approximately five minutes to complete.

Execution: orcl.oracle.com

Page Refreshed **Jun 9, 2005 4:34:54 AM** Delete Run Edit

Summary

The Stop and Suspend operations will wait for the current step to complete. A suspended job can be resumed later, at the next step. Stop

Status	**Running**	Type	**Database Backup**
Scheduled	**Jun 9, 2005 4:34:35 AM GMT-07:00**	Owner	**SYS**
		Description	**Whole Database Backup**
Started	**Jun 9, 2005 4:34:37 AM GMT-07:00**	Host Username	**oracle**
		Database Connect String	(DESCRIPTION=(ADDRESS_LIST=(ADDR...
Start Delayed	**2 seconds**	Database Username	**SYS**
Elapsed Time	**16 seconds**	Database Role	**[SYSDBA]**
		Oracle Home	[/u01/app/oracle/product/10.2.0/...]
		Oracle SID	**[orcl]**
		Version 10g or higher	**YES**
		Backup Strategy	**advanced**
		Offline Backup	**NO**
		Blackout	**NO**
		Database Name	**ORCL**
		Backup Script	Show

5. Schedule nightly disk-based incremental online backups for your whole database, without archived logs. Schedule it for 11:00 p.m. The schedule should be in effect indefinitely.

   a) In Enterprise Manager, select **Maintenance** > High Availability > Backup/Recovery > **Schedule Backup**.

   b) Select **Whole Database** as the object to be backed up.

   c) Enter `oracle` and `oracle` for **Host Credentials Username** and **Password** for your server, and then click **Schedule Customized Backup**.

   d) Select **Incremental Backup (Level 1)** for your Backup Type.

   e) Select **Online Backup** as Backup Mode.

   f) In the **Advanced** region, deselect the **Also backup all archived logs on disk** check box, and then click **Next** to continue.

   g) Select **Disk** as your backup location, and then click **Next** to continue.

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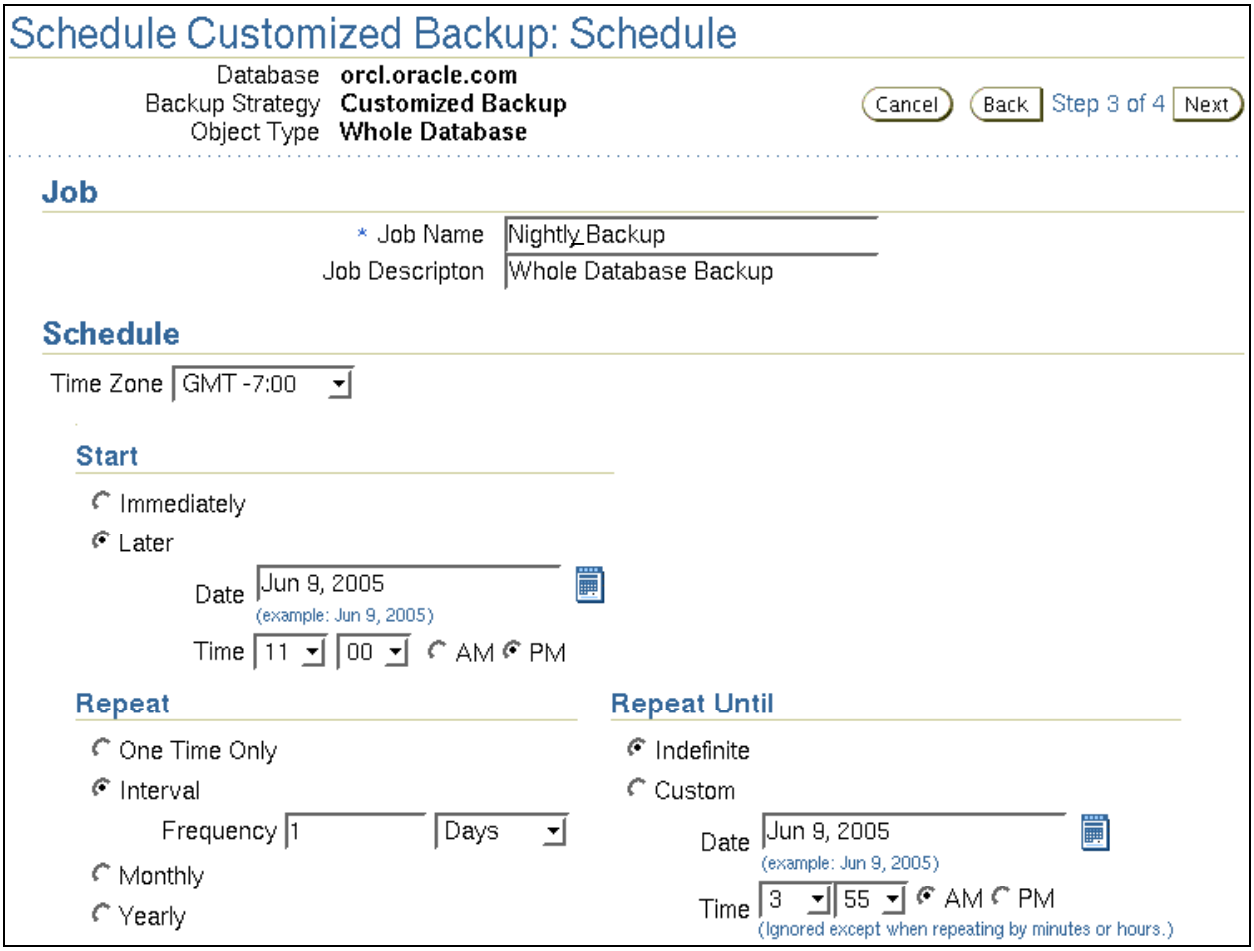
h) Change **Job Name** to `Nightly_Backup` and accept the default value for **Job Description**.

i) Select **Later** in the **Start** region. Accept today's date and use the drop-down lists and option buttons to select 11:00 p.m. for **Time**.

j) In the **Repeat** area, select **Interval**, and **Frequency** `1 Days`.

k) Select **Indefinite** in the **Repeat Until** region, and then click **Next**.



l) Click **Submit Job**, and then click **OK**.

m) Navigate to **Maintenance** > Related Links > **Jobs** to see the scheduled job in the **Job Activity** list.

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Solutions for Practice 16: Performing Database Recovery

Background: Many failures of the Oracle database can be traced to some sort of media failure, such as disk or controller failure. Recover your database from a variety of simulated media failures. SQL script files are provided for you in the `/home/oracle/labs` directory. If needed, use appendix C for Linux and appendix D for SQL syntax. Note that where OS file names are mentioned, your system may possibly have different file names than shown here.

1. Recover from the loss of a control file.

   a) As the `DBA1` user, run the `lab_16_01_a.sql` script to prepare some procedures to be called by the rest of this practice.

   ```
   @$HOME/labs/lab_16_01_a.sql
   ```

   b) Now run the `lab_16_01_b.sql` script. This script deletes one of your control files.

   ```
   @$HOME/labs/lab_16_01_b.sql
   ```

   c) The Help desk begins receiving calls saying that the database appears to be down. Troubleshoot and recover as necessary. Use Enterprise Manager's Database page to attempt to start up the database, and use SQL*Plus, if needed.

   - In Enterprise Manager, navigate to the Database page. It reports that the database is down and offers you the chance to start it up again. Attempt to do so by clicking **Startup**. You may need to wait one or two minutes before the page appears as described. If you see a Connection Refused message, ignore it; the connection will eventually be established.

   - Enter host credentials as `oracle` for **Username** and **Password**, and then click **OK**.

   - When asked whether you are sure that you want to start the database, click **Yes**.

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d) The startup of the instance fails with Enterprise Manager, and you can get no other information to explain the failure. So use the command-line tools.

- Connect to the instance with SQL*Plus `as sysdba` and check the current status of the instance.

```
sqlplus / as sysdba
select status from v$instance;
```

- The instance status is `STARTED`, which means that the database is in the `NOMOUNT` stage. Attempt to mount the database by entering this:

```
SQL> alter database mount;
```

```
SQL> alter database mount;
alter database mount
*
ERROR at line 1:
ORA-00205: error in identifying control file, check alert log for more info
```

e) The instance cannot move to the mount stage because it cannot find one of the control files. Check the last 10 rows of the alert log to see which control file is the problem.

```
SQL> host tail -10 $ORACLE_BASE/admin/orcl/bdump/aler*
```

Output:

```
SQL> host tail -10 $ORACLE_BASE/admin/orcl/bdump/aler*
ORA-205 signalled during: ALTER DATABASE   MOUNT...
Sun Oct 30 13:35:01 2005
alter database mount
Sun Oct 30 13:35:01 2005
ORA-00202: control file:
'/u01/app/oracle/flash_recovery_area/ORCL/controlfile/o1_mf_1p4sbncs_.ct
l'
ORA-27037: unable to obtain file status
Linux Error: 2: No such file or directory
Additional information: 3
Sun Oct 30 13:35:01 2005
ORA-205 signalled during: alter database mount...
```

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f) The control file in the Flash Recovery Area is missing. Restore the missing control file by copying the existing control file, and then mount and open the database.

```
SQL> host
$ cd /u01/app/oracle/oradata/ORCL/controlfile
$ ls -l
total 6908
-rw-r-----  1 oracle  oinstall  7061504 Oct 30 13:32 o1_mf_1p4sbn1o_.ctl
$ cp o1_mf_1p4sbn1o_.ctl
/u01/app/oracle/flash_recovery_area/ORCL/controlfile/o1_mf_1p4sbncs_.ctl
$ exit
```

```
SQL> alter database mount;
```

```
SQL> alter database open;
```

g) Why did you have to use two commands to move the instance state from `NOMOUNT` to `OPEN`?

Answer: Because the `ALTER DATABASE` command enables you to change only one state level per command

h) Why did you use operating system commands to restore the control file instead of using Oracle Recovery Manager?

Answer: Because all control files are identical. As long as any one control file is intact, it can be used to restore the others.

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Solutions for Practice 16: Performing Database Recovery (continued)

2. Recover from the loss of an application data file.

   a) Start a SQL*Plus session as the `DBA1` user, and run the `lab_16_02.sql` script. This script deletes one of your application data files.

```
$ sqlplus dba1/oracle @$HOME/labs/lab_16_02.sql
```

   b) The Help desk has received a call from a user who is unable to access the `COUNTRIES` table in the `HR` application schema. Count the rows in the table to see whether there is a problem.

```
SQL> select count(*) from HR.COUNTRIES;
select count(*) from HR.COUNTRIES
                        *
ERROR at line 1:
ORA-01116: error in opening database file 5
ORA-01110: data file 5:
'/u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1p4sd3y2_.dbf'
ORA-27041: unable to open file
Linux Error: 2: No such file or directory
Additional information: 3
```

   c) Troubleshoot and recover as necessary. The error message suggests that the data file for the `EXAMPLES` tablespace is corrupt or missing. Using operating system commands, verify that there is a problem with the file.

```
SQL> host ls
/u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1p4sd3y2_.dbf
ls: /u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1p4sd3y2_.dbf:
No such file or directory
```

   d) Recover the data file to the current time, specifying the missing data file to be recovered.

      - In Enterprise Manager, select **Maintenance** > High Availability > Backup/Recovery > **Perform Recovery**.

      - Select **Datafiles** from the **Object Type** drop-down list.

      - In the Object Level Recovery region, select **Recover to current time** for the **Operation Type**.

      - Enter the host credentials as `oracle` and `oracle` for **Username** and **Password**, and then click **Perform Object Level Recovery**.

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- On the Datafiles page, select the data file in question.

Select	Datafile Name	Datafile Number	Status	Enabled
☑	/u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1p4sd3y2_.dbf	5	ONLINE	READ WRITE

- Click **Next**.

- Because the problem is simply a deleted file rather than a bad hard drive, there is no need to restore the file to a different location. Select **No. Restore the files to the default location**, and then click **Next**.

- Click **Submit**. (*It will take one or two minutes for the operation to complete.)*

e) When you see the Operation Succeeded message, ensure that the restored data file is online.

- In Enterprise Manager, select **Administration** > Database Administration > Storage > **Datafiles**.

Datafiles

Object Type Datafile

Search

Select an object type and optionally enter an object name to filter the data that is displayed in your results set.

Object Name

Go

By default Datafiles are case-sensitive searches. To run an exact match, double quote the search string. You can use the wildcard symbol (%) in a double quoted string.

Create

Edit View Delete Actions Create Like Go

Select	File Name	Tablespace	Status	Size (MB)	Used (MB)	Used (%)
◉	/u01/app/oracle/oradata/ORCL/datafile/inventory01.dbf	INVENTORY	ONLINE	50.000	42.188	84.38
○	/u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1pbkt0j1_.dbf	EXAMPLE	ONLINE	100.000	68.250	68.25
○	/u01/app/oracle/oradata/ORCL/datafile/o1_mf_sysaux_1p4s741n_.dbf	SYSAUX	ONLINE	270.000	264.812	98.08
○	/u01/app/oracle/oradata/ORCL/datafile/o1_mf_system_1p4s740z_.dbf	SYSTEM	SYSTEM	490.000	480.688	

f) Verify that the `COUNTRIES` table is now accessible.

```
SQL> select count(*) from HR.COUNTRIES;

  COUNT(*)
----------
        25
```


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3. Recover from the loss of a system data file.

   a) Why is recovery from the loss of a system data file or a data file belonging to an undo tablespace different from recovering an application data file?

   Answer: Because recovery of system or undo data files must be done with the database closed, whereas recovery of an application data file can be done with the database open and available to users.

   b) As `SYSDBA`, run the `lab_16_03.sql` script. This script deletes the system data file.

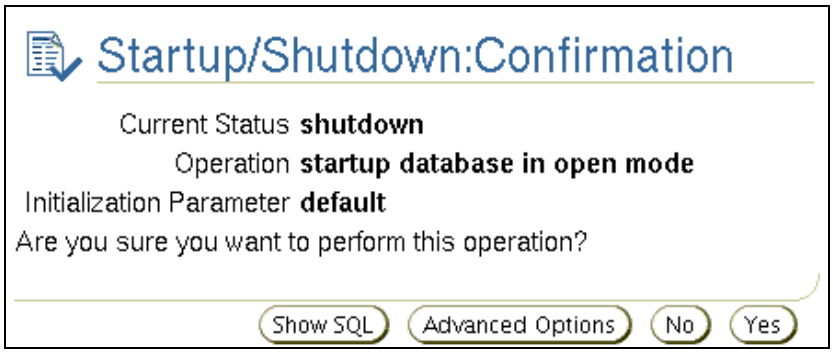
```
SQL> @lab_16_03.sql

PL/SQL procedure successfully completed.

ORACLE instance shut down.
SQL>
```

   c) In Enterprise Manager, review the Database home page. The database is shut down, so you click **Startup** to try to open it. If you see a message that says the connection was refused, dismiss it, and reenter the EM home page URL in the browser.

   - Enter the host credentials as `oracle` and `oracle` for the host **Username** and **Password**, and enter `DBA1` and `oracle` for the database credentials, and then click **OK**.



   - Click **Yes**.

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d) This command will fail with the database left in the `MOUNT` state, because there is a data file missing from the `SYSTEM` tablespace.

e) Click **Perform Recovery**.

- If prompted, enter host (`oracle/oracle`) and database (`dba1/oracle AS SYSDBA`) credentials, and then click **Continue**.
- In the **Object Level Recovery** region, select **Datafiles** for Object Type.
- Select **Recover to current time** for **Operation Type**.
- Fill in the host credentials if not already set, and then click **Perform Object Level Recovery**.
- Select the data file for the `SYSTEM` tablespace, and then click **Next**.
- Because the problem is simply a deleted file rather than a bad hard drive, there is no need to restore to a different location. Select **No. Restore the files to the default location**, and then click **Next**.
- Click **Submit**. It will take three to four minutes for the operation to complete.

f) When you see the Operation Succeeded message, click **Open Database**.

g) After you see the success message, click **OK**, and then verify that the database is open and operating normally by logging into EM as `DBA1/oracle, as SYSDBA`, and reviewing the Database home page.

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Solutions for Practice 17: Performing Flashback

Background: You decide to gain hands-on experience in some of the flashback functionality. To avoid impacting other users, you will first copy the `DEPARTMENTS` table of the `HR` schema to `DEPARTMENTS2`.

1. Log in to SQL*Plus as `DBA1` user and create a new `HR.DEPARTMENTS2` table based on the `HR.DEPARTMENTS` table.

   a) Log in to SQL*Plus as `dba1/oracle`.

```
$ sqlplus dba1/oracle
```

   b) Enter the following command to create the copy table:

```
SQL> create table hr.departments2 as select * from hr.departments;
```

   c) Count the rows in the `DEPARTMENTS2` table. There should be 27 rows.

```
SQL> SELECT COUNT(*) FROM HR.DEPARTMENTS2;

  COUNT(*)
----------
        27
```

2. Drop the `HR.DEPARTMENTS2` table, and then verify that it has indeed been dropped.

```
SQL> DROP TABLE HR.DEPARTMENTS2;

Table dropped.

SQL> SELECT * FROM HR.DEPARTMENTS2;
SELECT * FROM HR.DEPARTMENTS2
                 *
ERROR at line 1:
ORA-00942: table or view does not exist
```

3. Use the `FLASHBACK TABLE` command to restore the table. Count the rows in the `DEPARTMENTS2` table.

```
SQL> FLASHBACK TABLE hr.departments2 TO BEFORE DROP;

Flashback complete.

SQL> SELECT COUNT(*) FROM hr.departments2;

  COUNT(*)
----------
        27
```


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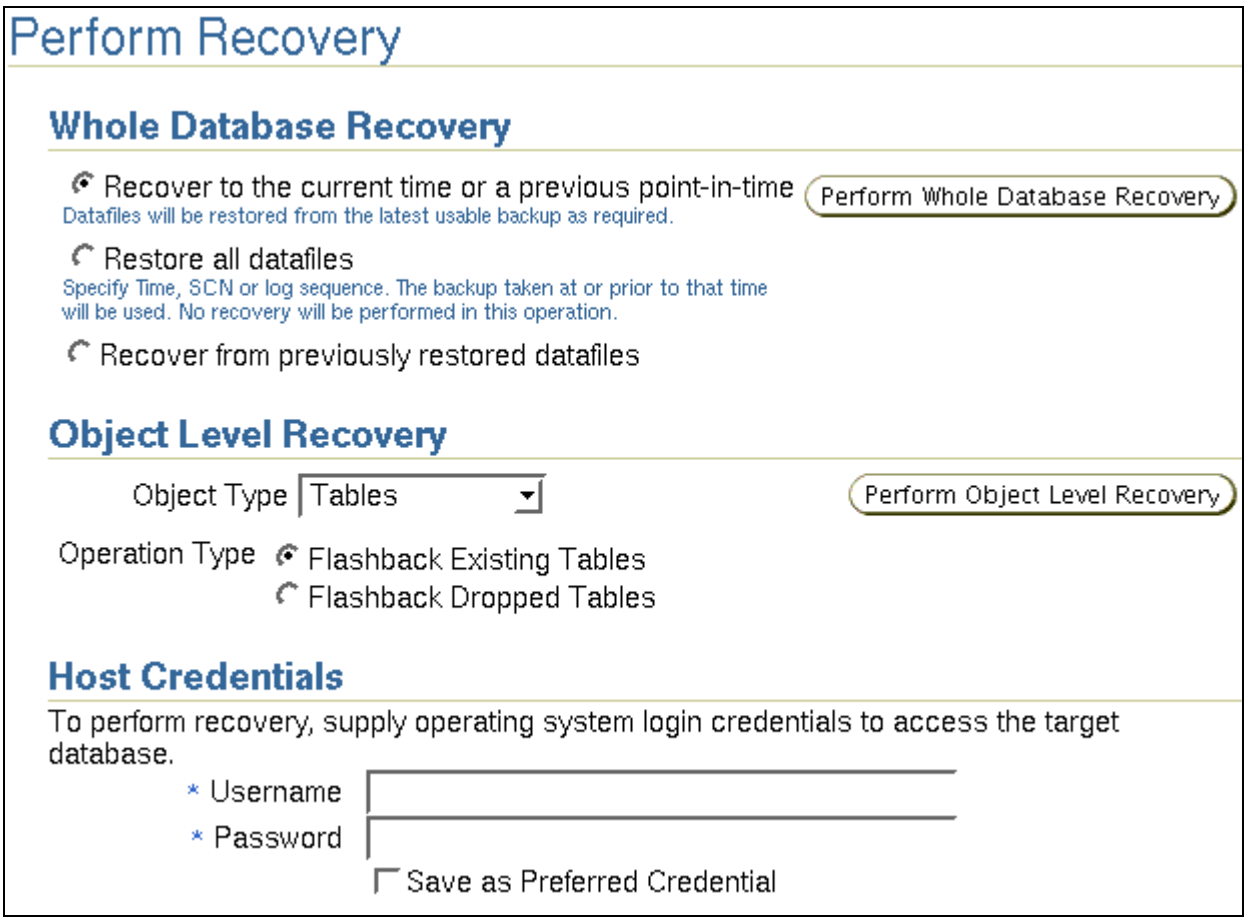
4. Run the `lab_17_04.sql` script to insert three rows into the `HR.DEPARTMENTS2` table by using three separate transactions. The new rows have `DEPARTMENT_ID` values of `280`, `290`, and `300`.

```
SQL> @lab_17_04.sql
```

5. Use Enterprise Manager to perform flashback to the version of the table where only the first of the three new rows is present (with `DEPARTMENT_ID` = 280). First, evaluate row changes to decide on a point in time. Limit your analysis to the new rows just added: where `department_id >= 280`. If you receive an error while performing the flashback, you may need to enable row movement on the table. See the next step.

   a) In Enterprise Manager, select **Maintenance** > High Availability > Backup/Recovery > **Perform Recovery**.

   b) Select Tables from the **Object Type** drop-down list, and then select **Flashback Existing Tables** for **Operation Type**. Click **Perform Object Level Recovery**.



   c) Select **Evaluate row changes and transactions to decide on a point in time**, and enter `HR.DEPARTMENTS2` as the fully qualified name of the table in the **Table** field, and then click **Next**.

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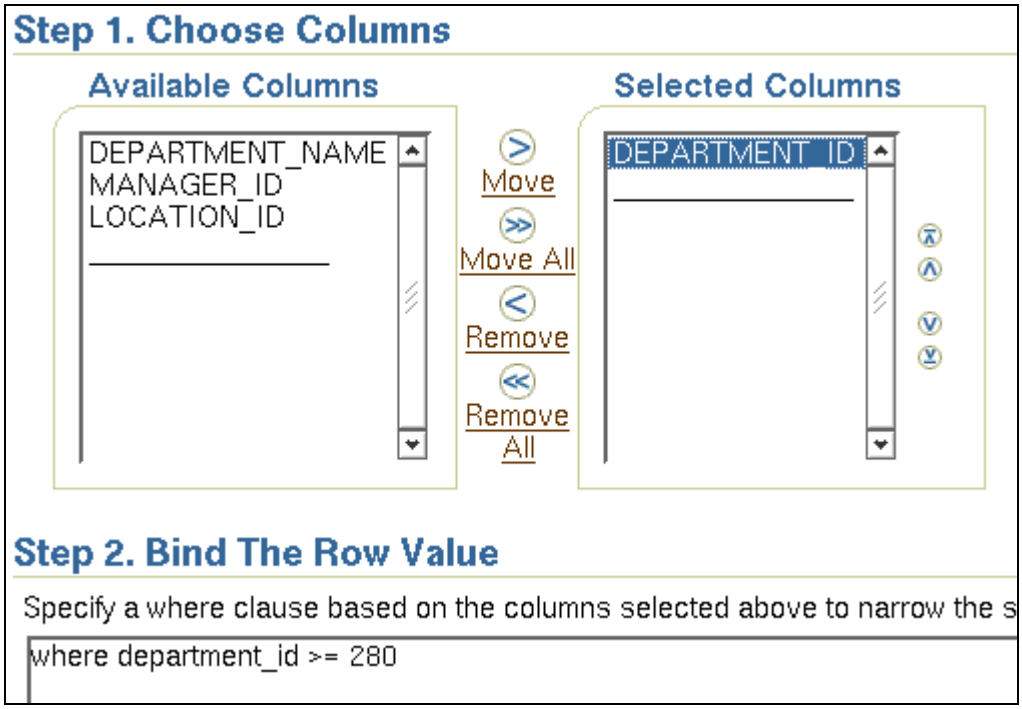
d) Highlight `DEPARTMENT_ID` under **Available Columns,** and then click the **Move** button to move it under **Selected Columns**. Under Step 2, enter a `WHERE` clause that will select the added rows. For example, earlier you added rows with `DEPARTMENT_IDs` of `280`, `290`, and `300`, so the "`WHERE department_id >= 280`" clause is suitable.



e) Click **Next** to continue.

f) You can now review the rows under Flashback Versions Query Result.

