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14

Backup and Recovery Concepts

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Objectives

After completing this lesson, you should be able to:

- Identify the types of failure that can occur in an Oracle database
- Describe ways to tune instance recovery
- Identify the importance of checkpoints, redo log files, and archive log files
- Configure the fast recovery area
- Configure ARCHIVELOG mode

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Part of Your Job

The database administrator's duties are to:

- Protect the database from failure wherever possible
- Increase the mean time between failures (MTBF)
- Protect critical components by redundancy
- Decrease the mean time to recover (MTTR)
- Minimize the loss of data

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Part of Your Job

The goal of the database administrator (DBA) is to ensure that the database is open and available when users need it. To achieve that goal, the DBA (working with the system administrator):

- Anticipates and works to avoid common causes of failure
- Works to increase the mean time between failures (MTBF) that negatively affect availability
- Ensures that hardware is as reliable as possible, that critical components are protected by redundancy, and that operating system maintenance is performed in a timely manner. The Oracle database provides advanced configuration options to increase MTBF, including:
 - Real Application Clusters (discussed in the *Oracle Database 11g: Real Application Clusters* course)
 - Streams (discussed in the *Oracle Database 11g: Implement Streams* course)
 - Oracle Data Guard (discussed in the *Oracle Database 11g: Data Guard Administration* course)
- Decreases the mean time to recover (MTTR) by practicing recovery procedures in advance and configuring backups so that they are readily available when needed

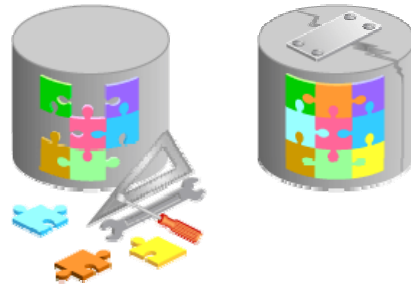
Part of Your Job (continued)

- Minimizes the loss of data. DBAs who follow accepted best practices can configure their databases so that no committed transaction is ever lost. Entities that assist in guaranteeing this include:
 - Archive log files (discussed later in this lesson)
 - Flashback technology
 - Standby databases and Oracle Data Guard (discussed in the *Oracle Database 11g: Data Guard Administration* course)

Categories of Failure

Failures can generally be divided into the following categories:

- Statement failure
- User process failure
- Network failure
- User error
- Instance failure
- Media failure



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Categories of Failure

- **Statement failure:** A single database operation (select, insert, update, or delete) fails.
- **User process failure:** A single database session fails.
- **Network failure:** Connectivity to the database is lost.
- **User error:** A user successfully completes an operation, but the operation (dropping a table or entering bad data) is incorrect.
- **Instance failure:** The database instance shuts down unexpectedly.
- **Media failure:** A loss of any file that is needed for database operation (that is, the files have been deleted or the disk has failed).

Statement Failure

Typical Problems	Possible Solutions
Attempts to enter invalid data into a table	Work with users to validate and correct data.
Attempts to perform operations with insufficient privileges	Provide appropriate object or system privileges.
Attempts to allocate space that fail	<ul style="list-style-type: none">• Enable resumable space allocation.• Increase owner quota.• Add space to tablespace.
Logic errors in applications	Work with developers to correct program errors.

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Statement Failure

When a single database operation fails, DBA involvement may be necessary to correct errors with user privileges or database space allocation. DBAs may also need to assist in troubleshooting, even for problems that are not directly in their task area. This can vary greatly from one organization to another. For example, in organizations that use off-the-shelf applications (that is, organizations that have no software developers), the DBA is the only point of contact and must examine logic errors in applications.

To understand logic errors in applications, you should work with developers to understand the scope of the problem. Oracle Database tools may provide assistance by helping to examine audit trails or previous transactions.

Note: In many cases, statement failures are by design and desired. For example, security policies and quota rules are often decided upon in advance. When a user gets an error while trying to exceed his or her limits, it may be desired for the operation to fail and no resolution may be necessary.

User Process Failure

Typical Problems	Possible Solutions
A user performs an abnormal disconnect.	A DBA's action is not usually needed to resolve user process failures. Instance background processes roll back uncommitted changes and release locks. Watch for trends. 
A user's session is abnormally terminated.	
A user experiences a program error that terminates the session.	

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User Process Failure

User processes that abnormally disconnect from the instance may have uncommitted work in progress that needs to be rolled back. The Process Monitor (PMON) background process periodically polls server processes to ensure that their sessions are still connected. If PMON finds a server process whose user is no longer connected, PMON recovers from any ongoing transactions; it also rolls back uncommitted changes and releases any locks that are held by the failed session.

A DBA's intervention should not be required to recover from user process failure, but the administrator must watch for trends. One or two users disconnecting abnormally is not a cause for concern. A small percentage of user process failures may occur from time to time.

But consistent and systemic failures indicate other problems. A large percentage of abnormal disconnects may indicate a need for user training (which includes teaching users to log out rather than just terminate their programs). It may also be indicative of network or application problems.

Network Failure

Typical Problems	Possible Solutions
Listener fails.	Configure a backup listener and connect-time failover.
Network Interface Card (NIC) fails.	Configure multiple network cards.
Network connection fails.	Configure a backup network connection.

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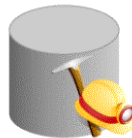
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Network Failure

The best solution to network failure is to provide redundant paths for network connections. Backup listeners, network connections, and network interface cards reduce the chance that network failures will affect system availability.

User Error

Typical Causes	Possible Solutions
User inadvertently deletes or modifies data.	Roll back transaction and dependent transactions or rewind table.
User drops a table.	Recover table from recycle bin.



Oracle LogMiner

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User Error

Users may inadvertently delete or modify data. If they have not yet committed or exited their program, they can simply roll back.

You can use Oracle LogMiner to query your online redo logs and archived redo logs through an Enterprise Manager or SQL interface. Transaction data may persist in online redo logs longer than it persists in undo segments; if you have configured archiving of redo information, redo persists until you delete the archived files. Oracle LogMiner is discussed in the *Oracle Database Utilities* reference.

Users who drop a table can recover it from the recycle bin by flashing back the table to before the drop. Flashback technologies are discussed in detail in the *Oracle Database 11g: Administration Workshop II* course.

If the recycle bin has already been purged, or if the user dropped the table with the PURGE option, the dropped table can still be recovered by using point-in-time recovery (PITR) if the database has been properly configured. PITR is discussed in the *Oracle Database 11g: Administration Workshop II* course and in the *Oracle Database Backup and Recovery User's Guide*.

Flashback Technology

Using Flashback technology:

- Viewing past states of data
- Winding data back and forth in time
- Assisting users in error analysis and recovery



For error analysis:

Oracle Flashback Query

Oracle Flashback Versions Query

Oracle Flashback Transaction Query

For error recovery:

Oracle Flashback Transaction Backout

Oracle Flashback Table

Oracle Flashback Drop

Oracle Flashback Database

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Flashback Technology

The Oracle database provides Oracle Flashback technology: a group of features that support viewing past states of data—and winding data back and forth in time—without requiring restoring the database from backup. With this technology, you help users analyze and recover from errors. For users who have committed erroneous changes, use the following to analyze the errors:

- **Flashback Query:** View committed data as it existed at some point in the past. The `SELECT` command with the `AS OF` clause references a time in the past through a time stamp or SCN.
- **Flashback Version Query:** View committed historical data for a specific time interval. Use the `VERSIONS BETWEEN` clause of the `SELECT` command (for performance reasons with existing indexes).
- **Flashback Transaction Query:** View all database changes made at the transaction level

Possible solutions to recover from user error:

- **Flashback Transaction Backout:** Rolls back a specific transaction and dependent transactions
- **Flashback Table:** Rewinds one or more tables to their contents at a previous time without affecting other database objects

Flashback Technology (continued)

- **Flashback Drop:** Reverses the effects of dropping a table by returning the dropped table from the recycle bin to the database along with dependent objects such as indexes and triggers
- **Flashback Database:** Returns the database to a past time or system change number (SCN)

Instance Failure

Typical Causes	Possible Solutions
Power outage	Restart the instance by using the <code>STARTUP</code> command. Recovering from instance failure is automatic, including rolling forward changes in the redo logs and then rolling back any uncommitted transactions. Investigate the causes of failure by using the alert log, trace files, and Enterprise Manager.
Hardware failure	
Failure of one of the critical background processes	
Emergency shutdown procedures	

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Instance Failure

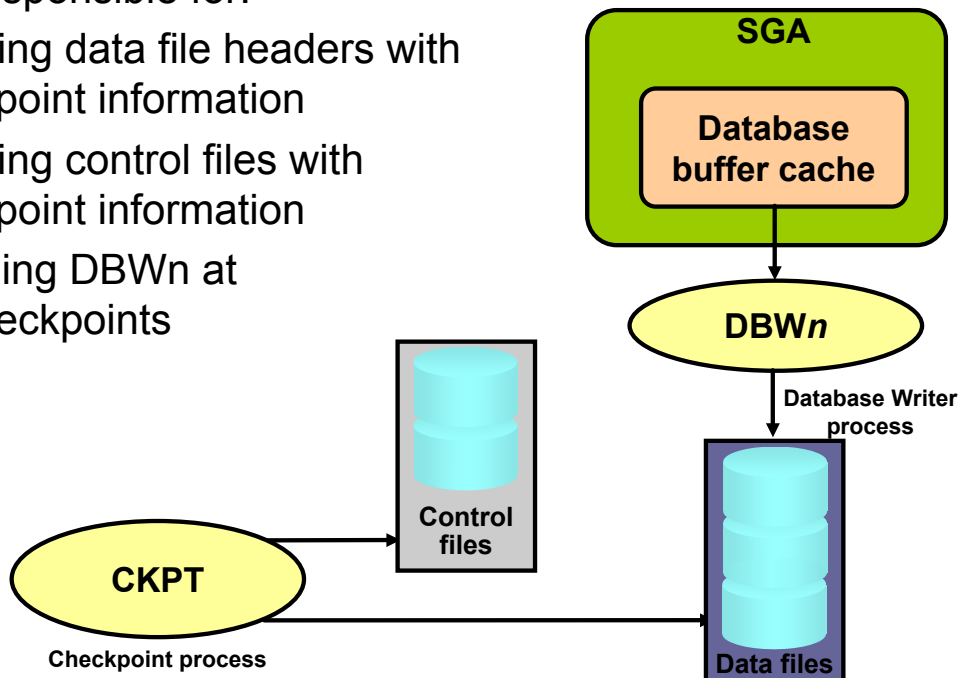
Instance failure occurs when the database instance is shut down before synchronizing all database files. An instance failure can occur because of hardware or software failure or through the use of the emergency `SHUTDOWN ABORT` and `STARTUP FORCE` shutdown commands.

Administrator involvement in recovering from instance failure rarely required if Oracle Restart enabled and monitoring your database. Oracle Restart attempts to restart your database instance as soon as it fails. If manual intervention is required then there may be a more serious problem that prevents the instance from restarting, such as a memory CPU failure.

Understanding Instance Recovery: Checkpoint (CKPT) Process

CKPT is responsible for:

- Updating data file headers with checkpoint information
- Updating control files with checkpoint information
- Signaling DBWn at full checkpoints



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Understanding Instance Recovery: Checkpoint (CKPT) Process

To understand instance recovery, you need to understand the functioning of certain background processes.

Every three seconds (or more frequently), the CKPT process stores data in the control file to document the modified data blocks that DBWn has written from the SGA to disk. This is called an “incremental checkpoint.” The purpose of a checkpoint is to identify that place in the online redo log file where instance recovery is to begin (which is called the “checkpoint position”).

In the event of a log switch, the CKPT process also writes this checkpoint information to the headers of data files.

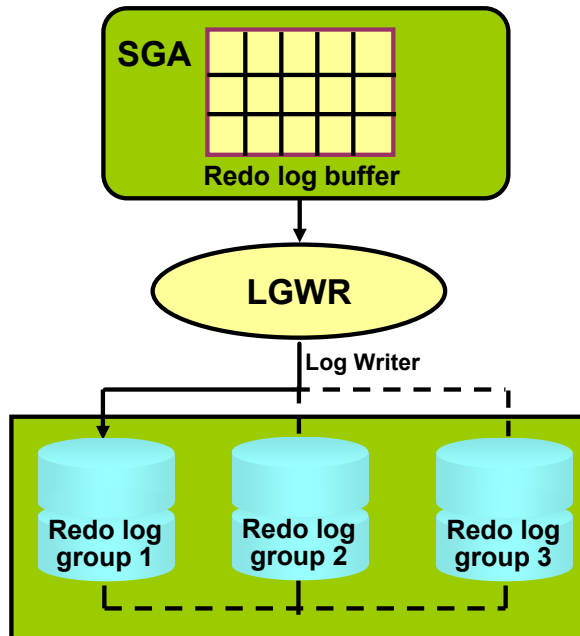
Checkpoints exist for the following reasons:

- To ensure that modified data blocks in memory are written to the disk regularly so that data is not lost in case of a system or database failure
- To reduce the time required for instance recovery (Only the online redo log file entries following the last checkpoint need to be processed for recovery.)
- To ensure that all committed data has been written to data files during shutdown

The checkpoint information written by the CKPT process includes checkpoint position, system change number (SCN), location in the online redo log file to begin recovery, information about logs, and so on.

Note: The CKPT process does not write data blocks to the disk or redo blocks to the online redo log files.

Understanding Instance Recovery: Redo Log Files and Log Writer



Redo log files:

- Record changes to the database
- Should be multiplexed to protect against loss

Log Writer writes:

- At commit
- When one-third full
- Every three seconds
- Before DBWn writes
- Before clean shutdowns

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Understanding Instance Recovery: Redo Log Files and Log Writer

Redo log files record changes to the database as a result of transactions and internal Oracle server actions. (A transaction is a logical unit of work consisting of one or more SQL statements run by a user.) Redo log files protect the database from the loss of integrity because of system failures caused by power outages, disk failures, and so on. Redo log files should be multiplexed to ensure that the information stored in them is not lost in the event of a disk failure.

The redo log consists of groups of redo log files. A group consists of a redo log file and its multiplexed copies. Each identical copy is said to be a member of that group, and each group is identified by a number. The Log Writer (LGWR) process writes redo records from the redo log buffer to all members of a redo log group until the files are filled or a log switch operation is requested.

It then switches and writes to the files in the next group. Redo log groups are used in a circular fashion.

Best practice tip: If possible, multiplexed redo log files should reside on different disks.

Understanding Instance Recovery

Automatic instance or crash recovery:

- Is caused by attempts to open a database whose files are not synchronized on shutdown
- Uses information stored in redo log groups to synchronize files
- Involves two distinct operations:
 - Rolling forward: Redo log changes (both committed and uncommitted) are applied to data files.
 - Rolling back: Changes that are made but not committed are returned to their original state.

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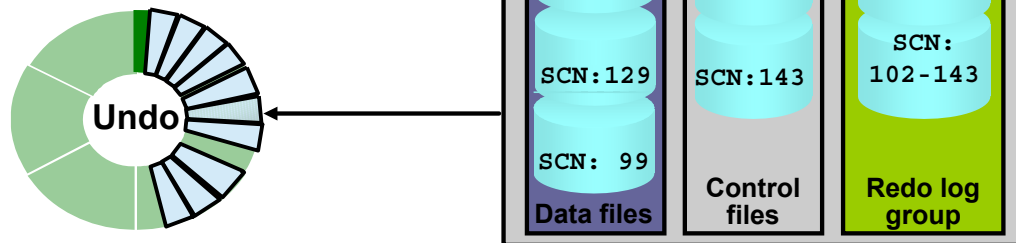
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Instance Recovery

The Oracle database automatically recovers from instance failure. All that needs to happen is for the instance to be started normally. If Oracle Restart is enabled and configured to monitor this database then this happens automatically. The instance mounts the control files and then attempts to open the data files. When it discovers that the data files have not been synchronized during shutdown, the instance uses information contained in the redo log groups to roll the data files forward to the time of shutdown. Then the database is opened and any uncommitted transactions are rolled back.

Phases of Instance Recovery

1. Startup instance (data files are out of sync)
2. Roll forward (redo)
3. Committed and uncommitted data in files
4. Database opened
5. Roll back (undo)
6. Committed data in files



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Phases of Instance Recovery

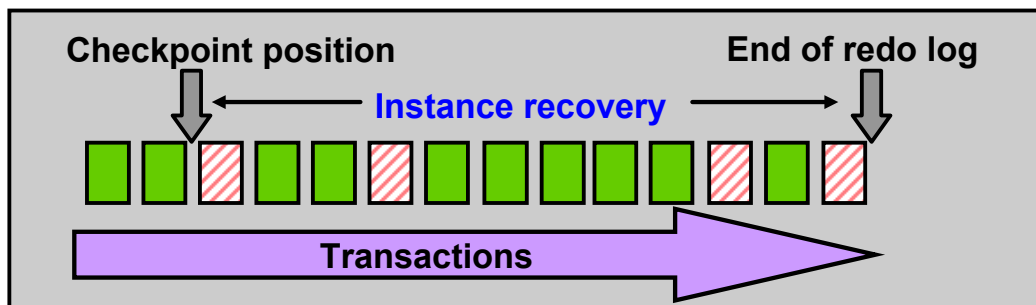
For an instance to open a data file, the system change number (SCN) contained in the data file's header must match the current SCN that is stored in the database's control files.

If the numbers do not match, the instance applies redo data from the online redo logs, sequentially "redoing" transactions until the data files are up-to-date. After all data files have been synchronized with the control files, the database is opened and users can log in.

When redo logs are applied, *all* transactions are applied to bring the database up to the state as of the time of failure. This usually includes transactions that are in progress but have not yet been committed. After the database has been opened, those uncommitted transactions are rolled back. At the end of the rollback phase of instance recovery, the data files contain only committed data.

Tuning Instance Recovery

- During instance recovery, the transactions between the checkpoint position and the end of redo log must be applied to data files.
- You tune instance recovery by controlling the difference between the checkpoint position and the end of redo log.



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Tuning Instance Recovery

Transaction information is recorded in the redo log groups before the instance returns `commit complete` for a transaction. The information in the redo log groups guarantees that the transaction can be recovered in case of a failure. The transaction information also needs to be written to the data file. The data file write usually happens at some time after the information is recorded in redo log groups because the data file write process is much slower than the redo writes. (Random writes for data files are slower than serial writes for redo log files.)

Every three seconds, the checkpoint process records information in the control file about the checkpoint position in the redo log. Therefore, the Oracle database knows that all redo log entries recorded before this point are not necessary for database recovery. In the graphic in the slide, the striped blocks have not yet been written to the disk.

The time required for instance recovery is the time required to bring data files from their last checkpoint to the latest SCN recorded in the control file. The administrator controls that time by setting an MTTR target (in seconds) and through the sizing of redo log groups. For example, for two redo groups, the distance between the checkpoint position and the end of the redo log group cannot be more than 90% of the smallest redo log group.

Using the MTTR Advisor

- Specify the desired time in seconds or minutes.
- The default value is 0 (disabled).
- The maximum value is 3,600 seconds (one hour).

The screenshot shows the Oracle Enterprise Manager web interface for a database instance named 'orcl.oracle.com'. The 'Availability' tab is selected, and the 'Backup/Recovery' section is expanded. The 'Recovery Settings' link is highlighted with a red box, and a red arrow points from it to the 'Recovery Settings' panel. The 'Recovery Settings' panel shows the 'Instance Recovery' section, which includes a description of the fast-start checkpointing feature and a 'Desired Mean Time To Recover' field set to 0 minutes. The 'Current Estimated Mean Time To Recover' is 15 seconds.

Database Instance: orcl.oracle.com

Home Performance **Availability** Server Schema Data Mo

High Availability Console

Backup/Recovery

Setup Manage

Backup Settings Schedule Backup

Recovery Settings Manage Current Backups

Recovery Catalog Settings Backup Reports

Recovery Settings

Show SQL Revert Apply

Instance Recovery

The fast-start checkpointing feature is enabled by specifying a non-zero desired mean-time to recover (MTTR) value, which will be used to set the FAST_START_MTTR_TARGET initialization parameter. This parameter controls the amount of time the database takes to perform crash recovery for a single instance. When fast-start checkpointing is enabled, Oracle automatically maintains the speed of checkpointing so that the requested MTTR is achieved. Setting the value to 0 will disable this functionality.

Current Estimated Mean Time To Recover (seconds) 15

Desired Mean Time To Recover 0 Minutes

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Using the MTTR Advisor

For assistance in setting the MTTR target, select either of the following:

- Enterprise Manager > Advisor Central (in the Related Links section) > MTTR Advisor
- Enterprise Manager > Availability > Recovery Settings

The FAST_START_MTTR_TARGET initialization parameter simplifies the configuration of recovery time from instance or system failure. The MTTR Advisor converts the FAST_START_MTTR_TARGET value into several parameters to enable instance recovery in the desired time (or as close to it as possible). Please note, explicitly setting the FAST_START_MTTR_TARGET parameter to 0 disables the MTTR advisor.

The FAST_START_MTTR_TARGET parameter must be set to a value that supports the service level agreement for your system. A small value for the MTTR target increases I/O overhead because of additional data file writes (affecting the performance). However, if you set the MTTR target too large, the instance takes longer to recover after a crash.

Media Failure

Typical Causes	Possible Solutions
Failure of disk drive	<ol style="list-style-type: none">1. Restore the affected file from backup.2. Inform the database about a new file location (if necessary).3. Recover the file by applying redo information (if necessary).
Failure of disk controller	
Deletion or corruption of a file needed for database operation	

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Media Failure

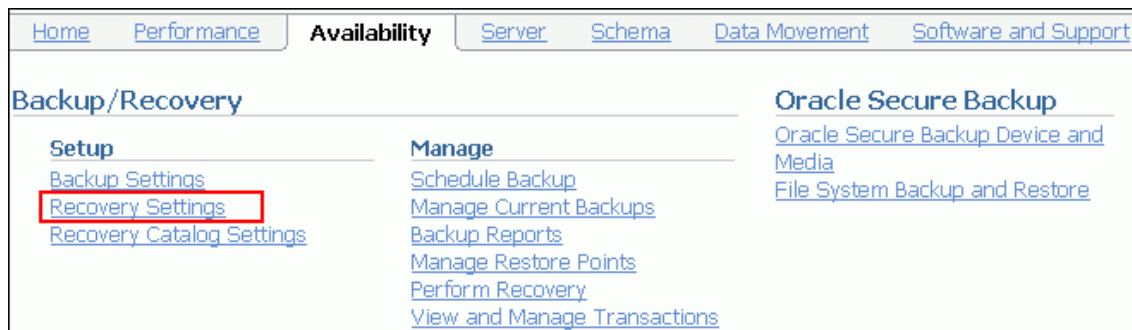
Oracle Corporation defines *media failure* as any failure that results in the loss or corruption of one or more database files (data, control, or redo log file).

Recovering from media failure requires that you restore and recover the missing files. To ensure that your database can be recovered from media failure, follow the best practices outlined in the next few pages.

Configuring for Recoverability

To configure your database for maximum recoverability, you must:

- Schedule regular backups
- Multiplex control files
- Multiplex redo log groups
- Retain archived copies of redo logs



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Configuring for Recoverability

To provide the best protection for your data, you must:

- **Schedule regular backups**
Most media failures require that you restore the lost or damaged file from backup.
- **Multiplex control files**
All control files associated with a database are identical. Recovering from the loss of a single control file is not difficult; recovering from the loss of *all* control files is much more challenging. Guard against losing all control files by having at least two copies.
- **Multiplex redo log groups**
To recover from instance or media failure, redo log information is used to roll data files forward to the last committed transaction. If your redo log groups rely on a single redo log file, the loss of that file means that data is likely to be lost. Ensure that there are at least two copies of each redo log group; if possible, each copy should be under different disk controllers.
- **Retain archived copies of redo logs**
If a file is lost and restored from backup, the instance must apply redo information to bring that file up to the latest SCN contained in the control file. With the default setting, the database can overwrite redo information after it has been written to the data files. Your database can be configured to retain redo information in archived copies of the redo logs. This is known as placing the database in ARCHIVELOG mode.

You can perform configuration tasks in Enterprise Manager or with the command line.

Configuring the Fast Recovery Area

Fast recovery area:

- Strongly recommended for simplified backup storage management
- Storage space (separate from working database files)
- Location specified by the `DB_RECOVERY_FILE_DEST` parameter
- Size specified by the `DB_RECOVERY_FILE_DEST_SIZE` parameter
- Large enough for backups, archived logs, flashback logs, multiplexed control files, and multiplexed redo logs
- Automatically managed according to your retention policy

Configuring the fast recovery area means determining location, size, and retention policy.

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Configuring the Fast Recovery Area

The fast recovery area is a space that is set aside on the disk to contain archived logs, backups, flashback logs, multiplexed control files, and multiplexed redo logs. A fast recovery area simplifies backup storage management and is strongly recommended. You should place the fast recovery area on storage space that is separate from the location of your database data files and primary online log files and control file.

The amount of disk space to allocate for the fast recovery area depends on the size and activity levels of your database. As a general rule, the larger the fast recovery area, the more useful it is. Ideally, the fast recovery area should be large enough for copies of your data and control files and for flashback, online redo, and archived logs needed to recover the database with the backups kept based on the retention policy. (In short, the fast recovery area should be at least twice the size of the database so that it can hold one backup and several archived logs.)

Space management in the fast recovery area is governed by a backup retention policy. A retention policy determines when files are obsolete, which means that they are no longer needed to meet your data recovery objectives. The Oracle database automatically manages this storage by deleting files that are no longer needed.

Multiplexing Control Files

To protect against database failure, your database should have multiple copies of the control file.

	ASM Storage	File System Storage
Best Practice	One copy on each disk group (such as +DATA and +FRA)	At least two copies, each on separate disk (at least one on separate disk controller)
Steps to create additional control files	No additional control file copies required.	<ol style="list-style-type: none">1. Alter the SPFILE with the ALTER SYSTEM SET control_files command.2. Shut down the database.3. Copy control file to a new location.4. Open the database and verify the addition of the new control file.

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Multiplexing Control Files

A control file is a small binary file that describes the structure of the database. It must be available for writing by the Oracle server whenever the database is mounted or opened. Without this file, the database cannot be mounted, and recovery or re-creation of the control file is required. Your database should have a minimum of two control files on different storage devices to minimize the impact of a loss of one control file.

The loss of a single control file causes the instance to fail because all control files must be available at all times. However, recovery can be a simple matter of copying one of the other control files. The loss of all control files is slightly more difficult to recover from but is not usually catastrophic.

Multiplexing Control Files (continued)

Adding a Control File

If using ASM as your storage technique, then as long as you have two control files, one in each disk group (such as +DATA and +FRA), then you should not require further multiplexing. In a database using OMF (such as a database using ASM storage), all additional control files must be created as part of a recovery process using RMAN (or through Enterprise Manager). In a database using regular file system storage, adding a control file is a manual operation:

1. Alter the SPFILE with the following command:

```
ALTER SYSTEM SET control_files =  
    '/u01/app/oracle/oradata/orcl/control01.ctl' ,  
    '/u02/app/oracle/oradata/orcl/control02.ctl' ,  
    '/u03/app/oracle/oradata/orcl/control03.ctl' SCOPE=SPFILE;
```

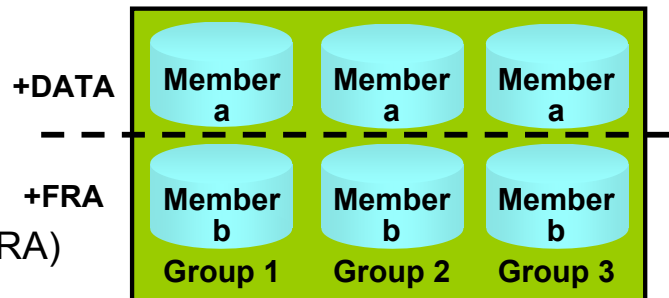
2. Shut down the database.
3. Use the operating system to copy an existing control file to the location you select for your new file.
4. Open the database.

Note: More information on using RMAN is covered in the course titled *Oracle Database 11g: Administration Workshop II* and online product documentation.

Redo Log Files

Multiplex redo log groups to protect against media failure and loss of data. This increases database I/O. It is suggested that redo log groups have:

- At least two members (files) per group
- Each member:
 - On a separate disk or controller if using file system storage
 - In a separate disk group (such as +DATA and +FRA) if using ASM



Note: Multiplexing redo logs may impact overall database performance.

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Redo Log Files

Redo log groups are made up of one or more redo log files. Each log file in a group is a duplicate of the others. Oracle Corporation recommends that redo log groups have at least two files per group. If using file system storage, then each member should be distributed on separate disks or controllers so that no single equipment failure destroys an entire log group. If using ASM storage, then each member should be in a separate disk group, such as +DATA and +FRA. The loss of an entire current log group is one of the most serious media failures because it can result in loss of data. The loss of a single member of a multiple-member log group is trivial and does not affect database operation (other than causing an alert to be published in the alert log). Recovery from the loss of an entire log group requires advanced recovery techniques and is discussed in the course titled *Oracle Database 11g: Administration Workshop II*.

Remember that multiplexing redo logs may heavily influence database performance because a commit cannot complete until the transaction information has been written to the logs. You must place your redo log files on your fastest disks served by your fastest controllers. If possible, do not place any other database files on the same disks as your redo log files (unless you are using Automatic Storage Management [ASM]). Because only one group is written to at a given time, there is no performance impact in having members from several groups on the same disk.

Multiplexing the Redo Log

If Storage Type is File System, then you are prompted to enter a File Name and File Directory.

Redo Log Groups

Search

Enter an object name to filter the results

Object Name

By default, the search returns all upper case-sensitive matches, double quote the object name to search for a specific match.

Selection Mode

Edit View Delete Actions Clear logfile Go

Select	Group	Status	# of Members	Archived	Size (KB)	Sequence	First Change#
<input checked="" type="radio"/>	1	Active	2	No	51200	7	834285
<input type="radio"/>	2	Active	2	No	51200	8	849739
<input type="radio"/>	3	Current	2	No	51200	9	849745

Edit Redo Log Group

Actions Clear logfile

Group # 1

File size 51200 KB

Status ACTIVE

Redo Log Members

Edit Remove

Select	File Name	File Directory
<input checked="" type="radio"/>	group_1.261.689304441	+DATA/orcl/onlineolog/
<input type="radio"/>	group_1.257.689304447	+FRA/orcl/onlineolog/

Create

Edit Redo Log Group: 1: Add Redo Log Member

Cancel Continue

Storage Type Automatic Storage Management

* DiskGroup DATA

Template <Default>

Alias Directory

Alias Name

☐ Reuse File

Red arrows indicate the workflow: from the 'Edit' button in the Redo Log Groups table to the 'Edit Redo Log Group' page, then to the 'Add' button in the Redo Log Members section, and finally to the 'Add Redo Log Member' dialog.

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Multiplexing the Redo Log

You can multiplex your redo log by adding a member to an existing log group. To add a member to a redo log group (with open database and no impact on user performance), perform the following steps:

1. Select Enterprise Manager > Server > Redo Log Groups.
2. Select a group and click the Edit button, or click the group number link.
The Edit Redo Log Group page appears.
3. In the Redo Log Members region, click Add.
The Add Redo Log Member page appears.
4. Choose the appropriate Storage Type, and enter the required information. For ASM, choose the disk group and, if desired, specify template and alias information. For File System storage, enter the file name and the file directory. Click Continue.

Repeat these steps for every existing group that you want to multiplex. An example showing the SQL syntax of adding a redo log member to redo log group 1 (using ASM) is shown here:

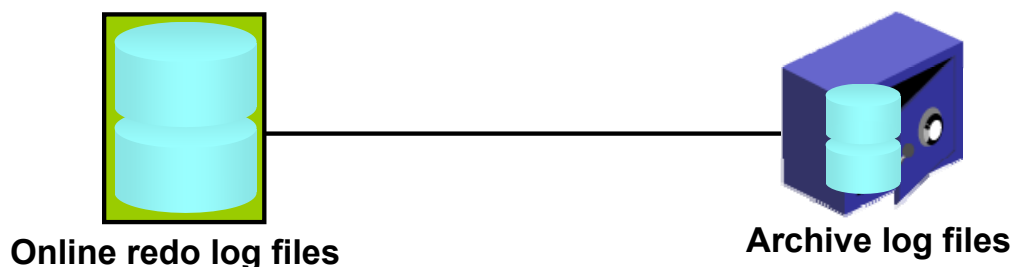
```
SQL> ALTER DATABASE ADD LOGFILE MEMBER '+DATA' TO GROUP 1;
```

When you add the redo log member to a group, the member's status is marked as INVALID (as can be seen in the V\$LOGFILE view). This is the expected state because the new member of the group has not yet been written to. When a log switch occurs and the group containing the new member becomes CURRENT, the member's status changes to null.

Archive Log Files

To preserve redo information, create archived copies of redo log files by performing the following steps.

1. Specify archive log file-naming convention.
2. Specify one or more archive log file locations.
3. [Switch the database to ARCHIVELOG mode.](#)



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Archive Log Files

The instance treats the online redo log groups as a circular buffer in which to store transaction information, filling one group and then moving on to the next. After all groups have been written to, the instance begins overwriting information in the first log group.

To configure your database for maximum recoverability, you must instruct the database to make a copy of the online redo log group before allowing it to be overwritten. These copies are known as *archived logs*.

To facilitate the creation of archive log files:

1. Specify a naming convention for your archive logs.
2. Specify a destination or destinations for storing your archive logs. One of the destinations is probably your fast recovery area.
3. Place the database in ARCHIVELOG mode.

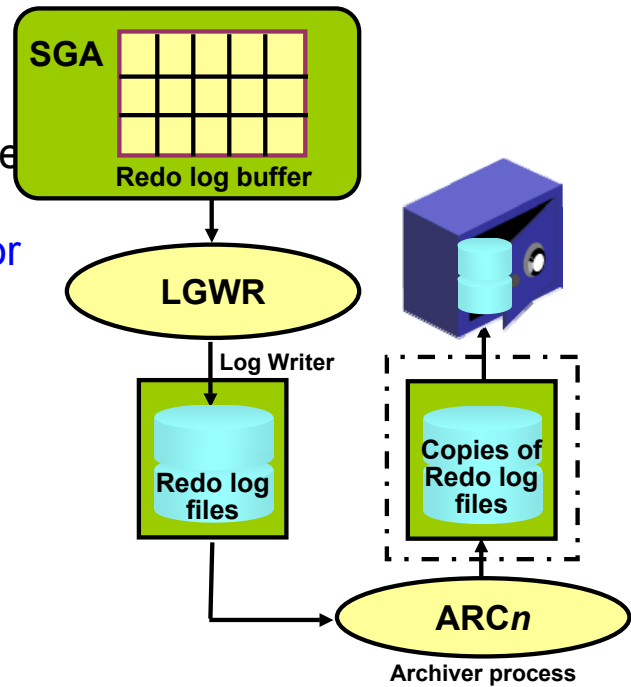
Note: Steps 1 and 2 are not necessary if you are using a fast recovery area.

The destination should exist before placing the database in ARCHIVELOG mode. When a directory is specified as a destination, there should be a slash at the end of the directory name.

Archiver (ARCn) Process

Archiver (ARCn):

- Is an optional background process
- Automatically archives online redo log files **when ARCHIVELOG mode is set for the database**
- Preserves the record of all changes made to the database



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The Archiver (ARCn) Process

ARCn is an optional background process. However, it is crucial to the recovery of a database after the loss of a disk. When an online redo log group gets filled, the Oracle instance begins writing to the next online redo log group. The process of switching from one online redo log group to another is called a *log switch*. The ARCn process initiates archiving of the filled log group at every log switch. It automatically archives the online redo log group before the log group can be reused so that all the changes made to the database are preserved. This enables recovery of the database to the point of failure even if a disk drive is damaged.

One of the important decisions that a DBA must make is whether to configure the database to operate in ARCHIVELOG mode or in NOARCHIVELOG mode.

- In NOARCHIVELOG mode, the online redo log files are overwritten each time a log switch occurs.
- In ARCHIVELOG mode, inactive groups of filled online redo log files must be archived before they can be used again.

Note

- ARCHIVELOG mode is essential for most backup strategies (and is very easy to configure).
- If the Archive log file destination fills up or cannot be written, the database will eventually come to a halt. Remove archive files from the archive log file destination and the database will resume operations.

Archive Log File: Naming and Destinations

Specify naming and archive destination information on the Recovery Settings page. If using file system storage then it is recommended that you add multiple locations across different disks.

Media Recovery

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

☒ ARCHIVELOG Mode*

Log Archive Filename Format*

Number	Archived Redo Log Destination	Status	Type
1	<input type="text" value="USE_DB_RECOVERY_FILE_DEST"/>	VALID	Local

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

TIP You can specify up to 10 archived redo log destinations.

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Archive Log File: Naming and Destinations

To configure archive log file names and destinations, select Enterprise Manager > Availability > Configure Recovery Settings.

Each archive log file must have a unique name to avoid overwriting older log files. Specify the naming format as shown in the slide. To help create unique file names, Oracle Database 11g allows several wildcard characters in the name format:

- **%s:** Includes the log sequence number as part of the file name
- **%t:** Includes the thread number as part of the file name
- **%r:** Includes the resetlogs ID to ensure that the archive log file name remains unique (even after certain advanced recovery techniques that reset log sequence numbers)
- **%d:** Includes the database ID as part of the file name

The format should include %s, %t, and %r as best practice (%d can also be included if multiple databases share the same archive log destination).

By default if the fast recovery area is enabled, then `USE_DB_RECOVERY_FILE_DEST` is specified as an archive log file destination. Archive log files can be written to as many as ten different destinations. Destinations may be local (a directory) or remote (an Oracle Net alias for a standby database). Click Add Another Row to add further destinations. To change recovery settings, you must be connected as SYSDBA or SYSOPER.

Note: If you do not want archives sent to this location, delete `USE_DB_RECOVERY_FILE_DEST`.

Enabling ARCHIVELOG Mode

To place the database in ARCHIVELOG mode, perform the following steps in Enterprise Manager:

1. Select the ARCHIVELOG Mode check box and click Apply.
The database can be set to ARCHIVELOG mode only from the MOUNT state.
2. Restart the database (with SYSDBA privileges).
3. (Optional) View the archive status.
4. Back up your database.

Note: Databases in ARCHIVELOG mode have access to the full range of backup and recovery options.

```
sqlplus / as sysdba  
  
shutdown immediate  
startup mount  
alter database archivelog;  
alter database open;  
archive log list
```

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Enabling ARCHIVELOG Mode

1. In Enterprise Manager, select Availability > Configure Recovery Settings > ARCHIVELOG Mode. The equivalent SQL command is:
`SQL> ALTER DATABASE ARCHIVELOG;`
This command can be issued only while the database is in the MOUNT state. The instance must therefore be restarted to complete this last step.
2. In Enterprise Manager, you are prompted for operating system and database credentials during the restart of the database. The database credentials *must* be for a user with the SYSDBA privileges.
3. After the instance is restarted, the changes that you have made to the archive processes, log format, and log destinations are in effect. In SQL*Plus, you can see them with the ARCHIVE LOG LIST command.
4. Back up your database after switching to ARCHIVELOG mode because *your database is only recoverable from the last backup taken in that mode.*

With the database in NOARCHIVELOG mode (the default), recovery is possible only until the time of the last backup. All transactions made after that backup are lost.

In ARCHIVELOG mode, recovery is possible until the time of the last commit. Most production databases are run in ARCHIVELOG mode.

Quiz

Statement failure is never by design and always requires the DBA to address the issue.

1. True
2. False

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Answer: 2

Quiz

Which parameters configure the fast recovery area?

1. FLASH_RECOVERY_AREA_SIZE
2. DB_RECOVERY_FILE_DEST
3. FLASH_RECOVERY_AREA_LOC
4. DB_RECOVERY_FILE_DEST_SIZE

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Answers: 2, 4

Summary

In this lesson, you should have learned how to:

- Identify the types of failure that can occur in an Oracle database
- Describe ways to tune instance recovery
- Identify the importance of checkpoints, redo log files, and archive log files
- Configure the fast recovery area
- Configure ARCHIVELOG mode

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Practice 14 Overview: Configuring for Recoverability

This practice covers the following topics:

- Verifying control files
- Configuring a default fast recovery area
- Multiplexing redo log groups
- Placing your database in ARCHIVELOG mode
- Ensuring that redundant archive logs are created

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15

Performing Database Backups

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Objectives

After completing this lesson, you should be able to:

- Create consistent database backups
- Back up your database without shutting it down
- Create incremental backups
- Automate database backups
- Manage backups and view backup reports
- Monitor the fast recovery area

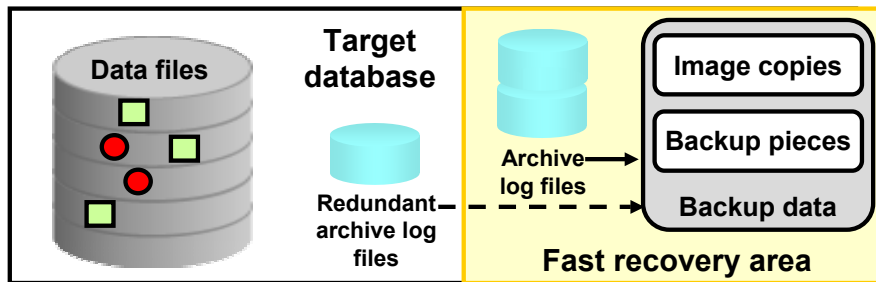
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Backup Solutions: Overview

Backups can be performed by using:

- Recovery Manager
- Oracle Secure Backup
- User-managed backup



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Backup Solutions: Overview

As you will see in the remainder of this lesson, Recovery Manager (RMAN) is the recommended method of backing up your Oracle database.

Oracle Secure Backup complements existing functionality by adding backup to tape and backup of operating system files.

User-managed backups are based on scripts that a DBA must write. This option is being phased out because it is more labor intensive.

Oracle Secure Backup

- Oracle Secure Backup and RMAN provide an end-to-end backup solution for Oracle environments:
 - Centralized tape backup management for file system data and the Oracle database
 - Most well-integrated media management layer for RMAN backups
 - Backup of any data anywhere on the network
- A single technical support resource for the entire backup solution expedites problem resolution.
- This ensures reliable data protection at lower cost and complexity.



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Oracle Secure Backup

Oracle's current backup and recovery product for the database is Recovery Manager. Oracle Secure Backup complements existing functionality in the following ways:

- **Complete backup solution:** Oracle Secure Backup provides data protection for the database and nondatabase data to protect the entire Oracle environment.
- **Media management:** Oracle Secure Backup provides the media management layer for RMAN database backups to tape. Before Oracle Secure Backup, customers had to purchase expensive third-party media management products offering integration with RMAN tape backups.
- **Backup anywhere on the network:** Oracle Secure Backup backs up data from multiple network-attached computer systems to tertiary storage resources on the network. Oracle Secure Backup supports diverse configurations of servers, clients, Network Attached Storage (NAS) servers, and tertiary storage devices and protects network storage environments.

The combination of RMAN and Oracle Secure Backup provides an end-to-end backup solution that is entirely within the Oracle product stack. This solution makes better customer support possible because Oracle Corporation is responsible for the entire backup solution.

User-Managed Backup

A user-managed scenario:

- Is a manual process of tracking backup needs and status
- Typically uses your own written scripts
- Requires that database files be put in the correct mode for backup
- Relies on operating system commands to make backups of files

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User-Managed Backup

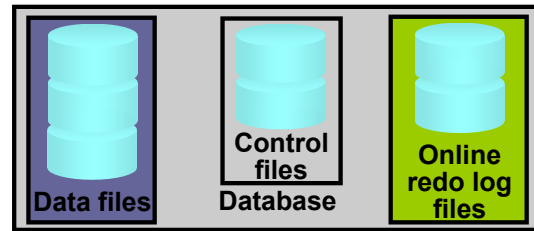
A user-managed backup can be performed interactively. However, most often it entails the writing of scripts to perform the backup. There are several scenarios that can be run, and scripts must be written to handle them.

Some of the actions that scripts must take:

- Querying V\$DATAFILE to determine the data files that need to be backed up and their current state
- Querying V\$LOGFILE to identify the online redo log files
- Querying V\$CONTROLFILE to identify the control file to back up
- Placing each tablespace in online backup mode
- Querying V\$BACKUP to see what data files are part of a tablespace that has been placed in online backup mode
- Issuing operating system copy commands to copy the data files to the backup location
- Bringing each tablespace out of online backup mode

Terminology

- Backup strategy may include:
 - Entire database (whole)
 - Portion of the database (partial)
- Backup type may indicate inclusion of:
 - All data blocks within your chosen files (full)
 - Only information that has changed since a previous backup (incremental)
 - Cumulative (changes since last level 0)
 - Differential (changes since last incremental)
- Backup mode may be:
 - Offline (consistent, cold)
 - Online (inconsistent, hot)



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Terminology

Whole database backup: Includes all data files and at least one control file (Remember that all control files in a database are identical.)

Partial database backup: May include zero or more tablespaces and zero or more data files; may or may not include a control file

Full backup: Makes a copy of each data block that contains data and that is within the files being backed up

Incremental backup: Makes a copy of all data blocks that have changed since a previous backup. The Oracle database supports two levels of incremental backup (0 and 1). A level 1 incremental backup can be one of two types: *cumulative* or *differential*. A cumulative backup backs up all changes since the last level 0 backup. A differential backup backs up all changes since the last incremental backup (which could be either a level 0 or level 1 backup). Change Tracking with RMAN supports incremental backups.

Offline backups (also known as “cold” or *consistent* backup): Are taken while the database is not open. They are consistent because, at the time of the backup, the system change number (SCN) in data file headers matches the SCN in the control files.

Online backups (also known as “hot” or *inconsistent* backup): Are taken while the database is open. They are inconsistent because, with the database open, there is no guarantee that the data files are synchronized with the control files.

Terminology

Backups may be stored as:

- Image copies
- Backup sets

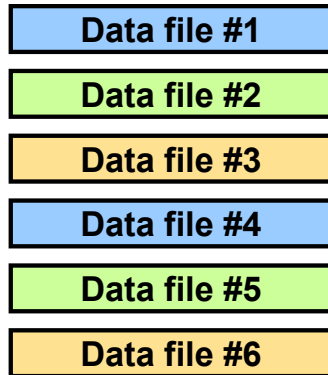
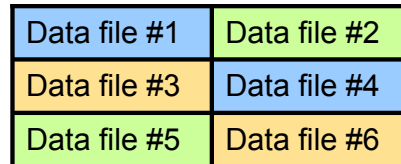


Image copies

(Duplicate data and log files in OS format)



Backup set

(Binary, compressed files in Oracle proprietary format)

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Terminology (continued)

Image copies: Are duplicates of data or archived log files (similar to simply copying the files by using operating system commands)

Backup sets: Are collections of one or more binary files that contain one or more data files, control files, server parameter files, or archived log files. With backup sets, empty data blocks are not stored, thereby causing backup sets to use less space on the disk or tape. Backup sets can be compressed to further reduce the space requirements of the backup.

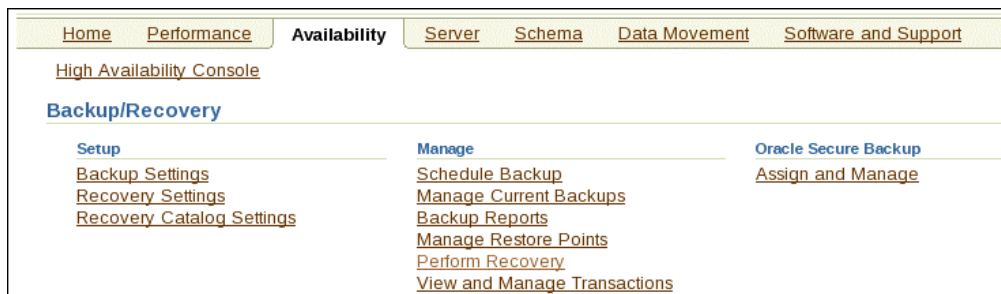
Image copies must be backed up to the disk. Backup sets can be sent to the disk or directly to the tape.

The advantage of creating a backup as an image copy is improved granularity of the restore operation. With an image copy, only the file or files need to be retrieved from your backup location. With backup sets, the entire backup set must be retrieved from your backup location before you extract the file or files that are needed.

The advantage of creating backups as backup sets is better space usage. In most databases, 20% or more of the data blocks are empty blocks. Image copies back up every data block, even if the data block is empty. Backup sets significantly reduce the space required by the backup. In most systems, the advantages of backup sets outweigh the advantages of image copies.

Recovery Manager (RMAN)

- Powerful control and scripting language
- Integrated with Enterprise Manager
- Published API that enables interface with most popular backup software
- Backing up data, control, archived log, and server parameter files
- Backing up files to the disk or tape



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Recovery Manager (RMAN)

RMAN is the component of the Oracle database that is used to perform backup and recovery operations. It can make consistent and inconsistent backups, perform incremental and full backups, and back up either the whole database or a portion of it.

RMAN uses its own powerful job control and scripting language, as well as a published API that interfaces RMAN with many popular backup software solutions.

RMAN can store backups on the disk for quick recovery or place them on the tape for long-term storage. For RMAN to store backups on the tape, you must either use Oracle Secure Backup or configure an interface to the tape device known as a Media Management Library (MML).

Enterprise Manager supplies a graphical interface to the most commonly used RMAN functionality. Advanced backup and recovery operations are accessible through RMAN's command-line client. For more information about advanced RMAN capabilities, see the course titled *Oracle Database 11g: Administration Workshop II* or consult the *Oracle Backup and Recovery User's Guide*.

Configuring Backup Settings

Backup Settings

Device Backup Set Policy

Disk Settings

Parallelism Test Disk Backup

Concurrent streams to disk drives

Disk Backup Location

The flash recovery area is the current disk backup location. If you would like to override the disk backup location, specify an existing directory or diskgroup.

Disk Backup Type

- ☒ Backup Set
An Oracle backup file format that allows for more efficient backups by interleaving multiple backup files into one output file.
- ☐ Compressed Backup Set
An Oracle backup set in which the data is compressed to reduce its size.
- ☐ Image Copy
A bit-by-bit copy of database files that can be used as-is to perform recovery.

Backup Set Policy

Maximum Backup Piece (File) Size MB Specify a value to restrict the size of each backup piece.

Compression Algorithm

Specify the compression algorithm that will be used for both disk and tape compressed backup sets.

- ☒ BZIP2
Optimized for maximum compression. Consumes more CPU resources, but will usually produce more compact backups.
- ☐ ZLIB
Optimized for CPU efficiency. Requires the Oracle Advanced Compression option.

Tape Settings

The following parameters require additional configuration on different media pools.

Copies of Datafile Backups Specify the number of identical copies for datafile backups.

Copies of Archivelog Backups Specify the number of identical copies for archivelog backups.

Host Credentials

To save the backup settings, supply operating system login credentials to access the target database.

* Username

* Password

☐ Save as Preferred Credential

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Configuring Backup Settings

Select Enterprise Manager > Availability > Backup Settings. Here you can manage the persistent backup settings that are used for creating backups. There are separate settings for the disk and the tape. Tape settings depend on the media management library capabilities. Disk settings include:

- **Parallelism:** How many separate streams of backup information do you want to create? The best setting for parallelism depends on your hardware. As hardware resources increase, the appropriate degree of parallelism also increases. Generally, you want to set your parallelism to the number of disks that your disk backup location is striped over. For tape backup, you want to set your parallelism to the same number of tape drives that you have.
- **Disk backup location:** Where should backups be stored? The default is the fast recovery area. If you change this, click Test Disk Backup to verify that RMAN can write to the new location.
- **Disk backup type:** Select Backup Set, Compressed Backup Set, or Image Copy.

Click the Backup Set tab to set the maximum file size of backup pieces, specify the compression algorithm to be used for compressed backup sets, and specify redundancy for tape backups. Host credentials are required for Enterprise Manager to save changes to the backup settings.

Configuring Backup Settings

Backup Settings

Device Backup Set Policy

Backup Policy

☒ Automatically backup the control file and server parameter file (SPFILE) with every backup and database structural change

Autobackup Disk Location

An existing directory or diskgroup name where the control file and server parameter file will be backed up. If you do not specify a location, the files will be backed up to the flash recovery area location.

☐ Optimize the whole database backup by skipping unchanged files such as read-only and offline datafiles that have been backed up

☐ Enable block change tracking for faster incremental backups

Block Change Tracking File

Specify a location and file, otherwise an Oracle managed file will be created in the database area.

Tablespaces Excluded From Whole Database Backup

Populate this table with the tablespaces you want to exclude from a whole database backup. Use the Add button to add tablespace.

Select Tablespace Name	Tablespace Number	Status	Contents
No Items Selected			

TIP These tablespaces can be backed up separately using tablespace backup.

Retention Policy

☐ Retain All Backups
You must manually delete any backups

☐ Retain backups that are necessary for a recovery to any time within the specified number of days (point-in-time recovery)

☒ Retain at least the specified number of full backups for each datafile

Days: 31
Recovery Window

Backups: 1
Redundancy

Archived Redo Log Deletion Policy

Specify the deletion policy for archived redo log files. The archived redo log files will be eligible for deletion if the flash recovery area becomes full.

☒ None
If a flash recovery area is set, archived redo log files that have been backed up to a tertiary device and are obsolete based on the retention policy will be deleted.

☐ Delete archived redo log files after they have been backed up the specified number of times

Backups: 1

Host Credentials

To save the backup settings, supply operating system login credentials to access the target database.

Username:

Password:

☐ Save as Preferred Credential

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Configuring Backup Settings (continued)

Click the Policy tab to:

- Automatically back up the control file and server parameter file (SPFILE) with each backup. You can also specify a location for these backups if you do not want them to go to the fast recovery area.
- Optimize backups by not backing up files that exactly match a file that is already part of the retained backups. This setting enables you to skip read-only and offline data files.
- Enable block change tracking and specify a location for the tracking file. If you intend to create incremental backups, this setting can decrease the time required to choose which blocks to include in the incremental backup.
- Exclude tablespaces from a whole database backup. Some administrators choose not to back up tablespaces containing data or objects that can be easily re-created (such as indexes or data that is batch-loaded frequently).
- Specify a retention policy: How long should RMAN keep your backups? If you are using the fast recovery area to store backups, RMAN automatically deletes old backups to make room for new ones (if the retention policy allows it). By default, only the last backup is retained. The retention policy can be specified as a number of backups or a number of days.

Scheduling Backups: Strategy

Schedule Backup

Oracle provides an automated backup strategy based on your disk and/or tape configuration. Alternatively, you can implement your own customized backup strategy.

Oracle-Suggested Backup

Schedule a backup using Oracle's automated backup strategy.

This option will back up the entire database. The database will be backed up on daily and weekly intervals.

[Schedule Oracle-Suggested Backup](#)

Customized Backup

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

[Schedule Customized Backup](#)

☒ Whole Database
☐ Tablespaces
☐ Datafiles
☐ Archived Logs
☐ All Recovery Files on Disk
Includes all archived logs and disk backups that are not already backed up to tape.

Host Credentials

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

* Username
* Password
☐ Save as Preferred Credential

Backup Strategies

Oracle-suggested:

- Provides an out-of-the-box backup strategy based on the backup destination
- Sets up recovery window for backup management
- Schedules recurring and immediate backups
- Automates backup management

Customized:

- Specify the objects to be backed up
- Choose disk or tape backup destination
- Override the default backup settings
- Schedule the backup

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Scheduling Backups: Strategy

Select Enterprise Manager > Availability > Schedule Backup. Select either the Oracle-Suggested Backup strategy or your own customized strategy. The Oracle-Suggested Backup strategy makes a one-time whole-database backup, which is performed online. This is a baseline incremental level 0 backup. The automated backup strategy then schedules incremental level 1 backups for each successive day. For day 3 and onward, RMAN applies the level 1 backup from the beginning of day n-1 to the level 0 backup before beginning the incremental backup for that day.

By clicking Schedule Customized Backup, you gain access to a wider range of configuration options. Select the objects that you want to back up—the whole database (the default) or individual tablespaces, data files, archived logs, or any Oracle backups currently residing on the disk (to move them to the tape).

Both strategies enable you to set up encrypted backups.

Scheduling Backups: Options

Options Settings Schedule Review

Schedule Customized Backup: Options

Database orcl.oracle.com Cancel Step 1 of 4 Next

Backup Strategy Customized Backup

Object Type Whole Database

Backup Type

☒ Full Backup

☐ Use as the base of an incremental backup strategy

☐ Incremental Backup

A level 1 cumulative incremental backup includes all blocks changed since the most recent level 0 backup.

☐ Refresh the latest datafile copy on disk to the current time using the incremental backup

Backup Mode

☒ Online Backup

Can be performed when the database is open.

☐ Offline Backup

If the database is open at the time of backup, it will be shut down and mounted before the backup, then re-opened after the backup.

Advanced

☒ Also back up all archived logs on disk

☐ Delete all archived logs from disk after they are successfully backed up

☐ Delete obsolete backups

Delete backups that are no longer required to satisfy the retention policy.

☐ Use proxy copy supported by media management software to perform a backup

If proxy copy of the selected files is not supported, a conventional backup will be performed.

Maximum Files per Backup Set

Section Size KB

Backs up large files in parallel, using sections of the specified size. (This parameter overrides Maximum Backup Piece Size in Backup Settings.)

[Encryption](#)

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Scheduling Backups: Options

Select full or incremental backup type. If you are performing a full database backup, you can select “Use as the base of an incremental backup strategy” to make the full database backup an incremental level 0 backup. If you are using image copies, you can select “Refresh the latest datafile copy on disk to the current time using the incremental backup” to update the existing backup rather than create a new image copy.

Select Online Backup if you want to perform this task while users are continuing to use the database. If users do not need access, select “Offline Backup,” which is performed with a mounted instance.

Select “Delete obsolete backups” to remove any backups that fall outside the retention policy that you configured earlier. RMAN automatically removes obsolete backups if you are backing up to the fast recovery area. Details about the advanced options and encryption are discussed in the course titled *Oracle Database 11g: Administration Workshop II* and in the backup and recovery documentation.

Scheduling Backups: Settings

The screenshot shows the 'Schedule Customized Backup: Settings' dialog box. At the top, there is a progress bar with four steps: Options, Settings (current), Schedule, and Review. The 'Settings' step is highlighted. Below the progress bar, the title 'Schedule Customized Backup: Settings' is displayed. To the right of the title are buttons for 'Cancel', 'Back', 'Step 2 of 4', and 'Next'. The main content area shows the following settings: Database: orcl.oracle.com, Backup Strategy: Customized Backup, and Object Type: Whole Database. Below these settings, there is a section for selecting the destination media. The 'Disk' option is selected with a radio button, and the 'Disk Backup Location' is set to '+FRA'. The 'Tape' option is unselected. Below the media selection, there is a section for 'Media Management Vendor (MMV) Library Parameters' which is set to 'Not specified'. At the bottom of the dialog, there are two buttons: 'View Default Settings' and 'Override Default Settings'. Below these buttons, a small note states: 'Changed settings will only apply to the current backup.'

Options Settings Schedule Review

Schedule Customized Backup: Settings Cancel Back Step 2 of 4 Next

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

Select the destination media for this backup. You can also override the default backup settings.

☒ Disk
Disk Backup Location +FRA
☐ Tape
Media Management Vendor (MMV) Library Parameters Not specified

View Default Settings Override Default Settings
Changed settings will only apply to the current backup.

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Scheduling Backups: Settings

Select whether the backup is to go to the disk or to the tape.

To create a one-time backup (in addition to your regularly scheduled backups), click Override Current Settings and specify your backup settings.

Scheduling Backups: Schedule

Options Settings **Schedule** Review

Schedule Customized Backup: Schedule Cancel Back Step 3 of 4 Next

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

Job

Job Name: BACKUP_ORCL.Oracle.COM_000
Job Description: Whole Database Backup

Schedule

Type: ☐ One Time (Immediately) ☐ One Time (Later) ☒ Repeating

Frequency Type: By Minutes

Repeat Every: Minutes

Time Zone: (UTC-08:00) US Pacific Time (PST)

Start Date: Jun 18, 2009

Start Time: 1:00 AM

Repeat Until: ☒ Indefinite ☐ Specified Date

Date: (example: Jun 18, 2009)

Time: AM PM

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Scheduling Backups: Schedule

Choose how you want the backup to be scheduled—either as a one-time job or as an automated, recurring process.

To configure a database for maximum recoverability, Oracle suggests regularly scheduled backups. Automating backups can simplify the administrator's workload.

When you select Repeating, the page displays additional scheduling details.

Scheduling Backups: Review

Options Settings Schedule **Review**

Schedule Customized Backup: Review

Database **orcl.oracle.com** Cancel Edit RMAN Script Back Step 4 of 4 Submit Job

Backup Strategy **Customized Backup**

Object Type **Whole Database**

Settings

Destination **Disk**

Backup Type **Full Backup**

Backup Mode **Online Backup**

Flash Recovery Area **+FRA**

RMAN Script

The RMAN script below is generated based on previous input.

```
backup device type disk tag '%TAG' database;
backup device type disk tag '%TAG' archivelog all not backed up;
```

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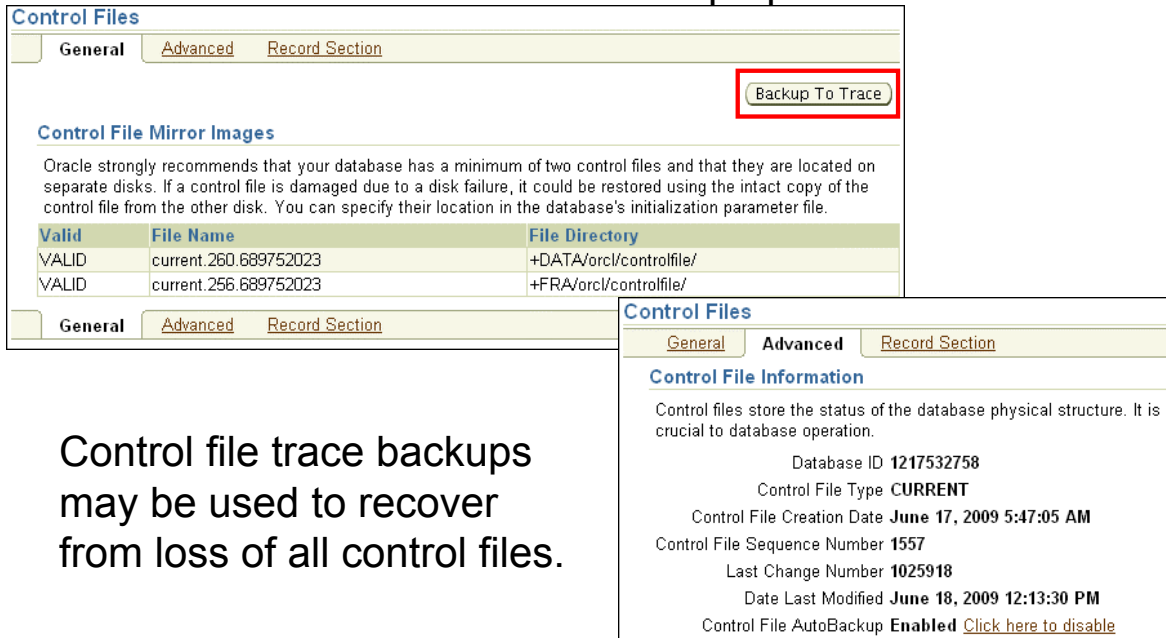
Scheduling Backups: Review

RMAN uses its own command syntax and scripting language.

Using this page, you can customize the RMAN scripts (if needed) or copy them for recording purposes.

Backing Up the Control File to a Trace File

Control files have an additional backup option.



The screenshot shows the Oracle Enterprise Manager interface for 'Control Files'. It has three tabs: 'General', 'Advanced', and 'Record Section'. The 'Advanced' tab is selected, and a 'Backup To Trace' button is highlighted with a red box. Below this is a section titled 'Control File Mirror Images' with a descriptive paragraph and a table of mirror images.

Valid	File Name	File Directory
VALID	current.260.689752023	+DATA/orcl/controlfile/
VALID	current.256.689752023	+FRA/orcl/controlfile/

Below the table, there is another 'Control Files' section with tabs 'General', 'Advanced', and 'Record Section'. The 'Advanced' tab is selected, showing 'Control File Information' with details like Database ID, Control File Type, Creation Date, Sequence Number, Last Change Number, Date Last Modified, and AutoBackup status.

Control file trace backups may be used to recover from loss of all control files.

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Backing Up the Control File to a Trace File

Select Enterprise Manager > Server > Control Files to manage your database's control files. Control files have an additional backup option; they may be backed up to a trace file. A control file trace backup contains the SQL statement required to re-create the control files in the event that all control files are lost.

Although it is very unlikely that a properly configured database (with multiple copies of the control file placed on separate disks and separate controllers) would lose all control files at the same time, it is possible. Therefore, the administrator should back up the control file to a trace file after each change to the physical structure of the database (adding tablespaces or data files, or adding additional redo log groups).

Trace copies of the control file can be created by using Enterprise Manager (as shown in the slide) or with the following SQL command:

```
SQL> ALTER DATABASE BACKUP CONTROLFILE TO TRACE;
```

The trace backup is created in the location specified by the `DIAGNOSTIC_DEST` initialization parameter (for example, `/u01/app/oracle/diag/rdbms/orcl/orcl/trace` with a file name such as `orcl_vktm_8400.trc`).

You can view information from within the control file on the Advanced tab of the Control Files page.

Managing Backups

Manage Current Backups

[Catalog Additional Files](#)
[Crosscheck All](#)
[Delete All Obsolete](#)
[Delete All Expired](#)

This backup data was retrieved from the database control file.

