

# **Oracle Database 10g: Administration Workshop I**

**Volume II • Student Guide**

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**Appendix B: Solutions**

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**Appendix D: SQL Statement Syntax**

**Appendix E: Acronyms and Terms**

**Appendix F: Next Steps - Continuing Your Education**

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## Preface

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## **Profile**

### **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)

## Related Publications

### Oracle Publications

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

### Additional Publications

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

## Typographic Conventions

### Typographic Conventions in Text

Convention	Element	Example
Bold	Emphasized words and phrases in Web content only	To navigate within this application, do <b>not</b> click the Forward and Back buttons.
Bold italic	Glossary term (if there is a glossary)	The <b><i>algorithm</i></b> 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: <code>debug.set ('I', 300);</code> 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 ( <i>but</i> Oracle Payables)
Italic	Emphasized words and phrases, titles of books and courses, variables	<i>Do not</i> save changes to the database.  For further information, see <i>Oracle Database SQL Reference 10g Release 1(10.1)</i> .  Enter <code>user_id@us.oracle.com</code> , where <code>user_id</code> is the name of the user.

## 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;

## 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**

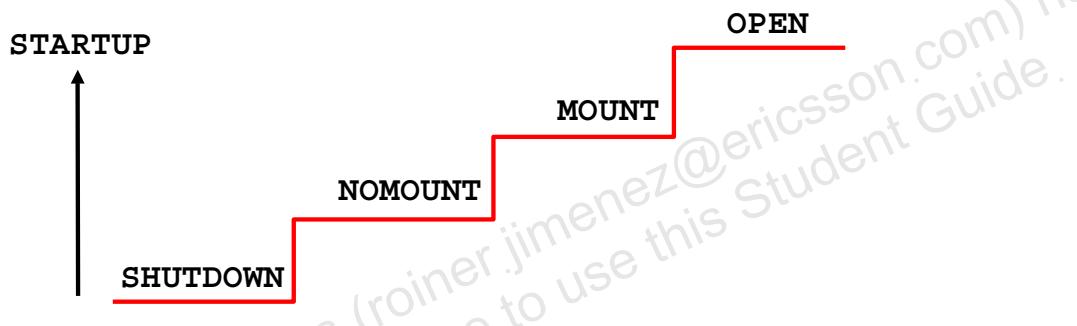


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# Opening a Database

## 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.

## 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:

```

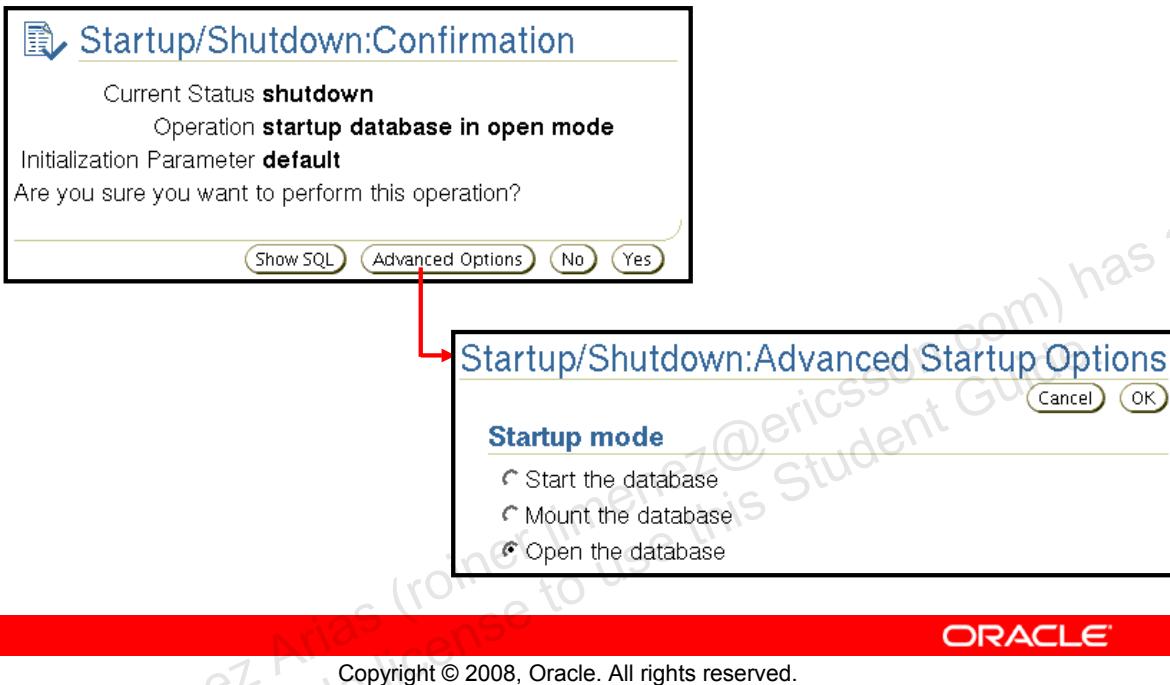
ORA-01113: file 4 needs media recovery
ORA-01110: data file 4:
'/oracle/oradata/orcl/users01.dbf'

```

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 .

# Changing Instance Status

Use Database Control to alter the instance's status.



## 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
```

# 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.

## 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.



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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*.

## 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.

## 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 #;
```

## 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.

## 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.

**Object Level Recovery**

Object Type

Operation Type  Recover to current time  
Datafile will be restored as required.  
 Restore datafiles  
Specify Time, SCN or log sequence. The backup taken at or prior to that time will be used. No recovery will be performed in this operation.  
 Recover from previously restored datafiles  
 Block Recovery



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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.

# 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**



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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.

# **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 10g 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.

# 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.

## 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

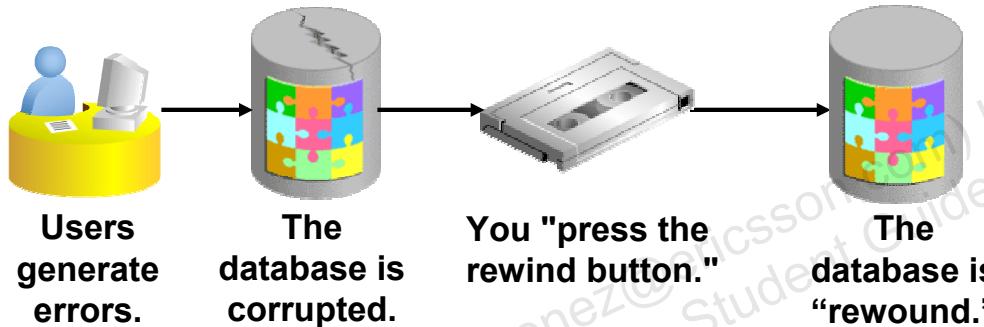
Oracle Database 10g introduces expanded database flashback capabilities. If a major error occurs that makes unisolated changes, such as a batch job being run twice in succession, then you can request a flashback operation that quickly recovers the entire database to a previous point in time. This eliminates 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.

# Flashback Database: Overview

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

## The Flashback Database operation:

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



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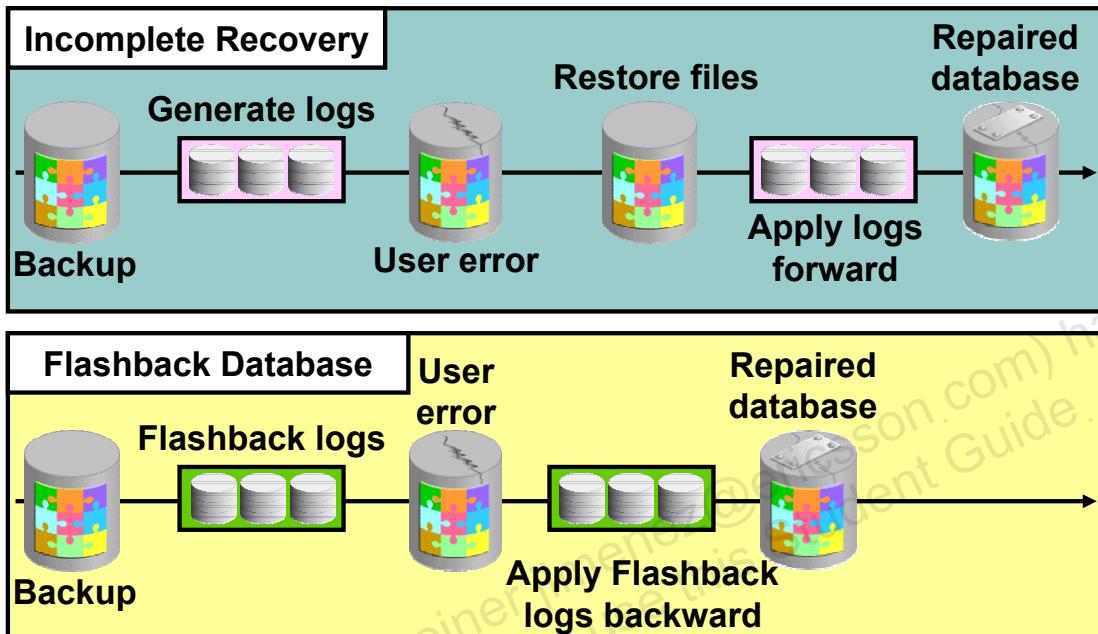
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## Flashback Database: Overview

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.

# 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.

## 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

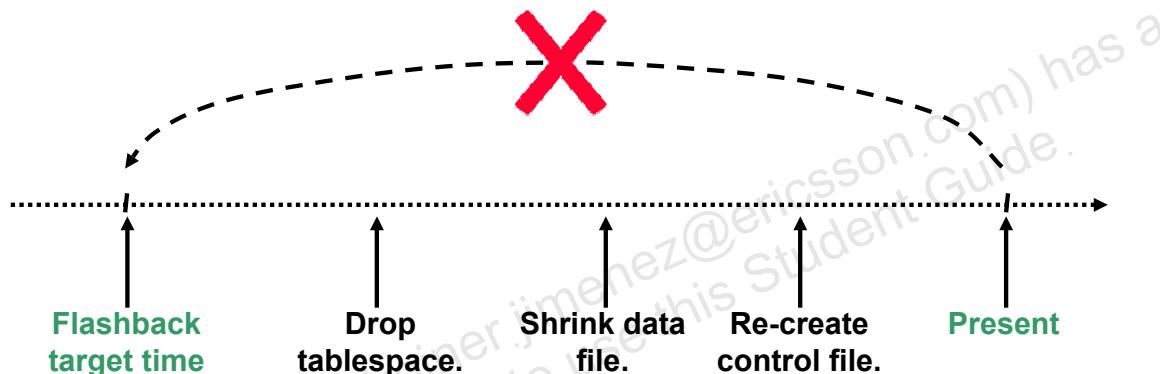
In situations where you cannot use the Flashback Database feature, you must use an incomplete recovery operation to return the database to a specific time. After the Flashback Database operation is complete, you can open the database in read-only mode to verify that the correct target time or system 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.

## 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.

# 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  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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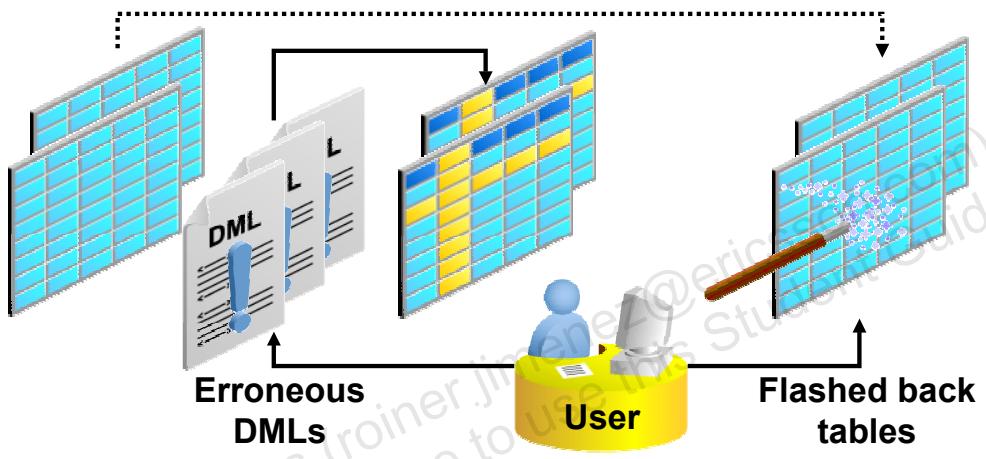
## Enabling Flashback Database

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.

# 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.

## 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.

# Enabling Row Movement on a Table

Edit Table: HR.EMPLOYEES

Actions Create Like Go Show SQL Revert Apply

General Constraints Segments Storage Options Statistics Indexes

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

**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 flashback 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.

# Performing Flashback Table

Perform Object Level Recovery: Point-in-time

Object Type **Tables** Operation Type **Flashback Existing Tables**

Specify the point in time to which to recover.

Evaluate row changes and transactions to decide on a point in time  
\* Table **HR.EMPLOYEES**   
Example: SCOTT.EMP

Flashback to a timestamp  
Date **May 5, 2005**  Time **05 32 AM**  PM  
Example: Mar 19, 2003

Flashback to a known SCN  
SCN

Cancel Step 1 of 7 Next

```
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.

## **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.

## 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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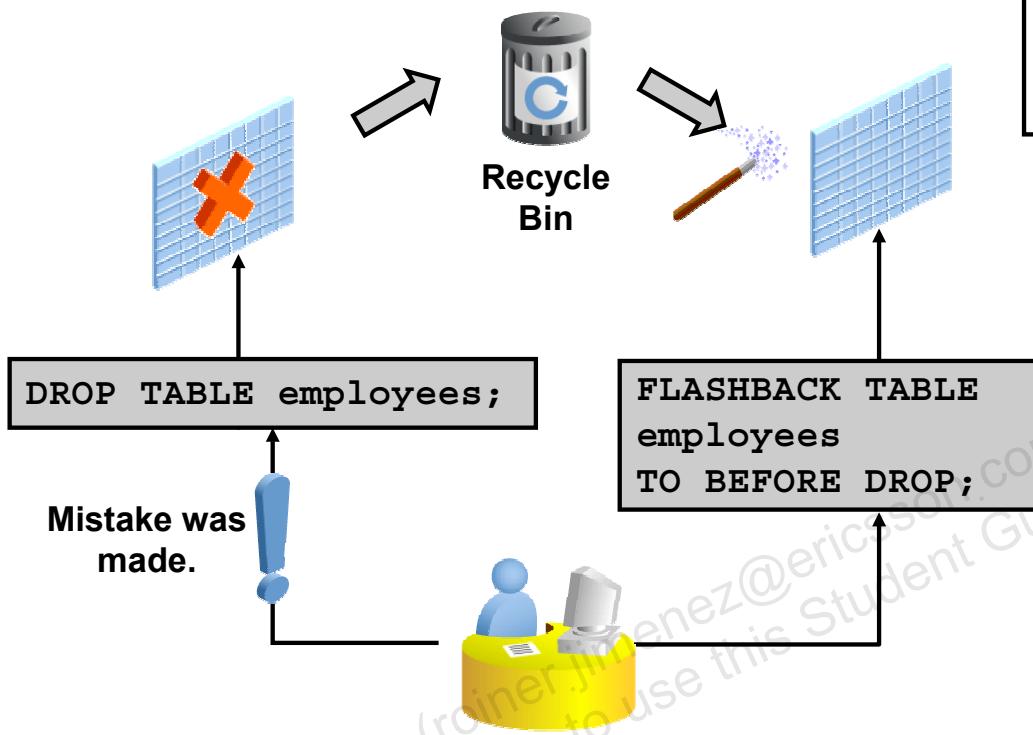
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## Flashback Table: Considerations

- 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.

## Flashback Drop: Overview

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



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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.

# Flashing Back Dropped Tables Through Enterprise Manager

**Results**

Select All | Select None | Expand All | Collapse All

Select	Object Name	Schema	Object Type	Tablespace	Drop Time	Create Time	Size	Operation
<input type="checkbox"/>	▼ Recycle Bin							<input type="button" value="View Content"/>
<input checked="" type="checkbox"/>	EMP	HR	TABLE	USERS	2005-05-04:10:35:37	2005-05-04:10:35:22	8	<input type="button" value="View Content"/>
<input type="checkbox"/>	► EMP_IX	HR	INDEX	USERS	2005-05-04:10:35:37	2005-05-04:10:35:31	8	<input type="button" value="View Content"/>

**Dependent bitmap index will also be flashed back.**

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL
198	Donald	OConnell	DOCONN
199	Douglas	Grant	DGRANT
200	Jennifer	Whalen	JWHALE

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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.

## 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.

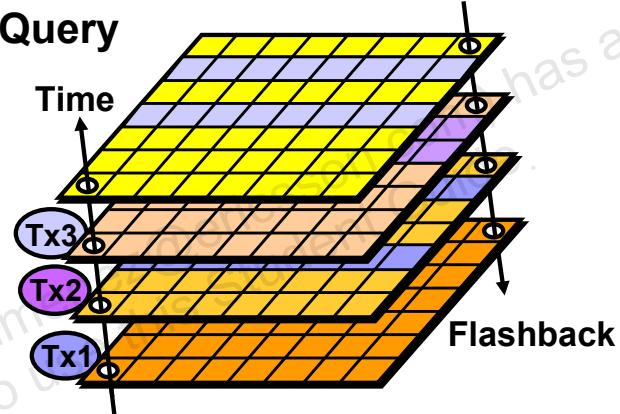
When you perform Flashback Drop on a table, all objects dependent on that table are also flashed back from the recycle bin. There are exceptions to this: Bitmap-join indexes, referential integrity constraints, and materialized view logs are not flashed back, even though their parent table is.

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

# 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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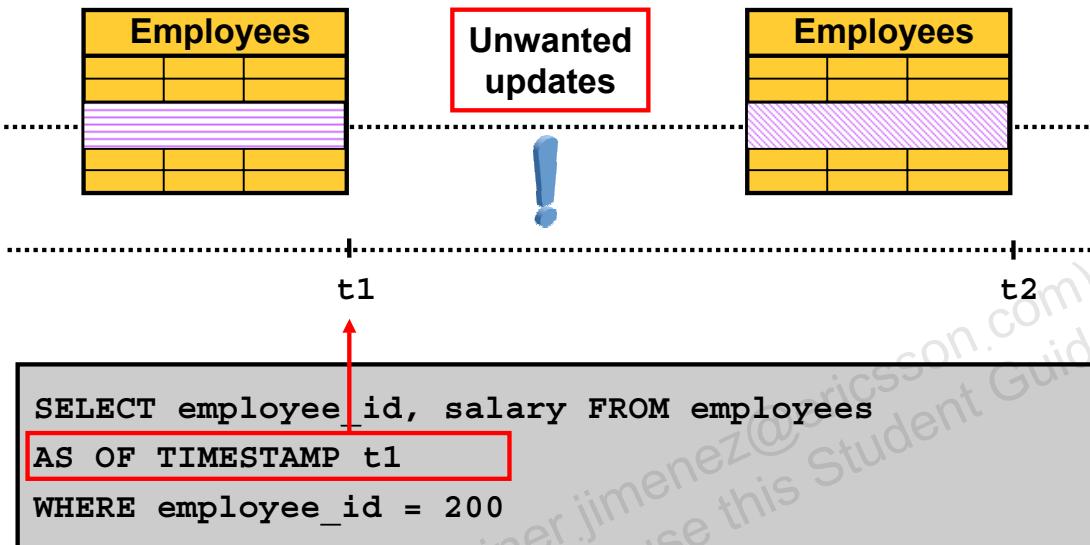
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## Flashback Time Navigation

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.

## Flashback Query: Overview



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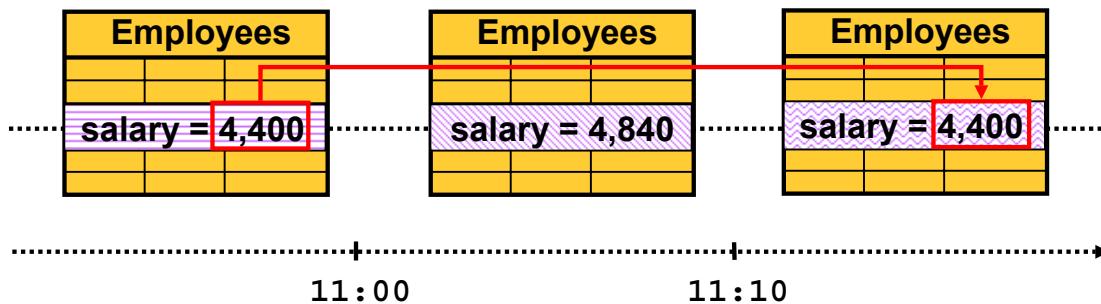
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### Flashback Query: Overview

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.

## 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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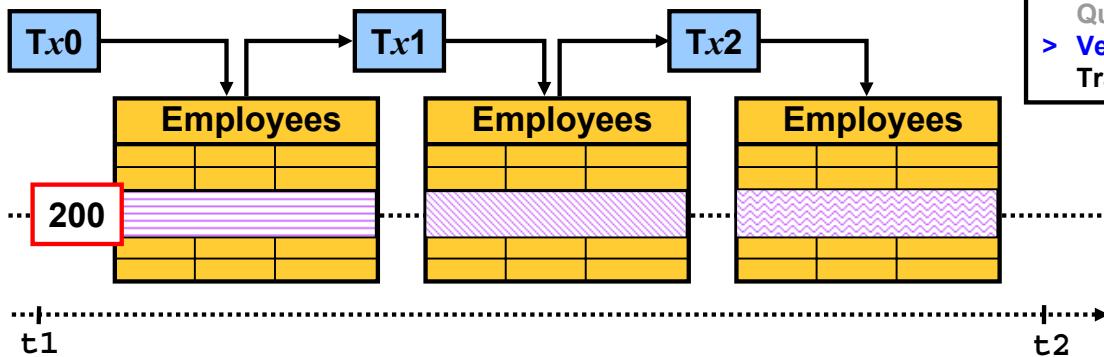
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## Flashback Query: Example

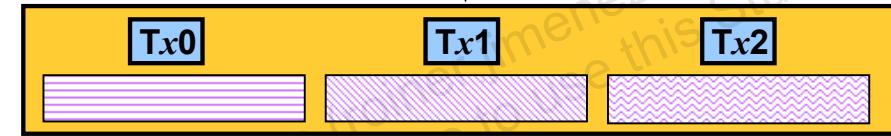
If a raise has been erroneously given to a particular employee recently, you can update the salary again, assigning the salary provided by a subquery that returns the flashed back value.

# Flashback Versions Query: Overview

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



```
SELECT versions_xid, salary FROM employees
VERSIONS BETWEEN TIMESTAMP t1 and t2
WHERE employee_id = 200;
```



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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.

# Flashback Versions Query Through Enterprise Manager

Perform Object Level Recovery: Flashback Versions Query Filter

Cancel Show Flashback Versions Query SQL Back Step 2 of 7 Next  
Object Type Tables Operation Type Flashback Existing Tables Table Name hr.jobs

Flashback Versions Query allows you to query metadata and historical data within a time interval. Select the filter conditions that allows you to retrieve the different versions of rows in a table that existed in a specific time interval.

**Step 1. Choose Columns**

Available Columns		Selected Columns	
JOB_TITLE	MIN_SALARY	JOB_ID	MAX_SALARY

Move Move All Remove Remove All

**Step 2. Bind The Row Value**

Specify a where clause based on the columns selected above to narrow the search to a particular set of values.

where job\_id = 'IT\_PROG'

**Flashback Versions Query Result**

Select	Flashback SCN	Flashback Timestamp	Transaction ID	Operation	JOB_ID	MAX SALARY
<input checked="" type="radio"/>	531132	May 5, 2005 10:50:44 AM	0800029007C010000	UPDATE	IT_PROG	13200
<input type="radio"/>	531111	May 5, 2005 10:50:20 AM	030029007E010000	UPDATE	IT_PROG	11000

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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.

## 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

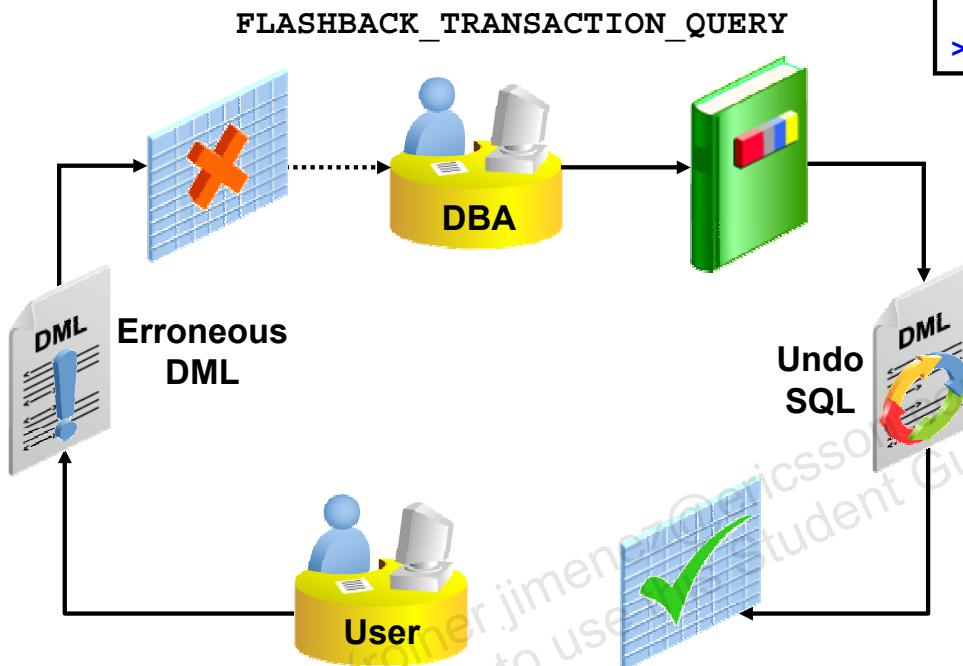
You cannot use the VERSIONS clause to query a view. However, a view definition can use the VERSIONS clause.

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.

# 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.

# Flashback Transaction Query Through Enterprise Manager

**Flashback Versions Query Result**

Select	Flashback SCN	Flashback Timestamp	Transaction ID	Operation	JOB_ID	MIN_SALARY
<input checked="" type="radio"/>	489358	Aug 5, 2005 11:54:29 AM	090003002D010000	UPDATE	AD_PRES	30000
<input type="radio"/>	489347	Aug 5, 2005 11:54:11 AM	0A001C00CF000000	UPDATE	AD_PRES	25000
<input type="radio"/>	489318	Aug 5, 2005 11:53:17 AM	0800110002010000	UPDATE	AD_PRES	22000

↓

**Choose SCN: Transaction Details**

Transaction ID	0A001C00CF000000	<input type="button" value="OK"/>		
User	HR			
Commit SCN	489348			
Commit Time	Aug 5, 2005 12:00:00 AM			
Table	Operation	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.

## 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.

# 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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# 18

## Moving Data

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# Objectives

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

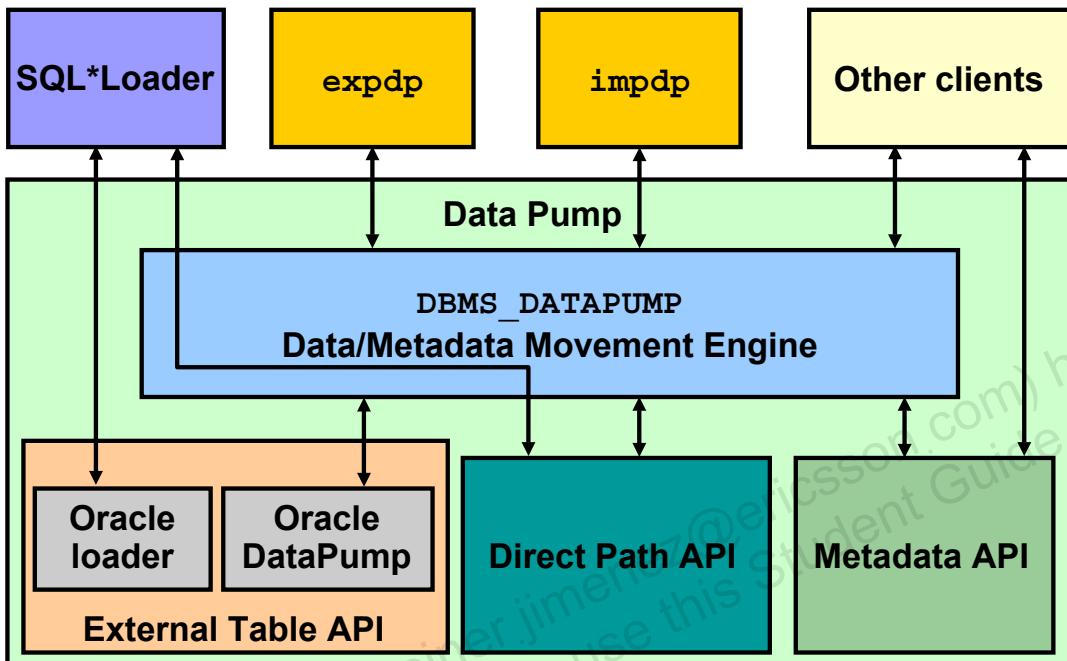
**After completing this lesson, you should be able to do the following:**

- **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 10g 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.

# Directory Object: Overview

**Search**

Object Name

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

Select	Name	Path
<input checked="" type="radio"/>	ADMIN_DIR	/ade/aime_10.2_lnx_push/oracle/md/admin
<input type="radio"/>	DATA FILE DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/sales_history/
<input type="radio"/>	DATA PUMP DIR	/u01/app/oracle/product/10.2.0/db_1/rdbms/log/
<input type="radio"/>	LOG FILE DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/log/
<input type="radio"/>	MEDIA_DIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/product_media/
<input type="radio"/>	SUBDIR	/u01/app/oracle/product/10.2.0/db_1/demo/schema/order_entry//2002/Sep
<input type="radio"/>	WORK DIR	/ade/aime_10.2_lnx_push/oracle/work
<input type="radio"/>	XMLEDIR	/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.

# Creating Directory Objects

**Create Directory Object**

**1** General **Privileges**

\* Name EXTAB\_LOG\_DIR  
\* Path /home/oracle/labs/extab2

**2** Test File System

**3** General **Privileges**

This page shows the list of users who have privileges for this directory

Select User Name	Read Access	Write Access
HR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

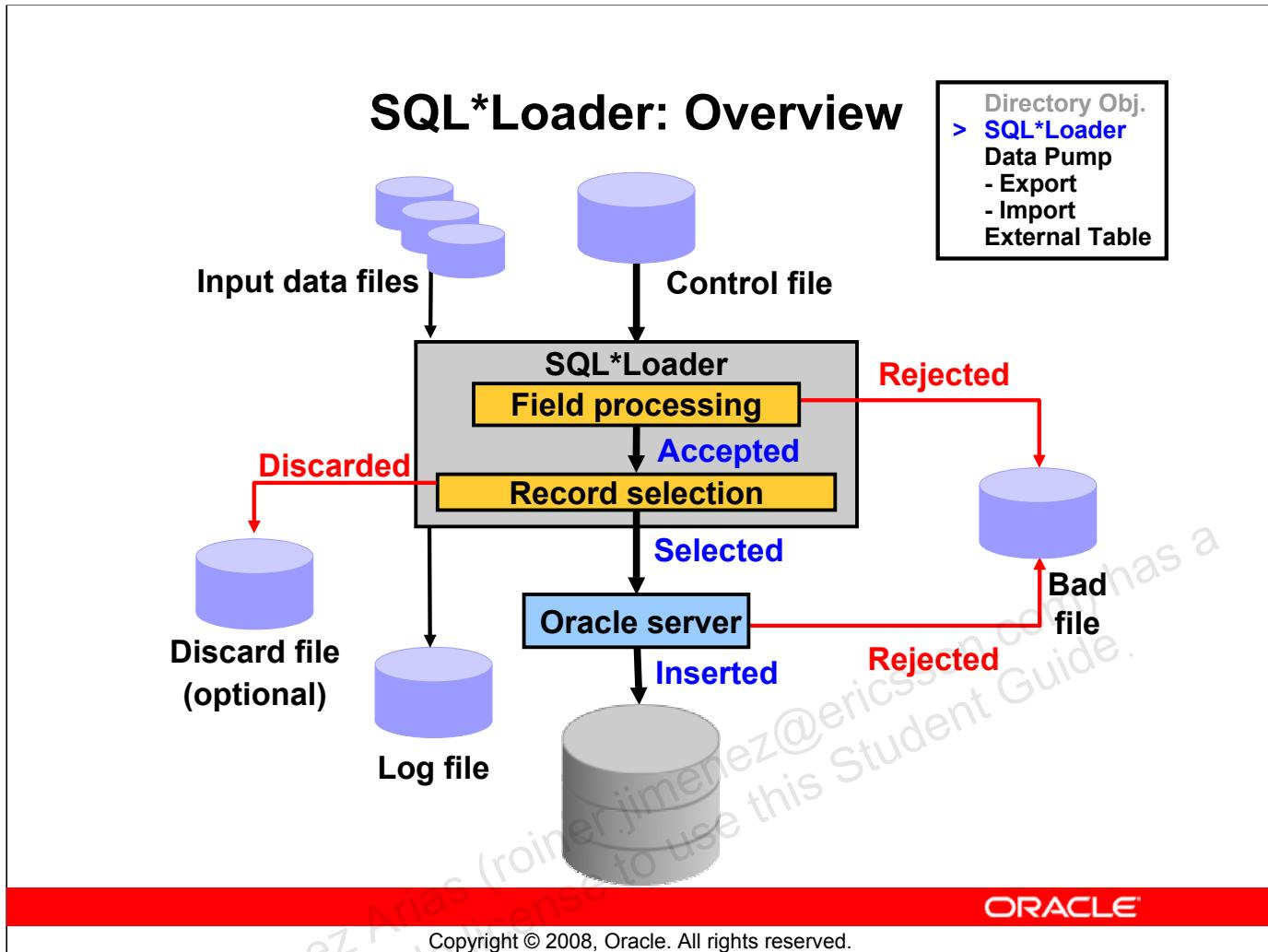
**4** Show SQL

```
CREATE DIRECTORY "EXT_DAT_DIR" AS '/home/oracle/labs/extab1'
GRANT READ ON DIRECTORY "EXT_DAT_DIR" TO "HR"
GRANT WRITE ON DIRECTORY "EXT_DAT_DIR" TO "HR"
```

**5** OK

## 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.



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

### 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

## 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.

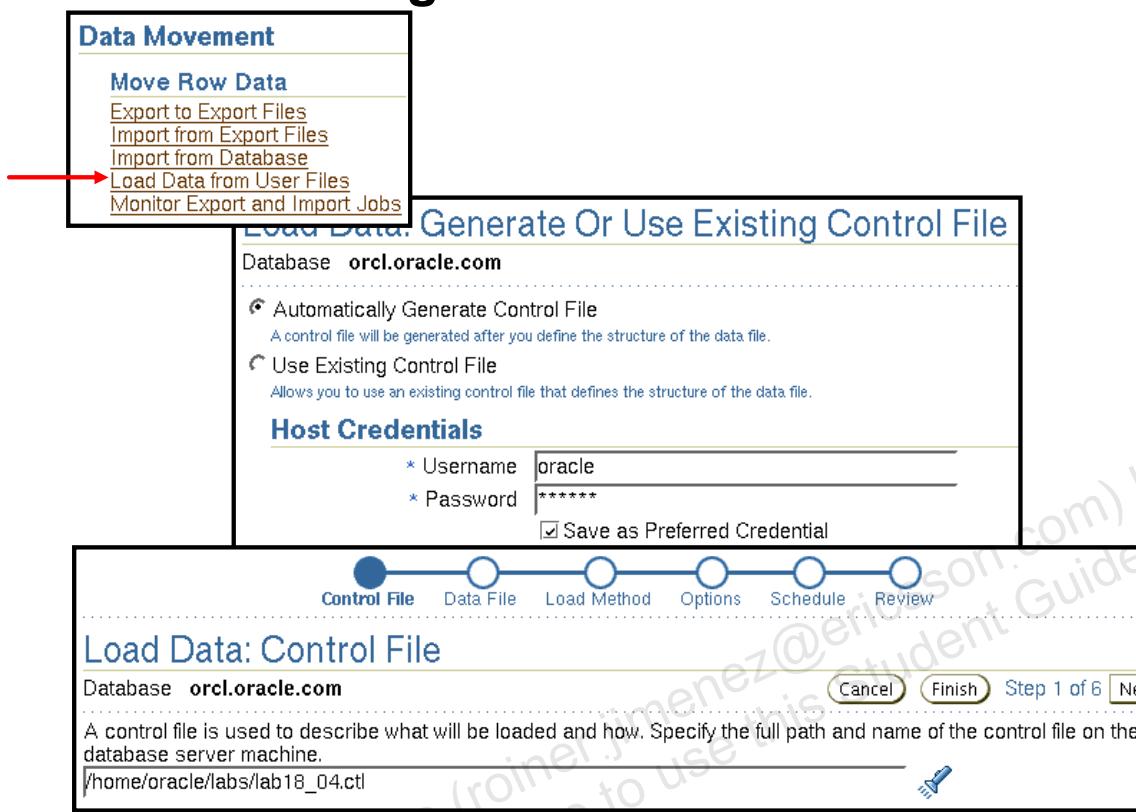
**Log file:** When SQL\*Loader begins execution, it creates a log file. If it cannot create a log file, execution terminates. The log file contains a detailed summary of the load, including a description of any errors that occurred during the load.

**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.

# Loading Data with SQL\*Loader



## 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.

# 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

## SQL\*Loader Control File (continued)

```

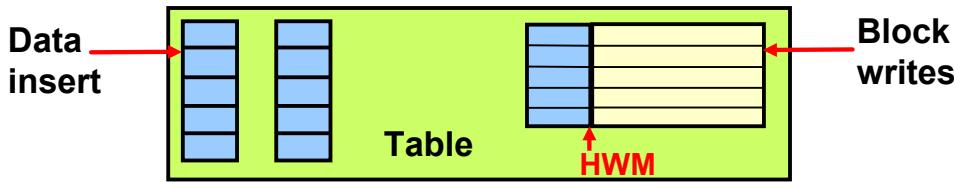
1  -- This is a sample control file
2 LOAD DATA
3 INFILE 'SAMPLE.DAT'
4 BADFILE 'sample.bad'
5 DISCARDFILE 'sample.dsc'
6 APPEND
7 INTO TABLE emp
8 WHEN (57) = '.'
9 TRAILING NULLCOLS
10 (hiredate SYSDATE,
    deptno POSITION(1:2) INTEGER EXTERNAL(3)
    NULLIF deptno=BLANKS,
    job POSITION(7:14) CHAR 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:

- 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.
- 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.
- The INFILE keyword specifies the name of a data file containing data that you want to load.
- The BADFILE keyword specifies the name of a file into which rejected records are placed.
- The DISCARDFILE keyword specifies the name of a file into which discarded records are placed.
- 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.
- 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.
- 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 57<sup>th</sup> 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.
- The TRAILING NULLCOLS clause prompts SQL\*Loader to treat any relatively positioned columns that are not present in the record as null columns.
- The remainder of the control file contains the field list, which provides information about column formats in the table that is being loaded.