Flashback Versions Query Result

Select	Flashback SCN	Flashback Timestamp	Transaction ID	Operation	DEPARTMENT_ID
◉	6800080	Jun 9, 2005 5:15:32 PM	0A002B00A6030000	INSERT	300
○	6800061	Jun 9, 2005 5:15:15 PM	03002400CB030000	INSERT	290
○	6800049	Jun 9, 2005 5:14:53 PM	05000600FA030000	INSERT	280

g) Under **Flashback Versions Query Result**, select the middle transaction from the list to flash back. Click **Next** to continue.

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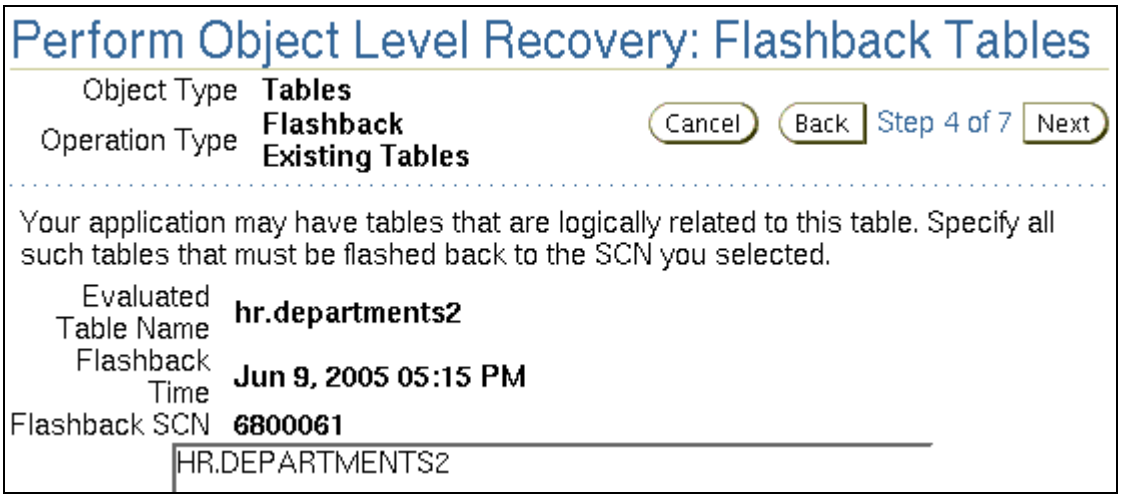
h) On the next page, you are asked to include any tables related to or dependent on the table that you are flashing back. Because there are none, click **Next** to continue.

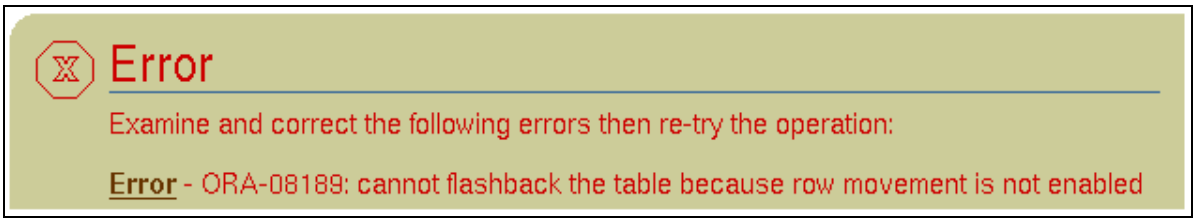


i) Review the SQL statement that you are about to execute. Click **Show SQL**, view the SQL statement, click **OK**, and then click **Submit**.

```
FLASHBACK TABLE HR.DEPARTMENTS2 TO SCN 6800061
```

6. On the next page, you find that the operation has failed because row movement is not enabled for the table. You may recall from the lesson that row movement must be enabled for this feature to work.

a) Note this error:



b) To enable row movement for this table, select **Administration** > Schema > Database Objects > **Tables**.

c) Enter `HR` in the **Schema** field and `DEPARTMENTS2` in the **Object Name** field, and then click **Go**.

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Solutions for Practice 17: Performing Flashback (continued)

d) One table is displayed in the **Results** region and is selected by default. Click **Edit**.

Selection Mode Single Create

Edit View Delete With Options Actions Create Like Go

Select	Schema	Table Name	Tablespace	Partitioned	Rows	Last Analyzed
◉	HR	DEPARTMENTS2	USERS	NO		

The Edit Table page appears.

e) Click the **Options** tab.

f) From the **Enable Row Movement** drop-down list, select **Yes**.

Enable Row Movement Yes

☐ Parallel - Use multiple threads when creating this object or when executing DML against this object.
Parallel Degree ◉ Default ○ Value

☐ Cache - Place frequently accessed data to the top of the buffer cache.

General Constraints Segments Storage **Options** Statistics Indexes

g) Click **Show SQL**, and then click **Return**.

```
ALTER TABLE "HR"."DEPARTMENTS2" ENABLE ROW MOVEMENT
```

h) Click **Apply** to apply the change.

After the table modification is confirmed, you can perform the flashback operation.

Repeat step 5 to perform the version flashback of the table. Because row movement has been enabled, it should succeed this time.

Confirmation

The selected tables, HR.DEPARTMENTS2, have been flashed back.

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Solutions for Practice 17: Performing Flashback (continued)

i) In SQL*Plus, count the rows of the `HR.DEPARTMENTS2` table to confirm the flashback operation. Note that there is only one additional row now, not three. Then display the rows where `DEPARTMENT_ID >= 280`. Note that only one of the original three is remaining.

```
SQL> select count(*) from hr.departments2;

  COUNT(*)
----------
        28

SQL> select * from hr.departments2 where department_id >= 280;

DEPARTMENT_ID DEPARTMENT_NAME                MANAGER_ID LOCATION_ID
------------- ------------------------------ ---------- -----------
          280 DUMMY1

SQL>
```

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Solutions for Practice 18: Moving Data

Background: In the recent past, you received a number of questions about the HR schema. To analyze them, without interfering in the daily activities, you decide to use the Data Pump Wizard to export the HR schema to file. When you perform the export, you are not sure into which database you will be importing this schema.

In the end, you find out that the only database for which the management approves an import for, is the ORCL database. So you perform the import with the Data Pump Wizard, remapping the HR schema to a newly created HR_TEST schema in the HR_TEST tablespace. To follow best practice guidelines, you also decide to create a DP user who will be a DBA performing Data Pump jobs. For your convenience in class, the creation of the DP user is included in the lab_18_01.sql script. SQL scripts are in the /home/oracle/labs directory. However, there is one step missing.

Then, you receive two data load requests for which you decide to use SQL*Loader.

1. Review the lab_18_01.sql script, which creates the HR_TEST tablespace, the HR_TEST_ROLE role, and the HR_TEST and DP users.

   a) Double-click the **oracle's Home** icon on your desktop, double-click **labs**, and then double-click **lab_18_01.sql** to review this script.

   b) Note the passwords for these users.

      HR_TEST password: **hr_4test**

      DP password: **dp_4test**

   c) Which additional step do you need to perform to allow the DP user access to Enterprise Manager as Administrator?

   You need to log in to Enterprise Manager as the SYS user in the SYDBA role and make the DP user an EM Administrator (as you learned in the lesson titled "Managing the Oracle Instance").

   d) Close the lab_18_01.sql window.

2. Execute the lab_18_02.sh script. Then, perform the required step to make the DP user an EM administrator.

   a) Right-click your desktop and select **Open Terminal**. Then navigate to the /home/oracle/labs directory by entering **cd labs**.

   b) Enter **./lab_18_02.sh** to create the HR_TEST tablespace, the HR_TEST_ROLE role, and the HR_TEST and DP users.

   c) Log in to Enterprise Manager as the SYS user in the SYSDBA role.

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d) Make the DP user an EM Administrator (as you learned in the lesson titled "Managing the Oracle Instance"). (Select Setup > Create > Enter Name: DP, Password: dp_4test, Super Administrator, checked > Click Finish > Finish > Logout.)

3. Log in to Enterprise Manager as the DP user in the Normal role and export the HR schema.

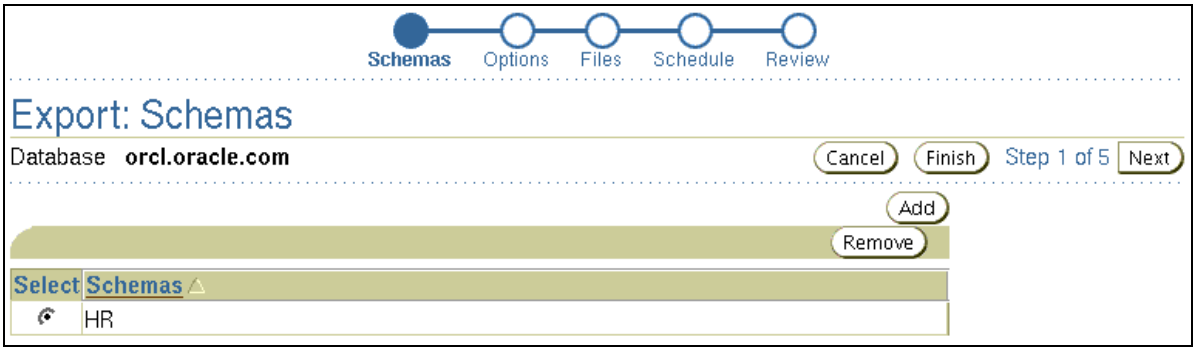
a) Invoke Enterprise Manager as the DP user in the Normal role for your ORCL database. The **Connect As** setting should be Normal.

If this is the first time that the DP user logs in, click **I agree** to accept the licensing agreement.

b) Select **Maintenance** > Data Movement > Move Row Data > **Export to Export Files**.

c) Select **Schemas**, enter **oracle** as **Username** and **Password**, select **Save as Preferred Credential**, and then click **Continue**.

d) On the Export: Schemas page, click **Add**, select the HR schema, and then click the **Select** button.



e) Click **Next**.

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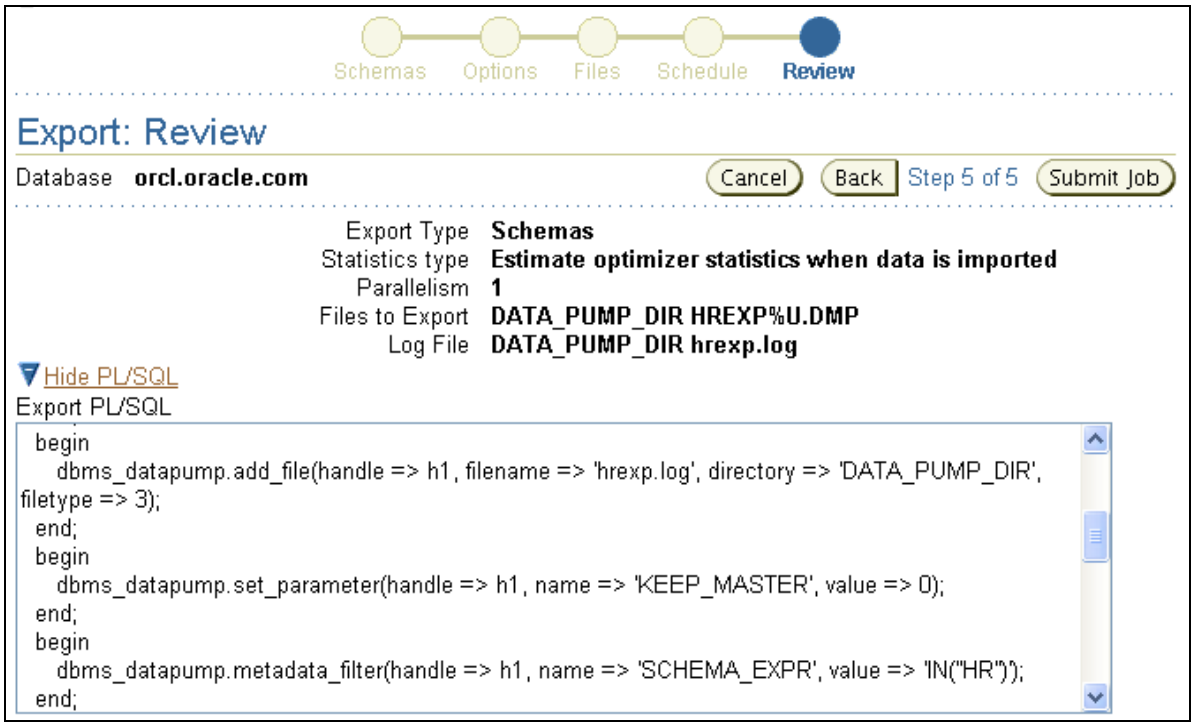
f) On the Export: Options page, select `DATA_PUMP_DIR` from the **Directory Object** drop-down list, and enter **`hrexp.log`** as **Log File**.

g) Review Advanced Options, but do not change, and then click **Next**.

h) On the Export: Files page, select `DATA_PUMP_DIR` from the **Directory Object** drop-down list, enter **`HREXP%U.DMP`** as **File Name**, and then click **Next**.

i) On the Export: Schedule page, enter **`hrexp`** as **Job Name** and **`Export HR schema`** as **Description**, accept the immediate job start time, and then click **Next**.

j) On the Export: Review page, click **Show PL/SQL** and review the PL/SQL that the Export Wizard helped you to create.



k) Click **Submit Job**.

A processing message appears, and then a success message. If not, resolve any errors, which may have occurred.

l) When the Job Activity Confirmation page appears, click the HREXP job name, and then monitor the job progress by clicking the browser's **Reload** button.

Note: Please wait, not only for the job to be created, but also for the job to complete execution. (It may take two minutes.)

4. As the `DP` user, import the exported `HR` schema back into the `ORCL` database, remapping it to the previously created `HR_TEST` schema.

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Solutions for Practice 18: Moving Data (continued)

a) Invoke Enterprise Manager as the `DP` user in the `Normal` role for your `ORCL` database.

b) Select **Maintenance** > Data Movement > Move Row Data > **Import from Export Files**.

c) On the Import: Files page, select `DATA_PUMP_DIR` from the **Directory Object** drop-down list, and enter **`HREXP%U.DMP`** as **File Name**.

d) Select **Schemas** as the Import Type.

e) Confirm `oracle` as your **Host Credentials**, and then click **Continue**.

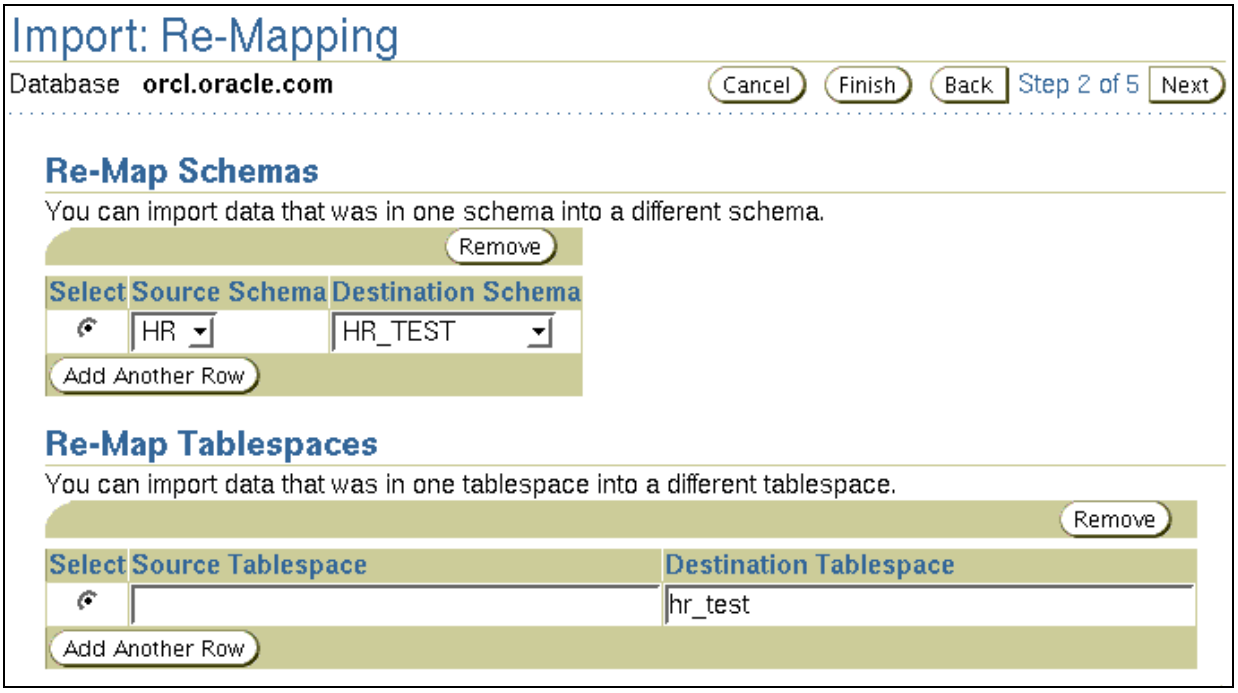
At this point, the export file is read, to verify the contents. Wait for this to complete.

f) On the Import: Schemas page, click **Add**, select HR, and then click **Select**.

g) Click **Next**.

h) On the Import: Re-Mapping page, click **Add Another Row** under **Re-Map Schemas**. Then select **`HR_TEST`** as **Destination Schema**.

i) Click **Add Another Row** under **Re-Map Tablespaces**, enter **`HR_TEST`** as **Destination Tablespace.**



j) Click **Next**.

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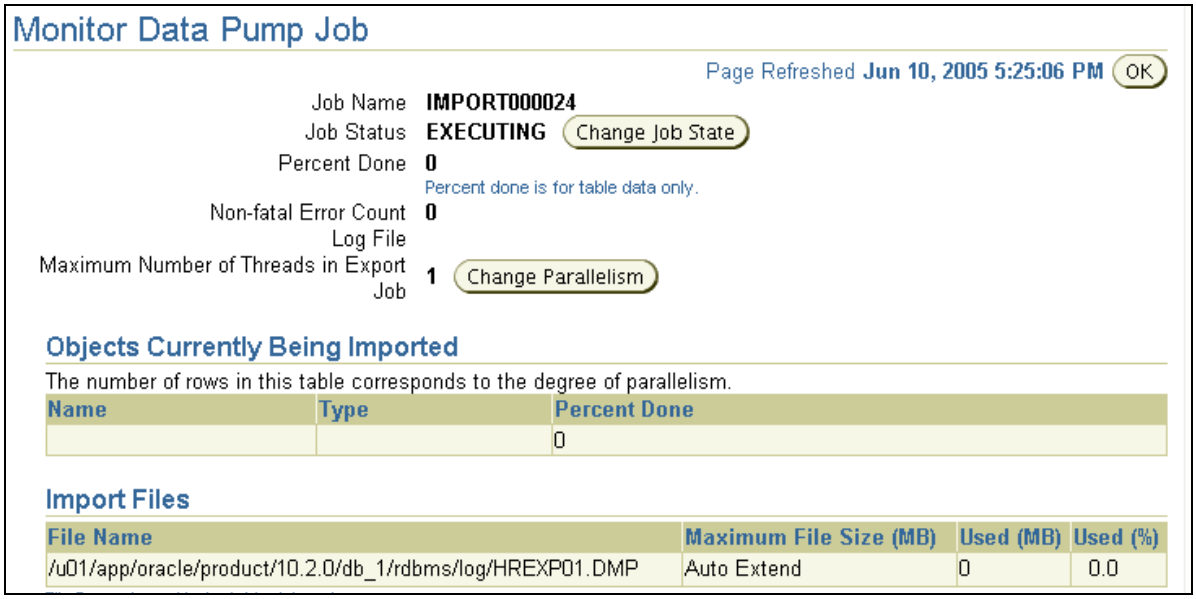
k) On the Import: Options page, select **`DATA_PUMP_DIR`** from the **Directory Object** drop-down list, enter **`hrimport.log`** as **Log File**, review the advanced options, but leave them at their default values, and then click **Next**.

l) On the Import: Schedule page, enter **`hrimp`** as **Job Name** and **`Import HR schema for test purposes`** as **Description**.

m) Select **Later** as **Start** and enter a time between 2 and 5 minutes from now (to give yourself time for the following steps):

- Click **Next**.
- On the Import: Review page, review the PL/SQL that the Data Pump Wizard creates for you, and then click **Submit Job**.
- After the confirmation that the job was successfully created, note the job name (for example `HRIMP`), and navigate to **Maintenance** > Data Movement > Move Row Data > **Monitor Export and Import Jobs**.
- Click your last job (for example, `HRIMP`).
- On the "Monitor Data Pump job" page, click **Reload** in your browser, when it is time to execute your job.



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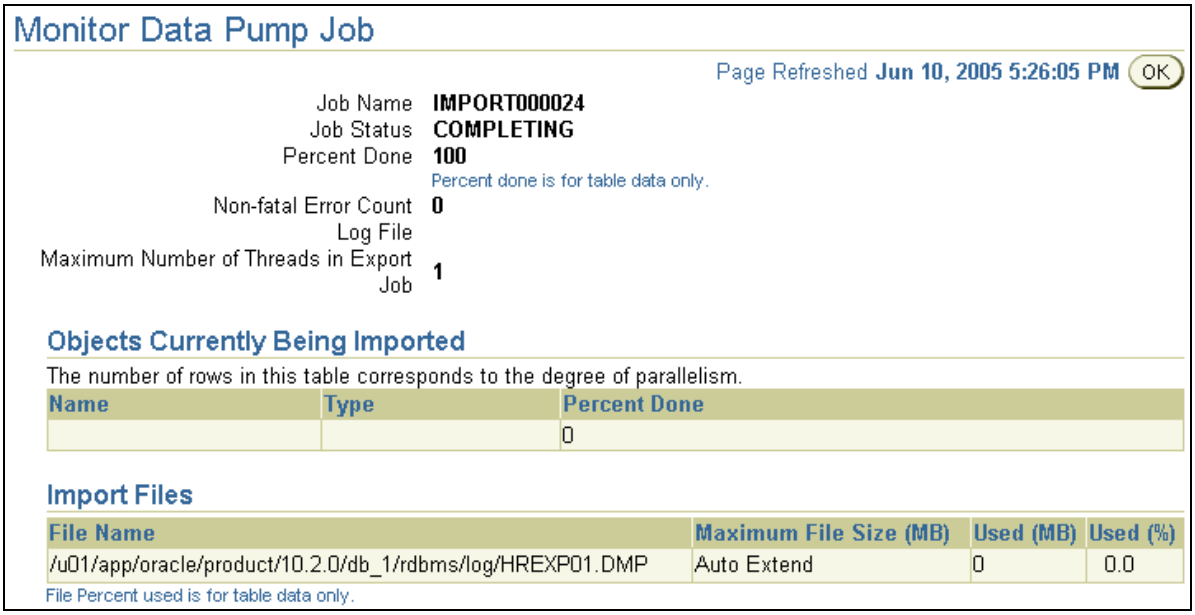
- *Optional,as this requires quick action:* Click **Change Job State**.

