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

**Electronic Presentation**

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**ORACLE®**

**Authors**

Tom Best  
Maria Billings

**Technical Contributors  
and Reviewers**

Celia Antonio  
Larry Baumann  
Tammy Bednar  
Howard Bradley  
M.J. Bryksa  
Sandra Cheevers  
Steve Friedberg  
Joel Goodman  
John Hibbard  
Magnus Isaksson  
Sushma Jagannath  
Christine Jeal  
Steven Karam  
Donna Keesling  
Stella Kister  
Pierre Labrousse  
Stefan Lindblad  
Dee Matishak  
Paul Needham  
Raza Siddiqui  
James Spiller  
Janet Stern  
Barry Trute  
Jean-Francois Verrier  
Anthony Woodell

**Editor**

Joyce Raftery

**Graphic Designer**

Satish Bettegowda

**Publisher**

Jobi Varghese

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# 1 Introduction

# Course Objectives

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

- **Install, create, and administer Oracle Database 10g**
- **Configure the database for an application**
- **Employ basic monitoring procedures**
- **Implement a backup and recovery strategy**
- **Move data between databases and files**

# Suggested Schedule

**1**

- 1. Introduction
- 2. Installation
- 3. DB Creation
- 4. Instance

**2**

- 5. Storage
- 6. Users
- 7. Schema
- 8. Data & Concurrency

**3**

- 9. Undo
- 10. Security
- 11. Network
- 12. Proactive Maintenance

**4**

- 13. Performance
- 14. Backup & Recovery Concepts
- 15. Backup

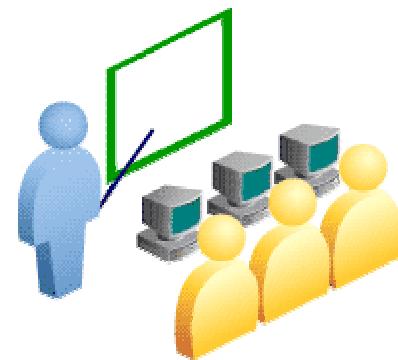
**5**

- 16. Recovery
- 17. Flashback
- 18. Moving Data

# Lesson Objectives

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

- **Describe the course objectives**
- **Explain the Oracle Database 10g architecture**



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# Oracle Products and Services

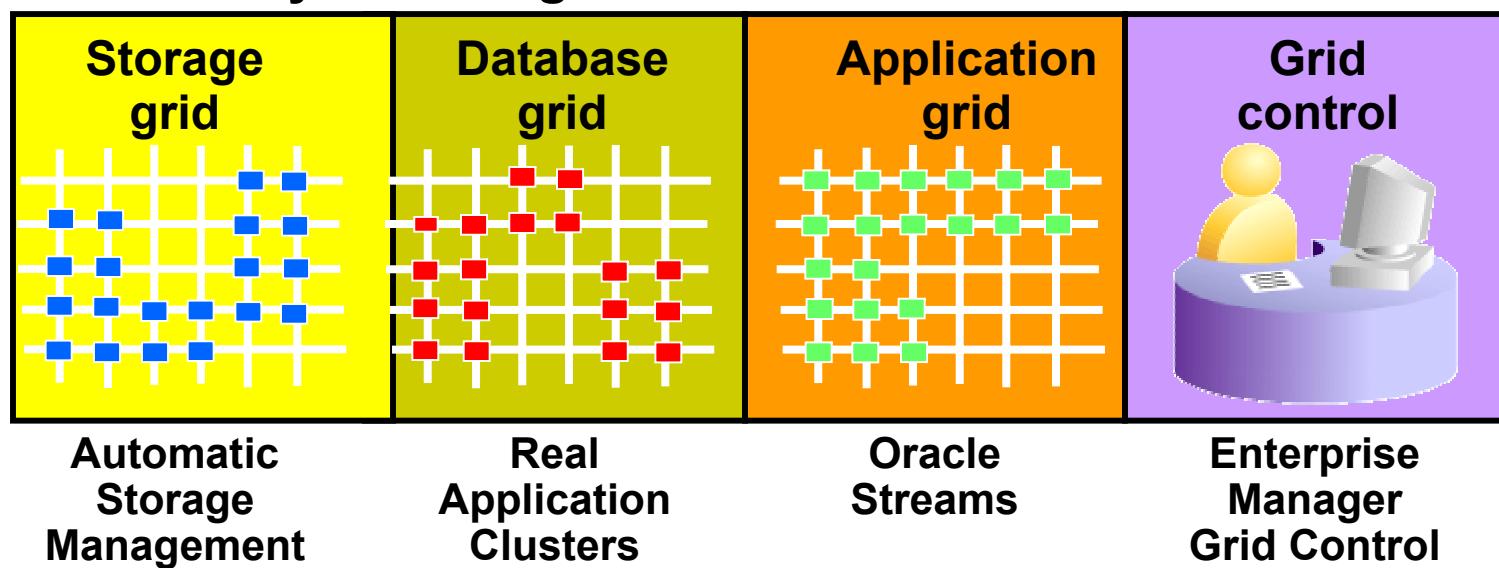
- Oracle databases
- Oracle Application Server
- Oracle applications
- Oracle Collaboration Suite
- Oracle Developer Suite
- Oracle services



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# Oracle Database 10g: “g” Stands for Grid

- **Global Grid Forum (GGF)**
- **Oracle’s grid infrastructure:**
  - Low cost
  - High quality of service
  - Easy to manage



# Oracle Database Architecture

## An Oracle server:

- Is a database management system that provides an open, comprehensive, integrated approach to information management
- Consists of an **Oracle instance** and an **Oracle database**



# Database Structures

## DB structures

- Memory
- Process
- Storage

Memory structures

Instance

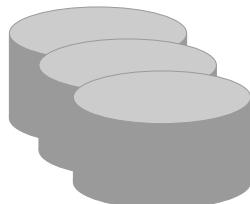
System Global Area (SGA)

Process structures



Background processes

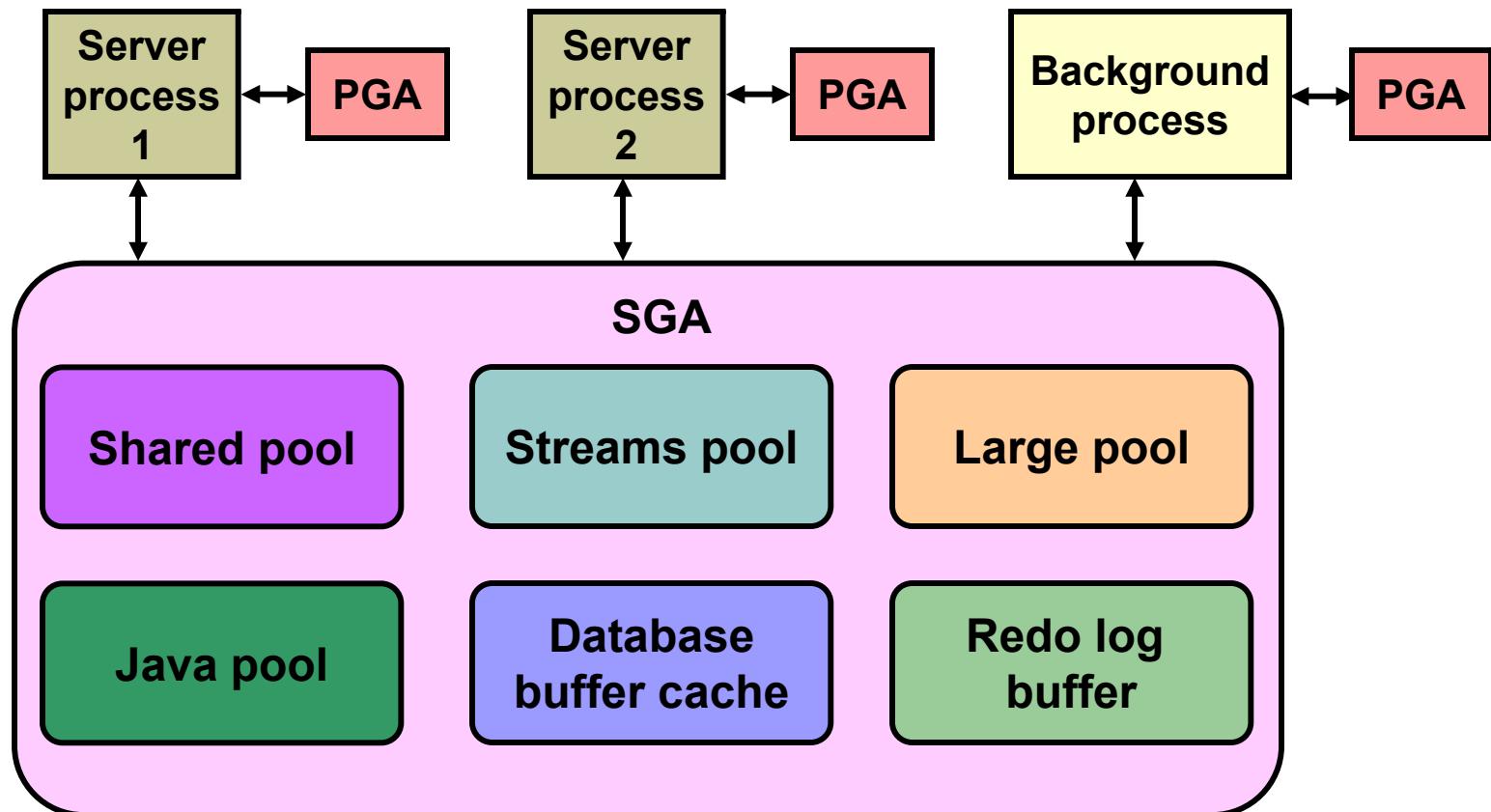
Storage structures



Database files

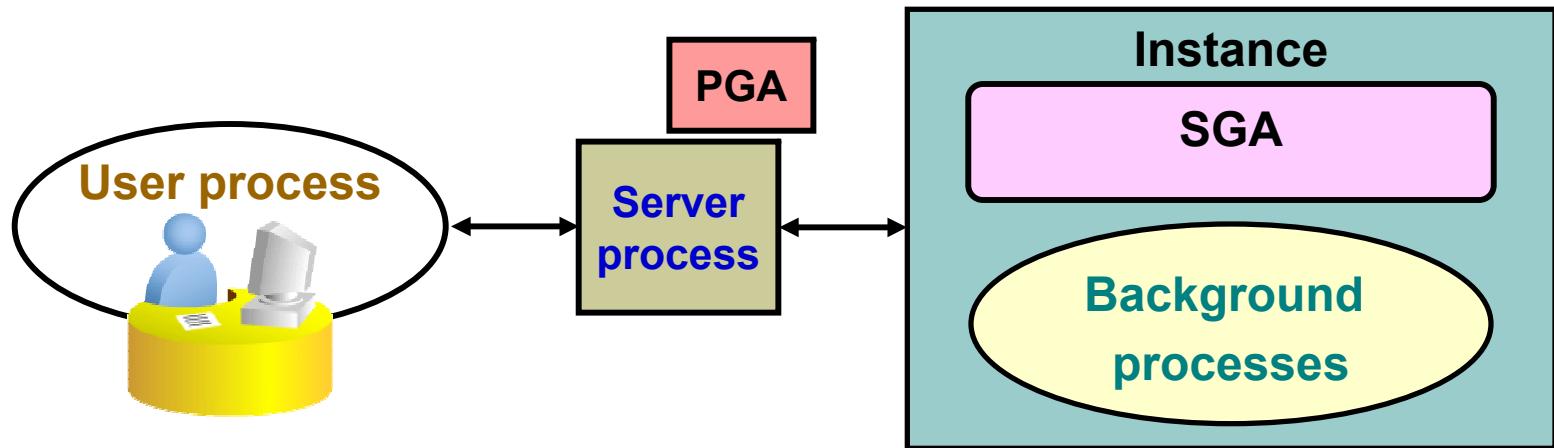
# Oracle Memory Structures

DB structures  
> **Memory**  
Process  
Storage



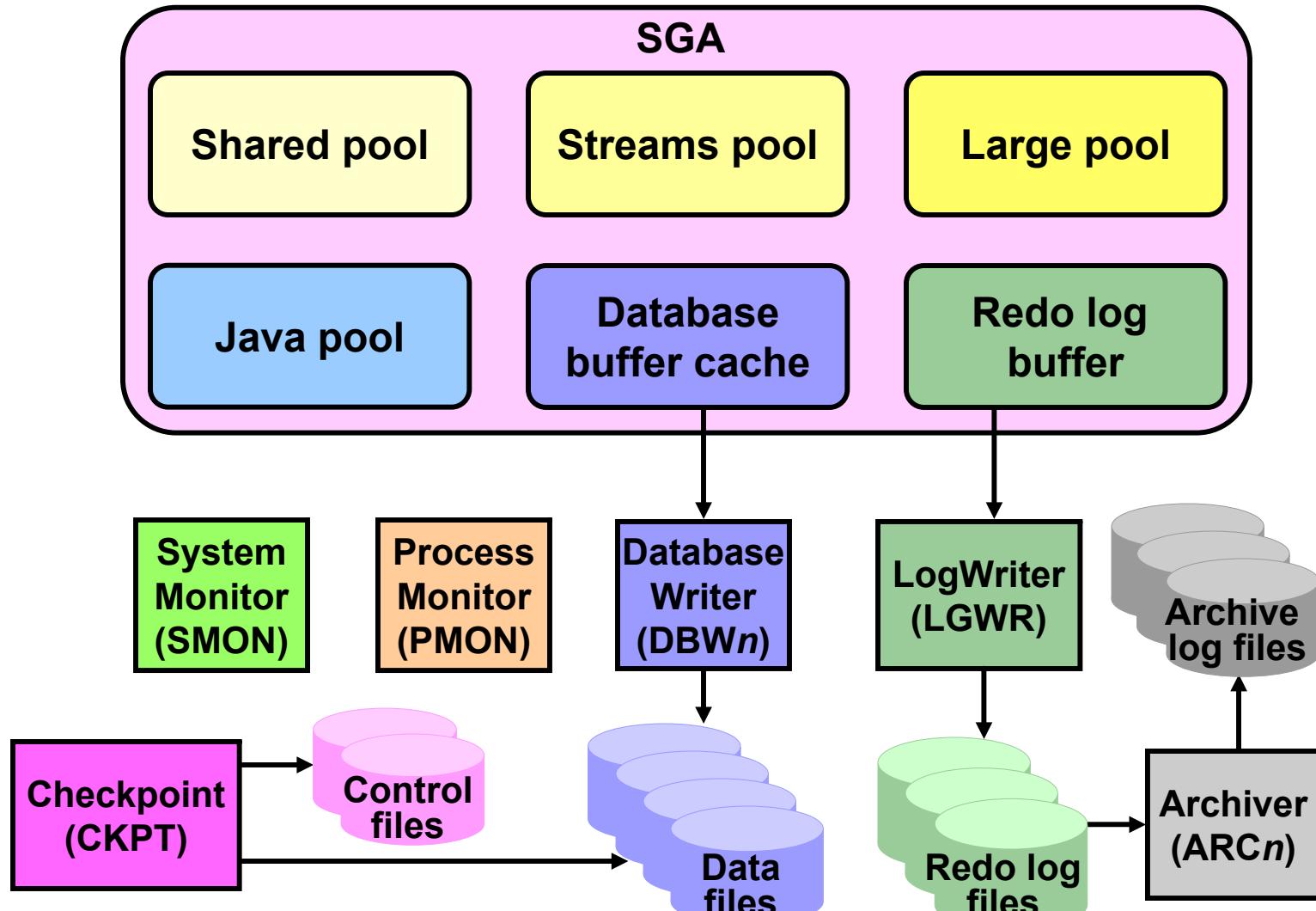
# Process Structures

DB structures  
Memory  
> **Process**  
Storage

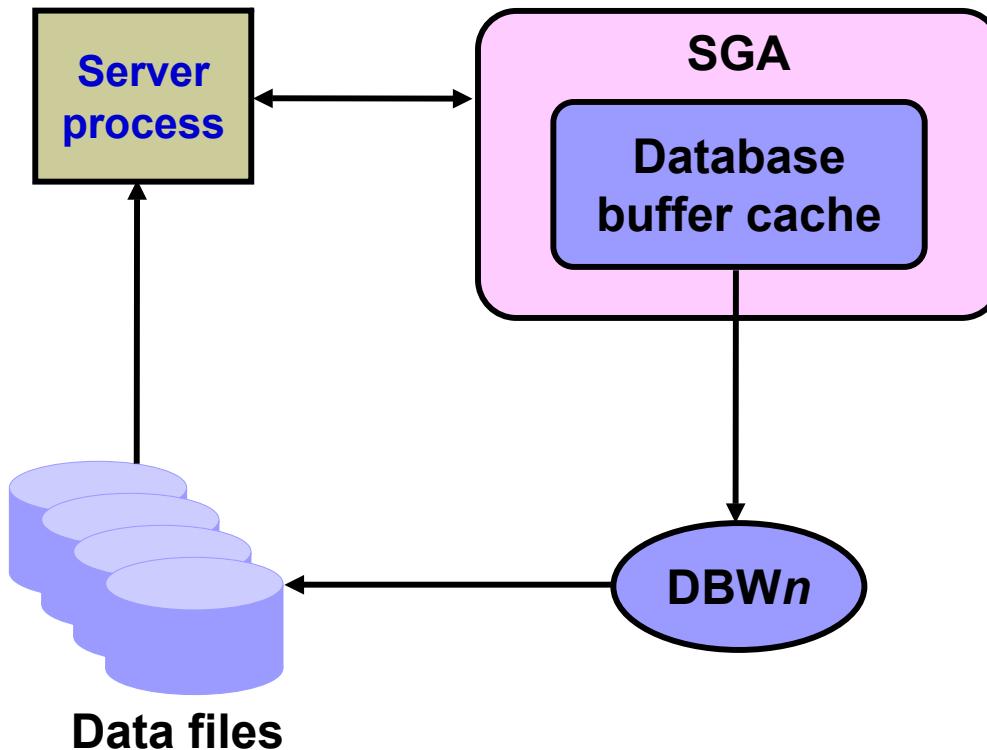


- **User process:** Is started at the time a database user requests a connection to the Oracle server
- **Server process:** Connects to the Oracle instance and is started when a user establishes a session
- **Background processes:** Are started when an Oracle instance is started

# Oracle Instance Management



# Server Process and Database Buffer Cache



## Buffers:

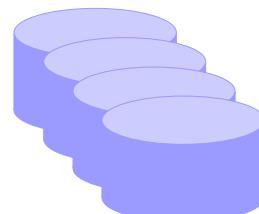
- Pinned
- Clean
- Free or unused
- Dirty

# Physical Database Structure

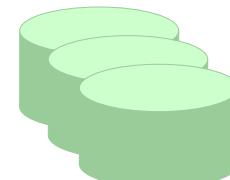
DB structures  
Memory  
Process  
> Storage



**Control files**



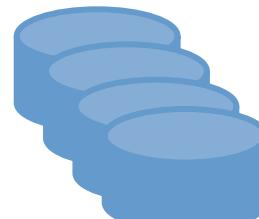
**Data files**



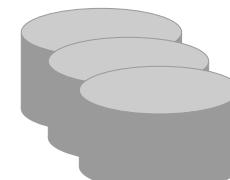
**Online redo log files**



**Parameter file**



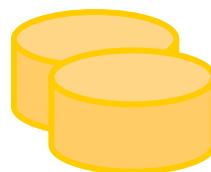
**Backup files**



**Archive log files**



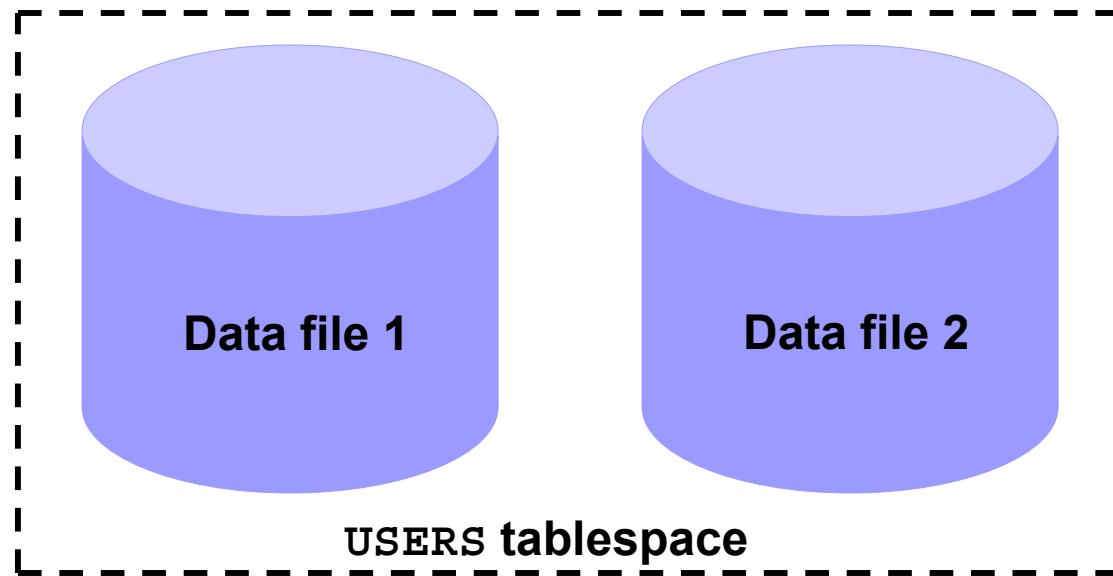
**Password file**



**Alert and trace log files**

# Tablespaces and Data Files

- **Tablespaces consist of one or more data files.**
- **Data files belong to only one tablespace.**

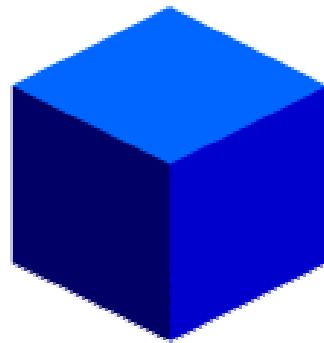


# **SYSTEM and SYSAUX Tablespaces**

- **The SYSTEM and SYSAUX tablespaces are mandatory tablespaces.**
- **They 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 (such as the Enterprise Manager Repository).**

# Segments, Extents, and Blocks

- Segments exist within a tablespace.
- Segments are made up of a collection of extents.
- Extents are a collection of data blocks.
- Data blocks are mapped to disk blocks.



Segment



Extents

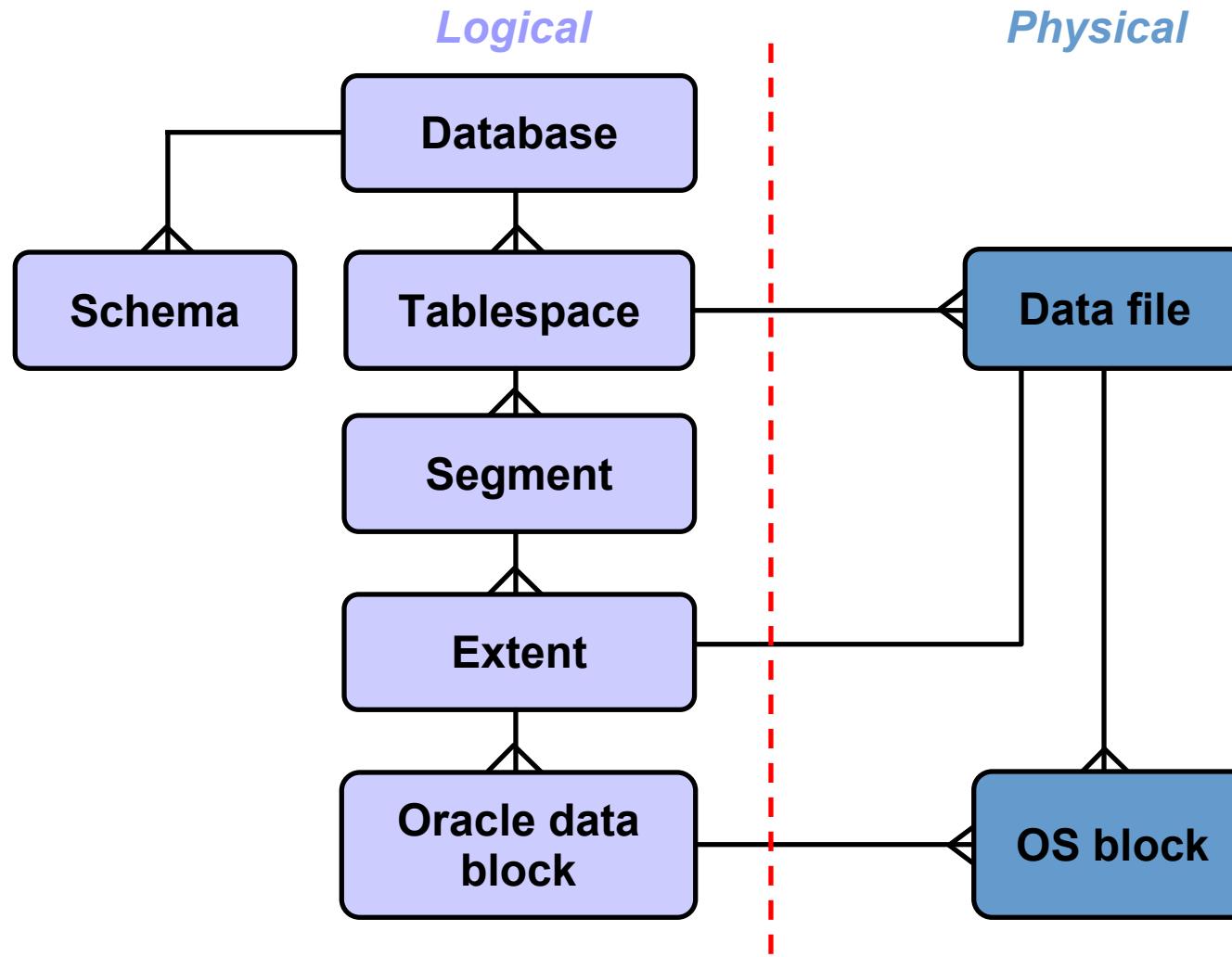


Data  
blocks

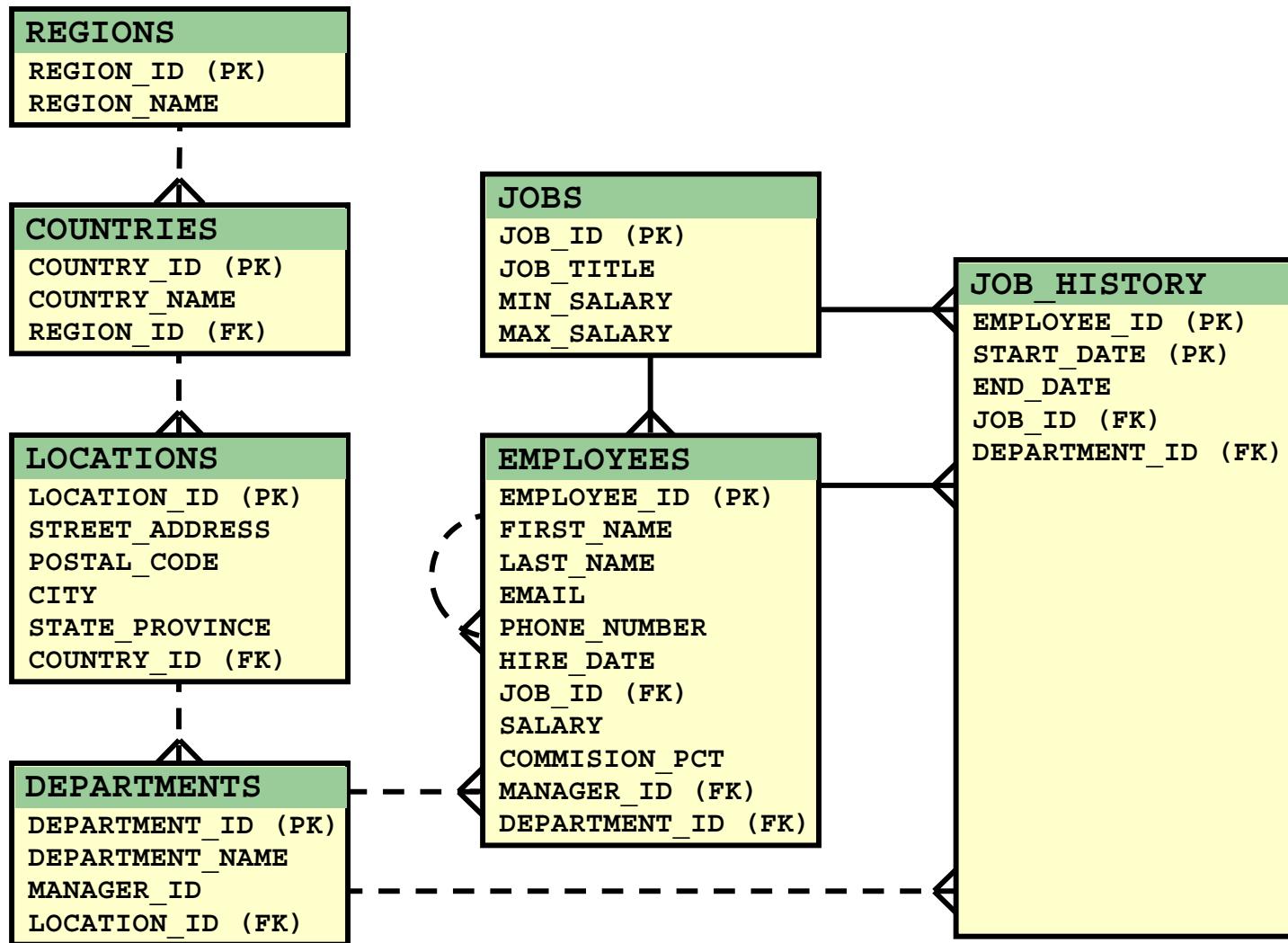


Disk  
blocks

# Logical and Physical Database Structures



# Course Examples: The HR Schema



# Database Architecture: Summary of Structural Components

- **Memory structures:**
  - **System Global Area (SGA): Database buffer cache, redo buffer, and various pools**
  - **Program Global Area (PGA)**
- **Process structures:**
  - **User process and Server process**
  - **Background processes: SMON, PMON, DBW $n$ , CKPT, LGWR, ARC $n$ , and so on**
- **Storage structures:**
  - **Logical: Database, schema, tablespace, segment, extent, and Oracle block**
  - **Physical: Files for data, parameters, redo, and OS block**



# **Summary**

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

- **Describe the course objectives**
- **Explain the Oracle Database 10g architecture**

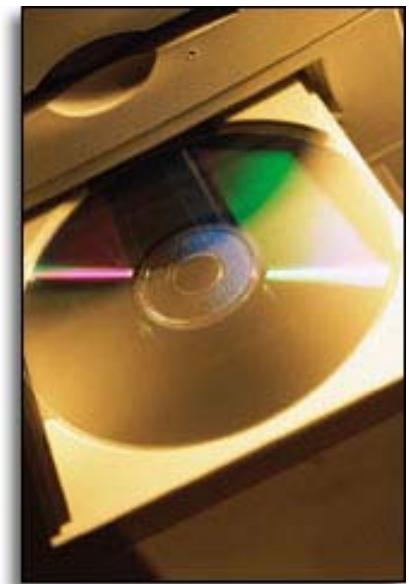
# Installing the Oracle Database Software



# Objectives

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

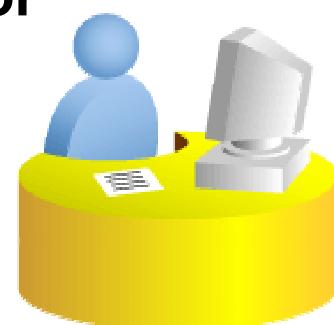
- **Describe your role as a database administrator (DBA), and explain typical tasks and tools**
- **Plan an Oracle database installation**
- **Use Optimal Flexible Architecture (OFA)**
- **Install the Oracle software by using Oracle Universal Installer (OUI)**



# Tasks of an Oracle Database Administrator

A prioritized approach for designing, implementing, and maintaining an Oracle database involves the following tasks:

1. Evaluating the database server hardware
2. Installing the Oracle software
3. Planning the database and security strategy
4. Creating, migrating, and opening the database
5. Backing up the database
6. Enrolling system users and planning for their Oracle Network access
7. Implementing the database design
8. Recovering from database failure
9. Monitoring database performance



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# Tools Used to Administer an Oracle Database

- **Oracle Universal Installer**
- **Database Configuration Assistant**
- **Database Upgrade Assistant**
- **Oracle Net Manager**
- **Oracle Enterprise Manager**
- **SQL\*Plus and iSQL\*Plus**
- **Recovery Manager**
- **Oracle Secure Backup**
- **Data Pump**
- **SQL\*Loader**
- **Command-line tools**



# Installation: System Requirements

- **Memory requirements:**
  - 1 GB for the instance with Database Control
- **Disk space requirements:**
  - 1.5 GB of swap space
  - 400 MB of disk space in the /tmp directory
  - Between 1.5 GB and 3.5 GB for the Oracle software
  - 1.2 GB for the preconfigured database (optional)
  - 2.4 GB for the flash recovery area (optional)
- **Operating system:** See documentation.



# Checking the System Requirements

- **Adequate temporary space**
- **64-bit versus 32-bit issues**
- **Checks for the correct operating system (OS)**
- **OS patch level**
- **System packages**
- **System and kernel parameters**
- **X Server permissions**
- **Sufficient swapping**
- **Nonempty ORACLE\_HOME**

```
[oracle@EDRSR4P1 solutions]$ cd /stage/Disk1
[oracle@EDRSR4P1 Disk1]$ ls
doc install response runInstaller stage welcome.html
[oracle@EDRSR4P1 Disk1]$ ./runInstaller
Starting Oracle Universal Installer...

Checking installer requirements...

Checking operating system version: must be redhat-3, SuSE-9, redhat-4, UnitedLinux-1.0, asianux-1 or asianux-2
                                                Passed

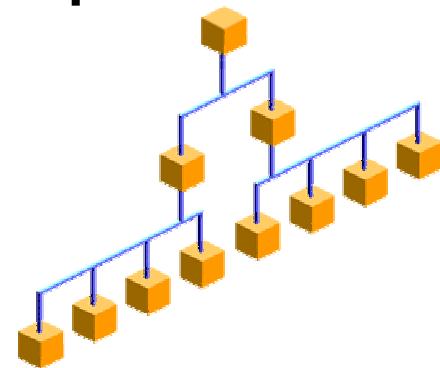
All installer requirements met.

Preparing to launch Oracle Universal Installer from /tmp/OraInstall2005-10-18_02-17-50PM. Please wait ...[oracle@EDRSR4P1 Disk1]$
```

# Optimal Flexible Architecture (OFA)

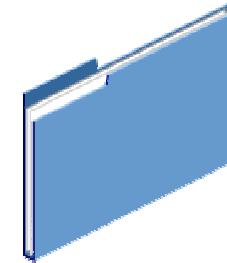
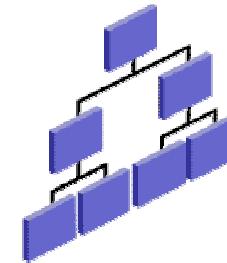
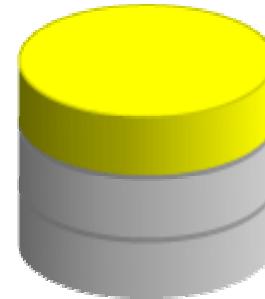
OFA is designed to:

- Organize large amounts of software
- Facilitate routine administrative tasks
- Facilitate switching between multiple Oracle databases
- Manage and administer database growth adequately
- Help eliminate fragmentation of free space



# Using Optimal Flexible Architecture

- **Naming mount points:**
  - /u01
  - /disk01
- **Naming directories:**
  - /u01/app/oracle
  - /u01/app/appmgm
- **Naming files:**
  - **Control files:** controln.ctl
  - **Redo log files:** redon.log
  - **Data files:** tn.dbf

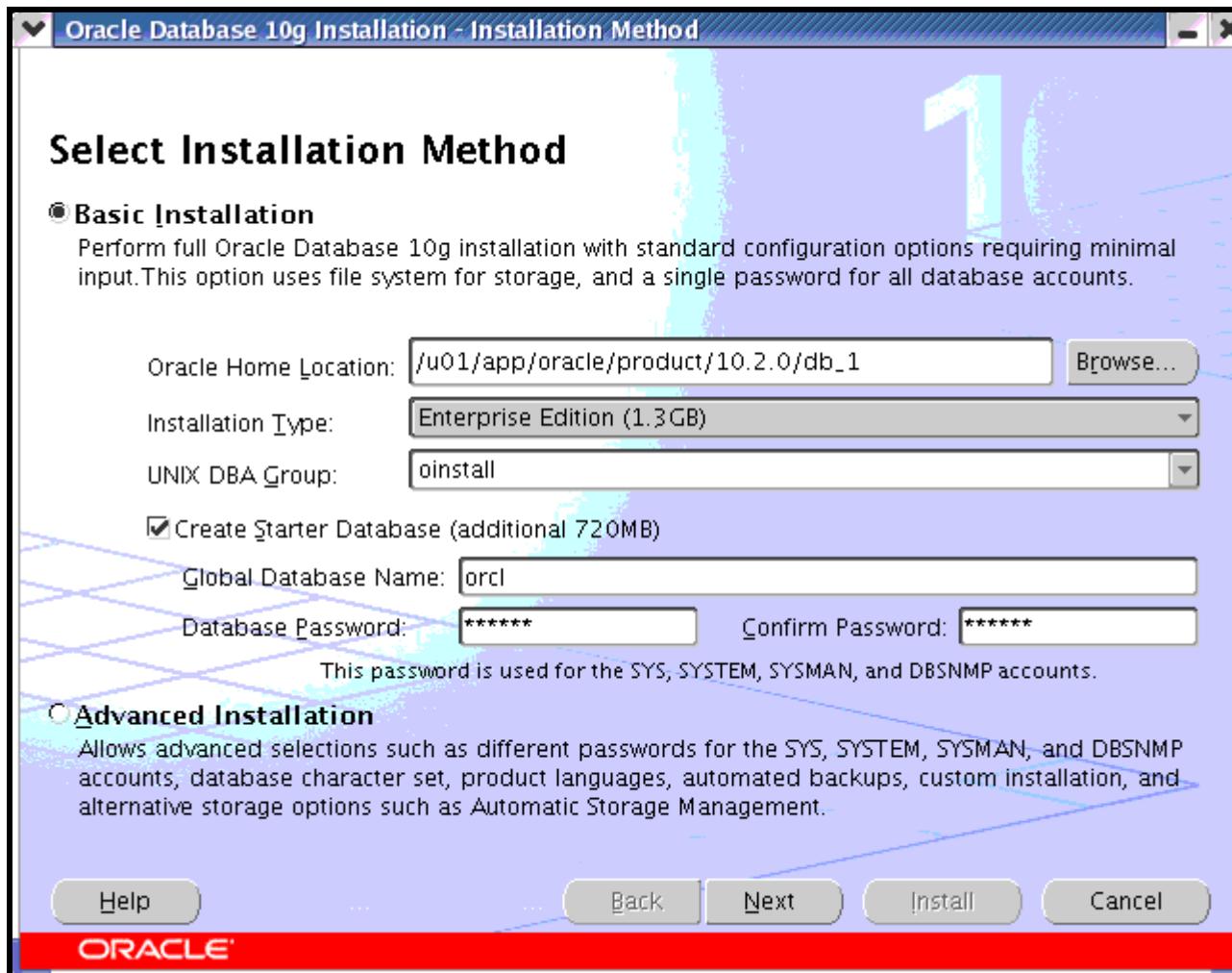


# Setting Environment Variables

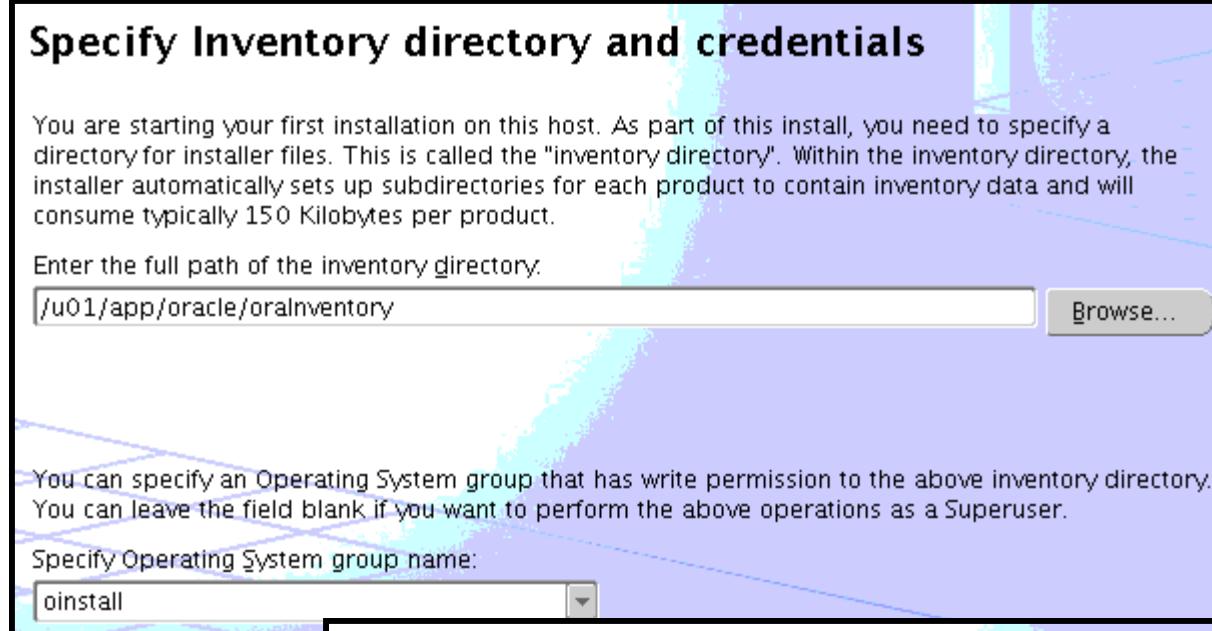
- **ORACLE\_BASE**: The base of the Oracle directory structure for OFA
- **ORACLE\_HOME**: The directory containing the Oracle software
- **ORACLE\_SID**: The initial instance name (by default, ORCL)
- **NLS\_LANG**: The language, territory, and client character set settings



# Oracle Universal Installer (OUI)



# Installing the Oracle Software



## Product-specific Prerequisite Checks

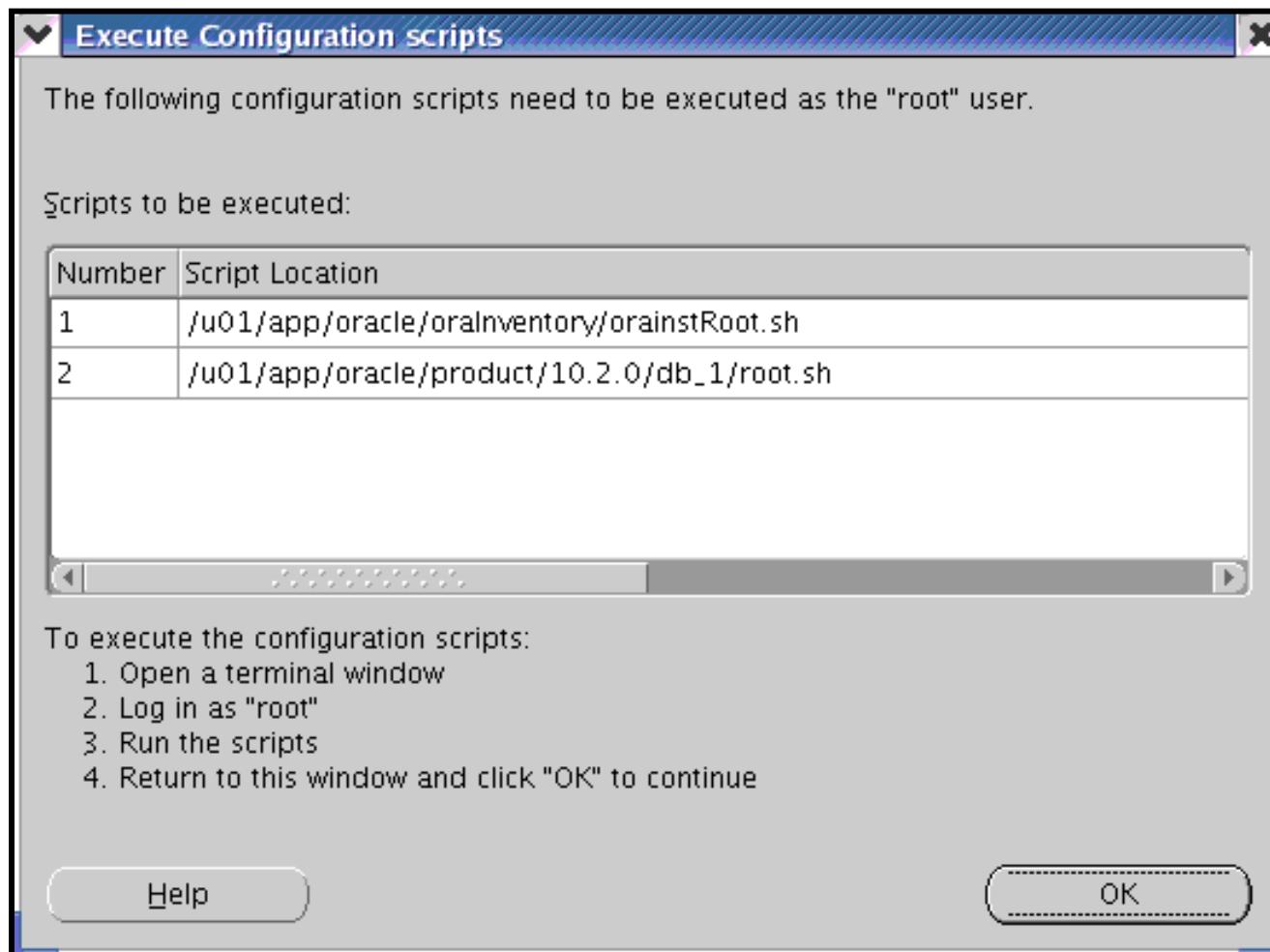
The installer will now verify that the system meets all the minimum requirements for installing and configuring the chosen product. You are required to manually verify and confirm the items that are flagged as warnings or manual checks. For details on performing those checks, click on the item and see the details at the bottom.

# Database Configuration Options

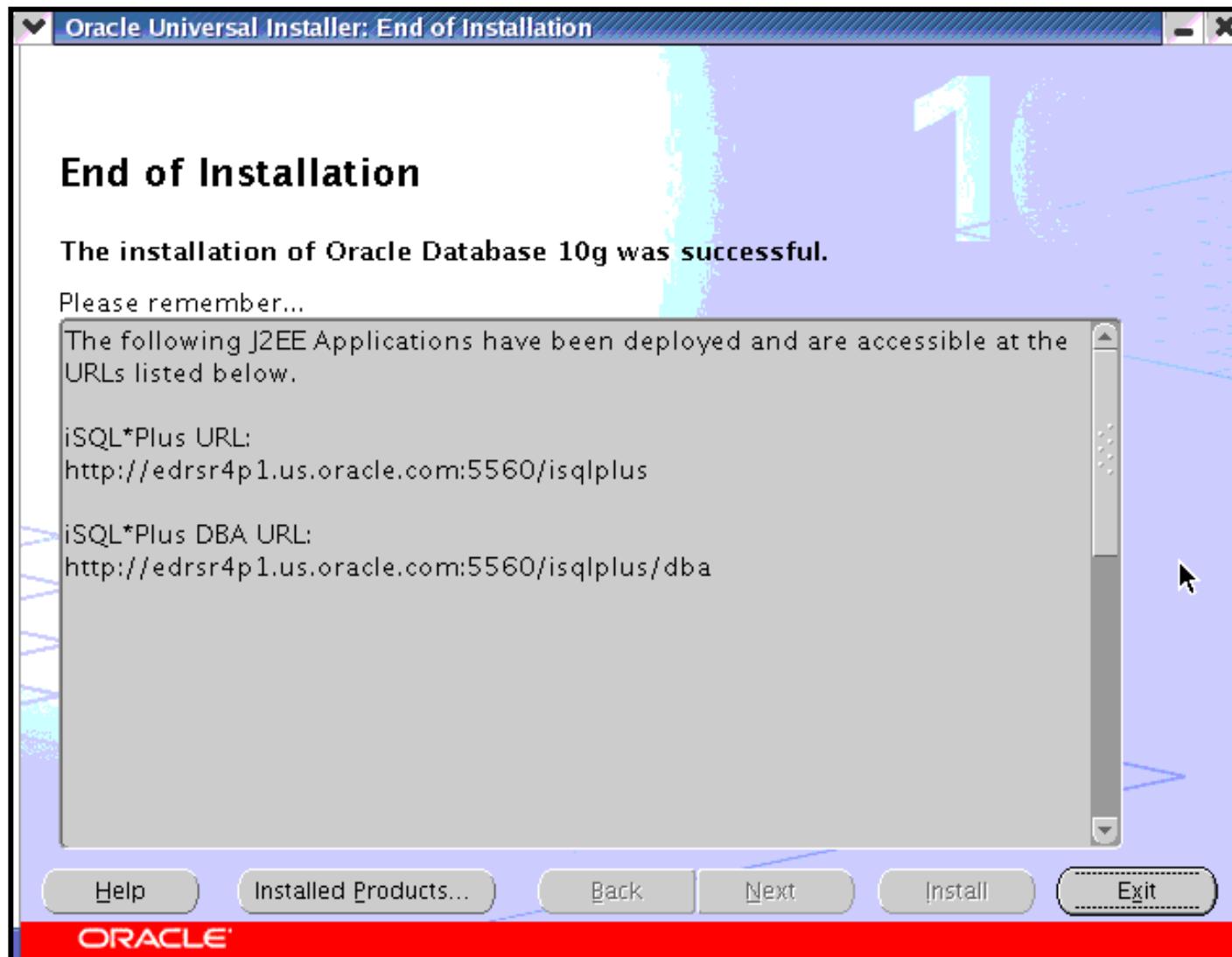
**Summary**  
Oracle Database 10g 10.2.0.1.0

- ⊖ **Global Settings**
  - Source: /stage/Disk1/install/../stage/products.xml
  - Oracle Home: /u01/app/oracle/product/10.2.0/db\_1 (OraDb10g\_home1)
  - Installation Type: Enterprise Edition
- ⊖ **Product Languages**
  - English
- ⊖ **Space Requirements**
  - / Required 1.36GB (includes 108MB temporary) : Available 8.66GB
- ⊖ **New Installations (107 products)**
  - Agent Required Support Files 10.2.0.1.0
  - Assistant Common Files 10.2.0.1.0
  - Bali Share 1.1.18.0.0
  - Buildtools Common Files 10.2.0.1.0
  - Character Set Migration Utility 10.2.0.1.0

# Executing Configuration Scripts



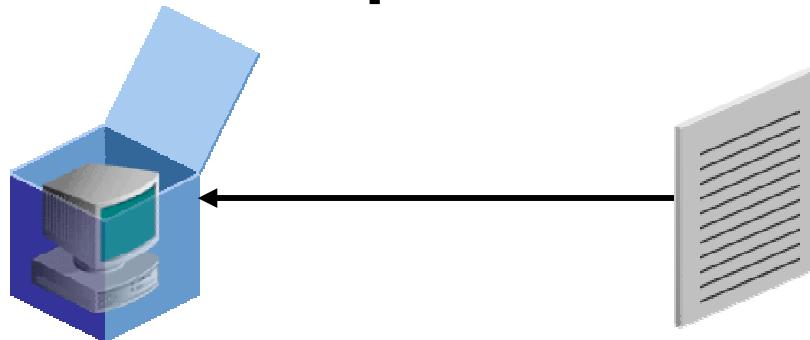
# Completing Your Installation



# **Advanced Installation Options**

- **Database storage options:**
  - File system
  - Automatic Storage Management
  - Raw devices
- **Database management options:**
  - Enterprise Manager Grid Control
  - Enterprise Manager Database Control
- **Database backup and recovery options**
- **E-mail notification options**
- **Cluster Ready Services**
- **Cloning**

# Installation Option: Silent Mode



To install and configure Oracle products with OUI in silent mode, perform the following steps:

1. Create the `oraInst.loc` file, if it does not already exist.
2. Prepare a response file based on file templates that are delivered with the Oracle software.
3. Record a response file:  
`.runInstaller -record -destinationFile <filename>`
4. Run OUI in silent or suppressed mode.
5. If required, run NetCA and DBCA in silent mode.