# 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.

## 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.

# 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 10g 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 10g and is, therefore, available in all configurations. However, parallelism is available in Enterprise Edition only.

## 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.

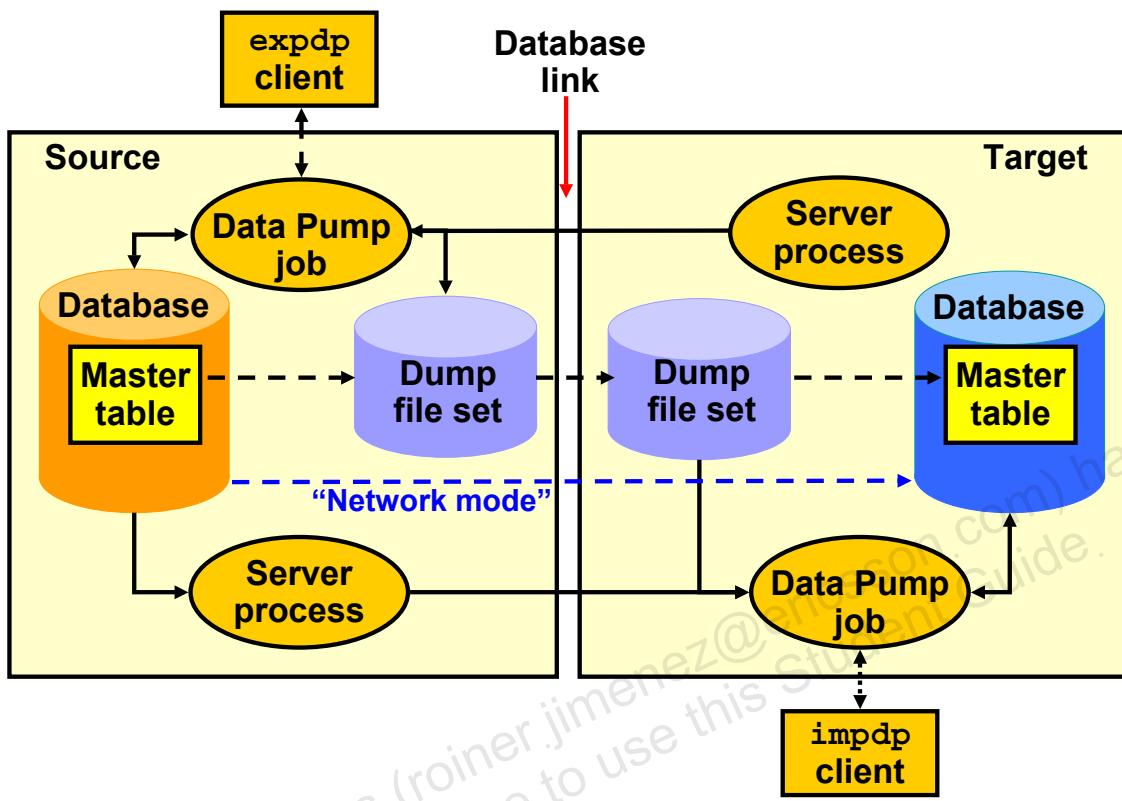
Network mode enables you to export from a remote database directly to a dump file set. This can be done by using a database link to the source system.

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

In addition, Oracle Database 10g 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.

# Data Pump Export and Import: Overview



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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.

# 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.

# Fine-Grained Object Selection

## 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%'"

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

## 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"
```

## 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.

# Export Options: Files

Database **orcl.oracle.com**

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**

Log File **hrexp.log**

**Show Advanced Options**

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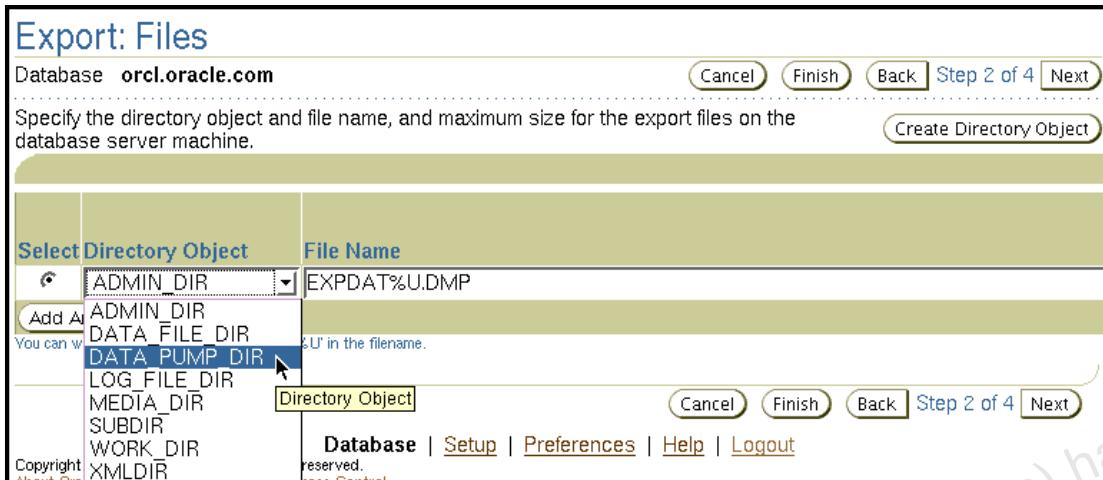
## Export Options: Files

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.

# 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.

## 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.

# Scheduling and Running a Job

Options   Files   **Schedule**   Review

## Export: Schedule

Database **orcl.oracle.com**      **Cancel** **Back** **Step 3 of 4** **Next**

Specify a name and description for the export job. Specify a date to start the job.

**Job Parameters**

Job Name **hrexp**  
Description Export HR schema

**Job Schedule**

**Start**

Immediately  
 Later

Date  
Time

[Database Instance: orcl.oracle.com](#) > Export: Export Type

**Processing**

**Submit job is progressing. This may take some time.**  
This may take several minutes. This page will automatically forward to the next page when done.

 Process is in progress.

**TIP** This operation cannot be cancelled. It will continue even if the browser window is closed.

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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.

# Data Pump File Naming and Size

**Export: Review**

Database **orcl.oracle.com**

Cancel Back Step 4 of 4 Submit Job

Export Type	<b>Database</b>
Statistics type	<b>Estimate optimizer statistics when data is imported</b>
Parallelism	<b>1</b>
Files to Export	<b>DATA_PUMP_DIR EXPDAT%U.DMP</b>
Log File	<b>DATA_PUMP_DIR /home/oracle/labs/hrep.log</b>

**Hide PL/SQL**

Export PL/SQL

```

declare
  h1 NUMBER;
begin
begin
  h1 := dbms_datapump.open(operation => 'EXPORT', job_mode => 'FULL', job_name => 'hrep', version => 'COMPATIBLE');
end;
begin
  dbms_datapump.set_parallel(handle => h1, degree => 1);
end;
begin

```

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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.

Preeexisting 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.

# Data Pump Import

**Import: Files**

Database **orcl.oracle.com**

Database Version of Files to Import **10g or later**  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.

Select Directory Object	File Name
<input checked="" type="radio"/> DATA_PUMP_DIR	EXPDAT%U.DMP
<input type="button" value="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	*****
<input type="checkbox"/> Save as Preferred Credential	

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

## 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.

## 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.

# 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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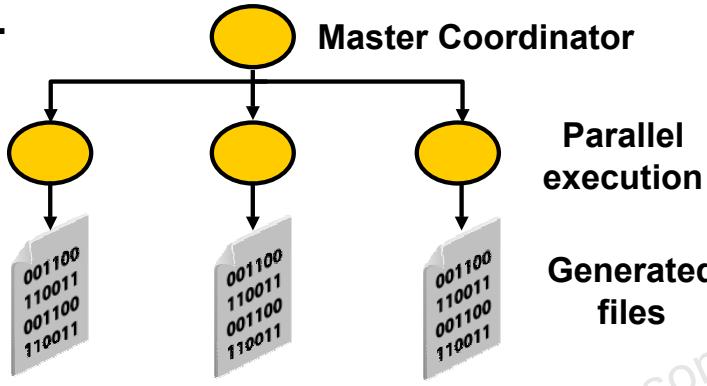
## Data Pump Import: Transformations (continued)

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.

# 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.

# 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

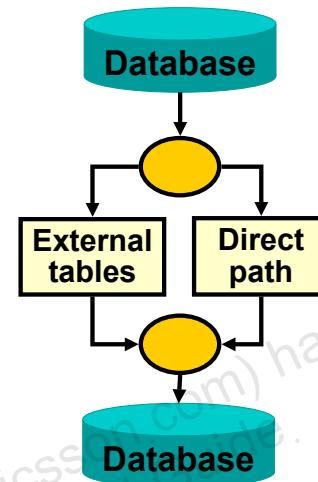
You can try using the parameters (shown in the slide) to improve performance, although the effect may not be the same on all platforms.

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.

# 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.

# Using Enterprise Manager to Monitor Data Pump Jobs

The screenshot shows the Oracle Enterprise Manager 10g Database Control interface. On the left, there's a navigation menu under 'Database Instance: EDRSR14P1'. The 'Maintenance' tab is selected. A red box highlights the 'Monitor Export and Import Jobs' link under the 'Move Row Data' section. A red arrow points from this link to the main content area. The main content area is titled 'Export and Import Jobs' and shows a table with one row:

Data Pump Job	Owner	Job Status
NEW_1	SYSTEM	DEFINING

An 'OK' status indicator is visible at the bottom right of the table. The bottom of the screen has a red bar with the 'ORACLE' logo and the text 'Copyright © 2008, Oracle. All rights reserved.'

## 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.

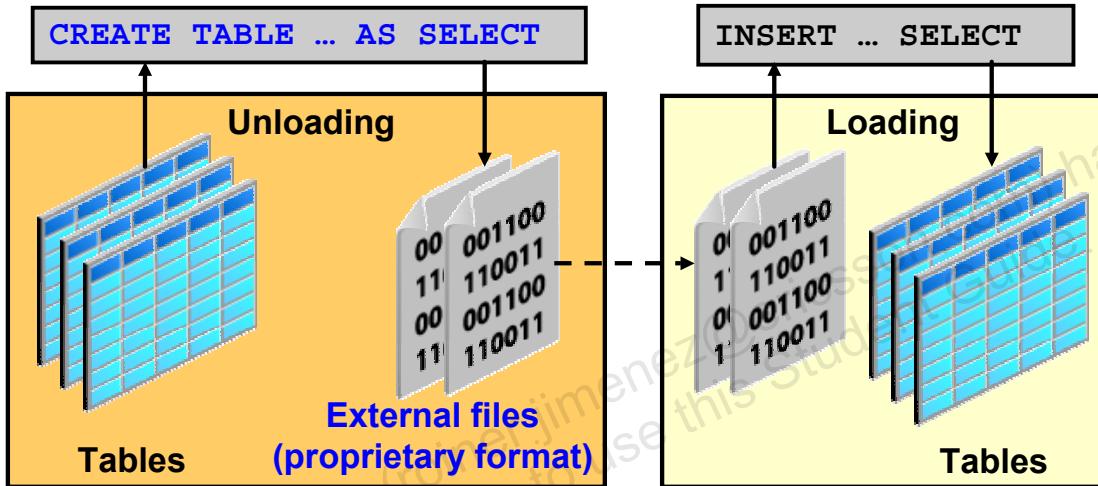
You can view the current status of the job and also change the status to EXECUTE, STOP, or SUSPEND.

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.

# 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

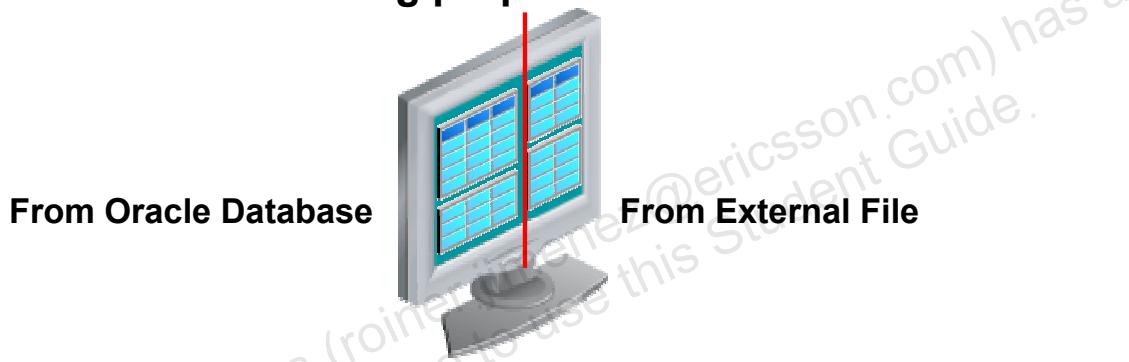
An “external table” is composed of proprietary format (that is, Direct Path API) flat files that are operating system independent. As data is extracted from the Oracle database and “unloaded” into files, it is transparently converted from its Oracle internal representation into an equivalent Oracle native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

# 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.



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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.

# 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.

## 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.

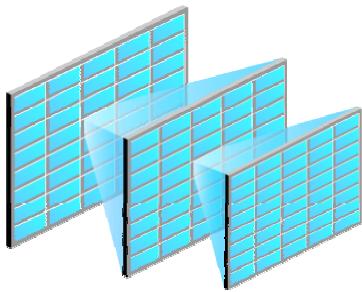
**Tip:** If you have a lot of data to load, enable PARALLEL for the load operation:

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

# Data Dictionary

**View information about external tables in:**

- [DBA | ALL | USER] \_EXTERNAL\_TABLES
- [DBA | ALL | USER] \_EXTERNAL\_LOCATIONS
- [DBA | ALL | USER] \_TABLES, and others



ORACLE

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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.

## 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**



**ORACLE**

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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**

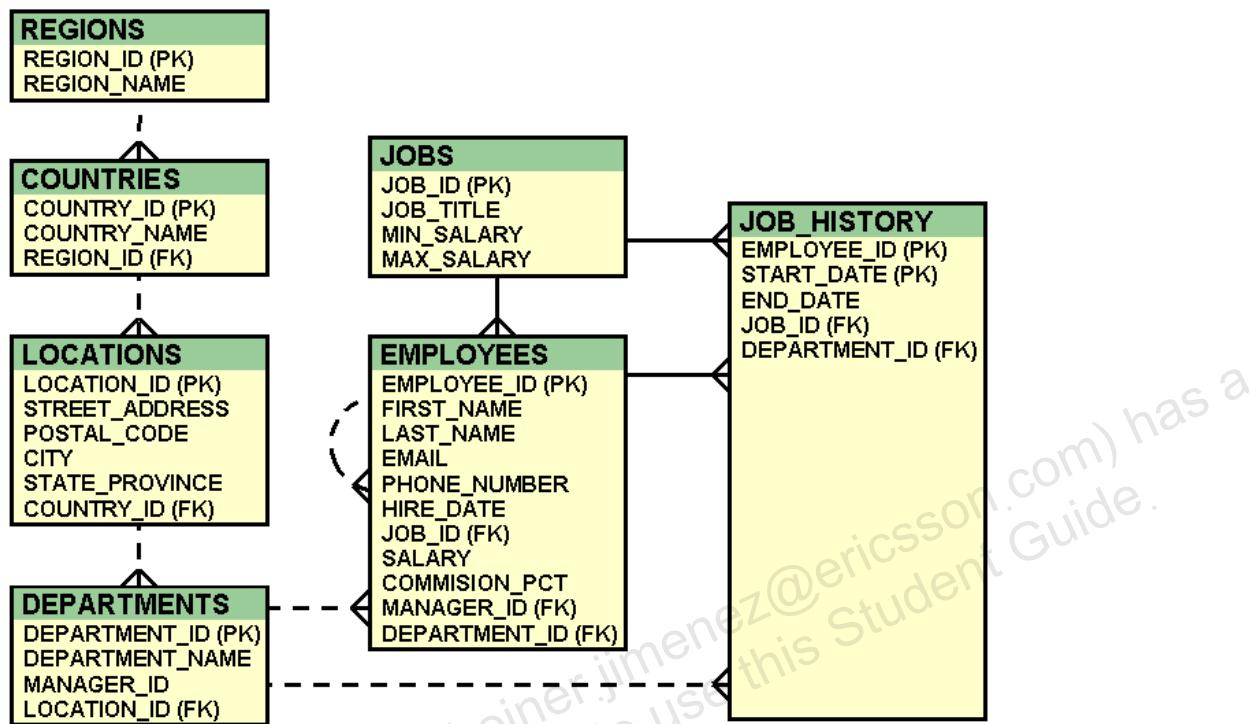
---

### **Practices**

---

## 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)
  )
/

```

## 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))
/

```

## 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__EMPL__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)
```

## 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 10g 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	<code>/u01/app/oracle/product/10.2.0/db_1</code>
Installation Type	Enterprise Edition
UNIX DBA Group	<code>oinstall</code>
Create Starter Database	<i>Deselected</i>
Inventory Directory	<code>/u01/app/oracle/oraInventory</code>

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.*

## 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.

iSQL\*PlusURL: \_\_\_\_\_

iSQL\*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.

## 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.

## 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.

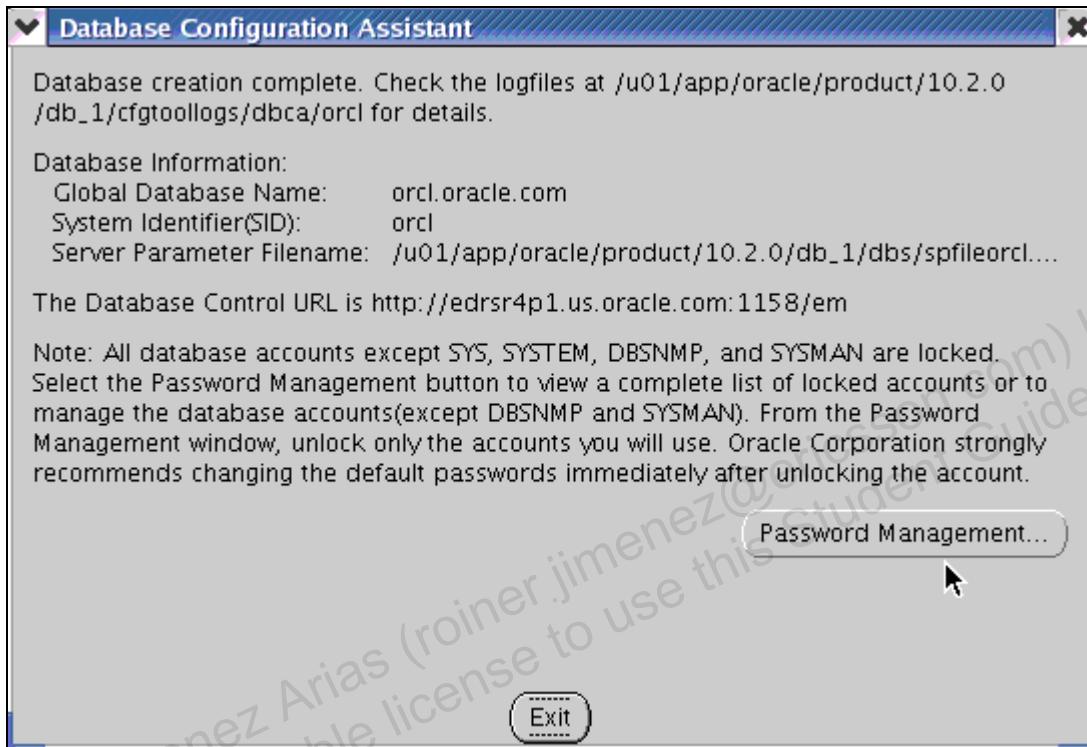
Create a database with the following settings:

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).

### 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.

## 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 10g Licensing Information” page appears. Acknowledge this information.

2. View the initialization parameters (Navigation aid: Administration > 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?
- 

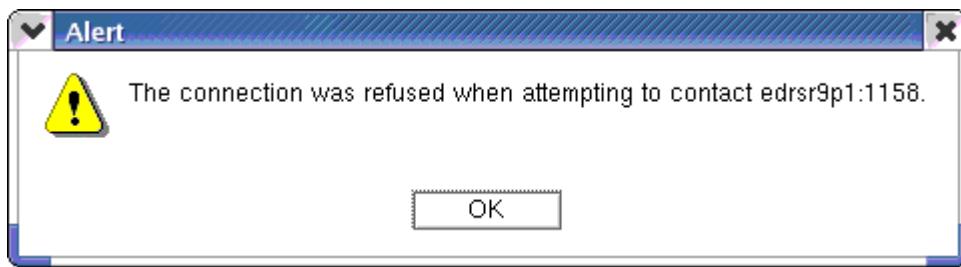
4. Shut down the database instance by using Enterprise Manager.

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.”

## 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 *iSQL\*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 *iSQL\*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 *iSQL\*Plus* and close the *iSQL\*Plus* window.

## 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).

---

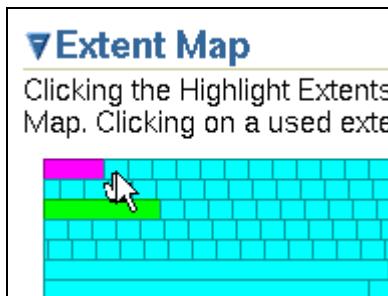
*Question 3:* Which index in the EXAMPLE tablespace takes up the most space? (Navigation aid: Search type “INDEX”)

---

## 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	<i>deselected</i>
Data File Name	inventory01.dbf
File Size	5 MB
Extent Allocation	Automatic
Segment Space Management	Automatic
Enable Logging	<i>selected</i>

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?
-

## 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.

## 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 HRP PROFILE, 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"
```

## 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	<i>selected</i>
Password	newuser
Expire Password now	<i>selected</i>
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.

## 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
```

## 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)

## 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.

## 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 *iSQL\*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`.
-

## 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.

## 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?

---

## Practice 10: Implementing Oracle Database Security

**Background:** You have just been informed of suspicious activities in the HR.JOB\$ 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.JOB\$ 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.JOB\$, 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.

## 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.*

**Login Information**

Provide username and password for the testing the connection.

\* Username

\* Password

**Test**

**Log**

Attempting to connect using userid:system

The test was successful.

## Practice 11: Configuring the Oracle Network Environment (continued)

5. Test your changes to the network configuration by using SQL\*Plus or iSQL\*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

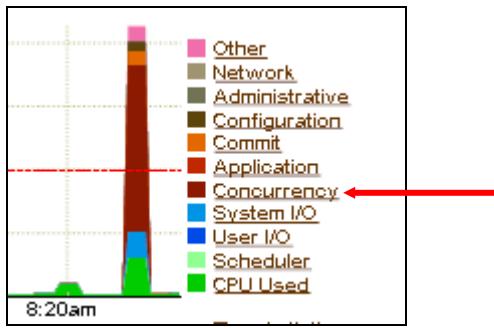
7. Start the LISTENER2 listener.

## 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, identified 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.

## 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 impulse 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.

## 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?
-

### Practice 13: Performance Management (continued)

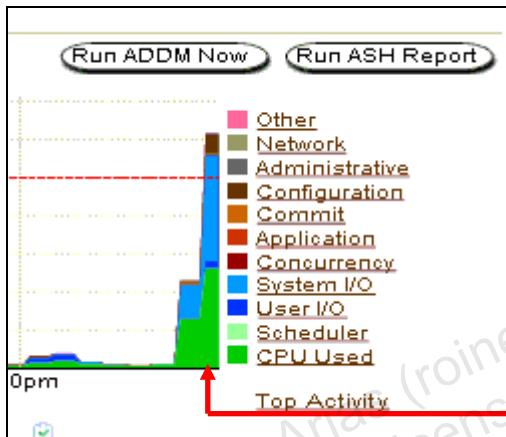
9. Simulate a working load on your instance by running the lab\_13\_09.sql script as the DBA1 user. Note the SID value for task 10.

---

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.

## 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?

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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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**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).

## 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.

## 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	<code>oracle</code>
Host Credentials Password	<code>oracle</code>
Backup Type	Full Backup
Use as the base of an incremental backup strategy	<i>selected</i>
Backup Mode	Online Backup
Backup Location	Disk
Disk Backup Location	Flash Recovery Area
Also backup all archived logs on disk	<i>deselected</i>
Schedule	<i>Defaults selected</i>

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

## 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	<i>selected</i>
Backup Mode	Online Backup
Also backup all archived logs on disk	<i>deselected</i>
Backup Location	Disk – Flash Recovery Area
Job Name	Nightly_Backup
Job Description	<i>Default selected</i>
Start	Later
Time	11:00 p.m.
Repeat	Interval
Frequency	1 Days

## 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?

---

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*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?

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- 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.

## 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	<i>selected</i>
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.

## 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>
```

## 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.

### 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	<i>selected</i>
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.

## 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.

### 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	<i>selected</i>
Username	oracle
Password	oracle
Save as Preferred Credential	<i>selected</i>
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	<i>selected</i>
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:

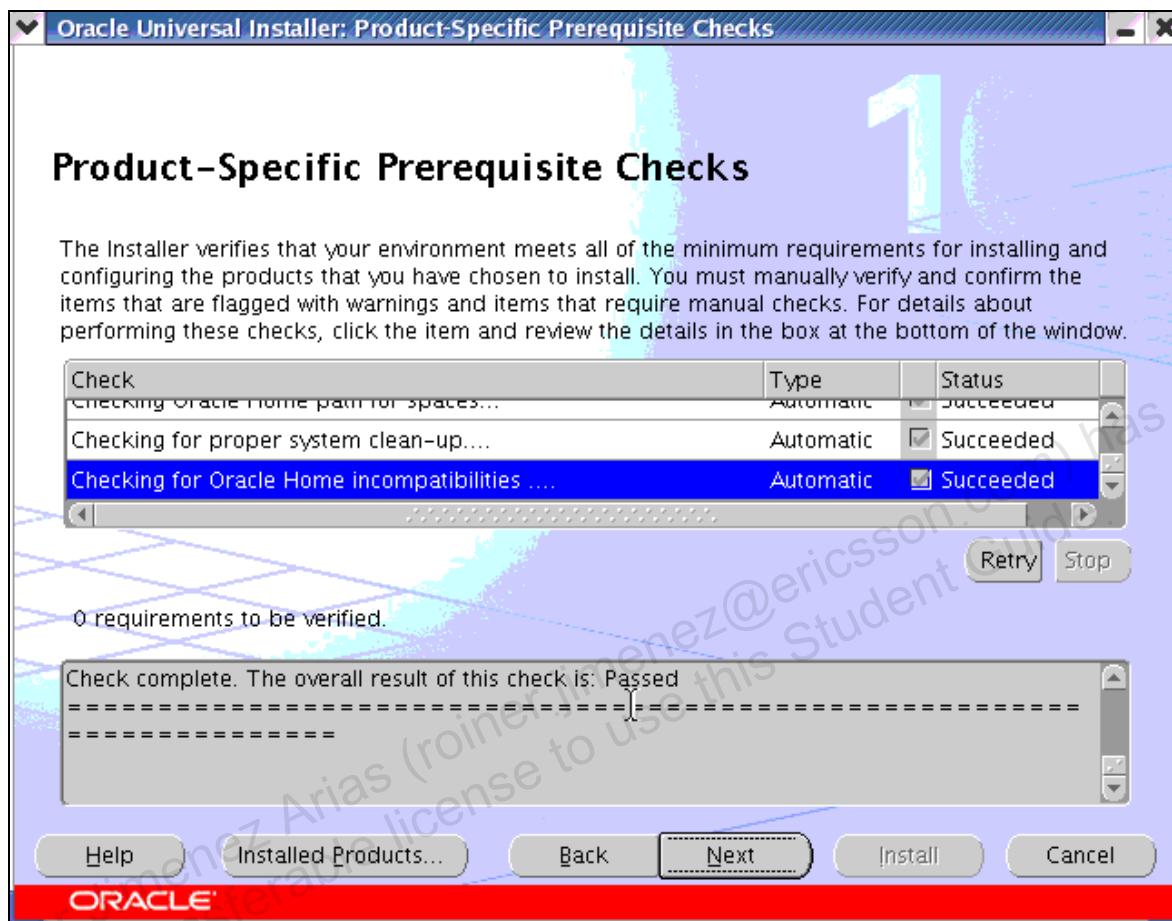
Object	Setting
Database Home Location	<code>/u01/app/oracle/product/10.2.0/db_1</code>
Installation Type	Enterprise Edition
UNIX DBA Group	<code>oinstall</code>
Create Starter Database	<code>Deselected</code>

**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**.

## Solutions for Practice 2: Installing the Oracle Database Software (continued)

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

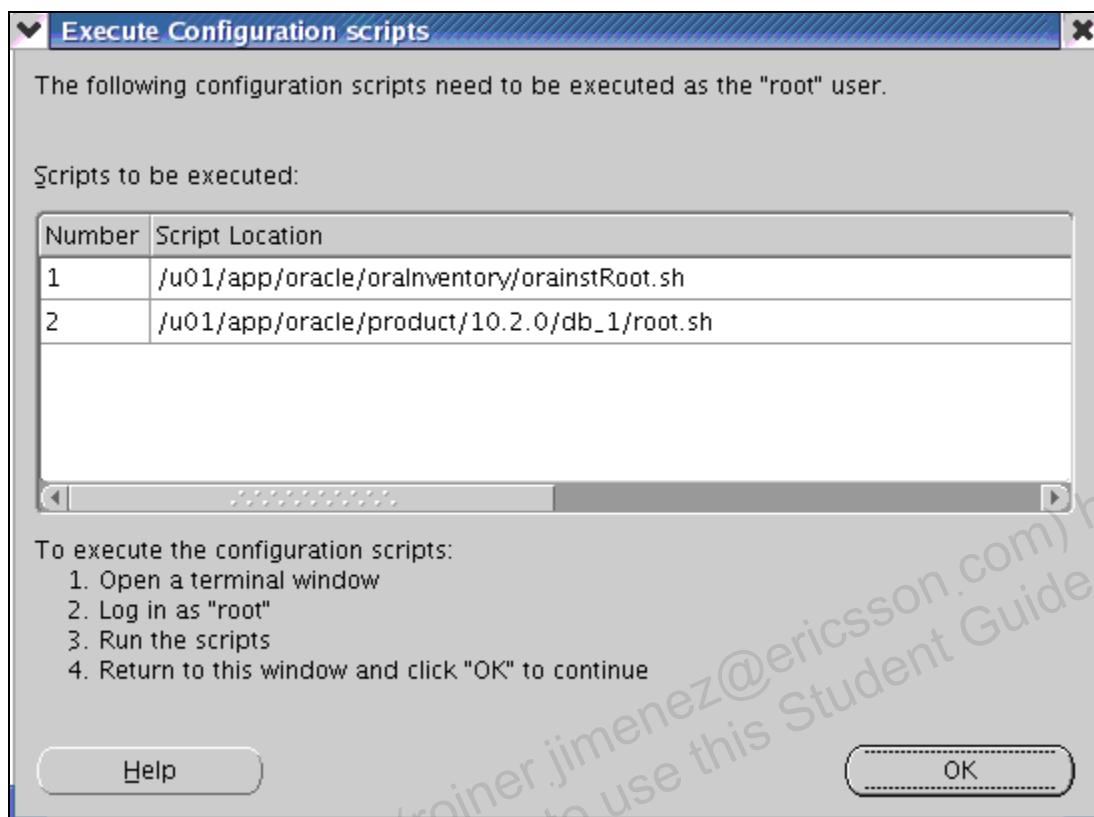


- d) After OUI has finished its prerequisite checks on the Product-Specific Prerequisite Checks page, click **Next**.
3. When the prerequisite checks are finished, the Summary page is displayed.
  - a) Click **Install** to begin your installation.

*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.

## Solutions for Practice 2: Installing the Oracle Database Software (continued)



- a) Right-click your desktop and select **Open Terminal**.
- b) Run the `orainstRoot.sh` and `root.sh` scripts as root, and then click **OK**.

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

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

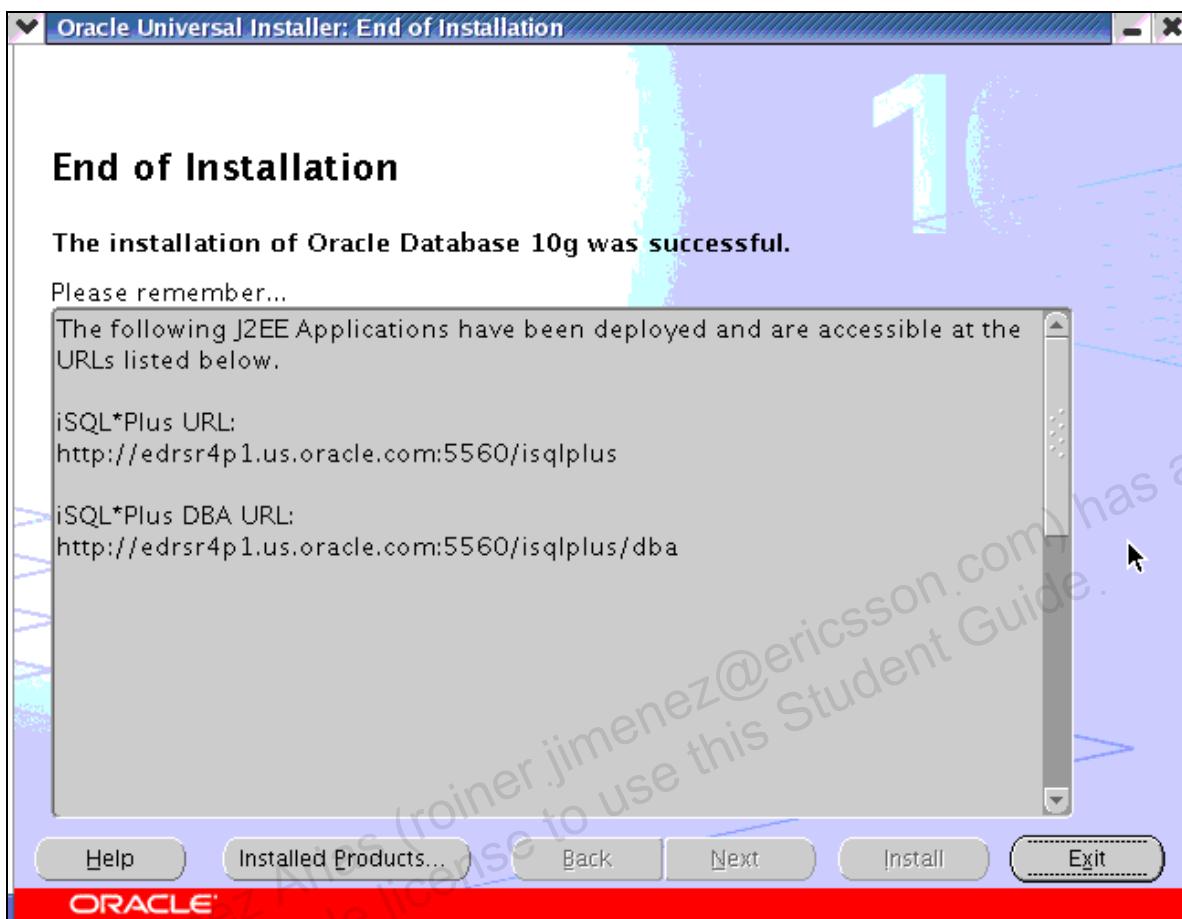
## Solutions for Practice 2: Installing the Oracle Database Software (continued)

```
[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.

