ORACLE UNIVERSITY

Integrated Cloud Applications & Platform Services

Oracle Database 12*c: Administration* Workshop

Electronic Presentation

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ORACLE

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Introduction

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Objectives

After completing this lesson, you should be able to:

- Explain the course objectives
- Describe the course schedule
- Describe the evolution of Oracle Database
- Describe Enterprise Cloud Computing
- Describe the HR schema

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Course Objectives

After completing this course, you should be able to:

- Describe Oracle Database architecture
- Configure the database to support your applications
- Manage database security and implement auditing
- Implement basic backup and recovery procedures
- Move data between databases and files
- Employ basic monitoring procedures and manage performance
- Manage resources and automate tasks
- Work with Oracle Support

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Suggested Schedule

Day	Lessons
1	1. Introduction 2. Exploring the Oracle Database Architecture 3. Oracle Database Management Tools 4. Managing the Database Instance
2	5. Configuring the Oracle Network Environment 6. Administering User Security 7. Managing Database Storage Structures 8. Managing Space 9. Managing Undo Data
3	10. Managing Data Concurrency 11. Implementing Oracle Database Auditing 12. Backup and Recovery Concepts 13. Backup and Recovery: Configuration
4	14. Performing Database Backups 15. Performing Database Recovery 16. Moving Data 17. Performing Database Maintenance
5	18. Managing Performance 19. Managing Performance: SQL Tuning 20. Using Resource Manager 21. Using Oracle Scheduler

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Oracle Database Innovation

… continuing with
Oracle Database 12*c*

Private DB Cloud
Defense in Depth
Information Lifecycle Mgt
Extreme Availability
Flex Clusters
Performance and Ease of Use

… with Oracle Database 11*g*

Oracle Grid Infrastructure
Real Application Testing
Automatic SQL Tuning
Fault Management

… with Oracle Database 10*g*

Audit Vault
Database Vault
Secure Enterprise Search
Grid Computing
Automatic Storage Mgmt
Self Managing Database

XML Database, Oracle Data Guard, RAC, Flashback Query, Virtual Private Database
Built-in Java VM , Partitioning Support, Built-in Messaging, Object Relational Support, Multimedia Support

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Enterprise Cloud Computing

RAC clusters for availability

Grids of low-cost hardware and storage

Managing change across the enterprise

Enterprise Manager Cloud Control and database consolidation across the enterprise

ORACLE 9i INTERNET

ORACLE DATABASE 10g

ORACLE DATABASE 11g

ORACLE DATABASE 12c

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Course Examples: HR Sample Schema

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Summary

In this lesson, you should have learned how to:

- Explain the course objectives
- Describe the course schedule
- Describe the evolution of Oracle Database
- Describe Enterprise Cloud Computing
- Describe the HR schema

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Exploring Oracle Database Architecture

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Objectives

After completing this lesson, you should be able to:

- List the major architectural components of Oracle Database
- Explain memory structures
- Describe background processes
- Correlate logical and physical storage structures
- Describe pluggable databases
- Describe ASM storage components

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Oracle Database Server Architecture: Overview

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Oracle Database Instance Configurations

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Connecting to the Database Instance

- Connection: Communication between a user process and an instance
- Session: Specific connection of a user to an instance through a user process

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Oracle Database Memory Structures

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Shared Pool

- Is a portion of the SGA
- Contains:
  - Library cache
    - Shared SQL area
  - Data dictionary cache
  - Server result cache

System Global Area (SGA)

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Database Buffer Cache

- Is part of the SGA
- Holds copies of data blocks that are read from data files
- Is shared by all concurrent users

System Global Area (SGA)

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Redo Log Buffer

- Is a circular buffer in the SGA
- Holds information about changes made to the database
- Contains redo entries that have the information to redo changes made by operations such as DML and DDL

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Large Pool

Provides large memory allocations for:

- Session memory for the shared server and the Oracle XA interface
- I/O server processes
- Oracle Database backup and restore operations

System Global Area (SGA)

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Java Pool

Java pool memory is used to store all session-specific Java code and data in the JVM.

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Streams Pool

Streams pool memory is used exclusively by Oracle Streams to:

- Store buffered queue messages
- Provide memory for Oracle Streams processes

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Program Global Area (PGA)

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In-Memory Column Store: Introduction

- Instant query response:
  - Faster queries on very large tables on any columns (100x)
  - Use of scans, joins, and aggregates
  - Without indexes
  - Best suited for analytics: few columns, many rows
- Faster DML: Removal of most analytics indexes (3 to 4x)
- Full application transparency

ORACLE E-BUSINESS SUITE
ORACLE FUSION APPLICATIONS
ORACLE SIEBEL
ORACLE JD EDWARDS
ORACLE PEOPLESOFT

- Easy setup:
  - In-memory column store configuration
  - Segment attributes

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In-Memory Column Store: Overview

- A new pool in the SGA: In-Memory column store
  - Segments populated into the IM column store are converted into a columnar format.
  - In-Memory segments are transactionally consistent with the buffer cache.
- Only one segment on disk and in row format

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Full Database In-Memory Caching

Traditional Buffer Cache Usage

DB_CACHE_SIZE= 10*g*

Loaded in buffer cache if table size < small % of buffer cache size

Full Database In-Memory Caching

Entire database loaded into the buffer cache:

- Huge performance benefits
- Two modes
  - Full Database Caching
  - Force Full Database Caching

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Quiz

The memory region that contains data and control information for a server or background process is called:

a. Shared pool
b. PGA
c. Buffer cache
d. User session data

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Quiz

What is read into the database buffer cache from data files?

a. Rows
b. Changes
c. Blocks
d. SQL

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Process Architecture

- User process
  - Is the application or tool that connects to the Oracle database
- Database processes
  - Server process: Connects to the Oracle instance and is started when a user establishes a session
  - Background processes: Are started when an Oracle instance is started
- Daemon / Application processes
  - Networking listeners
  - Grid Infrastructure daemons

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Process Structures

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Database Writer Process (DBWn)

Writes modified (dirty) buffers in the database buffer cache to disk:

- Asynchronously while performing other processing
- To advance the checkpoint

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Log Writer Process (LGWR)

- Writes the redo log buffer to a redo log file on disk
  - When a user process commits a transaction
  - When an online redo log switch occurs
  - When the redo log buffer is one-third full or contains 1 MB of buffered data
  - Before a DBW*n* process writes modified buffers to disk
  - When three seconds have passed since the last write
- Serves as coordinator of LG*nn* processes and ensures correct order for operations that must be ordered

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Checkpoint Process (CKPT)

- Records checkpoint information in
  - Control file
  - Each data file header
- Signals DBW*n* to write blocks to disk

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System Monitor Process (SMON)

- Performs recovery at instance startup
- Cleans up unused temporary segments

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Process Monitor Process (PMON)

- Performs process recovery when a user process fails
  - Cleans up the database buffer cache
  - Frees resources that are used by the user process
- Monitors sessions for idle session timeout

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Recoverer Process (RECO)

- Used with the distributed database configuration
- Automatically connects to other databases involved in in-doubt distributed transactions
- Automatically resolves all in-doubt transactions
- Removes any rows that correspond to in-doubt transactions

Recoverer process
in database A

In-doubt transaction
in database B

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Listener Registration Process (LREG)

Registers information about the database instance and dispatcher processes with the Oracle Net Listener

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Archiver Processes (ARC*n*)

- Copy redo log files to a designated storage device after a log switch has occurred
- Can collect transaction redo data and transmit that data to standby destinations

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Database Storage Architecture

Control files

Data files

Online redo log files

Parameter file

Backup files

Archived redo log files

Password file

Alert log and trace files

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Logical and Physical Database Structures

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Segments, Extents, and Blocks

- Segments exist in a tablespace.
- Segments are collections of extents.
- Extents are collections of data blocks.
- Data blocks are mapped to disk blocks.

Segment

Extents

Data blocks

Disk blocks (File System Storage)

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Tablespaces and Data Files

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SYSTEM and SYSAUX Tablespaces

- The SYSTEM and SYSAUX tablespaces are mandatory tablespaces that are created at the time of database creation. They must be online.
- The SYSTEM tablespace is used for core functionality (for example, data dictionary tables).
- The auxiliary SYSAUX tablespace is used for additional database components.
- The SYSTEM and SYSAUX tablespaces should not be used for application data.

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Oracle Container Database: Introduction

- *Pluggable database*: Is a set of database schemas that appears logically to users and applications as a separate database
- *Multitenant container database*: Has a database instance and database files at the physical level
- All pluggable databases share:
  - Background processes
  - Shared/process memory
  - Oracle metadata

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Multitenant Architecture

All PDBs share:

- Background processes
- Shared/process memory
- Oracle metadata
- Redo log files
- Control files
- Undo tablespace

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Automatic Storage Management

- Is a portable and high-performance cluster file system
- Manages Oracle database files
- Manages application files with ASM Cluster File System (ACFS)
- Spreads data across disks to balance load
- Mirrors data in case of failures
- Solves storage management challenges

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ASM Storage Components

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Interacting with an Oracle Database: Memory, Processes, and Storage

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Quiz

The Process Monitor process (PMON):

a. Performs recovery at instance startup
b. Performs process recovery when a user process fails
c. Automatically resolves all in-doubt transactions
d. Writes the redo log buffer to a redo log file

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Summary

In this lesson, you should have learned how to:

- List the major architectural components of Oracle Database
- Explain memory structures
- Describe background processes
- Correlate logical and physical storage structures
- Describe pluggable databases
- Describe ASM storage components

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Practice: Overview

This is a paper practice with questions about:

- Database architecture
- Memory
- Processes
- File structures

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Oracle Database Management Tools

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Objectives

After completing this lesson, you should be able to:

- Use SQL*Plus to access the Oracle database
- Use Oracle Enterprise Manager Database Express to perform administrative tasks
- Use Oracle Enterprise Manager Cloud Control to manage the database instance

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Oracle Database Management Tools: Introduction

- SQL*Plus provides an interface to your database so that you can:
  - Perform database management operations
  - Execute SQL commands to query, insert, update, and delete data in your database
- SQL Developer
  - Is a graphical user interface for accessing your instance of Oracle Database
  - Supports development in both SQL and PL/SQL
  - Is available in the default installation of Oracle Database
- Oracle Enterprise Manager Database Express
- Oracle Enterprise Manager Cloud Control

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Using SQL*Plus

SQL*Plus is:

- A command-line tool
- Used interactively or in batch mode

```
$ sqlplus hr

SQL*Plus: Release 12.1.0.2.0 Production on Mon Oct 6 13:28:12 2014

Copyright (c) 1982, 2014, Oracle.  All rights reserved.

Enter password:
Last Successful login time: Mon Oct 06 2014 13:24:35 +00:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options

SQL> SELECT last_name FROM employees;
LAST_NAME
-------------------------
Abel
Ande
…
```


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Calling SQL*Plus from a Shell Script

```
$ ./batch_sqlplus.sh

SQL*Plus: Release 12.1.0.1.0 Production on Thu Nov 15 09:10:48 2012

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Last Successful login time: Wed Nov 14 2012 12:10:11 +00:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics, Real Application Testing and
Unified Auditing options

SQL>
  COUNT(*)
----------
       107
SQL>
107 rows updated.
SQL>
Commit complete.
SQL> Disconnected from Oracle Database 12c Enterprise Edition Release 12.1.0.1.0
- 64bit Production
With the Partitioning, OLAP, Advanced Analytics, Real Application Testing
and Unified Auditing options
$
```

Output

```
# Name of this file: batch_sqlplus.sh
# Count employees and give raise.
sqlplus hr/hr <<EOF
select count(*) from employees;
update employees set salary = salary*1.10;
commit;
quit
EOF
```


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Calling a SQL Script from SQL*Plus

script.sql

```
select * from departments where location_id = 1400;
quit
```

Output

```
$ sqlplus hr/hr @script.sql

SQL*Plus: Release 12.1.0.1.0 Production on Thu Nov 15 09:32:36 2012

Copyright (c) 1982, 2012, Oracle.  All rights reserved.

Last Successful login time: Thu Nov 15 2012 09:30:49 +00:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics, Real Application Testing
and Unified Auditing options

DEPARTMENT_ID DEPARTMENT_NAME                MANAGER_ID LOCATION_ID
------------- ------------------------------ ---------- -----------
           60 IT                                    103        1400

Disconnected from Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 - 64bit
Production
With the Partitioning, OLAP, Advanced Analytics, Real Application Testing
and Unified Auditing options
```


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Oracle SQL Developer: Connections

Perform DBA operations in the DBA navigator by using DBA connections:

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Oracle SQL Developer: DBA Actions

Using DBA features through DBA navigator

Performing DBA actions

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Oracle Enterprise Manager Database Express Architecture

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Configuring Enterprise Manager Database Express

- Configure an HTTP listener port for each database instance.
  - Verify `DISPATCHERS` parameter.

```
dispatchers=(PROTOCOL=TCP)(SERVICE=sampleXDB)
```

  - Use `DBMS_XDB.setHTTPPort` procedure.

```
exec DBMS_XDB.setHTTPPort(5500)
```

  - Launch Enterprise Manager Database Express:

```
http://hostname:5500/em
```

- Use a different port for each instance.
- Browser requires Flash plug-in.

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Logging In to Oracle Enterprise Manager Database Express

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Using the Database Home Page

ORACLE Enterprise Manager Database Express 12c

Help | SYSTEM | Log Out

ORCL (12.1.0.2.0) Configuration Storage Security Performance EDRSR9P1

Database Home

Page Refreshed 1:32:14 PM GMT Auto Refresh 1 Minute

Status

Up Time	3 days, 19 hours, 45 minutes, 16
Type	Single instance (orcl)
Version	12.1.0.2.0 Enterprise Edition
Database Name	ORCL
Instance Name	orcl
Platform Name	Linux x86 64-bit
Host Name	EDRSR9P1
Oracle Home	/u01/app/oracle/product/12.1.0/db
Thread	1
Archiver	Stopped

Performance

Activity Class | Services

2, 1.6, 1.2, .8, .4, 0

12:35 PM, 12:45 PM, 12:55 PM, 1:05 PM, 1:15 PM, 1:25 PM

Oct 6

Wait, User I/O, CPU

Incidents - Last 24 Hours

Inst...	Time	Inci...	Pro...	Error
No Incidents				

Resources

Host CPU

20%, 16%, 12%, 8%, 4%, 0%

Other, Instance(s)

Active Sessions

1, .8, .6, .4, .2, 0

Wait, User I/O, CPU

Memory

600 MB, 400 MB, 200 MB, 0 MB

PGA, Other SGA, Shared I/O Pool, Java Pool, Large Pool, Shared Pool, Buffer Cache

Data Storage

3 GB, 2.25 GB, 1.5 GB, .75 GB, 0 GB

User Data, Logs, Undo, Temporary, Sysaux, System

Running Jobs

Ins...	Owner	Name	Ela...	Started
No Running Jobs				

SQL Monitor - Last Hour (20 max)

Status	Duration	T...	ID	User	Parallel	Database ...	SQL Tex
No SQL executions were monitored							

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Using Enterprise Manager Database Express Menus

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Oracle Enterprise Manager Cloud Control Components

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Controlling the Enterprise Manager Cloud Control Framework

Component Control Utilities		
Repository	OMS	Agent
SQL*Plus or Server Control	Enterprise Manager Control	Enterprise Manager Control
Listener Control		

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Starting the Enterprise Manager Cloud Control Framework

To start the Cloud Control framework, perform the following steps:

1. Start the repository database listener.
2. Start the repository database instance.
3. Start OMS.
4. Start the agent on the OMS/repository server.
5. Start the agents on the managed servers.

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Stopping the Enterprise Manager Cloud Control Framework

To stop the Enterprise Manager Cloud Control framework, perform the following steps:

1. Stop the agents on managed servers.
2. Stop the agent on the OMS/repository server.
3. Stop OMS.
4. Stop the repository database instance.

Agents

Repository

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Types of Enterprise Manager Cloud Control Targets

Enterprise Manager Cloud Control can monitor, administer, maintain, and manage many different types of targets including:

- Oracle databases
- Oracle Database Listener
- Oracle Fusion Middleware products
- Oracle Application Server
- Oracle WebLogic Server
- Oracle applications, including E-Business Suite, SOA, Siebel, and PeopleSoft
- Exadata and Exalogic
- Cloud Control Components: OMR and OMS
- Third-party products

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Enterprise Manager Cloud Control

ORACLE Enterprise Manager Cloud Control 12c

Setup Help GUEST_SUPER_ADMIN Log Out

Enterprise Targets Favorites History Search Target Name

Enterprise Summary

Page Refreshed Aug 22, 2011 2:29:31 PM UTC

Overview

View All Targets

Targets Monitored 1420

Status

Targets with Status 1006

Targets with Pending Activation 122

Incidents

Open 816

Updated in last 24 hours 333

Category				
Availability	238	13	2	-
Performance	-	2	-	-
Security	-	18	-	-
Others	-	533	23	-

Problems

Open 57 Without Service Request 57

Updated in last 24 hours 33

Jobs

Suspended Executions (last 7 days) 27

Problem Executions (last 7 days) 54438

Action Required Executions (last 7 days) 0

Patch Recommendations

View by Classification Target Type

Inventory and Usage

Show Hosts See Details

View Platform

Platform	Hosts	OS Patches
Enterprise Linux AS release 4 (October Update 8)	23	No
Enterprise Linux Server release 5.6 (Carthage)	19	No
Enterprise Linux Server release 5.4 (Carthage)	9	No
SunOS	2	No
Enterprise Linux Enterprise Linux AS release 4 (October Update 8)	1	No

Compliance Summary

Compliance Frameworks | Compliance Standards

View View Trends

Name	Target Evaluations			Violations			Average Compliance Score (%)
No data to display							

Least Compliant Targets

View View Trends

Target Name	Target Type	Standard Evaluations			Violations			Average Compliance Score (%)
racle.com	Host	1	0	0	4	0	0	51
oracle.com	Host	1	0	0	1	0	0	51
acle.com	Host	1	0	0	4	0	0	51
racle.com	Host	1	0	0	1	0	0	51
acle.com	Host	1	0	0	5	0	0	51

Service Requests

Sign in to My Oracle Support

Enter your Single Sign-On username and password.

* User Name

* Password

Go

Lost your password?

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Using Enterprise Manager Cloud Control

- Predefined home page based on roles
- Setting any page as home page
- Menu-based navigation
- Making any page “favorite” for quick access

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Quiz

Enterprise Manager Database Express can be used to manage many databases concurrently.

a. True
b. False

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Summary

In this lesson, you should have learned how to:

- Use SQL*Plus to access the Oracle database
- Use Oracle Enterprise Manager Database Express to perform administrative tasks
- Use Oracle Enterprise Manager Cloud Control to manage the database instance

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Practice: Overview

This practice covers the following topics:

- Connecting to the database by using SQL*Plus
- Navigating in Enterprise Manager Database Express
- Navigating in Enterprise Manager Cloud Control

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Managing the Database Instance

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Objectives

After completing this lesson, you should be able to:

- Start and stop the Oracle database instance and components
- Modify database initialization parameters
- Describe the stages of database startup
- Describe database shutdown options
- View the alert log
- Access dynamic performance views

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Initialization Parameter Files

spfileorcl.ora

or

initorcl.ora

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Types of Initialization Parameters

Basic

```
CONTROL_FILES
DB_BLOCK_SIZE
PROCESSES
UNDO_TABLESPACE
…
```

Advanced

```
COMMIT_LOGGING
COMMIT_WAIT
DB_CACHE_SIZE
SHARED_POOL_SIZE
…
```


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Initialization Parameters: Examples

Parameter	Specifies
CONTROL_FILES	One or more control file names
DB_FILES	Maximum number of database files
PROCESSES	Maximum number of OS user processes that can simultaneously connect
DB_BLOCK_SIZE	Standard database block size used by all tablespaces
DB_CACHE_SIZE	Size of the standard block buffer cache

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Initialization Parameters: Examples

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Initialization Parameters: Examples

Parameter	Specifies
PGA_AGGREGATE_TARGET	Amount of PGA memory available to all server processes
SHARED_POOL_SIZE	Size of shared pool (in bytes)
UNDO_MANAGEMENT	Undo space management mode to be used

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Using SQL*Plus to View Parameters

```
SQL> SELECT name, value FROM v$parameter;
NAME                    VALUE
------------            ----------
lock_name_space
processes                300
sessions                 472
timed_statistics         TRUE
timed_os_statistics      0
…

SQL> SHOW PARAMETER SHARED_POOL_SIZE
NAME                                 TYPE        VALUE
------------------------------------ ----------- ---------------------
shared_pool_size                     big integer 0

SQL> show parameter para
NAME                                 TYPE        VALUE
------------------------------------ ----------- ---------------------
cell_offload_parameters              string
fast_start_parallel_rollback         string      LOW
parallel_adaptive_multi_user         boolean     TRUE
parallel_automatic_tuning            boolean     FALSE
…
```


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Changing Initialization Parameter Values

- Static parameters:
  - Can be changed only in the parameter file
  - Require restarting the instance before taking effect
- Dynamic parameters:
  - Can be changed while database is online
  - Can be altered at:
    - Session level
    - System level
  - Are valid for duration of session or based on `SCOPE` setting
  - Are changed by using the `ALTER SESSION` and `ALTER SYSTEM` commands

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Changing Parameter Values: Examples

```
SQL> ALTER SESSION
  2  SET NLS_DATE_FORMAT ='mon dd yyyy';

Session altered.

SQL> SELECT SYSDATE FROM dual;

SYSDATE
-----------
oct 17 2012
```

```
SQL> ALTER SYSTEM  SET
  2  SEC_MAX_FAILED_LOGIN_ATTEMPTS=2
  3  COMMENT='Reduce for tighter security.'
  4  SCOPE=SPFILE;

System altered.
```


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Quiz

The majority of database parameters are dynamic and can be changed without having to shut down the database instance.

a. True
b. False

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Starting Up an Oracle Database Instance: NOMOUNT

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Starting Up an Oracle Database Instance: MOUNT

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Starting Up an Oracle Database Instance: OPEN

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Startup Options: Examples

- Using the SQL*Plus utility:

```
SQL> startup                                  1
```

```
SQL> startup nomount                          2
```

```
SQL> alter database mount;                    3
```

```
SQL> alter database open;                     4
```

- Using the Server Control utility with Oracle Restart

```
$ srvctl start database –d orcl –o mount
```


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Shutdown Modes

Shutdown Modes	A	I	T	N
Allows new connections	No	No	No	No
Waits until current sessions end	No	No	No	Yes
Waits until current transactions end	No	No	Yes	Yes
Forces a checkpoint and closes files	No	Yes	Yes	Yes

Shutdown modes:

- A = ABORT
- I = IMMEDIATE
- T = TRANSACTIONAL
- N = NORMAL

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Shutdown Options

On the way down:

- Uncommitted changes rolled back, for `IMMEDIATE`
- Database buffer cache written to data files
- Resources released

During:

`SHUTDOWN NORMAL`
or
`SHUTDOWN TRANSACTIONAL`
or
`SHUTDOWN IMMEDIATE`

On the way up:

- No instance recovery

Consistent database

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Shutdown Options

On the way down:

- Modified buffers not written to data files
- Uncommitted changes not rolled back

During:

`SHUTDOWN ABORT`
or
Instance failure
or
`STARTUP FORCE`

On the way up:

- Online redo log files used to reapply changes
- Undo segments used to roll back uncommitted changes
- Resources released

Inconsistent database

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Shutdown Options: Examples

- Using SQL*Plus:

```
SQL> shutdown                                  1
```

```
SQL> shutdown transactional                    2
```

```
SQL> shutdown immediate                        3
```

```
SQL> shutdown abort                            4
```

- Using the SRVCTL utility with Oracle Restart

```
$ srvctl stop database –d orcl –o abort
```


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Viewing the Alert Log

```
heduler window
arameter

3, old size 839680K, new size 849920K

(LGWR switch)
Current log# 3 seq# 27 mem# 0: /u01/app/oracle/oradata/orcl/redo03.log
Mon Oct 06 21:07:54 2014
Resize operation completed for file# 3, old size 849920K, new size 860160K
Mon Oct 06 22:00:01 2014
Setting Resource Manager plan SCHEDULER[0x4443]:DEFAULT_MAINTENANCE_PLAN via scheduler window
Setting Resource Manager plan DEFAULT_MAINTENANCE_PLAN via parameter
Mon Oct 06 22:00:03 2014
Begin automatic SQL Tuning Advisor run for special tuning task  "SYS_AUTO_SQL_TUNING_TASK"
End automatic SQL Tuning Advisor run for special tuning task  "SYS_AUTO_SQL_TUNING_TASK"
```


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Using Trace Files

- Each server and background process can write to an associated trace file.
- Error information is written to the corresponding trace file.
- Automatic diagnostic repository (ADR)
  - Is a systemwide central tracing and logging repository
  - Stores database diagnostic data such as:
    - Traces
    - Alert log
    - Health monitor reports

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Administering the DDL Log File

- Enable the capture of certain DDL statements to a DDL log file by setting `ENABLE_DDL_LOGGING` to `TRUE`.
- DDL log contains one log record for each DDL statement.
- Two DDL logs containing the same information:
  - XML DDL log: `log.xml` written to `$ORACLE_BASE/diag/rdbms/<dbname>/<SID>/log/ddl`
  - Text DDL: `ddlsid.log` written to `$ORACLE_BASE/diag/rdbms/<dbname>/<SID>/log`
- Example:

```
$ more ddl_orcl.log
Thu Nov 15 08:35:47 2012
diag_adl:drop user app_user
```


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Understanding the Debug Log File

- Debug log contains warnings about conditions, states, or events that do not inhibit correct operation of an Oracle Database component.
- The log is intended for use by Oracle Support when diagnosing a problem.
- It is included in incident packaging service (IPS) incident packages.
- It is written to `$ORACLE_BASE/diag/rdbms/<db_name>/<SID>/debug`.