# Summary

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

- **Describe your role as a DBA, and explain tasks and tools**
- **Plan your installation, starting with the appropriate documentation**
- **Perform preinstallation tasks, such as checking system requirements**
- **Install software by using OUI**

# **Practice Overview: Installing the Oracle Software**

**This practice covers installing the Oracle software by using Oracle Universal Installer.**

**Note: Completing this practice is critical for all the subsequent practice sessions.**



# **Creating an Oracle Database**



# Objectives

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

- **Create a database with the Database Configuration Assistant (DBCA)**
- **Create a database design template with the DBCA**
- **Generate database creation scripts with the DBCA**

# Planning the Database

**As a DBA, you must plan:**

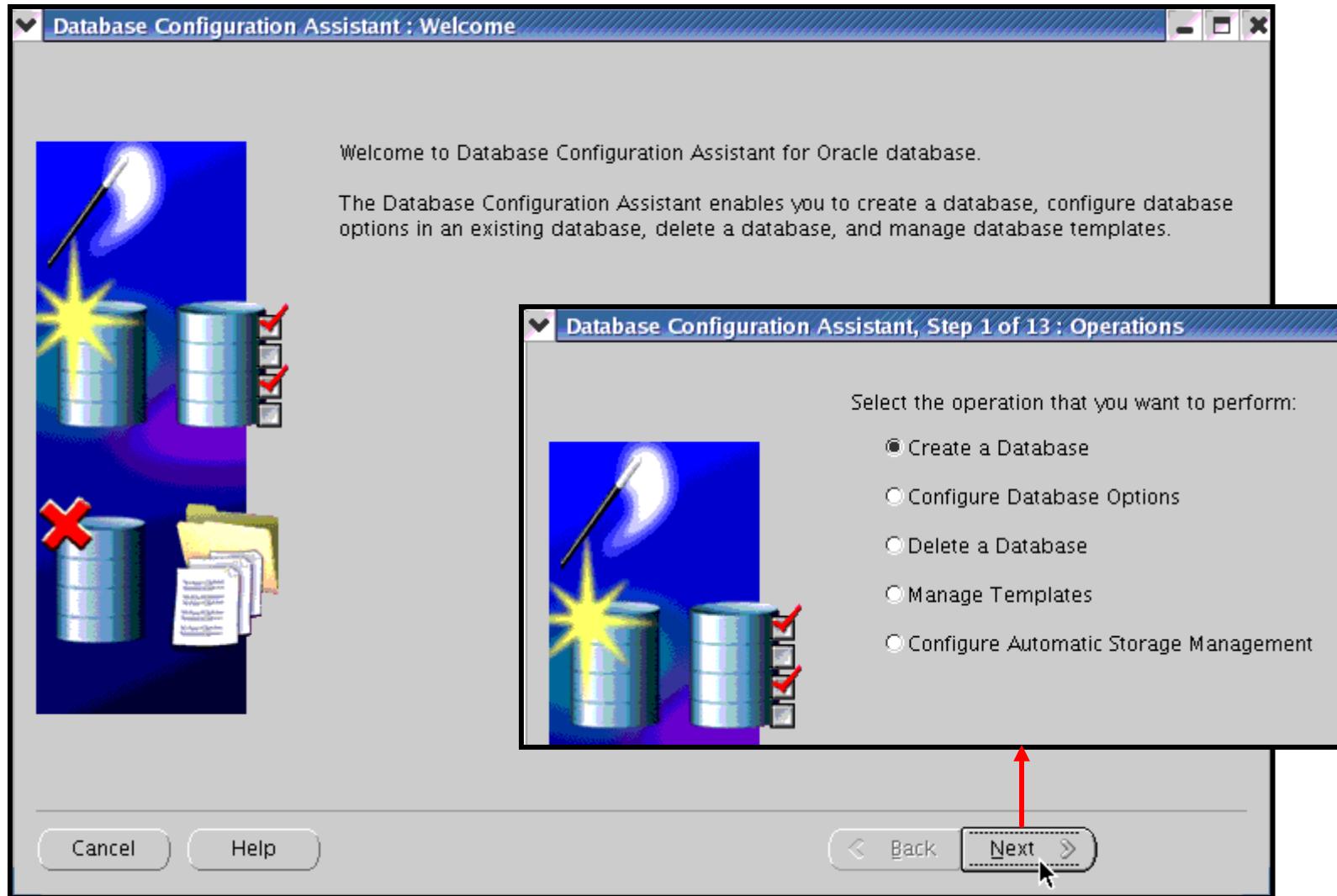
- **The logical storage structure of the database and its physical implementation:**
  - How many disk drives do you have for this?
  - How many data files will you need? (Plan for growth.)
  - How many tablespaces will you use?
  - Which type of information will be stored?
  - Are there any special storage requirements due to type or size?
- **The overall database design**
- **A backup strategy for the database**



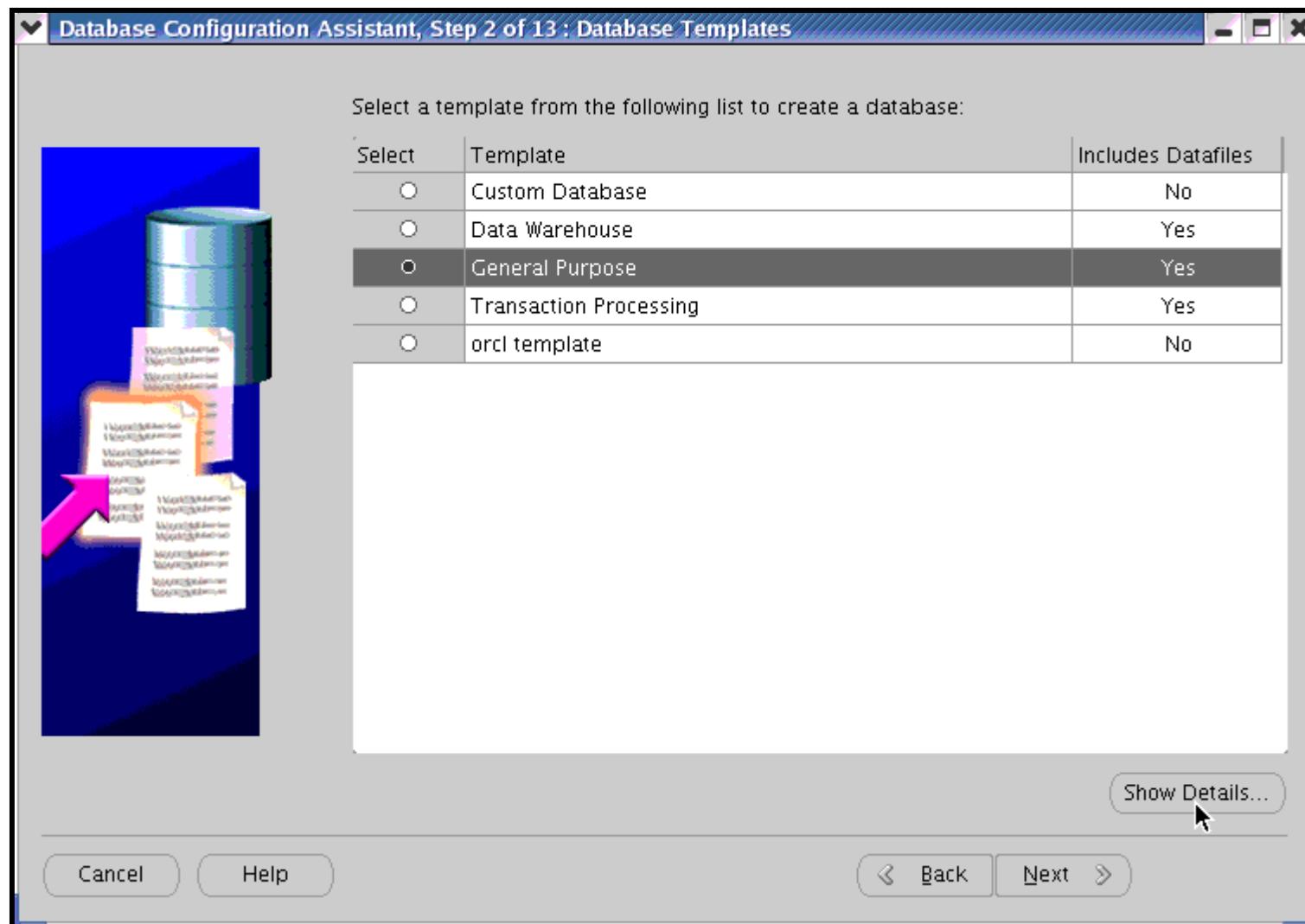
# Databases: Examples

- **Data Warehouse:**
  - Research and marketing data
  - State or federal tax payments
  - Professional licensing (doctors, nurses, and so on)
- **Transaction Processing:**
  - Store checkout register system
  - Automatic teller machine (ATM) transactions
- **General Purpose:**
  - Retail billing system, for example, of a software house or a nursery

# Database Configuration Assistant (DBCA)



# Using the DBCA to Create a Database



# Using the DBCA to Create a Database

Database Configuration Assistant, Step 3 of 12 : Database Identification

**3**

An Oracle database is uniquely identified by a Global Database Name, typically of the form "name.domain".

Global Database Name:

A database is referenced by at least one Oracle instance which is uniquely identified from any other instance on this computer by an Oracle System Identifier (SID).

SID:

Each Oracle database may be managed centrally using the Oracle Enterprise Manager Grid Control or locally using the Oracle Enterprise Manager Database Control. Choose the management option that you would like to use to manage this database.

Configure the Database with Enterprise Manager

Use Grid Control for Database Management

Management Service

Use Database Control for Database Management

Enable Email Notifications

Outgoing Mail (SMTP) Server:

Email Address:

Enable Daily Backup

Backup Start Time:    AM  PM

OS Username:

Password:

**4**

# Using the DBCA to Create a Database

For security reasons, you must specify passwords for the following user accounts in the new database.

- Use the Same Password for All Accounts

Password:

\*\*\*\*\*

Confirm Password:

\*\*\*\*\*

- Use Different Pas

Select the storage mechanism you would like to use for the database.

- File System

Use the File System for Database storage.

5

6

7

Specify locations for the Database files to be created:

- Use Database File Locations from Template

- Use Common Location for All Database Files

Database Files Location:

[Browse...]

- Use Oracle-Managed Files

Database Area:

(ORACLE\_BASE)/oradata

[Browse...]

Multiplex Redo Logs and Control Files...

ation and  
u must either  
ng ASM disk group.

for Real Application  
ment and a Cluster  
e for each datafile,

[Browse...]



If you want to specify different locations for any database files, pick either of the above options and use the Storage page to specify each location.

# Using the DBCA to Create a Database

Choose the recovery options for the database:

Specify Flash Recovery Area

This is used as the default for all backup and recovery operations, and is also required for automatic backup using Enterprise Manager. Oracle recommends that the database files and recovery files be located on physically different disks for data protection and performance.

Flash Recovery Area:

Flash Recovery Area Size:

Enable Archiving

8

Sample Schemas | Custom Scripts 9

Sample Schemas illustrate the use of a layered approach to complexity, and are used by some demonstration programs. Installing this will give you the following schemas in your database: Human Resources, Order Entry, Online Catalog , Product Media, Information Exchange, Sales History . It will also create a tablespace called EXAMPLE. The tablespace will be about 130 MB.

Specify whether or not to add the Sample Schemas to your database.

Sample Schemas

# Using the DBCA to Create a Database

Database Configuration Assistant, Step 10 of 12 : Initialization Parameters

10

Typical – Allocate memory as a percentage of the total physical memory (1000 MB)  
Percentage: 40

Custom

Shared Memory Management:  Automatic  Manual

SGA Size: 270 M Bytes  
PGA Size: 90 M Bytes

Total Memory for Oracle: 400 M Bytes

*i* Total memory includes 40MB of Oracle Process Size and the defaults for the empty parameters, if any.

Memory Distribution

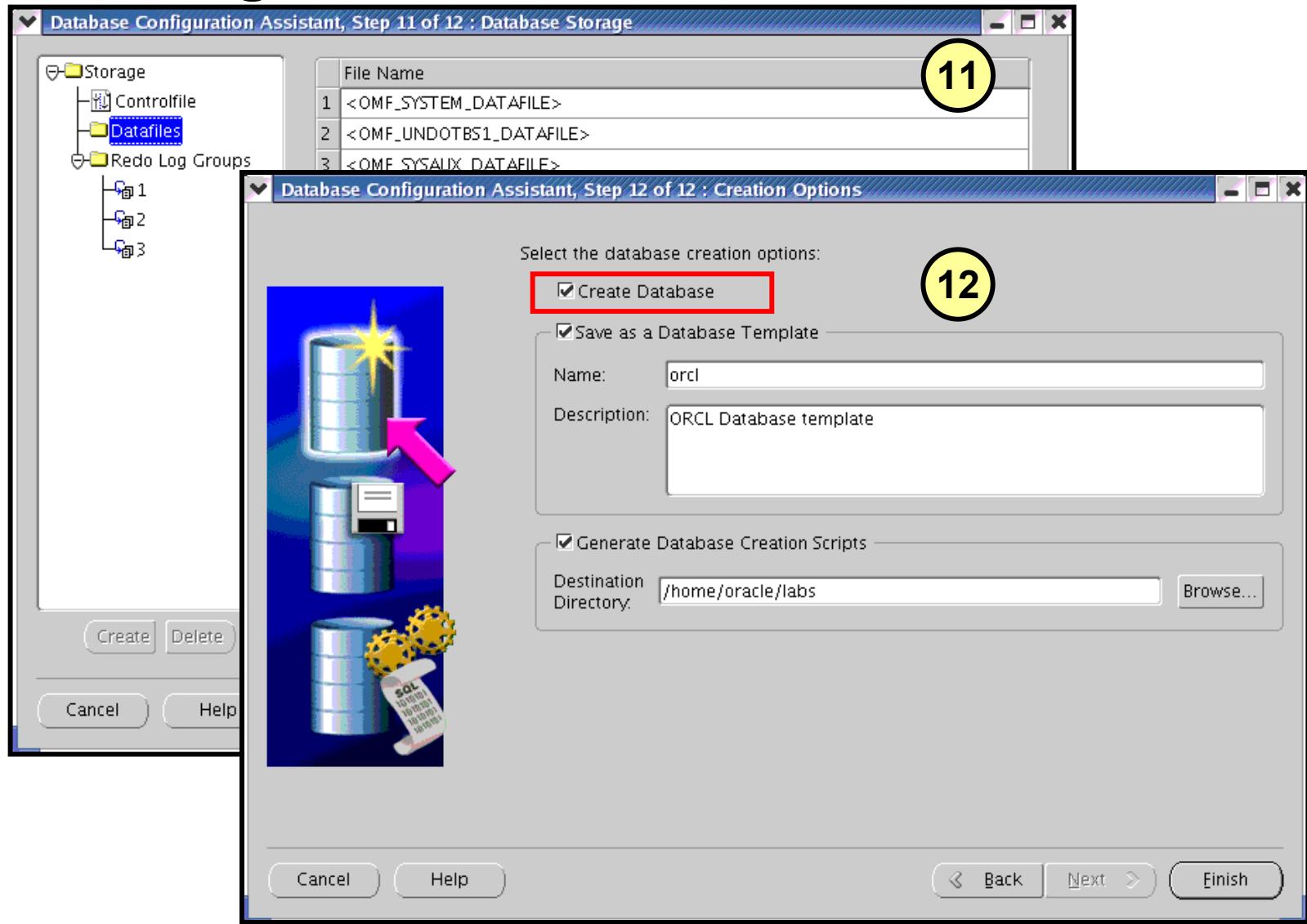
SGA Size: 270 M Bytes  
PGA Size: 90 M Bytes  
Oracle Process Size: 40 M Bytes

Total Memory for Oracle: 400 M Bytes

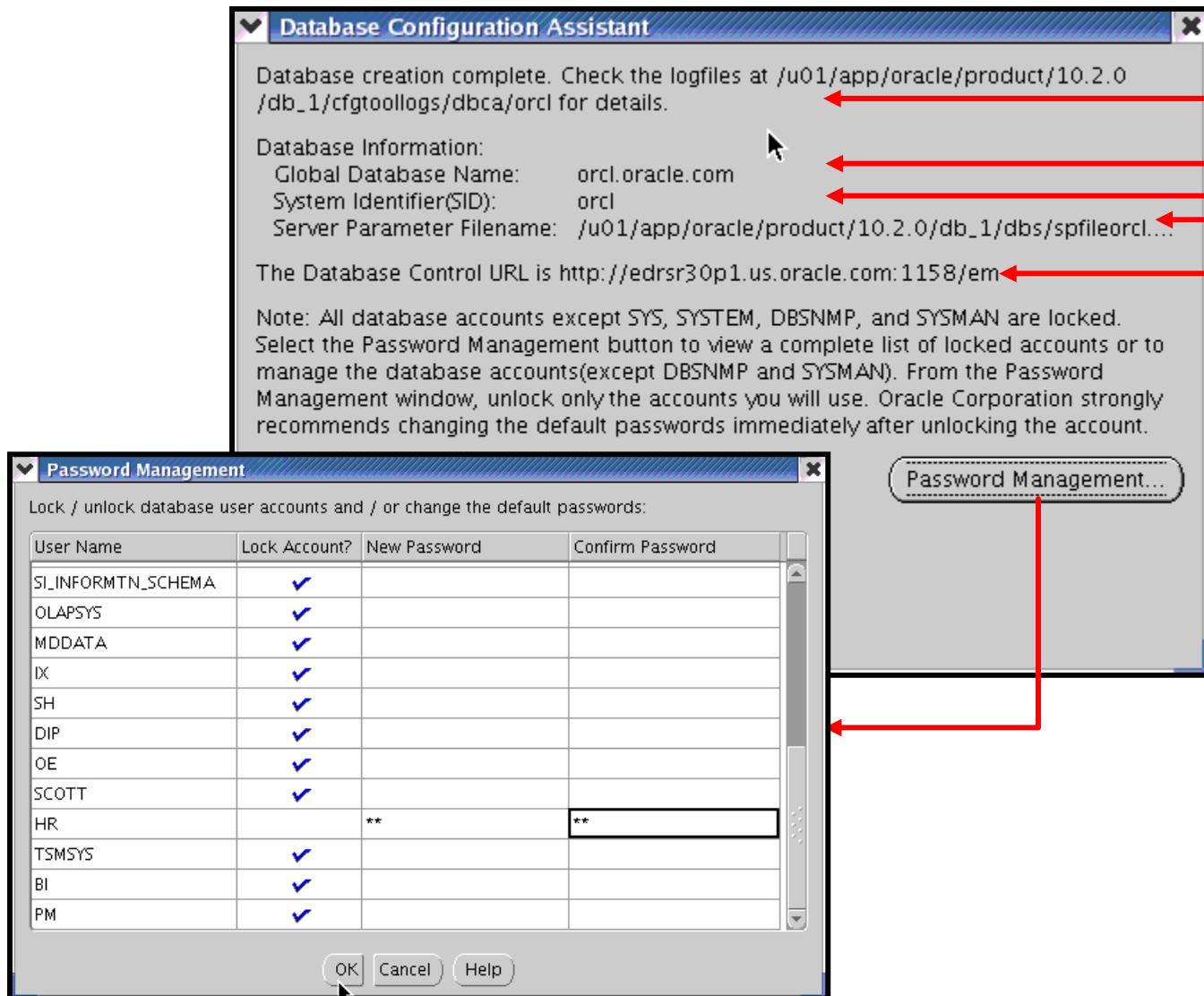
Close A

B

# Using the DBCA to Create a Database



# Password Management



# Creating a Database Design Template

Database Configuration Assistant, Step 2 of 5 : Template Management

Select the template management operation you want to perform:

- Create a database template
- From an existing template
- From an existing database (structure only)  
The template will contain structural information about the source database including database options, tablespaces, datafiles, and initialization parameters specified in the source database. User defined schemas and their data will not be part of the created template.
- From an existing database (structure as well as data)  
The template will contain the structural information as well as physical datafiles specified in the source database. Databases created using such a template will be identical to the source database. User defined schemas and their data will be part of the template.
- Delete a database template

Choose a database from which you want to create the template. The database may be local or reside on a remote machine.

Specify a user with DBA role

Username:

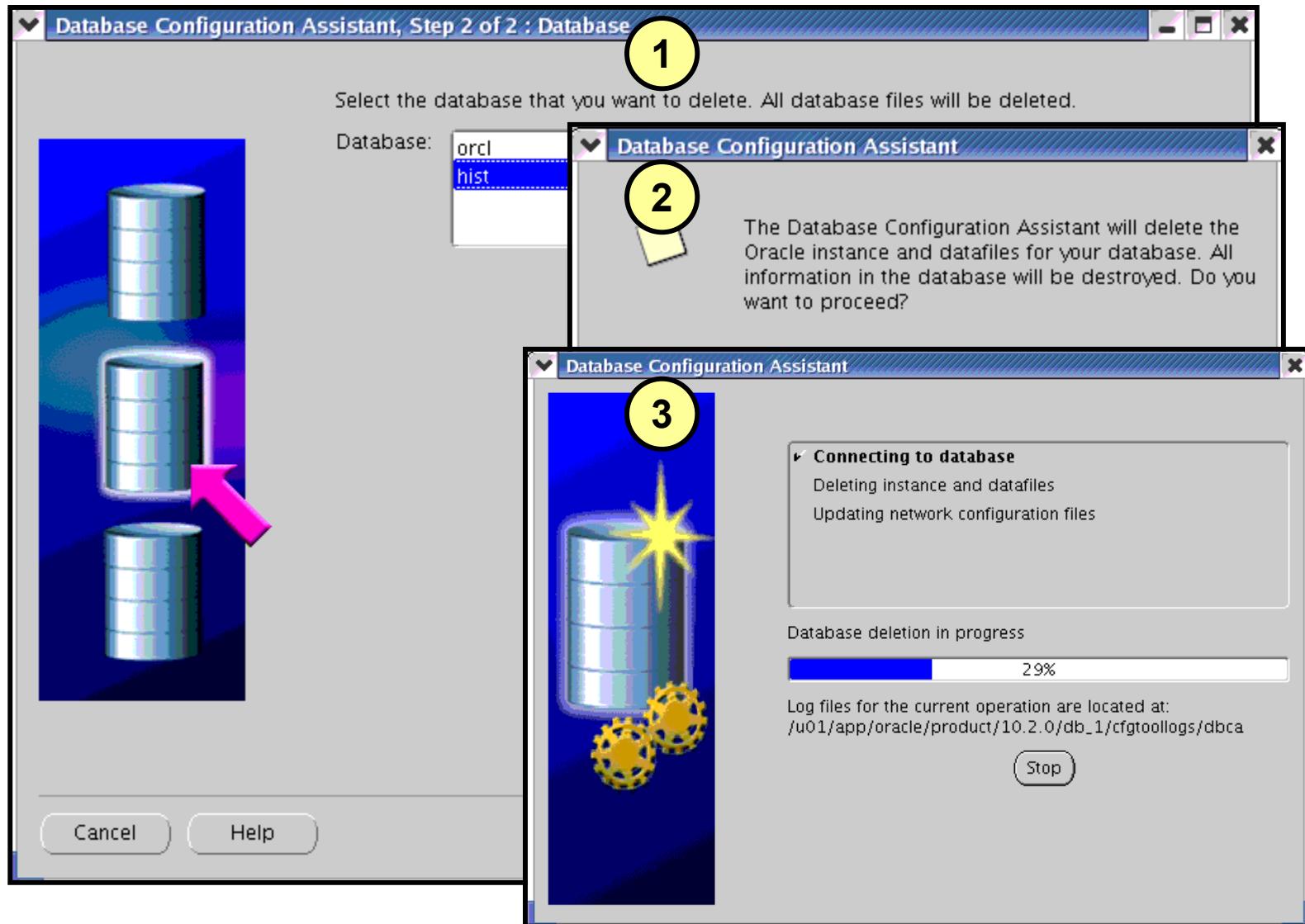
Password:

Service:

Tip: If your Oracle Net service is not configured for this Oracle home, the service may be specified using the form <host>:<port>:<sid>. For example: orange:1521:orcl



# Using the DBCA to Delete a Database



# **Summary**

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

- **Create a database**
- **Create a database design template**
- **Generate database creation scripts**

# **Practice Overview: Using the DBCA**

**This practice covers the following topics:**

- **Creating the ORCL database by using the DBCA**
- **Unlocking the HR schema**

**Note: Completing the database creation and unlocking the HR schema is critical for all following practice sessions.**

**Optionally:**

- **Creating the ORCL database design template by using the DBCA**
- **Creating database creation scripts with the DBCA**

# Managing the Oracle Instance

4

# Objectives

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

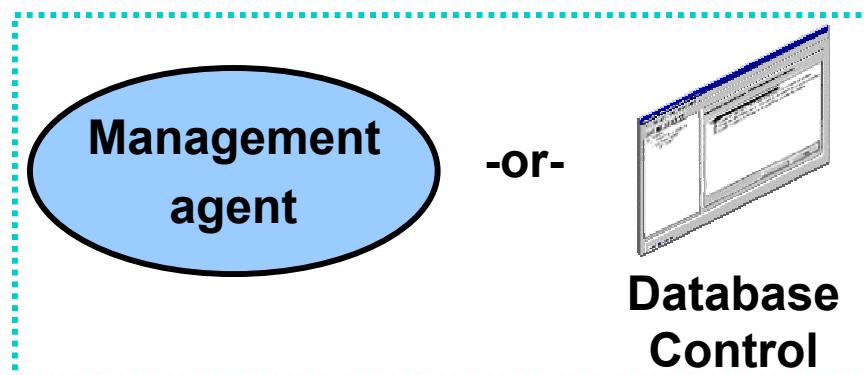
- Start and stop the Oracle database and components
- Use Enterprise Manager (EM)
- Access a database with SQL\*Plus and *i*SQL\*Plus
- Modify database initialization parameters
- Describe the stages of database startup
- Describe the database shutdown options
- View the alert log
- Access dynamic performance views

# Management Framework

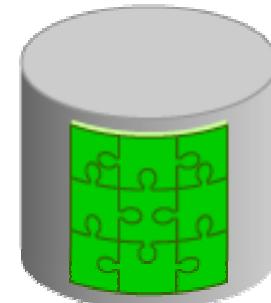
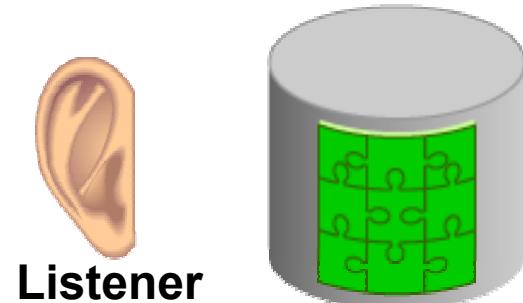
> Components  
SQL\*Plus  
Init Params  
DB Startup  
DB Shutdown  
Alert Log  
Perf Views

The three components of the Oracle Database 10g management framework are:

- Database instance
- Listener
- Management interface
  - Database Control
  - Management agent (when using Grid Control)



Management interface



# Starting and Stopping Database Control

```
$ emctl start dbconsole
TZ set to US/Pacific
Oracle Enterprise Manager 10g Database Control Release 10.2.0.1.0
Copyright (c) 1996, 2005 Oracle Corporation. All rights reserved.
http://edrsr9p1.us.oracle.com:1158/em/console/aboutApplication
Starting Oracle Enterprise Manager 10g Database Control
..... started.
-----
Logs are generated in directory
/u01/app/oracle/product/10.2.0/db_1/edrsr9p1.us.oracle.com_orcl/sy
sman/log
```

```
$ emctl stop dbconsole
TZ set to US/Pacific
Oracle Enterprise Manager 10g Database Control Release 10.2.0.1.0
Copyright (c) 1996, 2005 Oracle Corporation. All rights reserved.
http://edrsr9p1.us.oracle.com:1158/em/console/aboutApplication
Stopping Oracle Enterprise Manager 10g Database Control ...
... Stopped.
```

# Oracle Enterprise Manager

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout Database

Logged in As DBA1

## Database Instance: orcl.oracle.com

Home Performance Administration Maintenance

Page Refreshed Jun 24, 2005 10:59:25 AM Refresh View Data Automatically (60 sec)

Host

Runnable Processes Maximum CPU

Average Active Sessions

Active Sessions SQL Response Time

High Availability

Instance Name **orcl**  
Version **10.2.0.0.0**  
Host **edrsr9p1.us.oracle.com**  
Listener **LISTENER edrsr9p1.us.oracle.com**

Backup/Recovery Schedule Backup Perform Recovery Manage Current Backups Manage Restore Points

Backup/Recovery Settings Backup Settings Recovery Settings Recovery Catalog Settings

Oracle Backup Oracle Backup Device and Media File System Backup and Restore

Database Administration

Storage Control Files Tablespaces Temporary Tablespace Groups Datafiles Rollback Segments

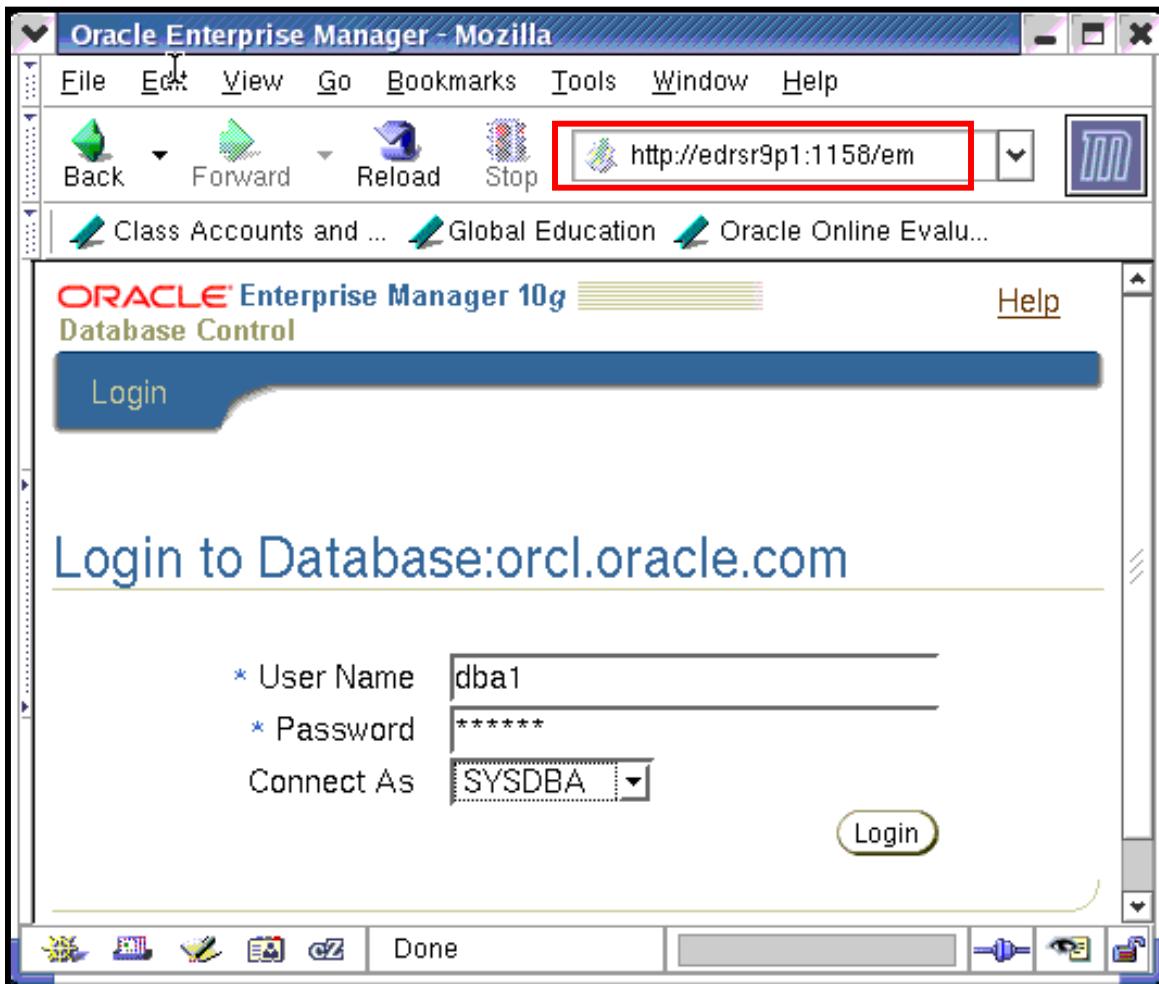
Database Configuration Memory Parameters Undo Management All Initialization Parameters Database Feature

Database Scheduler Jobs Chains Schedules Programs Job Classes

High Availability Instance Recovery Time (sec) 12  
Last Backup Jun 23, 2005 11:00:39 PM  
Archive Flash Recovery Area (%) 73.32

Maximum CPU 1

# Accessing Oracle Enterprise Manager



# Database Home Page

**ORACLE Enterprise Manager 10g** Database Control

Database Instance: orcl.oracle.com

Home Performance Administration Maintenance **Property pages** ← Page Refreshed Jun 21, 2005 12:12

**General**

 Status Up  
Up Since Jun 20, 2005 1:27:  
Instance Name orcl  
Version 10.2.0.0.0  
Host edrsr9p1.us.oracle.  
Listener LISTENER edrsr9r

[View All Properties](#)

**Host CPU**

Shutdown



100%  
75  
50  
25  
0

1.0  
0.5  
0.0

Legend: Other (light green), orcl (dark green)

Load 0.48 Paging 0.00

**Diagnostic Summary**

ADDM Findings 0

**Space Summary**

Database Size (GB) 2.867

**High**

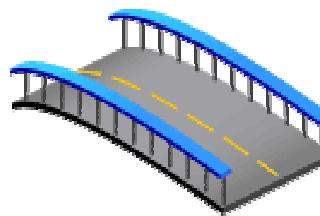
Ins

# Using SQL\*Plus and *i*SQL\*Plus to Access Your Database

**SQL\*Plus and *i*SQL\*Plus provide additional interfaces to your database to:**

- Perform database management operations
- Execute SQL commands to query, insert, update, and delete data in your database

Components  
> **SQL\*Plus**  
Init Params  
DB Startup  
DB Shutdown  
Alert Log  
Perf Views



# Using iSQL\*Plus

The screenshot illustrates the iSQL\*Plus interface with three main components:

- iSQL\*Plus Connection Role (Top Right):** A dialog box titled "iSQL\*Plus Connection Role" with three options:
  - Connect as:
    - Normal
    - SYSOPER  
Requires WebDBA role and HTTP authentication
    - SYSDBA  
Requires WebDBA role and HTTP authentication
- Login Dialog (Bottom Right):** A dialog box titled "Login" with fields for:
  - \* Indicates required field
  - \* Username: hr
  - \* Password: \*\*
  - Connect Identifier: orclA "Login" button is at the bottom.
- Workspace (Bottom Left):** The main workspace window with:
  - Text area containing the SQL query: "select \* from employees;"
  - Buttons: Execute, Load Script, Save Script, Cancel
  - A preview table showing employee data:

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD

# Setting Up *iSQL\*Plus* for SYSDBA and SYSOPER Access

For a user to login to *iSQL\*Plus* as SYSDBA or SYSOPER you must set up the user in the OC4J user manager by performing the following steps:

1. Create a user
2. Grant the webDba role to the user

```
$ cd $ORACLE_HOME/oc4j/j2ee/isqlplus/\
> application-deployments/isqlplus
$JAVA_HOME/bin/java \
> -Djava.security.properties=\
> $ORACLE_HOME/oc4j/j2ee/home/config/jazn.security.props \
> -jar $ORACLE_HOME/oc4j/j2ee/home/jazn.jar \
> -user "iSQL*Plus DBA/admin" -password welcome -shell
JAZN> adduser "iSQL*Plus DBA" username password
JAZN> grantrole webDba "iSQL*Plus DBA" username
```

# Using SQL\*Plus

## SQL\*Plus is:

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

```
$ sqlplus hr/hr

SQL*Plus: Release 10.2.0.1.0 - Production on Mon Jul 25 12:37:21 2005
Copyright (c) 1982, 2005, Oracle. All rights reserved.

Connected to:
Oracle Database 10g Enterprise Edition Release 10.2.0.1.0 - Production
With the Partitioning, OLAP and Data Mining options

SQL> select last_name from employees;

LAST_NAME
-----
Abel
Ande
Atkinson
```

# Calling SQL\*Plus from a Shell Script

```
$ ./batch_sqlplus.sh
```

```
SQL*Plus: Release 10.2.0.1.0 - Production on Mon Jul 25 12:47:44 2005  
Copyright (c) 1982, 2005, Oracle. All rights reserved.
```

```
Connected to:
```

```
Oracle Database 10g Enterprise Edition Release 10.2.0.1.0 - Production  
With the Partitioning, OLAP and Data Mining options
```

```
SQL>  
COUNT(*)  
-----
```

```
107
```

```
SQL>  
107 rows updated.
```

```
SQL>  
Commit complete.  
SQL> Disconnected from Oracle Dat
```

```
10.2.0.1.0 - Production  
With the Partitioning, OLAP and Data Mining options  
[oracle@EDRSR9P1 oracle]$
```

```
# 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  
exit
```

Output

# 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 10.2.0.1.0 - Production on Mon Jul 25 12:57:02 2005  
Copyright (c) 1982, 2005, Oracle. All rights reserved.
```

Connected to:

```
Oracle Database 10g Enterprise Edition Release 10.2.0.1.0 - Production  
With the Partitioning, OLAP and Data Mining options
```

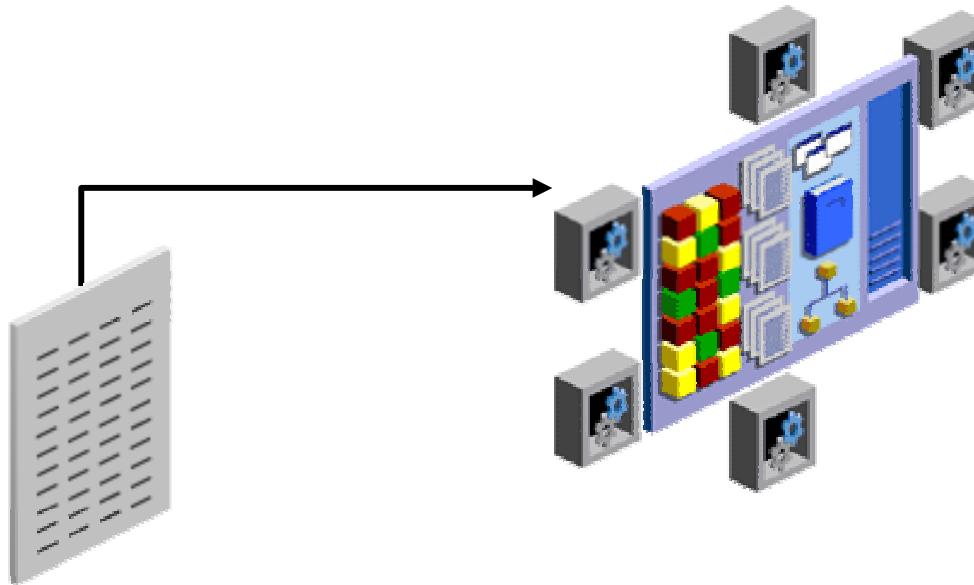
DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
60	IT	103	1400

```
Disconnected from Oracle Database 10g Enterprise Edition Release  
10.2.0.1.0 - Production  
With the Partitioning, OLAP and Data Mining options  
$
```

ORACLE

# Initialization Parameter Files

Components  
SQL\*Plus  
> **Init Params**  
DB Startup  
DB Shutdown  
Alert Log  
Perf Views



`spfileorcl.ora`

# Simplified Initialization Parameters

Basic



`CONTROL_FILES`  
`DB_BLOCK_SIZE`  
`PROCESSES`  
`UNDO_MANAGEMENT`

...

Advanced



`DB_CACHE_SIZE`  
`DB_FILE_MULTIBLOCK_READ_COUNT`  
`SHARED_POOL_SIZE`

...

# Viewing and Modifying Initialization Parameters

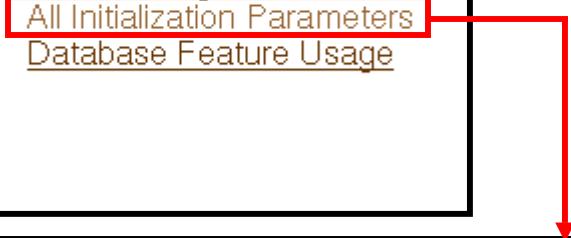
**Database Administration**

**Storage**

- [Control Files](#)
- [Tablespaces](#)
- [Temporary Tablespace Groups](#)
- [Datafiles](#)
- [Rollback Segments](#)
- [Redo Log Groups](#)
- [Archive Logs](#)

**Database Configuration**

- [Memory Parameters](#)
- [Undo Management](#)
- [All Initialization Parameters](#)
- [Database Feature Usage](#)



**Initialization Parameters**

**Current** [SPFile](#)

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

Name      Basic      Modified      Dynamic      Category

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

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

[Save to File](#)

Name ▲	Help	Revisions	Value	Comments	Type	Basic	Modified	Dynamic	Category
open_cursors	<a href="#">?</a>		300		Integer	✓	✓	✓	Cursors and Library Cache
session_cached_cursor	<a href="#">?</a>		0		Integer				Cursors and Library Cache

# Database Startup and Shutdown

## Startup/Shutdown:Specify Host and Target Database Credentials

Specify the following credentials in database.

### Host Credentials

Specify the OS user name and machine.

\* Username   
\* Password

### Database Credentials

Specify the credentials for the target database.

To use OS authentication, leave the user name and password fields blank.

\* Username   
\* Password   
Database **orcl.oracle.com**  
\* Connect As **SYSDBA**   
 Save as Prefe  
**Note that you need to login SYSOPER in order to change**

## Startup/Shutdown:Confirmation

Current Status **shutdown**

Operation **startup database in open mode**

Initialization Parameter **default**

Are you sure you want to perform this operation?

Show SQL

Advanced Options

No

Yes

or

## Startup/Shutdown:Confirmation

Current Status **open**

Operation **shutdown immediate**

Are you sure you want to perform this operation?

Show SQL

Advanced Options

No

Yes

Cancel

OK

Components  
SQL\*Plus  
Init Params  
> **DB Startup**  
**DB Shutdown**  
**Alert Log**  
**Perf Views**

# Starting Up an Oracle Database Instance

**Database Instance**

Status **Down**  
Host **edrsr9p1.us.oracle.com**  
Port **1521**  
SID **orcl**  
Oracle Home **/u01/app/oracle/product/10.2.0/db\_1**

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

**Startup** **Perform Recovery**

**Startup/Shutdown:Confirmation**

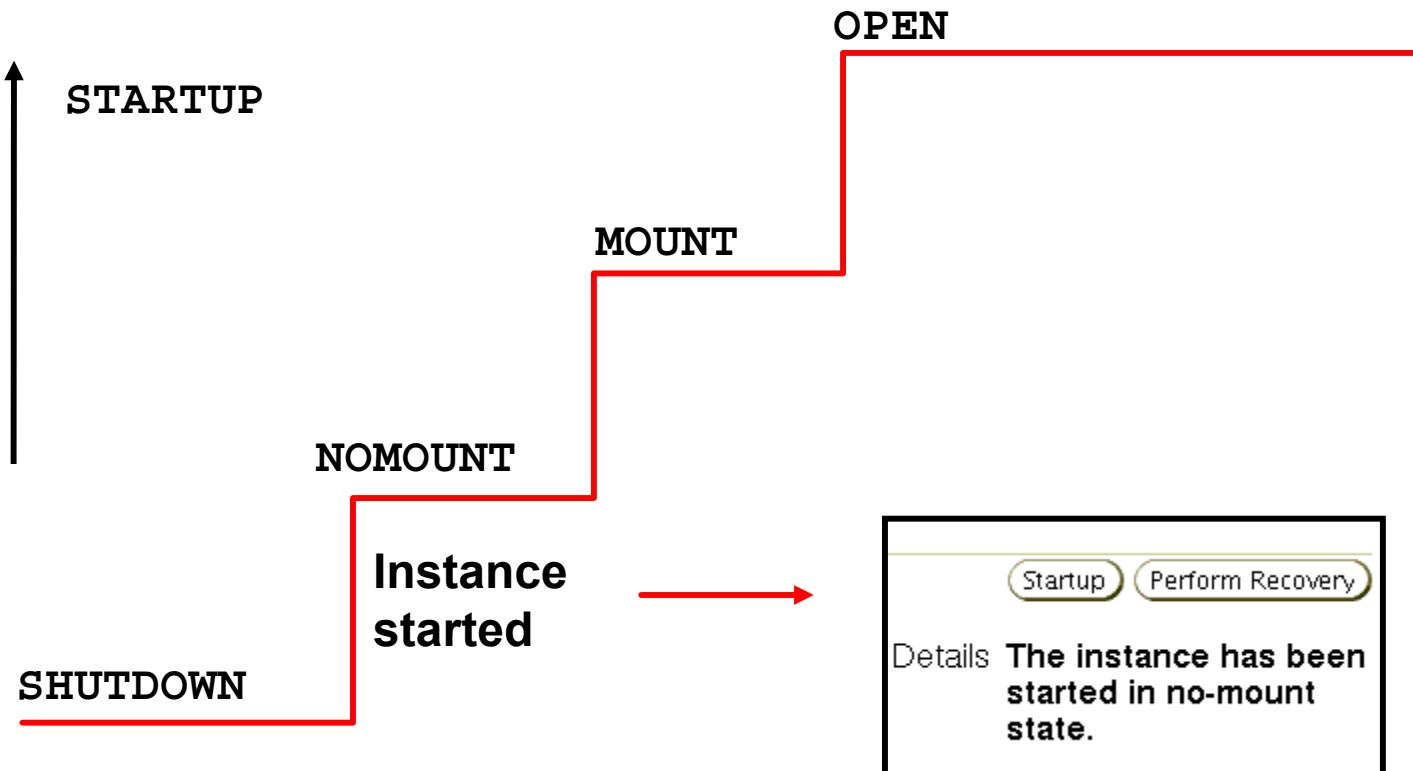
Current Status **shutdown**  
Operation **startup database in open mode**  
Initialization Parameter **default**  
Are you sure you want to perform this operation?

**Show SQL** **Advanced Options** **No** **Yes**

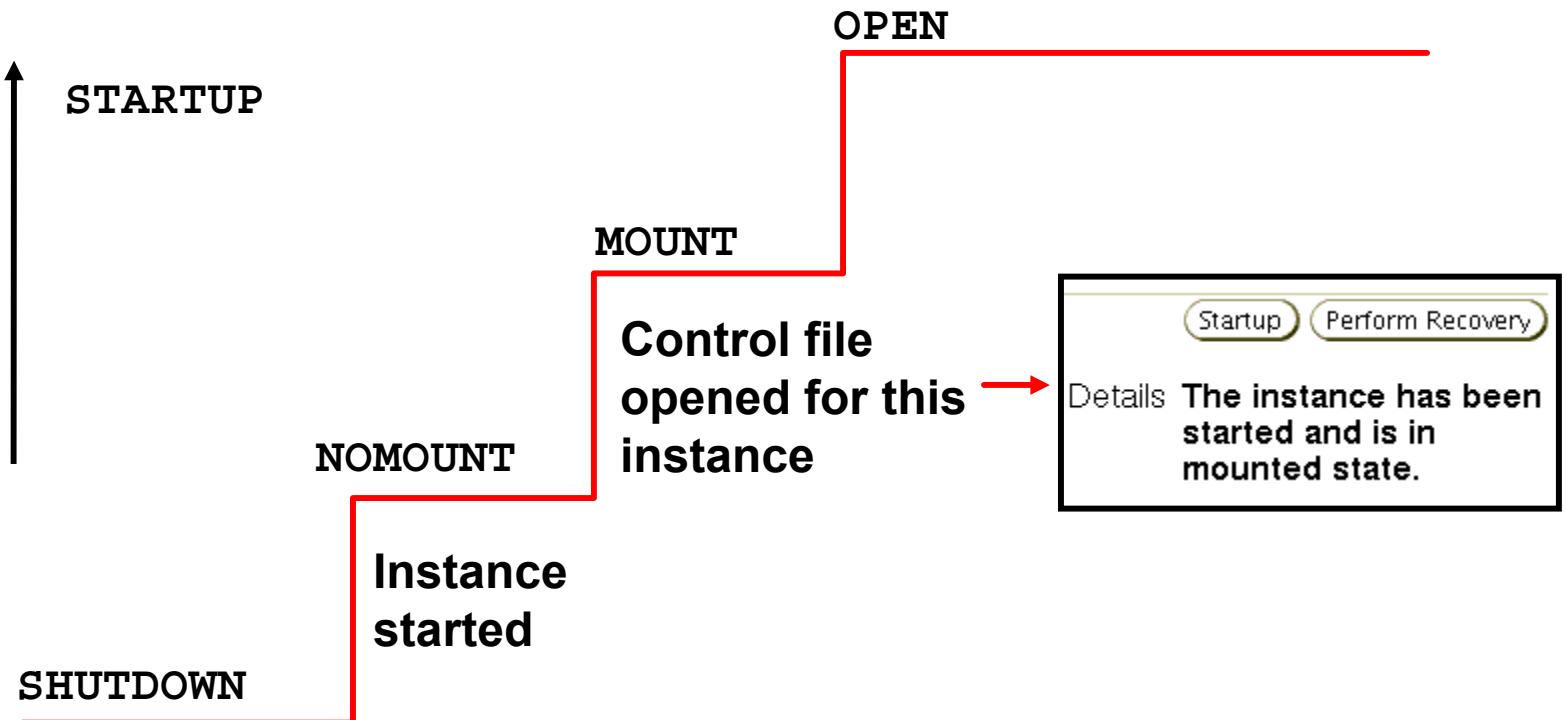
**Startup mode**

Start the database  
 Mount the database  
 Open the database

# Starting Up an Oracle Database Instance: NOMOUNT

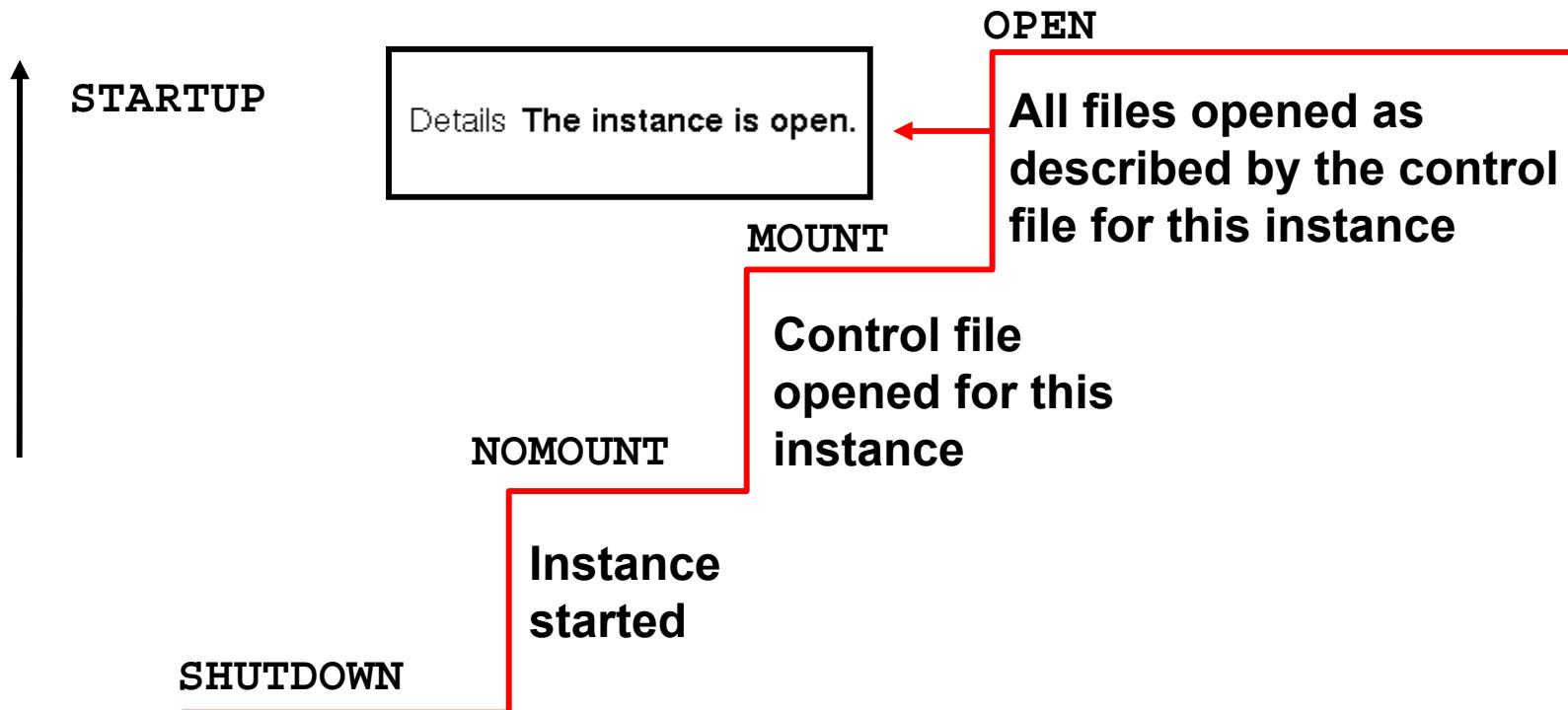


# Starting Up an Oracle Database Instance: MOUNT



# Starting Up an Oracle Database Instance:

## OPEN



# Shutting Down an Oracle Database Instance

Components  
SQL\*Plus  
Init Params  
DB Startup  
> **DB Shutdown**  
Alert Log  
Perf Views

**General**

Status Up  
Up Since Jun 21, 2005 1:25:04 PM PDT  
Instance Name orcl  
Version 10.2.0.0.0  
Host edrsr9p1.us.oracle.com  
Listener LISTENER edrsr9p1.us.oracle...

Shutdown

**Startup/Shutdown:Confirmation**

Current Status open  
Operation **shutdown immediate**  
Are you sure you want to perform this operation?

Show SQL Advanced Options No Yes

**Startup/Shutdown:Advanced Shutdown Options**

Specify the shutdown mode

Normal Browse Sessions  
 Wait for all currently connected users to disconnect from the database  
 Transactional  
Disconnect all connected users after transactions have completed  
 Immediate  
Rollback active transactions and disconnect all connected users  
 Abort  
Instantaneous shutdown by aborting the database instance

# Shutdown Modes

Shutdown Mode	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 mode:

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

# SHUTDOWN Options

## On the way down:

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

During

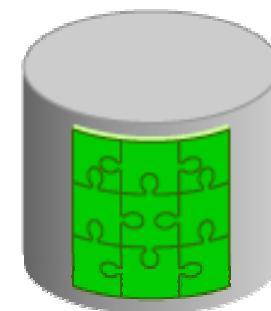
SHUTDOWN  
NORMAL  
or

SHUTDOWN  
TRANSACTIONAL  
or  
SHUTDOWN  
IMMEDIATE

## On the way up:

- No instance recovery

Consistent database  
(clean database)

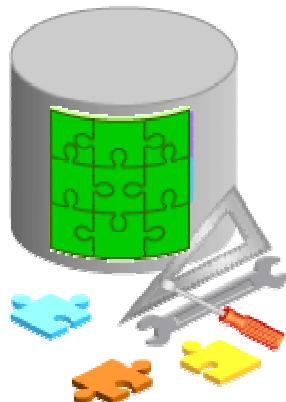


ORACLE®

# 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  
(dirty database)

# Using SQL\*Plus to Start Up and Shut Down

```
[oracle@EDRSR9P1 oracle]$ sqlplus dba1/oracle as sysdba

SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.