## Solutions for Practice 2: Installing the Oracle Database Software (continued)



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

iSQL\*Plus URL: \_\_\_\_\_

iSQL\*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.

## 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).

**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.

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

*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.

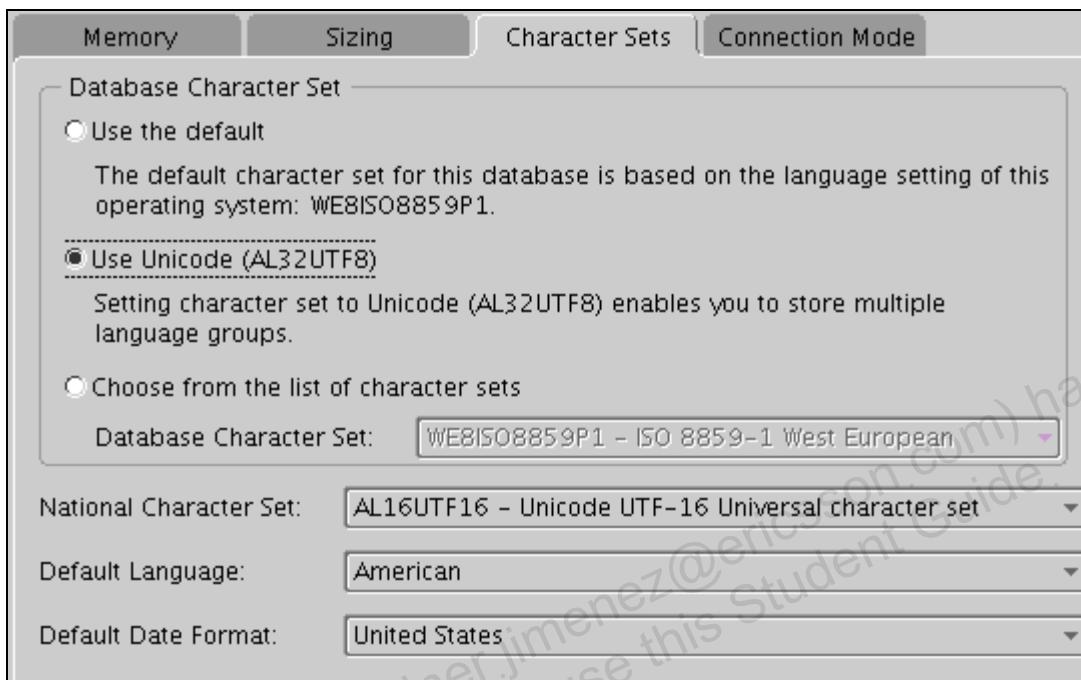
- e) Click **Close** to close the Template Details window.
- f) Click **Next**.

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. Enter or confirm **SGA** size of **270 MB** and **PGA** size of **140 MB**.

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

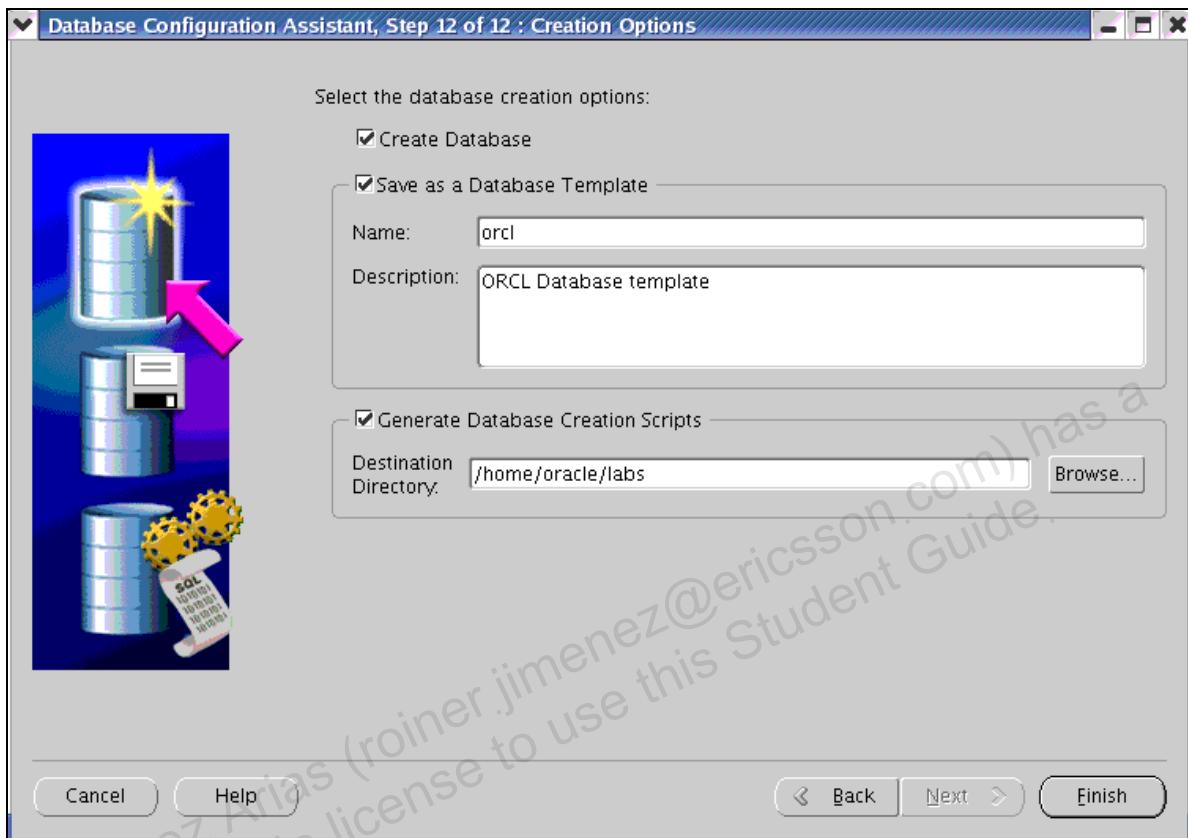
- j) On the Initialization Parameters Character Sets tabbed, select **Use Unicode (AL32UTF8)**.



- 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**.

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

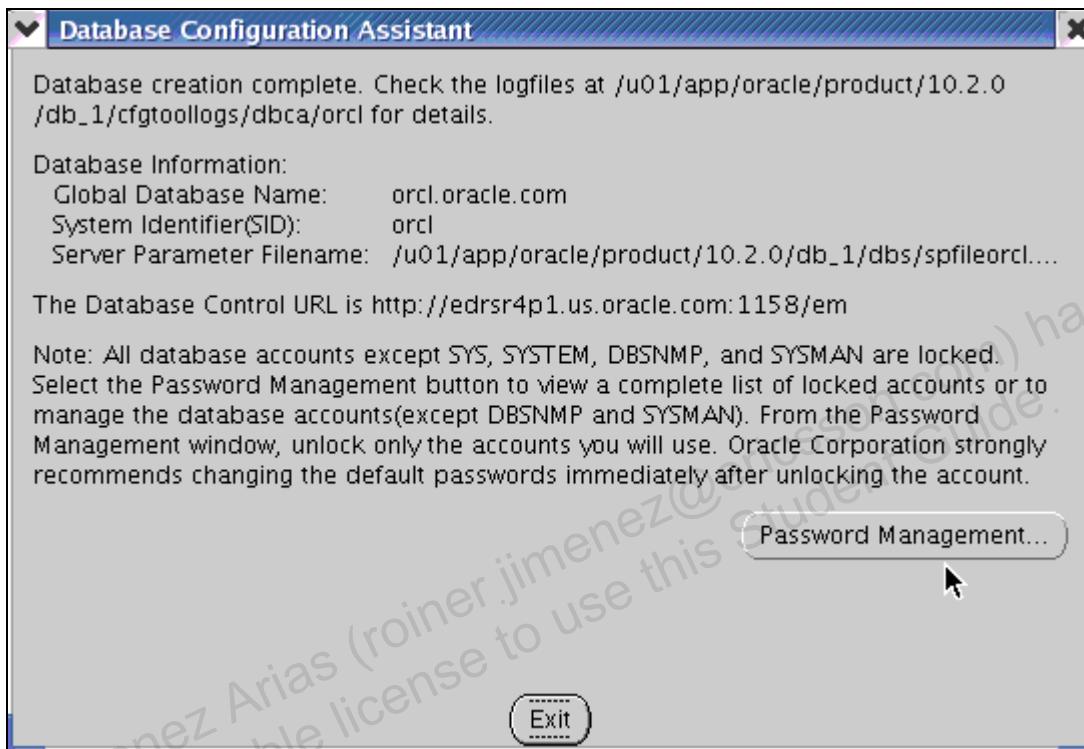
- m) On the Creation Options page, select **Create Database**.



- 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).

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

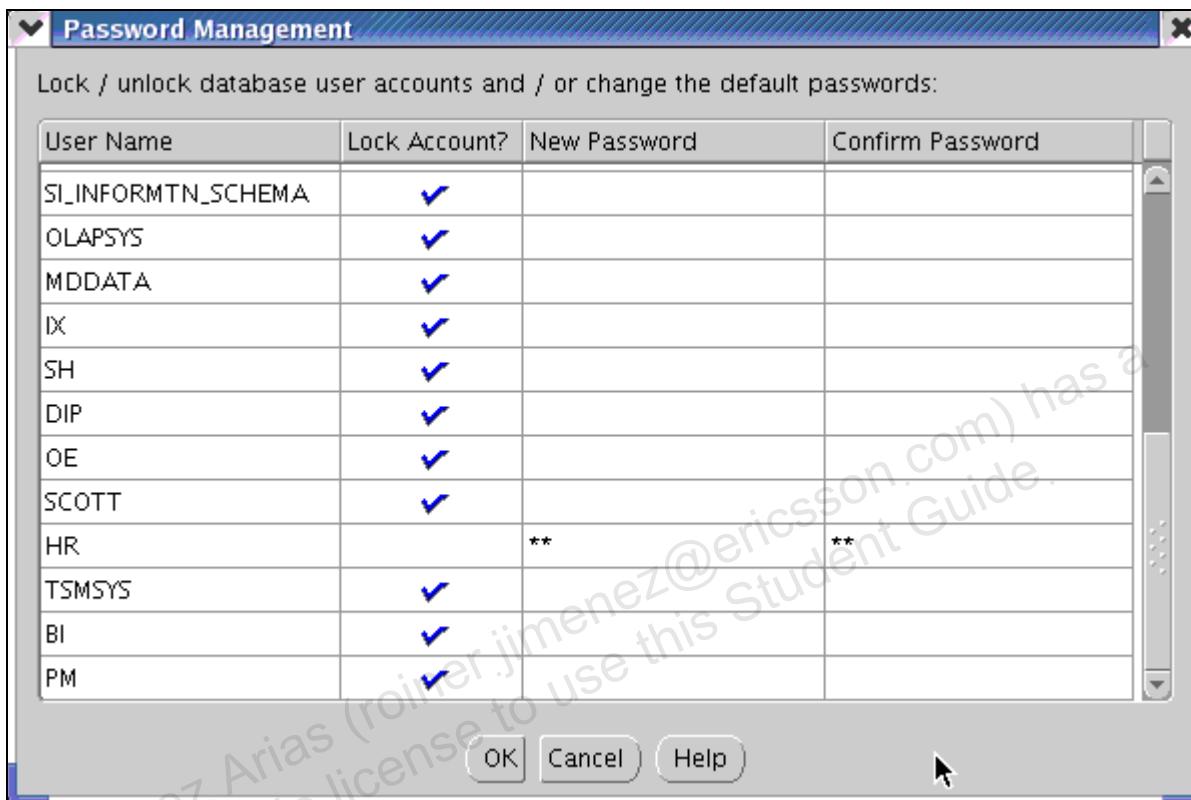
- q) The DBCA displays the progress of the various installation steps. When the database itself has been created, the DBCA displays essential information about the database. Make note of this information. The Database Control URL will be used in several of the following practice sessions.



- r) Click the **Password Management** button.  
s) Scroll down the Password Management page until you see the HR User Name.

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

- 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.

## 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.

## Solutions for Practice 4: Managing the Oracle Instance (continued)

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

The dialog box has the title "Login to Database:orcl.oracle.com". It contains three input fields: "User Name" with value "sys", "Password" with value "\*\*\*\*\*", and "Connect As" with value "SYSDBA" in a dropdown menu. A "Login" button is at the bottom right.

- 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 10g 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**.

The menu has several options: Memory Parameters, Undo Management, All Initialization Parameters (which is highlighted with a red box), and Database Feature Usage.

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

The dialog box has a header "Initialization Parameters". Below it, there are tabs "Current" and "SPFile". A message says "The parameter values listed here are currently used by the running instance(s). You can change static parameters in SPFILE mode." There is a table with columns "Name", "Basic", "Modified", "Dynamic", and "Category". A search bar at the bottom says "Filter on a name or partial name".

Name	Basic	Modified	Dynamic	Category
job	All	All	All	All

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

## Solutions for Practice 4: Managing the Oracle Instance (continued)

- 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?

- In the Enterprise Manager browser session, click the **Database** tab.
- Click **Shutdown**.
- For **Host Credentials**, enter oracle as **Username** and oracle as **Password**.
- Click OK.

The Startup/Shutdown: Confirmation page appears.

- Click **Advanced Options** to see the mode for shutting down, but do not change the mode; it should remain as “Immediate.”
- Click **Cancel** to return to the previous page.
- 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**

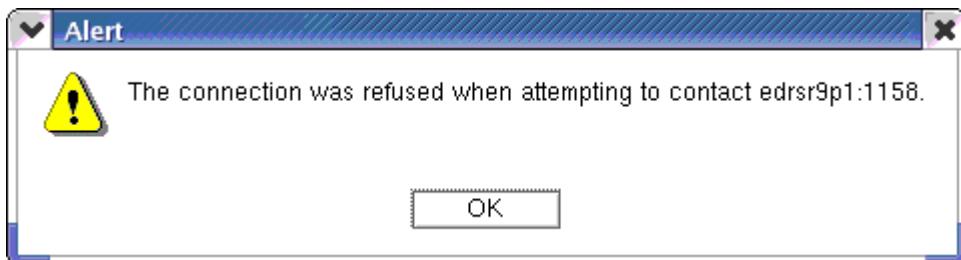
**Return**

```
SHUTDOWN immediate
```

- h) Click **Return**.

## Solutions for Practice 4: Managing the Oracle Instance (continued)

- 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.”



**Database Instance**

Status **Down**      Details **There has been a user-initiated shutdown.**

Host **edrsr9p1.us.oracle.com**      Startup

Port **1521**      Perform Recovery

SID **orcl**

Oracle Home **/u01/app/oracle/product/10.2.0/db\_1**

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**.

## Solutions for Practice 4: Managing the Oracle Instance (continued)

- 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**.

## Solutions for Practice 4: Managing the Oracle Instance (continued)

- 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 *iSQL\*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 *iSQL\*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 *iSQL\*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**.

## Solutions for Practice 4: Managing the Oracle Instance (continued)

- 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 `isqlplusctl start` command at the OS prompt, and then retry step (b).

```
$ isqlplusctl 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.

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Connected as `HR@orcl`

**Workspace**

Enter SQL, PL/SQL and SQL\*Plus statements.

`SELECT * FROM EMPLOYEES;`

**Execute** **Load Script** **Save Script** **Cancel**

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 *iSQL\*Plus* window.

## 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.

Select	Name
<input checked="" type="radio"/>	SYS
<input checked="" type="radio"/>	SYSTEM

## Solutions for Practice 5: Managing Database Storage Structures (continued)

- 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**

## Solutions for Practice 5: Managing Database Storage Structures (continued)

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

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS	TABLE	12,288	27
SH.SUPPLEMENTARY_DEMOGRAPHICS	TABLE	4,096	19
OE.PRODUCT_DESCRIPTIONS	TABLE	2,072	18

- 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**.

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?

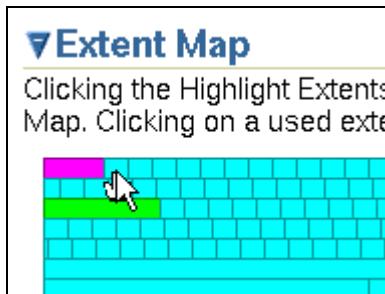
Answer: SH.CUSTOMERS\_PK

*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**.

## Solutions for Practice 5: Managing Database Storage Structures (continued)

- 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.REGION\$	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.

- In Enterprise Manager, select **Administration** > Database Administration > Storage > **Tablespaces**.
- Click **Create**.
- 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.
- Click **Add** in the Datafiles region.
- On the Add Datafile page, enter inventory01 . dbf for **File Name**, and 5 MB as **File Size**.
- Click **Continue**.
- Click the **Storage** tab, and verify that **Extent Allocation** is **Automatic**, **Segment Space Management** is **Automatic**, and **Logging** is enabled.
- Click the **General** tab.
- Click **Show SQL** to see the SQL that will be run, and then click **Return**.
- Click **OK**, and a successful Update Message appears.

## Solutions for Practice 5: Managing Database Storage Structures (continued)

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?
- Select **Administration** > Database Administration > Storage > **Tablespaces**.
  - Select the INVENTORY tablespace, and then click **Edit**.
  - In the **Datafiles** region, click **Edit**.
  - Change **File Size** from 5 MB to 50 MB.
  - Click **Continue** to return to the General tabbed page.
  - Click **Show SQL** to see the SQL that will be run. Note that it is an ALTER DATABASE statement. Click **Return**.

## Solutions for Practice 5: Managing Database Storage Structures (continued)

### 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.
- Go to the SQL\*Plus window.
  - Enter the following to run the script:

```
$ sqlplus dba1/oracle @lab_05_07.sql
```
  - 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.
- Enter the following to run the script:

```
$ sqlplus dba1/oracle @lab_05_08.sql
```

## 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.

## Solutions for Practice 6: Administering User Security (continued)

**Create Profile**

[Show SQL](#) [Cancel](#) [OK](#)

**General** [Password](#)

\* Name

**Details**

CPU/Session (Sec./100)	<input type="text" value="DEFAULT"/>	
CPU/Call (Sec./100)	<input type="text" value="DEFAULT"/>	
Connect Time (Minutes)	<input type="text" value="DEFAULT"/>	
Idle Time (Minutes)	<input type="text" value="15"/>	

**Database Services**

Concurrent Sessions (Per User)	<input type="text" value="DEFAULT"/>	
Reads/Session (Blocks)	<input type="text" value="DEFAULT"/>	
Reads/Call (Blocks)	<input type="text" value="DEFAULT"/>	
Private SGA (KBytes)	<input type="text" value="DEFAULT"/>	
Composite Limit (Service Units)	<input type="text" value="DEFAULT"/>	

- 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**.

## Solutions for Practice 6: Administering User Security (continued)

**Initialization Parameters**

**Current** **SPFile**

The parameter values listed here are currently used by the running instance(s). You can change static parameters in SPFile mode.

Name	Basic	Modified	Dynamic	Category
RESOURCE_LIMIT	All	All	All	All

[Filter on a name or partial name](#)

Apply changes in current running instance(s) mode to SPFile. For static parameters, you must restart the database.

[Save to File](#)

Name	Help	Revisions	Value	Comments	Type	Basic	Modified	Dynamic	Category
resource_limit	<a href="#">i</a>		TRUE		Boolean			<input checked="" type="checkbox"/>	Resource Manager

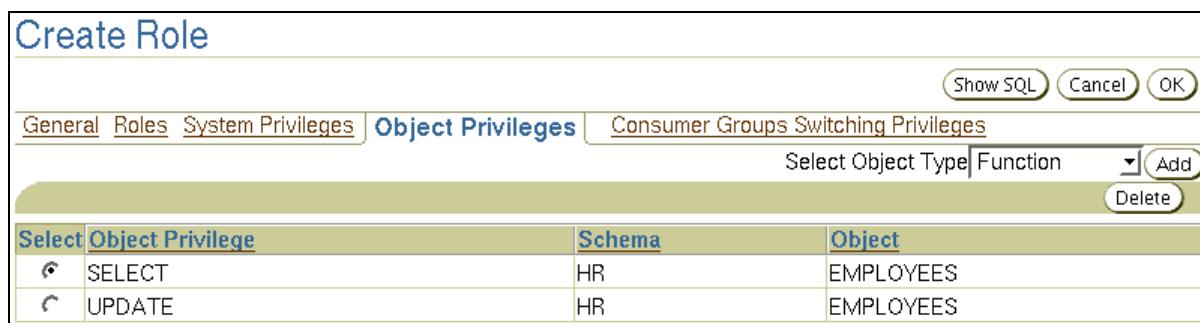
4. Create the role named **HRCLERK** with SELECT and UPDATE permissions on the **HR.EMPLOYEES** table.
  - a) Select **Administration** > Schema > Users & Privileges > **Roles**.
  - b) Click the **Create** button at the top-right of the page.
  - c) Enter **HRCLERK** in the **Name** field. This role 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.

## Solutions for Practice 6: Administering User Security (continued)



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.

## Solutions for Practice 6: Administering User Security (continued)

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.

**Create User**

* Name	DHAMBY
Profile	HRPROFILE
Authentication	Password
* Enter Password	***** newuser
* Confirm Password	***** newuser
For Password choice, the role is authorized via password.	
<input checked="" type="checkbox"/> Expire Password now	
Default Tablespace	
Temporary Tablespace	
Status	<input type="radio"/> Locked <input checked="" type="radio"/> Unlocked

- 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.

**Edit User: DHAMBY**

Role	Admin Option	Default
CONNECT	<input type="checkbox"/>	<input checked="" type="checkbox"/>
HRCLERK	<input type="checkbox"/>	<input checked="" type="checkbox"/>

- 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.

## 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 "*****"
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 appear on 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

## Solutions for Practice 6: Administering User Security (continued)

- 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.

## Solutions for Practice 6: Administering User Security (continued)

*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

## 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**.

## Solutions for Practice 7: Managing Schema Objects (continued)

- 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.

<b>Definition</b>	
Name	CHK_REORDER
* Check Condition	reorder_threshold > 0
<b>Attributes</b>	
<input type="checkbox"/> Disabled <input type="checkbox"/> Deferrable - In subsequent transactions this allows constraint checking to be deferred until the end of the transaction. <input type="checkbox"/> Initially Deferred - Set the default deferred behavior to check constraints at the end of a transaction. <input checked="" type="checkbox"/> Validate - Check to ensure all existing data meets the constraint criteria. <input type="checkbox"/> 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
<input type="radio"/>	PK_INV	PRIMARY	PRODUCT_ID	NO	NO	NO	YES	NO
<input checked="" type="radio"/>	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.

## Solutions for Practice 7: Managing Schema Objects (continued)

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
```

- 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.

## Solutions for Practice 7: Managing Schema Objects (continued)

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)

- In Enterprise Manager, select **Administration** > **Schema** > **Database Objects** > **Tables**.
- Click **Create**.
- Leave the default setting for **Table Organization**, and then click **Continue**.
- Enter OBSOLETE\_PRODUCTS for **Name**.
- Enter INVENTORY for **Schema**.
- Leave the Tablespace setting as the default for this schema.
- Set the **Define Using** drop-down list to **SQL**.
- In the SQL region, enter the following statement:

```
SELECT product_id, product_name, code, cost, price
FROM inventory.product_master
```

Create Table	
<input type="button" value="Show SQL"/> <input type="button" value="Cancel"/> <input type="button" value="OK"/>	
<b>General</b> <a href="#">Constraints</a> <a href="#">Storage</a> <a href="#">Options</a>	
* Name <input type="text" value="OBSCOLETE_PRODUCTS"/>	
Schema <input type="text" value="INVENTORY"/>	
Tablespace <input type="text" value="&lt;Default&gt;"/>	
Organization <b>Standard, Heap Organized</b>	
Define Using <input type="button" value="SQL"/>	
<b>SQL</b>	
Enter a SQL select statement below. The results of this query will be used to populate this table with data.	
<pre>CREATE TABLE OBSOLETE_PRODUCTS AS SELECT product_id, product_name, code, cost, price FROM inventory.product_master</pre>	

- Click **OK** to create the table.

## Solutions for 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.

- 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 ▾		
<b>Add Column Expression</b>				

- 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.

## Solutions for Practice 7: Managing Schema Objects (continued)

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.poht_prod_id_qty on  
inventory.product_on_hand(product_id, quantity);
```

## Solutions for Practice 7: Managing Schema Objects (continued)

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**.

## Solutions for Practice 7: Managing Schema Objects (continued)

- 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.

- Select **Administration** > **Schema** > **Database Objects** > **Views**.
- Click **Create**.
- Enter WAREHOUSE\_VW in the **Name** field, and INVENTORY in the **Schema** field.
- 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
```



- Click **OK**.

## Solutions for 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.

- 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)))
```

## Solutions for Practice 7: Managing Schema Objects (continued)

- 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 *iSQL\*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 *iSQL\*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 *iSQL\*Plus* Workspace, enter:

```
SELECT * FROM dictionary
WHERE table_name like 'ALL_CON%'
ORDER BY table_name;
```

- e) Click the **Execute** button.

## Solutions for Practice 7: Managing Schema Objects (continued)

Connected as HR@orcl

**Workspace**

Enter SQL, PL/SQL and SQL\*Plus statements.

`SELECT * FROM dictionary  
WHERE table_name like 'ALL_CON%'  
ORDER BY table_name;`

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 iSQL\*Plus Workspace, enter:

```
SELECT * FROM user_indexes;
```

- b) Click the **Execute** button.

How many indexes are owned by the INVENTORY user?

*Answer:* 4

## Solutions for Practice 7: Managing Schema Objects (continued)

Connected as INVENTORY@orcl

### Workspace

Enter SQL, PL/SQL and SQL\*Plus statements.

SELECT \* FROM user\_indexes;

INDEX_NAME	INDEX_TYPE	TABLE_OWNER	TABLE_NAME	TABLE_TYPE
CODE_FUNC	FUNCTION-BASED NORMAL	INVENTORY	PRODUCT_MASTER	TABLE
PROD_NAME_CODE	NORMAL	INVENTORY	PRODUCT_MASTER	TABLE
PK_INV	NORMAL	INVENTORY	PRODUCT_MASTER	TABLE
POH_PROD_ID_QTY	NORMAL	INVENTORY	PRODUCT_ON_HAND	TABLE

- c) Note that there are four rows returned.
- d) Log out of iSQL\*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.

## 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.
```

## Solutions for Practice 8: Managing Data and Concurrency (continued)

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 Wait Value Class	Wait Event	P1	P2	P3	Seconds in Wait
<input type="radio"/> Blocking Sessions									
<input checked="" type="radio"/> NGREENBERG	1	<a href="#">133</a>	1784	Idle	SQL*Net message from client	16508152321	0	538	
<input type="radio"/> SMAVRIS	0	<a href="#">158</a>	11895	6smgtv6h8958b	Application	eng: TX - row lock contention	1415053318327682540		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**

## Solutions for Practice 8: Managing Data and Concurrency (continued)

- 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?

- Click the browser's **Back** button.
- Now, on the Session Details: NGREENBERG page, click **Kill Session**.
- 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
```

- Click **Return**, and then click **Yes** to carry out the **KILL SESSION** command.
- 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> █
```

- Close all open SQL sessions by entering **exit**, and then close the terminal windows.

## 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.

<b>Advisor</b>			
* New Undo Retention	2 days		
Analysis Time Period	Last Seven Days		
Choose the time period that best represents system activity			
Selected Analysis Time Period	October 21, 2005 8:00 AM To October 28, 2005 8:00 AM		
<b>Analysis</b>			
Required Tablespace Size for New Undo Retention (MB)	110	Undo Retention (days)	15
Required Tablespace Size for Current Undo Retention (MB)	11	Best Possible Undo Retention (days)	594
Maximum Extensible Undo Tablespace Size (MB)	32652		

- f) *Question:* What does the analysis recommend as “Required Tablespace Size for New Undo Retention”?

*Answer:* 110 MB

- g) Click **OK**.

## 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.

- Click **Edit Undo Tablespace**.
- 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.