- *Optional (continued):* Click **Suspend** and later **Resume** to halt the job and then to continue it again.

n) In the end, you want to see that your job executed 100% without any errors.



o) Click **OK**.

p) Verify that the import succeeded by viewing the log file.

```
$ cat </u01/app/oracle/product/10.2.0/db_1/rdbms/log/hrimport.log
```

Note: You may see an error saying that the hr_test object already exists. This is because that user existed when you did the export, and still exists. This is not a problem.

q) Using SQL*Plus, connect to the database as the `HR_TEST` user.

```
$ sqlplus hr_test/hr_4test
```

r) Select data from tables in the `hr_test` schema, for verification of the import.

```
SQL> select * from jobs;
```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Solutions for Practice 18: Moving Data (continued)

5. As the `DP` user, load data into the `PRODUCT_MASTER` table by using SQL*Loader via Enterprise Manager Database Control.

   a) Invoke Enterprise Manager as the `DP` user in the `Normal` role for your `ORCL` database.

   b) Select **Maintenance** > Data Movement > Move Row Data > **Load Data from User Files**.

   c) Click **Use Existing Control File**.

   d) If you have not done so before, enter **`oracle`** as **Username** and as **Password**, click **Save as Preferred Credential**, and then click **Continue**.

   e) On the Load Data: Control File page, enter **`/home/oracle/labs/lab_18_05.ctl`** as control file name and path, or use the flashlight icon to select this control file. Click **Next**.

   f) On the Load Data: Data File page, click **Provide the full path and name on the database server machine** and enter **`/home/oracle/labs/lab_18_05.dat`** as data file name and path, or use the flashlight icon to select this data file. Click **Next**.

   g) On the Load Data: Load Method page, accept **Conventional Path**, and then click **Next**.

   h) On the Load Data: Options page, accept all defaults, but enter **`/home/oracle/labs/lab_18_05.log`** as log file name and path.

   i) Review the advanced options, but do not change any, and then click **Next**.

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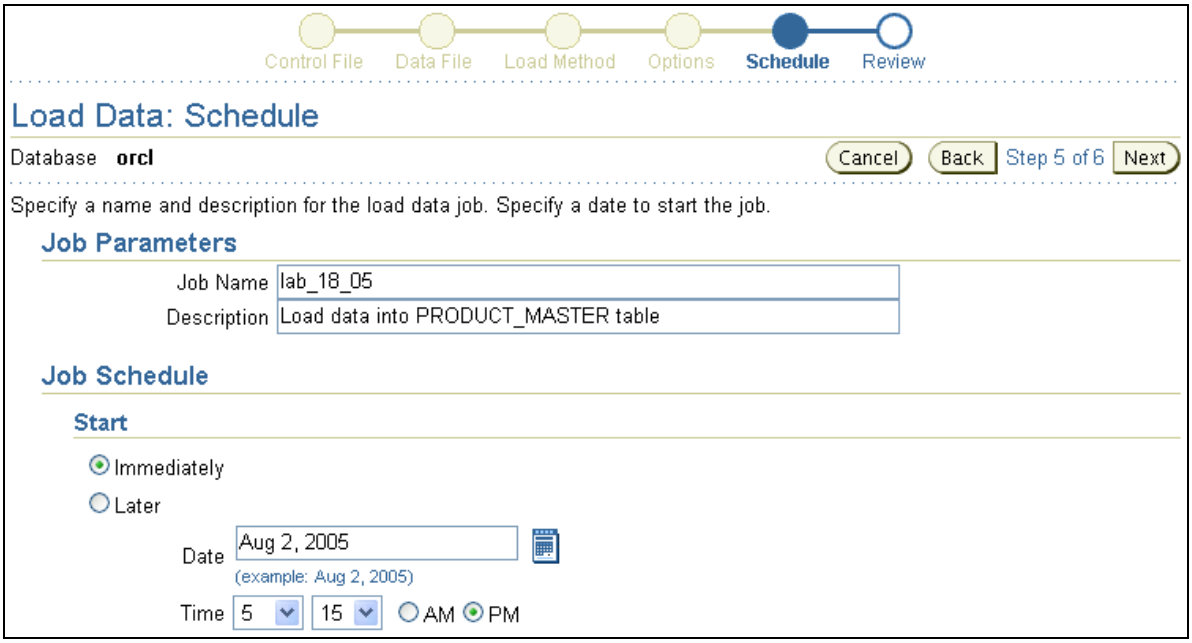
j) On the Load Data: Schedule page, enter **`lab_18_05`** as **Job Name** and **`Load data into the PRODUCT_MASTER table`** as **Description**. Let the job start immediately, and then click **Next**.



k) On the Load Data: Review page, review the loading information and parameters, and then click **Submit Job**.

l) Confirm your results by viewing your `lab_18_05.log` file in your `/home/oracle/labs` directory.

6. As the `INVENTORY` user, load data into the `PRODUCT_ON_HAND` table by using SQL*Loader command line.

a) Invoke a terminal window and navigate to the `/home/oracle/labs` directory.

b) Enter the following SQL*Loader command (in continuation, without pressing [Enter] before reaching the end of the command): **`sqlldr userid=inventory/verysecure control=lab_18_06.ctl log=lab-_18_06.log data=lab_18_06.dat`**.

```
sqlldr userid=inventory/verysecure control=lab_18_06.ctl
log=lab_18_06.log data=lab_18_06.dat

SQL*Loader: Release 10.2.0.1.0 - Production on Tue Aug 02 22:24:44
2005

Copyright © 1982, 2005, Oracle. All rights reserved.

Commit point reached - logical record count 64
Commit point reached - logical record count 82
Commit point reached - logical record count 83
```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Solutions for Practice 18: Moving Data (continued)

c) Confirm your results by viewing your `lab_18_06.log` file in your `/home/oracle/labs` directory.

Congratulations!

You completed all practices for the

Oracle Database 10g: Administration Workshop I

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Appendix C
Basic Linux and vi Commands

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vi Commands

The Visual Interpreter/Editor (*vi*) is the most widely used text editor available for the UNIX environment. While almost everybody curses its unwieldy command syntax, it is still the only editor almost certain to be included with every version of the UNIX and Linux operating system. The following are a partial list of available *vi* commands.

vi has two modes. Command line (where anything typed is taken as an editing command) and input mode (where everything typed will be treated as part of the file being edited. To enter the input mode, type a, A, i, I, o, O, c, C, s, S, r, or R. To return to the command line mode, use the <ESC> key. To access the *vi* editor from SQLPlus, enter the following command:

```
SQL>define _editor=vi
```

To edit a file from SQLPlus prompt, edit <*filename*> (press enter), from the Linux command prompt, vi <*filename*> (press enter)

To MOVE the cursor:

h - move left j - move down k - move up l - move right

w - one word forward b - one word backward e - end of current word

W, B, or E - same as lower case but ignores punctuation

0 (zero) - Move to beginning of current line $ - end of current line

G - go to last line of file H - go to top line on the screen

L - go to last line on screen M - go to middle line on the screen

/<string> - Search forward to the next occurrence of <string>

?<string> - Search backward to the next occurrence of <string>

n - Repeat previous search N - Repeat previous search in opposite direction

<ctrl> f - Scroll forward one page <ctrl> b - Scroll backward one page

To UNDO previous changes:

u - Will undo the most recent change. U - Will undo the most recently deleted text.

:e! - re-edit current file without saving any changes made since last change

To ENTER NEW text:

a - Append text after the current cursor position.

A - Append text to the end of a line (jumps to end of line and begin appending).

c - Change object C - Change from current cursor position to end of the line

i - Insert text before the current cursor position. I - Insert text at the beginning of a line.

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o - Insert a blank line BELOW the current cursor position.

O - Insert a blank line ABOVE the current cursor position.

r - Replace character at current cursor position R - Replace all characters until <ESC> is pressed

s - substitute text for character under cursor

:s/A/B/opt substitutes string B for string A. %s/A/B/opt is global replace

options include: g (change all occurences on current line) c (confirm prior to each change)

p (print changed lines) S - Substitute entire line to the end

. <period> - repeat last change *n*. <integer><period> repeat last change *n* times

To leave the input mode, press <ESC>

To DELETE existing text:

x - Will delete the character directly under the current cursor location.

dd - Will delete the entire line where the cursor is located.

d*n*d (where *n* is some integer) will delete *n* lines from current cursor position

dw - delete current word D - delete to end of current line

J - Delete return at end of current line. Join this line and the next

<int> J - Join the next <int> lines

COPY, CUT, and PASTE: *vi* uses a single buffer where the last changed or deleted text is stored. This text may be manipulated with the following commands:

Y - Yank a copy of the current line y <integer> - Yank a copy of next <int> lines

yw - Yank a copy of the current word yb - Yank a copy of the previous word

p - Put buffer contents after cursor P - Put buffer contents before cursor

Also, see the s and S commands under the input section

To SAVE edited changes to an operating system file:

zz - Will terminate edit mode. :w filename - Will save changes to the filename specified.

:wq - Write all changes and quit the edit mode

To QUIT without saving changes:

ZZ - Will terminate edit mode. :q! - Will terminate the file without saving changes.

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Basic Linux Commands

This appendix is meant to serve only as a quick reference while you are in class. For more details on these commands, consult the man pages, your Linux documentation, or other Linux command reference books.

Files and Directories	Linux Commands	Description/Comments

Command manual	`man <command>`
	`man -k <string>`
	`man man`
		Find the manual entry for this <command>.
		Show all the manual entries that contain this <string>.
		Displays the manual page for `man`.

Command information	`info <command>`	Show the information system entry for this command. Using `info info` shows a tutorial of the `info` documentation system.
Print to standard out	`cat <file>`	Concatenate and print – print the named file to the terminal screen.
List users	`cat /etc/password`	
Change working directory	`cd <directory>`	Change working directory to specified directory cd with no parameters changes to $HOME.
Copy a file	`cp <source_file> <destination_file>`	Copy a source file to a destination file.
View a file	`less <file>`	View a file a page at a time. This is a GNU version of `more`, or `pg`.
View a file	`more <file>`	View a file a page at a time. BSD version.
List directory	`ls <directory>`	Options –l long listing, -R recursive, -a show hidden files, -t sort by time, -r reverse sort, default directory is current working directory.
Create a directory	`mkdir <directory>`	Make a directory defaults into the current working directory, full path may be specified.
Move or rename a file	`mv <old_file> <new_file>`	Move changes the name of a file or moves it to a different directory.

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Process List	`ps` `ps -ef`	Shows the processes report Shows all processes on the system with a full listing. Many option exist see the man page for details.
Print working directory	`pwd`	Print to stdout the current working directory.
Remove or erase a file	`rm <file>`	Removing a file on Linux is permanent. Options –r recursive, and –f force (including subdirectories) are *very dangerous*. Often the `rm` command is aliased with `rm –i` The option –i asks 'Are you sure?'
Create an empty file	`touch <file>`	Create a file.
Name of the machine	`hostname`	Returns the name of the machine.
The IP address of the machine	`host <machine_name>`	Queries the Domain Name Server, and returns the IP address of the machine name.
Remote shell	`rsh <host> <command>`	Execute a <command> on <host>. Rsh is not secure, use ssh instead.
Remote shell	`ssh <host>`	Secure shell, has features to replace rsh, rcp, ftp, and telnet.
Remote shell	`telnet <host>`	Start a terminal session on <host>. Telnet is not secure use ssh instead.
Search a file for a pattern	`grep <option> <pattern> <file>`	Search a <file> or stream for a regular expression defined by <pattern> and show the line that contains that pattern. A common option is –i for case insensitive. `grep` can accept input from a file or `stdin` through a pipe as in: `netstat -a| grep ESTABLISHED`
Source a script	`. <script_file>`	In the `bash` shell this command '.' forces the script to run in the shell. Normal behavior is for the script to run in a child shell.

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An interpreter	`awk`	A macro language for reformatting or interpreting input. For each line of input, a variety of actions can be taken. May be referred to as nawk – for "new awk."
Sort a file	`sort`	Sort a file takes input from stdin or a filename argument, many options to sort by a particular column, field, etc. See man page.
Command line editor	`sed`	Sed is a command line editor, with many possible commands and options that are very good for editing from a shell script.
Visual editor	`vi <file>`	Terminal based editor available on every Unix system, Linux provides vim, an improved vi, that is a superset of vi.
Gnu editor	`emacs <file>`	This is a GPL editor with extensive customizable features available on most UNIX and Linux distributions.
WSIWIG editor	`gedit <file>`	A full-screen editor, requiring X. Available under Gnome.
WSIWIG	`kate <file>`	A full-screen editor, requires X. Available under KDE
Terminal output	`stdout`	Standard out (stdout), is not a command but a concept, most Linux commands write to stdout by default unless redirected.
Terminal input (keyboard)	`stdin`	Standard in (stdin), is not a command but a concept, most Linux commands read from stdin by default unless redirected.
Alias	`alias <command> <alias>`	Make a substitution when a user types <command> substitute and execute <alias>, common alias is alias 'rm' 'rm –i'. These aliases are set in the .bashrc file.
Show shell variables	`set`	Prints all of the variables that are currently defined in the shell.

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Show environment variables	`printenv or env`	Prints all the environment variables – an environment variable has been 'exported' so that it will be inherited by child processes.
File Creation mask	`umask –S u=rwx,g=rx,o=rx`	Set the default permissions for all files created by this shell or its children. The –S option uses the symbolic notation, the numeric notation is obsolete.
Clock	`xclock`	An X client that shows a clock on the screen. Often used to test the X windows system.
X access control	`xhost` `xhost +<Xclient>`	Show the current access control in place. Add a Xclient that is allowed to access the local DISPLAY, if no <Xclient> is given all are allowed.

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System Administration	Linux Commands	Description / Comments
Root file system	/	The root directory for the system directory tree.
Home Directory	/home	Typically the directory in which all user home directories placed. For example: /home/oracle.
Tmp directory	/tmp	A temporary storage area. Do notput anything here you want to keep. SA often have a cron job to remove everything periodically.
Boot directory	/boot	A small partition to hold the kernel image(s) and boot loader instructions.
Log directory	/var/log	The location of most system log files.
Sample configuration files	/etc/inittab	Configuration files are located per the application. Any configuration file that you change after installation should be included in the backup.
Password files	/etc/passwd /etc/shadow	The /etc/passwd file holds user information and must be readable by others; even with encrypted passwords this can be a security hole. The /etc/shadow file holds the encrypted passwords and is only readable by root.
Groups file	/etc/group	The /etc/groups file defines the groups on a server and the users that are members of the group; primary group for a user is defined in the /etc/passwd file.
X configuration file	/etc/X11/XF86Config	The file that sets the X server settings for your video card, monitor, mouse, and keyboard. Usually set up with a vendor supplied tool, such as sax2.

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Schedule a command to run at a regularly scheduled time	`crontab -e`	Use this command to edit the `crontab` file, to create the specification for the `cron` daemon to use.
Schedule a script to run at a particular frequency	`/etc/anacrontab`	Edit the file to specify a script to run at a particular frequency (see `man anacrontab` for details).
Schedule a command to run at a single specified time	`at <options> TIME`	Runs a job specified by <options> at a specified TIME parameter.
Schedule a command	`batch <options> <TIME>`	Run a command when the load average drops below .8, optionally after a set TIME.
Mount a file system	`mount <opt> <dev> <mount_point>`	Mount a file system on device <dev> at <mount_point> with the options specified by <dev>.
Unmount a file system	`umount <dev>` `umount <mount_point>`	Unmount the file system or device.
Maximum # of user ID	`65535`	
Recover root password	{lilo} control-x linux S passwd root {grub} c kernel vmlinuz-2.4.9-13 **single** ro root=/dev/hda8 initrd /initrd-2.4.9-13.img boot passwd root	This is a procedure to recover the root password if is lost. This requires physical access to the machine and system console. You start by rebooting the machine, then during the LILO boot press and hold [Ctrl] + [x] to get a prompt and command LILO to boot linux to runlevel S. The second procedure uses the grub boot loader.
Create new user	`useradd`	The –D option alone shows the defaults. –D with other options changes the defaults options; without –D override, the default (e.g., –g) sets a primary group.

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Delete user	`userdel`	Remove a user and optionally all files belonging to the user.
Modify user account	`usermod`	Change `/etc/password` information.
Create new group	`groupadd`	–g sets the group id; default is first free value above 500.
Delete group	`groupdel`	Remove a group from the system. May not remove a group that is a primary group for a user. Files owned by deleted group must be manually changed with chown.
Change run levels	`init <runlevel>`	The `init` command causes the rcN.d scripts to be evaluated, for the change in run level. `init 6` forces a reboot.
Synchronize the disks	`sync`	Forces the buffer cache and page cache to write all dirty buffers to disk. Used just before a reboot to prevent disk corruption.
Shutdown the Linux system	`shutdown <mode> <delay>`	Do a graceful shutdown of the system, shut down processes, run all shutdown scripts, and sync disks. The modes are –r, reboot and –h, halt. The delay is a required parameter is a number in seconds or 'now'. Option shutdown warning message may be sent as well.
Error logs	`dmesg`	View boot messages. This log is circular, and limited system errors could overwrite boot information after a time.
Network IP configuration	`/etc/sysconfig/network-scripts/`	This directory holds scripts executed as part of the boot up sequence by `rc.sysinit`.
Hosts IP addresses	`/etc/hosts`	A list of hosts that your machine knows about. Must at minimum include the name of the local machine and loopback IP.
Name service switch	`/etc/nsswitch.conf`	

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Network parameters	`sysctl -a | grep net`	View all net parameters that are set for the kernel.
Routing daemon	`routed`	
NIC Configurations	`ifconfig -a`	Show all the network devices currently configured.
Secondary IP Address	`modprobe ip_alias`	
	`ifconfig eth0:1 IP`	
Login prompt	`/etc/issue`	Banner message user sees when issued the login prompt.
YP/NIS service binder	`/sbin/ypbind`	Finds and attaches to a NIS server for name resolution and other services.
Module information	`modinfo <options> <module>`	Display information about kernel modules: –l shows license, –p parameters, –d description.
List modules	`lsmod`	Show currently loaded modules.
Load module	`insmod`	Load a loadable module.
Unload module	`rmmod`	Unload a loadable module.
Install Software	`rpm -ivh package`	Install –i, verbose –v, with progress hash marks –h.
Uninstall software	`rpm -e package`	Erase package –e; will not uninstall if dependencies exist.
List installed software	`rpm -qa`	Query –q, All –a, lists all installed packages.
Verify installed software	`rpm -V package`	Compares installed files with the rpm database information.
List all files	`rpm -ql package`	List all the files that are part of a package.
Package owner	`rpm -qf file`	List the package when given the full file name.
Machine model	`uname -m`	Shows CPU level (e.g., i686).
OS Level	`uname -r`	Shows kernel version.
Run Level	`runlevel`	Shows previous and current runlevel.
Kernel Parameters	`sysctl -a`	Show settings of all settable kernel parameters.
Max # File Descriptors	`sysctl fs.file-max`	Shows the value of maximum number of file descriptor per process.

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Kernel parameter settings	`/etc/sysctl.conf`	Compiled in kernel parameters; may be reset at bootup by setting them in this file.
Change Kernel Parameter	`echo <value> > </proc/<file>`	Write the new value of a kernel parameter into the `/proc` file system.
	`echo 2147483648 >/proc/sys/kernel/shmmax`	Set the value of the maximum size of a shared memory segment.
Shared Memory	`sysctl kernel.shmmax`	Show the `shmmax` parameter.
Change Kernel Parameter	`sysctl -w <parameter>=<value>`	Change a kernel parameter; the –p option reads the setting from a file and sets them. The default file is `/etc/sysctl.conf`
Set Process limits	`ulimit <option> <value>`	Set limits on a shell and processes started by the shell. Users can make limits more restrictive; generally only root can make limit less restrictive; some options require root privilege. Options: –u sets number of processes, –n number of file handles; many others (see `man bash`).
Show process limits	`ulimit`	Without options ulimit show the current limit settings.
Interprocess Communication (Shared Memory and Semaphores)	`ipcs <option>`	Options: –m the current usage of shared memory; –s usage of semaphores; –a shows all.
Remove a shared memory segment	`ipcrm shm <shmid>`	Releases the shared memory segment identified by `<shmid>`. *This is very dangerous*. You can corrupt a database that is using the segment that is released.

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System Performance	Linux Commands	Description / Comments
Performance monitor	`top`	View real-time OS and process statistics.
System activity reporter	`sar –<options> <interval> <count>`	Options: –q shows CPU queue, –u CPU utilization, –d device activity, –n DEV network device activity, many more (see `man` page). Interval is in seconds.
Virtual Memory statistics	`vmstat <interval> < count>`	Interval is in seconds.
Virtual Memory statistics	`cat /proc/meminfo`	Shows instantaneous virtual memory usage.
Kernel Cache statistics	`cat /proc/slabinfo`	Kernel slab allocator statistics: frequently allocated cache objects such as inode, dentries, and asynchronous IO buffers.
I/O statistics	`iostat <option> <interval> <count>`	Options: –d device activity, –c CPU activity, –x extended disk activity statistics. The interval is in seconds.
Multiprocessor Statistics	`mpstat -P <cpu> <count> <interval>`	Return CPU statistics for particular processor or *all* CPUs in an smp system.
Physical RAM	`64 GB(Theoretical)`	Maximum physical RAM requires enterprise kernel (Red Hat Enterprise Linux AS 21 only supports up to 16 GB).
Swap device	`swapon -s`	Shows devices currently in use for swap. The swap device is arbitrary designated at install. It may be changed or added to. Multiple swap devices may be created; swap size should be at least as large as physical memory.

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Display swap size	`free`	Show the current memory and swap usage.
Activate Swap	`swapon -a`	Turn on swap.
Free disk blocks	`df -k`	Measured in KB; use –m for MB units.
Device listing	`cat /proc/devices`	List devices known to the system by major and minor number.

Disk information	`cat /proc/scsi/scsi0/sda/model`
	
	`cat /proc/ide/ide0/hda/model`
		View SCSI disk information.
		
		View IDE disk information.

Print network statistics	`netstat <options>`	Print a wide variety of network statistics (see `man netstat`).
Graphical system statistics viewer	`xosview`	An X-based display of recent OS statistics.

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Misc System Information	Linux Commands	Description / Comments
NFS exported	`/etc/exports`	Database file are not supported on simple NFS.
NFS Client mounted directories	`/var/lib/nfs/xtab`	
Max File System	`2 TB with 4KB block size (on 32 kernel)`	With ext3 and ext2, others vary.

Max File Size
 	
File size can not exceed file system
	`2 GB {512B block size}`
	
	`2 TB {4KB block size}`
		The oracle database can create files up to 64 GB with a 16 KB database block size.
		
		The 32-bit kernel limits file and block devices to 2 TB.

File System Block size	`dumpe2fs <device>`	Dump the file system properties to `stdout`.
Filesystem table	`/etc/fstab`	Mounts these file systems at boot up.

Journal Filesystem types	`ext3`
	
	`reiserfs`	

Disk Label	`fdisk -l`	`fdisk` is not available on all distributions.
Extend File system	`resize2fs` `resize_reiserfs`	Extending a file system is applicable to only some file system types.
Backup	`tar cvf /dev/rst0 /`	Create a backup of the root / file system.
Restore	`tar xvf /dev/rst0`	Restore the root / file system.
Prepare boot volumes	`/sbin/lilo`	Must be run after changing `/etc/lilo.conf` to push changes to boot loader.
Startup script	`/etc/rc.d/rc`	
Kernel	`/boot/vmlinuz`	
Kernel Bits	`getconf WORD_BIT`	POSIX call to get kernel information. There are many other variables besides `WORD_BIT`.

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Boot single user	{lilo} control-x linux S {grub} c kernel vmlinuz-2.4.9-13 **single** ro root=/dev/hda8 initrd /initrd-2.4.9-13.img boot	Use LILO facility. Use GRUB Boot Loader.
Time zone Management	/etc/sysconfig/clock	
SW Directory	/var/lib/rpm	Directory where rpm database are kept.
Devices	/dev	This directory holds all the device files.
CPU	cat /proc/cpuinfo	Shows CPU static information.
Whole Disk	/dev/sda	Device name.
CDROM	/dev/cdrom	Usually mounted at /mnt/cdrom.
CDROM file type	iso9660	
Floppy drive	/dev/fd0	Usually mounted at /mnt/floppy.
System information	/proc	The /proc filesystem is a memory-based file system that allows access to process and kernel settings and statistics.
Compile and link a executable	make -f <file> <command>	Use a make file <file> to determine which parts of a large program need to be recompiled, and issue the commands required to compile, link, and prepare the executable for use.