SQL> startup
ORACLE instance started.

Total System Global Area  285212672 bytes
Fixed Size                  1218472 bytes
Variable Size                250177624 bytes
Database Buffers            33554432 bytes
Redo Buffers                 262144 bytes

Database mounted.
Database opened.

SQL>
```

# Viewing the Alert Log

Components  
SQL\*Plus  
Init Params  
DB Startup  
DB Shutdown  
> **Alert Log**  
Perf Views

**Database Home page > Related Links region >  
Alert Log Content**

Database Instance: orcl.oracle.com > Most Recent Alert Log Entries

**Search Criteria**

Begin Date  Time    AM  PM  
(example: Jun 21, 2005)

End Date  Time    AM  PM  
(example: Jun 21, 2005)

**Most Recent Alert Log Entries**

Page Refreshed Jun 21, 2005 6:57:23 PM

This shows the last 100,000 bytes of the alert log. The log is constantly growing, so select the browser's Refresh button to see the most recent log entries.

Number of Lines Displayed **1,920**

```
Sun Jun 12 23:00:11 2005
ARC1: Evaluating archive thread 1 sequence 21203
Sun Jun 12 23:00:11 2005
ARC1: Beginning to archive thread 1 sequence 21203 (7033265-7046024) (orcl)
ARCH: Connecting to console port...
```

# Viewing the Alert History

## Related Links

[Advisor Central](#)  
[All Metrics](#)  
[Jobs](#)  
[Metric Collection Errors](#)  
[Recovery Catalogs](#)

[Alert History](#)  
[Blackouts](#)  
[Manage Metrics](#)  
[Monitoring Configuration](#)  
[SQL History](#)

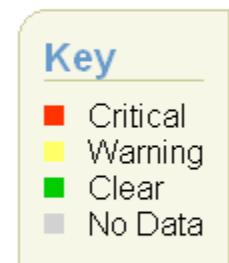
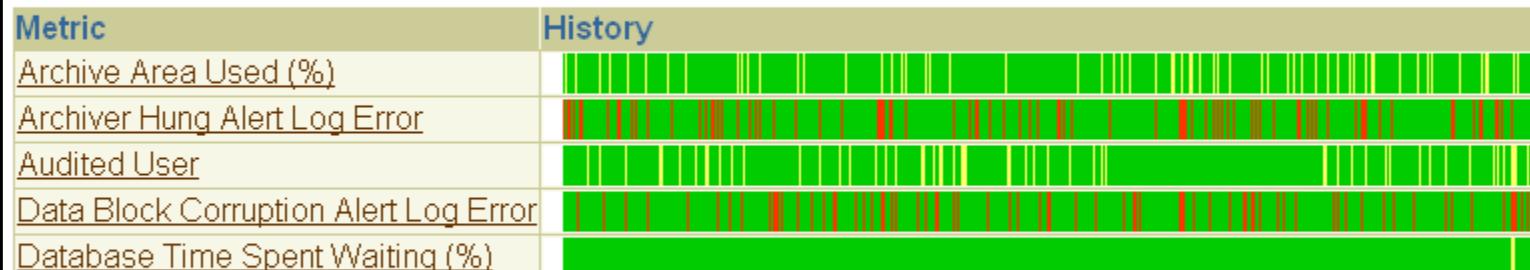
[Alert Log Content](#)  
[iSQL\\*Plus](#)  
[Metric Baselines](#)  
[Monitor in Memory Access Mode](#)  
[User-Defined Metrics](#)

[Alert History](#)

## Alert History

Page Refreshed Jun 21, 2005 7:03:24 PM

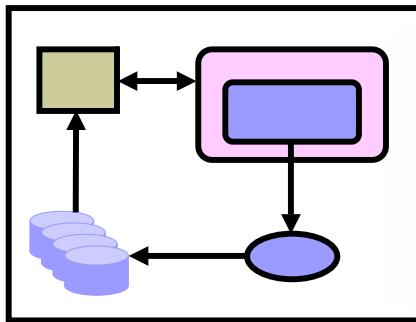
[View Data](#) [Last 24 hours](#)



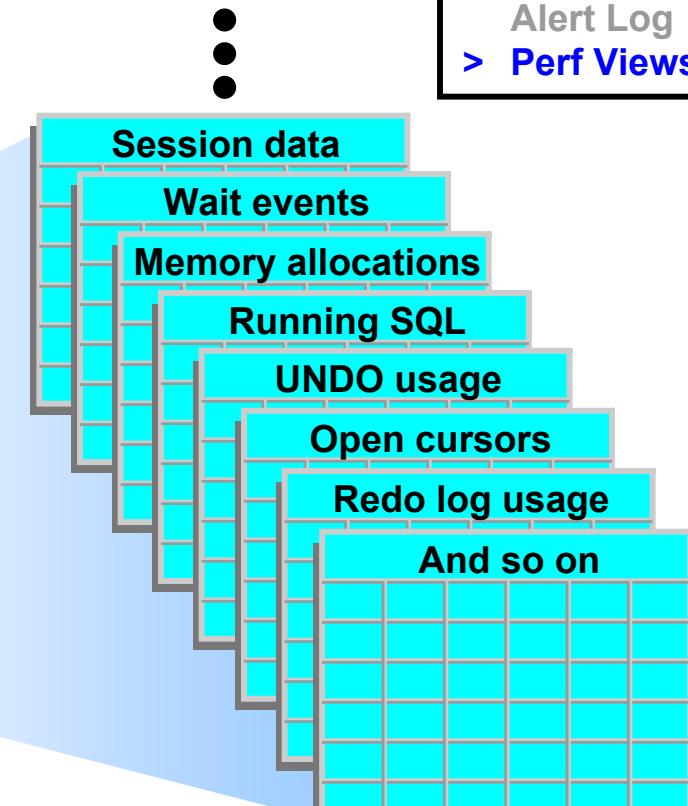
7:03 102 AM 4 6 8 102 PM 4 6 8  
Jun 20, 2005

# Dynamic Performance Views

**Dynamic performance views**  
provide access to  
information about changing  
states and conditions in the  
database.



Oracle instance



# Dynamic Performance Views: Usage Examples

a

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

b

```
SQL> SELECT * FROM v$session WHERE machine =  
'EDRSR9P1' and logon_time > SYSDATE - 1;
```

c

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

# **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.

# Summary

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

- Start and stop the Oracle database and components
- Use Enterprise Manager and describe its high-level functionality
- Access a database with SQL\*Plus and *i*SQL\*Plus
- Modify database initialization parameters
- Describe the stages of database startup
- Describe the database shutdown options
- View the alert log
- Access dynamic performance views

# **Practice Overview: Managing the Oracle Instance**

**This practice covers the following topics:**

- Navigating in Enterprise Manager**
- Viewing and modifying initialization parameters**
- Stopping and starting the database instance**
- Viewing the alert log**
- Connecting to the database by using SQL\*Plus  
and *i*SQL\*Plus**

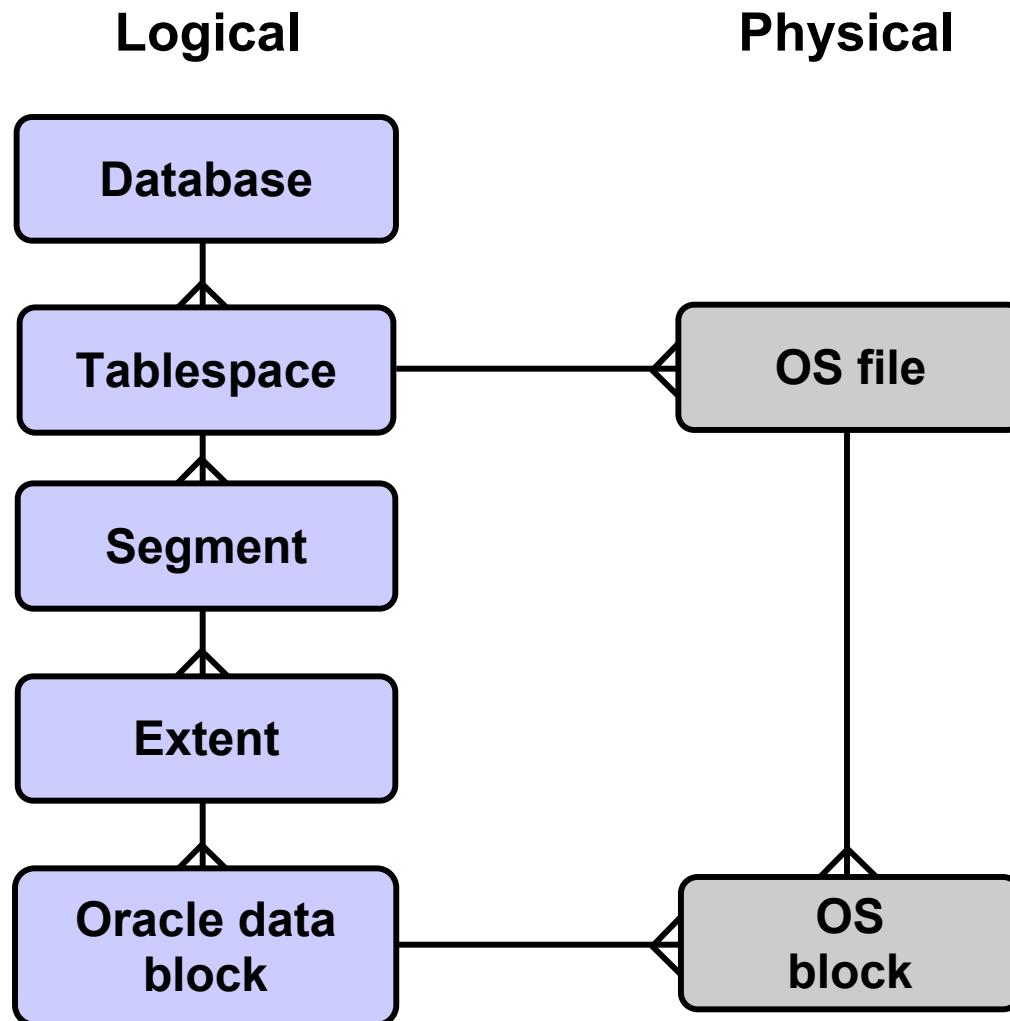
# Managing Database Storage Structures

# Objectives

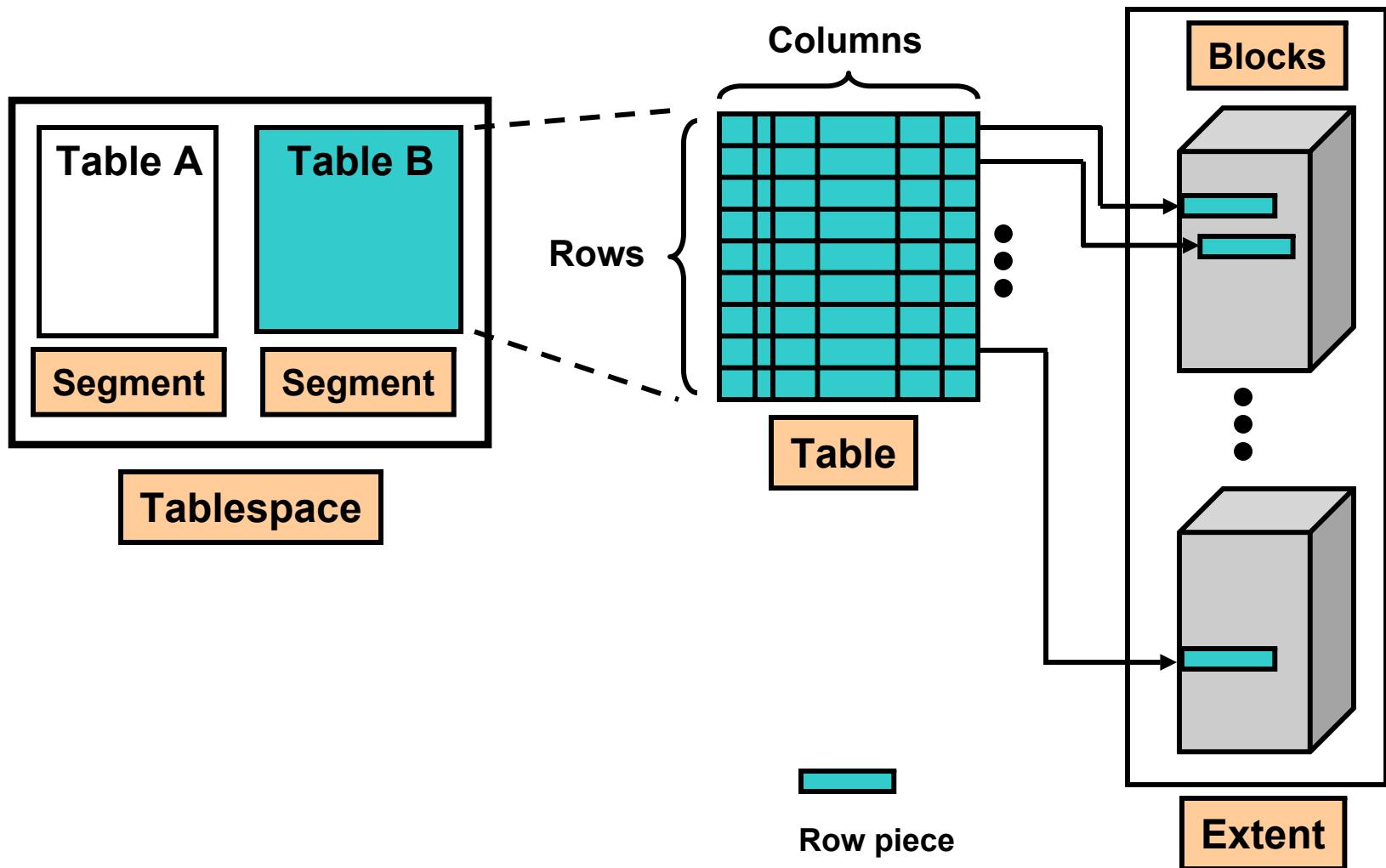
**After completing this lesson, you should be able to do the following:**

- **Describe how table row data is stored in blocks**
- **Define the purpose of tablespaces and data files**
- **Create and manage tablespaces**
- **Obtain tablespace information**
- **Describe the main concepts and functionality of Automatic Storage Management (ASM)**

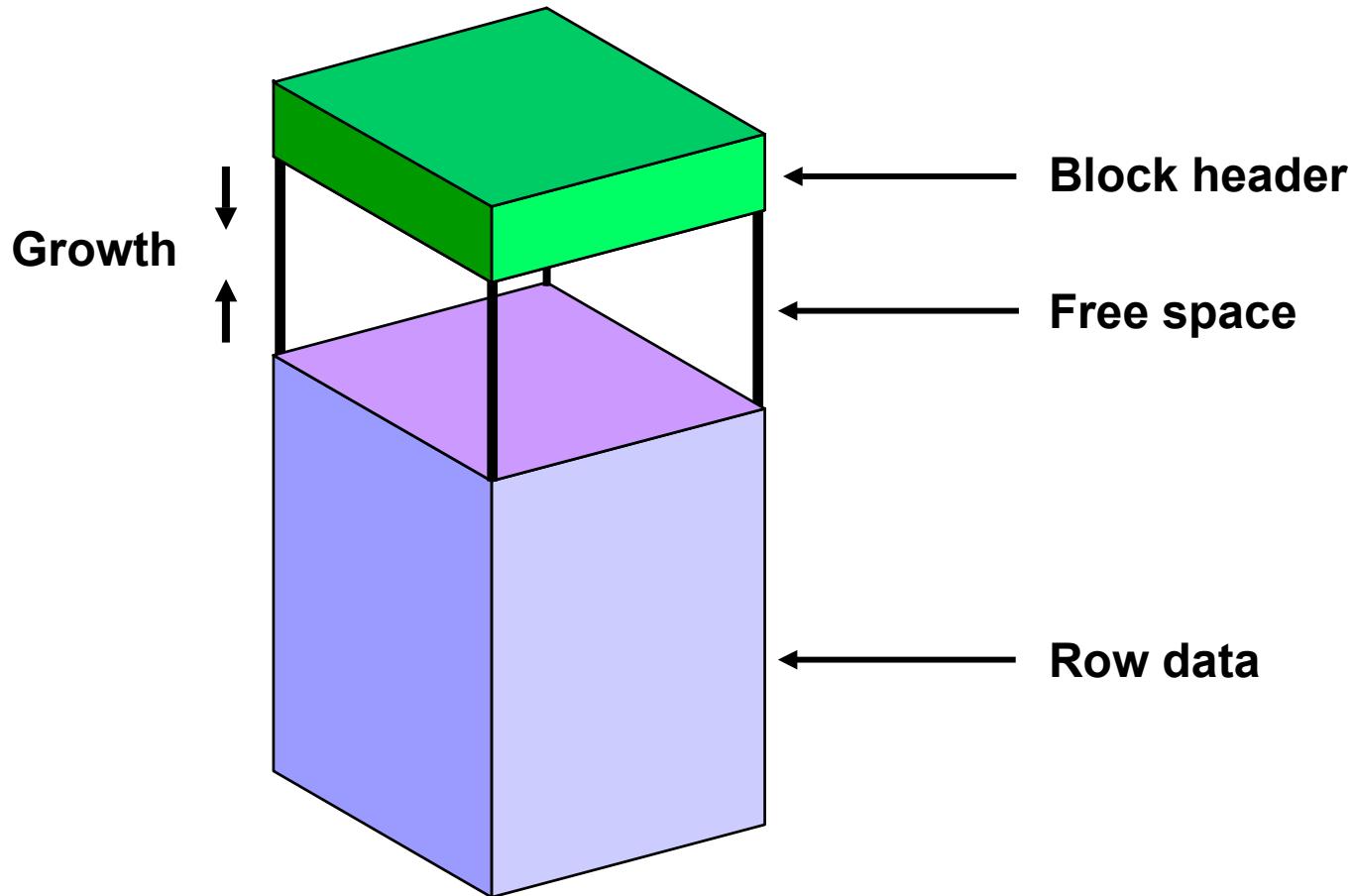
# Storage Structures



# How Table Data Is Stored



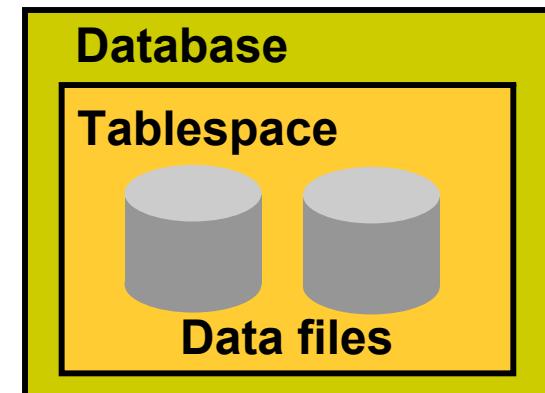
# Anatomy of a Database Block



# Tablespaces and Data Files

The Oracle database stores data logically in tablespaces and physically in data files.

- **Tablespaces:**
  - Can belong to only one database
  - Consist of one or more data files
  - Are further divided into logical units of storage
  - Are a repository for schema object data
- **Data files:**
  - Can belong to only one tablespace and one database
  - Are the underlying files that make up a tablespace



# 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	Defines the location for RMAN backups

## Example:

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

# Space Management in Tablespaces

- **Locally managed tablespace:**
  - Free extents are managed in the tablespace.
  - A bitmap is used to record free extents.
  - Each bit corresponds to a block or group of blocks.
  - The bit value indicates free or used extents.
  - The use of locally managed tablespaces is recommended.
- **Dictionary-managed tablespace:**
  - Free extents are managed by the data dictionary.
  - Appropriate tables are updated when extents are allocated or unallocated.
  - These tablespaces are supported only for backward compatibility.



# Exploring the Storage Structure

The screenshot shows the Oracle Enterprise Manager 10g Database Control interface. The title bar reads "ORACLE Enterprise Manager 10g Database Control". Below it, the main content area is titled "Database Instance: orcl.oracle.com". A navigation bar at the top includes "Home", "Performance", "Administration" (which is highlighted in blue), and "Maintenance". A descriptive text block below the navigation bar states: "The Administration tab displays links that allow you to administer database objects and Oracle database. The Maintenance tab displays links that provide functions that control Oracle databases." Under the "Administration" tab, there are two columns of links: "Storage" (Control Files, Tablespaces, Temporary Tablespace Groups, Datafiles, Rollback Segments, Redo Log Groups, Archive Logs) and "Database Configuration" (Memory Parameters, Undo Management, All Initialization Parameters, Database Feature Usage). An arrow points from the text "Click the links to view detailed information." at the bottom to the "Storage" link in the screenshot.

Click the links to view  
detailed information.

# Creating a New Tablespace

**Create Tablespace**

**General** **Storage**

\* Name INVENTORY

**Extent Management**

Locally Managed     Permanent  
 Dictionary Managed     Set as default permanent tablespace  
 Temporary     Set as default temporary tablespace  
 Undo    Undo Retention Guarantee:  Yes  No

**Type**

**Status**

Read Write     Read Only     Offline

**Datafiles**

Use bigfile tablespace  
Tablespace can have only one datafile with no practical size limit.

Add Edit Remove

Select	Name	Directory	Size (MB)
<input checked="" type="radio"/>	inventory01.dbf	/u01/app/oracle/oradata/orcl/	50.00

**General** **Storage**

# Storage for Locally Managed Tablespaces

**Extent Allocation**

Automatic  
 Uniform

Size  KB

**Segment Space Management**

Automatic  
Objects in the tablespace automatically manage their free space. It offers high performance for free space management.

Manual  
Objects in the tablespace will manage their free space using free lists. It is provided for backward compatibility.

**Enable logging**

Yes  
Generate redo logs for creation of tables, indexes and partitions, and for subsequent inserts. Recoverable

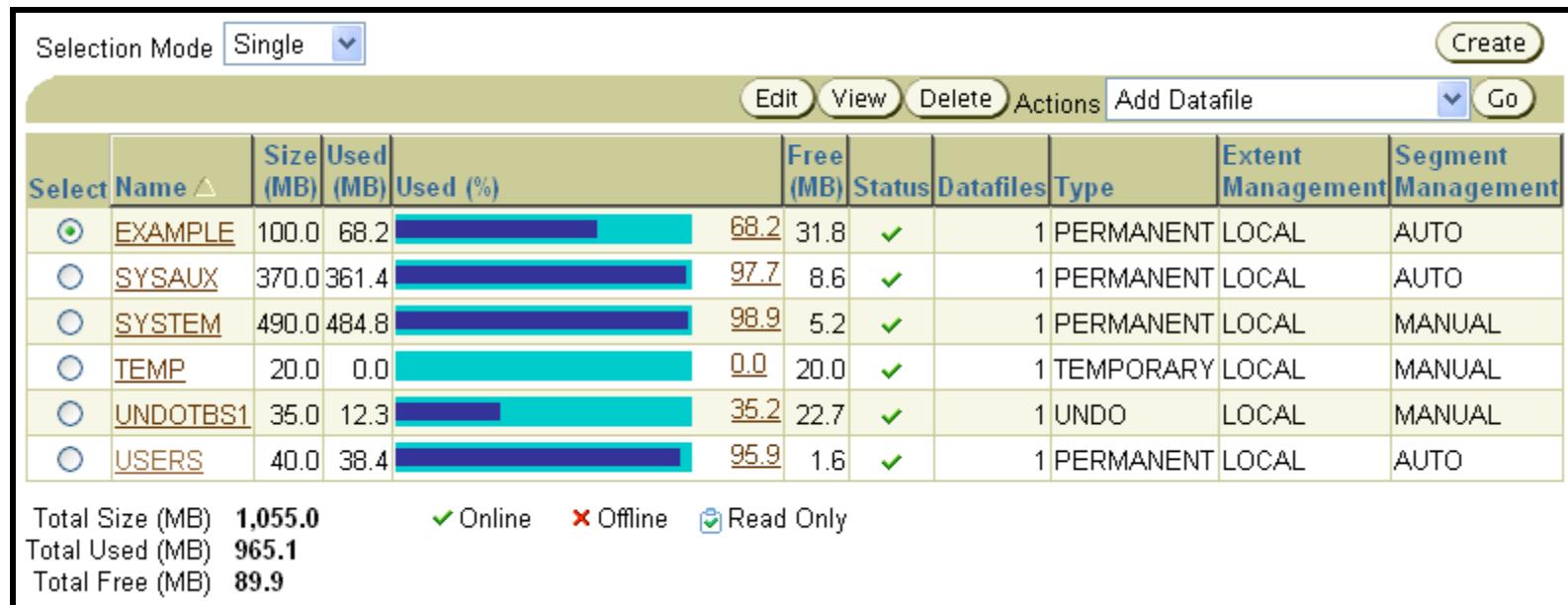
No  
Redo log entries are smaller, the above operations are not logged and not recoverable.

**Block information**

Block Size (B) 8192

# Tablespaces in the Preconfigured Database

- SYSTEM
- SYSAUX
- TEMP
- UNDOTBS1
- USERS
- EXAMPLE



# Altering a Tablespace

Database Instance: orcl.oracle.com > Tablespaces > Edit Tablespace: EXAMPLE      Logged in As DBA1

## Edit Tablespace: EXAMPLE

Actions

**General** [Storage](#) [Thresholds](#)

Name   
Bigfile tablespace

**Extent Management**

Locally Managed  
 Dictionary Managed

**Type**

Permanent  
 Set as default permanent tablespace

Temporary  
 Set as default temporary tablespace

Undo

**Status**

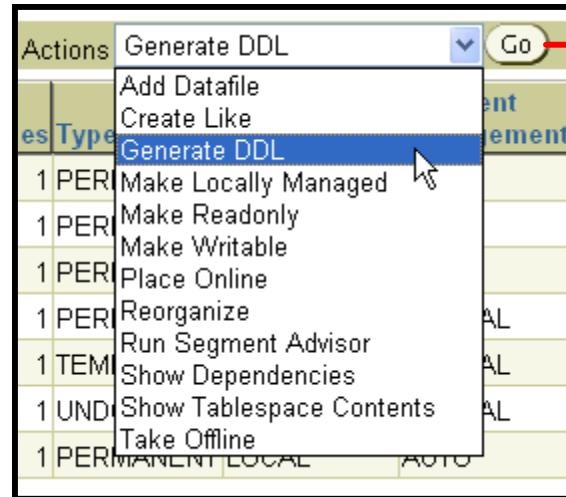
Read Write  
 Read Only  
 Offline

Offline Mode

**Datafiles**

Select	Name	Directory	Size (MB)	Used (MB)
<input checked="" type="checkbox"/>	example01.dbf	/u01/app/oracle/oradata/orcl/	100.00	68.25

# Actions with Tablespaces



## Show DDL

[Return](#)

```
CREATE SMALLFILE TABLESPACE "EXAMPLE" DATAFILE  
'/u01/app/oracle/oradata/orcl/example01.dbf' SIZE 100M REUSE AUTOEXTEND ON  
NEXT 640K MAXSIZE 32767M NOLOGGING EXTENT MANAGEMENT LOCAL SEGMENT SPACE  
MANAGEMENT AUTO
```

# Dropping Tablespaces



Select	Name ▲	Size (MB)	Used (MB)	Used (%)	Free (MB)	Status	Datafiles	Type	Extent Management	Segment Management
<input checked="" type="radio"/>	EXAMPLE	100.0	68.2	<div style="width: 68.2%; background-color: #00008B; height: 10px;"></div>	68.2	31.8	<input checked="" type="checkbox"/>	1	PERMANENT LOCAL	AUTO
<input type="radio"/>	INVENTORY	5.0	0.1	<div style="width: 0.1%; background-color: #00FFFF; height: 10px;"></div>	1.2	4.9	<input checked="" type="checkbox"/>	1	PERMANENT LOCAL	AUTO
<input type="radio"/>	SYSAUX	240.0	237.2	<div style="width: 98.8%; background-color: #00008B; height: 10px;"></div>	98.8	2.8	<input checked="" type="checkbox"/>	1	PERMANENT LOCAL	AUTO
<input type="radio"/>	SYSTEM	470.0	468.1	<div style="width: 99.6%; background-color: #00008B; height: 10px;"></div>	99.6	1.9	<input checked="" type="checkbox"/>	1	PERMANENT LOCAL	MANUAL
<input type="radio"/>	TEMP	20.0	0.0	<div style="width: 0%; background-color: #00FFFF; height: 10px;"></div>	0.0	20.0	<input checked="" type="checkbox"/>	1	TEMPORARY LOCAL	MANUAL
<input type="radio"/>	UNDOTBS1	35.0	9.6	<div style="width: 27.3%; background-color: #00008B; height: 10px;"></div>	27.3	25.4	<input checked="" type="checkbox"/>	1	UNDO LOCAL	MANUAL
<input type="radio"/>	USERS	5.0	3.0	<div style="width: 60%; background-color: #00008B; height: 10px;"></div>	60.0	2.0	<input checked="" type="checkbox"/>	1	PERMANENT LOCAL	AUTO

# Viewing Tablespace Information

```
SELECT tablespace_name, status, contents, logging, extent_management,  
allocation_type, segment_space_management  
FROM dba_tablespaces
```



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

```
SELECT ts#, name FROM v$tablespace
```



TS#	NAME
0	SYSTEM
1	UNDOTBS1
2	SYSAUX
4	USERS
3	TEMP
6	EXAMPLE
7	INVENTORY

# Gathering Storage Information

**Tablespaces**

Object Type **Tablespace**

**Search**  
Select an object type and optionally enter an object name to filter the data that is displayed in your results set.

Object Name

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

Selection Mode **Single**

Select	Name	Size (MB)	Used (MB)	Used (%)	Free (MB)	Status	Datafiles	Type	Actions
<input checked="" type="radio"/>	EXAMPLE	100.0	68.2	68.2	31.8	✓	1	PERMANENT	<input type="button" value="Add Datafile"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> <input type="button" value="Actions"/>
<input checked="" type="radio"/>	SYSAUX	550.0	542.4	98.6	7.6	✓	1	PERMANENT	<input type="button" value="Add Datafile"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> <input type="button" value="Actions"/>
<input checked="" type="radio"/>	SYSTEM	500.0	492.3	98.5	7.7	✓	1	PERMANENT	<input type="button" value="Add Datafile"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> <input type="button" value="Actions"/>
<input checked="" type="radio"/>	TEMP	20.0	0.0	0.0	20.0	✓	1	TEMPORARY	<input type="button" value="Add Datafile"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> <input type="button" value="Actions"/>
<input checked="" type="radio"/>	UNDOTBS1	110.0	1.4	1.4	108.6	✓	1	UNDO	<input type="button" value="Add Datafile"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Delete"/> <input type="button" value="Actions"/>

**Add Datafile**

- 
- 
- 
- 
- 
- 
- 
- 
- 
- 
- Take Offline**

# Viewing Tablespace Contents

Database Instance: EDRSR10P1\_orcl.us.oracle.com > Tablespaces > View Tablespace: EXAMPLE > Show Tablespace Contents

## Show Tablespace Contents

Size (MB)	100.0	Used (MB)	68.3	Extent Mgmt	LOCAL	Auto Extend	Yes
Block Size (KB)	8	Used (%)	68.3	Segment Mgmt	AUTO	Extents	836

### Segments

**Search**

Segment Name	Type	Minimum Size (KB)	Minimum Extents
<input type="text"/>	All Types	<input type="text"/>	<input type="text"/>

You can use the wildcard symbol (%) in the segment name.

Previous 1-10 of 418 Next 10

Segment Name	Type	Size (KB)	Extents
SH.CUSTOMERS	TABLE	12,288	27
SH.SUPPLEMENTARY_DEMOGRAPHICS	TABLE	4,096	19
OE.PRODUCT_DESCRIPTIONS	TABLE	3,072	18
SH.SALES.SALES_Q4_2001	TABLE PARTITION	2,048	17
SH.SALES.SALES_Q3_2001		1,024	16
SH.SALES.SALES_Q1_1999		1,024	16
SH.CUSTOMERS_PK		1,024	16
SH.SALES.SALES_Q2_2001		960	15
SH.SALES.SALES_Q1_2001		960	15
SH.SALES.SALES_Q1_2000		960	15

► Extent Map

**Extent Map**

Clicking the Highlight Extents button highlights the extent in the map. Clicking on a used extent in the map highlights the segment in the list.

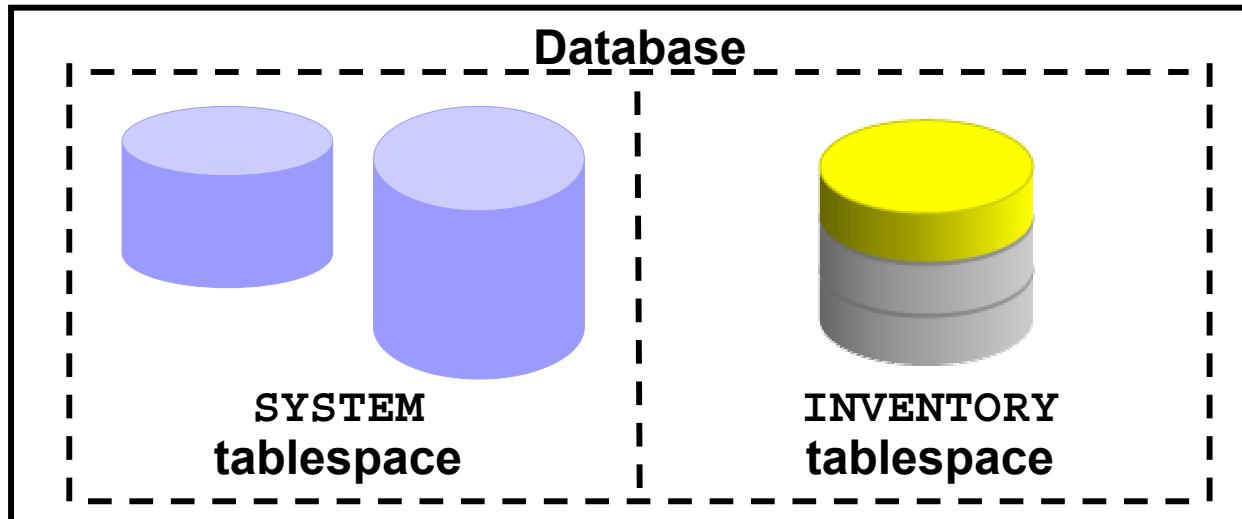
Header  
Used  
Free  
Selected  
Unmapped

Next 10

# Enlarging the Database

You can enlarge the database in the following ways:

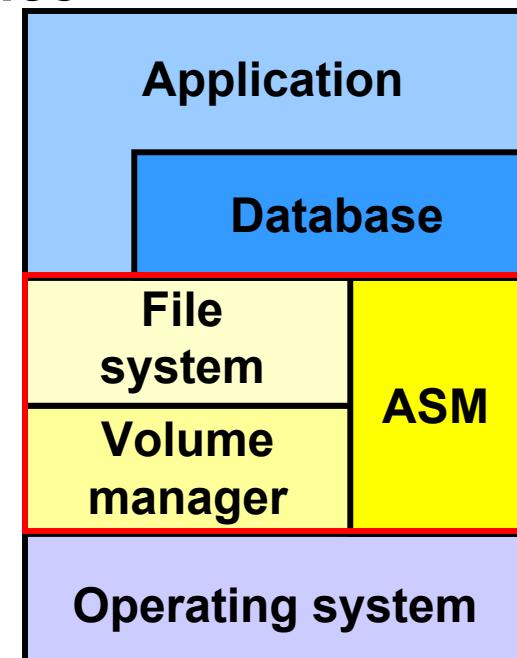
- Creating a new tablespace
- Adding a data file to an existing tablespace
- Increasing the size of a data file
- Providing for the dynamic growth of a data file



# What Is Automatic Storage Management?

## Automatic Storage Management

- Is a portable and high-performance cluster file system
- Manages Oracle database files
- Spreads data across disks to balance load
- Mirrors data
- Solves many storage management challenges

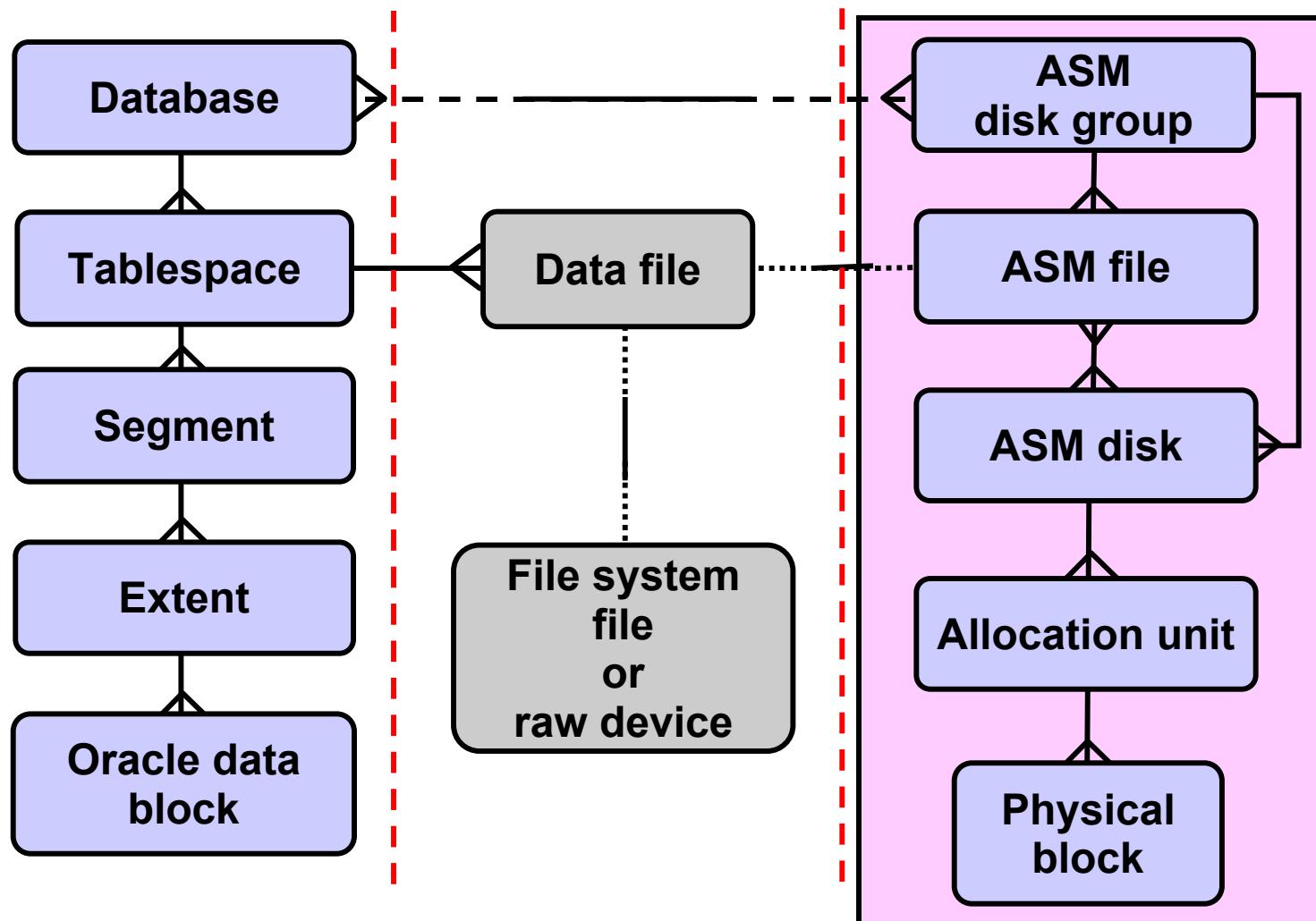


# **ASM: Key Features and Benefits**

## **ASM**

- Stripes files, but not logical volumes**
- Provides online disk reconfiguration and dynamic rebalancing**
- Allows for adjustable rebalancing speed**
- Provides redundancy on a per-file basis**
- Supports only Oracle database files**
- Is cluster aware**
- Is automatically installed**

# ASM: Concepts



# **Summary**

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

- **Describe how table row data is stored in blocks**
- **Define the purpose of tablespaces and data files**
- **Create and manage tablespaces**
- **Obtain tablespace information**
- **Describe the main concepts and functionality of Automatic Storage Management (ASM)**

# **Practice Overview: Managing Database Storage Structures**

**This practice covers the following topics:**

- **Creating tablespaces**
- **Gathering information about tablespaces**



# **Administering User Security**

# Objectives

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

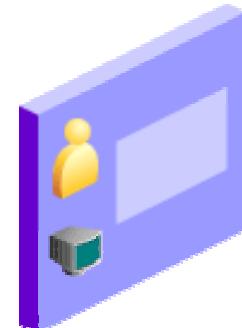
- **Create and manage database user accounts**
  - Authenticate users
  - Assign default storage areas (tablespaces)
- **Grant and revoke privileges**
- **Create and manage roles**
- **Create and manage profiles**
  - Implement standard password security features
  - Control resource usage by users

# Database User Accounts

> **User**  
Authentication  
Privilege  
Role  
Profile  
PW Security  
Quota

**Each database user account has:**

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



# Predefined Accounts: SYS and SYSTEM

- **The SYS account:**
  - Is granted the DBA role
  - Has all privileges with ADMIN OPTION
  - Is required for startup, shutdown, and some maintenance commands
  - Owns the data dictionary
  - Owns the Automatic Workload Repository (AWR)
- **The SYSTEM account is granted the DBA role.**
- **These accounts are not used for routine operations.**

# Creating a User

Create User

Show SQL Cancel OK

**General** Roles System Privileges Object Privileges Quotas Consumer Groups Switching Privileges Proxy Users

\* Name DHAMBY  
Profile HRPROFILE  
Authentication Password  
\* Enter Password \*\*\*\*\*  
\* Confirm Password \*\*\*\*\*  
For Password choice, the role is authorized via password.  
 Expire Password now  
Default Tablespace  
Temporary Tablespace   
  
Status  Locked  Unlocked

Select Administration > Schema > Users & Privileges > Users, and then click the Create button.

# Authenticating Users

User  
> **Authentication**  
Privilege  
Role  
Profile  
PW Security  
Quota



- **Password**
- **External**
- **Global**

## Edit User: HR

Actions

[General](#) [Roles](#) [System Privileges](#) [Object Privileges](#) [Quotas](#) [Consumer Groups](#) [Switching Privileges](#) [Proxy Users](#)

Name	HR
Profile	<input type="button" value="DEFAULT"/>
Authentication	<input type="button" value="Password"/> <input type="button" value=""/>
* Enter Password	<input type="password"/>
* Confirm Password	<input type="password"/>
For Password choice, the role is authorized via password.	
<input type="checkbox"/> Expire Password now	
Default Tablespace	USERS
Temporary Tablespace	TEMP
Status	<input checked="" type="radio"/> Locked <input type="radio"/> Unlocked

# **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**

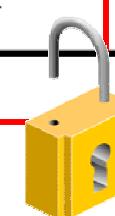
- **SYSBA and SYSOPER connections are authorized via password file or OS.**
  - Password file authentication records the DBA user by name.
  - OS authentication does not record the specific user.
  - OS authentication takes precedence over password file authentication for SYSDBA and SYSOPER.



# Unlocking a User Account and Resetting the Password

Select	UserName △	Account Status	Expiration Date	Default Tablespace	Temporary Tablespace	Profile	
⌚	<u>ANONYMOUS</u>	EXPIRED & LOCKED	May 2, 2005 3:24:45 PM PDT	SYS AUX	TEMP	DEFAULT	005 3:57:07 PM PST
⌚	<u>BI</u>	EXPIRED & LOCKED	May 2, 2005 3:24:45 PM PDT	USERS	TEMP	DEFAULT	May 2, 2005 3:20:28 PM PDT
⌚	<u>CTXSYS</u>	EXPIRED & LOCKED	May 2, 2005 3:24:45 PM PDT	SYS AUX	TEMP	DEFAULT	Mar 15, 2005 3:56:15 PM PST
⌚	<u>DBSNMP</u>	OPEN		SYS AUX	TEMP	MONITORING_PROFILE	Mar 15, 2005 3:47:59 PM PST
⌚	<u>DHAMBY</u>	OPEN		USERS	TEMP	HRPROFILE	May 5, 2005 8:43:27 PM PDT
⌚	<u>DIP</u>	EXPIRED & LOCKED		USERS	TEMP	DEFAULT	Mar 15, 2005 3:36:04 PM PST
⌚	<u>DMSYS</u>	EXPIRED & LOCKED	May 2, 2005 3:24:45 PM PDT	SYS AUX	TEMP	DEFAULT	Mar 15, 2005 3:55:30 PM PST
⌚	<u>EXFSYS</u>	EXPIRED & LOCKED	May 2, 2005 3:24:45 PM PDT	SYS AUX	TEMP	DEFAULT	Mar 15, 2005 3:54:58 PM PST
⌚	<u>HR</u>	OPEN		USERS	TEMP	DEFAULT	May 2, 2005 3:20:27 PM PDT

Select the user, and click Unlock User.



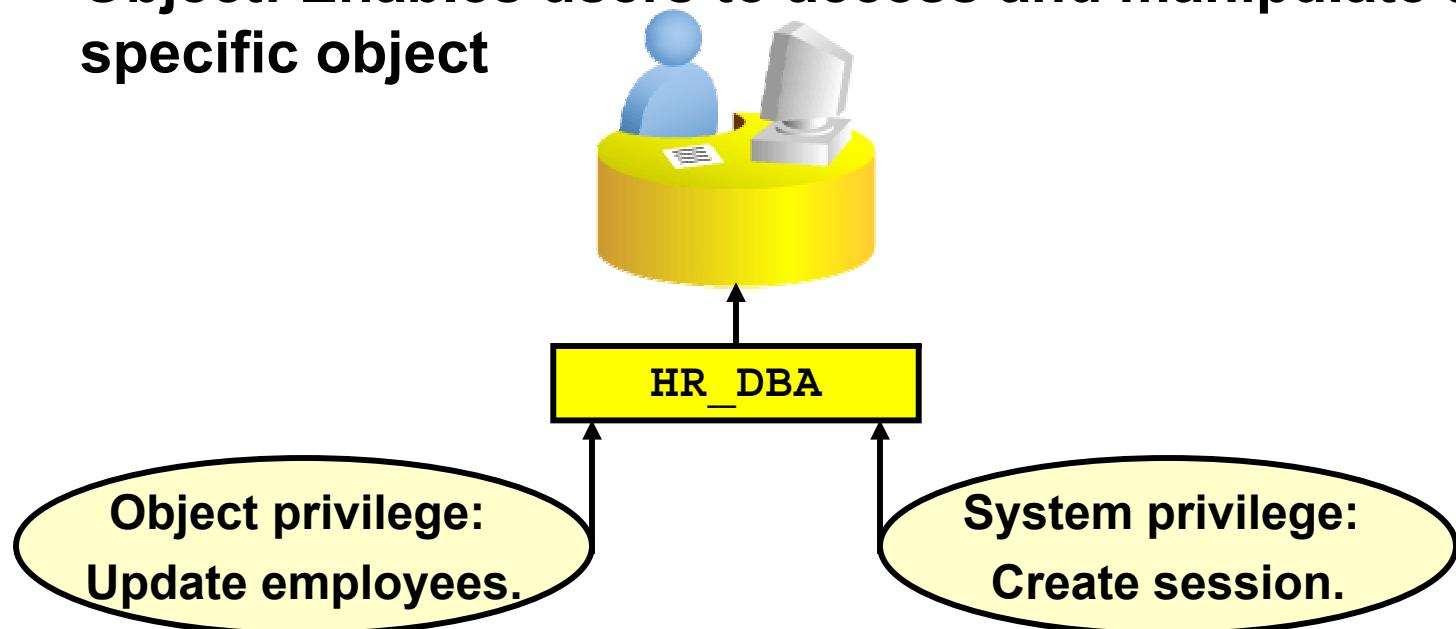
A red arrow points from the 'Select' column of the HR row to the 'Select' column of the ANONYMOUS row. Another red arrow points from the 'Unlock User' option in the Actions menu to the 'Unlock User' button in the 'Actions' column of the HR row.

# Privileges

User  
Authentication  
> **Privilege**  
Role  
Profile  
PW Security  
Quota

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



# System Privileges

**Edit User: HR**

Actions Create Like Go Show SQL Revert Apply

General Roles System Privileges Object Privileges Quotas Consumer Groups Switching Privileges Proxy Users

**System Privilege**

System Privilege	Admin Option
ALTER SESSION	<input type="checkbox"/>
CREATE DATABASE LINK	<input type="checkbox"/>
CREATE SEQUENCE	<input type="checkbox"/>
CREATE SESSION	<input type="checkbox"/>
CREATE SYNONYM	<input type="checkbox"/>
CREATE VIEW	<input type="checkbox"/>
UNLIMITED TABLESPACE	<input type="checkbox"/>

**Edit List**

Database Instance: orcl.oracle.com > Users > Edit User: HR

Logged in As SYS

**Modify System Privileges**

Available System Privileges

- ACCESS ANY WORKSPACE
- ADMINISTER ANY SQL TUNING SET
- ADMINISTER DATABASE TRIGGER
- ADMINISTER RESOURCE MANAGER
- ADMINISTER SQL TUNING SET
- ADVISOR
- ALTER ANY CLUSTER
- ALTER ANY DIMENSION
- ALTER ANY EVALUATION CONTEXT
- ALTER ANY INDEX

Selected System Privileges

- ALTER SESSION
- CREATE DATABASE LINK
- CREATE SEQUENCE
- CREATE SESSION
- CREATE SYNONYM
- CREATE VIEW
- UNLIMITED TABLESPACE

Cancel OK

The screenshot illustrates the Oracle Database User Management interface. At the top, there's a navigation bar with tabs: General, Roles, System Privileges (which is selected and highlighted in blue), Object Privileges, Quotas, Consumer Groups, Switching Privileges, and Proxy Users. Below the tabs is a toolbar with actions like 'Create Like', 'Go', 'Show SQL', 'Revert', and 'Apply'. On the right side of the toolbar, there's a button labeled 'Edit List' with a red box and arrow pointing to it. The main area shows a table of system privileges with checkboxes for each. Below this, a modal dialog titled 'Modify System Privileges' lists 'Available System Privileges' on the left and 'Selected System Privileges' on the right. The 'Selected' list contains the privileges that were checked in the main table above. The Oracle logo is at the bottom right.

# Object Privileges

The screenshot shows the Oracle Database Object Privileges interface. A red arrow points from the 'Object Type' dropdown menu in the main window down to the 'Add Table Object Privileges' dialog box.

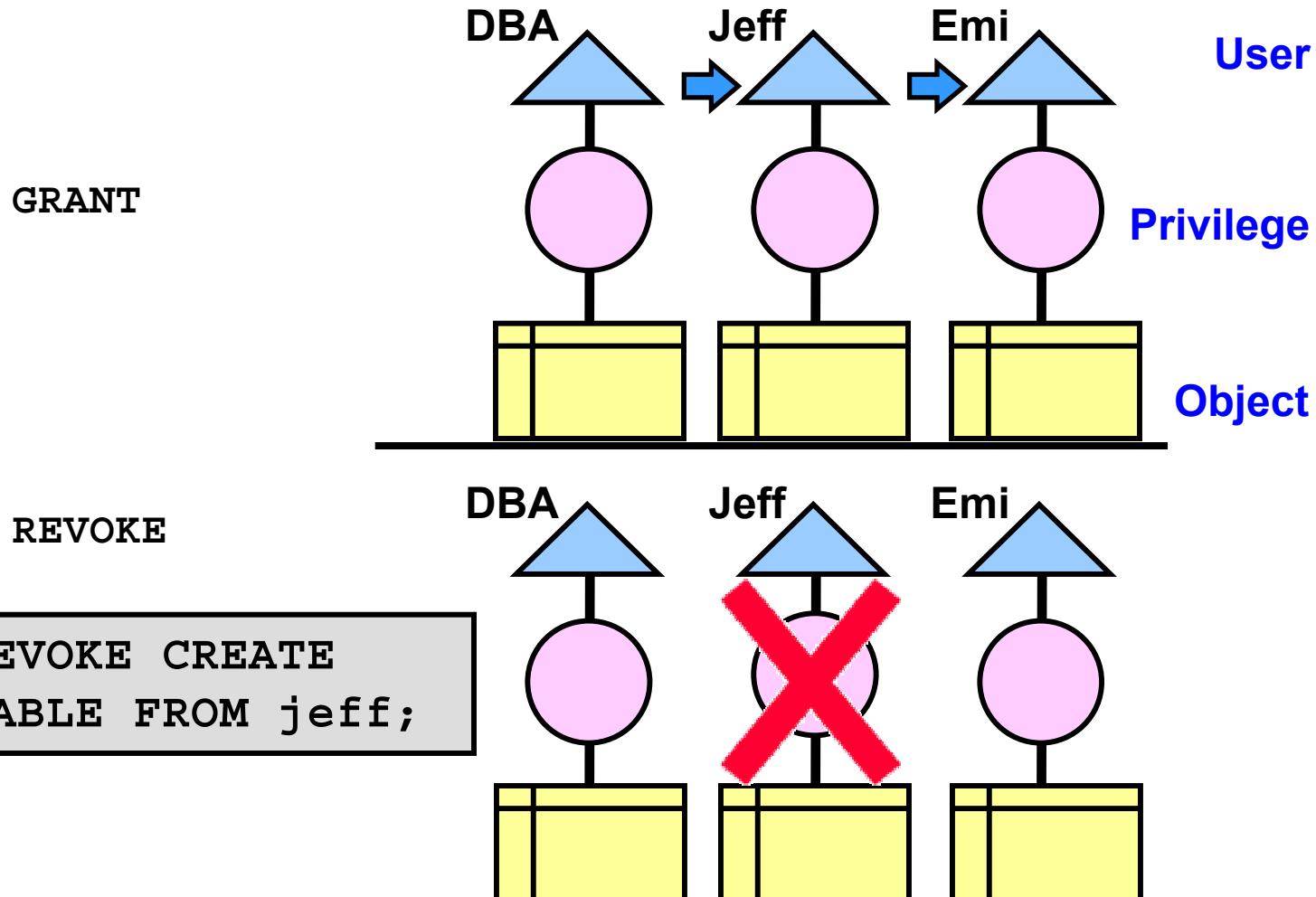
**Main Window (Object Privileges):**

- Header: Object Privileges, Quotas, Consumer Groups, Switching Privileges, Proxy Users.
- Toolbar: Select Object Type (Function), Add, Delete.
- Table: Shows a single row for DBMS\_STATS under Schema SYS.
- Actions: Create Like, Go, Show S.
- Bottom: Database | Setup | Preferences | Help | Logout.

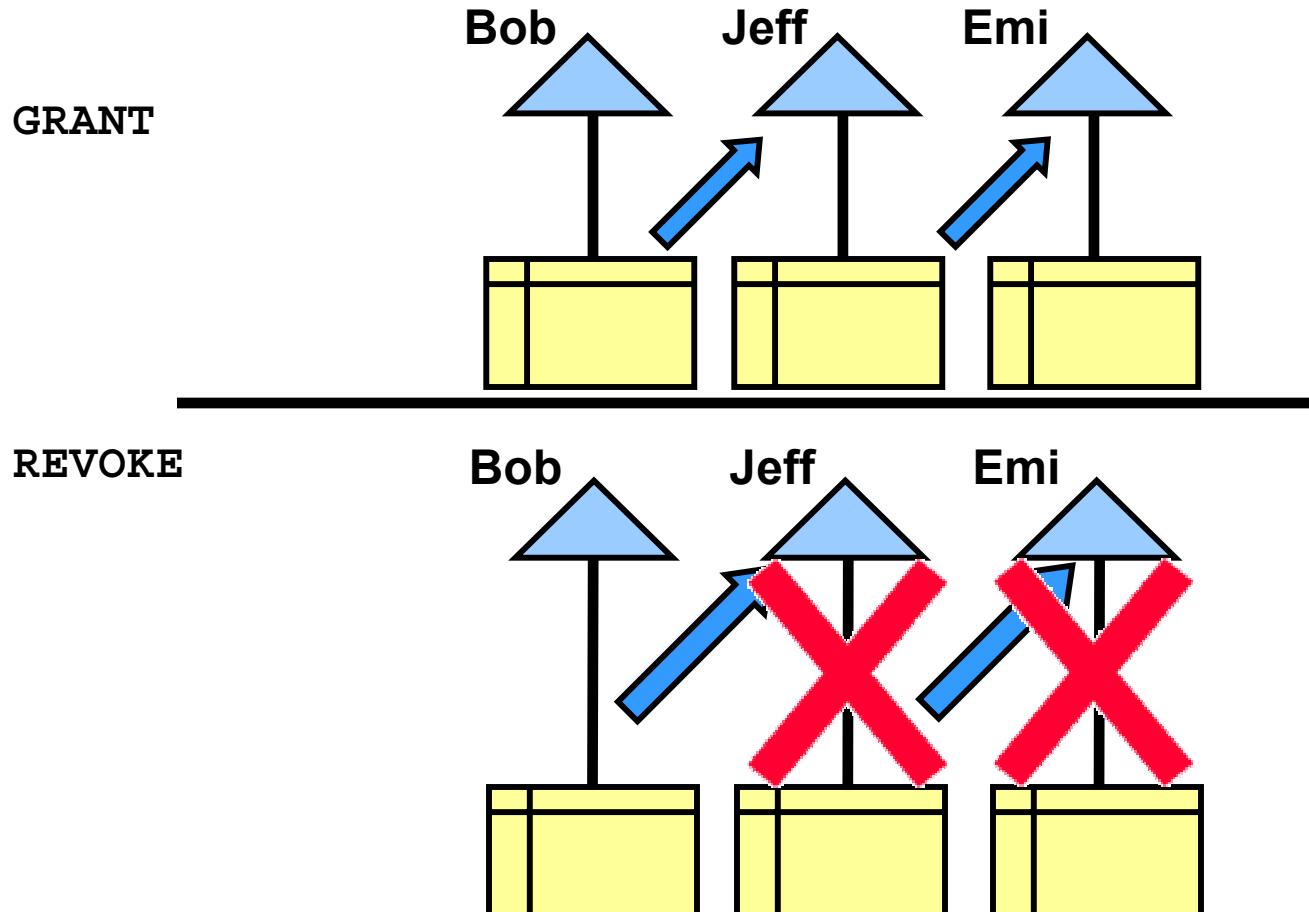
**Add Table Object Privileges Dialog:**

- \* Select Table Objects: OE.CUSTOMERS, OE.INVENTORIES, OE.ORDERS.
- (SchemaName.Table,...)
- Select object and then choose privileges to assign.
- Available Privileges: ALTER, DELETE, INDEX, INSERT, REFERENCES, UPDATE (with UPDATE selected).
- Selected Privileges: SELECT (with SELECT selected).
- Action buttons: Move, Move All, Remove, Remove All.

# Revoking System Privileges with ADMIN OPTION



# Revoking Object Privileges with GRANT OPTION



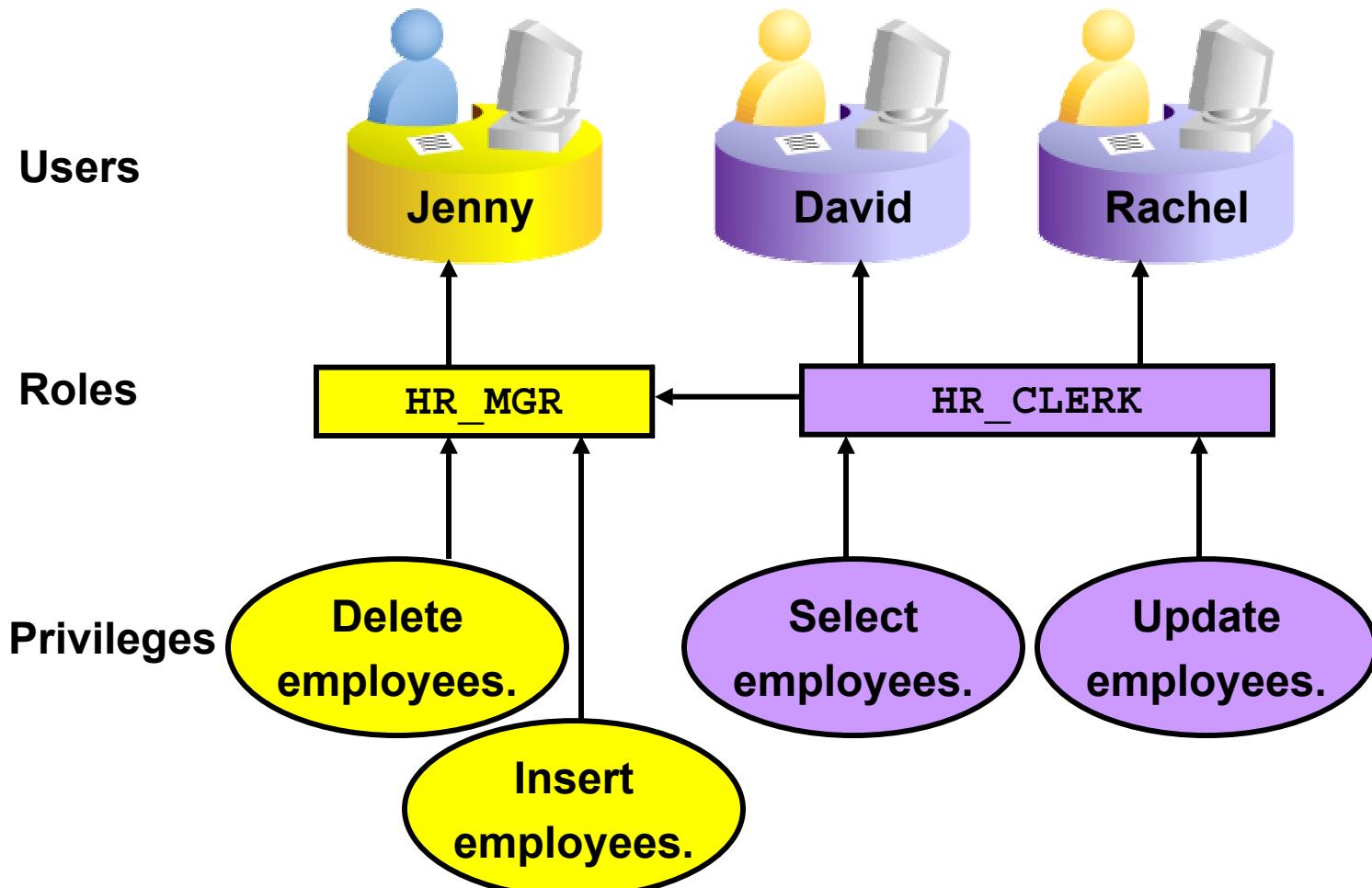
# Benefits of Roles

- **Easier privilege management**
- **Dynamic privilege management**
- **Selective availability of privileges**

User  
Authentication  
Privilege  
> **Role**  
Profile  
PW Security  
Quota



# Assigning Privileges to Roles and Roles to Users



# Predefined Roles

CONNECT	CREATE SESSION
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
DBA	Most system privileges, several other roles. Do not grant to nonadministrators.
SELECT_CATALOG_ROLE	No system privileges, but HS_ADMIN_ROLE and over 1,700 object privileges on the data dictionary

# Creating a Role

Create Role

Show SQL Cancel OK

General Roles System Privileges Object Privileges Consumer Groups Switching Privileges

Select Object Type: Function Add

Function Java Class Java Source Job Classes Jobs Package Procedure Programs Queue Schedules Sequence Snapshot Synonym Table Table Column Types View View Column Workspace

OK

Select Object Privilege Schema

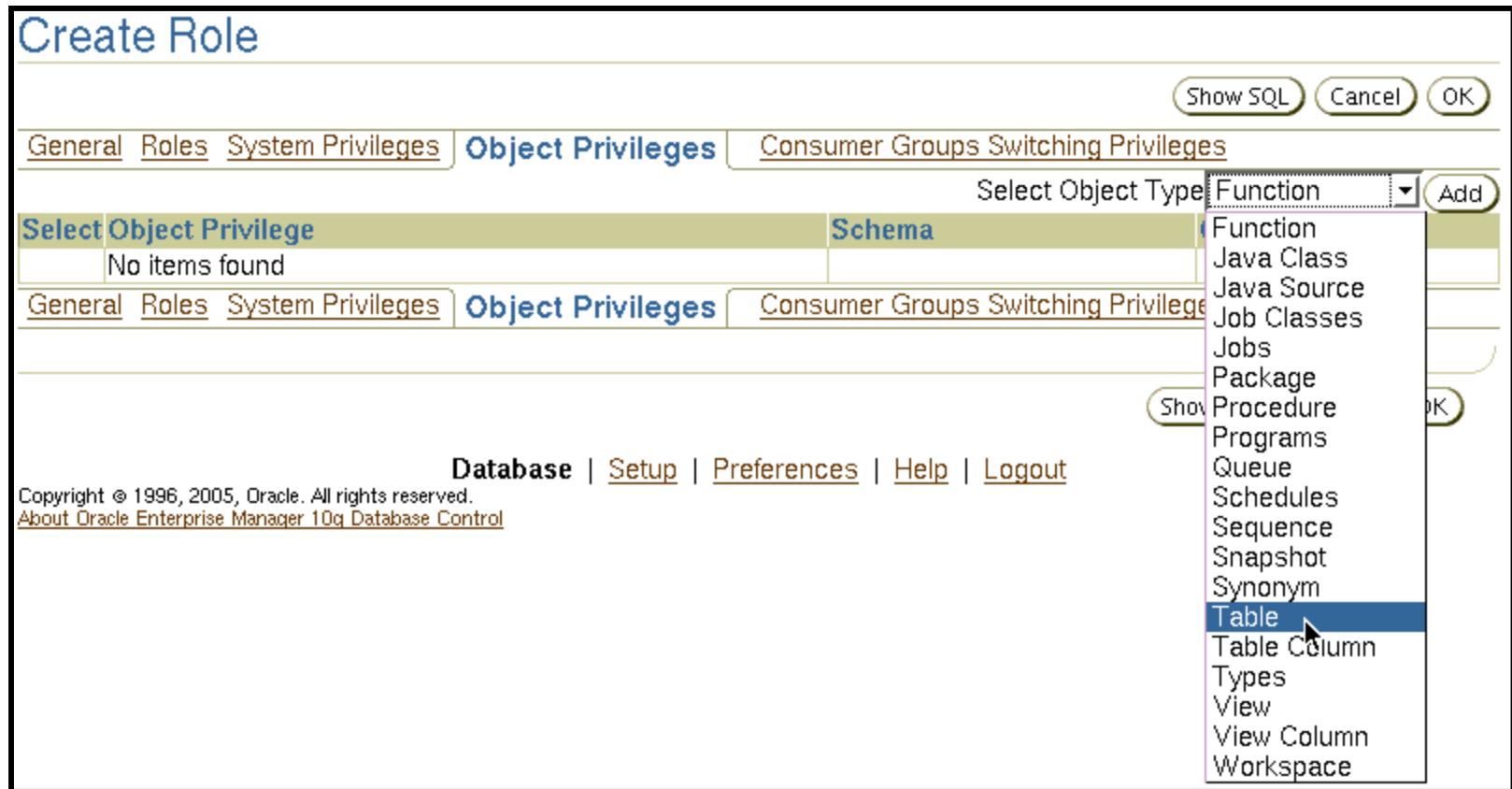
No items found

Show

General Roles System Privileges Object Privileges Consumer Groups Switching Privileges

Database | Setup | Preferences | Help | Logout

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[About Oracle Enterprise Manager 10g Database Control](#)



Select Administration > Schema > Users & Privileges > Roles.

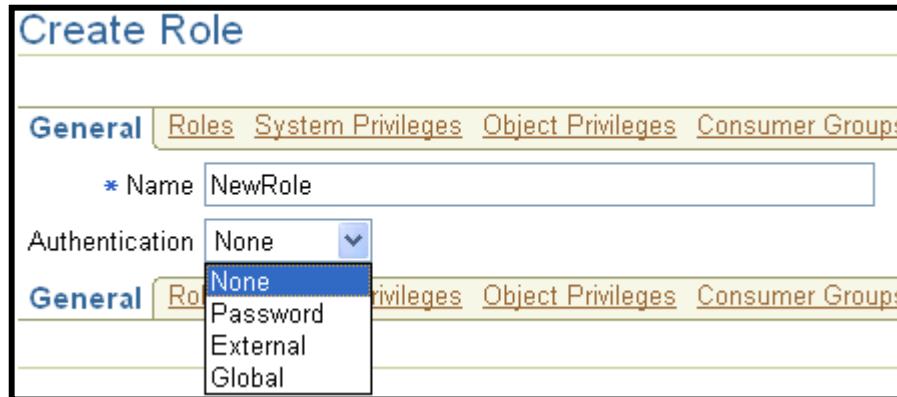
ORACLE®

# Secure Roles

- Roles may be nondefault.