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Using Dynamic Performance Views

Provide access to information about changing states of the instance memory structures

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Dynamic Performance Views: Usage Examples

1
```
SELECT sql_text, executions FROM v$sql
WHERE cpu_time > 200000;
```

2
```
SELECT * FROM v$session
WHERE machine = 'EDXX9P1'
AND logon_time > SYSDATE - 1;
```

3
```
SELECT sid, ctime FROM v$lock
WHERE block > 0;
```


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Dynamic Performance Views: Considerations

- These views are owned by the `SYS` user.
- Different views are available at different times:
  - The instance has been started.
  - The database is mounted.
  - The database is open.
- You can query `V$FIXED_TABLE` to see all the view names.
- These views are often referred to as “v-dollar views.”
- Read consistency is not guaranteed on these views because the data is dynamic.

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Data Dictionary: Overview

```
SELECT * FROM dictionary;
```


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Data Dictionary Views

	Who Can Query	Contents	Subset of	Notes
DBA_	DBA	Everything	N/A	May have additional columns meant for DBA use only
ALL_	Everyone	Everything that the user has privileges to see	DBA_ views	Includes user's own objects and other objects that the user has been granted privileges to see
USER_	Everyone	Everything that the user owns	ALL_ views	Is usually the same as ALL_ except for the missing OWNER column. (Some views have abbreviated names as PUBLIC synonyms.)

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Data Dictionary: Usage Examples

1
```
SELECT table_name, tablespace_name
FROM user_tables;
```

2
```
SELECT sequence_name, min_value, max_value,
increment_by
FROM all_sequences
WHERE sequence_owner IN ('MDSYS','XDB');
```

3
```
SELECT USERNAME, ACCOUNT_STATUS
FROM dba_users
WHERE ACCOUNT_STATUS = 'OPEN';
```

4
```
DESCRIBE dba_indexes
```


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Quiz

Which data dictionary view can be used to find the names of all tables in the database?

a. USER_TABLES

b. ALL_TABLES

c. DBA_TABLES

d. ANY_TABLES

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Summary

In this lesson, you should have learned how to:

- Start and stop the Oracle database instance and components
- Modify database initialization parameters
- Describe the stages of database startup
- Describe database shutdown options
- View the alert log
- Access dynamic performance views

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Practice: Overview

This practice covers the following topics:

- Viewing and modifying initialization parameters
- Stopping and starting the database instance
- Viewing log files

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Configuring the Oracle Network Environment

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Objectives

After completing this lesson, you should be able to:

- Use Enterprise Manager Cloud Control and Oracle Net Manager to:
  - Create additional listeners
  - Create Oracle Net Service aliases
  - Control Oracle Net Listener
- Use the Listener Control Utility to manage Oracle Net Listener
- Use `tnsping` to test Oracle Net connectivity
- Identify when to use shared servers and when to use dedicated servers

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Oracle Net Services: Overview

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Oracle Net Listener: Overview

```
<ORACLE_HOME>/network/admin/listener.ora
./sqlnet.ora
```


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Establishing Oracle Network Connections

To make a client or middle-tier connection, Oracle Net requires the client to know the:

- Host where the listener is running
- Port that the listener is monitoring
- Protocol that the listener is using
- Name of the service that the listener is handling

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Connecting to an Oracle Database

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Name Resolution

```
CONNECT jsmith/jspass@finflowers
```

Name resolution

```
finflowers =(DESCRIPTION=
  (ADDRESS=(PROTOCOL=tcp)(HOST=flowers-server)(PORT=1521))
  (CONNECT_DATA=
    (SERVICE_NAME=finance.us.flowers.com)))
```

LISTENER
port 1521

finance

flowers-server

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Establishing a Connection

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User Sessions

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Naming Methods

Oracle Net supports several methods of resolving connection information:

- Easy connect naming: Uses a TCP/IP connect string
- Local naming: Uses a local configuration file
- Directory naming: Uses a centralized LDAP-compliant directory server
- External naming: Uses a supported non-Oracle naming service

Oracle Net configuration files

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Easy Connect

- Is enabled by default
- Requires no client-side configuration
- Supports only TCP/IP (no SSL)
- Offers no support for advanced connection options such as:
  - Connect-time failover
  - Source routing
  - Load balancing

```
SQL> CONNECT hr/hr@db.us.oracle.com:1521/dba11g
```

No Oracle Net configuration files

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Local Naming

- Requires a client-side names-resolution file
- Supports all Oracle Net protocols
- Supports advanced connection options such as:
  - Connect-time failover
  - Source routing
  - Load balancing

Oracle Net configuration files

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Directory Naming

- Requires LDAP with Oracle Net names resolution information loaded:
  - Oracle Internet Directory
  - Microsoft Active Directory Services
- Supports all Oracle Net protocols
- Supports advanced connection options

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External Naming Method

- Uses a supported non-Oracle naming service
- Includes:
  - Network Information Service (NIS) External Naming
  - Distributed Computing Environment (DCE) Cell Directory Services (CDS)

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Tools for Configuring and Managing Oracle Net Services

- Enterprise Manager Net Services Administration page
- Oracle Net Manager
- Oracle Net Configuration Assistant
- Listener Control Utility

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Defining Oracle Net Services Components

Component	Description	File
Listeners	A process that resides on the server whose responsibility is to listen for incoming client connection requests and manage the traffic to the server.	`listener.ora`
Naming methods	A resolution method used by a client application to resolve a connect identifier to a connect descriptor when attempting to connect to a database service.	
Naming (net service name)	A simple name (connect identifier) for a service that resolves to a connect descriptor to identify the network location and identification of a service.	`tnsnames.ora` (local configuration)
Profiles	A collection of parameters that specifies preferences for enabling and configuring Oracle Net features on the client or server.	`sqlnet.ora`

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Using Enterprise Manager Cloud Control

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Using Oracle Net Manager

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Using Oracle Net Configuration Assistant

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Using the Listener Control Utility

```
$ lsnrctl
LSNRCTL for Linux: Version 12.1.0.2.0 - Production on 08-OCT-2014 10:07:23

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Welcome to LSNRCTL, type "help" for information.

LSNRCTL> help
The following operations are available
An asterisk (*) denotes a modifier or extended command:

start           stop            status          services
version         reload          save_config     trace
spawn           quit            exit            set*
show*
```


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Listener Control Utility Syntax

Commands for the Listener Control Utility can be issued from the command line or from the `lsnrctl` prompt.

- Command-line syntax:

```
$ lsnrctl <command name>
$ lsnrctl start
$ lsnrctl status
```

- Prompt syntax:

```
LSNRCTL> <command name>
LSNRCTL> start
LSNRCTL> status
```


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Advanced Connection Options

Oracle Net supports the following advanced connection options with local and directory naming:

- Connect-time failover
- Load balancing
- Source routing

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Testing Oracle Net Connectivity

The `tnsping` utility that tests Oracle Net service aliases:

- Ensures connectivity between the client and the Oracle Net Listener
- Does not verify that the requested service is available
- Supports Easy Connect Names Resolution:

```
tnsping host01.example.com:1521/orcl
```

- Supports local and directory naming:

```
tnsping orcl
```


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Comparing Dedicated Server and Shared Server Configurations

- Dedicated server configuration: One server process for each client
- Shared server configuration: A small pool of server processes can serve a large number of clients

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User Sessions: Dedicated Server Process

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User Sessions: Shared Server Processes

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SGA and PGA Usage

Oracle Shared Server: User session data is held in the SGA.

Remember to consider shared server memory requirements when sizing the SGA.

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Shared Server Configuration Considerations

Certain types of database work must not be performed using shared servers:

- Database administration
- Backup and recovery operations
- Batch processing and bulk load operations
- Data warehouse operations

Dispatcher

Dedicated server process

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Configuring Communication Between Databases

- Sending data or messages between sites requires network configuration on both sites.
- You must configure the following:
  - Network connectivity (for example, `tnsnames.ora`)
  - Database links

```
CREATE DATABASE LINK <remote_global_name>
CONNECT TO <user> IDENTIFIED BY <pwd>
USING '<connect_string_for_remote_db>';
```


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Connecting to Another Database

tnsnames.ora

```
REMOTE_ORCL =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)
(HOST = host02.example.com)
(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orcl2.example.com)
    )
  )
```

SQL*Plus

```
CONNECT hr/hr@orcl1;

CREATE DATABASE LINK remote
CONNECT TO HR IDENTIFIED BY HR
USING 'REMOTE_ORCL';

SELECT * FROM employees@remote
```


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Quiz

Which configuration files are used to configure the listener?

a. `listener.ora`
b. `listener.conf`
c. `tnsnames.ora`
d. `tnsnames.conf`
e. `sqlnet.ora`
f. `sqlnet.conf`

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Quiz

When using the shared server process architecture, the UGA portion of the PGA is relocated into the SGA.

a. True
b. False

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Summary

In this lesson, you should have learned how to:

- Use Enterprise Manager to:
  - Create additional listeners
  - Create Oracle Net Service aliases
  - Control the Oracle Net Listener
- Use `tnsping` to test Oracle Net connectivity
- Identify when to use shared servers and when to use dedicated servers

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Practice: Overview

This practice covers the following topics:

- Configuring local names resolution to connect to another database
- Creating a second listener

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6

Administering User Security

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Objectives

After completing this lesson, you should be able to:

- Create and manage database user accounts:
  - Authenticate users
  - Assign default storage areas (tablespaces)
- Grant and revoke privileges
- Create and manage roles
- Create and manage profiles:
  - Implement standard password security features
  - Control resource usage by users

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Database User Accounts

Each database user account has:

- A unique username
- An authentication method
- A default tablespace
- A temporary tablespace
- A user profile
- An initial consumer group
- An account status

A schema:

- Is a collection of database objects that are owned by a database user
- Has the same name as the user account

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Predefined Administrative Accounts

- SYS:
  - Owns the data dictionary and the Automatic Workload Repository (AWR)
  - Used for startup and shutdown of the database instance
- SYSTEM: Owns additional administrative tables and views
- SYSBACKUP: Facilitates Oracle Recovery Manager (RMAN) backup and recovery operations
- SYSDG: Facilitates Oracle Data Guard operations
- SYSKM: Facilitates Transparent Data Encryption wallet operations

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Administrative Privileges

Privilege	Description
SYSDBA	Standard database operations, such as starting and shutting down the database instance, creating the server parameter file (SPFILE), and changing the ARCHIVELOG mode Allows the grantee to view user data
SYSOPER	Standard database operations, such as starting and shutting down the database instance, creating the server parameter file (SPFILE), and changing the ARCHIVELOG mode
SYSBACKUP	Oracle Recovery Manager (RMAN) backup and recovery operations by using RMAN or SQL*Plus
SYSDG	Data Guard operations by using the Data Guard Broker or the DGMGRL command-line interface
SYSKM	Manage Transparent Data Encryption wallet operations

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Protecting Privileged Accounts

Privileged accounts can be protected by:

- Using a password file with case-sensitive passwords
- Enabling strong authentication for administrator roles

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Authenticating Users

- Password: User definition includes a password that must be supplied when the user attempts to log in to the database
- External: Authentication by a method outside the database (operating system, Kerberos, or Radius)
- Global: Users are identified by using an LDAP-based directory service

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Administrator Authentication

Operating system security:

- DBAs must have the OS privileges to create and delete files.
- Typical database users should not have the OS privileges to create or delete database files.

Administrator security:

- For SYSDBA and SYSOPER connections:
  - DBA user by name is audited for password file and strong authentication methods.
  - OS account name is audited for OS authentication.
  - OS authentication takes precedence over password file authentication for privileged users.
  - Password file uses case-sensitive passwords.

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OS Authentication and OS Groups

1

$ORACLE_HOME/rdbms/lib/
config.[cs]

2

```
#define SS_DBA_GRP "dba"
#define SS_OPER_GRP "opdba"
#define SS_ASM_GRP ""
#define SS_BKP_GRP "bkpdba"
#define SS_DGD_GRP "dgdba"
#define SS_KMT_GRP "kmdba"
```

3

```
$ mv config.o config.o.orig
$ make -f ins_rdbms.mk ioracle
```


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Managing Users

ORACLE Enterprise Manager Database Express 12c

Help | SYSTEM | Log Out

ORCL (12.1.0.2.0) Configuration Storage Security Performance EDRSR

Users

Page Refreshed 12:18:16 PM GMT

Actions | Create User | Create Like | Drop User | Open | Name

- Create User
- Create Like
- Drop User
- View Details
- Alter Account
- Alter Tablespaces
- Alter Privileges & Roles
- Grant Object Privileges

	Account Status	Expiration Date	Default Tablespace	Temporary Tablespace	Profile	Created
		Mon Jul 7, 2014 6:52:34 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 5:53:17 A
		Mon Jul 7, 2014 6:31:11 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 6:29:17 A
		Mon Jul 7, 2014 6:29:17 A	USERS	TEMP	DEFAULT	Mon Jul 7, 2014 6:29:17 A
		Mon Jul 7, 2014 5:53:07 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 5:53:07 A
		Mon Jul 7, 2014 5:39:13 A	USERS	TEMP	DEFAULT	Mon Jul 7, 2014 5:39:13 A
		Thu Oct 2, 2014 5:44:11	USERS	TEMP	DEFAULT	Thu Oct 2, 2014 5:06:01
CTXSYS		Mon Jul 7, 2014 6:12:03 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 6:11:11 A
DBA1		Sun Apr 5, 2015 10:37:18	SYSTEM	TEMP	DEFAULT	Tue Oct 7, 2014 10:37:18
DBSNMP		Mon Apr 6, 2015 11:58:1	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 5:53:06 A
DIP		Mon Jul 7, 2014 5:43:05 A	USERS	TEMP	DEFAULT	Mon Jul 7, 2014 5:43:05 A
DVF		Mon Jul 7, 2014 6:52:34 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 6:51:55 A
DVSYS		Mon Jul 7, 2014 6:52:07 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 6:51:55 A
FLOWS_FILES		Mon Jul 7, 2014 6:31:11 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 6:29:17 A
GSMADMIN_INTERNAL		Mon Jul 7, 2014 5:42:58 A	SYSAUX	TEMP	DEFAULT	Mon Jul 7, 2014 5:42:58 A
GSMCATUSER		Mon Jul 7, 2014 5:56:36 A	USERS	TEMP	DEFAULT	Mon Jul 7, 2014 5:56:36 A
GSMUSER		Mon Jul 7, 2014 5:42:58 A	USERS	TEMP	DEFAULT	Mon Jul 7, 2014 5:42:58 A
HR		Mon Apr 6, 2015 11:58:1	USERS	TEMP	DEFAULT	Thu Oct 2, 2014 5:05:59

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Creating a User

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Unlocking a User Account and Resetting the Password

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Privileges

There are two types of user privileges:

- System: Enables users to perform particular actions in the database
- Object: Enables users to access and manipulate a specific object

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System Privileges

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Revoking System Privileges with `ADMIN OPTION`

GRANT

REVOKE

```
REVOKE CREATE
TABLE FROM joe;
```


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Granting Object Privileges

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Object Privileges

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Revoking Object Privileges with `GRANT OPTION`

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Using Roles to Manage Privileges

- Roles:
  - Used to group together privileges and roles
  - Facilitate granting of multiple privileges or roles to users
- Benefits of roles:
  - Easier privilege management
  - Dynamic privilege management
  - Selective availability of privileges

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Assigning Privileges to Roles and Assigning Roles to Users

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Predefined Roles

Role	Privileges Included
CONNECT	CREATE SESSION
DBA	Most system privileges; several other roles. Do not grant to non-administrators.
RESOURCE	CREATE CLUSTER, CREATE INDEXTYPE, CREATE OPERATOR, CREATE PROCEDURE, CREATE SEQUENCE, CREATE TABLE, CREATE TRIGGER, CREATE TYPE
SCHEDULER_ ADMIN	CREATE ANY JOB, CREATE EXTERNAL JOB, CREATE JOB, EXECUTE ANY CLASS, EXECUTE ANY PROGRAM, MANAGE SCHEDULER
SELECT_CATALOG_ROLE	SELECT privileges on data dictionary objects

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Creating a Role

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Secure Roles

- Roles can be nondefault and enabled when required.

```
SET ROLE vacationdba;
```

- Roles can be protected through authentication.
- Roles can also be secured programmatically.

```
CREATE ROLE secure_application_role
IDENTIFIED USING <security_procedure_name>;
```


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Assigning Roles to Users

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Privilege Analysis

- Analyze used privileges to revoke unnecessary privileges.
- Use `DBMS_PRIVILEGE_CAPTURE` package.

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Privilege Analysis Flow

Requires CAPTURE_ADMIN role

1

Define **types** of analysis.

- Database
- Role
- Context
- Role and Context

Define **conditions** of analysis.

- **No condition:** all privileges
- **Roles**: MGR_SALES, PUBLIC
- **Condition:**
  - **Users** = HR, SCOTT, OE
  - **Modules** = sales

DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE

2

Start / stop analyzing used privileges.

DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE

DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE

3

Report used privileges.

DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT

DBA_USED_PUBPRIVS	
DBA_USED_OBJPRIVS	DBA_UNUSED_OBJPRIVS
DBA_USED_SYSPRIVS	DBA_UNUSED_SYSPRIVS
DBA_USED_PRIVS	DBA_UNUSED_PRIVS
DBA_USED_OBJPRIVS_PATH	DBA_UNUSED_OBJPRIVS_PATH
DBA_USED_SYSPRIVS_PATH	DBA_UNUSED_SYSPRIVS_PATH

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Profiles and Users

Users are assigned only one profile at a time.

Profiles:

- Control resource consumption
- Manage account status and password expiration

Note: `RESOURCE_LIMIT` must be set to `TRUE` before profiles can impose resource limitations.

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Implementing Password Security Features

Note: Do not use profiles that cause the `SYS`, `SYSMAN`, and `DBSNMP` passwords to expire and the accounts to be locked.

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Creating a Password Profile

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Supplied Password Verification Functions

- The following functions are created by the `$ORACLE_HOME/rdbms/admin/utlpwdmg.sql` script:
  - `VERIFY_FUNCTION_11g`
  - `ORA12C_VERIFY_FUNCTION`
  - `ORA12C_STRONG_VERIFY_FUNCTION`

- The functions require the following of passwords:
  - Have a minimum number of characters
  - Not be the username, username with a number, or username reversed
  - Not be the database name or the database name with a number
  - Have at least one alphabetic and one numeric character
  - Differ from the previous password by at least three letters

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Modifications to the Default Profile

The `utlpwdmg.sql` script also modifies the `DEFAULT` profile as follows:

```
ALTER PROFILE DEFAULT LIMIT
PASSWORD_LIFE_TIME 180
PASSWORD_GRACE_TIME 7
PASSWORD_REUSE_TIME UNLIMITED
PASSWORD_REUSE_MAX  UNLIMITED
FAILED_LOGIN_ATTEMPTS 10
PASSWORD_LOCK_TIME 1
PASSWORD_VERIFY_FUNCTION
  ora12c_verify_function;
```


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Assigning Quotas to Users

- Users who do not have the `UNLIMITED TABLESPACE` system privilege must be given a quota before they can create objects in a tablespace.
- Quotas can be:
  - A specific value in megabytes or kilobytes
  - Unlimited

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Applying the Principle of Least Privilege

- Protect the data dictionary:

```
O7_DICTIONARY_ACCESSIBILITY=FALSE
```

- Revoke unnecessary privileges from `PUBLIC`.
- Use access control lists (ACL) to control network access.
- Restrict the directories accessible by users.
- Limit users with administrative privileges.
- Restrict remote database authentication:

```
REMOTE_OS_AUTHENT=FALSE
```


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Quiz

All passwords created in Oracle Database are not case-sensitive by default.

a. True
b. False

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Quiz

A database role:

a. Can be enabled or disabled
b. Can consist of system and object privileges
c. Is owned by its creator
d. Cannot be protected by a password

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Quiz

With `RESOURCE_LIMIT` set at its default value of `FALSE`, profile password limitations are ignored.

a. True
b. False

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Quiz

Applying the principle of least privilege is not enough to harden the Oracle database.

a. True

b. False

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Summary

In this lesson, you should have learned how to:

- Create and manage database user accounts:
  - Authenticate users
  - Assign default storage areas (tablespaces)
- Grant and revoke privileges
- Create and manage roles
- Create and manage profiles:
  - Implement standard password security features
  - Control resource usage by users

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Practice: Overview

This practice covers the following topics:

- Creating a profile to limit resource consumption
- Creating two roles:
  - `HRCLERK`
  - `HRMANAGER`
- Creating four new users:
  - One manager and two clerks
  - One schema user for the next practice session

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7

Managing Database Storage Structures

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Objectives

After completing this lesson, you should be able to:

- Describe the storage of table row data in blocks
- Create and manage tablespaces
- Obtain tablespace information

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How Table Data Is Stored

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Database Block: Contents

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Exploring the Storage Structure

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Creating a New Tablespace

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Creating a New Tablespace

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Creating a New Tablespace

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Tablespaces Created by Default: Overview

- EXAMPLE (optional)
- SYSAUX
- SYSTEM
- TEMP
- UNDOTBS1
- USERS

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Altering a Tablespace

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Adding a Data File to a Tablespace

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Making Changes to a Data File

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Dropping Tablespaces

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Viewing Tablespace Information

```
SQL> SELECT tablespace_name, status, contents, logging,
  2  extent_management, allocation_type,
  3  segment_space_management
  4  FROM dba_tablespaces;

TABLESPACE_NAME STATUS  CONTENTS  LOGGING  EXTENT_MAN ALLOCATIO SEGMEN
--------------- ------- --------- -------- ---------- --------- -----
SYSTEM          ONLINE  PERMANENT LOGGING   LOCAL     SYSTEM    MANUAL
SYSAUX          ONLINE  PERMANENT LOGGING   LOCAL     SYSTEM    AUTO
UNDOTBS1        ONLINE  UNDO      LOGGING   LOCAL     SYSTEM    MANUAL
TEMP            ONLINE  TEMPORARY NOLOGGING LOCAL     UNIFORM   MANUAL
USERS           ONLINE  PERMANENT LOGGING   LOCAL     SYSTEM    AUTO
EXAMPLE         ONLINE  PERMANENT NOLOGGING LOCAL     SYSTEM    AUTO

SQL> SELECT file_name, file_id, tablespace_name
  2  FROM dba_data_files;
FILE_NAME                                   FILE_ID    TABLESPACE_NAME
------------------------------------------ ---------- ----------------
/u01/app/oracle/oradata/orcl/system01.dbf           1 SYSTEM
/u01/app/oracle/oradata/orcl/sysaux01.dbf           3 SYSAUX
/u01/app/oracle/oradata/orcl/users01.dbf            6 USERS
/u01/app/oracle/oradata/orcl/example01.dbf          2 EXAMPLE
/u01/app/oracle/oradata/orcl/undotbs01.dbf          4 UNDOTBS1
```


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Oracle Managed Files (OMF)

Specify file operations in terms of database objects rather than file names.