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LVM	Linux (UnitedLinux)	Description / Comments
LVM	`Logical Volume Manager`	This package is not provided by Red Hat Enterprise Linux AS 2.1 and may not be added without tainting the kernel. Kernel support is provided in United Linux.
LVM Concepts	`logical extents`	A Logical volume is made up of logical extents.
	`logical volume`	A set of logical extents taken from a volume group and presented to the OS as a disk volume. These extents may be striped across multiple disks.
	`volume group`	A set of physical disk partitions created by `fdisk` or the like, initialized with `pvcreate`, then grouped into a physical volume with `vgcreate`.
Display volume group	`vgdisplay -v`	
Modify physical volume	`pvchange`	
Prepare physical disk	`pvcreate`	
List physical volume	`pvdisplay`	
Remove disk from volume group	`vgreduce`	
Move logical volumes to another physical volumes	`pvmove`	
Create volume group	`vgcreate`	
Remove volume group	`vgremove`	
Volume group availability	`vgchange`	
Restore volume group	`vgcfgrestore`	

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Exports volume group	`vgexport`	
Imports volume group	`vgimport`	
Volume group listing	`vgscan`	
Change logical volume characteristics	`lvchange`	
List logical volume	`lvdisplay`	
Make logical volume	`lvcreate`	
Extend logical volume	`lvextend`	
Reduce logical volume	`lvreduce`	
Remove logical volume	`lvremove`	
Create striped volumes	`lvcreate -i 3 -I 64`	

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Appendix D
SQL Statement Syntax

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SQL Statements

This excerpt from the Oracle Database SQL Quick Reference guide presents the syntax for Oracle SQL statements. SQL statements are the means by which programs and users access data in an Oracle database.

Table 1 shows each SQL statement and its related syntax. Table 2 shows the syntax of the subclauses found in the table 1.

See Also: Oracle Database SQL Reference for detailed information about Oracle SQL

Table 1: Syntax for SQL Statements

SQL Statement	Syntax
ALTER CLUSTER	ALTER CLUSTER [schema.]cluster { physical_attributes_clause | SIZE size_clause | allocate_extent_clause | deallocate_unused_clause | { CACHE | NOCACHE } } [physical_attributes_clause | SIZE size_clause | allocate_extent_clause | deallocate_unused_clause | { CACHE | NOCACHE }]... [parallel_clause] ;
ALTER DATABASE	ALTER DATABASE [database] { startup_clauses | recovery_clauses | database_file_clauses | logfile_clauses | controlfile_clauses | standby_database_clauses | default_settings_clauses | redo_thread_clauses | security_clause } ;
ALTER DIMENSION	ALTER DIMENSION [schema.]dimension { ADD { level_clause | hierarchy_clause | attribute_clause | extended_attribute_clause } [ADD

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SQL Statement	Syntax

	`{ level_clause`
	`| hierarchy_clause`
	`| attribute_clause`
	`| extended_attribute_clause`
	`}`
	`]...`
	`| DROP`
	`{ LEVEL level`
	`[ RESTRICT | CASCADE ]`
	`| HIERARCHY hierarchy`
	`| ATTRIBUTE attribute`
	`[ LEVEL level [ COLUMN column`
	`[, COLUMN column ]... ]`
	`}`
	`[ DROP`
	`{ LEVEL level`
	`[ RESTRICT | CASCADE ]`
	`| HIERARCHY hierarchy`
	`| ATTRIBUTE attribute`
	`[ LEVEL level [ COLUMN column`
	`[, COLUMN column ]... ]`
	`}`
	`]...`
	`| COMPILE`
	`} ;`

ALTER DISKGROUP	`ALTER DISKGROUP`
	`{ disk_clauses | diskgroup_clauses }`
	`[ { disk_clauses | diskgroup_clauses } ]... ;`

ALTER FUNCTION	`ALTER FUNCTION [ schema. ]function`
	`COMPILE [ DEBUG ]`
	`[ compiler_parameters_clause`
	`[ compiler_parameters_clause ] ... ]`
	`[ REUSE SETTINGS ] ;`

ALTER INDEX	`ALTER INDEX [ schema. ]index`
	`{ { deallocate_unused_clause`
	`| allocate_extent_clause`
	`| shrink_clause`
	`| parallel_clause`
	`| physical_attributes_clause`
	`| logging_clause`
	`}`
	`[ deallocate_unused_clause`
	`| allocate_extent_clause`
	`| shrink_clause`
	`| parallel_clause`
	`| physical_attributes_clause`
	`| logging_clause`
	`]...`
	`| rebuild_clause`

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SQL Statement	Syntax
		PARAMETERS ('ODCI_parameters') | { ENABLE	DISABLE } | UNUSABLE | RENAME TO new_name | COALESCE | { MONITORING	NOMONITORING } USAGE | UPDATE BLOCK REFERENCES | alter_index_partitioning } ;
ALTER INDEXTYPE	ALTER INDEXTYPE [schema.]indextype { { ADD	DROP } [schema.]operator (parameter_types) [, { ADD	DROP } [schema.]operator (parameter_types)]... [using_type_clause] 	COMPILE } ;
ALTER JAVA	ALTER JAVA { SOURCE	CLASS } [schema.]object_name [RESOLVER ((match_string [,] { schema_name | - }) [(match_string [,] { schema_name | - })]...)] { { COMPILE	RESOLVE } 	invoker_rights_clause } ;
ALTER MATERIALIZED VIEW	ALTER MATERIALIZED VIEW [schema.](materialized_view) [physical_attributes_clause | table_compression | LOB_storage_clause [, LOB_storage_clause]... | modify_LOB_storage_clause [, modify_LOB_storage_clause]... | alter_table_partitioning | parallel_clause | logging_clause | allocate_extent_clause | shrink_clause | { CACHE	NOCACHE }] [alter_iot_clauses] [USING INDEX physical_attributes_clause] [MODIFY scoped_table_ref_constraint | alter_mv_refresh]

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SQL Statement	Syntax
	[{ ENABLE | DISABLE } QUERY REWRITE | COMPILE | CONSIDER FRESH] ;
ALTER MATERIALIZED VIEW LOG	ALTER MATERIALIZED VIEW LOG [FORCE] ON [schema.]table [physical_attributes_clause | alter_table_partitioning | parallel_clause | logging_clause | allocate_extent_clause | shrink_clause | { CACHE | NOCACHE }] [ADD { { OBJECT ID | PRIMARY KEY | ROWID | SEQUENCE } [(column [, column]...)] | (column [, column]...) } [, { { OBJECT ID | PRIMARY KEY | ROWID | SEQUENCE } [(column [, column]...)] | (column [, column]...) }]... [new_values_clause]] ;
ALTER OPERATOR	ALTER OPERATOR [schema.]operator { add_binding_clause | drop_binding_clause | COMPILE } ;
ALTER OUTLINE	ALTER OUTLINE [PUBLIC | PRIVATE] outline { REBUILD | RENAME TO new_outline_name | CHANGE CATEGORY TO new_category_name | { ENABLE | DISABLE } } [REBUILD | RENAME TO new_outline_name | CHANGE CATEGORY TO new_category_name

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SQL Statement	Syntax
		{ ENABLE | DISABLE }]... ;
ALTER PACKAGE	ALTER PACKAGE [schema.]package COMPILE [DEBUG] [PACKAGE | SPECIFICATION | BODY] [compiler_parameters_clause [compiler_parameters_clause] ...] [REUSE SETTINGS] ;
ALTER PROCEDURE	ALTER PROCEDURE [schema.]procedure COMPILE [DEBUG] [compiler_parameters_clause [compiler_parameters_clause] ...] [REUSE SETTINGS] ;
ALTER PROFILE	ALTER PROFILE profile LIMIT { resource_parameters | password_parameters } [resource_parameters | password_parameters]... ;
ALTER RESOURCE COST	ALTER RESOURCE COST { CPU_PER_SESSION | CONNECT_TIME | LOGICAL_READS_PER_SESSION | PRIVATE_SGA } integer [{ CPU_PER_SESSION | CONNECT_TIME | LOGICAL_READS_PER_SESSION | PRIVATE_SGA } integer] ... ;
ALTER ROLE	ALTER ROLE role { NOT IDENTIFIED | IDENTIFIED { BY password | USING [schema.]package | EXTERNALLY | GLOBALLY } } ;
ALTER ROLEBACK SEGMENT	ALTER ROLLBACK SEGMENT rollback_segment { ONLINE | OFFLINE | storage_clause

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SQL Statement	Syntax
		SHRINK [TO integer [K | M]] };
ALTER SEQUENCE	ALTER SEQUENCE [schema.]sequence { INCREMENT BY integer | { MAXVALUE integer | NOMAXVALUE } | { MINVALUE integer | NOMINVALUE } | { CYCLE | NOCYCLE } | { CACHE integer | NOCACHE } | { ORDER | NOORDER } } [INCREMENT BY integer | { MAXVALUE integer | NOMAXVALUE } | { MINVALUE integer | NOMINVALUE } | { CYCLE | NOCYCLE } | { CACHE integer | NOCACHE } | { ORDER | NOORDER }]... ;
ALTER SESSION	ALTER SESSION { ADVISE { COMMIT | ROLLBACK | NOTHING } | CLOSE DATABASE LINK dblink | { ENABLE | DISABLE } COMMIT IN PROCEDURE | { ENABLE | DISABLE } GUARD | { ENABLE | DISABLE | FORCE } PARALLEL { DML | DDL | QUERY } [PARALLEL integer] | { ENABLE RESUMABLE [TIMEOUT integer] [NAME string] | DISABLE RESUMABLE } | alter_session_set_clause } ;
ALTER SYSTEM	ALTER SYSTEM { archive_log_clause | checkpoint_clause | check_datafiles_clause | DUMP ACTIVE SESSION HISTORY [MINUTES integer] | distributed_recov_clauses | restricted_session_clauses | FLUSH { SHARED_POOL | BUFFER_CACHE } | end_session_clauses | SWITCH LOGFILE | { SUSPEND | RESUME } | quiesce_clauses | shutdown_dispatcher_clause | REGISTER | SET alter_system_set_clause [alter_system_set_clause]... | RESET alter_system_reset_clause [alter_system_reset_clause]... } ;

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SQL Statement	Syntax
ALTER TABLE	ALTER TABLE [schema.]table [alter_table_properties | column_clauses | constraint_clauses | alter_table_partitioning | alter_external_table_clauses | move_table_clause] [enable_disable_clause | { ENABLE | DISABLE } { TABLE LOCK | ALL TRIGGERS } [enable_disable_clause | { ENABLE | DISABLE } { TABLE LOCK | ALL TRIGGERS }]...] ;
ALTER TABLESPACE	ALTER TABLESPACE tablespace { DEFAULT [table_compression] storage_clause | MINIMUM EXTENT integer [K | M] | RESIZE size_clause | COALESCE | RENAME TO new_tablespace_name | { BEGIN | END } BACKUP | datafile_tempfile_clauses | tablespace_logging_clauses | tablespace_group_clause | tablespace_state_clauses | autoextend_clause | flashback_mode_clause | tablespace_retention_clause } ;
ALTER TRIGGER	ALTER TRIGGER [schema.]trigger { ENABLE | DISABLE | RENAME TO new_name | COMPILE [DEBUG] [compiler_parameters_clause [compiler_parameters_clause] ...] [REUSE SETTINGS] } ;
ALTER TYPE	ALTER TYPE [schema.]type { compile_type_clause | replace_type_clause | { alter_method_spec | alter_attribute_definition | alter_collection_clauses | [NOT] { INSTANTIABLE | FINAL } }

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SQL Statement	Syntax
	[dependent_handling_clause] } ;
ALTER USER	ALTER USER { user { IDENTIFIED { BY password [REPLACE old_password] | EXTERNALLY | GLOBALLY AS 'external_name' } | DEFAULT TABLESPACE tablespace | TEMPORARY TABLESPACE { tablespace | tablespace_group_name } | QUOTA { integer [K | M] | UNLIMITED } ON tablespace [QUOTA { integer [K | M] | UNLIMITED } ON tablespace]... | PROFILE profile | DEFAULT ROLE { role [, role]... | ALL [EXCEPT role [, role]...] | NONE } | PASSWORD EXPIRE | ACCOUNT { LOCK | UNLOCK } } (continued) UPDATE MANUALLY too big to fit on page, split manually
(cont.) ALTER USER	[{ IDENTIFIED { BY password [REPLACE old_password] | EXTERNALLY | GLOBALLY AS 'external_name' } | DEFAULT TABLESPACE tablespace | TEMPORARY TABLESPACE { tablespace | tablespace_group_name } | QUOTA { integer [K | M] | UNLIMITED } ON tablespace [QUOTA { integer [K | M] | UNLIMITED } ON tablespace]... | PROFILE profile | DEFAULT ROLE { role [, role]... | ALL [EXCEPT role [, role]...] | NONE }

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SQL Statement	Syntax
		PASSWORD EXPIRE | ACCOUNT { LOCK	UNLOCK } }]... | user [, user]... proxy_clause ; UPDATE MANUALLY too big to fit on page, split manually
ALTER VIEW	ALTER VIEW [schema.]view { ADD out_of_line_constraint | MODIFY CONSTRAINT constraint { RELY	NORELY } | DROP { CONSTRAINT constraint | PRIMARY KEY | UNIQUE (column [, column]...) } | COMPILE } ;
ANALYZE	ANALYZE { TABLE [schema.]table [PARTITION (partition) | SUBPARTITION (subpartition)] | INDEX [schema.]index [PARTITION (partition) | SUBPARTITION (subpartition)] | CLUSTER [schema.]cluster } { validation_clauses | LIST CHAINED ROWS [into_clause] | DELETE [SYSTEM] STATISTICS | compute_statistics_clause | estimate_statistics_clause } ;
ASSOCIATE STATISTICS	ASSOCIATE STATISTICS WITH { column_association	function_association } ;
AUDIT	AUDIT { sql_statement_clause	schema_object_clause } [BY { SESSION	ACCESS }] [WHENEVER [NOT] SUCCESSFUL] ;
CALL	CALL { routine_clause | object_access_expression } [INTO :host_variable [[INDICATOR] :indicator_variable]] ;

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SQL Statement	Syntax

COMMENT	COMMENT ON
	  { TABLE [schema.]
	  { table | view }
	  | COLUMN [schema.]
	  { table. | view. | materialized_view. } column
	  | OPERATOR [schema.] operator
	  | INDEXTYPE [schema.] indextype
	  | MATERIALIZED VIEW materialized_view
	  }
	  IS 'text' ;

COMMIT	COMMIT [WORK]
	  [COMMENT 'text'
	  | FORCE 'text' [, integer]
	  ] ;

CREATE CLUSTER	CREATE CLUSTER [schema.]cluster
	  (column datatype [SORT]
	  [, column datatype [SORT]]...
	  )
	  [{ physical_attributes_clause
	  | SIZE size_clause
	  | TABLESPACE tablespace
	  | { INDEX
	  | [SINGLE TABLE]
	  HASHKEYS integer [HASH IS expr]
	  }
	  }
	  [physical_attributes_clause
	  | SIZE size_clause
	  | TABLESPACE tablespace
	  | { INDEX
	  | [SINGLE TABLE]
	  HASHKEYS integer [HASH IS expr]
	  }
	  ]...
	  ]
	  [parallel_clause]
	  [NOROWDEPENDENCIES | ROWDEPENDENCIES]
	  [CACHE | NOCACHE] ;

CREATE CONTEXT	CREATE [OR REPLACE] CONTEXT namespace
	  USING [schema.] package
	  [INITIALIZED { EXTERNALLY | GLOBALLY }
	  | ACCESSED GLOBALLY
	  ] ;

CREATE CONTROLFILE	CREATE CONTROLFILE
	  [REUSE]
	  [SET]
	  DATABASE database

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SQL Statement	Syntax
	[logfile_clause] { RESETLOGS | NORESETLOGS } [DATAFILE file_specification [, file_specification]...] [{ MAXLOGFILES integer | MAXLOGMEMBERS integer | MAXLOGHISTORY integer | MAXDATAFILES integer | MAXINSTANCES integer | { ARCHIVELOG | NOARCHIVELOG } | FORCE LOGGING } [MAXLOGFILES integer | MAXLOGMEMBERS integer | MAXLOGHISTORY integer | MAXDATAFILES integer | MAXINSTANCES integer | { ARCHIVELOG | NOARCHIVELOG } | FORCE LOGGING]...] [character_set_clause] ;
CREATE DATABASE	CREATE DATABASE [database] { USER SYS IDENTIFIED BY password | USER SYSTEM IDENTIFIED BY password | CONTROLFILE REUSE | MAXDATAFILES integer | MAXINSTANCES integer | CHARACTER SET charset | NATIONAL CHARACTER SET charset | SET DEFAULT { BIGFILE | SMALLFILE } TABLESPACE | database_logging_clauses | tablespace_clauses | set_time_zone_clause }... ;
CREATE DATABASE LINK	CREATE [SHARED] [PUBLIC] DATABASE LINK dblink [CONNECT TO { CURRENT_USER | user IDENTIFIED BY password [dblink_authentication] } | dblink_authentication] [USING 'connect_string'] ;
CREATE DIMENSION	CREATE DIMENSION [schema.]dimension level_clause [level_clause]... { hierarchy_clause

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SQL Statement	Syntax
		attribute_clause | extended_attribute_clause } [hierarchy_clause | attribute_clause | extended_attribute_clause]... ;
CREATE DIRECTORY	CREATE [OR REPLACE] DIRECTORY directory AS 'path_name' ;
CREATE DISKGROUP	CREATE DISKGROUP diskgroup_name [{ HIGH | NORMAL | EXTERNAL } REDUNDANCY] [FAILGROUP failgroup_name] DISK qualified_disk_clause [, qualified_disk_clause]... [[FAILGROUP failgroup_name] DISK qualified_disk_clause [, qualified_disk_clause]...]... ;
CREATE FUNCTION	CREATE [OR REPLACE] FUNCTION [schema.]function [(argument [IN | OUT | IN OUT] [NOCOPY] datatype [, argument [IN | OUT | IN OUT] [NOCOPY] datatype]...)] RETURN datatype [{ invoker_rights_clause | DETERMINISTIC | parallel_enable_clause } [invoker_rights_clause | DETERMINISTIC | parallel_enable_clause]...] { { AGGREGATE | PIPELINED } USING [schema.]implementation_type | [PIPELINED] { IS | AS } { pl/sql_function_body | call_spec } } ;
CREATE INDEX	CREATE [UNIQUE | BITMAP] INDEX [schema.]index ON { cluster_index_clause | table_index_clause | bitmap_join_index_clause } ;

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SQL Statement	Syntax
CREATE INDEXTYPE	CREATE [OR REPLACE] INDEXTYPE [schema.]indextype FOR [schema.]operator (paramater_type [, paramater_type]...) [, [schema.]operator (paramater_type [, paramater_type]...)]... using_type_clause ;
CREATE JAVA	CREATE [OR REPLACE] [AND { RESOLVE | COMPILE }] [NOFORCE] JAVA { { SOURCE | RESOURCE } NAMED [schema.]primary_name | CLASS [SCHEMA schema] } [invoker_rights_clause] [RESOLVER ((match_string [,] { schema_name | - }) [(match_string [,] { schema_name | - })]...)] { USING { BFILE (directory_object_name , server_file_name) | { CLOB | BLOB | BFILE } subquery | 'key_for_BLOB' } | AS source_text } ;
CREATE LIBRARY	CREATE [OR REPLACE] LIBRARY [schema.]libname { IS | AS } 'filename' [AGENT 'agent_dblink'] ;
CREATE MATERIALIZED VIEW	CREATE MATERIALIZED VIEW [schema.]materialized_view [OF [schema.]object_type] [(scoped_table_ref_constraint)] { ON PREBUILT TABLE [{ WITH | WITHOUT } REDUCED PRECISION] | physical_properties materialized_view_props } [USING INDEX [physical_attributes_clause | TABLESPACE tablespace] [physical_attributes_clause | TABLESPACE tablespace]... | USING NO INDEX] [create_mv_refresh]

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SQL Statement	Syntax
	[FOR UPDATE] [{ DISABLE | ENABLE } QUERY REWRITE] AS subquery ;
CREATE MATERIALIZED VIEW LOG	CREATE MATERIALIZED VIEW LOG ON [schema.] table [physical_attributes_clause | TABLESPACE tablespace | logging_clause | { CACHE | NOCACHE } [physical_attributes_clause | TABLESPACE tablespace | logging_clause | { CACHE | NOCACHE }]...] [parallel_clause] [table_partitioning_clauses] [WITH { OBJECT ID | PRIMARY KEY | ROWID | SEQUENCE | (column [, column]...) } [, { OBJECT ID | PRIMARY KEY | ROWID | SEQUENCE | (column [, column]...) }]... [new_values_clause]] ;
CREATE OPERATOR	CREATE [OR REPLACE] OPERATOR [schema.] operator binding_clause ;
CREATE OUTLINE	CREATE [OR REPLACE] [PUBLIC | PRIVATE] OUTLINE [outline] [FROM [PUBLIC | PRIVATE] source_outline] [FOR CATEGORY category] [ON statement] ;
CREATE PACKAGE	CREATE [OR REPLACE] PACKAGE [schema.]package [invoker_rights_clause] { IS | AS } pl/sql_package_spec ;
CREATE PACKAGE BODY	CREATE [OR REPLACE] PACKAGE BODY [schema.]package { IS | AS } pl/sql_package_body ;

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SQL Statement	Syntax
CREATE PFILE	CREATE PFILE [= 'pfile_name'] FROM SPFILE [= 'spfile_name'] ;
CREATE PROCEDURE	CREATE [OR REPLACE] PROCEDURE [schema.]procedure [(argument [IN | OUT | IN OUT] [NOCOPY] datatype [, argument [IN | OUT | IN OUT] [NOCOPY] datatype]...)] [invoker_rights_clause] { IS | AS } { pl/sql_subprogram_body | call_spec } ;
CREATE PROFILE	CREATE PROFILE profile LIMIT { resource_parameters | password_parameters } [resource_parameters | password_parameters]... ;
CREATE ROLE	CREATE ROLE role [NOT IDENTIFIED | IDENTIFIED { BY password | USING [schema.] package | EXTERNALLY | GLOBALLY }] ;
CREATE ROLEBACK SEGMENT	CREATE [PUBLIC] ROLLBACK SEGMENT rollback_segment [{ TABLESPACE tablespace | storage_clause } [TABLESPACE tablespace | storage_clause]...];
CREATE SCHEMA	CREATE SCHEMA AUTHORIZATION schema { create_table_statement | create_view_statement | grant_statement } [create_table_statement | create_view_statement | grant_statement]... ;

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SQL Statement	Syntax
CREATE SEQUENCE	CREATE SEQUENCE [schema.]sequence [{ INCREMENT BY | START WITH } integer | { MAXVALUE integer | NOMAXVALUE } | { MINVALUE integer | NOMINVALUE } | { CYCLE | NOCYCLE } | { CACHE integer | NOCACHE } | { ORDER | NOORDER }] [{ INCREMENT BY | START WITH } integer | { MAXVALUE integer | NOMAXVALUE } | { MINVALUE integer | NOMINVALUE } | { CYCLE | NOCYCLE } | { CACHE integer | NOCACHE } | { ORDER | NOORDER }]... ;
CREATE SPFILE	CREATE SPFILE [= 'spfile_name'] FROM PFILE [= 'pfile_name'] ;
CREATE SYNONYM	CREATE [OR REPLACE] [PUBLIC] SYNONYM [schema.]synonym FOR [schema.]object [@ dblink] ;
CREATE TABLE	{ relational_table | object_table | XMLType_table }
CREATE TABLESPACE	CREATE [BIGFILE | SMALLFILE] { permanent_tablespace_clause | temporary_tablespace_clause | undo_tablespace_clause } ;
CREATE TRIGGER	CREATE [OR REPLACE] TRIGGER [schema.]trigger { BEFORE | AFTER | INSTEAD OF } { dml_event_clause | { ddl_event [OR ddl_event]... | database_event [OR database_event]... } ON { [schema.]SCHEMA | DATABASE } } [WHEN (condition)] { pl/sql_block | call_procedure_statement } ;
CREATE TYPE	{ create_incomplete_type | create_object_type | create_varray_type | create_nested_table_type }

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SQL Statement	Syntax

CREATE TYPE BODY	CREATE [OR REPLACE] TYPE BODY [schema.]type_name
	{ IS | AS }
	{ subprogram_declaration
	| map_order_func_declaration
	}
	[; { subprogram_declaration
	| map_order_func_declaration
	}
	]...
	END ;

CREATE USER	CREATE USER user IDENTIFIED { BY password | EXTERNALLY | GLOBALLY AS 'external_name' } [DEFAULT TABLESPACE tablespace | TEMPORARY TABLESPACE { tablespace | tablespace_group_name } | QUOTA { integer [K | M] | UNLIMITED } ON tablespace [QUOTA { integer [K | M] | UNLIMITED } ON tablespace]... | PROFILE profile | PASSWORD EXPIRE | ACCOUNT { LOCK | UNLOCK } [DEFAULT TABLESPACE tablespace | TEMPORARY TABLESPACE { tablespace | tablespace_group_name } | QUOTA { integer [K | M] | UNLIMITED } ON tablespace [QUOTA { integer [K | M] | UNLIMITED } ON tablespace]... | PROFILE profile | PASSWORD EXPIRE | ACCOUNT { LOCK | UNLOCK }]...] ;
CREATE VIEW	CREATE [OR REPLACE] [[NO] FORCE] VIEW [schema.]view [(alias [inline_constraint [inline_constraint]...]