```
SET ROLE vacationdba;
```

- Roles may be protected through authentication.



- Roles may also be secured programmatically.

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

# Assigning Roles to Users

Database Instance: orcl.oracle.com > Users > Edit User: HR      Logged in As DBA1

## Modify Roles

Available Roles

- AQ\_ADMINISTRATOR\_ROLE
- AQ\_USER\_ROLE
- AUTHENTICATEDUSER
- CONNECT
- CTXAPP
- DBA**
- DELETE\_CATALOG\_ROLE
- EJBCLIENT
- EXECUTE\_CATALOG\_ROLE
- EXP\_FULL\_DATABASE

Selected Roles

- RESOURCE

Move    Move All    Remove    Remove All

Cancel    OK



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# Profiles and Users

**Users are assigned only one profile at any given time.**

## Profiles:

- **Control resource consumption**
- **Manage account status and password expiration**

User  
Authentication  
Privilege  
Role  
➤ **Profile**  
**PW Security**  
**Quota**

Create Profile

Show SQL Cancel OK

**General** Password

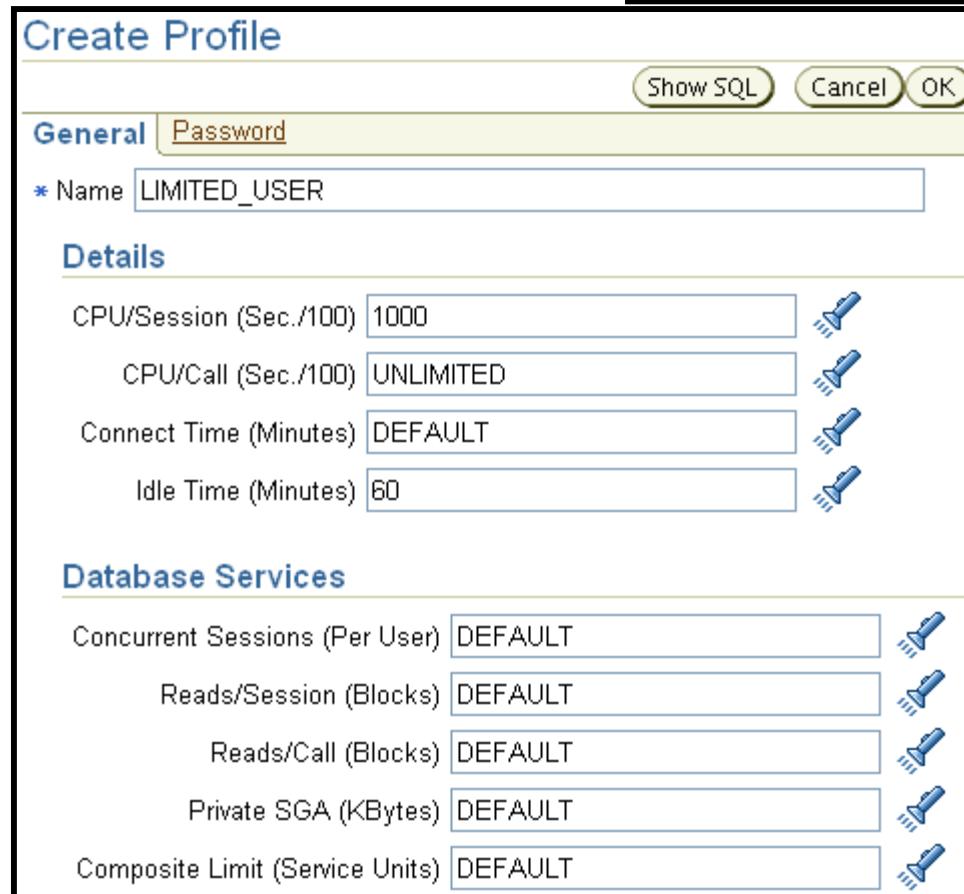
\* Name

**Details**

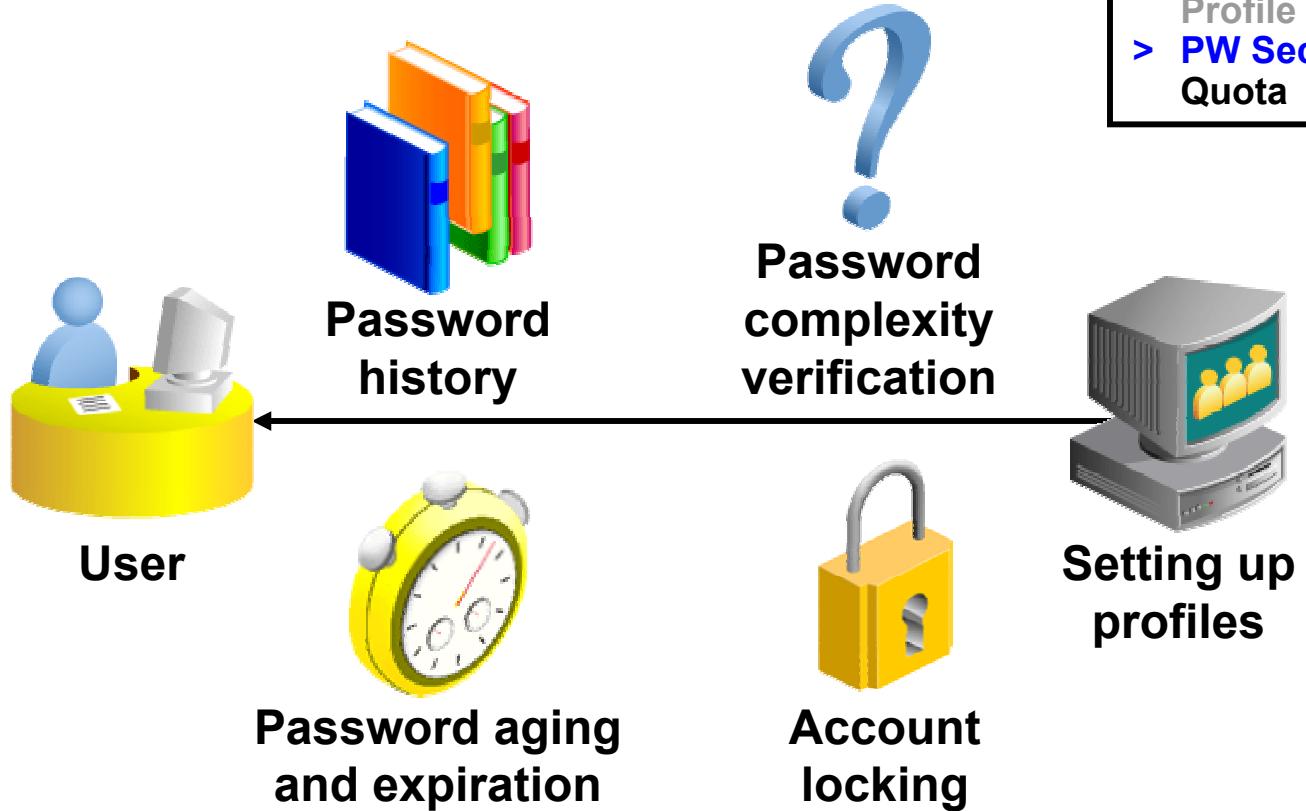
CPU/Session (Sec./100)    
CPU/Call (Sec./100)    
Connect Time (Minutes)    
Idle Time (Minutes)  

**Database Services**

Concurrent Sessions (Per User)    
Reads/Session (Blocks)    
Reads/Call (Blocks)    
Private SGA (KBytes)    
Composite Limit (Service Units)  



# Implementing Password Security Features



**Note: Do not use profiles that cause the passwords for SYS, SYSMAN, and DBSNMP to expire and, subsequently, cause those accounts to get locked.**

# Creating a Password Profile

Create Profile

General    Password

Show SQL Cancel OK

**Password**

Expire in (days)  

Lock (days past expiration)  

**History**

Number of passwords to keep  

Number of days to keep for  

**Complexity**

Complexity function  

**Failed Login**

Number of failed login attempts to lock after  

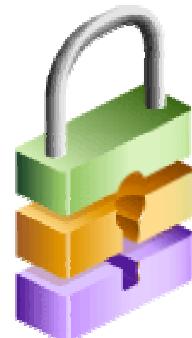
Number of days to lock for  

# **Supplied Password Verification Function: VERIFY\_FUNCTION**

**The supplied password verification function enforces these password restrictions:**

- The minimum length is four characters.
- The password cannot be the same as the username.
- The password must have at least one alphabetic, one numeric, and one special character.
- The password must differ from the previous password by at least three letters.

**Tip: Use this function as a template to create your own customized password verification.**



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# Assigning Quota to Users

User  
Authentication  
Privilege  
Role  
Profile  
PW Security  
> Quota

**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

Edit User: HR

Show SQL Revert Apply

General Roles System Privileges Object Privileges Quotas Consumer Groups Proxy Users

Tablespace	Quota	Value	Unit
EXAMPLE	Value ▾	250	MBytes ▾
SYSAUX	None ▾	0	MBytes ▾
SYSTEM	None ▾	0	MBytes ▾
TEMP	None ▾	0	MBytes ▾
UNDOTBS1	None ▾	0	MBytes ▾
USERS (Default)	Unlimited ▾	0	MBytes ▾

# 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

# **Practice Overview: Administering Users**

**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



# **Managing Schema Objects**

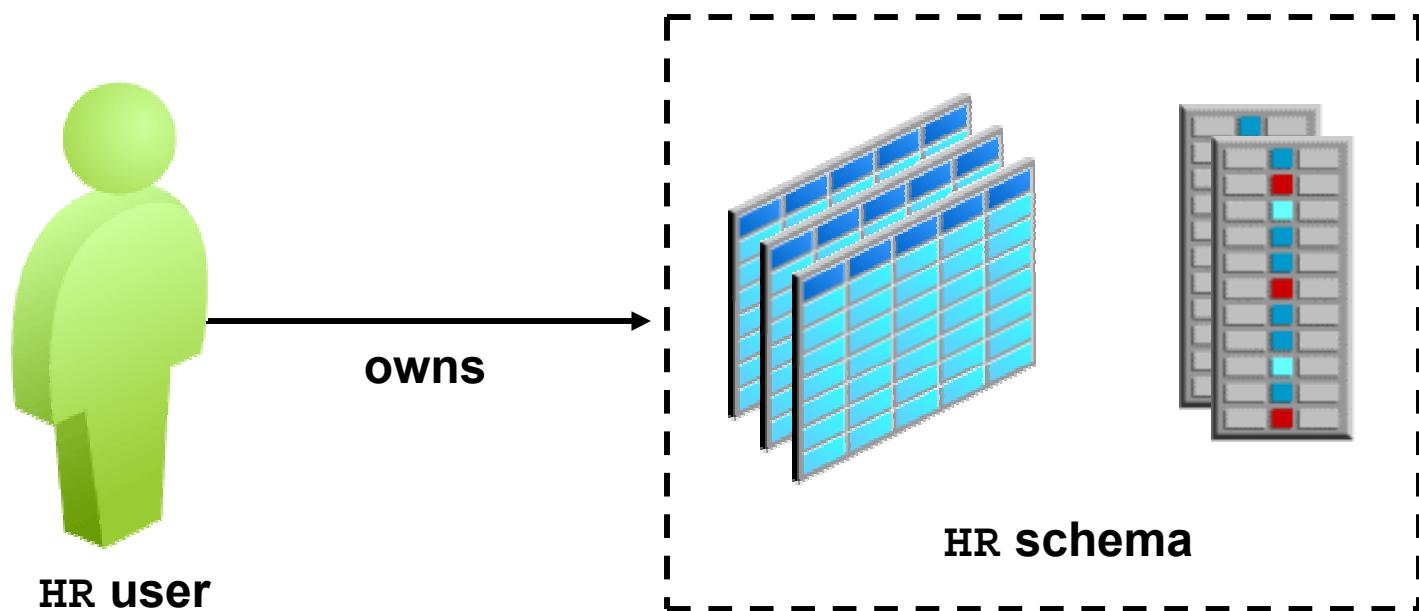
# Objectives

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

- Define schema objects and data types
- Create and modify tables
- Define constraints
- View the columns and contents of a table
- Create indexes
- Create views
- Create sequences
- Explain the use of temporary tables
- Use the data dictionary

# What Is a Schema?

- > Schema
- Constraints
- Indexes
- Views
- Sequences
- Temp Tables
- Data Dict



# Accessing Schema Objects

Database Instance: orcl.oracle.com

Home Performance Administration Maintenance

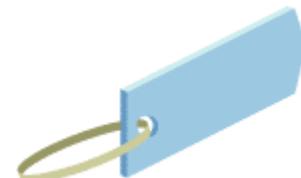


Schema

<b>Database Objects</b>	<b>Programs</b>	<b>XML Database</b>
<a href="#">Tables</a>	<a href="#">Packages</a>	<a href="#">Configuration</a>
<a href="#">Indexes</a>	<a href="#">Package Bodies</a>	<a href="#">Resources</a>
<a href="#">Views</a>	<a href="#">Procedures</a>	<a href="#">Access Control Lists</a>
<a href="#">Synonyms</a>	<a href="#">Functions</a>	<a href="#">XML Schemas</a>
<a href="#">Sequences</a>	<a href="#">Triggers</a>	<a href="#">XMLType Tables</a>
<a href="#">Database Links</a>	<a href="#">Java Classes</a>	<a href="#">XMLType Views</a>
<a href="#">Directory Objects</a>	<a href="#">Java Sources</a>	
<a href="#">Reorganize Objects</a>		
<b>Users &amp; Privileges</b>	<b>Materialized Views</b>	<b>BI &amp; OLAP</b>
<a href="#">Users</a>	<a href="#">Materialized Views</a>	<a href="#">Dimensions</a>
<a href="#">Roles</a>	<a href="#">Materialized View Logs</a>	<a href="#">Cubes</a>
<a href="#">Profiles</a>	<a href="#">Refresh Groups</a>	<a href="#">OLAP Dimensions</a>
<a href="#">Audit Settings</a>		<a href="#">Measure Folders</a>

# Naming Database Objects

- **The length of names must be from 1 to 30 bytes, with these exceptions:**
  - Names of databases are limited to 8 bytes.
  - Names of database links can be as long as 128 bytes.
- Nonquoted names cannot be Oracle-reserved words.
- Nonquoted names must begin with an alphabetic character from your database character set.
- Quoted names are not recommended.



# Specifying Data Types in Tables

## Common data types:

- **CHAR (*size* [BYTE | CHAR]): Fixed-length character data of *size* bytes or characters**
- **VARCHAR2 (*size* [BYTE | CHAR]): Variable-length character string having a maximum length of *size* bytes or characters**
- **DATE: Valid date ranging from January 1, 4712 B.C. through A.D. December 31, 9999**
- **NUMBER (*p*, *s*): Number with precision *p* and scale *s***

ABC



42

# Creating and Modifying Tables

The screenshot shows the Oracle Database Table Creation Wizard. The top navigation bar includes tabs for General, Constraints, Storage, Options, and Partitions. The General tab is selected, showing fields for Name (jobs), Schema (shopowner), and Tablespace (USERS). A red box highlights the Name field with the instruction: "Specify the table name and schema." Below this, the Organization is set to Standard, Heap Organized, and the Define Using option is Column Specification.

**Specify the column names, data types, and lengths.**

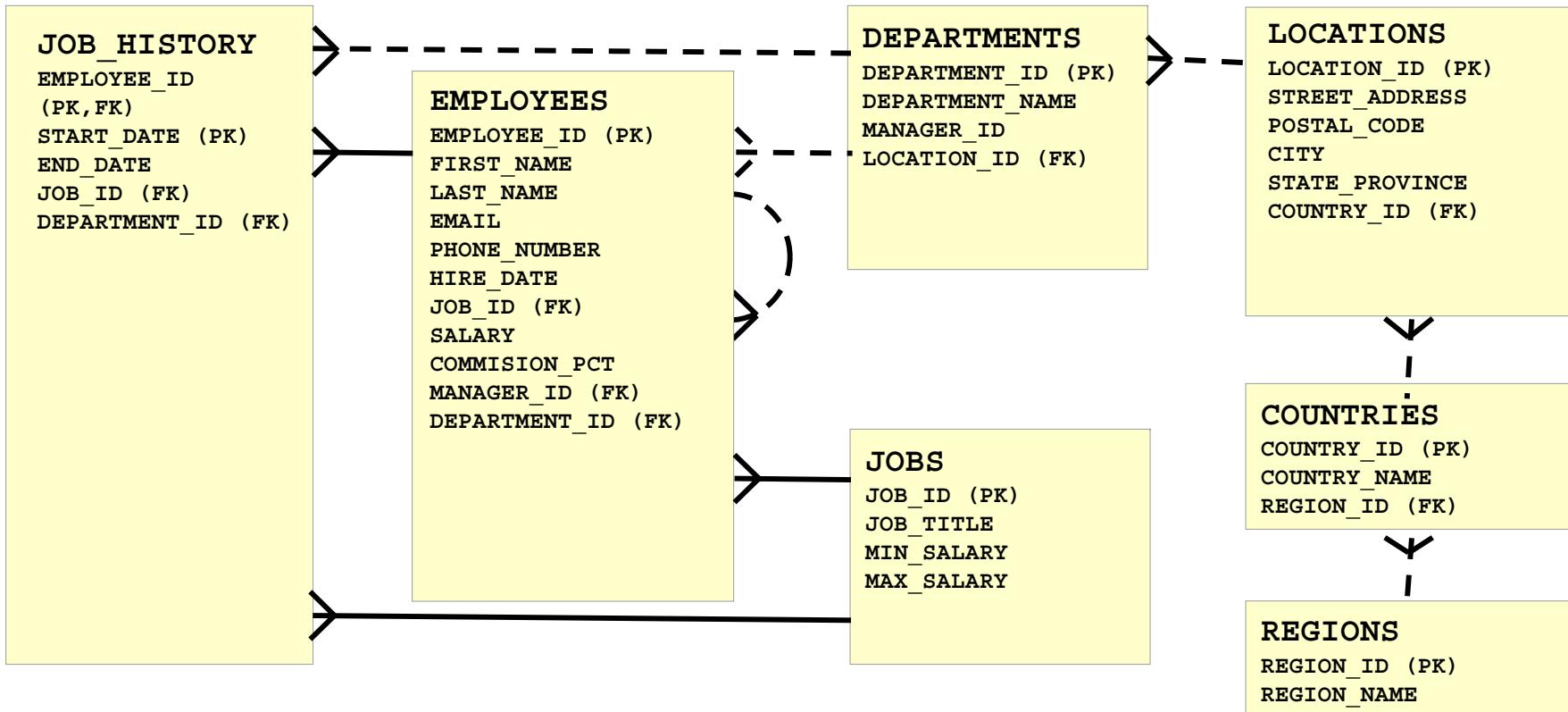
The Columns tab displays a grid for defining table columns. The columns are Select, Name, Data Type, and Size. Five rows are shown:

Select	Name	Data Type	Size
<input checked="" type="radio"/>	job_id	NUMBER	5
<input type="radio"/>	job_title	VARCHAR2	30
<input type="radio"/>	min_salary	NUMBER	6
<input type="radio"/>	max_salary	NUMBER	6
<input type="radio"/>		VARCHAR2	

An arrow points from the text "Specify the column names, data types, and lengths." to the Name column header of the grid. The bottom of the grid has a button labeled "Add 5 Table Columns".

# Understanding Data Integrity

Schema  
> Constraints  
Indexes  
Views  
Sequences  
Temp Tables  
Data Dict



# Defining Constraints

## Add UNIQUE Constraint

[Cancel](#)

[Continue](#)

Up to 32 columns can make up a UNIQUE key constraint. The unique key columns constitute a unique identifier for each row in the table.

### Definition

Name

### Table Columns

#### Available Columns

COUNTRY\_ID  
REGION\_ID

- Move
- Move All
- Remove
- Remove All

#### Selected Columns

COUNTRY\_NAME

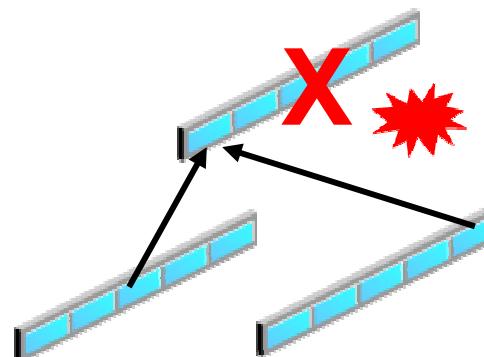
- 
- 
- 
-

# Constraint Violations

Examples of how a constraint can be violated are:

- Inserting a duplicate primary key value
- Deleting the parent of a child row in a referential integrity constraint
- Updating a column to a value that is out of the bounds of a check constraint

101	...
102	...
103	...



ID	AGE
...	22
...	49
...	16
...	5

# Constraint States

DISABLE  
NOVALIDATE



DISABLE  
VALIDATE



ENABLE  
NOVALIDATE



ENABLE  
VALIDATE



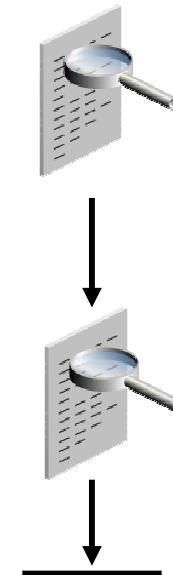
# Constraint Checking

Constraints are checked at the time of:

- Statement execution, for *nondeferred* constraints
- COMMIT, for *deferred* constraints

**Case: DML statement, followed by COMMIT**

- 1 Nondeferred constraints checked
- 2 COMMIT issued
- 3 Deferred constraints checked
- 4 COMMIT complete



# Creating Constraints with SQL: Examples

a

```
ALTER TABLE countries  
ADD (UNIQUE(country_name) ENABLE NOVALIDATE);
```

b

```
ALTER TABLE employees ADD CONSTRAINT pk PRIMARY KEY  
(employee_id)
```

c

```
CREATE TABLE t1 (pk NUMBER PRIMARY KEY, fk NUMBER, c1 NUMBER,  
c2 NUMBER,  
CONSTRAINT ri FOREIGN KEY (fk) REFERENCES t1, CONSTRAINT ck1  
CHECK (pk > 0 and c1 > 0));
```

# Viewing the Columns in a Table

View Table: HR.DEPARTMENTS

Actions Create Like

**General**

Name	DEPARTMENTS
Schema	HR
Tablespace	EXAMPLE
Organization	Standard, Heap Organized

**Columns**

	Name	Data Type	Size	Scale	Not NULL	Default Value
✓	DEPARTMENT_ID	NUMBER	4		<input checked="" type="checkbox"/>	
	DEPARTMENT_NAME	VARCHAR2	30		<input checked="" type="checkbox"/>	
	MANAGER_ID	NUMBER	6		<input type="checkbox"/>	
	LOCATION_ID	NUMBER	4		<input type="checkbox"/>	

✓ Indicates a Primary Key column

# Viewing the Contents of a Table

View Data for Table: HR.REGIONS

Query `SELECT "REGION_ID", "REGION_NAME" FROM "HR"."REGIONS"`

Result

REGION_ID	REGION_NAME
1	Europe
2	Americas
3	Asia
4	Middle East and Africa

Refine Query OK

# Actions with Tables

The screenshot shows the Oracle Database interface for managing tables. On the left, a sidebar titled 'Actions' lists various database operations. The 'Create Index' option is highlighted with a blue selection bar and a red arrow points from it to the 'Create Index' dialog box on the right.

**Create Index Dialog (Right Side):**

- General Tab:** Contains fields for Name (highlighted in yellow), Schema (HR), Tablespace (<Default>), and Index Type (Standard - B-tree selected). Buttons include 'Show SQL', 'Schedule Job', 'Cancel', and 'OK'.
- Indexed Table Object:** Shows 'Index On' set to 'Table' and 'Table Name' set to 'HR.EMPLOYEES'. A 'Populate Columns' button is available.
- TIP:** A note states: "TIP The indexed columns and their orders are indicated by the Order field".
- Table Columns:** A table listing columns from the HR.EMPLOYEES table with sorting orders:

Column Name	Data Type	Sorting Order	Order
EMPLOYEE_ID	NUMBER	ASC	
FIRST_NAME	VARCHAR2	ASC	
LAST_NAME	VARCHAR2	ASC	
EMAIL	VARCHAR2	ASC	

# Dropping a Table

**Dropping a table removes:**

- **Data**
  - **Table structure**
  - **Database triggers**
  - **Corresponding indexes**
  - **Associated object privileges**
- ```
DROP TABLE hr.employees PURGE;
```

**Optional clauses for the DROP TABLE statement:**

- **CASCADE CONSTRAINTS: Dependent referential integrity constraints**
- **PURGE: No flashback possible**

# Truncating a Table

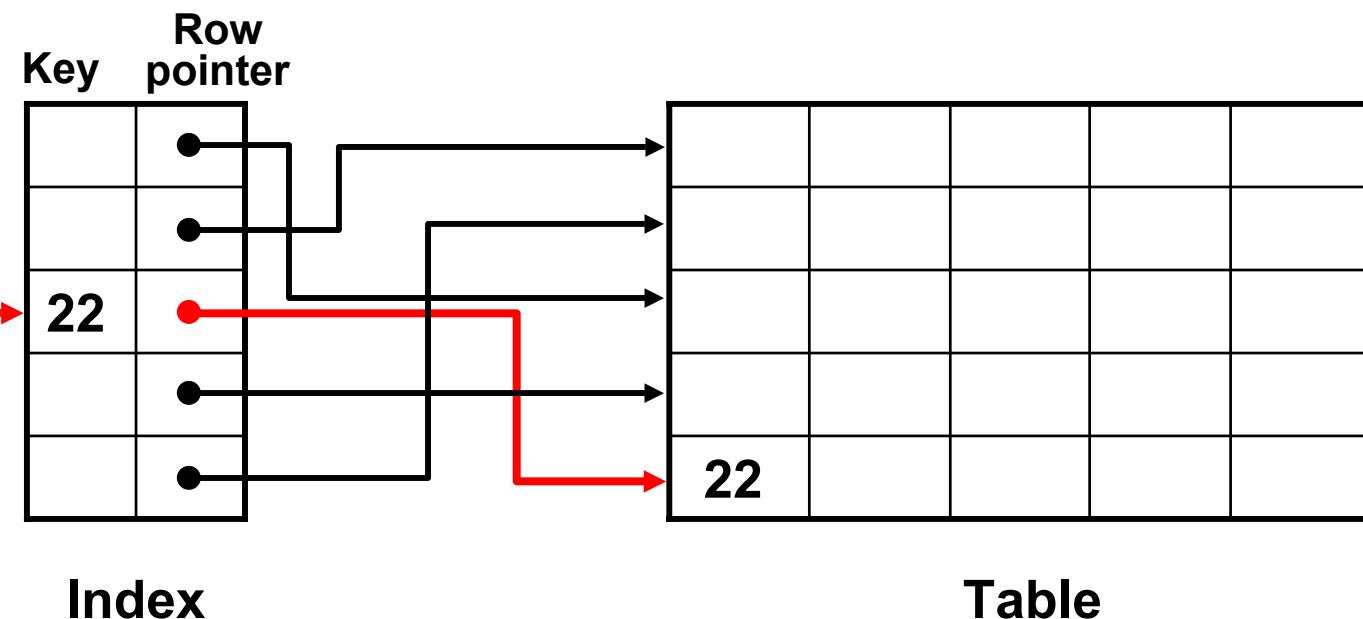
```
TRUNCATE TABLE hr.employees;
```

- Truncating a table makes its row data unavailable, and optionally releases used space.
- Corresponding indexes are truncated.

# Indexes

Schema  
Constraints  
> **Indexes**  
Views  
Sequences  
Temp Tables  
Data Dict

... WHERE key = 22

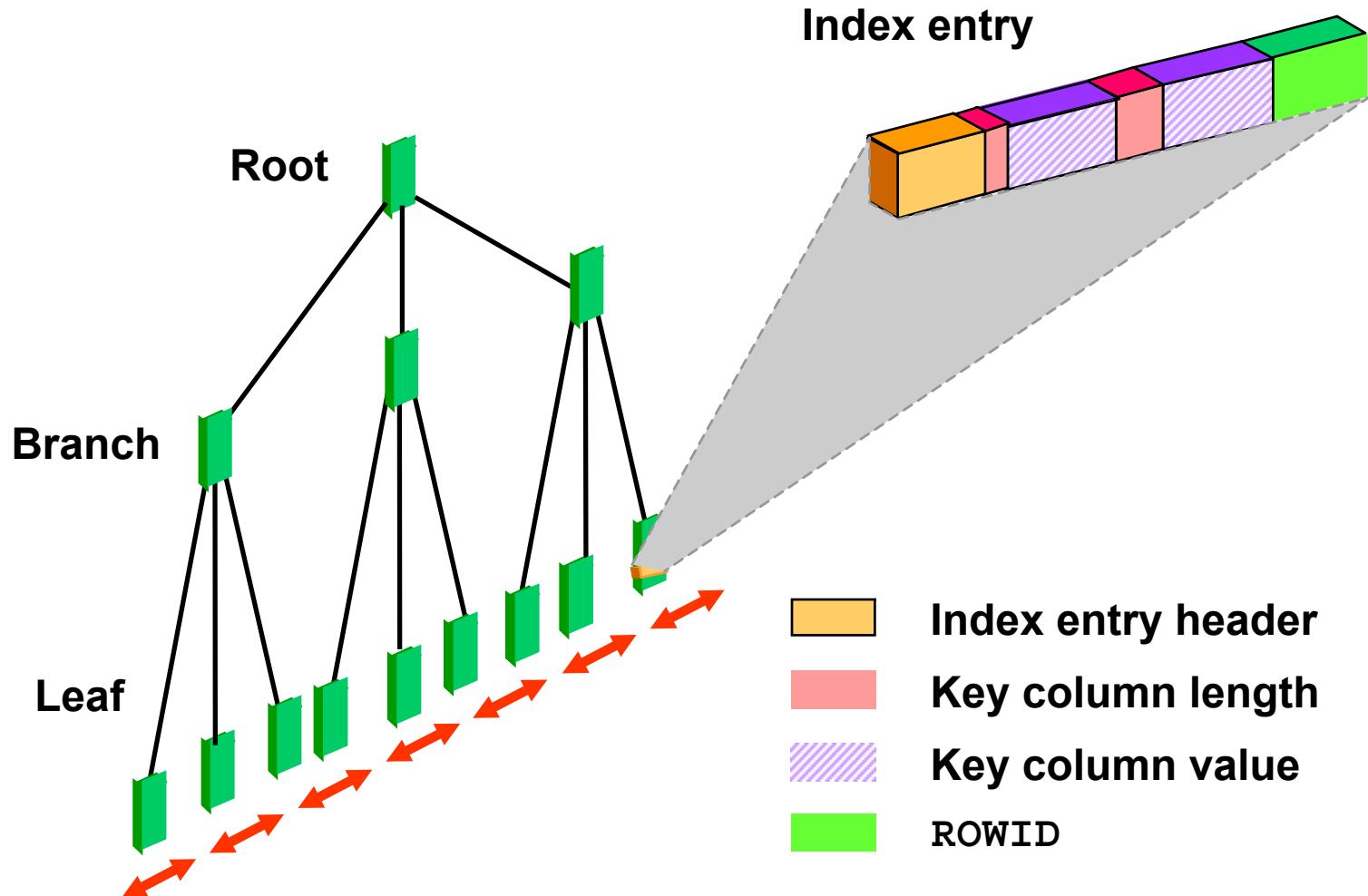


# Types of Indexes

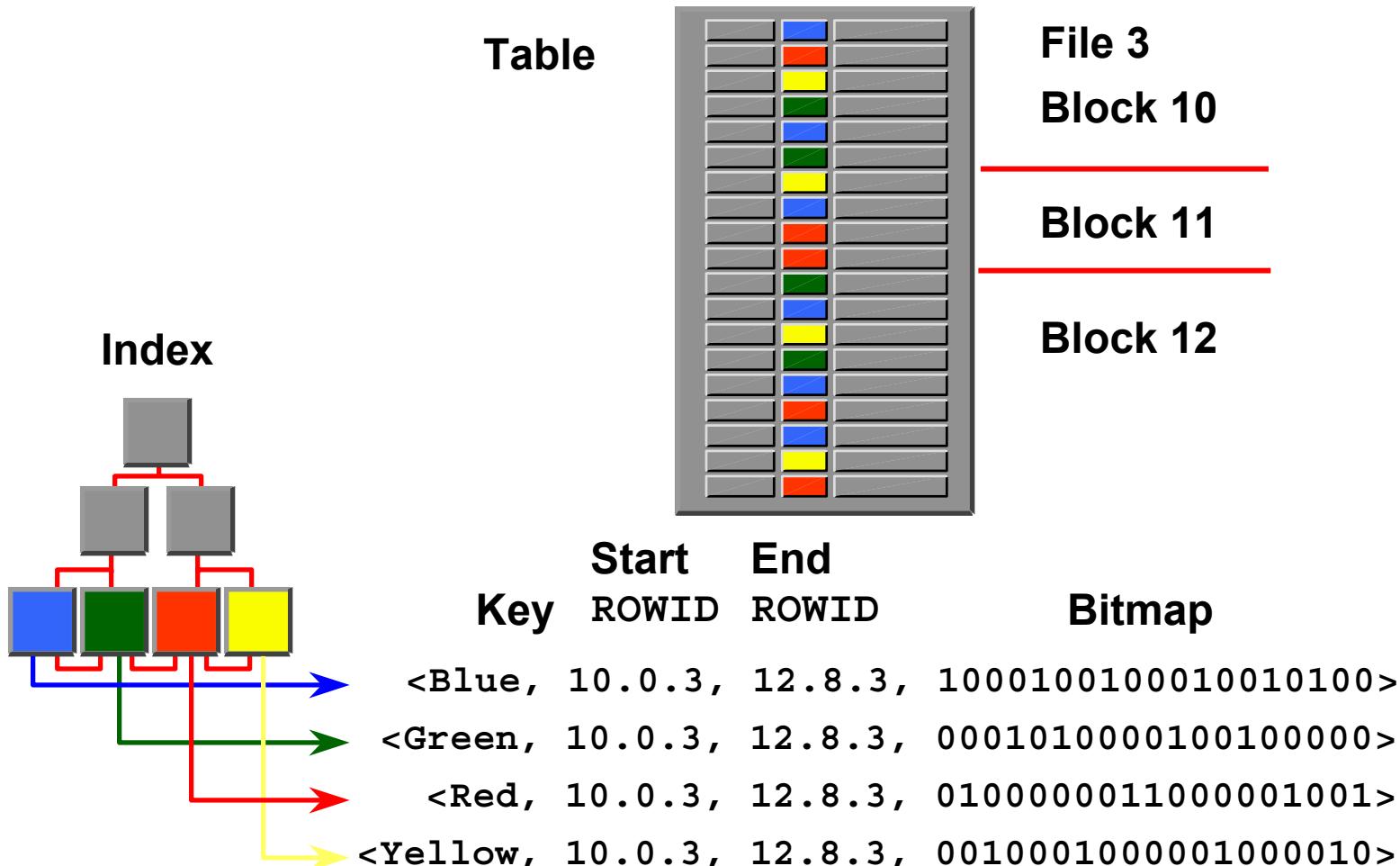
**These are several types of index structures available to you, depending on the need:**

- **A B-tree index is in the form of a binary tree and is the default index type.**
- **A bitmap index has a bitmap for each distinct value indexed, and each bit position represents a row that may or may not contain the indexed value. This is best for low-cardinality columns.**

# B-Tree Index



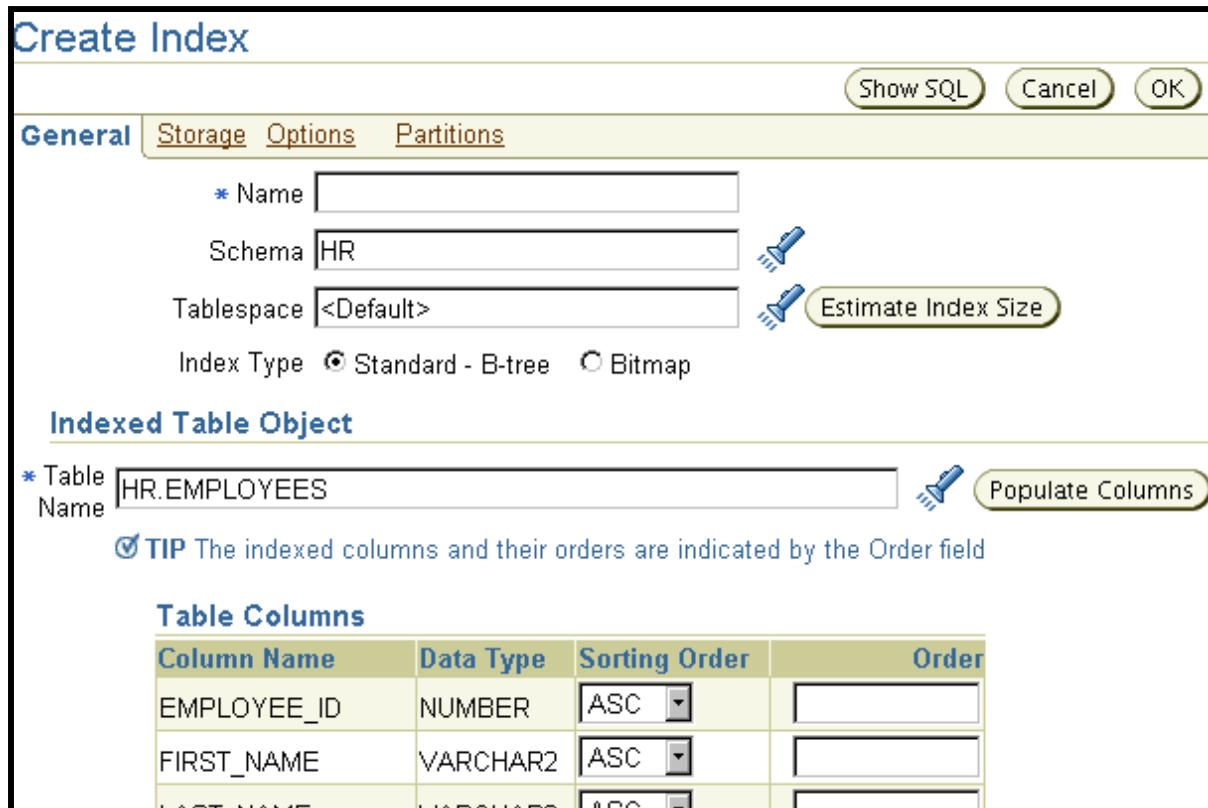
# Bitmap Indexes



# Index Options

- A **unique index** ensures that every indexed value is unique.
- An index can have its key values stored in ascending or descending order.
- A **reverse key index** has its key value bytes stored in reverse order.
- A **composite index** is one that is based on more than one column.
- A **function-based index** is an index based on a function's return value.
- A **compressed index** has repeated key values removed.

# Creating Indexes