Parameter	Description
DB_CREATE_FILE_DEST	Defines the location of the default file system directory for data files and temporary files
DB_CREATE_ONLINE_LOG_DEST_n	Defines the location for redo log files and control file creation
DB_RECOVERY_FILE_DEST	Gives the default location for the fast recovery area

Example:

```
SQL> ALTER SYSTEM
  2  SET DB_CREATE_FILE_DEST='/u01/app/oracle/oradata';
SQL> CREATE TABLESPACE tbs_1;
```


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Quiz

A database can have a mixture of Oracle-managed and unmanaged files.

a. True
b. False

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Enlarging the Database

You can enlarge the database in the following ways:

- Create a new tablespace.
- Add a data file to an existing smallfile tablespace.
- Increase the size of a data file.
- Provide for the dynamic growth of a data file.

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Moving or Renaming an Online Data File

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Moving or Renaming an Online Data File

- Relocating an online data file:

```
ALTER DATABASE MOVE DATAFILE '/disk1/myexample01.dbf'
               TO '/disk2/myexample01.dbf';
```

- Copying a data file from a file system to ASM:

```
ALTER DATABASE MOVE DATAFILE '/disk1/myexample01.dbf'
               TO '+DiskGroup2' KEEP;
```

- Renaming an online data file:

```
ALTER DATABASE MOVE DATAFILE '/disk1/myexample1.dbf'
               TO '/disk1/myexample01.dbf';
```


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Summary

In this lesson, you should have learned how to:

- Describe the storage of table row data in blocks
- Create and manage tablespaces
- Obtain tablespace information

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Practice: Overview

This practice covers the following topics:

- Creating tablespaces
- Gathering information about tablespaces

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Managing Space

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Objectives

After completing this lesson, you should be able to:

- Describe how the Oracle Database server automatically manages space
- Save space by using compression
- Proactively monitor and manage tablespace space usage
- Describe segment creation in the Oracle database
- Control deferred segment creation
- Use the Segment Advisor
- Reclaim wasted space from tables and indexes by using the segment shrink functionality
- Manage resumable space allocation

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Space Management: Overview

Space is automatically managed by the Oracle Database server. It generates alerts about potential problems and recommends possible solutions. Features include:

- Oracle Managed Files (OMF)
- Free-space management with bitmaps (“locally managed”) and automatic data file extension
- Proactive space management (default thresholds and server-generated alerts)
- Space reclamation (shrinking segments, online table redefinition)
- Capacity planning (growth reports)

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Block Space Management

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Row Chaining and Migration

Example:

- On update: Row length increases, exceeding the available free space in the block.
- Data needs to be stored in a new block.
- Original physical identifier of row (`ROWID`) is preserved.
- The Oracle Database server needs to read two blocks to retrieve data.
- The Segment Advisor finds segments containing the migrated rows.
- There is automatic coalescing of fragmented free space inside the block.

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Quiz

When a row is chained or migrated, the I/O performance associated with this row decreases because the Oracle Database server must scan more than one data block to retrieve the information for the row.

a. True
b. False

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Free Space Management Within Segments

- Tracked by bitmaps in segments

Benefits:

- More flexible space utilization
- Runtime adjustment
- Multiple process search of BMBs

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Types of Segments

- A segment is a set of extents allocated for a certain logical structure. The different types of segments include:
  - Table and cluster segments
  - Index segment
  - Undo segment
  - Temporary segment
- Segments are dynamically allocated by the Oracle Database server.

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Allocating Extents

- Searching the data file's bitmap for the required number of adjacent free blocks
- Sizing extents with storage clauses:
  - `UNIFORM`
  - `AUTOALLOCATE`
- Viewing extent map
- Obtaining deallocation advice

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Understanding Deferred Segment Creation

- `DEFERRED_SEGMENT_CREATION = TRUE` is the default.
- Segment creation takes place as follows:
  1. Table creation > Data dictionary operation
  2. DML > Segment creation

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Viewing Deferred Segment Information

```
SQL> SHOW PARAMETERS deferred_segment_creation
NAME                                 TYPE        VALUE
------------------------------------ ----------- ------
deferred_segment_creation            boolean     TRUE

SQL> CREATE TABLE seg_test(c number, d varchar2(500));
Table created.
SQL> SELECT segment_name FROM user_segments;
no rows selected
```

Inserting rows and creating segments:

```
SQL> INSERT INTO seg_test VALUES(1, 'aaaaaaa');
1 row created.

SQL> SELECT segment_name FROM user_segments;
SEGMENT_NAME
-----------------------------------------------------
SEG_TEST
```


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Controlling Deferred Segment Creation

With the `DEFERRED_SEGMENT_CREATION` parameter in the:

- Initialization file
- `ALTER SESSION` command
- `ALTER SYSTEM` command

With the `SEGMENT CREATION` clause:

- `IMMEDIATE`
- `DEFERRED` (default)

```
CREATE TABLE SEG_TAB3(C1 number, C2 number)
  SEGMENT CREATION IMMEDIATE TABLESPACE SEG_TBS;
CREATE TABLE SEG_TAB4(C1 number, C2 number)
  SEGMENT CREATION DEFERRED;
```

Note: Indexes inherit table characteristics.

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Restrictions and Exceptions

- Segment creation on demand is:
  - Only for nonpartitioned tables and indexes
  - Not for IOTs, clustered tables, or other special tables
  - Not for tables in dictionary-managed tablespaces
- If you were to migrate a table without segments from a locally managed to a dictionary-managed tablespace, you must drop and re-create it.

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Additional Automatic Functionality

Without user intervention:

- No segments for unusable indexes and index partitions
- Creating an index without a segment:

```
CREATE INDEX test_i1 ON seg_test(c) UNUSABLE;
```

- Removing any allocated space for an index:

```
ALTER INDEX test_i UNUSABLE;
```

- Creating the segment for an index:

```
ALTER INDEX test_i REBUILD;
```

```
SELECT segment_name, partition_name, segment_type
FROM  user_segments
WHERE segment_name like '%DEMO';
```


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Quiz

Which of the following statements are true?

a. Deferred segment creation is always enabled. You cannot control it.

b. You can control the deferred segment creation with the `SEGMENT CREATION` clause of the `CREATE TABLE` command.

c. Segment creation on demand is available for all types of tables, including those owned by the `SYS` user.

d. Segment creation on demand is available for nonpartitioned tables.

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Table Compression: Overview

Reducing storage costs by compressing all data:

- Basic compression for direct-path insert operations: 10x
- Advanced row compression for all DML operations: 2–4x

Compression Method	Compression Ratio	CPU Overhead	CREATE and ALTER TABLE Syntax	Typical Applications
Basic table compression	High	Minimal	`COMPRESS [BASIC]`	DSS
Advanced row compression	High	Minimal	`ROW STORE COMPRESS ADVANCED`	OLTP, DSS

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Compression for Direct-Path Insert Operations

- Is enabled with `CREATE TABLE … COMPRESS BASIC …;`
- Is recommended for bulk loading data warehouses
- Maximizes contiguous free space in blocks

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Advanced Row Compression for DML Operations

- Is enabled with
  `CREATE TABLE … ROW STORE COMPRESS ADVANCED …;`
- Is recommended for active OLTP environments

Uncompressed block

OLTP compression with symbol table at the beginning of the block

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Specifying Table Compression

You can specify table compression for:

- An entire heap-organized table
- A partitioned table (Each partition can have a different type or level of compression.)
- The storage of a nested table

You cannot :

- Specify basic and advanced row compression on tables with more than 255 columns
- Drop a column if a table is compressed for direct-loads, but you can drop it if the table is advance row compressed

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Using the Compression Advisor

The Compression Advisor:

- Analyzes objects to give an estimate of space savings for different compression methods
- Helps in deciding the correct compression level for an application
- Recommends various strategies for compression
  - Picks the right compression algorithm for a particular data set
  - Sorts on a particular column for increasing the compression ratio
  - Presents tradeoffs between different compression algorithms
- Works for OLTP compression (via Enterprise Manager)

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Using the DBMS_COMPRESSION Package

To determine optimal compression ratios:

```
BEGIN
DBMS_COMPRESSION.GET_COMPRESSION_RATIO ('USERS','SH','SALES',
 NULL,DBMS_COMPRESSION.COMP_FOR_OLTP, blkcnt_cmp, blkcnt_uncmp,
 rowcnt_cmp, rowcnt_uncmp, comp_ration, comptype);
DBMS_OUTPUT.PUT_LINE('Blk count compressed = ' || blkcnt_cmp);
DBMS_OUTPUT.PUT_LINE('Blk count uncompressed = ' ||
blkcnt_uncmp);
DBMS_OUTPUT.PUT_LINE('Row count per block compressed = ' ||
rowcnt_cmp);
DBMS_OUTPUT.PUT_LINE('Row count per block uncompressed = ' ||
rowcnt_uncmp);
DBMS_OUTPUT.PUT_LINE('Compression type = ' || comptype);
DBMS_OUTPUT.PUT_LINE('Compression ratio = '||comp_ratio||' to
1');
```


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Proactive Tablespace Monitoring

Tablespaces > Edit Tablespace: EXAMPLE

Edit Tablespace: EXAMPLE

General | **Storage** | Thresholds | Automatic Data Optimization | In-Memory Columnar

Extent Allocation

Allocation Type Automatic

Segment Space Management

Type Automatic

Compression Options

Enable data segment compression to reduce disk and cache usage. This can be used in both OLTP

Compression
- (●) No Compression
- ( ) Basic Compression
  Dictionary based compression for direct load operations only. Supports limited data types and c
- ( ) OLTP Compression
  Dictionary based compression for all SQL operations
- ( ) Warehouse Compression
  Hybrid Columnar compression optimized for query performance. This is supported only with Or
  - ( ) Query Low
  - ( ) Query High

Tablespaces > Edit Tablespace: EXAMPLE

Edit Tablespace: EXAMPLE

Actions Add Datafile

General | Storage | **Thresholds** | Automatic Data Optimization | In-Memory Columnar

Available Space (MB) 32767.98
Space Used (%) 3.72

Space Used (MB) 1219.06
Available Free Space (MB) 31548.92

To view or modify Tablespace Space Used (%) or Free Space (MB) thresholds, navigate to the Database Monitoring Metric and Collection Settings page.

Metric and Collection Settings

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Thresholds and Resolving Space Problems

Locally managed tablespace

Resolve space problem by:

- Adding or resizing data file
- Setting `AUTOEXTEND ON`
- Shrinking objects
- Reducing `UNDO_RETENTION`
- Checking for long-running queries in temporary tablespaces

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Monitoring Tablespace Space Usage

- Read-only and offline tablespaces: Do not set up alerts.
- Temporary tablespace: Threshold corresponds to space currently used by sessions.
- Undo tablespace: Threshold corresponds to space used by active and unexpired extents.
- Auto-extensible files: Threshold is based on the maximum file size.

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Shrinking Segments

1 `ALTER TABLE employees SHRINK SPACE COMPACT;`

DML operations and queries can be issued during compaction.

2 `ALTER TABLE employees SHRINK SPACE;`

DML operations are blocked when the HWM is adjusted.

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Results of Shrink Operation

- Improved performance and space utilization
- Indexes maintained
- Triggers not executed
- Number of migrated rows may be reduced.
- Rebuilding secondary indexes on IOTs recommended

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Reclaiming Space Within ASSM Segments

- Online and in-place operation
- Applicable only to segments residing in ASSM tablespaces
- Candidate segment types:
  - Heap-organized tables and index-organized tables
  - Indexes
  - Partitions and subpartitions
  - Materialized views and materialized view logs

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Using the Segment Advisor

ORACLE Enterprise Manager Cloud Control 12c

Setup | ADMIN

Enterprise | Targets | Favorites | History | Search Target Name

orcl

Logged in as dba1

Oracle Database | Performance | Availability | Security | Schema | Administration

Scope | Objects | Schedule | Review

Segment Advisor: Scope

Database orcl Logged In As dba1

Cancel | Step 1 of 4 | Next

Automatic Segment Advisor Information

Beginning in Oracle Database 11, Oracle provides an Automatic Segment Advisor task which automatically detects segment issues.

You can get advice on shrinking segments for individual schema objects or entire tablespaces.

- (•) Tablespaces
- ( ) Schema Objects

Overview

The segment advisor determines whether objects have unused space that can be released, taking estimated future space requirements into consideration. The estimated future space calculation is based on historical trends.

Cancel | Step 1 of 4 | Next

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Automatic Segment Advisor

The Automatic Segment Advisor:

- Is started by a Scheduler job set to run during the default maintenance window:
  - Weeknights, Monday–Friday, from 10:00 PM to 2:00 AM
  - Saturday and Sunday, both windows start at 6:00 AM and last for 20 hours
- Examines database statistics, samples segment data, and then selects the following objects to analyze:
  - Tablespaces that have exceeded a critical or warning threshold
  - Segments that have the most activity
  - Segments that have the highest growth rate

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Shrinking Segments by Using SQL

1
```
ALTER TABLE employees ENABLE ROW MOVEMENT;
```

2
```
ALTER TABLE employees SHRINK SPACE CASCADE;
```

3
```
ALTER TABLE employees MODIFY LOB(resume) (SHRINK
SPACE);
```

4
```
ALTER TABLE employees OVERFLOW SHRINK SPACE;
```


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Shrinking Segments by Using Enterprise Manager

Selection Mode: Single

Edit | View | Delete With Options | Actions: Shrink Segment | Go

Select	Schema	Table Name	Tablespace	Partitioned
○	HR	COUNTRIES	EXAMPLE	NO
○	HR	DEPARTMENTS	EXAMPLE	NO
◉	HR	EMPLOYEES	EXAMPLE	NO
○	HR	JOBS		
○	HR	JOB_HI		
○	HR	LOCATI		
○	HR	REGION		

Shrink Options

◉ Compact Segments and Release Space

This will first compact the segments and then release the recovered space to the tablespace. During the short space rele affected.

○ Compact Segments

Compacting will compact segment data without releasing the recovered space. After compacting the data, the recovered

Segment Selection

◉ Shrink HR.EMPLOYEES Only

○ Shrink HR.EMPLOYEES and All Dependent Segments

Dependent Segments

Schema	Segment Name	Type
HR	EMPLOYEES	TABLE
HR	EMP_EMP_ID_PK	INDEX
HR	EMP_DEPARTMENT_IX	INDEX
HR	EMP_JOB_IX	INDEX
HR	EMP_EMAIL_UK	INDEX
HR	EMP_NAME_IX	INDEX
HR	EMP_MANAGER_IX	INDEX

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Managing Resumable Space Allocation

A resumable statement:

- Enables you to suspend large operations instead of receiving an error
- Gives you a chance to fix the problem while the operation is suspended, rather than starting over
- Is suspended for the following conditions:
  - Out of space
  - Maximum extents reached
  - Space quota exceeded
- A resumable statement can be suspended and resumed multiple times.

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Using Resumable Space Allocation

- Queries, DML operations, and certain DDL operations can be resumed if they encounter an out-of-space error.
- A resumable statement can be issued through SQL, PL/SQL, SQL*Loader, and Data Pump utilities, or the Oracle Call Interface (OCI).
- A statement executes in resumable mode only if its session has been enabled by one of the following actions:
  - The **RESUMABLE_TIMEOUT** initialization parameter is set to a nonzero value.
  - An **ALTER SESSION ENABLE RESUMABLE** statement is issued:

```
ALTER SESSION ENABLE RESUMABLE;
INSERT INTO sales_new SELECT * FROM sh.sales;
ALTER SESSION DISABLE RESUMABLE;
```


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Resuming Suspended Statements

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What Operations Are Resumable?

The following operations are resumable:

- Queries: `SELECT` statements that run out of temporary space (for sort areas)
- DML: `INSERT`, `UPDATE`, and `DELETE` statements
- The following DDL statements:
  - **`CREATE TABLE ... AS SELECT`**
  - **`CREATE INDEX`**
  - **`ALTER INDEX ... REBUILD`**
  - **`ALTER TABLE ... MOVE PARTITION`**
  - **`ALTER TABLE ... SPLIT PARTITION`**
  - **`ALTER INDEX ... REBUILD PARTITION`**
  - **`ALTER INDEX ... SPLIT PARTITION`**
  - **`CREATE MATERIALIZED VIEW`**

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Quiz

Select the true statements about space management:

a. Segment creation in Oracle Database 12*c* is deferred for all tables. There are no exceptions.

b. All UNUSABLE indexes and index partitions are created without a segment.

c. Shrinking segment space is a nonresumable operation.

d. You can set thresholds by tablespace.

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Summary

In this lesson, you should have learned how to:

- Describe how the Oracle Database server automatically manages space
- Save space by using compression
- Proactively monitor and manage tablespace space usage
- Describe segment creation in the Oracle database
- Control deferred segment creation
- Use the Segment Advisor
- Reclaim wasted space from tables and indexes by using the segment shrink functionality
- Manage resumable space allocation

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Practice: Overview

This practice covers the following topics:

- Using threshold alerts to proactively manage tablespaces
- Using the Segment Advisor to shrink space
- Viewing alerts and alert history in SQL*Plus and Enterprise Manager

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9

Managing Undo Data

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Objectives

After completing this lesson, you should be able to:

- Explain DML and undo data generation
- Monitor and administer undo data
- Describe the difference between undo data and redo data
- Configure undo retention
- Guarantee undo retention
- Enable temporary undo
- Use the Undo Advisor

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Undo Data: Overview

Undo data is:

- A record of the action of a transaction
- Captured for *every* transaction that changes data
- Retained at least until the transaction is ended
- Used to support:
  - Rollback operations
  - Read-consistent queries
  - Oracle Flashback Query, Oracle Flashback Transaction, and Oracle Flashback Table
  - Recovery from failed transactions

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Transactions and Undo Data

- Each transaction is assigned to only one undo segment.
- An undo segment can service more than one transaction at a time.

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Storing Undo Information

- Undo information is stored in undo segments, which are stored in an undo tablespace.
- Undo tablespaces:
  - Are used only for undo segments
  - Have special recovery considerations
  - May be associated with only a single instance
  - Require that only one of them be the current writable undo tablespace for a given instance at any given time

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Comparing Undo Data and Redo Data

	Undo	Redo
Record of	How to undo a change	How to reproduce a change
Used for	Rollback, read consistency, flashback	Rolling forward database changes
Stored in	Undo segments	Redo log files

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Managing Undo

Automatic undo management:

- Fully automated management of undo data and space in a dedicated undo tablespace
- For all sessions
- Self-tuning in `AUTOEXTEND` tablespaces to satisfy long-running queries
- Self-tuning in fixed-size tablespaces for best retention

DBA tasks in support of Flashback operations:

- Configuring undo retention
- Changing undo tablespace to a fixed size
- Avoiding space and “snapshot too old” errors

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Configuring Undo Retention

- `UNDO_RETENTION` specifies (in seconds) how long already committed undo information is to be retained.
- Set this parameter when:
  - The undo tablespace has the `AUTOEXTEND` option enabled
  - You want to set undo retention for LOBs
  - You want to guarantee retention

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Categories of Undo

Category	Description
Active: Uncommitted undo information	Supports an active transaction and is never overwritten
Unexpired: Committed undo information	Required to meet the undo retention interval
Expired: Expired undo information	Overwritten when space is required for an active transaction

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Guaranteeing Undo Retention

```
SQL> ALTER TABLESPACE undotbs1 RETENTION GUARANTEE;
```

SELECT statements running 15 minutes or less are always satisfied.

A transaction will fail if it generates more undo than there is space.

Note: This example is based on an `UNDO_RETENTION` setting of 900 seconds (15 minutes).

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Changing an Undo Tablespace to a Fixed Size

- Rationale:
  - Supporting Flashback operations
  - Limiting tablespace growth
- Steps:
  1. Run regular workload.
  2. Self-tuning mechanism establishes minimum required size.
  3. (Optional) Use the Enterprise Manager Cloud Control Undo Advisor, which calculates required size for future growth.
  4. (Optional) Change undo tablespace to a fixed size.

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Temporary Undo: Overview

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Temporary Undo: Benefits

- Temporary undo reduces the amount of undo stored in the undo tablespaces.
- Temporary undo reduces the size of the redo log.
- Temporary undo enables DML operations on temporary tables in a physical standby database with the Oracle Active Data Guard option.

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Enabling Temporary Undo

- Enable temporary undo for a session:

```
SQL> ALTER session SET temp_undo_enabled = true;
```

- Enable temporary undo for the database instance:

```
SQL> ALTER system SET temp_undo_enabled = true;
```

- Temporary undo mode is selected when a session first uses a temporary object.