- To increase the size of the existing data file, select the data file, and then click **Edit**.
- 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**.
- 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_1pzf0nlk_.dbf'
RESIZE 200M
ALTER DATABASE DATAFILE
'/u01/app/oracle/oradata/ORCL/datafile/o1_mf_undotbs1_1pzf0nlk_.dbf'
AUTOEXTEND OFF
```

- Click **Return**, then click **Apply** to implement your change.

## 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**.

Audit Settings															
<p><span style="color: yellow;">!</span> Standard auditing for this database is disabled. To enable it, change the Audit Trail configuration parameter and restart the database. All the audit trail information either have no data or contain only obsolete audit records.</p>															
<table border="1"> <thead> <tr> <th colspan="2">Configuration</th> </tr> </thead> <tbody> <tr> <td>Audit Trail</td> <td style="background-color: red;">NONE</td> </tr> <tr> <td>Audit SYS User Operations</td> <td>FALSE</td> </tr> <tr> <td>Audit File Directory</td> <td>/u01/app/oracle/admin/orcl/adump</td> </tr> <tr> <td colspan="2">Audit File Directory value is effective only when Audit Trail is set to "OS" or "XML".</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Audit Trails</th> </tr> </thead> <tbody> <tr> <td>Database Audit Trail</td> <td>Audited Failed Logins Audited Privileges Audited Objects</td> </tr> </tbody> </table>		Configuration		Audit Trail	NONE	Audit SYS User Operations	FALSE	Audit File Directory	/u01/app/oracle/admin/orcl/adump	Audit File Directory value is effective only when Audit Trail is set to "OS" or "XML".		Audit Trails		Database Audit Trail	Audited Failed Logins Audited Privileges Audited Objects
Configuration															
Audit Trail	NONE														
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Audit File Directory value is effective only when Audit Trail is set to "OS" or "XML".															
Audit Trails															
Database Audit Trail	Audited Failed Logins Audited Privileges Audited Objects														

- 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**.

Show SQL	
<pre>ALTER SYSTEM SET audit_trail = "XML" SCOPE=SPFILE</pre>	

- h) Review the statement and then click **Return**.
- i) On the Initialization Parameters page, click **Apply**.

## Solutions for Practice 10: Implementing Oracle Database Security (continued)

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.
- 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.
  - Then, select **Administration > Schema > Users & Privileges > Audit Settings**.

Privilege	User	Proxy	Success	Failure
Select Privilege	User	Proxy		Add
No object found.				

- Click the **Audited Objects** tab, and then click the **Add** button.
- 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).
- Move DELETE, INSERT, and UPDATE into the **Selected Statements** area by double-clicking each of them.
- Click **Show SQL**.

### Show SQL

```
AUDIT DELETE, INSERT, UPDATE ON HR.JOBS BY SESSION
```

## Solutions for Practice 10: Implementing Oracle Database Security (continued)

- 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.
- Select **Administration > Schema > Users & Privileges > Audit Settings**.
  - Click **Audited Objects** in the **Audit Trails** area, which is on the right side of the page.
  - On the Audited Objects page, review the collected information, and optionally click **Show SQL**.

**Audited Objects**

[▼ Hide SQL](#)

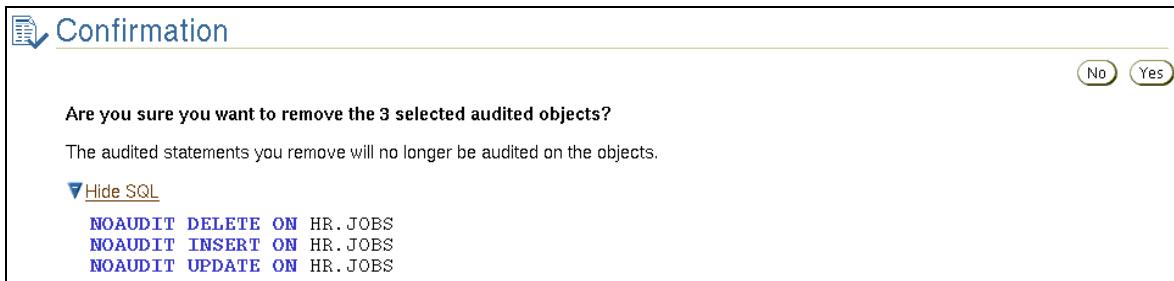
```
SELECT "OBJECT_SCHEMA", "OBJECT_NAME", "DB_USER", "STATEMENT_TYPE",
"EXTENDED_TIMESTAMP" FROM SYS.DBA_COMMON_AUDIT_TRAIL WHERE (action between 1 and 16) or
(action between 18 and 29) or (action between 32 and 41) or (action = 43) or (action between 51 and 99) or
(action = 103) or (action between 110 and 113) or (action between 116 and 121) or (action between 123 and 128)
or (action between 160 and 162)
```

| 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.
- On the Audit Settings page, click the **Audited Objects** tab.
  - Enter `HR` as **Schema**, and then click **Search**.
  - Select all three rows, and then click **Remove**.

## Solutions for Practice 10: Implementing Oracle Database Security (continued)

- d) On the Confirmation page, click **Show SQL**.

Confirmation

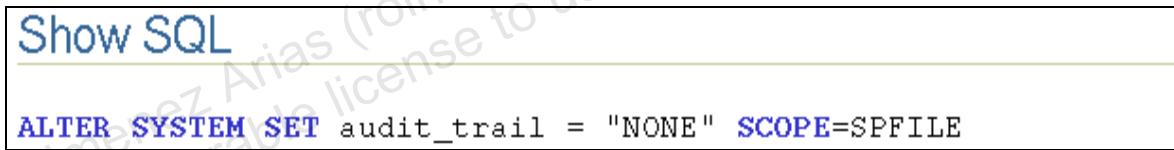
Are you sure you want to remove the 3 selected audited objects?

The audited statements you remove will no longer be audited on the objects.

**Hide SQL**

```
NOAUDIT DELETE ON HR.JOBS
NOAUDIT INSERT ON HR.JOBS
NOAUDIT UPDATE ON HR.JOBS
```

- 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**.

Show SQL

```
ALTER SYSTEM SET audit_trail = "NONE" SCOPE=SPFILE
```

- 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.

## 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.

## Solutions for Practice 11: Configuring the Oracle Network Environment (continued)

- f) Select **Database Default**.

Create Net Service Name

General Advanced

\* Net Service Name

**Database Information**

To identify the database or service, you must provide either its service name (recommended) or the Oracle System Identifier (SID). The service name is normally its global database name, a name comprising the database name and domain name.

Use Service Name  
Service Name

Use SID  
SID

Choose if you want a shared or dedicated server database connection.

Database Default  
Requests will be served by whatever database default is.

Dedicated Server  
Requests will be served by dedicated server.

Shared Server  
Request will be served by shared server.

**Addresses**

Add

- 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>

Add Address

Protocol

\* Port

\* Host   
The host name or IP address of the computer.

Your partner's server

**Advanced Parameters**

The following parameters are introduced in Oracle version 10g.

Total Send Buffer Size   
(Bytes) Cumulative size for all send operations.

Total Receive Buffer Size (Bytes)   
Cumulative size for all receive operations.

## Solutions for Practice 11: Configuring the Oracle Network Environment (continued)

- 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.*

**Login Information**

Provide username and password for the testing the connection.

\* Username

\* Password

**Test**

**Log**

Attempting to connect using userid:system

The test was successful.

5. Test your changes to the network configuration by using SQL\*Plus or iSQL\*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;
```

## Solutions for Practice 11: Configuring the Oracle Network Environment (continued)

```
[oracle@EDRSR9P1 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**.

## Solutions for Practice 11: Configuring the Oracle Network Environment (continued)

- 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**.

| Select                           | Protocol | Protocol Details                            |
|----------------------------------|----------|---------------------------------------------|
| <input checked="" type="radio"/> | TCP/IP   | Host: edrsr30p1.us.oracle.com<br>Port: 1561 |

- 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**

|                                  |                                     |
|----------------------------------|-------------------------------------|
| * 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.

## Solutions for Practice 11: Configuring the Oracle Network Environment (continued)

The screenshot shows the Oracle Database Listener Configuration page. At the top, a green banner displays the message "Listener 'LISTENER2' created successfully." Below this, the title "Listeners: /u01/app/oracle/product/10.2.0/db\_1/network/admin" is shown. A search bar contains the text "Listener Name LISTENER2" and a "Go" button. To the right of the search bar are buttons for "Edit", "Delete", "Actions", "Start/Stop" (with a dropdown menu), and "Create". The main area is a table titled "Protocol Details" with columns: Select, Name, Protocol, Status, and Enterprise Manager Target. The table contains one row for LISTENER2, which is selected (indicated by a blue border). The details for LISTENER2 are: Protocol: TCP/IP, Host: edrsr30p1.us.oracle.com, Port: 1561. The Status is "Stopped" and the Enterprise Manager Target is "Not a target".

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.

## 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, identified 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
```

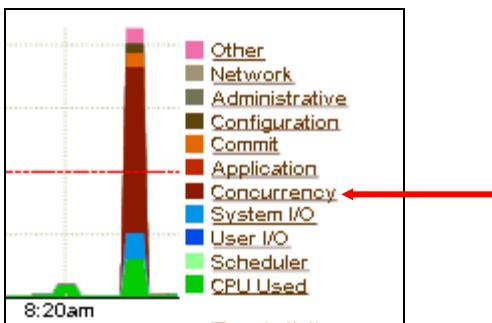
4. Create activity to be analyzed. Execute the lab\_12\_04.sh script to perform these tasks.

- 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
```

## Solutions for Practice 12: Proactive Maintenance (continued)

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.

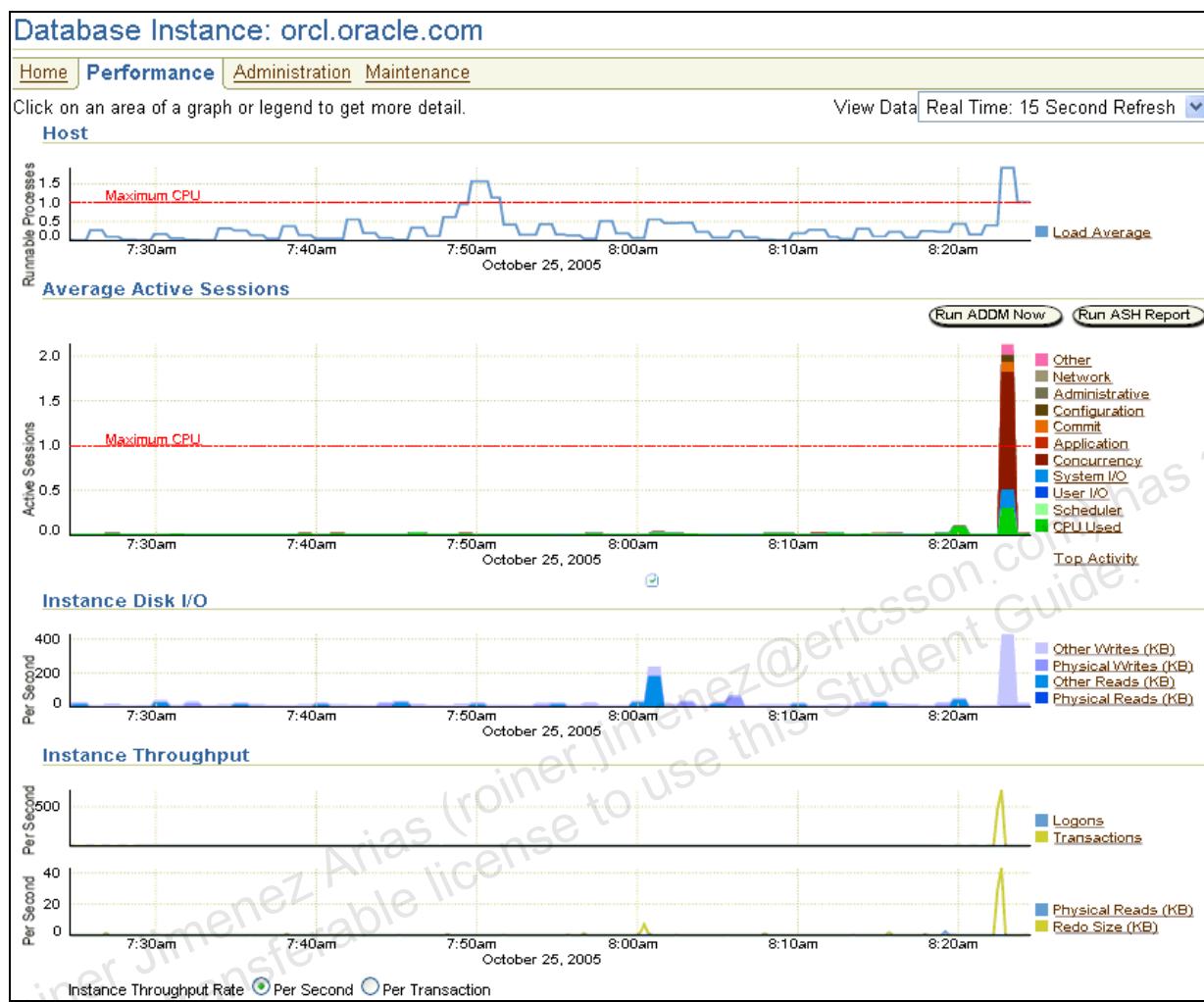
After the spike is finished, execute the `lab_12_05.sh` script. This script forces the creation of a new snapshot and gathers statistics on your ADDM table.

- Invoke Enterprise Manager as the DBA1 user in the SYSDBA role for your ORCL database.
- 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.

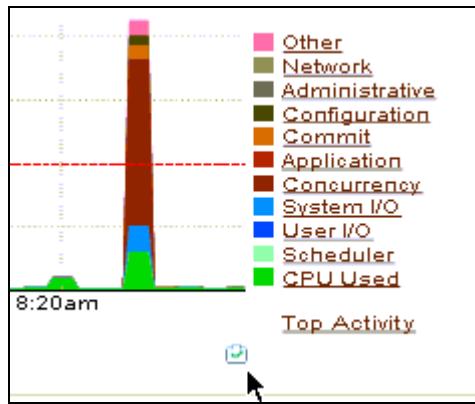
**Note:** If you do not get the expected findings, your system might be more powerful than anticipated. Update the `lab_12_04.sh` file to increase the contention by adding users. For example, set users to 16 instead of 8. Be careful to not set this to a value too high for your system, because you can slow it down too much. Ask your instructor for guidance if need be.

## Solutions for Practice 12: Proactive Maintenance (continued)



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.

## Solutions for 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 impulse 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.

The screenshot shows the Oracle Advisor Central page. At the top, there are links for ADDM, Segment Advisor, Undo Management, Memory Advisor, SQL Access Advisor, MTTR Advisor, and SQL Tuning Advisor. Below that is a 'Search' section with dropdown menus for Advisory Type (set to All Types), Task Name, Advisor Runs (Last Run), and Status (All). A 'Go' button is next to the search criteria. Below the search is a table titled 'Results' with columns: Advisory Type, Name, Description, User, Status, Start Time, Duration (seconds), and Expires In (days). Two rows are listed: one for ADDM (auto run) and one for Segment Advisor (Auto Space Advisor).

| Advisory Type   | Name                        | Description                                                             | User | Status    | Start Time               | Duration (seconds) | Expires In (days) |
|-----------------|-----------------------------|-------------------------------------------------------------------------|------|-----------|--------------------------|--------------------|-------------------|
| ADDM            | ADDM:1099806762_1_161       | ADDM auto run: snapshots [160, 161], instance 1, database id 1099806762 |      | COMPLETED | Oct 25, 2005 8:26:51 AM  | 2                  | 30                |
| Segment Advisor | SYS_AUTO_SPCADV_70525102005 | Auto Space Advisor                                                      | SYS  | COMPLETED | Oct 24, 2005 10:00:09 PM | 5                  | 29                |

- 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).

## Solutions for Practice 12: Proactive Maintenance (continued)

**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

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

[View Snapshots](#) [View Report](#)

| 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<br>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<br>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 impulse 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**

Select All | Select None | Show All Details | Hide All Details [Schedule SQL Tuning Advisor](#)

| Select Details           | Category   | Benefit (%) ▾ |
|--------------------------|------------|---------------|
| <input type="checkbox"/> | SQL Tuning | 78.5          |

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.

| <input type="checkbox"/>            | Show SQL Tuning | 58  |
|-------------------------------------|-----------------|-----|
| <input checked="" type="checkbox"/> | Show SQL Tuning | 3.5 |

**Findings Path**

Expand All | Collapse All

| Findings                                                       | Impact (%) | Additional Information |
|----------------------------------------------------------------|------------|------------------------|
| SQL statements consuming significant database time were found. | 100        |                        |

## Solutions for Practice 12: Proactive Maintenance (continued)

- 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.

## Solutions for Practice 12: Proactive Maintenance (continued)

- 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
```

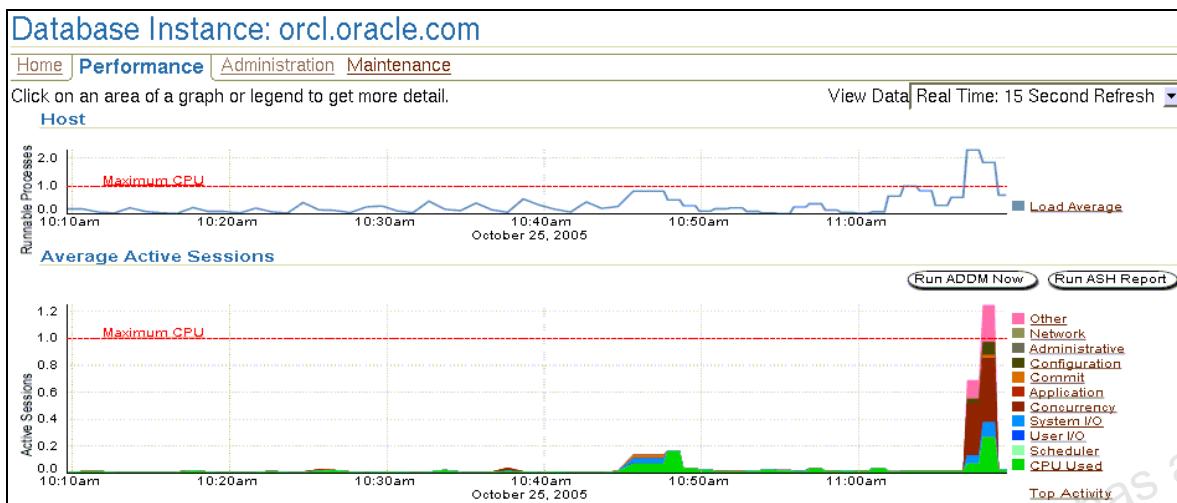
9. In Enterprise Manager, review the Performance page as a user connected as SYSDBA. View performance data in real time with a 15-seconds refresh cycle. After a while, you should see a spike on the “Average Active Sessions” graph.

**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.

## Solutions for Practice 12: Proactive Maintenance (continued)

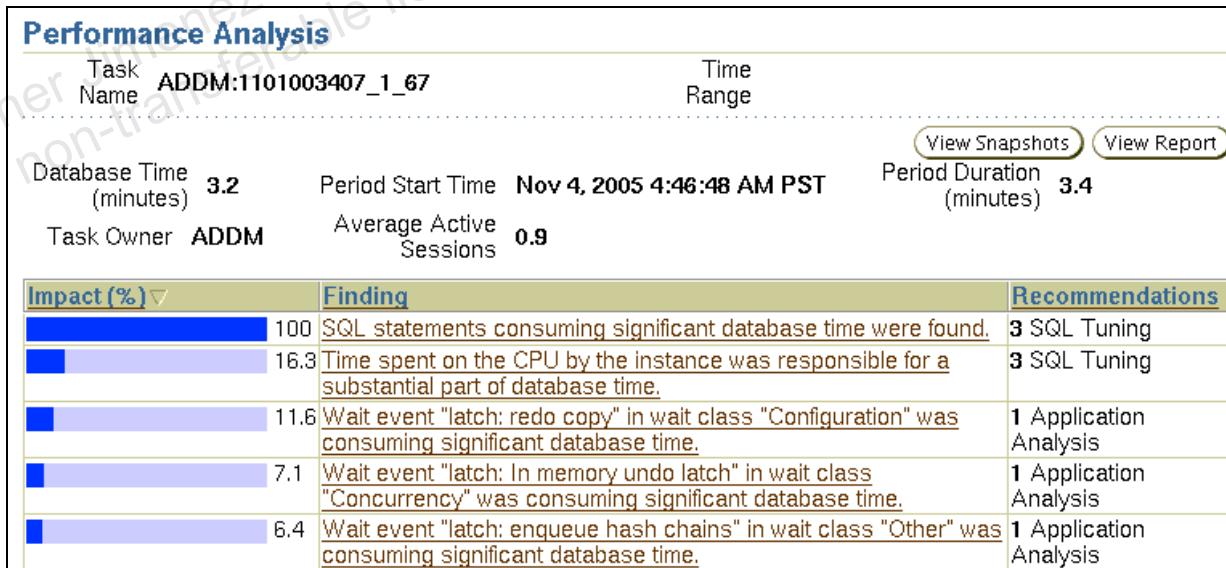


- c) After the spike is finished, enter the following in a terminal window:

```
./lab_12_09.sh
```

### 10. Review the Performance Analysis on the Database home page.

- Navigate to the Database home page, and then click **Advisor Central** at the bottom of the page.
- 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.

## 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
```

## 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.

## Solutions for Practice 13: Performance Management (continued)

- 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

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](#)

(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](#)

[General](#) [Activity](#) [Statistics](#) [Open Cursors](#) [Blocking Tree](#) [Wait Event History](#)

| Server                                                                                                                                                                                                                                                                                                                     | Client                                                                                                                                                                                      | Application                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Current Status <b>INACTIVE</b><br>Serial Number <b>2114</b><br>DB User Name <b>HR</b><br>OS Process ID <b>14577</b><br>Logged On Since <b>Oct 28, 2005 1:36:20 PM</b><br>Logged On For <b>12 Minutes, 53 Seconds</b><br>Connection Type <b>DEDICATED</b><br>Type <b>USER</b><br>Resource Consumer Group <b>Unavailable</b> | OS User Name <b>oracle</b><br>OS Process ID <b>14576</b><br>Host <b>EDRSR9P1</b><br>Terminal <b>pts/4</b><br>Current Client ID <b>Unavailable</b><br>Current Client Info <b>Unavailable</b> | Current SQL <b>None</b><br>Current SQL Command <b>UNKNOWN</b><br>Previous SQL <b>bckcqw5pd108f</b><br>Last Call Elapsed Time <b>12 Minutes, 15 Seconds</b><br>SQL Trace <b>DISABLED</b><br>Open Cursors <b>42</b><br>Program <b>sqlplus@EDRSR9P1 (TNS V1-V3)</b><br>Service <b>SYS\$USERS</b><br>Current Module <b>SQL*Plus</b><br>Current Action <b>Unavailable</b> |

## Solutions for Practice 13: Performance Management (continued)

- 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

| Statistics                                                | Activity     | Plan                                       | Tuning Information   |                            |            |          |          |
|-----------------------------------------------------------|--------------|--------------------------------------------|----------------------|----------------------------|------------|----------|----------|
| Data Source                                               | Cursor Cache | Capture Time<br>Oct 28, 2005<br>1:52:40 PM | Parsing Schema<br>HR | Optimizer Mode<br>ALL_ROWS |            |          |          |
| <a href="#">Expand All</a>   <a href="#">Collapse All</a> |              |                                            |                      |                            |            |          |          |
| Operation                                                 | Object       | Object Type                                | Order Rows           | Size (KB)                  | Cost (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.
- Select **Administration** > Schema > Database Objects > **Indexes**.
  - Select Table Name as the **Search By** value.
  - Enter HR as **Schema Name**.
  - Enter employees for **Object Name**.
  - Click **Go**, and the list of six indexes appears.
  - Click the index named EMP\_EMP\_ID\_PK.
  - Click the index link and note that the status of the index is UNUSABLE.

## Solutions for Practice 13: Performance Management (continued)

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.
- 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';
```

- See that the output lists six indexes, all on the EMPLOYEES table.

| 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.
- In Enterprise Manager, on the page displaying the EMP\_EMP\_ID\_PK index, select **Reorganize** in the **Actions** list, and then click **Go**.
  - Click **Add**, to add each of the other five indexes to the reorganization operation.
  - In the Add screen, choose Indexes for the **Type** drop-down list, and enter hr in the **Schema** field.
  - Click **Search**.

## Solutions for Practice 13: Performance Management (continued)

- e) Select the five other indexes whose names start with “EMP\_.”

**Search**

Type: Indexes  
Schema: hr  
Object Name:  
Partition Name:  
Tablespace:

Search

**Available Objects: Indexes**

Select All | Select None

| Select                              | Name                       |
|-------------------------------------|----------------------------|
| <input type="checkbox"/>            | HR.DEPT_ID_PK              |
| <input type="checkbox"/>            | HR.DEPT_LOCATION_IX        |
| <input checked="" type="checkbox"/> | HR.EMP_DEPARTMENT_IX       |
| <input checked="" type="checkbox"/> | HR.EMP_EMAIL_UK            |
| <input checked="" type="checkbox"/> | HR.EMP_JOB_IX              |
| <input checked="" type="checkbox"/> | HR.EMP_MANAGER_IX          |
| <input checked="" type="checkbox"/> | HR.EMP_NAME_IX             |
| <input type="checkbox"/>            | HR.JHIST_DEPARTMENT_IX     |
| <input type="checkbox"/>            | HR.JHIST_EMPLOYEE_IX       |
| <input type="checkbox"/>            | HR.JHIST_EMP_ID_ST_DATE_PK |

- 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**.

## Solutions for Practice 13: Performance Management (continued)

- 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<br>GMT-07:00 | Type  | Reorganize |
| Targets     | orcl.oracle.com                      | 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<br>GMT-07:00 | Oct 28, 2005 2:03:45 PM<br>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<br>(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.

## Solutions for 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. Please note the SID value for task 10.

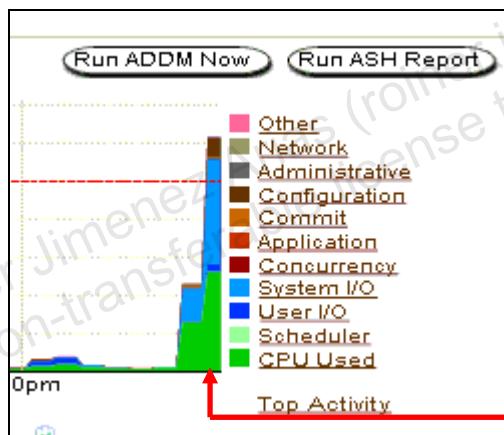
*Possible answer:* 147 (Your answer is most likely a different one).

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.



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 main categories that active sessions are waiting for?

*Answer:* System I/O and CPU Used. Depending on your operating system the graph may also show Concurrency.

## Solutions for Practice 13: Performance Management (continued)

*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:

- [log file switch completion](#)
- [log file switch \(checkpoint incomplete\)](#)
- [log buffer space](#)

*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**.

| Detail for Selected 5 Minute Interval |          |                                                                                            |                    |      |                              |            |                 |
|---------------------------------------|----------|--------------------------------------------------------------------------------------------|--------------------|------|------------------------------|------------|-----------------|
| Start Time Nov 2, 2005 4:33:50 PM     |          | Activity (%)                                                                               | SID                | User | Program                      | Service    | Plan Hash Value |
|                                       |          |  100.00 | 131                | DBA1 | sqlplus@EDRSR4P1 (TNS V1-V3) | SYS\$USERS | 2494303166      |
| Statistics                            | Activity | Plan                                                                                       | Tuning Information |      |                              |            |                 |

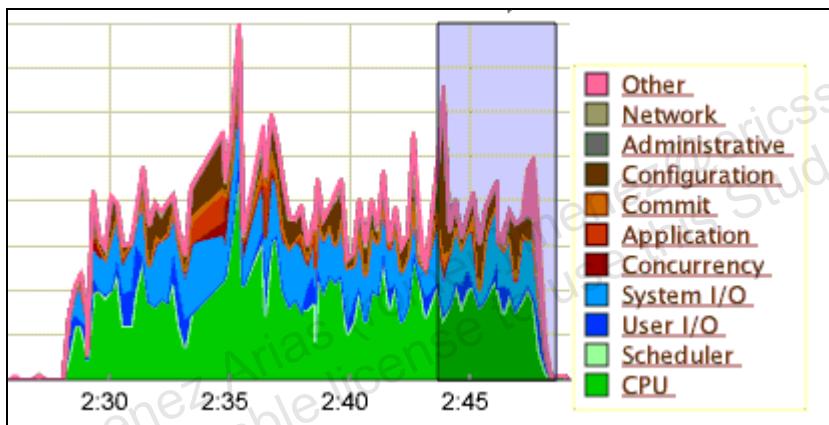
## Solutions for Practice 13: Performance Management (continued)

- 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.



## 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**.

The screenshot shows the 'Control Files' section of the Oracle Enterprise Manager interface. At the top, there are tabs for 'General', 'Advanced', and 'Record Section'. A 'Backup To Trace' button is located in the top right corner. Below these, a section titled 'Control File Mirror Images' contains a note about Oracle's recommendation for having two control files on separate disks. A table lists the two control files with their file names and directory paths. At the bottom, there are again tabs for 'General', 'Advanced', and 'Record Section'.

| Valid | File Name            | File Directory                                        |
|-------|----------------------|-------------------------------------------------------|
| VALID | o1_mf_1p4sbn1o_.ctl  | /u01/app/oracle/oradata/ORCL/controlfile/             |
| VALID | o1_mf_1p4sbnncs_.ctl | /u01/app/oracle/flash_recovery_area/ORCL/controlfile/ |

- 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?

## Solutions for Practice 14: Backup and Recovery Concepts (continued)

- 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.

| Select                              | Group | Status   | # of Members | Archived | Size (KB) | Sequence | First Change# |
|-------------------------------------|-------|----------|--------------|----------|-----------|----------|---------------|
| <input checked="" type="checkbox"/> | 1     | Inactive | 2            | No       | 51200     | 26       | 1408043       |
| <input checked="" type="checkbox"/> | 2     | Inactive | 2            | No       | 51200     | 27       | 1424729       |
| <input checked="" type="checkbox"/> | 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.

| Select                              | File Name             | File Directory                                      |
|-------------------------------------|-----------------------|-----------------------------------------------------|
| <input checked="" type="checkbox"/> | o1_mf_1_1p4sbq1m_.log | /u01/app/oracle/oradata/ORCL/onlinelog/             |
| <input checked="" type="checkbox"/> | 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.

## Solutions for Practice 14: Backup and Recovery Concepts (continued)

- 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.

### Media Recovery

The database is currently in NOARCHIVELOG mode. In ARCHIVELOG mode, hot backups and recovery to the latest time is possible, but you must provide space for logs. If you change the database to ARCHIVELOG mode, you should make a backup immediately. In NOARCHIVELOG mode, you can make only cold backups and data may be lost in the event of database corruption.

ARCHIVELOG Mode\*

Log Archive Filename Format\* %t\_%s\_%r.dbf

The naming convention for the archived log files. %s: log sequence number; %t: thread number; %S and %T: padding the filename to the left with zeroes.

| Number | Archive Log Destination   | Quota (512B) | Status | Type  |
|--------|---------------------------|--------------|--------|-------|
| 1      | /u01/app/oracle/archive/  |              |        | Local |
| 2      | Archive Log Destination   |              |        | Local |
| 3      |                           |              |        | Local |
| 4      |                           |              |        | Local |
| 5      |                           |              |        | Local |
| 6      |                           |              |        | Local |
| 7      |                           |              |        | Local |
| 8      |                           |              |        | Local |
| 9      |                           |              |        | Local |
| 10     | USE_DB_RECOVERY_FILE_DEST | n/a          | VALID  | Local |

**TIP** It is recommended that archive log files be written to multiple locations spread across the different disks.

**TIP** You can specify up to 10 archive log destinations.

### Flash Recovery Area

It is highly recommended that you use flash recovery area to automate your disk backup management.

Flash Recovery Area Location /u01/app/oracle/flash\_recovery\_area

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).

## Solutions for Practice 14: Backup and Recovery Concepts (continued)

- 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.

## 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.

- 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.

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

- 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.

The screenshot shows the 'Backup Settings' page in Oracle Enterprise Manager. The 'Device' tab is selected, showing the 'Disk Settings' section. Under 'Disk Settings', there is a 'Parallelism' input field set to '1'. Below it is a 'Concurrent streams to disk drives' link. The 'Disk Backup Location' input field is set to 'Flash recovery area'. A note below the field states: 'Flash recovery area is your current the disk backup location. If you would like to override the disk backup location, specify an existing directory or diskgroup name.' An arrow points to the 'Test Disk Backup' button, which is highlighted with a yellow oval.

- Test making a backup to disk, as a backup set, with `oracle` for Host Credentials.
  - Select **Backup Set** as your Disk Backup Type.
  - Scroll to the bottom and enter `oracle` and `oracle` for **Host Credentials Username** and **Password** for your server.
  - Click **Test Disk Backup**.
  - When the test finishes, click **OK**.

## Solutions for Practice 15: Performing Database Backups (continued)

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.

- Select **Maintenance > High Availability > Backup/Recovery > Schedule Backup**.
- Select **Whole Database** as the object to be backed up.
- Enter **oracle** and **oracle** for **Host Credentials Username and Password** for your server.

The screenshot shows the Oracle Database 10g Control Panel interface. On the left, there's a sidebar with a tree view of the database structure. The main area has two tabs: 'Customized Backup' (selected) and 'Host Credentials'. The 'Customized Backup' tab shows options for selecting objects to back up (Whole Database, Tablespaces, Datafiles, Archivelogs, All Recovery Files on Disk), with a note about including archivelogs and disk backups. The 'Host Credentials' tab shows fields for entering a username ('oracle') and password ('\*\*\*\*\*'), with a checkbox to save it as a preferred credential.

**Customized Backup**

Select the object(s) you want to back up.

**Schedule Customized Backup**

Customized:

- Specify the objects to back up
- Choose a destination
- Override the settings
- Schedule the backup

**Host Credentials**

To perform a backup, supply operating system login credentials to access the target database.

\* Username

\* Password

Save as Preferred Credential

- Click **Schedule Customized Backup**.
- Select **Full Backup** for your Backup Type, and select the **Use as the base of an incremental backup strategy** check box.
- Select **Online Backup** as Backup Mode.
- In the **Advanced** region, deselect the **Also backup all archived logs on disk** check box, and then click **Next** to continue.

## Solutions for Practice 15: Performing Database Backups (continued)

- 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.

**Job**

|                 |                           |
|-----------------|---------------------------|
| * Job Name      | BACKUP_ORCL.ORACLE.COM_01 |
| Job Description | Whole Database Backup     |

**Schedule**

Time Zone

**Start**

Immediately

Later

Date

(example: Jun 9, 2005)

Time    AM  PM

**Repeat**

One Time Only

Interval

Frequency  Minutes

Monthly

Yearly

**Repeat Until**

Indefinite

Custom

Date

(example: Jun 9, 2005)

Time    AM  PM

(Ignored except when repeating by minutes or hours.)

- j) Click **Submit Job** to perform the online database backup.

## Solutions for Practice 15: Performing Database Backups (continued)

- 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        | <b>Running</b>                | Type                  | <b>Database Backup</b>                                |
| Scheduled     | <b>Jun 9, 2005 4:34:35 AM</b> | Owner                 | <b>SYS</b>                                            |
|               | <b>GMT-07:00</b>              | Description           | <b>Whole Database Backup</b>                          |
| Started       | <b>Jun 9, 2005 4:34:37 AM</b> | Host Username         | <b>oracle</b>                                         |
|               | <b>GMT-07:00</b>              | Database              | <a href="#">(DESCRIPTION=(ADDRESS_LIST=(ADDR...))</a> |
| Start Delayed | <b>2 seconds</b>              | Connect String        | <b>SYS</b>                                            |
| Elapsed Time  | <b>16 seconds</b>             | Database              | <b>[SYSDBA]</b>                                       |
|               |                               | Username              | <a href="#">[yu01/app/oracle/product/10.2.0/...]</a>  |
|               |                               | Database Role         | <b>[orcl]</b>                                         |
|               |                               | Oracle Home           | <b>YES</b>                                            |
|               |                               | Oracle SID            | <b>advanced</b>                                       |
|               |                               | Version 10g or higher | <b>NO</b>                                             |
|               |                               | Backup Strategy       | <b>NO</b>                                             |
|               |                               | Offline Backup        | <b>NO</b>                                             |
|               |                               | Blackout              | <b>ORCL</b>                                           |
|               |                               | Database Name         | <a href="#">Show</a>                                  |
|               |                               | Backup Script         |                                                       |

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.

## Solutions for Practice 15: Performing Database Backups (continued)

- 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**.

**Schedule Customized Backup: Schedule**

Database **orcl.oracle.com**  
 Backup Strategy **Customized Backup**  
 Object Type **Whole Database**

**Job**

\* Job Name **Nightly\_Backup**  
 Job Description **Whole Database Backup**

**Schedule**

Time Zone **GMT -7:00**

**Start**

Immediately  
 Later

Date **Jun 9, 2005**  
(example: Jun 9, 2005)

Time **11** **00** **AM** **PM**

**Repeat**

One Time Only  
 Interval

Frequency **1** **Days**

Monthly  
 Yearly

**Repeat Until**

Indefinite  
 Custom

Date **Jun 9, 2005**  
(example: Jun 9, 2005)

Time **3** **55** **AM** **PM**  
(Ignored except when repeating by minutes or hours.)

- 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.

## 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.

- 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
```

- Now run the lab\_16\_01\_b.sql script. This script deletes one of your control files.

```
@$HOME/labs/lab_16_01_b.sql
```

- 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**.

## Solutions for Practice 16: Performing Database Recovery (continued)

- 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...
```

## Solutions for Practice 16: Performing Database Recovery (continued)

- 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_1p4sbn1o_.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.