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SQL Statement	Syntax
		out_of_line_constraint [, alias [inline_constraint [inline_constraint]...] | out_of_line_constraint]...) | object_view_clause | XMLType_view_clause] AS subquery [subquery_restriction_clause] ;
DELETE	DELETE [hint] [FROM] { dml_table_expression_clause | ONLY (dml_table_expression_clause) } [t_alias] [where_clause] [returning_clause] ;
DISASSOCIATE STATISTICS	DISASSOCIATE STATISTICS FROM { COLUMNS [schema.]table.column [, [schema.]table.column]... | FUNCTIONS [schema.]function [, [schema.]function]... | PACKAGES [schema.]package [, [schema.]package]... | TYPES [schema.]type [, [schema.]type]... | INDEXES [schema.]index [, [schema.]index]... | INDEXTYPES [schema.]indextype [, [schema.]indextype]... } [FORCE] ;
DROP CLUSTER	DROP CLUSTER [schema.]cluster [INCLUDING TABLES [CASCADE CONSTRAINTS]] ;
DROP CONTEXT	DROP CONTEXT namespace ;
DROP DATABASE	DROP DATABASE ;
DROP DATABASE LINK	DROP [PUBLIC] DATABASE LINK dblink ;
DROP DIMENSION	DROP DIMENSION [schema.]dimension ;
DROP DIRECTORY	DROP DIRECTORY directory_name ;

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SQL Statement	Syntax
DROP DISKGROUP	DROP DISKGROUP diskgroup_name [{ INCLUDING | EXCLUDING } CONTENTS] ;
DROP FUNCTION	DROP FUNCTION [schema.]function_name ;
DROP INDEX	DROP INDEX [schema.]index [FORCE] ;
DROP INDEXTYPE	DROP INDEXTYPE [schema.]indextype [FORCE] ;
DROP JAVA	DROP JAVA { SOURCE | CLASS | RESOURCE } [schema.]object_name ;
DROP LIBRARY	DROP LIBRARY library_name ;
DROP MATERIALIZED VIEW	DROP MATERIALIZED VIEW [schema.]materialized_view [PRESERVE TABLE] ;
DROP MATERIALIZED VIEW LOG	DROP MATERIALIZED VIEW LOG ON [schema.]table ;
DROP OPERATOR	DROP OPERATOR [schema.]operator [FORCE] ;
DROP OUTLINE	DROP OUTLINE outline ;
DROP PACKAGE	DROP PACKAGE [BODY] [schema.]package ;
DROP PROCEDURE	DROP PROCEDURE [schema.]procedure ;
DROP PROFILE	DROP PROFILE profile [CASCADE] ;
DROP ROLE	DROP ROLE role ;
DROP ROLLBACK SEGMENT	DROP ROLLBACK SEGMENT rollback_segment ;
DROP SEQUENCE	DROP SEQUENCE [schema.]sequence_name ;
DROP SYNONYM	DROP [PUBLIC] SYNONYM [schema.]synonym [FORCE] ;

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SQL Statement	Syntax
DROP TABLE	DROP TABLE [schema.]table [CASCADE CONSTRAINTS] [PURGE] ;
DROP TABLESPACE	DROP TABLESPACE tablespace [INCLUDING CONTENTS [AND DATAFILES] [CASCADE CONSTRAINTS]] ;
DROP TRIGGER	DROP TRIGGER [schema.]trigger ;
DROP TYPE	DROP TYPE [schema.]type_name [FORCE | VALIDATE] ;
DROP TYPE BODY	DROP TYPE BODY [schema.]type_name ;
DROP USER	DROP USER user [CASCADE] ;
DROP VIEW	DROP VIEW [schema.] view [CASCADE CONSTRAINTS] ;
EXPLAIN PLAN	EXPLAIN PLAN [SET STATEMENT_ID = 'text'] [INTO [schema.]table [@ dblink]] FOR statement ;
FLASHBACK DATABASE	FLASHBACK [STANDBY] DATABASE [database] { TO { SCN | TIMESTAMP } expr | TO BEFORE { SCN | TIMESTAMP } expr };
FLASHBACK TABLE	FLASHBACK TABLE [schema.]table [, [schema.]table]... TO { { SCN | TIMESTAMP } expr [{ ENABLE | DISABLE } TRIGGERS] | BEFORE DROP [RENAME TO table] } ;
GRANT	GRANT { grant_system_privileges | grant_object_privileges } ;
INSERT	INSERT [hint] { single_table_insert | multi_table_insert } ;

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SQL Statement	Syntax
LOCK TABLE	LOCK TABLE [schema.] { table | view } [{ PARTITION (partition) | SUBPARTITION (subpartition) } | @ dblink] [, [schema.] { table | view } [{ PARTITION (partition) | SUBPARTITION (subpartition) } | @ dblink]]... IN lockmode MODE [NOWAIT] ;
MERGE	MERGE [hint] INTO [schema.]table [t_alias] USING [schema.] { table | view | subquery } [t_alias] ON (condition) [merge_update_clause] [merge_insert_clause] ;
NOAUDIT	NOAUDIT { sql_statement_clause [, sql_statement_clause]... | schema_object_clause [, schema_object_clause]... } [WHENEVER [NOT] SUCCESSFUL] ;
PURGE	PURGE { { TABLE table | INDEX index } | { RECYCLEBIN | DBA_RECYCLEBIN } | TABLESPACE tablespace [USER user] } ; DO NOT IMPORT AS INSET problem importing file, locks up FrameMaker
RENAME	RENAME old_name TO new_name ;
REVOKE	REVOKE { revoke_system_privileges | revoke_object_privileges } ;

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SQL Statement	Syntax
ROLLBACK	ROLLBACK [WORK] [TO [SAVEPOINT] savepoint | FORCE 'text'] ;
SAVEPOINT	SAVEPOINT savepoint ;
SELECT	subquery [for_update_clause] ;
SET CONSTRAINT[S]	SET { CONSTRAINT | CONSTRAINTS } { constraint [, constraint]... | ALL } { IMMEDIATE | DEFERRED } ;
SET ROLE	SET ROLE { role [IDENTIFIED BY password] [, role [IDENTIFIED BY password]]... | ALL [EXCEPT role [, role]...] | NONE } ;
SET TRANSACTION	SET TRANSACTION { { READ { ONLY | WRITE } | ISOLATION LEVEL { SERIALIZABLE | READ COMMITTED } | USE ROLLBACK SEGMENT rollback_segment } [NAME 'text'] | NAME 'text' } ;
TRUNCATE	TRUNCATE { TABLE [schema.]table [{ PRESERVE | PURGE } MATERIALIZED VIEW LOG] | CLUSTER [schema.]cluster } [{ DROP | REUSE } STORAGE] ;
UPDATE	UPDATE [hint] { dml_table_expression_clause | ONLY (dml_table_expression_clause) } [t_alias] update_set_clause [where_clause] [returning_clause] ;

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Table 2: Syntax for Subclauses

Subclause	Syntax
activate_standby_db_clause	ACTIVATE [PHYSICAL | LOGICAL] STANDBY DATABASE [SKIP [STANDBY LOGFILE]]
add_binding_clause	ADD BINDING (parameter_type [, parameter_type]...) RETURN (return_type) [implementation_clause] using_function_clause
add_column_clause	ADD (column datatype [DEFAULT expr] [{ inline_constraint [inline_constraint]... | inline_ref_constraint }] [, column datatype [DEFAULT expr] [{ inline_constraint [inline_constraint]... | inline_ref_constraint }]]...) [column_properties]
add_disk_clause	ADD [FAILGROUP failgroup_name] DISK qualified_disk_clause [, qualified_disk_clause]... [[FAILGROUP failgroup_name] DISK qualified_disk_clause [, qualified_disk_clause]...]...
add_hash_index_partition	ADD PARTITION [partition_name] [TABLESPACE tablespace_name] [parallel_clause]
add_hash_partition_clause	ADD PARTITION [partition] partitioning_storage_clause [update_index_clauses] [parallel_clause]

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Subclause	Syntax
add_hash_subpartition	ADD subpartition_spec [update_index_clauses] [parallel_clause]
add_list_partition_clause	ADD PARTITION [partition] list_values_clause [table_partition_description] [update_index_clauses]
add_list_subpartition	ADD subpartition_spec [update_index_clauses]
add_logfile_clauses	ADD [STANDBY] LOGFILE { [INSTANCE 'instance_name' | THREAD integer] [GROUP integer] redo_log_file_spec [, [GROUP integer] redo_log_file_spec]... | MEMBER 'filename' [REUSE] [, 'filename' [REUSE]]... TO logfile_descriptor [, logfile_descriptor]... }
add_overflow_clause	ADD OVERFLOW [segment_attributes_clause] [(PARTITION [segment_attributes_clause] [, PARTITION [segment_attributes_clause]]...)]
add_range_partition_clause	ADD PARTITION [partition] range_values_clause [table_partition_description] [update_index_clauses]
add_table_partition	{ add_range_partition_clause | add_hash_partition_clause | add_list_partition_clause }
alias_file_name	+diskgroup_name [(template_name)] /alias_name
allocate_extent_clause	ALLOCATE EXTENT [({ SIZE size_clause | DATAFILE 'filename' | INSTANCE integer }

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Subclause	Syntax
	[SIZE size_clause | DATAFILE 'filename' | INSTANCE integer]...)]
alter_attribute_definition	{ { ADD | MODIFY } ATTRIBUTE { attribute [datatype] | (attribute datatype [, attribute datatype]...) } | DROP ATTRIBUTE { attribute | (attribute [, attribute]...) } }
alter_collection_clauses	MODIFY { LIMIT integer | ELEMENT TYPE datatype }
alter_datafile_clause	DATAFILE { 'filename' | filenumber } [, 'filename' | filenumber]... } { ONLINE | OFFLINE [FOR DROP] | RESIZE size_clause | autoextend_clause | END BACKUP }
alter_external_table_clauses	{ add_column_clause | modify_column_clauses | drop_column_clause | parallel_clause | external_data_properties | REJECT LIMIT { integer | UNLIMITED } | PROJECT COLUMN { ALL | REFERENCED } } [add_column_clause | modify_column_clauses | drop_column_clause | parallel_clause | external_data_properties | REJECT LIMIT { integer | UNLIMITED } | PROJECT COLUMN { ALL | REFERENCED }]...

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Subclause	Syntax
alter_index_partitioning	{ modify_index_default_attrs | add_hash_index_partition | modify_index_partition | rename_index_partition | drop_index_partition | split_index_partition | coalesce_index_partition | modify_index_subpartition }
alter_iot_clauses	{ index_org_table_clause | alter_overflow_clause | alter_mapping_table_clauses | COALESCE }
alter_mapping_table_clauses	MAPPING TABLE { UPDATE BLOCK REFERENCES | allocate_extent_clause | deallocate_unused_clause }
alter_method_spec	{ ADD | DROP } { map_order_function_spec | subprogram_spec } [{ ADD | DROP } { map_order_function_spec | subprogram_spec }]...
alter_mv_refresh	REFRESH { { FAST | COMPLETE | FORCE } | ON { DEMAND | COMMIT } | { START WITH | NEXT } date | WITH PRIMARY KEY | USING { DEFAULT MASTER ROLLBACK SEGMENT | MASTER ROLLBACK SEGMENT rollback_segment } | USING { ENFORCED | TRUSTED } CONSTRAINTS }
alter_overflow_clause	{ OVERFLOW { allocate_extent_clause | deallocate_unused_clause } [allocate_extent_clause | deallocate_unused_clause

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Subclause	Syntax
	]... | add_overflow_clause }
alter_session_set_clause	SET parameter_name = parameter_value [parameter_name = parameter_value]...
alter_system_reset_clause	parameter_name [SCOPE = { MEMORY | SPFILE | BOTH }] SID = 'sid'
alter_system_set_clause	parameter_name = parameter_value [, parameter_value]... [COMMENT 'text'] [DEFERRED] [SCOPE = { MEMORY | SPFILE | BOTH }] [SID = { 'sid' | * }]
alter_table_partitioning	{ modify_table_default_attrs | set_subpartition_template | modify_table_partition | modify_table_subpartition | move_table_partition | move_table_subpartition | add_table_partition | coalesce_table_partition | drop_table_partition | drop_table_subpartition | rename_partition_subpart | truncate_partition_subpart | split_table_partition | split_table_subpartition | merge_table_partitions | merge_table_subpartitions | exchange_partition_subpart }
alter_table_properties	{ { physical_attributes_clause | logging_clause | table_compression | supplemental_table_logging | allocate_extent_clause | deallocate_unused_clause | shrink_clause | { CACHE | NOCACHE } | upgrade_table_clause | records_per_block_clause | parallel_clause | row_movement_clause } [physical_attributes_clause

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Subclause	Syntax
		logging_clause | table_compression | supplemental_table_logging | allocate_extent_clause | deallocate_unused_clause | shrink_clause | { CACHE	NOCACHE } | upgrade_table_clause | records_per_block_clause | parallel_clause | row_movement_clause]... | RENAME TO new_table_name } [alter_iot_clauses]
alter_tempfile_clause	TEMPFILE { 'filename' [, 'filename']... | filenumber [, filenumber]... } { RESIZE size_clause | autoextend_clause | DROP [INCLUDING DATAFILES] | ONLINE | OFFLINE }
alter_varray_col_properties	MODIFY VARRAY varray_item (modify_LOB_parameters)
analytic_clause	[query_partition_clause] [order_by_clause [windowing_clause]]
archive_log_clause	ARCHIVE LOG [INSTANCE 'instance_name' | THREAD integer] { { SEQUENCE integer | CHANGE integer | CURRENT [NOSWITCH] | GROUP integer | LOGFILE 'filename' [USING BACKUP CONTROLFILE] | NEXT | ALL | START } [TO 'location'] | STOP }

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Subclause	Syntax
array_DML_clause	[WITH | WITHOUT] ARRAY DML [([schema.]type [, [schema.]varray_type]) [, ([schema.]type [, [schema.]varray_type])...]
attribute_clause	ATTRIBUTE level DETERMINES { dependent_column | (dependent_column [, dependent_column]...) }
auditing_by_clause	BY { proxy [, proxy]... | user [, user]... }
auditing_on_clause	ON { [schema.]object | DIRECTORY directory_name | DEFAULT }
autoextend_clause	AUTOEXTEND { OFF | ON [NEXT size_clause] [maxsize_clause] }
binding_clause	BINDING (parameter_type [, parameter_type]...) RETURN return_type [implementation_clause] using_function_clause [, (parameter_type [, parameter_type]...) RETURN return_type [implementation_clause] using_function_clause]...
bitmap_join_index_clause	[schema.]table ([[schema.]table. | t_alias.]column [ASC | DESC] [, [[schema.]table. | t_alias.]column [ASC | DESC]]...) FROM [schema.]table [t_alias] [, [schema.]table [t_alias]]...

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Subclause	Syntax
	WHERE condition [local_partitioned_index] index_attributes
build_clause	BUILD { IMMEDIATE | DEFERRED }
C_declaration	C [NAME name] LIBRARY lib_name [AGENT IN (argument[, argument]...)] [WITH CONTEXT] [PARAMETERS (parameter[, parameter]...)]
call_spec	LANGUAGE { Java_declaration | C_declaration }
cancel_clause	CANCEL [IMMEDIATE] [WAIT | NOWAIT]
cell_assignment	measure_column [{ { condition | expr | single_column_for_loop } [, { condition | expr | single_column_for_loop }]... | multi_column_for_loop }] Note: The outer square brackets are part of the syntax. In this case, they do not indicate optionality.
cell_reference_options	[{ IGNORE | KEEP } NAV] [UNIQUE { DIMENSION | SINGLE REFERENCE }]
character_set_clause	CHARACTER SET character_set
check_datafiles_clause	CHECK DATAFILES [GLOBAL | LOCAL]
check_diskgroup_clauses	CHECK { ALL | DISK disk_name [, disk_name]... | DISKS IN FAILGROUP failgroup_name

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Subclause	Syntax
	[, failgroup_name]... | FILE filename [, filename]... } [CHECK { ALL | DISK disk_name [, disk_name]... | DISKS IN FAILGROUP failgroup_name [, failgroup_name]... | FILE filename [, filename]... }]... [REPAIR | NOREPAIR]
checkpoint_clause	CHECKPOINT [GLOBAL | LOCAL]
cluster_index_clause	CLUSTER [schema.] cluster index_attributes
coalesce_index_partition	COALESCE PARTITION [parallel_clause]
coalesce_table_partition	COALESCE PARTITION [update_index_clauses] [parallel_clause]
column_association	COLUMNS [schema.]table.column [, [schema.]table.column]... using_statistics_type
column_clauses	{ { add_column_clause | modify_column_clause | drop_column_clause } [add_column_clause | modify_column_clause | drop_column_clause]... | rename_column_clause | modify_collection_retrieval [modify_collection_retrieval]... | modify_LOB_storage_clause | alter_varray_col_properties }

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Subclause	Syntax
column_properties	{ object_type_col_properties | nested_table_col_properties | { varray_col_properties | LOB_storage_clause } [(LOB_partition_storage [, LOB_partition_storage]...)] | XMLType_column_properties } [{ object_type_col_properties | nested_table_col_properties | { varray_col_properties | LOB_storage_clause } [(LOB_partition_storage [, LOB_partition_storage]...)] | XMLType_column_properties }]...
commit_switchover_clause	{ PREPARE | COMMIT } TO SWITCHOVER [TO { { PHYSICAL | LOGICAL } PRIMARY | PHYSICAL STANDBY [{ WITH | WITHOUT } SESSION SHUTDOWN { WAIT | NOWAIT }] | LOGICAL STANDBY } | CANCEL]
compile_type_clause	COMPILE [DEBUG] [SPECIFICATION | BODY] [compiler_parameters_clause [compiler_parameters_clause] ...] [REUSE SETTINGS]
compiler_parameters_clause	parameter_name = parameter_value
composite_partitioning	PARTITION BY RANGE (column_list) [subpartition_by_list | subpartition_by_hash] (PARTITION [partition] range_values_clause table_partition_description [, PARTITION [partition] range_values_clause table_partition_description] ...)

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Subclause	Syntax
compute_statistics_clause	COMPUTE [SYSTEM] STATISTICS [for_clause]

conditional_insert_clause	[ALL | FIRST]
	WHEN condition
	THEN insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  [insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  ]...
	[WHEN condition
	  THEN insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  [insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  ]...
	]...
	[ELSE insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  [insert_into_clause
	  [values_clause]
	  [error_logging_clause]
	  ]...
	]

constraint	{ inline_constraint | out_of_line_constraint | inline_ref_constraint | out_of_line_ref_constraint }

constraint_clauses	{ ADD { out_of_line_constraint
	  [out_of_line_constraint]...
	  | out_of_line_REF_constraint
	  }
	| MODIFY { CONSTRAINT constraint
	  | PRIMARY KEY
	  | UNIQUE (column [, column]...)
	  }
	  constraint_state
	| RENAME CONSTRAINT old_name TO new_name
	| drop_constraint_clause
	}

constraint_state	[[[NOT] DEFERRABLE] [INITIALLY { IMMEDIATE | DEFERRED }] | [INITIALLY { IMMEDIATE | DEFERRED }]

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Subclause	Syntax
	[[NOT] DEFERRABLE]] [RELY | NORELY] [using_index_clause] [ENABLE | DISABLE] [VALIDATE | NOVALIDATE] [exceptions_clause]
constructor_declaration	[FINAL] [INSTANTIABLE] CONSTRUCTOR FUNCTION datatype [[SELF IN OUT datatype,] parameter datatype [, parameter datatype]...] RETURN SELF AS RESULT { IS | AS } { pl/sql_block | call_spec }
constructor_spec	[FINAL] [INSTANTIABLE] CONSTRUCTOR FUNCTION datatype [([SELF IN OUT datatype,] parameter datatype [, parameter datatype]...)] RETURN SELF AS RESULT [{ IS | AS } call_spec]
context_clause	[WITH INDEX CONTEXT, SCAN CONTEXT implementation_type [COMPUTE ANCILLARY DATA]] [WITH COLUMN CONTEXT]
controlfile_clauses	{ CREATE [LOGICAL | PHYSICAL] STANDBY CONTROLFILE AS 'filename' [REUSE] | BACKUP CONTROLFILE TO { 'filename' [REUSE] | trace_file_clause } }
create_datafile_clause	CREATE DATAFILE { 'filename' | filenumber } [, 'filename' | filenumber]... } [AS { file_specification [, file_specification]... | NEW }]

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Subclause	Syntax
create_incomplete_type	CREATE [OR REPLACE] TYPE [schema.]type_name ;
create_mv_refresh	{ REFRESH { { FAST | COMPLETE | FORCE } | ON { DEMAND | COMMIT } | { START WITH | NEXT } date | WITH { PRIMARY KEY | ROWID } | USING { DEFAULT [MASTER | LOCAL] ROLLBACK SEGMENT | [MASTER | LOCAL] ROLLBACK SEGMENT rollback_segment } [DEFAULT [MASTER | LOCAL] ROLLBACK SEGMENT | [MASTER | LOCAL] ROLLBACK SEGMENT rollback_segment]... | USING { ENFORCED | TRUSTED } CONSTRAINTS } [{ FAST | COMPLETE | FORCE } | ON { DEMAND | COMMIT } | { START WITH | NEXT } date | WITH { PRIMARY KEY | ROWID } | USING { DEFAULT [MASTER | LOCAL] ROLLBACK SEGMENT | [MASTER | LOCAL] ROLLBACK SEGMENT rollback_segment } [DEFAULT [MASTER | LOCAL] ROLLBACK SEGMENT | [MASTER | LOCAL] ROLLBACK SEGMENT rollback_segment]... | USING { ENFORCED | TRUSTED } CONSTRAINTS]... | NEVER REFRESH }
create_nested_table_type	CREATE [OR REPLACE] TYPE [schema.]type_name [OID 'object_identifier'] { IS | AS } TABLE OF datatype ;

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Subclause	Syntax
create_object_type	CREATE [OR REPLACE] TYPE [schema.]type_name [OID 'object_identifier'] [invoker_rights_clause] { { IS | AS } OBJECT | UNDER [schema.]supertype } [sqlj_object_type] [(attribute datatype [sqlj_object_type_attr] [, attribute datatype [sqlj_object_type_attr]... [, element_spec [, element_spec]...])] [[NOT] FINAL] [[NOT] INSTANTIABLE] ;
create_varray_type	CREATE [OR REPLACE] TYPE [schema.]type_name [OID 'object_identifier'] { IS | AS } { VARRAY | VARYING ARRAY } (limit) OF datatype ;
database_file_clauses	{ RENAME FILE 'filename' [, 'filename']... TO 'filename' | create_datafile_clause | alter_datafile_clause | alter_tempfile_clause }
database_logging_clauses	{ LOGFILE [GROUP integer] file_specification [, [GROUP integer] file_specification]... | MAXLOGFILES integer | MAXLOGMEMBERS integer | MAXLOGHISTORY integer | { ARCHIVELOG | NOARCHIVELOG } | FORCE LOGGING }
datafile_tempfile_clauses	{ ADD { DATAFILE | TEMPFILE } [file_specification [, file_specification]...] | RENAME DATAFILE 'filename' [, 'filename']... TO