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Monitoring Temporary Undo

```
SELECT to_char(BEGIN_TIME,'dd/mm/yy hh24:mi:ss'),
       TXNCOUNT,MAXCONCURRENCY,UNDOBLKCNT,USCOUNT,NOSPACEERRCNT
FROM   V$TEMPUNDOSTAT;

TO_CHAR(BEGIN_TIM TXNCOUNT MAXCONCURRENCY UNDOBLKCNT USCOUNT NOSPACEERRCNT
----------------- -------- -------------- ---------- ------- -------------
…
19/08/12 22:19:44        0              0          0       0             0
19/08/12 22:09:44        0              0          0       0             0
…
19/08/12 13:09:44        0              0          0       0             0
19/08/12 12:59:44        3              1         24       1             0

576 rows selected.

SQL>
```


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Viewing Undo Information

ORACLE Enterprise Manager Database Express 12c

ORCL (12.1.0.2.0) | Configuration | Storage | Security | Performance

Undo Management Details | Change Analysis Parameters | Switch Undo Tablespace

Configuration

Undo Summary

Undo Setting

Undo Management	auto
Low Undo Retention Threshold	900s

Tablespace

Name	UNDOTBS1
Retention Guaranteed	No
Size	150MB (78.5% free)
Auto Extensible	Yes (maximum size unlimited)

Errors and Warnings

Snapshot Too Old Errors	0
Out of Space Errors	0
Unexpired Blocks Stolen	0

Advisor Findings

Health	No problems

Undo Statistics Summary

Analysis Period (Last Day)

Adjusted Start Time	Sun Oct 12, 2014 7:24:41 AM
Adjusted End Time	Mon Oct 13, 2014 7:14:55 AM
Duration	23 hours, 50 minutes, 14 seconds
Target Undo Retention	Required Undo Retention (35 minutes)

Undo Retention Analysis

Required Undo Retention	35 minutes
Best Undo Retention	266 days, 6 hours, 14 minutes, 10 seconds

Undo Statistics

Undo Generation Rate	1 KB/s
Maximum Undo Used	36MB
Longest SQL	89w8y2pgn25yd
Longest SQL Execution Time	35 minutes
Transaction Rate	0 transaction(s) per second

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Viewing Undo Activity

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Using the Undo Advisor

ORACLE Enterprise Manager Cloud Control 12c

Setup | ADMIN

Enterprise | Targets | Favorites | History

Search Target Name

orcl

Logged in as sys

Oracle Database | Performance | Availability | Security | Schema | Administration

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) 150

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 15 minutes

Run Analysis

Analysis Results

Edit Undo Tablespace | Edit Undo Retention

Selected Analysis Time Period **Oct 6, 2014 8:00:00 AM UTC To Oct 13, 2014 8:00:00 AM UTC**

Minimum Required Undo Tablespace Size (MB) **158**

Recommended Undo Tablespace Size (MB) **163**

TIP Oracle advises that you configure the undo tablespace to be three times the Recommended Undo Tablespace Size to allow for workload fluctuations.

Potential Problems **No Problem Found**

Recommendations **No Recommendation**

Show Graph

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Quiz

All you need to do to guarantee that all queries under 15 minutes will find the undo data needed for read consistency, is set the `UNDO_RETENTION` parameter to 15 minutes.

a. True

b. False

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Summary

In this lesson, you should have learned how to:

- Explain DML and undo data generation
- Monitor and administer undo data
- Describe the difference between undo data and redo data
- Configure undo retention
- Guarantee undo retention
- Enable temporary undo
- Use the Undo Advisor

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Practice: Overview

This practice covers the following topics:

- Viewing system activity
- Calculating undo tablespace sizing to support a 48-hour retention interval
- Modifying an undo tablespace to support a 48-hour retention interval

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10

Managing Data Concurrency

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Objectives

After completing this lesson, you should be able to:

- Describe the locking mechanism and how Oracle manages data concurrency
- Monitor and resolve locking conflicts

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Locks

- Prevent multiple sessions from changing the same data at the same time
- Are automatically obtained at the lowest possible level for a given statement
- Do not escalate

Transaction 1

```
SQL> UPDATE employees
  2  SET salary=salary+100
  3  WHERE employee_id=100;
```

Transaction 2

```
SQL> UPDATE employees
  2  SET salary=salary*1.1
  3  WHERE employee_id=100;
```


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Locking Mechanism

- High level of data concurrency:
  - Row-level locks for inserts, updates, and deletes
  - No locks required for queries
- Automatic queue management
- Locks held until the transaction ends (with a commit or rollback operation)

Example

Assume that the rows for `EMPLOYEE_ID` 100 and 101 reside in the same block:

Transaction 1

```
SQL> UPDATE employees
  2  SET salary=salary+100
  3  WHERE employee_id=100;
```

Transaction 2

```
SQL> UPDATE employees
  2  SET salary=salary*1.1
  3  WHERE employee_id=101;
```


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Data Concurrency

Time:	Transaction 1	`UPDATE hr.employees`
		`SET salary=salary+100`
		`WHERE employee_id=100;`

	Transaction 2	`UPDATE hr.employees`
		`SET salary=salary+100`
		`WHERE employee_id=101;`

09:00:00	Transaction 3	`UPDATE hr.employees`
		`SET salary=salary+100`
		`WHERE employee_id=102;`

	…	…

	Transaction *x*	`UPDATE hr.employees`
		`SET salary=salary+100`
		`WHERE employee_id=`*`xxx;`

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DML Locks

Transaction 1

```
SQL> UPDATE employees
  2  SET salary=salary*1.1
  3  WHERE employee_id= 107;
1 row updated.
```

Transaction 2

```
SQL> UPDATE employees
  2  SET salary=salary*1.1
  3  WHERE employee_id= 106;
1 row updated.
```

Each DML transaction must acquire *two* locks:

- `EXCLUSIVE` row lock on the row or rows being updated
- Table lock (`TM`) in `ROW EXCLUSIVE` (`RX`) mode on the table containing the rows

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Enqueue Mechanism

The enqueue mechanism keeps track of:

- Sessions waiting for locks
- Requested lock mode
- Order in which sessions requested the lock

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Lock Conflicts

Transaction 1	Time	Transaction 2
`UPDATE employees SET salary=salary+100 WHERE employee_id=100;` `1 row updated.`	**9:00:00**	`UPDATE employees SET salary=salary+100 WHERE employee_id=101;` `1 row updated.`

`UPDATE employees SET COMMISION_PCT=2 WHERE employee_id=101;`
Session waits enqueued due to lock conflict.
	9:00:05
	
		`SELECT sum(salary) FROM employees;`
		`SUM(SALARY)`
		`----------`
		`692634`

Session still waiting!	**16:30:00**	Many selects, inserts, updates, and deletes during the last 7.5 hours, but no commits or rollbacks!
`1 row updated.` Session continues.	**16:30:01**	`commit;`

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Possible Causes of Lock Conflicts

- Uncommitted changes
- Long-running transactions
- Unnecessarily high locking levels

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Detecting Lock Conflicts

- Select Blocking Sessions from the Performance menu.

- Click the Session ID link to view information about the locking session.

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Resolving Lock Conflicts

To resolve a lock conflict:

- Have the session holding the lock commit or roll back
- Terminate the session holding the lock (in an emergency)

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Resolving Lock Conflicts by Using SQL

SQL statements can be used to determine the blocking session and kill it.

1

```
SQL> SELECT sid, serial#, username
  2  FROM v$session WHERE sid IN
  3  (SELECT blocking_session FROM v$session);
```

Result:

SID	SERIAL#	USERNAME
144	8982	HR

2

```
SQL> ALTER SYSTEM KILL SESSION '144,8982' immediate;
```


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Deadlocks

Transaction 1		Transaction 2
UPDATE employees SET salary = salary x 1.1 WHERE employee_id = 1000;	9:00	UPDATE employees SET manager = 1342 WHERE employee_id = 2000;
UPDATE employees SET salary = salary x 1.1 WHERE employee_id = 2000;	9:15	UPDATE employees SET manager = 1342 WHERE employee_id = 1000;
ORA-00060: Deadlock detected while waiting for resource	9:16	

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Quiz

The lock mechanism defaults to a fine-grained, row-level locking mode.

a. True
b. False

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Quiz

When a deadlock occurs, Oracle database automatically:

a. Waits 300 seconds before terminating both sessions
b. Terminates one statement with an error in one session
c. Terminates the statements with an error in both sessions
d. Takes no action by default and leaves it to the DBA

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Summary

In this lesson, you should have learned how to:

- Describe the locking mechanism and how Oracle manages data concurrency
- Monitor and resolve locking conflicts

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Practice: Overview

This practice covers the following topics:

- Identifying locking conflicts
- Resolving locking conflicts

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11

Implementing Oracle Database Auditing

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Objectives

After completing this lesson, you should be able to:

- Describe DBA responsibilities for security and auditing
- Enable unified auditing
- Create unified audit policies
- Maintain the audit trail

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Database Security

A secure system ensures the confidentiality of the data that it contains. There are several aspects of security:

- Restricting access to data and services
- Authenticating users
- Monitoring for suspicious activity

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Monitoring for Compliance

- Monitoring or auditing must be an integral part of your security procedures.
- Review the following:
  - Mandatory auditing
  - Standard database auditing
  - Value-based auditing
  - Fine-grained auditing (FGA)

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Types of Activities to be Audited

You can audit the following types of activities:

- User accounts, roles, and privileges
- Object actions
- Application context values
- Oracle Data Pump
- Oracle Database Real Application Security
- Oracle Database Vault
- Oracle Label Security
- Oracle Recovery Manager
- Oracle SQL*Loader direct path events

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Mandatorily Audited Activities

The following activities are audited:

- CREATE/ALTER/DROP AUDIT POLICY
- AUDIT/NOAUDIT
- EXECUTE of:
  - DBMS_FGA
  - DBMS_AUDIT_MGMT
- ALTER TABLE against AUDSYS audit trail table
- Top-level statements by administrative users (SYS, SYSDBA, SYSOPER, SYSASM, SYSBACKUP, SYSDG, and SYSKM) until the database opens

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Understanding Auditing Implementation

- *Mixed mode auditing* is the default when a new Oracle Database 12*c* database is created.
- Mixed mode auditing enables the use of:
  - Pre–Oracle Database 12*c* auditing features
  - *Unified auditing* features of Oracle Database 12*c*
- The recommendation from Oracle is to migrate to unified auditing.
- Query `V$OPTION` to determine if the database has been migrated to unified auditing:

```
SELECT value FROM v$option
WHERE parameter = 'Unified Auditing'
```


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Administering the Roles Required for Auditing

A user must be granted one of the following roles to perform auditing:

- `AUDIT_ADMIN` enables the user to:
  - Create unified and fine-grained audit policies
  - Execute the `AUDIT` and `NOAUDIT` SQL statements
  - View audit data
  - Manage the audit trail (table in the `AUDSYS` schema)
- `AUDIT_VIEWER` enables the user to:
  - View and analyze audit data

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Database Auditing: Overview

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Understanding the Audit Architecture

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Enabling Unified Auditing

1. In SQL*Plus, shut down the database instance:

```
SQL> SHUTDOWN IMMEDIATE
```

2. Shut down the listener:

```
$ lsnrctl stop
```

3. At the operating system prompt, enable the unified auditing executable:

```
$ cd $ORACLE_HOME/rdbms/lib
$ make -f ins_rdbms.mk uniaud_on ioracle ORACLE_HOME=$ORACLE_HOME
```

4. Restart the listener:

```
$ lsnrctl start
```

5. In SQL*Plus, restart the database instance:

```
SQL> STARTUP
```


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Configuring Auditing

Method	Description
Unified audit policies	Group audit settings into a policy

Default unified audit policies	Three default policies:
	`ORA_SECURECONFIG`
	`ORA_DATABASE_PARAMETER_AUDIT`
	`ORA_ACCOUNT_MGMT_AUDIT`

Fine-grained audit policies	Define specific conditions that must be met for auditing to take place

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Using Enterprise Manager Cloud Control

ORACLE Enterprise Manager Cloud Control 12c

Setup | ADMIN

Enterprise | Targets | Favorites | History | Search Target Name

orcl

Logged in as dba1

Oracle Database | Performance | Availability | Security | Schema | Administration

Page Refreshed Oct 13, 2014 11:57:04 AM GMT+00:00

Audit Settings

General

Audit Mode	Unified + Traditional
Policies	2 6
OS Audit Files	1
Tablespace	SYSAUX(2.97% Full)
Purge Jobs	Not Set
Last Archived On	Not Set
Last Purged On	Not Set

Audit Trail By Component

Show data for last 1 day 1 week 1 month

No audit data found

Audit Trail By Policy

Show data for last 1 day 1 week 1 month

No audit data found

Actions | Create | Create Like | Edit | Delete | Show | Enable | Disable

Audit Policy	Comments	System Privileges	Roles	Component Actions	Object Actions	Conditional	Enabled	Audit	Users
ORA_ACCOUNT_MGMT		0	0	9	0				
ORA_CIS_RECOMMENDATIONS	Audit policy containing aud...	7	0	19	0				
ORA_DATABASE_PARAMETER		0	0	3	0				
ORA_DV_AUDPOL		0	0	0	1768				
ORA_LOGON_FAILURES		0	0	1	0		✓	By	ALL USERS
ORA_RAS_POLICY_MGMT		0	0	33	0				
ORA_RAS_SESSION_MGMT		0	0	14	0				
ORA_SECURECONFIG		29	0	16	1		✓	By	ALL USERS

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Creating a Unified Audit Policy

- Use the `CREATE AUDIT POLICY` statement:

```
CREATE AUDIT POLICY select_emp_pol
ACTIONS select on hr.employees
```

- Use Enterprise Manager Cloud Control:

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Creating an Audit Policy: System-Wide Audit Options

- System privileges:

```
CREATE AUDIT POLICY audit_syspriv_pol1
PRIVILEGES SELECT ANY TABLE, CREATE LIBRARY
```

- Actions:

```
CREATE AUDIT POLICY audit_actions_pol2
ACTIONS AUDIT, ALTER TRIGGER
```

- Roles:

```
CREATE AUDIT POLICY audit_role_pol3
ROLES mgr_role
```

- System privileges, actions, and roles:

```
CREATE AUDIT POLICY audit_mixed_pol4
PRIVILEGES DROP ANY TABLE
ACTIONS    CREATE TABLE, DROP TABLE, TRUNCATE TABLE
ROLES      emp_role
```


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Creating an Audit Policy: Object-Specific Actions

Create audit policies based on object-specific options.

```
CREATE AUDIT POLICY audit_objpriv_pol5
ACTIONS SELECT, UPDATE, LOCK ON hr.employees
```

```
CREATE AUDIT POLICY audit_objpriv_pol6
ACTIONS ALL
```

```
CREATE AUDIT POLICY audit_objpriv_pol7
ACTIONS EXECUTE, GRANT ON hr.raise_salary_proc
```


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Creating an Audit Policy: Specifying Conditions

- Condition and evaluation **PER SESSION**

```
CREATE AUDIT POLICY audit_mixed_pol5
ACTIONS RENAME ON hr.employees,ALTER  ON hr.jobs,
WHEN 'SYS_CONTEXT (''USERENV'', ''SESSION_USER'')=''JIM'''
EVALUATE PER SESSION
```

- Condition and evaluation **PER STATEMENT**

```
CREATE AUDIT POLICY audit_objpriv_pol6
ACTIONS ALTER ON OE.ORDERS
WHEN 'SYS_CONTEXT(''USERENV'',''CLIENT_IDENTIFIER'')=''OE'''
EVALUATE PER STATEMENT
```

- Condition and evaluation **PER INSTANCE**

```
CREATE AUDIT POLICY audit_objpriv_pol7
ROLES dba
WHEN SYS_CONTEXT(''USERENV'',''INSTANCE_NAME'')=''sales'''
EVALUATE PER INSTANCE
```


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Enabling and Disabling Audit Policies

Enable audit policies:

- Apply to all users.

```
SQL> AUDIT POLICY audit_syspriv_pol1;
```

- Apply only to some users.

```
SQL> AUDIT POLICY audit_pol2 BY scott, oe;
SQL> AUDIT POLICY audit_pol3 BY sys;
```

- Exclude some users.

```
SQL> AUDIT POLICY audit_pol4 EXCEPT jim, george;
```

- Audit the recording based on failed or succeeded actions.

```
SQL> AUDIT POLICY audit_syspriv_pol1 WHENEVER SUCCESSFUL ;
SQL> AUDIT POLICY audit_objpriv_pol2 WHENEVER NOT SUCCESSFUL ;
```

```
SQL> AUDIT POLICY auditpol5 BY joe WHENEVER SUCCESSFUL ;
```

Disable audit policies by using the `NOAUDIT` command.

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Altering a Unified Audit Policy

- Use the `ALTER AUDIT POLICY` statement:

```
ALTER AUDIT POLICY select_emp_pol
ADD ACTIONS select on hr.job_history
```

- Use Enterprise Manager Cloud Control:

Audit Policy	System Privileges	Roles	Component Actions	Object Actions	Conditional	Enabled	Audit	Users
ORA_SECURECONFIG	29	0	15	0		✓	All	
ORA_RAS_POLICY_MGMT	0	0	32	0				
ORA_RAS_SESSION_MGMT	0	0	14	0				
ORA_ACCOUNT_MGMT	0	0	9	0				
ORA_DATABASE_PARAMETER	0	0	3	0				
SELECT_EMP_POL	0	0	0	1		✓	By	HR

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Viewing Audit Policy Information

```
SQL> SELECT policy_name, audit_option, condition_eval_opt
  2  FROM   audit_unified_policies;

POLICY_NAME          AUDIT_OPTION     CONDITION_EVAL_OPT
-------------------- ---------------- ----------------
POL1                 DELETE           INSTANCE
POL2                 TRUNCATE TABLE   NONE
POL3                 RENAME           SESSION
POL4                 ALL ACTIONS      STATEMENT
```

```
SQL> SELECT policy_name, enabled_opt, user_name, success, failure
  2  FROM   audit_unified_enabled_policies;

POLICY_NAME          ENABLED_ USER_NAME  SUC FAI
-------------------- -------- ---------- --- ---
POL3                 BY       PM         NO  YES
POL2                 EXCEPT   SYSTEM     NO  YES
POL4                 BY       SYS        YES YES
POL6                 BY       ALL USERS  YES NO
```


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Setting the Write Mode for Audit Trail Records

```
DBMS_AUDIT_MGMT.SET_AUDIT_TRAIL_PROPERTY
```


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Value-Based Auditing

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Fine-Grained Auditing

- Monitors data access on the basis of content
- Audits `SELECT`, `INSERT`, `UPDATE`, `DELETE`, and `MERGE`
- Can be linked to one or more columns in a table or view
- May execute a procedure
- Is administered with the `DBMS_FGA` package

Policy: `AUDIT_EMPS_SALARY`

```
SELECT name, salary
  FROM employees
  WHERE
    department_id = 10;
```

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FGA Policy

- Defines:
  - Audit criteria
  - Audit action
- Is created with DBMS_FGA .ADD_POLICY

```
dbms_fga.add_policy (
 object_schema   => 'HR',
 object_name     => 'EMPLOYEES',
 policy_name => 'audit_emps_salary',
 audit_condition=> 'department_id=10',
 audit_column    => 'SALARY,COMMISSION_PCT',
 handler_schema  => 'secure',
 handler_module  => 'log_emps_salary',
 enable          => TRUE,
 statement_types => 'SELECT,UPDATE');
```

```
SELECT name, job_id
  FROM employees
  WHERE
    department_id = 20;
```

```
SELECT name, salary
  FROM employees
  WHERE
    department_id = 10;
```

employees

Not audited

SECURE.LOG_ EMPS_SALARY

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Audited DML Statement: Considerations

- Records are audited if the FGA predicate is satisfied and the relevant columns are referenced.
- `DELETE` statements are audited regardless of columns specified.
- `MERGE` statements are audited with the underlying `INSERT`, `UPDATE`, and `DELETE` generated statements.

```
UPDATE hr.employees
SET salary = 1000
WHERE commission_pct = .2;
```

Not audited because none of the employees are in department 10

```
UPDATE hr.employees
SET salary = 1000
WHERE employee_id = 200;
```

Audited because the employee is in department 10

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FGA Guidelines

- To audit all rows, use a `null` audit condition.
- To audit all columns, use a `null` audit column.
- Policy names must be unique.
- The audited table or view must already exist when you create the policy.
- If the audit condition syntax is invalid, an `ORA-28112` error is raised when the audited object is accessed.
- If the audited column does not exist in the table, no rows are audited.
- If the event handler does not exist, no error is returned and the audit record is still created.

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Archiving and Purging the Audit Trail

- Periodically archive and purge the audit trail to prevent it from growing too large.
- Create an archive by:
  - Copying audit trail records to a database table
  - Using Oracle Audit Vault
- Purge the audit trail by:
  - Creating and scheduling a purge job to run at a specified time by using the `DBMS_AUDIT_MGMT.CREATE_PURGE_JOB` PL/SQL procedure
  - Manually by using the `DBMS_AUDIT_MGMT.CLEAN_AUDIT_TRAIL` PL/SQL procedure

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Purging Audit Trail Records

- Schedule an automatic purge job:

```
DBMS_AUDIT_MGMT.CREATE_PURGE_JOB
(AUDIT_TRAIL_TYPE=> DBMS_AUDIT_MGMT.AUDIT_TRAIL_UNIFIED,
 AUDIT_TRAIL_PURGE_INTERVAL => 12,
 AUDIT_TRAIL_PURGE_NAME => 'Audit_Trail_PJ',
 USE_LAST_ARCH_TIMESTAMP => TRUE,
 CONTAINER => DBMS_AUDIT_MGMT.CONTAINER_CURRENT);
```

- Manually purge the audit records:

```
DBMS_AUDIT_MGMT.CLEAN_AUDIT_TRAIL(
   AUDIT_TRAIL_TYPE  => DBMS_AUDIT_MGMT.AUDIT_TRAIL_UNIFIED)
```


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Quiz

Top-level statements performed before the database opens by administrative users such as SYS and SYSDBA are mandatorily audited.

a. True
b. False

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Summary

In this lesson, you should have learned how to:

- Describe DBA responsibilities for security and auditing
- Enable unified auditing
- Create unified audit policies
- Maintain the audit trail

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Practice: Overview

This practice covers the following topics:

- Enabling unified auditing
- Granting the `AUDIT_ADMIN` role
- Creating and enabling a unified audit policy
- Testing the audit policy
- Reviewing audit information
- Maintaining the audit trail

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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 instance recovery
- Describe complete and incomplete recovery

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DBA Responsibilities

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

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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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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	• 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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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.
A user's session is abnormally terminated.	
A user experiences a program error that terminates the session.	Watch for trends.

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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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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. Recover table from a backup.

Oracle LogMiner

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Flashback Technology

Use Flashback technology for:

- 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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Instance Failure

Typical Causes	Possible Solutions
Power outage	Restart the instance by using the STARTUP 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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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: Redo Log Files and Log Writer

Redo log files:

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

Log Writer (LGWR) writes:

- At commit
- When one-third full
- Every three seconds
- Before DBW*n* writes
- Before clean shutdowns

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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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Phases of Instance Recovery

1. Instance startup (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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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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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).