[Backup Sets](#)
[Image Copies](#)

Search

Status:

Contents: ☒ Datafile ☒ Archived Redo Log ☒ SPFILE ☒ Control File

Completion Time:
[Go](#)

Results

[Crosscheck](#)
[Change to Unavailable](#)
[Delete](#)
[Validate](#)

[Select All](#) | [Select None](#)

Select	Key	Tag	Completion Time	Contents	Device Type	Status	Keep	Pieces
<input type="checkbox"/>	4	TAG20090618T121325	Jun 18, 2009 12:13:27 PM	CONTROLFILE, SPFILE	DISK	AVAILABLE	NO	1
<input type="checkbox"/>	3	BACKUP_ORCL_ORACLE_061809120854	Jun 18, 2009 12:13:21 PM	ARCHIVED LOG	DISK	AVAILABLE	NO	1
<input type="checkbox"/>	2	TAG20090618T121228	Jun 18, 2009 12:12:56 PM	CONTROLFILE, SPFILE	DISK	AVAILABLE	NO	1
<input type="checkbox"/>	1	BACKUP_ORCL_ORACLE_061809120854	Jun 18, 2009 12:12:20 PM	DATAFILE	DISK	AVAILABLE	NO	1

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Managing Backups

Select Enterprise Manager > Availability > Manage Current Backup to manage your existing backups. On this page, you can see when a backup was completed, where it was created (disk or tape), and whether it is still available.

At the top of the Manage Current Backups page, four buttons enable you to work with existing backups:

- **Catalog Additional Files:** Although RMAN (working through Enterprise Manager) is the recommended way to create backups, you might have image copies or backup sets that were created by some other means or in some other environment with the result that RMAN is not aware of them. This task identifies those files and adds them to the catalog.
- **Crosscheck All:** RMAN can automatically delete obsolete backups, but you can also delete them by using operating system commands. If you delete a backup without using RMAN, the catalog does not know whether the backup is missing until you perform a cross-check between the catalog and what is really there.
- **Delete All Obsolete:** This deletes backups older than the retention policy.
- **Delete All Expired:** This deletes the catalog listing for any backups that are not found when the cross-check is performed.

Viewing Backup Reports

View Backup Report

The following backup jobs are known to the database. The data is retrieved from the database control file.

Search

Status: Start Time: Type:

Results

Total 1 (Completed ☒ 1)

Backup Name	Status	Start Time	Time Taken	Type	Output Devices	Input Size	Output Size	Output Rate (Per Sec)
BACKUP_ORCL_ORACLE_061809120854	COMPLETED	Jun 18, 2009 12:09:16	00:04:14	DB FULL	DISK	1.64G	1.34G	5.42M

Related Links

[Manage Current](#)

Inputs

Datfiles

Datafile Number	Output Type	Output Key	File Size	Tablespace	Checkpoint Time	Incremental Level	Compression Ratio	Corrupted Blocks	File Creation Time	File Checkpoint SCN	Resetlogs SCN
1	BACKUPSET	1	750.01M	SYSTEM	Jun 18, 2009 12:09:18 PM GMT+07:00		1.158	0	Apr 24, 2009 10:31:11 AM GMT+07:00	1025302	740137
2	BACKUPSET	1	651.26M	SYSAUX	Jun 18, 2009 12:09:18 PM GMT+07:00		1.43	0	Apr 24, 2009 10:31:17 AM GMT+07:00	1025302	740137
3	BACKUPSET	1	100.01M	UNDOTBS1	Jun 18, 2009 12:09:18 PM GMT+07:00		11.595	0	Apr 24, 2009 11:29:42 AM GMT+07:00	1025302	740137
4	BACKUPSET	1	148.20M	USERS	Jun 18, 2009 12:09:18 PM GMT+07:00		1.102	0	Apr 24, 2009 10:31:30 AM GMT+07:00	1025302	740137
5	BACKUPSET	1	100.01M	EXAMPLE	Jun 18, 2009 12:09:18 PM GMT+07:00		1.442	0	Jun 17, 2009 5:49:29 AM GMT+07:00	1025302	740137

Control Files

Output Type	Output Key/Checkpoint Time	File Size	File Checkpoint SCN	Resetlogs SCN
BACKUPSET	2 Jun 18, 2009 12:12:28 PM GMT+07:00	9.30M	1025706	740137
BACKUPSET	4 Jun 18, 2009 12:13:25 PM GMT+07:00	9.30M	1025894	740137

SPFile

Backup Set	Modification Time	File Size
4	Jun 18, 2009 11:21:10 AM GMT+07:00	0.00K
2	Jun 18, 2009 11:21:10 AM GMT+07:00	0.00K

Archived Logs

Output Type	Output Key	Thread Number	Sequence Number	File Size	Low Time	High Time	Compression Ratio	Resetlogs SCN
BACKUPSET	3	1	14	42.14M	Jun 18, 2009 6:41:27 AM GMT+07:00	Jun 18, 2009 12:13:04 PM GMT+07:00	1	740137

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Viewing Backup Reports

Information about backup jobs can also be viewed by selecting Enterprise Manager > Availability > Backup Reports. The content is based on the control file. The backup report contains summary information as well as detailed information about the input and output of a specific job, including timing, SCN, sizing, compression, corruption (if any), and so on.

Monitoring the Fast Recovery Area

Flash Recovery

This database is using a flash recovery area. The chart shows space used by each file type that is not reclaimable by Oracle. Performing backups to tertiary storage is one way to make space reclaimable. Usable Flash Recovery Area includes free and reclaimable space.

Flash Recovery Area Location

Flash Recovery Area Size MB

Flash Recovery Area Size must be set when the location is set.

Non-reclaimable Flash Recovery Area (GB) 1.5

Reclaimable Flash Recovery Area (MB) 53

Free Flash Recovery Area (GB) 2.8

☐ Enable Flashback Database

Flashback database can be used for fast database point-in-time recovery, as it returns the 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. The flash recovery area must be set to enable flashback database.

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

☐ Apply initialization parameter changes to SPFILE only. If not checked, parameter changes will be made to both the SPFILE and the running instance.

* Changes to this setting or parameter require a database restart.

Flash Recovery Area Usage

File Type	Size (GB)	Percentage
Backup Piece	1.34	30.8%
Online Log	0.15	3.4%
Control File	0.01	0.2%
Archived Redo Log	0	0%
Image Copy	0	0%
Flashback Log	0	0%
Usable	2.85	85.6%

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Monitoring the Fast Recovery Area

If you have configured your archived logs to be written to this location, it is important to monitor this space to ensure that it does not reach its capacity. If the instance is unable to create an archived log because of lack of space, it pauses until the administrator corrects the situation.

Select Enterprise Manager > Availability > Recovery Settings. On this page, you can:

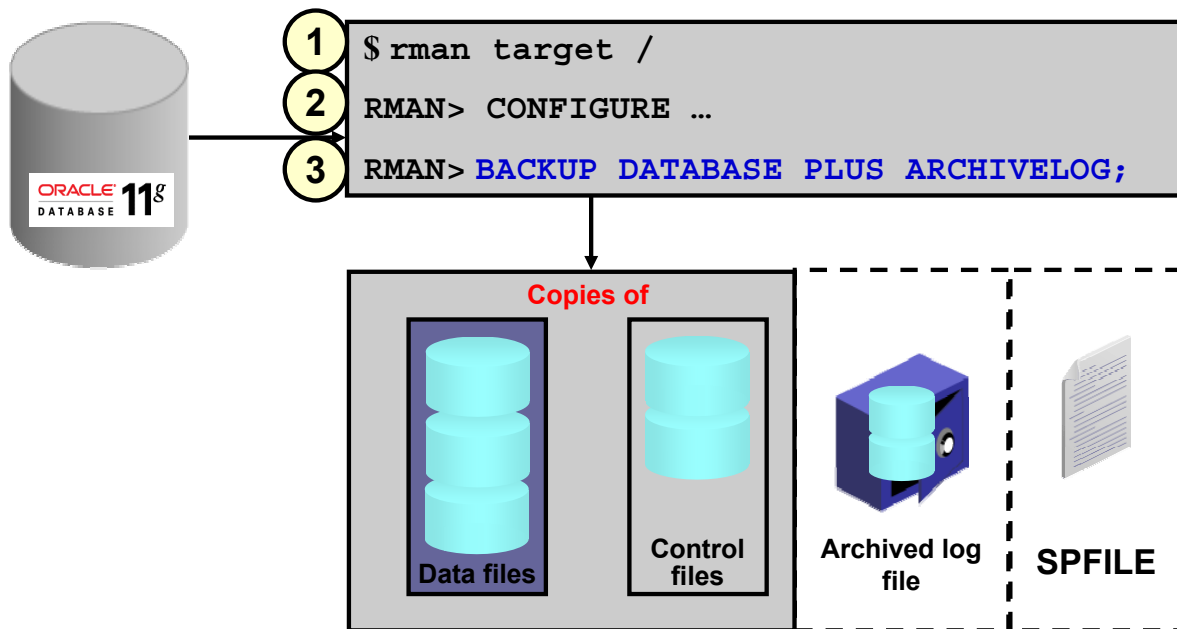
- Verify how much of the fast recovery area has been consumed
- Specify the location of the fast recovery area
- Specify the size of the fast recovery area
- Configure Flashback Database
- Specify the retention time

The retention time determines when files are obsolete (that is, when they are no longer needed to meet your data recovery objectives). The Oracle database automatically manages this storage, deleting files that are no longer needed. When you back up the recovery area, RMAN can fail over to other archived redo log destinations if the archived redo log in the fast recovery area is inaccessible or corrupted.

Periodically copying backups to tape frees space in the fast recovery area for other files, but retrieving files from tape causes longer database restoration and recovery times.

Note: The Enterprise Manager interface has not yet been updated to reflect the change in name from flash recovery area to fast recovery area.

Using the RMAN Command Line



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Using the RMAN Command Line

1. In a terminal session, start RMAN and connect to the target database.
2. Execute configuration commands:
 - `CONFIGURE DEFAULT DEVICE TYPE TO disk;`
 - `CONFIGURE DEVICE TYPE DISK BACKUP TYPE TO COPY;`
 - `CONFIGURE CONTROLFILE AUTOBACKUP ON;`
3. A whole database backup is a copy of all data files and the control file. You can optionally include the server parameter file (SPFILE) and archived redo log files. Using RMAN to make an image copy of all the database files simply requires mounting or opening the database, starting RMAN, and entering the `BACKUP` command shown in the slide. Optionally, you can supply the `DELETE INPUT` option when backing up archive log files. That causes RMAN to remove the archive log files after backing them up. This is useful especially if you are not using a fast recovery area, which would perform space management for you, deleting files when space pressure grows. In that case, the command in the slide would look like the following:
`RMAN> BACKUP DATABASE PLUS ARCHIVELOG DELETE INPUT;`
You can also create a backup (either a backup set or image copies) of previous image copies of all data files and control files in the database by using the following command:
`RMAN> BACKUP COPY OF DATABASE;`

Quiz

Using the change-tracking feature, an image copy backup performed by RMAN can skip blocks that have not changed since the last backup.

1. True
2. False

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Answer: 2

Summary

In this lesson, you should have learned how to:

- Create consistent database backups
- Back up your database without shutting it down
- Create incremental backups
- Automate database backups
- Manage backups and view backup reports
- Monitor the fast recovery area

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Practice 15 Overview: Creating Database Backups

This practice covers the following topics:

- Backing up your database while the database is open for user activity
- Scheduling automatic nightly incremental backups for your database

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Performing Database Recovery

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Objectives

After completing this lesson, you should be able to:

- Determine the need for performing recovery
- Access different interfaces (such as Enterprise Manager and command line)
- Describe and use available options, such as Recovery Manager (RMAN) and the Data Recovery Advisor
- Perform recovery:
 - Control file
 - Redo log file
 - Data file

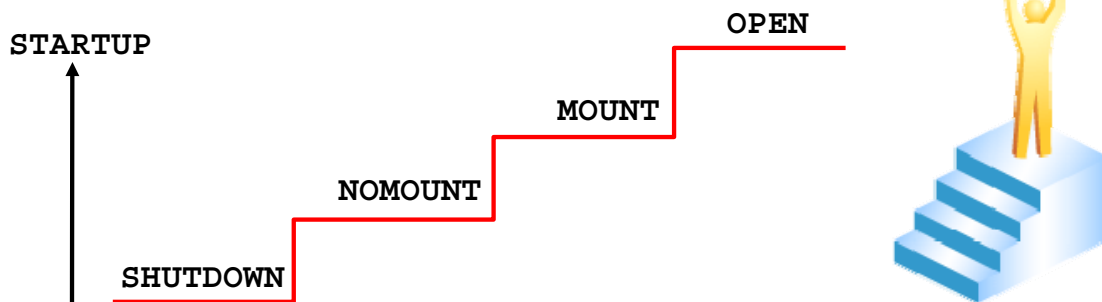
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Opening a Database

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 with the following stages:

- **NOMOUNT:** 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 does the following:
 - 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 if 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 require media recovery are listed, but no error message is displayed.

Keeping a Database Open

After the database 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 a database is open, instance failure can be caused by media failure: for example, by the loss of a control file, the loss of an entire redo log group, or the loss of a data file belonging to the `SYSTEM` or `UNDO` tablespaces. Even if an inactive redo log group is lost, the database would eventually fail due to log switches.

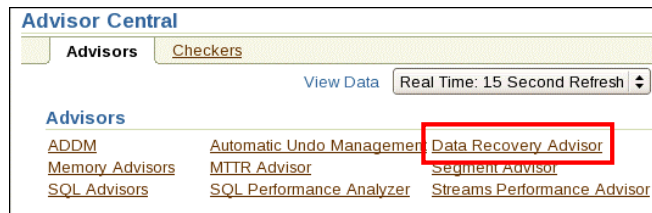
In many cases, the failed instance does not completely shut down but is unable to continue to perform work. Recovering from these types of media failure must be done with the database down. As a result, the administrator must use the `SHUTDOWN ABORT` command before beginning recovery efforts.

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 or by using the Data Recovery Advisor.

Data Recovery Advisor

- Fast detection, analysis, and repair of failures
- Down-time and run-time failures
- Minimizing disruptions for users
- User interfaces:
 - Enterprise Manager GUI (several paths)
 - RMAN command line
- Supported database configurations:
 - Single instance
 - Not RAC
 - Supporting failover to standby, but not analysis and repair of standby databases



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Data Recovery Advisor

The Data Recovery Advisor automatically gathers data failure information when an error is encountered. In addition, it can proactively check for failures. In this mode, it can potentially detect and analyze data failures before a database process discovers the corruption and signals an error. (Note that repairs are always under human control.)

Data failures can be very serious. For example, if your current log files are missing, you cannot open your database. Some data failures (like block corruptions in data files) are not catastrophic because they do not take the database down or prevent you from opening the Oracle database. The Data Recovery Advisor handles both cases: the one when you cannot start up the database (because required database files are missing, inconsistent, or corrupted) and the one when file corruptions are discovered during run time.

The preferred way to address serious data failures is as follows:

1. Fail over to a standby database if you are in a Data Guard configuration. This allows users to come back online as soon as possible.
2. Repair the primary cause of the data failure (fortunately, this does not affect your users).

Functionality of the Data Recovery Advisor (continued)

User Interfaces

The Data Recovery Advisor is available from Enterprise Manager (EM) Database Control and Grid Control. When failures exist, there are several ways to access the Data Recovery Advisor. The following examples all begin on the Database Instance home page:

- Availability tabbed page > Perform Recovery > Advise and Recover
- Active Incidents link > on the Support Workbench “Problems” page: Checker Findings tabbed page > Launch Recovery Advisor
- Database Instance Health > click specific link (for example, ORA 1578) in the Incidents section > Support Workbench, Problems Detail page > Data Recovery Advisor
- Database Instance Health > Related Links section: Support Workbench > Checker Findings tabbed page: Launch Recovery Advisor
- Related Link: Advisor Central > Advisors tabbed page: Data Recovery Advisor
- Related Link: Advisor Central > Checkers tabbed page: Details > Run Detail tabbed page: Launch Recovery Advisor

You can also use the Data Recovery Advisor by using the RMAN command line:

```
rman target /  
rman> list failure all;
```

Supported Database Configurations

In the current release, the Data Recovery Advisor supports single-instance databases. Oracle Real Application Clusters databases are not supported.

The Data Recovery Advisor cannot use blocks or files transferred from a standby database to repair failures on a primary database. Furthermore, you cannot use the Data Recovery Advisor to diagnose and repair failures on a standby database. However, the Data Recovery Advisor does support failover to a standby database as a repair option (as mentioned above).

Loss of a Control File

If a control file is lost or corrupted, the instance normally aborts.

- If control files are stored in ASM disk groups, recovery options are as follows:
 - Perform guided recovery using Enterprise Manager.
 - Put database in `NOMOUNT` mode and use an RMAN command to restore control file from existing control file.

```
RMAN> restore controlfile from  
      '+DATA/orcl/controlfile/current.260.695209463';
```

- If control files are stored as regular file system files then:
 - Shut down the database
 - Copy existing control file to replace lost control file

After control file is successfully restored, open the database.

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Loss of a Control File

The options for recovery from the loss of a control file depend on the storage configuration of the control files and on whether at least one control file remains or have all been lost.

If using ASM storage, and at least one control file copy remains, you can perform guided recovery using Enterprise Manager or perform manual recovery using RMAN as follows:

1. Put the database in `NOMOUNT` mode.
2. Connect to RMAN and issue the `restore controlfile` command to restore the control file from an existing control file, for example:

```
restore controlfile from  
'+DATA/orcl/controlfile/current.260.695209463';
```
3. After the control file is successfully restored, open the database.

If your control files are stored as regular file system files and at least one control file copy remains, then, while the database is down, you can just 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.

Note: Recovering from the loss of all control files is covered in the course titled *Oracle Database 11g: Administration Workshop II*.

Loss of a Redo Log File

If a member of a redo log file group is lost and if the group still has at least one member, note the following results:

- 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:

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  
      '+DATA/orcl/onlineolog/group_1.261.691672257';
```

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

```
SQL> ALTER DATABASE ADD LOGFILE MEMBER '+DATA' TO GROUP 2;
```

Enterprise Manager can also be used to drop and re-create the log file member.

Note: If 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, then 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.
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 then select the Clear Logfile action. You can also clear the affected group manually with the following command:

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

Loss of a Redo Log File (continued)

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 if 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 that were 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.

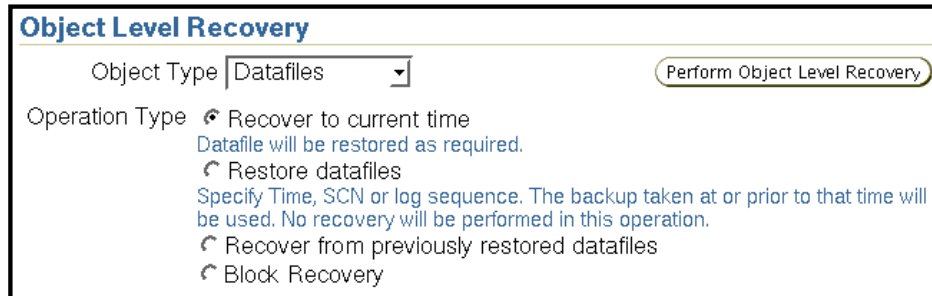
To perform this type of recovery:

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.

If you have a database in NOARCHIVELOG mode that has an incremental backup strategy, RMAN first restores the most recent level 0 and then RMAN recovery applies the incremental backups.

Loss of a Noncritical Data File in ARCHIVELOG Mode

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



The screenshot shows the 'Object Level Recovery' dialog box. At the top, the title is 'Object Level Recovery'. Below it, there is a dropdown menu for 'Object Type' with 'Datafiles' selected. To the right of this is a button labeled 'Perform Object Level Recovery'. Under the 'Object Type' dropdown, there is a section for 'Operation Type' with four radio button options: 'Recover to current time' (which is selected), 'Restore datafiles', 'Recover from previously restored datafiles', and 'Block Recovery'. Below the 'Recover to current time' option, there is a blue text note: 'Datafile will be restored as required. 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.'



Users

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Loss of a Noncritical Data File in ARCHIVELOG Mode

With the database in ARCHIVELOG mode, the loss of any data file not belonging to the `SYSTEM` or `UNDO` tablespaces affects only the 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:

1. Click **Perform Recovery** on the Maintenance properties page.
2. Select **Datafiles** as the recovery type, and then 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 is possible up to the time of the last commit 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 if that file belongs to the `SYSTEM` or `UNDO` tablespace, perform the following tasks:

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



Users

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Loss of a System-Critical Data File in ARCHIVELOG Mode

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:

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 then 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.

Data Failure: Examples

- Inaccessible components: Missing data files at the OS level, incorrect access permissions, offline tablespace
- Physical corruptions: Block checksum failures, invalid block header field values
- Logical corruptions: Inconsistent dictionary; corrupt row piece, index entry, or transaction
- Inconsistencies: Control file older or newer than the data files and online redo logs
- I/O failures: Limit on the number of open files exceeded, inaccessible channels, network or I/O error



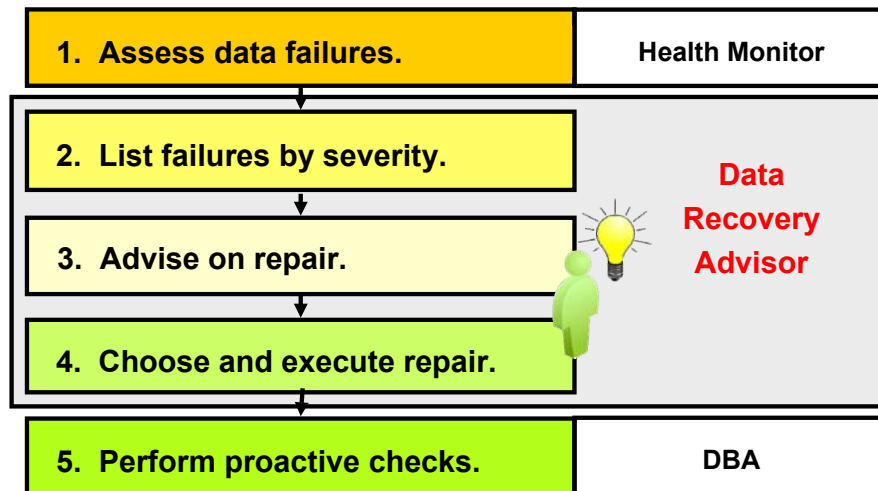
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Data Failure: Examples

The Data Recovery Advisor can analyze failures and suggest repair options for a growing list of issues.

Data Recovery Advisor



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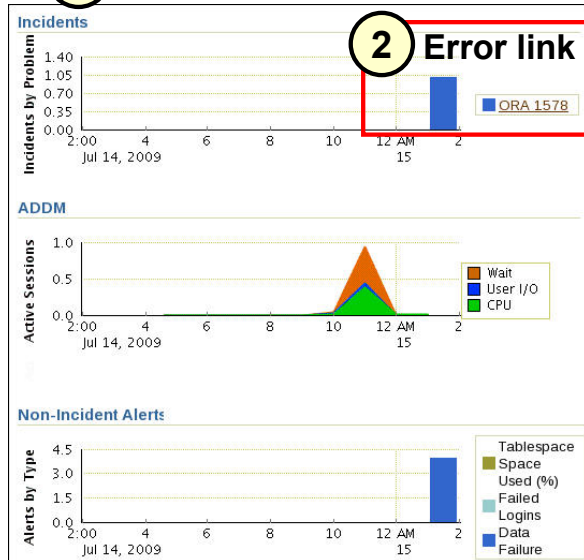
Data Recovery Advisor

The automatic diagnostic workflow in Oracle Database 11g performs workflow steps for you. With the Data Recovery Advisor you only need to initiate an advise and a repair.

1. Health Monitor automatically executes checks and logs failures and their symptoms as “findings” into the automatic diagnostic repository (ADR).
2. The Data Recovery Advisor consolidates findings into failures. It lists the results of previously executed assessments with failure severity (critical or high).
3. When you ask for repair advice on a failure, the Data Recovery Advisor maps failures to automatic and manual repair options, checks basic feasibility, and presents you with the repair advice.
4. You can execute a repair manually, or you can request the Data Recovery Advisor to do it for you.
5. In addition to the automatic, primarily “reactive” checks of Health Monitor and the Data Recovery Advisor, Oracle recommends using the `VALIDATE` command as a “proactive” check.

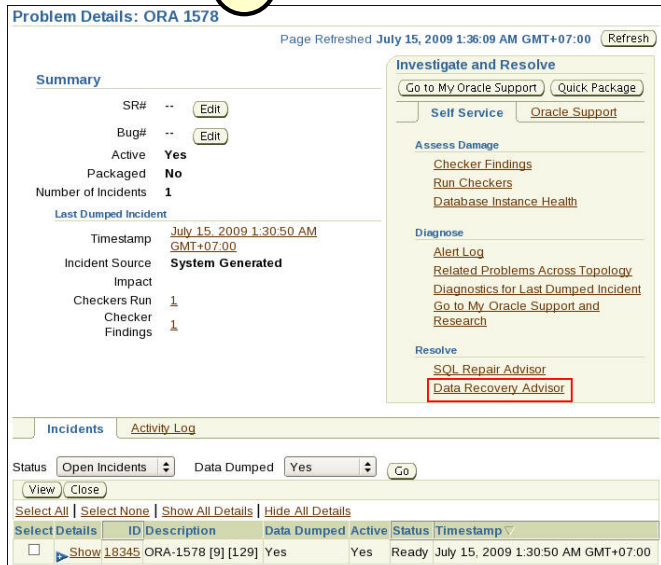
Assessing Data Failures

1 Database instance health



2 Error link

3 Problem details



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Assessing Data Failures

The example in the slide shows one of several possible ways to see the interaction of Health Monitor and the Data Recovery Advisor.

Data Failures

The screenshot displays the Oracle Enterprise Manager 11g Database Control interface. At the top, the title bar reads "ORACLE Enterprise Manager 11g Database Control" with a "Help" link. Below this, a breadcrumb trail shows "Database Instance: orcl.oracle.com >". The main content area is divided into several sections. On the left, under the "Information" tab, there is a list: "1. Database Failures - 1" and "2. Current Status - MOUNTED". Below this is the "Perform Recovery" section. Under "Oracle Advised Recovery", a message states: "The Data Recovery Advisor has detected failures. Click on 'Advise and Recover' to have Oracle analyze and produce recovery advice." A red box highlights the "Advise and Recover" button. Below the message, a table shows the detected failure: "Failures Detected Critical: 1 High: 0 Low: 0", "Failure System datafile 1: '+DATA/orcl/datafile'", and "Description /system.256.692202091' is missing". To the right of this is the "User Directed Recovery" section, which includes a "Recovery Scope" dropdown set to "Whole Database" and a "Recover" button. Below this, the "Operation Type" section has three radio button options: "Recover to the current time or a previous point-in-time" (selected), "Restore all datafiles", and "Recover from previously restored datafiles". On the far right, an "Overview" section lists several recovery actions: "Recover database failures as advised by Oracle", "Restore and/or recover the entire database or selected objects", "Restore files to a new location", "Recover tablespaces to a point-in-time based on a timestamp, system change number (SCN), or log sequence number", "Recover datafile data blocks that are marked as corrupted, or based on datafile block IDs or tablespace block addresses", and "Flashback database or tables to a specific system change number (SCN) or timestamp". At the bottom left of the main content area is a link for "Decrypt Backups".

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Data Failures

Data failures are detected by checks, which are diagnostic procedures that assess the health of the database or its components. Each check can diagnose one or more failures, which are then mapped to a repair.

Checks can be reactive or proactive. When an error occurs in the database, reactive checks are automatically executed. You can also initiate proactive checks (for example, by executing the `VALIDATE DATABASE` command).

In Enterprise Manager, select Availability > Perform Recovery or click the Perform Recovery button if you find your database in a “down” or “mounted” state. Click “Advise and Recover” to have Enterprise Manager analyze and produce recovery advice.

Listing Data Failures

ORACLE Enterprise Manager 11g Database Control

Database Instance: orcl.oracle.com >

View and Manage Failures

Last Refresh July 15, 2009 2:38:38 AM GMT+07:00

Select dropdown values and optionally enter failure description and impact strings to filter the data that is displayed in your results set.

Failure Description Impact Priority Status Time Detected

CRITICAL or HIGH OPEN All Go

Select failures and ... Advise Close Set Priority High Set Priority Low

Select All Select None Expand All Collapse All

Select	Failure Description	Impact	Priority	Status	Time Detected
<input type="checkbox"/>	▼ Data Failures				
<input checked="" type="checkbox"/>	System datafile 1: '+DATA/orcl /datafile/system.256.692202091' is missing	Database cannot be opened	CRITICAL	OPEN	2009-07-15 02:36:06.0

☒ **TIP** All CRITICAL failures must be selected before "Advise". All CRITICAL failures must be unselected before "Set Priority High" or "Set Priority Low".

☐ Use a Recovery Catalog

Recovery Catalog Database **Not specified**

Edit Recovery Catalog Information

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Listing Data Failures

This “View and Manage Failures” page is the home page for the Data Recovery Advisor. The example in the screenshot shows how the Data Recovery Advisor lists data failures and details. Activities that you can initiate include advising, setting priorities, and closing failures.

The underlying RMAN LIST FAILURE command can also display data failures and details. Failure assessments are not initiated here; they are executed and stored in the ADR.

Failures are listed in decreasing priority order: CRITICAL, HIGH, LOW. Failures with the same priority are listed in order of increasing time stamps.

Advising on Repair

(1) After manual repair
(2) Automatic repair

Manual Actions

Database Instance: orcl.oracle.com >

Manual Action Details

If file +DATA/orcl/datafile/system.256.692202091 was unintentionally renamed or moved, restore it

Recovery Advice

The repair includes complete media recovery with no data loss

RMAN Script

```
# restore and recover datafile
restore datafile 1;
recover datafile 1;
```

Review

The repair includes complete media recovery with no data loss

Failures That Will Be Resolved

Expand All | Collapse All

Failure Description	Impact	Priority
System datafile 1: '+DATA/orcl/datafile/system.256.692202091' is missing	Database cannot be opened	CRITICAL

RMAN Script

```
# restore and recover datafile
restore datafile 1;
recover datafile 1;
```

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Advising on Repair

On the “View and Manage Failures” page, the Data Recovery Advisor generates a manual checklist after you click the Advise button. Two types of failures can appear.

- Failures that require human intervention: An example is a connectivity failure when a disk cable is not plugged in.
- Failures that are repaired faster if you can undo a previous erroneous action: For example, if you renamed a data file by error, it is faster to rename it back to its previous name than to initiate RMAN restoration from backup.

You can initiate the following actions:

- Click “Re-assess Failures” after you perform a manual repair. Resolved failures are implicitly closed; any remaining failures are displayed on the “View and Manage Failures” page.
- Click “Continue with Advise” to initiate an automated repair. When the Data Recovery Advisor generates an automated repair option, it generates a script that shows how RMAN plans to repair the failure. Click Continue if you want to execute the automated repair. If you do not want the Data Recovery Advisor to automatically repair the failure, you can use this script as a starting point for your manual repair.

Executing Repairs

The screenshot displays the Oracle Data Recovery Advisor (DRA) interface. At the top, a green banner reads "Recovery Succeeded" with the message "Recovery succeeded. See Recovery Results below." Below this, the "Recovery Results" section contains the following text:

Recovery Manager: Release 11.2.0.1.0 - Production on Wed Jul 15 02:47:57 2009
Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.

RMAN>
connected to target database: ORCL (DBID=1219972082, not open)
using target database control file instead of recovery catalog

RMAN>
echo set on

media recovery complete, elapsed time 00:00:40
Finished recover at 15-JUL-09
repair failure complete

RMAN> exit;
Recovery Manager complete.

At the bottom right of the main window, there are two buttons: "Open Database" and "OK". A red box highlights the "Open Database" button, and a red arrow points from it to a separate message box that says "The database has been opened successfully."

The Oracle logo is visible in the bottom right corner of the interface, and the copyright notice "Copyright © 2009, Oracle. All rights reserved." is at the very bottom.

Executing Repairs

The Data Recovery Advisor displays these pages. In the example, a successful repair is completed in 40 seconds.

Data Recovery Advisor Views

Querying dynamic data dictionary views

- V\$IR_FAILURE: Listing of all failures, including closed ones (result of the LIST FAILURE command)
- V\$IR_MANUAL_CHECKLIST: Listing of manual advice (result of the ADVISE FAILURE command)
- V\$IR_REPAIR: Listing of repairs (result of the ADVISE FAILURE command)
- V\$IR_FAILURE_SET: Cross-reference of failure and advise identifiers



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Data Recovery Advisor Views

Usage Example

Suppose that you need to display all failures that were detected on June 21, 2007.

```
SELECT * FROM v$ir_failure
WHERE trunc (time_detected) = '21-JUN-2007';
```

See the *Oracle Database Reference* for details about the dynamic data dictionary views used by the Data Recovery Advisor.

Quiz

An Instance will not fail if the following event occurs:

1. Loss of a control file if there is a remaining multiplexed control file
2. Loss of the SYSTEM tablespace
3. Loss of one redo log member if there is a remaining multiplexed redo log member from the same group of the lost member
4. Loss of the active undo tablespace

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Answer: 3

Quiz

The information used by the Data Recovery Advisor is only available via the Enterprise Manager interface.

1. True
2. False

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Answer: 2

Summary

In this lesson, you should have learned how to:

- Determine the need for performing recovery
- Access different interfaces (such as Enterprise Manager and command line)
- Describe and use available options, such as Recovery Manager (RMAN) and the Data Recovery Advisor
- Perform recovery:
 - Control file
 - Redo log file
 - Data file

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Practice 16 Overview: Performing Database Recovery

This practice covers recovering from the loss of a:

- Control file
- Noncritical data file
- System-critical data file

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Moving Data

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Objectives

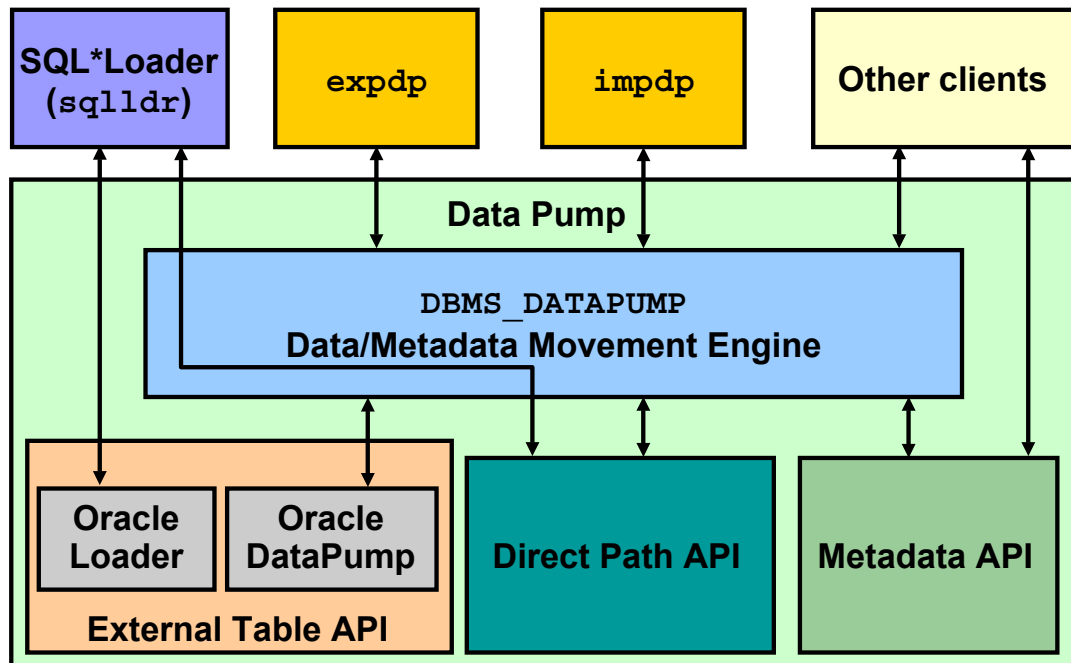
After completing this lesson, you should be able to:

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

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Moving Data: General Architecture



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Moving Data: General Architecture

Major functional components:

- **DBMS_DATAPUMP:** Contains the API for high-speed export and import utilities for bulk data and metadata movement
- **Direct Path API (DPAPI):** Oracle Database 11g supports a Direct Path API interface that minimizes data conversion and parsing at both unload and load time.
- **DBMS_METADATA:** 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:** Has been integrated with external tables, providing automatic migration of loader control files to external table access parameters
- **expdp and impdp:** Thin layers that make calls to the DBMS_DATAPUMP package to initiate and monitor Data Pump operations
- **Other clients:** 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.

Oracle Data Pump: Overview

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

- Is callable via `DBMS_DATAPUMP`
- Provides the following tools:
 - `expdp`
 - `impdp`
 - Web-based interface
- Provides four data movement methods:
 - Data file copying
 - Direct path
 - External tables
 - Network link support
- Detaches from and reattaches to long-running jobs
- Restarts Data Pump jobs



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Oracle Data Pump: Overview

Oracle 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 11g 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 meta-information remains undisturbed. It does not matter whether the job is stopped voluntarily or involuntarily due to a crash.

Oracle Data Pump: Benefits

Data Pump offers many benefits and some new features over earlier data movement tools, such as:

- Fine-grained object and data selection
- Explicit specification of database version
- Parallel execution
- Estimation of export job space consumption
- Network mode in a distributed environment
- Remapping capabilities
- Data sampling and metadata compression
- Compression of data during a Data Pump export
- Security through encryption
- Ability to export XMLType data as CLOBs
- Legacy mode to support old import and export files

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Oracle 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 you can 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 Enhancements in Oracle Database 11g

In Oracle Database 11g, new features have been added that enable you to:

- Compress both data and metadata, only data, only metadata, or no data during an export
- Specify additional encryption options in the following areas:
 - You can choose to encrypt both data and metadata, only data, only metadata, no data, or only encrypted columns during an export.
 - You can specify a specific encryption algorithm to use during an export.
 - You can specify the type of security to use for performing encryption and decryption during an export. For example, perhaps the dump file set will be imported into a different or remote database and it must remain secure in transit. Or perhaps the dump file set will be imported onsite using the Oracle Encryption Wallet but it may also need to be imported offsite where the Oracle Encryption Wallet is not available.
- Perform table mode exports and imports using the transportable method; specify how partitioned tables should be handled during import operations
- Overwrite existing dump files during an export operation
- Rename tables during an import operation
- Specify that a data load should proceed even if nondeferred constraint violations are encountered (This is valid only for import operations that use the external tables access method.)
- Specify that XMLType columns are to be exported in uncompressed CLOB format regardless of the XMLType storage format that was defined for them
- During an export, specify a remap function that takes as a source the original value of the designated column and returns a remapped value that will replace the original value in the dump file
- Remap data as it is being imported into a new database
- Legacy mode to support the use of original Export (exp) and Import (imp) scripts

Directory Objects for Data Pump

ORACLE Enterprise Manager 11g Database Control

Database Instance: orcl.oracle.com > Logged in As SYS

Directory Objects

Search

Object Name Go

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

Selection Mode Create

Edit View Delete Actions Create Like Go

Select	Name	Path
<input checked="" type="radio"/>	DATA_FILE_DIR	/u01/app/oracle/product/11.2.0/dbhome_1/demo/schema/sales_history/
<input type="radio"/>	DATA_PUMP_DIR	/u01/app/oracle/admin/orcl/dpdump/
<input type="radio"/>	LOG_FILE_DIR	/u01/app/oracle/product/11.2.0/dbhome_1/demo/schema/log/
<input type="radio"/>	MEDIA_DIR	/u01/app/oracle/product/11.2.0/dbhome_1/demo/schema/product_media/
<input type="radio"/>	ORACLE_OCM_CONFIG_DIR	/u01/app/oracle/product/11.2.0/dbhome_1/ccr/state
<input type="radio"/>	SS_OE_XMLDIR	/u01/app/oracle/product/11.2.0/dbhome_1/demo/schema/order_entry/
<input type="radio"/>	SUBDIR	/u01/app/oracle/product/11.2.0/dbhome_1/demo/schema/order_entry//2002/Sep
<input type="radio"/>	XMLDIR	/ade/b/1191423112/oracle/rdbms/xml

Database | Setup | Preferences | Help | Logout

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Directory Objects for Data Pump

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 that you do not need to hard-code directory path specifications. You thus 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 Schema > Database Objects > Directory Objects.

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

Creating Directory Objects

1 Create

Selection Mode: Single

Edit View Delete Actions: Create Like Go

Select Name Path

DATA_FILE_DIR /u01/app/oracle/p

3 General Privileges

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

Add

Select Remove

Select All | Select None

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

2 * Name ext_tab_logdir

* Path /home/oracle/labs/extab1

Test File System

5 General Privileges

Show SQL Cancel OK

4 Show SQL

Return

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

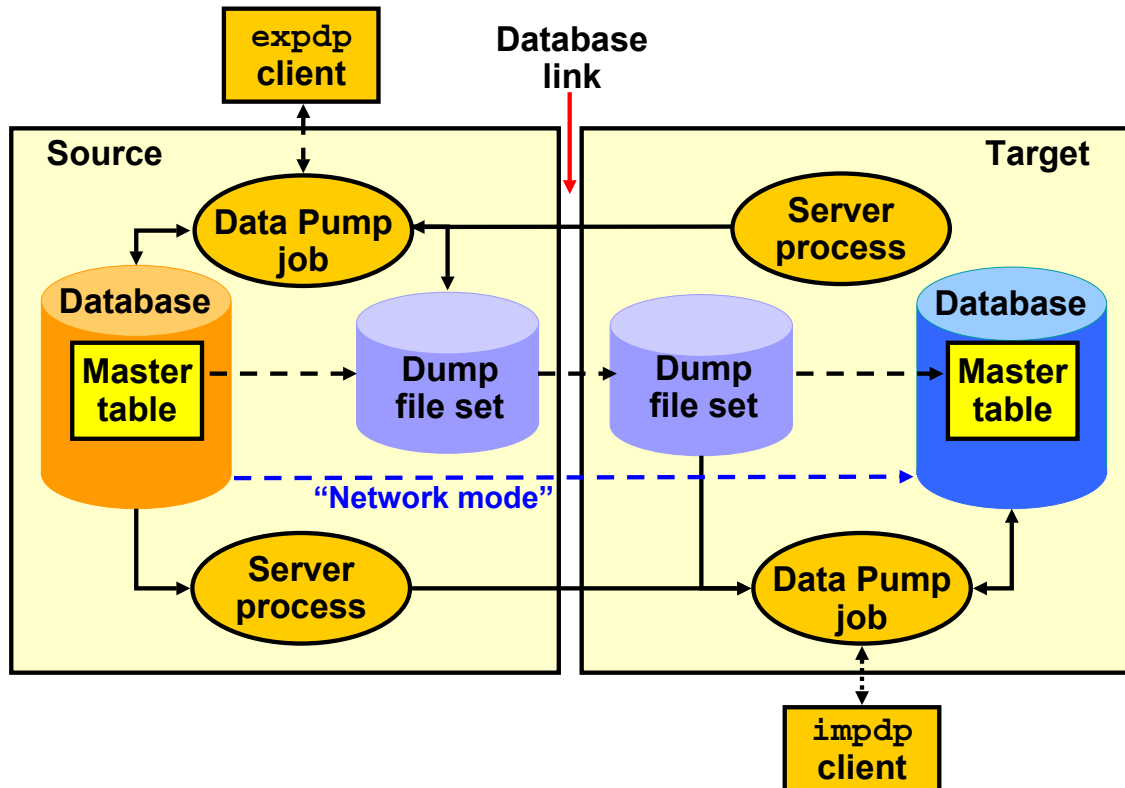
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Creating Directory Objects

1. On the Directory Objects page, click the Create button.
2. Enter the name of the directory object and the OS path to which it maps. OS directories should be created before they are used. You can test this by clicking the Test File System button. For the test, provide the host login credentials (that is, the OS user who has privileges on this OS directory).
3. Permissions for directory objects are not the same as 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 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. Click Return when finished.
5. Click OK to create the object.

Data Pump Export and Import Clients: Overview



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Data Pump Export and Import Clients: 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
 - Enterprise Manager
- 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:

- **Command line interface:** Enables you to specify most of the export parameters directly on the command line
- **Parameter file interface:** Enables you to specify all command line parameters in a parameter file. The only exception is the `PARFILE` parameter.
- **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.
- **Web interface:** On the Database Control home page, click the Data Movement tab, and then select one of the following links from the Move Row Data region: Export to Export Files, Import from Export 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. The available modes are listed in the slide and are the same as in the original export and import utilities.

Data Pump Export using Database Control

The screenshot shows the Oracle Database Control interface for instance 'orcl.oracle.com'. The 'Data Movement' tab is selected. Under the 'Move Row Data' section, the 'Export to Export Files' link is highlighted with a red box and a red arrow. Below this, the 'Export: Export Type' dialog is shown. The 'Schemas' radio button is selected. The 'Host Credentials' section shows the username 'oracle' and a masked password. The 'Save as Preferred Credential' checkbox is checked. 'Cancel' and 'Continue' buttons are visible at the bottom of the dialog.

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Data Pump Export Using Database Control

Enterprise Manager Database control provides a wizard to guide you through the process of performing a Data Pump export and import procedure. The example above shows a Data Pump export.

From the Database Instance home page, click the Data Movement tab, and locate the Data Pump export and import options under the "Move Row Data" section of the web page. Click "Export to Export Files" to begin a Data Pump export session.

The next window to appear is the selection of export type. If a privileged user is connected to the database instance, then the export types include the following:

- Database
- Schemas
- Tables
- Tablespace

If a non-administrative account is used, then the export type list is limited to the following:

- Schemas
- Tables

Click Continue to proceed with the export.

Data Pump Export Example: Basic Options

The screenshot shows the 'Export: Options' dialog box in Oracle Data Pump. At the top, there is a progress bar with four steps: Options (selected), Files, Schedule, and Review. Below the progress bar, the 'Database' is set to 'orcl.oracle.com'. There are 'Cancel', 'Finish', 'Step 1 of 4', and 'Next' buttons. The 'Maximum Number of Threads in Export Job' is set to '1'. A note states: 'This option allows you to make tradeoffs between resource consumption and elapsed time. Parallelism is only available in Enterprise Edition.' The 'Estimate Disk Space' section explains that it calculates an estimate of disk space consumption for table row data only. It offers two methods: 'Blocks' (selected) and 'Statistics'. The 'Blocks' method is described as the quickest rough estimate, while the 'Statistics' method provides the most accuracy if tables have been recently analyzed. There is an 'Estimate Disk Space Now' button and a note that this calculation may take a few minutes. The 'Optional File' section has a checked 'Generate Log File' option. The 'Directory Object' is set to 'DATA_PUMP_DIR' with a 'Create Directory Object' button. The 'Log File' is set to 'EXPDAT.LOG'. There is a 'Show Advanced Options' link. At the bottom, there are 'Cancel', 'Finish', 'Step 1 of 4', and 'Next' buttons.

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Data Pump Export Example: Basic Options

The Options page displays configurable options for the Data Pump export job. The "Maximum Number of Threads in Export Job" entry corresponds to the `PARALLEL` parameter on the command line. The value you specify should be less than, or equal to, the number of files in the dump file set. This option determines the number of parallel I/O server processes that are used, but the master control process and worker processes acting as query coordinators in parallel query operations do not count toward this total.

An estimation of how much disk space the export job will consume (in bytes) will be printed on the standard output and log file. The estimation can be based on block counts multiplied by block sizes or based on recent statistics analysis. This option corresponds to the `ESTIMATE` command line parameter.

An optional log file can be specified for the export job for all messages regarding work in progress, work completed, and errors encountered. The user performing the export will need write permissions on the directory object specified for the log file. If the log file being specified already exists, it will be overwritten. This option corresponds to the `LOGFILE` parameter on the command line.

Data Pump Export Example: Advanced Options

The screenshot shows the 'Content' section of the Oracle Data Pump Export Advanced Options dialog. It includes three radio buttons for 'What to Export from the Source Database': 'All' (selected), 'Data Only', and 'Metadata Only'. Below these are three radio buttons for 'Export Content': 'Include All Objects' (selected), 'Include Only Objects Specified Below', and 'Exclude Only Objects Specified Below'. A table titled 'Objects to Include or Exclude' has columns 'Select Object Type' and 'Object Name Expression', with a note 'No items found' and an 'Add Another Row' button. A text box provides an example for the 'Object Name Expression'. The 'Flashback' section has a checkbox for 'Export read-consistent view of data' and two radio buttons for 'As the specified System Change Number (SCN)' and 'As the SCN which most closely matches the specified time'. The 'Query' section has a text box for 'Specify SELECT statement predicate clauses' and a table with columns 'Select Predicate Clause' and 'Table Name', also with a 'No items found' note and an 'Add' button.

Content

What to Export from the Source Database ☒ All
Export both metadata and data

☐ Data Only
Export only table row data

☐ Metadata Only
Export only database object definitions

Export Content ☒ Include All Objects
☐ Include Only Objects Specified Below
☐ Exclude Only Objects Specified Below

Objects to Include or Exclude

Select Object Type	Object Name Expression
No items found	

Add Another Row

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

Flashback

☐ Export read-consistent view of data

☒ As the specified System Change Number (SCN)
SCN

☐ As the SCN which most closely matches the specified time
Date
Time ☒ 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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Data Pump Export Example: Advanced Options

Advanced options can be displayed by clicking the "Show Advanced Options" link.

The "Content" section of the page enables you to filter what export unloads: data only, metadata only, or both. This option corresponds to the CONTENT command line parameter. The "Content" section also allows for the INCLUDE and EXCLUDE command line parameters to be specified.

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, as in these 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"]

Flashback query can be used when data is being exported.

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. Here is an example:

```
QUERY=hr.employees:"WHERE department_id in (10,20)"
```

Data Pump Export Example: Files

Options Files Schedule Review

Export: Files

Database **orcl.oracle.com** Cancel Finish Back Step 2 of 4 Next

Specify the directory object and file name, and maximum size for the export files on the database server machine. Create Directory Object

Remove

Select	Directory Object	File Name	Maximum File Size (MB)
<input checked="" type="radio"/>	DATA_PUMP_DIR	HR_SCHEMA.DMP	

Add Another Row

You can wildcard a set of dump files using "%U" in the filename. A "%D" wildcard will be replaced with the date the job is run using a YYYYMMDD format.

Cancel Finish Back Step 2 of 4 Next

[Database](#) | [Help](#) | [Logout](#)

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Data Pump Export Example: Files

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. Created dump files are autoextensible by default.

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, 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 that are initially created is equal to the PARALLEL parameter.

Preexisting files that match the resulting file names are not overwritten by default. Instead, they result in an error and cause the job to be aborted. If you want the files to be overwritten then set REUSE_DUMPFILES=Y. Click Next to proceed with the export.

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

Data Pump Export Example: Files (continued)

- You do not need to create a directory object manually before using Data Pump Export. A default directory object named `DATA_PUMP_DIR` is created for every database, whether newly created or upgraded by a script on UNIX or Windows platforms. 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/DB_UNIQUE_NAME/dpdump`
- `<ORACLE_HOME>/admin/DB_UNIQUE_NAME/dpdump`

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, that value is used. Otherwise, the value of `ORACLE_HOME` is used. If the `DATA_PUMP_DIR` subdirectory is for some reason 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 attempted operation. 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.

Data Pump Export Example: Schedule

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

Description

Job Schedule

Time Zone

Start

☒ Immediately

☐ Later

Date

(example: Jul 11, 2009)

Time ☐ AM ☒ PM

Repeat

☒ One Time Only

☐ Interval

Frequency

☐ Monthly

☐ Yearly

Repeat Until

☒ Indefinite

☐ Custom

Date

(example: Jul 11, 2009)

Time ☒ AM ☐ PM

(ignored except when repeating by minutes or hours.)

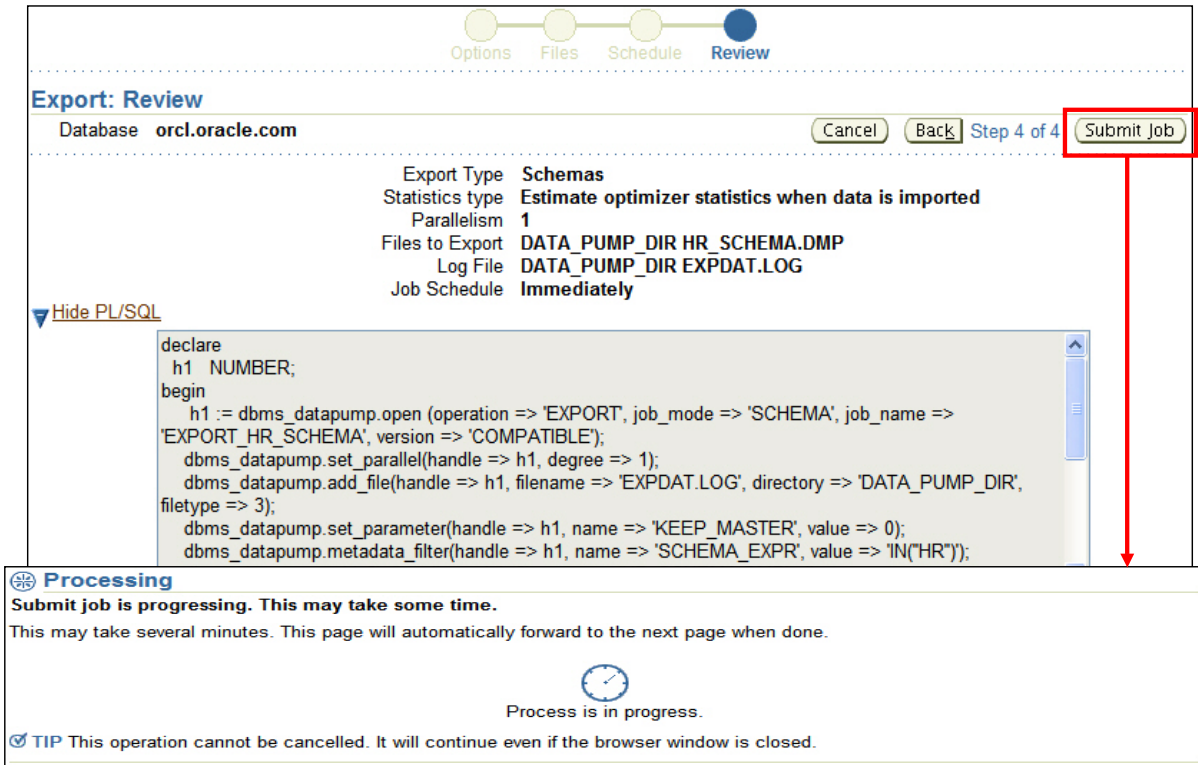
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Data Pump Export Example: Schedule

Data Pump jobs (created through this wizard) can be scheduled as repeatable jobs by Enterprise Manager Database Control. If the Job Name is not specified, a system-generated name will be used. Click Next to proceed with the export.

Data Pump Export Example: Review



Options Files Schedule **Review**

Export: Review

Database orcl.oracle.com Cancel Back Step 4 of 4 **Submit Job**

Export Type Schemas
Statistics type Estimate optimizer statistics when data is imported
Parallelism 1
Files to Export DATA_PUMP_DIR HR_SCHEMA.DMP
Log File DATA_PUMP_DIR EXPDAT.LOG
Job Schedule Immediately

▼ Hide PL/SQL

```
declare
h1 NUMBER;
begin
h1 := dbms_datapump.open (operation => 'EXPORT', job_mode => 'SCHEMA', job_name =>
'EXPORT_HR_SCHEMA', version => 'COMPATIBLE');
dbms_datapump.set_parallel(handle => h1, degree => 1);
dbms_datapump.add_file(handle => h1, filename => 'EXPDAT.LOG', directory => 'DATA_PUMP_DIR',
filetype => 3);
dbms_datapump.set_parameter(handle => h1, name => 'KEEP_MASTER', value => 0);
dbms_datapump.metadata_filter(handle => h1, name => 'SCHEMA_EXPR', value => 'IN(''HR'')');
```

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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Data Pump Export Example: Review

The "Review" page displays a summary of the information entered and allows you to view to PL/SQL procedure syntax that will be used for the export job. Click the "Submit Job" button to continue. Once the job is submitted, it cannot be cancelled and it is safe to close the browser.

Data Pump Import Example: impdp

Data Pump can be invoked on the command line to allow further command line options to be specified.

```
$ impdp hr DIRECTORY=DATA_PUMP_DIR \  
DUMPFILE=HR_SCHEMA.DMP \  
PARALLEL=1 \  
CONTENT=ALL \  
TABLES="EMPLOYEES" \  
LOGFILE=DATA_PUMP_DIR:import_hr_employees.log \  
JOB_NAME=importHR \  
TRANSFORM=STORAGE:n
```

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Data Pump Import Example: impdp

Data Pump provides command line clients for import and export operations. The example above illustrates a Data Pump import using the impdp utility. When running Data Pump using the command line, more options are provided. For a complete list of options, please consult the documentation manual "*Oracle Database Utilities 11g Release 2 (11.2).*"

Data Pump Import: Transformations

You can remap:

- Data files by using REMAP_DATAFILE
- Tablespaces by using REMAP_TABLESPACE
- Schemas by using REMAP_SCHEMA
- Tables by using REMAP_TABLE
- Data by using REMAP_DATA

```
REMAP_TABLE = 'EMPLOYEES': 'EMP'
```

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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 enables objects to be moved from one tablespace to another.
- REMAP_SCHEMA provides the old FROMUSER /TOUSER capability to change object ownership.
- REMAP_TABLE provides the ability to rename entire tables.
- REMAP_DATA provides the ability to remap data as it is being inserted.

Using Enterprise Manager to Monitor Data Pump Jobs

The screenshot shows the Oracle Enterprise Manager interface for database instance 'orcl.oracle.com'. The 'Data Movement' tab is selected. Under the 'Move Row Data' section, the 'Monitor Export and Import Jobs' link is highlighted with a red box. A red arrow points from this link to the 'Export and Import Jobs' page shown below.

Database Instance: orcl.oracle.com

Home Performance Availability Server Schema **Data Movement** Software and Support

Move Row Data **Move Database Files** **Streams** **Advanced Replication**

[Export to Export Files](#) [Clone Database](#) [Setup](#) [Setup](#)

[Import from Export Files](#) [Transport Tablespaces](#) [Manage](#) [Manage](#)

[Import from Database](#)

[Load Data from User Files](#)

[Monitor Export and Import Jobs](#)

Export and Import Jobs Page Refreshed Sep 1, 2008 12:23:20 AM MDT OK

In database versions 10g and greater, Enterprise Manager uses data pump jobs to do the actual export and import operations. Although Enterprise Manager exports and imports can also be monitored from their corresponding Job Summary pages, data pump jobs defined outside of Enterprise Manager can only be monitored from here.

[Delete Data Pump Job](#)

Select Data Pump Job	EM Job	Owner	Job Status
INVENTORY_EXPORT	Yes	DBA1	EXECUTING

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Using Enterprise Manager to Monitor Data Pump Jobs

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

You can view the current status of the job and 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 on the Maintenance page.

Migration with Data Pump Legacy Mode

- Assistance in transitioning from `imp` and `exp` utilities to `impdp` and `expdp` utilities
- Data Pump in legacy mode:
 1. Encounters unique `imp` or `exp` parameter and enters legacy mode
 2. Attempts to map the old syntax to the new syntax
 3. Displays new syntax
 4. Exits legacy mode

Best practice tip: Oracle strongly recommends that you view the new syntax and make script changes as time permits.



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Migration with Data Pump Legacy Mode

Because of the extensive use of import and export scripts, Oracle Database 11g Release 2 provides migration assistance with Data Pump legacy mode. The Data Pump utilities:

1. Enter legacy mode if a parameter unique to `exp/imp` is present, either on the command line or in a script
2. Map the old parameter to the equivalent `expdp` or `impdp` parameter (if possible)
3. Display the converted command, so that you can view the new syntax and make script changes, as your time permits
4. Exit legacy mode, if a mix of old and new parameters are present (Mixing a Data Pump parameter with an original export or import parameter causes Data Pump to exit without performing the desired task.)

For additional new features, see *Oracle Database Utilities 11g Release 2*.

Data Pump Legacy Mode

The Data Pump export and import utilities:

- Read and write files only in Data Pump format
- Accept `exp` and `imp` utility commands in legacy mode
- Include legacy mode parameters that:

- Can be identical to the new syntax:

```
FILESIZE=integer[B | K | M | G]
```

- Can be similar:

```
QUERY= query_clause
```

- Are ignored, when the command is superceded by Data Pump defaults

```
BUFFER=integer
```

```
COMPRESS={y|n}
```

```
DIRECT={y|n}
```

- Cause an error when old and new syntax is mixed

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Data Pump Legacy Mode

The Data Pump utilities operate only with files in the Data Pump format. (Files created by the `exp` utility must be read by the `imp` utility.) The Data Pump legacy mode allows you to continue the use of your existing scripts with the Data Pump utilities. But you must use the new Data Pump syntax, if you want to access new features of the database.

When the utilities find unique `exp` or `imp` parameters, they enter legacy mode.

- Identical parameters are used unchanged. Example: The `FILESIZE=integer[B | K | M | G]` parameter specifies the maximum size of a dump file.
- The `QUERY=query_clause` parameter does not cause any conversion, but note that the `expdp` utility handles queries less restrictive than the deprecated export utility. So your query results may be a little different.
- Some parameters are ignored, because they are superceded by new defaults. Examples:
 - The `BUFFER=integer` parameter is ignored, because the `expdp` utility has no conventional path mode.
 - The `COMPRESS={y|n}` parameter is ignored, because the `expdp` utility has no equivalent parameter.
 - The `DIRECT={y|n}` parameter is ignored, because the `expdp` utility determines if the requested export should use direct path or external table mode.
- A mixture of `exp/imp` and Data Pump parameters causes a job to fail.

Data Pump Legacy Mode

- Legacy mode parameters:
 - Are mapped to Data Pump parameters, if possible:
`consistent={y|n}` -> `FLASHBACK_TIME`
`GRANTS=n` -> `EXCLUDE=CONSTRAINTS`
`INDEXES=n` -> `EXCLUDE=INDEX`
`LOG=filename` -> `LOGFILE=filename`
`FILE=filename` -> `dumpfile=directory-object:filename`
 - Can be similar, but not identical:
`FEEDBACK=integer` -> `STATUS`
 - Cause an error when incompatible with new Data Pump:
`VOLSIZE=integer`

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Data Pump Legacy Mode (continued)

Use the Data Pump legacy mode to transition deprecated scripts to the current version. Several parameters can be mapped to the new syntax:

- Data Pump knows the current time and maps the `CONSISTENT={y|n}` parameter to the `FLASHBACK_TIME` parameter.
- The `GRANTS=n` parameter is remapped to `EXCLUDE=GRANT`.
- The `INDEXES=n` parameter is remapped to `EXCLUDE=INDEX`.
- The `LOG=filename` parameter is remapped to `LOGFILE=filename`. The contents of the log file (informational and error messages) are in the expdp format.
- The `FILE=filename` parameter is remapped to `dumpfile=directory-object:filename`. But if the expdp utility cannot find the path to an existing directory object, it aborts.

A parameter can be mapped, but the new functionality is different. The `FEEDBACK=integer` parameter is remapped to `STATUS`. It is not a direct mapping because the status of the export job, not just the number of processed rows, is returned.

A parameter can cause the job to abort, because it is incompatible with Data Pump. The `VOLSIZE=integer` parameter of the exp utility specifies the tape volume size. Data Pump does not work with tape drives; Oracle Secure Backup manages tapes.

For a complete mapping of exp and imp parameters to the Data Pump utilities, see *Oracle Database Utilities 11g Release 2*.

Managing File Locations

- Original `exp` and `imp` utilities: Fully qualified file names
- Data Pump directory object for file locations
 - Default (in prior versions): `DATA_PUMP_DIR` parameter
 - New optional `DATA_PUMP_DIR_schema-name` directory object
 - Managed with the `CREATE DIRECTORY` and `GRANT SQL` commands
 - Default location (independent of legacy mode), when:
 - Command line without `DIRECTORY` parameter
 - User without `EXP_FULL_DATABASE` privilege

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Managing File Locations

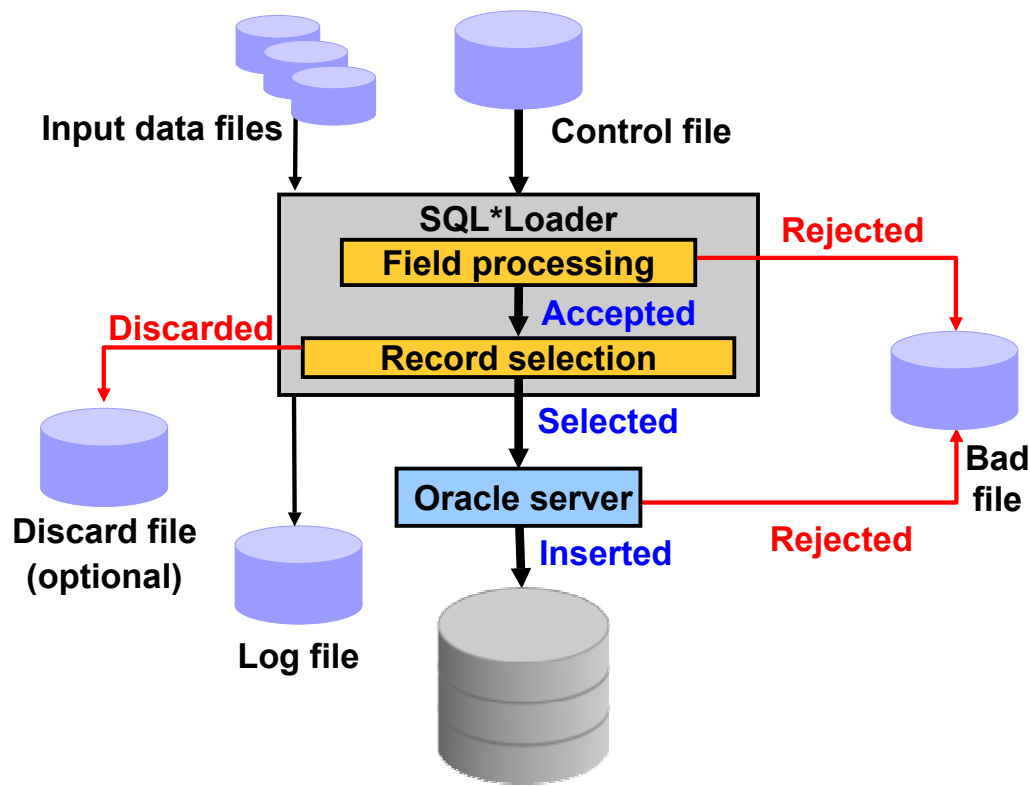
The original and the Data Pump utilities differ in their handling of file locations, because the original utilities were client based (all file names were fully qualified).

The Data Pump utilities are server based. They require that a directory object is used when specifying file locations. The directory object must be accessible to the schema. The default location in prior versions was set by the `DATA_PUMP_DIR` initialization parameter.

This functionality does not introduce new mandatory DBA tasks. It introduces an optional `DATA_PUMP_DIR_schema-name` directory object. If you choose to create this directory object with the `CREATE DIRECTORY` and `GRANT SQL` commands, you allow the specified schemas the ability to use Data Pump export or import (which will have an impact on the usual server resources such as CPU, memory usage, and disk usage).

The Data Pump utilities use this directory object when none is specified in the command line and when the user does not have the `EXP_FULL_DATABASE` privilege. This is independent of the legacy mode.

SQL*Loader: Overview



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SQL*Loader: Overview

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

SQL*Loader uses the following files:

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 such session-wide information as the following:
 - 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, the row is inserted into the table. If the row is determined to be invalid, 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, see the *Oracle Database Utilities* guide.

Loading Data with SQL*Loader

Load Data: Generate Or Use Existing Control File

Database **orcl.oracle.com** Cancel Continue

☐ Automatically Generate Control File
A control file will be generated after you define the structure of the data file.

☒ Use Existing Control File
Allows you to use an existing control file that defines the structure of the data file.

Host Credentials

* Username

* Password

☐ Save as Preferred Credential

Progress Bar: Control File (selected), Data File, Load Method, Options, Schedule, Review

Load Data: Control File

Database **orcl.oracle.com** Cancel Finish Step 1 of 6 Next

A control file is used to describe what will be loaded and how. Specify the full path and name of the control file on the database server machine.

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Loading Data with SQL*Loader

Use the “Load Data from User Files Wizard” to load data from a flat file into an Oracle database.

To display the wizard, select Enterprise Manager Data Movement > Move Row Data > Load Data from User Files.

SQL*Loader Control File

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

- Location of the data to be loaded
- 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

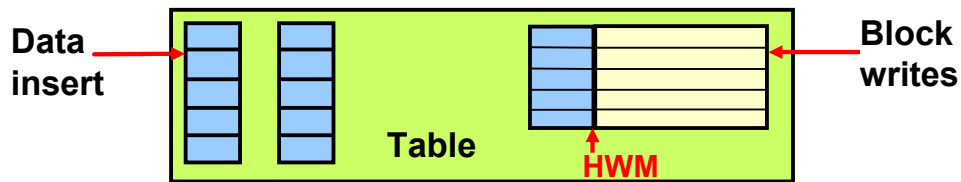
SQL*Loader Control File (continued)

```
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 this sample control file (by line numbers) is as follows:

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

Loading Methods



Conventional Load	Direct Path Load
Uses <code>COMMIT</code>	Uses data saves (faster operation)
Always generates redo entries	Generates redo only under specific conditions
Enforces all constraints	Enforces only <code>PRIMARY KEY</code> , <code>UNIQUE</code> , and <code>NOT NULL</code>
Fires <code>INSERT</code> triggers	Does not fire <code>INSERT</code> 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
Maintains index entries on each insert	Merges new index entries at the end of the load

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Comparing Direct and Conventional Path Loads

Method of Saving Data

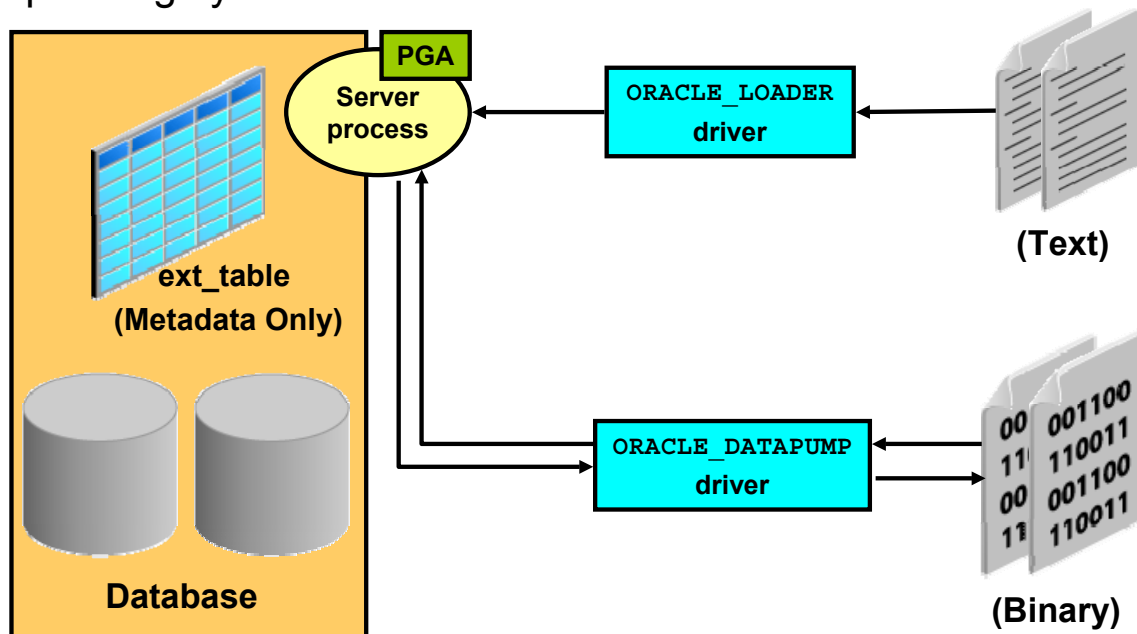
A conventional path load executes SQL `INSERT` statements to populate tables in an Oracle database. A direct path load eliminates much of the Oracle database overhead by formatting Oracle data blocks and writing the data blocks directly to the database files. A direct load does not compete with other users for database resources, so it can usually load data at close to disk speed. 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 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.