## 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.

**Note:** Depending on your operating system, the output may not include the last three lines as shown below. This is not important for the flow of the practice.

```
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**.

Solutions for Practice 16: Performing Database Recovery (continued)

- On the Datafiles page, select the data file in question.

| Select                              | Datafile Name                                                     | Datafile Number | Status | Enabled    |
|-------------------------------------|-------------------------------------------------------------------|-----------------|--------|------------|
| <input checked="" type="checkbox"/> | /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 <input type="text"/>                                                                                                                                                                                                  |                                                                   |            |        |           |           |                                                                     |
| <input type="button" value="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.                                                           |                                                                   |            |        |           |           |                                                                     |
| <input type="button" value="Create"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> Actions <input type="button" value="Like"/> <input type="button" value="Go"/> |                                                                   |            |        |           |           |                                                                     |
| Select                                                                                                                                                                                                                            | File Name                                                         | Tablespace | Status | Size (MB) | Used (MB) | Used (%)                                                            |
| <input checked="" type="radio"/>                                                                                                                                                                                                  | /u01/app/oracle/oradata/ORCL/datafile/inventory01.dbf             | INVENTORY  | ONLINE | 50.000    | 42.188    | <div style="width: 84.38%; background-color: #0070C0;"></div> 84.38 |
| <input checked="" type="radio"/>                                                                                                                                                                                                  | /u01/app/oracle/oradata/ORCL/datafile/o1_mf_example_1pbkt0j1_.dbf | EXAMPLE    | ONLINE | 100.000   | 68.250    | <div style="width: 68.25%; background-color: #00B050;"></div> 68.25 |
| <input checked="" type="radio"/>                                                                                                                                                                                                  | /u01/app/oracle/oradata/ORCL/datafile/o1_mf_sysaux_1p4s741n_.dbf  | SYSAUX     | ONLINE | 270.000   | 264.812   | <div style="width: 98.08%; background-color: #00A050;"></div> 98.08 |
| <input checked="" type="radio"/>                                                                                                                                                                                                  | /u01/app/oracle/oradata/ORCL/datafile/o1_mf_system_1p4s740z_.dbf  | SYSTEM     | SYSTEM | 490.000   | 480.688   | <div style="width: 98.0%; background-color: #0070C0;"></div> 98.0%  |

- f) Verify that the COUNTRIES table is now accessible.

```
SQL> select count(*) from HR.COUNTRIES;
```

COUNT( \* )

25

## Solutions for Practice 16: Performing Database Recovery (continued)

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

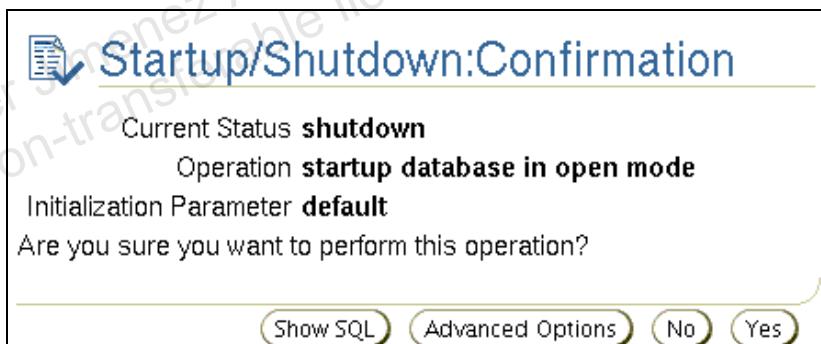
- a) Why is recovery from the loss of a system data file or a data file belonging to an undo tablespace different from recovering an application data file?

*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**.

## Solutions for Practice 16: Performing Database Recovery (continued)

- 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 (db1/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.

## 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
```

## Solutions for Practice 17: Performing Flashback (continued)

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.

**Perform Recovery**

**Whole Database Recovery**

Recover to the current time or a previous point-in-time  
Datafiles will be restored from the latest usable backup as required.

Restore all datafiles  
Specify Time, SCN or log sequence. The backup taken at or prior to that time will be used. No recovery will be performed in this operation.

Recover from previously restored datafiles

**Object Level Recovery**

Object Type

Operation Type  Flashback Existing Tables  
 Flashback Dropped Tables

**Host Credentials**

To perform recovery, supply operating system login credentials to access the target database.

\* Username   
\* Password   
 Save as Preferred Credential

- 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.

## Solutions for Practice 17: Performing Flashback (continued)

- 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.

**Step 1. Choose Columns**

**Available Columns**

|                 |
|-----------------|
| DEPARTMENT_NAME |
| MANAGER_ID      |
| LOCATION_ID     |

**Selected Columns**

|               |
|---------------|
| DEPARTMENT_ID |
|---------------|

Move  
Move All  
Remove  
Remove All

**Step 2. Bind The Row Value**

Specify a where clause based on the columns selected above to narrow the search

```
where department_id >= 280
```

- 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 flashback. Click **Next** to continue.

## Solutions for Practice 17: Performing Flashback (continued)

- 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.

**Perform Object Level Recovery: Flashback Tables**

|                |                              |
|----------------|------------------------------|
| Object Type    | Tables                       |
| Operation Type | Flashback<br>Existing Tables |

Cancel Back Step 4 of 7 Next

Your application may have tables that are logically related to this table. Specify all such tables that must be flashed back to the SCN you selected.

|                      |                      |
|----------------------|----------------------|
| Evaluated Table Name | hr.departments2      |
| Flashback Time       | Jun 9, 2005 05:15 PM |
| Flashback SCN        | 6800061              |

HR.DEPARTMENTS2

- 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:

**Error**

Examine and correct the following errors then re-try the operation:

**Error** - ORA-08189: cannot flashback the table because row movement is not enabled

- 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**.

## Solutions for Practice 17: Performing Flashback (continued)

- d) One table is displayed in the **Results** region and is selected by default. Click **Edit**.

The screenshot shows the Oracle Database Edit Table interface. At the top, there is a toolbar with buttons for Selection Mode (set to Single), Create, Edit, View, Delete With Options, Actions, Create Like, and Go. Below the toolbar is a table header row with columns: Select, Schema, Table Name, Tablespace, Partitioned, Rows, and Last Analyzed. A single row is selected in the table, showing the schema as HR, table name as DEPARTMENTS2, tablespace as USERS, and partitioned status as NO.

The Edit Table page appears.

- e) Click the **Options** tab.  
f) From the **Enable Row Movement** drop-down list, select **Yes**.

The screenshot shows the Options tab of the Edit Table page. The Enable Row Movement dropdown is set to Yes. There are two configuration options below it: Parallel (with sub-options Parallel Degree set to Default) and Cache. At the bottom of the tab, there are several tabs: General, Constraints, Segments, Storage, Options (which is selected), Statistics, and 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.

The screenshot shows a Confirmation dialog box. It features a blue icon of a document with a checkmark, followed by the word "Confirmation". Below the icon, a message states: "The selected tables, HR.DEPARTMENTS2, have been flashed back."

## 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>
```

## 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**

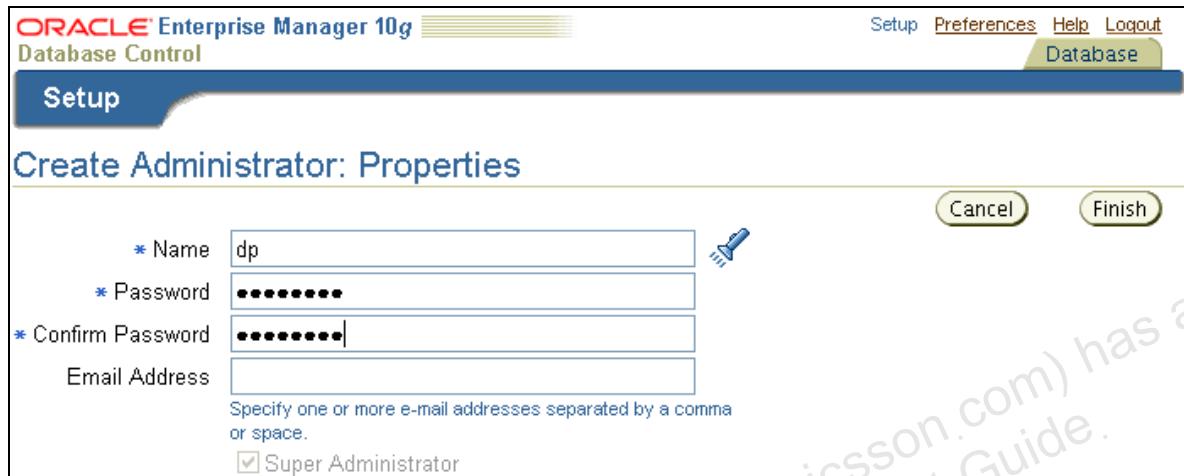
- c) Which additional step do you need to perform to allow the DP user access to Enterprise Manager as Administrator?

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”).

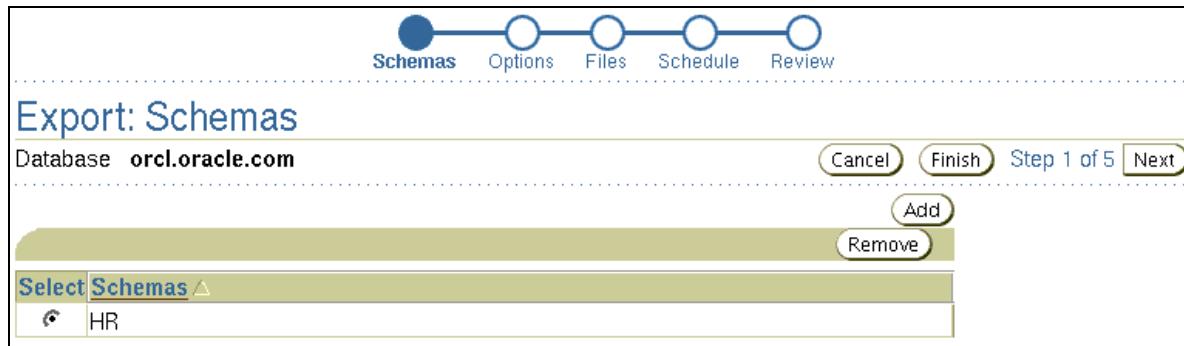
- d) Close the lab\_18\_01.sql window.
2. Execute the lab\_18\_02.sh script. Then, perform the required step to make the DP user an EM administrator.
  - a) Right-click your desktop and select **Open Terminal**. Then navigate to the /home/oracle/labs directory by entering **cd labs**.
  - b) Enter **./lab\_18\_02.sh** 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.

## Solutions for Practice 18: Moving Data (continued)

- 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.)



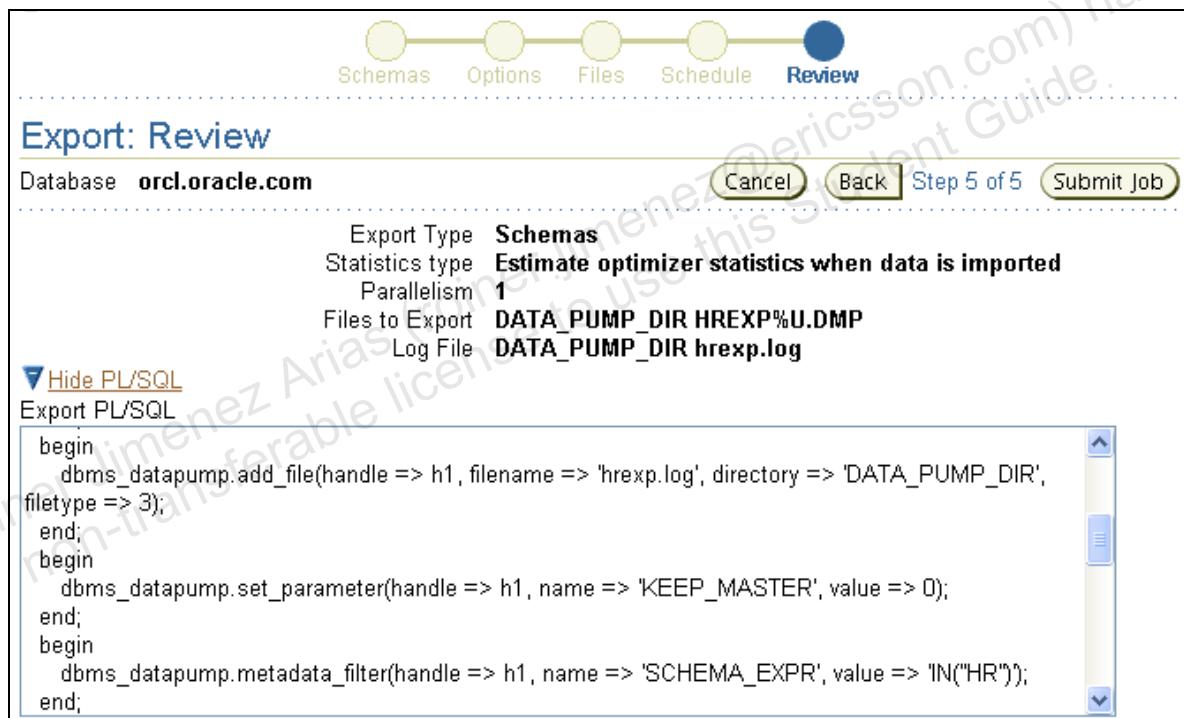
3. Log in to Enterprise Manager as the DP user in the Normal role and export the HR schema.
- Invoke Enterprise Manager as the DP user in the Normal role for your ORCL database. The **Connect As** setting should be Normal.  
If this is the first time that the DP user logs in, click **I agree** to accept the licensing agreement.
  - Select **Maintenance** > **Data Movement** > **Move Row Data** > **Export to Export Files**.
  - Select **Schemas**, enter **oracle** as **Username** and **Password**, select **Save as Preferred Credential**, and then click **Continue**.
  - On the Export: Schemas page, click **Add**, select the HR schema, and then click the **Select** button.



- Click **Next**.

## Solutions for Practice 18: Moving Data (continued)

- 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.

## Solutions for Practice 18: Moving Data (continued)

- Invoke Enterprise Manager as the DP user in the Normal role for your ORCL database.
- Select **Maintenance > Data Movement > Move Row Data > Import from Export Files.**
- On the Import: Files page, select DATA\_PUMP\_DIR from the **Directory Object** drop-down list, and enter **HREXP%U.DMP** as **File Name**.
- Select **Schemas** as the Import Type.
- 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.

- On the Import: Schemas page, click **Add**, select HR, and then click **Select**.
- Click **Next**.
- On the Import: Re-Mapping page, click **Add Another Row** under **Re-Map Schemas**. Then select **HR\_TEST** as **Destination Schema**.
- Click **Add Another Row** under **Re-Map Tablespaces**, enter **HR\_TEST** as **Destination Tablespace**.

**Import: Re-Mapping**

Database **orcl.oracle.com**

**Re-Map Schemas**  
You can import data that was in one schema into a different schema.

| Select                           | Source Schema | Destination Schema |
|----------------------------------|---------------|--------------------|
| <input checked="" type="radio"/> | HR            | HR_TEST            |

**Re-Map Tablespaces**  
You can import data that was in one tablespace into a different tablespace.

| Select                           | Source Tablespace | Destination Tablespace |
|----------------------------------|-------------------|------------------------|
| <input checked="" type="radio"/> | hr                | hr_test                |

- Click **Next**.

## Solutions for Practice 18: Moving Data (continued)

- 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.

**Monitor Data Pump Job**

Page Refreshed Jun 10, 2005 5:25:06 PM **OK**

|                                         |                                                   |
|-----------------------------------------|---------------------------------------------------|
| Job Name                                | <b>IMPORT000024</b>                               |
| Job Status                              | <b>EXECUTING</b> <a href="#">Change Job State</a> |
| Percent Done                            | <b>0</b>                                          |
| Percent done is for table data only.    |                                                   |
| Non-fatal Error Count                   | <b>0</b>                                          |
| Log File                                |                                                   |
| Maximum Number of Threads in Export Job | <b>1</b> <a href="#">Change Parallelism</a>       |

**Objects Currently Being Imported**

The number of rows in this table corresponds to the degree of parallelism.

| Name | Type | Percent Done |
|------|------|--------------|
|      |      | 0            |

**Import Files**

| File Name                                                 | Maximum File Size (MB) | Used (MB) | Used (%) |
|-----------------------------------------------------------|------------------------|-----------|----------|
| /u01/app/oracle/product/10.2.0/db_1/rdbms/log/HREXP01.DMP | Auto Extend            | 0         | 0.0      |

## Solutions for Practice 18: Moving Data (continued)

- *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.

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

Job Name: IMPORT000024  
Job Status: COMPLETING  
Percent Done: 100  
Percent done is for table data only.  
Non-fatal Error Count: 0  
Log File: /u01/app/oracle/product/10.2.0/db\_1/rdbms/log/HREXP01.DMP  
Maximum Number of Threads in Export Job: 1

Page Refreshed Jun 10, 2005 5:26:05 PM **OK**

| Name | Type | Percent Done |
|------|------|--------------|
|      |      | 0            |

**Objects Currently Being Imported**  
The number of rows in this table corresponds to the degree of parallelism.

| File Name                                                 | Maximum File Size (MB) | Used (MB) | Used (%) |
|-----------------------------------------------------------|------------------------|-----------|----------|
| /u01/app/oracle/product/10.2.0/db_1/rdbms/log/HREXP01.DMP | Auto Extend            | 0         | 0.0      |

File Percent used is for table data only.

- Click **OK**.
- 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.

- Using SQL\*Plus, connect to the database as the HR\_TEST user.

```
$ sqlplus hr_test/hr_4test
```

- Select data from tables in the hr\_test schema, for verification of the import.

```
SQL> select * from jobs;
```

## 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**.

## Solutions for Practice 18: Moving Data (continued)

- 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**.

**Load Data: Schedule**

Database **orcl**

Specify a name and description for the load data job. Specify a date to start the job.

**Job Parameters**

|             |                                     |
|-------------|-------------------------------------|
| Job Name    | lab_18_05                           |
| Description | Load data into PRODUCT_MASTER table |

**Job Schedule**

**Start**

Immediately  
 Later

Date    
(example: Aug 2, 2005)

Time      AM  PM

**Cancel** **Back** **Step 5 of 6** **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.
- Invoke a terminal window and navigate to the **/home/oracle/labs** directory.
  - 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

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Commit point reached - logical record count 64
Commit point reached - logical record count 82
Commit point reached - logical record count 83
```

## 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.

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 occurrences 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.  
dnd (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.

## 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><br>man -k <string><br>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<br>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.                                                                          |

|                               |                                                               |                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Process List                  | <code>ps</code><br><code>ps -ef</code>                        | Shows the processes report<br>Shows all processes on the system with a full listing. Many option exist see the man page for details.                                                                                                                                                                                                             |
| Print working directory       | <code>pwd</code>                                              | Print to stdout the current working directory.                                                                                                                                                                                                                                                                                                   |
| Remove or erase a file        | <code>rm &lt;file&gt;</code>                                  | Removing a file on Linux is permanent. Options <code>-r</code> recursive, and <code>-f</code> force (including subdirectories) are <i>very dangerous</i> . Often the <code>rm</code> command is aliased with <code>rm -i</code> . The option <code>-i</code> asks ‘Are you sure?’                                                                |
| Create an empty file          | <code>touch &lt;file&gt;</code>                               | Create a file.                                                                                                                                                                                                                                                                                                                                   |
| Name of the machine           | <code>hostname</code>                                         | Returns the name of the machine.                                                                                                                                                                                                                                                                                                                 |
| The IP address of the machine | <code>host &lt;machine_name&gt;</code>                        | Queries the Domain Name Server, and returns the IP address of the machine name.                                                                                                                                                                                                                                                                  |
| Remote shell                  | <code>rsh &lt;host&gt; &lt;command&gt;</code>                 | Execute a <code>&lt;command&gt;</code> on <code>&lt;host&gt;</code> . Rsh is not secure, use ssh instead.                                                                                                                                                                                                                                        |
| Remote shell                  | <code>ssh &lt;host&gt;</code>                                 | Secure shell, has features to replace rsh, rcp, ftp, and telnet.                                                                                                                                                                                                                                                                                 |
| Remote shell                  | <code>telnet &lt;host&gt;</code>                              | Start a terminal session on <code>&lt;host&gt;</code> . Telnet is not secure use ssh instead.                                                                                                                                                                                                                                                    |
| Search a file for a pattern   | <code>grep &lt;option&gt; &lt;pattern&gt; &lt;file&gt;</code> | Search a <code>&lt;file&gt;</code> or stream for a regular expression defined by <code>&lt;pattern&gt;</code> and show the line that contains that pattern. A common option is <code>-i</code> for case insensitive. grep can accept input from a file or <code>stdin</code> through a pipe as in:<br><code>netstat -a   grep ESTABLISHED</code> |
| Source a script               | <code>. &lt;script_file&gt;</code>                            | 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.                                                                                                                                                                                                             |

|                           |                                                  |                                                                                                                                                                |
|---------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| An interpreter            | <code>awk</code>                                 | 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 awk – for “new awk.” |
| Sort a file               | <code>sort</code>                                | 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       | <code>sed</code>                                 | Sed is a command line editor, with many possible commands and options that are very good for editing from a shell script.                                      |
| Visual editor             | <code>vi &lt;file&gt;</code>                     | Terminal based editor available on every Unix system, Linux provides vim, an improved vi, that is a superset of vi.                                            |
| Gnu editor                | <code>emacs &lt;file&gt;</code>                  | This is a GPL editor with extensive customizable features available on most UNIX and Linux distributions.                                                      |
| WSIWIG editor             | <code>gedit &lt;file&gt;</code>                  | A full-screen editor, requiring X. Available under Gnome.                                                                                                      |
| WSIWIG                    | <code>kate &lt;file&gt;</code>                   | A full-screen editor, requires X. Available under KDE                                                                                                          |
| Terminal output           | <code>stdout</code>                              | Standard out (stdout), is not a command but a concept, most Linux commands write to stdout by default unless redirected.                                       |
| Terminal input (keyboard) | <code>stdin</code>                               | Standard in (stdin), is not a command but a concept, most Linux commands read from stdin by default unless redirected.                                         |
| Alias                     | <code>alias &lt;command&gt; &lt;alias&gt;</code> | 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      | <code>set</code>                                 | Prints all of the variables that are currently defined in the shell.                                                                                           |

|                            |                                                           |                                                                                                                                                                           |
|----------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Show environment variables | <code>printenv</code> or <code>env</code>                 | Prints all the environment variables – an environment variable has been ‘exported’ so that it will be inherited by child processes.                                       |
| File Creation mask         | <code>umask -S u=rwx,g=rx,o=rx</code>                     | Set the default permissions for all files created by this shell or its children. The <code>-S</code> option uses the symbolic notation, the numeric notation is obsolete. |
| Clock                      | <code>xclock</code>                                       | An X client that shows a clock on the screen. Often used to test the X windows system.                                                                                    |
| X access control           | <code>xhost</code><br><code>xhost +&lt;Xclient&gt;</code> | Show the current access control in place.<br>Add a Xclient that is allowed to access the local DISPLAY, if no <code>&lt;Xclient&gt;</code> is given all are allowed.      |

| <b>System Administration</b> | <b>Linux Commands</b>      | <b>Description / Comments</b>                                                                                                                                                                                           |
|------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 not put 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<br>/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.                                                                   |

|                                                         |                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Schedule a command to run at a regularly scheduled time | <code>crontab -e</code>                                                                                                                                 | Use this command to edit the <code>crontab</code> file, to create the specification for the <code>cron</code> daemon to use.                                                                                                                                                                                                                           |
| Schedule a script to run at a particular frequency      | <code>/etc/anacrontab</code>                                                                                                                            | Edit the file to specify a script to run at a particular frequency (see <code>man anacrontab</code> for details).                                                                                                                                                                                                                                      |
| Schedule a command to run at a single specified time    | <code>at &lt;options&gt; TIME</code>                                                                                                                    | Runs a job specified by <code>&lt;options&gt;</code> at a specified <code>TIME</code> parameter.                                                                                                                                                                                                                                                       |
| Schedule a command                                      | <code>batch &lt;options&gt; &lt;TIME&gt;</code>                                                                                                         | Run a command when the load average drops below .8, optionally after a set <code>TIME</code> .                                                                                                                                                                                                                                                         |
| Mount a file system                                     | <code>mount &lt;opt&gt; &lt;dev&gt; &lt;mount_point&gt;</code>                                                                                          | Mount a file system on device <code>&lt;dev&gt;</code> at <code>&lt;mount_point&gt;</code> with the options specified by <code>&lt;dev&gt;</code> .                                                                                                                                                                                                    |
| Unmount a file system                                   | <code>umount &lt;dev&gt;</code><br><code>umount &lt;mount_point&gt;</code>                                                                              | Unmount the file system or device.                                                                                                                                                                                                                                                                                                                     |
| Maximum # of user ID                                    | 65535                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                        |
| Recover root password                                   | <pre>{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</pre> | <p>This is a procedure to recover the root password if it 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.</p> <p>The second procedure uses the grub boot loader.</p> |
| Create new user                                         | <code>useradd</code>                                                                                                                                    | <p>The <code>-D</code> option alone shows the defaults.</p> <p><code>-D</code> with other options changes the defaults options; without <code>-D</code> override, the default (e.g., <code>-g</code>) sets a primary group.</p>                                                                                                                        |

|                           |                                                  |                                                                                                                                                                                                                                                                                                              |
|---------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delete user               | <code>userdel</code>                             | Remove a user and optionally all files belonging to the user.                                                                                                                                                                                                                                                |
| Modify user account       | <code>usermod</code>                             | Change <code>/etc/password</code> information.                                                                                                                                                                                                                                                               |
| Create new group          | <code>groupadd</code>                            | <code>-g</code> sets the group id; default is first free value above 500.                                                                                                                                                                                                                                    |
| Delete group              | <code>groupdel</code>                            | 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 <code>chown</code> .                                                                                                                                   |
| Change run levels         | <code>init &lt;runlevel&gt;</code>               | The <code>init</code> command causes the <code>rcN.d</code> scripts to be evaluated, for the change in run level. <code>init 6</code> forces a reboot.                                                                                                                                                       |
| Synchronize the disks     | <code>sync</code>                                | 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 | <code>shutdown &lt;mode&gt; &lt;delay&gt;</code> | Do a graceful shutdown of the system, shut down processes, run all shutdown scripts, and sync disks. The modes are <code>-r</code> , reboot and <code>-h</code> , halt. The delay is a required parameter is a number in seconds or ‘now’. Option <code>shutdown</code> warning message may be sent as well. |
| Error logs                | <code>dmesg</code>                               | View boot messages. This log is circular, and limited system errors could overwrite boot information after a time.                                                                                                                                                                                           |
| Network IP configuration  | <code>/etc/sysconfig/network-scripts/</code>     | This directory holds scripts executed as part of the boot up sequence by <code>rc.sysinit</code> .                                                                                                                                                                                                           |
| Hosts IP addresses        | <code>/etc/hosts</code>                          | 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       | <code>/etc/nsswitch.conf</code>                  |                                                                                                                                                                                                                                                                                                              |

|                           |                                                                   |                                                                                                                                   |
|---------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Network parameters        | <code>sysctl -a   grep net</code>                                 | View all net parameters that are set for the kernel.                                                                              |
| Routing daemon            | <code>routed</code>                                               |                                                                                                                                   |
| NIC Configurations        | <code>ifconfig -a</code>                                          | Show all the network devices currently configured.                                                                                |
| Secondary IP Address      | <code>modprobe ip_alias</code><br><code>ifconfig eth0:1 IP</code> |                                                                                                                                   |
| Login prompt              | <code>/etc/issue</code>                                           | Banner message user sees when issued the login prompt.                                                                            |
| YP/NIS service binder     | <code>/sbin/ypbind</code>                                         | Finds and attaches to a NIS server for name resolution and other services.                                                        |
| Module information        | <code>modinfo &lt;options&gt; &lt;module&gt;</code>               | Display information about kernel modules: <code>-l</code> shows license, <code>-p</code> parameters, <code>-d</code> description. |
| List modules              | <code>lsmod</code>                                                | Show currently loaded modules.                                                                                                    |
| Load module               | <code>insmod</code>                                               | Load a loadable module.                                                                                                           |
| Unload module             | <code>rmmmod</code>                                               | Unload a loadable module.                                                                                                         |
| Install Software          | <code>rpm -ivh package</code>                                     | Install <code>-i</code> , verbose <code>-v</code> , with progress hash marks <code>-h</code> .                                    |
| Uninstall software        | <code>rpm -e package</code>                                       | Erase package <code>-e</code> ; will not uninstall if dependencies exist.                                                         |
| List installed software   | <code>rpm -qa</code>                                              | Query <code>-q</code> , All <code>-a</code> , lists all installed packages.                                                       |
| Verify installed software | <code>rpm -V package</code>                                       | Compares installed files with the rpm database information.                                                                       |
| List all files            | <code>rpm -ql package</code>                                      | List all the files that are part of a package.                                                                                    |
| Package owner             | <code>rpm -qf file</code>                                         | List the package when given the full file name.                                                                                   |
| Machine model             | <code>uname -m</code>                                             | Shows CPU level (e.g., i686).                                                                                                     |
| OS Level                  | <code>uname -r</code>                                             | Shows kernel version.                                                                                                             |
| Run Level                 | <code>runlevel</code>                                             | Shows previous and current runlevel.                                                                                              |
| Kernel Parameters         | <code>sysctl -a</code>                                            | Show settings of all settable kernel parameters.                                                                                  |
| Max # File Descriptors    | <code>sysctl fs.file-max</code>                                   | Shows the value of maximum number of file descriptor per process.                                                                 |

|                                                           |                                          |                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>. <i>This is very dangerous.</i> You can corrupt a database that is using the segment that is released.                                                                                                                          |

| <b>System Performance</b> | <b>Linux Commands</b>              | <b>Description / Comments</b>                                                                                                                                                                                               |
|---------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 <i>all</i> 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. |

|                                    |                                                                                          |                                                                             |
|------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Display swap size                  | <code>free</code>                                                                        | Show the current memory and swap usage.                                     |
| Activate Swap                      | <code>swapon -a</code>                                                                   | Turn on swap.                                                               |
| Free disk blocks                   | <code>df -k</code>                                                                       | Measured in KB; use <code>-m</code> for MB units.                           |
| Device listing                     | <code>cat /proc/devices</code>                                                           | List devices known to the system by major and minor number.                 |
| Disk information                   | <code>cat /proc/scsi/scsi0/sda/model</code><br><code>cat /proc/ide/ide0/hda/model</code> | View SCSI disk information.<br>View IDE disk information.                   |
| Print network statistics           | <code>netstat &lt;options&gt;</code>                                                     | Print a wide variety of network statistics (see <code>man netstat</code> ). |
| Graphical system statistics viewer | <code>xosview</code>                                                                     | An X-based display of recent OS statistics.                                 |

| 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<br>File size can not exceed file system | 2 GB {512B block size}<br>2 TB {4KB block size} | The oracle database can create files up to 64 GB with a 16 KB database block size.<br>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<br>Filesystem types                           | ext3<br>reiserfs                                |                                                                                                                                                |
| Disk Label                                            | fdisk -l                                        | fdisk is not available on all distributions.                                                                                                   |
| Extend File system                                    | resize2fs<br>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.                                                         |

|                               |                                                                                                                                                        |                                                                                                                                                                                 |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Boot single user              | {lilo}<br>control-x<br>linux S<br><br>{grub}<br>c<br>kernel vmlinuz-2.4.9-13 <b>single</b><br>ro root=/dev/hda8<br>initrd /initrd-2.4.9-13.img<br>boot | Use LILO facility.<br><br>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. |

| <b>LVM</b>                                       | <b>Linux (UnitedLinux)</b> | <b>Description / Comments</b>                                                                                                                                 |
|--------------------------------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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               |                                                                                                                                                               |

|                                       |                     |  |
|---------------------------------------|---------------------|--|
| 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   | <pre>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 ] ;</pre> |
| ALTER DATABASE  | <pre>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   } ;</pre>                                                                                          |
| ALTER DIMENSION | <pre>ALTER DIMENSION [ schema. ]dimension   { ADD     { level_clause     hierarchy_clause     attribute_clause     extended_attribute_clause   }   [ ADD</pre>                                                                                                                                                                                             |

| SQL Statement   | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <pre> { 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 } ; </pre> |
| ALTER DISKGROUP | <pre> ALTER DISKGROUP { disk_clauses   diskgroup_clauses } [ { disk_clauses   diskgroup_clauses } ]... ; </pre>                                                                                                                                                                                                                                                                                                         |
| ALTER FUNCTION  | <pre> ALTER FUNCTION [ schema. ]function COMPILE [ DEBUG ] [ compiler_parameters_clause [ compiler_parameters_clause ] ... ] [ REUSE SETTINGS ] ; </pre>                                                                                                                                                                                                                                                                |
| ALTER INDEX     | <pre> 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 </pre>                                                                            |

| SQL Statement           | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre> PARAMETERS ('ODCI_parameters') { ENABLE   DISABLE } UNUSABLE RENAME TO new_name COALESCE { MONITORING   NOMONITORING } USAGE UPDATE BLOCK REFERENCES alter_index_partitioning } ; </pre>                                                                                                                                                                                                                                                                                               |
| ALTER INDEXTYPE         | <pre> ALTER INDEXTYPE [ schema. ]indextype { { ADD   DROP } [ schema. ]operator (parameter_types) [, { ADD   DROP } [ schema. ]operator (parameter_types) ]... [ using_type_clause ]   COMPILE } ; </pre>                                                                                                                                                                                                                                                                                    |
| ALTER JAVA              | <pre> ALTER JAVA { SOURCE   CLASS } [ schema. ]object_name [ RESOLVER ( ( match_string [, ] { schema_name   - } ) [ ( match_string [, ] { schema_name   - } ) ]... ] { { COMPILE   RESOLVE }   invoker_rights_clause } ; </pre>                                                                                                                                                                                                                                                              |
| ALTER MATERIALIZED VIEW | <pre> 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 ] </pre> |

| SQL Statement               | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>[ { ENABLE   DISABLE } QUERY REWRITE   COMPILE   CONSIDER FRESH ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                          |
| ALTER MATERIALIZED VIEW LOG | <pre>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 ] ] ;</pre> |
| ALTER OPERATOR              | <pre>ALTER OPERATOR [ schema. ]operator { add_binding_clause   drop_binding_clause   COMPILE } ;</pre>                                                                                                                                                                                                                                                                                                                                                                                  |
| ALTER OUTLINE               | <pre>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</pre>                                                                                                                                                                                                                                              |

| <b>SQL Statement</b>   | <b>Syntax</b>                                                                                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <pre>  { ENABLE   DISABLE } ]... ;</pre>                                                                                                                                                                           |
| ALTER PACKAGE          | <pre>ALTER PACKAGE [ schema. ]package COMPILE [ DEBUG ] [ PACKAGE   SPECIFICATION   BODY ] [ compiler_parameters_clause [ compiler_parameters_clause ] ... ] [ REUSE SETTINGS ] ;</pre>                            |
| ALTER PROCEDURE        | <pre>ALTER PROCEDURE [ schema. ]procedure COMPILE [ DEBUG ] [ compiler_parameters_clause [ compiler_parameters_clause ] ... ] [ REUSE SETTINGS ] ;</pre>                                                           |
| ALTER PROFILE          | <pre>ALTER PROFILE profile LIMIT { resource_parameters   password_parameters } [ resource_parameters   password_parameters ]... ;</pre>                                                                            |
| ALTER RESOURCE COST    | <pre>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 ] ... ;</pre> |
| ALTER ROLE             | <pre>ALTER ROLE role { NOT IDENTIFIED   IDENTIFIED { BY password   USING [ schema. ]package   EXTERNALLY   GLOBALLY } }</pre>                                                                                      |
| ALTER ROLEBACK SEGMENT | <pre>ALTER ROLLBACK SEGMENT rollback_segment { ONLINE   OFFLINE   storage_clause</pre>                                                                                                                             |