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Media Failure

Typical Causes	Possible Solutions
Failure of disk drive	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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Comparing Complete and Incomplete Recovery

Recovery can have two kinds of scope:

- Complete recovery: Brings the database or tablespace up to the present, including all committed data changes made to the point in time when the recovery was requested
- Incomplete or point-in-time recovery (PITR): Brings the database or tablespace up to a specified point in time in the past, before the recovery operation was requested

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Complete Recovery Process

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Point-in-Time Recovery Process

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Oracle Data Protection Solutions

Backup and Recovery Objective	Recovery Time Objective (RTO)	Oracle Solution
Physical data protection	Hours/Days	Recovery Manager Oracle Secure Backup
Logical data protection	Minutes/Hours	Flashback Technologies
Recovery analysis	Minimize time for problem identification and recovery planning	Data Recovery Advisor

Disaster Recovery Objective	Recovery Time Objective (RTO)	Oracle Solution
Physical data protection	Seconds/Minutes	Data Guard Active Data Guard

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Quiz

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

a. True
b. False

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Summary

In this lesson, you should have learned how to:

- Identify the types of failure that can occur in an Oracle database
- Describe instance recovery
- Describe complete and incomplete recovery

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Backup and Recovery: Configuration

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Objectives

After completing this lesson, you should be able to:

- Configure the fast recovery area
- Multiplex the control file
- Multiplex redo log files
- Configure `ARCHIVELOG` mode

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Configuring for Recoverability

Configure your database for maximum recoverability by:

- Scheduling regular backups
- Multiplexing control files
- Multiplexing redo log groups
- Retaining archived copies of redo logs

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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
- Configuration of the fast recovery area includes specifying the location, size, and retention policy.

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Monitoring the Fast Recovery Area

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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	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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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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Multiplexing the Redo Log

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Creating Archived Redo Log Files

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

1. Specify archived redo log file-naming convention.
2. Specify one or more archived redo log file locations.
3. Place the database in `ARCHIVELOG` mode.

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Archiver (ARC*n*) Process

Archiver (ARC*n*):

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

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Archived Redo Log Files: Naming and Destinations

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

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* %t_%s_%r.dbf

Number	Archived Redo Log Destination	Status	Type
1	USE_DB_RECOVERY_FILE_DEST	VALID	Local

Add Another Row

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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Configuring ARCHIVELOG Mode

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

- Using Enterprise Manager Cloud Control:
  1. On the Recovery Settings page, select “ARCHIVELOG Mode” and click Apply. The database can be set to ARCHIVELOG mode only from the MOUNT state.
  2. Restart the database instance by clicking “Yes” when prompted.
- Using SQL commands:
  - Mount the database.
  - Issue the ALTER DATABASE ARCHIVELOG command.
  - Open the database.

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Quiz

Which parameters configure the fast recovery area?

a. FLASH_RECOVERY_AREA_SIZE

b. DB_RECOVERY_FILE_DEST

c. FLASH_RECOVERY_AREA_LOC

d. DB_RECOVERY_FILE_DEST_SIZE

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Summary

In this lesson, you should have learned how to:

- Configure the fast recovery area
- Multiplex the control file
- Multiplex redo log files
- Configure `ARCHIVELOG` mode

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Practice: Overview

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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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

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Backup Solutions: Overview

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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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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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Understanding Backup 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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Understanding Types of Backups

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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RMAN Backup Types

- A *full backup* contains all used data file blocks.
- A *level 0 incremental backup* is equivalent to a full backup that has been marked as level 0.
- A *cumulative level 1 incremental backup* contains only blocks modified since the last level 0 incremental backup.
- A *differential level 1 incremental backup* contains only blocks modified since the last incremental backup.

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Using Recovery Manager (RMAN)

- Provides a powerful control and scripting language
- Includes a published API that enables interface with most popular backup software
- Backs up data, control, archived redo log, and server parameter files
- Backs up files to disk or tape
- Is integrated with Enterprise Manager Cloud Control

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Configuring Backup Settings

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Configuring Backup Settings

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Oracle-Suggested Backup

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

Full backup
+ daily incremental
= new “full” backup
+ daily archived logs for recovery

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Selecting a Backup Strategy

ORACLE Enterprise Manager Cloud Control 12c

Schedule Backup

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

Oracle-Suggested Backup

Schedule a backup using Oracle's automated backup strategy.

Schedule Oracle-Suggested Backup

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

Customized Backup

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

- (●) Whole Database
- ( ) Tablespaces
- ( ) Datafiles
- ( ) Archived Logs
- ( ) All Recovery Files on Disk

Includes all archived logs and disk backups that are not already backed

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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Backing Up the Control File to a Trace File

- Control files can be backed up to a trace file, generating a SQL command to re-create the control file.
- Control file trace backups may be used to recover from loss of all control files.

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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: Available

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

Completion Time: Within a month

Go

Results

Crosscheck | Change to Unavailable | Delete | Validate

Select All | Select None

Select	Key	Tag	Completion Time	Contents	Device Type	Status	Keep	Pieces
☐	5	ORA$OEM_LEVEL_0	Jan 4, 2013 2:04:06 AM	SPFILE, CONTROLFILE	DISK	AVAILABLE	NO	1
☐	4	BACKUP_ORCL_000021_010313095405	Jan 3, 2013 9:57:35 AM	CONTROLFILE	DISK	AVAILABLE	NO	1
☐	3	BACKUP_ORCL_000021_010313095405	Jan 3, 2013 9:57:30 AM	ARCHIVED LOG	DISK	AVAILABLE	NO	1
☐	2	BACKUP_ORCL_000021_010313095405	Jan 3, 2013 9:57:20 AM	SPFILE, CONTROLFILE	DISK	AVAILABLE	NO	1
☐	1	BACKUP_ORCL_000021_010313095405	Jan 3, 2013 9:57:05 AM	DATAFILE	DISK	AVAILABLE	NO	1

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Using RMAN Commands to Create Backups

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Quiz

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

a. True
b. False

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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

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Practice: Overview

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
- 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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Keeping a Database Open

After the database is open, it fails in 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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Data Recovery Advisor

- Fast detection, analysis, and repair of failures
- Handling of down-time and runtime failures
- Minimizing disruptions for users
- User interfaces:
  - Enterprise Manager Cloud Control
  - RMAN command line

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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 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 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 re-enter all changes that were made since the last backup.

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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.

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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.

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Quiz

An Oracle Database instance will not fail if the following event occurs:

a. Loss of a control file if there is a remaining multiplexed control file
b. Loss of the `SYSTEM` tablespace
c. Loss of one redo log member if there is a remaining multiplexed redo log member from the same group of the lost member
d. Loss of the active undo tablespace

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Summary

In this lesson, you should have learned how to:

- Determine the need for performing recovery
- 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: Overview

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

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Moving Data: General Architecture

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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`
  - GUI interface in Enterprise Manager Cloud Control
- Provides four data movement methods:
  - Data file copying
  - Direct path
  - External tables
  - Network link support
- Detaches from and re-attaches to long-running jobs
- Restarts Data Pump jobs

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Oracle Data Pump: Benefits

Data Pump offers many benefits and many features, 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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Directory Objects for Data Pump

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.

Selection Mode Single

Edit | View | Delete | Actions Create Like Go

Select	Name	Path
◉	DATA_FILE_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/demo/schema/sales_history/
○	DATA_PUMP_DIR	/u01/app/oracle/admin/orcl/dpdump/
○	LOG_FILE_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/demo/schema/log/
○	MEDIA_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/demo/schema/product_media/
○	OPATCH_LOG_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/QOpatch
○	OPATCH_SCRIPT_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/QOpatch
○	ORACLE_OCM_CONFIG_DIR	/u01/app/oracle/product/12.1.0/dbhome_1/ccr/hosts/EDRSR11P1/state
○	ORACLE_OCM_CONFIG_DIR2	/u01/app/oracle/product/12.1.0/dbhome_1/ccr/state
○	SS_OE_XMLDIR	/u01/app/oracle/product/12.1.0/dbhome_1/demo/schema/order_entry/
○	SUBDIR	/u01/app/oracle/product/12.1.0/dbhome_1/demo/schema/order_entry//2002/Sep
○	XMLDIR	/u01/app/oracle/product/12.1.0/dbhome_1/rdbms/xml
○	XSDDIR	/ade/b/4061281185/oracle/rdbms/xml/schema

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Creating Directory Objects

Directory Objects > Create Directory Object

Create Directory Object

General | Privileges

* Name ext_tab_logdir

* Path /home/oracle/labs/extab1 Test File System

General | **Privileges**

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

Add

Remove

Select All | Select None

Select	User Name	Read Access	Write Access
☐	HR	☑	☑

Directory Objects > Create Directory Object > Show SQL

Show SQL

```
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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Data Pump Export and Import Clients: Overview

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Data Pump Utility: Interfaces and Modes

- Data Pump Export and Import interfaces:
  - Command line
  - Parameter file
  - Interactive command line
  - Enterprise Manager Cloud Control
- Data Pump Export and Import modes:
  - Full
  - Schema
  - Table
  - Tablespace
  - Transportable tablespace
  - Transportable database

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Performing a Data Pump Export by Using Enterprise Manager Cloud Control

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Performing a Data Pump Import

Data Pump can be invoked on the command line:

```
$ 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: 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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Using Enterprise Manager Cloud Control to Monitor Data Pump Jobs

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SQL*Loader: Overview

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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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Loading Methods

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

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Loading Data by Using Enterprise Manager Cloud Control

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SQL*Loader Express Mode

- Specify a table name to initiate an Express Mode load.
- Table columns must be scalar data types (character, number, or datetime).
- A data file can contain only delimited character data.
- SQL*Loader uses table column definitions to determine input data types.
- There is no need to create a control file.

```
$ sqlldr hr TABLE=test
```

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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 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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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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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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Using External Tables

- Querying an 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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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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Quiz

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

a. True
b. False

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Quiz

An index can be created on an external table.

a. True

b. False

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Summary

In this lesson, you should have learned how to:

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

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Practice: Overview

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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Database Maintenance

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Objectives

After completing this lesson, you should be able to:

- Manage the Automatic Workload Repository (AWR)
- Use the Automatic Database Diagnostic Monitor (ADDM)
- Describe and use the advisory framework
- Set alert thresholds
- Use server-generated alerts
- Use automated tasks

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Database Maintenance

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Viewing the Alert History

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Terminology

- Statistics: Data collections providing database and object detail
  - Optimizer statistics: Used by query optimizer
  - Database statistics: Used for performance
- Metric: Rate of change in a cumulative statistic
- Threshold: A boundary value against which metric values are compared
- Automatic Workload Repository (AWR): Infrastructure for data gathering, analysis, and solutions recommendations
- AWR Baseline: A set of AWR snapshots for performance comparison

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Automatic Workload Repository (AWR): Overview

- Built-in repository of performance information
- Snapshots of database metrics taken every 60 minutes and retained for eight days
- Foundation for all self-management functions

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AWR Infrastructure

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Automatic Workload Repository

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AWR Baselines

```
DBMS_WORKLOAD_REPOSITORY.CREATE_BASELINE ( -
        start_snap_id IN NUMBER,
        end_snap_id   IN NUMBER,
        baseline_name IN VARCHAR2);
```


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Accessing the AWR Page

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Managing the AWR

- Retention period
  - Default: Eight days
  - Consider storage needs
- Collection interval
  - Default: 60 minutes
  - Consider storage needs and performance impact
- Collection level
  - Basic (disables most ADDM functionality)
  - Typical (recommended)
  - All (adds additional SQL tuning information to snapshots)

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Statistic Levels

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Automatic Database Diagnostic Monitor (ADDM)

- Runs after each AWR snapshot
- Monitors the instance; detects bottlenecks
- Stores results in the AWR

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ADDM Findings in Enterprise Manager Cloud Control

Advisor Central > Automatic Database Diagnostic Monitor (ADDM)

Logged in as DBA1

Automatic Database Diagnostic Monitor (ADDM)

Page Refreshed **Oct 16, 2014 12:17:32 PM** Refresh

Database Activity

Run ADDM | Finding History

The icon selected below the graph identifies the ADDM analysis period. Click on a different icon to select a different analysis period.

TIP For an explanation of the icons and symbols used in this page, see the Icon Key

ADDM Performance Analysis

Task Name ADDM:1387695062_1_314

View Report | JVM Diagnostics

Task Owner SYS Average Active Sessions 0 End Time Oct 16, 2014 12:00:17 PM

Impact (%)
ADDM did not find any problems during this period

Icon Key

This is the legend for the various ADDM Task and Snapshot icons

ADDM Task Legend

- Task(s) with findings
- Selected task with findings
- Task(s) with no findings
- Selected task with no findings
- Task(s) with errors
- Selected task with errors

Snapshot Legend

- Snapshot
- Start snapshot
- End snapshot

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ADDM Findings in Enterprise Manager Database Express

ORACLE Enterprise Manager Database Express 12c

Help | DBA1 | Log Out

ORCL (12.1.0.2.0) Configuration Storage Security Performance

Performance Hub: Real Time - Last Hour | Select Time Period | Hide Time Picker | PerfHub Report | AWR Report | Page Refreshed 12:24:02 PM GMT | Auto Refresh | 1 Minute

Summary | Activity | Workload | Monitored

ADDM Tasks

Show Task Details

Task Name
ADDM:1387695062_1_314

ORACLE Enterprise Manager Database Express 12c

ORCL (12.1.0.2.0) Configuration Storage Security Performance

Automatic Database Diagnostic Monitor (ADDM)

ADDM Performance Analysis

Summary

Task Name	ADDM:1387695062_1_314
Task Owner	SYS
Average Active Sessions	0
Period Start Time	Thu Oct 16, 2014 11:00:10 AM
End Time	Thu Oct 16, 2014 12:00:17 PM

Findings

View Details

Finding

Informational Findings

There was no significant database activity to run the ADDM.

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Advisory Framework

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Viewing the Advisor Central Page in Enterprise Manager Cloud Control

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Using Packages to Invoke the Advisors

Package Name	Advisor Name
DBMS_ADDM	Automatic Database Diagnostic Monitor (DBMS_ADDM)
DBMS_ADVISOR	SQL Access Advisor and Segment Advisor
DBMS_COMPRESSION	Compression Advisor
DBMS_SQLDIAG	SQL Repair Advisor
DBMS_SQLPA	SQL Performance Analyzer
DBMS_SQLTUNE	SQL Tuning Advisor

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Automated Maintenance Tasks

Autotask maintenance process:

1. Maintenance Window opens.
2. Autotask background process schedules jobs.
3. Scheduler initiates jobs.
4. Resource Manager limits impact of Autotask jobs.

Default Autotask maintenance jobs:

- Gathering optimizer statistics
- Automatic Segment Advisor
- Automatic SQL Advisor

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Automated Maintenance Tasks

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Automated Maintenance Tasks Configuration

Automated Maintenance Tasks > Automated Maintenance Tasks

Automated Maintenance Tasks Configuration

Global Status ◉ Enabled ○ Disabled

Task Settings

Optimizer Statistics Gathering ◉ Enabled ○ Disabled Configure

Segment Advisor ◉ Enabled ○ Disabled

Automatic SQL Tuning ◉ Enabled ○ Disabled Configure

Maintenance Window Group Assignment

Edit Window Group

Window	Optimizer Statistics Gathering	Segment Advisor	Automatic SQL Tuning
	Select All | Select None	Select All | Select None	Select All | Select None
THURSDAY_WINDOW	☑	☑	☑
FRIDAY_WINDOW	☑	☑	☑
SATURDAY_WINDOW	☑	☑	☑
SUNDAY_WINDOW	☑	☑	☑
MONDAY_WINDOW	☑	☑	☑
TUESDAY_WINDOW	☑	☑	☑
WEDNESDAY_WINDOW	☑	☑	☑

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Server-Generated Alerts

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Setting Metrics Thresholds

Database Instance: orcl > Metric and Collection Settings

Metric and Collection Settings

Cancel OK

Metrics | Other Collected Items

View: Metrics with thresholds

Expand All | Collapse All

Metric	Comparison Operator	Warning Threshold	Critical Threshold	Corrective Actions	Collection Schedule	Edit
orcl						
Alert Log					Disabled	
Archiver Hung Alert Log Error	Contains		ORA-	None		
Data Block Corruption Alert Log Error	Contains		ORA-	None		
Generic Alert Log Error	Matches	ORA-0*(600?		None		
Media Failure Alert Log Error	Contains		ORA-	None		
Session Terminated Alert Log Error	Contains	ORA-		None		
Alert Log Error Status					Disabled	
Archiver Hung Alert Log Error Status	>	0		None		
Data Block Corruption Alert Log Error Status	>	0		None		

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Reacting to Alerts

- If necessary, you should gather more input (for example, by running ADDM or another advisor).
- Investigate critical errors.
- Take corrective measures.
- Acknowledge alerts that are not automatically cleared.

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Alert Types and Clearing Alerts

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Quiz

Stateless alerts, such as `SNAPSHOT TOO OLD` can be found in the dictionary view `DBA_OUTSTANDING_ALERTS`.

a. True

b. False

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Summary

In this lesson, you should have learned how to:

- Manage the Automatic Workload Repository (AWR)
- Use the Automatic Database Diagnostic Monitor (ADDM)
- Describe and use the advisory framework
- Set alert thresholds
- Use server-generated alerts
- Use automated tasks

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Practice: Overview

This practice covers proactively managing your database with ADDM, including:

- Setting up an issue for analysis
- Reviewing your database performance
- Implementing a solution

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Managing Performance

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Objectives

After completing this lesson, you should be able to use:

- Enterprise Manager to monitor performance
- Automatic Memory Management (AMM)
- The Memory Advisor to size memory buffers

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Performance Monitoring

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Performance Monitoring

Use the Enterprise Manager Database Express home page for:

- Performance overview
- Graphs of metrics and details

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Tuning Activities

The three activities in performance management are:

- Performance planning
- Instance tuning
- SQL tuning

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Performance Planning

- Investment options
- System architecture
- Scalability
- Application design principles
- Workload testing, modeling, and implementation
- Deploying new applications

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Instance Tuning

- Have well-defined goals.
- Allocate memory to database structures.
- Consider I/O requirements in each part of the database.
- Tune the operating system for optimal performance of the database.

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Performance Tuning Methodology

The tuning steps:

- Tune from the top down. Tune the:
  1. Design
  2. Application code
  3. Instance
- Tune the area with the greatest potential benefit. Identify and tune:
  - SQL using the greatest resources
  - The longest waits
  - The largest service times
- Stop tuning when the goal is met.

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Performance Tuning Data

Type of data gathered:

- Cumulative statistics:
  - Wait events with time information
  - Time model
- Metrics: Statistic rates
- Sampled statistics: Active session history
  - Statistics by session
  - Statistics by SQL
  - Statistics by service
  - Other dimensions

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Using the Enterprise Manager Database Express Performance Hub Page

ORACLE Enterprise Manager Database Express 12c

Help | DBA1 | Log Out

ORCL (12.1.0.2.0) Configuration Storage Security Performance

Performance Hub: Real Time - Last Hour | Select Time Period | Hide Time Picker | PerfHub Report | AWR Report | Page Refreshed 10:22:39 AM GMT | Auto Refresh | 1 Minute

0.2
0.1
0
09:25AM 09:30AM 09:35AM 09:40AM 09:45AM 09:50AM 09:55AM 10:00AM 10:05AM 10:10AM 10:15AM 10:20AM

Summary | Activity | Workload | Monitored SQL | ADDM | Current ADDM Findings

Host: Runnable Processes

Show Load Average

1.8
1.2
.6
0
9:25 AM 9:35 AM 9:45 AM 9:55 AM 10:05 AM 10:15 AM
Oct 17

Load Average
Other Host CPU
Background CPU...
Foreground CPU ...

Memory: Host Total 7.7GB

Show Host Memory

600 MB
400 MB
200 MB
0 MB
9:25 AM 9:35 AM 9:45 AM 9:55 AM 10:05 AM 10:15 AM
Oct 17

Total PGA
Shared I/O Pool
Streams Pool
Java Pool
Large Pool
Shared Pool
Buffer Cache

Active Sessions

Activity | Services

Foreground Only | Foreground + Background

1.8
1.2
.6
0
9:25 AM 9:35 AM 9:45 AM 9:55 AM 10:05 AM 10:15 AM
Oct 17

Average Active S...
Miscellaneous
Other
Commit
User I/O
CPU

I/O

Requests | Throughput | Latency

I/O Type | I/O Function | I/O Consumer Group

18 /s
12 /s
6 /s
0 /s
9:25 AM 9:35 AM 9:45 AM 9:55 AM 10:05 AM 10:15 AM
Oct 17

Large Writes
Large Reads
Small Writes
Small Reads

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Using the Enterprise Manager Cloud Control Performance Home Page

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Monitoring Session Performance

ORACLE Enterprise Manager Cloud Control 12c

Setup | ADMIN

Enterprise | Targets | Favorites | History

Search Target Name

orcl

Logged in as dba1

Oracle Database | Performance | Availability | Security | Schema | Administration

Logged in as DBA1

Top Activity

Drag the shaded box to change the time period for the detail section below.

View Data: Real Time: 15 Second Refresh

Maximum CPU

Active Sessions: 2, 1.8, 1.6, 1.4, 1.2, 1, 0.8, 0.6, 0.4, 0.2, 0

09:36AM 09:41AM 09:46AM 09:51AM 09:56AM 10:01AM 10:06AM 10:11AM 10:16AM 10:21AM 10:26AM 10:31AM

Other
Queueing
Network
Administrative
Configuration
Commit
Application
Concurrency
System I/O
User I/O
Scheduler
CPU + CPU Wait

Detail for Selected 5 Minute Interval

Start Time Oct 17, 2014 9:58:00 AM

Run ASH Report

Top SQL

Actions: Schedule SQL Tuning Advisor | Go

Select All | Select None

Select	Activity (%)	SQL ID	SQL Type
☐	16.67	3un99a0zwp4vd	SELECT
☐	8.33	antwva8smnnmt	INSERT
☐	8.33	0wuwk1v9z5caf	INSERT
☐	8.33	dcstr36r0vz0d	SELECT

Top Sessions

View: Top Sessions

Activity (%)	Session ID	User Name	Program
18.37	7	SYS	oracle@EDRSR9P1 (CKPT)
12.24	244	SYS	oracle@EDRSR9P1 (LG00)
10.20	38	SYS	oracle@EDRSR9P1 (J001)
8.16	71	SYS	oracle@EDRSR9P1 (M001)
8.16	243	SYS	oracle@EDRSR9P1 (LGWR)

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Performance Monitoring: Top Sessions

Top Consumers

Collected From **Oct 17, 2014 10:38:36 AM U**

Overview | Top Services | Top Modules | Top Actions | Top Clients | **Top Sessions**

Kill Session | View | Disable SQL Trace | Enable SQL Trace

Select	SID	DB User	CPU (1/100 sec)	PGA Memory (bytes)	Physical Reads	Logical Reads	Hard Parses	Total Parses	Disk Sorts	Status	Program	Module
◉	47	DBSNMP	22	10006632	1	459	7	50	0	ACTIVE	OMS	EM Realtime Connection
○	247	MMON	1	12243256	0	0	0	0	0	ACTIVE	oracle@EDRSR9P1 (MMON)	
○	32	DBSNMP	1	8678856	0	9	0	6	0	ACTIVE	JDBC Thin Client	emagent_SQL_oracle_datab
○	240	QM00	0	2207848	0	0	0	0	0	ACTIVE	oracle@EDRSR9P1 (QM00)	Streams
○	241	DBRM	0	1888568	0	0	0	0	0	ACTIVE	oracle@EDRSR9P1 (DBRM)	
○	280	Q003	0	1290344	0	0	0	0	0	ACTIVE	oracle@EDRSR9P1 (Q003)	Streams

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Displaying Session-Related Statistics

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Performance Monitoring: Top Services

Top Consumers

Latest Data Collected From Target **Oct 17, 2014 10:41:20 AM UTC** Refresh

Overview | **Top Services** | Top Modules | Top Actions | Top Clients | Top Sessions

View Active Services

Enable SQL Trace | Disable SQL Trace | View SQL Trace File

Select All | Select None

Select	Service	Activity (% for the last 5 minutes)	SQL Trace Enabled	Delta Elapsed Time (seconds)	Cumulative Elapsed Time (seconds)	Delta CPU Time (seconds)	Cumulative CPU Time (seconds)
☐	SYS$BACKGROUND	61.9	FALSE	0	0	0	
☐	SYS$USERS	38.1	FALSE	0	9825	0	74

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Displaying Service-Related Statistics

For *n*-tier environments, because session statistics are not as helpful, you can see service-level statistics in these views:

- **`V$SERVICE_EVENT`:** Aggregated wait counts and wait times for each service, on a per-event basis
- **`V$SERVICE_WAIT_CLASS`:** Aggregated wait counts and wait times for each service on a wait-class basis

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Viewing Wait Events

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Oracle Wait Events

- A collection of wait events provides information about the sessions or processes that had to wait or must wait for different reasons.
- These events are listed in the `V$EVENT_NAME` view.