External Tables

External tables are read-only tables stored as files on the operating system outside of the Oracle database.



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External Tables

External tables access data in external sources as if it were in a table in the database. You can connect to the database and create metadata for the external table using DDL. The DDL for an external table consist of two parts: one part the describes the Oracle Database column types, and another part that describes the mapping of the external data to the Oracle Database data columns.

An external table does not describe any data that is stored in the database. Nor does it describe how data is stored in the external source. Instead, it describes how the external table layer must present the data to the server. It is the responsibility of the access driver and the external table layer to do the necessary transformations required on the data in the external file so that it matches the external table definition. External tables are read only; therefore, no DML operations are possible, and no index can be created on them.

There are two access driver used with external tables. The `ORACLE_LOADER` access driver can only be used to read table data from an external table and load it into the database. It uses text files as the data source. The `ORACLE_DATAPUMP` access driver can both load table data from an external file into the database and also unload data from the database into an external file. It uses binary files as the external files. The binary files have the same format as the files used by the `impdp` and `expdp` utilities and can be interchanged with them.

External Table Benefits

- Data can be used directly from the external file or loaded into another database.
- External data can be queried and joined directly in parallel with tables residing in the database, without requiring it to be loaded first.
- The results of a complex query can be unloaded to an external file.
- You can combine generated files from different sources for loading purposes.

From Oracle Database



From external file

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External Table Benefits

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. External data can be queried and joined directly in parallel to tables residing in the database, without requiring the data to be loaded first. You can choose to have your applications directly access external tables with the `SELECT` command, or you can choose to have data loaded first into a target database.

The results of a complex query can be unloaded to an external file using the `ORACLE_DATAPUMP` access driver.

Data files that are 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.

Defining an External Tables 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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Defining an External Table with ORACLE_LOADER

The metadata for an external table is created using the SQL language in the database. The ORACLE_LOADER access driver uses the SQL*Loader syntax to define the external table. This command does not create the external text files.

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

When the table extab_employees is accessed, SQL*Loader functionality is used to load the table, and at that instance the log file and bad file are created.

Best-practice tip: If you have a lot of data to load, enable PARALLEL for the load operation:

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

External Table Population with ORACLE_DATAPUMP

```
CREATE TABLE ext_emp_query_results
  (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 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.

The external table is read-only after it has been populated. The SELECT command can be very complex, allowing specific information to be populated in the external table. The external table, having the same file structure as binary data pump files, can then be migrated to another system, and imported with the impdp utility or read as an external table.

Note: For more information about the ORACLE_DATAPUMP access driver parameters, see the *Oracle Database Utilities 11g Release 2 (11.2) guide*.

Using External Tables

- Querying and external table:

```
SQL> SELECT * FROM extab_employees;
```

- Querying and joining an external table with an internal table

```
SQL> SELECT e.employee_id, e.first_name, e.last_name,  
d.department_name FROM departments d, extab_employees e  
WHERE d.department_id = e.department_id;
```

- Appending data to an internal table from an external table

```
SQL> INSERT /*+ APPEND */ INTO hr.employees SELECT * FROM  
extab_employees;
```

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Using External Tables

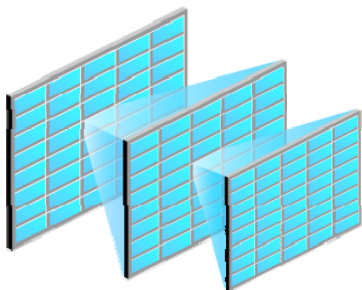
External tables are queried just like internal database tables. The first example illustrates querying an external table `EXTAB_EMPLOYEES` with only displaying the results. The results are not stored in the database.

The second example shows the joining of an internal table `DEPARTMENTS` with an external table `EXTAB_EMPLOYEES` and only displaying the results. The third example on the slide illustrates the direct appending of an internal tables data with the query and load of data from an external table.

Data Dictionary

View information about external tables in:

- [DBA | ALL | USER] _EXTERNAL_TABLES
- [DBA | ALL | USER] _EXTERNAL_LOCATIONS
- [DBA | ALL | USER] _TABLES
- [DBA | ALL | USER] _TAB_COLUMNS
- [DBA | ALL] _DIRECTORIES



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Data Dictionary

The data dictionary views in the slide list the following table information:

[DBA | ALL | USER] _EXTERNAL_TABLES: Specific attributes of external tables in the database

[DBA | ALL | USER] _EXTERNAL_LOCATIONS: Data sources for external tables

[DBA | ALL | USER] _TABLES: Descriptions of the relational tables in the database

[DBA | ALL | USER] _TAB_COLUMNS: Descriptions of the columns of tables, views, and clusters in the database

[DBA | ALL] _DIRECTORIES: Describes the directory objects in the database.

Quiz

Like other database objects, Directory objects are owned by the user that creates them unless another schema is specified during creation.

1. True
2. False

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Answer: 2

Quiz

An index can be created on an external table.

1. True
2. False

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Answer: 2

Summary

In this lesson, you should have learned how to:

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

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Practice 17 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 to your database
- Using the Load Data Wizard to load data into your database
- Loading data by using the command line

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18

Working with Support

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Objectives

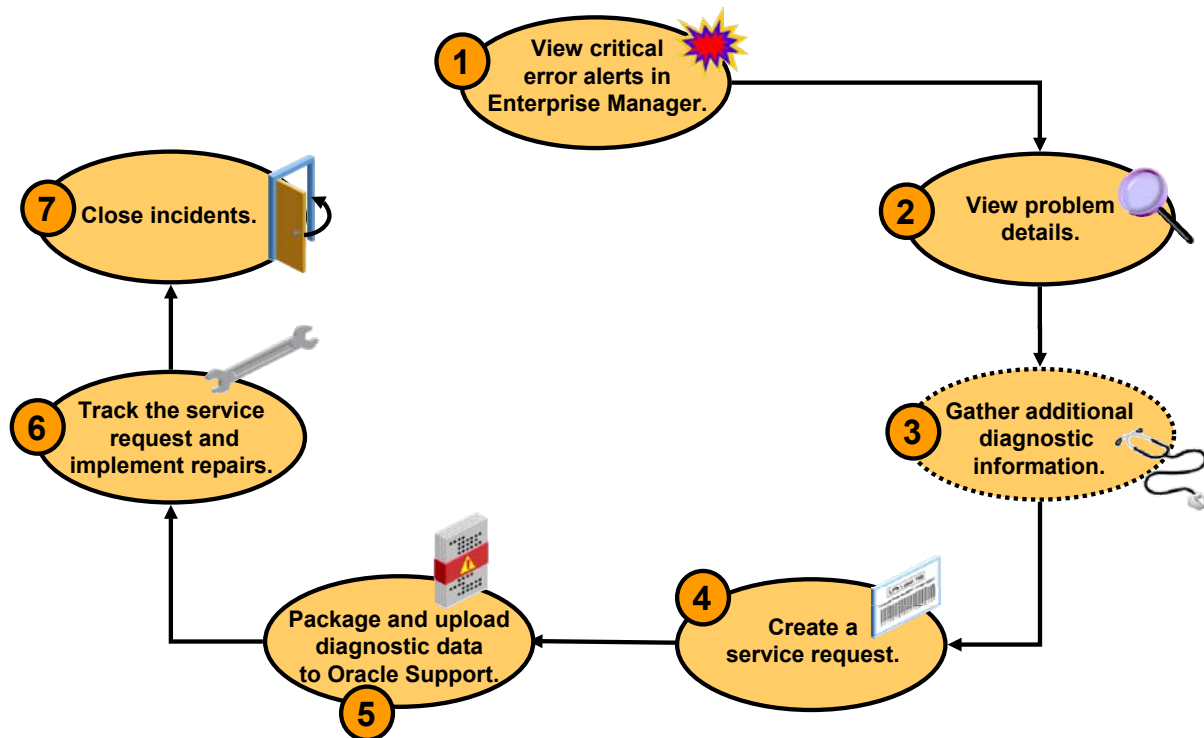
After completing this lesson, you should be able to:

- Use the Enterprise Manager Support Workbench
- Work with My Oracle Support
- Search My Oracle Support
- Log service requests (SR)
- Manage patches
 - Apply a patch
 - Stage a patch

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Using the Support Workbench



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Using the Support Workbench

Using the Enterprise Manager Support Workbench, you can investigate, report, and (in some cases) resolve a problem by performing the following general steps:

1. On the Database Home page in Enterprise Manager, review critical error alerts. View the details by selecting an alert.
2. Examine the problem details and view a list of all incidents that were recorded for the problem. Display findings from any health checks that were automatically run.
3. (Optional) Run additional health checks and invoke the SQL Test Case Builder, which gathers all required data related to a SQL problem and packages the information in a way that enables the problem to be reproduced at Oracle Support.
4. Create a service request with My Oracle Support and (optionally) record the service request number with the problem information.
5. Invoke the Incident Packaging Service, which packages all gathered diagnostic data for a problem and (optionally) uploads the data to Oracle Support. You can edit the data to remove sensitive information before uploading.
6. You can maintain an activity log for the service request in the Support Workbench. Run Oracle advisors to help repair SQL failures or corrupted data.
7. Set the status for one, some, or all incidents for the problem to be closed.

Viewing Critical Error Alerts in Enterprise Manager

The screenshot displays the Oracle Enterprise Manager 11g Database Control interface. The top navigation bar includes links for Setup, Preferences, Help, Logout, and Database. The main content area is titled "Database Instance: database". On the left sidebar, the "General" tab is selected, showing instance details like Status (Up), Up Since (Apr 2, 2007 12:28:32), Instance Name (b), Version (11.1.0.4.0), Host (stacq17.us.oracle.com), and Listener (LISTENER_stacq17.us.or). A red box highlights the "Active Incidents" link under the "Diagnostic Summary" section. The main pane shows the "Support Workbench" for "Problems (5)". It lists statistics: New Problems in Last 24 Hours (0), All Active Problems (1), All Problems (5); New Incidents in Last 24 Hours (2), All Active Incidents (2), All Incidents (43). Below this, there's a table of incidents. One incident is highlighted: ID 1, Description ORA-1578, Number Of Incidents 36, Last Incident April 9, 2007 10:00:24 PM PDT, Last Comment Created package : Id = 5 Name = Pkg_database_ORA_1578_040607125612, Active Packaged Yes, SR# 1234. A red arrow points from the "Active Incidents" link in the sidebar to the "Incidents (36)" section.

Select Details	ID	Description	Number Of Incidents	Last Incident	Last Comment	Active Packaged	SR#
<input type="checkbox"/>	1	ORA-1578	36	April 9, 2007 10:00:24 PM PDT	Created package : Id = 5 Name = Pkg_database_ORA_1578_040607125612	Yes	1234

Incidents (36)	
3953	ORA-1578 [1] [63671] [] [] [] [] [] []
3956	ORA-1578 [1] [63673] [] [] [] [] [] []
3955	ORA-1578 [1] [63673] [] [] [] [] [] []
3954	ORA-1578 [1] [63671] [] [] [] [] [] []
5000	ORA-1578 [1] [63671] [] [] [] [] [] []
5001	ORA-1578 [1] [63673] [] [] [] [] [] []
There are more incidents ...	

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You begin the process of investigating problems (critical errors) by reviewing critical error alerts on the Database Home page. To view critical error alerts, access the Database Home page in Enterprise Manager. On the Home page, you can click the Active Incidents link in the Diagnostic Summary section if there are incidents. You can also use the Alerts section and look for critical alerts that are flagged as Incidents.

When you click the Active Incidents link, you access the Support Workbench page, where you can retrieve details about all problems and corresponding incidents. From there, you can also retrieve all Health Monitor checker findings and created packages.

Note: The tasks described in this section are all performed in Enterprise Manager. You can also accomplish all of these tasks with the ADRCI command-line utility. See the *Oracle Database Utilities* guide for more information on the ADRCI utility.

Viewing Problem Details

Support Workbench

Problem Details: ORA 1578

Page Refreshed **April 10, 2007 8:02:14 AM PDT** [Refresh](#)

Summary

SR# **1234** [Edit](#)

Bug# **--** [Edit](#)

Active **Yes**

Packaged **Yes**

Number of Incidents **36**

First Incident [April 2, 2007 12:27:37 PM PDT](#)

Last Incident

Timestamp [April 9, 2007 10:00:24 PM PDT](#)

Incident Source **System Generated**

Impact

Checkers Run **0**

Checker Findings **0**

Investigate and Resolve

[Go to Metalink](#) [Quick Package](#)

Self Service [Oracle Support](#)

Assess Damage

[Checker Findings](#)

[Run Checkers](#)

[Database Instance Health](#)

Diagnose

[Alert Log](#)

[Related Problems Across Topology](#)

[Diagnostic Dumps for Last Incident](#)

[Go to Metalink and Research](#)

Resolve

[SQL Repair Advisor](#)

[Data Recovery Advisor](#)

Incidents [Activity Log](#)

View [All Incidents](#)

[View](#) [Close](#)

[Select All](#) [Select None](#) [Show All Details](#) [Hide All Details](#)

Select Details	ID	Description	Data Dumped	Active	Status	Timestamp
<input type="checkbox"/>	3953	ORA 1578 [1] [63671] □□□□□□	No	No	Ready	April 2, 2007 12:27:37 PM PDT

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Viewing Problem Details

From the Problems subpage on the Support Workbench page, click the ID of the problem that you want to investigate. This takes you to the corresponding Problem Details page.

On this page, you can see all incidents that are related to your problem. You can associate your problem with a My Oracle Support service request and bug number. In the “Investigate and Resolve” section of the page, you see a Self Service subpage that has direct links to the operations that you can perform for this problem. In the same section, the Oracle Support subpage has direct links to My Oracle Support.

The Activity Log subpage shows you the system-generated operations that have occurred on your problem so far. This subpage enables you to add your own comments while investigating the problem.

On the Incidents subpage, you can click a related incident ID to access the corresponding Incident Details page.

Viewing Incident Details: Dump Files

Incident Details: 3953

Summary

Problem Key [ORA-1578](#)
[1]
[63671]

Status **Ready**

Active **No**

Timestamp **April 2, 2007 12:27:3**

Impact **Unknown**

ECID **Unknown**

Data Dumped **No**

Source **System Generated**

Correlation Keys **SID = 129.232, Proct**

Purge Date **April 22, 2007 5:30:24 AM PDT (Purging Enabled)**
[Disable Purging](#)

Contents: [b_oracle_15201_i3953.trc](#)

File [/ade/aime_emdbasa_b/oracle/log/diag/rdbms/b/b/incident/incdir_3953/b_oracle_15201_i3953.trc](#)

Modified **April 2, 2007 12:27:40 PM PDT**

Size **3.28 MB**

Trace files are for Oracle internal use only.

Trace Map

A Trace Map provides a table of contents for a dump file.

TIP Select a section to see its detailed trace records below.

Details

[Expand All](#) | [Collapse All](#)

[/ade/aime_emdbasa_b/oracle/log/diag/rdbms/b/b/incident/incdir_3953/b_oracle_15201_i3953.trc](#)

[Error Stack:](#)

[incident_dump:===== Dump for incident 3953 \(ORA 1578\) =====](#)

ORA-01578: ORACLE data block corrupted (file # 1, block # 63671)
ORA-01110: data file 1: '/ade/aime_emdbasa_b/oracle/dbs/t_db1.f'

[Dump Files](#) | [Checker Findings](#) | [Additional Diagnostics](#)

File Name	Size (MB)	Timestamp	Path	View Contents
b_oracle_15201_i3953.trc	3.28	April 2, 2007 12:27:40 PM PDT	/ade/aime_emdbasa_b/oracle/log/diag/rdbms/b/b/incident/incdir_3953	
b_m000_15218_i3953_87.trc	0.15	April 2, 2007 12:27:42 PM PDT	/ade/aime_emdbasa_b/oracle/log/diag/rdbms/b/b/incident/incdir_3953	

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Viewing Incident Details: Dump Files

When you access the Incident Details page, the Dump Files subpage lists all corresponding dump files. You can then click the eyeglass icon for a particular dump file to visualize the file content with its various sections.

Viewing Incident Details: Checker Findings

Incident Details: 3953

Page Refreshed April 10, 2007 8:08:22 AM PDT Refresh

Summary

Problem Key

ORA-1578
[1]
[63671]

Status

Ready

Active

No

Timestamp

April 2, 2007 12:27:37 PM PDT

Impact

Unknown

ECID

Unknown

Data Dumped

No

Source

System Generated

Correlation Keys

SID = 129.232, ProcId = 39.24
PQ = (16777216, 1175542056), Client ProcId = oracle@stacg17
(TNS V1-V3):15201_3003220672

Purge Date

April 22, 2007 5:30:24 AM PDT (Purging Enabled)
Disable Purging

Dump Files

Checker Findings

Additional Diagnostics

File Name

b_ora_15201_3953
b_m000_1518_39

Dump Files

Checker Findings

Additional Diagnostics

Search

Description

Damage Translation

Status

Time Detected

Open

All

Go

Data Corruption

Select findings and click on the "Launch Recovery Advisor" button to repair those findings.

Launch Recovery Advisor

Select All | Select None | Expand All | Collapse All

Select	Description	Priority	Damage Translation	Incident ID	Status	Time Detected
<input type="checkbox"/>	▼ All Findings					
<input type="checkbox"/>	▶ Datafile 1: /ade/jaine_emdba_b/oracle/dbs/t_db1.F contains one or more corrupt blocks	High	Some objects in tablespace SYSTEM might be unavailable	3953	Open	April 2, 2007 12:27:41 PM PDT

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Viewing Incident Details: Checker Findings

On the Incident Details page, click Checker Findings to view the Checker Findings subpage. This page displays findings from any health checks that were automatically run when the critical error was detected. You will usually have the opportunity to select one or more findings and invoke an advisor to fix the issue.

Creating a Service Request

Problem Details: ORA 603

Page Refreshed April 16, 2007 7:25:42 AM PDT (Refresh)

Investigate and Resolve

Go to Metalink Quick Package

Self Service Oracle Support

Assess Damage

Run Checker Database In

Diagnose

Alert Log

Related Prob

Diagnostic D

Go to Metal

ORACLE

PRODUCTS SOLUTIONS SERVICES TECHNOLOGIES

ORACLEMETALINK

Metalink Information

Oracle Employee Registration

OracleMetalink Login and Registration

Returning Users

Log in to Metalink

Forgot My Password

First Time Users

Register for Metalink

Registration Problems

Frequently Asked Questions

WELCOME TO METALINK

Explorer User Prompt

Script Prompt:

Please enter a Service Request Number (SR)

OK

Cancel

1234

Incidents Activity Log

Problem Details: ORA 603

Summary

SR# 1234 Edit

Bug# -- Edit

Active No

Packaged No

Number of Incidents 4

First Incident April 13, 2007 5:34:24 PM PDT

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Creating a Service Request

Before you can package and upload diagnostic information for the problem to Oracle Support, you must create a service request (SR). To create a service request, you first access My Oracle Support. My Oracle Support can be accessed directly from the Problem Details page when you click the “Go to My Oracle Support” button in the “Investigate and Resolve” section of the page. Once on My Oracle Support, log in and create a service request in the usual manner.

When finished, you have the opportunity to enter that service request for your problem. This is entirely optional and is for your reference only.

In the Summary section, click the Edit button that is adjacent to the SR# label. In the window that opens, enter the SR# and then click OK.

Packaging and Uploading Diagnostic Data to Oracle Support

Problem Details: ORA 603

Page Refreshed April 16, 2007 8:05:16 AM PDT [Refresh](#)

Summary

SR# 1234 [Edit](#)

Bug# -- [Edit](#)

Active No

Investigate and Resolve

[Go to Metalink](#) [Quick Package](#)

[Self Service](#) [Oracle Support](#)

Quick Packaging: Create New Package

Target database

Problems Selected ORA 603

Use quick packaging to generate an upload file for a single problem. The upload file will still be created but it will not be sent to Oracle Support.

* Package Name Pkg_database_ORA_603

Package Description

☒ Send to Oracle Support ☐ Yes ☐ No

Service Request Number (SR#) 1234

[A service request must be created before you can create a package.](#)

[Cancel](#) Step 1 of 4 [Next](#)

Quick Packaging: View Contents

Target database

Problems Selected ORA 603

Package Name Pkg_database_ORA_603_041607080712

Logged In

Service Request Number (SR#)

Total Size (uncompressed)

Incidents to be Packaged

ID	Type	Problem ID	Description
6213	Main	4 ORA-603	[] [] [] [] [] [] [] [] [] []
3942	Main	4 ORA-603	[] [] [] [] [] [] [] [] [] []
3944	Main	4 ORA-603	[] [] [] [] [] [] [] [] [] []
6215	Main	4 ORA-603	[] [] [] [] [] [] [] [] [] []
3938	Correlated	1 ORA-1578 [1]	[63729] [] [] [] [] [] [] [] [] []
6160	Correlated	2 ORA-600 [4136] [2]	[10.31.75] [] [] [] [] [] [] [] [] []

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Packaging and Uploading Diagnostic Data to Oracle Support

The Support Workbench provides two methods for creating and uploading an incident package: the Quick Packaging method and the Advanced Packaging method. The example in the slide shows how to use Quick Packaging.

Quick Packaging is a more automated method with a minimum of steps. You select a single problem, provide an incident package name and description, and then schedule the incident package upload, either immediately or at a specified date and time. The Support Workbench automatically places diagnostic data related to the problem into the incident package, finalizes the incident package, creates the ZIP file, and then uploads the file. With this method, you do not have the opportunity to add, edit, or remove incident package files or add other diagnostic data such as SQL test cases.

To package and upload diagnostic data to Oracle Support:

1. On the Problem Details page, in the Investigate and Resolve section, click Quick Package. The Create New Package page of the Quick Packaging wizard appears.
2. Enter a package name and description.
3. Enter the service request number to identify your problem.
4. Click Next, and then proceed with the remaining pages of the Quick Packaging Wizard. Click Submit on the Review page to upload the package.

Tracking the Service Request and Implementing Repairs

Problem Details: ORA 603

Page Refreshed **April 16, 2007 8:39:07 AM PDT** (Refresh)

Summary

SR# **1234** (Edit)

Bug# **--** (Edit)

Active **No**

Packaged **Yes**

Number of Incidents **4**

First Incident [April 13, 2007 5:34:24 PM PDT](#)

Last Incident

Timestamp [April 13, 2007 6:40:24 PM PDT](#)

Incident Source **System Generated**

Impact

Checkers Run **0**

Checker Findings **0**

Investigate and Resolve

(Go to Metalink) (Quick Package)

[Self Service](#) **Oracle Support**

Collect and Send Diagnostic Data

[Create a Service Request with Metalink](#)

[Record Service Request Number to Problem](#)

[Generate Additional Dumps and Test Cases](#)

[Package the Problem](#)

[View/Send Upload Files](#)

Track and Close

[Check the Service Request Status with Metalink](#)

[Close the problem](#)

Incidents **Activity Log**

Comment (Add Comment)

User	Action	Description	Timestamp
SYS	Comment	Set SR : 1234	April 16, 2007 8:34:45 AM PDT
SYS	Comment	Set SR : null	April 16, 2007 8:34:30 AM PDT
SYS	Package	Failed to send upload file to Oracle: packageId = 1 file = /ade/aime_emdba_b/oracle/stacg17.us.oracle.com_b/sysman/emd/state/Pkg_database_ORA_603_041607080712_COM_1.zip	April 16, 2007 8:14:12 AM PDT
SYS	Package	Created physical file : packageId = 1 file = /ade/aime_emdba_b/oracle/stacg17.us.oracle.com_b/sysman/emd/state/Pkg_database_ORA_603_041607080712_COM_1.zip	April 16, 2007 8:14:10 AM PDT
SYS	Comment	Created package : Id = 1 Name = Pkg_database_ORA_603_041607080712	April 16, 2007 8:09:30 AM PDT

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Tracking the Service Request and Implementing Repairs

After uploading diagnostic information to Oracle Support, you can perform various activities to track the service request and implement repairs. Among these activities are the following:

- Add an Oracle bug number to the problem information. On the Problem Details page, click the Edit button that is adjacent to the Bug# label. This is for your reference only.
- Add comments to the problem activity log:
 1. Access the Problem Details page for the problem.
 2. Click Activity Log to display the Activity Log subpage.
 3. In the Comment field, enter a comment and then click Add Comment.

Your comment is recorded in the activity log.

- Respond to a request by Oracle Support to provide additional diagnostics. Your Oracle Support representative can provide instructions for gathering and uploading additional diagnostics.

Tracking the Service Request and Implementing Repairs

Incident Details: 3953 Page Refreshed **April 10, 2007 8:08:22 AM PDT** [Refresh](#)

Summary

Problem Key [ORA-1578](#)
[1]
[63671]

Status **Ready**

Active **No**

Timestamp **April 2, 2007 12:27:37 PM PDT**

Impact **Unknown**

ECID **Unknown**

Data Dumped **No**

Source **System Generated**

Correlation Keys **SID = 129.232, ProcId = 39.24**
PQ = (16777216, 1175542056), Client ProcId = oracle@stacg17
(TNS V1-V3).15201_3083220672

Purge Date **April 22, 2007 5:30:24 AM PDT (Purging Enabled)**
[Disable Purging](#)

[Dump Files](#) [Checker Findings](#) [Additional Diagnostics](#)

Search

Description Damage Translation Status Time Detected

Data Corruption

Select findings and click on the "Launch Recovery Advisor" button to repair those findings.

[Launch Recovery Advisor](#)

[Select All](#) | [Select None](#) | [Expand All](#) | [Collapse All](#)

Select	Description	Priority	Damage Translation	Incident ID	Status	Time Detected
<input type="checkbox"/>	All Findings					
<input type="checkbox"/>	Datafile 1: /ade/aime_endbsa_b/oracle/dbs/t_01.f contains one or more corrupt blocks	High	Some objects in tablespace SYSTEM might be unavailable	3953	Open	April 2, 2007 12:27:41 PM PDT

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Tracking the Service Request and Implementing Repairs (continued)

From the Incident Details page, you can run an Oracle advisor to implement repairs. Access the suggested advisor in one of the following places:

- On the Self-Service tab of the "Investigate and Resolve" section of the Problem Details page
- On the Checker Findings subpage of the Incident Details page (as shown in the slide)

The advisors that help you repair critical errors are:

- **Data Recovery Advisor:** Corrupted blocks, corrupted or missing files, and other data failures
- **SQL Repair Advisor:** SQL statement failures

Closing Incidents and Problems

The screenshot displays the Oracle Service Request (ORA 1578) details page. The page is titled "Problem Details: ORA 1578" and shows the "Summary" tab. The "Incidents" section at the bottom contains a table with one incident, ORA 1578, which is in the "Open" status. A red box highlights the "Close" button in the "Status" column of this incident. A red arrow points from this button to a confirmation dialog box that asks, "Are you sure you want to close the incident: 30177?". Another red box highlights the "Close the problem" link in the "Track and Close" section of the "Investigate and Resolve" tab. A second confirmation dialog box is shown, asking, "Are you sure you want to close the problem: ORA 1578?".

Problem Details: ORA 1578

Page Refreshed July 9, 2007 12:53:11 AM GMT+07:00 [Refresh](#)

Summary

SR# -- [Edit](#)

Bug# -- [Edit](#)

Active **Yes**

Packaged **No**

Number of Incidents **1**

Last Incident

Timestamp [July 9, 2007 12:43:48 AM GMT+07:00](#)

Incident Source **System Generated**

Impact

Checkers Run [1](#)

Checker Findings [1](#)

Investigate and Resolve

[Go to Metalink](#) [Quick Package](#)

[Self Service](#) [Oracle Support](#)

Collect and Send Diagnostic Data

[Create a Service Request with Metalink](#)

[Record Service Request Number to](#)

Confirmation

Are you sure you want to close the problem: ORA 1578?
Once the problem is closed, the associated data will be purged after 30 days.

[No](#) [Yes](#)

Track and Close

[Check the Service Request Status with Metalink](#)

[Close the problem](#)

Incidents [Activity Log](#)

Status [Open Incidents](#) Data Dumped [Yes](#) [Go](#)

[View](#) [Close](#)

[Select All](#) [Select None](#) [Show All Details](#) [Hide All Details](#)

[Select Details](#)

	ID	Description	Data Dumped	Active	Status	Timestamp
<input checked="" type="checkbox"/>	30177	ORA 1578 [9] [44] [] [] [] [] []	Yes	Yes	Ready	July 9, 2007 12:43:48 AM GMT+07:00

[Show](#)

Confirmation

Are you sure you want to close the incident: 30177?
Once the incident is closed, the associated data will be purged after 30 days.

[No](#) [Yes](#)

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When a particular incident is no longer of interest, you can close it. By default, closed incidents are not displayed on the Problem Details page. All incidents, whether closed or not, are purged after 30 days. You can disable purging for an incident on the Incident Details page.

1. Access the Support Workbench home page.
2. Select the desired problem, and then click View.
The Problem Details page appears.
3. Select the incidents to close, and then click Close.
A confirmation page appears.
4. Click Yes on the Confirmation page to close your incident.

Incident Packaging Configuration

Edit Incident Packaging Configuration [Restore Defaults] [Cancel] [OK]

Incident Data Retention

Incident Metadata Retention Period (day)

Incident Files Retention Period (day)

Packaging Settings

These settings are used in selecting incidents and files from a problem when the problem is added to a package.

Cutoff Age for Incident Inclusion (day)

Leading Incidents Count

Trailing Incidents Count

Correlation Time Proximity (min)

Time Window for Package Content (min)

[Edit] [OK]

Support Workbench

Problems (4) [Check]

New Problems in Last 24 Hours

New Incidents in Last 24 Hours

View [All] [Package]

Select All | Select None | Show All Details | Hide All Details

Select	Details	ID	Description	Number Of Incidents
<input type="checkbox"/>	Show	4	ORA 603	4
<input type="checkbox"/>	Show	3	ORA 600 [4137]	2
<input type="checkbox"/>	Show	2	ORA 600 [4136]	6
<input type="checkbox"/>	Show	1	ORA 1578	8

Performance and Critical Error

Problems (4) | Checker Findings (8) | Packages (1)

Related Links

[Advisor Central](#)

[Create User-Reported Problem](#)

[Alert Log Contents](#)

[Incident Packaging Configuration](#)

[Alert Log Errors](#)

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Incident Packaging Configuration

You can configure retention rules and packaging generation. Access the Incident Packaging configuration page from the Related Links section of the Support Workbench page by clicking the Incident Package Configuration link. Here are the parameters you can change:

- **Incident Metadata Retention Period:** Metadata is information about the data. For incidents, it includes the incident time, ID, size, and problem. Data is the actual content of an incident (such as traces).
- **Cutoff Age for Incident Inclusion:** This value includes incidents for packaging that are in the range to now. When you set the cutoff date to 90, the system includes only those incidents that are within the last 90 days.
- **Leading Incidents Count and Trailing Incidents Count:** For every problem included in a package, the system selects a certain number of incidents from the problem from the beginning (leading) and the end (trailing). For example, if the problem has 30 incidents and the leading incident count is 5 and the trailing incident count is 4, the system includes the first 5 incidents and the last 4 incidents.
- **Correlation Time Proximity:** This parameter is the time interval that defines “happened at the same time.” Correlating incidents (or problems) with certain other incidents or problems helps you answer the question “Which problems seem to have a connection with each other?” One criterion for correlation is time correlation: Find the incidents that happened at the same time as the incidents in a certain problem.

Enterprise Manager Support Workbench for ASM

The screenshot shows the Oracle Enterprise Manager 11g Database Control interface. The page title is "Support Workbench" and it indicates the page was refreshed on June 25, 2009 at 8:5. The interface includes tabs for "Problems (0)", "Checker Findings (0)", and "Packages (0)". A summary section shows counts for new and active problems and incidents. Below this is a table with columns for ID, Description, Number Of Incidents, Last Incident, and Last Comment. The table currently displays "No problems found." At the bottom, there are "Related Links" including "Alert Log Contents", "Alert Log Errors", "Create User-Reported Problem", "Incident Packaging Configuration", "Checker Central", and "Support Workbench (orcl)".

ORACLE Enterprise Manager 11g
Database Control

Automatic Storage Management: +ASM edrsr22p1.us.oracle.com >

Support Workbench Page Refreshed June 25, 2009 8:5

Problems (0) [Checker Findings \(0\)](#) [Packages \(0\)](#)

New Problems in Last 24 Hours **0** All Active Problems **0** All Problems **0**
New Incidents in Last 24 Hours **0** All Active Incidents **0** All Incidents **0**

View Last 24 Hours Search

Select	Details	ID	Description	Number Of Incidents	Last Incident	Last Comment
No problems found.						

Problems (0) [Checker Findings \(0\)](#) [Packages \(0\)](#)

Related Links

[Alert Log Contents](#) [Alert Log Errors](#) [Create User-Reported Problem](#)
[Incident Packaging Configuration](#) [Checker Central](#) [Support Workbench \(orcl\)](#)

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Enterprise Manager Support Workbench for ASM

Oracle Enterprise Manager has been enhanced to help diagnose and package incidents to Oracle Support Services for Oracle ASM instances.

Oracle Enterprise Manager provides Oracle ASM Support Workbench to monitor Oracle ASM alerts and incidents.

To access Support Workbench for Oracle ASM:

1. Click the Software and Support tab on the database home page.
2. Click Support Workbench in the Support section of the Software and Support page.
3. Click Support Workbench (*ASM_instance_name*) under the Related Links section on the Support Workbench page.

You can view information about current and past problems on the Problems page.

To create a package to send to Oracle Support Services, select an incident and click Package on the Support Workbench Problems page. Support Workbench then guides you through the packaging process.

Working with Oracle Support

- Oracle Support Services (OSS) provides 24 × 7 solution support.
- Support is delivered in the following ways:
 - My Oracle Support Web site
 - Telephone
 - Oracle Direct Connect (ODC) remote diagnostic tool
- The Customer Support Identifier (CSI) number is used to track the software and support that are licensed to each customer.

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Working with Oracle Support

Oracle Support Services (OSS) provides 24 × 7 solution support to all Oracle customers throughout the world. OSS has support centers around the globe to provide this coverage whenever it is required, 365 days a year.

Support is delivered to Oracle customers through the My Oracle Support Web site, on the telephone, and by using the Oracle Direct Connect (ODC) remote diagnostic tool.

After purchasing Oracle software, customers are provided with a Customer Support Identifier (CSI) number. This number is used to track the software and support licensed to each customer. The CSI number provides access to all the available patches, documentation, and troubleshooting information on My Oracle Support. The CSI number enables customers to log a service request (SR) with OSS.

Note: Service requests were formerly called technical assistance requests (TARs).

My Oracle Support Integration

- Enterprise Manager automatically alerts users to new critical patches.
- The Enterprise Manager patch wizard can be used to select an interim patch.
- You can review the patch's README file from within Enterprise Manager.
- You can download the selected patches from My Oracle Support into the Enterprise Manager patch cache.

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My Oracle Support Integration

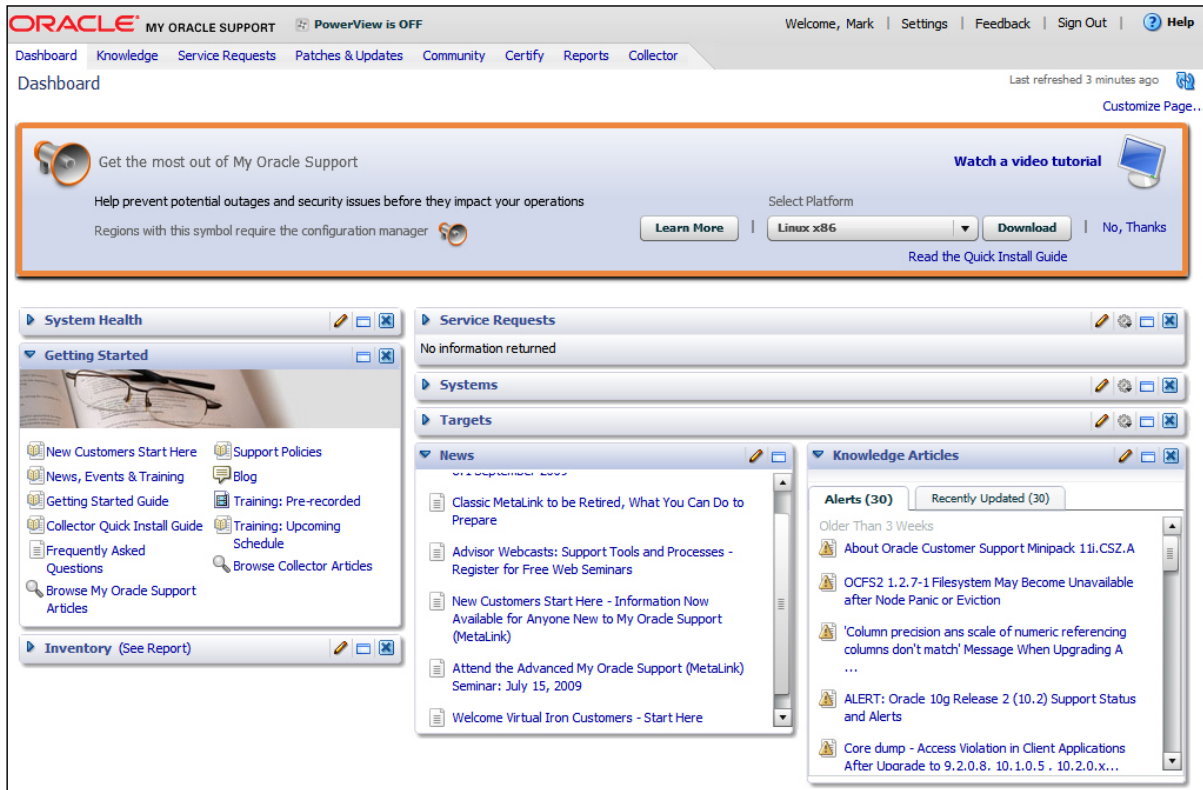
Oracle Enterprise Manager (Enterprise Manager) significantly facilitates software patching with its built-in My Oracle Support integration. Enterprise Manager automatically alerts users to new critical patches and flags all systems that require a specific patch. You can invoke the Enterprise Manager patch wizard to determine what interim patches are available for installation.

Alternatively, you can use the patch wizard to select an interim patch and determine whether any of your systems require that patch. You can review the patch details and README patch notes directly from within Enterprise Manager.

You can use the Enterprise Manager patch wizard to download interim patches from My Oracle Support into the Enterprise Manager patch cache, eliminating the need for repeated downloads. You can stage appropriate patches on the destination system or systems for manual application at a later time. To further automate the patching process, you can also provide a customizable patch application script that is executed on the destination system at a user-defined time by the resident Enterprise Manager agents. As patches are applied to a system, the corresponding Oracle Universal Installer (OUI) inventory is automatically updated to keep track of the systems' correct patch level.

Click Patch in the Deployments region of the Maintenance page to access the patch wizard.

Using My Oracle Support



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Using My Oracle Support

To register for My Oracle Support, go to <http://myoraclesupport.oracle.com/> and select the link Register here. At the prompt, enter your CSI number and answer a few basic questions. After registering, you are ready to use My Oracle Support. Note that each CSI number has an administrator designated by the customer who controls new-user access to My Oracle Support. Customers must designate this individual, and then new users must work with this individual to create new accounts and grant appropriate My Oracle Support access.

My Oracle Support has a variety of tools and methods available for researching problems.

Searching for answers on My Oracle Support through the standard and advanced search engines is relatively straightforward. A common problem is that too many results are returned. The following are some simple steps that can improve the quality and relevance of search results:

- Use full and exact error text when performing your search. For example, `ORA-1400: mandatory (NOT NULL) column` returns more relevant answers than `ORA-1400`.
- When researching errors in Oracle E-Business Suite, enter the name of the code as part of the search criteria. For example, `APXINWKB ORA-1400: mandatory (NOT NULL) column` returns fewer and better results than if you supply only the error message.

Using My Oracle Support (continued)

You can use the Knowledge tab to access the Knowledge Browser if you prefer a drill-down method of searching for information rather than searching by keyword. The Knowledge Browser provides easy-to-use access to OSS's most frequently used technical content.

The Knowledge Browser is organized to provide up-to-date information at your fingertips:

- Recent announcements and information in the *Featured News and Articles* section
- Information by product category
- Case studies
- Tools and training
- Online documentation
- Electronic technical reference manuals (eTRMs)
- Oracle Integration Repository
- Customer Knowledge Exchange

My Oracle Support Forums (Forums) enable you to interact with other Oracle customers to share ideas and discuss Oracle products. You can use My Oracle Support Forums to find out how other customers perform complex tasks or meet various business requirements with Oracle products. You should not use Forums as a substitute for logging an SR.

Customers can use the patch engine to search for patches by using a variety of methods. The following are the most common patch searches:

- **Patch Number:** If you know the patch number, you can enter it.
- **Latest Consolidated Patch:** You can use this when upgrading to determine the latest patches for the products you are using.
- **Includes File:** When a problem is encountered in a specific piece of code, a patch is often available to fix the issue. For this reason, support representatives often recommend that customers apply a patch to update code to the most current version available for the release. You can find and apply the latest versions of Oracle software by identifying the name and version of the code and then using the patch search utility to find out whether a more current version of the code is available.

Note: For detailed information about performing these searches, refer to My Oracle Support Technical Note 166650.1 ("Working Effectively with Global Customer Support").

You can use the BUGs link to search the BUG database when researching issues. A variety of methods are available for searching the BUG database.

Researching an Issue

To research an issue on My Oracle Support, perform the following steps:

1. Perform a keyword search.
2. Review the documentation.
3. Use the self-service toolkits.
4. Use the automated diagnostic tests and business flows.
5. Search for applicable patches.
6. Log a service request (SR).

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Researching an Issue

My Oracle Support provides several resources that can be used to research an issue. The following steps outline basic troubleshooting techniques that use My Oracle Support resources:

1. **Keyword search:** Most issues can be resolved quickly and easily by using the keyword search utility on My Oracle Support. Effective searches can provide much information about a specific problem and its solutions.
2. **Documentation:** If keyword searching fails to yield a solution, you should review the documentation to ensure that setup problems are not the root cause. Setup issues account for more than one-third of all service requests; it is always good to review setups early in the troubleshooting process. Documentation consists of user guides and implementation manuals published in PDF format as well as product README files and installation notes published in HTML. Both of these document types are available on My Oracle Support and can be accessed through the self-service toolkits for each product.

Researching an Issue (continued)

3. **Self-service toolkits:** Self-service toolkits (SSTKs) provide a wealth of information about each product. In most cases, they contain FAQs, patch listings, and other helpful information that can assist you in researching and troubleshooting the issues that you are facing. Because SSTKs contain the most frequently used content about each product, you should reference them periodically to identify known issues before they cause problems within your environment.
4. **Diagnostics and flows:** Many recent innovations in Oracle Support Services have been in the area of automated diagnostic tests and business flows. Tests and flows have been created for you to check the setup of your system or gather information about a problem. In the case of diagnostic tests, this can be done by running a Java or SQL script. The output of these tests can help you in resolving issues and can also help Oracle Support Services identify the cause of your problem if it becomes necessary to log a service request.
5. **Patches and BUGs:** There are times when BUGs are found in Oracle products, and patches are required to correct the problem. When troubleshooting a problem, you should review your system to see whether patches are available to provide you with a more recent release of the product. With the patch search tool, you can search for patches that contain specific files. Searching for the latest code and patching your environment to the most recent version improves the troubleshooting process by eliminating existing BUGs that could be possible candidates for the problem. You should also leverage the BUG search engine to see whether a BUG has been logged for your issue but not yet fixed.
6. **Logging a service request (SR):** When all self-service options fail, it may become necessary to engage a support representative to assist in resolving your issue.

Logging Service Requests

- Log an SR by clicking the Service Request tab on the My Oracle Support home page.
- My Oracle Support performs searches based on the CSI number and SR profile.
- Provide the following information when logging an SR:
 - Explanation of the issue, including error messages
 - Steps taken to troubleshoot the issue
 - Software version
 - Steps required to reproduce the problem
 - Business impact of the issue

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Logging Service Requests

You may research an issue on My Oracle Support, but may be unable to locate a solution. In this case, you should log a service request (SR) through My Oracle Support. You can log an SR by clicking the Service Request tab on the My Oracle Support home page.

The first step in creating an SR is the selection of a CSI number and SR profile. After the required profile information has been submitted, My Oracle Support gathers some specifics about the problem, including the problem type, error message, brief summary of the issue, and language preference. My Oracle Support performs a search by using this information and attempts to find a solution.

The search conducted during this phase may provide different results than the searches you have performed earlier. Both searches retrieve notes and BUGs from the same database; however, the search engines and weighting are slightly different. Because the search results can differ, it is important that the search results are reviewed during the SR creation process, even if previous searches have been conducted by using the My Oracle Support search engine.

Logging Service Requests (continued)

If the search results fail to resolve the issue, the SR creation process continues with a series of questions and requests for information. After the questions are answered, the SR is submitted electronically and routed to a support representative who analyzes the issue further. Any files, screenshots, or other additional information must be uploaded immediately after the SR is logged by using the upload utility provided in the SR section of My Oracle Support.

You must ensure that the following items are clearly documented in the SR. By providing the following information, you can equip the support representative effectively to prioritize and work on the issue:

- Clear explanation of the problem, including exact error messages
- Explanation of the steps taken to troubleshoot the problem and the findings
- Exact versions of the software
- Steps required to reproduce the problem
- Business impact of this issue, including milestones, dates, and costs

Each SR is assigned a unique identifier called the *SR number*. When you log an SR, My Oracle Support provides you with the SR number (or your support representative advises you about the SR number if you log the SR by telephone). The support representative subsequently receives the SR in his or her queue through an automated allocation process that Oracle Support Services uses to distribute all phone and Web-sourced service requests. This automated process ensures that all SRs are assigned to the support representative who is best able to work on the specific issue that is being reported.

Note: For more information, refer to My Oracle Support Technical Note 166650.1 (“Working Effectively with Global Customer Support”).

Managing Patches

Kinds of patches

- Interim patches
 - For specific issues
 - No regression testing
- CPUs (Critical Patch Updates)
 - Critical security issues
 - Regression testing
 - Does not advance version number
- Patch releases



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Managing Patches

You can apply different kinds of patches at different times for different reasons.

- Interim patches (also known as *one-off* or *one-of patches*) are created to solve a specific problem. They do not go through a full regression test. Interim patches are typically installed with the `opatch` utility. The Enterprise Manager Patching Wizard can help automate the patching process by downloading, applying, and staging the patches. This wizard uses the `opatch` utility in the background.
- CPU patches (Critical Patch Update patches) include security patches and dependent non-security patches. The CPU patches are cumulative, which means fixes from previous Oracle security alerts and critical patch updates are included. It is not required to have previous security patches applied before applying the CPU patches. However, you must be on the stated patch set level. CPU patches are for a specific patch release level (such as 10.2.0.3). CPU patches are installed with the `opatch` utility or through EM Patching Wizard. The CPU patches are issued quarterly. CPU patches and interim patches can also be removed from your system with `opatch rollback -id <patch id>`.
Oracle does extensive testing of Critical Patch Updates with our own applications, as well as running regression tests for the Critical Patch Updates themselves. To verify that a patch has been applied, query the inventory with `opatch -lsinventory` and see if the patch is listed.

Applying a Patch Release

- Patch releases are fully tested product fixes that:
 - Do not include new functionality
 - Affect only the software residing in your Oracle home on installation
 - Contain individual bug fixes
 - Carry version numbers
- To apply a patch:
 1. Determine your Oracle software environment.
 2. Set your My Oracle Support login credentials.
 3. Stage the patch release.

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Applying a Patch Release

Software management involves keeping your Oracle software up-to-date with the latest product fixes. Periodically, Oracle issues patch releases (product fixes) for its software. Patch releases are fully tested product fixes only; they do not include new functionality. Application of a patch release affects only the software residing in your Oracle home, with no upgrade or change to the database.

Patches are individual bug fixes. Patch sets are a collection of bug fixes up to the time of the patch set release. All patch and patch set releases carry version numbers. For example, if you bought Oracle Database 11g Release 11.1.0.2, an available patch set is 11.1.0.3. Every patch or patch set also has a patch number to identify it. Every patch release has an associated README file that describes its bug fixes. The README also has instructions for manually applying the patch.

Enterprise Manager enables you to find the latest patch release on the My Oracle Support Web site and download it to your Oracle home.

Using the Patch Advisor

Logged in As 3

Patch Advisor

Critical Security Patches

Select Advisory	Impact	Abstract	Affected Hosts	Affected Hosts
No patch advisories are currently applicable to your installation at this point in time				

Patch Recommendations by Feature

View Based on Usage Go

Schedule Patching

Select All | Select None

Select Patch Number	Created On	Description	Impacted Feature	README
<input type="checkbox"/> 4751921	2007-02-14	A useful Patch	Services	View
<input type="checkbox"/> 4751923	2007-02-15	Another useful patch	Services, Data Mining	View
<input type="checkbox"/> 4751925	2007-02-15	Yet Another useful patch	Audit Options	View

TIP It is recommended to check patch prerequisites before applying patches.

Related Links

- [Patch Prerequisites](#)
- [Database Feature Usage](#)
- [Interim Patches Applied](#)
- [Stage Patch](#)
- [Patching Setup](#)

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Using the Patch Advisor

The Patch Advisor shows you Critical Patch Updates and recommended patches for your system. The recommendation can be based on features usage, or you can display all available patches. The Patch Setup must be configured, and the RefreshFromMetalink job must run before the patches are visible.

Click Patch Setup in the Related links section of the Patch Advisor page to navigate to the Patch Setup page.

Using the Patch Wizard

Select Patches

Select the Patches to apply. Click on "Add Patches" to search and select patches from Metalink or Software Library.

Target List

Instance Name: database
Target Type: Database Instance
Release: 11.1.0.4.0
Host: stadl29.us.oracle.com
Staging Location: %oracle_home%/EMStagedPatches
This is the directory on the host where the updates will be staged.

Patches

Add Patches

Software Update Name	Patch Number	Created On	Type	Product	Platform	Release	Interim Patch	Applicable On	Description
p4751921_11.1.0.4.0_46_9480	4751921	2007-02-14 00:00:00.0	Patch	Oracle Database	Linux x86	11.1.0.4.0			A useful Patch

Post Patch SQL to apply

☒ Default (for Critical Patch Updates and Patchsets)
☐ Custom SQL File Path: Specify the file location on the host (e.g., %oracle_home%/files/patch.sql).
☐ None

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Using the Patch Wizard

When you click Apply Patch in the Database Software Patching section of the “Software and Support” page, the Patch Wizard is invoked.

The first step is Select Patches. Click Add Patch to select more patches to apply in this scheduled run.

The Target List step is reserved for patching RAC and is skipped in Oracle Database 11g.

The Library Step Properties are skipped unless the customer has customized the deployment procedures with custom variables. In the latter case, the Library Step properties are not skipped, and the user enters values for the custom variable.

In the next step, you provide the credentials for running the patch job and for determining if the job should run immediately or at a later time.

You then review the job and submit it.

Applying a Patch

Search And Select Patches

CancelSelect

☒ Search Metalink

☐ Search Software Library

Search

Patch Number

Product FamilyOracle Database

ProductOracle Database

Release11.1.0.5.0

Patch TypeAll Patches

PlatformAny

LanguageAny

Go

Select All | Select None

Select	Software Update Name	Patch Number	Created On	Type	Product	Platform	Release	Interim Patch Applicable On	Description	README
<input checked="" type="checkbox"/>	p6037441_11.1.0.5.0_46_9480	6037441		Patch	Oracle Database	Linux x86		11.1.0.5.0		<div>View</div>

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Applying a Patch

You can find and apply a patch, CPU, or patch release by using the “Software and Support” page.

Staging a Patch

Patch: Select Patch Cancel Step 1 of 6 Next

To look up patches at [OracleMetaLink](#), enter search criteria and click Search. This may take a few moments depending on the number of matches found. From Search Results, select the patch to be applied and click Next.
For advanced features like multiple patch application, patch flow customization, sudo and PAM support please use the "[Deployment Procedures](#)" functionality. For details on Deployment Procedures, consult the relevant [documentation](#)

Search by Number Search by Criteria

* Patch Number
Platform
(If you run a 32-bit Oracle product on a 64-bit operating system, choose a 32-bit platform.)
Language
Search Clear

Search Results View Details View ReadMe

Select	Patch Number	Created On	Type	Product	Platform	Release	Interim Patch Applicable On	Description	Status
<input checked="" type="radio"/>	6037441	May 11, 2007	Patch	Oracle Database	Linux x86		11.1.0.5.0	DUMMY BUG FOR DUMMY PATCH UPLOAD TO ARU FOR BETA TESTING	available

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Staging a Patch

When you click Stage Patch in the Database Software Patching section of the “Software and Support” page, the Patch Wizard is invoked.

The first step is to select the patch either by number or by criteria.

You then select the destination. In this step, you can choose from a list of available targets.

In the third step, provide the credentials of the OS user that is to do the patching, It is recommended that this be the user that owns the software installation.

In the next step, you can choose either to stage the patch or to stage and apply the patch.

The fifth step schedules the job.

The final step enables you to review and submit the patch job.

The staged patches are stored in the \$ORACLE_HOME/EMStagedPatches_<sid> directory on UNIX and Linux platforms, and in the %ORACLE_HOME%\EMStagedPatches_<sid> directory on Windows platforms.

Online Patching: Overview

For a bug fix or diagnostic patch on a running Oracle instance, online patching provides the ability to do the following:

- Install
- Enable
- Disable



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Online Patching: Overview

Online patching provides the ability to install, enable, and disable a bug fix or diagnostic patch on a live, running Oracle instance. Using online patching is the recommended solution for avoiding down time when applying online patches. Oracle provides the capability to perform online patching with any Oracle database using the `opatch` command-line utility. Online patches can be provided when the changed code is small in scope and complexity (for example, with diagnostic patches or small bug fixes).

Installing an Online Patch

- Applying an online patch does not require instance shutdown, relinking of the Oracle binary, or instance restart.
- OPatch can be used to install or uninstall an online patch.
- OPatch detects conflicts between two online patches, as well as between an online patch and a conventional patch.
- To determine if a patch is an online patch:

```
opatch query -is_online_patch <patch location>  
OR  
opatch query <patch location> -all
```

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Installing an Online Patch

Unlike traditional patching mechanisms, applying an online patch does not require instance shutdown or restart.

Similar to traditional patching, you can use OPatch to install an online patch.

You can determine whether a patch is an online patch by using the following commands:

```
opatch query -is_online_patch <patch location> or  
opatch query <patch location> -all
```

Note: The patched code is shipped as a dynamic/shared library, which is then mapped to memory by each Oracle process.

Benefits of Online Patching

- No down time and no interruption of business
- Extremely fast installation and uninstallation times
- Integrated with OPatch:
 - Conflict detection
 - Listed in patch inventory
 - Works in RAC environment
- Persist across instance shutdown and startup

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Benefits of Online Patching

You do not have to shut down your database instance while you apply the online patch. Unlike conventional patching, online patching enables fast installation and uninstallation. Because online patching uses OPatch, you get all the benefits that you already have with conventional patching that uses OPatch. It does not matter how long or how many times you shut down your database—an online patch always persists across instance shutdown and startup.

Conventional Patching and Online Patching

Conventional Patches	Online Patches
Require down time to apply or remove	Do not require down time to apply or remove
Installed and uninstalled via OPatch	Installed and uninstalled via OPatch
Persist across instance startup and shutdown	Persist across instance startup and shutdown
Take several minutes to install or uninstall	Take only a few seconds to install or uninstall

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Conventional Patching and Online Patching

Conventional patching basically requires a shutdown of your database instance.

Online patching does not require any down time. Applications can keep running while you install an online patch. Similarly, online patches that have been installed can be uninstalled with no down time.

Online Patching Considerations

- Online patches are supported on the following platforms:
 - Linux x86 32/64
 - HP Itanium
 - Sun Sparc Solaris 64
 - AIX
 - Windows x86 32/64
- Some extra memory is consumed.
 - Exact amount depends on:
 - Size of patch
 - Number of concurrently running Oracle processes
 - Minimum amount of memory: Approximately one OS page per running Oracle process

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Online Patching Considerations

One operating system (OS) page is typically 4 KB on Linux x86 and 8 KB on Solaris SPARC64. With an average of approximately one thousand Oracle processes running at the same time, this represents around 4 MB of extra memory for a small online patch.

Online Patching Considerations

- There may be a small delay (a few seconds) before every Oracle process installs or uninstalls an online patch.
- Not all bug fixes and diagnostic patches are available as an online patch.
- Use online patches in situations when down time is not feasible.
- When down time is possible, you should install all relevant bug fixes as conventional patches.

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Online Patching Considerations (continued)

A vast majority of diagnostic patches are available as online patches. For bug fixes, it really depends on their nature. Not every bug fix or diagnostic patch is available as an online patch. But the long-term goal of the online-patching facility is to provide online-patching capabilities for Critical Patch Updates.

Note: You must uninstall the online patch before applying the conventional patch.

Quiz

Which of the following statements are true about online patches?

1. Can be installed using OPatch
2. Require down time to apply
3. Persist across instance startup and shutdown
4. Do not require down time to remove

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Answers: 1, 3, and 4

Summary

In this lesson, you should have learned how to:

- Use the Support Workbench
- Work with Oracle Support
- Search My Oracle Support
- Log service requests
- Manage patches
 - Apply a patch release
 - Stage a patch release

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Practice 18 Overview: Using EM Tools for Alerts and Patches

This practice covers using the Support Workbench to investigate a critical error.

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Appendix A

Practices and Solutions

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Practices for Lesson 1

Background: In this practice, you review concepts about Oracle architecture components and answer questions to test your knowledge of the concepts learned in the lesson.

Practice 1-1: Exploring the Oracle Database Architecture

Fill in the blanks with the correct answers.

- 1) The two main components of a basic Oracle Database system:

_____ and _____

Hint: see page 1-6

- 2) The Instance consists of _____ and _____ processes.

Hint: see page 1-6

- 3) A session is a connection between the _____ process and the _____ process.

Hint: see page 1-8

- 4) Name the main components of the SGA:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Hint: see page 1-9

Practice 1-1: Exploring the Oracle Database Architecture (continued)

5) List six of the many background processes an Oracle Database instance might have:

- _____
- _____
- _____
- _____
- _____
- _____

Hint: see page 1-21

6) The _____ process writes the dirty buffers to the data files.

Hint: see page 1-23

7) The _____ process writes the redo entries to the online redo log files.

Hint: see page 1-25

8) The primary files associated with an Oracle database are:

- _____
- _____
- _____

Additional important files are:

- _____
- _____
- _____
- _____
- _____

Hint: see page 1-33

Practice 1-1: Exploring the Oracle Database Architecture (continued)

9) The logical storage structures of an Oracle database are:

- _____
- _____
- _____
- _____
- _____

Hint: see page 1-35

10) The _____ process copies the redo log files to an archive destination.

Hint: see page 1-31

11) The _____ contains data and control information for a server or background process.

Hint: see page 1-17

12) The logical tablespace structure is associated with the physical _____ files on disk.

Hint: see page 1-35

13) LGWR writes when:

- _____
- _____
- _____
- _____

Hint: see page 1-25

Practice 1-1: Exploring the Oracle Database Architecture (continued)

14) State whether the following statements are true or false.

- a) The SGA includes the Database buffer cache and Redo log buffer. ____
- b) Each server process has its own PGA. ____
- c) The buffers in the database buffer cache are organized in two lists: the most recently used list and the least recently used (LRU) list. ____
- d) User processes run the application or tool that connects to an Oracle Instance.

- e) Oracle Database processes include server processes and background processes.

- f) Checkpoints are recorded in log file headers. ____

Hint: see pages 1-9, 1-10, 1-13, 1-20, 1-21, 1-27

Practices for Lesson 2

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 your Oracle software installation. You are performing two installations. The first installation is the Oracle Grid Infrastructure for a standalone server. The second installation is the Oracle Database 11g software.

The installation media is staged at:

- `/stage/11.2.0/clusterware/Disk1.` for Oracle Grid Infrastructure
- `/stage/11.2.0/database/Disk1.` for Oracle Database 11g

Perform the following tasks as the default `oracle` OS user, unless otherwise indicated.

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

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure

In this practice you install the Oracle Grid Infrastructure for a standalone sever. During the installation, you configure the +DATA ASM disk group that will be used for storing database files for your database. After the installation is complete, you configure the +FRA ASM disk group that will be used for database backups and other database files for your database.

- 1) Start the Oracle Universal Installer (OUI) for the Oracle Grid Infrastructure. As the `oracle` user, navigate to the `/stage/11.2.0/clusterware/Disk1` directory and enter `./runInstaller`.
 - a) Right-click the desktop and click Open Terminal to open a terminal window. Then enter the following:

```
$ cd /stage/11.2.0/clusterware/Disk1
$ ./runInstaller
```

- 2) On the Select Installation Option page, select the Install and Configure Grid Infrastructure for a standalone server option and click Next.
- 3) On the Product Languages page, select all the available languages and click Next.

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- 4) On the Create ASM Disk Group page, ensure the Disk Group Name is DATA and Redundancy is Normal. Select the first four disk groups (ORCL:ASMDISK01, ORCL:ASMDISK02, ORCL:ASMDISK03, and ORCL:ASMDISK04) and then click Next.

Oracle Grid Infrastructure - Setting up Grid Infrastructure - Step 3 of 10

Create ASM Disk Group

Select Disk Group Characteristics and select disks

Disk Group Name: DATA

Redundancy: ☐ High ☒ Normal ☐ External

Add Disks

☒ Candidate Disks ☐ All Disks

	Disk Path	Size (in MB)	Status
<input checked="" type="checkbox"/>	ORCL:ASMDISK01	2304	Candidate
<input checked="" type="checkbox"/>	ORCL:ASMDISK02	2304	Candidate
<input checked="" type="checkbox"/>	ORCL:ASMDISK03	2304	Candidate
<input checked="" type="checkbox"/>	ORCL:ASMDISK04	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK05	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK06	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK07	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK08	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK09	2304	Candidate
<input type="checkbox"/>	ORCL:ASMDISK10	2304	Candidate

Change Discovery Path

Help < Back Next > Finish Cancel

- 5) On the Specify ASM Password page, select the option to use the same passwords for both SYS and SYSTEM accounts. Enter **oracle_4U** as the password and click Next.
- 6) The Privileged Operating System Groups page is next. Because your installation is for a standalone server, the same operating system group (dba) can be used for all of the administration groups shown.

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- a) Select **dba** for all three options and click **Next** to continue.

The screenshot shows the 'Oracle Grid Infrastructure - Setting up Grid Infrastructure - Step 5 of 10' window. The title bar includes the Oracle Database 11g logo. The window is titled 'Privileged Operating System Groups'. On the left is a navigation pane with steps: Installation Option, Product Languages, Create ASM Disk Group, **ASM Password**, **Operating System Groups** (highlighted), Installation Location, Prerequisite Checks, Summary, Setup, and Finish. The main area contains the instruction: 'Select the name of the operating system group of which you are a member to be used for OS authentication to Automatic Storage Management (ASM)'. Below this are three dropdown menus, all set to 'dba':

- ASM Database Administrator (OSDBA) Group
- ASM Instance Administration Operator (OSOPER) Group
- ASM Instance Administrator (OSASM) Group (with a yellow warning icon)

At the bottom are buttons for Help, < Back, Next >, Finish, and Cancel.

- b) A warning appears because we have specified the same operating group for all administrator groups. This is expected, so click **Yes** to continue.

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- 7) On the Installation Location page, ensure that the value for Oracle Base is `/u01/app/oracle`. For Software Location, enter `/u01/app/oracle/product/11.2.0/grid`. Click **Next**.

Oracle Grid Infrastructure - Setting up Grid Infrastructure - Step 6 of 10

Specify Installation Location

Installation Option
Product Languages
Create ASM Disk Group
ASM Password
Operating System Groups
Installation Location
Prerequisite Checks
Summary
Setup
Finish

Specify a base location for storing all Oracle software and configuration-related files. This location is the Oracle base directory. Create one Oracle base for each operating system user. By default, software and configuration files are installed by version and database name in the Oracle base directory.

Oracle Base: Browse...

This software directory is the Oracle Grid Infrastructure home directory. Change the defaults below either to specify an alternative location, or to select an existing grid infrastructure home.

Software Location: Browse...

Help < Back Next > Finish Cancel

- 8) On the Create Inventory page, accept all the defaults and click **Next** to continue.
- 9) The Perform Prerequisite Checks page is next. The OUI checks to make sure that your environment meets the minimum requirements for this installation. In many cases if a prerequisite check fails, the OUI can generate a fixup script to fix the problem. In our classroom, all prerequisites have been met so no issues are found and the OUI automatically advances to the next page.
- 10) On the Summary page, review the settings and information, and then click **Finish**.
- 11) The Setup page appears showing the progress of the installation and the status of the individual tasks being performed. When the Execute Configuration scripts window appears, follow the steps listed in the window.
- a) Open a terminal window and log in as `root`.