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Subclause	Syntax
	'filename' [, 'filename']... | { DATAFILE | TEMPFILE } { ONLINE | OFFLINE } }
datafile_tempfile_spec	['filename'] [SIZE size_clause] [REUSE] [autoextend_clause]
dblink	database[.domain [.domain]...] [@ connect_descriptor]
dblink_authentication	AUTHENTICATED BY user IDENTIFIED BY password
deallocate_unused_clause	DEALLOCATE UNUSED [KEEP size_clause]
default_cost_clause	DEFAULT COST (cpu_cost, io_cost, network_cost)
default_selectivity_clause	DEFAULT SELECTIVITY default_selectivity
default_tablespace	DEFAULT TABLESPACE tablespace [DATAFILE datafile_tempfile_spec] extent_management_clause
default_settings_clauses	{ SET DEFAULT { BIGFILE | SMALLFILE } TABLESPACE | DEFAULT TABLESPACE tablespace | DEFAULT TEMPORARY TABLESPACE { tablespace | tablespace_group_name } | RENAME GLOBAL_NAME TO database.domain [.domain]... | { ENABLE BLOCK CHANGE TRACKING [USING FILE 'filename' [REUSE]] | DISABLE BLOCK CHANGE TRACKING } | flashback_mode_clause | set_time_zone_clause }
default_temp_tablespace	[BIGFILE | SMALLFILE] DEFAULT TEMPORARY TABLESPACE tablespace [TEMPFILE file_specification [, file_specification]...] extent_management_clause

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Subclause	Syntax
dependent_handling_clause	{ INVALIDATE | CASCADE [{ [NOT] INCLUDING TABLE DATA | CONVERT TO SUBSTITUTABLE }] [[FORCE] exceptions_clause] }
dimension_join_clause	JOIN KEY { child_key_column | (child_key_column [, child_key_column]...) } REFERENCES parent_level [JOIN KEY { child_key_column | (child_key_column [, child_key_column]...) } REFERENCES parent_level]...
disk_clauses	{ diskgroup_name { add_disk_clause | drop_disk_clauses | resize_disk_clauses } | { diskgroup_name | ALL } undrop_disk_clause }
diskgroup_alias_clauses	{ ADD ALIAS alias_name FOR filename [, alias_name FOR filename]... | DROP ALIAS alias_name [, alias_name]... | RENAME ALIAS old_alias_name TO new_alias_name [, old_alias_name TO new_alias_name]... }
diskgroup_availability	{ MOUNT | DISMOUNT [FORCE | NOFORCE] }
diskgroup_clauses	{ diskgroup_name { rebalance_diskgroup_clause | check_diskgroup_clauses | diskgroup_template_clauses | diskgroup_directory_clauses | diskgroup_alias_clauses

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Subclause	Syntax

	`| drop_diskgroup_file_clause`
	`}`
	`| { diskgroup_name | ALL }`
	`diskgroup_availability`
	`}`

diskgroup_directory_clauses	`{ ADD DIRECTORY`
	`filename`
	`[, filename ]...`
	`| DROP DIRECTORY`
	`filename [ FORCE | NOFORCE ]`
	`[, filename [ FORCE | NOFORCE ] ]...`
	`| RENAME DIRECTORY`
	`old_dir_name TO new_dir_name`
	`[, old_dir_name TO new_dir_name ]...`
	`}`

diskgroup_file_spec	`[ ' { fully_qualified_file_name`
	`| numeric_file_name`
	`| incorporate_file_name`
	`| alias_file_name`
	`}`
	`'`
	`]`
	`[ SIZE size_clause ]`
	`[ REUSE ]`
	`[ autoextend_clause ]`

diskgroup_template_clauses	`{ { ADD | ALTER } TEMPLATE`
	`qualified_template_clause`
	`[, qualified_template_clause ]...`
	`| DROP TEMPLATE`
	`template_name`
	`[, template_name ]...`
	`}`

distributed_recov_clauses	`{ ENABLE | DISABLE } DISTRIBUTED RECOVERY`

dml_event_clause	`{ DELETE | INSERT | UPDATE`
	`[ OF column [, column ]... ]`
	`}`
	`[ OR { DELETE | INSERT | UPDATE`
	`[ OF column [, column]... ]`
	`}`
	`]...`
	`ON { [ schema. ]table`
	`| [ NESTED TABLE nested_table_column OF ]`
	`[ schema. ] view`
	`}`
	`[ referencing_clause ]`
	`[ FOR EACH ROW ]`

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Subclause	Syntax

dml_table_expression_clause	{ [schema.]
	  { table
	  [{ PARTITION (partition)
	  | SUBPARTITION (subpartition)
	  }
	  | @ dblink
	  ]
	  | { view | materialized view } [@ dblink]
	  }
	| (subquery [subquery_restriction_clause])
	| table_collection_expression
	}

domain_index_clause	INDEXTYPE IS indextype
	  [parallel_clause]
	  [PARAMETERS ('ODCI_parameters')]

drop_binding_clause	DROP BINDING (parameter_type [, parameter_type]...) [FORCE]

drop_column_clause	{ SET UNUSED { COLUMN column
	  | (column [, column]...)
	  }
	  [{ CASCADE CONSTRAINTS | INVALIDATE }
	  [CASCADE CONSTRAINTS | INVALIDATE]...
	  ]
	| DROP { COLUMN column
	  | (column [, column]...)
	  }
	  [{ CASCADE CONSTRAINTS | INVALIDATE }
	  [CASCADE CONSTRAINTS | INVALIDATE]...
	  ]
	  [CHECKPOINT integer]
	| DROP { UNUSED COLUMNS
	  | COLUMNS CONTINUE
	  }
	  [CHECKPOINT integer]
	}

drop_constraint_clause	DROP
	  { { PRIMARY KEY
	  | UNIQUE (column [, column]...)
	  }
	  [CASCADE]
	  [{ KEEP | DROP } INDEX]
	  | CONSTRAINT constraint
	  [CASCADE]
	  }

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Subclause	Syntax
drop_disk_clauses	DROP { DISK disk_name [FORCE | NOFORCE] [, disk_name [FORCE | NOFORCE]]... | DISKS IN FAILGROUP failgroup_name [FORCE | NOFORCE] [, failgroup_name [FORCE | NOFORCE]]... }
drop_diskgroup_file_clause	DROP FILE filename [, filename]...
drop_index_partition	DROP PARTITION partition_name
drop_logfile_clauses	DROP [STANDBY] LOGFILE { logfile_descriptor [, logfile_descriptor]... | MEMBER 'filename' [, 'filename']... }
drop_table_partition	DROP PARTITION partition [update_index_clauses [parallel_clause]]
drop_table_subpartition	DROP SUBPARTITION subpartition [update_index_clauses [parallel_clause]]
element_spec	[inheritance_clauses] { subprogram_spec | constructor_spec | map_order_function_spec } [subprogram_clause | constructor_spec | map_order_function_spec]... [, pragma_clause]
else_clause	ELSE else_expr
enable_disable_clause	{ ENABLE | DISABLE } [VALIDATE | NOVALIDATE] { UNIQUE (column [, column]...) | PRIMARY KEY | CONSTRAINT constraint } [using_index_clause]

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Subclause	Syntax
	[exceptions_clause] [CASCADE] [{ KEEP | DROP } INDEX]
end_session_clauses	{ DISCONNECT SESSION 'integer1, integer2' [POST_TRANSACTION] | KILL SESSION 'integer1, integer2' } [IMMEDIATE]
estimate_statistics_clause	ESTIMATE [SYSTEM] STATISTICS [for_clause] [SAMPLE integer { ROWS | PERCENT }]
exceptions_clause	EXCEPTIONS INTO [schema.]table

exchange_partition_subpart	EXCHANGE { PARTITION partition
	  | SUBPARTITION subpartition
	  }
	  WITH TABLE table
	  [{ INCLUDING | EXCLUDING } INDEXES]
	  [{ WITH | WITHOUT } VALIDATION]
	  [exceptions_clause]
	  [update_index_clauses [parallel_clause]]

expr	{ simple_expression | compound_expression | case_expression | cursor_expression | datetime_expression | function_expression | interval_expression | object_access_expression | scalar_subquery_expression | model_expression | type_constructor_expression | variable_expression }
expression_list	{ expr [, expr]... | (expr [, expr]...) }

extended_attribute_clause	ATTRIBUTE attribute
	LEVEL level
	DETERMINES { dependent_column
	  | (dependent_column
	  [, dependent_column]...
	  )
	[LEVEL level

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Subclause	Syntax
	DETERMINES { dependent_column | (dependent_column [, dependent_column]...)]...
extent_management_clause	EXTENT MANAGEMENT { DICTIONARY | LOCAL [AUTOALLOCATE | UNIFORM [SIZE size_clause]] }
external_data_properties	DEFAULT DIRECTORY directory [ACCESS PARAMETERS { (opaque_format_spec) | USING CLOB subquery }] LOCATION ([directory:] 'location_specifier' [, [directory:] 'location_specifier']...)
external_table_clause	([TYPE access_driver_type] external_data_properties) [REJECT LIMIT { integer | UNLIMITED }]
file_specification	{ datafile_tempfile_spec | diskgroup_file_spec | redo_log_file_spec }
finish_clause	[DISCONNECT [FROM SESSION]] [parallel_clause] FINISH [SKIP [STANDBY LOGFILE]] [WAIT | NOWAIT]
flashback_mode_clause	FLASHBACK { ON | OFF }
flashback_query_clause	[VERSIONS BETWEEN { SCN | TIMESTAMP } { expr | MINVALUE } AND { expr | MAXVALUE }

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Subclause	Syntax
	] AS OF { SCN | TIMESTAMP } expr
for_clause	FOR { TABLE | ALL [INDEXED] COLUMNS [SIZE integer] | COLUMNS [SIZE integer] { column | attribute } [SIZE integer] [{ column | attribute } [SIZE integer]]... | ALL [LOCAL] INDEXES } [FOR { TABLE | ALL [INDEXED] COLUMNS [SIZE integer] | COLUMNS [SIZE integer] { column | attribute } [SIZE integer] [{ column | attribute } [SIZE integer]]... | ALL [LOCAL] INDEXES }]...
for_update_clause	FOR UPDATE [OF [[schema.] { table | view } .]column [, [[schema.] { table | view } .]column]...] [NOWAIT | WAIT integer]
full_database_recovery	[STANDBY] DATABASE [{ UNTIL { CANCEL | TIME date | CHANGE integer } | USING BACKUP CONTROLFILE } [UNTIL { CANCEL | TIME date | CHANGE integer } | USING BACKUP CONTROLFILE]...]

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Subclause	Syntax
fully_qualified_file_name	+diskgroup_name/db_name/file_type/ file_type_tag.filenumber.incarnation_number
function_association	{ FUNCTIONS [schema.]function [, [schema.]function]... | PACKAGES [schema.]package [, [schema.]package]... | TYPES [schema.]type [, [schema.]type]... | INDEXES [schema.]index [, [schema.]index]... | INDEXTYPES [schema.]indextype [, [schema.]indextype]... } { using_statistics_type | { default_cost_clause [, default_selectivity_clause] | default_selectivity_clause [, default_cost_clause] } }
function_declaration	FUNCTION name (parameter datatype[, parameter datatype]...) RETURN datatype { IS | AS } { pl/sql_block | call_spec }
function_spec	FUNCTION name (parameter datatype [, parameter datatype]...) return_clause
general_recovery	RECOVER [AUTOMATIC] [FROM 'location'] { { full_database_recovery | partial_database_recovery | LOGFILE 'filename' } [{ TEST | ALLOW integer CORRUPTION | parallel_clause } [TEST | ALLOW integer CORRUPTION | parallel_clause]...

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Subclause	Syntax
	] | CONTINUE [DEFAULT] | CANCEL }
global_partitioned_index	GLOBAL PARTITION BY { RANGE (column_list) (index_partitioning_clause) | HASH (column_list) { individual_hash_partitions | hash_partitions_by_quantity } }
grant_object_privileges	{ object_privilege | ALL [PRIVILEGES] } [(column [, column]...)] [, { object_privilege | ALL [PRIVILEGES] } [(column [, column]...)]]... on_object_clause TO grantee_clause [WITH HIERARCHY OPTION] [WITH GRANT OPTION]
grant_system_privileges	{ system_privilege | role | ALL PRIVILEGES } [, { system_privilege | role | ALL PRIVILEGES }]... TO grantee_clause [IDENTIFIED BY password] [WITH ADMIN OPTION]
grantee_clause	{ user | role | PUBLIC } [, { user | role | PUBLIC }]...
group_by_clause	GROUP BY { expr | rollup_cube_clause | grouping_sets_clause } [, { expr | rollup_cube_clause | grouping_sets_clause }

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Subclause	Syntax
	]... [HAVING condition]
grouping_expression_list	expression_list [, expression_list]...
grouping_sets_clause	GROUPING SETS ({ rollup_cube_clause | grouping_expression_list })
hash_partitioning	PARTITION BY HASH (column [, column] ...) { individual_hash_partitions | hash_partitions_by_quantity }
hash_partitions_by_quantity	PARTITIONS hash_partition_quantity [STORE IN (tablespace [, tablespace]...)] [OVERFLOW STORE IN (tablespace [, tablespace]...)]
hierarchical_query_clause	[START WITH condition] CONNECT BY [NOCYCLE] condition
hierarchy_clause	HIERARCHY hierarchy (child_level CHILD OF parent_level [CHILD OF parent_level]... [dimension_join_clause])
implementation_clause	{ ANCILLARY TO primary_operator (parameter_type [, parameter_type]...) [, primary_operator (parameter_type [, parameter_type]...)]... | context_clause }
incomplete_file_name	+diskgroup_name [(template_name)]
index_attributes	[{ physical_attributes_clause | logging_clause | ONLINE | COMPUTE STATISTICS | TABLESPACE { tablespace | DEFAULT } | key_compression

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Subclause	Syntax
		{ SORT | NOSORT } | REVERSE | parallel_clause } [physical_attributes_clause | logging_clause | ONLINE | COMPUTE STATISTICS | TABLESPACE { tablespace | DEFAULT } | key_compression | { SORT | NOSORT } | REVERSE | parallel_clause]...]
index_expr	{ column | column_expression }
index_org_overflow_clause	[INCLUDING column_name] OVERFLOW [segment_attributes_clause]
index_org_table_clause	[{ mapping_table_clause | PCTTHRESHOLD integer | key_compression } [mapping_table_clause | PCTTHRESHOLD integer | key_compression]...] [index_org_overflow_clause]
index_partition_description	PARTITION [partition [{ segment_attributes_clause | key_compression } [segment_attributes_clause | key_compression]...]]
index_partitioning_clause	PARTITION [partition] VALUES LESS THAN (value[, value...]) [segment_attributes_clause]
index_properties	[{ { global_partitioned_index | local_partitioned_index

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Subclause	Syntax

	`    }`
	`  | index_attributes`
	`  }`
	`      [ { { global_partitioned_index`
	`          | local_partitioned_index`
	`          }`
	`        | index_attributes`
	`        }`
	`      ]...`
	`| domain_index_clause`
	`]`

index_subpartition_clause	`{ STORE IN (tablespace[, tablespace ]...)`
	`| (SUBPARTITION`
	`      [ subpartition [ TABLESPACE tablespace ] ]`
	`   [, SUBPARTITION`
	`         [ subpartition [ TABLESPACE tablespace`
	`] ]`
	`   ]...`
	`  )`
	`}`

individual_hash_partitions	`(PARTITION`
	`    [ partition partitioning_storage_clause ]`
	`  [, PARTITION`
	`        [ partition partitioning_storage_clause`
	`]`
	`  ]...`
	`)`

inheritance_clauses	`[ NOT ] { OVERRIDING | FINAL | INSTANTIABLE }`
	`  [ [ NOT ] { OVERRIDING | FINAL | INSTANTIABLE`
	`} ]...`

inline_constraint	`[ CONSTRAINT constraint_name ]`
	`{ [ NOT ] NULL`
	`| UNIQUE`
	`| PRIMARY KEY`
	`| references_clause`
	`| CHECK (condition)`
	`}`
	`[ constraint_state ]`

inline_ref_constraint	`{ SCOPE  IS [ schema. ] scope_table`
	`| WITH ROWID`
	`| [ CONSTRAINT constraint_name ]`
	`  references_clause`
	`  [ constraint_state ]`
	`}`

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Subclause	Syntax
inner_cross_join_clause	table_reference { [INNER] JOIN table_reference { ON condition | USING (column [, column]...) } | { CROSS | NATURAL [INNER] } JOIN table_reference }
insert_into_clause	INTO dml_table_expression_clause [t_alias] [(column [, column]...)]
integer	[+ | -] digit [digit]...
interval_day_to_second	INTERVAL '{ integer | integer time_expr | time_expr }' { { DAY | HOUR | MINUTE } [(leading_precision)] | SECOND [(leading_precision [, fractional_seconds_precision])] } [TO { DAY | HOUR | MINUTE | SECOND [(fractional_seconds_precision)] }]
interval_year_to_month	INTERVAL 'integer [- integer]' { YEAR | MONTH } [(precision)] [TO { YEAR | MONTH }]
into_clause	INTO [schema.] table
invoker_rights_clause	AUTHID { CURRENT_USER | DEFINER }
Java_declaration	JAVA NAME 'string'
join_clause	{ inner_cross_join_clause | outer_join_clause }
key_compression	{ COMPRESS [integer] | NOCOMPRESS }

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Subclause	Syntax
level_clause	LEVEL level IS { level_table.level_column | (level_table.level_column [, level_table.level_column]...) }
list_partitioning	PARTITION BY LIST (column) (PARTITION [partition] list_values_clause table_partition_description [, PARTITION [partition] list_values_clause table_partition_description]...)
list_values_clause	VALUES ({ value | NULL [, { value | NULL }...) | DEFAULT)
LOB_parameters	{ TABLESPACE tablespace | { ENABLE | DISABLE } STORAGE IN ROW | storage_clause | CHUNK integer | PCTVERSION integer | RETENTION | FREEPOOLS integer | { CACHE | { NOCACHE | CACHE READS } [logging_clause] } } [TABLESPACE tablespace | { ENABLE | DISABLE } STORAGE IN ROW | storage_clause | CHUNK integer | PCTVERSION integer | RETENTION | FREEPOOLS integer | { CACHE | { NOCACHE | CACHE READS } [logging_clause] }]...
LOB_partition_storage	PARTITION partition { LOB_storage_clause | varray_col_properties } [LOB_storage_clause | varray_col_properties]... [(SUBPARTITION subpartition

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Subclause	Syntax
	{ LOB_storage_clause | varray_col_properties } [LOB_storage_clause | varray_col_properties]...)]
LOB_storage_clause	LOB { (LOB_item [, LOB_item]...) STORE AS (LOB_parameters) | (LOB_item) STORE AS { LOB_segname (LOB_parameters) | LOB_segname | (LOB_parameters) } }
local_partitioned_index	LOCAL [on_range_partitioned_table | on_list_partitioned_table | on_hash_partitioned_table | on_comp_partitioned_table]
logfile_clause	LOGFILE [GROUP integer] file_specification [, [GROUP integer] file_specification]...
logfile_clauses	{ { ARCHIVELOG [MANUAL] | NOARCHIVELOG } | [NO] FORCE LOGGING | RENAME FILE 'filename' [, 'filename']... TO 'filename' | CLEAR [UNARCHIVED] LOGFILE logfile_descriptor [, logfile_descriptor]... [UNRECOVERABLE DATAFILE] | add_logfile_clauses | drop_logfile_clauses | supplemental_db_logging }
logfile_descriptor	{ GROUP integer | ('filename' [, 'filename']...) | 'filename' }

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Subclause	Syntax
logging_clause	{ LOGGING | NOLOGGING }
main_model	[MAIN main_model_name] model_column_clauses [cell_reference_options] model_rules_clause
managed_standby_recovery	RECOVER MANAGED STANDBY DATABASE [recover_clause | cancel_clause | finish_clause]
map_order_func_declaration	{ MAP | ORDER } MEMBER function_declaration
map_order_function_spec	{ MAP | ORDER } MEMBER function_spec
mapping_table_clauses	{ MAPPING TABLE | NOMAPPING }
materialized_view_props	[column_properties] [table_partitioning_clauses] [CACHE | NOCACHE] [parallel_clause] [build_clause]
maximize_standby_db_clause	SET STANDBY DATABASE TO MAXIMIZE { PROTECTION | AVAILABILITY | PERFORMANCE }
maxsize_clause	MAXSIZE { UNLIMITED | size_clause }
merge_insert_clause	WHEN NOT MATCHED THEN INSERT [(column [, column]...)] VALUES ({ expr [, expr]... | DEFAULT }) [where_clause]

merge_table_partitions	MERGE PARTITIONS partition_1, partition_2
	  [INTO partition_spec]
	  [update_index_clauses]
	  [parallel_clause]

merge_table_subpartitions	MERGE SUBPARTITIONS subpart_1, subpart_2
	  [INTO subpartition_spec]
	  [update_index_clauses]
	  [parallel_clause]

merge_update_clause	WHEN MATCHED THEN UPDATE SET column = { expr | DEFAULT }

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Subclause	Syntax
	[, column = { expr | DEFAULT }]... [where_clause] [DELETE where_clause]
model_clause	MODEL [cell_reference_options] [return_rows_clause] [reference_model] [reference_model]... main_model
model_column	expr [[AS] c_alias]
model_column_clauses	[query_partition_clause [c_alias]] DIMENSION BY (model_column [, model_column]...) MEASURES (model_column [, model_column]...)
model_rules_clause	RULES [UPSERT | UPDATE] [{ AUTOMATIC | SEQUENTIAL } ORDER] [ITERATE (number) [UNTIL (condition)]] ([UPDATE | UPSERT] cell_assignment [order_by_clause] = expr [[UPDATE | UPSERT] cell_assignment [order_by_clause] = expr]...)
modify_col_properties	(column [datatype] [DEFAULT expr] [inline_constraint [inline_constraint]...] [LOB_storage_clause] [, column [datatype] [DEFAULT expr] [inline_constraint [inline_constraint]...] [LOB_storage_clause]])
modify_col_substitutable	COLUMN column [NOT] SUBSTITUTABLE AT ALL LEVELS [FORCE]
modify_collection_retrieval	MODIFY NESTED TABLE collection_item RETURN AS { LOCATOR | VALUE }

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Subclause	Syntax
modify_column_clauses	MODIFY { modify_col_properties | modify_col_substitutable }
modify_hash_partition	MODIFY PARTITION partition { partition_attributes | alter_mapping_table_clause | [REBUILD] UNUSABLE LOCAL INDEXES }
modify_hash_subpartition	{ { allocate_extent_clause | deallocate_unused_clause | shrink_clause | { LOB LOB_item | VARRAY varray } modify_LOB_parameters [{ LOB LOB_item | VARRAY varray } modify_LOB_parameters]... } | [REBUILD] UNUSABLE LOCAL INDEXES }
modify_index_default_attrs	MODIFY DEFAULT ATTRIBUTES [FOR PARTITION partition] { physical_attributes_clause | TABLESPACE { tablespace | DEFAULT } | logging_clause } [physical_attributes_clause | TABLESPACE { tablespace | DEFAULT } | logging_clause]...
modify_index_partition	MODIFY PARTITION partition { { deallocate_unused_clause | allocate_extent_clause | physical_attributes_clause | logging_clause | key_compression } [deallocate_unused_clause | allocate_extent_clause | physical_attributes_clause | logging_clause | key_compression]... | PARAMETERS ('ODCI_parameters')

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Subclause	Syntax
		COALESCE 	UPDATE BLOCK REFERENCES 	UNUSABLE }
modify_index_subpartition	MODIFY SUBPARTITION subpartition { UNUSABLE | allocate_extent_clause | deallocate_unused_clause }

modify_list_partition	MODIFY PARTITION partition
	  { partition_attributes
	
		{ADD	DROP} VALUES
			  (partition_value[, partition_value]...)
			
				[REBUILD] UNUSABLE LOCAL INDEXES
				  }

modify_list_subpartition	{ allocate_extent_clause
	
		deallocate_unused_clause
		
			shrink_clause
			
				{ LOB LOB_item	VARRAY varray }
					  modify_LOB_parameters
					  [{ LOB LOB_item
						VARRAY varray }
						  modify_LOB_parameters
						  ] ...
						