```
CREATE INDEX my_index ON  
employees(last_name, first_name);
```

# What Is a View?

Schema  
Constraints  
Indexes  
> Views  
...

LOCATION table

| LOCATION_ID | STREET_ADDRESS          | POSTAL_CODE | CITY      | STATE_PROVINCE  | CO |
|-------------|-------------------------|-------------|-----------|-----------------|----|
| 2200        | 12-98 Victoria Street   | 2901        | Sydney    | New South Wales | AU |
| 2800        | Rua Frei Caneca 1360    | 01307-002   | Sao Paulo | Sao Paulo       | BR |
| 1000        | 1297 Via Cola di Rie    | 00989       | Roma      |                 | IT |
| 1100        | 93091 Calle della Testa | 10934       | Venice    |                 | IT |

COUNTRY table

| CO | COUNTRY_NAME | REGION_ID |
|----|--------------|-----------|
| AR | Argentina    | 2         |
| AU | Australia    | 3         |
| BE | Belgium      | 1         |
| BR | Brazil       | 2         |

View

| LOCATION_ID | COUNTRY_NAME |
|-------------|--------------|
| 2200        | Australia    |
| 2800        | Brazil       |

```
CREATE VIEW v AS SELECT location_id, country_name FROM
locations l, countries c
WHERE l.country_id = c.country_id AND c.country_id in
('AU', 'BR');
```

# Creating Views

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

## Create View

Show SQL    Cancel    OK

**General** Options Object

\* Name STAFF

\* Schema HR

Aliases

**CREATE OR REPLACE VIEW "HR"."STAFF" AS SELECT EMPLOYEE\_ID,  
LAST\_NAME, JOB\_ID, MANAGER\_ID, DEPARTMENT\_ID  
FROM EMPLOYEES**

Replace the view if exists

\* Query Text

```
SELECT EMPLOYEE_ID, LAST_NAME, JOB_ID, MANAGER_ID,  
DEPARTMENT_ID  
FROM EMPLOYEES
```

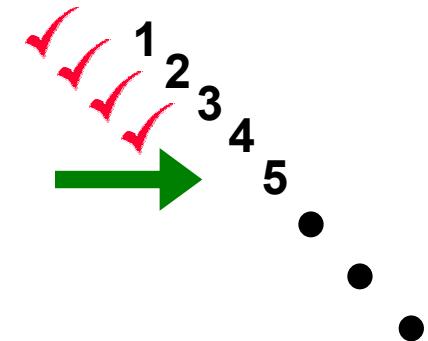
The screenshot shows the Oracle Database 'Create View' dialog. In the 'General' tab, the 'Name' field is set to 'STAFF' and the 'Schema' field is set to 'HR'. A red arrow points from the 'Show SQL' button to a highlighted section of the dialog containing the generated SQL code. The code is: **CREATE OR REPLACE VIEW "HR"."STAFF" AS SELECT EMPLOYEE\_ID, LAST\_NAME, JOB\_ID, MANAGER\_ID, DEPARTMENT\_ID FROM EMPLOYEES**. Below the code, there is a checked checkbox labeled 'Replace the view if exists'. The 'Query Text' field at the bottom contains the same SQL code. The 'Show SQL' button is highlighted with a yellow background.

# Sequences

Schema  
Constraints  
Indexes  
Views  
> Sequences  
Temp Tables  
Data Dict

A sequence is a mechanism for automatically generating integers that follow a pattern.

- A sequence has a name, which is how it is referenced when the next value is requested.
- A sequence is not associated with any particular table or column.
- The progression can be ascending or descending.
- The interval between numbers can be of any size.
- A sequence can cycle when a limit is reached.



# Creating a Sequence

## Create Sequence

Show SQL Cancel OK

### General

\* Name ABC\_SEQ

\* Schema HR

### Show SQL

Return

```
CREATE SEQUENCE "HR"."ABC_SEQ" CYCLE NOORDER CACHE 20  
MAXVALUE 100 MINVALUE 1 INCREMENT BY 5 START WITH 10
```

### Values

\* Maximum Value  Value   Unlimited

\* Minimum Value  Value   Unlimited

\* Interval

\* Initial

### Options

Cycle Values - Sequence will wrap around on reaching limit

Order Values - Sequence numbers will be generated in order

### Cache Options

Use Cache

Cache Size

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# Using a Sequence

## Workspace

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

Clear

```
INSERT INTO local_temp VALUES  
  (local_temp_id.nextval, sysdate, 8, 20);
```

Execute

Load Script

Save Script

Cancel

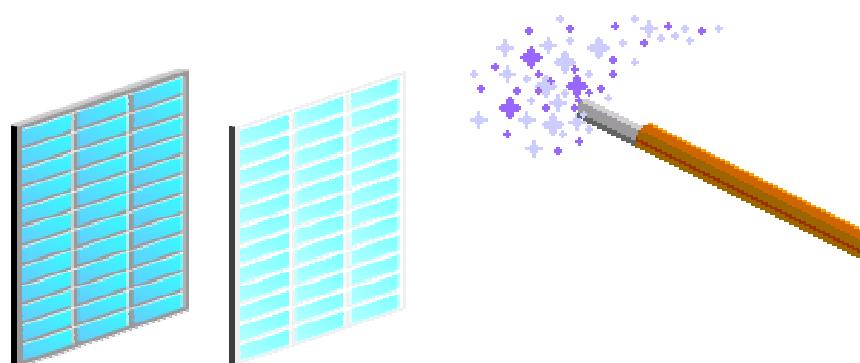
1 row created.

# Temporary Tables

Schema  
Constraints  
Indexes  
Views  
Sequences  
> **Temp Tables**  
Data Dict

A temporary table:

- Provides storage of data that is automatically cleaned up when the session or transaction ends
- Provides private storage of data for each session
- Is available to all sessions for use without affecting each other's private data



# Temporary Tables: Considerations

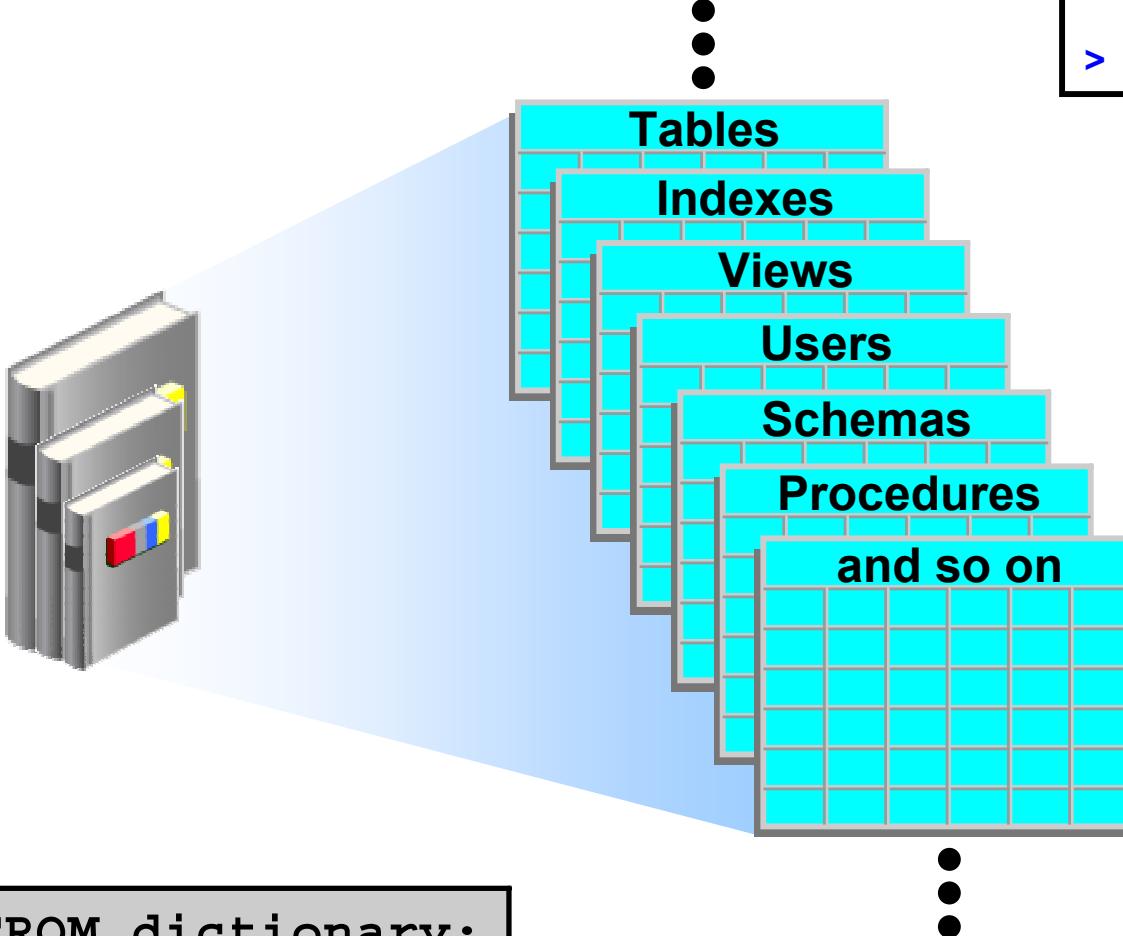
- **Use the GLOBAL TEMPORARY clause to create temporary tables:**

```
CREATE GLOBAL TEMPORARY TABLE employees_temp  
ON COMMIT PRESERVE ROWS  
AS SELECT * FROM employees;
```

- **Use the TRUNCATE TABLE command to delete the contents of the table.**
- **You can create the following on temporary tables:**
  - Indexes
  - Views
  - Triggers

# Data Dictionary: Overview

Schema  
Constraints  
Indexes  
Views  
Sequences  
Temp Tables  
> Data Dict



```
SELECT * FROM dictionary;
```

# Data Dictionary Views

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

# Data Dictionary: Usage Examples

a

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

b

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

c

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

d

```
DESCRIBE dba_indexes;
```

# Summary

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

- **Define schema objects and data types**
- **Create and modify tables**
- **Define constraints**
- **View the columns and contents of a table**
- **Create indexes**
- **Create views**
- **Create sequences**
- **Explain the use of temporary tables**
- **Use the data dictionary**

# **Practice Overview: Administering Schema Objects**

**This practice covers the following topics:**

- **Creating tables with columns**
- **Creating constraints:**
  - Primary Key
  - Foreign Key
  - Check constraint
- **Creating indexes**

# 8

## Managing Data and Concurrency

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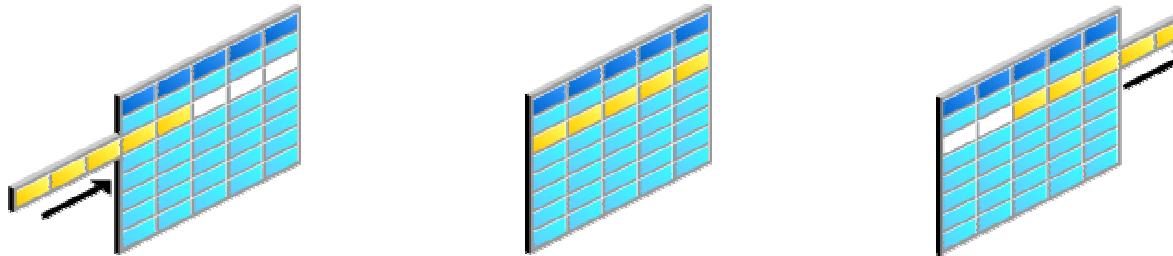
# Objectives

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

- **Manage data through the use of SQL**
- **Identify and administer PL/SQL objects**
- **Describe triggers and triggering events**
- **Monitor and resolve locking conflicts**

# Manipulating Data Through SQL

> SQL  
PL/SQL  
Locks



```
SQL> INSERT INTO employees VALUES
  2  (9999,'Bob','Builder','bob@abc.net',NULL,SYSDATE,
  3  'IT_PROG',NULL,NULL,100,90);

1 row created.

SQL> UPDATE employees SET SALARY=6000
  2 WHERE EMPLOYEE_ID = 9999;

1 row updated.

SQL> DELETE from employees
  2 WHERE EMPLOYEE_ID = 9999;

1 row deleted.
```

# The INSERT Command

- **Create one row at a time.**
- **Insert many rows from another table.**

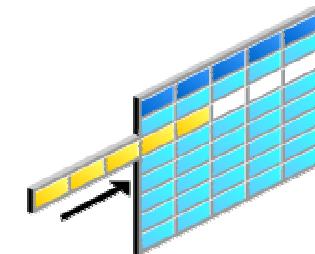
**Workspace**

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

```
insert into dept_80
(select * from employees
where department_id = 80)
```

Execute   Load Script   Save Script   Cancel

34 rows created.



# The UPDATE Command

**Use the UPDATE command to change zero or more rows of a table.**

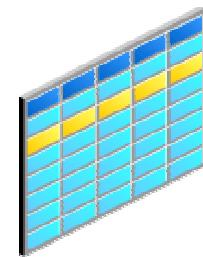
**Workspace**

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

```
update employees
set salary = salary * 1.1
where department_id = 90;
```

Execute   Load Script   Save Script   Cancel

4 rows updated.



# The DELETE Command

**Use the DELETE command to remove zero or more rows from a table.**

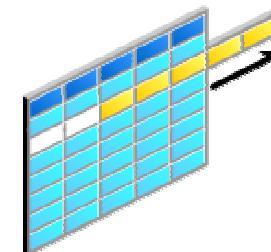
**Workspace**

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

```
delete from employees  
where department_id = 200
```

Execute   Load Script   Save Script   Cancel

0 rows deleted.



# The MERGE Command

**Use the MERGE command to perform both INSERT and UPDATE in a single command.**

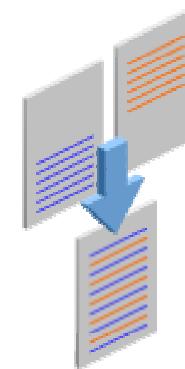
Workspace

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

```
MERGE INTO jobs j
  USING (SELECT * FROM jobs_acquisition) a
  ON (j.job_id = a.job_id)
  WHEN MATCHED THEN UPDATE SET j.job_title = a.job_title
  WHEN NOT MATCHED THEN INSERT
    (j.job_id, j.job_title, j.min_salary, j.max_salary)
    VALUES (a.job_id, a.job_title, a.min_salary, a.max_salary)
```

Execute   Load Script   Save Script   Cancel

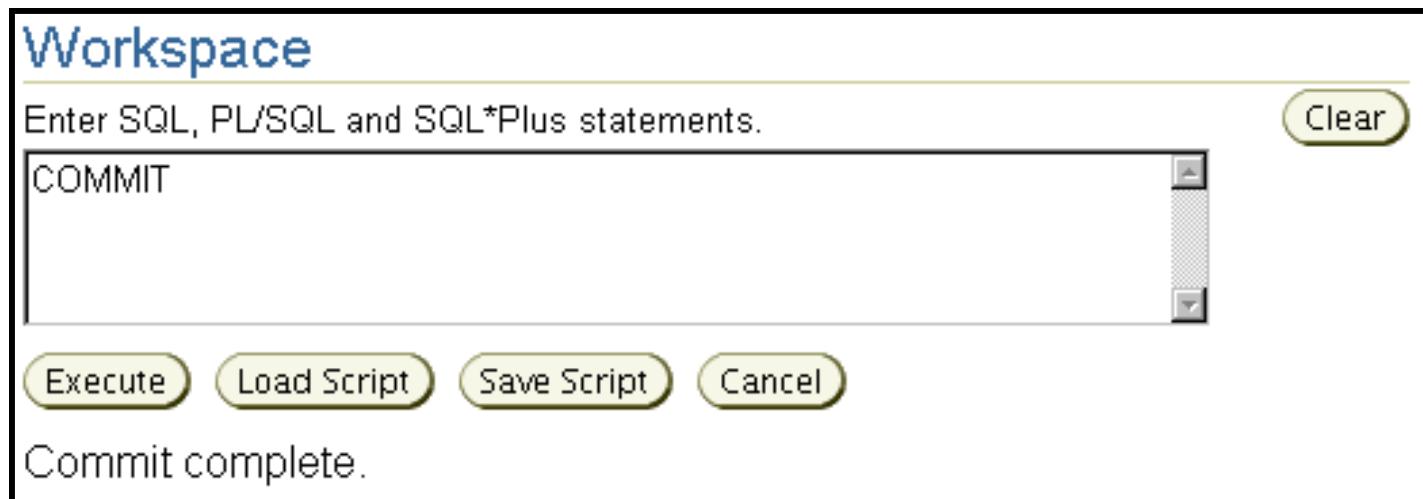
5 rows merged.



# The COMMIT and ROLLBACK Commands

**The following are used to finish a transaction:**

- **COMMIT: Makes the change permanent**
- **ROLLBACK: Undoes the change**



# PL/SQL

SQL  
-> PL/SQL  
Locks

**Oracle's Procedural Language extension to SQL (PL/SQL) is a fourth-generation programming language (4GL). It provides:**

- **Procedural extensions to SQL**
- **Portability across platforms and products**
- **Higher level of security and data integrity protection**
- **Support for object-oriented programming**



# Administering PL/SQL Objects

**Database administrators should be able to:**

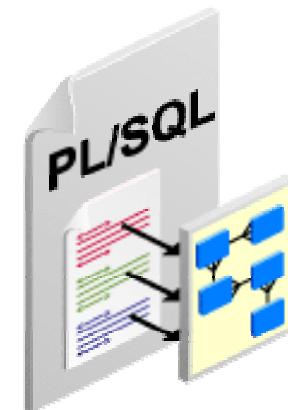
- Identify problem PL/SQL objects
- Recommend the appropriate use of PL/SQL
- Load PL/SQL objects into the database
- Assist PL/SQL developers in troubleshooting

| <u>Programs</u>       |
|-----------------------|
| Packages              |
| <u>Package Bodies</u> |
| Procedures            |
| Functions             |
| Triggers              |
| Java Classes          |
| Java Sources          |

# PL/SQL Objects

**There are many types of PL/SQL database objects:**

- **Package**
- **Package body**
- **Type body**
- **Procedure**
- **Function**
- **Trigger**



# Functions

## Create Function

\* Name **compute\_tax**  
\* Schema **hr**  
\* Source (

```
    salary in number
)
return number
as
begin
  if salary < 5000 then
    return salary * 0.15;
  else
    return salary * 0.33;
  end if;
end;
```

## Functions

Object Type **Function**

### Search

Select an object type and optionally enter a schema name and an object name to filter the data that is displayed in your results set.

Schema **DBA1**



Object Name

Status **All**

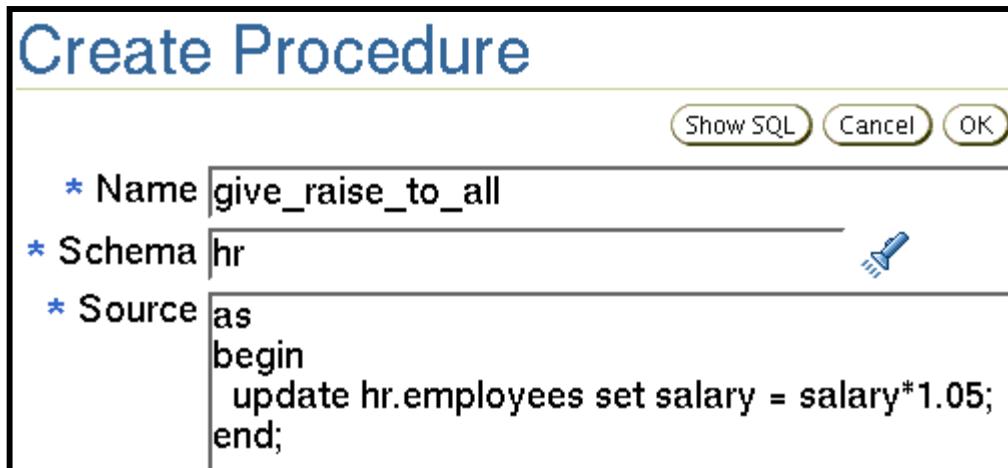
**Go**

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

**Create**

# Procedures

- Are used to perform a specific action
- Pass values in and out by using an argument list
- Can be invoked using:
  - The **CALL** command, which is a SQL statement
  - The **EXECUTE** command, which is a SQL\*Plus command



# Packages

**Packages are collections of functions and procedures.**  
**Each package should consist of two objects:**

- **Package specification**
- **Package body**

Create Package

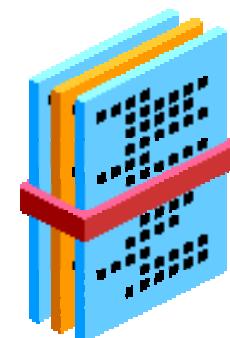
Show SQL Cancel OK

\* Name money

\* Schema hr

\* Source as

```
procedure give_raise_to_all;
function compute_tax (salary in number) return number;
end;
```

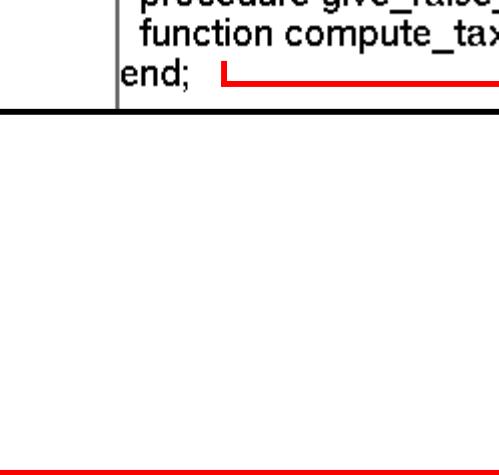
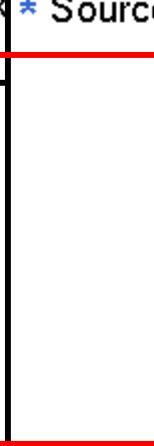
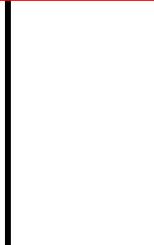


**Package specification**

# Package Specification and Body

## Create Package

Show SQL Cancel OK

|                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Name <input type="text" value="money"/>                                                                                                                                                   | * Schema <input type="text" value="hr"/>                                                                                                                                                                                                                                                                               |
| * Source <input type="text" value="as"/><br>procedure give_raise_to_all;<br>function compute_tax<br>end;  | * Source <input type="text" value="as"/><br>function compute_tax (salary in number) return number<br>as<br>begin<br>if salary < 5000 then<br>return salary * 0.15;<br>else<br>return salary * 0.33;<br>end if;<br>end;<br><br><br> |

# Built-in Packages

- The Oracle database comes with over 350 built-in PL/SQL packages, which provide:
  - Administration and maintenance utilities
  - Extended functionality
- Use the DESCRIBE command to view subprograms.

The screenshot shows a workspace window with the following content:

```
Workspace
Enter SQL, PL/SQL and SQL*Plus statements.
describe dbms_output
```

A red arrow points from the word "dbms\_output" in the workspace to the "PROCEDURE DISABLE" section of the output window.

The output window displays the following information:

PROCEDURE DISABLE  
PROCEDURE ENABLE

| Argument Name | Type       | In/Out | Default? |
|---------------|------------|--------|----------|
| BUFFER_SIZE   | NUMBER(38) | IN     | DEFAULT  |

PROCEDURE GET\_LINE

| Argument Name | Type       | In/Out | Default? |
|---------------|------------|--------|----------|
| LINE          | VARCHAR2   | OUT    |          |
| STATUS        | NUMBER(38) | OUT    |          |

# Triggers

## Triggers

Object Type Trigger

### Search

Select an object type and optionally enter a schema name and an object name to filter the data that is displayed in your results set.

Schema HR



Object Name

Status All

Go

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

Selection Mode Single

Create

Edit

View

Delete

Actions

Create Like

Go

| Select                           | Schema | Trigger Name       | Type             | Event                      | Base Object Type | Base Object Owner | Base Object Name | Status | Enabled? |
|----------------------------------|--------|--------------------|------------------|----------------------------|------------------|-------------------|------------------|--------|----------|
| <input checked="" type="radio"/> | HR     | SECURE EMPLOYEES   | BEFORE STATEMENT | INSERT OR UPDATE OR DELETE | TABLE            | HR                | EMPLOYEES        | VALID  | NO       |
| <input checked="" type="radio"/> | HR     | UPDATE JOB HISTORY | AFTER EACH ROW   | UPDATE                     | TABLE            | HR                | EMPLOYEES        | VALID  | YES      |

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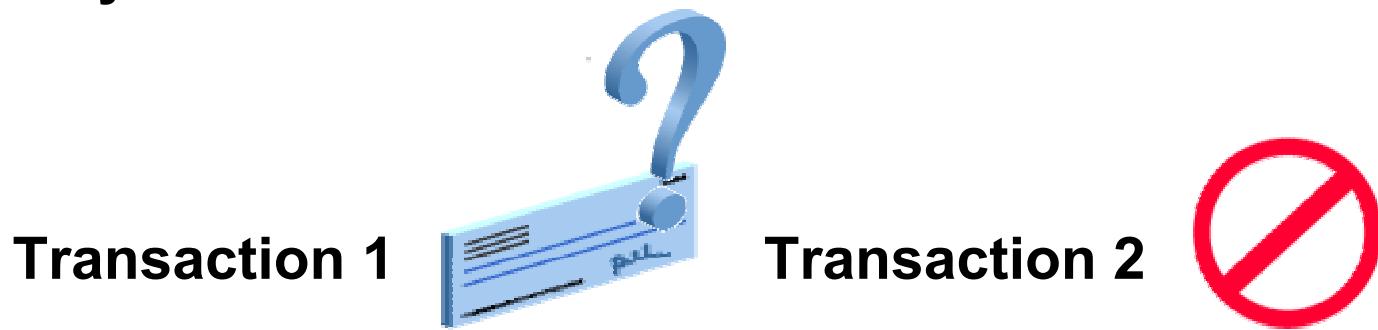
# Triggering Events

| Event Type | Examples of Events                                     |
|------------|--------------------------------------------------------|
| DML        | INSERT, UPDATE, DELETE                                 |
| DDL        | CREATE, DROP, ALTER, GRANT, REVOKE, RENAME             |
| Database   | LOGON, LOGOFF, STARTUP, SHUTDOWN, SERVERERROR, SUSPEND |

# Locks

SQL  
PL/SQL  
> Locks

- Locks prevent multiple sessions from changing the same data at the same time.
- They are automatically obtained at the lowest possible level for a given statement.
- They do not escalate.



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

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

# 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 the COMMIT or ROLLBACK operation)

Transaction 1



Transaction 2



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

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

# Data Concurrency

|                                             |                      |                                                                        |
|---------------------------------------------|----------------------|------------------------------------------------------------------------|
| <b>Time:</b><br><br><br><br><b>09:00:00</b> | <b>Transaction 1</b> | UPDATE hr.employees<br>SET salary=salary+100<br>WHERE employee_id=100; |
|                                             | <b>Transaction 2</b> | UPDATE hr.employees<br>SET salary=salary+100<br>WHERE employee_id=101; |
|                                             | <b>Transaction 3</b> | UPDATE hr.employees<br>SET salary=salary+100<br>WHERE employee_id=102; |
|                                             | ...                  | ...                                                                    |
|                                             | <b>Transaction x</b> | UPDATE hr.employees<br>SET salary=salary+100<br>WHERE employee_id=xxx; |

# 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.
```

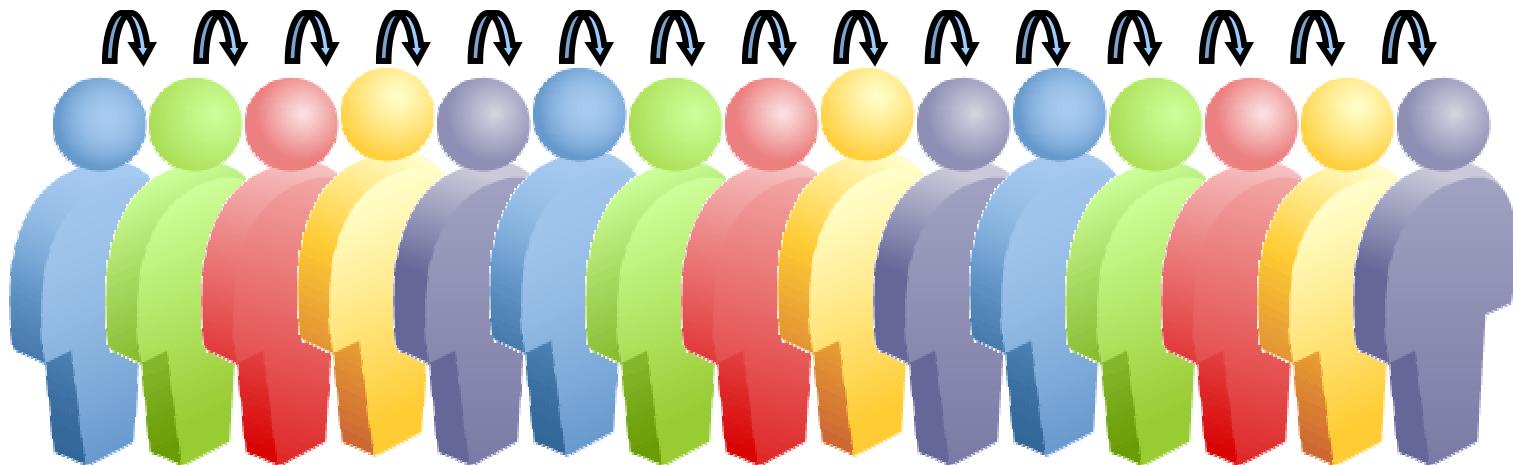
Each DML transaction must acquire *two locks*:

- EXCLUSIVE row lock for the row or rows being updated
- ROW EXCLUSIVE table-level lock for the table containing the rows

# Enqueue Mechanism

The enqueue mechanism keeps track of:

- Sessions waiting for locks
- The requested lock mode
- The order in which sessions requested the lock



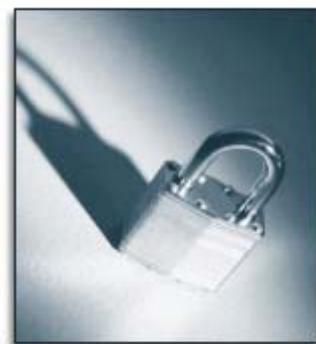
# Lock Conflicts

## Transaction 1      Time      Transaction 2

|                                                                                                                    |                                                                                               |                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| UPDATE employees SET salary=salary+100 WHERE employee_id=100;<br>1 row updated.                                    | 9:00:00                                                                                       | UPDATE employees SET salary=salary+100 WHERE employee_id=101;<br>1 row updated.                     |
| UPDATE employees SET COMMISION_PCT=2 WHERE employee_id=101;<br><b>Session waits enqueued due to lock conflict.</b> | 9:00:05<br> | SELECT sum(salary) FROM employees;<br>SUM(SALARY)<br>-----<br>692634                                |
| <b>Session still waiting!</b>                                                                                      | 16:30:00                                                                                      | Many selects, inserts, updates, and deletes during the last 7.5 hours, but no commits or rollbacks! |
| 1 row updated.<br><b>Session continues.</b>                                                                        | 16:30:01                                                                                      | commit;                                                                                             |

# Possible Causes of Lock Conflicts

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



# Detecting Lock Conflicts

Select Blocking Sessions from the Performance page.

| Blocking Sessions                                                                                                          |                     |                  |                     |                       |                               |             |                               |            |        |      |                 |
|----------------------------------------------------------------------------------------------------------------------------|---------------------|------------------|---------------------|-----------------------|-------------------------------|-------------|-------------------------------|------------|--------|------|-----------------|
| Page Refreshed Jun 23, 2005 2:41:04 PM  |                     |                  |                     |                       |                               |             |                               |            |        |      |                 |
| <a href="#">View Session</a> <a href="#">Kill Session</a>                                                                  |                     |                  |                     |                       |                               |             |                               |            |        |      |                 |
| <a href="#">Expand All</a>   <a href="#">Collapse All</a>                                                                  |                     |                  |                     |                       |                               |             |                               |            |        |      |                 |
| Select                                                                                                                     | Username            | Sessions Blocked | Session ID          | Session Serial Number | SQL Hash Value                | Wait Class  | Wait Event                    | P1         | P2     | P3   | Seconds in Wait |
| <input type="radio"/>                                                                                                      | ▼ Blocking Sessions |                  |                     |                       |                               |             |                               |            |        |      |                 |
| <input checked="" type="radio"/>                                                                                           | ▼ HR                | 1                | <a href="#">130</a> | 308                   | <a href="#">duf40r50uy5gd</a> | Idle        | SQL*Net message from client   | 1413697536 | 1      | 0    | 81              |
| <input checked="" type="radio"/>                                                                                           | HR                  | 0                | <a href="#">133</a> | 5361                  | <a href="#">duf40r50uy5gd</a> | Application | enq: TX - row lock contention | 1415053318 | 589840 | 1672 | 72              |

Click the Session ID link to view information about the locking session, including the actual SQL statement.

# Resolving Lock Conflicts

To resolve a lock conflict:

- Have the session holding the lock commit or roll back
- Terminate the session holding the lock as a last resort

Session Details: HR (133)

Collected From Jun 23, 2005 View Data Real Time: Manual Refresh ▾  
Target 2:46:20 PM Refresh

Kill Session Enable SQL Trace Disable SQL Trace

**General** Activity Statistics Open Cursors Blocking Tree Wait Event History



# Resolving Lock Conflicts Using SQL

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

1

```
SQL> select sid, serial#, username  
      from v$session where sid in  
        (select blocking_session from v$session)
```

**Result:**

| SID | SERIAL# | USERNAME |
|-----|---------|----------|
| 144 | 8982    | HR       |

2

```
SQL> alter system kill session '144,8982' immediate;
```

# Deadlocks

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

# Summary

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

- **Manage data through the use of SQL**
- **Identify and administer PL/SQL objects**
- **Describe triggers and triggering events**
- **Monitor and resolve locking conflicts**

# **Practice Overview: Managing Data and Concurrency**

**This practice covers the following topics:**

- Identifying locking conflicts**
- Resolving locking conflicts**



# **Managing Undo Data**

# Objectives

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

- 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
- Use the Undo Advisor

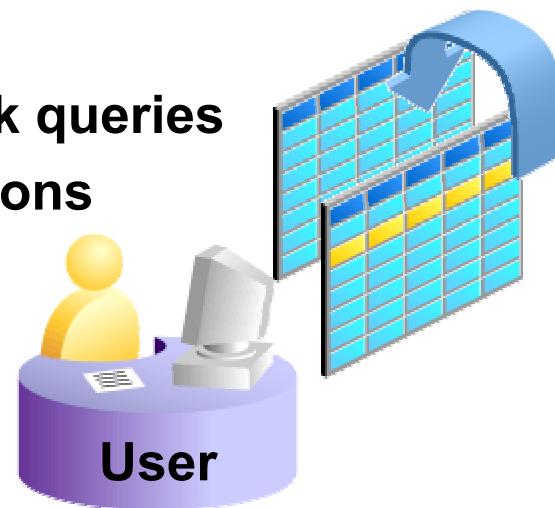
# Data Manipulation

- **Data manipulation language (DML) consists of the following SQL statements:**
  - **INSERT**
  - **UPDATE**
  - **DELETE**
  - **MERGE**
- **DML always executes as part of a transaction, which can be:**
  - **Rolled back, using the ROLLBACK command**
  - **Committed, using the COMMIT command**

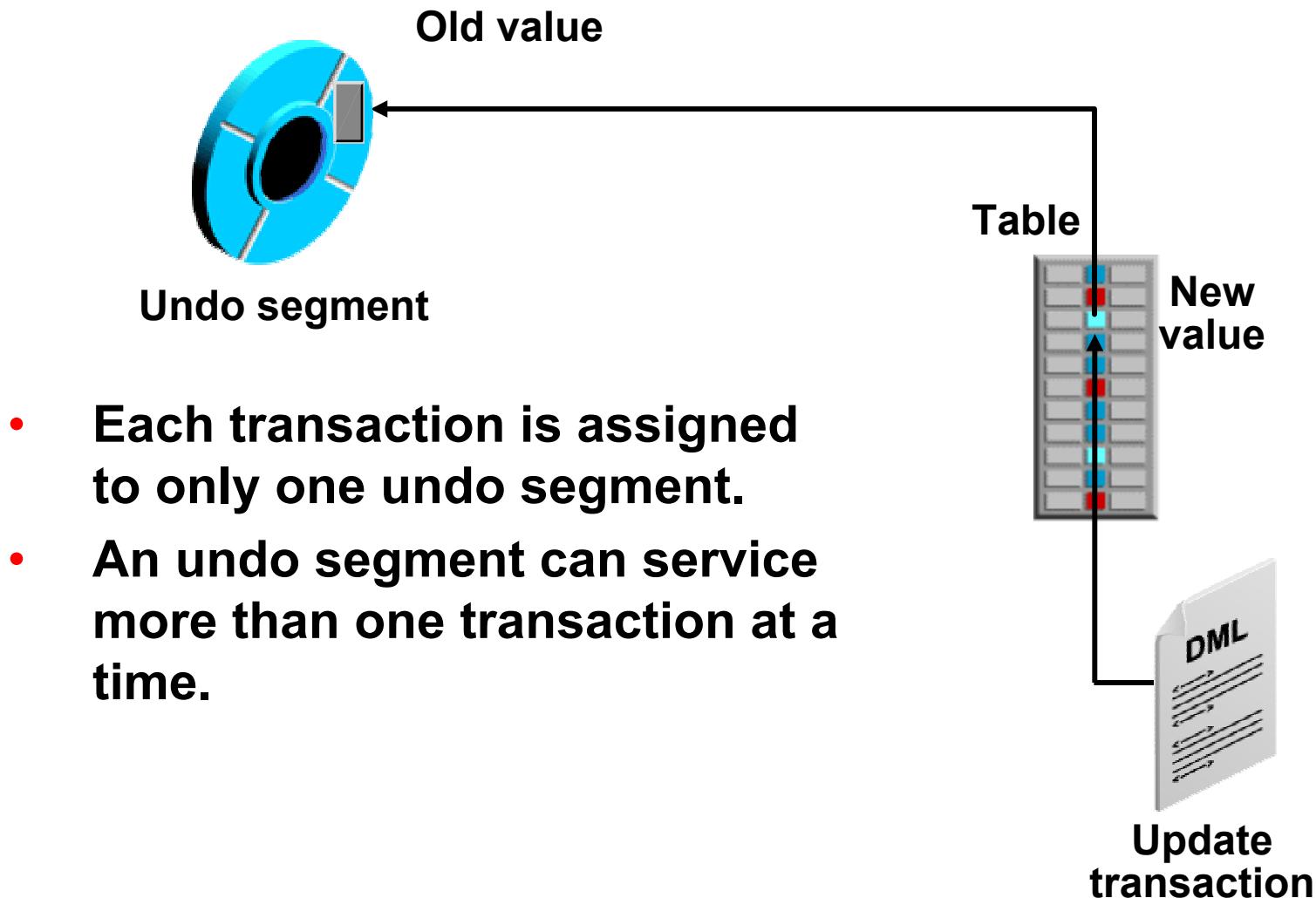
# Undo Data

## Undo data is:

- A copy of original, premodified data
- Captured for every transaction that changes data
- Retained at least until the transaction is ended
- Used to support:
  - Rollback operations
  - Read-consistent and flashback queries
  - Recovery from failed transactions



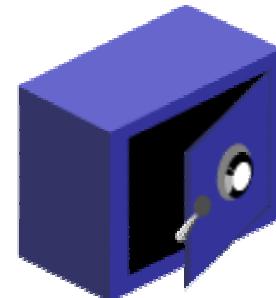
# Transactions and Undo Data



# Storing Undo Information

**Undo information is stored in undo segments, which are, in turn, 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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# Undo Data Versus 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                   |
| Protects against | Inconsistent reads in multiuser systems | Data loss                        |

# Monitoring Undo

**Undo usually requires little management. The areas to monitor include:**

- **Free space in an undo tablespace**
- **“Snapshot too old” errors**



# Administering Undo

**Administration of undo should include preventing:**

- **Space errors in an undo tablespace:**
  - Size the undo tablespace properly.
  - Ensure that large transactions commit periodically.
- **“Snapshot too old” errors:**
  - Configure an appropriate undo retention interval.
  - Size the undo tablespace properly.
  - Consider guaranteeing undo retention.

**Use automatic undo management:**

```
UNDO_MANAGEMENT=AUTO  
UNDO_TABLESPACE=UNDOTBS1
```



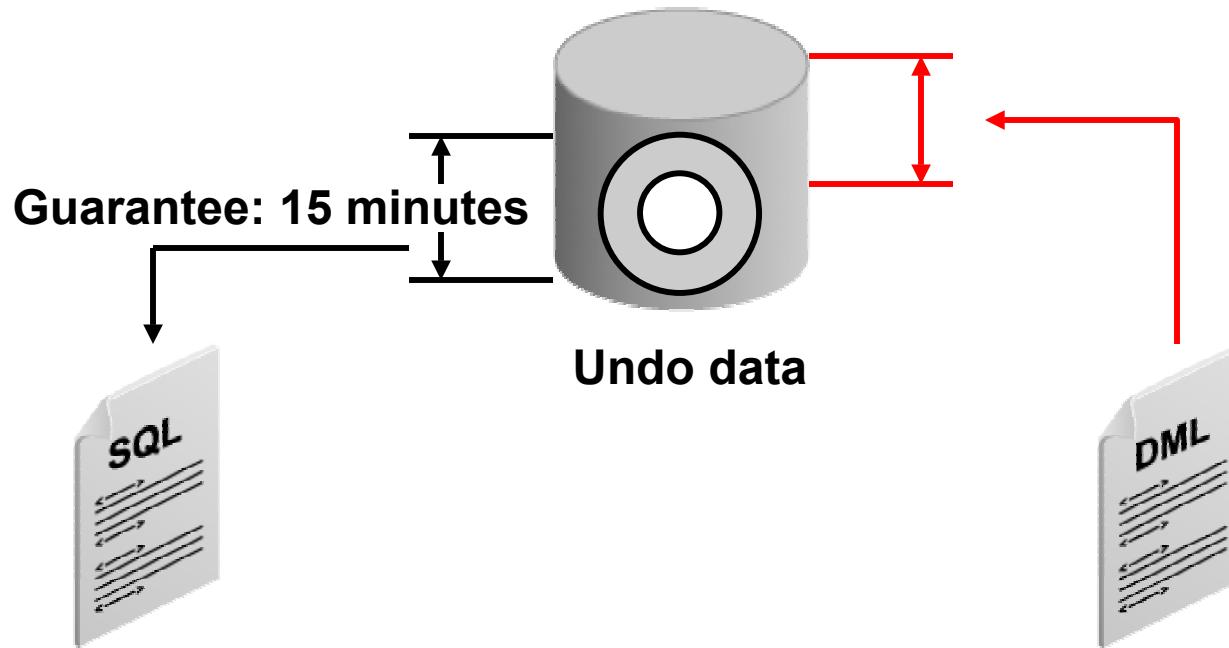
# Configuring Undo Retention

**UNDO\_RETENTION** specifies (in seconds) how long already committed undo information is to be retained. The only time you must set this parameter is when:

- The undo tablespace has the AUTOEXTEND option enabled
- You want to set undo retention for LOBs
- You want to guarantee retention



# Guaranteeing Undo Retention



**SELECT statements  
running 15 minutes or less  
are always satisfied.**

**A transaction that generates  
more undo than what there  
is space for will fail.**

# Sizing the Undo Tablespace

## Undo Management

Undo Advisor

### Configuration

Auto-tuned Undo Retention (minutes) **15**  
Minimum Undo Retention (minutes) **15**  
Guarantee Minimum Undo Retention **No**

Undo Tablespace **UNDOTBS1** [Change Tablespace](#)  
Size (MB) **35**  
Auto-Extensible **Yes**

**Current table-space size**

### Recommendations

Choose the time period that best represents the system activity to get the recommendations for undo retention [Edit Undo Tablespace](#)

Analysis Time Period **Last One Hour** [Update Analysis](#)  
Selected Analysis Time Period **5/11/05 4:18 PM - 5/11/05 5:18 PM**

Potential Problems **No Problem Found**  
Recommendations **No Recommendation**

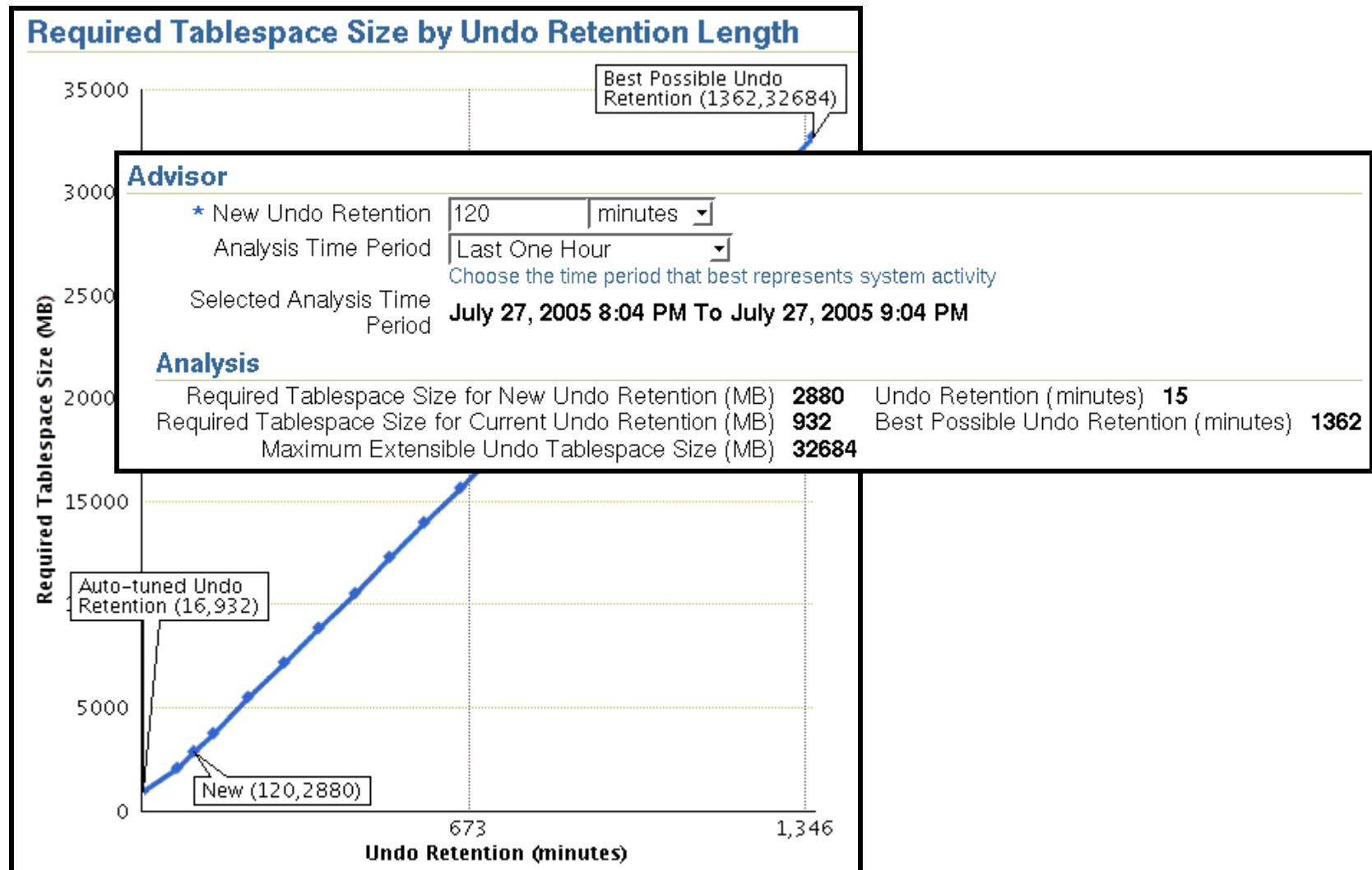
### System Activity and Tablespace Usage

The recommendations are based on system activity and undo tablespace usage for the selected analysis time period.