```
$ su -  
Password:  
#
```

- b) Run the scripts shown in the Execute Configuration scripts window.

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- i) The first script is `/u01/app/oraInventory/orainstRoot.sh`.

```
# /u01/app/oraInventory/orainstRoot.sh
Changing permissions of /u01/app/oraInventory.
Adding read,write permissions for group.
Removing read,write,execute permissions for world.

Changing groupname of /u01/app/oraInventory to oinstall.
The execution of the script is complete.
#
```

- ii) The second script is `/u01/app/oracle/product/11.2.0/grid/root.sh`. Accept the default of `/usr/local/bin` for the local bin directory by pressing Enter when prompted.

```
# /u01/app/oracle/product/11.2.0/grid/root.sh
Running Oracle 11g root.sh script...

The following environment variables are set as:
ORACLE_OWNER= oracle
ORACLE_HOME=  /u01/app/oracle/product/11.2.0/grid

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.
2009-07-08 09:35:07: Checking for super user privileges
2009-07-08 09:35:07: User has super user privileges
2009-07-08 09:35:07: Parsing the host name
Using configuration parameter file:
/u01/app/oracle/product/11.2.0/grid/crs/install/crsconfig_params
Creating trace directory
LOCAL ADD MODE
Creating OCR keys for user 'oracle', privgrp 'oinstall'..
Operation successful.
CRS-4664: Node edrsr12p1 successfully pinned.
Adding daemon to inittab
CRS-4123: Oracle High Availability Services has been started.
ohasd is starting
```

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

```
edrsr12p1      2009/07/08 09:35:39
/u01/app/oracle/product/11.2.0/grid/cdata/edrsr12p1/backup_200
90708_093539.olr
Successfully configured Oracle Grid Infrastructure for a
Standalone Server
#
```

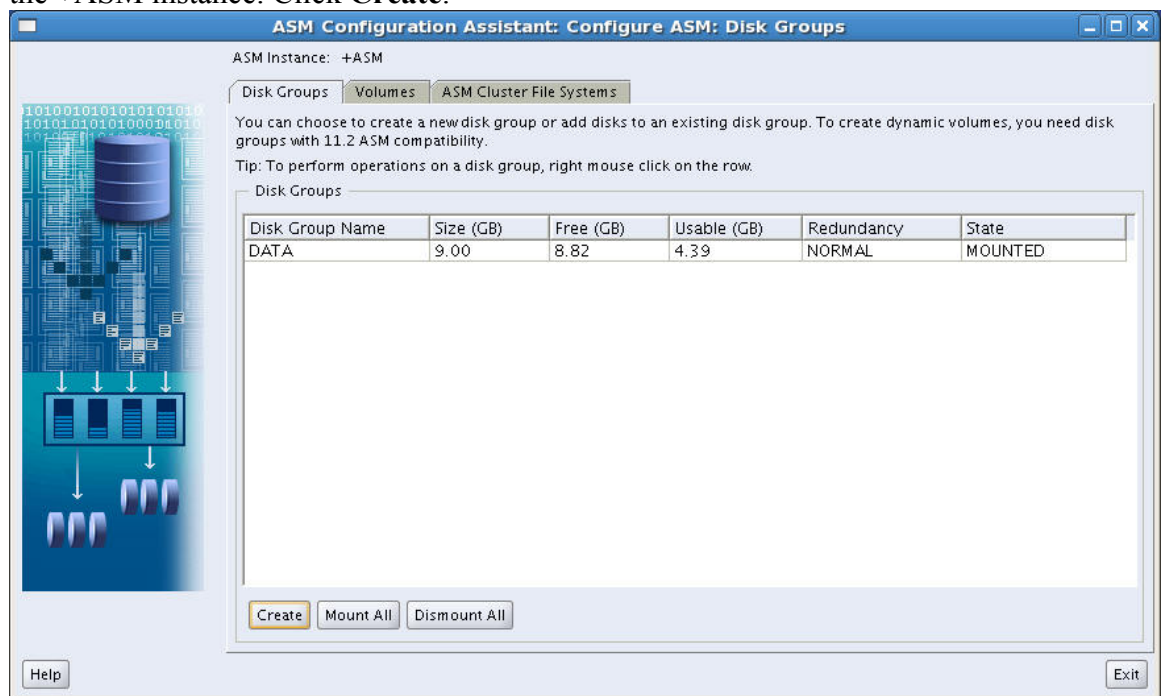
- c) Click **OK** in the Execute Configuration scripts window. The OUI continues with the remaining installation tasks.
- 12) Click **Close** on the Finish page to complete the installation of the Oracle Grid Infrastructure for a standalone server.
- 13) The next step is to configure the +FRA disk group. In a terminal window, logged in as oracle, perform the following steps:
- a) Use the oraenv utility to set the environment for the terminal session. Enter **+ASM** when prompted for the ORACLE_SID:

```
$ . oraenv
ORACLE_SID = [orcl] ? +ASM
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid is
/u01/app/oracle
```

- b) Start the ASM Configuration Assistant by entering **asmca** at the command line.

```
$ asmca
```

- c) The ASM Configuration Assistant opens displaying the current disk groups for the +ASM instance. Click **Create**.



Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- d) Enter **FRA** for the Disk Group Name. Select External (None) for redundancy. Select disk groups **ORCL:ASMDISK05**, **ORCL:ASMDISK06**, **ORCL:ASMDISK07**, and **ORCL:ASMDISK08** and click **OK**.

Create Disk Group

Disk Group Name:

Redundancy

Redundancy is achieved by storing multiple copies of the data on different failure groups. Normal redundancy needs disks from at least two different failure groups, and high redundancy from at least three different failure groups.

☐ High ☐ Normal ☒ External (None)

Select Member Disks

☒ Show Eligible ☐ Show All

Quorum failure groups are used to store voting files in extended clusters and do not contain any user data. It requires ASM compatibility of 11.2 or higher.

<input type="checkbox"/>	Disk Path	Header Status	Disk Name	Size (MB)	Quorum
<input checked="" type="checkbox"/>	ORCL:ASMDISK05	FORMER		2304	<input type="checkbox"/>
<input checked="" type="checkbox"/>	ORCL:ASMDISK06	FORMER		2304	<input type="checkbox"/>
<input checked="" type="checkbox"/>	ORCL:ASMDISK07	FORMER		2304	<input type="checkbox"/>
<input checked="" type="checkbox"/>	ORCL:ASMDISK08	FORMER		2304	<input type="checkbox"/>
<input type="checkbox"/>	ORCL:ASMDISK09	PROVISIONED		2304	<input type="checkbox"/>
<input type="checkbox"/>	ORCL:ASMDISK10	PROVISIONED		2304	<input type="checkbox"/>
<input type="checkbox"/>	ORCL:ASMDISK11	PROVISIONED		2304	<input type="checkbox"/>

Note: If you do not see the disks which you believe are available, check Disk Discovery Path and read/write permissions on the disks. The Disk Discovery Path limits set of disks considered for discovery.

Disk Discovery Path: <default> Change Disk Discovery Path

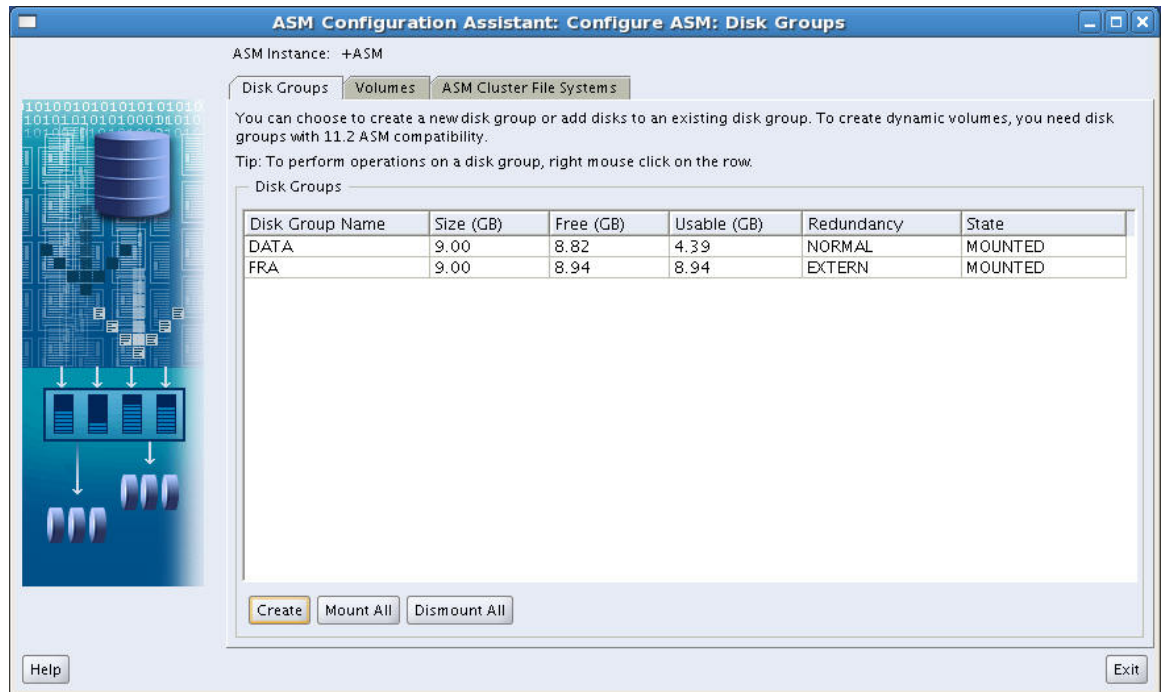
Click on the Show Advanced Options button to change the diskgroup attributes. Diskgroup compatibility attributes may need to be modified based on the usage of diskgroup for different versions of databases or ASM Cluster File Systems.

Show Advanced Options OK Cancel Help

- e) Click **OK** in the DiskGroup: Creation window when it appears.

Practice 2-1: Installing and Configuring the Oracle Grid Infrastructure (continued)

- f) Notice that now there are two disk groups (DATA and FRA) listed for the +ASM instance. Click **Exit**.



- g) Click **Yes** when asked if you really want to quit this application.

14) Close any open terminal windows.

Practice 2-2: Installing the Oracle Database 11g Software

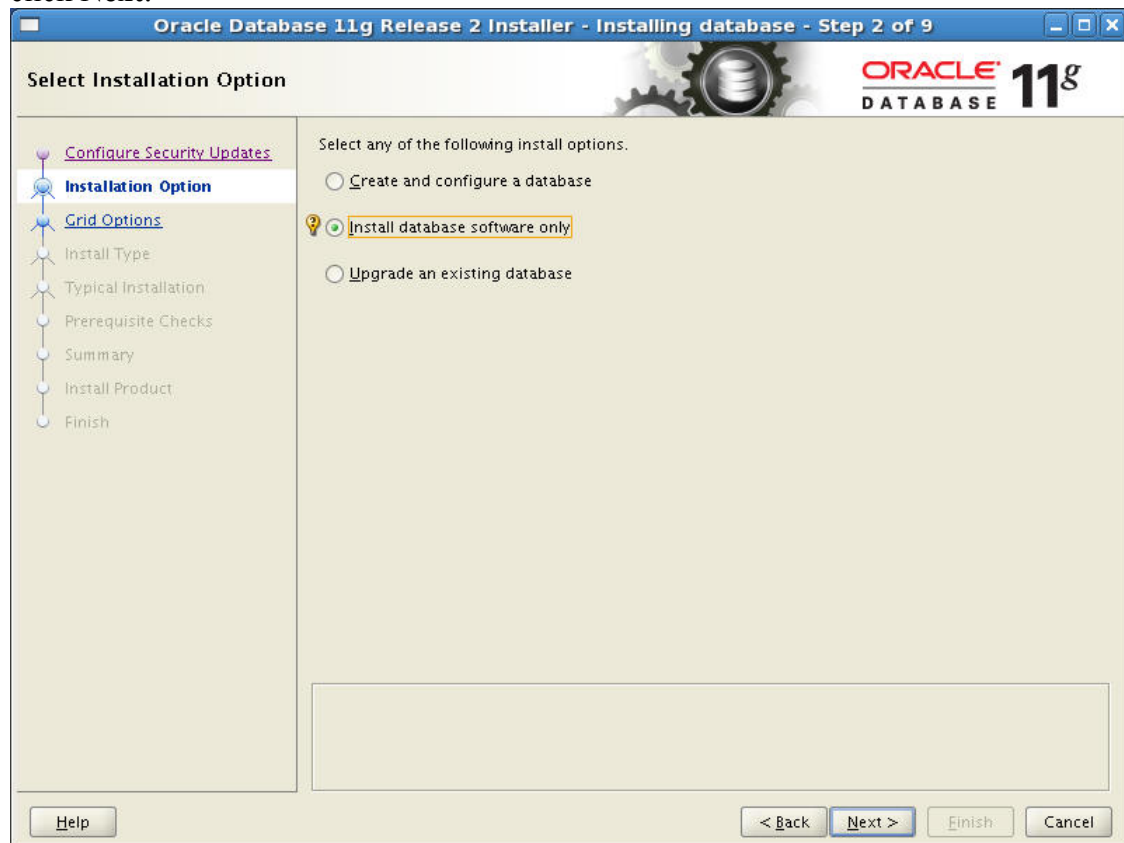
The next step is to install the Oracle Database 11g software.

- 1) Open a new terminal window and install the Oracle database software as the `oracle` user. Navigate to the `/stage/11.2.0/database/Disk1` directory, and start the Oracle Universal Installer (OUI) by entering `./runInstaller`.

- a) Right-click the desktop and click Open Terminal to open a terminal window. Then enter the following:

```
$ cd /stage/11.2.0/database/Disk1
$ ./runInstaller
```

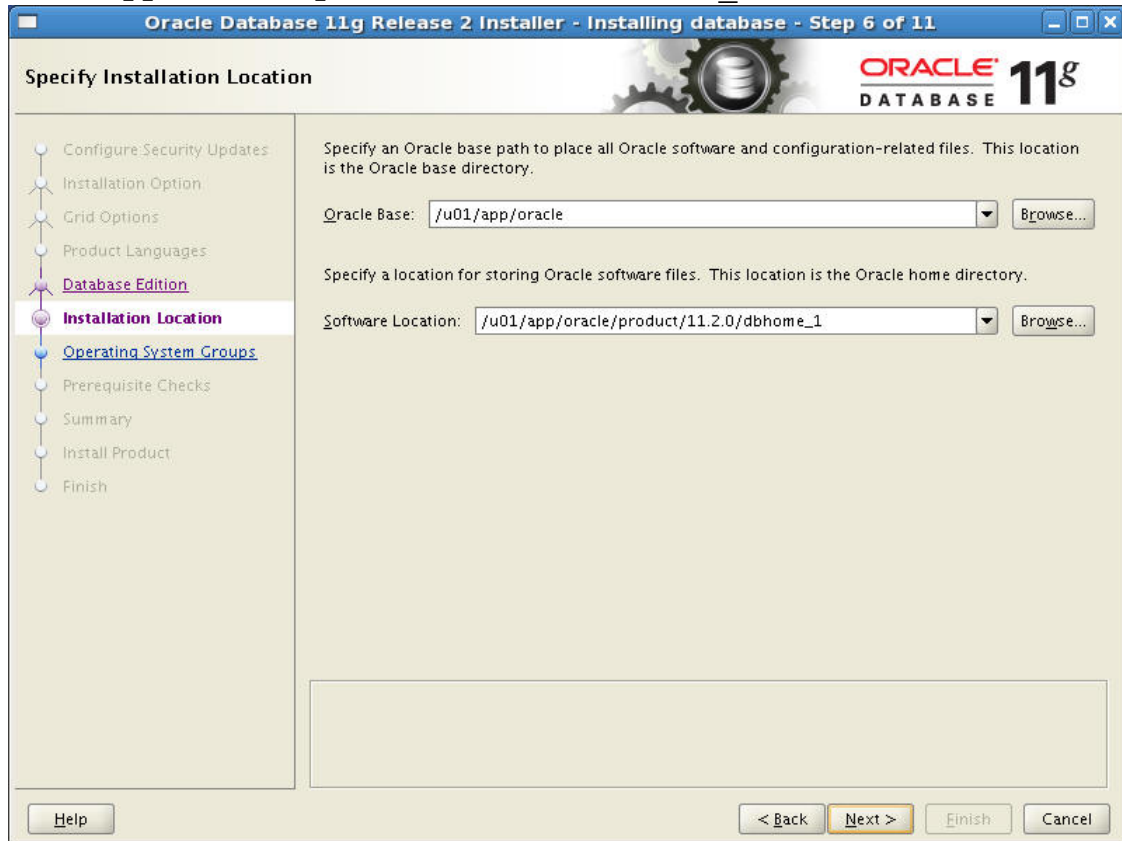
- 2) The Configure Security Updates page is the first to appear. In your real-world environment, you would enter your email address and My Oracle Support password; however, because the classroom is an isolated environment, please leave the email and password fields blank. Deselect the option to receive security updates from My Oracle Support and click **Next**.
- 3) Click **Yes** in the Email Address Not Specified warning message that appears.
- 4) On the Installation Option page, select the **Install database software only** option and click **Next**.



- 5) Ensure that **Single instance database installation** is selected on the Install Type page and click **Next**.
- 6) On the Product Languages page, select all the available languages and click **Next**.

Practice 2-2: Installing the Oracle Database 11g Software (continued)

- 7) On the Select Database Edition page, ensure **Enterprise Edition (3.95GB)** is selected and click **Next**.
- 8) On the Installation Location page, ensure that the value for Oracle Base is **/u01/app/oracle**. For Software Location, enter **/u01/app/oracle/product/11.2.0/dbhome_1**. Click **Next**.



- 9) Select **dba** for both the OSDBA and OSOPER groups on the Privileged Operating System Groups page and click **Next**.
- 10) The OUI then performs prerequisite checks. No problems should be found and the Summary page should appear next. Click **Finish**.
- 11) The Install Product page appears, showing you the progress of the installation and the status for each individual task being performed. When the Execute Configuration scripts window appears, follow the steps listed in the window.
 - a) Open a terminal window and log in as **root**.

```
$ su -  
Password:  
#
```

- b) Run the script shown in the Execute Configuration scripts window. Accept the default for the local **bin** directory and do not overwrite any files (you can just press [Enter] because the default option is to not overwrite).

Practice 2-2: Installing the Oracle Database 11g Software (continued)

```
# /u01/app/oracle/product/11.2.0/dbhome_1/root.sh
Running Oracle 11g root.sh script...

The following environment variables are set as:
    ORACLE_OWNER= oracle
    ORACLE_HOME=  /u01/app/oracle/product/11.2.0/dbhome_1

Enter the full pathname of the local bin directory:
[/usr/local/bin]:
The file "dbhome" already exists in /usr/local/bin.  Overwrite
it? (y/n)
[n]:
The file "oraenv" already exists in /usr/local/bin.  Overwrite
it? (y/n)
[n]:
The file "coraenv" already exists in /usr/local/bin.
Overwrite it? (y/n)
[n]:

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.
Finished product-specific root actions.
#
```

c) Click **OK** on the Execute Configuration scripts window.

12) Click **Close** on the Finish page to complete the installation of the Oracle Database 11g software.

Practices for Lesson 3

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).

Practice 3-1: Creating an Oracle Database

In this practice, you create the `orcl` database. You use the Database Configuration Assistant (DBCA) to create the database.

- 1) Start the Database Configuration Assistant (DBCA).
 - a) Open a terminal window as the **oracle** user by right-clicking your desktop and selecting **Open Terminal**.
 - b) Set your `ORACLE_HOME` environment variable by using **oraenv**. Enter **orcl** for the SID and then enter **/u01/app/oracle/product/11.2.0/dbhome_1** for `ORACLE_HOME`.
Note: You enter the full `ORACLE_HOME` path at this time because the `orcl` database does not yet exist. After the database is created, you will only have to enter `orcl` as the SID and it will determine the correct `ORACLE_HOME`.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
ORACLE_HOME = [/home/oracle] ?
u01/app/oracle/product/11.2.0/dbhome_1
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
```

- c) To start the DBCA, enter:

```
$ dbca
```

- 2) Click **Next** on the Welcome page to begin the `orcl` database creation.
- 3) On the Operations page, select **Create a Database**, and then click **Next**.
- 4) On the Database Templates page, select the **General Purpose or Transaction Processing** template.

- a) Click **Show Details** and answer the following questions:

- i) **Question 1:** How many control files are created?

Answer: Two

Note: The location will change later in this practice when we choose to use ASM as our storage technique.

- ii) **Question 2:** How many redo log groups are created?

Answer: Three

Note: The location will change later in this practice when we choose to use ASM as our storage technique.

- iii) **Question 3:** What is the database block size (`db_block_size`)?

Answer: 8 KB

Practice 3-1: Creating an Oracle Database (continued)

iv) **Question 4:** What is the value of Sample Schemas?

Answer: Sample Schemas is set to False.

Note: You will change this setting later in this practice so that the HR sample schema is included in your database.

v) **Question 5:** What is the template default for the Database Character Set?

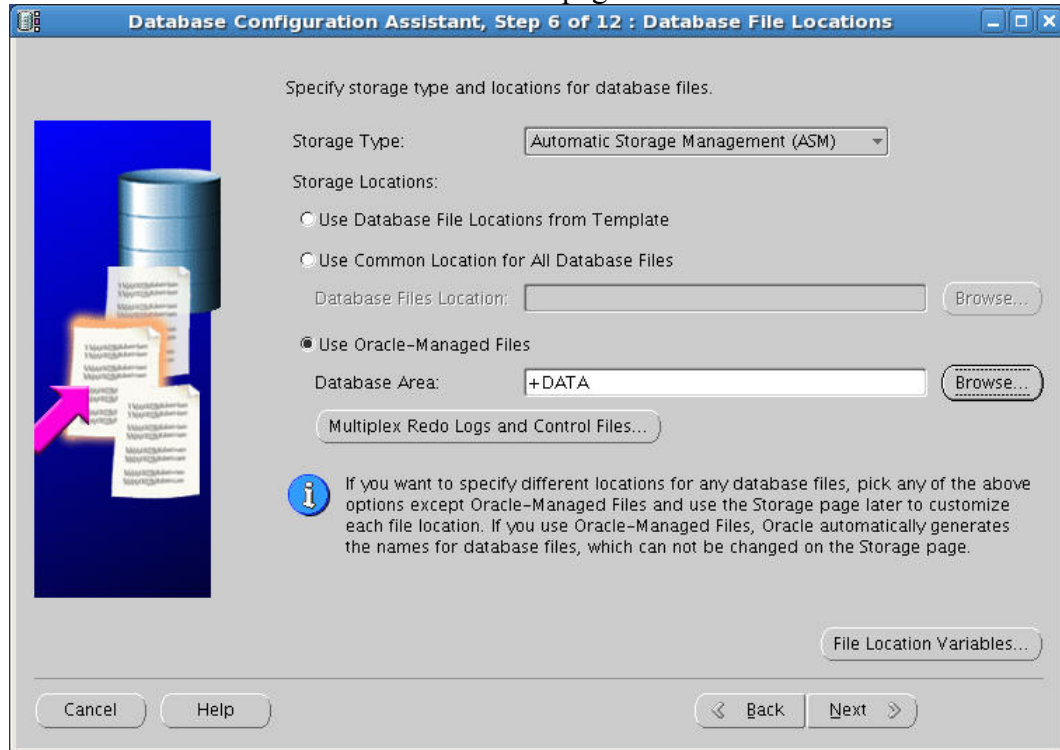
Answer: WE8MSWIN1252

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

- b) Click **Close** to close the Template Details window.
- c) Click **Next** on the Database Templates page to continue the database creation process.
- 5) On the Database Identification page, enter **orcl.example.com** as Global Database Name. The SID defaults to the database name **orcl**. Click **Next**.
- 6) On the Management Options page, ensure that the following items are selected:
 - a) On the Enterprise Manager tab, ensure that both **Configure Enterprise Manager** and **Configure Database Control for local Management** are selected.
 - b) On the Automatic Maintenance Tasks tab, ensure that **Enable automatic maintenance tasks** is selected.
 - c) Click **Next** to continue.
- 7) On the Database Credentials page, select **Use the Same Password for All Accounts** and enter **oracle_4U** as Password and Confirm Password. Then click **Next**.
- 8) On the Storage Options page, specify ASM as the storage type and choose the **+DATA** disk group as the storage location.
 - a) Select **Automatic Storage Management (ASM)** for Storage Type
 - b) The storage location defaults to Use Oracle-managed Files. Click the **Browse** button for Database Area.
 - c) In the Select Disk Group window, ensure that the **DATA** disk group is selected and click **OK**.

Practice 3-1: Creating an Oracle Database (continued)

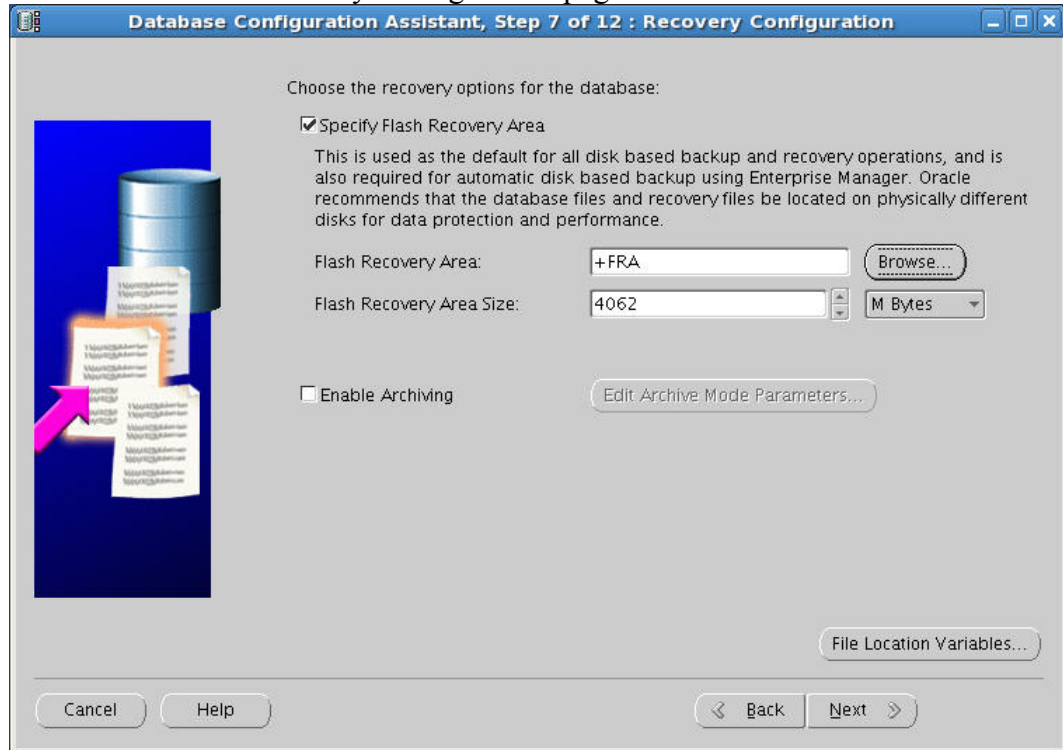
- d) Click **Next** on the Database File Locations page.



- e) The ASM Credentials window appears. Enter the password you specified during ASM installation and configuration (for your classroom environment this should be **oracle_4U**) and click **OK**.
- 9) On the Recovery Configuration page, configure the Fast Recovery Area.
Note: The Flash Recovery Area is now the Fast Recovery Area but in this release the pages in Enterprise Manager still refer to it as Flash Recovery Area. Watch for this to change in future releases as the product goes through this change.
- a) Select **Specify Flash Recovery Area**
 - b) Click the **Browse** button for Flash Recovery Area.
 - c) In the Select Disk Group window, select the **FRA** disk group and click **OK**.

Practice 3-1: Creating an Oracle Database (continued)

d) Click **Next** on the Recovery Configuration page.

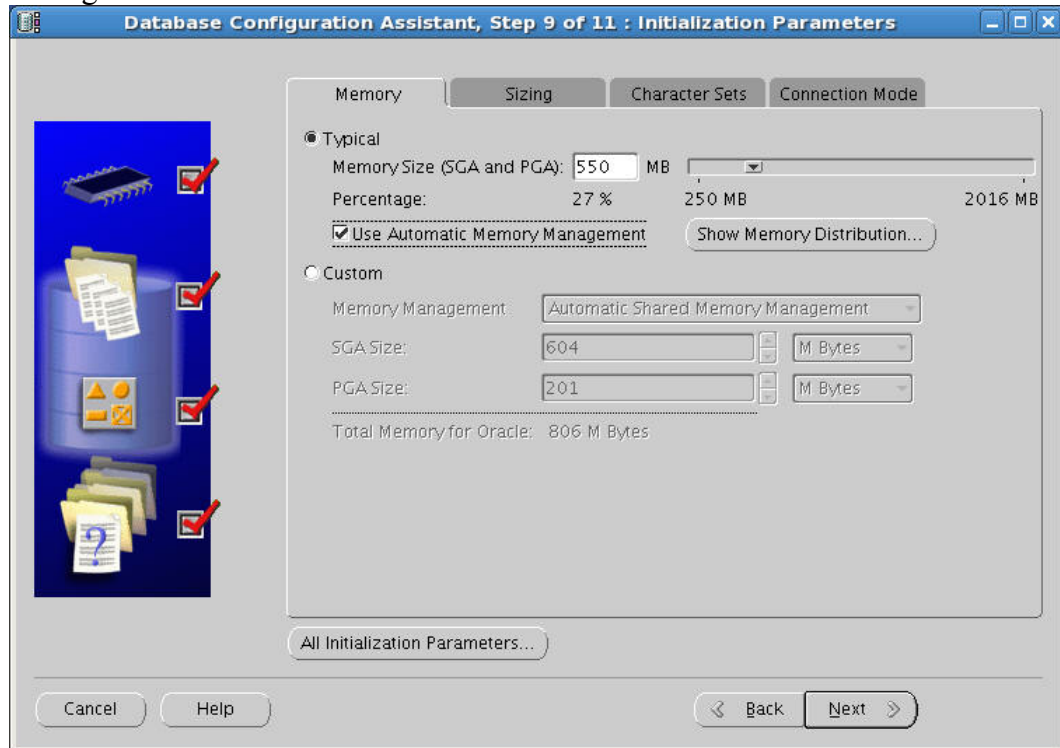


10) On the Database Content page, select **Sample Schemas**, and then click **Next**.

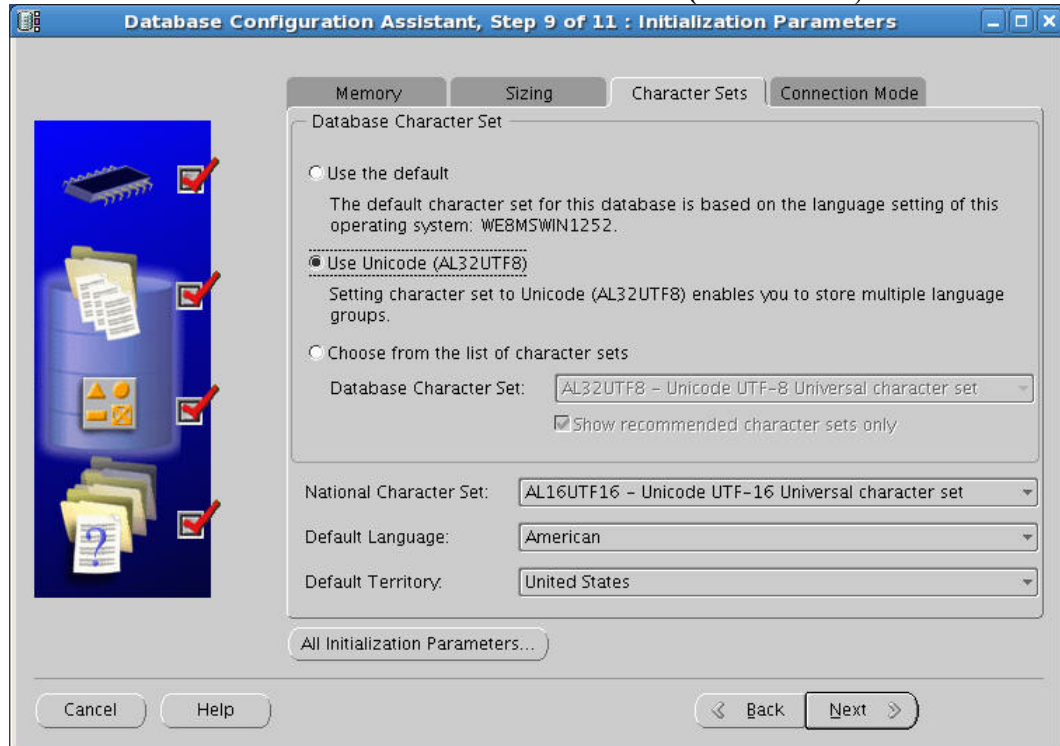
11) On the Memory tabbed page of the Initialization Parameters page, select **Typical** and specify a size of **550 MB** for Memory Size. Modify the character set to use **Unicode AL32UTF8**.

Practice 3-1: Creating an Oracle Database (continued)

- a) Select **Typical** and set the value for **Memory Size (SGA and PGA)** to **550 MB**. Ensure **Automatic Memory Management** is selected for the Memory Management field.



- b) Click the Character Sets tab and select **Use Unicode (AL32UTF8)**.



Practice 3-1: Creating an Oracle Database (continued)

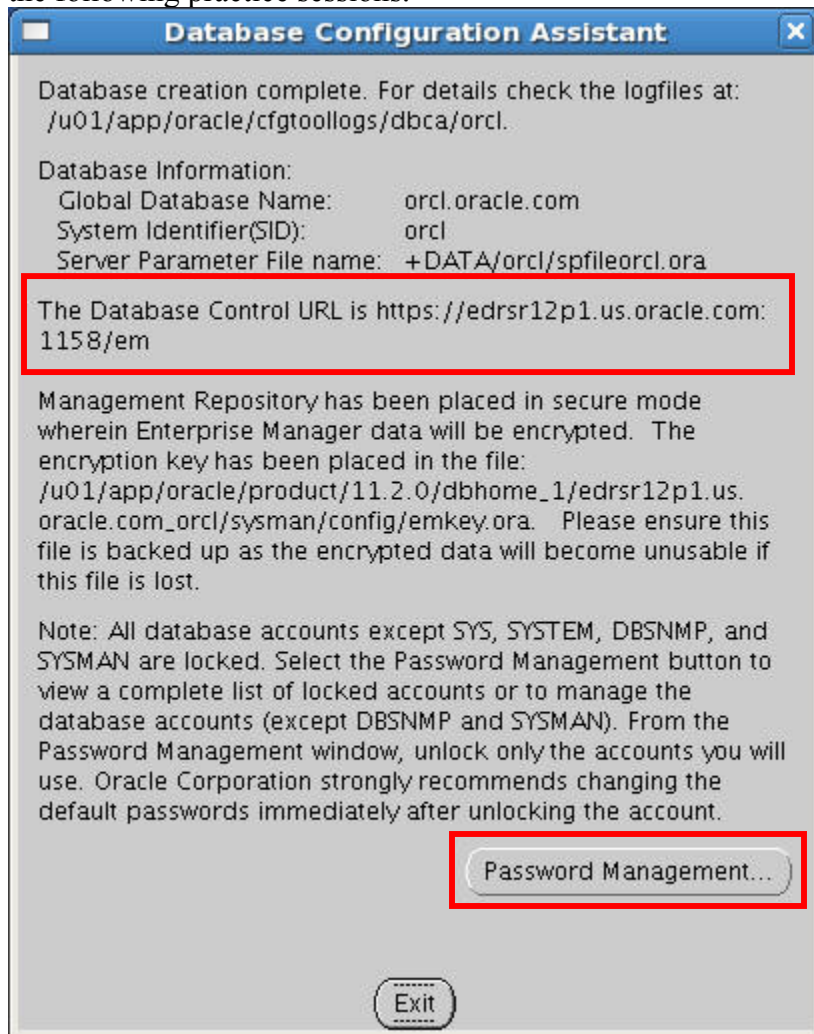
- c) Review the Sizing and Connection Mode tabbed pages, but do not change any values. Then click **Next**.
- 12) On the Database Storage page, review your file names and locations. Then click **Next**.
- 13) On the Creation Options page make the following selections:
 - a) Select **Create Database**.
 - b) Select **Save as a Database Template** option. Enter **orcl** as the Name for the database template and **orcl Database Template** as the Description.
 - c) Select **Generate Database Creation Scripts** and enter **/home/oracle/labs** as the Destination Directory.
 - d) Then click **Finish**.
- 14) The Confirmation page appears.
 - a) Review options and parameters, specifically the ones in the table below, and click **OK**.

Name	Value
Sample Schemas	true
db_block_size	8KB
db_create_file_dest	+DATA
db_recovery_file_dest	+FRA
memory_target	550MB
Database Character Set	AL32UTF8

- b) Click **OK** to acknowledge that the template has been created.
- c) Click **OK** to acknowledge the generation of the database scripts.

Practice 3-1: Creating an Oracle Database (continued)

- 15) 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.



- a) **Important:** Make note of your Database Control URL here:

https://_____ **:** _____ **/em**

You will be using this URL many times throughout the remainder of the course.

- b) Click the **Password Management** button.
- c) Scroll down the Password Management page until you see the **HR** username.

Practice 3-1: Creating an Oracle Database (continued)

- d) Deselect **Lock Account?** and enter **oracle_4U** as the New Password and Confirm Password. Then click **OK**.

User Name	Lock Account?	New Password	Confirm Password
ORACLE_OCM	✓		
BI	✓		
PM	✓		
MDDATA	✓		
IX	✓		
SH	✓		
DIP	✓		
OE	✓		
APEX_PUBLIC_USER	✓		
HR		*****	*****
SPATIAL_CSW_ADMIN_...	✓		
SPATIAL_WFS_ADMIN_U...	✓		

- e) Click **Exit** to close the DBCA.

You have completed your task to create a database, a database template, and database generation scripts.

Practices for Lesson 4

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.

Practice 4-1: Managing the Oracle Instance

In this practice, you get to know the Oracle Enterprise Manager interface a little better. Using Oracle Enterprise Manager you perform the following tasks:

- View and change instance parameters
- Shut down the database
- Start up the database

You also view various instance parameters using SQL*Plus and look the text version of the alert log from a terminal window.

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

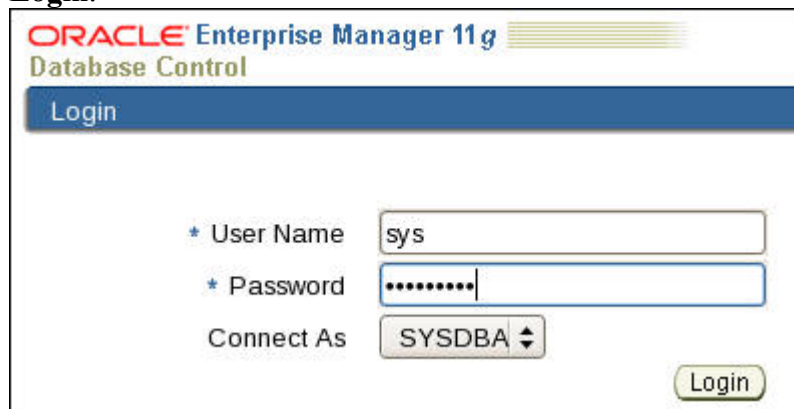
Answer: 1158

- a) Double-click the **Web Browser** icon on your desktop to open your Web browser as the `oracle` user.
- b) Enter the URL that you wrote down in Practice 3. It has the following format:

`https://hostname:portnumber/em`

Note: The first time you connect you will get a Secure Connection Failed message (or something similar) and an Alert window may appear. To get past this, you add an exception and accept the certificate.

- i) Click **OK** on the Alert window if it appears.
 - ii) Click the **Or you can add an exception...** link at the bottom of the page.
 - iii) A warning regarding adding exceptions appears. Click the **Add Exception...** button.
 - iv) On the Add Security Exception window, click the **Get Certificate** button.
 - v) The Certificate Status is displayed. Ensure that the option to permanently store this exception is selected and click the **Confirm Security Exception** button.
- c) In the Oracle Enterprise Manager login screen, enter **sys** as the User Name, enter **oracle_4U** as the Password, and select **SYSDBA** for Connect As. Then click **Login**.



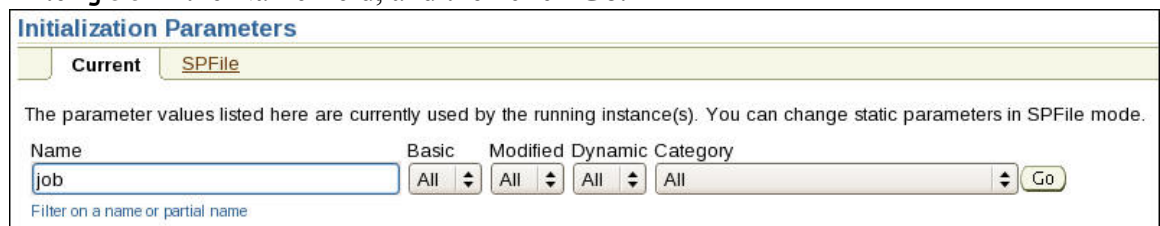
- 2) View the initialization parameters and set the `JOB_QUEUE_PROCESSES` parameter to **15**. What SQL statement is run to do this?

Practice 4-1: Managing the Oracle Instance (continued)

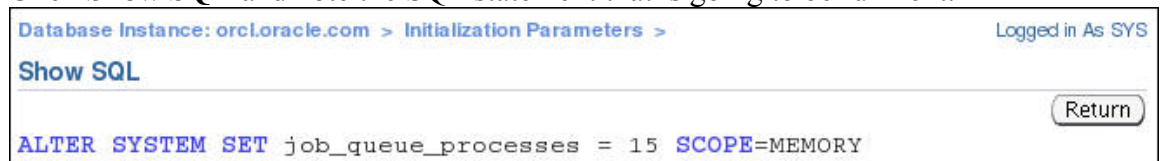
- a) Select **Server** > **Initialization Parameters** (in the Database Configuration section).



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



- c) When the **JOB_QUEUE_PROCESSES** initialization parameter appears, change its value to **15**.
- d) Click **Show SQL** and note the SQL statement that is going to be run next.



- 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 running.
- 4) Shut down the database instance by using Enterprise Manager.
- a) In the Enterprise Manager browser session, click the **Database** tab.
 - b) Click the **Shutdown** button.
 - c) For Host Credentials, enter **oracle** as Username and **oracle** as Password.
 - d) Click **OK**. The Startup/Shutdown: Confirmation page appears.
 - e) Click **Advanced Options** to see the mode for shutting down, but do not change the mode; it should remain as “Immediate.”
 - f) Click **Cancel** to return to the previous page.
 - g) Click **Yes** to confirm the shutdown operation.
 - h) Click **Refresh**. If you see an error during the refresh, click **OK** and continue to refresh. The error will resolve itself.

Practice 4-1: Managing the Oracle Instance (continued)

- i) Note that the Status of the instance is now “Down.”



Database Instance

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

Host **edrsr12p1.us.oracle.com**

Port **1521**

SID **orcl**

Oracle Home **/u01/app/oracle/product/11.2.0/dbhome_1**

Startup **Perform Recovery**

- 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 set your environment to the orcl database using oraenv.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

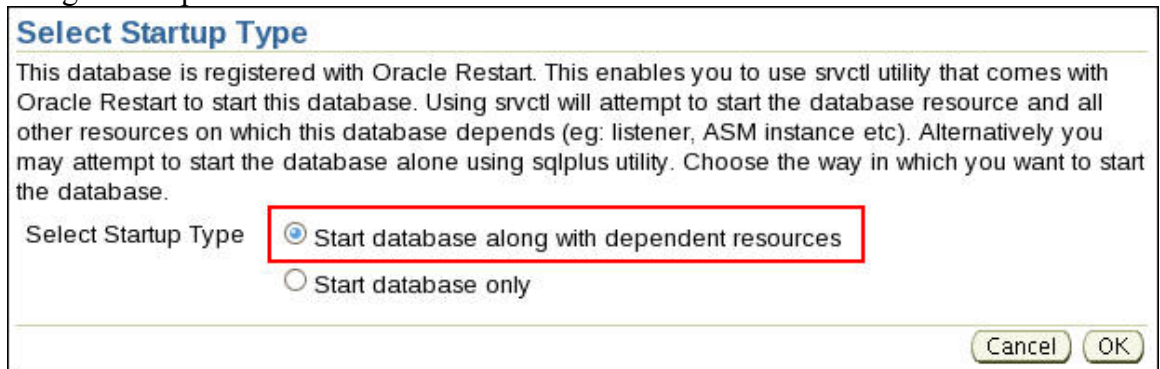
- b) Enter the following to attempt to log in to the database:

```
$ sqlplus hr
```

- c) Enter **oracle_4U** for the password.
- d) Note the “ORACLE not available” error message.
- e) 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.
- a) In Enterprise Manager, click the **Startup** button.
- b) Enter **oracle** for both Username and Password in the Host Credentials region.
- c) Click **OK**.

Practice 4-1: Managing the Oracle Instance (continued)

- d) The Select Startup Type page appears. Ensure the option to start the database along with dependent resources is selected and click **OK**.



Select Startup Type

This database is registered with Oracle Restart. This enables you to use srvctl utility that comes with Oracle Restart to start this database. Using srvctl will attempt to start the database resource and all other resources on which this database depends (eg: listener, ASM instance etc). Alternatively you may attempt to start the database alone using sqlplus utility. Choose the way in which you want to start the database.

Select Startup Type ☒ Start database along with dependent resources ☐ Start database only

Cancel OK

- e) The Startup/Shutdown: Confirmation page appears.
- f) Click **Advanced Options** to see the modes and options available for starting up, but do not change the mode; the startup mode should remain as “Open”.
- g) Click **Cancel** to return to the previous page.
- h) Click **Yes** to confirm the startup operation.
- i) The Startup page appears as the database is starting up. Wait for the login page to appear, at which time you can log in as **SYS** user with the **oracle_4U** password and the SYSDBA privilege.
- Note:** When you first connect you may see a Failed status for the Agent Connection to Instance. Wait a few minutes and this should go away and the database home page should appear.
- 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 Contents**. Click **Go**.
- b) Scroll through 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.

Jul 10, 2009 5:44:48 AM GMT+07:00	NOTIFICATION	16	admin_ddl opiexe:2994:4222364190	ALTER DATABASE OPEN
Jul 10, 2009 5:44:48 AM GMT+07:00	NOTIFICATION	16	admin_ddl opiexe:3065:2802784106	Completed: ALTER DATABASE MOUNT

- c) Note that the modes that the database goes through during startup are MOUNT and OPEN.
- d) Locate and view the text version of the alert log.
Connect to the database as the **system** user (password is **oracle_4U**) using SQL*Plus and query the **V\$DIAG_INFO** view. To view the text-only alert log without the XML tags, complete these steps:
- i) In the V\$DIAG_INFO query results, note the path that corresponds to the Diag Trace entry.

```
SQL> select * from V$DIAG_INFO;
```

Practice 4-1: Managing the Oracle Instance (continued)

```
INST_ID NAME
-----
VALUE
-----
...
          1 Diag Trace
/u01/app/oracle/diag/rdbms/orcl/orcl/trace
...
```

ii) Exit from SQL*Plus and change directory to that path.

```
$ cd /u01/app/oracle/diag/rdbms/orcl/orcl/trace
```

iii) Open the **alert_orcl.log** file with a text editor.

Note: The file will be named alert_<sid>.log in other databases, where <sid> is the instance name.

e) Try to locate the entries for the shutdown and startup performed earlier in the practice.

8) Connect to the database using SQL*Plus as sysdba.

Note: Remember to use **oraenv** to set your environment to the **orcl** database if you have not already done so in your terminal window.

```
$ sqlplus / as sysdba
```

9) Use the **SHOW PARAMETER** command to verify the settings for **SGA_MAX_SIZE**, **DB_CACHE_SIZE**, and **SHARED_POOL_SIZE**.

```
SQL> show parameter sga_max_size

NAME                                TYPE        VALUE
-----                                -
sga_max_size                        big integer 552M
SQL> show parameter db_cache_size

NAME                                TYPE        VALUE
-----                                -
db_cache_size                      big integer 0
SQL> show parameter shared_pool_size

NAME                                TYPE        VALUE
-----                                -
shared_pool_size                   big integer 0
SQL>
```

10) Check the value of **JOB_QUEUE_PROCESSES**.

Practice 4-1: Managing the Oracle Instance (continued)

```
SQL> show parameter job_queue_processes
```

NAME	TYPE	VALUE
-----	-----	-----
job_queue_processes	integer	1000

```
SQL>
```

Note: Earlier in this practice, you changed the JOB_QUEUE_PROCESSES parameter to 15, but the scope of that change was for the running instance only. That change did not get saved in the SPFILE. So the next time you performed a shutdown and startup, the value reverted to the value in the SPFILE.

Practice 4-2: Testing Oracle Restart and Your Database

In this practice, you test the Oracle Restart functionality by causing your database to crash and watching for Oracle Restart to restart your database.

- 1) Use Enterprise Manager to determine whether your `orcl` database instance is currently managed by Oracle Restart.
 - a) Go to the Home page by clicking the **Database** tab.
 - b) On the Home page, look at the **High Availability** section and see that Oracle Restart is **Enabled** for your database instance.
- 2) To determine the effect of Oracle Restart, kill the LGWR process of your `orcl` database instance. What do you observe?
 - a) Set your environment variables for your `orcl` database instance.

```
$ . oraenv
ORACLE_SID = [orcl] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
Enter
```

- b) Enter `ps -ef | grep ora_lgwr_orcl` to find the process ID for the LGWR process for your database.

```
$ ps -ef | grep ora_lgwr_orcl
oracle   10478      1   0 10:54 ?           00:00:00 ora_lgwr_orcl
oracle   11371  24865   0 11:00 pts/3      00:00:00 grep
ora_lgwr_orcl
```

- c) Kill the LGWR using the `kill -9` command and the process ID you determined in the previous step. This will cause the instance to shut down.

```
$ kill -9 10478
```

- d) Enter `ps -ef | grep ora_lgwr_orcl` again to see if the LGWR process is restarted. Repeat this until you see that the LGWR has started again. Notice that the `ora_lgwr_orcl` process has a different process ID now than the process ID you used when issuing the `kill -9` command.

```
$ ps -ef | grep ora_lgwr_orcl
oracle   11849 11687   0 11:06 pts/3      00:00:00 grep
ora_lgwr_orcl
$ ps -ef | grep ora_lgwr_orcl
oracle   11855 11687   0 11:06 pts/3      00:00:00 grep
ora_lgwr_orcl
$ ps -ef | grep ora_lgwr_orcl
oracle   11946      1   0 11:06 ?           00:00:00 ora_lgwr_orcl
oracle   12034 11687   0 11:07 pts/3      00:00:00 grep
ora_lgwr_orcl
```

Practice 4-2: Testing Oracle Restart and Your Database (continued)

- 3) Connect to the database using SQL*Plus as sysdba to confirm that your database has restarted successfully. Query v\$instance to see the status of your database.

Note: Remember to use **oraenv** to set your environment to the **orcl** database if you have not already done so in your terminal window.

```
$ sqlplus / as sysdba

SQL*Plus: Release 11.2.0.1.0 Production on Tue Aug 18 11:16:40
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.2.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL> select status from v$instance;

STATUS
-----
OPEN

SQL>
```

Practices for Lesson 5

Background: In these practices, you explore the benefits of the ASM Fast Mirror Resync feature. You also explore the functionality of the ASM command-line utility, ASMCMD.

Practice 5-1: ASM Fast Mirror Resync

In this practice, you compare the time it takes to add an offlined disk following a non-data-loss issue. You compare the same operation once without using ASM Fast Mirror Resync, and once using it.

- 1) Determine the compatibility values for your existing ASM disk groups. What do you observe?
 - a) Set the proper environment variables for the +ASM instance. Run the query in the following screenshot to check COMPATIBLE values for both ASM and the database. You should see that the database compatibility value is set to 10.1.

```
$ . oraenv
ORACLE_SID = [orcl] ? +ASM
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid is
/u01/app/oracle
$ sqlplus / as sysasm

SQL> select name,compatibility,database_compatibility from
v$asm_diskgroup;
```

NAME	COMPATIBILITY	DATABASE_COMPATIBILITY
DATA	11.2.0.0.0	10.1.0.0.0
FRA	11.2.0.0.0	10.1.0.0.0

- 2) Using Enterprise Manager, navigate to the **DATA** disk group page.
 - a) Connect to Enterprise Manager Database Control as user SYS using the URL that was given during the previous lab. For example:
https://edrsr12p1.us.oracle.com:1158/em/
 - b) Click the **+ASM** link on the main Database page.
 - c) On the ASM home page, click the **Disk Groups** tab.
 - d) On the Automatic Storage Management Login page, enter **sys** in the Username field and **oracle_4U** in the Password field, and select **SYSASM** from the Connect As drop-down list. Select the **Save as Preferred Credentials** check box. Then click **Login**.
 - e) On the Disk Groups page, click the **DATA** link in the table.
- 3) Using Enterprise Manager Database Control, change the Database compatibility attribute of the **DATA** disk group. Set it to **11.2.0.0.0**.
 - a) On the Disk Group: DATA General subpage, click **Edit** in the Advanced Attributes section.
 - b) On the Edit Advanced Attributes for Disk Group: DATA page, enter **11.2.0.0.0** for the Database Compatibility. Then click **OK**.

Practice 5-1: ASM Fast Mirror Resync (continued)

- c) Navigate back to the **Disk Group: DATA General** subpage. Make sure that you see that the Database Compatibility field was updated. You should also see that disks are around 40% full.
 - d) Attempt to change the Database Compatibility back to version **10.1.0.0.0**. What do you observe?
- 4) Use SQL*Plus to verify that the previous update was done correctly:
- a) From a terminal window, connected as the user `oracle`, launch SQL*Plus and look at `V$ASM_DISKGROUP`:

```
$ . oraenv
ORACLE_SID = [orcl] ? +ASM
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid is
/u01/app/oracle
$ sqlplus / as sysasm
SQL> select name,compatibility,database_compatibility from
v$asm_diskgroup;
```

NAME	COMPATIBILITY	DATABASE_COMPATIBILITY
-----	-----	-----
DATA	11.2.0.0.0	11.2.0.0.0
FRA	11.2.0.0.0	10.1.0.0.0

- b) Exit SQL*Plus when finished.
- 5) Execute the `lab_05_01_05.sh` script from the `labs` directory to set up the environment for this practice. The script creates a new tablespace called `TBSJMW` in the `DATA` disk group using a 50 MB file. It then creates a new table called `SYSTEM.JMW` residing in this new tablespace. The script then inserts some rows in the newly created table.

```
$ cd ~/labs
$ ./lab_05_01_05.sh
ORACLE_SID = [oracle] ? The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle

SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 29 04:43:05
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options
```

Practice 5-1: ASM Fast Mirror Resync (continued)

```
SQL> SQL> SQL> SQL>
Tablespace created.

SQL> SQL> drop table jmw purge
      *
ERROR at line 1:
ORA-00942: table or view does not exist

SQL> SQL>
Table created.

SQL> SQL>
1 row created.

SQL> SQL>
Commit complete.

SQL> SQL> 2 3 4 5 6 7
PL/SQL procedure successfully completed.

SQL> SQL> Disconnected from Oracle Database 11g Enterprise
Edition Release 11.2.0.1.0 - Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options
$
```

- 6) Offline the second disk that is part of the DATA disk group making sure that the Disk Repair Time attribute is set to 0:
 - a) Navigate back to the **Disk Group: DATA General** page. Select the second disk (**ASMDISK02**), and click **Offline**.
 - b) On the Confirmation page, change the Disk Repair Time from its default (**3.6 hours**) to **0.0** and click **Show SQL**.

```
ALTER DISKGROUP DATA OFFLINE DISK ASMDISK02 DROP AFTER 0.0 h
```

- c) Click **Return**.
 - d) Navigate back to the Confirmation page. Click **Yes**.
- 7) What do you observe?
 - a) Navigate back to the **Disk Group: DATA General** page. You can see that ASMDISK02 is now offlined. Refresh your browser page until you no longer see the offlined disk. It will be renamed to something similar to this:
DROPPED_0000_DATA
The Pending Operations will show 1 as the disk is being dropped. Click the 1 to view the progress of the rebalance operation.

Practice 5-1: ASM Fast Mirror Resync (continued)

- b) Navigate back to the **Disk Group: DATA General** page. You should now see that all three of the remaining disks are around 54% full. This forced the lost mirrored extents to be rebalanced across surviving disks.
- 8) Modify some rows in the **SYSTEM.JMW** table (delete 499 rows). Is it working?
 - a) You can still modify the JMW table:

```
$ . oraenv
ORACLE_SID = [+ASM] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus system
Enter password: oracle_4U

SQL> delete from system.jmw where rownum<500;

499 rows deleted.

SQL> commit;
```

- 9) Add the dropped ASM disk back to the DATA disk group:
 - a) You now need to wipe out the dropped disk before you can add it back. You must be root to do this:

```
# oracleasm listdisks
# oracleasm deletedisk ASMDISK02
# oracleasm createdisk ASMDISK02 /dev/xvdc
```

- b) Navigate back to the **Disk Group: DATA General** page. Click **Add**.
- c) On the Add Disks page, select **ORCL:ASMDISK02** from the Candidate Member Disks table. Set REBALANCE POWER to **11**.
- d) Click Show SQL.

```
ALTER DISKGROUP DATA ADD DISK 'ORCL:ASMDISK02' SIZE 2304 M
REBALANCE POWER 11
```

- e) Click **Return**.
 - f) On the Add Disks page, click **OK**.
- 10) What do you observe?
 - a) Navigate back to the **Disk Group: DATA General** page. Click the **Pending Operations 1** link to monitor the rebalancing operation.
 - b) You can see that a rebalance operation is going on for a while.
 - c) Allow the rebalance to complete. This may take several minutes.

Practice 5-1: ASM Fast Mirror Resync (continued)

- 11) Take the second disk, which is part of the DATA disk group, offline, making sure that the Disk Repair Time attribute is set to its default value of **3.6** hours. Modify the **SYSTEM.JMW** table again (delete another batch of 499 rows). What are your observations?
- a) Navigate back to the **Disk Group: DATA General** page. Select the second disk (**ASMDISK02**), and click **Offline**.
 - b) On the Confirmation page, leave the default value of **3.6 Hours** in the Disk Repair Time field, and click **Yes**.
 - c) Navigate back to the **Disk Group: DATA General** page. You can see that **ASMDISK02** is not empty. Even if you refresh your browser page, no rebalance is taking place.
 - d) You can still modify the **SYSTEM.JMW** table.

```
$ . oraenv
ORACLE_SID = [+ASM] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus system
Enter password: oracle_4U

SQL> delete from system.jmw where rownum<500;

SQL> commit;
```

- 12) Now, how would you add the offlined disk back into the DATA disk group? It is not necessary to wipe out the dropped disk.
- a) Navigate back to the **Disk Group: DATA General** page. Select the offline disk and click **Online**.
 - b) On the Confirmation page, click **Yes**.
 - c) Navigate back to the **Disk Group: DATA General** page. You should see the disk back to its level (around 41% full), without the need of any rebalance operation. The disk is added back immediately.

Practice 5-2: Using ASMCMD

In this practice, you use ASMCMD commands to manage diskgroups.

- 1) Start ASMCMD and view the contents of the **+DATA** diskgroup. Get a listing of the **DATAFILE** directory.

```
$ . oraenv
ORACLE_SID = [orcl] ? +ASM
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid is
/u01/app/oracle
$ asmcmd
ASMCMD> ls +DATA/*

+DATA/ASM/:
ASMPARAMETERFILE/

+DATA/ORCL/:
CONTROLFILE/
DATAFILE/
ONLINELOG/
PARAMETERFILE/
TEMPFILE/
Spfileorcl.ora

ASMCMD> ls +DATA/ORCL/DATAFILE
EXAMPLE.260.630800437
SYSAUX.257.628766309
SYSTEM.256.628766309
TBSJMW.269.628767357
UNDOTBS1.258.628766309
USERS.259.628766309
```

- 2) Using ASMCMD, generate a list of all the commands that are allowed with the **help** command.

```
ASMCMD> help
```

- 3) Navigate to the **CONTROLFILE** directory of the **ORCL** database in the **DATA** disk group and use ASMCMD to copy the current control file to the **/tmp** directory. Use the **help cp** command for syntax guidance.

```
ASMCMD> cd +DATA/ORCL/CONTROLFILE
ASMCMD> ls
Current.260.692183799
ASMCMD> help cp
ASMCMD> cp Current.260.692183799 /tmp
copying +DATA/ORCL/CONTROLFILE/Current.260.692183799 ->
/tmp/Current.260.692183799
```

Practice 5-2: Using ASMCMD (continued)

- 4) Attempt to remove the current control file. Use the **help rm** command for guidance on syntax.