| <b>SQL Statement</b> | <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre>  SHRINK [ TO integer [ K   M ] ] };</pre>                                                                                                                                                                                                                                                                                                                                                                                                                               |
| ALTER SEQUENCE       | <pre>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 } ]...;</pre>                                                                      |
| ALTER SESSION        | <pre>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 } ;</pre>                                                                                                                 |
| ALTER SYSTEM         | <pre>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 ]... } ;</pre> |

| SQL Statement    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ALTER TABLE      | <pre> 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 }   ]... ] ; </pre>                                                     |
| ALTER TABLESPACE | <pre> 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   } ; </pre> |
| ALTER TRIGGER    | <pre> ALTER TRIGGER [ schema. ]trigger   { ENABLE     DISABLE     RENAME TO new_name     COMPILE [ DEBUG ]     [ compiler_parameters_clause       [ compiler_parameters_clause ] ...     ]     [ REUSE SETTINGS ]   } ; </pre>                                                                                                                                                                                                                  |
| ALTER TYPE       | <pre> ALTER TYPE [ schema. ]type   { compile_type_clause     replace_type_clause     { alter_method_spec       alter_attribute_definition       alter_collection_clauses       [ NOT ] { INSTANTIABLE   FINAL }   } </pre>                                                                                                                                                                                                                      |

| <b>SQL Statement</b> | <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre>[ dependent_handling_clause ] } ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ALTER USER           | <pre>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</pre> |
| (cont.) ALTER USER   | <pre>[ { 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   }</pre>                                                                                                                                                                                                                                        |

| SQL Statement        | Syntax                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre>             PASSWORD EXPIRE             ACCOUNT { LOCK   UNLOCK }         }       ]...         user [, user ]... proxy_clause ; UPDATE MANUALLY too big to fit on page, split manually </pre>                                                                                                                                                                                              |
| ALTER VIEW           | <pre> ALTER VIEW [ schema. ]view   { ADD out_of_line_constraint     MODIFY CONSTRAINT constraint     { RELY   NORELY }     DROP { CONSTRAINT constraint       PRIMARY KEY       UNIQUE (column [, column ]...)   }     COMPILE } ; </pre>                                                                                                                                                        |
| ANALYZE              | <pre> 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 } ; </pre> |
| ASSOCIATE STATISTICS | <pre> ASSOCIATE STATISTICS WITH   { column_association   function_association } ; </pre>                                                                                                                                                                                                                                                                                                         |
| AUDIT                | <pre> AUDIT   { sql_statement_clause   schema_object_clause }   [ BY { SESSION   ACCESS } ]   [ WHENEVER [ NOT ] SUCCESSFUL ] ; </pre>                                                                                                                                                                                                                                                           |
| CALL                 | <pre> CALL   { routine_clause     object_access_expression } [ INTO :host_variable   [ [ INDICATOR ] :indicator_variable ] ] ; </pre>                                                                                                                                                                                                                                                            |

| SQL Statement      | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COMMENT            | <pre>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' ;</pre>                                                                                                                                                                                                                                                           |
| COMMIT             | <pre>COMMIT [ WORK ]   [ COMMENT 'text'     FORCE 'text' [, integer ] ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| CREATE CLUSTER     | <pre>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 ] ;</pre> |
| CREATE CONTEXT     | <pre>CREATE [ OR REPLACE ] CONTEXT namespace   USING [ schema. ] package   [ INITIALIZED { EXTERNALLY   GLOBALLY }     ACCESSED GLOBALLY ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                               |
| CREATE CONTROLFILE | <pre>CREATE CONTROLFILE   [ REUSE ]   [ SET ]   DATABASE database</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| SQL Statement        | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre> [ 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 ] ; </pre> |
| CREATE DATABASE      | <pre> 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 }... ; </pre>                                                                                                                                                      |
| CREATE DATABASE LINK | <pre> CREATE [ SHARED ] [ PUBLIC ] DATABASE LINK dblink [ CONNECT TO { CURRENT_USER   user IDENTIFIED BY password [ dblink_authentication ] }   dblink_authentication ] [ USING 'connect_string' ] ; </pre>                                                                                                                                                                                                                                                                                                   |
| CREATE DIMENSION     | <pre> CREATE DIMENSION [ schema. ]dimension level_clause [ level_clause ]... { hierarchy_clause </pre>                                                                                                                                                                                                                                                                                                                                                                                                        |

| SQL Statement    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <pre>   attribute_clause   extended_attribute_clause } [ hierarchy_clause   attribute_clause   extended_attribute_clause ]... ; </pre>                                                                                                                                                                                                                                                                                                                                                                     |
| CREATE DIRECTORY | <pre>CREATE [ OR REPLACE ] DIRECTORY directory AS 'path_name' ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| CREATE DISKGROUP | <pre> 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 ]... ]... ; </pre>                                                                                                                                                                                                                        |
| CREATE FUNCTION  | <pre> 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 } } ; </pre> |
| CREATE INDEX     | <pre>CREATE [ UNIQUE   BITMAP ] INDEX [ schema. ]index ON { cluster_index_clause   table_index_clause   bitmap_join_index_clause } ;</pre>                                                                                                                                                                                                                                                                                                                                                                 |

| SQL Statement            | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CREATE INDEXTYPE         | <pre>CREATE [ OR REPLACE ] INDEXTYPE [ schema. ]indextype FOR [ schema. ]operator (paramater_type                      [, paramater_type ]...) [, [ schema. ]operator (paramater_type                      [, paramater_type ]...) ]... using_type_clause ;</pre>                                                                                                                                                                                                                                                   |
| CREATE JAVA              | <pre>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 } ;</pre> |
| CREATE LIBRARY           | <pre>CREATE [ OR REPLACE ] LIBRARY [ schema. ]libname { IS   AS } 'filename' [ AGENT 'agent_dblink' ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                       |
| CREATE MATERIALIZED VIEW | <pre>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 ]</pre>                                                                               |

| SQL Statement                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <pre>[ FOR UPDATE ] [ { DISABLE   ENABLE }   QUERY REWRITE ] AS subquery ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| CREATE MATERIALIZED VIEW LOG | <pre>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 ] ] ;</pre> |
| CREATE OPERATOR              | <pre>CREATE [ OR REPLACE ] OPERATOR   [ schema. ] operator binding_clause ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| CREATE OUTLINE               | <pre>CREATE [ OR REPLACE ]   [ PUBLIC   PRIVATE ] OUTLINE [ outline ]   [ FROM [ PUBLIC   PRIVATE ] source_outline ]   [ FOR CATEGORY category ]   [ ON statement ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| CREATE PACKAGE               | <pre>CREATE [ OR REPLACE ] PACKAGE [ schema. ]package   [ invoker_rights_clause ]   { IS   AS } pl/sql_package_spec ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| CREATE PACKAGE BODY          | <pre>CREATE [ OR REPLACE ] PACKAGE BODY   [ schema. ]package   { IS   AS } pl/sql_package_body ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| <b>SQL Statement</b>    | <b>Syntax</b>                                                                                                                                                                                                                                                                                |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CREATE PFILE            | CREATE PFILE [= 'pfile_name' ]<br>FROM SPFILE [= 'spfile_name' ] ;                                                                                                                                                                                                                           |
| CREATE PROCEDURE        | CREATE [ OR REPLACE ] PROCEDURE [ schema. ]procedure<br>[ (argument [ IN   OUT   IN OUT ]<br>[ NOCOPY ]<br>datatype<br>[, argument [ IN   OUT   IN OUT ]<br>[ NOCOPY ]<br>datatype<br>]...<br>)<br>]<br>[ invoker_rights_clause ]<br>{ IS   AS }<br>{ pl/sql_subprogram_body   call_spec } ; |
| CREATE PROFILE          | CREATE PROFILE profile<br>LIMIT { resource_parameters<br>  password_parameters<br>}<br>[ resource_parameters<br>  password_parameters<br>]... ;                                                                                                                                              |
| CREATE ROLE             | CREATE ROLE role<br>[ NOT IDENTIFIED<br>  IDENTIFIED { BY password<br>  USING [ schema. ] package<br>EXTERNALLY<br>  GLOBALLY<br>}<br>] ;                                                                                                                                                    |
| CREATE ROLLBACK SEGMENT | CREATE [ PUBLIC ] ROLLBACK SEGMENT rollback_segment<br>[ { TABLESPACE tablespace   storage_clause }<br>[ TABLESPACE tablespace   storage_clause ]...<br>];                                                                                                                                   |
| CREATE SCHEMA           | CREATE SCHEMA AUTHORIZATION schema<br>{ create_table_statement<br>  create_view_statement<br>  grant_statement<br>}<br>[ create_table_statement<br>  create_view_statement<br>  grant_statement<br>]... ;                                                                                    |

| SQL Statement     | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CREATE SEQUENCE   | <pre>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 } ]...;</pre> |
| CREATE SPFILE     | <pre>CREATE SPFILE [= 'spfile_name' ] FROM PFILE [= 'pfile_name' ] ;</pre>                                                                                                                                                                                                                                                                                                                                                                  |
| CREATE SYNONYM    | <pre>CREATE [ OR REPLACE ] [ PUBLIC ] SYNONYM [ schema. ]synonym FOR [ schema. ]object [ @ dblink ] ;</pre>                                                                                                                                                                                                                                                                                                                                 |
| CREATE TABLE      | <pre>{ relational_table   object_table   XMLType_table }</pre>                                                                                                                                                                                                                                                                                                                                                                              |
| CREATE TABLESPACE | <pre>CREATE [ BIGFILE   SMALLFILE ] { permanent_tablespace_clause temporary_tablespace_clause undo_tablespace_clause } ;</pre>                                                                                                                                                                                                                                                                                                              |
| CREATE TRIGGER    | <pre>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 } ;</pre>                                                                                                                                       |
| CREATE TYPE       | <pre>{ create_incomplete_type create_object_type create_varray_type create_nested_table_type }</pre>                                                                                                                                                                                                                                                                                                                                        |

| SQL Statement    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CREATE TYPE BODY | <pre>CREATE [ OR REPLACE ] TYPE BODY [ schema. ]type_name   { IS   AS }   { subprogram_declaration     map_order_func_declaration   }   [ ; { subprogram_declaration     map_order_func_declaration   }   ] ]... END ;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| CREATE USER      | <pre>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 } ]... ] ;</pre> |
| CREATE VIEW      | <pre>CREATE [ OR REPLACE ] [ [ NO ] FORCE ] VIEW   [ schema. ]view   [ (alias [ inline_constraint     inline_constraint ]... ]</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| SQL Statement           | Syntax                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>   out_of_line_constraint   [, alias [ inline_constraint             [ inline_constraint ]... ]               out_of_line_constraint             ]...     object_view_clause   XMLType_view_clause ] AS subquery [ subquery_restriction_clause ] ; </pre>                                                                                                                                                    |
| DELETE                  | <pre> DELETE [ hint ] [ FROM ] { dml_table_expression_clause   ONLY (dml_table_expression_clause) } [ t_alias ] [ where_clause ] [ returning_clause ] ; </pre>                                                                                                                                                                                                                                                    |
| DISASSOCIATE STATISTICS | <pre> 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 ] ; </pre> |
| DROP CLUSTER            | <pre> DROP CLUSTER [ schema. ]cluster [ INCLUDING TABLES [ CASCADE CONSTRAINTS ] ] ; </pre>                                                                                                                                                                                                                                                                                                                       |
| DROP CONTEXT            | <pre> DROP CONTEXT namespace ; </pre>                                                                                                                                                                                                                                                                                                                                                                             |
| DROP DATABASE           | <pre> DROP DATABASE ; </pre>                                                                                                                                                                                                                                                                                                                                                                                      |
| DROP DATABASE LINK      | <pre> DROP [ PUBLIC ] DATABASE LINK dblink ; </pre>                                                                                                                                                                                                                                                                                                                                                               |
| DROP DIMENSION          | <pre> DROP DIMENSION [ schema. ]dimension ; </pre>                                                                                                                                                                                                                                                                                                                                                                |
| DROP DIRECTORY          | <pre> DROP DIRECTORY directory_name ; </pre>                                                                                                                                                                                                                                                                                                                                                                      |

| <b>SQL Statement</b>       | <b>Syntax</b>                                                                   |
|----------------------------|---------------------------------------------------------------------------------|
| DROP DISKGROUP             | DROP DISKGROUP diskgroup_name<br>[ { INCLUDING   EXCLUDING }<br>CONTENTS<br>] ; |
| 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<br>{ SOURCE   CLASS   RESOURCE }<br>[ schema. ]object_name ;          |
| DROP LIBRARY               | DROP LIBRARY library_name ;                                                     |
| DROP MATERIALIZED VIEW     | DROP MATERIALIZED VIEW<br>[ schema. ]materialized_view<br>[ PRESERVE TABLE ] ;  |
| DROP MATERIALIZED VIEW LOG | DROP MATERIALIZED VIEW LOG<br>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<br>[ FORCE ] ;                       |

| <b>SQL Statement</b> | <b>Syntax</b>                                                                                                                                                                     |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DROP TABLE           | DROP TABLE [ schema. ]table<br>[ CASCADE CONSTRAINTS ]<br>[ PURGE ] ;                                                                                                             |
| DROP TABLESPACE      | DROP TABLESPACE tablespace<br>[ INCLUDING CONTENTS [ AND DATAFILES ]<br>[ CASCADE CONSTRAINTS ]<br>] ;                                                                            |
| DROP TRIGGER         | DROP TRIGGER [ schema. ]trigger ;                                                                                                                                                 |
| DROP TYPE            | DROP TYPE [ schema. ]type_name<br>[ FORCE   VALIDATE ] ;                                                                                                                          |
| DROP TYPE BODY       | DROP TYPE BODY [ schema. ]type_name ;                                                                                                                                             |
| DROP USER            | DROP USER user [ CASCADE ] ;                                                                                                                                                      |
| DROP VIEW            | DROP VIEW [ schema. ] view<br>[ CASCADE CONSTRAINTS ] ;                                                                                                                           |
| EXPLAIN PLAN         | EXPLAIN PLAN<br>[ SET STATEMENT_ID = 'text' ]<br>[ INTO [ schema. ]table [ @ dblink ] ]<br>FOR statement ;                                                                        |
| FLASHBACK DATABASE   | FLASHBACK [ STANDBY ] DATABASE [ database ]<br>{ TO { SCN   TIMESTAMP } expr<br>  TO BEFORE { SCN   TIMESTAMP } expr<br>} ;                                                       |
| FLASHBACK TABLE      | FLASHBACK TABLE<br>[ schema. ]table<br>[, [ schema. ]table ]...<br>TO { { SCN   TIMESTAMP } expr<br>[ { ENABLE   DISABLE } TRIGGERS ]<br>  BEFORE DROP [ RENAME TO table ]<br>} ; |
| GRANT                | GRANT { grant_system_privileges<br>  grant_object_privileges<br>} ;                                                                                                               |
| INSERT               | INSERT [ hint ]<br>{ single_table_insert   multi_table_insert } ;                                                                                                                 |

| SQL Statement | Syntax                                                                                                                                                                                                                                                                            |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOCK TABLE    | <pre> LOCK TABLE [ schema. ] { table   view } [ { PARTITION (partition)     SUBPARTITION (subpartition)   } ]   @ dblink ] [, [ schema. ] { table   view } [ { PARTITION (partition)     SUBPARTITION (subpartition)   } ]   @ dblink ] ]... IN lockmode MODE [ NOWAIT ] ; </pre> |
| MERGE         | <pre> MERGE [ hint ]   INTO [ schema. ]table [ t_alias ]   USING [ schema. ] { table   view   subquery }     [ t_alias ]   ON ( condition )   [ merge_update_clause ]   [ merge_insert_clause ] ; </pre>                                                                          |
| NOAUDIT       | <pre> NOAUDIT   { sql_statement_clause   [, sql_statement_clause ]...     schema_object_clause   [, schema_object_clause ]...   }   [ WHENEVER [ NOT ] SUCCESSFUL ] ; </pre>                                                                                                      |
| PURGE         | <pre> PURGE   { { TABLE table     INDEX index   }     { RECYCLEBIN   DBA_RECYCLEBIN }     TABLESPACE tablespace     [ USER user ]   }   DO NOT IMPORT AS INSERT problem importing file, locks   up FrameMaker </pre>                                                              |
| RENAME        | <pre> RENAME old_name   TO new_name ; </pre>                                                                                                                                                                                                                                      |
| REVOKE        | <pre> REVOKE { revoke_system_privileges           revoke_object_privileges       } ; </pre>                                                                                                                                                                                       |

| SQL Statement     | Syntax                                                                                                                                                                               |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ROLLBACK          | <pre>ROLLBACK [ WORK ] [ TO [ SAVEPOINT ] savepoint   FORCE 'text' ] ;</pre>                                                                                                         |
| SAVEPOINT         | <pre>SAVEPOINT savepoint ;</pre>                                                                                                                                                     |
| SELECT            | <pre>subquery [ for_update_clause ] ;</pre>                                                                                                                                          |
| SET CONSTRAINT[S] | <pre>SET { CONSTRAINT   CONSTRAINTS } { constraint [, constraint ]...   ALL } { IMMEDIATE   DEFERRED } ;</pre>                                                                       |
| SET ROLE          | <pre>SET ROLE { role [ IDENTIFIED BY password ] [, role [ IDENTIFIED BY password ] ]...   ALL [ EXCEPT role [, role ]... ] NONE } ;</pre>                                            |
| SET TRANSACTION   | <pre>SET TRANSACTION { { READ { ONLY   WRITE }   ISOLATION LEVEL { SERIALIZABLE   READ COMMITTED }   USE ROLLBACK SEGMENT rollback_segment } [ NAME 'text' ]   NAME 'text' } ;</pre> |
| TRUNCATE          | <pre>TRUNCATE { TABLE [ schema. ]table [ { PRESERVE   PURGE } MATERIALIZED VIEW LOG ]   CLUSTER [ schema. ]cluster } [ { DROP   REUSE } STORAGE ] ;</pre>                            |
| UPDATE            | <pre>UPDATE [ hint ] { dml_table_expression_clause   ONLY (dml_table_expression_clause) } [ t_alias ] update_set_clause [ where_clause ] [ returning_clause ] ;</pre>                |

**Table 2: Syntax for Subclauses**

| <b>Subclause</b>           | <b>Syntax</b>                                                                                                                                                                                                                                                                                                           |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| activate_standby_db_clause | ACTIVATE<br>[ PHYSICAL   LOGICAL ]<br>STANDBY DATABASE<br>[ SKIP [ STANDBY LOGFILE ] ]                                                                                                                                                                                                                                  |
| add_binding_clause         | ADD BINDING<br>(parameter_type<br>[ , parameter_type ]...)<br>RETURN (return_type)<br>[ implementation_clause ]<br>using_function_clause                                                                                                                                                                                |
| add_column_clause          | ADD<br>( column datatype<br>[ DEFAULT expr ]<br>[ { inline_constraint<br>[ inline_constraint ]...<br>  inline_ref_constraint<br>}<br>]<br>[ , column datatype<br>[ DEFAULT expr ]<br>[ { inline_constraint<br>[ inline_constraint ]...<br>  inline_ref_constraint<br>}<br>]<br>]<br>[ ...<br>]<br>[ column_properties ] |
| add_disk_clause            | ADD<br>[ FAILGROUP failgroup_name ]<br>DISK qualified_disk_clause<br>[ , qualified_disk_clause ]...<br>[ [ FAILGROUP failgroup_name ]<br>DISK qualified_disk_clause<br>[ , qualified_disk_clause ]...<br>]<br>[ ...                                                                                                     |
| add_hash_index_partition   | ADD PARTITION<br>[ partition_name ]<br>[ TABLESPACE tablespace_name ]<br>[ parallel_clause ]                                                                                                                                                                                                                            |
| add_hash_partition_clause  | ADD PARTITION [ partition ]<br>partitioning_storage_clause<br>[ update_index_clauses ]<br>[ parallel_clause ]                                                                                                                                                                                                           |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                          |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| add_hash_subpartition      | ADD subpartition_spec<br>[ update_index_clauses ]<br>[ parallel_clause ]                                                                                                                                                                                                                        |
| add_list_partition_clause  | ADD PARTITION [ partition ]<br>list_values_clause<br>[ table_partition_description ]<br>[ update_index_clauses ]                                                                                                                                                                                |
| add_list_subpartition      | ADD subpartition_spec<br>[ update_index_clauses ]                                                                                                                                                                                                                                               |
| add_logfile_clauses        | ADD [ STANDBY ] LOGFILE<br>{ [ INSTANCE 'instance_name'   THREAD integer ]<br>[ GROUP integer ] redo_log_file_spec<br>[, [ GROUP integer ] redo_log_file_spec ]...<br>  MEMBER 'filename' [ REUSE ]<br>[, 'filename' [ REUSE ] ]...<br>TO logfile_descriptor<br>[, logfile_descriptor ]...<br>} |
| add_overflow_clause        | ADD OVERFLOW [ segment_attributes_clause ]<br>[ (PARTITION [ segment_attributes_clause ]<br>[, PARTITION [ segment_attributes_clause ]]<br>]...<br>)<br>]                                                                                                                                       |
| add_range_partition_clause | ADD PARTITION [ partition ]<br>range_values_clause<br>[ table_partition_description ]<br>[ update_index_clauses ]                                                                                                                                                                               |
| add_table_partition        | { add_range_partition_clause<br>  add_hash_partition_clause<br>  add_list_partition_clause<br>}                                                                                                                                                                                                 |
| alias_file_name            | +diskgroup_name [ (template_name) ] /alias_name                                                                                                                                                                                                                                                 |
| allocate_extent_clause     | ALLOCATE EXTENT<br>[ ( { SIZE size_clause<br>  DATAFILE 'filename'<br>  INSTANCE integer<br>} )                                                                                                                                                                                                 |

| Subclause                    | Syntax                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <pre>[ SIZE size_clause     DATAFILE 'filename'     INSTANCE integer ]... )</pre>                                                                                                                                                                                                                                                                                                                  |
| alter_attribute_definition   | <pre>{ { ADD   MODIFY } ATTRIBUTE   { attribute [ datatype ]     ( attribute datatype     [, attribute datatype ]...   ) }   DROP ATTRIBUTE   { attribute     ( attribute [, attribute ]... ) } }</pre>                                                                                                                                                                                            |
| alter_collection_clauses     | <pre>MODIFY { LIMIT integer     ELEMENT TYPE datatype }</pre>                                                                                                                                                                                                                                                                                                                                      |
| alter_datafile_clause        | <pre>DATAFILE { 'filename'   filenumber } [, 'filename'   filenumber ]...   { ONLINE   OFFLINE [ FOR DROP ]   RESIZE size_clause   autoextend_clause   END BACKUP }</pre>                                                                                                                                                                                                                          |
| alter_external_table_clauses | <pre>{ 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 } ]... ]</pre> |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                              |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| alter_index_partitioning    | { modify_index_defaultAttrs<br>  add_hash_index_partition<br>  modify_index_partition<br>  rename_index_partition<br>  drop_index_partition<br>  split_index_partition<br>  coalesce_index_partition<br>  modify_index_subpartition<br>}                                            |
| alter_iot_clauses           | { index_org_table_clause<br>  alter_overflow_clause<br>  alter_mapping_table_clauses<br>  COALESCE<br>}                                                                                                                                                                             |
| alter_mapping_table_clauses | MAPPING TABLE<br>{ UPDATE BLOCK REFERENCES<br>  allocate_extent_clause<br>  deallocate_unused_clause<br>}                                                                                                                                                                           |
| alter_method_spec           | { ADD   DROP }<br>{ map_order_function_spec<br>  subprogram_spec<br>}<br>[ { ADD   DROP }<br>{ map_order_function_spec<br>  subprogram_spec<br>}<br>]...<br>]                                                                                                                       |
| alter_mv_refresh            | REFRESH<br>{ { FAST   COMPLETE   FORCE }<br>  ON { DEMAND   COMMIT }<br>  { START WITH   NEXT } date<br>  WITH PRIMARY KEY<br>  USING<br>{ DEFAULT MASTER ROLLBACK SEGMENT<br>  MASTER ROLLBACK SEGMENT<br>rollback_segment<br>}<br>  USING { ENFORCED   TRUSTED } CONSTRAINTS<br>} |
| alter_overflow_clause       | { OVERFLOW<br>  { allocate_extent_clause<br>  deallocate_unused_clause<br>}<br>  { allocate_extent_clause<br>  deallocate_unused_clause<br>}                                                                                                                                        |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre> ]...   add_overflow_clause }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| alter_session_set_clause  | SET parameter_name = parameter_value<br>[ parameter_name = parameter_value ]...                                                                                                                                                                                                                                                                                                                                                                                                |
| alter_system_reset_clause | parameter_name<br>[ SCOPE = { MEMORY   SPFILE   BOTH } ]<br>SID = 'sid'                                                                                                                                                                                                                                                                                                                                                                                                        |
| alter_system_set_clause   | parameter_name =<br>parameter_value [, parameter_value ]...<br>[ COMMENT 'text' ]<br>[ DEFERRED ]<br>[ SCOPE = { MEMORY   SPFILE   BOTH } ]<br>[ SID = { 'sid'   * } ]                                                                                                                                                                                                                                                                                                         |
| alter_table_partitioning  | { modify_table_defaultAttrs<br>set_subpartition_template<br>modify_table_partition<br>modify_table_subpartition<br>move_table_partition<br>move_table_subpartition<br>add_table_partition<br>coalesce_table_partition<br>drop_table_partition<br>drop_table_subpartition<br>rename_partition_subpart<br>truncate_partition_subpart<br>split_table_partition<br>split_table_subpartition<br>merge_table_partitions<br>merge_table_subpartitions<br>exchange_partition_subpart } |
| alter_table_properties    | { physical_attributes_clause<br>logging_clause<br>table_compression<br>supplemental_table_logging<br>allocate_extent_clause<br>deallocate_unused_clause<br>shrink_clause<br>{ CACHE   NOCACHE }<br>upgrade_table_clause<br>records_per_block_clause<br>parallel_clause<br>row_movement_clause }<br>[ physical_attributes_clause                                                                                                                                                |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                               |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre> 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 ] </pre> |
| alter_tempfile_clause       | <pre> TEMPFILE { 'filename' [, 'filename' ]... filenumber [, filenumber ]... }   RESIZE size_clause   autoextend_clause   DROP [ INCLUDING DATAFILES ]   ONLINE   OFFLINE } </pre>                                                                                                                   |
| alter_varray_col_properties | <pre> MODIFY VARRAY varray_item ( modify_LOB_parameters ) </pre>                                                                                                                                                                                                                                     |
| analytic_clause             | <pre> [ query_partition_clause ] [ order_by_clause [ windowing_clause ] ] </pre>                                                                                                                                                                                                                     |
| archive_log_clause          | <pre> 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 } </pre>                                              |

| Subclause                | Syntax                                                                                                                                                                                                                                                                |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| array_DML_clause         | [ WITH   WITHOUT ]<br>ARRAY DML<br>[ ([ schema. ]type<br>[, [ schema. ]varray_type ]) ]<br>[, ([ schema. ]type<br>[, [ schema. ]varray_type ])... ]                                                                                                                   |
| attribute_clause         | ATTRIBUTE level DETERMINES<br>{ dependent_column<br>  ( dependent_column<br>[, dependent_column ]... ) }<br>}                                                                                                                                                         |
| auditing_by_clause       | BY { proxy [, proxy ]...<br>  user [, user ]... }<br>}                                                                                                                                                                                                                |
| auditing_on_clause       | ON { [ schema. ]object<br>  DIRECTORY directory_name<br>  DEFAULT }<br>}                                                                                                                                                                                              |
| autoextend_clause        | AUTOEXTEND<br>{ OFF<br>  ON [ NEXT size_clause ]<br>[ maxsize_clause ] }<br>}                                                                                                                                                                                         |
| binding_clause           | BINDING<br>(parameter_type [, parameter_type ]...)<br>RETURN return_type<br>[ implementation_clause ]<br>using_function_clause<br>[, (parameter_type [, parameter_type ]...)<br>RETURN return_type<br>[ implementation_clause ]<br>using_function_clause<br>]...<br>] |
| bitmap_join_index_clause | [ schema. ]table<br>( [ [ schema. ]table.   t_alias. ]column<br>[ ASC   DESC ]<br>[, [ [ schema. ]table.   t_alias. ]column<br>[ ASC   DESC ]<br>]...<br>)<br>FROM [ schema. ]table [ t_alias ]<br>[, [ schema. ]table [ t_alias ]<br>]...<br>]                       |

| Subclause               | Syntax                                                                                                                                                                                                                                                                             |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>WHERE condition       [ local_partitioned_index ] index_attributes</pre>                                                                                                                                                                                                      |
| build_clause            | BUILD { IMMEDIATE   DEFERRED }                                                                                                                                                                                                                                                     |
| C_declaraction          | C [ NAME name ] LIBRARY lib_name [ AGENT IN (argument[, argument ]...) ] [ WITH CONTEXT ] [ PARAMETERS (parameter[, parameter ]...) ]                                                                                                                                              |
| call_spec               | LANGUAGE { Java_declaration   C_declaraction }                                                                                                                                                                                                                                     |
| cancel_clause           | CANCEL [ IMMEDIATE ] [ WAIT   NOWAIT ]                                                                                                                                                                                                                                             |
| cell_assignment         | <pre>measure_column [ { { condition   expr   single_column_for_loop } [ , { condition   expr   single_column_for_loop } ] ...   multi_column_for_loop } ]</pre> <p>Note: The outer square brackets are part of the syntax.<br/>In this case, they do not indicate optionality.</p> |
| 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 | <pre>CHECK { ALL   DISK     disk_name     [, disk_name ]...   DISKS IN FAILGROUP     failgroup_name</pre>                                                                                                                                                                          |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                       |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre>[ , failgroup_name ]...   FILE   filename   [ , filename ]... } [ CHECK { ALL   DISK   disk_name   [ , disk_name ]...   DISKS IN FAILGROUP   failgroup_name   [ , failgroup_name ]...   FILE   filename   [ , filename ]... } ]... [ REPAIR   NOREPAIR ]</pre>                          |
| 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 } |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| column_properties          | <pre> { 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 } ] ... </pre> |
| commit_switchover_clause   | <pre> { PREPARE   COMMIT } TO SWITCHOVER [ TO { { PHYSICAL   LOGICAL } PRIMARY   PHYSICAL STANDBY [ { WITH   WITHOUT } SESSION SHUTDOWN { WAIT   NOWAIT } ]   LOGICAL STANDBY }   CANCEL ]</pre>                                                                                                                                                                                                                                       |
| compile_type_clause        | <pre> COMPILE [ DEBUG ] [ SPECIFICATION   BODY ] [ compiler_parameters_clause [ compiler_parameters_clause ] ... ] [ REUSE SETTINGS ]</pre>                                                                                                                                                                                                                                                                                            |
| compiler_parameters_clause | <pre>parameter_name = parameter_value</pre>                                                                                                                                                                                                                                                                                                                                                                                            |
| composite_partitioning     | <pre> 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 ] ... )</pre>                                                                                                                                                                    |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| compute_statistics_clause | COMPUTE [ SYSTEM ] STATISTICS [ for_clause ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| conditional_insert_clause | [ ALL   FIRST ]<br>WHEN condition<br>THEN insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>[ insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>]...<br>[ WHEN condition<br>THEN insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>[ insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>]...<br>]...<br>[ ELSE insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>[ insert_into_clause<br>[ values_clause ]<br>[ error_logging_clause ]<br>]...<br>] |
| constraint                | { inline_constraint<br>  out_of_line_constraint<br>  inline_ref_constraint<br>  out_of_line_ref_constraint<br>}                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| constraint_clauses        | { ADD { out_of_line_constraint<br>[ out_of_line_constraint ]...<br>  out_of_line_REF_constraint<br>}<br>  MODIFY { CONSTRAINT constraint<br>  PRIMARY KEY<br>  UNIQUE (column [, column ]...)<br>}<br>constraint_state<br>  RENAME CONSTRAINT old_name TO new_name<br>  drop_constraint_clause<br>}                                                                                                                                                                                                                                                         |
| constraint_state          | [ [ NOT ] DEFERRABLE ]<br>[ INITIALLY { IMMEDIATE   DEFERRED } ]<br>[ INITIALLY { IMMEDIATE   DEFERRED } ]                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Subclause               | Syntax                                                                                                                                                                                                             |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>[ [ NOT ] DEFERRABLE ] ] [ RELY   NORELY ] [ using_index_clause ] [ ENABLE   DISABLE ] [ VALIDATE   NOVALIDATE ] [ exceptions_clause ]</pre>                                                                  |
| constructor_declaration | <pre>[ FINAL ] [ INSTANTIABLE ] CONSTRUCTOR FUNCTION datatype [ [ SELF IN OUT datatype, ]   parameter datatype   [, parameter datatype ]... ] RETURN SELF AS RESULT { IS   AS } { pl/sql_block   call_spec }</pre> |
| constructor_spec        | <pre>[ FINAL ] [ INSTANTIABLE ] CONSTRUCTOR FUNCTION datatype [ ([ SELF IN OUT datatype, ]   parameter datatype   [, parameter datatype ]... ) ] RETURN SELF AS RESULT [ { IS   AS } call_spec ]</pre>             |
| context_clause          | <pre>[ WITH INDEX CONTEXT,   SCAN CONTEXT implementation_type   [ COMPUTE ANCILLARY DATA ] ] [ WITH COLUMN CONTEXT ]</pre>                                                                                         |
| controlfile_clauses     | <pre>{ CREATE [ LOGICAL   PHYSICAL ]   STANDBY CONTROLFILE AS   'filename' [ REUSE ]   BACKUP CONTROLFILE TO   { 'filename' [ REUSE ]     trace_file_clause   } }</pre>                                            |
| create_datafile_clause  | <pre>CREATE DATAFILE   { 'filename'   filenumber }   [, 'filename'   filenumber ]... } [ AS { file_specification   [, file_specification ]...     NEW   } ]</pre>                                                  |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| create_incomplete_type   | CREATE [ OR REPLACE ]<br>TYPE [ schema. ]type_name ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| create_mv_refresh        | { REFRESH<br>{ { FAST   COMPLETE   FORCE }<br>  ON { DEMAND   COMMIT }<br>  { START WITH   NEXT } date<br>WITH { PRIMARY KEY   ROWID }<br>USING<br>{ DEFAULT [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT<br>  [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT rollback_segment<br>}<br>[ DEFAULT [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT<br>  [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT rollback_segment<br>]...<br>  USING<br>{ ENFORCED   TRUSTED }<br>CONSTRAINTS<br>}<br>[ { FAST   COMPLETE   FORCE }<br>ON { DEMAND   COMMIT }<br>  { START WITH   NEXT } date<br>WITH { PRIMARY KEY   ROWID }<br>USING<br>{ DEFAULT [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT<br>  [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT rollback_segment<br>}<br>[ DEFAULT [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT<br>  [ MASTER   LOCAL ]<br>ROLLBACK SEGMENT<br>]...<br>  USING<br>{ ENFORCED   TRUSTED }<br>CONSTRAINTS<br>]...<br>  NEVER REFRESH<br>} |
| create_nested_table_type | CREATE [ OR REPLACE ]<br>TYPE [ schema. ]type_name<br>[ OID 'object_identifier' ]<br>{ IS   AS } TABLE OF datatype ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| create_object_type        | <pre> 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 ]; </pre> |
| create_varray_type        | <pre> CREATE [ OR REPLACE ]   TYPE [ schema. ]type_name   [ OID 'object_identifier' ]   { IS   AS } { VARRAY   VARYING ARRAY }   (limit) OF datatype ; </pre>                                                                                                                                                                                                                                                                            |
| database_file_clauses     | <pre> { RENAME FILE   'filename' [, 'filename' ]...   TO 'filename'   create_datafile_clause   alter_datafile_clause   alter_tempfile_clause } </pre>                                                                                                                                                                                                                                                                                    |
| database_logging_clauses  | <pre> { LOGFILE   [ GROUP integer ] file_specification   [, [ GROUP integer ] file_specification ]...   MAXLOGFILES integer   MAXLOGMEMBERS integer   MAXLOGHISTORY integer   { ARCHIVELOG   NOARCHIVELOG }   FORCE LOGGING } </pre>                                                                                                                                                                                                     |
| datafile_tempfile_clauses | <pre> { ADD { DATAFILE   TEMPFILE }   [ file_specification   [, file_specification ]...   ]   RENAME DATAFILE 'filename' [, 'filename' ]...   TO </pre>                                                                                                                                                                                                                                                                                  |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | 'filename' [, 'filename' ]...<br>  { DATAFILE   TEMPFILE } { ONLINE   OFFLINE }                                                                                                                                                                                                                                                                                                                             |
| datafile_tempfile_spec     | [ 'filename' ]<br>[ SIZE size_clause ]<br>[ REUSE ]<br>[ autoextend_clause ]                                                                                                                                                                                                                                                                                                                                |
| dblink                     | database[.domain [.domain ]... ]<br>[ @ connect_descriptor ]                                                                                                                                                                                                                                                                                                                                                |
| dblink_authentication      | AUTHENTICATED BY user<br>IDENTIFIED BY password                                                                                                                                                                                                                                                                                                                                                             |
| deallocate_unused_clause   | DEALLOCATE UNUSED<br>[ 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<br>[ DATAFILE datafile_tempfile_spec ]<br>extent_management_clause                                                                                                                                                                                                                                                                                                            |
| default_settings_clauses   | { SET DEFAULT<br>{ BIGFILE   SMALLFILE } TABLESPACE<br>  DEFAULT TABLESPACE tablespace<br>  DEFAULT TEMPORARY TABLESPACE<br>{ tablespace   tablespace_group_name }<br>  RENAME GLOBAL_NAME TO<br>database.domain [.domain ]...<br>  { ENABLE BLOCK CHANGE TRACKING<br>[ USING FILE 'filename' [ REUSE ] ]<br>  DISABLE BLOCK CHANGE TRACKING<br>}<br>  flashback_mode_clause<br>  set_time_zone_clause<br>} |
| default_temp_tablespace    | [ BIGFILE   SMALLFILE ]<br>DEFAULT TEMPORARY TABLESPACE tablespace<br>[ TEMPFILE file_specification<br>[, file_specification ]...<br>]<br>extent_management_clause                                                                                                                                                                                                                                          |