Longest Running Query (seconds) **333**  
Average Undo Generation Rate (KB/minute) **24.0**  
Maximum Undo Generation Rate (KB/minute) **63.0**

**Undo consumption rate**

# Using the Undo Advisor



# Summary

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

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

# **Practice Overview: Managing Undo Segments**

**This practice covers the following topics:**

- Calculating undo tablespace sizing to support a 48-hour retention interval**
- Modifying an undo tablespace to support a 48-hour retention interval**

# 10

## Implementing Oracle Database Security

# Objectives

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

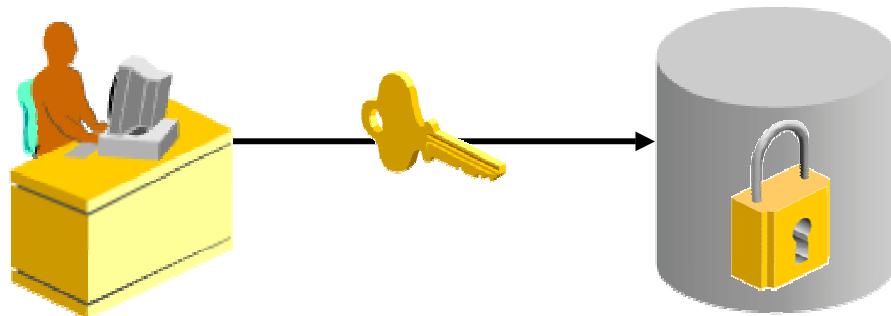
- **Describe your DBA responsibilities for security**
- **Apply the principle of least privilege**
- **Enable standard database auditing**
- **Specify audit options**
- **Review audit information**
- **Maintain the audit trail**



# Industry Security Requirements

> Requirements  
Least Privilege  
Auditing  
Value-based  
FGA  
DBA  
Sec. Updates

- Legal:
  - Sarbanes-Oxley Act (SOX)
  - Health Information Portability and Accountability Act (HIPAA)
  - California Breach Law
  - UK Data Protection Act
- Auditing



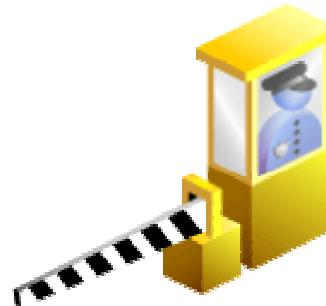
# Separation of Responsibilities

- **Users with DBA privileges must be trusted.**  
**Consider:**
  - Abuse of trust
  - That audit trails protect the trusted position
- **DBA responsibilities must be shared.**
- **Accounts must never be shared.**
- **The DBA and the system administrator must be different people.**
- **Separate operator and DBA responsibilities.**

# 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**



# Principle of Least Privilege

Requirements  
> **Least Privilege**  
Auditing  
Value-based  
FGA  
DBA  
Sec. Updates

- **Install only required software on the machine.**
- **Activate only required services on the machine.**
- **Give OS and database access to only those users that require access.**
- **Limit access to the root or administrator account.**
- **Limit access to the SYSDBA and SYSOPER accounts.**
- **Limit users' access to only the database objects required to do their jobs.**

# Applying the Principle of Least Privilege

- **Protect the data dictionary:**

```
O7_DICTIONARY_ACCESSIBILITY=FALSE
```

- **Revoke unnecessary privileges from PUBLIC:**

```
REVOKE EXECUTE ON UTL_SMTP, UTL_TCP, UTL_HTTP,  
UTL_FILE FROM PUBLIC;
```

- **Restrict the directories accessible by users.**
- **Limit users with administrative privileges.**
- **Restrict remote database authentication:**

```
REMOTE_OS_AUTHENT=FALSE
```

# Monitoring for Suspicious Activity

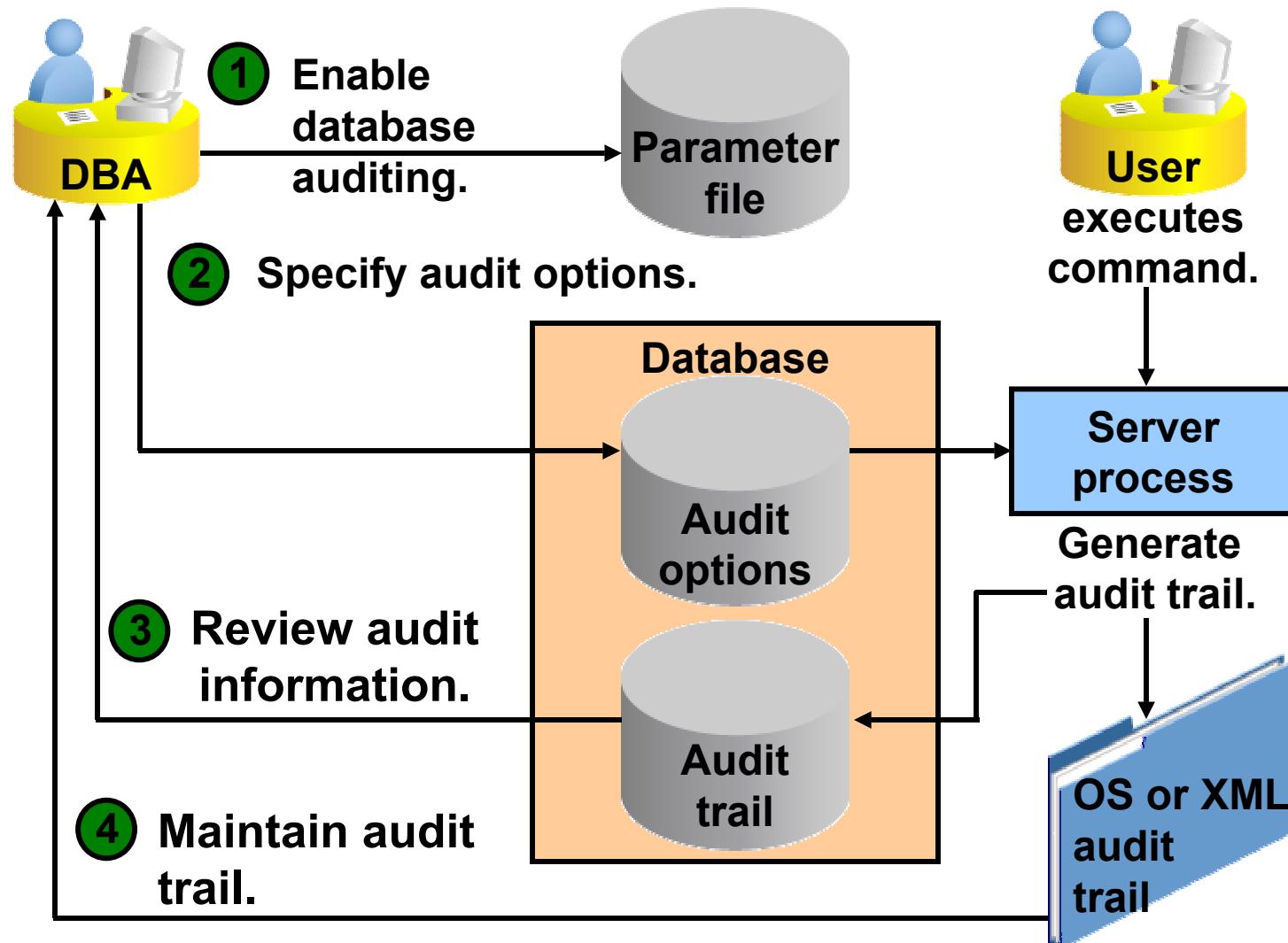
Requirements  
Least Privilege  
> **Auditing**  
Value-based  
FGA  
DBA  
Sec. Updates

**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)
- DBA auditing



# Standard Database Auditing



# Enabling Auditing

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

## Initialization Parameters

[Show SQL](#) [Revert](#) [Apply](#)

[Current](#) **SPFILE**

The parameter values listed here are from the SPFILE `/u01/app/oracle/product/10.2.0/db_1/dbs/spfileorcl.ora`

| Name  | Basic | Dynamic | Category |
|-------|-------|---------|----------|
| audit | All   | All     | All      |

[Go](#)

Filter on a name or partial name

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

[Reset](#)

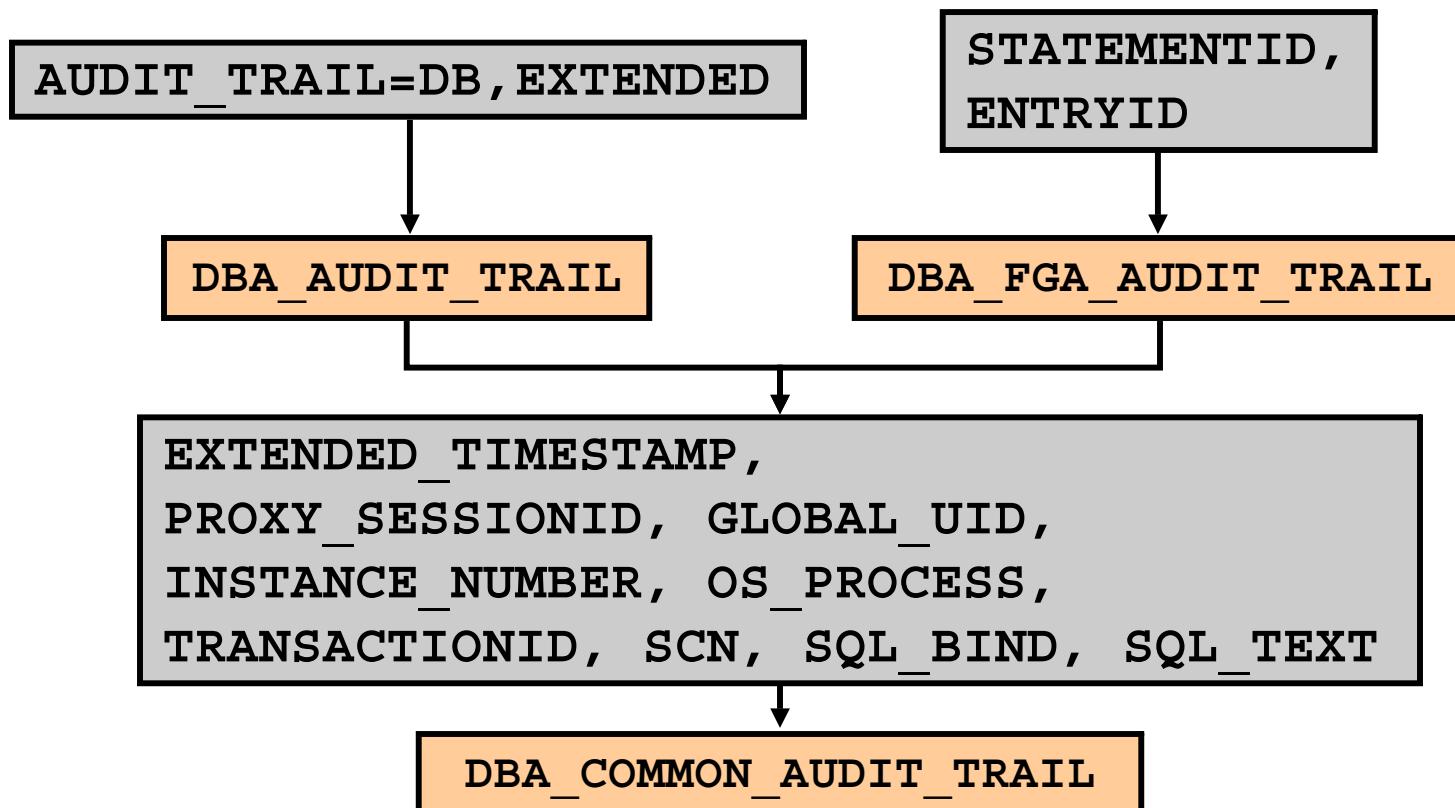
| Select                           | Name ▲               | Help              | Revisions | Value                         | Comments | Type    | Basic | Dynamic                             | Category              |
|----------------------------------|----------------------|-------------------|-----------|-------------------------------|----------|---------|-------|-------------------------------------|-----------------------|
| <input checked="" type="radio"/> | audit_file_dest      | <a href="#">i</a> |           | /u01/app/oracle/admin/orcl/ac |          | String  |       | <input checked="" type="checkbox"/> | Security and Auditing |
| <input type="radio"/>            | audit_sys_operations | <a href="#">i</a> |           | Unspecified                   |          | Boolean |       |                                     | Security and Auditing |
| <input type="radio"/>            | audit_syslog_level   |                   |           |                               |          | String  |       |                                     | Miscellaneous         |
| <input type="radio"/>            | audit_trail          | <a href="#">i</a> |           | XML                           |          | String  |       |                                     | Security and Auditing |

```
ALTER SYSTEM SET audit_trail="XML" SCOPE=SPFILE;
```

**Restart database after modifying a static initialization parameter.**

# Uniform Audit Trails

**Use AUDIT\_TRAIL to enable database auditing**



# Enterprise Manager Audit Page



## Audit Settings

Audit information can be located in the database or in an OS file. Some information is always written to the OS audit file. Other information can optionally be written to either the OS audit file or to the database.

### Configuration

Audit Trail XML  
Audit SYS User Operations FALSE  
Audit File Directory /u01/app/oracle/admin/orcl/adump  
Audit File Directory value is effective only when Audit Trail is set to "OS" or "XML".

Default Options For Future Audited Objects 0

### Audit Trails

Database Audit Trail [Audited Failed Logins](#)  
[Audited Privileges](#)  
[Audited Objects](#)

**Audited Privileges (0)** [Audited Objects \(1\)](#) [Audited Statements \(0\)](#)

| Privilege        | User      | Proxy |  |
|------------------|-----------|-------|--|
|                  | SYS       |       |  |
| <hr/>            |           |       |  |
| Select           | Privilege | User  |  |
| No object found. |           | Proxy |  |

Show SQL

**AUDIT DELETE, INSERT, UPDATE ON HR.JOB\$ BY SESSION**

# Specifying Audit Options

- **SQL statement auditing:**

```
AUDIT table;
```

- **System-privilege auditing (nonfocused and focused):**

```
AUDIT select any table, create any trigger;
```

```
AUDIT select any table BY hr BY SESSION;
```

- **Object-privilege auditing (nonfocused and focused):**

```
AUDIT ALL on hr.employees;
```

```
AUDIT UPDATE,DELETE on hr.employees BY ACCESS;
```

# Using and Maintaining Audit Information

## Audited Objects

[Filter Result](#)[Return](#)[▼ Hide SQL](#)

```
SELECT "OBJECT_SCHEMA", "OBJECT_NAME", "DB_USER", "STATEMENT_TYPE",
"EXTENDED_TIMESTAMP" FROM SYS.DBA_COMMON_AUDIT_TRAIL WHERE (action between 1 and 16) or
(action between 19 and 29) or (action between 32 and 41) or (action = 43) or (action between 51 and 99) or
(action = 103) or (action between 110 and 113) or (action between 116 and 121) or (action between 123 and 128)
or (action between 160 and 162)
```

| Schema | Object Name | User Name  | Action      | Time (In Session's Time Zone)      |
|--------|-------------|------------|-------------|------------------------------------|
| HR     | JOBS        | AUDIT_USER | SESSION REC | 2005-10-21 17:52:33.783793000 -7:0 |
| HR     | JOBS        | HR         | SESSION REC | 2005-10-21 17:52:34.147582000 -7:0 |

## Disable audit options if you are not using them.

### Confirmation

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

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

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

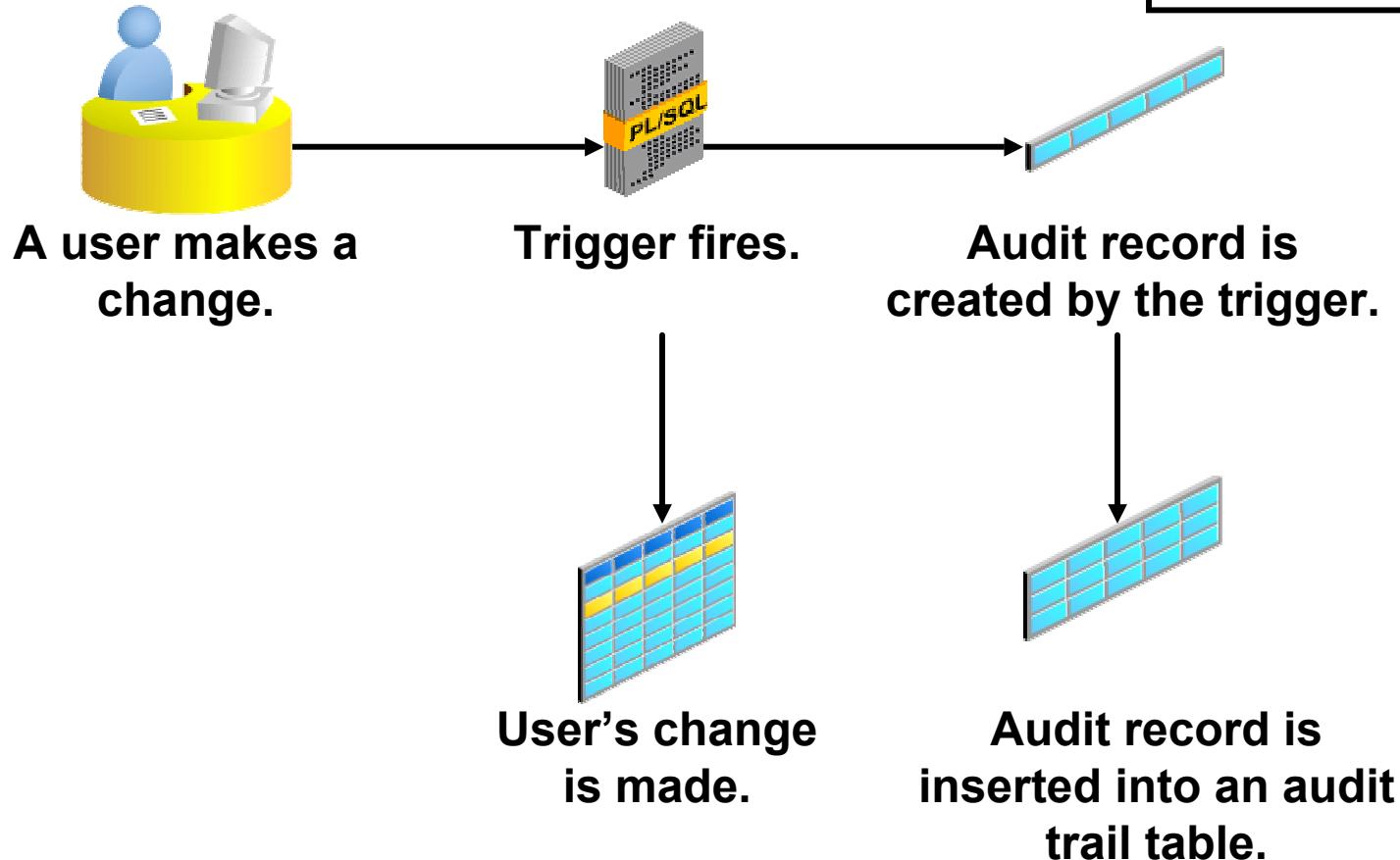
[▼ Hide SQL](#)

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

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

# Value-Based Auditing

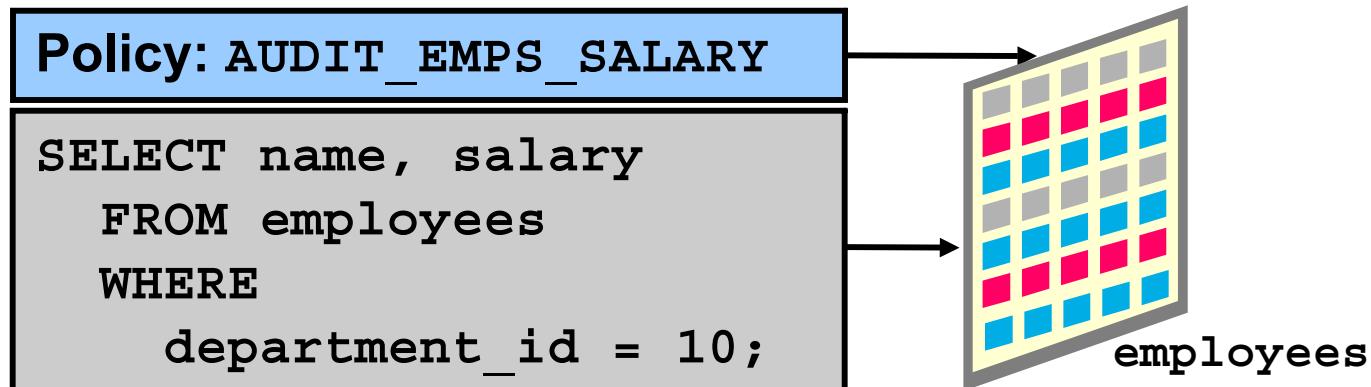
Requirements  
Least Privilege  
Auditing  
> **Value-based**  
FGA  
DBA  
Sec. Updates



# Fine-Grained Auditing

Requirements  
Least Privilege  
Auditing  
Value-based  
> **FGA**  
DBA  
Sec. Updates

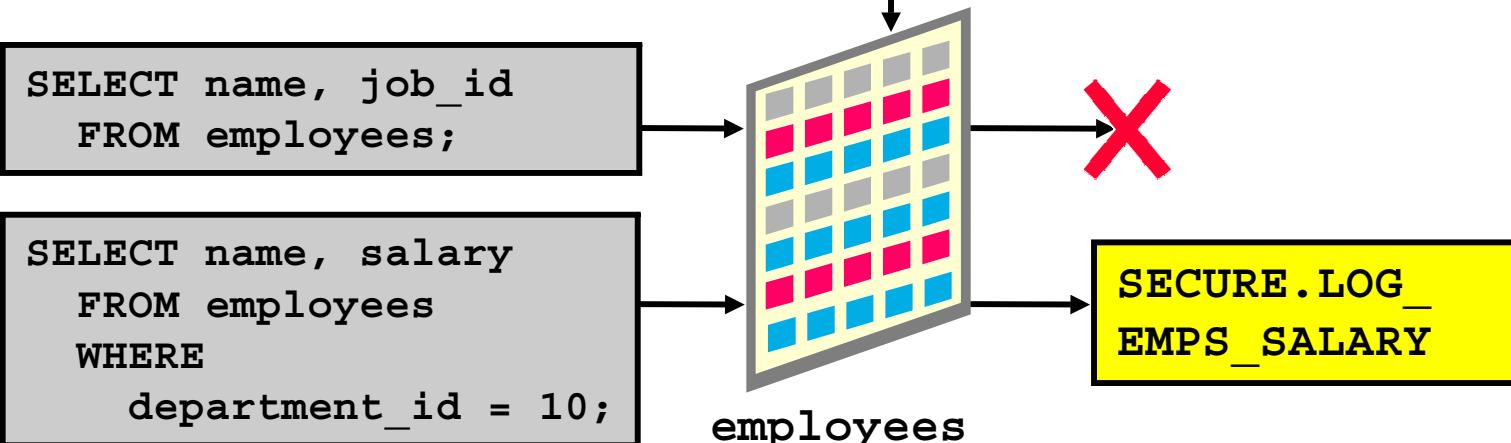
- Monitors data access on the basis of content
- Audits SELECT, INSERT, UPDATE, DELETE, and MERGE
- Can be linked to a table or view, to one or more columns
- May fire a procedure
- Is administered with the DBMS\_FGA package



# 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',
    handler_schema => 'secure',
    handler_module => 'log_emps_salary',
    enable          => TRUE,
    statement_types => 'SELECT' );
```



# 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 any specified columns.**
- **MERGE statements are audited with the underlying INSERT or UPDATE generated statements.**

```
UPDATE hr.employees  
SET salary = 10  
WHERE department_id = 10;
```

```
UPDATE hr.employees  
SET salary = 10  
WHERE employee_id = 111;
```



# FGA Guidelines

- To audit all statements, use a null condition.
- 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.

# DBA Auditing

Requirements  
Least Privilege  
Auditing  
Value-based  
FGA  
> **DBA**  
Sec. Updates

**Users with the SYSDBA or SYSOPER privileges can connect when the database is closed.**

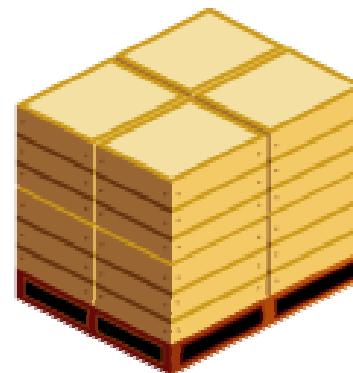
- Audit trail must be stored outside the database.
- Connections as SYSDBA or SYSOPER are always audited.
- You can enable additional auditing of SYSDBA or SYSOPER actions with `audit_sys_operations`.
- You can control the audit trail with `audit_file_dest`.



# Maintaining the Audit Trail

**The audit trail should be maintained. Follow these best practice guidelines:**

- **Review and store old records.**
- **Prevent storage problems.**
- **Avoid loss of records.**

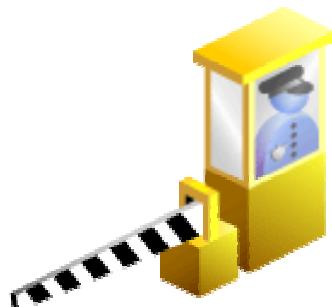


# Security Updates

Requirements  
Least Privilege  
Auditing  
Value-based  
FGA  
DBA

> Sec. Updates

- Oracle posts security alerts on the Oracle Technology Network Web site at:  
<http://www.oracle.com/technology/deploy/security/alerts.htm>
- Oracle database administrators and developers can also subscribe to be notified about critical security alerts via e-mail by clicking the “Subscribe to Security Alerts Here” link.



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# Applying Security Patches

- **Use the Critical Patch Update process.**
- **Apply all security patches and workarounds.**
- **Contact the Oracle security products team.**



# Summary

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

- **Describe your DBA responsibilities for security**
- **Apply the principle of least privilege**
- **Enable standard database auditing**
- **Specify audit options**
- **Review audit information**
- **Maintain the audit trail**



# **Practice Overview: Implementing Oracle Database Security**

**This practice covers the following topics:**

- Enabling standard database auditing**
- Specifying audit options for the HR.JOBS table**
- Updating the table**
- Reviewing audit information**
- Maintaining the audit trail**

# 11

## Configuring the Oracle Network Environment

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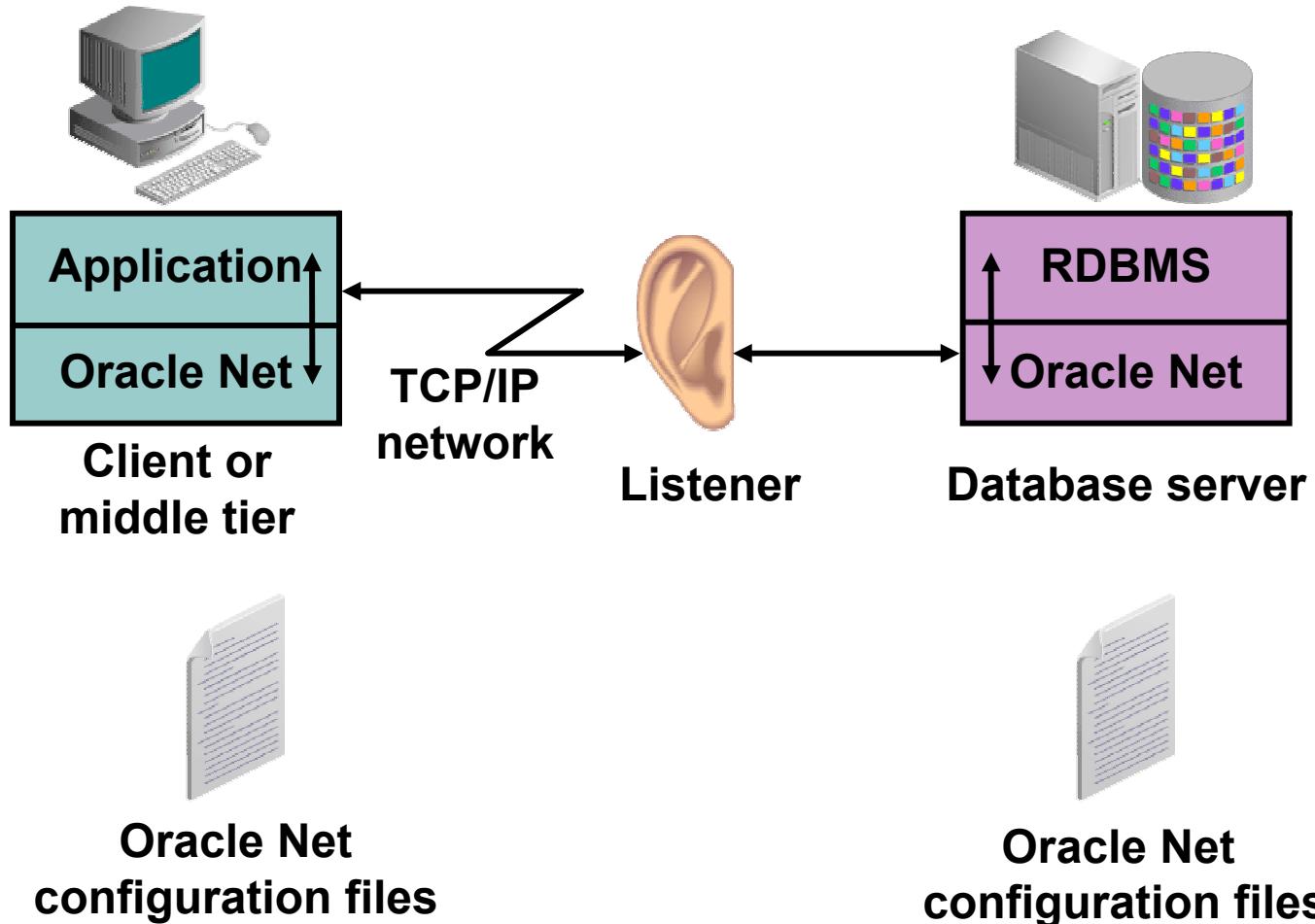
Copyright © 2008, Oracle. All rights reserved.

# Objectives

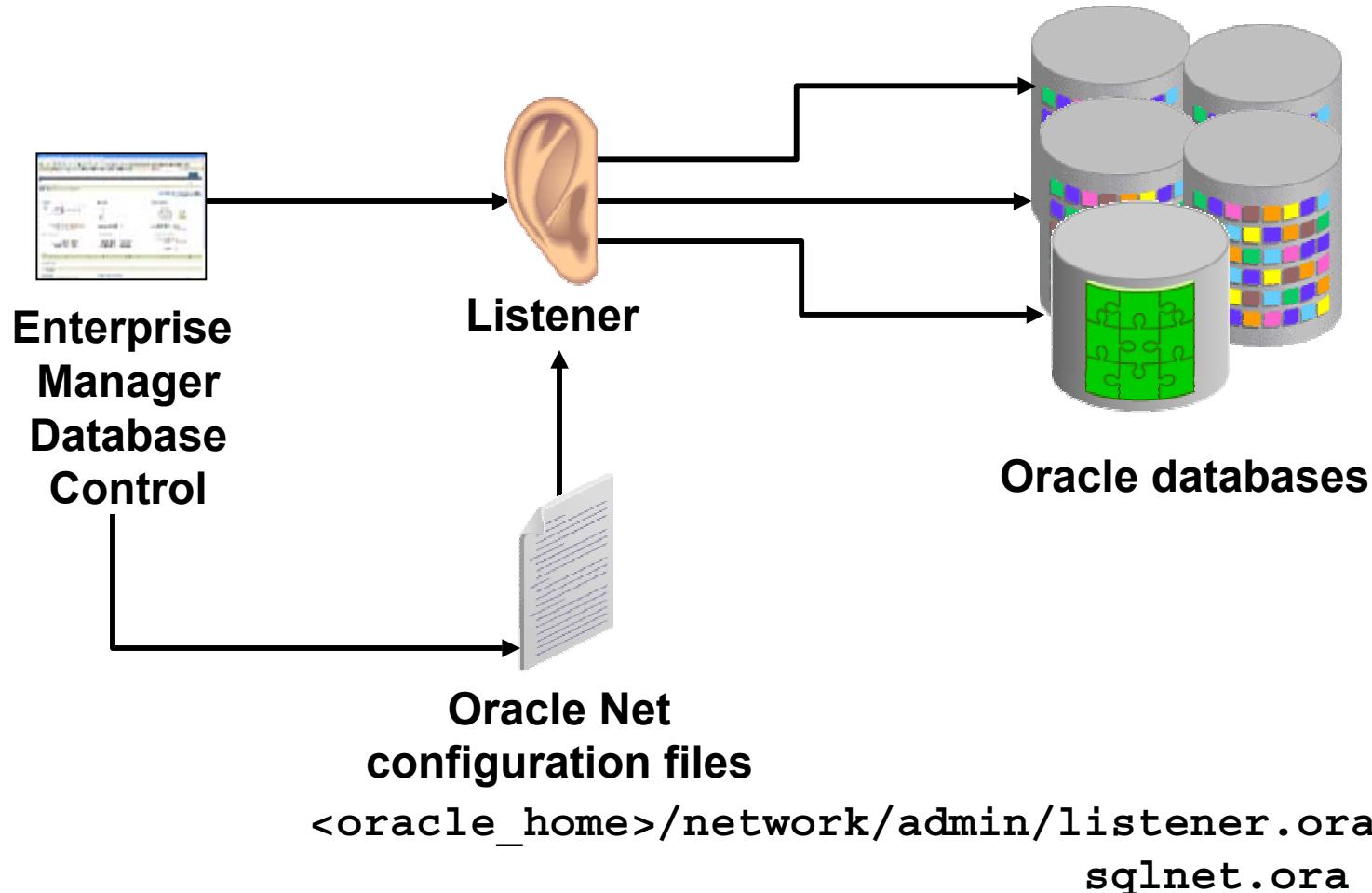
**After completing this lesson, you should be able to:**

- **Use Enterprise Manager to:**
  - Create additional listeners
  - Create Oracle Net Service aliases
  - Configure connect-time failover
  - Control the Oracle Net Listener
- **Use tnsping to test Oracle Net connectivity**
- **Identify when to use shared servers versus dedicated servers**

# Oracle Net Services



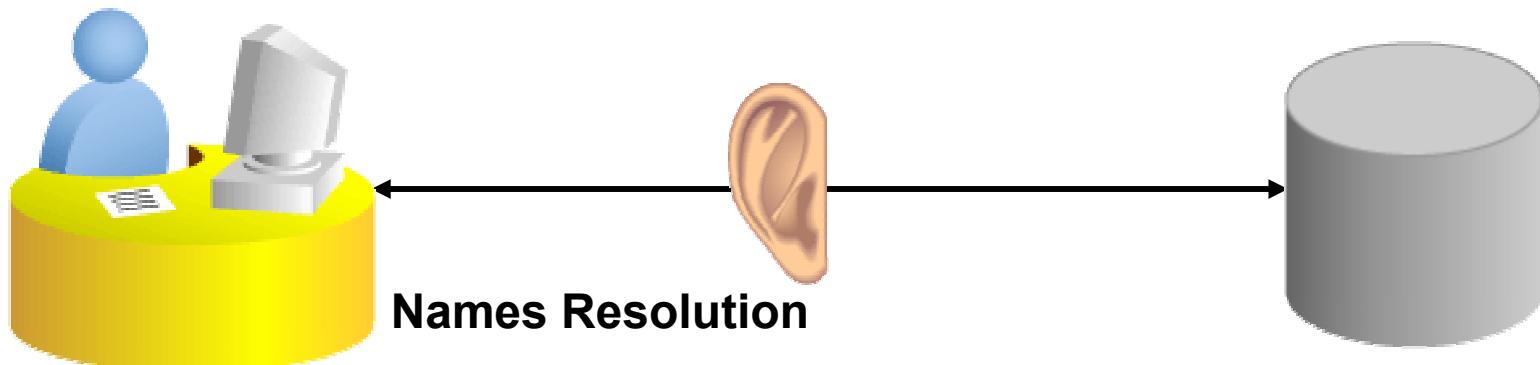
# Oracle Net Listener



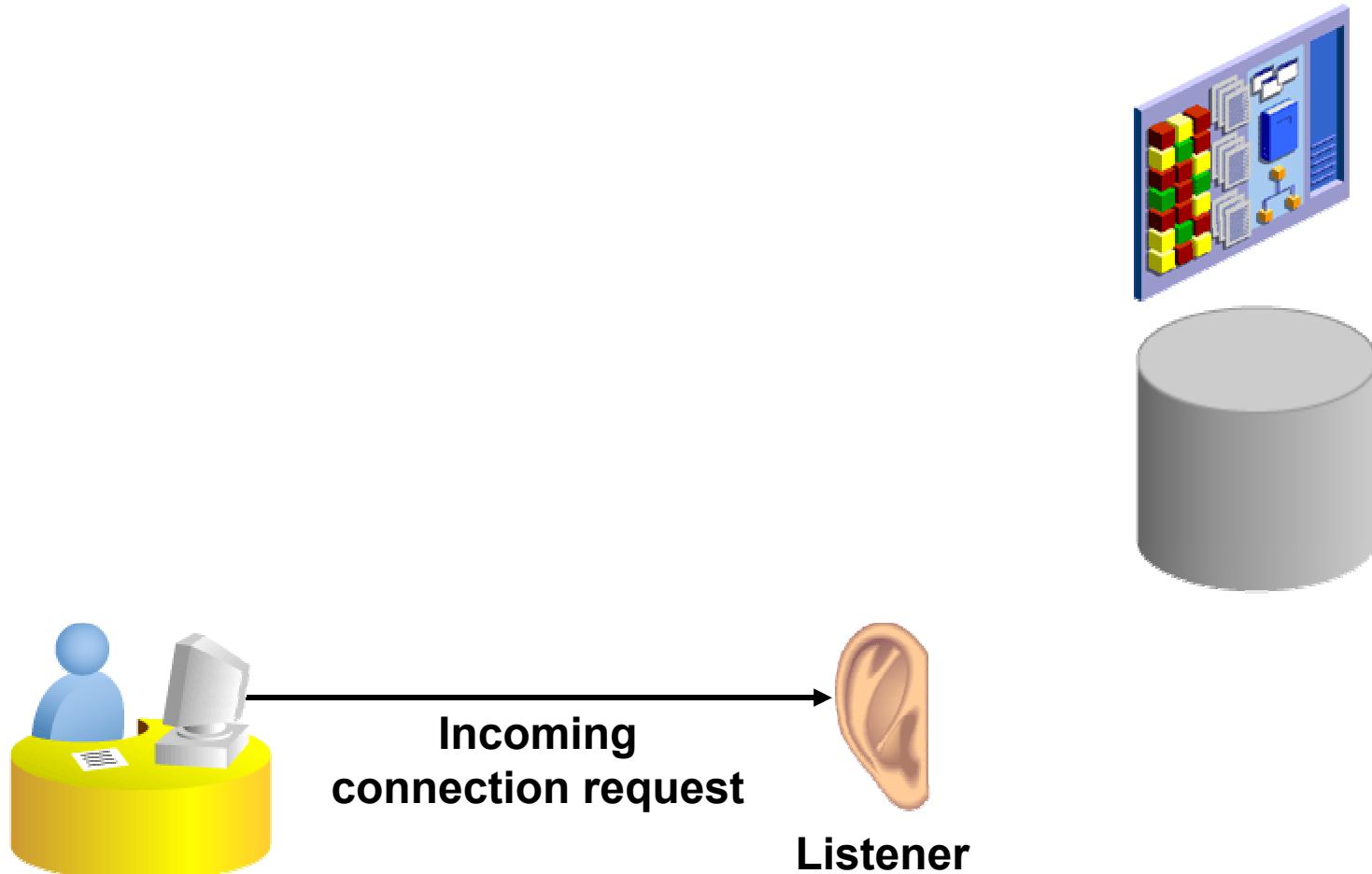
# Establishing Net Connections

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

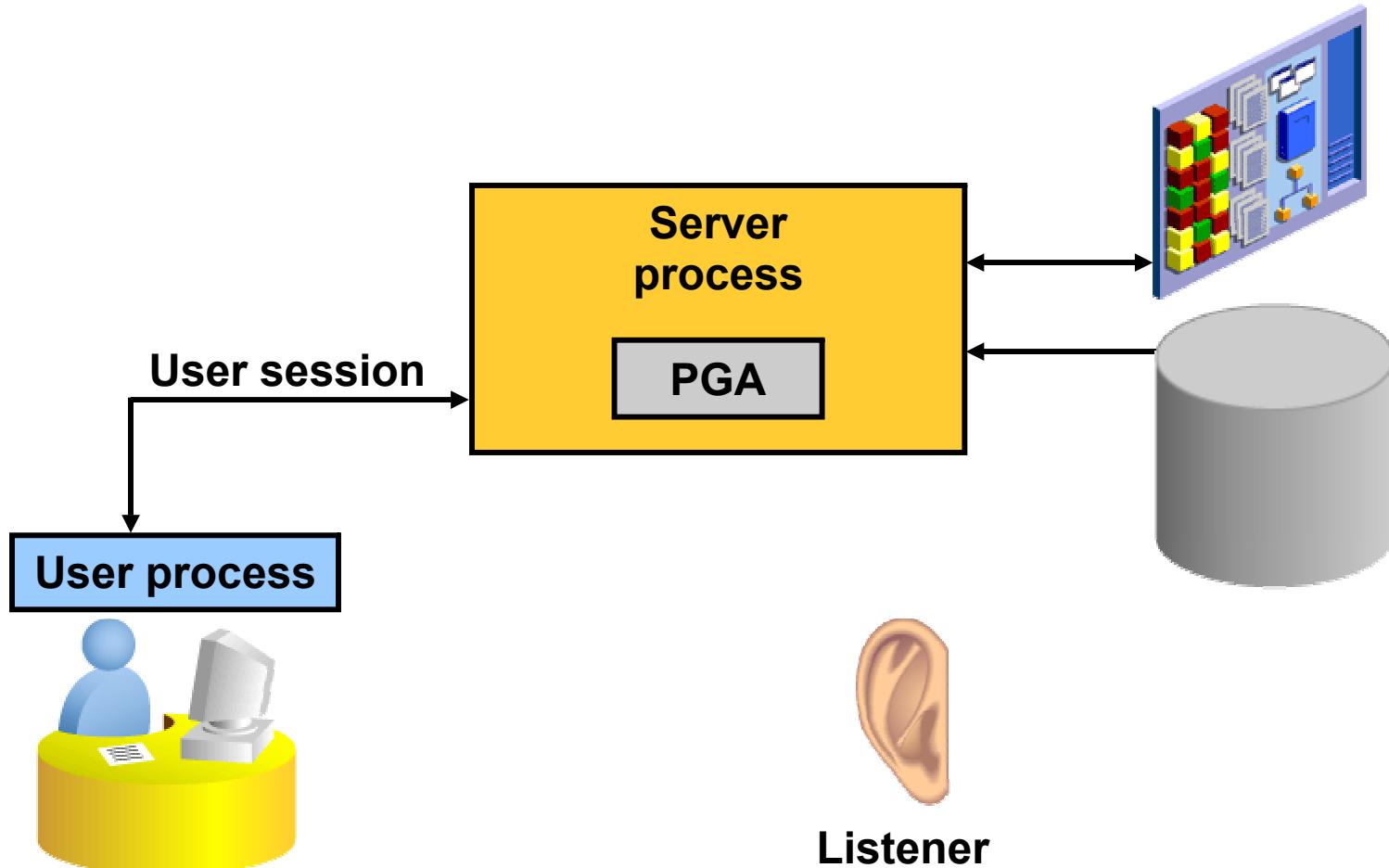
- Host where the listener is running
- Port that the listener is monitoring
- Protocol that the listener is using
- Name of the service that the listener is handling



# Establishing a Connection

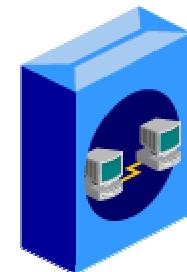


# User Sessions



# Tools for Configuring and Managing the Oracle Network

- Enterprise Manager Net Services Administration page
- Oracle Net Manager
- Oracle Net Configuration Assistant launched by Oracle Universal Installer
- Command line



# Listener Control Utility

**Oracle Net listeners can be controlled with the command-line lsnrctl utility (or from EM).**