Note: It is important that the ORCL database instance is currently running and the **DATA** disk group is mounted.

```
ASMCMD> help rm
ASMCMD> rm Current.260.692183799
ORA-15032: not all alterations performed
ORA-15028: ASM file
'+DATA/ORCL/CONTROLFILE/Current.260.692183799' not dropped;
currently being accessed (DBD ERROR: OCISmtExecute)
```

- 5) Determine the syntax for the **lsdg** command, and generate a list of all disk groups.

```
ASMCMD> help lsdg
ASMCMD> lsdg
State      Type      Rebal  Sector  Block      AU  Total_MB
Free_MB    Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED    NORMAL    N           512     4096  1048576      13824
10269              600           4834              0
N  DATA/
MOUNTED    EXTERN    N           512     4096  1048576      9216
8982              0           8982              0
N  FRA/
```

- 6) Determine the syntax for the **mkdgm** command, and create a new disk group named **DATA2** of type **external** redundancy, using two disks: **ORCL:ASMDISK11** and **ORCL:ASMDISK12**. Verify the disk group created successfully.

```
ASMCMD> help mkdgm
ASMCMD> mkdgm <dg name="DATA2" redundancy="external"> <dsk
string="ORCL:ASMDISK11" /> <dsk string="ORCL:ASMDISK12" />
</dg>
ASMCMD> lsdg
State      Type      Rebal  Sector  Block      AU  Total_MB
Free_MB    Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED    NORMAL    N           512     4096  1048576      13824
10269              600           4834              0
N  DATA/
MOUNTED    EXTERN    N           512     4096  1048576      4608
4556              0           4556              0
N  DATA2/
MOUNTED    EXTERN    N           512     4096  1048576      9216
8982              0           8982              0
N  FRA/
```

Practice 5-2: Using ASMCMD (continued)

- 7) Determine the syntax for the **dropdg** command, and drop the **DATA2** disk group created in the last step. Verify the result.

```
ASMCMD> help dropdg
ASMCMD> dropdg DATA2
ASMCMD> lsdg
```

State	Type	Rebal	Sector	Block	AU	Total_MB
Free_MB	Req_mir_free_MB		Usable_file_MB		Offline_disks	
Voting_files	Name					
MOUNTED	NORMAL	N	512	4096	1048576	13824
10269		600		4834		0
N DATA/						
MOUNTED	EXTERN	N	512	4096	1048576	9216
8982		0		8982		0
N FRA/						

Practices for Lesson 6

Background: In this practice you configure connectivity between your machine and a database on one of your classmate's machines. You also configure and test an additional listener. This practice is entirely for educational purposes and no future practices rely on successful completion of this practice.

Practice 6-1: Configuring the Oracle Network to Access Another Database

Configure your network environment so that you can connect to a partner's `orcl` database. Use local naming and create a new network service name called `testorcl` that maps to your partner's `orcl` database. Test your network changes by attempting to connect to your partner's database using the `testorcl` service name.

- 1) Make a copy of your `tnsnames.ora` file. It is in your database `$ORACLE_HOME/network/admin` directory.
 - a) In a terminal window use `oraenv` to set your environment to your database home.

```
$ . oraenv
ORACLE_SID = [orcl] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

- b) Enter `cd $ORACLE_HOME/network/admin` to navigate to the `/u01/app/oracle/product/11.1.0/db_1/network/admin` directory.
 - c) Enter `cp tsnames.ora tsnames.old` to create a copy of the `tnsnames.ora` file.
 - d) Enter `ls -l`, if you want to see the copy and its 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 **SYS** 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**.
 - b) The Netservices Administration: Host Login page appears. If you previously saved the `oracle` username and `oracle` password as preferred credentials for your host login, 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.

Practice 6-1: Configuring the Oracle Network to Access Another Database (continued)

- e) Select **Use Service Name**, and enter **orcl.example.com** as Service Name.

Note: You can also choose to enter a SID by selecting the Use SID option. In this case, you must enter **orcl**.

- f) Select **Database Default**.

The screenshot shows the 'Create Net Service Name' dialog box with the 'Advanced' tab selected. The 'Net Service Name' is 'testorcl'. Under 'Database Information', 'Use Service Name' is selected with 'Service Name' as 'orcl.example.com'. 'Use SID' is unselected. Under 'Choose if you want a shared or dedicated server database connection.', 'Database Default' is selected. The 'Cancel' and 'OK' buttons are in the top right.

- g) Click **Add** in the **Addresses** region.

- h) On the Add Address page, specify the following values:

Option	Value
Protocol	TCP/IP
Port	1521
Host	<Your partner's host name or IP address—for example, edrsr25p1.us.oracle.com or 139.185.35.125 >

The screenshot shows the 'Add Address' dialog box. 'Protocol' is set to 'TCP/IP'. 'Port' is '1521'. 'Host' is 'edrsr25p1.us.oracle.com'. The 'Advanced Parameters' section is visible but empty. The 'Cancel' and 'OK' buttons are in the top right.

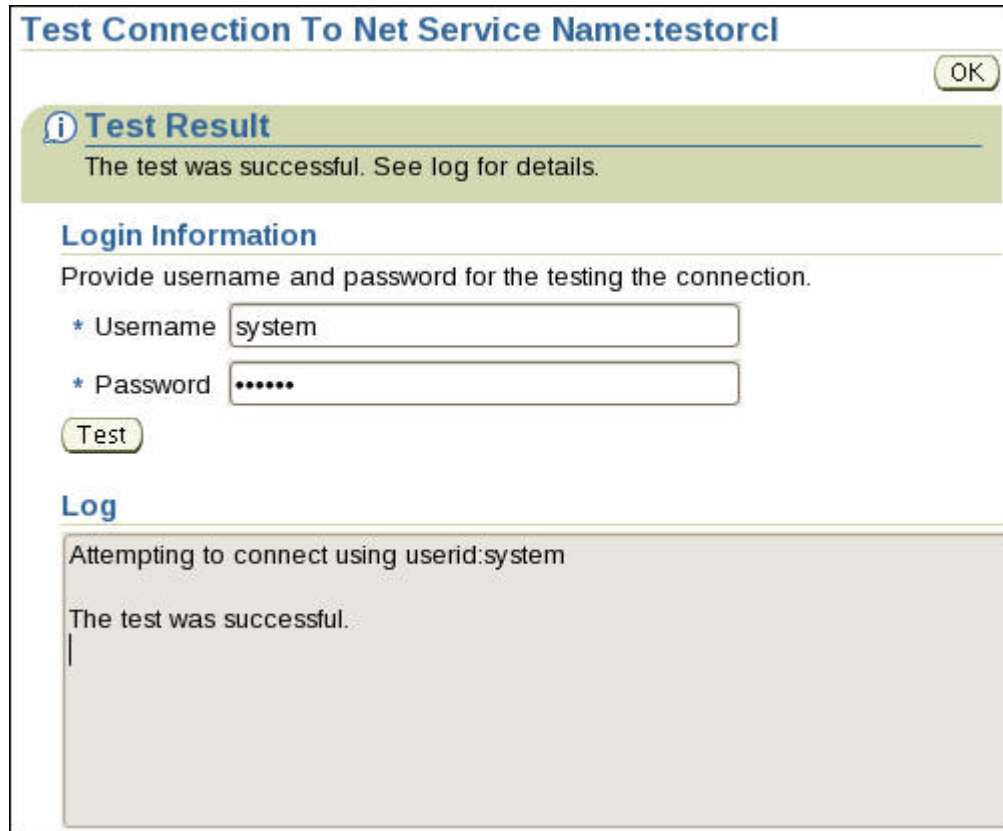
- i) Click **OK** to return to the Create Net Service Name properties page.

- j) Click **OK**.

The Creation Message appears: Net Service “testorcl” created successfully.

Practice 6-1: Configuring the Oracle Network to Access Another Database (continued)

- 4) In Enterprise Manager, test access to your partner's `orcl` database as the **system** user with the `oracle_4U` password by using the **testorcl** Local Naming.
- a) Select **testorcl** on the Local Naming page, and then click **Test Connection**.
- The message "Test Connection To Net Service Name: testorcl" appears.
- b) Enter **system** as Username and `oracle_4U` as Password, and then click **Test**.
- The Processing page displays status information. It is followed by a success message. *If you receive any errors or warnings, resolve them.*



Click **OK** after the test is completed.

- 5) Test your changes to the network configuration using SQL*Plus. Enter **system@testorcl** and then enter `oracle_4U` when prompted for the password. To see your partner's information, select the `instance_name` and `host_name` columns from the `v$instance` table.
- a) Ensure your environment is set for the `orcl` database by running `oraenv`.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

Practice 6-1: Configuring the Oracle Network to Access Another Database (continued)

b) In a terminal window, enter:

```
$ sqlplus system@testorcl

SQL*Plus: Release 11.2.0.1.0 Production on Fri Jul 10 11:07:11
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL>
```

The Oracle SQL*Plus window opens. *If you receive any errors or warnings, resolve them.*

c) At the SQL> prompt, enter the following command:

```
SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
-----
HOST_NAME
-----
orcl
edrsr25p1.us.oracle.com
```

Practice 6-2: Creating an Alternate Listener

In this practice, you create a second listener, called `LISTENER2`, using Enterprise Manager.

- 1) Create a new listener called `LISTENER2`. Use port 1561 for this listener.
 - a) Log in to Enterprise Manager as the **SYS** user in the **SYSDBA** role. On the Database Instance – Home page, click the **Listener** link in the **General** region.
 - b) In the **Related Links** region, click **Net Services Administration**.
 - c) 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**.
 - d) On the Listeners page, which gives you an overview of the existing listeners, click the **Create** button.
The Create Listener page appears.
 - e) Enter **LISTENER2** as Listener Name, and then click **Add** to add a listener address.
 - f) Enter or confirm the following values:

Option	Value
Protocol	TCP/IP
Port	1561
Host	<Your computer's host name—for example, edrsr12p1.us.oracle.com

- g) Click **OK**.
- h) Click the **Static Database Registration** tab.

Create Listener [Cancel] [OK]

General | [Authentication](#) | [Logging & Tracing](#) | **[Static Database Registration](#)** | [Other Services](#)

* Listener Name: LISTENER2

Addresses
Listener must have at least one address. If address is changed, listener will be stopped before applying changes. [Add]

[Edit] [Remove]

Select	Protocol	Protocol Details
<input checked="" type="checkbox"/>	TCP/IP	Host: edrsr12p1.us.oracle.com Port: 1561

- i) Click the **Add** button to connect the new listener with your `orcl` database.
- j) Enter the following values:

Option	Value
Service Name	orcl
Oracle Home Directory	/u01/app/oracle/product/11.2.0/dbhome_1
Oracle System Identifier	orcl

Practice 6-2: Creating an Alternate Listener (continued)

Option	Value
(SID)	

Add Database ServiceCancelOK

Service Name

orcl

Oracle Home Directory

/u01/app/oracle/product/11.1.0/db_1

Oracle System Identifier (SID)

orcl

- k) Click **OK** to add the database service.
- l) Click **OK** to create the LISTENER2 listener.

Creation Message

Listener "LISTENER2" created successfully.

Listeners: /u01/app/oracle/product/11.1.0/db_1/network/admin

A listener process is identified by the listening end-points ('Host' and 'Port'), along with the other parameters like, logging and tracing levels, log/trace directories etc. All these parameters are defined in the 'Listener Parameter File' (listener.ora). This page shows the status of a listener as 'Started' only when the listener is running, and has been started using the 'Listener Parameter File' at the same location as shown above.

Listener Name Go

Create

Edit Delete Actions Start/Stop Go

Select	Name	Protocol Details	Status	Enterprise Manager Target
	LISTENER2	Protocol TCP/IP Host edrsr12p1.us.oracle.com Port 1561	Stopped	Not a target

Practice 6-2: Creating an Alternate Listener (continued)

- 2) 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.
- 3) Check the status of the new listener and test the new listener.
 - a) Ensure your environment is set for the **orcl** database by running **oraenv**.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

- b) Issue the following commands at the command prompt

```
$ lsnrctl status LISTENER2
```

- c) Connect to your database using the new listener using an easy connect string.
Note: This method of connecting is not a recommended approach for a production environment; it is being used in this simple classroom environment just to prove the newly created listener works.

```
$ sqlplus hr/oracle_4U@your_ip_address:1561/orcl
```

Your connection is through your newly created listener. Exit SQL*Plus after you complete this step.

- 4) You can now stop this new LISTENER2 because you do not need it for the remainder of the course.

```
$ lsnrctl stop LISTENER2
```

Practices for Lesson 7

Background: You need to view existing storage structure information and create a new tablespace for the INVENTORY application. You also need to create a database user to perform all administrative tasks without using the SYS and SYSTEM accounts.

Note: Because the creation of users has not been covered, a script is provided for this practice.

Practice 7-1: Viewing Database Storage Structure Information

In this practice, you examine existing storage structure information for your database. Before you begin, you run a script that creates a new user DBA1 that will be used for your DBA tasks from now on. You must configure this user in Enterprise Manager to be one of the Administrators.

- 1) Run the `lab_07_01_01.sh` script that creates a directory that will be used later and the DBA1 user. It is located at `/home/oracle/labs`. The password for DBA1 is `oracle_4U`.
 - a) If you do not have a terminal window open from previous practices, open one now by right-clicking on your desktop and selecting **Open Terminal**.
 - b) Ensure your environment variables are set appropriately so that you can connect to your `orcl` database.

```
$ . oraenv
ORACLE_SID = [orcl] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
```

- c) Change the current directory to the `labs` directory by entering:

```
$ cd labs
```

- d) Enter the following command to run the script that creates the DBA1 user:

```
$ ./lab_07_01_01.sh
```

- e) Leave the terminal 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** and then on the Setup page select **Administrators**.



- 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.

Practice 7-1: Viewing Database Storage Structure Information (continued)

Administrators

Administrators are database users who can login to Enterprise Manager to perform management tasks like set Blackouts, email notification schedules. Page Refreshed Jul 8, 2009 11:38:17 AM GMT+07:00 [Refresh](#)

Search [Go](#)

[View](#) [Edit](#) [Subscribe to Rules](#) [Delete](#) [Create](#)

Select Name	Access
<input checked="" type="radio"/> SYS	Super Administrator
<input type="radio"/> SYSMAN	Repository Owner
<input type="radio"/> <u>SYSTEM</u>	Super Administrator

- c) Enter **dba1** as Name and leave Email Address blank. Select **Super Administrator** for the Administrator Privilege and then click **Review**.

Create Administrator: Properties [Cancel](#) [Review](#)

* Name

E-mail Address

Specify one or more e-mail addresses separated by a comma or space. If you are entering these for the first time, they will be used to create a default 24x7 notification schedule for this Administrator.

Administrator Privilege

☒ Grant SELECT_CATALOG_ROLE

- d) On the Create Administrator dba1: Review page, click **Finish**.
- 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_4U** as Password, and select **SYSDBA** as Connect As. Then click **Login**.

The Database Home page appears.

- 3) Using Enterprise Manager, view information about the **EXAMPLE** tablespace. Answer the following questions about it:
- a) *Question 1:* What percentage of free space can be used up before the Warning threshold is reached?
- i) In Enterprise Manager, select **Server** > Storage > **Tablespaces**.
- ii) Click the **EXAMPLE** tablespace name.

Answer: 85%

Tablespace Full Metric Thresholds

Space Used (%)

This tablespace is using the database default space used thresholds.

Warning (%)	85
Critical (%)	97

- b) *Question 2:* How many segments are there in the **EXAMPLE** tablespace?
- i) From the **Actions** drop-down list, select **Show Tablespace Contents**, and then click **Go**.

Practice 7-1: Viewing Database Storage Structure Information (continued)

ii) The Show Tablespace Contents page appears.

Answer: 420 (Your answer may vary.)

Segments

Search

Segment Name Type Minimum Size (KB) Minimum Extents

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.

Previous 1-10 of 420 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS	TABLE	12,288	27
PM.SYS_LOB0000073976C00034\$\$	LOBSEGMENT	5,120	20
SH.SUPPLEMENTARY_DEMOGRAPHICS	TABLE	4,096	19
PM.SYS_LOB0000073976C00054\$\$	LOBSEGMENT	4,096	19
OE.PRODUCT_DESCRIPTIONS	TABLE	3,072	18
SH.SALES.SALES_Q4_2001	TABLE PARTITION	2,048	17
SH.SALES.SALES_Q1_1999	TABLE PARTITION	1,024	16
SH.SALES.SALES_Q3_2001	TABLE PARTITION	1,024	16
SH.CUSTOMERS_PK	INDEX	1,024	16
SH.SALES.SALES_Q3_1999	TABLE PARTITION	960	15

Previous 1-10 of 420 Next 10

c) Question 3: Which index in the EXAMPLE tablespace takes up the most space?

- Select INDEX from the **Type** drop-down list in the Search region, and then click **Go**.
- Notice the Size column is the sort column and that it is sorted in descending order.

Segments

Search

Segment Name Type Minimum Size (KB) Minimum Extents

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.

Previous 1-10 of 78 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS_PK	INDEX	1,024	16
OE.PROD_NAME_IX	INDEX	512	8
OE.PR_DDESC_PK	INDEX	320	5
SH.CUSTOMERS_YOB_BIX	INDEX	192	3
SH.TIMES_PK	INDEX	128	2

Answer: SH.CUSTOMERS_PK

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

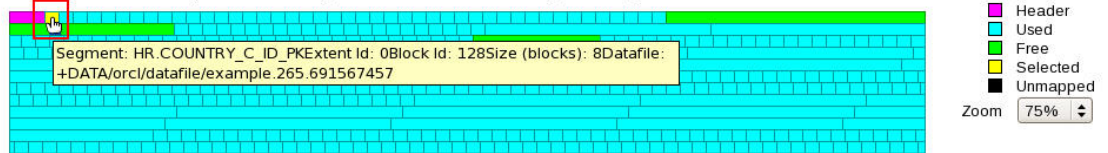
- Scroll to the bottom of the page, and then click the plus icon to the left of the Extent Map label.

Practice 7-1: Viewing Database Storage Structure Information (continued)

- ii) After several seconds, the extent map appears. Note that the map legend indicates that pink is the tablespace header.
- iii) Scroll back to the top of the page, select **All Types** from the **Type** drop-down list, and then click **Go**.
- iv) Click the extent just to the right of the tablespace header extent (the extent will turn yellow to show that it is selected). Notice that if you move the cursor over the segment, it tells you the name of the segment stored in that location.

Extent Map

Clicking the Highlight Extents button for a segment in the table will cause all extents that belong to that segment to be highlighted in the Extent Map. Clicking on a used extent in the Extent Map will select the segment to which that extent belongs in the segment table.



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

Previous 10 121-130 of 420 Next 10				
Highlight Extents	Segment Name	Type	Size (KB) ▾	Extents
<input type="radio"/>	SH.COSTS.COSTS_Q1_2003	TABLE PARTITION	64	1
<input type="radio"/>	SH.COSTS.COSTS_Q2_2003	TABLE PARTITION	64	1
<input type="radio"/>	SH.COSTS.COSTS_Q3_2003	TABLE PARTITION	64	1
<input type="radio"/>	SH.COSTS.COSTS_Q4_2003	TABLE PARTITION	64	1
<input type="radio"/>	HR.REG_ID_PK	INDEX	64	1
<input checked="" type="radio"/>	HR.COUNTRY_C_ID_PK	INDEX	64	1
<input type="radio"/>	HR.LOC_ID_PK	INDEX	64	1
<input type="radio"/>	HR.LOC_CITY_IX	INDEX	64	1
<input type="radio"/>	HR.LOC_STATE_PROVINCE_IX	INDEX	64	1
<input type="radio"/>	HR.LOC_COUNTRY_IX	INDEX	64	1
Previous 10 121-130 of 420 Next 10				

Answer: HR.COUNTRY_C_ID_PK

Practice 7-2: Creating a Tablespace

In this practice, you create the Inventory tablespace that will be used in a later practice.

- 1) Create a new, locally managed tablespace (LMT) called **INVENTORY** of size **5 MB**.
 - a) In Enterprise Manager, select **Server**> Storage > **Tablespaces**.
 - b) Click **Create**.
 - c) Enter **INVENTORY** as the tablespace name, and verify that Extent Management is **Locally Managed**, Type is **Permanent**, Status is **Read Write**, and Use bigfile tablespace is **not** selected.
 - d) Click **Add** in the Datafiles region.
 - e) On the Add Datafile page, select **Automatic Storage Management** for Storage Type, ensure that **DATA** is selected for DiskGroup, and enter **5 MB** as File Size. Then click **Continue**.

Add Datafile Cancel Continue

Storage Type: Automatic Storage Management

* DiskGroup: DATA

Template: <Default>

Alias Directory:

Alias Name:

Tablespace: **INVENTORY**

File Size: 5 MB

☐ Reuse Existing File

Storage

☐ Automatically extend datafile when full (AUTOEXTEND)

Increment: KB

Maximum File Size: ☒ Unlimited ☐ Value MB

- f) Click the **Storage** tab, and verify that Extent Allocation is **Automatic**, Segment Space Management is **Automatic**, Compression Options is **Disabled**, and Logging is set to **Yes**.

Practice 7-2: Creating a Tablespace (continued)

- g) Click the **General** tab and review your settings.

Create Tablespace

Information
Modification to the datafile will not take effect until you click "OK" button.

General Storage

* Name

Extent Management
☒ Locally Managed
☐ Dictionary Managed

Type
☒ Permanent
☐ Set as default permanent tablespace
☐ Encryption
☐ Temporary
☐ Set as default temporary tablespace
☐ Undo
Undo Retention Guarantee ☐ Yes ☒ No

Status
☒ Read Write
☐ Read Only
☐ Offline

Datafiles
☐ Use bigfile tablespace
Tablespace can have only one datafile with no practical size limit.

Select Name	Directory	Size (MB)
<input checked="" type="radio"/> <ASM Generated>	+DATA/	5.00

- h) Click **Show SQL** to see the SQL that will be run, and then click **Return**
- i) Click **OK**, and a successful Update Message appears.
- 2) As the **DBA1** user, run the **lab_07_02_02.sql** script to create and populate a table (called X) in the INVENTORY tablespace. What error do you eventually see?
- a) In a terminal window, navigate to the labs directory. Remember to use `oraenv` to set your environment for the `orcl` database if you have not done so already.

```
$ cd labs
```

- b) Log in to SQL*Plus as the **dba1** user (with a password of **oracle_4U**) and run the **lab_07_02_02.sql** script.

Note: Remember to use `oraenv` to set your environment to the `orcl` database, if you have not already done so in your terminal window.

```
$ sqlplus dba1
```

```
SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 8 12:06:50  
2009
```


Practice 7-2: Creating a Tablespace (continued)

```
Copyright (c) 1982, 2009, Oracle. All rights reserved.

Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL> @lab_07_02_02.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 the rows to be inserted.

```
...
SQL> insert into x select * from x
2 /

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.

SQL> quit
Disconnected from Oracle Database 11g Enterprise Edition
Release 11.1.0.6.0 - Production
With the Partitioning, OLAP, Data Mining and Real Application
Testing options
```

- 3) Go to the Enterprise Manager window and increase the amount of space available for the **INVENTORY** tablespace. For educational purposes, you will accomplish this using two different methods. First, increase the size of the current datafile to **40 MB**. Then, to show that both ASM and non-ASM datafiles can exist for the same tablespace, add a second datafile using file system storage. This second datafile should be **30 MB** in size. For both techniques use the show SQL functionality to view the supporting SQL statements.
- a) Select **Server> Storage > Tablespaces**.
 - b) Select the **INVENTORY** tablespace, and then click **Edit**.

Practice 7-2: Creating a Tablespace (continued)

- c) In the Datafiles region, click **Edit**.
- d) Change File Size from 5 MB to **40 MB**.
- e) Click **Continue** to return to the General tabbed page.
- f) Click **Show SQL** to see the SQL that will be run. Note that it is an ALTER DATABASE statement. Click **Return**.

[Show SQL](#)

Return

```
ALTER DATABASE DATAFILE '+DATA/orcl/datafile/inventory.268.693647553' RESIZE 40M
```

- g) In the Datafiles region, click **Add**.
- h) Select **File System** for the Storage Type. Enter **inventory02.dbf** for the File Name. Enter **/u01/app/oracle/oradata/orcl** for the File Directory. Enter **30 MB** for the File Size.
Note: This directory was created by the script you ran earlier.
- i) Click **Continue** to return to the General tabbed page.
- j) Click **Show SQL** to see the SQL that will be run. Note that it is an ALTER DATABASE statement. Click **Return**.

[Show SQL](#)

Return

```
ALTER TABLESPACE "INVENTORY" ADD DATAFILE '/u01/app/oracle/oradata/orcl/inventory02.dbf' SIZE 30M
```

- k) Click **Apply**.
- l) Notice now that there are now two datafiles for the INVENTORY tablespace, one that is using ASM storage and the other using file system (non-ASM) storage.

Datafiles					Add	
Edit Remove						
Select	Name	Directory	Size (MB)	Used (MB)		
<input checked="" type="radio"/>	inventory02.dbf	/u01/app/oracle/oradata/orcl/	30.00	<div></div>	-34.00	
<input type="radio"/>	inventory.268.693647553	+DATA/orcl/datafile/	40.00	<div></div>	-24.00	

- 4) Go back to the terminal window and run the **lab_07_02_04.sql** script. It drops the table and re-executes the original script that previously returned the space error.
 - a) Go to the terminal window.
 - b) Log in to SQL*Plus as the **dba1** user (with a password of **oracle_4U**) and run the **lab_07_02_04.sql** script.
Note: Remember to use **oraenv** to set your environment to the **orcl** database if you have not already done so in your terminal window.

```
$ sqlplus dba1

SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 8 12:06:50
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.
```


Practice 7-2: Creating a Tablespace (continued)

```
Enter password:
```

```
Connected to:
```

```
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -  
Production
```

```
With the Partitioning, Automatic Storage Management, OLAP,  
Data Mining  
and Real Application Testing options
```

```
SQL> @lab_07_02_04.sql
```

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

- 5) In a terminal window, run the **lab_07_02_05.sql** script in SQL*Plus as the **dba1** user to clean up the tablespace for later practice sessions.

Note: Remember to use `oraenv` to set your environment to the `orcl` database, if you have not already done so in your terminal window.

```
$ sqlplus dba1
```

```
SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 8 12:06:50  
2009
```

```
Copyright (c) 1982, 2009, Oracle. All rights reserved.
```

```
Enter password:
```

```
Connected to:
```

```
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -  
Production
```

```
With the Partitioning, Automatic Storage Management, OLAP,  
Data Mining  
and Real Application Testing options
```

```
SQL> @lab_07_02_05.sql
```

Practices for Lesson 8

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 must be able to log in to the `orcl` database and to 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 are automatically logged out after 15 minutes. You also need to create a new user account for the inventory application that you are installing.

Practice 8-1: Creating and Using a Profile

In this practice, you create the INVENTORY user to own the new Inventory application. You create a profile to limit the idle time of users. If a user is idle or forgets to log out after 15 minutes, the user session is ended.

- 1) **Mandatory task:** Review and run the `lab_08_01_01.sh` script (located in the `/home/oracle/labs` directory) to create the **INVENTORY** user (with a password of **oracle_4U**), which you will use in the next practice.

a) In a terminal window enter:

```
$ cd $HOME/labs
$ cat lab_08_01_01.sh
# Oracle Database 11g: Administration Workshop I
# Oracle Server Technologies - Curriculum Development
#
# ***Training purposes only***
#***Not appropriate for production use***
#
# Start this script as OS user: oracle
#   This script creates the INVENTORY schema user
#   The DROP command fails the first time
#   you execute the script.
#   The error can be ignored.

cd ~/labs

. set_db.sh

sqlplus / as sysdba << EOF

drop user inventory cascade;

create user inventory identified by oracle_4U
default tablespace inventory;

grant connect, resource to inventory;

exit;
EOF
$ ./lab_08_01_01.sh

SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 8 13:00:36
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
```

Practice 8-1: Creating and Using a Profile (continued)

```
and Real Application Testing options

SQL> SQL> drop user inventory cascade
      *
ERROR at line 1:
ORA-01918: user 'INVENTORY' does not exist

SQL> SQL> 2
User created.

SQL> SQL>
Grant succeeded.

SQL> SQL> Disconnected from Oracle Database 11g Enterprise
Edition Release 11.2.0.1.0 - Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options
$
```

- 2) Create a profile named **HRPROFILE** that allows only 15 minutes idle time.
 - a) Invoke Enterprise Manager as the **DBA1** user in the **SYSDBA** role for your **orcl** database.
 - b) Click the **Server** tab, and then click **Profiles** in the Security section.
 - c) Click the **Create** button.
 - d) Enter **HRPROFILE** in the Name field.
 - e) Enter **15** in the Idle Time (Minutes) field.
 - 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 are enforced.
 - a) Click the **Server** tab, and then click **Initialization Parameters** in the Database Configuration section.
 - b) Enter **resource_limit** in the Name field, and then click **Go**.
 - c) Select **TRUE** from the Value drop-down list, and then click **Apply**.

Practice 8-2: Creating Roles

In this practice, you create the **HRCLERK** and **HRMANAGER** roles that will be used in the next practice.

- 1) Create the role named **HRCLERK** with **SELECT** and **UPDATE** permissions on the **HR.EMPLOYEES** table.
 - a) Click the **Server** tab and then click **Roles** in the Security section.
 - b) Click the **Create** button.
 - c) Enter **HRCLERK** in the Name field. This role is not authenticated.
 - d) Click **Object Privileges** tab.
 - 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.

Show SQL

Return

```
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.
- 2) Create the role named **HRMANAGER** with **INSERT** and **DELETE** permissions on the **HR.EMPLOYEES** table. Grant the **HRCLERK** role to the **HRMANAGER** role.
 - a) Click the **Server** tab, and then click **Roles** in the Security section.
 - b) Click **Create**.
 - c) Enter **HRMANAGER** in the Name field. This role is not authenticated.
 - d) Click **Object Privileges** tab.
 - 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 the **Roles** tab, and then click **Edit List**.
 - i) Move the **HRCLERK** role into the Selected Roles box, and then click **OK**.

Practice 8-2: Creating Roles (continued)

- j) Click the **Show SQL** button, and review your underlying SQL statement.

Show SQL

Return

```
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.

Practice 8-3: Creating and Configuring Users

In this practice, you create the following users and assign appropriate profiles and roles to these users:

Name	Username	Description
David Hamby	DHAMBY	A new HR Clerk
Rachel Pandya	RPANDYA	A new HR Clerk
Jenny Goodman	JGOODMAN	A new HR Manager

- 1) Create an account for David Hamby, a new HR clerk.
 - a) Click the **Server** tab, and then click **Users** in the Security section.
 - b) Click **Create**, and enter **DHAMBY** in the Name field.
 - c) Select **HRPROFILE** for the Profile.
 - d) Select Password Authentication, and enter **newuser** as password. Enter it into the **Confirm Password** field also. Select the **Expire Password now** check box so that David will have to change the password the first time he logs in.
 - e) Click the **Roles** tab. Notice that the **CONNECT** role has automatically been assigned to the user.
 - f) Add the **HRCLERK** role by clicking Edit List and moving the **HRCLERK** role into the Selected Roles box. Click **OK** to close the Modify Roles window.
 - g) Click **OK** again to create the user.
- 2) Create an account for Rachel Pandya, another new HR clerk. Repeat the steps shown above in step 1 but with **RPANDYA** as the username.
- 3) Create an account for Jenny Goodman, the new HR manager. Repeat the steps under step 1 but use **JGOODMAN** as the username and select the **HRMANAGER** role instead of the **HRCLERK** role.
 - a) Click the **Show SQL** button and review your underlying SQL statement.

[Show SQL](#)

Return

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

- b) Click **Return**, and then click **OK** to create the user.
- 4) Test the new users in SQL*Plus. Connect to the `orcl` database as the `DHAMBY` user. Use `oracle_4U` 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:

```
$ . oraenv
```

Practice 8-3: Creating and Configuring Users (continued)

```
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus dhamby
```

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
Enter password: newuser    <<<Password does not appear on screen
ERROR:
ORA-28001: the password has expired

Changing password for dhamby
New password: oracle_4U    <<<Password does not appear on screen
Retype new password: oracle_4U    <<<Password does not appear on screen
Password changed

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP, Data
Mining
and Real Application Testing 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
```

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
```

5) Repeat the test as the **JGOODMAN** user. Use **oracle_4U** as the new password. 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
Enter password:
ERROR:
ORA-28001: the password has expired
<Change the password to oracle_4U as shown above>
```


Practice 8-3: Creating and Configuring Users (continued)

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.

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

- 6) Use SQL*Plus to connect to the **orcl** database as the **RPANDYA** user. Change the password to **oracle_4U**. (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.

Practice 8-3: Creating and Configuring Users (continued)

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

Practices for Lesson 9

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.

Practice 9-1: Resolving Lock Conflicts

In this practice, you use two separate SQL*Plus sessions to cause a lock conflict. Using Enterprise Manager, you detect the cause of the lock conflict and then resolve the conflict. For your convenience, the SQL code that will cause the lock conflict has been provided in scripts that you run during this practice.

- 1) Make an uncommitted update to the row in question by running the **lab_09_01_01.sql** script. This script first creates the users (smavris and ngreenberg) that are involved in this practice and the hremmployee role that will give these new users access to the hr.employee table. It then logs in to SQL*Plus as the ngreenberg user and performs an update on the hr.employee table. The script does not perform a commit, leaving the update uncommitted in this session.

- a) Ensure your environment is configured for the orcl database by running oraenv.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

- b) 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

SQL*Plus: Release 11.2.0.1.0 Production on Thu Jul 9
03:57:42 2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL> @lab_09_01_01.sql
Creating users...

... ... Some output not shown here to conserve space ...

Connecting as ngreenberg ...
Connected.
SQL> show user
USER is "NGREENBERG"
```

Practice 9-1: Resolving Lock Conflicts (continued)

```
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>
```

- c) Leave this session connected in the state that it is currently. **Do not** exit at this time.
- 2) Make an attempt to update the same row in a separate session by running, in a separate terminal window, the **lab_09_01_02.sql** script. Make sure that you see the message “Update is being attempted now” before moving on. Do not worry if the session seems to “hang”—this is the condition that you are trying to create.
 - a) Open a terminal window to start another command shell, and enter the following to run the second script.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus dba1

SQL*Plus: Release 11.2.0.1.0 Production on Thu Jul 9
04:04:47 2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL> @lab_09_01_02.sql
Sleeping for 20 seconds to ensure first process gets the
lock first.

PL/SQL procedure successfully completed.

Sleep is finished.
Connected.
```

Practice 9-1: Resolving Lock Conflicts (continued)

USER is "SMAVRIS"
Update is being attempted now.

- b) Notice that this session appears to be hung. Leave this session as is and move on to the next step.
- 3) Using Enterprise Manager, click the **Blocking Sessions** link on the Performance page and detect which session is causing the locking conflict.
 - a) In Enterprise Manager, click the **Performance** page.
 - b) Click **Blocking Sessions** in the **Additional Monitoring Links** area. You should see the following:

Select	Username	Sessions Blocked	Session ID	Serial Number	SQL ID	Wait Class	Wait Event	P1 Value	P2 Value	P3 Value	Seconds in Wait
<input type="radio"/>	Blocking Sessions										
<input checked="" type="radio"/>	NGREENBERG	1	51	7460		Idle	SQL*Net message from client	1650815232	1	0	862
<input type="radio"/>	SMAVRIS	0	52	4319	6smgtv6h8958b	Application	enq: TX - row lock contention	1415053318	327697	778	383

- 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 for **Previous SQL**.

Session Details: 51 (NGREENBERG)
Collected From Target Jul 9, 2009 4:21:57 AM GMT+07:00
View Data: Real Time: 15 Second Refresh Refresh
Kill Session Enable SQL Trace

General Activity Statistics Open Cursors Blocking Tree Wait Event History Parallel SQL SQL Monitoring

Server Current Status INACTIVE Serial Number 7460 DB User Name NGREENBERG OS Process ID 7129 Login Time Jul 9, 2009 3:59:24 AM Login Duration 22:34 (mm:ss) Connection Type DEDICATED Type USER Resource Consumer Group Unavailable	Client OS User Name oracle OS Process ID 6962 Host edrsr12p1.us.oracle.com Terminal pts/2 Current Client ID Unavailable Current Client Info Unavailable	Application Current SQL None Current SQL Command UNKNOWN Previous SQL 6smgtv6h8958b Last Call Duration 22:34 (mm:ss) SQL Trace DISABLED Current SQL Trace Level 1 Trace With Wait Information DISABLED Trace With Bind Information DISABLED Open Cursors 35 Program sqlplus@edrsr12p1.us.oracle.com (TNS V1-V3) Service SYS\$USERS Current Module SQL*Plus Current Action Unavailable
--	--	--

- c) Note the SQL that was most recently run.

SQL Details: 6smgtv6h8958b

Switch to SQL ID Go
View Data: Real Time: Manual Refresh Refresh SQL Worksheet Schedule SQL Tuning Advisor SQL Repair Advisor

Text SQL

```
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?

Practice 9-1: Resolving Lock Conflicts (continued)

- a) Click the browser's **Back** button.
- b) Now, on the Session Details: NGREENBERG page, click **Kill Session**.
- c) Leave the Options set to **Kill Immediate**, and then click **Show SQL** to see the statement that is going to be executed to kill the session.

Note: Your session and serial number are most likely to be different from those shown here.

Show DDL

ALTER SYSTEM KILL SESSION '51,7460' IMMEDIATE

Return

- d) Click **Return**, and then click **Yes** to carry out the KILL SESSION command.
- 6) Return to the SQL*Plus command window, and note that SMAVRIS's update has now completed successfully. It may take a few seconds for the success message to appear.

```
USER is "SMAVRIS"
Update is being attempted now.

1 row updated.

Update is completed.
SQL>
```

- 7) Try issuing a SQL select statement in the NGREENBERG session. What do you see?

```
SQL> SELECT sysdate from dual;
SELECT sysdate from dual
      *
ERROR at line 1:
ORA-03135: connection lost contact
Process ID: 7129
Session ID: 51 Serial number: 7460

SQL>
```

Answer: The session has been disconnected.

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

Practices for Lesson 10

Background: The business users and management in your organization decide, that they need to have a 48-hour retention of undo in the Oracle database to support their flashback needs. Your task is to configure the `orcl` database to support this requirement.

Practice 10-1: Managing Undo Data

In this practice, you first view your system activity regarding undo, and then you configure the `orcl` database to support 48-hour retention for flashback operations.

- 1) In Enterprise Manager, as the **DBA1** user, view the undo related system activity.
 - a) Click the **Server** tabbed page and select **Automatic Undo Management** in the Database Configuration section.
 - b) Click the **System Activity** tabbed page.

Automatic Undo Management
In the General tab, you can view the current undo settings for your instance and use the Undo Advisor to analyze the undo tablespace requirements. This analysis can be performed based on the specified analysis period or the desired undo retention. The system activity for the specified time period can be viewed in the System Activity tab.

[General](#) [System Activity](#)

System Activity During Analysis Period

Selected Analysis Time Period	Jul 2, 2009 5:00:00 AM GMT+07:00 To Jul 9, 2009 5:00:00 AM GMT+07:00
Longest Running Query (minutes)	18.0
Average Undo Generation Rate (KB/minute)	75.0
Maximum Undo Generation Rate (KB/minute)	1,385.0
Queries failed due to low Retention	0
Transactions failed due to small Undo Tablespace	0

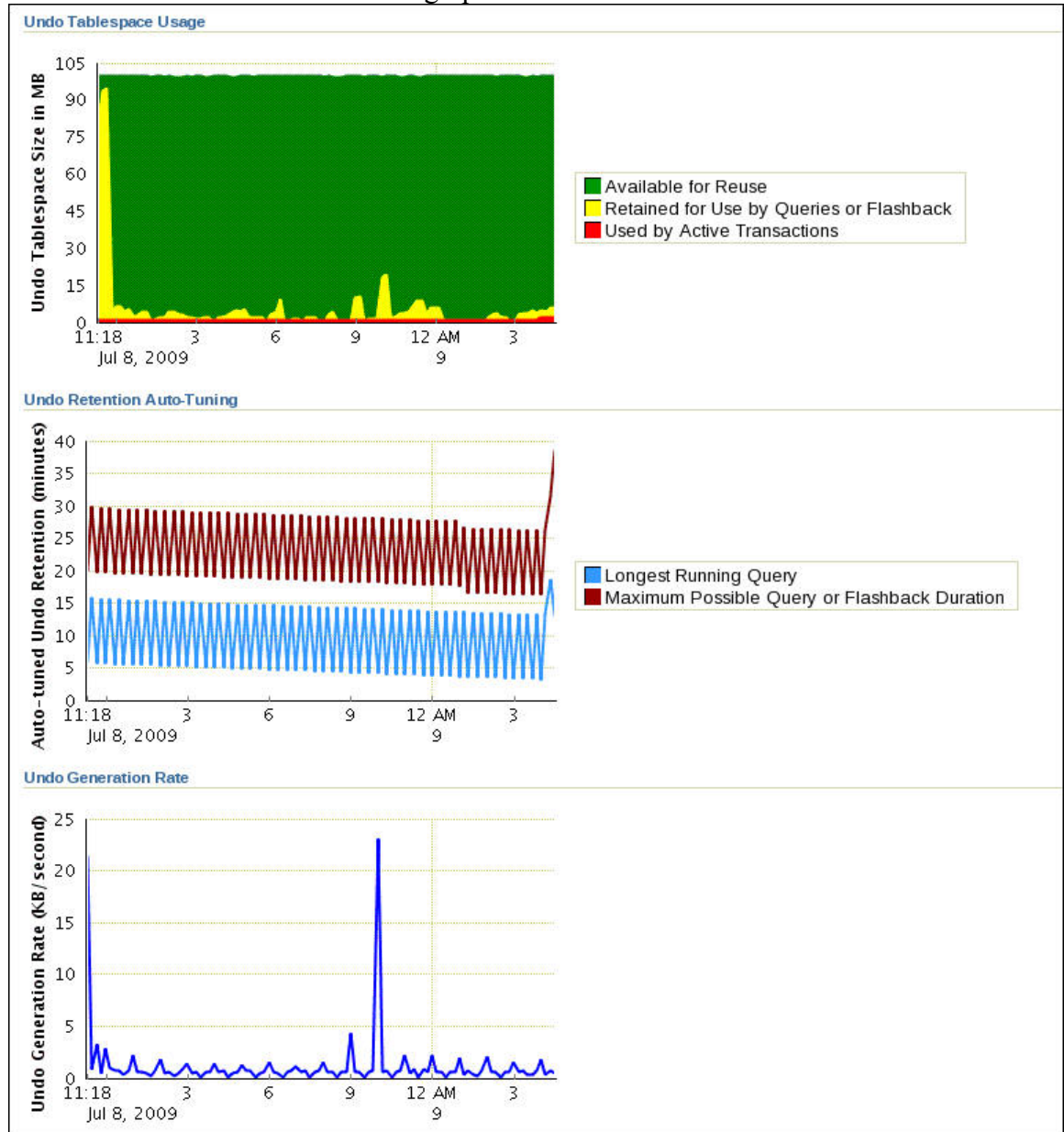
[Show Graph](#)

Note: Your information will look different on all analysis screenshots, based on your analysis period and the system activity during this period.

- c) *Question:* Looking at the preceding screenshot, how many errors did this system encounter?
Answer: None
- d) *Question:* Looking at the preceding screenshot, what is the duration of the longest running query?
Answer: 18 minutes (Your answer may be different.)

Practice 10-1: Managing Undo Data (continued)

- e) Click the Plus icon to show related graphs.



- f) *Question:* How many graphs are displayed?

Answer: Three. (Undo Tablespace Usage, Undo Retention Auto-Tuning, and Undo Generation Rate)

- g) *Question:* Looking at the preceding Undo Retention Auto-Tuning graph, could this system support flashback above and beyond the current longest running query?

Answer: Yes, (but most likely not enough to support the required 48 hours).

- 2) Modify the undo retention time and calculate the undo tablespace size to support the requested 48-hour retention.

Practice 10-1: Managing Undo Data (continued)

- Click the **General** tab to go back to the General Automatic Undo Management page.
- Under the Undo Advisor section, select “**Specified manually to allow for longer duration queries or flashback.**”
- Enter **48 hours** as Duration and click the **Run Analysis** button.

Undo Retention Settings

Undo Retention (minutes) **15**
Retention Guarantee **No**

Undo Tablespace for this Instance

Tablespace **UNDOTBS1** [Change Tablespace](#)
Size (MB) **100**
Auto-Extensible **Yes**

Undo Advisor: Undo Retention and Undo Tablespace Sizing Advice

Undo retention is the length of time that undo data is retained in the undo tablespaces. Undo data must be retained for the length of the longest running query, the longest running transaction, and the longest flashback duration (except for Flashback Database). The undo tablespace should be sized large enough to hold the undo generated by the database during the undo retention period. Note that the undo retention parameter is also used as the retention value for LOB columns.

Analysis Period

Analysis Time Period **Last Seven Days**

Desired Undo Retention

☐ Automatically chosen based on longest query in analysis period

☒ Specified manually to allow for longer duration queries or flashback

Duration **48** **hours**

[Run Analysis](#)

Analysis Results

[Edit Undo Tablespace](#) [Edit Undo Retention](#)

Practice 10-1: Managing Undo Data (continued)

- d) When the Undo Advisor is finished, examine the results.

Automatic Undo Management

In the General tab, you can view the current undo settings for your instance and use the Undo Advisor to analyze the undo tablespace requirements. This analysis can be performed based on the specified analysis period or the desired undo retention. The system activity for the specified time period can be viewed in the System Activity tab.

General **System Activity**

Undo Retention Settings

Undo Retention (minutes) **15**
Retention Guarantee **No**

Undo Tablespace for this Instance

Tablespace **UNDOTBS1** **Change Tablespace**
Size (MB) **100**
Auto-Extensible **Yes**

Undo Advisor: Undo Retention and Undo Tablespace Sizing Advice

Undo retention is the length of time that undo data is retained in the undo tablespaces. Undo data must be retained for the length of the longest running query, the longest running transaction, and the longest flashback duration (except for Flashback Database). The undo tablespace should be sized large enough to hold the undo generated by the database during the undo retention period. Note that the undo retention parameter is also used as the retention value for LOB columns.

Analysis Period

Analysis Time Period **Last Seven Days**
Desired Undo Retention ☐ Automatically chosen based on longest query in analysis period
☒ Specified manually to allow for longer duration queries or flashback
Duration **48** hours
Run Analysis

Analysis Results

Selected Analysis Time Period **Jul 2, 2009 8:00:00 AM GMT+07:00 To Jul 9, 2009 8:00:00 AM GMT+07:00**

Minimum Required Undo Tablespace Size (MB) **249**

Recommended Undo Tablespace Size (MB) **20**

☒ **TIP** Recommended size is three times the minimum size to allow for workload fluctuations

Potential Problems **No Problem Found**
Recommendations **No Recommendation**

Show Graph

Note: Your recommended size might be different from what is shown here.

- e) Click the **Show SQL** button in the upper-right corner of the General Automatic Undo Management page.

Show SQL

ALTER SYSTEM SET UNDO_RETENTION = 172800

Return

- f) This command will change the undo retention to support the 48-hour requirement. Review the SQL statement and click **Return**.
- g) Click **Apply** to make the change to undo retention.
- h) Now adjust the undo tablespace size by clicking the **Edit Undo Tablespace** button.
- i) Scroll down to Datafiles and click **Edit** to make a change to the datafile file size for the Undo tablespace.
- j) Change the file size to the Minimum Required Undo Tablespace Size that was determined when you ran the Undo Advisor (249 MB is the value in the screenshot above) and click **Continue**.

Practice 10-1: Managing Undo Data (continued)

- k) Verify the SQL commands that will be executed by clicking Show SQL.

Show SQL

Return

```
ALTER DATABASE DATAFILE '+DATA/orcl/datafile/undotbs1.258.691672083' RESIZE 249M
ALTER DATABASE DATAFILE '+DATA/orcl/datafile/undotbs1.258.691672083' AUTOEXTEND ON NEXT 5M
```

Click **Return**.

- l) Click **Apply** to change the tablespace size.
- 3) Go back to the **Automatic Undo Management** page to see the results of the changes you just made. You see that the undo retention time has increased to support the 48 hours requirement. Your undo tablespace size has also increased based on the changes you made to the size of the datafile for the undo tablespace.

Automatic Undo Management

In the General tab, you can view the current undo settings for your instance and use the Undo Advisor to analyze the undo tablespace requirements. This analysis can be performed based on the specified analysis period or the desired undo retention. The system activity for the specified time period can be viewed in the System Activity tab.

General

System Activity

Undo Retention Settings

Undo Retention (minutes) **2880**
Retention Guarantee **No**

Undo Tablespace for this Instance

Tablespace **UNDOTBS1**

Change Tablespace

Size (MB) **249**
Auto-Extensible **Yes**

- a) *Question:* Which Flashback operations are potentially affected by this change?

Answer: Flashback query, Flashback transaction, and Flashback table.

- b) *Question:* Do undo data survive the shutdown of a database?

Answer: Yes, undo is persistent.

Practices for Lesson 11

Background: You have just been informed of suspicious activities in the `HR.JOBS` table in your `orcl` database. The highest 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.

Practice 11-1: Configuring Database Auditing

Log in as the **DBA1** user (with `oracle_4U` 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) Click the **Server** tab, and then click **Audit Settings** in the Security section.
 - c) Click the value of Audit Trail, the **DB** 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, enter **XML** as the value.
 - g) Click **Show SQL**.

Show SQL

ALTER SYSTEM SET audit_trail = "XML" SCOPE=SPFILE

Return

- h) Review the statement and then click **Return**.
 - i) On the Initialization Parameters page, click **Apply**.
 - 2) Because you changed a static parameter, you must restart the database. Do so by running the **lab_11_01_02.sh** script.
 - a) In a terminal window, enter:

```
$ cd /home/oracle/labs
$ ./lab_11_01_02.sh
```
 - b) Continue with the next step when you see that the database is restarted.
 - 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. Because the database has been restarted, you have to log in to Enterprise Manager again as the **DBA1** user.
 - a) Click **logout** in the upper-right corner of the Enterprise Manager window.
 - b) Log in as the **DBA1** user in the **SYSDBA** role for your **orcl** database.
 - c) Click the Database home page tab to ensure that Enterprise Manager had time to update the status of the database and its agent connections.
 - d) Click the **Server** tab, and then click **Audit Settings** in the Security section.
 - e) Click the **Audited Objects** tab at the bottom of the page, and then click the **Add** button.

Practice 11-1: Configuring Database Auditing (continued)

- f) 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).
- g) Move **DELETE**, **INSERT**, and **UPDATE** into the Selected Statements area by double-clicking each of them.
- h) Click **Show SQL**.

SQL*Plus window showing the generated audit statement:

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

Buttons: [Show SQL](#) (left), [Return](#) (right)

- i) Review the statement, and then click **Return**.
 - j) Click **OK** to activate this audit.
- 4) Provide input for the audit, by executing the **lab_11_01_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_11_01_04.sh
```

- 5) In Enterprise Manager, review the audited objects.
- a) Click the **Server** tab, and then click **Audit Settings** in the Security section.
 - b) Click **Audited Objects** in the Audit Trails area, which is on the right side of the page.
 - c) On the Audited Objects page, review the collected information.

Audited Objects

Buttons: [Show SQL](#) (left), [Filter Result](#) (right), [Return](#) (right)

Schema	Object Name	User Name	Action	Time (In Session's Time Zone)
HR	JOBS	HR	SESSION REC	2009-07-09 08:57:01.812159
HR	JOBS	AUDIT_USER	SESSION REC	2009-07-09 08:57:01.71946

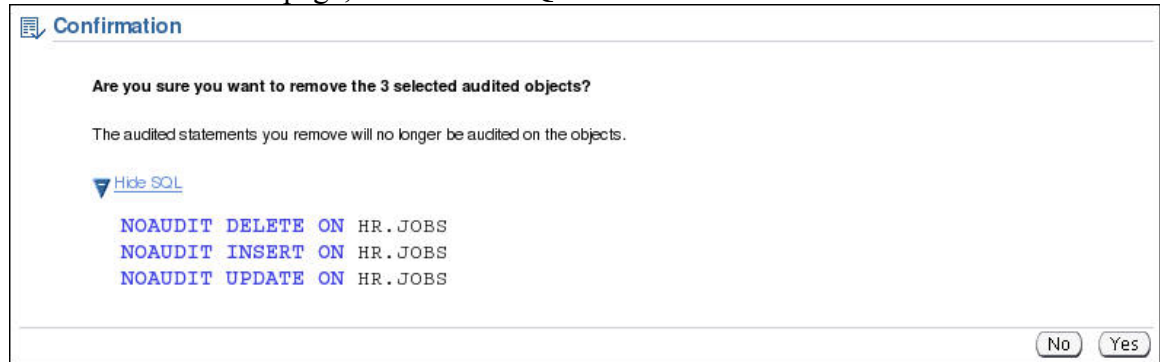
Question: Can you tell which user increased and which user decreased the salaries?

Answer: No, the standard audit records only show which user accessed the table.

- d) Click **Return**.
- 6) Undo your audit settings for **HR.JOBS**, disable database auditing, and then restart the database by using the **lab_11_01_06.sh** script.
- a) On the Audit Settings page, click the **Audited Objects** tab at the bottom of the page.
 - b) Enter **HR** as Schema, and then click **Search**.
 - c) Select all three rows, and then click **Remove**.

Practice 11-1: Configuring Database Auditing (continued)

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



The image shows a 'Confirmation' dialog box with a title bar. The main text asks: 'Are you sure you want to remove the 3 selected audited objects?'. Below this, a smaller line of text states: 'The audited statements you remove will no longer be audited on the objects.' There is a 'Hide SQL' link with a downward arrow icon. Below the link, three lines of SQL code are displayed: 'NOAUDIT DELETE ON HR.JOBS', 'NOAUDIT INSERT ON HR.JOBS', and 'NOAUDIT UPDATE ON HR.JOBS'. At the bottom right, there are two buttons: 'No' and 'Yes'.

- e) Review the statements, and 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, enter **DB** as the value.
j) Click **Show SQL**.



The image shows a 'Show SQL' dialog box. It contains a single line of SQL code: 'ALTER SYSTEM SET audit_trail = "DB" SCOPE=SPFILE'. At the bottom right, there is a 'Return' button.

- 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_11_01_06.sh** script. In a terminal window, enter:

```
$ cd /home/oracle/labs
$ ./lab_11_01_06.sh
```

- 7) Maintain your audit trail: Because you are completely finished with this task, backup and 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
```

- b) Create a backup of the audit trail files, and then remove the files

```
$ tar -czf $HOME/audit_today.tar.z *
```

```
$ rm -f *
```

- c) Close the terminal window.

Practices for Lesson 12

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 database environment for this exercise.

Practice 12-1: Database Maintenance

- 1) Create a new, locally managed tablespace called TBSSPC. It has a data file of 50 MB in the +DATA disk group. Ensure that the TBSSPC tablespace does not use Automatic Segment Space Management (ASSM). Execute the **lab_12_01_01.sh** script to perform these tasks. In a terminal window, enter:

```
$ cd /home/oracle/labs
$ cat lab_12_01_01.sh
...
sqlplus / as sysdba << END

set echo on

drop tablespace TBSSPC including contents and datafiles;

CREATE SMALLFILE TABLESPACE "TBSSPC"
DATAFILE '+DATA' SIZE 50M
AUTOEXTEND ON NEXT 10M MAXSIZE 200M
LOGGING
EXTENT MANAGEMENT LOCAL
SEGMENT SPACE MANAGEMENT MANUAL;

exit;
END

$ ./lab_12_01_01.sh
```

- 2) Create a new SPCT user, identified by oracle_4U. Assign the TBSSPC tablespace as the default tablespace. Assign the TEMP tablespace as the temporary tablespace. Grant the following roles to the SPCT users: CONNECT, RESOURCE, and DBA. Execute the **lab_12_01_02.sh** script to perform these tasks. In a terminal window, enter:

```
$ cat lab_12_01_02.sh
...
sqlplus / as sysdba << END

set echo on

drop user spct cascade;

create user spct identified by oracle_4U
default tablespace TBSSPC
temporary tablespace temp;

grant connect, resource, dba to spct;

exit;
END

$ ./lab_12_01_02.sh
```

Practice 12-1: Database Maintenance (continued)

- 3) Use the DBMS_ADVISOR package to set the database activity time to 30 minutes. As the SPCT user, drop and create the SPCT table and gather statistics for this table. Create a snapshot in Automatic Workload Repository (AWR). Execute the **lab_12_01_03.sh** script to perform these tasks. In a terminal window, enter:

```
$ cat lab_12_01_03.sh
...
sqlplus / as sysdba << EOF

set echo on

exec
dbms_advisor.set_default_task_parameter('ADDM','DB_ACTIVITY_MI
N',30);

connect spct/oracle_4U

drop table spct purge;
create table spct(id number, name varchar2(2000));

exec DBMS_STATS.GATHER_TABLE_STATS(-
ownname=>'SPCT', tabname=>'SPCT',-
estimate_percent=>DBMS_STATS.AUTO_SAMPLE_SIZE);

exec DBMS_WORKLOAD_REPOSITORY.CREATE_SNAPSHOT();

exit;
EOF
$ ./lab_12_01_03.sh
```

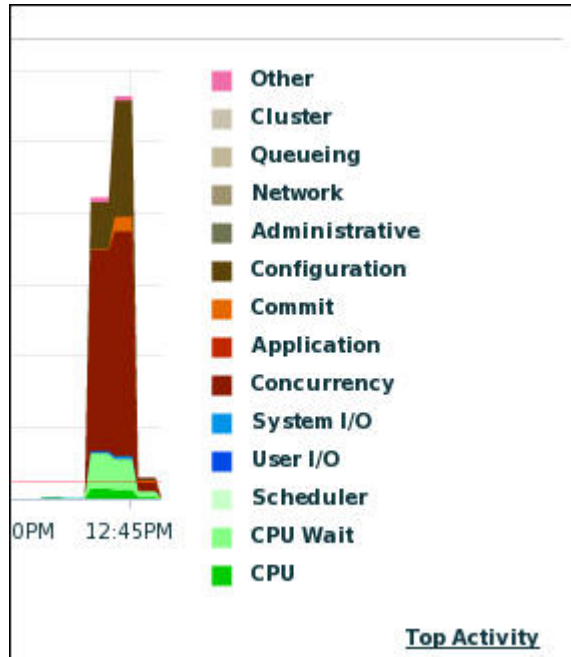
- 4) Create the activity to be analyzed. Execute the **lab_12_01_04.sh** script to perform these tasks.
In a terminal window, enter the following. You may have to press [Enter] after you see that several PL/SQL procedures have completed, in order to see the command prompt again.

```
$ ./lab_12_01_04.sh
```

- 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.
- a) Invoke Enterprise Manager as the **DBA1** user in the **SYSDBA** role for your **orcl** database.

Practice 12-1: Database Maintenance (continued)

- b) Click the **Performance** tab.



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

- c) After the spike is finished, execute the `lab_12_01_05.sh` script. This script forces the creation of a new snapshot and gathers statistics on your SPCT table.

Note: Causing the same performance problem in all environments is not easy. To help make your test more successful, wait an extra minute or so after the spike has completely finished before running the script.

After the spike has finished, in a terminal window, enter:

```
$ ./lab_12_01_05.sh
```

- 6) Look at the **Performance Analysis** findings in order of their impact. There are several access paths to this information. The results should look similar to the following:

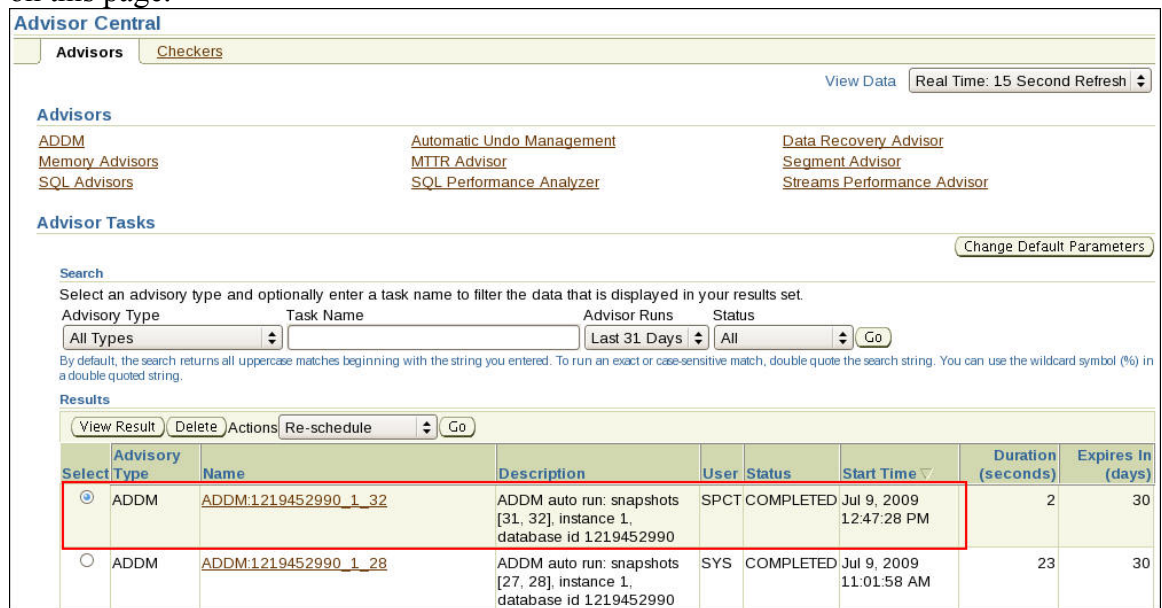
ADDM Performance Analysis			
Task Name ADDM:1219452990_1_32			
Filters View Snapshots View Report			
Task Owner	SPCT	Average Active Sessions	8.1
Period Start Time	Jul 9, 2009 12:42:25 PM GMT+07:00		
Period Duration	5 (minutes)		
Impact (%)	Finding	Occurrences (24 hrs ending with analysis period)	
95.9	Top SQL Statements	4 of 22	
32.1	Buffer Busy - Hot Objects	1 of 22	
21.6	Unusual "Concurrency" Wait Event	1 of 22	
19.8	High Watermark Waits	1 of 22	
10.5	Buffer Busy - Hot Block	1 of 22	
4.2	Shared Pool Latches	1 of 22	
2.4	Commits and Rollbacks	2 of 22	
2	Buffer Cache Latches	1 of 22	

Practice 12-1: Database Maintenance (continued)

Looking at the Performance Analysis section, you see that the first finding has a high percentage (in this example, 95.9%) 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.

Investigate the other findings in order of severity. Look at the Buffer Busy findings in particular. For one of the Buffer Busy results, you should see that there is read-and-write contention on your SPCT table. The recommended action is to use the Automatic Segment Space Management (ASSM) feature for your SPCT table. The following steps guide you through this exercise.

- Navigate to the Database home page, and then click **Advisor Central** at the bottom of the page.
- Your ADDM task should already be displayed. If not, search for it and display it on this page.



Advisor Central

Advisors Checkers View Data Real Time: 15 Second Refresh

Advisors

- ADDM
- Memory Advisors
- SQL Advisors
- Automatic Undo Management
- MITR Advisor
- SQL Performance Analyzer
- Data Recovery Advisor
- Segment Advisor
- Streams Performance Advisor

Advisor Tasks Change Default Parameters

Search

Select an advisory type and optionally enter a task name to filter the data that is displayed in your results set.

Advisory Type Task Name Advisor Runs Status

All Types Last 31 Days All Go

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

Results

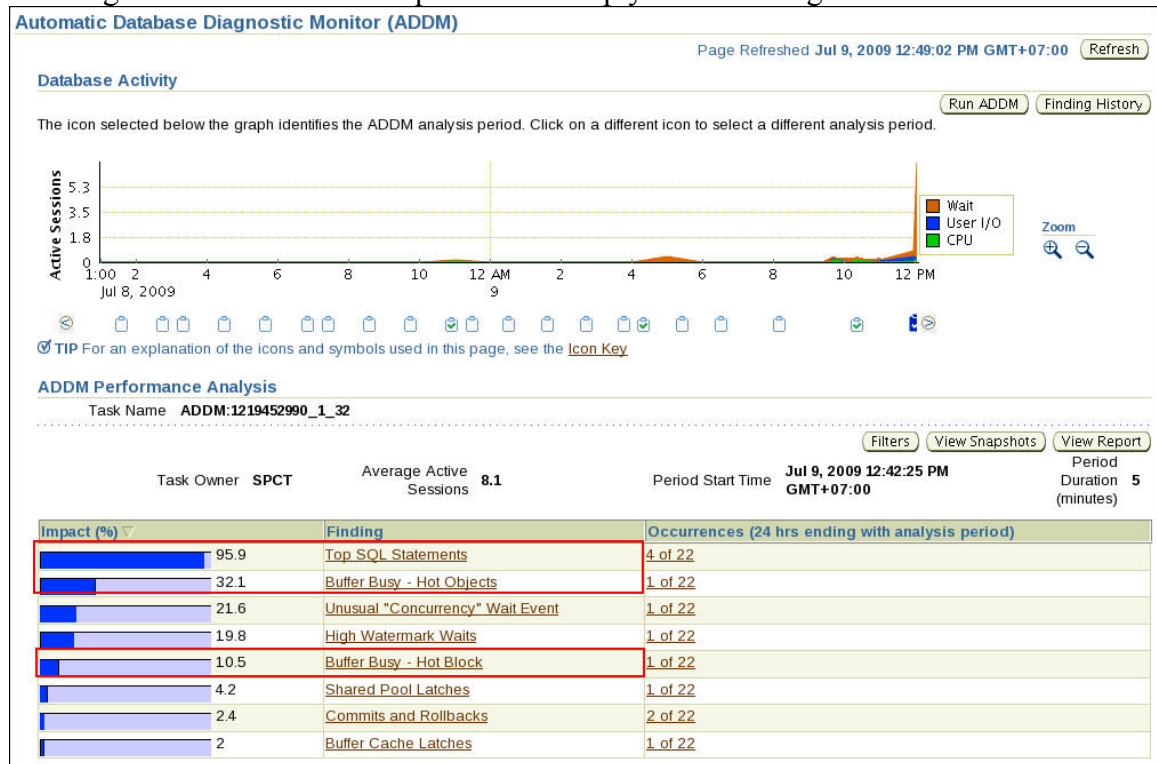
View Result Delete Actions Re-schedule Go

Select	Advisory Type	Name	Description	User	Status	Start Time	Duration (seconds)	Expires In (days)
<input checked="" type="radio"/>	ADDM	ADDM:1219452990_1_32	ADDM auto run: snapshots [31, 32], instance 1, database id 1219452990	SPCT	COMPLETED	Jul 9, 2009 12:47:28 PM	2	30
<input type="radio"/>	ADDM	ADDM:1219452990_1_28	ADDM auto run: snapshots [27, 28], instance 1, database id 1219452990	SYS	COMPLETED	Jul 9, 2009 11:01:58 AM	23	30

- Select the task, and then click the **View Result** button (alternatively, click the name of the task).