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Memory Management: Overview

DBAs must consider memory management to be a crucial part of their job because:

- There is a finite amount of memory available
- Allocating more memory to serve certain types of functions can improve overall performance
- Automatically tuned memory allocation is often the appropriate configuration, but specific environments or even short-term conditions may require further attention

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Managing Memory Components

- Automatic Memory Management (AMM) enables you to specify total memory allocated to instance (including both SGA and PGA)
- Automatic Shared Memory Management (ASMM):
  - Enables you to specify total SGA memory through one initialization parameter
  - Enables the Oracle server to manage the amount of memory allocated to the shared pool, Java pool, buffer cache, streams pool, and large pool
- Manually setting shared memory management:
  - Sizes the components through multiple individual initialization parameters
  - Uses the appropriate Memory Advisor to make recommendations

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Efficient Memory Usage: Guidelines

- Fit the SGA into physical memory.
- Use the Memory Advisors.
- Tune for the most efficient use of memory
  - Reduce overall physical I/O
  - Reduce the total memory needs

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Automatic Memory Management: Overview

With Automatic Memory Management, the database server can size the SGA and PGA automatically according to your workload.

Oracle recommends the use of AMM unless you have special requirements.

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Oracle Database Memory Parameters

Child parameters:

- Providing minimum values
- Automatic change of size only with autotuned parameters

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Enabling Automatic Memory Management (AMM) by Using Enterprise Manager Cloud Control

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Monitoring Automatic Memory Management

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Monitoring Automatic Memory Management

Use the following views to monitor Automatic Memory Management:

- `V$MEMORY_DYNAMIC_COMPONENTS`: Current status of all memory components
- `V$MEMORY_RESIZE_OPS`: Circular history buffer of the last 800 memory resize requests
- `V$MEMORY_TARGET_ADVICE`: Tuning advice for the `MEMORY_TARGET` initialization parameter

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Automatic Shared Memory Management: Overview

- Automatically adapts to workload changes
- Maximizes memory utilization
- Helps eliminate out-of-memory errors

Example:

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Enabling Automatic Shared Memory Management (ASMM)

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Understanding Automatic Shared Memory Management

- ASMM is based on workload information that `MMON` captures in the background.
- `MMON` uses memory advisors.
- Memory is moved to where it is needed the most by `MMAN`.
- If an SPFILE is used (which is recommended):
  - Component sizes are saved across shutdowns
  - Saved values are used to bootstrap component sizes
  - There is no need to relearn optimal values

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Automatic Shared Memory Advisor

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Enabling Automatic Shared Memory Management

To enable ASMM from manual shared memory management:

1. Get a value for **SGA_TARGET:**

```
SELECT ((SELECT SUM(value) FROM V$SGA) - (SELECT CURRENT_SIZE
FROM V$SGA_DYNAMIC_FREE_MEMORY)) "SGA_TARGET" FROM DUAL;
```

2. Use that value to set **SGA_TARGET**.
3. Set the values of the automatically sized SGA components to 0.

To switch to ASMM from Automatic Memory Management:

1. Set the **MEMORY_TARGET** initialization parameter to 0.
2. Set the values of the automatically sized SGA components to 0.

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Disabling Automatic Shared Memory Management

- Setting SGA_TARGET to 0 disables autotuning.
- Autotuned parameters are set to their current sizes.
- The SGA size as a whole is unaffected.

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Using V$PARAMETER to View Memory Component Sizes

```
SGA_TARGET = 8G
```

```
DB_CACHE_SIZE = 0
JAVA_POOL_SIZE = 0
LARGE_POOL_SIZE = 0
SHARED_POOL_SIZE = 0
STREAMS_POOL_SIZE = 0
```

```
SELECT name, value, isdefault
FROM   v$parameter
WHERE  name LIKE '%size';
```


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Managing the Program Global Area (PGA)

Automatic PGA memory management is enabled by default.

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Dynamic Performance Statistics

Systemwide

V$SYSSTAT
- STATISTIC#
- NAME
- CLASS
- VALUE
- STAT_ID

V$SYSTEM_EVENT
- EVENT
- TOTAL_WAITS
- TOTAL_TIMEOUTS
- TIME_WAITED
- AVERAGE_WAIT
- TIME_WAITED_MICRO

Session specific

V$SESSTAT
- SID
- STATISTIC#
- VALUE

V$SESSION_EVENT
- SID
- EVENT
- TOTAL_WAITS
- TOTAL_TIMEOUTS
- TIME_WAITED
- AVERAGE_WAIT
- MAX_WAIT
- TIME_WAITED_MICRO
- EVENT_ID

Service specific

V$SERVICE_STATS
- SERVICE_NAME_HASH
- SERVICE_NAME
- STAT_ID
- STAT_NAME
- VALUE

V$SERVICE_EVENT
- SERVICE_NAME
- SERVICE_NAME_HASH
- EVENT
- EVENT_ID
- TOTAL_WAITS
- TOTAL_TIMEOUTS
- TIME_WAITED
- AVERAGE_WAIT
- TIME_WAITED_MICRO

Cumulative stats

Wait events

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Troubleshooting and Tuning Views

Instance/Database
V$DATABASE
V$INSTANCE
V$PARAMETER
V$SPPARAMETER
V$SYSTEM_PARAMETER
V$PROCESS
V$BGPROCESS
V$PX_PROCESS_SYSSTAT
V$SYSTEM_EVENT

Disk
V$DATAFILE
V$FILESTAT
V$LOG
V$LOG_HISTORY
V$DBFILE
V$TEMPFILE
V$TEMPSEG_USAGE
V$SEGMENT_STATISTICS

Memory
V$BUFFER_POOL_STATISTICS
V$LIBRARYCACHE
V$SGAINFO
V$PGASTAT

Contention
V$LOCK
V$UNDOSTAT
V$WAITSTAT
V$LATCH

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Quiz

Automatic Memory Management allows the Oracle instance to reallocate memory from the _____ to the SGA .

a. Large Pool
b. Log Buffer
c. PGA
d. Streams Pool

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Quiz

SGA_TARGET may not be sized greater than _____ .

a. LOG_BUFFER

b. SGA_MAX_SIZE

c. STREAMS_POOL_SIZE

d. PGA_AGGREGATE_TARGET

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Summary

In this lesson, you should have learned how to use:

- Enterprise Manager to monitor performance
- Automatic Memory Management (AMM)
- The Memory Advisor to size memory buffers

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Practice: Overview

This practice covers the following topics:

- Using the Performance page in Enterprise Manager
- Diagnosing a memory allocation problem
- Enabling and implementing Automatic Memory Management
- Monitoring Top Services and Sessions

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Managing Performance: SQL Tuning

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Objectives

After completing this lesson, you should be able to:

- Manage optimizer statistics
- Use the SQL Tuning Advisor to:
  - Identify SQL statements that are using the most resources
  - Tune SQL statements that are using the most resources
- Use the SQL Access Advisor to tune a workload

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SQL Tuning

SQL tuning process

- Identify poorly tuned SQL statements.
- Tune the individual statements.
- Tune the application as a whole.

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Oracle Optimizer: Overview

The Oracle optimizer determines the most efficient execution plan and is the most important step in the processing of any SQL statement.

The optimizer:

- Evaluates expressions and conditions
- Uses object and system statistics
- Decides how to access the data
- Decides how to join tables
- Determines the most efficient path

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Optimizer Statistics

Optimizer statistics are:

- A snapshot at a point in time
- Persistent across instance restarts
- Collected automatically

```
SQL> SELECT COUNT(*) FROM hr.employees;
  COUNT(*)
----------
       214
SQL> SELECT num_rows FROM dba_tables
  2 WHERE owner='HR' AND table_name = 'EMPLOYEES';
  NUM_ROWS
----------
       107
```


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Optimizer Statistics Collection

- SQL performance tuning: Depends on collection of accurate statistics
- Optimizer statistics:
  - Object statistics
  - Operating system statistics
- Ways to collect statistics:
  - Automatically: Automatic Maintenance Tasks
  - Manually: `DBMS_STATS` package
  - By setting database initialization parameters
  - By importing statistics from another database

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Using the Optimizer Statistics Console

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Setting Global Preferences by Using Enterprise Manager Cloud Control

Manage Optimizer Statistics > Global Statistics Gathering Options

Global Statistics Gathering Options

Database orcl

Statistics History

Retention Period (days) 31

The number of days for which optimizer statistics history will be retained.

Gather Optimizer Statistics Default Options

Oracle recommends that you use the Gather Auto choice for the Gather Objects options when you use the Gather Optimizer Statistics process for use Gather Auto, the defaults for the other options are set here. Changing the options will impact the automated Optimizer Statistics Gathering task

Estimate Percentage	(•) Auto (Oracle recommended) ( ) 100% ( ) Percentage
Degree of Parallelism	(•) Table default ( ) Auto ( ) System default ( ) Degree
Granularity	Auto
Cursor Invalidation	(•) Auto (Oracle recommended) ( ) Immediate ( ) None
Cascade	(•) Auto (Oracle recommended) ( ) True ( ) False
Target Object Class (Auto Job)	(•) Auto (Oracle recommended) ( ) All ( ) Oracle
Stale Percentage	10
Incremental	( ) True (•) False
Publish	(•) True ( ) False
Histograms	FOR ALL COLUMNS SIZE AUTO

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Gathering Optimizer Statistics Manually

Gather Optimizer Statistics: Scope

Database orcl
Task Status Enabled
Logged In As dba1
Scope Database

Select the type of object for which you want to gather optimizer statistics.

Object Type
- (●) Database
- ( ) Schema
- ( ) Tables
- ( ) Indexes
- ( ) Fixed Objects
  In-memory structures/variables of the RDBMS that are exposed in the form of dynamic performance tables.
- ( ) Dictionary Objects
  Objects in 'SYS', 'SYSTEM' and all non-user defined schemas.

TIP The Objects step will be skipped when Database, Fixed Objects or Dictionary Objects is selected.

Options for Scope: Database

(●) Use Oracle-recommended option settings
Oracle will select objects for which to gather optimizer statistics based on the activity on the objects. Also, Oracle will use the best options for generating the statistics. The Customize Options step will be skipped if you choose this option.

▷ View Oracle-recommended option settings

( ) Customize Options
You can customize options on the Customize Options step

Validate With SQL Performance Analyzer

☐ Validate impact of stats on SQL performance prior to publishing (recommended). The database global statistics gathering option PUBLISH will be set to FALSE temporarily during the process.

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Setting Optimizer Statistics Preferences

- Optimizer statistics preferences set the default values of parameters used by:
  - Automatic statistics collection
  - `DBMS_STATS.GATHER_*_STATS` procedures
- Set preferences at levels:
  - Table, schema, database, or global
- Preferences: `CASCADE`, `DEGREE`, `ESTIMATE_PERCENT`, `NO_INVALIDATE`, `METHOD_OPT`, `GRANULARITY`, `INCREMENTAL`, `PUBLISH`, `STALE_PERCENT`
- Use `DBMS_STATS.SET | GET | DELETE | EXPORT | IMPORT_*_PREFS` to manage preferences

Optimizer statistics gathering task

```
EXEC DBMS_STATS.SET_TABLE_PREFS('SH','SALES','STALE_PERCENT','13');
```


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Concurrent Statistics Gathering

- The auto statistics gather job uses concurrency.
- Prevent concurrent statistics gathering to make the system overwhelmed through careful resource usage capping.
- Allow gathering index statistics concurrently.
- Allow gathering of statistics for multiple partitioned tables concurrently.

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Viewing Statistics Information

V$SYSSTAT
- STATISTIC#
- NAME
- CLASS
- VALUE
- STAT_ID

V$SYSTEM_WAIT_CLASS
- WAIT_CLASS_ID
- WAIT_CLASS#
- WAIT_CLASS
- TOTAL_WAITS
- TIME_WAITED

V$SGASTAT
- POOL
- NAME
- BYTES

V$EVENT_NAME
- EVENT_NUMBER
- EVENT_ID
- NAME
- PARAMETER1
- PARAMETER2
- PARAMETER3
- WAIT_CLASS

V$SYSTEM_EVENT
- EVENT
- TOTAL_WAITS
- TOTAL_TIMEOUTS
- TIME_WAITED
- AVERAGE_WAIT
- TIME_WAITED_MICRO

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SQL Plan Directives

- A SQL plan directive is additional information and instructions that the optimizer can use to generate a better plan:
  - Collect missing statistics
  - Create column group statistics
  - Perform dynamic sampling
- Directives can be used for multiple statements:
  - Directives are collected on query expressions
- They are persisted to disk in the SYSAUX tablespace.
- Directives are automatically maintained:
  - Created as needed during compilation or execution:
    - Missing statistics, cardinality misestimates
  - Purged if not used after a year

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Adaptive Execution Plans

- A query plan changes during execution because runtime conditions indicate that optimizer estimates are inaccurate.
- All adaptive execution plans rely on statistics that are collected during query execution.
- The two adaptive plan techniques are:
  - Dynamic plans
  - Re-optimization
- The database uses adaptive execution plans when `OPTIMIZER_FEATURES_ENABLE` is set to `12.1.0.1` or higher, and `OPTIMIZER_ADAPTIVE_REPORTING_ONLY` is set to the default value of `FALSE`.

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Using the SQL Advisors

Advisor Central

Advisors | Checkers

View Data

Advisors

ADDM
Maximum Availability Architecture (MAA) Advisor
Segment Advisor
Streams Performance Advisor
Automatic Undo Management
Memory Advisors
SQL Advisors
Data Recovery Advisor
MTTR Advisor
SQL Performance Analyzer Home

Advisor Central > SQL Advisors

SQL Advisors

The SQL Advisors address several important use cases having to do with SQL: identify physical structures optimizing a SQL workload, tune individual statements with heavy ex
result set divergence, build test cases for failed SQL.

SQL Access Advisor

SQL Access Advisor	Evaluate an entire workload of SQL and recommend indexes, partitioning, materialized views that will improve the collective perform

SQL Tuning Advisor

SQL Tuning Advisor	Analyze individual SQL statements, and recommend SQL profiles, statistics, indexes, and restructured SQL to SQL performance.
Automatic SQL Tuning Results	View the results of automated execution of SQL Tuning Advisor on observed high-load SQL.

SQL Repair Advisor

The SQL Repair Advisor can analyze and potentially patch failing SQL statements.

SQL Incident Analysis	SQL incident analysis is initiated from the Support Workbench for SQL failures that are generating Support Workbench incidents. Click here to go to Support Workbench.
SQL Failure Analysis	SQL failure analysis is used for non-incident SQL failures and can be accessed through either SQL Details or SQL Worksheet. Click here to go to SQL Worksheet.

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Automatic SQL Tuning Results

Advisor Central >

Logged in as DBA1

Automatic SQL Tuning Result Summary

The Automatic SQL Tuning runs during system maintenance windows as an automated maintenance task, searching for ways to improve the execution plans of high-load SQL statements.

Task Status

Automatic SQL Tuning (SYS_AUTO_SQL_TUNING_TASK) is currently Enabled Configure

Automatic Implementation of SQL Profiles is currently Disabled Configure

Key SQL Profiles 4 Implement All

TIP Key SQL Profiles were verified to yield at least a 3X performance improvement and would have been implemented automatically had auto-implementation been enabled.

SPA Validation Results Navigate to SPA home

Summary Time Period

Choose a time period to focus the graphs and statistics below on a specific range of tuning results. Drill down to view focused results or see the results for all SQLs by clicking the "View Report" button.

Time Period All Go View Report

Begin Date Oct 2, 2014 10:00:03 PM GMT+00:00 End Date Oct 20, 2014 8:17:05 AM GMT+00:00

Overall Task Statistics

Executions 17 Candidate SQL 326 Distinct SQL Examined 43

SQL Examined Status

Breakdown by Finding Type

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Implementing Automatic Tuning Recommendations

Advisor Central > SQL Tuning Summary:SYS.SYS_AUTO_SQL_TUNING_TASK >

Automatic SQL Tuning Result Details: All Analyzed SQLs

Begin Date Oct 2, 2014 10:00:03 PM GMT+00:00 End Date Oct 20, 2014 8:18:39 AM GMT+00:00

Recommendations

Only profiles that significantly improve SQL performance were implemented.

View Recommendations | Implement All SQL Profiles | Validate All Profiles with SPA

Select	SQL Text	Parsing Schema	SQL ID	Weekly DB Time Benefit(sec)	Per-Execution % Benefit	Statistics	SQL Profile	Index	Restructure SQL
	SELECT /*+first rows */								

Advisor Central > SQL Tuning Summary:SYS.SYS_AUTO_SQL_TUNING_TASK > SQL Tuning Details:SYS.SYS_AUTO_SQL_TUNING_TASK > Logged in as DBA1

Recommendations for SQL ID:9hr2tu8avpxs8

Return

Only one recommendation should be implemented.

SQL Information

SQL Text SELECT /*+first rows */ d.tablespace_name, NVL(a.bytes / 1024 / 1024, 0) allocated_space, DECODE(d.contents,'UNDO', NVL(u.bytes, 0)/1024/1024, NVL(a.bytes - NVL(f.bytes, 0), 0)/1024 /1024) used_space ...

Select Recommendation

Original Explain Plan (Annotated)

Implement | Validate with SPA

Select	Type	Findings	Recommendations	Rationale	Benefit (%)	Other Statistics	New Explain Plan	Compare Explain Plans
◉	Statistics	Optimizer statistics for table "SYS"."TS$" and its indices are stale.	Consider collecting optimizer statistics for this table.	The optimizer requires up-to-date statistics for the table in order to select a good execution plan.				
○	SQL Profile	A potentially better execution plan was found for this statement.	Consider accepting the recommended SQL profile. No SQL profile currently exists for this recommendation.	The SQL profile was not automatically created because its benefit could not be verified.	62.93			

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SQL Tuning Advisor: Overview

SQL Tuning Advisor

Comprehensive SQL tuning

- **Detect stale or missing statistics**
- **Tune SQL plan (SQL profile)**
- **Add missing index**
- **Restructure SQL**

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Using the SQL Tuning Advisor

- Use the SQL Tuning Advisor to analyze SQL statements and obtain performance recommendations.
- Sources for SQL Tuning Advisor to analyze:
  - Top Activity: Analyzes the top SQL statements currently active
  - SQL Tuning Sets: Analyzes a set of SQL statements you provide
  - Historical SQL (AWR): Analyzes SQL statements from statements collected by AWR snapshots

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Using the SQL Tuning Advisor

Schedule SQL Tuning Advisor

Specify the following parameters to schedule a job to run the SQL Tuning Advisor.

* Name: SQL_TUNING_1352461752065

Description:

* SQL Tuning Set: SYS.TOP_SQL_1352461750826

SQL Tuning Set Description: Automatically generated by Top SQL

SQL Statements Counts: 10

▷ **SQL Statements**

Scope

Total Time Limit (minutes): 30

Scope of Analysis:

- ○ Limited
  The analysis is done without SQL Profile recommendation and takes about 1 second per statement.
- ◉ Comprehensive
  This analysis includes SQL Profile recommendation, but may take a long time.
  Time Limit per Statement (minutes): 5

Schedule

Time Zone: UTC

◉ Immediately

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SQL Tuning Advisor Recommendations

Advisor Central > SQL Tuning Summary:SYS.SQL_TUNING_1352461752065 > Logged in As SYS

SQL Tuning Result Details: All Analyzed SQLs

Status Completed
Started 11/09/2012 11:51:01
Completed 11/09/2012 11:51:21
Running Time (minutes) 0

Tuning Set Owner SYS
Tuning Set Name TOP_SQL_1352461750826
Time Limit (seconds) 1800

Recommendations

Only profiles that significantly improve SQL performance were implemented.

View Recommendations | Implement All SQL Profiles

Select	SQL Text	Parsing Schema	SQL ID	Cumulative DB Time Benefit(sec)	Per-Execution % Benefit	Statistics	SQL Profile	Index	Restructure SQL
◉	WITH MONITOR_DATA AS (SELECT INST_ID, KE...	SYS	7r24h5ucyjggz	2.28	98		(98%) ✓		
○	SELECT ash.sql_id, decode(ash.sql_plan_h...	SYS	dzw9p1af48pgn						
○	SELECT ash.sql_id, decode(ash.sql_plan_h...	SYS	8k5pb5szj3gtd						
○	SELECT XMLTYPE(DBMS_REPORT.GET_REPORT_WI...	SYS	0w26sk6t6gq98						

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Duplicate SQL

Logged in as DBA1

Duplicate SQL

Page Refre

Applications can cause database to consume excessive CPU by parsing SQL statements that are similar and that can share the same SQL text. Such applications can also cause slow performance by creating contention

CPU Consumption Since Instance Started

CPU Used as percentage of Total CPU (%) 0.40
CPU Used for Parsing as percentage of CPU Used(%) 11.87

Duplicate SQL Statements

This report identifies similar SQL statements that could be shared by a single SQL statement if the database application used bind variables to replace literals and SQL coding conventions to remove differences based onl

Note: Only the first 2000 SQL statements that are executed only once are examined. The actual number of SQL statements that are duplicates can be more than 2000.