							[REBUILD] UNUSABLE LOCAL INDEXES
							
								{ ADD	DROP } VALUES (value[, value]...)
									}

modify_LOB_parameters	{ storage_clause
	| PCTVERSION integer
	| RETENTION
	| FREEPOOLS integer
	| REBUILD FREEPOOLS
	| { CACHE
	
		{ NOCACHE	CACHE READS } [logging_clause]
			  }
			| allocate_extent_clause
			| deallocate_unused_clause
			| shrink_clause
			
			}
			  [storage_clause
			
				PCTVERSION integer
				
					RETENTION
					
						FREEPOOLS integer
						
							REBUILD FREEPOOLS
							
								{ CACHE
								
									{ NOCACHE	CACHE READS } [logging_clause
										]

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Subclause	Syntax

	`}`
	`| allocate_extent_clause`
	`| deallocate_unused_clause`
	`| shrink_clause`
	`]...`

modify_LOB_storage_clause	`MODIFY LOB (LOB_item)` `(modify_LOB_parameters)`

modify_range_partition	`MODIFY PARTITION partition`
	`{ partition_attributes`
	`| { add_hash_subpartition`
	`| add_list_subpartition`
	`}`
	`| COALESCE SUBPARTITION`
	`[ update_index_clauses ]`
	`[ parallel_clause ]`
	`| alter_mapping_table_clause`
	`| [ REBUILD ] UNUSABLE LOCAL INDEXES`
	`}`

modify_table_default_attrs	`MODIFY DEFAULT ATTRIBUTES`
	`[ FOR PARTITION partition ]`
	`[ segment_attributes_clause ]`
	`[ table_compression ]`
	`[ PCTTHRESHOLD integer ]`
	`[ key_compression ]`
	`[ alter_overflow_clause ]`
	`[ { LOB (LOB_item)`
	`| VARRAY varray`
	`}`
	`(LOB_parameters)`
	`[ { LOB (LOB_item)`
	`| VARRAY varray`
	`}`
	`(LOB_parameters)`
	`]...`
	`]`

modify_table_partition	`{ modify_range_partition`
	`| modify_hash_partition`
	`| modify_list_partition`
	`}`

modify_table_subpartition	`MODIFY SUBPARTITION subpartition`
	`{ modify_hash_subpartition`
	`| modify_list_subpartition`
	`}`

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Subclause	Syntax
move_table_clause	MOVE [ONLINE] [segment_attributes_clause] [table_compression] [index_org_table_clause] [{ LOB_storage_clause | varray_col_properties } [{ LOB_storage_clause | varray_col_properties }]...] [parallel_clause]
move_table_partition	MOVE PARTITION partition [MAPPING TABLE] [table_partition_description] [update_index_clauses] [parallel_clause]
move_table_subpartition	MOVE SUBPARTITION subpartition_spec [update_index_clauses] [parallel_clause]

multi_column_for_loop	FOR (dimension_column
	[, dimension_column]...)
	IN ({ (literal [, literal]...)
	[(literal [, literal]...)...]
	| subquery
	}
	)

multi_table_insert	{ ALL insert_into_clause [values_clause] [insert_into_clause [values_clause]]... | conditional_insert_clause } subquery
multiset_except	nested_table1 MULTISET EXCEPT [ALL | DISTINCT] nested_table2
multiset_intersect	nested_table1 MULTISET INTERSECT [ALL | DISTINCT] nested_table2

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Subclause	Syntax
multiset_union	nested_table1 MULTISET UNION [ALL | DISTINCT] nested_table2
nested_table_col_properties	NESTED TABLE { nested_item | COLUMN_VALUE } [substitutable_column_clause] STORE AS storage_table [({ (object_properties) | [physical_properties] | [column_properties] } [(object_properties) | [physical_properties] | [column_properties]]...)] [RETURN AS { LOCATOR | VALUE }]
new_values_clause	{ INCLUDING | EXCLUDING } NEW VALUES
number	[+ | -] { digit [digit]... [.] [digit [digit]...] | . digit [digit]... } [e [+ | -] digit [digit]...] [f | d]
numeric_file_name	+diskgroup_name.filenumber.incarnation_number
object_properties	{ { column | attribute } [DEFAULT expr] [inline_constraint [inline_constraint]... | inline_ref_constraint] | { out_of_line_constraint | out_of_line_ref_constraint | supplemental_logging_props } }
object_table	CREATE [GLOBAL TEMPORARY] TABLE [schema.]table OF [schema.]object_type [object_table_substitution] [(object_properties)] [ON COMMIT { DELETE | PRESERVE } ROWS] [OID_clause]

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Subclause	Syntax
	[OID_index_clause] [physical_properties] [table_properties] ;
object_table_substitution	[NOT] SUBSTITUTABLE AT ALL LEVELS
object_type_col_properties	COLUMN column substitutable_column_clause
object_view_clause	OF [schema.]type_name { WITH OBJECT IDENTIFIER { DEFAULT | (attribute [, attribute]...) } | UNDER [schema.]superview } ({ out_of_line_constraint | attribute inline_constraint [inline_constraint]... } [, { out_of_line_constraint | attribute inline_constraint [inline_constraint]... }]...)
OID_clause	OBJECT IDENTIFIER IS { SYSTEM GENERATED | PRIMARY KEY }
OID_index_clause	OIDINDEX [index] ({ physical_attributes_clause | TABLESPACE tablespace } [physical_attributes_clause | TABLESPACE tablespace]...)
on_comp_partitioned_table	[STORE IN (tablespace [, tablespace]...)] (PARTITION [partition [{ segment_attribute_clause | key_compression } [segment_attribute_clause | key_compression]...] [index_subpartition_clause]]

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Subclause	Syntax

	`[, PARTITION`
	`[ partition`
	`[ { segment_attribute_clause`
	`| key_compression`
	`}`
	`[ segment_attribute_clause`
	`| key_compression`
	`]...`
	`]`
	`[ index_subpartition_clause ]`
	`]...`
	`]`
	`)`

on_hash_partitioned_table	`{ STORE IN (tablespace[, tablespace ]...)`
	`| (PARTITION`
	`[ partition [ TABLESPACE tablespace ] ]`
	`[, PARTITION`
	`[ partition [ TABLESPACE tablespace ] ]`
	`]...`
	`)`
	`}`

on_list_partitioned_table	`( PARTITION`
	`[ partition`
	`[ { segment_attributes_clause`
	`| key_compression`
	`}`
	`[ segment_attributes_clause`
	`| key_compression`
	`]...`
	`]`
	`]`
	`[, PARTITION`
	`[ partition`
	`[ { segment_attributes_clause`
	`| key_compression`
	`}`
	`[ segment_attributes_clause`
	`| key_compression`
	`]...`
	`]`
	`]`
	`]...`
	`)`

on_object_clause	`{ schema.object`
	`| { DIRECTORY directory_name`
	`| JAVA { SOURCE | RESOURCE } [ schema. ]object`
	`}`
	`}`

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Subclause	Syntax

on_range_partitioned_table	(PARTITION
	  [partition
	  [{ segment_attributes_clause
	  | key_compression
	  }
	  [segment_attributes_clause
	  | key_compression
	  ]...
	  ]
	  ]
	  [, PARTITION
	  [partition
	  [{ segment_attributes_clause
	  | key_compression
	  }
	  [segment_attributes_clause
	  | key_compression
	  ]...
	  ]
	  ]
	  ]...
	)

order_by_clause	ORDER [SIBLINGS] BY
	{ expr | position | c_alias }
	[ASC | DESC]
	[NULLS FIRST | NULLS LAST]
	  [, { expr | position | c_alias }
	  [ASC | DESC]
	  [NULLS FIRST | NULLS LAST]
	  ]...

out_of_line_constraint	[CONSTRAINT constraint_name] { UNIQUE (column [, column]...) | PRIMARY KEY (column [, column]...) | FOREIGN KEY (column [, column]...) references_clause | CHECK (condition) } [constraint_state]

out_of_line_ref_constraint	{ SCOPE FOR
	  ({ ref_col | ref_attr })
	  IS [schema.]scope_table
	| REF
	  ({ ref_col | ref_attr })
	  WITH ROWID
	| [CONSTRAINT constraint_name]
	  FOREIGN KEY
	  ({ ref_col | ref_attr })
	  references_clause
	  [constraint_state]
	}

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Subclause	Syntax
outer_join_clause	table_reference [query_partition_clause] { outer_join_type JOIN | NATURAL [outer_join_type] JOIN } table_reference [query_partition_clause] [ON condition | USING (column [, column]...)]
outer_join_type	{ FULL | LEFT | RIGHT } [OUTER]
parallel_clause	{ NOPARALLEL | PARALLEL [integer] }
parallel_enable_clause	PARALLEL_ENABLE [(PARTITION argument BY { ANY | { HASH | RANGE } (column [, column]...) }) [streaming_clause]]
partial_database_recovery	{ TABLESPACE tablespace [, tablespace]... | DATAFILE { 'filename' | filenumber } [, 'filename' | filenumber]... } | STANDBY { TABLESPACE tablespace [, tablespace]... | DATAFILE { 'filename' | filenumber } [, 'filename' | filenumber]... } } UNTIL [CONSISTENT WITH] CONTROLFILE }
partition_attributes	[{ physical_attributes_clause | logging_clause | allocate_extent_clause | deallocate_unused_clause | shrink_clause } [physical_attributes_clause | logging_clause | allocate_extent_clause | deallocate_unused_clause | shrink_clause]...] [OVERFLOW

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Subclause	Syntax
	{ physical_attributes_clause | logging_clause | allocate_extent_clause | deallocate_unused_clause } [physical_attributes_clause | logging_clause | allocate_extent_clause | deallocate_unused_clause]...] [table_compression] [{ LOB LOB_item | VARRAY varray } modify_LOB_parameters [{ LOB LOB_item | VARRAY varray } modify_LOB_parameters]...]
partition_extended_name	[schema.] { table | view } [PARTITION (partition) | SUBPARTITION (subpartition)]
partition_level_subpartition	{ SUBPARTITIONS hash_subpartition_quantity [STORE IN (tablespace[, tablespace]...)] | (subpartition_spec[, subpartition_spec]...) }
partition_spec	PARTITION [partition] [table_partition_description]
partitioning_storage_clause	[{ TABLESPACE tablespace | OVERFLOW [TABLESPACE tablespace] | LOB (LOB_item) STORE AS { LOB_segname [(TABLESPACE tablespace)] | (TABLESPACE tablespace) } | VARRAY varray_item STORE AS LOB LOB_segname } [{ TABLESPACE tablespace | OVERFLOW [TABLESPACE tablespace] | LOB (LOB_item) STORE AS { LOB_segname [(TABLESPACE tablespace)] | (TABLESPACE tablespace) } | VARRAY varray_item STORE AS LOB LOB_segname }]...]

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Subclause	Syntax
password_parameters	{ { FAILED_LOGIN_ATTEMPTS | PASSWORD_LIFE_TIME | PASSWORD_REUSE_TIME | PASSWORD_REUSE_MAX | PASSWORD_LOCK_TIME | PASSWORD_GRACE_TIME } { expr | UNLIMITED | DEFAULT } | PASSWORD_VERIFY_FUNCTION { function | NULL | DEFAULT } }
permanent_tablespace_clause	{ MINIMUM EXTENT integer [K | M] | BLOCKSIZE integer [K] | logging_clause | FORCE LOGGING | DEFAULT [table_compression] storage_clause | { ONLINE | OFFLINE } | extent_management_clause | segment_management_clause | flashback_mode_clause [MINIMUM EXTENT integer [K | M] | BLOCKSIZE integer [K] | logging_clause | FORCE LOGGING | DEFAULT [table_compression] storage_clause | { ONLINE | OFFLINE } | extent_management_clause | segment_management_clause | flashback_mode_clause]... }
physical_attributes_clause	[{ PCTFREE integer | PCTUSED integer | INITRANS integer | storage_clause } [PCTFREE integer | PCTUSED integer | INITRANS integer | storage_clause]...]
physical_properties	{ segment_attributes_clause [table_compression] | ORGANIZATION { HEAP [segment_attributes_clause]

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Subclause	Syntax
	[table_compression] | INDEX [segment_attributes_clause] index_org_table_clause | EXTERNAL external_table_clause } | CLUSTER cluster (column [, column]...) }
pragma_clause	PRAGMA RESTRICT_REFERENCES ({ method_name | DEFAULT } , { RNDS | WNDS | RNPS | WNPS | TRUST } [, { RNDS | WNDS | RNPS | WNPS | TRUST }]...)
procedure_declaration	PROCEDURE name (parameter datatype [, parameter datatype]...) { IS | AS } { pl/sql_block | call_spec }
procedure_spec	PROCEDURE name (parameter datatype [, parameter datatype]...) [{ IS | AS } call_spec]
proxy_authentication	{ AUTHENTICATION REQUIRED | AUTHENTICATED USING { PASSWORD | DISTINGUISHED NAME | CERTIFICATE [TYPE 'type'] [VERSION 'version'] } }
proxy_clause	{ GRANT | REVOKE } CONNECT THROUGH proxy [WITH { ROLE { role_name [, role_name]... | ALL EXCEPT role_name [, role_name]... } | NO ROLES }] [proxy_authentication]
qualified_disk_clause	search_string [NAME disk_name] [SIZE size_clause] [FORCE | NOFORCE]

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Subclause	Syntax

qualified_template_clause	`template_name`
	`ATTRIBUTES`
	`([ MIRROR | UNPROTECTED ]`
	`[ FINE | COARSE ]`
	`)`

query_partition_clause	`PARTITION BY`
	`{ value_expr[, value_expr ]...`
	`| ( value_expr[, value_expr ]... )`

query_table_expression	`{ query_name`
	`| [ schema. ]`
	`{ table [ { PARTITION (partition)`
	`| SUBPARTITION (subpartition)`
	`}`
	`[ sample_clause ]`
	`| [ sample_clause ]`
	`| @ dblink`
	`]`
	`| { view | materialized view } [ @ dblink ]`
	`}`
	`| (subquery [ subquery_restriction_clause ])`
	`| table_collection_expression`
	`}`

quiesce_clauses	`QUIESCE RESTRICTED | UNQUIESCE`

range_partitioning	`PARTITION BY RANGE (column[, column ]...)`
	`(PARTITION [ partition ]`
	`range_values_clause`
	`table_partition_description`
	`[, PARTITION [ partition ]`
	`range_values_clause`
	`table_partition_description`
	`]...`
	`)`

range_values_clause	`VALUES LESS THAN`
	`({ value | MAXVALUE }`
	`[, { value | MAXVALUE } ]...`
	`)`

rebalance_diskgroup_clause	`REBALANCE [ POWER integer ]`

rebuild_clause	`REBUILD`
	`[ { PARTITION partition`
	`| SUBPARTITION subpartition`
	`}`
	`| { REVERSE | NOREVERSE }`

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Subclause	Syntax
	] [parallel_clause | TABLESPACE tablespace | PARAMETERS ('ODCI_parameters') | ONLINE | COMPUTE STATISTICS | physical_attributes_clause | key_compression | logging_clause] [parallel_clause | TABLESPACE tablespace | PARAMETERS ('ODCI_parameters') | ONLINE | COMPUTE STATISTICS | physical_attributes_clause | key_compression | logging_clause]...
records_per_block_clause	{ MINIMIZE | NOMINIMIZE } RECORDS_PER_BLOCK
recover_clause	{ { DISCONNECT [FROM SESSION] | { TIMEOUT integer | NOTIMEOUT } } | { NODELAY | DEFAULT DELAY | DELAY integer } | NEXT integer | { EXPIRE integer | NO EXPIRE } | parallel_clause | USING CURRENT LOGFILE | UNTIL CHANGE integer | THROUGH { [THREAD integer] SEQUENCE integer | ALL ARCHIVELOG | { ALL | LAST | NEXT } SWITCHOVER } } [{ DISCONNECT [FROM SESSION] | { TIMEOUT integer | NOTIMEOUT } } | { NODELAY | DEFAULT DELAY | DELAY integer } | NEXT integer | { EXPIRE integer | NO EXPIRE } | parallel_clause | USING CURRENT LOGFILE | UNTIL CHANGE integer | THROUGH { [THREAD integer] SEQUENCE integer | ALL ARCHIVELOG | { ALL | LAST | NEXT } SWITCHOVER }] ...

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Subclause	Syntax
recovery_clauses	{ general_recovery | managed_standby_recovery | BEGIN BACKUP | END BACKUP }
redo_log_file_spec	['filename' | ('filename' [, 'filename']...)] [SIZE size_clause] [REUSE]

redo_thread_clauses	{ ENABLE | DISABLE }
	  { INSTANCE 'instance_name'
	  | [PUBLIC] THREAD integer
	  }

reference_model	REFERENCE reference_spreadsheet_name ON (subquery) spreadsheet_column_clauses [cell_reference_options]
references_clause	REFERENCES [schema.] { object_table | view } [(column [, column]...)] [ON DELETE { CASCADE | SET NULL }] [constraint_state]

referencing_clause	REFERENCING
	  { OLD [AS] old
	  | NEW [AS] new
	  | PARENT [AS] parent }
	  [OLD [AS] old
	  | NEW [AS] new
	  | PARENT [AS] parent]...

register_logfile_clause	REGISTER [OR REPLACE] [PHYSICAL | LOGICAL] LOGFILE [file_specification [, file_specification]...] FOR logminer_session_name

relational_properties	{ column datatype [SORT]
	  [DEFAULT expr]
	  [inline_constraint
	  [inline_constraint]...
	  | inline_ref_constraint

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Subclause	Syntax

	``
	  ]
	| { out_of_line_constraint
	  | out_of_line_ref_constraint
	  | supplemental_logging_props
	  }
	}
	  [, { column datatype [SORT]
	  [DEFAULT expr]
	  [inline_constraint
	  [inline_constraint]...
	  | inline_ref_constraint
	  ]
	  | { out_of_line_constraint
	  | out_of_line_ref_constraint
	  | supplemental_logging_props
	  }
	  ]...
	``

relational_table	```
	CREATE [GLOBAL TEMPORARY] TABLE [schema.
	]table
	  [(relational_properties)]
	  [ON COMMIT { DELETE | PRESERVE } ROWS]
	  [physical_properties]
	  [table_properties] ;
	``

rename_column_clause	``` RENAME COLUMN old_name TO new_name ```

rename_index_partition	```
	RENAME { PARTITION partition
	  | SUBPARTITION subpartition }
	  TO new_name
	``

rename_partition_subpart	``` RENAME { PARTITION | SUBPARTITION } current_name TO new_name ```

replace_type_clause	```
	REPLACE [invoker_rights_clause] AS OBJECT
	  (attribute datatype [, attribute datatype
	]...
	  [, element_spec [, element_spec]...])
	``

resize_disk_clauses	```
	RESIZE
	{ ALL [SIZE size_clause]
	| DISK
	  disk_name [SIZE size_clause]
	  [, disk_name [SIZE size_clause]]...
	| DISKS IN FAILGROUP
	  failgroup_name [SIZE size_clause]
	  [, failgroup_name [SIZE size_clause]]...
	}
	``

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Subclause	Syntax

resource_parameters	{ { SESSIONS_PER_USER
	  | CPU_PER_SESSION
	  | CPU_PER_CALL
	  | CONNECT_TIME
	  | IDLE_TIME
	  | LOGICAL_READS_PER_SESSION
	  | LOGICAL_READS_PER_CALL
	  | COMPOSITE_LIMIT
	  }
	  { integer | UNLIMITED | DEFAULT }
	| PRIVATE_SGA
	  { integer [K | M] | UNLIMITED | DEFAULT }
	}

restricted_session_clauses	{ ENABLE | DISABLE } RESTRICTED SESSION
return_clause	{ RETURN datatype [{ IS | AS } call_spec] | sqlj_object_type_sig }
return_rows_clause	RETURN { UPDATED | ALL } ROWS
returning_clause	RETURNING expr [, expr]... INTO data_item [, data_item]...
revoke_object_privileges	{ object_privilege | ALL [PRIVILEGES] } [, { object_privilege | ALL [PRIVILEGES] }]... on_object_clause FROM grantee_clause [CASCADE CONSTRAINTS | FORCE]

revoke_system_privileges	{ system_privilege
	| role
	| ALL PRIVILEGES
	}
	  [, { system_privilege
	  | role
	  | ALL PRIVILEGES
	  }
	  ]...
	FROM grantee_clause

rollup_cube_clause	{ ROLLUP | CUBE } (grouping_expression_list)
routine_clause	[schema.] [type. | package.] { function | procedure | method } [@dblink_name] ([argument [, argument]...])

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Subclause	Syntax
row_movement_clause	{ ENABLE | DISABLE } ROW MOVEMENT
sample_clause	SAMPLE [BLOCK] (sample_percent) [SEED (seed_value)]
schema_object_clause	{ object_option [, object_option]... | ALL } auditing_on_clause
scoped_table_ref_constraint	{ SCOPE FOR ({ ref_column | ref_attribute }) IS [schema.] { scope_table_name | c_alias } } [, SCOPE FOR ({ ref_column | ref_attribute }) IS [schema.] { scope_table_name | c_alias }]...
searched_case_expression	WHEN condition THEN return_expr [WHEN condition THEN return_expr]...
security_clause	GUARD { ALL | STANDBY | NONE }
segment_attributes_clause	{ physical_attributes_clause | TABLESPACE tablespace | logging_clause } [physical_attributes_clause | TABLESPACE tablespace | logging_clause]...
segment_management_clause	SEGMENT SPACE MANAGEMENT { MANUAL | AUTO }
select_list	{ * | { query_name.* | [schema.] { table | view | materialized view } .* | expr [[AS] c_alias] } [, { query_name.* | [schema.] { table | view | materialized view } .* | expr [[AS] c_alias] }]... }

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Subclause	Syntax
set_subpartition_template	SET SUBPARTITION TEMPLATE { (SUBPARTITION subpartition [list_values_clause] [partitioning_storage_clause] [, SUBPARTITION subpartition [list_values_clause] [partitioning_storage_clause]...]) | hash_subpartition_quantity }
set_time_zone_clause	SET TIME_ZONE = '{ { + | - } hh : mi | time_zone_region }'
shrink_clause	SHRINK SPACE [COMPACT] [CASCADE]
shutdown_dispatcher_clause	SHUTDOWN [IMMEDIATE] dispatcher_name
simple_case_expression	expr WHEN comparison_expr THEN return_expr [WHEN comparison_expr THEN return_expr]...
single_column_for_loop	FOR dimension_column { IN ({ literal [, literal]... | subquery }) | [LIKE pattern] FROM literal TO literal { INCREMENT | DECREMENT } literal }
single_table_insert	insert_into_clause { values_clause [returning_clause] | subquery }
size_clause	integer [K | M | G | T]
split_index_partition	SPLIT PARTITION partition_name_old AT (value [, value]...) [INTO (index_partition_description, index_partition_description)]

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Subclause	Syntax
	[parallel_clause] UPDATE MANUALLY problem importing file
split_table_partition	SPLIT PARTITION current_partition { AT | VALUES } (value [, value]...) [INTO (partition_spec, partition_spec)] [update_index_clauses] [parallel_clause] UPDATE MANUALLY problem importing file
split_table_subpartition	SPLIT SUBPARTITION subpartition VALUES ({ value | NULL } [, value | NULL]...) [INTO (subpartition_spec, subpartition_spec)] [update_index_clauses] [parallel_clause] UPDATE MANUALLY problem importing file
sql_statement_clause	{ { statement_option | ALL } [, { statement_option | ALL }]... | { system_privilege | ALL PRIVILEGES } [, { system_privilege | ALL PRIVILEGES }]... } [auditing_by_clause]
sqlj_object_type	EXTERNAL NAME java_ext_name LANGUAGE JAVA USING (SQLData | CustomDatum | OraData)
sqlj_object_type_attr	EXTERNAL NAME 'field_name'
sqlj_object_type_sig	RETURN { datatype | SELF AS RESULT } EXTERNAL { VARIABLE NAME 'java_static_field_name' | NAME 'java_method_sig' }
standby_database_clauses	(activate_standby_db_clause | maximize_standby_db_clause | register_logfile_clause | commit_switchover_clause | start_standby_clause | stop_standby_clause) [parallel_clause]
start_standby_clause	START LOGICAL STANDBY APPLY [IMMEDIATE] [NODELAY] [NEW PRIMARY dblink