Practice 12-1: Database Maintenance (continued)

- d) The ADDM page appears, showing the detailed results from the ADDM run.
- Note:** Do not click the Run ADDM Now button because you already executed the ADDM performance analysis when you ran the `lab_12_01_05.sh` script. Clicking the button now would produce an empty set of findings.



Looking at the Performance Analysis section, you see that the first finding has a high impact on the system (in this example, 95.9%). You also notice that there are Buffer Busy findings as well. Because the Top SQL Statements finding is impacting your system by such a high percent, your first impulse is to look at this finding in more detail.

Note: Because there are several factors that can affect performance on your classroom machine, your results may not be exactly as shown. The findings may appear in a different order. If you do not see results similar to the ones outlined in the preceding screenshot, you may need to restart this practice. If you still do not see the expected results, you may need to adjust the load by modifying the `lab_12_01_04.sh` and `lab_12_01_04.sql` scripts. Ask your instructor for assistance if this is the case. Take care not to increase the load too much or you will slow your system down too much.

- e) Click the “**Top SQL Statements**” link in the Finding column.
- f) 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.

Practice 12-1: Database Maintenance (continued)

- g) Look at the Buffer Busy findings on the Automatic Database Diagnostic Monitor (ADDM) page. Click the first occurrence of the Buffer Busy finding, in this case, the Buffer Busy – Hot Objects link.

Performance Finding Details: Buffer Busy - Hot Objects

Finding: Read and write contention on database blocks was consuming significant database time. [Finding History](#)

Impact (Active Sessions): 2.59
 Percentage of Finding's Impact (%): 32.1
 Period Start Time: Jul 9, 2009 12:42:25 PM GMT+07:00
 Period Duration (minutes): 5
 Filtered: No [Filters](#)

Recommendations

[Show All Details](#) | [Hide All Details](#)

Details	Category	Benefit (%)
Hide Schema		32.1
Action Consider using ORACLE's recommended solution of automatic segment space management in a locally managed tablespace for the tablespace "TBSSPC" containing the TABLE "SPCT.SPCT" with object ID 74614. Alternatively, you can move this object to a different tablespace that is locally managed with automatic segment space management. Database Object SPCT.SPCT		
Rationale There was significant read and write contention on TABLE "SPCT.SPCT" with object ID 74614. Database Object SPCT.SPCT		
Show Schema		32.1
Show Schema		32.1

Findings Path

[Expand All](#) | [Collapse All](#)

Findings	Percentage of Finding's Impact (%)	Additional Information
▼ Read and write contention on database blocks was consuming significant database time.	32.1	
▼ Read and write contention on database blocks was consuming significant database time.	32.1	
Wait class "Concurrency" was consuming significant database time.	59.8	

The findings show that there is read-and-write contention on database blocks. The recommendation is to use a tablespace that is locally managed with Automatic Segment Space Management.

- h) Go back to the ADDM page and look at the other Buffer Busy findings. One of them should look similar to the following:

Performance Finding Details: Buffer Busy - Hot Block

Finding: A hot data block with concurrent read and write activity was found. The block belongs to segment "SPCT.SPCT" and is block 631 in file 8. [Finding History](#)

Impact (Active Sessions): .85
 Percentage of Finding's Impact (%): 10.5
 Period Start Time: Jul 9, 2009 12:42:25 PM GMT+07:00
 Period Duration (minutes): 5
 Filtered: No [Filters](#)

Recommendations

[Show All Details](#) | [Hide All Details](#)

Details	Category	Benefit (%)
Hide Application Analysis		10.5
Action Investigate application logic to find the cause of high concurrent read and write activity to the data present in this block. Rationale The SQL statement with SQL_ID "3csh3g3mjhmzh" spent significant time on "buffer busy" waits for the hot block. SQL Text INSERT INTO SPCT.VALUES (NULL,'a') SQL ID 3csh3g3mjhmzh		
Show Schema		10.5

Findings Path

[Expand All](#) | [Collapse All](#)

Findings	Percentage of Finding's Impact (%)	Additional Information
▼ A hot data block with concurrent read and write activity was found. The block belongs to segment "SPCT.SPCT" and is block 631 in file 8.	10.5	
▼ Read and write contention on database blocks was consuming significant database time.	32.1	
Wait class "Concurrency" was consuming significant database time.	59.8	

This finding shows that there is a hot data block that belongs to the SPCT . SPCT table. The recommendation is to investigate the application logic to find the cause.

Practice 12-1: Database Maintenance (continued)

- 7) You decide to implement the recommendation to use Automated Segment Space Management. To do this, you must re-create the object. Create a new, locally managed tablespace, called TBSSPC2 with a 50 MB data file in the +DATA disk group. Ensure that the TBSSPC2 tablespace uses the Automatic Segment Space Management feature. Then execute the **lab_12_01_07.sh** script to drop the SPCT table, to re-create it in the new tablespace, to gather statistics, and to take a new snapshot.
- a) In Enterprise Manager, click the **Server** tab, and then **Tablespaces** in the Storage section.
 - b) Click **Create**.
 - c) Enter TBSSPC2 as the tablespace name, and verify that Extent Management is **Locally Managed**, Type is **Permanent**, Status is **Read Write**, and Use bigfile tablespace is *not* selected.
 - d) Click **Add** in the **Datafiles** region.
 - e) On the Add Datafile page, ensure that the DiskGroup is **DATA** and enter **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**, and view the SQL that will be run, and then click **Return**.

```
Show SQL
CREATE SMALLFILE TABLESPACE "TBSSPC2" DATAFILE '+DATA' SIZE 50M LOGGING EXTENT MANAGEMENT LOCAL SEGMENT
SPACE MANAGEMENT AUTO
```

- j) Click **OK**. A successful Confirmation message appears.
- k) In a terminal window, enter:

```
$ ./lab_12_01_07.sh
```

- 8) Execute your workload again. (Use the **lab_12_01_04.sh** script.)

In a terminal window, enter the following. You may have to press [Enter] after you see that several PL/SQL procedures have completed, in order to see the command prompt again.

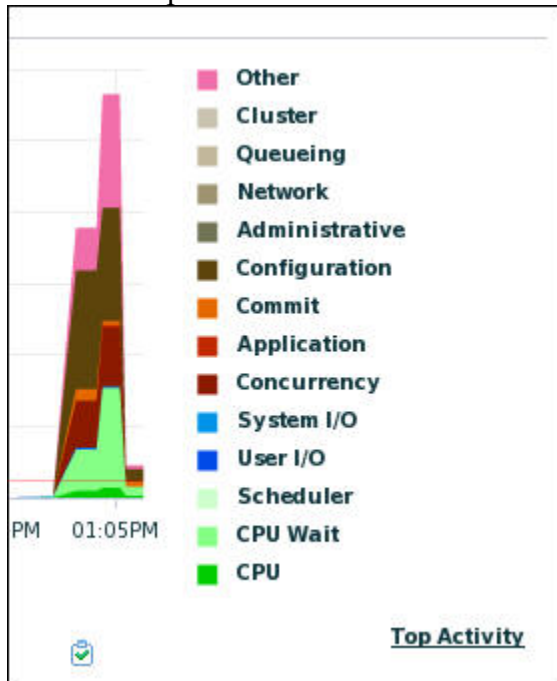
```
$ ./lab_12_01_04.sh
```

- 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.

After the spike is finished, execute the **lab_12_01_05.sh** script again. This script forces the creation of a new snapshot and gathers statistics on your ADDM table.

Practice 12-1: Database Maintenance (continued)

- a) Invoke Enterprise Manager as the **DBA1** user in the **SYSDBA** role for your **orcl** database.
- b) Click the **Performance** tabbed page. Watch for the spike in the Active Sessions chart to complete.



- c) After the spike is finished, run the **lab_12_01_05.sh** script to force the creation of a new snapshot and gather statistics on your SPCT table. Enter the following in a terminal window:

```
$ ./lab_12_01_05.sh
```

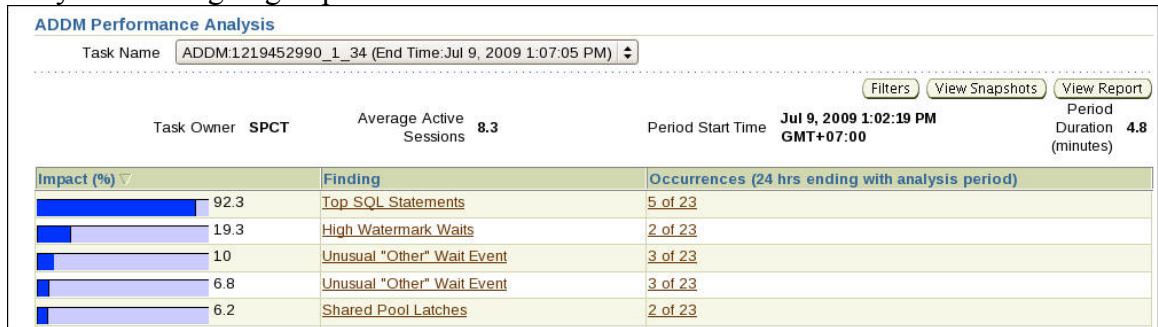
10) Review the ADDM from the **Advisor Central** link.

- a) Navigate to the Database home page, and then click **Advisor Central** at the bottom of the page.
- b) Click the top-most ADDM task name.

Practice 12-1: Database Maintenance (continued)

- c) You see that the Buffer Busy findings about the read-and-write contention is no longer there. By moving the ADDM table to the locally managed TBSSPC2 tablespace, which uses the Automatic Autoextend Segment feature, you obviously fixed the root cause of the contention problem.

Note: You may see additional Buffer Busy findings (at a lower impact percentage) and other further recommendations that could improve performance, but you are not going to pursue them at this time.



- 11) To not affect other practice sessions, execute the `lab_12_01_11.sh` script to clean up your environment.

In a terminal window, enter:

```
$ ./lab_12_01_11.sh
```

Practices for Lesson 13

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.

Practice 13-1: Managing Performance

- 1) Log in to SQL*Plus as the SYS user and perform maintenance on tables in the HR schema by running the `lab_13_01_01.sql` script.

```
$ cd ~/labs
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus / as sysdba
SQL> @lab_13_01_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_01_02.sql` script. To run this file, enter the following in SQL*Plus:

```
SQL> CONNECT hr
Password: oracle_4U <<<Password does not appear on screen
Connected.
SQL> @lab_13_01_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 the **Performance** tab, and then click **Search Sessions** in the Additional Monitoring Links section.
 - b) On the Search Sessions page, change the Search criteria to “**DB User**,” enter **HR** in the field to the right of that, and then click **Go**.
 - 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 in the Application section.

Practice 13-1: Managing Performance (continued)

- e) On the SQL Details page, you see the details 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.

SQL Details: bckcqw5pd108f

Switch to SQL ID Go View Data Real Time: Manual Refresh Refresh SQL Worksheet Schedule SQL Tuning Advisor SQL Repair Advisor

Text 

```
select *
from hr.employees
where employee_id = 200
```

Details

Select the plan hash value to see the details below. Plan Hash Value 1445457117

Statistics Activity **Plan** Plan Control Tuning History SQL Monitoring

Data Source Cursor Cache Capture Time Jul 9, 2009 10:44:01 AM (UTC+07:00) Parsing Schema HR Optimizer Mode ALL_ROWS

Additional Information

Expand All Collapse All

Operation	Object	Order	Rows	Bytes	Cost	CPU (%)	Time	Query Block Name/Object Alias	Filter	Projection
SELECT STATEMENT		2			3	100				
TABLE ACCESS FULL	EMPLOYEES	1	1	69	3	0.0	0.1	SEL\$1 / EMPLOYEES@SEL\$1	"EMPLOYEE_ID"=200	"EMPLOYEE_ID" [NUMBER,22], "EMP..."

Show Explain Rewrite

- 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**.
- From the Database Home page, click the **Schema** tab, and then **Indexes**.
 - Select **Table Name** as the Search By value.
 - Enter **HR** in the **Schema** field.
 - Enter **EMPLOYEES** for Object Name.
 - Click **Go**, and the list of six indexes appears.

Practice 13-1: Managing Performance (continued)

- f) Click the index named **EMP_EMP_ID_PK**.

Indexes

Object Type: Index

Search

Enter a schema name and an object name to filter the data that is displayed in your results set.

Search By: Table Name

Schema: HR

Object Name: EMPLOYEES

Go

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

Selection Mode: Single

Create

Edit View Delete Actions: Create Like Go

Select	Table Owner	Table	Indexed Columns	Index Owner	Index	Table Type	Tablespace	Partitioned	Last Analyzed
	HR	EMPLOYEES	EMAIL	HR	EMP_EMAIL_UK	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00
	HR	EMPLOYEES	MANAGER_ID, LAST_NAME	HR	EMP_NAME_IX	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00
	HR	EMPLOYEES	MANAGER_ID	HR	EMP_MANAGER_IX	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00
	HR	EMPLOYEES	DEPARTMENT_ID	HR	EMP_DEPARTMENT_IX	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00
	HR	EMPLOYEES	JOB_ID	HR	EMP_JOB_IX	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00
	HR	EMPLOYEES	EMPLOYEE_ID	HR	EMP_EMP_ID_PK	TABLE	EXAMPLE	NO	Aug 26, 2008 12:46:38 AM GMT+07:00

- g) On the View Index page, notice that the status of the index is UNUSABLE.

View Index: HR.EMP_EMP_ID_PK

Actions: Create Like Go Edit OK

General

Name: EMP_EMP_ID_PK

Schema: HR

Tablespace: EXAMPLE

Index Type: Normal

Status: UNUSABLE

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

- a) Go to the SQL*Plus session where you are still logged in as the HR user, and run this query:

```
SQL> select index_name, table_name, status
       from user_indexes where status <> 'VALID';
```

INDEX_NAME	TABLE_NAME	STATUS
EMP_EMAIL_UK	EMPLOYEES	UNUSABLE
EMP_EMP_ID_PK	EMPLOYEES	UNUSABLE
EMP_DEPARTMENT_IX	EMPLOYEES	UNUSABLE

Practice 13-1: Managing Performance (continued)

EMP_JOB_IX	EMPLOYEES	UNUSABLE
EMP_MANAGER_IX	EMPLOYEES	UNUSABLE
EMP_NAME_IX	EMPLOYEES	UNUSABLE

6 rows selected.

SQL>

- b) You notice that the output lists six indexes, all on the **EMPLOYEES** table. This is a problem you will need to fix.
- 6) You decide to use Enterprise Manager to reorganize all the indexes in the HR schema that are marked as UNUSABLE.
 - a) In Enterprise Manager, on the page displaying the EMP_EMP_ID_PK index, select **Reorganize** in the Actions list, and then click **Go**.
 - b) On the Reorganize Objects pages, click **Add**, to add each of the other five indexes to the reorganization operation.
 - c) In the Add screen, choose **Indexes** for the Type drop-down list, and enter **HR** in the Schema field. Click **Search**.
 - d) Select the five other indexes whose names start with “**EMP_**.”

Objects: Add

Database Instance: **orcl.oracle.com** Cancel OK

Logged In As: **SYS**

Search

Type: **Indexes** Include minimum size filter in search query
 Schema: **HR** Minimum Size (KB)
 Object Name:
 Partition Name:
 Tablespace:
Search

Available Objects: Indexes

Previous 1-10 of 17 Next 7

[Select All](#) | [Select None](#)

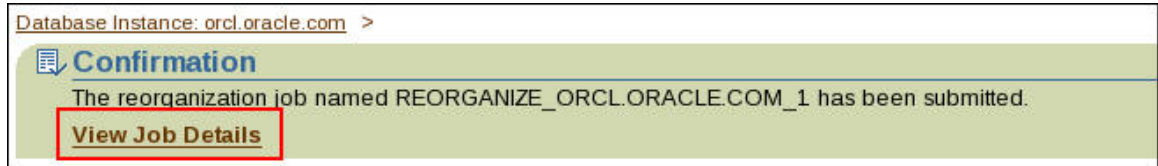
Select	Name	Type	Tablespace	Size (KB)	Partitioned	IOT
<input type="checkbox"/>	HR.DEPT_ID_PK	Index	EXAMPLE	64	NO	N/A
<input type="checkbox"/>	HR.DEPT_LOCATION_IX	Index	EXAMPLE	64	NO	N/A
<input checked="" type="checkbox"/>	HR.EMP_DEPARTMENT_IX	Index	EXAMPLE	64	NO	N/A
<input checked="" type="checkbox"/>	HR.EMP_EMAIL_UK	Index	EXAMPLE	64	NO	N/A
<input checked="" type="checkbox"/>	HR.EMP_JOB_IX	Index	EXAMPLE	64	NO	N/A
<input checked="" type="checkbox"/>	HR.EMP_MANAGER_IX	Index	EXAMPLE	64	NO	N/A
<input checked="" type="checkbox"/>	HR.EMP_NAME_IX	Index	EXAMPLE	64	NO	N/A
<input type="checkbox"/>	HR.JHIST_DEPARTMENT_IX	Index	EXAMPLE	64	NO	N/A
<input type="checkbox"/>	HR.JHIST_EMPLOYEE_IX	Index	EXAMPLE	64	NO	N/A
<input type="checkbox"/>	HR.JHIST_EMP_ID_ST_DATE_PK	Index	EXAMPLE	64	NO	N/A

Previous 1-10 of 17 Next 7

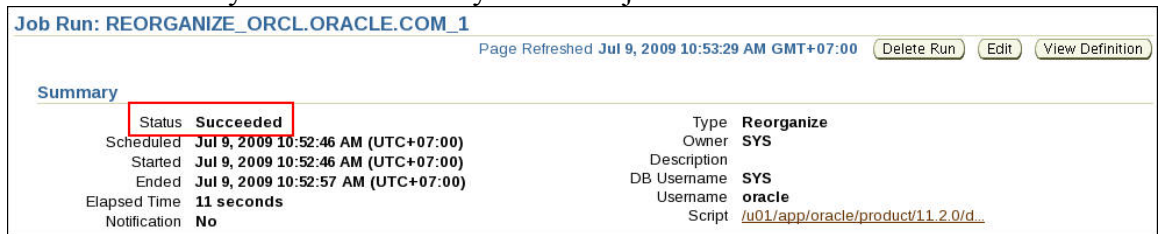
- e) Click **OK** to go back to the Reorganize Objects: Objects page.
- f) Verify that all six indexes for the EMPLOYEES table are listed and click **Next**.
- g) Keep all the default settings for Options, and then click **Next**. The reorganize script generation occurs, and then the Impact Report appears.
- h) Note that there are no problems reported on Impact Report, and then click **Next**.

Practice 13-1: Managing Performance (continued)

- i) On the Schedule page, enter **oracle** and **oracle** for Username and Password under Host Credentials.
- j) Click **Next**.
- k) On the Review page, click **Submit Job**.
- l) After the Confirmation page appears, click the **View job Details** to see the job status.



- m) Click **Reload** on your browser until you see the job has succeeded.



- 7) Return to the SQL*Plus session where the HR user is logged in, and run the **lab_13_01_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_01_07.sql
```

- b) Repeat the tasks listed in step 3 to view the execution plan for the query. Now the icon indicates the use of an index. Click **View Table**. Note that the plan now uses an index unique scan.

Details

Select the plan hash value to see the details below. Plan Hash Value:

[Statistics](#) [Activity](#) [Plan](#) [Plan Control](#) [Tuning History](#) [SQL Monitoring](#)

Data Source: **Cursor Cache** Capture Time: **Jul 9, 2009 10:55:37 AM (UTC+07:00)** Parsing Schema: **HR** Optimizer Mode: **ALL_ROWS**

Additional Information

[Expand All](#) | [Collapse All](#)

Operation	Object	Order	Rows	Bytes	Cost	CPU (%)	Time	Query Block Name/Object Alias	Predicate	Projection
SELECT STATEMENT		3			1	100				
TABLE ACCESS BY INDEX ROWID	EMPLOYEES	2	1	69	1	0	0:0:1	SEL\$1 / EMPLOYEES@SEL\$1		"EMPLOYEE_ID"[NUMBER,22], "EMP..."
INDEX UNIQUE SCAN	EMP_EMP_ID_PK	1	1		0			SEL\$1 / EMPLOYEES@SEL\$1	"EMPLOYEE_ID"=201	"EMPLOYEES".ROWID[ROWID,10], "..."

- 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.

Practice 13-1: Managing Performance (continued)

- 9) Simulate a working load on your instance by running the `lab_13_01_09.sql` script as the SYS user. **Please note the SID value that is reported.**

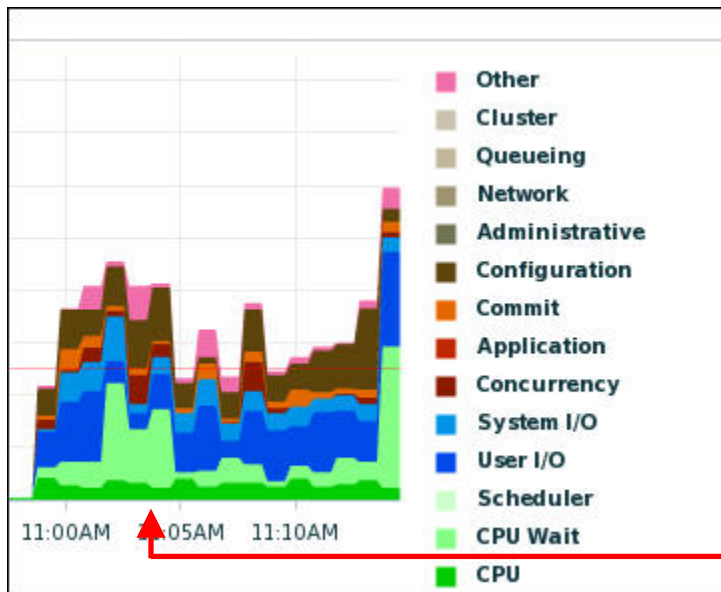
SID value reported: _____

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 / as sysdba
SQL> @lab_13_01_09.sql
```

- 10) Go back to Enterprise Manager and examine the performance of your database.
- In Enterprise Manager, navigate to the Performance page, and investigate system performance.
 - 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 some levels of activity in the **Average Active Sessions** graph before proceeding.

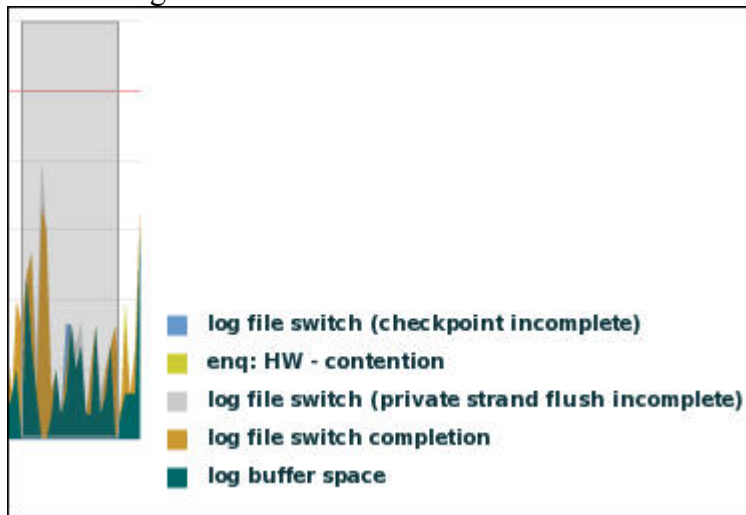
Question 1: In the **Average Active Sessions** graph, which are the two main categories that active sessions are waiting for?

Answer: In this example, it looks like CPU Wait and User I/O are quite high. Configuration is also showing high wait activity. Your results may differ from what is shown here.

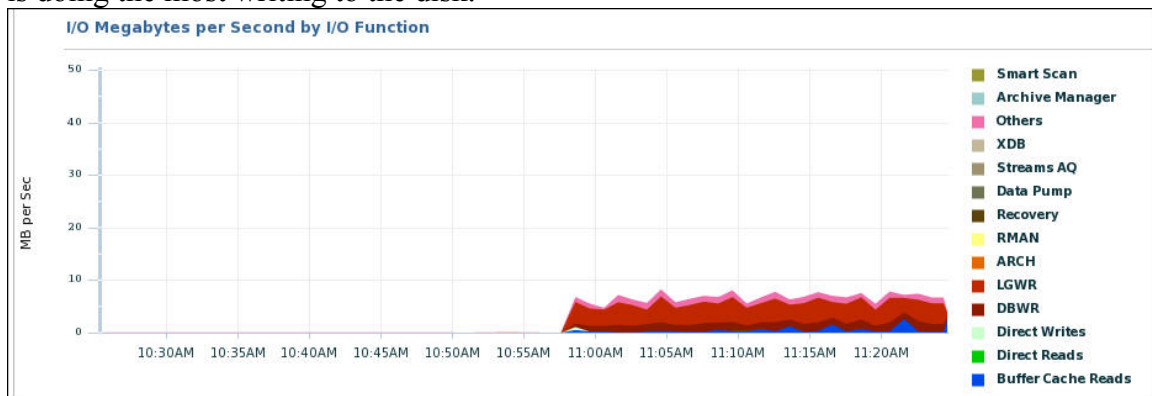
Question 2: In the Configuration category of waits, what is one of the contributors to the wait time? Click Configuration to see the graph.

Practice 13-1: Managing Performance (continued)

Answer: Any one of these, but log file switch completion and log buffer space seem to be the highest contributors:



Question 3: Click Back, and then click Settings on the Performance page. For the Detail Chart Settings select I/O for Default View, and I/O Function for I/O Chart Settings, and then click **OK**. Scroll down to the IO charts to determine which process is doing the most writing to the disk.



Answer: LGWR

c) Click **Top Activity** in the Additional Monitoring Links region.

Practice 13-1: Managing Performance (continued)

- d) Click the **SQL ID** of the first SQL statement listed in the Top SQL region.

Detail for Selected 5 Minute Interval
Start Time Jul 9, 2009 11:21:23 AM GMT+07:00

Top SQL

Actions

[Select All](#) | [Select None](#)

Select	Activity (%)	SQL ID	SQL Type
<input type="checkbox"/>	46.54	0qgwcxx1quwuv	DELETE
<input type="checkbox"/>	16.71	axn4pkyvbt51a	INSERT
<input type="checkbox"/>	4.06	348vt5h86jjj7	INSERT
<input type="checkbox"/>	2.39	6amygb1ygg2y7	INSERT
<input type="checkbox"/>	2.15	6gvch1xu9ca3g	PL/SQL EXECUTE

- e) See the first SQL statement.

- 11) Kill the session that is generating the load. Use the session ID recorded in step 9. The session ID is listed in the **SID** column of the Detail for Selected 5 Minute Interval.

- 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 Jul 9, 2009 11:21:23 AM

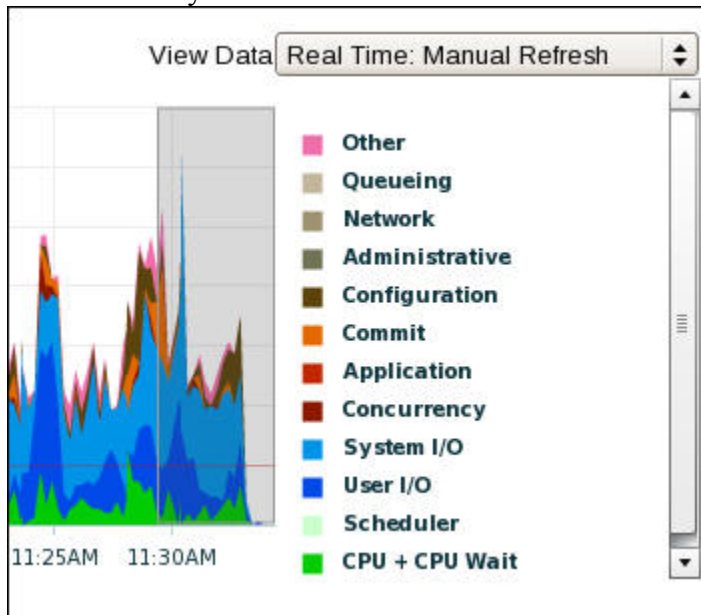
Activity (%)	SID	QC SID	User	Program	Service	Plan Hash Value
100.00	86		SYS	sqlplus@edrsr12p1.us.oracle.com (TNS V1-V3)	SYSDATABASES	2494303166

- 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 a warning, “WARNING, Session has expired.” or a SQL Error saying the session is marked for kill. This warning means you are attempting to refresh information about a session that has already been killed. You can ignore this warning.

Practice 13-1: Managing Performance (continued)

- 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.



Practices for Lesson 14

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. To do so, perform the following tasks:

- Ensure redundancy of control files and backup the control file to trace
- Review the fast recovery area configuration
- Ensure that there are at least two redo log members in each group
- Place your database in ARCHIVELOG mode
- Configure redundant archive log destinations

Practice 14-1: Configuring Your Database for Recovery

In this practice, you configure your database to reduce the chances of failure or data loss.

Note: Completing this practice is a prerequisite for all following backup and recovery practices.

- 1) First, run the **lab_14_01_01.sh** script to create some more data that will be used in scenarios during the upcoming practices. This script creates tables in the INVENTORY tablespace and simulates some basic activity on your database.

```
$ cd ~/labs
$ ./lab_14_01_01.sh
```

- 2) Verify that you have at least two control files to ensure redundancy.
 - a) Invoke Enterprise Manager as the **DBA1** user in the **SYSDBA** role for your **orcl** database.
 - b) Click **Server > Control Files** (in the Storage section).

Control Files

General Advanced Record Section

Backup To Trace

Control File Mirror Images

Oracle strongly recommends that your database has a minimum of two control files and that they are located on separate disks. If a control file is damaged due to a disk failure, it could be restored using the intact copy of the control file from the other disk. You can specify their location in the database's initialization parameter file.

Valid	File Name	File Directory
VALID	current.260.692191347	+DATA/orcl/controlfile/
VALID	current.256.692191347	+FRA/orcl/controlfile/

Question 1: On the Control Files: General page, how many control files do you have?

Answer: 2 .

- 3) Review the fast recovery area configuration and change the size to 8 GB.
 - a) In Enterprise Manager, select **Availability > Recovery Settings** in the Setup section.

Practice 14-1: Configuring Your Database for Recovery (continued)

- b) Scroll to the bottom of the page.

Flash Recovery

This database is using a flash recovery area. The chart shows space used by each file type that is not reclaimable by Oracle. Performing backups to tertiary storage is one way to make space reclaimable. Usable Flash Recovery Area includes free and reclaimable space.

Flash Recovery Area Location

Flash Recovery Area Size MB

Flash Recovery Area Size must be set when the location is set.

Non-reclaimable Flash Recovery Area (MB) **164**

Reclaimable Flash Recovery Area (B) **0**

Free Flash Recovery Area (GB) **7.84**

☐ Enable Flashback Database*

Flashback database can be used for fast database point-in-time recovery, as it returns the 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. The flash recovery area must be set to enable flashback database.

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**

☐ Apply initialization parameter changes to SPFILE only. If not checked, parameter changes will be made to both the SPFILE and the running instance.

Flash Recovery Area Usage

File Type	Size (GB)	Percentage (%)
Online Log	0.15	1.9%
Control File	0.01	0.1%
Archived Redo Log	0	0%
Backup Piece	0	0%
Image Copy	0	0%
Flashback Log	0	0%
Usable	7.84	98%

- c) **Question:** Is the fast recovery area enabled?

Answer: Yes, because the FRA was configured during database creation using dbca.

- d) Note the location of the fast recovery area.

For example: +FRA

- e) **Question:** Which essential DBA tasks can you perform in this section?

Answer: You can change the location, size or retention time for the fast recovery area, as well as enable the Flashback Database functionality.

- f) **Question:** Does changing the size of the fast recovery area require the database to be restarted?

Answer: No, a restart is not required for this change.

- g) Change the size of the Fast Recovery Area to 8 GB, by entering **8** into the “Flash Recovery Area Size” field and choosing **GB** from the pick-list next to the size field.

- h) Optionally, click **Show SQL**, review the statement and click **Return**.

Show SQL

ALTER SYSTEM SET db_recovery_file_dest_size = 8589934592 SCOPE=BOTH

Return

- i) Click **Apply**.

- 4) Check how many members each redo log group has. Ensure that there are at least two redo log members in each group. One set of members should be stored in the fast recovery area.

- a) Click **Server > Redo Log Groups**, and note how many members are in the “# of Members” column.

Practice 14-1: Configuring Your Database for Recovery (continued)

Answer: There are two members in each group.

Redo Log Groups

Object Type: Redo Log Group

Search
Enter an object name to filter the data that is displayed in your results set.
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:

Actions:

Select	Group	Status	# of Members	Archived	Size (KB)	Sequence	First Change#
<input checked="" type="radio"/>	1	Inactive	2	No	51200	127	3680499
<input type="radio"/>	2	Current	2	No	51200	128	3721156
<input type="radio"/>	3	Inactive	2	No	51200	126	3646837

- b) Select one of your Redo Log Groups and click View to see where each member of that group is stored. You should see one member in the +DATA disk group and the second member in the +FRA disk group.

View Redo Log Group: 1

Actions:

Group # 1
File size **51200 KB**
Status **INACTIVE**

Redo Log Members

File Name	File Directory
group_1.261.691672257	+DATA/orcl/onlinelog/
group_1.257.691672265	+FRA/orcl/onlinelog/

- 5) 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 are archived.
Note: You must continue with step 5, so that your changes are applied.

- a) In Enterprise Manager, select Availability > Recovery Settings in the Setup section.
- b) In the Media Recovery region, select the **ARCHIVELOG Mode** check box. Also, verify that Log Archive Filename Format contains %t, %s, and %r.

Media Recovery

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

☒ ARCHIVELOG Mode*

Log Archive Filename Format*

Number	Archived Redo Log Destination	Status	Type
1	USE_DB_RECOVERY_FILE_DEST	VALID	Local

☒ **TIP** It is recommended that archived redo log files be written to multiple locations spread across the different disks.
☒ **TIP** You can specify up to 10 archived redo log destinations.

Practice 14-1: Configuring Your Database for Recovery (continued)

- c) Notice the current configuration for the archive log destination is to `USE_DB_RECOVERY_FILE_DEST`, which points to the fast recovery area (+FRA).
Note: If you add archive log destinations, you must create the directory, if it does not already exist.
 - d) Click **Apply**.
 - e) When prompted whether you want to restart the database now, click **Yes**.
 - f) Enter the host credentials to restart the database (`oracle` as the Username and Password) and then click **OK**.
 - g) When asked to confirm, click **Yes** again.
 - h) Should you receive an error during the shutdown and startup activity, click **OK** to acknowledge the error, and then click Refresh again. (You might have been simply faster than the database.)
- 6) Optionally, once your database has restarted, use SQL*Plus to check whether your database is in ARCHIVELOG mode. In a terminal window, log in to SQL*Plus as **SYSDBA** and run the **archive log list** command.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ sqlplus / as sysdba

SQL*Plus: Release 11.2.0.1.0 Production on Sat Jul 11 10:16:40
2009

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Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

SQL> archive log list
Database log mode                Archive Mode
Automatic archival               Enabled
Archive destination              USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence       126
Next log sequence to archive     128
Current log sequence             128
SQL> exit
```

Practice 14-1: Configuring Your Database for Recovery (continued)

```
Disconnected from Oracle Database 11g Enterprise Edition  
Release 11.2.0.1.0 - Production  
With the Partitioning, Automatic Storage Management, OLAP,  
Data Mining  
and Real Application Testing options  
$
```

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.

Practices for Lesson 15

Background: Now that your database is ready for production, it is time to start taking backups. Perform backup of the control file to trace, an immediate backup to disk, and schedule nightly backup jobs that repeat indefinitely.

Practice 15-1: Performing Database Backups

In this practice, you backup your control file to trace, perform an immediate backup to disk, and schedule a nightly backup job.

- 1) Perform a backup of the control file to trace.
 - a) Invoke Enterprise Manager as the **DBA1** user in the **SYSDBA** role for your **orcl** database.
 - b) Click **Server > Control Files** (in the Storage section).

Valid	File Name	File Directory
VALID	current.260.692191347	+DATA/orcl/controlfile/
VALID	current.256.692191347	+FRA/orcl/controlfile/

- c) Click **Backup to Trace**.
 - d) When you receive the success message, note the trace directory location, and then click **OK**.

Control file successfully backed up to trace at /u01/app/oracle/diag/rdbms/orcl/orcl/trace

- e) Optionally, use a terminal window, logged in as the **oracle** user to view the trace file name at the end of the alert log by executing the following command:

```
cd /u01/app/oracle/diag/rdbms/orcl/orcl/trace
tail alert_orcl.log
```

The following output shows only the last few lines:

```
$ cd /u01/app/oracle/diag/rdbms/orcl/orcl/trace
$ tail alert_orcl.log
Sat Jul 11 09:10:03 2009
SMCO started with pid=23, OS id=9837
Sat Jul 11 09:46:31 2009
ALTER DATABASE BACKUP CONTROLFILE TO TRACE
Backup controlfile written to trace file
/u01/app/oracle/diag/rdbms/orcl/orcl/trace/orcl_ora_12190.trc
Completed: ALTER DATABASE BACKUP CONTROLFILE TO TRACE
Sat Jul 11 09:46:56 2009
ALTER DATABASE BACKUP CONTROLFILE TO TRACE
Backup controlfile written to trace file
/u01/app/oracle/diag/rdbms/orcl/orcl/trace/orcl_ora_12190.trc
Completed: ALTER DATABASE BACKUP CONTROLFILE TO TRACE
$
```

- f) Optionally, to view size and usage of the different sections within the control file, click the Record Section tabbed page.

The screenshot shows the Oracle Enterprise Manager 11g Database Control interface. The top navigation bar includes links for Setup, Preferences, Help, and Logout. The 'Help' link is highlighted with a red box. Below the navigation bar, the page title is 'Control Files'. The 'Record Section' tab is selected and highlighted with a red box. The main content area displays 'Control File Record Information' as a table.

Type	Record Size	Records Total	Records Used
CKPT PROGRESS	8180	11	0
DATABASE	316	1	1
DATAFILE	520	100	7
FILENAME	524	2298	14
LOG HISTORY	56	292	5
REDO LOG	72	16	3
REDO THREAD	256	8	1
TABLESPACE	68	100	7

Your numbers could look different. For additional information, click Help in the upper-right corner of the page.

- 2) 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 for restore operations immediately.

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

- a) Navigate to the **Availability** page and click **Backup Settings**.

The screenshot shows the Oracle Enterprise Manager 11g Backup Settings page. The 'Backup Set' tab is selected. Under the 'Disk Settings' section, the 'Parallelism' is set to 1. The 'Disk Backup Location' field is empty, and a red box highlights the message: 'The flash recovery area is the current disk backup location. If you would like to override the disk backup location, specify an existing directory or diskgroup.' The 'Disk Backup Type' section shows three options: 'Backup Set' (selected), 'Compressed Backup Set', and 'Image Copy'. A 'Test Disk Backup' button is located in the top right corner.

- b) Note the message under the Disk Backup Location that says the fast recovery area is the current disk backup location.

- 4) Establish the backup policy to automatically back up the SPFILE and control file.

- a) Click the **Policy** tab under the Backup Settings heading.

- b) Select “**Automatically backup the control file and server parameter file (SPFILE) with every backup and database structural change.**”

Backup Settings

Device Backup Set Policy

Backup Policy

☒ Automatically backup the control file and server parameter file (SPFILE) with every backup and database structural change

Autobackup Disk Location
An existing directory or diskgroup name where the control file and server parameter file will be backed up. If you do not specify a location, the files will be backed up to the flash recovery area location.

☐ Optimize the whole database backup by skipping unchanged files such as read-only and offline datafiles that have been backed up

☐ Enable block change tracking for faster incremental backups

Block Change Tracking File
Specify a location and file, otherwise an Oracle managed file will be created in the database area.

- c) Scroll to the bottom and enter **oracle** and **oracle** for Host Credentials Username and Password for your server, and select “**Save as Preferred Credential.**”
- d) Click **OK.**
- 5) Test making a backup to disk, as a backup set, with **oracle** for Host Credentials.
- a) Click the **Device** tab under the Backup Settings pages.
- b) Select **Backup Set** as your Disk Backup Type.
- c) Scroll to the bottom and ensure the Host Credentials are set to **oracle**.
- d) Scroll to the top of the page and click **Test Disk Backup.**
- e) A processing message appears. When the test finishes, and you see the “Disk Backup Test Successful!” message, scroll down to the bottom of the page and click **OK.**
- 6) Back up your entire database, with archive logs, while the database is open for user activity. This backup should be the base for an incremental backup strategy.
- a) **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.
- b) Select **Availability > Schedule Backup** (in the Manage section).
- If you find that the Oracle-Suggested Backup strategy fits your needs exactly, you would choose this option. For practice purposes, you will schedule a customized backup
- c) Select **Whole Database** as the object to be backed up.
- d) Confirm or enter **oracle** and **oracle** for Host Credentials Username and Password for your server.
- e) Click **Schedule Customized Backup.**

- f) On the Schedule Customized Backup: Options page, select **Full Backup** for your Backup Type, and select the “**Use as the base of an incremental backup strategy**” check box.
- g) Select **Online Backup** as Backup Mode.
- h) In the Advanced section, select “**Also back up all archived logs on disk**” and “**Delete all archived logs from disk after they are successfully backed up**”, and then click **Next** to continue.
- i) On the Schedule Customized Backup: Settings page, select **Disk** for your backup location. (Notice that your Disk Backup Location is retained and that you could override the current settings for a one-off backup. But do not click it this time.)

Schedule Customized Backup: Settings

Database: orcl.oracle.com Cancel Back Step 2 of 4 Next

Backup Strategy: Customized Backup

Object Type: Whole Database

Select the destination media for this backup. You can also override the default backup settings.

☒ Disk
Disk Backup Location: **+FRA**

☐ Tape

Media Management Vendor (MMV) Library Parameters: Not specified

View Default Settings Override Default Settings

Changed settings will only apply to the current backup.

- j) Click **Next**.
- k) Accept all the defaults on the Schedule Customized Backup: Schedule page and then click **Next** to continue.
Note: Schedule Type should be One Time (Immediately).
- l) On the Schedule Customized Backup: Review page, review the RMAN script, and then click **Submit Job**.

Schedule Customized Backup: Review

Database: orcl.oracle.com Cancel Edit RMAN Script Back Step 4 of 4 Submit Job

Backup Strategy: Customized Backup

Object Type: Whole Database

Settings

Destination	Disk
Backup Type	Use as the base of an incremental backup strategy
Backup Mode	Online Backup
Flash Recovery Area	+FRA

RMAN Script

The RMAN script below is generated based on previous input.

```
backup incremental level 0 cumulative device type disk tag '%TAG%' database;
backup device type disk tag '%TAG%' archivelog all not backed up delete all input;
```

- m) Click **View Job** to monitor the status of the backup job. The time for this backup depends on your hardware and system resources.

- n) Click your browser's **Refresh** or Requery button until the job is completed.

Execution: orcl.oracle.com

Page Refreshed Jul 11, 2009 10:35:15 AM GMT+07:00 [Delete Run](#) [Edit](#) [View Definition](#)

Summary

Status	Succeeded	Type	Database Backup
Scheduled	Jul 11, 2009 10:28:05 AM (UTC+07:00)	Owner	SYS
Started	Jul 11, 2009 10:28:05 AM (UTC+07:00)	Description	Whole Database Backup
Ended	Jul 11, 2009 10:34:32 AM (UTC+07:00)	Oracle SID	orcl
Elapsed Time	387 seconds	Backup Strategy	advanced
Notification	No	Version 10g or higher	YES
		Database Connect String	(DESCRIPTION=(ADDRESS_LIST=(ADDR...
		Database Name	ORCL
		Blackout	NO
		Encryption Mode	None
		Offline Backup	NO
		Backup Script	Show
		Oracle Home	/u01/app/oracle/product/11.2.0/d...
		Host Username	oracle
		Database Username	SYS
		Database Role	*****

Targets

Status

[Expand All](#) | [Collapse All](#)

Name	Targets	Status	Started	Ended	Elapsed Time (seconds)
▼ Execution: orcl.oracle.com	orcl.oracle.com	Succeeded	Jul 11, 2009 10:28:05 AM (UTC+07:00)	Jul 11, 2009 10:34:32 AM (UTC+07:00)	387
Step: Prebackup	orcl.oracle.com	Succeeded	Jul 11, 2009 10:28:25 AM (UTC+07:00)	Jul 11, 2009 10:28:26 AM (UTC+07:00)	1
Step: Backup	orcl.oracle.com	Succeeded	Jul 11, 2009 10:28:35 AM (UTC+07:00)	Jul 11, 2009 10:34:21 AM (UTC+07:00)	346
Step: Post Backup	orcl.oracle.com	Succeeded	Jul 11, 2009 10:34:30 AM (UTC+07:00)	Jul 11, 2009 10:34:32 AM (UTC+07:00)	2

- 7) Schedule nightly disk-based incremental online backups for your whole database, including archive logs. Have the archive logs deleted from disk after the backup is complete. Schedule it for execution at 11:00 PM. The schedule should be in effect indefinitely.
- In Enterprise Manager, select **Availability > Schedule Backup** (in the Manage section).
 - Select **Whole Database** as the object to be backed up.
 - Confirm or enter **oracle** and **oracle** for Host Credentials Username and Password for your server, and then click **Schedule Customized Backup**.
 - On the Schedule Customized Backup: Options page, select **Incremental Backup** as your Backup Type.
 - Select **Online Backup** as Backup Mode.
 - In the Advanced region, select “**Also backup all archived logs on disk**” and “**Delete all archived logs from disk after they are successfully backed up**”, and then click **Next** to continue.
 - On the Schedule Customized Backup: Settings page, select **Disk** as your backup location, and then click **Next** to continue.
 - On the Schedule Customized Backup: Schedule page, change Job Name to **Nightly_Backup** and accept the default value for Job Description.
 - Select **Repeating** in the Schedule region. Notice how additional context-sensitive details are displayed.

- j) Select **By Days** from the Frequency Type drop-down list, enter **1** in the Repeat Every field, confirm that Indefinite is selected as the Repeat Until value, and enter **11:00 PM** as Start Time.

Schedule Customized Backup: Schedule

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

Backup Strategy: **Customized Backup**

Object Type: **Whole Database**

Job

* Job Name:

Job Description:

Schedule

Type: ☐ One Time (Immediately) ☐ One Time (Later) ☒ Repeating

Frequency Type: **By Days**

Repeat Every: Days

Time Zone: **(UTC-06:00) US Central Time (CST)**

Start Date:

Start Time: : ☐ AM ☒ PM

Repeat Until: ☒ Indefinite ☐ Specified Date

Date:
(example: Jul 11, 2009)

Time: : ☒ AM ☐ PM

- k) Click **Next** to continue.

- l) On the Schedule Customized Backup: Review page, review your Settings and RMAN script.

Schedule Customized Backup: Review

Database: **orcl.oracle.com** Cancel Edit RMAN Script Back Step 4 of 4 Submit Job

Backup Strategy: **Customized Backup**

Object Type: **Whole Database**

Settings

Destination: **Disk**

Backup Type: **Incremental Backup**

Backup Mode: **Online Backup**

Flash Recovery Area: **+FRA**

RMAN Script

The RMAN script below is generated based on previous input.

```
backup incremental level 1 cumulative device type disk tag '%TAG' database;
backup device type disk tag '%TAG' archivelog all not backed up delete all input;
```

- m) Click **Submit Job**, and then click **OK**.

- n) Click **Jobs** on the Availability page in the Related Links section to see the scheduled job in the Job Activity list.

View <input type="button" value="Runs"/> <input type="button" value="View Results"/> <input type="button" value="Edit"/> <input type="button" value="Create Like"/> <input type="button" value="Copy To Library"/> <input type="button" value="Suspend"/> <input type="button" value="Resume"/> <input type="button" value="Stop"/> <input type="button" value="Delete"/> Create Job <input type="text" value="OS Command"/> <input type="button" value="Go"/>							
Select	Name	Status (Executions)	Scheduled	Targets	Target Type	Owner	Job Type
<input checked="" type="radio"/>	NIGHTLY_BACKUP	1 Scheduled	Jul 11, 2009 11:00:00 PM CDT	orcl.oracle.com	Database Instance	SYS	Database Backup
<input type="radio"/>	BACKUP_ORCLORACLE.COM_000003	1 Succeeded	Jul 11, 2009 10:28:05 AM (UTC+07:00)	orcl.oracle.com	Database Instance	SYS	Database Backup
<input type="radio"/>	REORGANIZE_ORCLORACLE.COM_1	1 Succeeded	Jul 9, 2009 10:52:46 AM (UTC+07:00)	orcl.oracle.com	Database Instance	SYS	Reorganize

Practices for Lesson 16

Background: Many failures of the Oracle database can be traced to some sort of media failure, such as disk or controller failure. In this practice, you encounter a number of problems from which you need to recover the database.

- Recover from the loss of a data file
- Recover from the loss of a file in the SYSTEM tablespace
- Recover from the loss of a control file

SQL script files are provided for you in the `/home/oracle/labs` directory. If needed, use the appendixes for Linux and for SQL syntax. *After you set up a failure with a SQL script, you must complete the recovery before continuing with any other practice.*

Note: Your system may have different OS file names than shown here. Your output might look different. (To conserve space, blank lines have been removed.)

Before beginning one of the recovery scenarios, you need to run a script that will prepare the environment for the remaining recovery practices.

- [illegible]

Practice 16-2: Recovering from the Loss of a Data File

In this practice, you experience the loss of an application data file. You then go through the steps to recover from this loss.

- 1) In a SQL*Plus session, as the SYS user, execute the `lab_16_02_01.sql` script from your labs directory. This script deletes one of your application data files.

Note: Remember to use `oraenv` to set your environment to the `orcl` database if you have not already done so in your terminal window.

```
$ sqlplus / as sysdba

SQL*Plus: Release 11.1.0.6.0 - Production on Sun Aug 31
10:45:19 2008

Copyright (c) 1982, 2007, Oracle. All rights reserved.

Connected to:
Oracle Database 11g Enterprise Edition Release 11.1.0.6.0 -
Production
With the Partitioning, OLAP, Data Mining and Real Application
Testing options

SQL> @lab_16_02_01.sql

PL/SQL procedure successfully completed.

"Data file deleted. Database should be open."
SQL>
```

- 2) 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 determine whether there is a problem.
Note: If you do not see the data file error, try doing an update to the INVENTORY.PRODUCT_MASTER table from another SQL*Plus session. It may take a little while before the Oracle database realizes that the file is missing. If you do not want to wait you may skip this step and move on with the next step.

```
SQL> select count(*) from INVENTORY.PRODUCT_MASTER;
select count(*) from INVENTORY.PRODUCT_MASTER
*
ERROR at line 1:
ORA-00376: file 7 cannot be read at this time
ORA-01110: data file 7:
'/u01/app/oracle/oradata/orcl/inventory02.dbf'
SQL>
```

- 3) Troubleshoot and recover as necessary. The error message suggests that the inventory02.dbf data file is corrupt or missing.
 - a) In Enterprise Manager, on the Home page, look in the Alerts section and notice the Data Failure alert.

Practice 16-2: Recovering from the Loss of a Data File (continued)

- b) Click **Availability > Perform Recovery**.
- c) Click **Advise and Recover**.
- d) On the View and Manage Failures page, click the plus (+) icon under the failure description. You should see a failure like the following:

View and Manage Failures

Select dropdown values and optionally enter failure description and impact strings to filter the data that is displayed

Failure Description Impact Priority Status Time Detected

CRITICAL or HIGH OPEN All

Select failures and ... Advise Close Set Priority High Set Priority Low

Select All | Select None | Expand All | Collapse All

Select Failure	Failure Description	Impact	Priority	Status	Time Detected
<input type="checkbox"/>	Data Failures				
<input checked="" type="checkbox"/>	One or more non-system datafiles are missing	See impact for individual child failures	HIGH	OPEN	2009-07-14 13:35:43.0
<input checked="" type="checkbox"/>	Datafile 7: /u01/app/oracle/oradata/orcl/inventory02.dbf is missing	Some objects in tablespace INVENTORY might be unavailable	HIGH	OPEN	2009-07-14 13:35:43.0

Note: If you do not see the nonsystem datafile failure, keep refreshing the page until it shows up.

- e) With the failures selected, click **Advise**.
- f) Because the file was not just renamed or moved, but deleted, you continue by clicking **“Continue with Advise.”**

Manual Actions

Cancel Re-assess Failures **Continue with Advise**

The following user actions may provide a faster recovery path for certain simple failures. Click "Re-assess Failures" if user actions are performed. Otherwise, click "Continue with Advise" to use the recovery advice generated for the failures selected.

Manual Action Details

If file /u01/app/oracle/oradata/orcl/inventory02.dbf was unintentionally renamed or moved, restore it

- g) On the Recovery Advise page, you see the RMAN script. Click **Continue**.

Recovery Advice

Cancel **Continue**

The repair includes complete media recovery with no data loss

RMAN Script

```
# restore and recover datafile
sql 'alter database datafile 7 offline';
restore datafile 7;
recover datafile 7;
sql 'alter database datafile 7 online';
```

- h) On the Review page, you see the failure and the suggested solution. Click **“Submit Recovery Job.”**
- i) A Processing window appears, followed by the Job Activity page. You should see a message that the job was successfully created. (Your link name is probably different.)

Confirmation

The job was created successfully

RECOVERY_ORCL.ORACLE.COM_000005

- j) Click the job name link.

Practice 16-2: Recovering from the Loss of a Data File (continued)

- k) On the Job Run page, check the Status in the Summary section. If it is Running, use your browser's **Refresh** or Requery button until the job is completed.

Summary	
Status	Succeeded
Scheduled	Jul 14, 2009 1:44:35 PM (UTC+07:00)
Started	Jul 14, 2009 1:44:35 PM (UTC+07:00)
Ended	Jul 14, 2009 1:45:18 PM (UTC+07:00)
Elapsed Time	42 seconds
Notification	No

- l) In your SQL*Plus session, verify that the INVENTORY.PRODUCT_MASTER table is now accessible.

Note: Your count value may be different than the one shown here.

```
SQL> select count(*) from INVENTORY.PRODUCT_MASTER;

COUNT (*)
-----
217368
```

- m) Now that recovery is complete, in Enterprise Manager, navigate to the database Home page and clear the alert.
- i) Click the link in the Message column for the Data Failure alert.
 - ii) Click **Clear Open Alert**.

Practice 16-3: Recovering from the Loss of a File in the SYSTEM Tablespace

In this practice, your system experiences the loss of a file in the SYSTEM tablespace. You then go through the steps to recover from this loss.

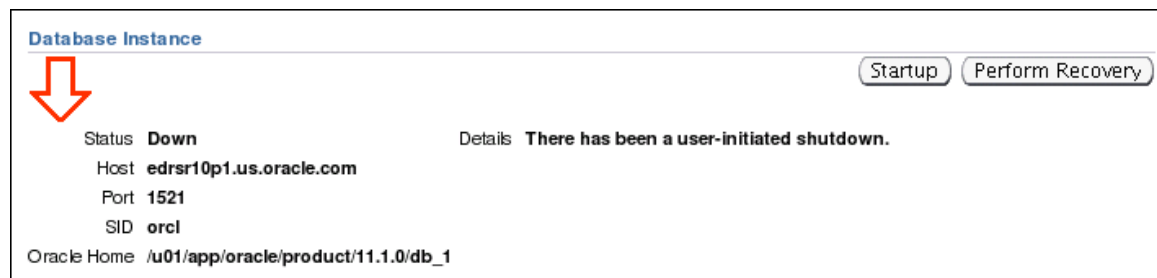
- 1) Why is recovery from the loss of a system data file or a data file belonging to an undo tablespace different from recovering an application data file?

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

- 2) As the `oracle` OS user, execute the `lab_16_03_02.sh` script in your `labs` directory. This script deletes the system data file.

```
$ ./lab_16_03_02.sh
```

- 3) In Enterprise Manager, review the Database home page. If you see a message that says the connection was refused, try re-entering the EM home page URL in the browser. You may need to try several times before you see the Database home page.



- 4) The database is shut down. Attempt to start your database.
 - a) Click **Startup** to try to open it.
 - b) On the “Startup/Shutdown:Specify Host and Target Database Credentials” page, enter **oracle** and **oracle** as Host Credentials. Click **OK**.
 - c) On the Select Startup Type page, leave the default selection and click **OK**.
 - d) On the Startup/Shutdown:Confirmation page, click **Yes**.

Practice 16-3: Recovering from the Loss of a File in the SYSTEM Tablespace (continued)

- e) A Srvctl Error appears saying that data file 1 cannot be identified. Click the **Database** tab to go back to your database Home page.

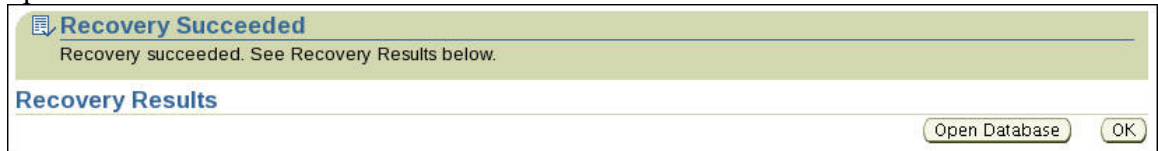
The screenshot shows the Oracle Enterprise Manager 11g Database Control interface. At the top, there is a navigation bar with the 'Database' tab highlighted. Below the navigation bar, a red error message is displayed: 'Srvctl Error'. The message states: 'An error occurred when executing the operation. Ensure that CRS processes and SRVCTL are functioning properly. Refresh the page to see the current status. Refer to the following error: startup open PRCR-1079 : Failed to start resource ora.orcl.db ORA-01157: cannot identify/lock data file 1 - see DBWR trace file ORA-01110: data file 1: '+DATA/orcl/datafile /system.256.692191147' CRS-2674: Start of 'ora.orcl.db' on 'edrsr12p1' failed'. Below the error message, the 'Startup/Shutdown: Select Operation' page is visible. It includes a 'Page Refreshed 7/14/09 1:58 PM' timestamp and a 'Refresh' button. The page has two tabs: 'Startup' and 'Shutdown'. Below the tabs, there are links for 'Select All' and 'Select None'. A table with three columns is shown: 'Select', 'Instance Name', 'Status', and 'Host Name'. The table contains one row for the instance 'orcl', which is selected (indicated by a checked checkbox) and has a status of 'Down' (indicated by a red arrow pointing down) and a host name of 'n/a'.

Select	Instance Name	Status	Host Name
<input checked="" type="checkbox"/>	orcl	↓	n/a

- 5) Click **Perform Recovery**.
- Enter **oracle** and **oracle** as Host Credentials, and click **Continue**.
 - Your database is currently down, so it needs to be started in a mounted state to perform the recovery. Click the **Start up the Database** link.
 - You are prompted again for the host credentials, enter **oracle** and **oracle** and click **OK**.
 - On the Select Startup Type page leave the default selection and click **OK**.
 - Click **Advanced Options** on the Startup/Shutdown: Confirmation page.
 - Select **Mount the database** for the Startup mode and click **OK**.
 - Click **Yes** back on the Startup/Shutdown: Confirmation page.
 - Startup is Successful. Click the **Database** tab.
 - Notice that your database is now in a mounted state. Click **Perform Recovery** again.
 - In the Host Credentials section, enter **oracle** for the username and password. Then click **Continue**.
 - On the Database Login page, enter **dba1** for the username, **oracle_4U** for the password, and **SYSDBA** for Connect As. Then click **Login**.
 - On the Perform Recovery page, click **Advise and Recover**.
 - On the View and Manage Failures page, review the description of the failure. Ensure the System datafile failure is selected and then click **Advise**.
 - On the Manual Actions page, click **Continue with Advise**.
 - On the Recovery Advice page, review the RMAN script and click **Continue**.
 - On the Review page, click **Execute Recovery**.

Practice 16-3: Recovering from the Loss of a File in the SYSTEM Tablespace (continued)

- k) A processing page appears, followed by the Perform Recovery: Result page. The duration of this operation depends on your system resources. The recovery operation should be successful.



- l) On the Perform Recovery: Result page, click **Open Database**.
- m) After you see the success message, click **OK**.
- n) Verify that the database is open and operating normally, by logging in to EM as the **DBA1** user as **SYSDBA**, and reviewing the Database home page.
- o) Now that recovery is complete, clear the alert.
 - i) Click the link in the Message column for the Data Failure alert.
 - ii) Click **Clear Open Alert**.

Practice 16-4: Recovering from the Loss of a Control File

In this practice, your system experiences the loss of a control file. To introduce the RMAN command-line environment, this practice guides you through a manual recovery process.

- 1) In a terminal window as the `oracle` user, run the **lab_16_04_01.sh** script. This script deletes one of your control files.

```
$/lab_16_04_01.sh
```

- 2) The Help desk begins receiving calls saying that the database appears to be down. Troubleshoot and recover as necessary. Use `SRVCTL` to try to start up the database.
 - a) In a terminal window, ensure that your environment is configured for your **orcl** database environment using **oraenv**.
 - b) Issue the following `SRVCTL` command to attempt to start up the database:
srvctl start database -d orcl -o open

```
$ srvctl start database -d orcl -o open
PRCR-1079 : Failed to start resource ora.orcl.db
ORA-00205: error in identifying control file, check alert log
for more info
CRS-2674: Start of 'ora.orcl.db' on 'edrsr12p1' failed
```

- c) Notice the error in identifying the control file.
- 3) Further investigate this failure by looking at your **alert_orcl.log** file (located in **/u01/app/oracle/diag/rdbms/orcl/orcl/trace** directory): In a terminal window, enter the following to see the last 20 lines of your **alert_orcl.log** file.

```
$ tail -20 alert_orcl.log
ALTER DATABASE MOUNT
NOTE: Loaded library:
/opt/oracle/extapi/32/asm/orcl/1/libasm.so
NOTE: Loaded library: System
SUCCESS: diskgroup DATA was mounted
SUCCESS: diskgroup FRA was mounted
ORA-00210: cannot open the specified control file
ORA-00202: control file:
'+FRA/orcl/controlfile/current.256.695531381'
ORA-17503: ksfdopn:2 Failed to open file
+FRA/orcl/controlfile/current.256.695531381
ORA-15012: ASM file
'+FRA/orcl/controlfile/current.256.695531381' does not exist
NOTE: dependency between database orcl and diskgroup resource
ora.DATA.dg is established
Sat Aug 22 03:18:05 2009
Checker run found 1 new persistent data failures
ORA-205 signalled during: ALTER DATABASE MOUNT...
Sat Aug 22 03:18:08 2009
Shutting down instance (abort)
```

Practice 16-4: Recovering from the Loss of a Control File (continued)

```
License high water mark = 1
USER (ospid: 17765): terminating the instance
Instance terminated by USER, pid = 17765
Sat Aug 22 03:18:08 2009
Instance shutdown complete
$
```

- 4) Notice that the missing control file is the one from your **+FRA** disk group. You know you also have a control file on the **+DATA** disk group. You can perform a recovery by restoring from the control file that is in the **+DATA** disk group, but you need to know the file name. Using **asmcmd**, determine the name of the control file in the **+DATA** disk group.

- a) Open a new terminal window and set your environment for your **+ASM** instance using **oraenv**.

```
$ . oraenv
ORACLE_SID = [oracle] ? +ASM
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid is
/u01/app/oracle
```

- b) Start **asmcmd** and use the **ls** command to determine the name of the control file in the **+DATA** disk group (this file will be in the **+data/orcl/controlfile** directory).

```
$ asmcmd
ASMCMD> ls +data/orcl/controlfile
Current.260.695209463
ASMCMD>
```

- c) Make a note of this name along with its full path because you will need this information for the next step.
- 5) In another terminal window, connect to **RMAN** and use the following command to restore your control file:

```
restore controlfile from  
'+DATA/orcl/controlfile/yourcontrolfilename';
```

Then mount and open your database.

- a) Set your environment for your **orcl** database using **oraenv** and then connect to **RMAN**.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$ rman target /

Recovery Manager: Release 11.2.0.2.0 - Production on Sat Aug
22 03:27:29 2009
```

Practice 16-4: Recovering from the Loss of a Control File (continued)

```
Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.
```

```
connected to target database (not started)
```

```
RMAN>
```

b) First, you need to put your database into NOMOUNT mode.

```
RMAN > startup nomount
```

```
Oracle instance started
```

```
Total System Global Area      577511424 bytes
```

```
Fixed Size                      1337984 bytes
```

```
Variable Size                   469763456 bytes
```

```
Database Buffers               100663296 bytes
```

```
Redo Buffers                    5746688 bytes
```

```
RMAN>
```

c) Restore the control file from the existing control file on the +DATA disk group.

Note: Use the file name determined in step 4.

```
RMAN> restore controlfile from  
'+DATA/orcl/controlfile/current.260.695209463';
```

```
Starting restore at 22-AUG-09  
using target database control file instead of recovery catalog  
allocated channel: ORA_DISK_1  
channel ORA_DISK_1: SID=23 device type=DISK
```

```
channel ORA_DISK_1: copied control file copy  
output file name=+DATA/orcl/controlfile/current.260.695209463  
output file name=+FRA/orcl/controlfile/current.256.695532623  
Finished restore at 22-AUG-09
```

```
RMAN>
```

d) Mount your database.

```
RMAN> alter database mount;
```

```
database mounted
```

e) Open your database.

```
RMAN> alter database open;
```

```
database open
```

***Practice 16-4: Recovering from the Loss of a Control File
(continued)***

- 6) Open a browser and log in to Enterprise Manager as the **dba1** user. On the Database home page, confirm that your database is again up and running.
- 7) Exit all sessions and close all windows.