```
$ lsnrctl

LSNRCTL for Linux: Version 10.2.0.0.0 on 12-MAY-2005 13:27:51
Copyright (c) 1991, 2004, Oracle. All rights reserved.
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
      change_password quit         exit
      set*           show*
```

# Listener Control Utility Syntax

**Commands from the listener control utility can be issued from the command line or from the LSNRCTL prompt.**

- **UNIX or Linux command-line syntax:**

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

- **Prompt syntax:**

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

# Listener Home Page

**General**

 [Shutdown](#)

Status **Up**  
Up Since **May 2, 2005 3:25:01 PM PDT**  
Instance Name **orcl**  
Version **10.2.0.0.0**  
Host [edrsr30p1.us.oracle.com](#)  
Listener **LISTENER\_edrsr30p1.us.oracle.com**

**Listener: LISTENER\_edrsr30p1.us.oracle.com**

[Home](#) [Performance](#) [Serviced Databases](#) Page Refreshed May 11, 2005 3:22:45 PM 

---

**General**

 [Edit](#) [Stop](#)

Status **Up**  
Availability (%) **100** (Last 24 Hours)  
Alias **LISTENER**  
Version **10.2.0.0**  
Oracle Home [/u01/app/oracle/product/10.2.0/db\\_1](#)  
Net Address [\(ADDRESS=\(PROTOCOL=TCP\)\(HOST=edrsr30p1.us.oracle.com\)\(PORT=1521\)\)](#)  
LISTENER.ORA Location [/u01/app/oracle/product/10.2.0/db\\_1/network/admin](#)  
Start Time **May 2, 2005 3:17:57 PM**  
Host [edrsr30p1.us.oracle.com](#)

---

[Home](#) [Performance](#) [Serviced Databases](#)

---

**Related Links**

|                                                                                                                                                                                             |                                                                            |                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <a href="#">All Metrics</a><br><a href="#">Blackouts</a><br><a href="#">Net Services Administration</a>  | <a href="#">Manage Metrics</a><br><a href="#">Monitoring Configuration</a> | <a href="#">Alert History</a><br><a href="#">Metric Collection Errors</a> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------|

# Net Services Administration Pages

## Net Services Administration: Host Login

Host **edrsr30p1.us.oracle.com**

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

\* Username **oracle**

\* Password **\*\*\*\*\***

Save as Preferred Credential

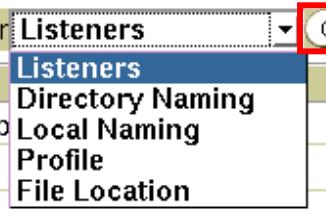
**Cancel** **Login**



## Net Services Administration

The table below contains configuration file locations used for network administration. Use this to access functions such as adding a listener or adding net service name. Choose the configuration file, then select the category that you want to administer and click Go.

| Select Configuration File Location                                                 | Oracle Home       | Administer                                                                                      |
|------------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------|
| <input checked="" type="radio"/> /u01/app/oracle/product/10.2.0/db_1/network/admin | /u01/app/oracle/p | <b>Listeners</b> ▾<br>Listeners<br>Directory Naming<br>Local Naming<br>Profile<br>File Location |



# Creating a Listener

## Net Services Administration

The table below contains configuration file locations used for network administration. Use this to access functions such as adding a listener or adding net service name. Choose the configuration file, then select the category that you want to administer and click Go.

Administrator **Listeners**  1

Select Configuration File Location Oracle Home

/u01/app/oracle/product/10.2.0/db\_1/network/admin /u01/app/oracle/p Local Naming

Host: edrsr30p1.us.oracle.com > Net Services Administration > Listeners: /u01/app/oracle/product/10.2.0/db\_1/network/admin

**Listeners: /u01/app/oracle/product/10.2.0/db\_1/network/admin** 2

Listener Name  Go Create

### Create Listener

Cancel OK

**General** Authentication Logging & Tracing Static Database Registration Other Services

\* Listener Name LISTENER2 3

**Addresses** 4

Listener must have at least one address. If address is changed, listener will be stopped before applying changes.

| Select Protocol   | Protocol Details           |
|-------------------|----------------------------|
| (No items found.) | Add <input type="button"/> |

# Adding Listener Addresses

## Add Address

Protocol

TCP/IP

5

\* Port

1561

6

\* Host

edrsr30p1.us.oracle.com

7

Cancel

OK

## Advanced Parameters

The following parameters are introduced in Oracle version 10g.

Total Send Buffer Size

(Bytes)

Cumulative size for all send operations.

Total Receive Buffer

Size (Bytes)

Cumulative size for all receive operations.

## Create Listener

Cancel

OK

General

Authentication Logging & Tracing Static Database Registration Other Services

\* Listener Name LISTENER2

## Addresses

Listener must have at least one address. If address is changed, listener will be stopped before applying changes.

Add

Edit

Remove

Select

Protocol

Protocol Details



TCP/IP

Host edrsr30p1.us.oracle.com

Port 1561

# Database Service Registration

### Add Database Service

\* Service Name

\* Oracle Home Directory

\* Oracle System Identifier (SID)



[General](#) [Authentication](#) [Logging & Tracing](#) **Static Database Registration** [Other Services](#)

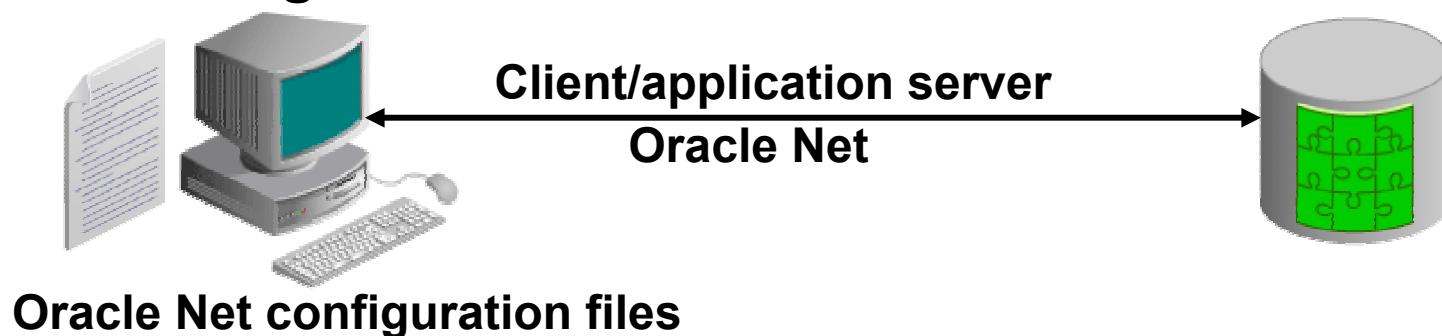
Configure the static registration of databases for the listener. Database information for Oracle8i or later releases is dynamically registered with the listener during instance startup. Therefore, static registration is not required for these releases, unless you require remote database startup from other than Oracle Enterprise Manager. Click Help for more details.

| Select                           | Service Name    | Oracle Home Directory               | Oracle System Identifier (SID) |
|----------------------------------|-----------------|-------------------------------------|--------------------------------|
| <input checked="" type="radio"/> | orcl.oracle.com | /u01/app/oracle/product/10.2.0/db_1 | orcl                           |

# Naming Methods

**Oracle Net supports several methods of resolving connection information:**

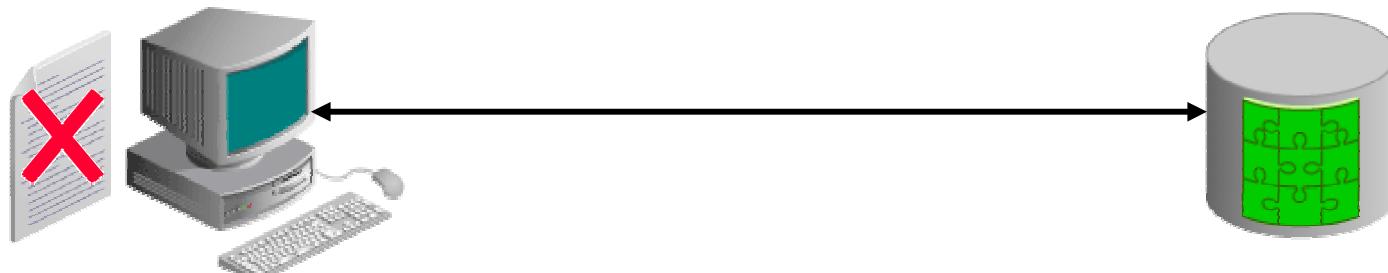
- **Easy connect naming:** Uses a TCP/IP connect string
- **Local naming:** Uses a local configuration file
- **Directory naming:** Uses a centralized LDAP-compliant directory server
- **External naming:** Uses a supported non-Oracle naming service



# 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

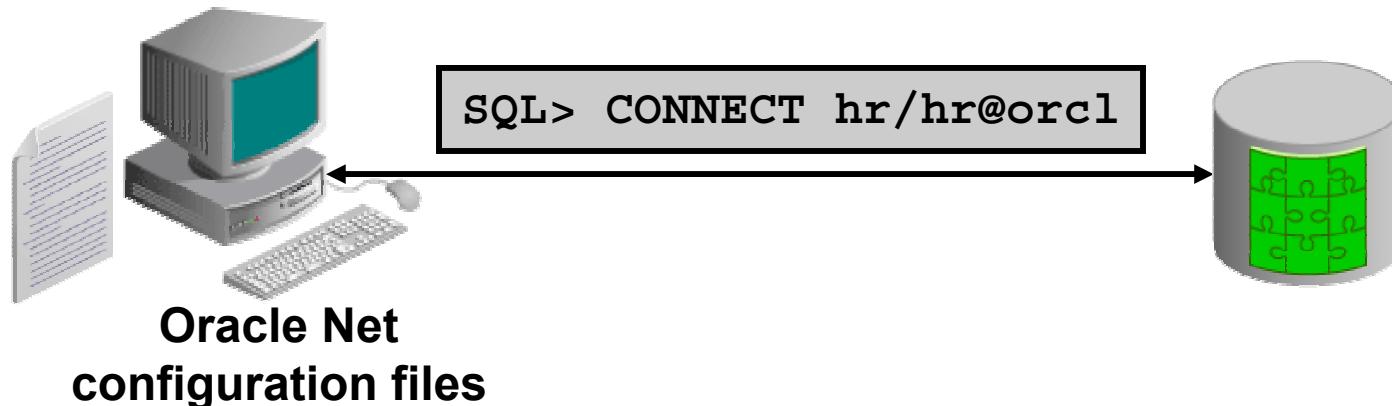
```
SQL> CONNECT hr/hr@db.us.oracle.com:1521/dba10g
```



No Oracle Net configuration files

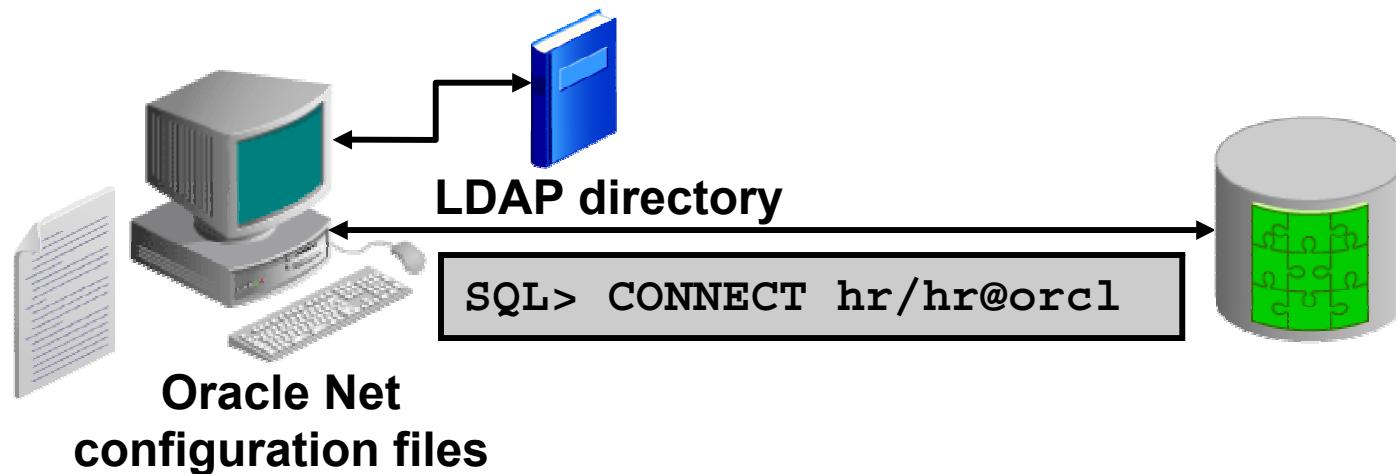
# Local Naming

- 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



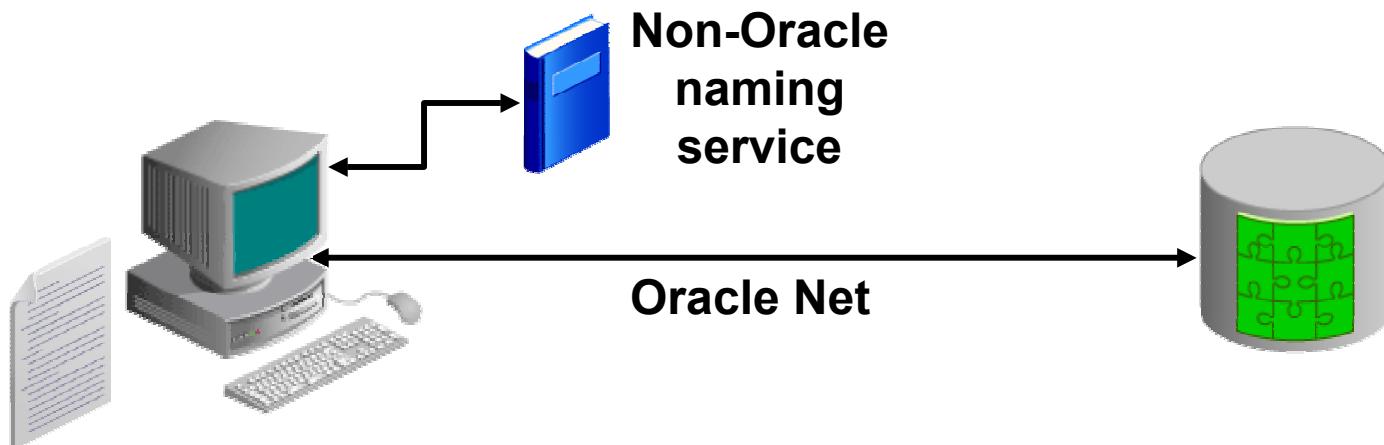
# Directory Naming

- 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

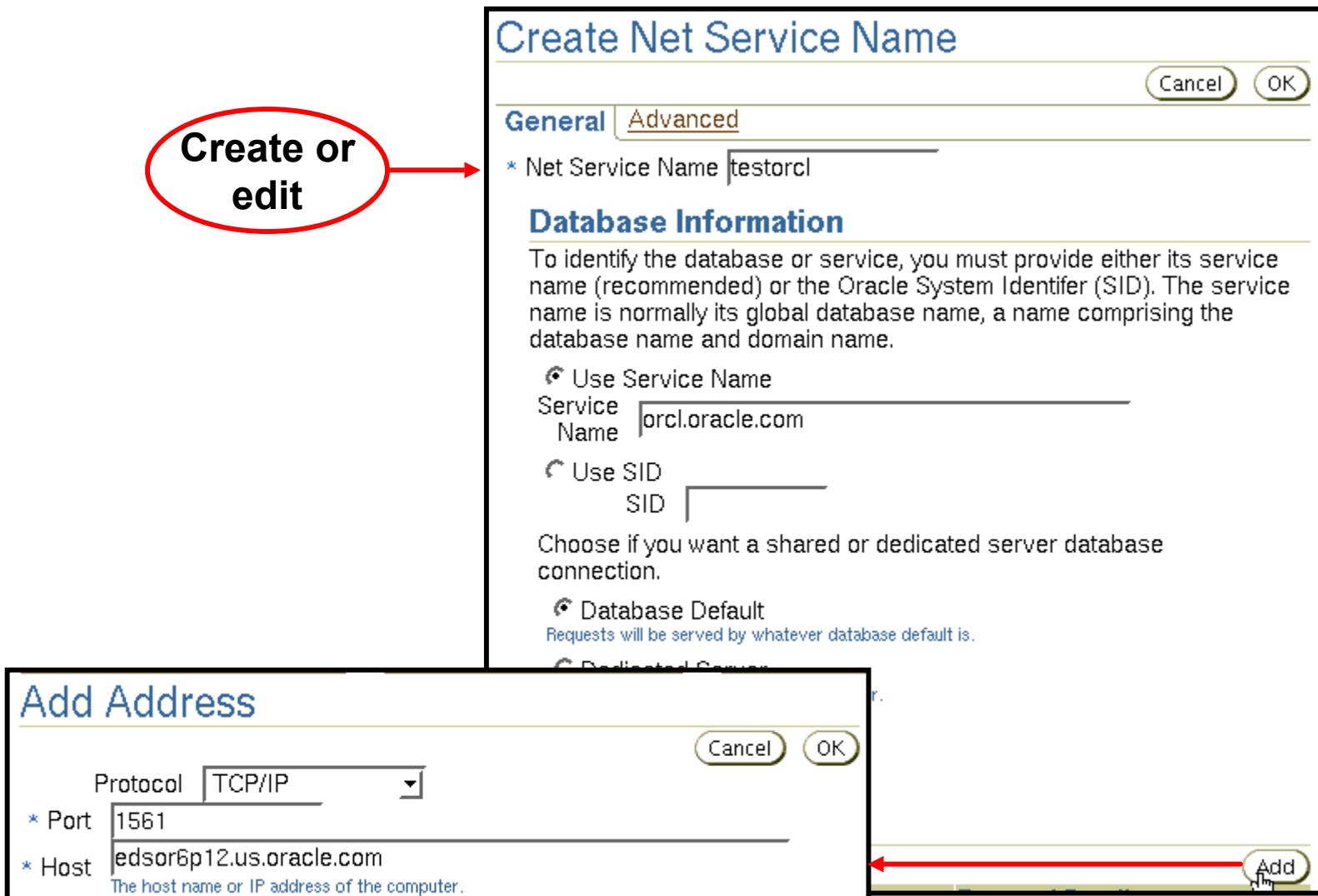


# External Naming Method

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



# Configuring Service Aliases



# Advanced Connection Options

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

- **Connect-time failover**
- **Load balancing**
- **Source routing**

## Connect-time Failover and Client Load Balancing

Configure whether addresses are tried randomly or sequentially during connections to the service. This setting is applicable only if there are more than one addresses configured.

- Try each address, in order, until one succeeds
- Try each address randomly, until one succeeds
- Try one address, selected at random
- Use each address in order until destination is reached
- Use only the first address

# 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:

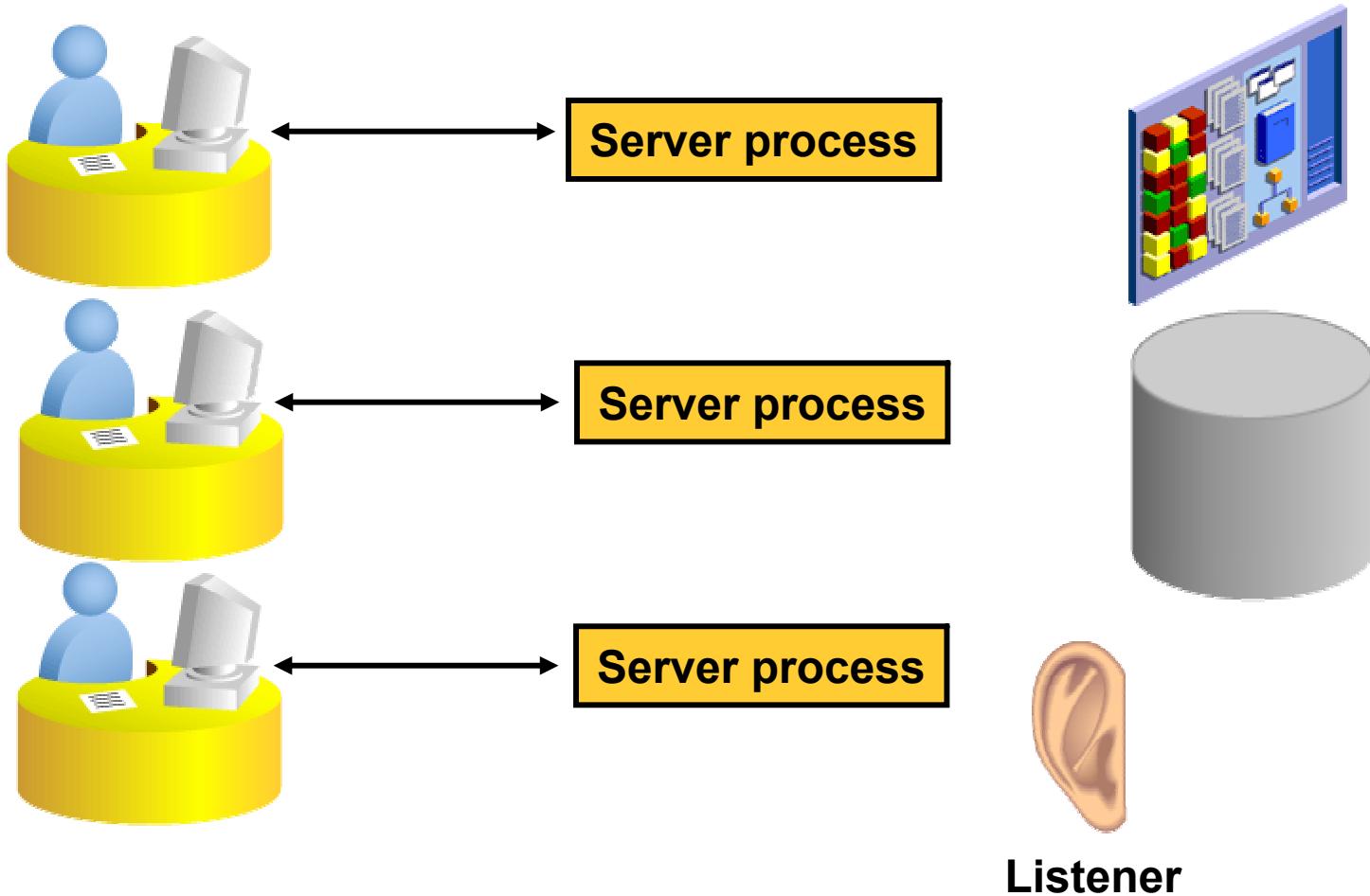
```
tnsping db.us.oracle.com:1521/dba10g
```

- Supports local and directory naming:

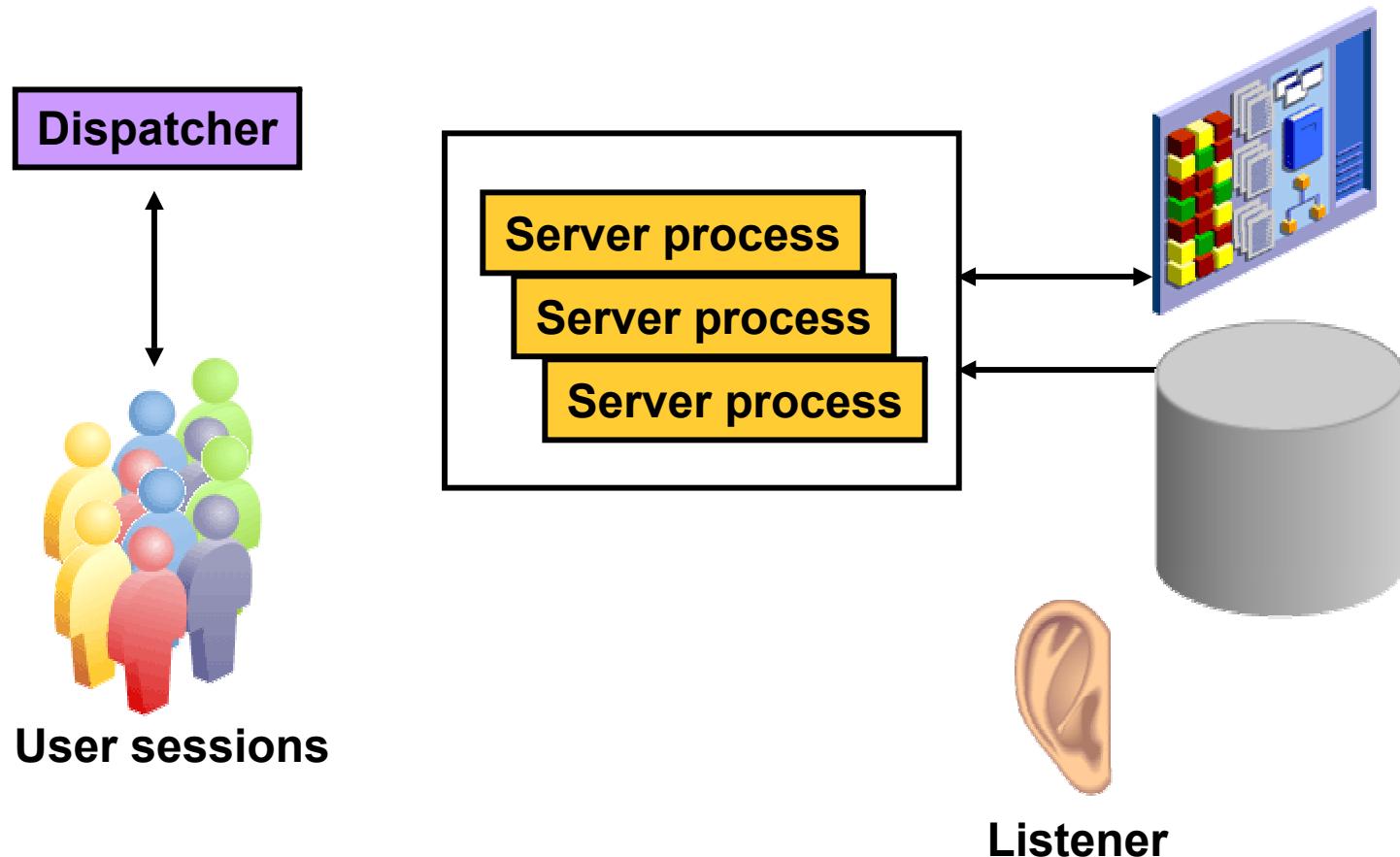
```
tnsping orcl
```

# User Sessions: Dedicated Server

User sessions

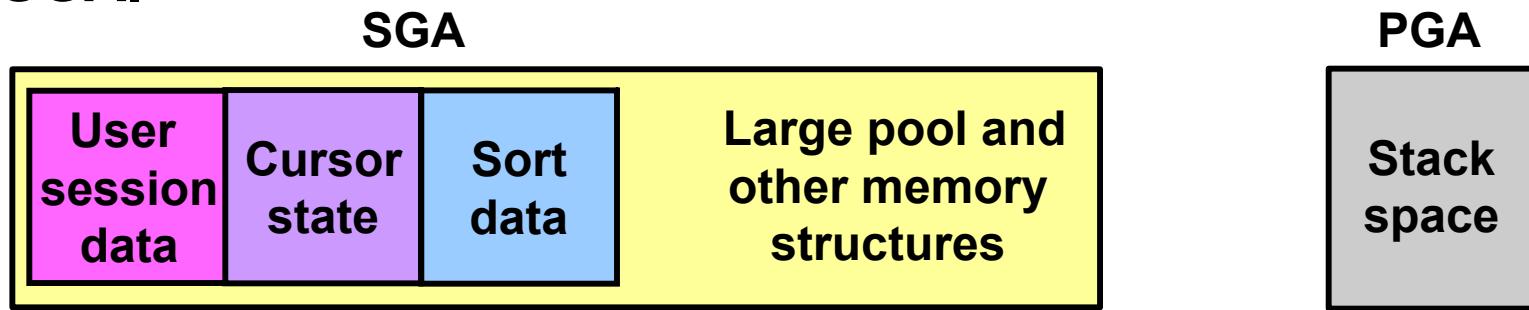


# User Sessions: Shared Servers



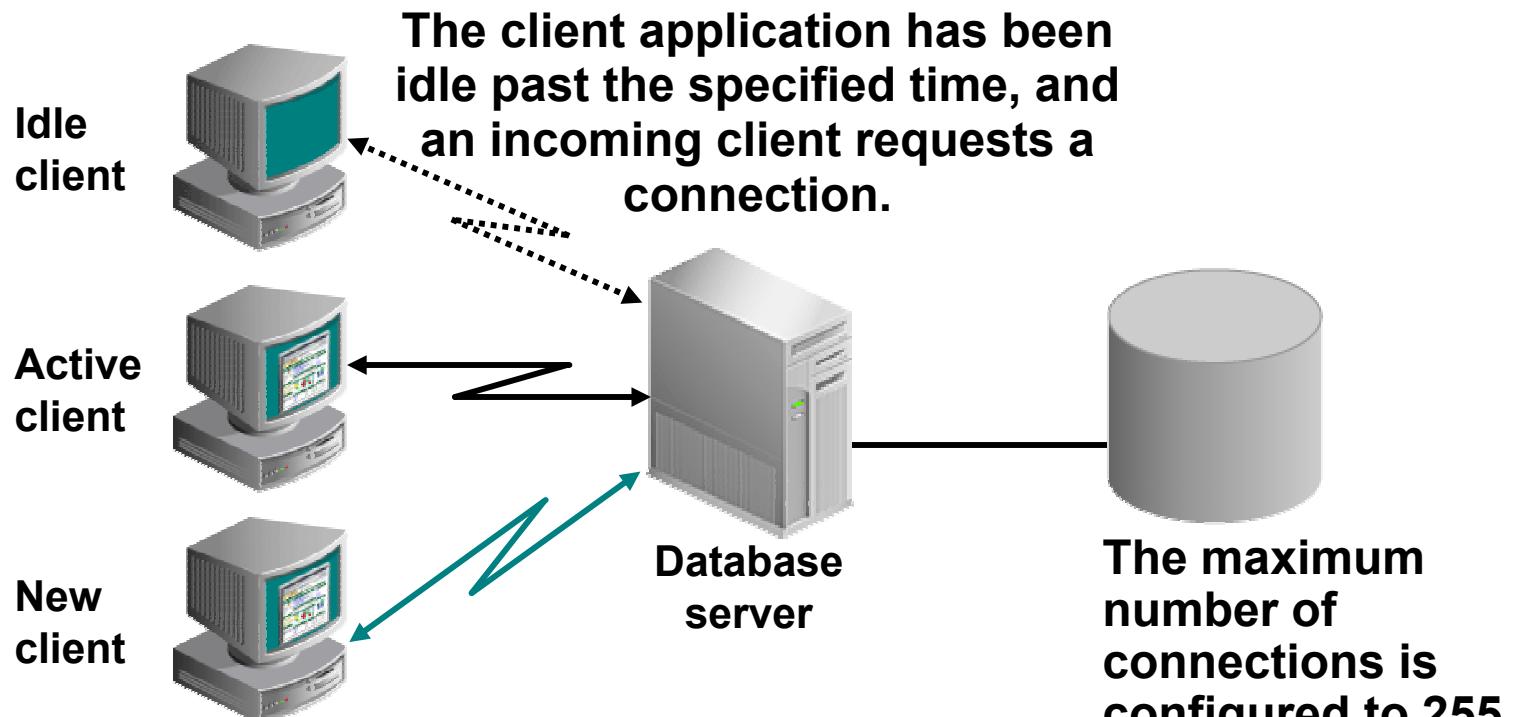
# SGA and PGA

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



**Remember to factor in shared server memory requirement when sizing the SGA.**

# Shared Server: Connection Pooling



# When Not to Use a Shared Server

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

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



Dispatcher



Dedicated  
Server process

# Summary

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

- **Use Enterprise Manager to:**
  - Create additional listeners
  - Create Oracle Net Service aliases
  - Configure connect-time failover
  - Control the Oracle Net Listener
- **Use tnsping to test Oracle Net connectivity**
- **Identify when to use shared servers versus dedicated servers**

# **Practice Overview: Working with Oracle Network Components**

**This practice covers:**

- **Configuring local Names Resolution to connect to another database**
- **Creating a second listener for connect-time failover**

# 12

## Proactive Maintenance

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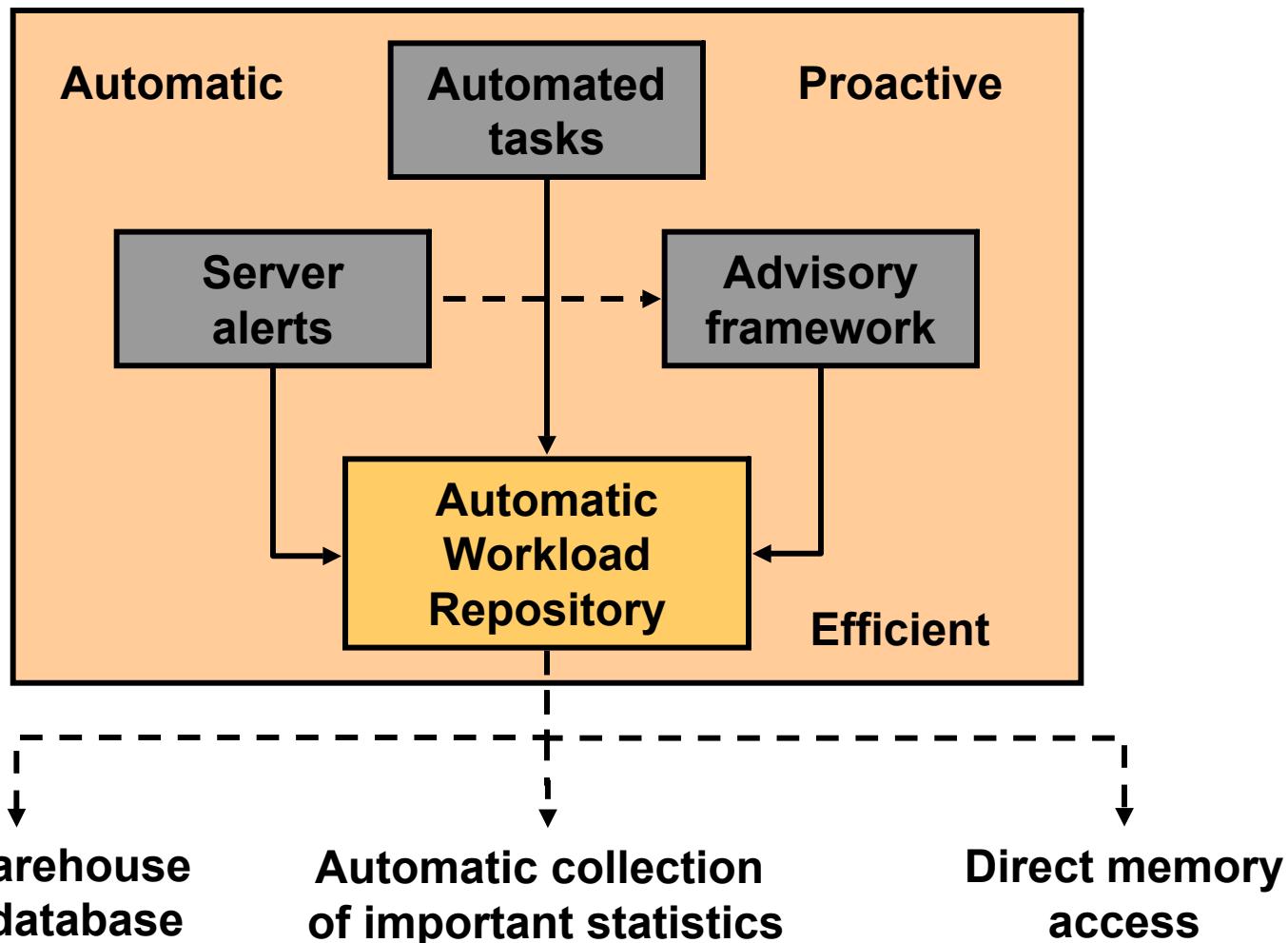
Copyright © 2008, Oracle. All rights reserved.

# Objectives

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

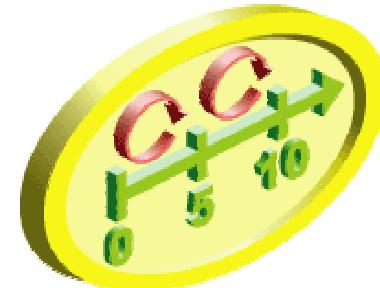
- **Use statistics**
- **Manage the Automatic Workload Repository (AWR)**
- **Use the Automatic Database Diagnostic Monitor (ADDM)**
- **Describe the advisory framework**
- **Set alert thresholds**
- **Use server-generated alerts**
- **Use automated tasks**

# Proactive Maintenance



# Introducing Terminology

- **Automatic Workload Repository (AWR):** Infrastructure for data gathering, analysis, and solutions recommendations
- **Baseline:** Data gathered of a “normal running database” for performance comparison
- **Metric:** Rate of change in a cumulative statistic
- **Statistics:** Data collections used for optimizing internal operations, such as execution of a SQL statement
- **Threshold:** A boundary value against which metric values are compared



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# Optimizer Statistics

> **Statistics**  
AWR  
ADDM  
Advisors  
Alerts  
AutoTasks

**Optimizer statistics are:**

- Not real 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
```

# Using the Manage Optimizer Statistics Page

Database Instance: orcl.oracle.com > Manage Optimizer Statistics      Logged in As DBA1

## Manage Optimizer Statistics

Database **orcl.oracle.com**

Optimizer Statistics are used by the query optimizer to choose the best execution plan for each SQL statement. Up-to-date optimizer statistics can greatly improve the performance of SQL statements.

**Oracle-Defined GATHER\_STATS\_JOB Job**

The GATHER\_STATS\_JOB updates optimizer statistics for objects with stale or missing statistics. It is executed within the maintenance window on a regular basis.

**Configuration**

Job Status **Enabled** [Configure](#)  
Next Run **Jun 6, 2005 10:00:00 PM PDT**  
Window Group for Next Run [MAINTENANCE WINDOW GROUP](#)  
Previous Runs **9**

**TIP** SYS user or user with ALTER privileges on the Oracle-defined job can configure and view the Oracle-defined Job

**Last Run**

|                  |                                   |
|------------------|-----------------------------------|
| Time             | <b>Jun 4, 2005 6:01:14 AM PDT</b> |
| Status           | <b>SUCCEEDED</b>                  |
| Duration (mins)  | <b>1.18</b>                       |
| Objects Analyzed | <b>97</b>                         |

**Operations**

[Gather Optimizer Statistics](#)  
[Restore Optimizer Statistics](#)  
[Lock Optimizer Statistics](#)  
[Unlock Optimizer Statistics](#)  
[Delete Optimizer Statistics](#)

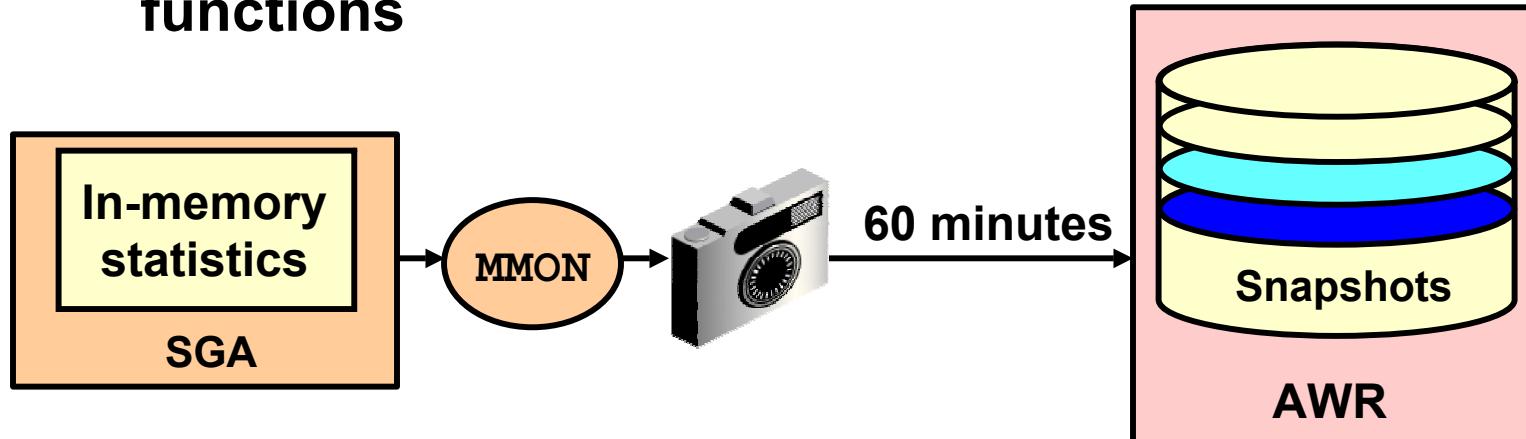
**Related Links**

[Object Status](#)  
[Statistics Options](#)  
[Job Scheduler](#)

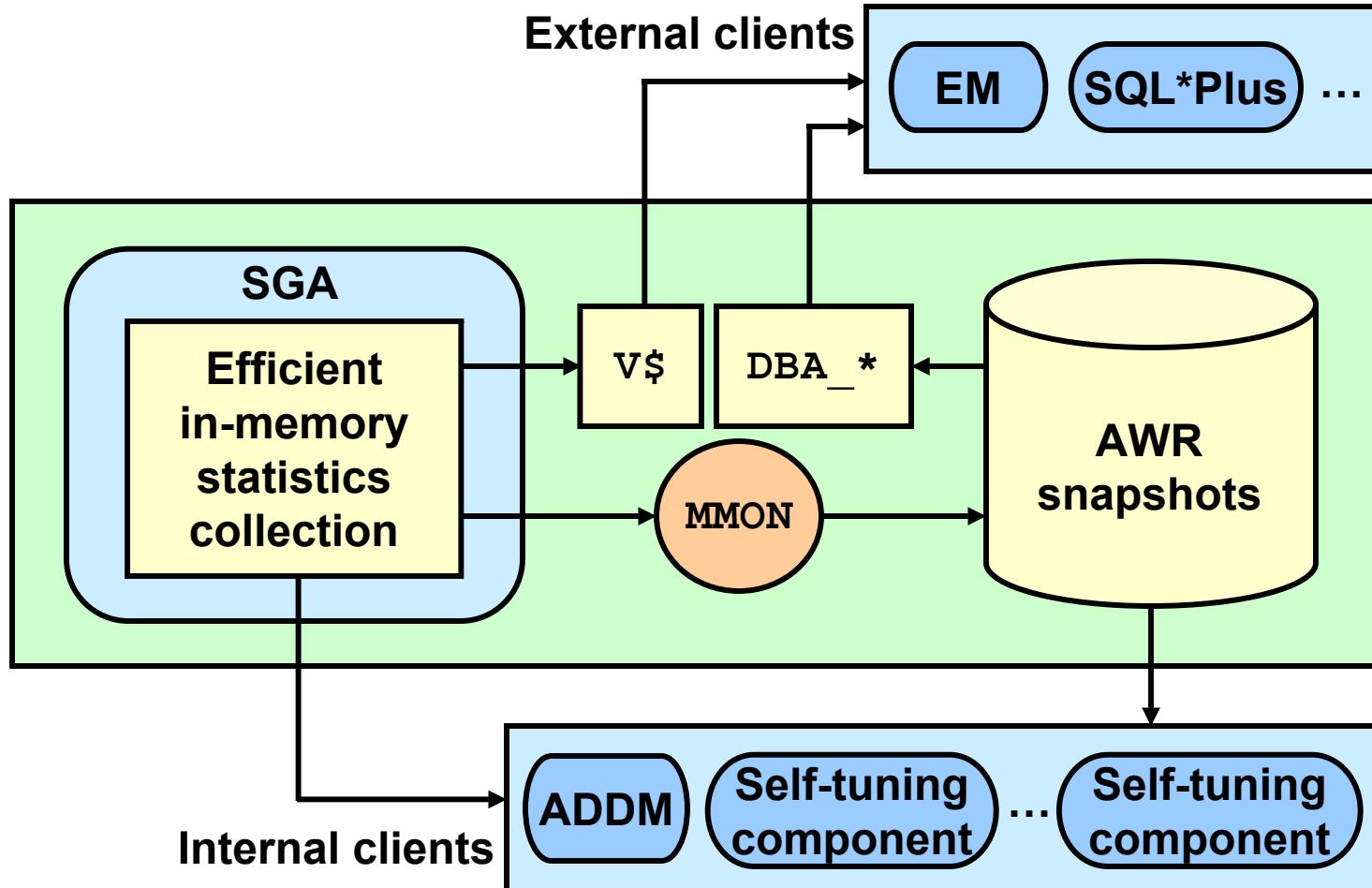
# Automatic Workload Repository (AWR)

Statistics  
➤ AWR  
ADDM  
Advisors  
Alerts  
AutoTasks

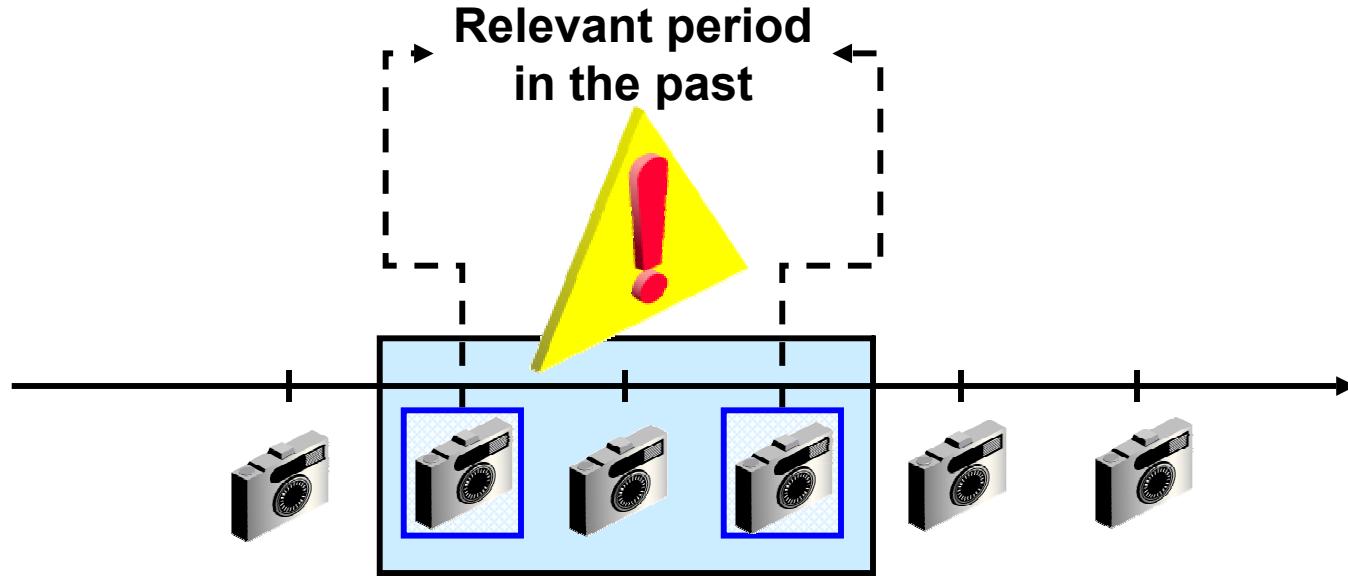
- Built-in repository of performance information
- Snapshots of database metrics taken every 60 minutes and retained for 7 days
- Foundation for all self-management functions



# AWR Infrastructure



# AWR Snapshot Sets



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

# Enterprise Manager and AWR

**Statistics Management**

[Automatic Workload Repository](#) [Manage Optimizer Statistics](#)

**Automatic Workload Repository**

The Automatic Workload Repository is used for storing data

**General**

Snapshot Retention (days) 7 [Edit](#)

Snapshot Interval (minutes) 60

Collection Level TYPICAL

Next Snapshot Capture Time Jun 3, 2005 6:00:15 PM

**Manage Snapshots and Preserved Snapshot Sets**

Snapshots 29

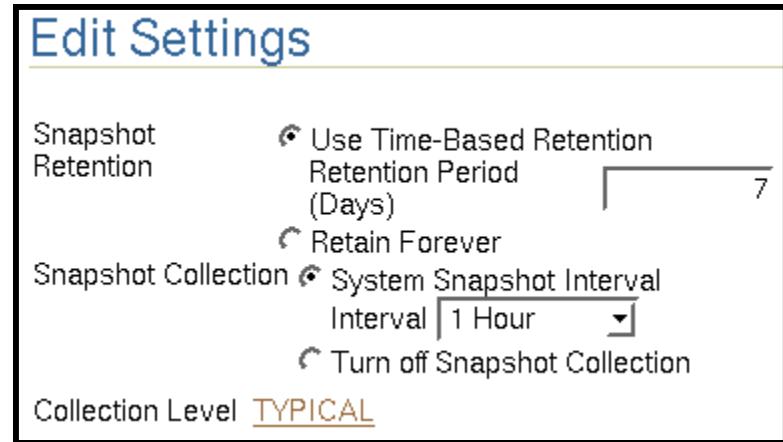
Preserved Snapshot Sets 0

Latest Snapshot Time Jun 3, 2005 5:00:15 PM

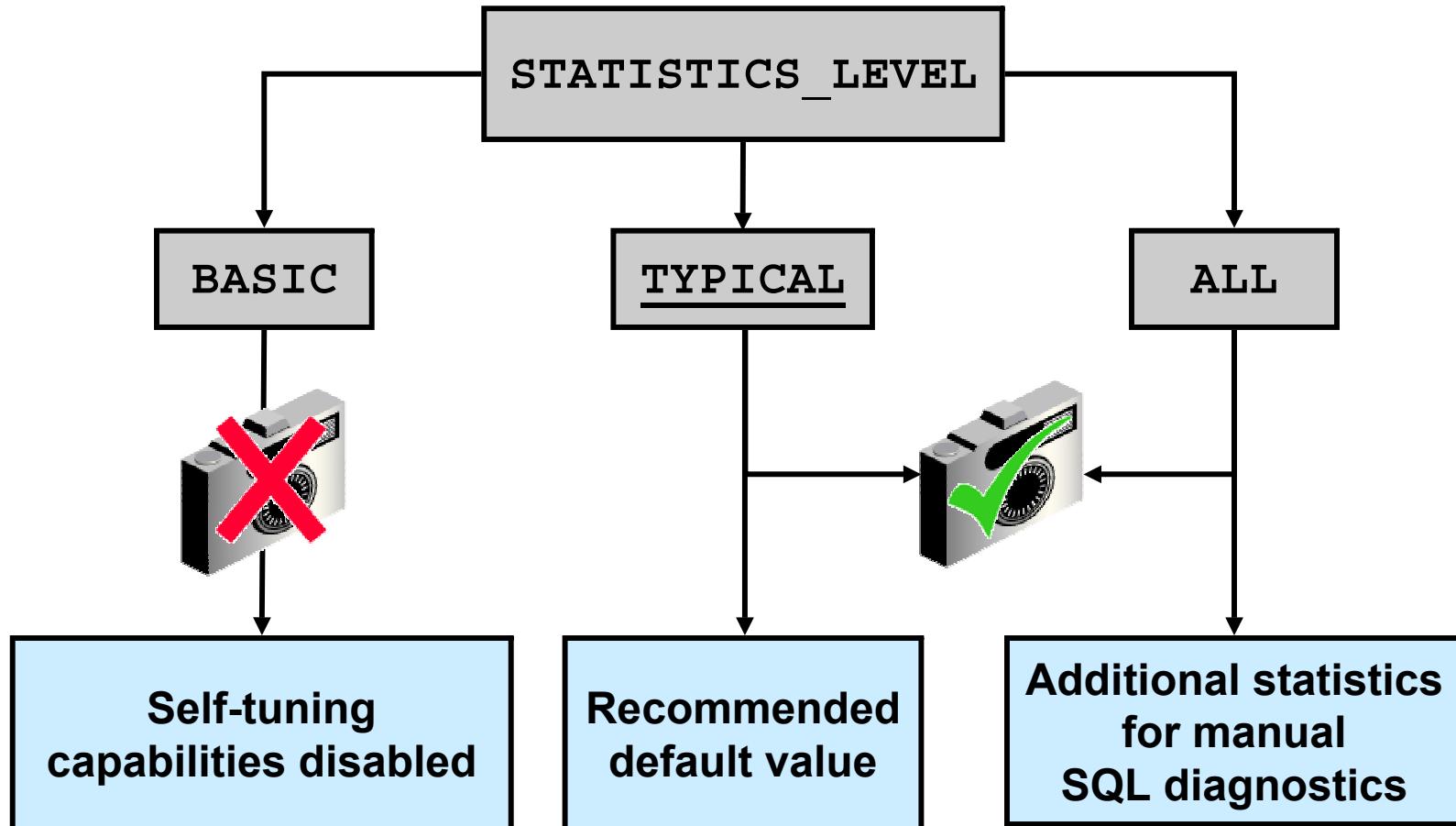
Earliest Snapshot Time Jun 2, 2005 1:00:43 PM

# Managing the AWR

- **Retention period**
  - The default is 7 days
  - Consider storage needs
- **Collection interval**
  - The default is 60 minutes
  - Consider storage needs and performance impact
- **Collection level**
  - Basic (disables most of ADDM functionality)
  - Typical (recommended)
  - All (adds additional SQL tuning information to snapshots)



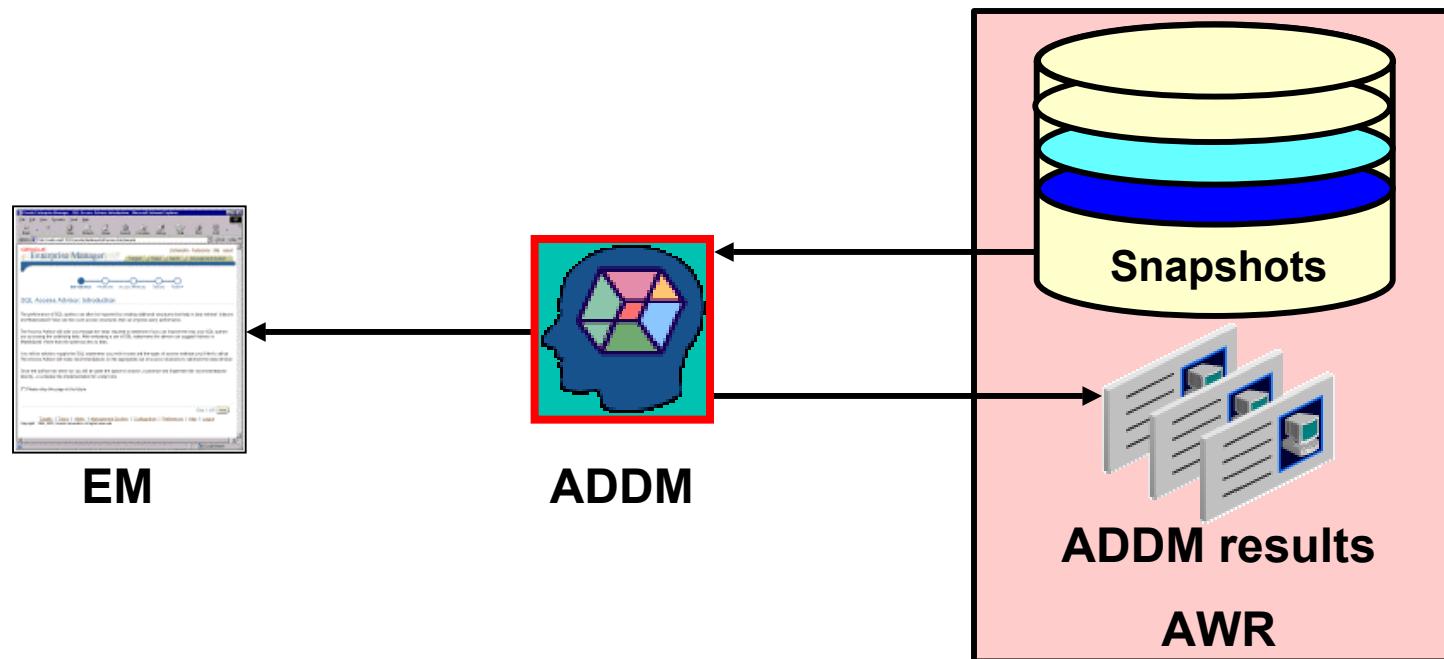
# Statistic Levels



# Automatic Database Diagnostic Monitor (ADDM)

Statistics  
AWR  
> ADDM  
Advisors  
Alerts  
AutoTasks

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



# ADDM Findings

Database Instance: EDRSR14P1\_orcl.oracle.com > Advisor Central > Automatic Database Diagnostic Monitor (ADDM)

Logged in As SYS

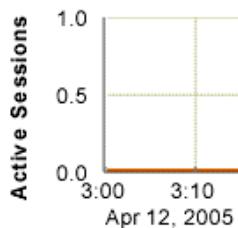
## Automatic Database Diagnostic Monitor (ADDM)

### Icon Key

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

#### Database Activity

The icon selected below



#### 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

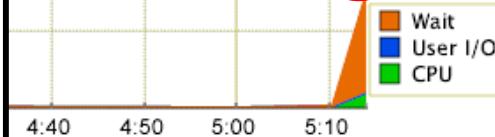
Page Refreshed Apr 12, 2005 5:21:43 AM PDT

Refresh

Run ADDM

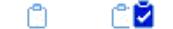
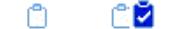
select a different analysis period.