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Subclause	Syntax
		INITIAL [scn_value] 	{ SKIP FAILED TRANSACTION	FINISH }]
startup_clauses	{ MOUNT [{ STANDBY	CLONE } DATABASE] | OPEN { [READ WRITE] [RESETLOGS	NORESETLOGS] [UPGRADE	DOWNGRADE] | READ ONLY } }
stop_standby_clause	{ STOP	ABORT } LOGICAL STANDBY APPLY
storage_clause	STORAGE ({ INITIAL integer [K | M] | NEXT integer [K | M] | MINEXTENTS integer | MAXEXTENTS { integer | UNLIMITED } | PCTINCREASE integer | FREELISTS integer | FREELIST GROUPS integer | OPTIMAL [integer [K | M] | NULL] | BUFFER_POOL { KEEP | RECYCLE | DEFAULT } } [INITIAL integer [K | M] | NEXT integer [K | M] | MINEXTENTS integer | MAXEXTENTS { integer | UNLIMITED } | PCTINCREASE integer | FREELISTS integer | FREELIST GROUPS integer | OPTIMAL [integer [K | M] | NULL] | BUFFER_POOL { KEEP | RECYCLE | DEFAULT }]...)
streaming_clause	{ ORDER	CLUSTER } BY (column [, column]...)
subpartition_by_hash	SUBPARTITION BY HASH (column [, column]...) [SUBPARTITIONS quantity [STORE IN (tablespace [, tablespace]...)] | subpartition_template]

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Subclause	Syntax
subpartition_by_list	SUBPARTITION BY LIST (column) [subpartition_template]
subpartition_spec	SUBPARTITION [subpartition] [list_values_clause] [partitioning_storage_clause]
subpartition_template	SUBPARTITION TEMPLATE (SUBPARTITION subpartition [list_values_clause] [partitioning_storage_clause] [, SUBPARTITION subpartition [list_values_clause] [partitioning_storage_clause]]) | hash_subpartition_quantity
subprogram_declaration	{ MEMBER | STATIC } { procedure_declaration | function_declaration | constructor_declaration }
subprogram_spec	{ MEMBER | STATIC } { procedure_spec | function_spec }
subquery	[subquery_factoring_clause] SELECT [hint] [{ { DISTINCT | UNIQUE } | ALL }] select_list FROM table_reference [, table_reference]... [where_clause] [hierarchical_query_clause] [group_by_clause] [HAVING condition] [model_clause] [{ UNION [ALL] | INTERSECT | MINUS } (subquery)] [order_by_clause]

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Subclause	Syntax
subquery_factoring_clause	WITH query_name AS (subquery) [, query_name AS (subquery)]...
subquery_restriction_clause	WITH { READ ONLY | CHECK OPTION [CONSTRAINT constraint] }
substitutable_column_clause	[ELEMENT] IS OF [TYPE] ([ONLY] type) | [NOT] SUBSTITUTABLE AT ALL LEVELS
supplemental_db_logging	{ ADD | DROP } SUPPLEMENTAL LOG { DATA | supplemental_id_key_clause }
supplemental_id_key_clause	DATA ({ ALL | PRIMARY KEY | UNIQUE | FOREIGN KEY } [, { ALL | PRIMARY KEY | UNIQUE | FOREIGN KEY }]...) COLUMNS
supplemental_log_grp_clause	GROUP log_group (column [NO LOG] [, column [NO LOG]]...) [ALWAYS]
supplemental_logging_props	{ supplemental_log_grp_clause | supplemental_id_key_clause }
supplemental_table_logging	{ ADD SUPPLEMENTAL LOG { supplemental_log_grp_clause | supplemental_id_key_clause } [, SUPPLEMENTAL LOG { supplemental_log_grp_clause | supplemental_id_key_clause }]... | DROP SUPPLEMENTAL LOG { supplemental_id_key_clause | GROUP log_group

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Subclause	Syntax
	} [, SUPPLEMENTAL LOG { supplemental_id_key_clause | GROUP log_group }]... }
table_collection_expression	TABLE (collection_expression) [(+)]
table_compression	{ COMPRESS | NOCOMPRESS }
table_index_clause	[schema.]table [t_alias] (index_expr [ASC | DESC] [, index_expr [ASC | DESC]]...) [index_properties]
table_partition_description	[segment_attributes_clause] [table_compression | key_compression] [OVERFLOW [segment_attributes_clause]] [{ LOB_storage_clause | varray_col_properties } [LOB_storage_clause | varray_col_properties]...] [partition_level_subpartition]
table_partitioning_clauses	{ range_partitioning | hash_partitioning | list_partitioning | composite_partitioning }
table_properties	[column_properties] [table_partitioning_clauses] [CACHE | NOCACHE] [parallel_clause] [ROWDEPENDENCIES | NOROWDEPENDENCIES] [enable_disable_clause] [enable_disable_clause]... [row_movement_clause] [AS subquery]
table_reference	{ ONLY (query_table_expression) [flashback_query_clause] [t_alias]

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Subclause	Syntax

		query_table_expression
		  [flashback_query_clause]
		  [t_alias]
		| (join_clause)
		| join_clause
		}

tablespace_clauses	{ EXTENT MANAGEMENT LOCAL
	| DATAFILE file_specification
	  [, file_specification]...
	| SYSAUX DATAFILE file_specification
	  [, file_specification]...
	| default_tablespace
	| default_temp_tablespace
	| undo_tablespace
	}

tablespace_group_clause	TABLESPACE GROUP { tablespace_group_name | '' }
tablespace_logging_clauses	{ logging_clause | [NO] FORCE LOGGING }
tablespace_retention_clause	RETENTION { GUARANTEE | NOGUARANTEE }
tablespace_state_clauses	{ ONLINE | OFFLINE [NORMAL | TEMPORARY | IMMEDIATE] } | READ { ONLY | WRITE } | { PERMANENT | TEMPORARY }

temporary_tablespace_clause	TEMPORARY TABLESPACE tablespace
	  [TEMPFILE file_specification
	  [, file_specification]...
	  ]
	  [tablespace_group_clause]
	  [extent_management_clause]

text	[N | n] { 'c [c]...' | { Q | q } 'quote_delimiter c [c]... quote_delimiter' }
trace_file_clause	TRACE [AS 'filename' [REUSE]] [RESETLOGS | NORESETLOGS]

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Subclause	Syntax
truncate_partition_subpart	TRUNCATE { PARTITION partition | SUBPARTITION subpartition } [{ DROP | REUSE } STORAGE] [update_index_clauses [parallel_clause]]
undo_tablespace	[BIGFILE | SMALLFILE] UNDO TABLESPACE tablespace [TABLESPACE file_specification [, file_specification]...]
undo_tablespace_clause	UNDO TABLESPACE tablespace [DATAFILE file_specification [, file_specification]...] [extent_management_clause] [tablespace_retention_clause]
undrop_disk_clause	UNDROP DISKS
update_all_indexes_clause	UPDATE INDEXES [(index ({ update_index_partition | update_index_subpartition })) [, (index ({ update_index_partition | update_index_subparition }))]...
update_global_index_clause	{ UPDATE | INVALIDATE } GLOBAL INDEXES
update_index_clauses	{ update_global_index_clause | update_all_indexes_clause }
update_index_partition	PARTITION [partition] [index_partition_description [index_subpartition_clause]] [, PARTITION [partition] [index_partition_description [index_subpartition_clause]]]...

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Subclause	Syntax
update_index_subpartition	SUBPARTITION [subpartition] [TABLESPACE tablespace] [, SUBPARTITION [subpartition] [TABLESPACE tablespace]]...
update_set_clause	SET { { (column [, column]...) = (subquery) | column = { expr | (subquery) | DEFAULT } } [, { (column [, column]...) = (subquery) | column = { expr | (subquery) | DEFAULT } }]... | VALUE (t_alias) = { expr | (subquery) } }
upgrade_table_clause	UPGRADE [[NOT] INCLUDING DATA] [column_properties]
using_function_clause	USING [schema.] [package. | type.]function_name
using_index_clause	USING INDEX { [schema.]index | (create_index_statement) | index_properties }
using_statistics_type	USING { [schema.] statistics_type | NULL }
using_type_clause	USING [schema.]implementation_type [array_DML_clause]
validation_clauses	{ VALIDATE REF UPDATE [SET DANGLING TO NULL] | VALIDATE STRUCTURE [CASCADE] [into_clause] { OFFLINE| ONLINE } }
values_clause	VALUES ({ expr | DEFAULT } [, { expr | DEFAULT }]...)

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Subclause	Syntax
varray_col_properties	VARRAY varray_item { [substitutable_column_clause] STORE AS LOB { [LOB_segname] (LOB_parameters) | LOB_segname } | substitutable_column_clause }
where_clause	WHERE condition
windowing_clause	{ ROWS | RANGE } { BETWEEN { UNBOUNDED PRECEDING | CURRENT ROW | value_expr { PRECEDING | FOLLOWING } } AND { UNBOUNDED FOLLOWING | CURRENT ROW | value_expr { PRECEDING | FOLLOWING } } | { UNBOUNDED PRECEDING | CURRENT ROW | value_expr PRECEDING } }
XML_attributes_clause	XMLATTRIBUTES (value_expr [AS c_alias] [, value_expr [AS c_alias]...)
XMLSchema_spec	[XMLSCHEMA XMLSchema_URL] ELEMENT { element | XMLSchema_URL # element }
XMLType_column_properties	XMLTYPE [COLUMN] column [XMLType_storage] [XMLSchema_spec]
XMLType_storage	STORE AS { OBJECT RELATIONAL | CLOB [{ LOB_segname [(LOB_parameters)] | LOB_parameters }]
XMLType_table	CREATE TABLE [GLOBAL TEMPORARY] TABLE [schema.]table OF XMLTYPE

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Subclause	Syntax
	[(oject_properties)] [XMLTYPE XMLType_storage] [XMLSchema_spec] [ON COMMIT { DELETE | PRESERVE } ROWS] [OID_clause] [OID_index_clause] [physical_properties] [table_properties] ;
XMLType_view_clause	OF XMLTYPE [XMLSchema_spec] WITH OBJECT IDENTIFIER { DEFAULT | (expr [, expr]...) }

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Appendix E

Acronyms and Terms

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Term	Definition
Active session pool	Number of current active sessions allowed for a resource group or subplan
ADDM	Automatic Database Diagnostic Monitor
ASM	Automatic Storage Management
ASM	Automatic Summary Management
ASMM	Automatic Shared Memory Management
ASSM	Automatic Segment Space Management
ATO	Automatic Tuning Optimizer
Automatic PGA Memory Management	A feature of the Oracle database that simplifies and improves the way PGA memory is allocated
Automatic Shared Memory Management	A feature of the Oracle database that automates the management of the most important shared memory structures used by an Oracle database instance
Automatic Storage Management	A mechanism that provides a vertical integration of the file system and the volume manager, specifically built for the Oracle database files
Automatic Database Diagnostic Management	A utility that performs a top-down instance analysis, identifies problems and potential causes, and makes recommendations for fixing the problems
Automatic Tuning Optimizer	A database feature that performs various analyses of SQL performance within the database
Automatic Workload Repository	An infrastructure that collects, processes, and maintains performance statistics for problem detection and self-tuning purposes
Auxiliary database	A database that is used when creating a duplicate database or performing tablespace point-in-time recovery
AWR	Automatic Workload Repository
Backup piece	An individual file that is part of a backup set
Backup set	A copy of one or more data or archived log files. It differs from image copies in that empty blocks are not stored.
Block change tracking	A feature that uses the change tracking writer (CTWR) background process to record the physical location of all database changes in a separate file
Block corruption	Corruption of a data block. A corrupted data block is a block that is not in a recognized Oracle format, or whose contents are not internally consistent.
Block Media Recovery	A recovery method that reduces the smallest recoverable unit of media recovery from a data file to a block
BMR	Block Media Recovery
Buffer cache	A region of memory that caches blocks of data retrieved from the database
CFS	Cluster File Storage

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Term	Definition
Change tracking file	A file used to store the physical location of database changes made since the last backup
Channel	A link or connection to a target database
CLI	Command-line interpreter
Cluster	A group of one or more tables that share the same data blocks
CMAN	Oracle Connection Manager. It functions as a net traffic firewall and proxy server.
Control file	A file that contains information about the physical structure of the database, including the locations of all data and redo log files
CRS	Cluster Ready Services
Data block	The smallest unit of physical storage within the database. Data blocks contain rows of data, index information, and so on.
Data dictionary cache	An area of memory within the shared pool that holds the definitions of dictionary objects in memory
Data file	A file that contains data for the database
Database Character Set Scanner	A utility that assesses the feasibility of migrating an Oracle database to a new database character set
DBA	Database administrator
DBA	Data block address, which is used to uniquely identify a data block within the database
DBCA	Database Configuration Assistant
DBVERIFY	An external command-line utility that performs a physical data structure integrity check on an offline database
DDL	Data definition language. It is the class of SQL statements that define and manipulate database objects.
DML	Data manipulation language. It is the class of SQL statements that query and manipulate data.
EM	Enterprise Manager
`emctl`	Enterprise Manager Control. It is a utility for starting, stopping, and checking the status of Database Control, the Oracle Agent, and Oracle Management servers.
Encoded character set	A character set that maps numeric codes to characters that a computer or terminal can display and receive
Enterprise Manager Database Control Console	A graphical interface used to manage the database
EXTPROC	External code libraries
FGA	Fine-grained auditing
FGAC	Fine-Grained Access Control
Flash recovery area	A unified storage location for all recovery-related files and activities in an Oracle database
Flashback buffer	An area in memory that stores Flashback Database data
Flashback Database	A new recovery method that uses Undo data, instead of Redo data, to recover the database

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Term	Definition
Flashback Drop	A feature that enables you to undo the effects of a `DROP TABLE` statement without resorting to traditional point-in-time recovery
Flashback Table	A command that enables you to recover a table and all its dependent objects from the recycle bin
Flashback Transaction Query	A diagnostic tool that you can use to view changes made to the database at the transaction level
Flashback Versions Query	A query syntax that provides a history of changes made to a row along with the corresponding identifier of the transaction that made the change
Format mask elements	A character literal that describes the format of datetime or numeric data stored in a character string
Growth trend report	Analysis of the growth of database segments
Globalization support	A feature set that ensures that utilities and error messages, sort order, alphabet, calendar, date, time, money, and numbers automatically adapt to the native language
Image copy	A bit-for-bit identical copy of a database file
Incarnation	A separate version of a physical database. The incarnation of the database changes when you open it with the `RESETLOGS` option, but you can recover backups from an earlier incarnation so long as the necessary redo is available.
Index-organized tables	A database structure that has the appearance of a table but stores its data in a B*Tree structure
`init.ora` or `init<sid>.ora`	The initialization parameter file that controls how the database instance is configured and run at startup time. Also known as "parameter file".
Instance	The collection of shared memory and processes used to access the Oracle database
IPC	Internal Process Communication
`isqplusctl`	Control utility for starting and stopping *i*SQL*Plus listener processes
ISV	Independent software vendor
Java pool	A region of memory in the SGA that is used for all session-specific Java code and data within the Java Virtual Machine (JVM)
JDBC	Java Database Connectivity
`j`*`nnn`*	Job Queue Processes. They execute scheduled jobs.
Keep buffer cache	An area of memory in the SGA used to cache data in the buffer cache for longer periods of time
Language and Character Set File Scanner	A statistic-based utility for determining the language and character set for unknown file text
Large pool	An optional memory storage area used for buffering large I/O requests
LCSSCAN	Language and Character Set File Scanner

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Term	Definition
LEGATO® NetWorker, Single-Server Version	Software included with Oracle Database 10*g* that enables the Recovery Manager utility to write to tape drives
Library cache	An area of memory within the shared pool that contains the fully parsed or compiled representations of PL/SQL blocks and SQL statements
Linguistic sort	A feature that produces a sort sequence that matches the alphabetic sequence of characters, and not their numeric values in the character encoding scheme
Listener	The gateway to the Oracle instance for all nonlocal user connections
Locale	A collection of information about the linguistic and cultural preferences from a particular region
Locale variants	A language-dependent territory definition
LSSV	LEGATO® NetWorker, Single-Server Version
Media management library	An interface used by RMAN when writing to or reading from tapes
Memory Advisor	A feature of Enterprise Manager that helps you tune the size of your memory structures
Memory Manager (MMAN)	A database background process that serves as the SGA memory broker and coordinates the sizing of memory components
Metric	A measurement of some database or instance characteristic
MML	Media management library
MMON	Management Monitor Process. This process issues alerts whenever a metric violates its threshold value. It captures statistics for SQL objects that have been recently modified.
National Language Support	Parameters and files that determine the locale-specific behavior of the database client and the database server
*n*K block size buffer	A region of memory in the SGA, which caches data blocks that are of a different size than the default database block size. It is used to support transportable tablespaces.
NLS	National Language Support
NLS Runtime Library	A comprehensive suite of language-independent functions that allow proper text and character processing and language-convention manipulations
`NLS_LANG`	An environment variable used to specify the language, territory, and character set used by a database
NLSRTL	National Language Support Runtime Library
NMP	Named Pipes
OC4J	Oracle Application Server Containers for J2EE
OMF	Oracle Managed Files
Optimizer statistics	Statistics that describe the database and the objects in the database, and are used by the query optimizer to choose the best execution plan for each SQL statement
OUI	Oracle Universal Installer

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Term	Definition
Oracle Locale Builder	A feature that provides a graphical user interface through which you can easily view, modify, and define locale-specific data
Oracle Managed Files	A feature of the Oracle database, which manages the creation, naming, and deletion of Oracle database files within dedicated areas of the disk
Oracle Net	An interface that enables network connections between Oracle Database 10*g* and client or middle-tier applications
Oracle Shared Server	A database server configuration that allows many user processes to share a small number of server processes, minimizing the number of server processes and maximizing the use of available system resources
`ORACLE_BASE`	Environment variable used to point to the base of the OFA structure
`ORACLE_HOME`	Environment variable used to identify a directory containing Oracle software
`ORACLE_SID`	Environment variable used to specify the default database instance name
Package	A collection of procedures and function definitions that are logically related. The procedures and functions are implemented by the package body.
Parallelization	Allocation of multiple channels for RMAN backup and recovery operations
PGA	Program Global Area
PGA Advisor	A feature of Enterprise Manager that gives detailed statistics for the work areas and provides recommendations about optimal usage of Program Global Area (PGA) memory on the basis of workload characteristics
Pipe	An area of memory used by one process to pass information to another
Private SQL area	An area of memory in the PGA that contains data such as bind information and run-time memory structures
Privilege	The right to execute a particular type of SQL statement. There are two basic forms of privileges: object and system.
Proactive Tablespace Monitoring	A feature of Oracle Database 10*g* that manages tablespace disk space usage
Program Global Area	Private memory area for use by a process
Recovery catalog	A separate database that keeps historical data concerning backup activities
Recovery Manager	The Oracle utility used to back up and restore database files
Recycle bin	A data dictionary table that maintains the relationships between the original names of dropped objects and their system-generated names
Recycle buffer cache	A region of memory in the SGA, which holds data that is quickly aged out of the buffer cache

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Term	Definition
Redo log buffer	A region of memory that caches redo information until it can be written to disk
Redo Log File Sizing Advisor	A feature of Enterprise Manager that offers redo log file-sizing advice
Resource Manager	A feature of the Oracle database that gives the Oracle database server more control over resource management decisions, thus circumventing problems resulting from inefficient operating system management
Resumable space allocation	A means for suspending, and later resuming, the execution of large database operations in the event of space allocation failures
RMAN	Recovery Manager
RMAN Repository	A storage structure that maintains metadata about a database's backup and recovery operations
Scheduler	A new database feature that enables database administrators and application developers to control when and where various tasks take place in the database environment
SCN	System change number
Segment Advisor	An advisor that monitors object space issues and analyzes growth trends
Segment Resource Estimator	The new segment resource estimation feature that enables you to estimate the amount of resources that the creation of a new segment would require
Server sessions	The server processes (UNIX) or threads (Windows NT/2000) invoked by a client utility to connect to the target database
Session memory	Memory in the PGA that is allocated to hold session variables and other information related to the session
SGA	System Global Area. It is the memory area shared by all server and background processes.
SGA Advisor	An advisor that makes recommendations for SGA-related parameter settings
Shared pool	A region of memory that caches various constructs that can be shared among users
Shrink Advisor	See the Segment Advisor.
SID	System Identifier. It defaults to the database name and uniquely identifies the instance on a given server.
SQL	Structured Query Language
SQL Access Advisor	A tool that determines optimal data access path (for example, the use of indexes and materialized views)
SQL Tuning Advisor	A tool that provides tuning advice for SQL statements
Statspack	A set of SQL, PL/SQL, and SQL*Plus scripts that allow the collection, automation, storage, and viewing of performance data. This feature has been replaced by the Automatic Workload Repository.
Streams pool	An optional region of memory in the SGA that is used by Oracle Streams

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Term	Definition
System statistics	Statistics that describe the system's hardware characteristics, such as I/O and CPU performance and utilization, to the query optimizer
Tablespace	A logical grouping of data files
Target database	The database that you are attempting to connect to
Threshold	A boundary value against which metric values are compared
Undo Advisor	A feature of Enterprise Manager that suggests parameter values and the amount of additional space that is needed to support flashback for a specified time
Undo data	A copy of original data stored whenever a DML transaction changes data. Undo data is used to roll back a transaction and to provide read-consistent views of changing data.
User Global Area	An area of memory within the shared pool or large pool that contains the session information for the Oracle shared server sessions
UTC	Universal Time Coordinates. This is a global time stamp in the Uniform Audit Trail.
VPD	Virtual Private Database
Wait event	Statistics that are incremented by a server process or thread to indicate that the process had to wait for an event to complete before being able to continue processing
Work area	A private allocation of memory in the PGA, used for sorts, hash joins, and other operations that are memory intensive
Workload repository	See AWR.

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Next Steps
Continuing Your Education

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"To stay competitive in the tech industry, never stop learning. Always be on the lookout for better ways of doing things and new technologies. Our industry does not reward people who let themselves stagnate"

–John Hall, Senior Vice President, Oracle University

Here are a few resources to help you with continuing your education.

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Continuing Education Resources

The resources to learn more about administering Oracle Database 10*g* include:

- **Oracle University Web site**
- **Oracle University University Knowledge Center**
- **Oracle Technology Network:**
  - **Oracle by Example**
  - **Oracle Magazine**
- **Technical support: Oracle *Meta*Link**

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- **Recommended follow-on classes:**
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  - **Oracle Database 10*g*: SQL Fundamentals I & II**
  - **Oracle Database 10*g*: PL/SQL Fundamentals**
- **Grid technology specialty courses:**
  - **Oracle Enterprise Manager 10*g* Grid Control**
  - **Oracle Database 10*g*: Real Application Clusters**
  - **Oracle Database 10*g*: Implement Streams**
  - **Oracle Database 10*g*: Data Guard Administration**
- **Other specialty courses**

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Continuing Your Education

The *Oracle Database 10g: Administration Workshop II* course continues your training as a database administrator. You cover advanced database recovery strategies, performance monitoring and tuning, and distributed data concepts.

In this course, SQL and PL/SQL are discussed. Because both of these topics are vast, you are provided with only an overview. You can find additional training on these topics that can enhance your abilities as an administrator.

Oracle recommends that you complete the *Oracle Database 10g: Administration Workshop II* course, before beginning specialty courses.

Consult Oracle University's website for an up-to-date list of all courses. Other specialty courses include:

- *Oracle Database 10g:Security*
- *Oracle Database 10g:Implement and Administer a Data Warehouse*

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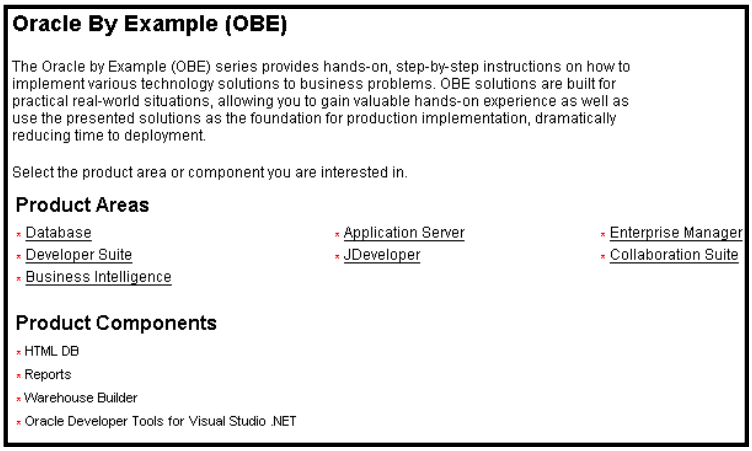

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