Practices for Lesson 17

Background: In the recent past, you received a number of questions about the HR schema. To analyze them without interfering in 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 learn 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 DBA1 schema.

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

Practice 17-1: Moving Data Using Data Pump

In this practice, you first grant the DBA1 user the privileges necessary to provide access to the DATA_PUMP_DIR directory. You then export the HR schema so that you can then import the tables that you want into the DBA1 schema. In the practice, you import only the EMPLOYEES table at this time.

- 1) First, you need to grant to the DBA1 user the appropriate privileges on the DATA_PUMP_DIR directory and create the users and roles required for this practice. A script exists that performs all the steps required to configure your environment for this practice.
 - a) Review the **lab_17_01_01.sql** script, which grants the DBA1 user privileges on the DATA_PUMP_DIR directory and performs other configurations to your environment, by executing the following in your labs directory:

```
$ cat lab_17_01_01.sql
```

- b) The lab_17_01_01.sh script calls the lab_17_01_01.sql script. Execute the **lab_17_01_01.sh** script now:

```
$ ./lab_17_01_01.sh
Create HR_TEST tablespace, HR_TEST_ROLE role, the HR_TEST
users

Tablespace created.

User created.

Role created.

Grant succeeded.

Grant succeeded.

Table altered.

Grant succeeded.

Grant succeeded.

You may now login as: hr_test/oracle_4U
spool off
$
```


Practice 17-1: Moving Data Using Data Pump (continued)

- 2) Log in to Enterprise Manager as the **DBA1** user in the **Normal** role and export the HR schema.
 - a) Invoke Enterprise Manager as the **DBA1** user as the **Normal** role for your **orcl** database. The **Connect As** setting should be Normal.
 - b) Select **Data Movement** > Move Row Data > **Export to Export Files**.
 - c) Select **Schemas**, enter **oracle** as Username and Password, select **Save as Preferred Credential**, and then click **Continue**.
 - d) On the Export: Schemas page, click **Add**, select the **HR** schema, and then click the **Select** button.
 - e) You see that HR is now in the list of schemas. Click **Next**.

Export: Schemas

Database orcl.oracle.com

Cancel Finish Step 1 of 5 **Next**

Add

Remove

Select Schemas

Select	Schemas
<input checked="" type="radio"/>	HR

- f) On the Export: Options page, select **DATA_PUMP_DIR** from the Directory Objects drop-down list, and enter **hrexpl.log** as Log File.

Optional File

☒ Generate Log File

Directory Object DATA_PUMP_DIR Create Directory Object

Log File hrexpl.log

- 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**.

Export: Files

Database orcl.oracle.com

Cancel Finish Back Step 3 of 5 **Next**

Create Directory Object

Specify the directory object and file name, and maximum size for the export files on the database server machine.

Select	Directory Object	File Name	Maximum File Size (MB)
<input checked="" type="radio"/>	DATA_PUMP_DIR	HREXP%U.DMP	

Add Another Row

You can wildcard a set of dump files using '%U' in the filename. A '%D' wildcard will be replaced with the date the job is run using a YYYYMMDD format.

Practice 17-1: Moving Data Using Data Pump (continued)

- 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**.

Export: Schedule

Database **orcl.oracle.com** Cancel Back Step 4 of 5 Next

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

Job Parameters

Job Name

Description

Job Schedule

Time Zone

Start

☒ Immediately ☐ Later

- 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** to submit the job.
- l) Click the link to the HREXP job to monitor the progress. Refresh your browser until you see that the job has successfully completed then move on to the next step.

Summary	
Status	Succeeded
Scheduled	Jul 14, 2009 2:44:00 PM (UTC+07:00)
Started	Jul 14, 2009 2:44:00 PM (UTC+07:00)
Ended	Jul 14, 2009 2:45:45 PM (UTC+07:00)
Elapsed Time	105 seconds
Notification	No

- 3) Now, import the **EMPLOYEES** table from the exported **HR** schema into the **DBA1** schema. To get a feeling for the command-line interface, you can use the **impdp** utility from the command line to import the **EMPLOYEES** table into the **DBA1** user schema.

- a) Ensure that your environment is configured for the **orcl** database by running **oraenv**.

```
$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

- b) Enter the following entire command string. Do not press [Enter] before reaching the end of the command:
- ```
impdp dba1/oracle_4U DIRECTORY=data_pump_dir
DUMPFILE=HREXP01.DMP REMAP_SCHEMA=hr:dba1
TABLES=hr.employees LOGFILE=empimport.log
```

## Practice 17-1: Moving Data Using Data Pump (continued)

```
$ impdp dba1/oracle_4U DIRECTORY=data_pump_dir
DUMPFILE=HREXP01.DMP REMAP_SCHEMA=hr:dba1 TABLES=hr.employees
LOGFILE=empimport.log

Import: Release 11.2.0.1.0 - Production on Thu Jul 16 00:46:18
2009

Copyright (c) 1982, 2009, Oracle and/or its affiliates. All
rights reserved.

Connected to: Oracle Database 11g Enterprise Edition Release
11.2.0.1.0 - Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options
Master table "DBA1"."SYS_IMPORT_TABLE_01" successfully
loaded/unloaded
Starting "DBA1"."SYS_IMPORT_TABLE_01": dba1/*****
DIRECTORY=data_pump_dir DUMPFILE=HREXP01.DMP
REMAP_SCHEMA=hr:dba1 TABLES=hr.employees LOGFILE=empimport.log
Processing object type SCHEMA_EXPORT/TABLE/TABLE
Processing object type SCHEMA_EXPORT/TABLE/TABLE_DATA
. . imported "DBA1"."EMPLOYEES" 16.81
KB 107 rows
Processing object type
SCHEMA_EXPORT/TABLE/GRANT/OWNER_GRANT/OBJECT_GRANT
Processing object type SCHEMA_EXPORT/TABLE/INDEX/INDEX
Processing object type
SCHEMA_EXPORT/TABLE/CONSTRAINT/CONSTRAINT
Processing object type
SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/INDEX_STATISTICS
Processing object type SCHEMA_EXPORT/TABLE/COMMENT
Processing object type
SCHEMA_EXPORT/TABLE/CONSTRAINT/REF_CONSTRAINT
ORA-39083: Object type REF_CONSTRAINT failed to create with
error:
ORA-00942: table or view does not exist
Failing sql is:
ALTER TABLE "DBA1"."EMPLOYEES" ADD CONSTRAINT "EMP_JOB_FK"
FOREIGN KEY ("JOB_ID") REFERENCES "DBA1"."JOBS" ("JOB_ID")
ENABLE

ORA-39083: Object type REF_CONSTRAINT failed to create with
error:
ORA-00942: table or view does not exist
Failing sql is:
ALTER TABLE "DBA1"."EMPLOYEES" ADD CONSTRAINT "EMP_DEPT_FK"
FOREIGN KEY ("DEPARTMENT_ID") REFERENCES "DBA1"."DEPARTMENTS"
("DEPARTMENT_ID") ENABLE

Processing object type SCHEMA_EXPORT/TABLE/TRIGGER
```

## Practice 17-1: Moving Data Using Data Pump (continued)

```
ORA-39082: Object type TRIGGER:"DBA1"."SECURE_EMPLOYEES"
created with compilation warnings
ORA-39082: Object type TRIGGER:"DBA1"."SECURE_EMPLOYEES"
created with compilation warnings
ORA-39082: Object type TRIGGER:"DBA1"."UPDATE_JOB_HISTORY"
created with compilation warnings
ORA-39082: Object type TRIGGER:"DBA1"."UPDATE_JOB_HISTORY"
created with compilation warnings
Processing object type
SCHEMA_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Job "DBA1"."SYS_IMPORT_TABLE_01" completed with 6 error(s) at
00:46:45
```

**Note:** You may see errors on constraints and triggers not being created because only the EMPLOYEES table is imported and not the other objects in the schema. These errors are expected.

c) You can also verify that the import succeeded by viewing the log file.

```
$ cat /u01/app/oracle/admin/orcl/dpdump/empimport.log
```

- 4) Confirm that the EMPLOYEES table has been loaded into the DBA1 schema by logging in to SQL\*Plus as the **DBA1** user and selecting data from the **EMPLOYEES** table.

a) Log in to SQL\*Plus as the **DBA1** user.

**Note:** Remember to use oraenv to set your environment to the orcl database if you have not already done so in your terminal window.

```
$ sqlplus dba1

SQL*Plus: Release 11.1.0.6.0 - Production on Sun Aug 31
16:54:32 2008

Copyright (c) 1982, 2007, Oracle. All rights reserved.

Enter Password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.1.0.6.0 -
Production
With the Partitioning, OLAP, Data Mining and Real Application
Testing options

SQL>
```

- b) Select a count of the rows from the **EMPLOYEES** table in the **DBA1** schema, for verification of the import.

### ***Practice 17-1: Moving Data Using Data Pump (continued)***

```
SQL> select count(*) from employees;
```

```
 COUNT(*)
```

```

```

```
 107
```

```
SQL>
```

## Practice 17-2: Loading Data Using SQL\*Loader

In this practice, you load data into the `PRODUCT_MASTER` table by using SQL\*Loader via Enterprise Manager Database Control. Data and control files are provided.

- 1) As the **DBA1** user, use Enterprise Manager to load the `lab_17_02_01.dat` data file. This data file contains rows of data for the **PRODUCT\_MASTER** table. The `lab_17_02_01.ctl` file is the control file for this load.  
Optionally, view the `lab_17_02_01.dat` and `lab_17_02_01.ctl` files to learn more about their structure before going further.
  - a) Invoke Enterprise Manager as the **DBA1** user as the **Normal** role for your **orcl** database.
  - b) Select **Data Movement** > Move Row Data > **Load Data from User Files**.
  - c) Click **Use Existing Control File**. If not already entered, enter **oracle** as Username and as Password, click **Save as Preferred Credential**, and then click **Continue**.

**Load Data: Generate Or Use Existing Control File**

Database **orcl.oracle.com** Cancel Continue

☐ Automatically Generate Control File  
A control file will be generated after you define the structure of the data file.

☒ **Use Existing Control File**  
Allows you to use an existing control file that defines the structure of the data file.

**Host Credentials**

\* Username

\* Password

☐ Save as Preferred Credential

- d) On the Load Data: Control File page, enter `/home/oracle/labs/lab_17_02_01.ctl` as the control file name and path, or use the flashlight icon to select this control file. Click **Next**.

**Load Data: Control File**

Database **orcl.oracle.com** Cancel Finish Step 1 of 6 Next

A control file is used to describe what will be loaded and how. Specify the full path and name of the control file on the database server machine

- e) 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_17_02_01.dat` as the data file name and path, or use the flashlight icon to select this data file. Click **Next**.

**Load Data: Data File**

Database **orcl.oracle.com** Cancel Finish Back Step 2 of 6 Next

How would you like to specify the file containing the data?

☐ The data file is specified in the control file

☒ **Provide the full path and name on the database server machine**

## Practice 17-2: Loading Data Using SQL\*Loader (continued)

- f) On the Load Data: Load Method page, select **Conventional Path**, and then click **Next**.

**Load Data: Load Method**

Database **orcl.oracle.com** Cancel Finish Back Step 3 of 6 Next

☒ **Conventional Path**  
Runs SQL INSERT statements to load data into database tables. Use this option if none of the choices below are appropriate.

☐ **Direct Path (faster)**  
Formats data blocks and writes them directly to the database files. No writing to clustered tables. No other writing to destination tables in progress. No SQL in the control file.

☐ **Parallel Direct Path (fastest)**  
Writes data into the same table or into the same partition table in concurrent sessions. Data is only appended. Triggers and constraints are disabled. No indexes maintained.

- g) On the Load Data: Options page, accept all defaults, but enter **/home/oracle/labs/lab\_17\_02\_01.log** as the log file name and path. Review the advanced options if you want, but do not change any, and then click **Next**.

**Optional Files**

☐ Generate bad file where records which contain errors are stored  
Bad File

☐ Generate discard file where rejected and uninserted records are stored  
Discard File

☒ Generate log file where logging information is to be stored  
Log File

[Show Advanced Options](#)

Cancel Finish Back Step 4 of 6 Next

- h) On the Load Data: Schedule page, enter **lab\_17\_02\_01** 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.oracle.com** Cancel Back Step 5 of 6 Next

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

**Job Parameters**

Job Name   
Description

**Job Schedule**

Time Zone

Start  
☒ **Immediately**  
☐ Later

- i) On the Load Data: Review page, review the loading information and parameters, and then click **Submit Job**.

## Practice 17-2: Loading Data Using SQL\*Loader (continued)

- j) Click the link to the LAB\_17\_02\_01 job to monitor the progress. After the job shows as successfully completed, move on to the next step.

| Summary      |                                     |
|--------------|-------------------------------------|
| Status       | Succeeded                           |
| Scheduled    | Jul 14, 2009 2:55:29 PM (UTC+07:00) |
| Started      | Jul 14, 2009 2:55:29 PM (UTC+07:00) |
| Ended        | Jul 14, 2009 2:55:37 PM (UTC+07:00) |
| Elapsed Time | 8 seconds                           |
| Notification | No                                  |

- k) Confirm your results by viewing your **lab\_17\_02\_01.log** file in your **/home/oracle/labs** directory.
- 2) As the **INVENTORY** user, load data into the **PRODUCT\_ON\_HAND** table by using SQL\*Loader command line. The **lab\_17\_02\_02.dat** data file contains rows of data for the **PRODUCT\_ON\_HAND** table. The **lab\_17\_02\_02.ctl** file is the control file for this load.
- Optionally, view the **lab\_17\_02\_02.dat** and **lab\_17\_02\_02.ctl** files to learn more about their structure before going further.
- a) Open a terminal window and navigate to the **/home/oracle/labs** directory.
- b) Ensure that your environment is configured for the **orcl** database by running **oraenv**.

```
$. oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base for
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1 is
/u01/app/oracle
$
```

- c) Enter the following SQL\*Loader command (in continuation, without pressing [Enter] before reaching the end of the command):

```
sqlldr userid=inventory/oracle_4U control=lab_17_02_02.ctl
log=lab_17_02_02.log data=lab_17_02_02.dat
```

```
$ sqlldr userid=inventory/oracle_4U control=lab_17_02_02.ctl
log=lab_17_02_02.log data=lab_17_02_02.dat

SQL*Loader: Release 11.2.0.1.0 - Production on Tue Jul 14
14:56:44 2009

Copyright (c) 1982, 2009, Oracle and/or its affiliates. All
rights reserved.

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



***Practice 17-2: Loading Data Using SQL\*Loader (continued)***

- d) Confirm your results by viewing your `lab_17_02_02.log` file in your `/home/oracle/labs` directory.



## Practice 18-1: Investigating a Critical Error

In this practice, you investigate a critical error. A data block has been corrupted. Use the Enterprise Manager Support Workbench, Health Checkers, and advisors to react to the error.

- 1) Set up the database for the practice. The setup creates a tablespace for the practice, and performs a tablespace backup. Run the `lab_18_01_01.sh` script. The scripts for this practice are in the `$HOME/labs` directory.

```
$ cd $HOME/labs
$./lab_18_01_01.sh
```

- 2) Run the `lab_18_01_02.sql` script from SQL\*Plus connected as `sysdba` to create the critical error. The script prompts you for a block number; enter the block number given by the script. Notice the error message. In our scenario, the error message could originally be seen by anyone and not reported immediately to the DBA.

**Note:** Remember to use `oraenv` to set your environment to the `orcl` database if you have not already done so in your terminal window.

```
$ sqlplus / as sysdba

SQL*Plus: Release 11.2.0.1.0 Production on Wed Jul 15 01:30:42
2009

Copyright (c) 1982, 2009, Oracle. All rights reserved.

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options

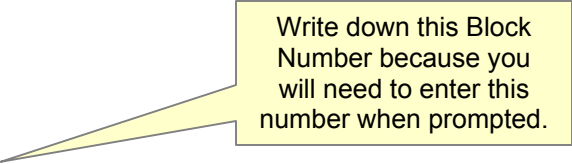
SQL> @lab_18_01_02.sql
Connected.

 FILE_NO BLOCK_NO

 9 129

System altered.

'Enter Block number when prompted'
Enter value for block_no: 129
0+1 records in
0+1 records out
80 bytes (80 B) copied, 6.693e-05 seconds, 1.2 MB/s
0+1 records in
0+1 records out
```



Write down this Block Number because you will need to enter this number when prompted.

## Practice 18-1: Investigating a Critical Error (continued)

```
79 bytes (79 B) copied, 6.3419e-05 seconds, 1.2 MB/s

SELECT * from js.jscopy
*
ERROR at line 1:
ORA-01578: ORACLE data block corrupted (file # 9, block # 129)
ORA-01110: data file 9:
'/u01/app/oracle/oradata/orcl/jstbs01.dbf'

Disconnected from Oracle Database 11g Enterprise Edition
Release 11.2.0.1.0 - Production
With the Partitioning, Automatic Storage Management, OLAP,
Data Mining
and Real Application Testing options
$
```

- 3) Log in to Enterprise Manager as the **DBA1** user in the **SYSDBA** role, and then view the alerts on the Database home page and investigate the alert details. When the incident appears in the alerts, click the Active Incidents link.

You should see one or more critical alerts. Depending on the timing, you may see one or more of the following:

| Severity | Category     | Name                         | Impact | Message                                                                                                                                                             | Alert Triggered         |
|----------|--------------|------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ×        | Data Failure | Data Failure Detected        |        | <a href="#">Checker run found 2 new persistent data failures.</a>                                                                                                   | Jul 15, 2009 1:32:46 AM |
| ×        | Incident     | Oracle Data Block Corruption |        | <a href="#">An Oracle data block corruption detected in /u01/app/oracle/diag/rdbms/orcl/orcl/alert/log.xml at time/line number: Wed Jul 15 01:30:50 2009/18258.</a> | Jul 15, 2009 1:32:46 AM |
| !        | User Audit   | Audited User                 |        | <a href="#">User SYS logged on from edrsr12p1.us.oracle.com.</a>                                                                                                    | Jul 15, 2009 1:17:22 AM |

The number of Active Incidents may not match the number of alerts immediately. Click the **Active Incidents** link.

| Diagnostic Summary                       |                                         |
|------------------------------------------|-----------------------------------------|
| ADDM Findings                            | 0                                       |
| Alert Log                                | <a href="#">Jul 15, 2009 1:30:50 AM</a> |
| Active Incidents                         | 1                                       |
| Key SQL Profiles                         | 1                                       |
| <a href="#">Database Instance Health</a> |                                         |

- 4) Investigate the details of the problem.

On the Support Workbench page and **Problems** tab, expand the problem with the description ORA 1578.

Click the incident number of the most recent (first listed) incident.

## Practice 18-1: Investigating a Critical Error (continued)

- 5) Examine the Incident Details page. Notice that the SQL text of the statement that received the error is listed, and the session information. Depending on the error this information can be very helpful in troubleshooting the error.

- 6) View a trace file.

Click the **eyeglasses** icon to view the first trace file listed. If you are prompted for Host Login Credentials, enter user `oracle` and password `oracle` and click Continue.

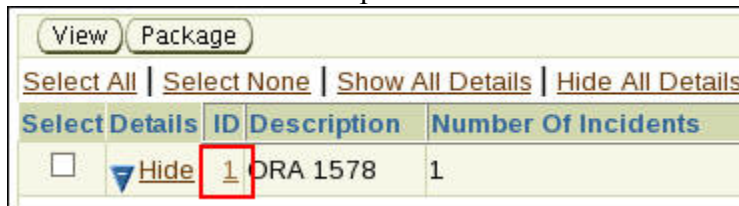
**Note:** If you do not see a trace file listed, please be patient. It can take a few minutes before the trace file appears in the list.

On the Contents page, you can see the trace file. Sections of the trace file can be expanded or collapsed. The trace file is intended for Oracle internal use. Click **OK**.

Click **Support Workbench** link in the breadcrumb at the top of the page to return to the Support Workbench page.

- 7) Determine how to resolve the problem.

Click ID of the ORA 1578 problem.



The screenshot shows a table with incident details. At the top are buttons for 'View' and 'Package'. Below them are links: 'Select All', 'Select None', 'Show All Details', and 'Hide All Details'. The table has four columns: 'Select Details', 'ID', 'Description', and 'Number Of Incidents'. The first row shows a checkbox, a dropdown menu set to 'Hide', the ID '1', the description 'ORA 1578', and the count '1'. The ID '1' is highlighted with a red box.

| Select Details           | ID | Description | Number Of Incidents |
|--------------------------|----|-------------|---------------------|
| <input type="checkbox"/> | 1  | ORA 1578    | 1                   |

- 8) When the problem details page appears, notice that the Investigate and Resolve section has two tabs that allow you to pursue the solution yourself or enlist the aid of Oracle Support.



The screenshot shows the 'Investigate and Resolve' page. At the top are buttons for 'Go to My Oracle Support' and 'Quick Package'. Below them are two tabs: 'Self Service' and 'Oracle Support'. The page is divided into three sections: 'Assess Damage' with links for 'Checker Findings', 'Run Checkers', and 'Database Instance Health'; 'Diagnose' with links for 'Alert Log', 'Related Problems Across Topology', 'Diagnostics for Last Dumped Incident', and 'Go to My Oracle Support and Research'; and 'Resolve' with links for 'SQL Repair Advisor' and 'Data Recovery Advisor'.

## Practice 18-1: Investigating a Critical Error (continued)

- 9) Get Checker information about the problem. Click **Support Workbench** in the breadcrumb at the top of the page to return to the Support Workbench page. Click **Checker Findings** tab.

**Support Workbench**

Page Refreshed July 15, 2009 3:00:50 AM GMT+07:00 [Refresh](#)

[Problems \(1\)](#) [Checker Findings \(3\)](#) [Packages \(0\)](#)

**Search**

Description  Damage Translation  Status  Time Detected  [Go](#)

- 10) Get advise. Under the Checker Findings tab, in the Data Corruption section, Select the finding with the description that starts with “Datafile ...” and click **Launch Recovery Advisor**.

**Data Corruption**

Select findings and click on the “Launch Recovery Advisor” button to repair those findings.

[Launch Recovery Advisor](#)

[Select All](#) | [Select None](#) | [Expand All](#) | [Collapse All](#)

| Select                              | Description                                                                                  | Priority | Damage Translation                                    | Incident ID | Status | Time Detected                      |
|-------------------------------------|----------------------------------------------------------------------------------------------|----------|-------------------------------------------------------|-------------|--------|------------------------------------|
| <input type="checkbox"/>            | ▼ All Findings                                                                               |          |                                                       |             |        |                                    |
| <input checked="" type="checkbox"/> | ▶ Datafile 9: '/u01/app/oracle/oradata/orcl/jstbs01.dbf' contains one or more corrupt blocks | High     | Some objects in tablespace JSTBS might be unavailable | 18345       | Open   | July 15, 2009 1:31:07 AM GMT+07:00 |

**Note:** The data file number given in the description is the same as the FILE\_NO shown when you ran the lab\_18\_01\_02.sql script in step 2.

- a) On the View and Manage Failures page, confirm that the failure “Datafile ...” is selected, and then click **Advise**.
- b) The Recovery Advice page recommends an RMAN script. This script will perform a block media recovery. Click **Continue**.
- c) The Review page shows the failures that will be resolved. Click **Submit Recovery Job**.
- d) The Processing page may appear briefly, after which the Job Activity page appears. The Job Status shows Running. Refresh the page after a few moments and repeat until the page shows No Jobs Found.
- 11) Open a terminal window and log in to SQL\*Plus as the **js** user with a password of **oracle\_4U**. Select from the **jscopy** table and ensure that you do not see any further block corruption errors.

**Note:** Remember to use oraenv to set your environment to the orcl database if you have not already done so in your terminal window.

```
SQL> select * from jscopy;
```

| EMPLOYEE_ID | FIRST_NAME | LAST_NAME    |
|-------------|------------|--------------|
| -----       | -----      | -----        |
| EMAIL       |            | PHONE_NUMBER |
| JOB_ID      | SALARY     | HIRE_DATE    |

### Practice 18-1: Investigating a Critical Error (continued)

|                |            |               |                 |
|----------------|------------|---------------|-----------------|
| -----          |            |               |                 |
| -----          |            |               |                 |
| COMMISSION_PCT | MANAGER_ID | DEPARTMENT_ID |                 |
| -----          |            |               |                 |
| 100            | Steven     | King          |                 |
| SKING          |            | 515.123.4567  | 17-JUN-87       |
| AD_PRES        | 24001      |               |                 |
|                |            | 90            |                 |
| 101            | Neena      | Kochhar       |                 |
| NKOCHHAR       |            | 515.123.4568  | 21-SEP-89 AD_VP |
| 17001          |            |               |                 |
|                | 100        | 90            |                 |
| ...            |            |               |                 |

- 12) When finished, run the **lab\_18\_01\_12.sh** script from the **\$HOME/labs** directory to remove the objects created in this practice.

```
$ cd $HOME/labs
$./lab_18_01_12.sh
```





---

## **Appendix B**

### **Basic Linux and vi Commands**

---

## 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.



## 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><br>man -k <string><br><br>man man | Find the manual entry for this <command>.<br>Show all the manual entries that contain this <string>.<br>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/passwd                                     |                                                                                                                                                |
| 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><br><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><br>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> .<br>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> .<br>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.<br><code>grep</code> can accept input from a file or stdin through a pipe as in:<br><code>netstat -a   grep ESTABLISHED</code> |
| Source a script               | <code>. &lt;script_file&gt;</code>                            | In the <code>bash</code> shell this command <code>.'</code> 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 <code>nawk</code> – 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 <code>vim</code> , an improved <code>vi</code> , that is a superset of <code>vi</code> .                                                                    |
| 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 ( <code>stdout</code> ), is not a command but a concept, most Linux commands write to <code>stdout</code> by default unless redirected.                                                                             |
| Terminal input (keyboard) | <code>stdin</code>                               | Standard in ( <code>stdin</code> ), is not a command but a concept, most Linux commands read from <code>stdin</code> by default unless redirected.                                                                               |
| Alias                     | <code>alias &lt;command&gt; &lt;alias&gt;</code> | Make a substitution when a user types <code>&lt;command&gt;</code> substitute and execute <code>&lt;alias&gt;</code> , common alias is <code>alias 'rm' 'rm -i'</code> . These aliases are set in the <code>.bashrc</code> 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>                                                                                                                                                                                                                                       |
|------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Substitute user              | <code>su - username</code>                           | Change the user that is currently performing the work. This can be used by any user to change who is the effective id of the session user. normal users must provide a password, root does not. The ‘-‘ parameter is optional. It runs the new users login scripts. |
| Limited root privileges      | <code>sudo</code>                                    | The root user may configure which users can execute certain commands as root, and whether a password is required or not. Useful for allowing specific users to perform certain root commands e.g. mount and unmount removable volumes such as CDROMs.               |
| Root file system             | <code>/</code>                                       | The root directory for the system directory tree.                                                                                                                                                                                                                   |
| Home Directory               | <code>/home</code>                                   | Typically the directory in which all user home directories placed. For example: <code>/home/oracle</code> .                                                                                                                                                         |
| Tmp directory                | <code>/tmp</code>                                    | 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               | <code>/boot</code>                                   | A small partition to hold the kernel image(s) and boot loader instructions.                                                                                                                                                                                         |
| Log directory                | <code>/var/log</code>                                | The location of most system log files.                                                                                                                                                                                                                              |
| Sample configuration files   | <code>/etc/inittab</code>                            | Configuration files are located per the application. Any configuration file that you change after installation should be included in the backup.                                                                                                                    |
| Password files               | <code>/etc/passwd</code><br><code>/etc/shadow</code> | The <code>/etc/passwd</code> file holds user information and must be readable by others; even with encrypted passwords this can be a security hole. The <code>/etc/shadow</code>                                                                                    |



|                      |                     |                                                                                                                                                               |
|----------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                     | 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 OS vendor supplied tool.                    |

|                                                         |                                               |                                                                                                                                                                                                                                  |
|---------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Schedule a command to run at a regularly scheduled time | crontab -e                                    | Use this command to edit the crontab file, to create the specification for the cron daemon to use.                                                                                                                               |
| Schedule a script to run at a particular frequency      | /etc/anacrontab                               | Edit the file to specify a script to run at a particular frequency (see man anacrontab for details).                                                                                                                             |
| Schedule a command to run at a single specified time    | at <options> TIME                             | Runs a job specified by <options> at a specified TIME parameter.                                                                                                                                                                 |
| Schedule a command                                      | batch <options> <TIME>                        | Run a command when the load average drops below .8, optionally after a set TIME.                                                                                                                                                 |
| Mount a file system                                     | mount <opt> <dev> <mount_point>               | Mount a file system on device <dev> at <mount_point> with the options specified by <dev>.                                                                                                                                        |
| Unmount a file system                                   | umount <dev><br>umount <mount_point>          | Unmount the file system or device.                                                                                                                                                                                               |
| Maximum # of user ID                                    | 65535                                         |                                                                                                                                                                                                                                  |
| Recover root password                                   | {lilo}<br>control-x<br>linux S<br>passwd root | This is a procedure to recover the root password if is lost. This requires physical access to the machine and system console. You start by rebooting the machine, then during the LILO boot press and hold [Ctrl] + [x] to get a |

|                 |                                                                                                                          |                                                                                                                                                                             |
|-----------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <pre>{grub} c kernel vmlinuz-2.4.9-13 <b>single</b> ro root=/dev/hda8 initrd /initrd-2.4.9-13.img boot passwd root</pre> | <p>prompt and command LILO to boot linux to runlevel S.</p> <p>The second procedure uses the grub boot loader.</p>                                                          |
| Create new user | <pre>useradd</pre>                                                                                                       | <p>The -D option alone shows the defaults.</p> <p>-D with other options changes the defaults options; without -D override, the default (e.g., -g) 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/passwd</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 shutdown 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>                      |                                                                                                                                   |
|                           | <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>rmmod</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> | View SCSI disk information.                                                 |
|                                    | <code>cat /proc/ide/ide0/hda/model</code>   | 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                        | 2 GB {512B block size}                  | The oracle database can create files up to 64 GB with a 16 KB database block size.     |
| File size can not exceed file system | 2 TB {4KB block size}                   | The 32-bit kernel limits file and block devices to 2 TB.                               |
| File System Block size               | dumpe2fs <device>                       | Dump the file system properties to stdout.                                             |
| Filesystem table                     | /etc/fstab                              | Mounts these file systems at boot up.                                                  |
| Journal Filesystem types             | ext3<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              | <pre>{lilo} control-x linux S  {grub} c kernel vmlinuz-2.4.9-13 <b>single</b> ro root=/dev/hda8 initrd /initrd-2.4.9-13.img boot</pre> | <p>Use LILO facility.</p> <p>Use GRUB Boot Loader.</p>                                                                                                                          |
| 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                  | <code>vgexport</code>            |  |
| Imports volume group                  | <code>vgimport</code>            |  |
| Volume group listing                  | <code>vgscan</code>              |  |
| Change logical volume characteristics | <code>lvchange</code>            |  |
| List logical volume                   | <code>lvdisplay</code>           |  |
| Make logical volume                   | <code>lvcreate</code>            |  |
| Extend logical volume                 | <code>lvextend</code>            |  |
| Reduce logical volume                 | <code>lvreduce</code>            |  |
| Remove logical volume                 | <code>lvremove</code>            |  |
| Create striped volumes                | <code>lvcreate -i 3 -I 64</code> |  |



---

# **Appendix C**

## **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   PARAMETERS ('ODCI_parameters') </pre>                                                                                                                    |

| SQL Statement           | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>   { 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   ] [ { ENABLE   DISABLE } QUERY REWRITE   COMPILE </pre> |



| SQL Statement               | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>   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   { ENABLE   DISABLE } ]... ; </pre>                                                                                                                                                                                                                                                                                   |

| SQL Statement         | Syntax                                                                                                                                                                                                                                                   |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 ROLBACK SEGMENT | <pre> ALTER ROLLBACK SEGMENT rollback_segment   { ONLINE     OFFLINE     storage_clause     SHRINK [ TO integer [ K   M ] ]   }; </pre>                                                                                                                  |

| SQL Statement  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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> |
| ALTER TABLE    | <pre> ALTER TABLE [ schema. ]table [ alter_table_properties   column_clauses </pre>                                                                                                                                                                                                                                                                                                                                                                                                                               |

| SQL Statement    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <pre>   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 } } [ dependent_handling_clause ] } ; </pre>                                                                                                                                                                    |

| SQL Statement | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 } }  [ { 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 } } ]...   user [, user ]... proxy_clause ; </pre> |

| SQL Statement        | Syntax                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>                                                                                                                                                                                                                                                                |
| COMMENT              | <pre> COMMENT ON {   TABLE [ schema. ]   { table   view }   COLUMN [ schema. ]   { table.   view.   materialized_view. } column   OPERATOR [ schema. ] operator   INDEXTYPE [ schema. ] indextype } ; </pre>                                                                                                                                                                                       |

| SQL Statement      | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    | <pre>   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 [ logfile_clause ] { RESETLOGS   NORESETLOGS } [ DATAFILE file_specification [, file_specification ]... ] [ { MAXLOGFILES integer   MAXLOGMEMBERS integer   MAXLOGHISTORY integer </pre>                                                                                                                                                                                                                                      |

| SQL Statement        | Syntax                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <pre>   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   attribute_clause   extended_attribute_clause   } [ hierarchy_clause   attribute_clause   extended_attribute_clause   ] ... ; </pre>                                                                                                                                           |



| SQL Statement    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CREATE DIRECTORY | CREATE [ OR REPLACE ] DIRECTORY directory<br>AS 'path_name' ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| CREATE DISKGROUP | CREATE DISKGROUP diskgroup_name<br>[ { HIGH   NORMAL   EXTERNAL } REDUNDANCY ]<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>]... ;                                                                                                                                                                                                                                                           |
| CREATE FUNCTION  | CREATE [ OR REPLACE ] FUNCTION [ schema. ]function<br>[ (argument [ IN   OUT   IN OUT ]<br>[ NOCOPY ] datatype<br>[, argument [ IN   OUT   IN OUT ]<br>[ NOCOPY ] datatype<br>]...<br>)<br>]<br>RETURN datatype<br>[ { invoker_rights_clause<br>  DETERMINISTIC<br>  parallel_enable_clause<br>}<br>[ invoker_rights_clause<br>  DETERMINISTIC<br>  parallel_enable_clause<br>]...<br>]<br>{ { AGGREGATE   PIPELINED }<br>USING [ schema. ]implementation_type<br>  [ PIPELINED ]<br>{ IS   AS }<br>{ pl/sql_function_body   call_spec }<br>}<br>; |
| CREATE INDEX     | CREATE [ UNIQUE   BITMAP ] INDEX [ schema. ]index<br>ON { cluster_index_clause<br>  table_index_clause<br>  bitmap_join_index_clause<br>}<br>;                                                                                                                                                                                                                                                                                                                                                                                                     |
| CREATE INDEXTYPE | CREATE [ OR REPLACE ] INDEXTYPE<br>[ schema. ]indextype FOR<br>[ schema. ]operator (paramater_type<br>[, paramater_type ]...)<br>[, [ schema. ]operator (paramater_type<br>[, paramater_type ]...)<br>]...<br>using_type_clause ;                                                                                                                                                                                                                                                                                                                  |

| SQL Statement                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 ] [ 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 </pre>                                                                                                                                                                                                                                                                                                                                                                                                 |

| SQL Statement       | Syntax                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <pre>   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>                                                                                                                                                                                                                                                                                                   |
| CREATE PFILE        | <pre> CREATE PFILE [= 'pfile_name' ] FROM SPFILE [= 'spfile_name' ] ; </pre>                                                                                                                                                                                                                                                                                                                           |
| CREATE PROCEDURE    | <pre> CREATE [ OR REPLACE ] PROCEDURE [ schema. ]procedure [ (argument [ IN   OUT   IN OUT ]   NOCOPY ]   datatype [, argument [ IN   OUT   IN OUT ]   NOCOPY ] </pre>                                                                                                                                                                                                                                 |

| SQL Statement           | Syntax                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>                                 datatype                                 ]...                                 )                                 ]                                 [ invoker_rights_clause ]                                 { IS   AS }                                 { pl/sql_subprogram_body   call_spec } ; </pre>                                                                  |
| CREATE PROFILE          | <pre> CREATE PROFILE profile   LIMIT { resource_parameters           password_parameters         }         [ resource_parameters           password_parameters         ]... ; </pre>                                                                                                                                                                                                                           |
| CREATE ROLE             | <pre> CREATE ROLE role   [ NOT IDENTIFIED     IDENTIFIED { BY password                   USING [ schema. ] package                   EXTERNALLY                   GLOBALLY                 }   ] ; </pre>                                                                                                                                                                                                      |
| CREATE ROLLBACK SEGMENT | <pre> CREATE [ PUBLIC ] ROLLBACK SEGMENT rollback_segment   [ { TABLESPACE tablespace   storage_clause }     [ TABLESPACE tablespace   storage_clause ]...   ] ; </pre>                                                                                                                                                                                                                                        |
| CREATE SCHEMA           | <pre> CREATE SCHEMA AUTHORIZATION schema   { create_table_statement     create_view_statement     grant_statement   }   [ create_table_statement     create_view_statement     grant_statement   ]... ; </pre>                                                                                                                                                                                                 |
| 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 }   ] ; </pre> |

| SQL Statement     | Syntax                                                                                                                                                                                                                                                                                                  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | <pre>   { 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>                                                                                                                                                                                            |
| 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>                                                                                             |

| SQL Statement | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 ]... ]       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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| SQL Statement           | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>                                                                                                                                                                                                                                                                                                                                                                                                              |
| DROP DISKGROUP          | <pre> DROP DISKGROUP diskgroup_name   [ { INCLUDING   EXCLUDING }   CONTENTS   ] ; </pre>                                                                                                                                                                                                                                                                                                                                                                 |
| DROP FUNCTION           | <pre> DROP FUNCTION [ schema. ]function_name ; </pre>                                                                                                                                                                                                                                                                                                                                                                                                     |
| DROP INDEX              | <pre> DROP INDEX [ schema. ]index [ FORCE ] ; </pre>                                                                                                                                                                                                                                                                                                                                                                                                      |

| SQL Statement              | Syntax                                                                                                 |
|----------------------------|--------------------------------------------------------------------------------------------------------|
| 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 ] ;                                              |
| 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 ;                                                                      |



| SQL Statement      | Syntax                                                                                                                                                                                                                                                    |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 } ;                                                                                                                                                                                         |
| LOCK TABLE         | LOCK TABLE<br>[ schema. ] { table   view }<br>[ { PARTITION (partition)<br>  SUBPARTITION (subpartition)<br>}<br>  @ dblink<br>]<br>[, [ schema. ] { table   view }<br>[ { PARTITION (partition)<br>  SUBPARTITION (subpartition)<br>}<br>  @ dblink<br>] |

| SQL Statement     | Syntax                                                                                                                                                                                                    |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | <pre> ] ... 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 ]   } ; </pre>                                                        |
| RENAME            | <pre> RENAME old_name       TO new_name ; </pre>                                                                                                                                                          |
| REVOKE            | <pre> REVOKE { revoke_system_privileges           revoke_object_privileges         } ; </pre>                                                                                                             |
| 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>                                                                         |

| SQL Statement   | Syntax                                                                                                                                                                                       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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**

| Subclause                  | Syntax                                                                                                                                |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| activate_standby_db_clause | <pre> ACTIVATE [ PHYSICAL   LOGICAL ] STANDBY DATABASE [ SKIP [ STANDBY LOGFILE ] ] </pre>                                            |
| add_binding_clause         | <pre> ADD BINDING (parameter_type [, parameter_type ]...) RETURN (return_type) [ implementation_clause ] using_function_clause </pre> |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| add_column_clause         | <pre> ADD   ( column datatype     [ DEFAULT expr ]     [ { inline_constraint       [ inline_constraint ]...         inline_ref_constraint     }     ]     [, column datatype       [ DEFAULT expr ]       [ { inline_constraint         [ inline_constraint ]...           inline_ref_constraint       }       ]     ]...   )   [ column_properties ] </pre> |
| add_disk_clause           | <pre> ADD   [ FAILGROUP failgroup_name ]   DISK qualified_disk_clause     [, qualified_disk_clause ]...   [ [ FAILGROUP failgroup_name ]     DISK qualified_disk_clause       [, qualified_disk_clause ]...   ]... </pre>                                                                                                                                    |
| add_hash_index_partition  | <pre> ADD PARTITION   [ partition_name ]   [ TABLESPACE tablespace_name ]   [ parallel_clause ] </pre>                                                                                                                                                                                                                                                       |
| add_hash_partition_clause | <pre> ADD PARTITION [ partition ]   partitioning_storage_clause   [ update_index_clauses ]   [ parallel_clause ] </pre>                                                                                                                                                                                                                                      |
| add_hash_subpartition     | <pre> ADD subpartition_spec   [ update_index_clauses ]   [ parallel_clause ] </pre>                                                                                                                                                                                                                                                                          |
| add_list_partition_clause | <pre> ADD PARTITION [ partition ]   list_values_clause   [ table_partition_description ]   [ update_index_clauses ] </pre>                                                                                                                                                                                                                                   |
| add_list_subpartition     | <pre> ADD subpartition_spec   [ update_index_clauses ] </pre>                                                                                                                                                                                                                                                                                                |

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

| Subclause                    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <pre> { 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> |
| alter_index_partitioning     | <pre> { modify_index_default_attrs   add_hash_index_partition   modify_index_partition   rename_index_partition   drop_index_partition   split_index_partition   coalesce_index_partition   modify_index_subpartition } </pre>                                                                                                                                                                            |
| alter_iot_clauses            | <pre> { index_org_table_clause   alter_overflow_clause   alter_mapping_table_clauses   COALESCE } </pre>                                                                                                                                                                                                                                                                                                  |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                            |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| alter_mapping_table_clauses | <pre> MAPPING TABLE {   UPDATE BLOCK REFERENCES     allocate_extent_clause     deallocate_unused_clause } </pre>                                                                                                                                                                                  |
| alter_method_spec           | <pre> {   ADD   DROP } {   map_order_function_spec     subprogram_spec } [ {   ADD   DROP }   {     map_order_function_spec       subprogram_spec   } ]... </pre>                                                                                                                                 |
| alter_mv_refresh            | <pre> REFRESH {   { FAST   COMPLETE   FORCE }     ON { DEMAND   COMMIT }     { START WITH   NEXT } date     WITH PRIMARY KEY     USING     {       DEFAULT MASTER ROLLBACK SEGMENT         MASTER ROLLBACK SEGMENT     }   rollback_segment }   USING { ENFORCED   TRUSTED } CONSTRAINTS } </pre> |
| alter_overflow_clause       | <pre> {   OVERFLOW   {     allocate_extent_clause       deallocate_unused_clause   }   [     allocate_extent_clause       deallocate_unused_clause   ]...     add_overflow_clause } </pre>                                                                                                        |
| alter_session_set_clause    | <pre> SET parameter_name = parameter_value [ parameter_name = parameter_value ]... </pre>                                                                                                                                                                                                         |
| alter_system_reset_clause   | <pre> parameter_name [ SCOPE = { MEMORY   SPFILE   BOTH } ] SID = 'sid' </pre>                                                                                                                                                                                                                    |
| alter_system_set_clause     | <pre> parameter_name = parameter_value [, parameter_value ]... [ COMMENT 'text' ] [ DEFERRED ] </pre>                                                                                                                                                                                             |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <pre>[ SCOPE = { MEMORY   SPFILE   BOTH } ] [ SID = { 'sid'   * } ]</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| alter_table_partitioning | <pre>{   modify_table_default_attrs   set_subpartition_template   modify_table_partition   modify_table_subpartition   move_table_partition   move_table_subpartition   add_table_partition   coalesce_table_partition   drop_table_partition   drop_table_subpartition   rename_partition_subpart   truncate_partition_subpart   split_table_partition   split_table_subpartition   merge_table_partitions   merge_table_subpartitions   exchange_partition_subpart }</pre>                                                                                                                                                                  |
| alter_table_properties   | <pre>{ { physical_attributes_clause   logging_clause   table_compression   supplemental_table_logging   allocate_extent_clause   deallocate_unused_clause   shrink_clause   { CACHE   NOCACHE }   upgrade_table_clause   records_per_block_clause   parallel_clause   row_movement_clause }  [ physical_attributes_clause   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> |



| Subclause                   | Syntax                                                                                                                                                                                                                                                |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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> |
| array_DML_clause            | <pre>[ WITH   WITHOUT ] ARRAY DML [ ([ schema. ]type [, [ schema. ]varray_type ]) [, ([ schema. ]type [, [ schema. ]varray_type ])... ]</pre>                                                                                                         |
| attribute_clause            | <pre>ATTRIBUTE level DETERMINES { dependent_column   ( dependent_column [, dependent_column ]... ) }</pre>                                                                                                                                            |
| auditing_by_clause          | <pre>BY { proxy [, proxy ]...   user [, user ]... }</pre>                                                                                                                                                                                             |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                           |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>]...                                                 |
| 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>WHERE condition<br>[ local_partitioned_index ]<br>index_attributes |
| build_clause             | BUILD { IMMEDIATE   DEFERRED }                                                                                                                                                                                                                                                                                   |
| C_declaration            | C [ NAME name ]<br>LIBRARY lib_name<br>[ AGENT IN (argument[, argument ]...) ]<br>[ WITH CONTEXT ]<br>[ PARAMETERS (parameter[, parameter ]...) ]                                                                                                                                                                |
| call_spec                | LANGUAGE { Java_declaration   C_declaration }                                                                                                                                                                                                                                                                    |
| cancel_clause            | CANCEL [ IMMEDIATE ] [ WAIT   NOWAIT ]                                                                                                                                                                                                                                                                           |

| Subclause               | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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  | <pre> [ { IGNORE   KEEP } NAV ] [ UNIQUE { DIMENSION   SINGLE REFERENCE } ] </pre>                                                                                                                                                                                                                                                                                                                                                                                                         |
| 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   [, 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>                                                                                                                                |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| checkpoint_clause        | CHECKPOINT [ GLOBAL   LOCAL ]                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| cluster_index_clause     | CLUSTER [ schema. ] cluster_index_attributes                                                                                                                                                                                                                                                                                                                                                                                                                              |
| coalesce_index_partition | COALESCE PARTITION<br>[ parallel_clause ]                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| coalesce_table_partition | COALESCE PARTITION<br>[ update_index_clauses ]<br>[ parallel_clause ]                                                                                                                                                                                                                                                                                                                                                                                                     |
| column_association       | COLUMNS [ schema. ]table.column<br>[, [ schema. ]table.column ]...<br>using_statistics_type                                                                                                                                                                                                                                                                                                                                                                               |
| column_clauses           | { { add_column_clause<br>  modify_column_clause<br>  drop_column_clause<br>}<br>[ add_column_clause<br>  modify_column_clause<br>  drop_column_clause<br>]...<br>  rename_column_clause<br>  modify_collection_retrieval<br>[ modify_collection_retrieval ]...<br>  modify_LOB_storage_clause<br>  alter_varray_col_properties<br>}                                                                                                                                       |
| column_properties        | { object_type_col_properties<br>  nested_table_col_properties<br>  { varray_col_properties   LOB_storage_clause }<br>[ (LOB_partition_storage<br>[, LOB_partition_storage ]...<br>)<br>]<br>  XMLType_column_properties<br>}<br>[ { object_type_col_properties<br>  nested_table_col_properties<br>  { varray_col_properties  <br>LOB_storage_clause }<br>[ (LOB_partition_storage<br>[, LOB_partition_storage ]...<br>)<br>]<br>  XMLType_column_properties<br>}<br>]... |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 | parameter_name = parameter_value                                                                                                                                                                                                                                                                                                                                                                                          |
| 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>                                                                                                                                                      |
| compute_statistics_clause  | COMPUTE [ SYSTEM ] STATISTICS [ for_clause ]                                                                                                                                                                                                                                                                                                                                                                              |
| conditional_insert_clause  | <pre> [ ALL   FIRST ] WHEN condition THEN insert_into_clause   [ values_clause ]   [ error_logging_clause ]   [ insert_into_clause     [ values_clause ]     [ error_logging_clause ]   ]... [ WHEN condition   THEN insert_into_clause     [ values_clause ]     [ error_logging_clause ]     [ insert_into_clause       [ values_clause ]       [ error_logging_clause ]     ]... ]... [ ELSE insert_into_clause </pre> |

| Subclause               | Syntax                                                                                                                                                                                                                                                                                                                            |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre> [ values_clause ] [ error_logging_clause ] [ insert_into_clause   [ values_clause ]   [ error_logging_clause ] ]... ] </pre>                                                                                                                                                                                                |
| constraint              | <pre> { inline_constraint   out_of_line_constraint   inline_ref_constraint   out_of_line_ref_constraint } </pre>                                                                                                                                                                                                                  |
| constraint_clauses      | <pre> { ADD { out_of_line_constraint       [ out_of_line_constraint ]...         out_of_line_REF_constraint     }   MODIFY { CONSTRAINT constraint             PRIMARY KEY             UNIQUE (column [, column ]...)         }       constraint_state   RENAME CONSTRAINT old_name TO new_name   drop_constraint_clause } </pre> |
| constraint_state        | <pre> [ [ [ NOT ] DEFERRABLE ]   [ INITIALLY { IMMEDIATE   DEFERRED } ]   [ INITIALLY { IMMEDIATE   DEFERRED } ]   [ [ 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, ] </pre>                                                                                                                                                                                                                                |

| Subclause              | Syntax                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <pre>         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>                                                                                                                                                                                                                                      |
| create_incomplete_type | <pre> CREATE [ OR REPLACE ] TYPE [ schema. ]type_name ; </pre>                                                                                                                                                                                                                                                                                                                                                       |
| create_mv_refresh      | <pre> { REFRESH   { { FAST   COMPLETE   FORCE }     ON { DEMAND   COMMIT }     { START WITH   NEXT } date     WITH { PRIMARY KEY   ROWID }     USING     { DEFAULT [ MASTER   LOCAL ]       ROLLBACK SEGMENT       [ MASTER   LOCAL ]       ROLLBACK SEGMENT rollback_segment     }   [ DEFAULT [ MASTER   LOCAL ]     ROLLBACK SEGMENT     [ MASTER   LOCAL ]     ROLLBACK SEGMENT rollback_segment   ]... } </pre> |

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



| Subclause                 | Syntax                                                                                                                                                                                                                               |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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   'filename' [, 'filename' ]...   { DATAFILE   TEMPFILE } { ONLINE   OFFLINE } }</pre> |
| datafile_tempfile_spec    | <pre>[ 'filename' ] [ SIZE size_clause ] [ REUSE ] [ autoextend_clause ]</pre>                                                                                                                                                       |
| dblink                    | <pre>database[.domain [.domain ]... ] [ @ connect_descriptor ]</pre>                                                                                                                                                                 |
| dblink_authentication     | <pre>AUTHENTICATED BY user IDENTIFIED BY password</pre>                                                                                                                                                                              |
| deallocate_unused_clause  | <pre>DEALLOCATE UNUSED [ KEEP size_clause ]</pre>                                                                                                                                                                                    |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                                                                                                                                                                                                                                          |
| dependent_handling_clause  | { INVALIDATE<br>  CASCADE [ { [ NOT ] INCLUDING TABLE DATA<br>  CONVERT TO SUBSTITUTABLE<br>}<br>]<br>[ [FORCE ] exceptions_clause ]<br>}                                                                                                                                                                                                                                                                   |
| dimension_join_clause      | JOIN KEY<br>{ child_key_column<br>  (child_key_column [, child_key_column ]...)<br>}<br>REFERENCES parent_level<br>[ JOIN KEY<br>{ child_key_column<br>  (child_key_column [, child_key_column<br>]...)<br>}<br>REFERENCES parent_level<br>]...                                                                                                                                                             |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                 |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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       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   } </pre>                                                                                                                                                             |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                 |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre> ' ] [ 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]... ] } ]... ON { [ schema. ]table       [ NESTED TABLE nested_table_column OF ]       [ schema. ] view     } [ referencing_clause ] [ FOR EACH ROW ] </pre> |
| dml_table_expression_clause | <pre> { [ schema. ]   { table     [ { PARTITION (partition)         SUBPARTITION (subpartition)     }       @ dblink   ]     { view   materialized view } [ @ dblink ] }   ( subquery [ subquery_restriction_clause ] )   table_collection_expression } </pre>                         |
| domain_index_clause         | <pre> INDEXTYPE IS indextype [ parallel_clause ] [ PARAMETERS ('ODCI_parameters') ] </pre>                                                                                                                                                                                             |
| drop_binding_clause         | <pre> DROP BINDING (parameter_type [, parameter_type ]...) [ FORCE ] </pre>                                                                                                                                                                                                            |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| drop_column_clause         | <pre> { SET UNUSED { COLUMN column                   (column [, column ]...)               }   [ { CASCADE CONSTRAINTS   INVALIDATE }     [ CASCADE CONSTRAINTS   INVALIDATE ]...   ]   DROP { COLUMN column           (column [, column ]...)       }   [ { CASCADE CONSTRAINTS   INVALIDATE }     [ CASCADE CONSTRAINTS   INVALIDATE ]...   ]   [ CHECKPOINT integer ]   DROP { UNUSED COLUMNS           COLUMNS CONTINUE       }   [ CHECKPOINT integer ] } </pre> |
| drop_constraint_clause     | <pre> DROP { { PRIMARY KEY     UNIQUE (column [, column ]...) }   [ CASCADE ]   [ { KEEP   DROP } INDEX ]   CONSTRAINT constraint   [ CASCADE ] } </pre>                                                                                                                                                                                                                                                                                                              |
| 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>                                                                                                                                                                                                                                                                                                                                    |

| Subclause                  | Syntax                                                                                                                                                                                                                                        |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| drop_table_partition       | DROP PARTITION partition<br>[ update_index_clauses [ parallel_clause ] ]                                                                                                                                                                      |
| drop_table_subpartition    | DROP SUBPARTITION subpartition<br>[ update_index_clauses [ parallel_clause ] ]                                                                                                                                                                |
| element_spec               | [ inheritance_clauses ]<br>{ subprogram_spec<br>  constructor_spec<br>  map_order_function_spec<br>}<br>[ subprogram_clause<br>  constructor_spec<br>  map_order_function_spec<br>]...<br>[, pragma_clause ]                                  |
| else_clause                | ELSE else_expr                                                                                                                                                                                                                                |
| enable_disable_clause      | { ENABLE   DISABLE }<br>[ VALIDATE   NOVALIDATE ]<br>{ UNIQUE (column [, column ]...)<br>  PRIMARY KEY<br>  CONSTRAINT constraint<br>}<br>[ using_index_clause ]<br>[ 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 ] ] |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                          |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| expr                      | <pre> { simple_expression   compound_expression   case_expression   cursor_expression   datetime_expression   function_expression   interval_expression   object_access_expression   scalar_subquery_expression   model_expression   type_constructor_expression   variable_expression } </pre> |
| expression_list           | <pre> { expr [, expr ]...   (expr [, expr ]...) } </pre>                                                                                                                                                                                                                                        |
| extended_attribute_clause | <pre> ATTRIBUTE attribute LEVEL level DETERMINES { dependent_column   (dependent_column   [, dependent_column ]... ) [ LEVEL level 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: ] 'location_specifier' [, [ directory: ] 'location_specifier' ]... ) </pre>                                                                                       |

| Subclause              | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 } ] AS OF { SCN   TIMESTAMP } expr</pre>                                                                                                                                                                                                                                                                                                                                            |
| for_clause             | <pre>FOR   { TABLE     ALL [ INDEXED ] COLUMNS [ SIZE integer ]     COLUMNS [ SIZE integer ]     { column   attribute } [ SIZE integer ]     [ { column   attribute }     [ SIZE integer ]     ]...     ALL [ LOCAL ] INDEXES   } [ FOR   { TABLE     ALL [ INDEXED ] COLUMNS     [ SIZE integer ]     COLUMNS [ SIZE integer ]     { column   attribute } [ SIZE integer ]     [ { column   attribute }     [ SIZE integer ]     ]...     ALL [ LOCAL ] INDEXES   } ]...</pre> |
| for_update_clause      | <pre>FOR UPDATE [ OF [ [ schema. ]       { table   view } . ]column [, [ [ schema. ]</pre>                                                                                                                                                                                                                                                                                                                                                                                      |



| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>         { table   view } . ]column         ]...     ]     [ NOWAIT   WAIT integer ] </pre>                                                                                                                                                                                                                                                                                                                                                               |
| full_database_recovery    | <pre> [ STANDBY ] DATABASE [ { UNTIL { CANCEL               TIME date               CHANGE integer           }     USING BACKUP CONTROLFILE }   [ UNTIL { CANCEL               TIME date               CHANGE integer           }     USING BACKUP CONTROLFILE ]... ] </pre>                                                                                                                                                                                   |
| fully_qualified_file_name | <pre> +diskgroup_name/db_name/file_type/ file_type_tag.filenumber.incarnation_number </pre>                                                                                                                                                                                                                                                                                                                                                                    |
| 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>                                                                                                                                                                                                                                                                                                                       |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                  |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 ]... ]   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 </pre>                                                                                                                                                                                                                         |

| Subclause                   | Syntax                                                                                                                                                       |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>   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 } ]... [ HAVING condition ] </pre> |
| grouping_expression_list    | <pre> expression_list [, expression_list ]... </pre>                                                                                                         |
| grouping_sets_clause        | <pre> GROUPING SETS ({ rollup_cube_clause   grouping_expression_list }) </pre>                                                                               |
| hash_partitioning           | <pre> PARTITION BY HASH (column [, column ] ...) { individual_hash_partitions   hash_partitions_by_quantity } </pre>                                         |
| hash_partitions_by_quantity | <pre> PARTITIONS hash_partition_quantity [ STORE IN     (tablespace [, tablespace ]...) ] [ OVERFLOW STORE IN     (tablespace [, tablespace ]...) ] </pre>   |
| hierarchical_query_clause   | <pre> [ START WITH condition ] CONNECT BY [ NOCYCLE ] condition </pre>                                                                                       |
| hierarchy_clause            | <pre> HIERARCHY hierarchy (child_level CHILD OF parent_level     [ CHILD OF parent_level ]... [ dimension_join_clause ] ) </pre>                             |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| implementation_clause     | <pre>{ ANCILLARY TO     primary_operator (parameter_type                       [, parameter_type ]...)     [, primary_operator ( parameter_type                           [, parameter_type                           ]...) ]...)   ...   context_clause }</pre>                                                                                                                                                                 |
| incomplete_file_name      | +diskgroup_name [ (template_name) ]                                                                                                                                                                                                                                                                                                                                                                                              |
| index_attributes          | <pre>[ { physical_attributes_clause     logging_clause     ONLINE     COMPUTE STATISTICS     TABLESPACE { tablespace   DEFAULT }     key_compression     { 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 | <pre>[ INCLUDING column_name ] OVERFLOW [ segment_attributes_clause ]</pre>                                                                                                                                                                                                                                                                                                                                                      |
| index_org_table_clause    | <pre>[ { mapping_table_clause     PCTTHRESHOLD integer     key_compression }   [ mapping_table_clause     PCTTHRESHOLD integer     key_compression ] ... ] [ index_org_overflow_clause ]</pre>                                                                                                                                                                                                                                   |

| Subclause                   | Syntax                                                                                                                                                                                                                                     |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| index_partition_description | <pre> PARTITION [ partition   [ { segment_attributes_clause       key_compression     }   [ segment_attributes_clause       key_compression   ] ... ] </pre>                                                                               |
| index_partitioning_clause   | <pre> PARTITION [ partition ] VALUES LESS THAN (value[, value... ]) [ segment_attributes_clause ] </pre>                                                                                                                                   |
| index_properties            | <pre> [ { { global_partitioned_index       local_partitioned_index     }     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>                                                                                                                           |

| Subclause               | Syntax                                                                                                                                                                                                                                                                                       |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>                                                                                                                                             |
| 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      | <pre>INTO dml_table_expression_clause [ t_alias ] [ (column [, column ]...) ]</pre>                                                                                                                                                                                                          |
| integer                 | <pre>[ +   - ] digit [ digit ]...</pre>                                                                                                                                                                                                                                                      |
| 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>                                                                                                                                                                                          |

| Subclause             | Syntax                                                                                                                                                                                                                                                                                                                                          |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 ]<br>  NOCOMPRESS<br>}                                                                                                                                                                                                                                                                                                     |
| level_clause          | LEVEL level IS<br>{ level_table.level_column<br>  (level_table.level_column<br>[, level_table.level_column ]...<br>)<br>}                                                                                                                                                                                                                       |
| list_partitioning     | PARTITION BY LIST (column)<br>(PARTITION [ partition ]<br>list_values_clause<br>table_partition_description<br>[, PARTITION [ partition ]<br>list_values_clause<br>table_partition_description<br>]...<br>)                                                                                                                                     |
| list_values_clause    | VALUES ({ value   NULL<br>[, { value   NULL }...]<br>  DEFAULT<br>})                                                                                                                                                                                                                                                                            |
| LOB_parameters        | { TABLESPACE tablespace<br>  { ENABLE   DISABLE } STORAGE IN ROW<br>  storage_clause<br>  CHUNK integer<br>  PCTVERSION integer<br>  RETENTION<br>  FREEPOOLS integer<br>  { CACHE<br>  { NOCACHE   CACHE READS } [ logging_clause ]<br>}<br>}<br><br>[ TABLESPACE tablespace<br>  { ENABLE   DISABLE } STORAGE IN ROW<br>  storage_clause<br>] |

| Subclause               | Syntax                                                                                                                                                                                                                                                                     |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <pre>   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   { 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_segname (LOB_parameters)       LOB_segname       (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' }</pre>                                                                                                                          |



| Subclause                  | Syntax                                                                                                                                                                                                                |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | <pre>   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>                                                                                                                                       |
| logging_clause             | <pre> { LOGGING   NOLOGGING } </pre>                                                                                                                                                                                  |
| main_model                 | <pre> [ MAIN main_model_name ] model_column_clauses [ cell_reference_options ] model_rules_clause </pre>                                                                                                              |
| managed_standby_recovery   | <pre> RECOVER MANAGED STANDBY DATABASE   [ recover_clause   cancel_clause     finish_clause ] </pre>                                                                                                                  |
| map_order_func_declaration | <pre> { MAP   ORDER } MEMBER function_declaration </pre>                                                                                                                                                              |
| map_order_function_spec    | <pre> { MAP   ORDER } MEMBER function_spec </pre>                                                                                                                                                                     |
| mapping_table_clauses      | <pre> { MAPPING TABLE   NOMAPPING } </pre>                                                                                                                                                                            |
| materialized_view_props    | <pre> [ column_properties ] [ table_partitioning_clauses ] [ CACHE   NOCACHE ] [ parallel_clause ] [ build_clause ] </pre>                                                                                            |
| maximize_standby_db_clause | <pre> SET STANDBY DATABASE TO MAXIMIZE { PROTECTION   AVAILABILITY   PERFORMANCE } </pre>                                                                                                                             |
| maxsize_clause             | <pre> MAXSIZE { UNLIMITED   size_clause } </pre>                                                                                                                                                                      |
| merge_insert_clause        | <pre> WHEN NOT MATCHED THEN INSERT [ (column [, column ]...) ] VALUES ( { expr [, expr ]...   DEFAULT } ) [ where_clause ] </pre>                                                                                     |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                        |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 }<br>[, 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                                                                                 |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                       |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre> [ inline_constraint ]... ] [ LOB_storage_clause ] ] ) </pre>                                                                                                                                                                                                                           |
| modify_col_substitutable    | <pre> COLUMN column [ NOT ] SUBSTITUTABLE AT ALL LEVELS [ FORCE ] </pre>                                                                                                                                                                                                                     |
| modify_collection_retrieval | <pre> MODIFY NESTED TABLE collection_item RETURN AS { LOCATOR   VALUE } </pre>                                                                                                                                                                                                               |
| modify_column_clauses       | <pre> MODIFY { modify_col_properties           modify_col_substitutable         } </pre>                                                                                                                                                                                                     |
| modify_hash_partition       | <pre> MODIFY PARTITION partition { partition_attributes   alter_mapping_table_clause   [ REBUILD ] UNUSABLE LOCAL INDEXES } </pre>                                                                                                                                                           |
| modify_hash_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 } </pre> |
| modify_index_default_attrs  | <pre> MODIFY DEFAULT ATTRIBUTES [ FOR PARTITION partition ] { physical_attributes_clause   TABLESPACE { tablespace   DEFAULT }   logging_clause } [ physical_attributes_clause   TABLESPACE { tablespace   DEFAULT }   logging_clause ]... </pre>                                            |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| modify_index_partition    | <pre> MODIFY PARTITION partition { { deallocate_unused_clause     allocate_extent_clause     physical_attributes_clause     logging_clause     key_compression   }   [ deallocate_unused_clause     allocate_extent_clause     physical_attributes_clause     logging_clause     key_compression   ] ...   PARAMETERS ('ODCI_parameters')   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 ] } </pre>                                                                                                                                                                                                                                |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                  |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | <pre> }   allocate_extent_clause   deallocate_unused_clause   shrink_clause }  [ storage_clause   PCTVERSION integer   RETENTION   FREEPOOLS integer   REBUILD FREEPOOLS   { CACHE     { NOCACHE   CACHE READS } [ logging_clause ]  }   allocate_extent_clause   deallocate_unused_clause   shrink_clause ] ... </pre> |
| modify_LOB_storage_clause  | <pre> MODIFY LOB (LOB_item) (modify_LOB_parameters) </pre>                                                                                                                                                                                                                                                              |
| 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_default_attrs | <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>   |

| Subclause                 | Syntax                                                                                                                                                                                                                                 |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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>                                                                                                                                    |
| 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>                                                                                               |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| multiset_except             | nested_table1<br>MULTISET EXCEPT [ ALL   DISTINCT ]<br>nested_table2                                                                                                                                                                                                                                                                          |
| multiset_intersect          | nested_table1<br>MULTISET INTERSECT [ ALL   DISTINCT ]<br>nested_table2                                                                                                                                                                                                                                                                       |
| 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>]<br>  . digit [ digit ]...<br>}<br>[ e [ +   - ] digit [ digit ]... ]<br>[ f   d ]                                                                                                                                                                                           |
| numeric_file_name           | +diskgroup_name.filename.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>}                                                                                                          |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| object_table               | <pre>CREATE [ GLOBAL TEMPORARY ] TABLE   [ schema. ]table OF   [ schema. ]object_type   [ object_table_substitution ]   [ (object_properties) ]   [ ON COMMIT { DELETE   PRESERVE } ROWS ]   [ OID_clause ]   [ OID_index_clause ]   [ physical_properties ]   [ table_properties ] ;</pre>                                                               |
| object_table_substitution  | [ NOT ] SUBSTITUTABLE AT ALL LEVELS                                                                                                                                                                                                                                                                                                                       |
| object_type_col_properties | COLUMN column substitutable_column_clause                                                                                                                                                                                                                                                                                                                 |
| object_view_clause         | <pre>OF [ schema. ]type_name { WITH OBJECT IDENTIFIER   { DEFAULT   ( attribute                     [, attribute ]... )   }   UNDER [ schema. ]superview } ({ out_of_line_constraint   attribute inline_constraint   [ inline_constraint ]... } [, { out_of_line_constraint     attribute inline_constraint     [ inline_constraint ]...   } ]... )</pre> |
| OID_clause                 | <pre>OBJECT IDENTIFIER IS { SYSTEM GENERATED   PRIMARY KEY }</pre>                                                                                                                                                                                                                                                                                        |
| OID_index_clause           | <pre>OIDINDEX [ index ] ({ physical_attributes_clause   TABLESPACE tablespace } [ physical_attributes_clause   TABLESPACE tablespace ]... )</pre>                                                                                                                                                                                                         |
| on_comp_partitioned_table  | <pre>[ STORE IN ( tablespace [, tablespace ]... ) ] ( PARTITION   [ partition     [ { segment_attribute_clause         key_compression</pre>                                                                                                                                                                                                              |



| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>         }         [ segment_attribute_clause           key_compression         ]...     ]     [ index_subpartition_clause ] ] [, 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> |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| on_object_clause           | <pre> { schema.object   { DIRECTORY directory_name     JAVA { SOURCE   RESOURCE } [ schema. ]object } } </pre>                                                                                                                                                                                                                                            |
| on_range_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> |
| order_by_clause            | <pre> ORDER [ SIBLINGS ] BY { expr   position   c_alias } [ ASC   DESC ] [ NULLS FIRST   NULLS LAST ] [, { expr   position   c_alias }   [ ASC   DESC ]   [ NULLS FIRST   NULLS LAST ] ] ... </pre>                                                                                                                                                       |
| out_of_line_constraint     | <pre> [ CONSTRAINT constraint_name ] { UNIQUE (column [, column ]...)   PRIMARY KEY (column [, column ]...)   FOREIGN KEY (column [, column ]...)   references_clause   CHECK (condition) } [ constraint_state ] </pre>                                                                                                                                   |
| out_of_line_ref_constraint | <pre> { SCOPE FOR   ({ ref_col   ref_attr })   IS [ schema. ]scope_table   REF   ({ ref_col   ref_attr })   WITH ROWID </pre>                                                                                                                                                                                                                             |