Expand All | Collapse All

Duplicates	Plan Hash Value	SQL Text
▽ Duplicates		
▷ 4	120363598	SELECT /* STN_REPT_STAT with_stats */ count(distinct sql_id) FROM (SELECT *
▷ 4	346815704	select /* STN_REPT_STAT with_results */ count(distinct object_id) from (SELECT /*+ cardina
▷ 4	3021663871	SELECT /* STN_REPT_STAT dist_in_report */ count(distinct sql_id) FROM (SELECT *
▷ 4	1555381724	SELECT /* STN_REPT_STAT with_errors */ count(distinct sql_id) FROM (SELECT *
▷ 4	3800876181	SELECT /* STN_REPT_STAT prof_times */ profile_impl, round(sum(last_week
▷ 4	120363598	SELECT /* STN_REPT_STAT with_index */ count(distinct sql_id) FROM (SELECT *
▷ 4	1033394119	SELECT DECODE(COUNT(*), 0, 'DISABLED', 'ENABLED') STATUS FROM DBA_AUTOTASK_WINDOW_CLIENTS WHERE SQL_

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SQL Access Advisor: Overview

Workload specification
- SQL statement
- SQL Tuning Set
- SQL cache contents
- Statistics
- Schema name

SQL Access Advisor

Recommendations
- Indexes
- Materialized views
- Materialized view logs
- Partitioning

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Using the SQL Access Advisor

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Workload Source

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Recommendation Options

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Recommendation Options

▽ **Advanced Options**

Workload Categorization

Workload Volatility

☐ Consider only queries

Choose this option if this is a Data Warehouse workload

Workload Scope

☐ Recommend dropping unused access structures

Select when workload represents all access structure use cases

Space Restrictions

Do you want to limit additional space used by recommended indexes and materialized views?

◉ No, show me all recommendations (unlimited space)

○ Yes, limit additional space to [ ] MB

Set to zero or negative to recommend dropping existing access structures to make room for better ones.

Tuning Prioritization

Prioritize tuning of SQL statements by PRIORITY,OPTIMIZER_COST Add Buffer Gets

SQL statements will be analyzed in descending order of the value of the prioritized statistic.

☑ Consider access structures creation costs recommendations

If checked, the SQL Access Advisor will weigh the cost of creation of access structures against the frequency and potential improvement of SQL s

Check this box if you do not want specific recommendations generated for statements that are not executed frequently.

Default Storage Locations

By default, indexes will be placed in the schema and tablespace of the table they reference, materialized views will be placed in the schema and logs will be placed in the default tablespace of the schema of the table they reference. These fields allow you to change these default locations.

Index Tablespace

Index Schema

Materialized View Tablespace

Materialized View Schema

Materialized View Log Tablespace

Partitioning Tablespaces

Comma-separated list

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Reviewing Recommendations

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SQL Performance Analyzer: Overview

- Targeted users: DBAs, QAs, application developers
- Helps predict the impact of system changes on SQL workload response time
- Builds different versions of SQL workload performance (that is, SQL execution plans and execution statistics)
- Executes SQL serially (concurrency not honored)
- Analyzes performance differences
- Offers fine-grained performance analysis on individual SQL
- Is integrated with SQL Tuning Advisor to tune regressions

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SQL Performance Analyzer: Use Cases

SQL Performance Analyzer is beneficial in the following use cases:

- Database upgrades
- Implementation of tuning recommendations
- Schema changes
- Statistics gathering
- Database parameter changes
- OS and hardware changes

It is accessible through Enterprise Manager and the `DBMS_SQLPA` package.

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Using SQL Performance Analyzer

1. Capture SQL workload on production.
2. Transport the SQL workload to a test system.
3. Build “before-change” performance data.
4. Make changes.
5. Build “after-change” performance data.
6. Compare results from steps 3 and 5.
7. Tune regressed SQL.

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Quiz

Even when you enable Automatic Maintenance tasks, the SQL Tuning Advisor always has to be started separately.

a. True

b. False

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Quiz

You can receive performance recommendations for historical SQL statements that are collected by AWR snapshots.

a. True

b. False

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Quiz

The SQL Access Advisor can recommend the proper set of materialized views, materialized view logs, partitioning, and indexes for a given workload.

a. True
b. False

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Quiz

The SQL Performance Analyzer provides you with detailed information about the performance of SQL statements, such as before-and-after execution statistics, and statements with performance improvement or degradation.

a. True
b. False

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Summary

In this lesson, you should have learned how to:

- Manage optimizer statistics
- Use the SQL Tuning Advisor to:
  - Identify SQL statements that are using the most resources
  - Tune SQL statements that are using the most resources
- Use the SQL Access Advisor to tune a workload

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Practice: Overview

This practice covers using SQL Tuning Advisor.

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Using Database Resource Manager

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Objectives

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

- Configure the Database Resource Manager
- Access and create resource plans
- Create consumer groups
- Specify directives for allocating resources to consumer groups
- Map consumer groups to plans
- Activate a resource plan
- Monitor the Resource Manager

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Database Resource Manager: Overview

Use the Resource Manager to:

- Manage mixed workload
- Control system performance

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Database Resource Manager: Concepts

User groups or sessions with similar resource needs

A blueprint for resource allocation among resource consumer groups (one active plan)

Specifies how a resource is divided among the resource consumer groups (within the scope of allocation methods)

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Using the Resource Manager

- You can manage database and operating system resources, such as:
  - CPU usage
  - Degree of parallelism
  - Number of active sessions
  - Undo generation
  - Operation execution time
  - Idle time
  - Database consolidation
  - Server consolidation
- You can also specify criteria that, if met, cause the automatic switching of sessions to another consumer group.

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Default Plan for Maintenance Windows

Resource Plans > View Resource Plan: DEFAULT_MAINTENANCE_PLAN

Logged in as DBA1

View Resource Plan: DEFAULT_MAINTENANCE_PLAN

Actions Create Like Go Edit Return

General | Parallelism | Runaway Query | Idle Time

A Resource Plan contains directives that specify how resources are allocated to Consumer Groups. For each Consumer Group, a directive specifies the amount of CPU resources are allocated. It also specifies limits,such as the maximum degree of parallelism, execution time, and amount of I/O, that each session in the Consumer Group can consume. You can enable a Resource Plan manually or automatically, using Scheduler Windows. The maximum number of consumer groups in a plan can not exceed 28.

Plan DEFAULT_MAINTENANCE_PLAN

Description Default plan for maintenance windows that prioritizes SYS_GROUP operations, leaving 5% for automated maintenance operations and 20% for other tasks.

☐ Activate this plan

☐ Automatic Plan Switching Enabled

Resource Allocations

Group/Subplan	Shares	Percentage	Utilization Limit %
ORA$AUTOTASK	5	5	90
SYS_GROUP	75	75	
OTHER_GROUPS	20	20	

Total Shares: 100

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Default Plan

Resource Plans > Edit Resource Plan: DEFAULT_MAINTENANCE_PLAN

Logged in as DBA1

Edit Resource Plan: DEFAULT_MAINTENANCE_PLAN

Actions Create Like Go | Execute On Multiple Databases | Show SQL | Revert | Apply

General | Parallelism | Runaway Query | Idle Time

A Resource Plan contains directives that specify how resources are allocated to Consumer Groups. For each Consumer Group, a directive specifies the amount of CPU resources are allocated. It also specifies limits,such as the maximum degree of parallelism, execution time, and amount of I/O, that each session in the Consumer Group can consume. You can enable a Resource Plan manually or automatically, using Scheduler Windows. The maximum number of consumer groups in a plan can not exceed 28.

Plan DEFAULT_MAINTENANCE_PLAN

Description Default plan for maintenance windows that prioritizes SYS_GROUP operations, leaving 5% for automated maintenance operat

☐ Activate this plan

☐ Automatic Plan Switching Enabled

Resource Allocations

Add/Remove

Group/Subplan	Shares	Percentage	Utilization Limit %
ORA$AUTOTASK	5	5	90
SYS_GROUP	75	75	
OTHER_GROUPS	20	20	

Total Shares: 100

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Creating a Simple Resource Plan

Create consumer groups and allocate resources to them by executing a single procedure call:

```
BEGIN
DBMS_RESOURCE_MANAGER.CREATE_SIMPLE_PLAN(SIMPLE_PLAN =>
    'SIMPLE_RESPLAN1',
CONSUMER_GROUP1 => 'CONSGROUP1', GROUP1_PERCENT => 80,
CONSUMER_GROUP2 => 'CONSGROUP2', GROUP2_PERCENT => 20);
END;
```

Consumer Group	Level 1	Level 2	Level 3
SYSGROUP	100%		
CONSGROUP1		80%	
CONSGROUP2		20%	
OTHER_GROUPS			100%

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Creating a Complex Resource Plan

1. Create a pending area.
2. Create, modify, or delete consumer groups.
3. Map sessions to consumer groups.
4. Create the resource plan.
5. Create resource plan directives.
6. Validate the pending area.
7. Submit the pending area.

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Specifying Resource Plan Directives

General | **Parallelism** | Runaway Query | Idle Time

Specify a limit on the degree of parallelism for any operation issued by this consumer group, a limit on the total number of parallel servers that this consumer group, and the maximum time a parallel statement can be queued.

Group	Bypass Queue	Max Degree of Parallelism	Parallel Server Limit	Parallel Statement Queue Timeout
ORA$AUTOTASK	☐			
SYS_GROUP	☐			
OTHER_GROUPS	☐			

General | Parallelism | **Runaway Query** | Idle Time

Specify the time duration or the resource limits under which a session can execute in a consumer group. If any of the limits are exceeded, the session can be switched to another consumer group, the session's SQL operation can be canceled, or the session can be killed.

Group	Elapsed Time Limit (Sec)	CPU Time Limit (Sec)	I/O Limit (MB)	Logical I/O Limit	I/O Request Limit (Requests)	Action
ORA$AUTOTASK						
SYS_GROUP						
OTHER_GROUPS						

General | Parallelism | Runaway Query | **Idle Time**

Specify the maximum time a session in the consumer group can be idle.

Group	Max Idle Time (sec)	Max Idle Time if Blocking Another Session (sec)
ORA$AUTOTASK		
SYS_GROUP		
OTHER_GROUPS		

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Resource Allocation Methods for Resource Plans

Parameter	Possible Values
`MGMT_MTH`: Allocating CPU usage	`EMPHASIS, RATIO`
`PARALLEL_DEGREE_LIMIT_MTH`: Limiting degree of parallelism of any operation	`PARALLEL_DEGREE_LIMIT_ABSOLUTE`
`ACTIVE_SESS_POOL_MTH`: Limiting number of active sessions, queuing inactive ones	`ACTIVE_SESS_POOL_ABSOLUTE`
`QUEUING_MTH`: Controlling queues, how inactive sessions enter active session pool	`FIFO_TIMEOUT`

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Comparison of EMPHASIS and RATIO

EMPHASIS	RATIO
The value specifies the maximum percentage of CPU resources a consumer group can use.	The value specifies a number that indicates the ratio of CPU resources to be allocated to the consumer group.
You can allocate resources for up to eight different levels.	You can specify values for only one level.
The sum of percentages at any given level must be less than or equal to 100.	You must use integer values, but there is no limit on the sum of values.
Default value is NULL.	Default value is NULL.

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Active Session Pool Mechanism

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Specifying Thresholds

Specifying execution time limit:

- Proactive estimation of the execution time for an operation (via cost-based optimizer statistics), default: `UNLIMITED`
- Specifying maximum estimated execution time at the resource consumer group level
- Huge jobs will not be allowed to start if the estimate is longer than `MAX_EST_EXEC_TIME:(ORA-07455)`

Specifying other thresholds:

- Limiting session I/O with `SWITCH_IO_MEGABYTES` (in MB)
- Limiting session I/O requests with `SWITCH_IO_REQS`

Returning to original consumer group with `SWITCH_FOR_CALL` (Default: `FALSE`, consumer group is not restored)

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Setting Idle Timeouts

```
DBMS_RESOURCE_MANAGER.UPDATE_PLAN_DIRECTIVE
 (PLAN => 'DAY_PLAN',
  GROUP_OR_SUBPLAN => 'APPUSER',
  COMMENT => 'Limit Idle Time Example',
  NEW_MAX_IDLE_TIME => 600,
  NEW_MAX_IDLE_BLOCKER_TIME => 300);
```


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Limiting CPU Utilization at the Database Level

- Database consolidation requirements:
  - Applications isolated from each other
  - Consistent performance
- CPU directives can be used to:
  - Specify a minimum CPU allocation for each application
  - Designate how unused allocations should be redistributed
  - Specify the `MAX_UTILIZATION_LIMIT` attribute to impose an absolute upper limit on CPU utilization (which overrides any redistribution of CPU within a plan)
  - Good candidate: Auto-maintenance tasks

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Limiting CPU Utilization at the Database Level

Specify minimum and maximum CPU utilization limits.

DB Consolidation Plan #1

	CPU Allocation	Maximum Utilization Limit
App 1	50%	60%
App 2	20%	30%
App 3	20%	30%
App 4	10%	20%

Specify maximum CPU utilization limits only.

DB Consolidation Plan #2

	CPU Allocation	Maximum Utilization Limit
App 1	null	50%
App 2	null	20%
App 3	null	20%
App 4	null	10%

```
EXEC DBMS_RESOURCE_MANAGER.CREATE_PLAN_DIRECTIVE( -
     plan                    => 'db_consolidation_plan',
     group_or_subplan        => 'App_1',
     mgmt_p1                 => 50,
     max_utilization_limit => 60);
```


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Limiting CPU Utilization at the Server Level: Instance Caging

- Managing CPU allocations on a multi-CPU server with multiple database instances
- Enabling instance caging:
  - Enable any CPU resource plan.

```
ALTER SYSTEM SET resource_manager_plan = 'default_plan';
```

  - Specify the maximum number of CPUs that the instance can use at any time.

```
ALTER SYSTEM SET cpu_count=4;
```

- Two approaches:
  - Over-provisioning: The sum of the CPU limit for each instance exceeds the actual number of CPUs.
  - Partitioning: The sum of the CPU limit for each instance equals the actual number of CPUs.

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Instance Caging: Examples

Over-provisioning approach:

One database instance can still impact the others.

With all four instances active, one instance can get 8 / (8 + 8 + 8 + 8) = 25% of CPU.

Partitioning approach:

One database instance cannot impact the others.

Each instance has a dedicated number of CPUs.

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Monitoring Instance Caging

View value of the CPU_COUNT parameter:

```
SELECT value FROM v$parameter WHERE name = 'cpu_count'
   AND (isdefault = 'FALSE' OR ismodified != 'FALSE');
```

Determine the Resource Manager status:

```
SELECT name FROM v$rsrc_plan
WHERE is_top_plan = 'TRUE' AND cpu_managed = 'ON';
```

Manage throttling:

```
SELECT begin_time, consumer_group_name,
   cpu_consumed_time, cpu_wait_time
FROM v$rsrcmgrmetric_history
ORDER BY begin_time;
```

```
SELECT name, consumed_cpu_time, cpu_wait_time
FROM v$rsrc_consumer_group;
```


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Runaway Queries and Resource Manager

- Parameters used to trigger consumer group switching:
  - SWITCH_IO_LOGICAL
  - SWITCH_ELAPSED_TIME
- Meta consumer group called LOG_ONLY
- Columns in V$SQL_MONITOR:
  - RM_LAST_ACTION
  - RM_LAST_ACTION_REASON
  - RM_LAST_ACTION_TIME
  - RM_CONSUMER_GROUP
- V$RSRCMGRMETRIC and V$RSRCMGRMETRIC_HISTORY always populated

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Resource Consumer Group Mapping

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Activating a Resource Plan

```
SQL> show parameter resource_manager_plan

NAME                      TYPE        VALUE
------------------------- ----------- -------------
resource_manager_plan     string      DEFAULT_PLAN
```


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Database Resource Manager Information

View Name	Information
DBA_RSRC_PLANS	Plans and status
DBA_RSRC_PLAN_DIRECTIVES	Plan directives
DBA_RSRC_CONSUMER_GROUPS	Consumer groups
DBA_RSRC_CONSUMER_GROUP_PRIVS	Users/roles
DBA_RSRC_GROUP_MAPPINGS	Consumer group mapping
DBA_RSRC_MAPPING_PRIORITY	Mapping priority
DBA_USERS	Column INITIAL_RSRC_CONSUMER_GROUP
DBA_RSRC_MANAGER_SYSTEM_PRIVS	Users/roles

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Viewing Resource Manager Statistics

Logged in As SYS

Resource Manager Statistics

Page Refreshed **Nov 27, 2012 3:31:54 PM UTC** Refresh View Data Manually

Active Resource Plan	INTERNAL_PLAN	
Total CPUs per Server	2	
Number CPUs Used per Instance	2	(Instance Caging Disabled)

TIP Use Instance Caging to limit the number of CPUs used by each database instance. Instance Caging is enabled by activating any resource plan with resource allocation values and setting the cpu_count parameter.

Consumer Group Statistics

Resource Allocation

Consumer Group	Current CPU Utilization (%)	Max Utilization Limit (%)
OTHER_GROUPS	0	0

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Monitoring the Resource Manager

- `V$SESSION`: Contains the `RESOURCE_CONSUMER_GROUP` column that shows the current group for a session
- `V$RSRC_PLAN`: A view that shows the active resource plan
- `V$RSRC_CONSUMER_GROUP`: A view that contains statistics for all active groups

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Quiz

Select the statements that are true about the Resource Manager and its functionality.

a. You can set threshold values only for execution time, not for session I/O.

b. You can limit CPU utilization at the database level to isolate applications for each other.

c. On a multi-CPU server with multiples database instances, you can limit each server's CPU utilization by enabling instance caging.

d. When the `SWITCH_TIME`, `SWITCH_IO_MEGABYTES`, or `SWITCH_IO_REQS` parameters cause a switch in consumer groups, you can never return to the original consumer groups.

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Summary

In this lesson, you should have learned how to do the following:

- Configure the Database Resource Manager
- Access and create resource plans
- Create consumer groups
- Specify directives for allocating resources to consumer groups
- Map consumer groups to plans
- Activate a resource plan
- Monitor the Resource Manager

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Practice: Overview

This practice covers the following topics:

- Creating a resource consumer group
- Specifying CPU resource allocation directives for consumer groups
- Associating users with a resource consumer group
- Activating a resource plan
- Testing in SQL*Plus
- Deactivating a resource plan

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Using Oracle Scheduler to Automate Tasks

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Objectives

After completing this lesson, you should be able to:

- Simplify management tasks by using Oracle Scheduler
- Create a job, program, and schedule
- Monitor job execution
- Use a time-based or event-based schedule for executing Oracle Scheduler jobs
- Describe the use of windows, window groups, job classes, and consumer groups
- Use email notification
- Use job chains to perform a series of related tasks
- Describe Scheduler jobs on remote systems
- Use advanced Scheduler features to prioritize jobs

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Simplifying Management Tasks

- Performing a series of month-end tasks on the last day of each month
- Running a dequeue procedure as soon as a message is enqueued
- Replicating table data via materialized view refreshes
- Running a daily job to back up database
- Computing table and index statistics twice a day
- Starting the batch load as soon as the file arrives on the file system
- Generating an hourly report on invalid server access attempts
- Rebuilding an index when finished rebuilding the current index

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Understanding a Simple Job

```
BEGIN
sys.dbms_scheduler.create_job(
job_name => '"HR"."CREATE_LOG_TABLE_JOB"',
job_type => 'PLSQL_BLOCK', job_action => 'begin
   execute immediate (''create table session_history(
   snap_time TIMESTAMP WITH LOCAL TIME ZONE,
   num_sessions NUMBER)'');  end;',
start_date => systimestamp at time zone
    'America/New_York',
job_class => 'DEFAULT_JOB_CLASS',
comments => 'Create the SESSION_HISTORY table',
auto_drop => FALSE, enabled => TRUE);
END;
```


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Oracle Scheduler Core Components

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Using Oracle Scheduler

To simplify management tasks with the Scheduler:

1. Create a program (enabled or disabled)—optional
   - To reuse this action within multiple jobs
   - To change the schedule for a job without having to re-create the PL/SQL block
2. Create and use a schedule.
3. Create and submit a job.

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Quiz

Select the statements that are true about the Scheduler.

a. Creating a program is a mandatory part of using the Scheduler.

b. When the job action is in a program (rather than directly in the job), you can change the job schedule without having to re-create the PL/SQL block.

c. Creating a job is an optional part of using the Scheduler.

d. Each job must have a schedule. It can be a predefined one or defined as part of the job creation.

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Persistent Lightweight Jobs

Persistent lightweight jobs:

- Reduce the overhead and time required to start a job
- Have a small footprint on disk for the job metadata and for storing runtime data
- Are created from a job template (in the command line)

```
BEGIN
DBMS_SCHEDULER.CREATE_JOB (
   job_name            =>  'my_lightweight_job2',
   program_name        =>  'MY_PROG',
   schedule_name       =>  'MY_SCHED',
   job_style           =>  'LIGHTWEIGHT');
END;
/
```

Choosing the right job:

- Use regular jobs for maximum flexibility.
- Use persistent lightweight jobs when you need to create a large number of jobs in a very short time.

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Using a Time-Based or Event-Based Schedule

Schedule

Time
- Calendaring expression
- Date-time expression

Event

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Creating a Time-Based Job

Example: Create a job that calls a backup script every night at 11:00, starting tonight.

```
BEGIN
 DBMS_SCHEDULER.CREATE_JOB(
  job_name=>'HR.DO_BACKUP',
  job_type => 'EXECUTABLE',
  job_action =>
'/home/usr/dba/rman/nightly_incr.sh',
  start_date=> SYSDATE,
  repeat_interval=>'FREQ=DAILY;BYHOUR=23',
                 /* next night at 11:00 PM */
  comments => 'Nightly incremental backups');
END;
/
```

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Creating an Event-Based Schedule

To create an event-based job, you must set:

- A queue specification (where your application enqueues messages to start a job)
- An event condition (same syntax as an Oracle Streams AQ rule condition) that if TRUE starts the job

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Creating Event-Based Schedules by Using Enterprise Manager Cloud Control

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Creating an Event-Based Job

Example: Create a job that runs if a batch load data file arrives on the file system before 9:00 AM.

```
BEGIN
 DBMS_SCHEDULER.CREATE_JOB(
  job_name=>'ADMIN.PERFORM_DATA_LOAD',
  job_type => 'EXECUTABLE',
  job_action => '/loaddir/start_my_load.sh',
  start_date => SYSTIMESTAMP,
  event_condition => 'tab.user_data.object_owner =
  ''HR'' and tab.user_data.object_name = ''DATA.TXT''
  and tab.user_data.event_type = ''FILE_ARRIVAL''
  and tab.user_data.event_timestamp < 9 ',
  queue_spec => 'HR.LOAD_JOB_EVENT_Q');
END;
```


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Event-Based Scheduling

Event types:

- User-generated or application-generated events
- Scheduler-generated events

Events raised by Scheduler jobs:

- JOB_STARTED
- JOB_SUCCEEDED
- JOB_FAILED
- JOB_BROKEN
- JOB_COMPLETED
- JOB_STOPPED
- JOB_SCH_LIM_REACHED
- JOB_DISABLED
- JOB_CHAIN_STALLED
- JOB_ALL_EVENTS
- JOB_RUN_COMPLETED
- JOB_OVER_MAX_DUR

Example of raising an event:

```
DBMS_SCHEDULER.SET_ATTRIBUTE('hr.do_backup',
 'raise_events', DBMS_SCHEDULER.JOB_FAILED);
```


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Creating Complex Schedules

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Quiz

Select the statements that are true about persistent lightweight jobs:

a. Persistent lightweight jobs have a small footprint on disk for the job metadata and also for storing runtime data.
b. Use persistent lightweight jobs for maximum flexibility.
c. Persistent lightweight jobs are created from a job template.
d. Persistent lightweight jobs can be created in Enterprise Manager and via command line.