| Subclause                 | Syntax                                                                                                                                                                                                                    |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| dependent_handling_clause | <pre>{ INVALIDATE   CASCADE [ { [ NOT ] INCLUDING TABLE DATA   CONVERT TO SUBSTITUTABLE } ] [ [FORCE] exceptions_clause ] }</pre>                                                                                         |
| dimension_join_clause     | <pre>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 ]...</pre> |
| disk_clauses              | <pre>{ diskgroup_name { add_disk_clause   drop_disk_clauses   resize_disk_clauses }   { diskgroup_name   ALL } undrop_disk_clause }</pre>                                                                                 |
| diskgroup_alias_clauses   | <pre>{ 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 ]... }</pre>      |
| diskgroup_availability    | <pre>{ MOUNT   DISMOUNT [ FORCE   NOFORCE ] }</pre>                                                                                                                                                                       |
| diskgroup_clauses         | <pre>{ diskgroup_name { rebalance_diskgroup_clause   check_diskgroup_clauses   diskgroup_template_clauses   diskgroup_directory_clauses   diskgroup_alias_clauses }</pre>                                                 |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                      |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>           drop_diskgroup_file_clause                     { diskgroup_name   ALL }           diskgroup_availability         }</pre>                                                                                                                                    |
| diskgroup_directory_clauses | <pre> { 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 ]... }</pre>                     |
| diskgroup_file_spec         | <pre> [ ' { fully_qualified_file_name       numeric_file_name       incorporate_file_name       alias_file_name     }   ,   [     SIZE size_clause   ]   [     REUSE   ]   [     autoextend_clause   ]</pre>                                                                |
| diskgroup_template_clauses  | <pre> { { ADD   ALTER } TEMPLATE     qualified_template_clause     [, qualified_template_clause ]...   DROP TEMPLATE     template_name     [, template_name ]... }</pre>                                                                                                    |
| distributed_recov_clauses   | <pre>{ ENABLE   DISABLE } DISTRIBUTED RECOVERY</pre>                                                                                                                                                                                                                        |
| dml_event_clause            | <pre> { DELETE   INSERT   UPDATE     [ OF column [, column ]... ] } [ OR { DELETE   INSERT   UPDATE     [ OF column [, column ]... ] } ] [ schema. ]table ON { [ NESTED TABLE nested_table_column OF ]     [ schema. ] view } [ referencing_clause ] [ FOR EACH ROW ]</pre> |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| dml_table_expression_clause | { [ schema. ]<br>{ table<br>[ { PARTITION (partition)<br>  SUBPARTITION (subpartition)<br>}<br>  @ dblink<br>]<br>  { view   materialized view } [ @ dblink ]<br>}<br>  ( subquery [ subquery_restriction_clause ] )<br>  table_collection_expression<br>}                                                                                                                                                                    |
| domain_index_clause         | INDEXTYPE IS indextype<br>[ parallel_clause ]<br>[ PARAMETERS ('ODCI_parameters') ]                                                                                                                                                                                                                                                                                                                                           |
| drop_binding_clause         | DROP BINDING<br>(parameter_type<br>[, parameter_type ]...)<br>[ FORCE ]                                                                                                                                                                                                                                                                                                                                                       |
| drop_column_clause          | { SET UNUSED { COLUMN column<br>  (column [, column ]...)<br>}<br>[ { CASCADE CONSTRAINTS   INVALIDATE }<br>[ CASCADE CONSTRAINTS   INVALIDATE ]...<br>]<br>  DROP { COLUMN column<br>  (column [, column ]...)<br>}<br>[ { CASCADE CONSTRAINTS   INVALIDATE }<br>[ CASCADE CONSTRAINTS   INVALIDATE ]...<br>]<br>[ CHECKPOINT integer ]<br>  DROP { UNUSED COLUMNS<br>  COLUMNS CONTINUE<br>}<br>[ CHECKPOINT integer ]<br>} |
| drop_constraint_clause      | DROP<br>{ { PRIMARY KEY<br>  UNIQUE (column [, column ]...)<br>}<br>[ CASCADE ]<br>[ { KEEP   DROP } INDEX ]<br>  CONSTRAINT constraint<br>  CASCADE ]<br>}                                                                                                                                                                                                                                                                   |

| Subclause                  | Syntax                                                                                                                                                                                                    |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| drop_disk_clauses          | <pre> DROP { DISK   disk_name [ FORCE   NOFORCE ]   [, disk_name [ FORCE   NOFORCE ] ]...   DISKS IN FAILGROUP   failgroup_name [ FORCE   NOFORCE ]   [, failgroup_name [ FORCE   NOFORCE ] ]... } </pre> |
| drop_diskgroup_file_clause | <pre> DROP FILE   filename   [, filename ]... </pre>                                                                                                                                                      |
| drop_index_partition       | DROP PARTITION partition_name                                                                                                                                                                             |
| drop_logfile_clauses       | <pre> DROP [ STANDBY ] LOGFILE { logfile_descriptor   [, logfile_descriptor ]...   MEMBER 'filename'   [, 'filename' ]... } </pre>                                                                        |
| drop_table_partition       | DROP PARTITION partition [ update_index_clauses [ parallel_clause ] ]                                                                                                                                     |
| drop_table_subpartition    | DROP SUBPARTITION subpartition [ update_index_clauses [ parallel_clause ] ]                                                                                                                               |
| element_spec               | <pre> [ inheritance_clauses ] { subprogram_spec   constructor_spec   map_order_function_spec } [ subprogram_clause   constructor_spec   map_order_function_spec ]... [, pragma_clause ] </pre>            |
| else_clause                | ELSE else_expr                                                                                                                                                                                            |
| enable_disable_clause      | <pre> { ENABLE   DISABLE } [ VALIDATE   NOVALIDATE ] { UNIQUE (column [, column ]...)   PRIMARY KEY   CONSTRAINT constraint } [ using_index_clause ] </pre>                                               |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                           |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | [ exceptions_clause ]<br>[ CASCADE ]<br>[ { KEEP   DROP } INDEX ]                                                                                                                                                                                                                                |
| end_session_clauses        | { DISCONNECT SESSION 'integer1, integer2'<br>[ POST_TRANSACTION ]<br>  KILL SESSION 'integer1, integer2'<br>}<br>[ IMMEDIATE ]                                                                                                                                                                   |
| estimate_statistics_clause | ESTIMATE [ SYSTEM ] STATISTICS [ for_clause ]<br>[ SAMPLE integer { ROWS   PERCENT } ]                                                                                                                                                                                                           |
| exceptions_clause          | EXCEPTIONS INTO [ schema. ]table                                                                                                                                                                                                                                                                 |
| exchange_partition_subpart | EXCHANGE { PARTITION partition<br>  SUBPARTITION subpartition<br>}<br>WITH TABLE table<br>[ { INCLUDING   EXCLUDING } INDEXES ]<br>[ { WITH   WITHOUT } VALIDATION ]<br>[ exceptions_clause ]<br>[ update_index_clauses [ parallel_clause ] ]                                                    |
| expr                       | { simple_expression<br>compound_expression<br>case_expression<br>cursor_expression<br>datetime_expression<br>function_expression<br>interval_expression<br>object_access_expression<br>scalar_subquery_expression<br>model_expression<br>type_constructor_expression<br>variable_expression<br>} |
| expression_list            | { expr [, expr ]...<br>  (expr [, expr ]...)<br>}                                                                                                                                                                                                                                                |
| extended_attribute_clause  | ATTRIBUTE attribute<br>LEVEL level<br>DETERMINES { dependent_column<br>  (dependent_column<br>[, dependent_column ]...<br>)<br>[ LEVEL level                                                                                                                                                     |

| Subclause                | Syntax                                                                                                                                                                                                 |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre>DETERMINES { dependent_column                (dependent_column                  [, dependent_column ]...                )            ]...</pre>                                                   |
| extent_management_clause | <pre>EXTENT MANAGEMENT { DICTIONARY   LOCAL [ AUTOALLOCATE   UNIFORM [ SIZE size_clause ] }</pre>                                                                                                      |
| external_data_properties | <pre>DEFAULT DIRECTORY directory [ ACCESS PARAMETERS { (opaque_format_spec)   USING CLOB subquery } ] LOCATION ( [ directory: ] 'locationSpecifier' [, [ directory: ] 'locationSpecifier' ]... )</pre> |
| external_table_clause    | <pre>([ TYPE access_driver_type ] external_data_properties ) [ REJECT LIMIT { integer   UNLIMITED } ]</pre>                                                                                            |
| file_specification       | <pre>{ datafile_tempfile_spec   diskgroup_file_spec   redo_log_file_spec }</pre>                                                                                                                       |
| finish_clause            | <pre>[ DISCONNECT [ FROM SESSION ] ] [ parallel_clause ] FINISH [ SKIP [ STANDBY LOGFILE ] ] [ WAIT   NOWAIT ]</pre>                                                                                   |
| flashback_mode_clause    | <pre>FLASHBACK { ON   OFF }</pre>                                                                                                                                                                      |
| flashback_query_clause   | <pre>[ VERSIONS BETWEEN { SCN   TIMESTAMP } { expr   MINVALUE } AND { expr   MAXVALUE }</pre>                                                                                                          |

| Subclause              | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | ]<br>AS OF { SCN   TIMESTAMP } expr                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| for_clause             | FOR<br>{ TABLE<br>  ALL [ INDEXED ] COLUMNS [ SIZE integer ]<br>  COLUMNS [ SIZE integer ]<br>{ column   attribute } [ SIZE integer ]<br>[ { column   attribute }<br>[ SIZE integer ]<br>]...<br>  ALL [ LOCAL ] INDEXES<br>}<br>[ FOR<br>{ TABLE<br>  ALL [ INDEXED ] COLUMNS<br>[ SIZE integer ]<br>  COLUMNS [ SIZE integer ]<br>{ column   attribute } [ SIZE integer ]<br>[ { column   attribute }<br>[ SIZE integer ]<br>]...<br>  ALL [ LOCAL ] INDEXES<br>}<br>]... |
| for_update_clause      | FOR UPDATE<br>[ OF [ [ schema. ]<br>{ table   view } . ]column<br>[, [ [ schema. ]<br>{ table   view } . ]column<br>]...<br>]<br>[ NOWAIT   WAIT integer ]                                                                                                                                                                                                                                                                                                                  |
| full_database_recovery | [ STANDBY ] DATABASE<br>[ { UNTIL { CANCEL<br>  TIME date<br>  CHANGE integer<br>}<br>  USING BACKUP CONTROLFILE<br>}<br>[ UNTIL { CANCEL<br>  TIME date<br>  CHANGE integer<br>}<br>  USING BACKUP CONTROLFILE<br>]...<br>]                                                                                                                                                                                                                                                |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| fully_qualified_file_name | +diskgroup_name/db_name/file_type/<br>file_type_tag.filenumbers.incarnation_number                                                                                                                                                                                                                                                                                                                                                                                                                        |
| function_association      | <pre>{ 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 ]     } } </pre> |
| function_declaration      | <pre>FUNCTION name     (parameter datatype[, parameter datatype] ]...)     RETURN datatype     { IS   AS } { pl/sql_block   call_spec }</pre>                                                                                                                                                                                                                                                                                                                                                             |
| function_spec             | <pre>FUNCTION name     (parameter datatype [, parameter datatype ]...)     return_clause</pre>                                                                                                                                                                                                                                                                                                                                                                                                            |
| general_recovery          | <pre>RECOVER [ AUTOMATIC ] [ FROM 'location' ] { { full_database_recovery   partial_database_recovery   LOGFILE 'filename' } [ { TEST   ALLOW integer CORRUPTION   parallel_clause } [ TEST   ALLOW integer CORRUPTION   parallel_clause ]... ]</pre>                                                                                                                                                                                                                                                     |

| Subclause                | Syntax                                                                                                                                                                                                                                              |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre>         ]   CONTINUE [ DEFAULT ]   CANCEL }</pre>                                                                                                                                                                                             |
| global_partitioned_index | <pre>GLOBAL PARTITION BY { RANGE   (column_list)   (index_partitioning_clause)   HASH   (column_list)   { individual_hash_partitions     hash_partitions_by_quantity   } }</pre>                                                                    |
| grant_object_privileges  | <pre>{ object_privilege   ALL [ PRIVILEGES ] } [ (column [, column]...) ] [, { object_privilege   ALL [ PRIVILEGES ] }   [ (column [, column]...) ] ] ]... on_object_clause TO grantee_clause [ WITH HIERARCHY OPTION ] [ WITH GRANT OPTION ]</pre> |
| grant_system_privileges  | <pre>{ system_privilege   role   ALL PRIVILEGES } [, { system_privilege   role   ALL PRIVILEGES } ] ]... TO grantee_clause [ IDENTIFIED BY password ] [ WITH ADMIN OPTION ]</pre>                                                                   |
| grantee_clause           | <pre>{ user   role   PUBLIC } [, { user   role   PUBLIC } ]...</pre>                                                                                                                                                                                |
| group_by_clause          | <pre>GROUP BY { expr   rollup_cube_clause   grouping_sets_clause } [, { expr   rollup_cube_clause   grouping_sets_clause }]</pre>                                                                                                                   |

| Subclause                   | Syntax                                                                                                                                                                              |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | ]<br>[ HAVING condition ]                                                                                                                                                           |
| grouping_expression_list    | expression_list [, expression_list ]...                                                                                                                                             |
| grouping_sets_clause        | GROUPING SETS<br>({ rollup_cube_clause   grouping_expression_list })                                                                                                                |
| hash_partitioning           | PARTITION BY HASH<br>(column [, column ] ...)<br>{ individual_hash_partitions<br>  hash_partitions_by_quantity }                                                                    |
| hash_partitions_by_quantity | PARTITIONS hash_partition_quantity<br>[ STORE IN<br>(tablespace [, tablespace ]...) ]<br>[ OVERFLOW STORE IN<br>(tablespace [, tablespace ]...) ]                                   |
| hierarchical_query_clause   | [ START WITH condition ]<br>CONNECT BY [ NOCYCLE ] condition                                                                                                                        |
| hierarchy_clause            | HIERARCHY hierarchy<br>(child_level CHILD OF parent_level<br>[ CHILD OF parent_level ]...<br>[ dimension_join_clause ]<br>)                                                         |
| implementation_clause       | { ANCILLARY TO<br>primary_operator (parameter_type<br>[, parameter_type ]...)<br>[, primary_operator ( parameter_type<br>[, parameter_type<br>]...<br>]...<br>  context_clause<br>} |
| incomplete_file_name        | +diskgroup_name [ (template_name) ]                                                                                                                                                 |
| index_attributes            | [ { physical_attributes_clause<br>  logging_clause<br>  ONLINE<br>  COMPUTE STATISTICS<br>  TABLESPACE { tablespace   DEFAULT }<br>  key_compression }                              |

| Subclause                   | Syntax                                                                                                                                                                                                                                                   |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>   { SORT   NOSORT }   REVERSE   parallel_clause } [ physical_attributes_clause   logging_clause   ONLINE   COMPUTE STATISTICS   TABLESPACE { tablespace   DEFAULT }   key_compression   { SORT   NOSORT }   REVERSE   parallel_clause ]... ]</pre> |
| index_expr                  | { column   column_expression }                                                                                                                                                                                                                           |
| index_org_overflow_clause   | [ INCLUDING column_name ] OVERFLOW [ segment_attributes_clause ]                                                                                                                                                                                         |
| index_org_table_clause      | <pre> [ { mapping_table_clause   PCTTHRESHOLD integer   key_compression } [ mapping_table_clause   PCTTHRESHOLD integer   key_compression ]... ] [ index_org_overflow_clause ]</pre>                                                                     |
| index_partition_description | <pre> PARTITION [ partition [ { segment_attributes_clause   key_compression } [ segment_attributes_clause   key_compression ]... ] ]</pre>                                                                                                               |
| index_partitioning_clause   | PARTITION [ partition ] VALUES LESS THAN (value[, value... ]) [ segment_attributes_clause ]                                                                                                                                                              |
| index_properties            | [ { { global_partitioned_index   local_partitioned_index                                                                                                                                                                                                 |

| Subclause                  | Syntax                                                                                                                                                                                                 |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | <pre>         }           index_attributes     }     [ { { global_partitioned_index             local_partitioned_index       }         index_attributes     }     ]...   domain_index_clause ] </pre> |
| index_subpartition_clause  | <pre> { STORE IN (tablespace[, tablespace ]...)   (SUBPARTITION   [ subpartition [ TABLESPACE tablespace ] ]   [, SUBPARTITION     [ subpartition [ TABLESPACE tablespace   ] ]   ]... ) } </pre>      |
| individual_hash_partitions | <pre> (PARTITION   [ partition partitioning_storage_clause ]   [, PARTITION     [ partition partitioning_storage_clause   ] ]   ]... ) </pre>                                                          |
| inheritance_clauses        | <pre> [ NOT ] { OVERRIDING   FINAL   INSTANTIABLE } [ [ NOT ] { OVERRIDING   FINAL   INSTANTIABLE } ]... </pre>                                                                                        |
| inline_constraint          | <pre> [ CONSTRAINT constraint_name ] { [ NOT ] NULL   UNIQUE   PRIMARY KEY   references_clause   CHECK (condition) } [ constraint_state ] </pre>                                                       |
| inline_ref_constraint      | <pre> { SCOPE IS [ schema. ] scope_table   WITH ROWID   [ CONSTRAINT constraint_name ]   references_clause   [ constraint_state ] } </pre>                                                             |

| Subclause               | Syntax                                                                                                                                                                                                                                                                             |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| inner_cross_join_clause | <pre>table_reference { [ INNER ] JOIN table_reference   { ON condition     USING (column [, column ]...)   }   { CROSS   NATURAL [ INNER ] } JOIN table_reference }</pre>                                                                                                          |
| insert_into_clause      | INTO dml_table_expression_clause [ t_alias ]<br>[ (column [, column ]...) ]                                                                                                                                                                                                        |
| integer                 | [ +   - ] digit [ digit ]...                                                                                                                                                                                                                                                       |
| interval_day_to_second  | <pre>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) ] } ]</pre> |
| interval_year_to_month  | <pre>INTERVAL 'integer [- integer ]' { YEAR   MONTH } [ (precision) ] [ TO { YEAR   MONTH } ]</pre>                                                                                                                                                                                |
| 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 }                                                                                                                                                                                                                                              |

| Subclause             | Syntax                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| level_clause          | <pre>LEVEL level IS   { level_table.level_column     (level_table.level_column     [, level_table.level_column ]...   ) }</pre>                                                                                                                                                                                                                                                                                     |
| list_partitioning     | <pre>PARTITION BY LIST (column) (PARTITION [ partition ]   list_values_clause   table_partition_description [, PARTITION [ partition ]   list_values_clause   table_partition_description ]... )</pre>                                                                                                                                                                                                              |
| list_values_clause    | <pre>VALUES ({ value   NULL   [, { value   NULL }...]   DEFAULT })</pre>                                                                                                                                                                                                                                                                                                                                            |
| LOB_parameters        | <pre>{ 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 ] } ] ]...</pre> |
| LOB_partition_storage | <pre>PARTITION partition { LOB_storage_clause   varray_col_properties } [ LOB_storage_clause   varray_col_properties ]... [ (SUBPARTITION subpartition</pre>                                                                                                                                                                                                                                                        |

| Subclause               | Syntax                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>         { LOB_storage_clause   varray_col_properties       }       [ LOB_storage_clause         varray_col_properties       ]...     ) ] </pre>                                                                                                                                                                                       |
| LOB_storage_clause      | <pre> LOB { (LOB_item [, LOB_item]...)   STORE AS (LOB_parameters)   (LOB_item)   STORE AS     { LOB_segnane (LOB_parameters)       LOB_segnane       (LOB_parameters)   } } </pre>                                                                                                                                                         |
| local_partitioned_index | <pre> LOCAL [ on_range_partitioned_table   on_list_partitioned_table   on_hash_partitioned_table   on_comp_partitioned_table ] </pre>                                                                                                                                                                                                       |
| logfile_clause          | <pre> LOGFILE [ GROUP integer ] file_specification [, [ GROUP integer ] file_specification ]... </pre>                                                                                                                                                                                                                                      |
| logfile_clauses         | <pre> { { 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 } </pre> |
| logfile_descriptor      | <pre> { GROUP integer   ('filename' [, 'filename' ]...)   'filename' } </pre>                                                                                                                                                                                                                                                               |

| <b>Subclause</b>           | <b>Syntax</b>                                                                                                               |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| logging_clause             | { LOGGING   NOLOGGING }                                                                                                     |
| main_model                 | [ MAIN main_model_name ]<br>model_column_clauses<br>[ cell_reference_options ]<br>model_rules_clause                        |
| managed_standby_recovery   | RECOVER MANAGED STANDBY DATABASE<br>[ recover_clause   cancel_clause  <br>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 ]<br>[ table_partitioning_clauses ]<br>[ CACHE   NOCACHE ]<br>[ parallel_clause ]<br>[ build_clause ]   |
| maximize_standby_db_clause | SET STANDBY DATABASE TO MAXIMIZE<br>{ PROTECTION   AVAILABILITY   PERFORMANCE }                                             |
| maxsize_clause             | MAXSIZE { UNLIMITED   size_clause }                                                                                         |
| merge_insert_clause        | WHEN NOT MATCHED THEN<br>INSERT [ (column [, column ]...) ]<br>VALUES ({ expr [, expr ]...   DEFAULT })<br>[ where_clause ] |
| merge_table_partitions     | MERGE PARTITIONS partition_1, partition_2<br>[ INTO partition_spec ]<br>[ update_index_clauses ]<br>[ parallel_clause ]     |
| merge_table_subpartitions  | MERGE SUBPARTITIONS subpart_1, subpart_2<br>[ INTO subpartition_spec ]<br>[ update_index_clauses ]<br>[ parallel_clause ]   |
| merge_update_clause        | WHEN MATCHED THEN<br>UPDATE SET column = { expr   DEFAULT }                                                                 |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                         |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | [ , column = { expr   DEFAULT } ]...<br>[ where_clause ]<br>[ DELETE where_clause ]                                                                                                                                                                                            |
| model_clause                | MODEL<br>[ cell_reference_options ]<br>[ return_rows_clause ]<br>[ reference_model ]<br>[ reference_model ]...<br>main_model                                                                                                                                                   |
| model_column                | expr [ [ AS ] c_alias ]                                                                                                                                                                                                                                                        |
| model_column_clauses        | [ query_partition_clause [ c_alias ] ]<br>DIMENSION BY (model_column<br>[ , model_column ]...)<br>MEASURES (model_column<br>[ , model_column ]...)                                                                                                                             |
| model_rules_clause          | RULES<br>[ UPSERT   UPDATE ]<br>[ { AUTOMATIC   SEQUENTIAL } ORDER ]<br>[ ITERATE (number) [ UNTIL (condition) ] ]<br>([ [ UPDATE   UPSERT ]<br>cell_assignment [ order_by_clause ] = expr<br>[ [ UPDATE   UPSERT ]<br>cell_assignment [ order_by_clause ] = expr<br>]...<br>) |
| modify_col_properties       | ( column [ datatype ]<br>[ DEFAULT expr ]<br>[ inline_constraint<br>[ inline_constraint ]... ]<br>[ LOB_storage_clause ]<br>, column [ datatype ]<br>[ DEFAULT expr ]<br>[ inline_constraint<br>[ inline_constraint ]... ]<br>[ LOB_storage_clause ]<br>]<br>)                 |
| modify_col_substitutable    | COLUMN column<br>[ NOT ] SUBSTITUTABLE AT ALL LEVELS<br>[ FORCE ]                                                                                                                                                                                                              |
| modify_collection_retrieval | MODIFY NESTED TABLE collection_item<br>RETURN AS { LOCATOR   VALUE }                                                                                                                                                                                                           |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| modify_column_clauses     | MODIFY { modify_col_properties<br>  modify_col_substitutable<br>}                                                                                                                                                                                                                                                                                     |
| modify_hash_partition     | MODIFY PARTITION partition<br>{ partition_attributes<br>  alter_mapping_table_clause<br>[ REBUILD ] UNUSABLE LOCAL INDEXES<br>}                                                                                                                                                                                                                       |
| modify_hash_subpartition  | { { allocate_extent_clause<br>  deallocate_unused_clause<br>  shrink_clause<br>  { LOB LOB_item<br>  VARRAY varray<br>}<br>  modify_LOB_parameters<br>[ { LOB LOB_item<br>  VARRAY varray<br>}<br>  modify_LOB_parameters<br>]...<br>  [ REBUILD ] UNUSABLE LOCAL INDEXES<br>}                                                                        |
| modify_index_defaultAttrs | MODIFY DEFAULT ATTRIBUTES<br>[ FOR PARTITION partition ]<br>{ physical_attributes_clause<br>  TABLESPACE { tablespace   DEFAULT }<br>  logging_clause<br>}<br>[ physical_attributes_clause<br>  TABLESPACE { tablespace   DEFAULT }<br>  logging_clause<br>]...<br>}                                                                                  |
| modify_index_partition    | MODIFY PARTITION partition<br>{ { deallocate_unused_clause<br>  allocate_extent_clause<br>  physical_attributes_clause<br>  logging_clause<br>  key_compression<br>}<br>  deallocate_unused_clause<br>  allocate_extent_clause<br>  physical_attributes_clause<br>  logging_clause<br>  key_compression<br>]...<br>  PARAMETERS ( 'ODCI_parameters' ) |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>   COALESCE   UPDATE BLOCK REFERENCES   UNUSABLE } </pre>                                                                                                                                                                                                                                                                                                                                |
| modify_index_subpartition | <pre> MODIFY SUBPARTITION subpartition {   UNUSABLE     allocate_extent_clause     deallocate_unused_clause } </pre>                                                                                                                                                                                                                                                                          |
| modify_list_partition     | <pre> MODIFY PARTITION partition {   partition_attributes     {ADD   DROP} VALUES   (partition_value[, partition_value ]...)     [ REBUILD ] UNUSABLE LOCAL INDEXES } </pre>                                                                                                                                                                                                                  |
| modify_list_subpartition  | <pre> { 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 ]...) } </pre>                                                                                              |
| modify_LOB_parameters     | <pre> { 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 ] } </pre> |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                           |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>         }           allocate_extent_clause           deallocate_unused_clause           shrink_clause ]... </pre>                                                                                                                                                                                          |
| modify_LOB_storage_clause | MODIFY LOB (LOB_item)<br>(modify_LOB_parameters)                                                                                                                                                                                                                                                                 |
| modify_range_partition    | <pre> 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 } </pre>                                                      |
| modify_table_defaultAttrs | <pre> 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) ]... ] </pre> |
| modify_table_partition    | <pre> { modify_range_partition   modify_hash_partition   modify_list_partition } </pre>                                                                                                                                                                                                                          |
| modify_table_subpartition | <pre> MODIFY SUBPARTITION subpartition { modify_hash_subpartition   modify_list_subpartition } </pre>                                                                                                                                                                                                            |

| Subclause               | Syntax                                                                                                                                                                                                                                                                                                                                |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| move_table_clause       | <pre>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 ]</pre> |
| move_table_partition    | <pre>MOVE PARTITION partition       [ MAPPING TABLE ]       [ table_partition_description ]       [ update_index_clauses ]       [ parallel_clause ]</pre>                                                                                                                                                                            |
| move_table_subpartition | <pre>MOVE SUBPARTITION       subpartition_spec       [ update_index_clauses ]       [ parallel_clause ]</pre>                                                                                                                                                                                                                         |
| multi_column_for_loop   | <pre>FOR (dimension_column       [, dimension_column ]...) IN ( { (literal [, literal ]...)       [ (literal [, literal ]...)... ]         subquery     }   ) )</pre>                                                                                                                                                                 |
| multi_table_insert      | <pre>{ ALL insert_into_clause       [ values_clause ]       [ insert_into_clause           [ values_clause ]         ]       ...         conditional_insert_clause     }   subquery</pre>                                                                                                                                             |
| multiset_except         | <pre>nested_table1 MULTISET EXCEPT [ ALL   DISTINCT ] nested_table2</pre>                                                                                                                                                                                                                                                             |
| multiset_intersect      | <pre>nested_table1 MULTISET INTERSECT [ ALL   DISTINCT ] nested_table2</pre>                                                                                                                                                                                                                                                          |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                                                                |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| multiset_union              | nested_table1<br>MULTISET UNION [ ALL   DISTINCT ]<br>nested_table2                                                                                                                                                                                                                                                                   |
| nested_table_col_properties | NESTED TABLE<br>{ nested_item   COLUMN_VALUE }<br>[ substitutable_column_clause ]<br>STORE AS storage_table<br>[ ( { object_properties )<br>  physical_properties ]<br>  column_properties ]<br>}<br>[ (object_properties)<br>  physical_properties ]<br>  column_properties ]<br>]...<br>)<br>]<br>[ RETURN AS { LOCATOR   VALUE } ] |
| new_values_clause           | { INCLUDING   EXCLUDING } NEW VALUES                                                                                                                                                                                                                                                                                                  |
| number                      | [ +   - ]<br>{ digit [ digit ]... [ . ] [ digit [ digit ]...<br>  . digit [ digit ]...<br>}<br>[ e [ +   - ] digit [ digit ]... ]<br>[ f   d ]                                                                                                                                                                                        |
| numeric_file_name           | +diskgroup_name.filenumber.incarnation_number                                                                                                                                                                                                                                                                                         |
| object_properties           | { { column   attribute }<br>[ DEFAULT expr ]<br>[ inline_constraint [ inline_constraint ]...<br>  inline_ref_constraint<br>]<br>  { out_of_line_constraint<br>  out_of_line_ref_constraint<br>  supplemental_logging_props<br>}<br>}                                                                                                  |
| object_table                | CREATE [ GLOBAL TEMPORARY ] TABLE<br>[ schema. ]table OF<br>[ schema. ]object_type<br>[ object_table_substitution ]<br>[ (object_properties) ]<br>[ ON COMMIT { DELETE   PRESERVE } ROWS ]<br>[ OID_clause ]                                                                                                                          |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | [ OID_index_clause ]<br>[ physical_properties ]<br>[ 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<br>{ WITH OBJECT IDENTIFIER<br>{ DEFAULT   ( attribute<br>[, attribute ]... )<br>}<br>  UNDER [ schema. ]superview<br>}<br>( { out_of_line_constraint<br>  attribute inline_constraint<br>[ inline_constraint ]...<br>}<br>[, { out_of_line_constraint<br>  attribute inline_constraint<br>[ inline_constraint ]...<br>}<br>]...<br>) |
| OID_clause                 | OBJECT IDENTIFIER IS<br>{ SYSTEM GENERATED   PRIMARY KEY }                                                                                                                                                                                                                                                                                                    |
| OID_index_clause           | OIDINDEX [ index ]<br>( { physical_attributes_clause<br>  TABLESPACE tablespace<br>}<br>[ physical_attributes_clause<br>  TABLESPACE tablespace<br>]...<br>)                                                                                                                                                                                                  |
| on_comp_partitioned_table  | [ STORE IN ( tablespace [, tablespace ]... ) ]<br>( PARTITION<br>[ partition<br>[ { segment_attribute_clause<br>  key_compression<br>}<br>[ segment_attribute_clause<br>  key_compression<br>]...<br>]<br>[ index_subpartition_clause ]<br>)                                                                                                                  |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>[ , PARTITION   [ partition     [ { segment_attribute_clause           key_compression       }       [ segment_attribute_clause           key_compression       ]...     ]     [ index_subpartition_clause ]   ]... ) )</pre>                                                                                                                                                  |
| on_hash_partitioned_table | <pre>{ STORE IN (tablespace[, tablespace]...)   (PARTITION   [ partition [ TABLESPACE tablespace ] ] [ , PARTITION   [ partition [ TABLESPACE tablespace ] ] ]... ) }</pre>                                                                                                                                                                                                         |
| on_list_partitioned_table | <pre>( PARTITION   [ partition     [ { segment_attributes_clause           key_compression       }       [ segment_attributes_clause           key_compression       ]...     ]   ] [ , PARTITION   [ partition     [ { segment_attributes_clause           key_compression       }       [ segment_attributes_clause           key_compression       ]...     ]   ] ] )... )</pre> |
| on_object_clause          | <pre>{ schema.object   { DIRECTORY directory_name   JAVA { SOURCE   RESOURCE } [ schema. ]object } }</pre>                                                                                                                                                                                                                                                                          |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| on_range_partitioned_table | ( PARTITION<br>[ partition<br>[ { segment_attributes_clause<br>  key_compression<br>}<br>[ { segment_attributes_clause<br>  key_compression<br>]...<br>]<br>]<br>[, PARTITION<br>[ partition<br>[ { segment_attributes_clause<br>  key_compression<br>}<br>[ { segment_attributes_clause<br>  key_compression<br>]...<br>]<br>]<br>]...<br>) |
| order_by_clause            | ORDER [ SIBLINGS ] BY<br>{ expr   position   c_alias }<br>[ ASC   DESC ]<br>[ NULLS FIRST   NULLS LAST ]<br>[, { expr   position   c_alias }<br>                                                                                                                                                                                             |
| out_of_line_constraint     | [ CONSTRAINT constraint_name ]<br>{ UNIQUE (column [, column ]....)<br>  PRIMARY KEY (column [, column ]....)<br>  FOREIGN KEY (column [, column ]....)<br>references_clause<br>  CHECK (condition)<br>}<br>[ constraint_state ]                                                                                                             |
| out_of_line_ref_constraint | { SCOPE FOR<br>({ ref_col   ref_attr })<br>IS [ schema. ]scope_table<br>  REF<br>({ ref_col   ref_attr })<br>WITH ROWID<br>  [ CONSTRAINT constraint_name ]<br>FOREIGN KEY<br>({ ref_col   ref_attr })<br>references_clause<br>[ constraint_state ]<br>}                                                                                     |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                         |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| outer_join_clause         | <pre>table_reference [ query_partition_clause ] { outer_join_type JOIN   NATURAL [ outer_join_type ] JOIN } table_reference [ query_partition_clause ] [ ON condition   USING ( column [, column ]...) ]</pre>                                                                                                 |
| outer_join_type           | { FULL   LEFT   RIGHT } [ OUTER ]                                                                                                                                                                                                                                                                              |
| parallel_clause           | { NOPARALLEL   PARALLEL [ integer ] }                                                                                                                                                                                                                                                                          |
| parallel_enable_clause    | <pre>PARALLEL_ENABLE [ (PARTITION argument BY     { ANY       { HASH   RANGE } (column [, column ]...)     } ) [ streaming_clause ] ]</pre>                                                                                                                                                                    |
| partial_database_recovery | <pre>{ TABLESPACE tablespace [, tablespace ]...   DATAFILE { 'filename'   filenumber }     [, 'filename'   filenumber ]... }   STANDBY { TABLESPACE tablespace [, tablespace ]...   DATAFILE { 'filename'   filenumber }     [, 'filename'   filenumber ]... } } UNTIL [ CONSISTENT WITH ] CONTROLFILE }</pre> |
| partition_attributes      | <pre>[ { 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</pre>                                           |