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                             |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <pre>   [ CONSTRAINT constraint_name ]   FOREIGN KEY     ({ ref_col   ref_attr })   references_clause   [ constraint_state ] } </pre>                                                                                                                                                                              |
| 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           | <pre> { FULL   LEFT   RIGHT } [ OUTER ] </pre>                                                                                                                                                                                                                                                                     |
| parallel_clause           | <pre> { NOPARALLEL   PARALLEL [ integer ] } </pre>                                                                                                                                                                                                                                                                 |
| 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'   filename }   [, 'filename'   filename ]...   }   STANDBY   { TABLESPACE tablespace [, tablespace ]...     DATAFILE { 'filename'   filename }     [, 'filename'   filename ]...     }   } UNTIL [ CONSISTENT WITH ] CONTROLFILE } </pre> |
| partition_attributes      | <pre> [ { physical_attributes_clause   logging_clause   allocate_extent_clause   deallocate_unused_clause   shrink_clause } </pre>                                                                                                                                                                                 |

| Subclause                    | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <pre> [ physical_attributes_clause   logging_clause   allocate_extent_clause   deallocate_unused_clause   shrink_clause ]... ] [ OVERFLOW { 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_segname [ (TABLESPACE tablespace) ]   (TABLESPACE tablespace) }   VARRAY varray_item STORE AS LOB LOB_segname } [ { TABLESPACE tablespace   OVERFLOW [ TABLESPACE tablespace ]   LOB (LOB_item) STORE AS { LOB_segname [ (TABLESPACE tablespace) </pre>                                                                                                                                                 |

| Subclause                   | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre>   (TABLESPACE tablespace)   }   VARRAY varray_item STORE AS LOB LOB_segname } ]... ] </pre>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 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>                                                                                                                                                                                                                                                                                                                                                 |

| Subclause             | Syntax                                                                                                                                                                                                                                                                                                             |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| physical_properties   | <pre> { segment_attributes_clause   [ table_compression ]   ORGANIZATION   { HEAP     [ segment_attributes_clause ]     [ 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>                                                   |

| Subclause                  | Syntax                                                                                                                                                                                                                                                                                                            |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| qualified_disk_clause      | search_string<br>[ NAME disk_name ]<br>[ SIZE size_clause ]<br>[ FORCE   NOFORCE ]                                                                                                                                                                                                                                |
| 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<br>} |
| 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 ]                                                                                                                                                                                                                                                                                       |

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| rebuild_clause           | <pre> REBUILD [ { PARTITION partition     SUBPARTITION subpartition   }   { REVERSE   NOREVERSE } ] [ 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 | <pre> { MINIMIZE   NOMINIMIZE } RECORDS_PER_BLOCK </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 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 </pre> |



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

| Subclause                | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| relational_properties    | <pre> { column datatype [ SORT ]   [ DEFAULT expr ]   [ inline_constraint     [ inline_constraint ]...     inline_ref_constraint   ]   { 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</pre>                                                                                                                                                                                                                                                                                                                                      |

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

| Subclause                   | Syntax                                                                                                                                                                                                                  |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| routine_clause              | [ schema. ] [ type.   package. ]<br>{ function   procedure   method }<br>[ @dblink_name ]<br>( [ argument [, argument ]... ] )                                                                                          |
| 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>}             |

| Subclause                  | Syntax                                                                                                                                                                                                                                                               |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | <pre>   expr [ [ AS ] c_alias ] } ]... } </pre>                                                                                                                                                                                                                      |
| 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              | <pre> SHRINK SPACE [ COMPACT ] [ CASCADE ] </pre>                                                                                                                                                                                                                    |
| shutdown_dispatcher_clause | <pre> SHUTDOWN [ IMMEDIATE ] dispatcher_name </pre>                                                                                                                                                                                                                  |
| 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                | <pre> integer [ K   M   G   T ] </pre>                                                                                                                                                                                                                               |

| Subclause                | Syntax                                                                                                                                                                                                                           |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| split_index_partition    | <pre> SPLIT PARTITION partition_name_old   AT (value [, value ]...)   [ INTO (index_partition_description,           index_partition_description         )   ]   [ parallel_clause ] </pre>                                      |
| split_table_partition    | <pre> SPLIT PARTITION current_partition   { AT   VALUES } (value [, value ]...)   [ INTO (partition_spec, partition_spec) ]   [ update_index_clauses ]   [ parallel_clause ] </pre>                                              |
| split_table_subpartition | <pre> SPLIT SUBPARTITION subpartition   VALUES ({ value   NULL }            [, value   NULL ]...)   [ INTO (subpartition_spec,           subpartition_spec         )   ]   [ update_index_clauses ]   [ parallel_clause ] </pre> |
| sql_statement_clause     | <pre> { { statement_option   ALL }   [, { statement_option   ALL } ]...   { system_privilege   ALL PRIVILEGES }   [, { system_privilege   ALL PRIVILEGES } ]... } [ auditing_by_clause ] </pre>                                  |
| sqlj_object_type         | <pre> EXTERNAL NAME java_ext_name LANGUAGE JAVA   USING (SQLData   CustomDatum   OraData) </pre>                                                                                                                                 |
| sqlj_object_type_attr    | <pre> EXTERNAL NAME 'field_name' </pre>                                                                                                                                                                                          |
| sqlj_object_type_sig     | <pre> RETURN { datatype   SELF AS RESULT } EXTERNAL { VARIABLE NAME 'java_static_field_name'             NAME 'java_method_sig'           } </pre>                                                                               |
| standby_database_clauses | <pre> ( activate_standby_db_clause   maximize_standby_db_clause   register_logfile_clause   commit_switchover_clause   start_standby_clause   stop_standby_clause ) [ parallel_clause ] </pre>                                   |

| Subclause            | Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| start_standby_clause | <pre> START LOGICAL STANDBY APPLY [ IMMEDIATE ] [ NODELAY ] [ NEW PRIMARY dblink   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 ]...) ] </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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



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

| Subclause                   | Syntax                                                                                                                                                                                                                                                                        |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <pre> ]...   DROP SUPPLEMENTAL LOG     { supplemental_id_key_clause       GROUP log_group     } [, 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>                              |

| Subclause                   | Syntax                                                                                                                                                                                                                                        |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| table_reference             | <pre> { ONLY   (query_table_expression)   [ flashback_query_clause ]   [ t_alias ]   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     | TABSPACE 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 TABSPACE 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>                                                                                                                                               |

| Subclause                  | Syntax                                                                                                                                                                                                 |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| trace_file_clause          | TRACE<br>[ AS 'filename' [ REUSE ] ]<br>[ RESETLOGS   NORESETLOGS ]                                                                                                                                    |
| 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                                          |

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

| Subclause                 | Syntax                                                                                                                                                                                                                                                                                                 |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| values_clause             | VALUES ( { expr   DEFAULT }<br>[, { expr   DEFAULT } ]...<br>)                                                                                                                                                                                                                                         |
| varray_col_properties     | VARRAY varray_item<br>{ [ substitutable_column_clause ]<br>STORE AS LOB<br>{ [ LOB_segname ] (LOB_parameters)<br>  LOB_segname<br>}<br>  substitutable_column_clause<br>}                                                                                                                              |
| where_clause              | WHERE condition                                                                                                                                                                                                                                                                                        |
| windowing_clause          | { ROWS   RANGE }<br>{ BETWEEN<br>{ UNBOUNDED PRECEDING<br>  CURRENT ROW<br>  value_expr { PRECEDING   FOLLOWING }<br>}<br>AND<br>{ UNBOUNDED FOLLOWING<br>  CURRENT ROW<br>  value_expr { PRECEDING   FOLLOWING }<br>}<br>  { UNBOUNDED PRECEDING<br>  CURRENT ROW<br>  value_expr PRECEDING<br>}<br>} |
| XML_attributes_clause     | XMLATTRIBUTES<br>(value_expr [ AS c_alias ]<br>[, value_expr [ AS c_alias ]...<br>)                                                                                                                                                                                                                    |
| XMLSchema_spec            | [ XMLSCHEMA XMLSchema_URL ]<br>ELEMENT { element   XMLSchema_URL # element }                                                                                                                                                                                                                           |
| XMLType_column_properties | XMLTYPE [ COLUMN ] column<br>[ XMLType_storage ]<br>[ XMLSchema_spec ]                                                                                                                                                                                                                                 |
| XMLType_storage           | STORE AS<br>{ OBJECT RELATIONAL<br>  CLOB [ { LOB_segname [ (LOB_parameters) ]<br>  LOB_parameters<br>}<br>]<br>}                                                                                                                                                                                      |

| Subclause           | Syntax                                                                                                                                                                                                                                                                                                |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XMLType_table       | <pre> CREATE TABLE [ GLOBAL TEMPORARY ] TABLE   [ schema. ]table OF XMLTYPE   [ (object_properties) ]   [ XMLTYPE XMLType_storage ]   [ XMLSchema_spec ]   [ ON COMMIT { DELETE   PRESERVE } ROWS ]   [ OID_clause ]   [ OID_index_clause ]   [ physical_properties ]   [ table_properties ] ; </pre> |
| XMLType_view_clause | <pre> OF XMLTYPE [ XMLSchema_spec ] WITH OBJECT IDENTIFIER { DEFAULT   ( expr [, expr ]...) } </pre>                                                                                                                                                                                                  |





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# **Appendix D**

## **Oracle Background Processes**

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## Oracle Background Processes

This appendix is not an exhaustive list of all background processes and is meant to serve as a quick reference. For more details on these background processes and any that have not been mentioned here, consult the Oracle Database Reference guide.

### General Processes

| Acronym      | Process Name                       | Description                                                                                                                                                                            | Required for basic operation | Started by default |
|--------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
| ARC <i>n</i> | Archiver Process                   | Writes filled redo logs to the archive log location(s). Possible processes include ARC0–ARC9 and ARCa–ARCt.                                                                            | No                           | No                 |
| CJQ0         | Job Queue Coordinator Process      | Spawns slave processes (Jnnn) to execute jobs in the queue.                                                                                                                            | No                           | Yes                |
| CKPT         | Checkpoint Process                 | Writes checkpoint information to control files and data file headers.                                                                                                                  | Yes                          | Yes                |
| DBRM         | Database Resource Manager Process  | Sets resource plans and performs other Resource Manager tasks.                                                                                                                         | No                           | Yes                |
| DBW <i>n</i> | Database Writer Process            | Writes dirty buffers from the buffer cache to the data files. Possible processes include DBW0–DBW9 and DBWa–DBWz.                                                                      | Yes                          | Yes                |
| DIA0         | Diagnostic Process                 | Responsible for hang detection and deadlock resolution. Triggers DIAG to perform diagnostic tasks.                                                                                     | Yes                          | Yes                |
| DIAG         | Diagnostic Capture Process         | Performs diagnostic dumps and executes global oradebug commands                                                                                                                        | Yes                          | Yes                |
| Dnnn         | Dispatcher Process                 | In a Shared Server configuration, dispatchers place connection requests in a connection request queue.                                                                                 | No                           | Yes                |
| EMNC         | EMON Coordinator Process           | Coordinates the event management and notification activity in the database, including Streams Event Notifications, Continuous Query Notifications, and Fast Application Notifications. | No                           | No                 |
| FBDA         | Flashback Data Archiver Process    | Archives historical rows for tracked tables into flashback data archives and manages the flashback archives.                                                                           | No                           | Yes                |
| FMON         | File Mapping Monitor Process       | Spawns FMPUTL, an external non-Oracle Database process that communicates with the mapping libraries provided by storage vendors. Responsible for managing the mapping information.     | No                           | No                 |
| Jnnn         | Job Queue Slave Process            | Processes jobs in the queue. Spawned by CJQ0.                                                                                                                                          | No                           | Yes                |
| LGWR         | Log Writer Process                 | Writes the log buffer out to the redo logs.                                                                                                                                            | Yes                          | Yes                |
| MMAN         | Memory Manager Process             | Serves as the SGA Memory Broker and coordinates the sizing of the memory components.                                                                                                   | No                           | Yes                |
| MMNL         | Manageability Monitor Lite Process | Performs frequent and lightweight manageability-related tasks, such as session history, capture and metrics computation.                                                               | No                           | Yes                |
| MMON         | Manageability Monitor Process      | Collects statistics for the Automatic Workload Repository.                                                                                                                             | No                           | Yes                |
| PMON         | Process Monitor                    | Recovers failed process resources. If Shared Server architecture is used, PMON monitors and                                                                                            | Yes                          | Yes                |

| Acronym | Process Name                         | Description                                                                                                                                                            | Required for basic operation | Started by default |
|---------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
|         |                                      | restarts any failed dispatcher or server processes.                                                                                                                    |                              |                    |
| Pnnn    | Parallel Query Slave Process         | Started and stopped as needed to participate in parallel query operations.                                                                                             | No                           | No                 |
| PSP0    | Process Spawner Process              | Starts and stops Oracle processes. Reduces workload of RBAL by starting/stopping ASM rebalance slaves.                                                                 | No                           | Yes                |
| RCBG    | Result Cache Background Process      | Supports SQL query and PLO/SQL function result caches.                                                                                                                 | No                           | No                 |
| RECO    | Recoverer Process                    | Resolves failures involving distributed transactions.                                                                                                                  | No                           | Yes                |
| RVWR    | Recovery Writer Process              | Writes flashback data to flashback database logs in the flash recovery area.                                                                                           | No                           | No                 |
| SMCO    | Space Management Coordinator Process | Coordinates the execution of various space management related tasks, such as proactive space allocation and space reclamation.                                         | No                           | Yes                |
| SMON    | System Monitor Process               | Performs recovery after instance failure and monitors temporary segments and extents.                                                                                  | Yes                          | Yes                |
| Snnn    | Shared Server Process                | In a shared Server configuration, shared servers check a connection request queue (populated by dispatchers) and services the connection requests.                     | No                           | Yes                |
| VKTM    | Virtual Keeper of Time Process       | Responsible for providing a wall-clock time (updated every second) and reference-tin counter (updated ever 20ms and available only when running at elevated priority). | Yes                          | Yes                |
| Wnnn    | Space Management Slave Process       | These are slave processes spawned by SMCO to execute space management tasks.                                                                                           | No                           | Yes                |

### Advanced Queuing Processes

| Acronym | Process Name            | Description                                                  | Required for basic operation | Started by default |
|---------|-------------------------|--------------------------------------------------------------|------------------------------|--------------------|
| Qnnn    | AQ Server Class Process | Processes messaged in the Streams AQ queue. Spawned by QMNC. | No                           | Yes                |
| QMNC    | AQ Coordinator Process  | Monitors message queues. Spawns Qnnn processes.              | No                           | Yes                |

### Automatic Storage Management Processes

| Acronym | Process Name           | Description                                                                                                                                                                                                                                               | Required for basic operation | Started by default |
|---------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
| ARBn    | ASM Rebalance Process  | Rebalances data extents across the ASM file systems. Possible processes are ARB0 – ARB9 and ARBA.                                                                                                                                                         | No                           | No                 |
| ASMB    | ASM Background Process | Communicates with the Automatic Storage Management instance.                                                                                                                                                                                              | No                           | No                 |
| DSKM    | Slave Diskmon Process  | Acts as conduit between RDBMS and ASM instances and the Master Diskmon daemon to communicate I/O Fencing Information, I/O Resource Manager Plans, and Transaction Commit Cache information to SAGE storage. If no SAGE storage is used, the slave diskmon | No                           | No                 |

| Acronym | Process Name                                      | Description                                                                                                                                                                                               | Required for basic operation | Started by default |
|---------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
|         |                                                   | process will exit silently after startup of the instance.                                                                                                                                                 |                              |                    |
| GMON    | ASM Disk Group Monitor Process                    | Maintains disk membership in ASM disk groups.                                                                                                                                                             | No                           | No                 |
| MARK    | Mark AU for Resynchronization Coordinator Process | Marks ASM Allocation Units as stale following a missed write to an offline disk.                                                                                                                          | No                           | No                 |
| RBAL    | ASM Rebalance Master Process                      | Coordinates rebalance activity for disk groups in an Automatic Storage Management instance. Performs global opens on Automatic Storage Management disks.                                                  | No                           | No                 |
| DRnn    | ASM Disk Resynchronization Slave Process          | Resynchronizes the contents of an offline disk. When a disk online SQL command is issued on a disk or disks that are offline, ASM spawns DRnn. Depending on the load, more than one slave may be spawned. | No                           | No                 |

### Data Guard Processes

| Acronym | Process Name                                         | Description                                                                                                                                                                                                                                                                                                                                                        | Required for basic operation | Started by default |
|---------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
| DMON    | Data Guard Broker Monitor Process                    | Starts when Data Guard Broker is started. DMON is the server-side component that interacts with the local database and the DMON processes of the other databases to perform the requested function. Also responsible for monitoring the health of the broker configuration and for ensuring that every database has a consistent description of the configuration. | No                           | No                 |
| FSFP    | Data Guard Broker Fast Start Failover Pinger Process | Observer process integrated in the DGMGROL client-side component. It monitors the DG Broker environment and initiates the failover on detecting a problem with Primary.                                                                                                                                                                                            | No                           | No                 |
| INSV    | Data Guard Broker Instance Slave Process             | Performs Data Guard Broker communication between instances of a RAC database.                                                                                                                                                                                                                                                                                      | No                           | No                 |
| LSP0    | Logical Standby Coordinator Process                  | Assigns transactions to different Data Guard appliers and coordinates among them to ensure that dependencies between transactions are honored.                                                                                                                                                                                                                     | No                           | No                 |
| LSP1    | Logical Standby Dictionary Build Process             | Builds the data dictionary for the Logical Standby.                                                                                                                                                                                                                                                                                                                | No                           | No                 |
| LSP2    | Logical Standby Set Guard Process                    | Maintains Guard Standby information for the Logical Standby.                                                                                                                                                                                                                                                                                                       | No                           | No                 |
| MRP0    | Managed Standby Recovery Process                     | Provides transparent support for XA global transactions in RAC.                                                                                                                                                                                                                                                                                                    | No                           | No                 |
| NSVn    | Data Guard Broker NetSlave Process                   | Performs broker network communications between databases in Data Guard configuration.                                                                                                                                                                                                                                                                              | No                           | No                 |

| Acronym | Process Name                     | Description                                                  | Required for basic operation | Started by default |
|---------|----------------------------------|--------------------------------------------------------------|------------------------------|--------------------|
|         |                                  | Possible processes include NSV0–NSV9.                        |                              |                    |
| RSM0    | Data Guard Broker Worker Process | Used by the DMON process to manage and monitor the database. | No                           | No                 |

### RMAN Processes

| Acronym | Process Name                   | Description                                                                                                                                                  | Required for basic operation | Started by default |
|---------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
| CTWR    | Change Tracking Writer Process | Writes to the RMAN Change Tracking Log, a bitmap representing the entire database. The bitmap has an associated SCN, which is the SCN as at the last backup. | No                           | No                 |

### Real Application Clusters Processes

| Acronym | Process Name                                 | Description                                                                                                                                                                                                                                                                                                                                                                  | Required for basic operation | Started by default |
|---------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
| ACMS    | Atomic Control File to Memory Server Process | Contributes to ensuring a distributed SGA memory update is either globally omitted on success or globally aborted in the event of a failure in an Oracle RAC environment.                                                                                                                                                                                                    | No                           | No                 |
| GTXn    | Global Transaction Process                   | Provides transparent support for XA global transactions in an Oracle RAC environment. The database auto tunes the number of these process based on the workload of XA global transactions. Possible processes are GTX0–GTX9 and GTXa–GTXj.                                                                                                                                   | No                           | No                 |
| LCK0    | Instance Enqueue Background Process          | Manage the global enqueued requests and the cross-instance broadcast. Handles all requests for resources other than data blocks.                                                                                                                                                                                                                                             | No                           | No                 |
| LMD0    | Global Enqueue Service Daemon 0 Process      | Manages enqueue manager service requests for Global Cache Service enqueues to control access to global enqueues and resources. The LMD0 process also handles deadlock detection and remote enqueued requests. Remote resource requests are the requests originating from another instance.                                                                                   | No                           | No                 |
| LMON    | Global Enqueue Service Monitor Process       | Monitors the entire cluster to manage the global enqueues and the resources. Manages instance and process failures and the associated recovery for the Global Cache Service (GCS) and Global Enqueue Service (GES). In particular LMON handles the part of recovery associated with global resources. LMON-provided services are also known as cluster group services (CGS). | No                           | No                 |
| LMSn    | Global Cache Service Process                 | Handles remote Global Cache Service (GCS) messages. The number of LMS processes varies depending on the amount of messaging traffic among nodes in the cluster.                                                                                                                                                                                                              | No                           | No                 |
| PING    | Interconnect Latency Measurement Process     | Assesses the latencies associated with communications for each pair of instances. Every                                                                                                                                                                                                                                                                                      | No                           | No                 |

| Acronym | Process Name                  | Description                                                                                                                                                                                                                                                                                                                                                    | Required for basic operation | Started by default |
|---------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------|
|         |                               | few seconds, the process in one instance (INSTANCE_NUMBER value) sends two messages to each instance (TARGET_INSTANCE value). One message has a size of 500 bytes and the other has a size of 8 KB. The message is received by the PING process on the target instance and is immediately acknowledged. The time for the round-trip is measured and collected. |                              |                    |
| RMSn    | Oracle RAC Management Process | Performs manageability tasks for Oracle RAC, such as creation of RAC-related resources when new instances are added to the clusters.                                                                                                                                                                                                                           | No                           | No                 |
| RSMN    | Remote Slave Monitor Process  | Manages background slave process creation and communication on remote instances.                                                                                                                                                                                                                                                                               | No                           | No                 |

---

## **Appendix E**

### **Acronyms and Terms**

---

| <b>Term</b>                              | <b>Definition</b>                                                                                                                                         |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Active session pool                      | Number of current active sessions allowed for a resource group or subplan                                                                                 |
| ADDMM                                    | 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                                                                                                                                           |
| Fast recovery area                          | A unified storage location for all recovery-related files and activities in an Oracle database                                                                    |
| FGA                                         | Fine-grained auditing                                                                                                                                             |
| FGAC                                        | Fine-Grained Access Control                                                                                                                                       |
| Flash recovery area                         | Renamed to Fast recovery area.                                                                                                                                    |
| 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                                                                          |

| Term                                    | Definition                                                                                                                                                                                                                         |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Flashback Drop                          | A feature that enables you to undo the effects of a DROP TABLE statement without resorting to traditional point-in-time recovery                                                                                                   |
| Flashback Table                         | A command that enables you to recover a table and all its dependent objects from the recycle bin                                                                                                                                   |
| Flashback Transaction Query             | A diagnostic tool that you can use to view changes made to the database at the transaction level                                                                                                                                   |
| Flashback Versions Query                | A query syntax that provides a history of changes made to a row along with the corresponding identifier of the transaction that made the change                                                                                    |
| Format mask elements                    | A character literal that describes the format of datetime or numeric data stored in a character string                                                                                                                             |
| Growth trend report                     | Analysis of the growth of database segments                                                                                                                                                                                        |
| Globalization support                   | A feature set that ensures that utilities and error messages, sort order, alphabet, calendar, date, time, money, and numbers automatically adapt to the native language                                                            |
| Image copy                              | A bit-for-bit identical copy of a database file                                                                                                                                                                                    |
| Incarnation                             | A separate version of a physical database. The incarnation of the database changes when you open it with the RESETLOGS option, but you can recover backups from an earlier incarnation so long as the necessary redo is available. |
| Index-organized tables                  | A database structure that has the appearance of a table but stores its data in a B*Tree structure                                                                                                                                  |
| init.ora or<br>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                                                                                                                                                              |

| <b>Term</b>                                          | <b>Definition</b>                                                                                                                                                               |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LCSSCAN                                              | Language and Character Set File Scanner                                                                                                                                         |
| LEGATO <sup>®</sup> 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 <sup>®</sup> 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             |

| <b>Term</b>                     | <b>Definition</b>                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OUI                             | Oracle Universal Installer                                                                                                                                                                                      |
| 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                                                                                                                                             |

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



# Oracle Restart

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## Objectives

After completing this lesson, you should be able to use Oracle Restart to manage components.

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# Oracle Restart

Oracle Restart implements a high availability solution for stand-alone Oracle databases.

- Can monitor and restart the following components:
  - Database instances
  - Oracle Net listener
  - Database services
  - Automatic Storage Management (ASM) instance
  - ASM disk groups
  - Oracle Notification Services (ONS/eONS)
- Runs periodic check operations to monitor the health of the components
- Runs out of the Oracle Grid Infrastructure home, which you install separately from Oracle Database homes

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## Oracle Restart

Oracle Restart is designed to improve the availability of your Oracle Database. It implements a high availability solution for single instance (nonclustered) environments only. For Oracle Real Application Cluster (Oracle RAC) environments, the functionality to automatically restart components is provided by Oracle Clusterware. Oracle Restart can monitor the health and automatically restart the following components:

- Database instances
- Oracle Net listener
- Database services
- ASM instance
- ASM disk groups
- Oracle Notification Services (ONS/eONS): Service for sending Fast Application Notification (FAN) events to integrated clients upon failover. The eONS is used by Oracle Enterprise Manager to receive notification of change in status of components managed by Oracle Restart.

Restarting an ASM disk group means mounting it. The ability to restart ONS is applicable only in Oracle Data Guard installations for automatic failover of connections between primary and standby databases through FAN.

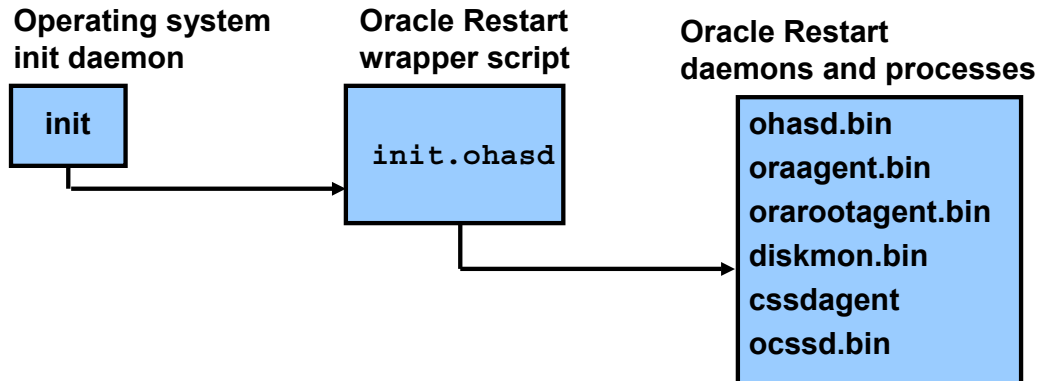
## **Oracle Restart (continued)**

Oracle Restart ensures that the components are started in the proper order, in accordance with component dependencies. If a component must be shut down, it ensures that the dependent components are cleanly shut down first.

Oracle Restart runs out of the Oracle Grid Infrastructure home, which you install separately from Oracle Database homes.

## Oracle Restart Process Startup

- Oracle Restart is started by the OS init daemon.



- The Oracle Restart installation modifies the `/etc/inittab` file to ensure start up every time the machine starts.

```
cat /etc/inittab
..
hl:35:respawn:/etc/init.d/init.ohasd run >/dev/null 2>&1 </dev/null
```

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### Oracle Restart Process Startup

During the installation of Oracle Restart, entries to start a wrapper script are placed in the `/etc/inittab` operating system file. The wrapper script sets up the environment variables and then starts the Oracle Restart daemons and processes.

When a command is used to stop Oracle Restart, the daemons will be stopped, but the wrapper script process will remain running.

The format of the UNIX `/etc/inittab` file is as follows:

```
id : run levels : action : process with parameters
```

The wrapper script is started with the `respawn` action so it will be restarted whenever it is terminated. In addition, the `respawn` action causes the `init` process to restart the daemons if they fail.

Some of the Oracle Restart daemons will be running under the `root` user with real-time priority, and others will be running under the Grid Infrastructure owner with user-mode priorities after they are started. On a Windows platform, operating system services are used instead of wrapper initialization scripts and the daemons are executable binaries.

**Note:** Executing the wrapper script directly is not supported.

## Controlling Oracle Restart

The CRSCTL utility can be used to control the state of Oracle Restart.

- To display the Oracle Restart configuration:

```
$ crsctl config has
```

- To enable or disable the automatic restart of Oracle Restart:

```
$ crsctl [enable | disable] has
```

- To start or stop Oracle Restart:

```
$ crsctl [start | stop] has
```

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## Controlling Oracle Restart

The CRSCTL utility can be used to control the state of Oracle Restart. It can be used to determine if the autostart capability is enabled or disabled as follows:

```
$ crsctl config has
CRS-4622: Oracle High Availability Services autostart is
enabled.
```

During the installation of Oracle Grid Infrastructure, entries are placed in the `/etc/inittab` operating system file to start a wrapper script as follows:

```
h1:35:respawn:/etc/init.d/init.ohasd run >/dev/null 2>&1
</dev/null
```

The wrapper script is responsible for setting up environment variables and then starting the Oracle High Availability Services Daemon (ohas) along with other related processes. The wrapper script is executed as the root user.

When the CRSCTL utility is used to disable the automatic restart of the Oracle Grid Infrastructure, the entry in the `/etc/inittab` file is not removed. The control files for ohas are used to control the state of ohas and determine if automatic restart is enabled or disabled. These are known as SCLS\_SCR files. For Linux, the location of the control files is defined to be:

```
/etc/oracle/scls_scr/$HOST/<Oracle Restart owner> and
/etc/oracle/scls_scr/$HOST/root
```

## Controlling Oracle Restart (continued)

If the CRSCTL utility is used to stop Oracle Restart, all components currently managed by Oracle Restart will also be stopped.

```
$ crsctl stop has
CRS-4549: Stopping resources.
CRS-2673: Attempting to stop 'ora.diskmon' on 'host01'
CRS-2673: Attempting to stop 'ora.DATA.dg' on 'host01'
CRS-2673: Attempting to stop 'ora.LISTENER.lsnr' on 'host01'
CRS-2677: Stop of 'ora.DATA.dg' on 'host01' succeeded
CRS-2673: Attempting to stop 'ora.asm' on 'host01'
CRS-2675: Stop of 'ora.diskmon' on 'host01' succeeded
CRS-2677: Stop of 'ora.LISTENER.lsnr' on 'host01' succeeded
CRS-2677: Stop of 'ora.asm' on 'host01' succeeded
CRS-2673: Attempting to stop 'ora.cssd' on 'host01'
CRS-2677: Stop of 'ora.cssd' on 'host01' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'host01'
CRS-2677: Stop of 'ora.diskmon' on 'host01' succeeded
CRS-4133: Oracle High Availability Services has been stopped.
```

In the example above, there is no Oracle Database software installed. If Oracle databases had been registered with Oracle Restart or they had been using ASM, they would have been stopped also.

When starting Oracle Restart with the CRSCTL utility, each component that is started is not displayed to standard output.

```
$ crsctl start has
CRS-4123: Oracle High Availability Services has been started.
```

**Note:** Invoking the wrapper script directly to start the Oracle Grid Infrastructure processes is not supported.

## Choosing the Correct SRVCTL Utility

- Invoke the Server Control (SRVCTL) utility from the Oracle Grid Infrastructure home when working with ASM instances, disk groups, listeners, and ONS.

```
$ export ORACLE_HOME=/u01/app/oracle/product/11.2.0/grid
$ $ORACLE_HOME/bin/srvctl command component options
```

- Invoke the SRVCTL utility from the Oracle Database home when working with the database or database instance.

```
$ export
ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1
$ $ORACLE_HOME/bin/srvctl command component options
```

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## Choosing the Correct SRVCTL Utility

Oracle Restart includes the SRVCTL utility that you use to start, stop, and manage Oracle Restart components. After the Oracle Database software is installed in addition to the Oracle Grid Infrastructure software, there will be a copy of the SRVCTL utility in each ORACLE\_HOME location. You need to determine the correct ORACLE\_HOME location in which to run the SRVCTL utility. You need to run the SRVCTL utility from the Grid Infrastructure software home directory when managing the ASM instance, ASM disk groups, Oracle Net listeners, and the ONS. You need to run the SRVCTL utility from the Oracle Database software home directory when managing the Oracle database instances. To determine the currently mapped location of the SRVCTL utility, use the which command as follows:

```
$ which srvctl
/u01/app/oracle/product/11.2.0/grid/bin/srvctl
```

**Note:** For the Oracle Net listener, the assumption is that Oracle Grid Infrastructure was installed before the Oracle Database software. If Oracle Restart is added to an existing Oracle Database installation, the Oracle Net listener could be running from the Oracle Database home directory. In that case, you should use the SRVCTL utility from the Oracle Database home to manage the Oracle Net listener.

# Oracle Restart Configuration

Oracle utilities will automatically update the Oracle Restart configuration.

| Create operations and the Oracle Restart configuration                                     | Automatically added to configuration? |
|--------------------------------------------------------------------------------------------|---------------------------------------|
| Create a database with OUI or DBCA                                                         | YES                                   |
| Create a database with SQL statement                                                       | NO                                    |
| Create an ASM instance with OUI, DBCA, or ASMCA                                            | YES                                   |
| Create a disk group (any method)                                                           | YES                                   |
| Add a listener with NETCA                                                                  | YES                                   |
| Create a database service with SRVCTL                                                      | YES                                   |
| Create a database service by modifying <code>SERVICE_NAMES</code> initialization parameter | NO                                    |
| Create a database service with <code>DBMS_SERVICE.CREATE_SERVICE</code>                    | NO                                    |

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## Oracle Restart Configuration

Oracle Restart maintains a list of all the components that it manages, and maintains configuration information for each component. All of this information is collectively known as the “Oracle Restart configuration.” When Oracle Restart is installed, many operations that create Oracle components using Oracle utilities will automatically add the components to the Oracle Restart configuration. If a component is created manually without using an Oracle utility, then SRVCTL commands can be used to add it to the Oracle Restart configuration if desired. The table in the above slide shows which create operations automatically add the component to the Oracle Restart configuration and which create operations do not update the Oracle Restart configuration.

**Note:** The same principal applies to delete operations.

## Using the SRVCTL Utility

- The SRVCTL utility is used to start, stop, and manage Oracle Restart components with the following syntax:

```
$ srvctl command component options
```

- The following command and components are supported:

|                   |                                                                                     |
|-------------------|-------------------------------------------------------------------------------------|
| <b>Commands</b>   | add config disable enable getenv modify<br>remove setenv start status stop unsetenv |
| <b>Components</b> | asm db dg filesystem home lsnr serv ons<br>eons                                     |

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## Using the SRVCTL Utility

When Oracle Restart is in use, Oracle strongly recommends that you use the SRVCTL utility to start, stop, and manage all Oracle Restart components. The SRVCTL utility is recommended for the following reasons:

- All dependencies between components are maintained. This enables Oracle Restart to start or to stop any dependent components first.
- Components are started according to their Oracle Restart configuration.
- Environment variables stored in the Oracle Restart configuration for the components are set.

Oracle Restart components can also be started with other utilities such as the listener control (LSNRCTL) utility or SQL\*Plus, but the benefits listed above may not be obtained with other utilities. The SRVCTL utility with Oracle Restart supports 12 commands and 9 components. The options that are allowed vary with each command and component combination. The SRVCTL utility syntax is as follows:

```
srvctl command component options
```

where:

- *command* is a verb such as start, stop, or remove
- *component* is the object on which SRVCTL performs the command, such as a database
- *options* extend the use of the preceding command to include additional parameters



## Obtaining Help for the SRVCTL Utility

The SRVCTL utility provides online help for its commands, components, and options.

- For help with general usage:

```
$ srvctl -h
```

- For help on a particular command:

```
$ srvctl command -h
```

- For help on a particular command and component:

```
$ srvctl command component -h
```

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### Obtaining Help for the SRVCTL Utility

The SRVCTL utility provides detailed online help for its commands, components, and options. To display the online Help, you use the help (-h) option to display usage information. If the help (-h) option is the only parameter specified, SRVCTL displays a general outline of all commands with the most common options used for each command and component combination. This will not be a complete list of all supported options. For more detailed and complete information, the help (-h) option can be used for a specific command, or for a specific command and component combination.

## Starting Components by Using the SRVCTL Utility

Oracle recommends that the SRVCTL utility be used to start all components.

- Examples of starting individual components:

```
$ srvctl start database -d PROD -o mount
$ srvctl start listener -l crmlistener
$ srvctl start service -d PROD -s "service1,service2"
$ srvctl start diskgroup -g "DATA,FRA"
$ srvctl start asm
$ srvctl start eons -v
$ srvctl start ons
```

- Example of starting all Oracle Restart components in a specified Oracle home:

```
$ srvctl start home -o oracle_home -s state_file
```

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## Starting Components by Using the SRVCTL Utility

The SRVCTL utility can be used to start individual components, along with any dependent components that are necessary. For example, the `srvctl start database -d PROD` command may also start the listener, the ASM instance, and multiple disk groups if those components have been defined as being managed by Oracle Restart and are listed as dependent components to the PROD database.

The SRVCTL utility can also be used to start all components that are associated with a specified Oracle home and have been configured for Oracle Restart with the following command:

```
srvctl start home -o /u01/app/oracle/product/11.2.0/dbhome_1
-s /usr/local/bin/group_state_file
```

The state file contains the current state information for the components in the Oracle home and is created when the `srvctl status home` command is executed. It is indicated with the state file option (`-s`), and must specify the complete path of the state file. The state file can be created in any directory.

**Note:** The options shown in the slide represent the most common options and are not a complete list. You can use the help option (`-h`) for a complete list of all available options for each command.

## Stopping Components by Using the SRVCTL Utility

Oracle recommends that the SRVCTL utility be used to stop all components.

- Examples of stopping individual components:

```
$ srvctl stop database -d PROD -o transactional
$ srvctl stop listener -l crmlistener -f
$ srvctl stop service -d PROD -s "service1,service2"
$ srvctl stop diskgroup -g "DATA,FRA" -f
$ srvctl stop asm -o immediate -f
$ srvctl stop eons -v
$ srvctl stop ons
```

- Example of stopping all Oracle Restart components in a specified Oracle home:

```
$ srvctl stop home -o oracle_home -s state_file -f
```

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### Stopping Components by Using the SRVCTL Utility

The SRVCTL utility can be used to stop individual components, along with any dependent components that must be stopped. For example, the `srvctl stop diskgroup -g "DATA" -f` command will force an unmount of the diskgroup even if files are open in it. It will also stop all database instances that depend on the DATA disk group.

The SRVCTL utility can also be used to stop all components that are associated with a specified Oracle home and have been configured for Oracle Restart with the following command:

```
srvctl stop home -o /u01/app/oracle/product/11.2.0/dbhome_1 -
s /usr/local/bin/group_state_file -f
```

This can be very useful when it is necessary to stop all components such as when you need to apply a patch to the software binaries.

**Note:** The options shown in the slide represent the most common options and are not a complete list. You can use the help option (-h) for a complete list of all available options for each command.

## Viewing Component Status

- You can use the `status` command to view the running status for any component managed by Oracle Restart.
- Display the running status for a database:

```
$ srvctl status database -d orcl
Database is running.
```

- Display the listener status:

```
$ srvctl status lsnr
Listener LISTENER is enabled
Listener LISTENER is running on node(s): host01
```

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## Viewing Component Status

You can use the SRVCTL utility to view the running status (running or not running) for any component managed by Oracle Restart. Additional information is displayed for some components.

The format of the command is as follows:

```
srvctl status object [options]
```

*object* can be one of the following:

- `asm`: ASM instance
- `db`: Database instance
- `dg`: Oracle ASM disk group
- `filesystem`: Oracle ASM file system
- `home`: Oracle home or Oracle Clusterware home
- `lsnr`: Oracle Net listener
- `ons, eons`: Oracle Notification Services
- `serv`: Database service

Refer to the *Oracle Database Administrators Guide* for a list of options for each of the above objects.

## Displaying the Oracle Restart Configuration for a Component

- You can use the `config` command to display the Oracle Restart configuration of a component.
- Display the Oracle Restart configuration for a database:

```
$ srvctl config database -d orcl
Database unique name: orcl
Database name: orcl
Oracle home: /u01/app/oracle/product/11.2.0/dbhome_1
Oracle user: oracle
Spfile: +DATA/orcl/spfileorcl.ora
Domain: example.com
Start options: open
Stop options: immediate
Database role:
Management policy: automatic
Disk Groups: DATA,FRA
Services: east,sales
```

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## Displaying the Oracle Restart Configuration for a Component

You can use the SRVCTL utility to display the Oracle Restart configuration of a component with the `config` command. The `config` command is valid for the database, service, asm, listener, ons, and eons components.

The configuration for an Oracle Restart component can be modified with the SRVCTL utility `modify` command. The following syntax shows an example of how to modify the database with the unique name of `orcl` to use a different, nonstandard directory for the server parameter file (SPFILE).

```
srvctl modify database -d orcl -p
/usr/local/oracle/spfileorcl.ora
```

## Manually Adding Components to the Oracle Restart Configuration

Components can be manually added to the Oracle Restart configuration with the `add` command.

- To define a new listener that was not created with NETCA, use the following syntax:

```
$ srvctl add listener -l MYLISTENER -p TCP:1525 -o /u01/app/oracle/product/11.2.0/grid
```

- To specify a nondefault location for the new listener's networking files, use the following syntax:

```
$ srvctl setenv listener -l MYLISTENER -t TNS_ADMIN=/usr/local/oracle
```

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### Manually Adding Components to the Oracle Restart Configuration

The SRVCTL utility can be used to manually add components to the Oracle Restart configuration with the `add` command. If the component was created with an Oracle utility such as NETCA, DBCA, ASMCA, or OUI, it would have been automatically added to the Oracle Restart configuration and it would not be necessary to manually add it.

The slide illustrates manually adding a new listener called MYLISTENER to the Oracle Restart configuration. The listener will use the software binaries of the Grid home installation, but will depend on a nonstandard location for the networking files. For this example, it is assumed that the `listener.ora` networking file has been created in the `/usr/local/oracle` directory. The `setenv` command of the `srvctl` utility is used to define environment variables that may be needed for specific components. The `TNS_ADMIN` environment variable is set to the nondefault location of the `listener.ora` file, and is defined only for the listener named MYLISTENER. This will not have an impact on any other listeners that may already exist and that use different directories for the networking files.

The SRVCTL utility includes a `remove` command to manually delete a component from the Oracle Restart configuration. To delete the listener created above, use the following syntax:

```
srvctl remove listener -l mylistener -f
```

This will also remove the environment variable that was associated with the listener.

## Quiz

You invoke the SRVCTL utility from the Oracle Grid Infrastructure home when working with:

1. Listeners
2. ASM instances
3. Database instances
4. ASM disk groups

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**Answers: 1, 2, and 4**

## Summary

In this lesson, you should have learned how to use Oracle Restart to manage components.

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## Practice 3-1: Overview

In this practice, you use Oracle Restart to manage components.

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## **Continuing Your Education and Further Reading**

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## Where Do You Go from Here?

“To stay competitive in the tech industry, never stop learning. Always be on the lookout for better ways of doing things and new technologies. Our industry does not reward people who let themselves stagnate.”

—John Hall, Senior Vice President, Oracle University

This appendix provides a few resources to help you with continuing your education.

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## Continuing Education Resources

Resources to learn more about working with Oracle Database 11g include:

- Oracle University Web site
- Oracle University Knowledge Center
- Oracle Technology Network:
  - Oracle by Example
  - *Oracle Magazine*
  - Oracle Database product page
- Technical support: My Oracle Support
- Oracle Database product page

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## Oracle University

Oracle University is the world's largest corporate educator with education centers around the globe. The goal is 100% student satisfaction.

Oracle certifications are tangible, industry-recognized credentials that provide measurable benefits to IT Professionals and their employers. Numerous certification paths exist, for example, for DBAs:

- Oracle Certified Associate (OCA)
- Oracle Certified Professional (OCP)
- Oracle Certified Master (OCM), and
- Specialty certifications, for example, Oracle 10g: Managing Oracle on Linux Certified Expert

## Continuing Your Education

- Database specialty classes:
  - *Oracle Database 10g: Administration Workshop II*
  - *Oracle Database 11g: Performance Tuning*
  - *Oracle Database 11g: Security*
- Other specialty classes:
  - *Oracle 11g: RAC and Grid Foundation Administration*
  - *Oracle Database 11g: RAC Administration*

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### Continuing Your Education

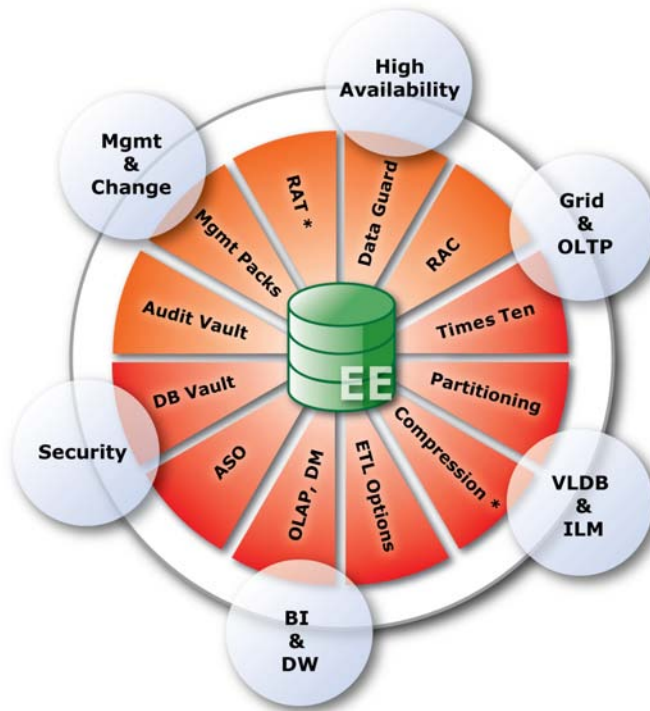
The *Oracle Database 10g: Administration Workshop II* course provides additional training as a database administrator. You cover advanced database recovery strategies, performance monitoring and tuning, and distributed data concepts. Oracle recommends that you complete this course before beginning specialty courses. Additional courses are available on topics that can enhance your abilities as an Oracle database administrator, such as:

- *Oracle Database 11g: Performance Tuning*
- *Oracle Database 11g: Security*

Other specialty courses include *Oracle 11g: RAC and Grid Foundation Administration* and *Oracle Database 11g: RAC Administration*.

Consult the Oracle University Web site for an up-to-date list of all courses. Consult the Oracle University Learning Paths for more suggested courses for your job description.

# Database Specialty Areas



## Modern Enterprise Grids

- Real Application Clusters
- Management packs
- TimesTen In-Memory Database

## Information Lifecycle Management

- Partitioning
- Advanced Compression

## Data Warehousing

- Oracle Information Appliances
- OLAP, Mining, Warehouse Builder

## Governance, Risk & Compliance

- Security Options
- Total Recall

## Change management

- Real Application Testing

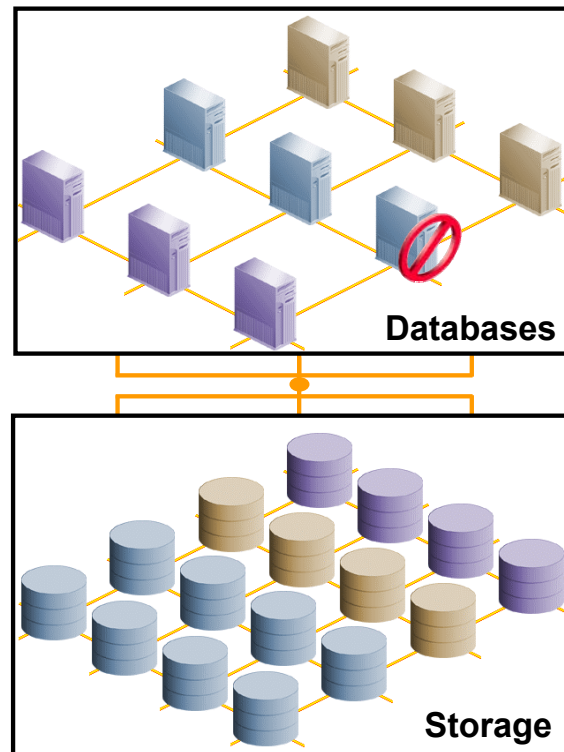
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# Oracle Real Application Clusters

- Consolidating different workloads to a single grid
- Virtualizing the information platform
- Flexible physical infrastructure (including dedicated servers)



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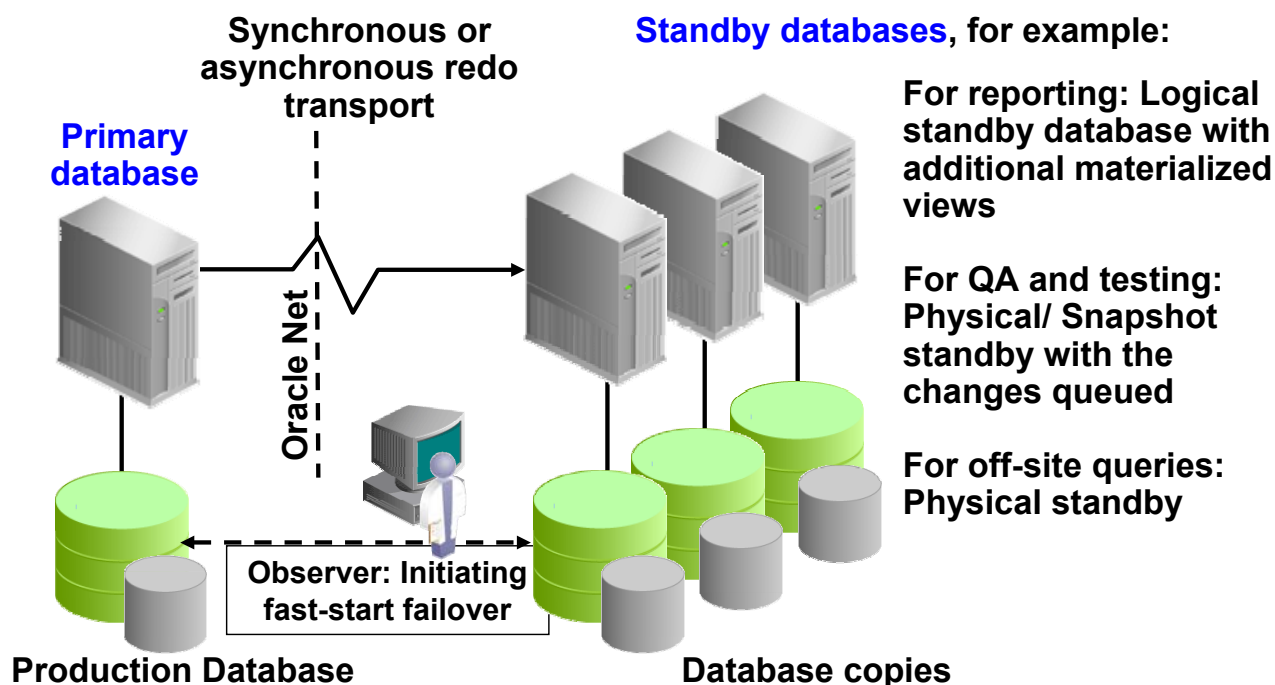
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## Why use RAC?

Oracle Real Application Clusters (RAC) enables high utilization of a cluster of standard, low-cost modular servers such as blades. RAC offers automatic workload management for services. Services are groups or classifications of applications that comprise business components corresponding to application workloads. Services in RAC enable continuous, uninterrupted database operations and provide support for multiple services on multiple instances. You assign services to run on one or more instances, and alternate instances can serve as backup instances. If a primary instance fails, Oracle moves the services from the failed instance to a surviving alternate instance. Oracle also automatically load-balances connections across instances hosting a service.

RAC harnesses the power of multiple low-cost computers to serve as a single large computer for database processing, and provides the only viable alternative to large-scale SMP boxes for all types of applications. RAC, which is based on a shared-disk architecture, can grow and shrink on demand without the need to artificially partition data among the servers of your cluster. RAC also offers a single-button addition and removal of servers to a cluster. Thus, you can easily provide or remove a server to or from the database.

# Oracle Data Guard



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## Oracle Data Guard

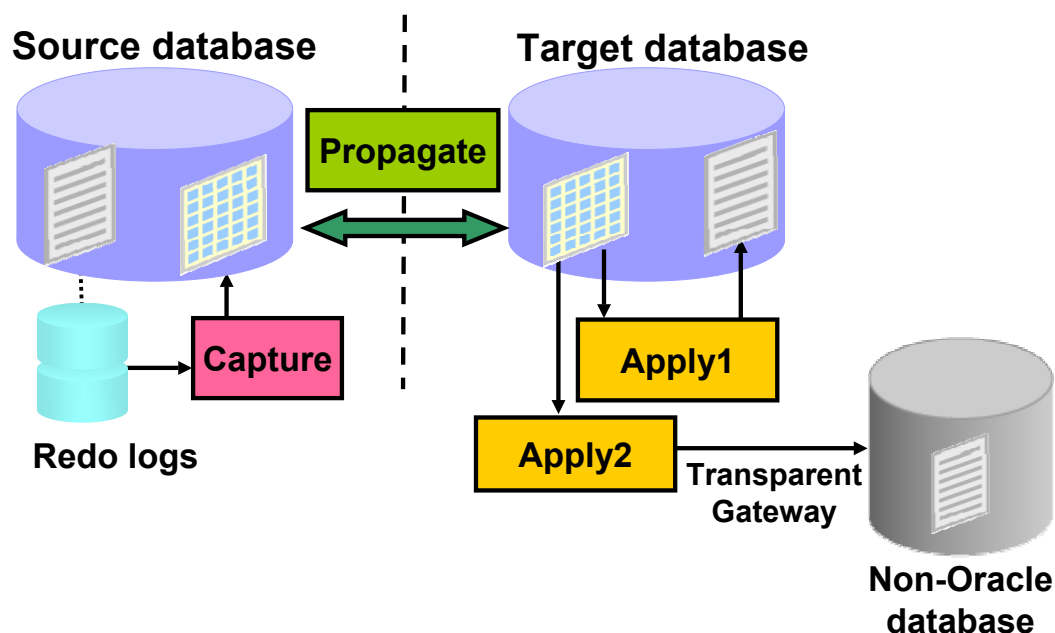
Oracle Data Guard is a management, monitoring, and automation software infrastructure that works with a production database and one or more standby databases to protect your data against failures, errors, and corruptions that might otherwise destroy your database. It protects critical data by providing facilities to automate the creation, management, and monitoring of the databases and other components in a Data Guard configuration. It automates the process of maintaining a copy of an Oracle production database (called a *standby database*) that can be used if the production database is taken offline for routine maintenance or becomes damaged.

In a Data Guard configuration, a production database is referred to as a *primary database*. A *standby database* is a synchronized copy of the primary database. Using a backup copy of the primary database, you can create from one to nine standby databases. The standby databases, together with the primary database, make up a Data Guard configuration. Each standby database is associated with only one primary database.

**Note:** You can use the Cascaded Redo Log Destinations feature to incorporate more than nine standby databases in your configuration.

Configuring standby redo log files is highly recommended on all standby databases in a Data Guard configuration, including the primary database to aid in role reversal.

# Streams Overview



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## Streams Overview

A stream is a flow of information either within a database or from one database to another. Oracle Streams is a set of processes and database structures that enable you to share data and messages in a data stream. The unit of information that is put into a stream is called an event:

- DDL or DML changes, formatted as an LCR
- User-created events

Events are staged in and propagated between queues.

Most people think of Streams as replication where all databases can be updatable, and without platform or release considerations. Characteristics include:

- All sites: Active and updateable
- Automatic conflict detection and optional resolution
- Supporting data transformations
- Flexible configurations: n-way, hub & spoke, and so on
- Different database platforms, releases and schemas
- Providing high availability for applications (where update conflicts can be avoided or managed)

## Oracle Streams: Basic Elements

By using Oracle Streams, you can share data and events in a data stream, either within a database or from one database to another.

Oracle Streams uses queues to stage events for propagation or consumption. You can use Oracle Streams to propagate events from one queue to another, and these queues can be in the same database or in different databases. You may stage two types of events in a queue used by Streams: captured events (logical change records, or LCRs) and user-enqueued events (which can be messages or LCRs):

- Changes to the database can be captured from the redo logs. You can then format these changes into LCRs. The LCRs can represent data manipulation language (DML) or data definition language (DDL) changes. The database where changes are generated in the redo log is called the source database.
- You can also enqueue user events explicitly with a user application. These explicitly enqueued events can be LCRs or user-created messages. A message is the smallest unit of information that is inserted into and retrieved from a queue. A message consists of data as well as information to govern the interpretation and use of the message data.

You can divide Oracle Streams into a small set of tasks. By configuring these tasks, you can control what information is put into a stream, how the stream flows from node to node, what happens to events in the stream as they flow into each node, and how the stream terminates.

You can customize each task to address specific requirements and business needs. The result is a new feature that provides greater functionality and flexibility than traditional solutions for capturing and managing events, and for sharing the events with other databases and applications. Oracle Streams provides the capabilities that are needed to build and operate distributed enterprises and applications, data warehouses, and high-availability solutions.

The three basic tasks of Oracle Streams are:

- **Capture:** To capture DML or DDL events automatically from the redo log. User-created events are not captured automatically but are placed into a queue via an explicit enqueue operation.
- **Staging:** To store and propagate events between databases. Propagation can be performed explicitly if needed.
- **Apply:** To apply DML or DDL events to a destination database or to pass the events to an application.

You can perform these tasks in a single database or combine them with tasks in other databases to form a distributed environment.

### Multi-Database Streams

Events propagate between the staging areas in each database. The capture and consumption elements can be active in any database. For example, you can configure bidirectional data replication with a capture process, propagation job, and apply process at each site. Or, you can have a single-source system with capture and propagation at one site and apply at several other databases. You can also have an arbitrary number of databases. Some of the more complex environments may need hundreds of databases sharing information with Oracle Streams.

# Oracle Technology Network

Oracle Technology Network is a *free* resource with information about the core Oracle software products, including database, Application Server, Collaboration Suite, and development tools. You can have access to:

- Technology centers
  - Discussion forums
  - Software downloads
  - Online documentation
  - Oracle by Example
  - Code samples
- ... and much more!



<http://www.oracle.com/technology>

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## Oracle Technology Network

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.

In addition to tips, tricks, and techniques for getting the most out of your Oracle software, you can download that software from OTN. Remember that all software downloads are free; each comes with a development license that allows you to use full versions of the products only when developing and making prototypes of your applications.

# Security

The screenshot shows the Oracle Technology Network website. At the top, there's a navigation bar with the Oracle logo, a search bar, and links for account management. Below this is a sidebar with categories like PRODUCTS, TECHNOLOGIES, ARCHITECTURE, and COMMUNITY. The main content area is titled "Security Technology Center" and features a padlock icon. It includes a description of Oracle's secure infrastructure, a link to a recent Critical Patch Update Advisory, and a "What's New" section with two articles: "Oracle Innovation Showcase: Mark Wilcox on Oracle Virtual Directory" and "Article: Keeping Current with Standards (from Oracle Magazine)". On the right, there are three boxes: "Security Technology" with links to Database Platform Security, Identity Management Infrastructure, and Security Developer Tools; "Security Downloads" with links to Oracle Identity Management, Oracle Database Vault, Oracle Audit Vault, Oracle Secure Backup, and Oracle Secure Enterprise Search; and "Security Response" with links to Critical Patch Updates, BEA Security Advisories Archive, Security Vulnerability Fixes - Policy and Process, and Critical Patch Update Implementation Best Practices (PDF).

<http://www.oracle.com/technology/deploy/security/index.html>

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## Security

For more information about all security-related aspects of the database, visit the “Security Technology Center,” which is updated regularly.

## Oracle by Example

- What is an OBE?
  - A set of hands-on, step-by-step instructions
- Where can I find them?
  - <http://www.oracle.com//technology/obe>
- What is available?
  - Hundreds of OBE tutorials on many of the Oracle product areas

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### Oracle by Example

The Oracle by Example (OBE) series provides hands-on, step-by-step instructions on how to use various new features of Oracle products. OBEs help to reduce the time spent on learning a new product capability and enhance the users' understanding of how the feature can be implemented in their environment. Currently, OBEs are available for the Oracle database, Fusion Middleware, Oracle Application Server, Oracle Enterprise Manager Grid Control, Oracle Collaboration Suite, JDeveloper, and Business Intelligence. OBEs can be accessed at <http://www.oracle.com/technology/obe>.

# Oracle Magazine

- Free subscription
- Oracle Magazine Archives  
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## Oracle Magazine

Among the many different types of resources to which you have access from OTN is *Oracle Magazine*. You can receive your free subscription also by mail.



# Oracle Applications Community

Oracle Technology Network is a resource for Oracle Applications users and implementers. You can have access to:

- Discussion forums
- User groups
- Online chat
- Documentation
- Training
- Upgrade information
  - ... and much more!



<http://www.oracle.com/technology/community/apps/index.html>

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## Technical Support: My Oracle Support

Access to My Oracle Support is included as part of your annual support maintenance fees. In addition to the most up-to-date technical information available, My Oracle Support gives you access to:

- Service requests (SRs)
- Certification matrices
- Technical forums monitored by Oracle experts
- Software patches
- Bug reports



<http://metalink.oracle.com>

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### Oracle *MetaLink*

My Oracle Support is your gateway to Oracle's Support resources. Here you find answers to the most common issues facing Oracle administrators and developers, as well as resources to solve many of those issues.

Like Oracle Technology Network, My Oracle Support includes the most recent headlines about issues that affect the Oracle professional.

## Oracle Database Product Page

From the Oracle Database product page on OTN, there are links to:

- Database Focus Areas
- White Papers
- Option Data Sheets
- Related technologies
- Discussions
- Other useful resources

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### Oracle Database Product Page

From the Oracle Database product page on OTN, there are links to useful information such as:

- **Database Focus Areas:** Provides links to other database-related focus areas such as Grid/Clustering, High Availability, Performance, and Manageability
- **White Papers:** Provides detailed information to help you learn more about the Oracle Database 11g product family
- **Option Data Sheets:** Provides detailed information about the various Oracle Database 11g options
- **Related technologies:** Provides links to related technologies such as Oracle Application Express and Oracle SQL Developer
- **Discussions:** Provides links to ongoing discussions related to Oracle Database 11g
- **Other resources:** Links to documentation, forums, links for learning more, and other useful resources

The documents here are live documents that are updated whenever the need arises, as well as new documents that may be added at any time. Check back regularly to find the latest information available.

## Thank You!

We hope your experience with Oracle University has been enjoyable. We welcome your feedback on how we can improve to better meet your needs:

- End-of-course evaluations
- Oracle University Office of Customer Satisfaction
- Oracle Education Services

We hope to see you in class again soon.

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### Thank You!

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