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Using Email Notification

- Email notifications for change of job state
- Triggered by job state events
- Multiple notifications, multiple recipients
- `*_SCHEDULER_NOTIFICATIONS` views

Using Scheduler Email Notification:

1. Specify the address of the SMTP server you will use to send email messages:

```
DBMS_SCHEDULER.SET_SCHEDULER_ATTRIBUTE
('email_server','host[:port]');
```

2. Optionally, set a default sender email address:

```
DBMS_SCHEDULER.SET_SCHEDULER_ATTRIBUTE
('email_sender','valid email address');
```

3. Add email notifications for a specified job. *(continued)*

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Adding and Removing Email Notifications

```
DBMS_SCHEDULER.ADD_JOB_EMAIL_NOTIFICATION (
  job_name        IN VARCHAR2,
  recipients      IN VARCHAR2,
  sender          IN VARCHAR2 DEFAULT NULL,
  subject         IN VARCHAR2
    DEFAULT dbms_scheduler.default_notification_subject,
  body            IN VARCHAR2
    DEFAULT dbms_scheduler.default_notification_body,
  events          IN VARCHAR2
    DEFAULT 'JOB_FAILED,JOB_BROKEN,JOB_SCH_LIM_REACHED,
             JOB_CHAIN_STALLED,JOB_OVER_MAX_DUR',
  filter_condition     IN VARCHAR2 DEFAULT NULL);
```

Comma-separated list of email addresses

Mandatory comma-separated list

```
DBMS_SCHEDULER.REMOVE_JOB_EMAIL_NOTIFICATION (
  job_name             IN VARCHAR2,
  recipients           IN VARCHAR2 DEFAULT NULL,
  events               IN VARCHAR2 DEFAULT NULL);
```


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Creating Job Chains

1. Create a chain object.
2. Define chain steps.
3. Define chain rules.
4. Starting the chain:
   - Enable the chain.
   - Create a job that points to the chain.

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Example of a Chain

Dependency scheduling

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Using Advanced Scheduler Features

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Job Classes

- Assign the same set of attribute values to member jobs
- Are created by the `CREATE_JOB_CLASS` procedure
- Specify jobs in a job class (with the `SET_ATTRIBUTE` procedure)
- Belong to the `SYS` schema
- Set resource allocation for member jobs
- Set the service attribute to a desired database service name
- Group jobs for prioritization

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Windows

Scheduler windows:

- Can start jobs or change resource allocation among jobs for various time periods
- One active at a time
- Created with the `CREATE_WINDOW` procedure

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Prioritizing Jobs Within a Window

Prioritizing jobs:

- At the class level (via resource plans)
- At the job level (with the job priority attribute)
- Not guaranteed for jobs in different job classes

Job	Priority
Job1	1
Job2	2
Job3	3
Job4	5
Job5	2

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Creating a Job Array

1. Declare variables of types `sys.job` and `sys.job_array`:

```
DECLARE
 newjob sys.job;
 newjobarr sys.job_array;
```

2. Initialize the job array:

```
BEGIN
  newjobarr := SYS.JOB_ARRAY();
```

3. Size the job array to hold the number of jobs needed:

```
  newjobarr.EXTEND(100);
```

(… continued)

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Creating a Job Array

4. Place jobs in the job array:

```
FOR i IN 1..100 LOOP
   newjob := SYS.JOB(job_name => 'LWTJK'||to_char(i),
                     job_style => 'LIGHTWEIGHT',
                     job_template => 'MY_PROG',
                     enabled => TRUE );
   newjobarr(i) := newjob;
 END LOOP;
```

5. Submit the job array as one transaction:

```
 DBMS_SCHEDULER.CREATE_JOBS(newjobarr,
                            'TRANSACTIONAL');
```


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Quiz

Select the statements that are true about the advanced Scheduler features and functionality:

a. Lightweight jobs can be created with a job array.

b. Prioritizing jobs at the class level (via resource plans) and at the job level (with the job priority attribute) are mutually exclusive.

c. Scheduler windows work with job classes to control resource allocation.

d. Job chains are used to implement “dependency scheduling.”

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Creating a File Watcher and an Event-Based Job

Perform the following tasks:

1. Create a Scheduler credential object and grant EXECUTE.
2. Create a file watcher and grant EXECUTE.
3. Create a Scheduler program object with a metadata argument that references the event message.
4. Create an event-based job that references the file watcher. (Optionally, enable the job to run for each instance of the file arrival event.)
5. Enable the file watcher, the program, and the job.

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Enabling File Arrival Events from Remote Systems

Perform the following tasks to enable the raising of file arrival events at remote systems:

1. Set up the database to run remote external jobs.
2. Install, configure, register, and start the Scheduler agent on the first remote system.
3. Repeat step 2 for each additional remote system.

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Scheduling Remote Database Jobs

- Create a job that runs stored procedures and anonymous PL/SQL blocks on another database instance on the same host or a remote host.
- The target database can be any release of Oracle Database.
- `DBMS_SCHEDULER.CREATE_DATABASE_DESTINATION` and `DBMS_SCHEDULER.CREATE_CREDENTIAL` can be used for remote database jobs.
- Jobs with job types of `PLSQL_BLOCK` and `STORED_PROCEDURE` can be the subject of `SET_ATTRIBUTE` calls for the `DESTINATION` and `CREDENTIAL` attributes.

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Creating Remote Database Jobs

Perform the following tasks to create a remote job:

1. Set up the originating database for remote jobs.
2. Create the job by using `DBMS_SCHEDULER.CREATE_JOB`.
3. Create a credential by using `DBMS_SCHEDULER.CREATE_CREDENTIAL`.
4. Set the job `CREDENTIAL_NAME` attribute by using `DBMS_SCHEDULER.SET_ATTRIBUTE`.
5. Set the job `DESTINATION` attribute by using `DBMS_SCHEDULER.SET ATTRIBUTE`.
6. Enable the job by using `DBMS_SCHEDULER.ENABLE`.

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Scheduling Multiple Destination Jobs

- This enables you to specify several targets on which your jobs should execute.
- It provides the ability to monitor and control the jobs from the database on which they were created.
- While running, a multiple-destination job is viewed as a collection of jobs, which are near-identical copies of each other.
- All jobs will execute based on the time zone that is specified in the start date of the job or will use the time zone of the source database.

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Viewing Scheduler Meta Data

Scheduler management views, displaying:

- `*_SCHEDULER_JOBS`: All jobs, enabled and disabled
- `*_SCHEDULER_SCHEDULES`: All schedules
- `*_SCHEDULER_PROGRAMS`: All programs
- `*_SCHEDULER_RUNNING_JOBS`: Active job states
- `*_SCHEDULER_JOB_LOG`: All job state changes
- `*_SCHEDULER_JOB_RUN_DETAILS`: All completed job runs

```
SELECT job_name, status, error#, run_duration
FROM user_scheduler_job_run_details;

JOB_NAME            STATUS   ERROR#   RUN_DURATION
----------------    ------   ------   ------------
GATHER_STATS_JOB    SUCCESS       0   +000 00:08:20
PART_EXCHANGE_JOB   FAILURE    6576   +000 00:00:00
```


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Quiz

Select the statements that are true about the Oracle Scheduler.

a. Creating remote database jobs is a manual task requiring the use of OS-specific commands.

b. A Scheduler credential is an object with which to authenticate with the host operating system for file access.

c. You can specify several targets on which your jobs should execute and monitor them from the database on which they were created.

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Summary

In this lesson, you should have learned how to:

- Simplify management tasks by using the Scheduler
- Create a job, program, and schedule
- Monitor job execution
- Use a time-based or event-based schedule for executing Scheduler jobs
- Describe the use of windows, window groups, job classes, and consumer groups
- Use email notification
- Use job chains to perform a series of related tasks
- Describe Scheduler jobs on remote systems
- Use advanced Scheduler features to prioritize jobs

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Practice: Overview

This practice covers the following topics:

- Creating a job that runs a program outside the database
- Creating a program and a schedule
- Creating a job that uses a program and a schedule
- Creating a lightweight job
- Monitoring job runs

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Oracle Database Cloud Service: Overview

ORACLE

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Objectives

After completing this lesson, you should be able to:

- Describe the Oracle Database Cloud - Database as a Service architecture and features
- Describe the creation of a database deployment
- Use Database as a Service cloud tooling to manage patches
- Manage the compute node associated with a database deployment
- Manage network access to a database deployment

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Database as a Service Architecture

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Database as a Service: Features and Tooling

Simple Provisioning

Automated Patching

Automated Backups

Any Language

Advanced Security

Local and Remote Management

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Software Editions: Included Database Options and Management Packs

Edition	Included Options	Included Packs
Standard	None	None
Enterprise	None	None
Enterprise - High Performance	Advanced Analytics, Advanced Compression, Advanced Security, Database Vault, Label Security, Multitenant, OLAP, Partitioning, Real Application Testing, Spatial and Graph	Cloud Management for Oracle Database, Database Lifecycle Management, Data Masking and Subsetting, Diagnostics, Tuning
Enterprise - Extreme Performance	Active Data Guard, Advanced Analytics, Advanced Compression, Advanced Security, Database In-Memory, Database Vault, Label Security, Multitenant, OLAP, Partitioning, Real Application Clusters, Real Application Testing, Spatial and Graph	Cloud Management for Oracle Database, Database Lifecycle Management, Data Masking and Subsetting, Diagnostics, Tuning

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Accessing the Oracle Database Cloud Service Console

1. Display the Sign In to Oracle Cloud page by clicking the My Services URL link in your Welcome email or by following these instructions:
   a. Open your web browser and go to the Oracle Cloud website.
   b. Click Sign In.
   c. In the My Services box, select the data center where your services are located.
   d. Click Sign In to My Services.
2. On the Sign In to Oracle Cloud page, enter your username, password, and the name of your identity domain. Then, click Sign In.
3. On the My Services Dashboard, click the navigation menu in the top corner and then click Oracle Database Cloud Service.
4. If a Welcome page is displayed, view the list of database deployments by clicking Services next to “Database Cloud Service.”

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Automated Database Provisioning

Automated provisioning based on input to the Create Oracle Database Cloud Service Instance wizard.

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Accessing Tools from the Service Console

Expand the action menu on the Database Cloud Service console to access tools:

Web application to monitor the Oracle database

Enterprise Manager Database Control 11*g*

Enterprise Manager Database Express 12*c*

Manage network security access rules

Application development using a web browser.

Add SSH public keys for the opc and `oracle` users

Delete the database deployment

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Managing the Compute Node Associated With a Database Deployment

Manage the compute node from the Oracle Database Cloud Service console:

Action	Result of the Action
Start	Oracle Compute Cloud Service instance is allocated, resources are attached, and it is started.
Stop	Oracle Compute Cloud Service instance is stopped. Only actions after stop are start and delete.
Restart	Oracle Compute Cloud Service instance is stopped and immediately started again.

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Managing Network Access to Database as a Service

- By default, network access to the compute nodes associated is provided by Secure Shell (SSH) connections on port 22.
- To access network protocols and services using a port other than port 22:
  - Use the Oracle Compute Cloud Service console or the Oracle Database Cloud Service console to enable access
  - Create an SSH tunnel to the port

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Enabling Access to a Compute Node Port

- Database as a Service relies on Oracle Compute Cloud Service to provide secure network access to database deployments.
- Oracle Compute Cloud Service security rules created, but not enabled:
  - ora_p2_dbconsole: For port 1158, used by Enterprise Manager 11*g* Database Control
  - ora_p2_dbexpress: For port 5500, used by Enterprise Manager Database Express 12*c*
  - ora_p2_dblistener: For port 1521, used by SQL*Net
  - ora_p2_http: For port 80, used for HTTP connections
  - ora_p2_httpssl: For port 443, used for HTTPS connections including Oracle REST Data Services, Oracle Application Express, and Oracle DBaaS Monitor
- Enable the security rules through the Database Cloud Service console

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Scaling a Database Deployment

Scale the compute shape or storage from the Action menu in the Oracle Database Cloud Service console:

Action	
Scale Up	Select a new compute shape. Add raw storage to the database deployment.
Scale Down	Select a new compute shape.

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Patching Database as a Service

- Patch management tasks:
  - Check prerequisites before applying a patch
  - Apply a patch
  - Roll back a patch or a failed patch
- Tools and utilities:
  - Oracle Database Cloud Service console for single-instance databases
  - `dbpatchm` subcommand of the `dbaascli` utility for single-instance databases
  - `raccli` utility for Oracle RAC databases
  - `dbpatchmdg` utility for Oracle Data Guard configurations

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Using the Oracle Database Cloud Service Console to Manage Patches

Check patch prerequisities

Apply a patch

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Summary

In this lesson, you should have learned how to:

- Describe the Oracle Database Cloud - Database as a Service architecture and features
- Describe the creation of a database deployment
- Use Database as a Service cloud tooling to manage patches
- Manage the compute node associated with a database deployment
- Manage network access to a database deployment

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Working with Oracle Support

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Objectives

After completing this lesson, you should be able to:

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

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Working with Oracle Support

- Oracle Support Services (OSS) provides 24×7 solution support.
- Support is delivered in the following ways:
  - My Oracle Support website
  - 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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Using My Oracle Support

ORACLE MY ORACLE SUPPORT | PowerView is Off | Welcome, | (0) | Contact Us | Help | Sign Out

Dashboard | Knowledge | Service Requests | Patches & Updates | Community | Certifications | On Demand | More... | Search Knowledge Base | Advanced

Dashboard | Customize Page...

News

- New Patch Nomenclature for Oracle Database, Fusion Middleware, Enterprise Manager, Grid Control and Collaboration Suite Products
- My Oracle Support社区已推出中文社区 - Introducing New Chinese Category in My Oracle Support Community
- Sun Software and Middleware Defects Moving to Bug Database
- My Oracle Support - Release Notes and Known Issues
- Oracle Critical Patch Updates for October 2012
- Changes to Managing Severity 1 Service Requests

Getting Started

- User Resource Center
- Webcasts and Recordings
- Discover the Get Proactive Portfolio
- My Oracle Support Community
- Follow Us
- Follow Oracle

Quick Video Training

- My Oracle Support Overview (08:46)
- Searching and Browsing (04:35)
- Patching and Updates (05:56)
- My Oracle Support Community (05:38)

Knowledge Base

Search & Browse | Recently Viewed | Recent Searches | Favorite Articles

Select a product or product line — Browse

Select a task: Overview

Version: Not Applicable

Enter search terms

Clear | Search

Service Requests

Knowledge Articles

Alerts (100) | Recently Updated (100)

Today

- Nov 29, 2012 **E1: 75A: 2011/2012 Australia Year-End Processing [1315052.1]** [JD Edwards EnterpriseOne Australia/New Zealand Payroll]
- Nov 29, 2012 **E1: 07: Florida SUI Reporting 2012 - Educational Wages [1470813.1]** [JD Edwards EnterpriseOne US Payroll]
- Nov 29, 2012 **E1: 75A: Australia Medicare Levy Surcharge [1484477.1]** [JD Edwards EnterpriseOne Australia/New Zealand Payroll]
- Nov 29, 2012 **E1: 75Z – New Zealand Student Loan – New Tax Codes – Effective 1 April, 2012 [1450304.1]** [JD Edwards EnterpriseOne Australia/New Zealand Payroll]
- Nov 29, 2012 **E1: 07/77: Quantum for Payroll - Vertex Release 3.1.0 [1498255.1]** [JD Edwards EnterpriseOne US Payroll, JD Edwards EnterpriseOne Canadian Payroll]

Show all documents

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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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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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Accessing My Oracle Support Community

ORACLE MY ORACLE SUPPORT COMMUNITY

Welcome, User496924 - Oracle | My Profile | Sign out | Help

Main Home | Discussions | Documents | Private Messages (0) | Contacts | Tags | Profile | Subscriptions Off | Search... | This Community | Go

What do you want to do? | Create a Community Post | Upload/Write a Reference Document

My Communities

Find a Community

Quick find

- Oracle Weblogic Server
- Patch Reviews - Middleware
- SQL*Plus
- WebCenter Interaction
- **Oracle Commerce**
- ATG Oracle Live Help
- ATG Web Commerce
- Endeca
- Other ATG Applications
- **Oracle Database**
- DB Diagnostic Repository (ADR
- Database - RAC/Scalability
- Database Administration
- Database Backup and Recover
- Database DataWarehousing

Subscribe to this Community

Top Participants

Community active users within last 90 days: 286

Guru
3003 points / 7343 total
MarkDPowell

Guru
2679 points / 9341 total
BobB

Guru
1713 points / 5935 total
VenkatB

Guru
1565 points / 7426 total
BPeasland

Database Administration News & Announcements

PSU and CPU OCT 2012 is now ready for download. See Doc ID 1477727.1 - Patch Set Update and Critical Patch Update October 2012 Availability Document

Database Administration Webcasts

Upcoming Webcasts

- No live Webcasts currently scheduled for this community. Please check back later.
- Look here for the upcoming **Advisor Webcast Schedule** across all products.

Archived Webcasts:

- An Introduction to Concurrency Control
- Introduction to DMU (Database Migration Assistant for Unicode)
- Database Transaction Recovery
- Getting a Testcase for Support - The Way Without Pain
- Reorganizing data in tables and tablespaces - Why? When? How?
- Getting a Testcase for Support - The Way Without Pain
- Client side NLS: NLS_LANG and other client NLS parameters explained
- Oracle JVM 11g New Features
- What is an ORA-600/ORA-7445 Error and What Should I do About it?
- This one-hour session is recommended for technical users who want to have a introduction overview on what steps are needed to change the characterset of an Oracle RDBMS. Intended audience: Oracle DBA's.
- This one-hour session will present the features and functionality of Oracle Connection Manager.
- Look here for **Advisor Webcast Archive** across all products

Database Administration Featured Discussions

Database Administration All Community Discussions

Database Administration All Community Documents

Database Administration Tips and Tricks

Database Administration Best Practices

Database Administration Product Specific

Database Administration White Papers

Popular Discussions

- Welcome to YOUR Database A (1911 views)
- Tips to effectively use YOUR O (1128 views)
- Alter table add column taking a (803 views)
- Tracing ORA-07445 (696 views)
- CLONE PROCESS (668 views)
- I can't find my posting in the Da (640 views)
- how to make DB auto startup a (586 views)
- RDA.zip file issue, download fr (537 views)
- ORA-609 : opiodr aborting proc (509 views)
- Init Parameters and SPFILE (491 views)

Popular Documents

- Script to identify Long Running (7916 views)
- Tablespace space forecasting (4169 views)
- A Case Study on Oracle Statist (2690 views)
- A couple of scripts for finding a (834 views)
- UNDERSTANDING ORACLE LO (535 views)
- A CHECKLIST TO MOVE THE DA (487 views)

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Managing Patches

Kinds of patches

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

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Applying a Patch Release

- Patch releases are fully tested product fixes that:
  - 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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Enterprise Manager Cloud Control: My Oracle Support Integration

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

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Using the Patch Advisor

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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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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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Benefits of Online Patching

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

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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
Are installed and uninstalled via OPatch	Are 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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Online Patching Considerations

- Some extra memory is consumed.
  - Exact amount depends on the size of the patch and number of concurrently running Oracle processes
  - Minimum amount of memory: Approximately one OS page per running Oracle process
- 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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Quiz

Which of the following statements are true about online patches?

a. They can be installed by using OPatch.
b. They require down time to apply.
c. They persist across instance startup and shutdown.
d. They do not require down time to remove.

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Using the Support Workbench

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Accessing the Support Workbench

Database Instance: orcl > Support Workbench

Support Workbench

Page Refreshed **November 29, 2012 10:10:01 AM UTC** Refresh

Problems (2) | Checker Findings (0) | Packages (0)

New Problems in Last 24 Hours	0	All Active Problems	1	All Problems	2
New Incidents in Last 24 Hours	2	All Active Incidents	2	All Incidents	12

View Last 24 Hours Filter by problem key Go Advanced Search

View | Package

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

Select	Details	ID	Description	Number Of Incidents	Last Incident	Last Comment	Active	Packaged	SR#
☐	▽ Hide	2	ORA 4036	11	November 28, 2012 1:10:54 PM UTC		Yes	No	

Incidents (11)

19538	ORA-4036	November 28, 2012 1:10:54 PM UTC
19537	ORA-4036	November 28, 2012 1:10:48 PM UTC
19522	ORA-	November 26, 2012 10:12:40 AM UTC
19521	ORA-4036	November 26, 2012 10:12:40 AM UTC
16992	ORA-4036	November 21, 2012 12:52:35 PM UTC

There are more inci

Click to access the Problem Details page.

Performance and Critical Error

Related Links

Advisor Central | Alert Log Contents | Create User-Reported Problem

Incident Packaging Configuration

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Viewing Problem Details

Database Instance: orcl > Support Workbench > Problem Details: ORA 4036

Problem Details: ORA 4036

Page Refreshed **November 29, 2012 1:30:18 PM UTC** Refresh

Summary

SR#	--	Edit
Bug#	--	Edit
Problem Id	2	
Number of Incidents	11	
First Incident	November 8, 2012 10:11:54 AM UTC	
Active	No	
Packaged	No	

Last Dumped Incident

Timestamp	November 28, 2012 1:10:54 PM UTC
Incident Source	System Generated
User Impact	
Checkers Run	0
Checker Findings	0

Investigate and Resolve

Quick Package

Assess Damage
- Run Checkers
- Database Instance Health

Diagnose
- Alert Log
- Related Problems Across Topology
- Diagnostics for Last Dumped Incident
- Search Knowledge Base

Collect and Send Diagnostic Data
- Package the Problem

Track and Close
- Manage problem resolution

Incidents | Activity Log

Click to access the Incident Details page.

Data Dumped Yes Go

View

Show All Details | Hide All Details

Select	Details	ID	Description	Data Dumped	Active	Status	Timestamp
○	▷ Show	19538	ORA-4036	Yes	No	Ready	November 28, 2012 1:10:54 PM UTC

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Viewing Incident Details

Incident Details: 19538

Page Refreshed **November 29, 2012 1:41:06 PM UTC** Refresh

Summary

Problem Key	ORA 4036
Problem Id	2
Status	Ready
Active	No
Timestamp	November 28, 2012 1:10:54 PM UTC
User Impact	
Source	System Generated

Data Dumped	Yes
ECID	Unknown
Error	ORA 4036
Correlation Keys	SID = 282.255, ProcId = 41.32 ECID = 004nsqrDbD6DWbl_4tYBUi0002Ib000K8R.662, PQ = (0, 1354108248) Client ProcId = oracle@EDRSR11P1 (TNS V1-V3).17543_139781106417216
Purge Date	December 28, 2012 1:10:54 PM UTC (Purging Enabled) Disable Purging

Dump Files | Checker Findings | Additional Diagnostics

File Name	Size (MB)	Timestamp	Path	View Contents
orcl_ora_17543_i19538.trc	6.25	November 28, 2012 1:10:59 PM UTC	/u01/app/oracle/diag/rdbms/orcl/orcl/incident/incdir_19538	
orcl_ora_17543.trc	0.03	November 28, 2012 1:11:01 PM UTC	/u01/app/oracle/diag/rdbms/orcl/orcl/trace	

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Packaging and Uploading Diagnostic Data to Oracle Support

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Tracking the Service Request and Implementing Repairs

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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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