| Subclause                    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <pre> { 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   ]... ] </pre>                                                                                                        |
| partition_extended_name      | <pre> [ schema.] { table   view } [ PARTITION (partition)   SUBPARTITION (subpartition) ] </pre>                                                                                                                                                                                                                                                                                                                                                                                             |
| partition_level_subpartition | <pre> { SUBPARTITIONS hash_subpartition_quantity   [ STORE IN (tablespace[, tablespace ]...) ]     (subpartition_spec[, subpartition_spec ]...) } </pre>                                                                                                                                                                                                                                                                                                                                     |
| partition_spec               | <pre> PARTITION [ partition ] [ table_partition_description ] </pre>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| partitioning_storage_clause  | <pre> [ { TABLESPACE tablespace     OVERFLOW [ TABLESPACE tablespace ]     LOB (LOB_item) STORE AS     { LOB_segnname [ (TABLESPACE tablespace) ]       (TABLESPACE tablespace)     }     VARRAY varray_item STORE AS LOB LOB_segnname }  [ { TABLESPACE tablespace     OVERFLOW [ TABLESPACE tablespace ]     LOB (LOB_item) STORE AS     { LOB_segnname [ (TABLESPACE tablespace)       (TABLESPACE tablespace)     ]     VARRAY varray_item STORE AS LOB   LOB_segnname   } ]... ] </pre> |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| password_parameters         | <pre>{ { 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 } }</pre>                                                                                                                                                                                                                                                                     |
| permanent_tablespace_clause | <pre>{ 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 ]... }</pre> |
| physical_attributes_clause  | <pre>[ { PCTFREE integer   PCTUSED integer   INITTRANS integer   storage_clause } [ PCTFREE integer   PCTUSED integer   INITTRANS integer   storage_clause ]... ]</pre>                                                                                                                                                                                                                                                                                                                                                     |
| physical_properties         | <pre>{ segment_attributes_clause   [ table_compression ]   ORGANIZATION   { HEAP     [ segment_attributes_clause ]</pre>                                                                                                                                                                                                                                                                                                                                                                                                    |

| Subclause             | Syntax                                                                                                                                                                              |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <pre> [ table_compression ]   INDEX   [ segment_attributes_clause ]   index_org_table_clause   EXTERNAL   external_table_clause }   CLUSTER cluster (column [, column ]...) }</pre> |
| pragma_clause         | <pre> PRAGMA RESTRICT_REFERENCES ( { method_name   DEFAULT } , { RNDS   WNDS   RNPS   WNPS   TRUST } [, { RNDS   WNDS   RNPS   WNPS   TRUST } ]... )</pre>                          |
| procedure_declaration | <pre> PROCEDURE name (parameter datatype                  [, parameter datatype ]...) { IS   AS } { pl/sql_block   call_spec }</pre>                                                |
| procedure_spec        | <pre> PROCEDURE name (parameter datatype [, parameter datatype ]...) [ { IS   AS } call_spec ]</pre>                                                                                |
| proxy_authentication  | <pre> { AUTHENTICATION REQUIRED   AUTHENTICATED USING { PASSWORD   DISTINGUISHED NAME   CERTIFICATE [ TYPE 'type' ] [ VERSION 'version' ] } }</pre>                                 |
| proxy_clause          | <pre> { GRANT   REVOKE } CONNECT THROUGH proxy [ WITH { ROLE { role_name [, role_name ]...   ALL EXCEPT role_name [, role_name ]... }   NO ROLES } ] [ proxy_authentication ]</pre> |
| qualified_disk_clause | <pre> search_string [ NAME disk_name ] [ SIZE size_clause ] [ FORCE   NOFORCE ]</pre>                                                                                               |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                         |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| qualified_template_clause  | template_name<br>ATTRIBUTES<br>([ MIRROR   UNPROTECTED ]<br>[ FINE   COARSE ]<br>)                                                                                                                                                                                                             |
| query_partition_clause     | PARTITION BY<br>{ value_expr[, value_expr ]...<br>  ( value_expr[, value_expr ]... )}                                                                                                                                                                                                          |
| query_table_expression     | { query_name<br>  schema.<br>{ table [ { PARTITION (partition)<br>  SUBPARTITION (subpartition)<br>}<br>  sample_clause<br>  sample_clause<br>  @ dblink<br>]<br>  { view   materialized view } [ @ dblink ]<br>}<br>(subquery [ subquery_restriction_clause ])<br>table_collection_expression |
| quiesce_clauses            | QUIESCE RESTRICTED   UNQUIESCE                                                                                                                                                                                                                                                                 |
| range_partitioning         | PARTITION BY RANGE (column[, column ]...)<br>(PARTITION [ partition ]<br>range_values_clause<br>table_partition_description<br>[, PARTITION [ partition ]<br>range_values_clause<br>table_partition_description<br>]...<br>)                                                                   |
| range_values_clause        | VALUES LESS THAN<br>({ value   MAXVALUE }<br>[, { value   MAXVALUE } ]...<br>)                                                                                                                                                                                                                 |
| rebalance_diskgroup_clause | REBALANCE [ POWER integer ]                                                                                                                                                                                                                                                                    |
| rebuild_clause             | REBUILD<br>[ { PARTITION partition<br>  SUBPARTITION subpartition<br>}<br>  { REVERSE   NOREVERSE } ]                                                                                                                                                                                          |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre> ] 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 ]... </pre>                                                                                                                                                                                                                                                                                                      |
| records_per_block_clause | { MINIMIZE   NOMINIMIZE } RECORDS_PER_BLOCK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| recover_clause           | <pre> { { 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 } ] ... </pre> |

| Subclause               | Syntax                                                                                                                                                  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| recovery_clauses        | { general_recovery<br>  managed_standby_recovery<br>  BEGIN BACKUP<br>  END BACKUP<br>}                                                                 |
| redo_log_file_spec      | [ 'filename'<br>  ('filename' [, 'filename' ]...)<br>]<br>[ SIZE size_clause ]<br>[ REUSE ]                                                             |
| redo_thread_clauses     | { ENABLE   DISABLE }<br>{ INSTANCE 'instance_name'<br>  [ PUBLIC ] THREAD integer<br>}                                                                  |
| reference_model         | REFERENCE reference_spreadsheet_name<br>ON (subquery)<br>spreadsheet_column_clauses<br>[ cell_reference_options ]                                       |
| references_clause       | REFERENCES [ schema. ] { object_table   view }<br>[ (column [, column ]...) ]<br>[ ON DELETE { CASCADE   SET NULL } ]<br>[ constraint_state ]           |
| referencing_clause      | REFERENCING<br>{ OLD [ AS ] old<br>  NEW [ AS ] new<br>  PARENT [ AS ] parent }<br>[ OLD [ AS ] old<br>  NEW [ AS ] new<br>  PARENT [ AS ] parent ]...  |
| register_logfile_clause | REGISTER<br>[ OR REPLACE ]<br>[ PHYSICAL   LOGICAL ]<br>LOGFILE<br>[ file_specification<br>[, file_specification ]...<br>]<br>FOR logminer_session_name |
| relational_properties   | { column datatype [ SORT ]<br>[ DEFAULT expr ]<br>[ inline_constraint<br>[ inline_constraint ]...<br>  inline_ref_constraint                            |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre>         ]   { 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     } ] ]... </pre> |
| relational_table         | <pre> CREATE [ GLOBAL TEMPORARY ] TABLE [ schema. ]table   [ (relational_properties) ]   [ ON COMMIT { DELETE   PRESERVE } ROWS ]   [ physical_properties ]   [ table_properties ] ; </pre>                                                                                                                                                                                          |
| rename_column_clause     | <pre> RENAME COLUMN old_name TO new_name </pre>                                                                                                                                                                                                                                                                                                                                      |
| rename_index_partition   | <pre> RENAME { PARTITION partition           SUBPARTITION subpartition } TO new_name </pre>                                                                                                                                                                                                                                                                                          |
| rename_partition_subpart | <pre> RENAME { PARTITION   SUBPARTITION } current_name TO new_name </pre>                                                                                                                                                                                                                                                                                                            |
| replace_type_clause      | <pre> REPLACE [ invoker_rights_clause ] AS OBJECT   (attribute datatype [, attribute datatype ] ]...   [, element_spec [, element_spec ]... ]) </pre>                                                                                                                                                                                                                                |
| resize_disk_clauses      | <pre> 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 ] ]... } </pre>                                                                                                                                           |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                           |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| resource_parameters        | { { SESSIONS_PER_USER<br>  CPU_PER_SESSION<br>  CPU_PER_CALL<br>  CONNECT_TIME<br>  IDLE_TIME<br>  LOGICAL_READS_PER_SESSION<br>  LOGICAL_READS_PER_CALL<br>  COMPOSITE_LIMIT<br>}<br>  { integer   UNLIMITED   DEFAULT }<br>  PRIVATE_SGA<br>  { integer [ K   M ]   UNLIMITED   DEFAULT }<br>} |
| restricted_session_clauses | { ENABLE   DISABLE } RESTRICTED SESSION                                                                                                                                                                                                                                                          |
| return_clause              | { RETURN datatype [ { IS   AS } call_spec ]<br>  sqlj_object_type_sig<br>}                                                                                                                                                                                                                       |
| return_rows_clause         | RETURN { UPDATED   ALL } ROWS                                                                                                                                                                                                                                                                    |
| returning_clause           | RETURNING expr [, expr ]...<br>INTO data_item [, data_item ]...                                                                                                                                                                                                                                  |
| revoke_object_privileges   | { object_privilege   ALL [ PRIVILEGES ] }<br>[ , { object_privilege   ALL [ PRIVILEGES ] } ]...<br>on_object_clause<br>FROM grantee_clause<br>[ CASCADE CONSTRAINTS   FORCE ]                                                                                                                    |
| revoke_system_privileges   | { system_privilege<br>  role<br>  ALL PRIVILEGES<br>}<br>[ , { system_privilege<br>  role<br>  ALL PRIVILEGES<br>}<br>]...<br>FROM grantee_clause                                                                                                                                                |
| rollup_cube_clause         | { ROLLUP   CUBE } (grouping_expression_list)                                                                                                                                                                                                                                                     |
| routine_clause             | [ schema. ] [ type.   package. ]<br>{ function   procedure   method }<br>[ @dblink_name ]<br>( [ argument [, argument ]... ] )                                                                                                                                                                   |

| Subclause                   | Syntax                                                                                                                                                                                                                                             |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| row_movement_clause         | { ENABLE   DISABLE } ROW MOVEMENT                                                                                                                                                                                                                  |
| sample_clause               | SAMPLE [ BLOCK ]<br>(sample_percent)<br>[ SEED (seed_value) ]                                                                                                                                                                                      |
| schema_object_clause        | { object_option [, object_option ]...   ALL }<br>auditing_on_clause                                                                                                                                                                                |
| scoped_table_ref_constraint | { SCOPE FOR<br>({ ref_column   ref_attribute })<br>IS [ schema. ] { scope_table_name   c_alias }<br>}<br>[, SCOPE FOR<br>({ ref_column   ref_attribute })<br>IS [ schema. ] { scope_table_name   c_alias }<br>}<br>[...]                           |
| searched_case_expression    | WHEN condition THEN return_expr<br>[ WHEN condition THEN return_expr ]...                                                                                                                                                                          |
| security_clause             | GUARD { ALL   STANDBY   NONE }                                                                                                                                                                                                                     |
| segment_attributes_clause   | { physical_attributes_clause<br>  TABLESPACE tablespace<br>  logging_clause<br>}<br>[ physical_attributes_clause<br>  TABLESPACE tablespace<br>  logging_clause<br>]...                                                                            |
| segment_management_clause   | SEGMENT SPACE MANAGEMENT { MANUAL   AUTO }                                                                                                                                                                                                         |
| select_list                 | { *<br>  { query_name.*<br>  [ schema. ]<br>{ table   view   materialized view } .*<br>  expr [ [ AS ] c_alias ]<br>}<br>[, { query_name.*<br>  [ schema. ]<br>{ table   view   materialized view } .*<br>  expr [ [ AS ] c_alias ]<br>}<br>]<br>} |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                      |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| set_subpartition_template  | <pre>SET SUBPARTITION TEMPLATE   { (SUBPARTITION subpartition       [ list_values_clause ]       [ partitioning_storage_clause ]     , SUBPARTITION subpartition       [ list_values_clause ]       [ partitioning_storage_clause ]...       )     )     hash_subpartition_quantity }</pre> |
| set_time_zone_clause       | <pre>SET TIME_ZONE =   '{ { +   - } hh : mi   time_zone_region }'</pre>                                                                                                                                                                                                                     |
| shrink_clause              | SHRINK SPACE [ COMPACT ] [ CASCADE ]                                                                                                                                                                                                                                                        |
| shutdown_dispatcher_clause | SHUTDOWN [ IMMEDIATE ] dispatcher_name                                                                                                                                                                                                                                                      |
| simple_case_expression     | <pre>expr WHEN comparison_expr       THEN return_expr       [ WHEN comparison_expr           THEN return_expr ]...</pre>                                                                                                                                                                    |
| single_column_for_loop     | <pre>FOR dimension_column   { IN ( { literal           [, literal ]...           subquery       }     )     [ LIKE pattern ]     FROM literal TO literal     { INCREMENT   DECREMENT } literal   }</pre>                                                                                    |
| single_table_insert        | <pre>insert_into_clause { values_clause [ returning_clause ]   subquery }</pre>                                                                                                                                                                                                             |
| size_clause                | integer [ K   M   G   T ]                                                                                                                                                                                                                                                                   |
| split_index_partition      | <pre>SPLIT PARTITION partition_name_old   AT (value [, value ]...)   [ INTO (index_partition_description,           index_partition_description         )   ]</pre>                                                                                                                         |

| Subclause                | Syntax                                                                                                                                                                                                                                         |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | [ parallel_clause ]<br>UPDATE MANUALLY problem importing file                                                                                                                                                                                  |
| split_table_partition    | SPLIT PARTITION current_partition<br>{ AT   VALUES } (value [, value ]...)<br>[ INTO (partition_spec, partition_spec) ]<br>[ update_index_clauses ]<br>[ parallel_clause ]<br>UPDATE MANUALLY problem importing file                           |
| split_table_subpartition | SPLIT SUBPARTITION subpartition<br>VALUES ({ value   NULL }<br>[, value   NULL ]...)<br>[ INTO (subpartition_spec,<br>subpartition_spec<br>)<br>]<br>[ update_index_clauses ]<br>[ parallel_clause ]<br>UPDATE MANUALLY problem importing file |
| sql_statement_clause     | { { statement_option   ALL }<br>[, { statement_option   ALL } ]...<br>  { system_privilege   ALL PRIVILEGES }<br>[, { system_privilege   ALL PRIVILEGES } ]...<br>}<br>[ auditing_by_clause ]                                                  |
| sqlj_object_type         | EXTERNAL NAME java_ext_name LANGUAGE JAVA<br>USING (SQLData   CustomDatum   OraData)                                                                                                                                                           |
| sqlj_object_type_attr    | EXTERNAL NAME 'field_name'                                                                                                                                                                                                                     |
| sqlj_object_type_sig     | RETURN { datatype   SELF AS RESULT }<br>EXTERNAL { VARIABLE NAME<br>'java_static_field_name'<br>  NAME 'java_method_sig'<br>}                                                                                                                  |
| standby_database_clauses | ( activate_standby_db_clause<br>  maximize_standby_db_clause<br>  register_logfile_clause<br>  commit_switchover_clause<br>  start_standby_clause<br>  stop_standby_clause<br>)<br>[ parallel_clause ]                                         |
| start_standby_clause     | START LOGICAL STANDBY APPLY<br>[ IMMEDIATE ]<br>[ NODELAY ]<br>[ NEW PRIMARY dblink ]                                                                                                                                                          |

| Subclause            | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre>   INITIAL [ scn_value ]   { SKIP FAILED TRANSACTION   FINISH }   </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| startup_clauses      | <pre> { MOUNT { { STANDBY   CLONE } DATABASE }   OPEN { [ READ WRITE ]   [ RESETLOGS   NORESETLOGS ]   [ UPGRADE   DOWNGRADE ]   READ ONLY }   } </pre>                                                                                                                                                                                                                                                                                                                                                                                                                     |
| stop_standby_clause  | <pre> { STOP   ABORT } LOGICAL STANDBY APPLY </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| storage_clause       | <pre> 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 } ]... ) </pre> |
| streaming_clause     | <pre> { ORDER   CLUSTER } BY (column [, column ]...) </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| subpartition_by_hash | <pre> SUBPARTITION BY HASH (column [, column ]...) [ SUBPARTITIONS quantity   STORE IN (tablespace [, tablespace ]...) ]   subpartition_template ] </pre>                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Subclause              | Syntax                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| subpartition_by_list   | SUBPARTITION BY LIST (column)<br>[ subpartition_template ]                                                                                                                                                                                                                                                                                                                                   |
| subpartition_spec      | SUBPARTITION [ subpartition ]<br>[ list_values_clause ]<br>[ partitioning_storage_clause ]                                                                                                                                                                                                                                                                                                   |
| subpartition_template  | SUBPARTITION TEMPLATE<br>(SUBPARTITION subpartition<br>[ list_values_clause ]<br>[ partitioning_storage_clause ]<br>[ , SUBPARTITION subpartition<br>[ list_values_clause ]<br>[ partitioning_storage_clause ]<br>]<br>)<br>  hash_subpartition_quantity                                                                                                                                     |
| subprogram_declaration | { MEMBER   STATIC }<br>{ procedure_declaraction<br>  function_declaraction<br>  constructor_declaraction<br>}                                                                                                                                                                                                                                                                                |
| subprogram_spec        | { MEMBER   STATIC }<br>{ procedure_spec   function_spec }                                                                                                                                                                                                                                                                                                                                    |
| subquery               | [ subquery_factoring_clause ]<br>SELECT<br>[ hint ]<br>[ { { DISTINCT   UNIQUE }<br>  ALL<br>}<br>]<br>select_list<br>FROM table_reference<br>[ , table_reference ]...<br>[ where_clause ]<br>[ hierarchical_query_clause ]<br>[ group_by_clause ]<br>[ HAVING condition ]<br>[ model_clause ]<br>[ { UNION [ ALL ]<br>  INTERSECT<br>  MINUS<br>}<br>(subquery)<br>]<br>[ order_by_clause ] |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                   |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| subquery_factoring_clause   | WITH query_name AS (subquery)<br>[ , query_name AS (subquery) ]...                                                                                                                                                                                                                       |
| subquery_restriction_clause | WITH { READ ONLY<br>  CHECK OPTION [ CONSTRAINT constraint ]<br>}                                                                                                                                                                                                                        |
| substitutable_column_clause | [ ELEMENT ] IS OF [ TYPE ] ([ ONLY ] type)<br>  [ NOT ] SUBSTITUTABLE AT ALL LEVELS                                                                                                                                                                                                      |
| supplemental_db_logging     | { ADD   DROP } SUPPLEMENTAL LOG<br>{ DATA   supplemental_id_key_clause }                                                                                                                                                                                                                 |
| supplemental_id_key_clause  | DATA<br>( { ALL<br>  PRIMARY KEY<br>  UNIQUE<br>  FOREIGN KEY<br>}<br>[ , { ALL<br>  PRIMARY KEY<br>  UNIQUE<br>  FOREIGN KEY<br>}<br>]<br>[ ...<br>])<br>COLUMNS                                                                                                                        |
| supplemental_log_grp_clause | GROUP log_group<br>(column [ NO LOG ]<br>[ , column [ NO LOG ] ]...)<br>[ ALWAYS ]                                                                                                                                                                                                       |
| supplemental_logging_props  | { supplemental_log_grp_clause<br>  supplemental_id_key_clause<br>}                                                                                                                                                                                                                       |
| supplemental_table_logging  | { ADD SUPPLEMENTAL LOG<br>{ supplemental_log_grp_clause<br>  supplemental_id_key_clause<br>}<br>[ , SUPPLEMENTAL LOG<br>{ supplemental_log_grp_clause<br>  supplemental_id_key_clause<br>}<br>]<br>[ ...<br>  DROP SUPPLEMENTAL LOG<br>{ supplemental_id_key_clause<br>  GROUP log_group |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                  |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>         }       [, SUPPLEMENTAL LOG         { supplemental_id_key_clause           GROUP log_group         }       ]...     }   }</pre>                                                                                                                           |
| table_collection_expression | TABLE (collection_expression) [ (+) ]                                                                                                                                                                                                                                   |
| table_compression           | { COMPRESS   NOCOMPRESS }                                                                                                                                                                                                                                               |
| table_index_clause          | <pre>[ schema. ]table [ t_alias ] (index_expr [ ASC   DESC ] [, index_expr [ ASC   DESC ] ]...) [ index_properties ]</pre>                                                                                                                                              |
| table_partition_description | <pre>[ 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 ]</pre> |
| table_partitioning_clauses  | <pre>{ range_partitioning   hash_partitioning   list_partitioning   composite_partitioning }</pre>                                                                                                                                                                      |
| table_properties            | <pre>[ column_properties ] [ table_partitioning_clauses ] [ CACHE   NOCACHE ] [ parallel_clause ] [ ROWDEPENDENCIES   NOROWDEPENDENCIES ] [ enable_disable_clause ] [ enable_disable_clause ]... [ row_movement_clause ] [ AS subquery ]</pre>                          |
| table_reference             | <pre>{ ONLY   (query_table_expression)   [ flashback_query_clause ]   [ t_alias ]</pre>                                                                                                                                                                                 |

| Subclause                   | Syntax                                                                                                                                                                                                                                     |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>   query_table_expression   [ flashback_query_clause ]   [ t_alias ]   (join_clause)   join_clause } </pre>                                                                                                                           |
| tablespace_clauses          | <pre> { EXTENT MANAGEMENT LOCAL   DATAFILE file_specification     [, file_specification ]...   SYSAUX DATAFILE file_specification     [, file_specification ]...   default_tablespace   default_temp_tablespace   undo_tablespace } </pre> |
| tablespace_group_clause     | TABLESPACE GROUP { tablespace_group_name   '' }                                                                                                                                                                                            |
| tablespace_logging_clauses  | <pre> { logging_clause   [ NO ] FORCE LOGGING } </pre>                                                                                                                                                                                     |
| tablespace_retention_clause | RETENTION { GUARANTEE   NOGUARANTEE }                                                                                                                                                                                                      |
| tablespace_state_clauses    | <pre> { ONLINE   OFFLINE [ NORMAL   TEMPORARY   IMMEDIATE ] }   READ { ONLY   WRITE }   { PERMANENT   TEMPORARY } </pre>                                                                                                                   |
| temporary_tablespace_clause | <pre> TEMPORARY TABLESPACE tablespace [ TEMPFILE file_specification     [, file_specification ]... ] [ tablespace_group_clause ] [ extent_management_clause ] </pre>                                                                       |
| text                        | <pre> [ N   n ] { 'c' [ c ]...   { Q   q }   quote_delimiter c [ c ]... quote_delimiter' } </pre>                                                                                                                                          |
| trace_file_clause           | <pre> TRACE [ AS 'filename' [ REUSE ] ] [ RESETLOGS   NORESETLOGS ] </pre>                                                                                                                                                                 |

| Subclause                  | Syntax                                                                                                                                                                                                            |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| truncate_partition_subpart | TRUNCATE { PARTITION partition<br>  SUBPARTITION subpartition<br>}<br>[ { DROP   REUSE } STORAGE ]<br>[ update_index_clauses [ parallel_clause ] ]                                                                |
| undo_tablespace            | [ BIGFILE   SMALLFILE ]<br>UNDO TABLESPACE tablespace<br>[ TABLESPACE file_specification<br>[, file_specification ]...<br>]                                                                                       |
| undo_tablespace_clause     | UNDO TABLESPACE tablespace<br>[ DATAFILE file_specification<br>[, file_specification ]...<br>]<br>[ extent_management_clause ]<br>[ tablespace_retention_clause ]                                                 |
| undrop_disk_clause         | UNDROP DISKS                                                                                                                                                                                                      |
| update_all_indexes_clause  | UPDATE INDEXES<br>[ (index ( { update_index_partition<br>  update_index_subpartition<br>}<br>)<br>)<br>[ , (index ( { update_index_partition<br>  update_index_subpartition<br>}<br>)<br>)<br>]<br>]...           |
| update_global_index_clause | { UPDATE   INVALIDATE } GLOBAL INDEXES                                                                                                                                                                            |
| update_index_clauses       | { update_global_index_clause<br>  update_all_indexes_clause<br>}                                                                                                                                                  |
| update_index_partition     | PARTITION [ partition ]<br>[ index_partition_description<br>[ index_subpartition_clause ]<br>]<br>[ , PARTITION [ partition ]<br>[ index_partition_description<br>[ index_subpartition_clause ]<br>]<br>]<br>]... |

| Subclause                 | Syntax                                                                                                                                                                                                                                                        |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| update_index_subpartition | SUBPARTITION [ subpartition ]<br>[ TABLESPACE tablespace ]<br>[, SUBPARTITION [ subpartition ]<br>[ TABLESPACE tablespace ]]<br>]...                                                                                                                          |
| update_set_clause         | SET<br>{ { (column [, column ]...) = (subquery)<br>  column = { expr   (subquery)   DEFAULT }<br>}<br>[, { (column [, column]...) = (subquery)<br>  column = { expr   (subquery)   DEFAULT }<br>}<br>]<br>]<br>  VALUE (t_alias) = { expr   (subquery) }<br>} |
| upgrade_table_clause      | UPGRADE [ [NOT ] INCLUDING DATA ]<br>[ column_properties ]                                                                                                                                                                                                    |
| using_function_clause     | USING [ schema. ] [ package.   type.<br>]function_name                                                                                                                                                                                                        |
| using_index_clause        | USING INDEX<br>{ [ schema. ]index<br>  (create_index_statement)<br>  index_properties<br>}                                                                                                                                                                    |
| using_statistics_type     | USING { [ schema. ] statistics_type   NULL }                                                                                                                                                                                                                  |
| using_type_clause         | USING [ schema. ]implementation_type<br>[ array_DML_clause ]                                                                                                                                                                                                  |
| validation_clauses        | { VALIDATE REF UPDATE<br>[ SET DANGLING TO NULL ]<br>  VALIDATE STRUCTURE<br>[ CASCADE ]<br>[ into_clause ]<br>{ OFFLINE  ONLINE }<br>}                                                                                                                       |
| values_clause             | VALUES ({ expr   DEFAULT }<br>[, { expr   DEFAULT } ]...<br>)                                                                                                                                                                                                 |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                       |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| varray_col_properties     | <pre> VARRAY varray_item   { [ substitutable_column_clause ]     STORE AS LOB       { [ LOB_segnane ] (LOB_parameters)         LOB_segnane       }       substitutable_column_clause   } </pre>                                                                                              |
| where_clause              | WHERE condition                                                                                                                                                                                                                                                                              |
| windowing_clause          | <pre> { 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   } } </pre> |
| XML_attributes_clause     | <pre> XMLATTRIBUTES   (value_expr [ AS c_alias ]   [, value_expr [ AS c_alias ]...   ) </pre>                                                                                                                                                                                                |
| XMLSchema_spec            | <pre> [ XMLSCHEMA XMLSchema_URL ] ELEMENT { element   XMLSchema_URL # element } </pre>                                                                                                                                                                                                       |
| XMLType_column_properties | <pre> XMLTYPE [ COLUMN ] column   [ XMLType_storage ]   [ XMLSchema_spec ] </pre>                                                                                                                                                                                                            |
| XMLType_storage           | <pre> STORE AS   { OBJECT RELATIONAL     CLOB [ { LOB_segnane [ (LOB_parameters) ]     LOB_parameters   }   ]   } </pre>                                                                                                                                                                     |
| XMLType_table             | <pre> CREATE TABLE [ GLOBAL TEMPORARY ] TABLE   [ schema. ]table OF XMLTYPE </pre>                                                                                                                                                                                                           |

| Subclause           | Syntax                                                                                                                                                                                                                  |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | [ (object_properties) ]<br>[ XMLTYPE XMLType_storage ]<br>[ XMLSchema_spec ]<br>[ ON COMMIT { DELETE   PRESERVE } ROWS ]<br>[ OID_clause ]<br>[ OID_index_clause ]<br>[ physical_properties ]<br>[ table_properties ] ; |
| XMLType_view_clause | OF XMLTYPE<br>[ XMLSchema_spec ]<br>WITH OBJECT IDENTIFIER<br>{ DEFAULT   ( expr [, expr ]... ) }                                                                                                                       |

---

## **Appendix E**

### **Acronyms and Terms**

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| <b>Term</b>                              | <b>Definition</b>                                                                                                                                         |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                                                                                      |

| <b>Term</b>                                 | <b>Definition</b>                                                                                                                                                 |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                          |

| <b>Term</b>                             | <b>Definition</b>                                                                                                                                                                                                                               |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flashback Drop                          | A feature that enables you to undo the effects of a <code>DROP TABLE</code> 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 <code>RESETLOGS</code> 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                                                                                                                                                                                                                  |
| isqlplusctl                             | Control utility for starting and stopping iSQL*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                                                                                                                                                                                                                      |
| jnnn                                    | 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                                                                                                                                                                                                         |

| <b>Term</b>                              | <b>Definition</b>                                                                                                                                                               |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LEGATO® NetWorker, Single-Server Version | Software included with Oracle Database 10g 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                                                                 |
| nK 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                                                                                                                                                      |

| <b>Term</b>                     | <b>Definition</b>                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 10g 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 10g 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                                                                                                                    |

| <b>Term</b>                  | <b>Definition</b>                                                                                                                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                                                                                     |

| <b>Term</b>         | <b>Definition</b>                                                                                                                                                           |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                                                                                                                                                    |

# **Next Steps**

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**The resources to learn more about administering Oracle Database 10g include:**

- **Oracle University Web site**
- **Oracle University University Knowledge Center**
- **Oracle Technology Network:**
  - **Oracle by Example**
  - **Oracle Magazine**
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  - Oracle Database 10g: SQL Fundamentals I & II
  - Oracle Database 10g: PL/SQL Fundamentals
- **Grid technology specialty courses:**
  - Oracle Enterprise Manager 10g Grid Control
  - Oracle Database 10g: Real Application Clusters
  - Oracle Database 10g: Implement Streams
  - Oracle Database 10g: 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.

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Oracle Technology Network (OTN) hosts the latest news about Oracle technology and products. Additionally, OTN provides peer-to-peer forums, white papers, security bulletins, and other vital information for the Oracle professional.

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# Oracle Technology Training

The screenshot shows the Oracle Technology Network website. At the top, there's a navigation bar with links for ORACLE.COM, TECHNOLOGY NETWORK, PARTNERS, STORE, SUPPORT, and a welcome message for Maria. Below the navigation is a search bar and a "SELECT COUNTRY" dropdown. The main content area features several sections: "PRODUCT CENTERS" (Database, Application Server, JDeveloper, Developer Suite, Enterprise Manager, Applications Technology, Collaboration Suite, More...); "TECHNOLOGY CENTERS" (BI & Data Warehousing, Grid, Java Developer, Linux, .NET Developer, PHP Developer, Web Services, Windows, XML, More...); and "COMMUNITY" (About OTN, Oracle ACEs, TechBlast Newsletter, Oracle Magazine). The central focus is the "Oracle Technology Training" section, which includes links for "Downloads", "Documentation", "Discussion Forums", "Articles", "Sample Code", "Training", "RSS XML", and "Resources For". Below this, there are detailed descriptions for "Oracle University", "Oracle 10g Books", "Oracle Developer Day", and "Live Online Product Demos", each with a brief summary and a link to more information. To the right, there are links for "Oracle By Example", "Getting Started with Oracle" page", "Free Software!", and "Sample Code Tutorials". The bottom of the page has a red footer with the Oracle logo and the copyright notice "Copyright © 2008, Oracle. All rights reserved."

# Oracle by Example

- **What is an OBE?**

A set of hands-on, step-by-step instructions

- **Where can I find them?**

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- **What is available?**

Over 100  
database  
OBEs

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