1



Zoom

2



TIP For an explanation of the icons and symbols used in this page, see the [Icon Key](#)

#### Performance Analysis

Task Name ADDM:1082506989\_1\_47

Time Range Apr 12, 2005 5:11:00 AM to Apr 12, 2005 5:15:00 AM

Database Time (minutes) 2.6

Period Start Time Apr 12, 2005 5:10:25 AM PDT

Period Duration (minutes) 3.5

Task Owner ADDM

Average Active Sessions 0.7

[View Snapshots](#)

[View Report](#)

| Impact (%) | Finding                                                                                                                                 | Recommendations                    |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 100        | SQL statements consuming significant database time were found.                                                                          | 2 SQL Tuning                       |
| 25.2       | A hot data block with concurrent read and write activity was found. The block belongs to segment "ADDM.ADDM" and is block 23 in file 6. | 1 Application Analysis<br>1 Schema |
| 25.2       | Read and write contention on database blocks was consuming significant database time.                                                   | 3 Schema                           |

3

# ADDM Recommendations

Database Instance: EDRSR14P1\_orcl.oracle.com > Advisor Central > Automatic Database Diagnostic Monitor (ADDM) >

Performance Finding Details

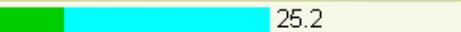
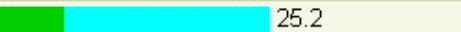
Logged in As SYS

## Performance Finding Details

|                             |                                                                                        |                   |                             |                              |     |
|-----------------------------|----------------------------------------------------------------------------------------|-------------------|-----------------------------|------------------------------|-----|
| Database Time<br>(minutes)  | 2.6                                                                                    | Period Start Time | Apr 12, 2005 5:10:25 AM PDT | Period Duration<br>(minutes) | 3.5 |
| Task Owner                  | ADDM                                                                                   | Task Name         | ADDM:1082506989_1_47        | Average Active Sessions      | 0.7 |
| Finding Impact<br>(minutes) | Read and write contention on database blocks was consuming significant database time.  |                   |                             |                              |     |
| Impact (%)                  |  25.2 |                   |                             |                              |     |

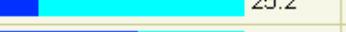
## Recommendations

Show All Details | Hide All Details

| Details   | Category                                                                                                                                                                                                                                                                                                                                  | Benefit (%)                                                                                |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| ▼ Hide    | Schema                                                                                                                                                                                                                                                                                                                                    |  25.2   |
| Action    | Consider using ORACLE's recommended solution of automatic segment space management in a locally managed tablespace for the tablespace "TBSADDM" containing the TABLE "ADDM.ADDM" with object id 54441. Alternatively, you can move this object to a different tablespace that is locally managed with automatic segment space management. |                                                                                            |
|           | Database Object <a href="#">ADDM.ADDM</a>                                                                                                                                                                                                                                                                                                 |                                                                                            |
| Rationale | There was significant read and write contention on TABLE "ADDM.ADDM" with object id 54441.                                                                                                                                                                                                                                                |                                                                                            |
|           | Database Object <a href="#">ADDM.ADDM</a>                                                                                                                                                                                                                                                                                                 |                                                                                            |
| ► Show    | Schema                                                                                                                                                                                                                                                                                                                                    |  25.2  |
| ► Show    | Schema                                                                                                                                                                                                                                                                                                                                    |  25.2 |

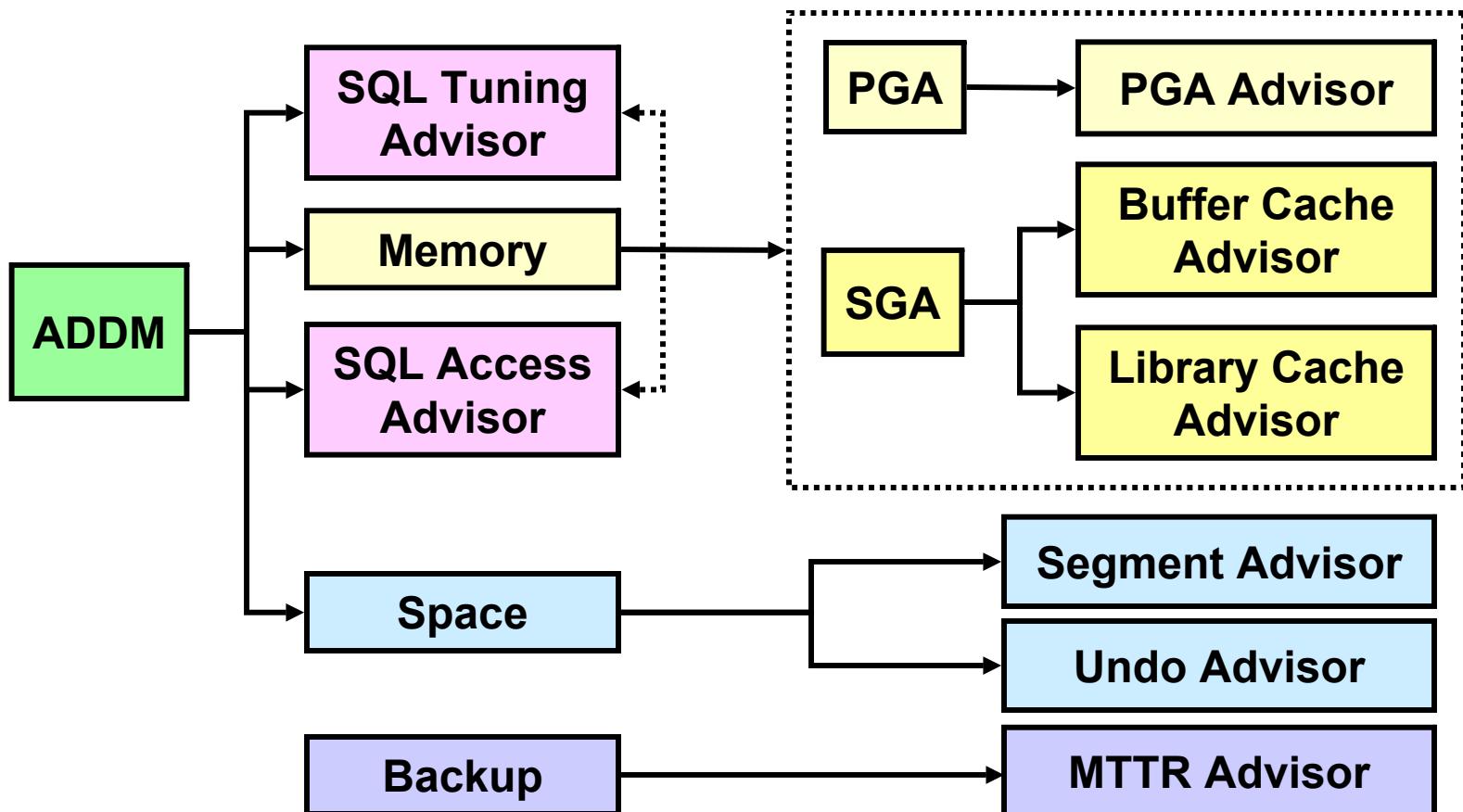
## Findings Path

Expand All | Collapse All

| Findings                                                                                | Impact (%)                                                                                 | Additional Information |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------|
| ▼ Read and write contention on database blocks was consuming significant database time. |  25.2 |                        |
| Wait class "Concurrency" was consuming significant database time.                       |  61.1 |                        |

# Advisory Framework

Statistics  
AWR  
ADDM  
> Advisors  
Alerts  
AutoTasks



# Enterprise Manager and Advisors

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout Database

Database Instance: EDRSR14P1\_orcl.oracle.com > Advisor Central Logged in As SYS

Advisor Central Page Refreshed Apr 13, 2005 8:42:15 AM PDT Refresh

**Advisors**

|                                 |                                    |                                    |
|---------------------------------|------------------------------------|------------------------------------|
| <a href="#">ADDM</a>            | <a href="#">Memory Advisor</a>     | <a href="#">MTTR Advisor</a>       |
| <a href="#">Segment Advisor</a> | <a href="#">SQL Access Advisor</a> | <a href="#">SQL Tuning Advisor</a> |
| <a href="#">Undo Management</a> |                                    |                                    |

**Advisor Tasks** Change Default Parameters

**Search**  
Select an advisory type and optionally enter a task name to filter the data that is displayed in your results set.

|                                          |                      |                                         |                                    |
|------------------------------------------|----------------------|-----------------------------------------|------------------------------------|
| Advisory Type                            | Task Name            | Advisor Runs                            | Status                             |
| <input type="button" value="All Types"/> | <input type="text"/> | <input type="button" value="Last Run"/> | <input type="button" value="All"/> |
| <input type="button" value="Go"/>        |                      |                                         |                                    |

**Results**

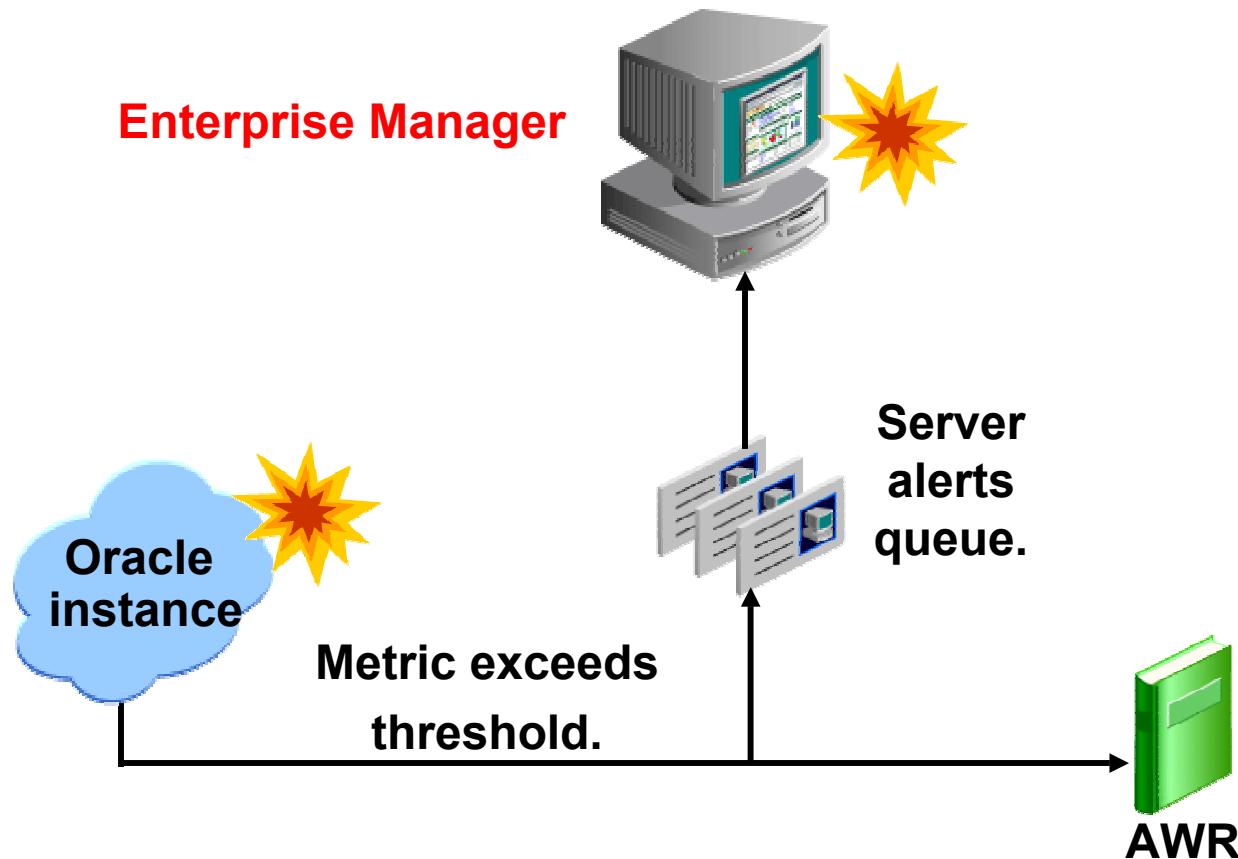
|                                  |                 |                                            |                                                                       |      |           |                         |                    |                   |
|----------------------------------|-----------------|--------------------------------------------|-----------------------------------------------------------------------|------|-----------|-------------------------|--------------------|-------------------|
| <input type="checkbox"/> Select  | Advisory Type   | Name                                       | Description                                                           | User | Status    | Start Time ▾            | Duration (seconds) | Expires In (days) |
| <input checked="" type="radio"/> | ADDM            | <a href="#">ADDM:1082506989_1_75</a>       | ADDM auto run: snapshots [74, 75], instance 1, database id 1082506989 | SYS  | COMPLETED | Apr 13, 2005 8:00:13 AM | 0                  | 30                |
| <input type="radio"/>            | Segment Advisor | <a href="#">SYS_AUTO_SPCADV_8021342005</a> | Auto Space Advisor                                                    | SYS  | COMPLETED | Apr 12, 2005 7:00:17 PM | 4                  | 29                |

# The DBMS ADVISED Package

| Procedure              | Description                                                         |
|------------------------|---------------------------------------------------------------------|
| CREATE_TASK            | Creates a new task in the repository                                |
| DELETE_TASK            | Deletes a task from the repository                                  |
| EXECUTE_TASK           | Initiates execution of the task                                     |
| INTERRUPT_TASK         | Suspends a task that is currently executing                         |
| GET_TASK_REPORT        | Creates and returns a text report for the specified task            |
| RESUME_TASK            | Causes a suspended task to resume                                   |
| UPDATE_TASK_ATTRIBUTES | Updates task attributes                                             |
| SET_TASK_PARAMETER     | Modifies a task parameter                                           |
| MARK_RECOMMENDATION    | Marks one or more recommendations as accepted, rejected, or ignored |
| GET_TASK_SCRIPT        | Creates a script of all the recommendations that are accepted       |

# Server-Generated Alerts

Statistics  
AWR  
ADDM  
Advisors  
➤ **Alerts**  
AutoTasks



# Default Server-Generated Alerts



**Database Control:  
SYSTEM metrics**

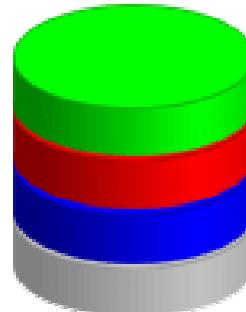


→ 97% Critical  
→ 85% Warning

**Tablespace  
Space Usage**



**Resumable  
Session  
Suspended**



**Recovery Area  
Low On  
Free Space**



**Snapshot  
Too Old**

# Setting Thresholds

Database Instance: orcl > Manage Metrics > Edit Thresholds

## Edit Thresholds

You can set a warning and critical threshold for each of the metrics below. When a threshold is reached, an alert will be generated and the response action, if specified, executed. The response action can be any command or script, with a fully qualified path, that is accessible to the Management Agent.

 **TIP** Some metrics do not allow a default set of thresholds for all their monitored objects. Click "Specify Multiple Thresholds" to set thresholds for specific objects.

Related Link [Response to Target Down](#)

| Select Metric                                                 | Comparison Operator | Warning Threshold | Critical Threshold | Response Action |
|---------------------------------------------------------------|---------------------|-------------------|--------------------|-----------------|
| <input checked="" type="radio"/> Archive Area Used (%)        | >                   | 80                |                    |                 |
| <input type="radio"/> Archiver Hung Alert Log Error           | Contains            |                   | ORA-               |                 |
| <input type="radio"/> Archiver Hung Alert Log Error Status    | >                   | 0                 |                    |                 |
| <input type="radio"/> Audited User                            | =                   | SYS               |                    |                 |
| <input type="radio"/> Average File Read Time (centi-seconds)  | >                   |                   |                    |                 |
| <input type="radio"/> Average File Write Time (centi-seconds) | >                   |                   |                    |                 |
| <input type="radio"/> Average Users Waiting Count             |                     |                   |                    |                 |
| <input type="radio"/> Administrative                          | >                   | 10                |                    |                 |
| <input type="radio"/> Application                             | >                   | 10                |                    |                 |
| <input type="radio"/> Cluster                                 | >                   | 30                |                    |                 |
| <input type="radio"/> Commit                                  | >                   | 30                |                    |                 |

# Creating and Testing an Alert

1. Specify a threshold.
2. Create a test case.
3. Check for an alert.

Show SQL

2

```
CREATE TABLE "HR"."FILLER" ( "EMPLOYEE_ID" NUMBER(6), "FIRST_NAME"
VARCHAR2(20), "LAST_NAME" VARCHAR2(25), "EMAIL" VARCHAR2(25),
"PHONE_NUMBER" VARCHAR2(20), "HIRE_DATE" DATE, "JOB_ID" VARCHAR2(10),
"SALARY" NUMBER(8, 2), "COMMISSION_PCT" NUMBER(2, 2), "MANAGER_ID"
NUMBER(6), "DEPARTMENT_ID" NUMBER(4)) TABLESPACE "INVENTORY" PCTFREE 10
INITTRANS 1 MAXTRANS 255 STORAGE ( INITIAL 64K BUFFER_POOL DEFAULT)
Nologging
```

## Tablespace Full Metric Thresholds

Monitor the fullness of the tablespace using either o

### Space Used (%)

A warning or critical alert will be generated if the percentage of space used exceeds the corresponding threshold.

Use Database Default Thresholds [Modify](#)

Warning (%) 85  
Critical (%) 97

Specify Thresholds

Warning (%)   
Critical (%)

Disable Thresholds

1

## Alerts

3

Category All



Go

Critical

x 1

Warning 1

| Severity | Category         | Name                      | Message                                 | Alert Triggered         |
|----------|------------------|---------------------------|-----------------------------------------|-------------------------|
|          | Tablespaces Full | Tablespace Space Used (%) | Tablespace INVENTORY is 98 percent full | Jun 3, 2005 10:44:04 AM |
|          | User Audit       | Audited User              | User SYS logged on from EDRSR30P1.      | Jun 3, 2005 8:25:04 AM  |

# Alerts Notification

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout Database

Preferences

Properties Targets Availability Metrics Objects Methods More

Edit Notification Rule Database Availability and Critical States: Metrics

Select the metrics and their severities for which you would like to receive notifications.

Cancel Back Step 4 of 7 Next

**Severity States**

Select the severity states for which you would like to receive notification.

Critical  
 Warning  
 Clear

**Metrics**

Severity states apply to all selected metrics.

**Available Metrics**

- Archiver Hung Alert Log Error
- Audited User
- Average File Read Time (centi-seconds)
- Average File Write Time (centi-seconds)
- Average Users Waiting Count
- BG Checkpoints (per second)
- Branch Node Splits (per second)
- Branch Node Splits (per transaction)
- Broken Job Count
- Buffer Cache Hit (%)

**Selected Metrics**

- Archiver Hung Alert Log Error Status
- Process Limit Usage (%)
- Archive Area Used (%)
- Session Limit Usage (%)
- Segments Approaching Maximum Extents Count
- Wait Time (%)
- Session Terminated Alert Log Error Status
- Tablespace Space Used (%)
- Generic Alert Log Error Status
- Data Block Corruption Alert Log Error Status

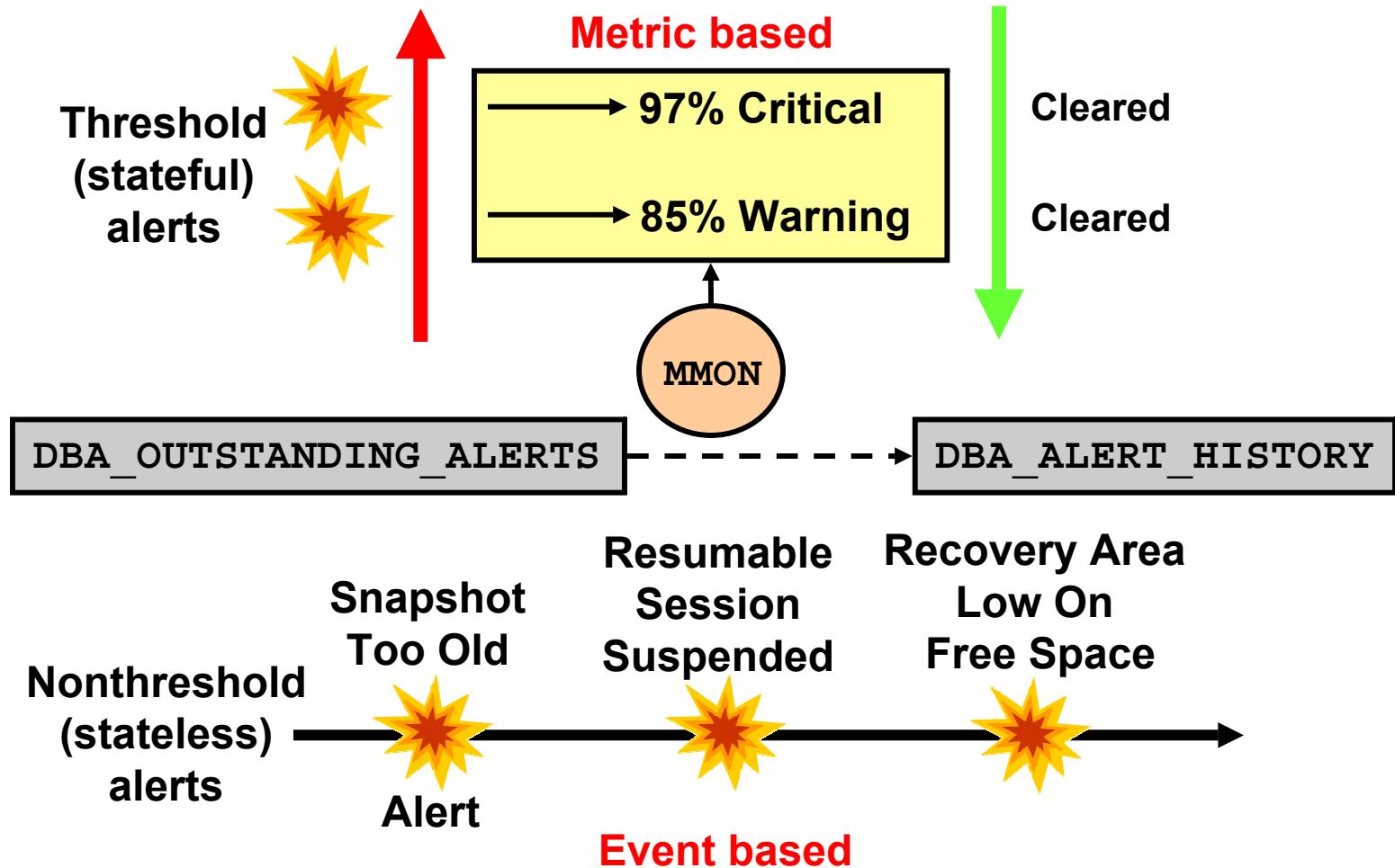
TIP You will skip the Objects step if none of the selected metrics could have objects.

# Reacting to Alerts

- If needed, gather more input, for example, by running ADDM or another advisor.
- Take corrective measures.
- Acknowledge alerts, which are not automatically cleared.



# Alert Types and Clearing Alerts



# Automated Maintenance Tasks

Statistics  
AWR  
ADDM  
Advisors  
Alerts  
➤ AutoTasks

- Scheduler initiates jobs
- Jobs run in the default maintenance window
- Limit maintenance impact on normal operation by using Resource Manager

## Examples of maintenance:

- Gathering optimizer statistics
- Gathering segment information
- Backing up database



# Summary

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

- **Use statistics**
- **Manage the Automatic Workload Repository**
- **Use the Automatic Database Diagnostic Monitor**
- **Describe the advisory framework**
- **Set alert thresholds**
- **Use server-generated alerts**
- **Use automated tasks**

# **Practice Overview: Proactive Maintenance**

**This practice covers the following topics:**

- **Proactively managing your database by using ADDM**
  - **Setting up an issue for analysis**
  - **Reviewing your database performance**
  - **Implementing a solution**

# 13

## Performance Management

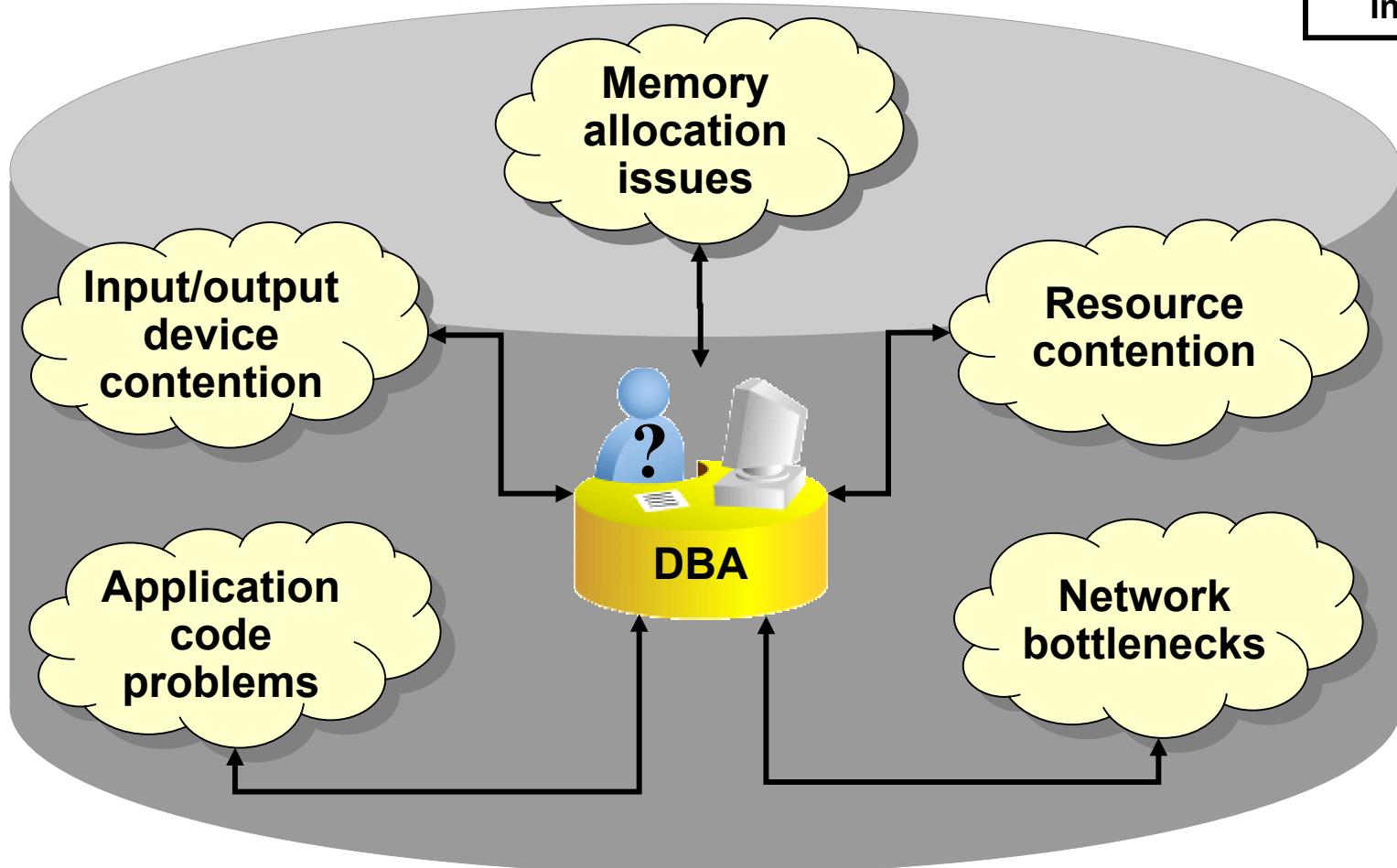
# Objectives

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

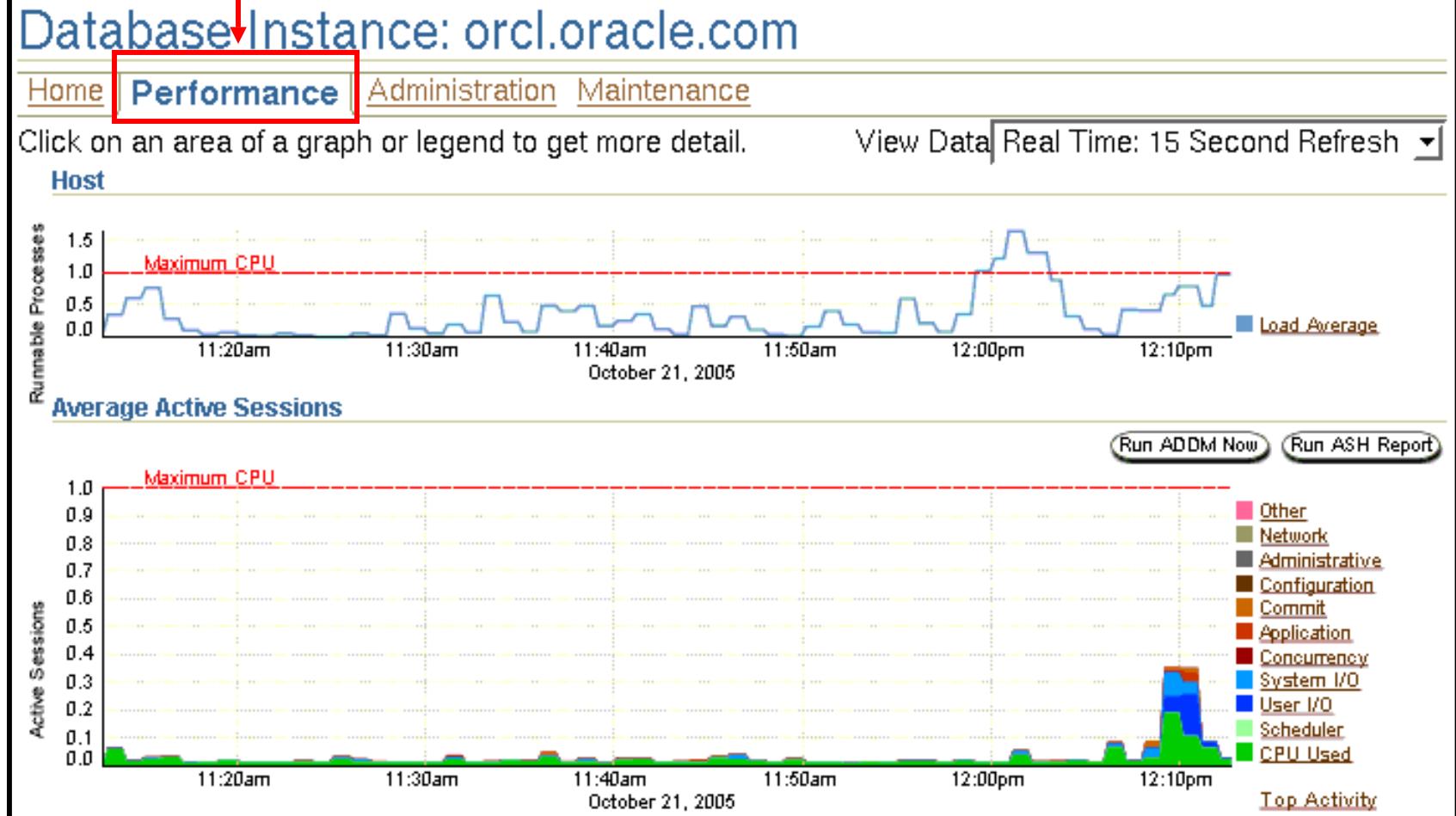
- **Use Enterprise Manager to monitor performance**
- **Tune SQL by using the SQL Tuning Advisor**
- **Tune SQL by using the SQL Access Advisor**
- **Use Automatic Shared Memory Management (ASSM)**
- **Use the Memory Advisor to size memory buffers**
- **View performance-related dynamic views**
- **Troubleshoot invalid and unusable objects**

# Performance Monitoring

> **Perf Mon**  
Tuning Adv  
Access Adv  
Memory  
Stats  
Invalid Obj



# Performance Monitoring



# Performance Monitoring

**Active Sessions Working: CPU Used**

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

View Data Real Time: 15 Second Refresh

CPU Used

## Detail for Selected 5 Minute Interval

Start Time Oct 21, 2005 12:06:35 PM PDT

### Top Working SQL

| Select All   Select None |              | Schedule SQL Tuning Advisor | Create SQL Tuning Set |
|--------------------------|--------------|-----------------------------|-----------------------|
| Select                   | Activity (%) | SQL ID                      | SQL Type              |
|                          | 30.19        | a0q0ya8fx52s                | INSERT                |
|                          | 9.43         | 257rmmxgva4z                | SELECT                |
|                          | 7.55         | 8f4zf0m1b7b6u               | INSERT                |
|                          | 7.55         | 9c3326865m2h9               | SELECT                |
|                          | 7.55         | cakg0hdijw2wf               | SELECT                |
|                          | 3.77         | fsz8wz5pmvamh               | SELECT                |
|                          | 3.77         | 6uvk7uc8m4mf0               | SELECT                |
|                          | 3.77         | 4c1xvg9ufwcjc               | SELECT                |
|                          | 1.89         | f787fyhjmkp61               | INSERT                |

Total Sample Count: 53

### Top Working Sessions

| Activity (%) | Session ID | User Name | Program                |
|--------------|------------|-----------|------------------------|
| 41.43        | 132        | HR        | sqlplus.exe            |
| 22.86        | 159        | DBSNMP    | OMS                    |
| 11.43        | 167        | SYS       | oracle@edrsr9p1 (DBW0) |
| 10.00        | 145        | SYS       | oracle@edrsr9p1 (m000) |
| 4.29         | 128        | SYSMAN    | OMS                    |
| 2.86         | 141        | SYSMAN    | OMS                    |
| 2.86         | 137        | SYSMAN    | OMS                    |
| 1.43         | 146        | SYS       | oracle@edrsr9p1 (q000) |

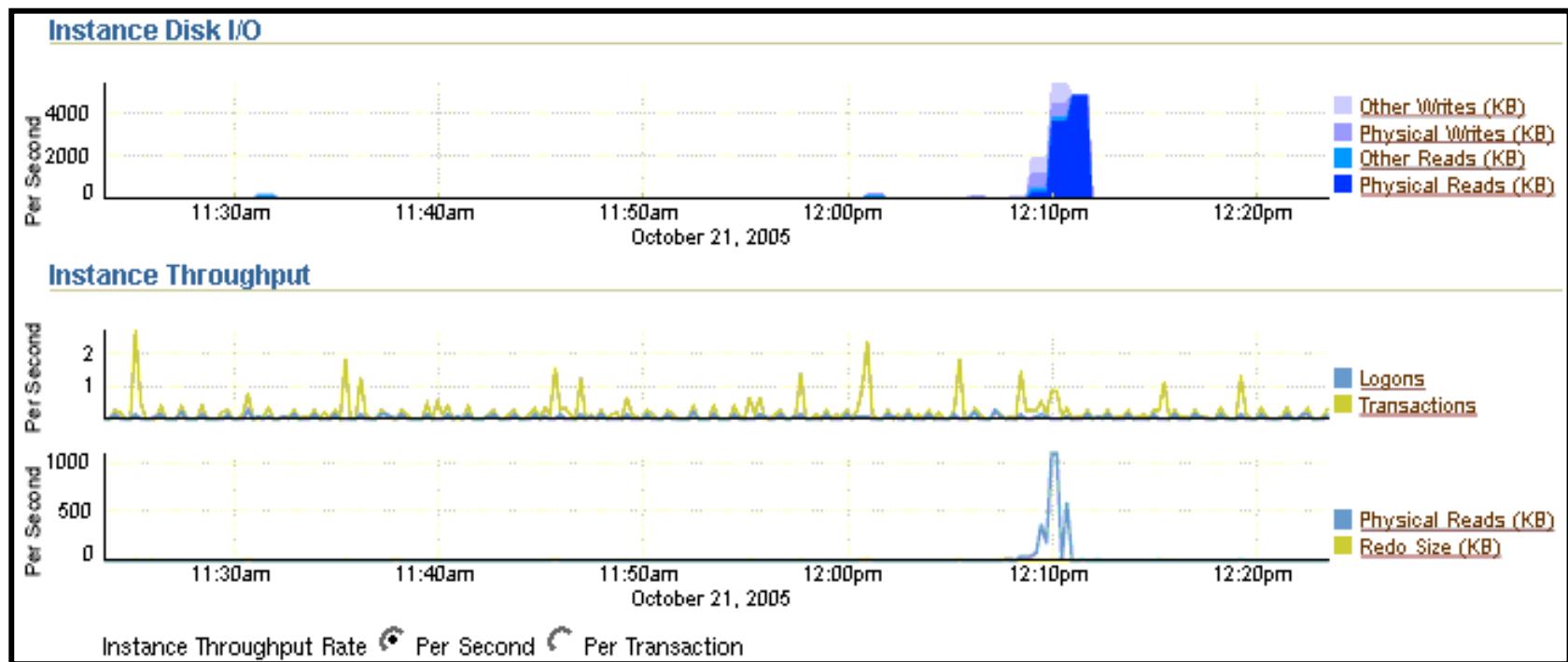
Total Sample Count: 70

13-5

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ORACLE®

# Performance Monitoring



# Performance Monitoring: Top Sessions

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

View Data | Real Time: 15 Second Refresh ▾

## Top Consumers

Collected From Oct 21, 2005 1:29:35 PM To Oct 21, 2005 1:29:50 PM

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

Show Active SQL Customize 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     | OS PID | Machine                | OS User | SQL Trace |
|--------|-----|---------|-------------------|--------------------|----------------|---------------|-------------|--------------|------------|--------|-------------|--------|------------------------|---------|-----------|
| C      | 152 | SH      | 430               | 781908             | 69451          | 72832         | 0           | 8            | 0          | ACTIVE | sqlplus.exe | 20866  | WORKGROUP\TBEST-LAP    | tbest   | DISABLED  |
| C      | 135 | HR      | 354               | 7597652            | 0              | 29851         | 1           | 1215         | 0          | ACTIVE | sqlplus.exe | 20351  | WORKGROUP\TBEST-LAP    | tbest   | DISABLED  |
| C      | 159 | DBSNMP  | 12                | 1175124            | 0              | 0             | 0           | 0            | 0          | ACTIVE | OMS         | 20349  | edrsr9p1.us.oracle.com |         | DISABLED  |

# Performance Monitoring: Top Services

| Select                   | Service              | Activity (% for the last 5 minutes) | SQL Trace Enabled | Delta Elapsed Time (seconds) |
|--------------------------|----------------------|-------------------------------------|-------------------|------------------------------|
| <input type="checkbox"/> | SYS\$USERS           |                                     | 37.8 FALSE        | 1                            |
| <input type="checkbox"/> | SYS\$BACKGROUND      |                                     | 27.0 FALSE        | 0                            |
| <input type="checkbox"/> | inventory.oracle.com |                                     | 24.3 FALSE        | 0                            |
| <input type="checkbox"/> | orcl.oracle.com      |                                     | 8.1 FALSE         | 0                            |
| <input type="checkbox"/> | hr.oracle.com        |                                     | 2.7 FALSE         | 1                            |

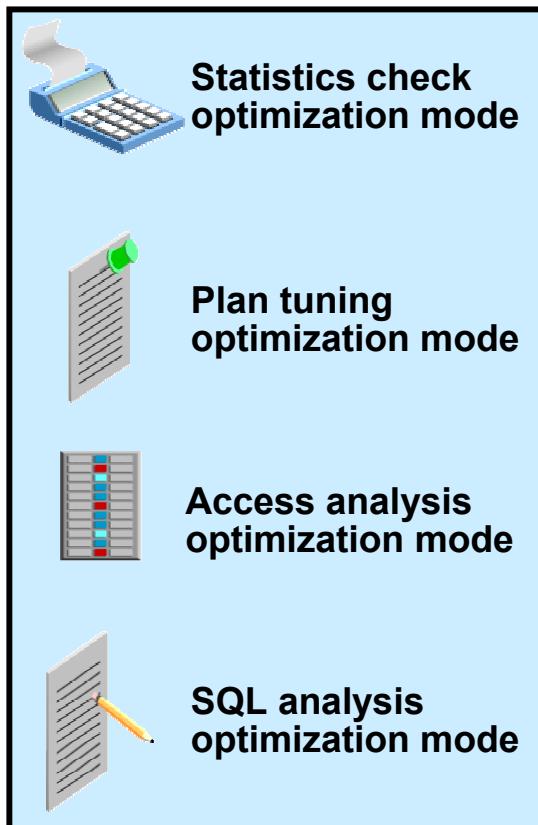
  

| Cumulative Elapsed Time (seconds) | Delta CPU Time (seconds) | Cumulative CPU Time (seconds) | Delta Physical I/O (blocks) | Cumulative Physical I/O (blocks) |
|-----------------------------------|--------------------------|-------------------------------|-----------------------------|----------------------------------|
| 4874                              | 1                        | 1774                          | 9518                        | 362289                           |
| 0                                 | 0                        | 0                             | 1                           | 328437                           |
| 262                               | 0                        | 58                            | 0                           | 10250                            |
| 2486                              | 0                        | 1186                          | 0                           | 4977                             |
| 1124                              | 0                        | 73                            | 5874                        | 55841                            |

# SQL Tuning Advisor: Overview

Perf Mon  
> **Tuning Adv**  
Access Adv  
Memory  
Stats  
Invalid Obj

## Automatic Tuning Optimizer



## Comprehensive SQL tuning



**SQL Tuning Advisor**

Detect stale or missing statistics

Tune SQL plan  
(SQL profile)

Add missing index  
Run access advisor

Restructure SQL

# SQL Tuning Advisor Options and Recommendations

**Scope**

Limited. Analysis without SQL Profile recommendation. Takes about 1 second per statement.  
 Comprehensive. Complete analysis including SQL Profile. May take a long time.

Total Time limit  Minutes

Execution Plan Current Statistics Execution History **Tuning History**

Collected From Target Jan 30, 2004 5:00:29 AM

The following table lists all the recommendations available for the SQL statement.

| Plan Hash Value | Advisor Task Owner | Advisor Task Name        | Task Completion         |
|-----------------|--------------------|--------------------------|-------------------------|
| 2840254885      | SYS                | SQL_TUNING_1075467455060 | Jan 30, 2004 4:58:19 AM |

**Recommendations**

[View Recommendations](#)

| Select                           | SQL Text                                                                 | Parsing Schema | SQL ID        | Statistics | SQL Profile | Index | Restructure SQL | Miscellaneous | Error |
|----------------------------------|--------------------------------------------------------------------------|----------------|---------------|------------|-------------|-------|-----------------|---------------|-------|
| <input checked="" type="radio"/> | select time_id, QUANTITY SOLD, AMOUNT SOLD from sales s, customers c ... | SH             | fu02q80b2kva1 |            | ✓           |       |                 |               |       |

**Select Recommendation**

[Original Explain Plan](#)

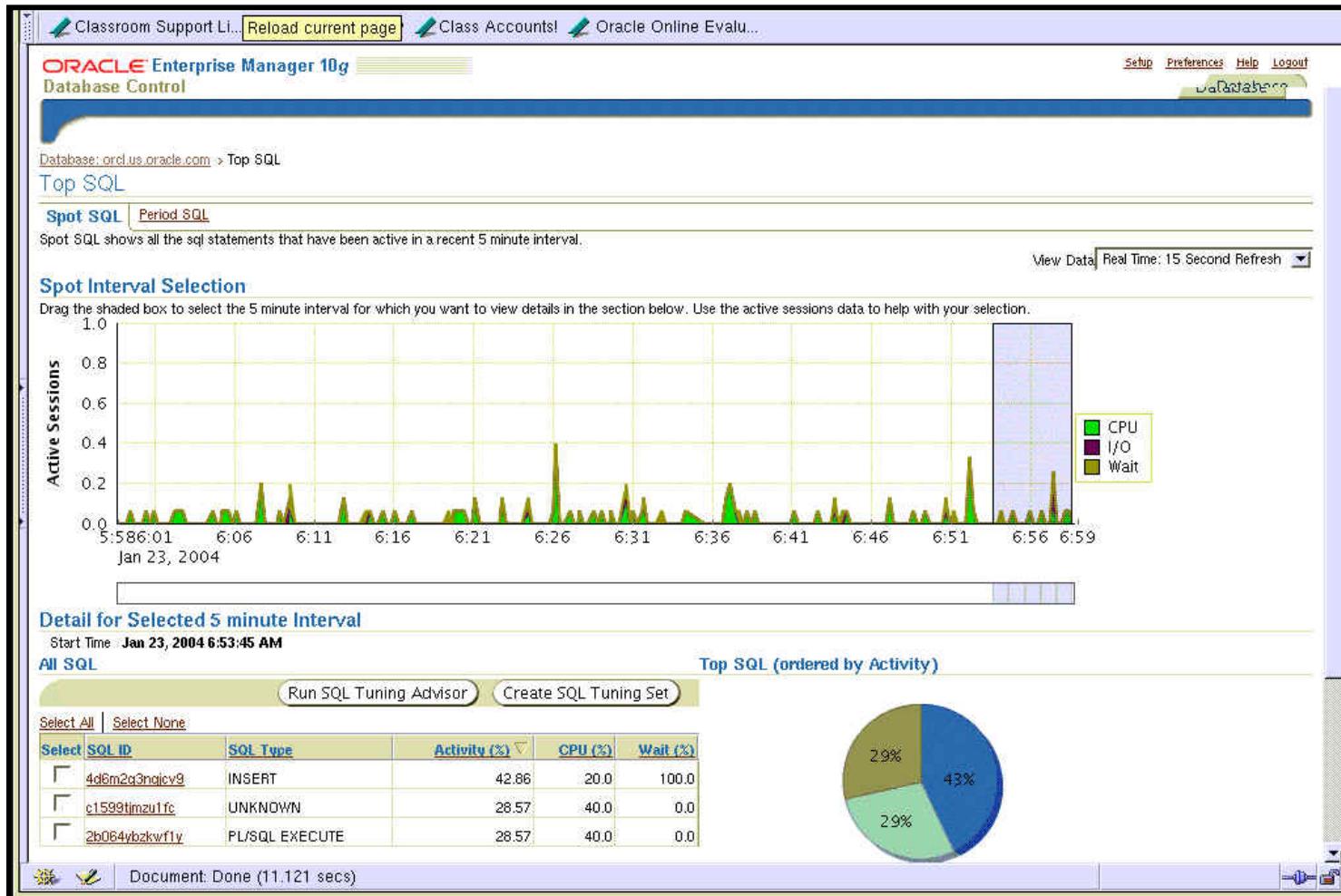
[Implement](#)

| Select Type                      | Findings    | Recommendations                                                   | Rationale                                       | Benefit (%) | New Explain Plan |
|----------------------------------|-------------|-------------------------------------------------------------------|-------------------------------------------------|-------------|------------------|
| <input checked="" type="radio"/> | SQL Profile | A potentially better execution plan was found for this statement. | Consider accepting the recommended SQL profile. | 99.97       |                  |

# 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 SQL:** Analyzes the top SQL statements currently active
  - **SQL Tuning Sets:** Analyzes a set of SQL statements you provide
  - **Snapshots:** Analyzes a snapshot
  - **Baselines:** Analyzes a baseline

# Using the SQL Tuning Advisor: Example



# SQL Tuning Advisor: SQL Statistics

```
select count(*) from x  
where object_id < 340
```

```
select count(*) from x  
where object_id < 220
```

Each statement causes a hard parse.

## Shared Cursors Statistics

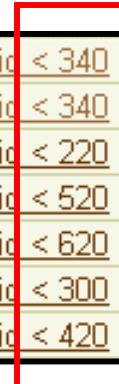
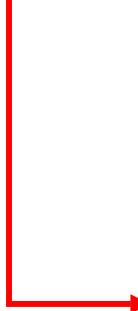
|                                 |                             |
|---------------------------------|-----------------------------|
| Total Parses                    | 1                           |
| Hard Parses                     | 1                           |
| Child Cursors                   | 1                           |
| Child Cursors With Loaded Plans | 1                           |
| Invalidations                   | 0                           |
| Largest Cursor Size (KB)        | 9.88                        |
| All Cursor Size (KB)            | 9.88                        |
| First Load Time                 | Apr 22, 2005<br>11:58:08 AM |
| Last Load Time                  | Apr 22, 2005<br>11:58:08 AM |

## Shared Cursors Statistics

|                                 |                             |
|---------------------------------|-----------------------------|
| Total Parses                    | 1                           |
| Hard Parses                     | 1                           |
| Child Cursors                   | 1                           |
| Child Cursors With Loaded Plans | 1                           |
| Invalidations                   | 0                           |
| Largest Cursor Size (KB)        | 8.83                        |
| All Cursor Size (KB)            | 8.83                        |
| First Load Time                 | Apr 22, 2005<br>11:58:02 AM |
| Last Load Time                  | Apr 22, 2005<br>11:58:02 AM |

# SQL Tuning Advisor: Identifying Duplicate SQL

| Duplicates   |                 |                                              |
|--------------|-----------------|----------------------------------------------|
|              | Plan Hash Value | SQL Text                                     |
| ▼ Duplicates |                 |                                              |
| + 6          | 989401810       | select count(*) from x where object_id < 340 |
| + 5          | 2941724873      | select * from x where object_id < 500        |



|     |           |                                              |
|-----|-----------|----------------------------------------------|
| ▼ 6 | 989401810 | select count(*) from x where object_id < 340 |
|     | 989401810 | select count(*) from x where object_id < 340 |
|     | 989401810 | select count(*) from x where object_id < 220 |
|     | 989401810 | select count(*) from x where object_id < 520 |
|     | 989401810 | select count(*) from x where object_id < 620 |
|     | 989401810 | select count(*) from x where object_id < 300 |
|     | 989401810 | select count(*) from x where object_id < 420 |

**Bind variable  
candidates**

# Using the SQL Access Advisor

Perf Mon  
Tuning Adv  
> **Access Adv**  
Memory  
Stats  
Invalid Obj

Classroom Support Li... Oracle University Class Accounts! Oracle Online Evalu...

Advisor Central > SQL Access Advisor Logged in As SYS ▾

Recommendations for Task: SQLACCESS2489618

Task Name: SQLACCESS2489618 Status: COMPLETED Advisor Mode: LIMITED

Started: Jan 23, 2004 9:59:25 AM Ended: Jan 23, 2004 10:00:17 AM

Running Time (seconds): 52 Time Limit (seconds): UNLIMITED

View: Recommendations

**Recommendations**

The following chart and table initially show the top recommendations ordered by their percentage improvement to the total cost of the whole workload. The top recommendation will have the biggest total performance improvement.

**Recommendations Ordered by Workload Cost Benefit (%)**

| Recommendation ID | Workload Cost Benefit (%) |
|-------------------|---------------------------|
| 14                | 0.045                     |
| 15                | 0.02                      |
| 3                 | 0.01                      |
| 34                | 0.01                      |
| 35                | 0.01                      |

**Select Recommendations for Implementation**

Schedule Implementation Show SQL

Select All Select None Previous 1-10 of 13 Next 3

| Select                              | Recommendation ID | Actions | Workload Cost Benefit (%) | Estimated Space Used (MB) | Affected SQL Statements |
|-------------------------------------|-------------------|---------|---------------------------|---------------------------|-------------------------|
| <input checked="" type="checkbox"/> | 14                | 1       | 0.04                      | 0.113                     | 2                       |
| <input checked="" type="checkbox"/> | 15                | 2       | 0.02                      | 0.241                     | 2                       |
| <input checked="" type="checkbox"/> | 3                 | 1       | 0.01                      | 0.113                     | 5                       |
| <input checked="" type="checkbox"/> | 34                | 1       | 0.01                      | 0.113                     | 1                       |
| <input checked="" type="checkbox"/> | 35                | 1       | 0.01                      | 0.128                     | 1                       |
| <input checked="" type="checkbox"/> | 16                | 1       | 0.00                      | 0.018                     | 2                       |
| <input checked="" type="checkbox"/> | 40                | 1       | 0.00                      | 0.008                     | 1                       |
| <input checked="" type="checkbox"/> | 41                | 1       | 0.00                      | 0.008                     | 1                       |

Transferring data from edcdr19p1.us.oracle.com...

# Managing Memory Components

Perf Mon  
Tuning Adv  
Access Adv  
➤ **Memory**  
Stats  
Invalid Obj

- **Automatic Shared Memory Management:**
  - Is recommended to simplify management
  - Enables you to specify the 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 the large pool
- **Manually setting shared memory management:**
  - Sizes the components through multiple individual initialization parameters
  - Uses the Memory Advisor to make recommendations

# Enabling Automatic Shared Memory Management (ASMM)



Database: orcl.us.oracle.com > Memory Parameters

## Memory Parameters

**SGA** [PGA](#)

The System Global Area (SGA) is a group of shared memory structures that are in memory when an Oracle database instance is started.

Automatic Shared Memory Management **Disabled** [Enable](#)

Click Enable to enable Automatic Shared Memory Management.

|                |            |    |
|----------------|------------|----|
| Shared Pool    | 80         | MB |
| Buffer Cache   | 24         | MB |
| Large Pool     | 8          | MB |
| Java Pool      | 48         | MB |
| Other (MB)     | 1          |    |
| Total SGA (MB) | <b>161</b> |    |

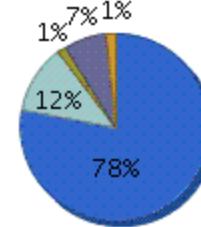
# Manually Setting Shared Memory Management

## Current Allocation

Automatic Shared Memory Management **Enabled** [Disable](#)

Total SGA Size (MB)  [Advice](#)

| SGA Component | Current Allocation (MB) |
|---------------|-------------------------|
| Shared Pool   | 212                     |
| Buffer Cache  | 32                      |
| Large Pool    | 4                       |
| Java Pool     | 20                      |
| Other         | 4                       |



- Shared Pool (77.9%)
- Buffer Cache (11.8%)
- Large Pool (1.5%)
- Java Pool (7.4%)
- Other (1.5%)

## Maximum SGA Size

The Maximum SGA Size specifies the maximum memory that the database may allocate. If you specify the Maximum SGA Size, you can later dynamically change the Total SGA Size above (provided Total SGA Size does not exceed the Maximum SGA Size).

Maximum SGA Size\* (MB)

# Using the Memory Advisor

Database Instance: orcl.oracle.com > Memory Parameters

## Memory Parameters

Page Refreshed September 13, 2005 11:16:45 AM PDT

Refresh

Show SQL

Revert

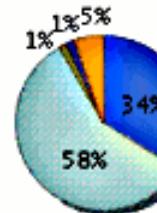
Apply

SGA PGA

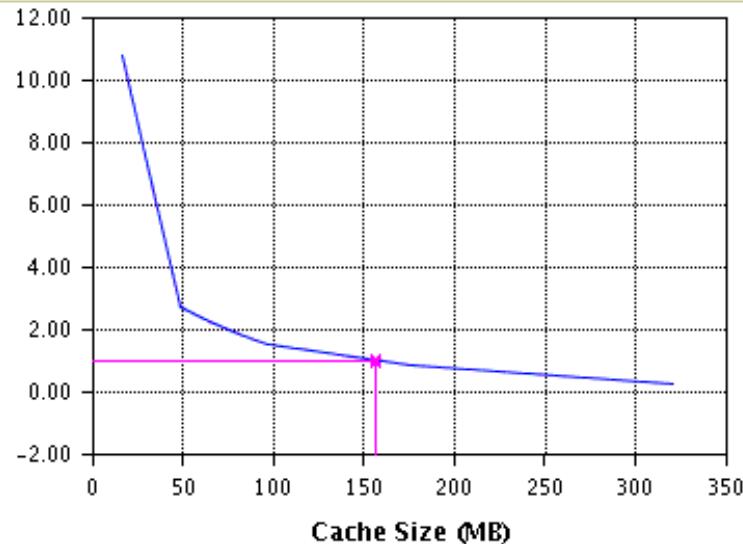
The System Global Area (SGA) is a group of shared memory structures that control information for one Oracle database. The SGA is allocated in memory when the database instance is started.

Automatic Shared Memory Management **Disabled** Enable

|                |     |    |                                                                                           |
|----------------|-----|----|-------------------------------------------------------------------------------------------|
| Shared Pool    | 92  | MB | <span style="border: 1px solid #ccc; border-radius: 10px; padding: 2px;">Advice</span>    |
| Buffer Cache   | 156 | MB | <span style="border: 1px solid #ccc; border-radius: 10px; padding: 2px;">Advice</span>    |
| Large Pool     | 4   | MB |                                                                                           |
| Java Pool      | 4   | MB |                                                                                           |
| Other (MB)     | 14  |    |                                                                                           |
| Total SGA (MB) | 270 |    | <span style="border: 1px solid #ccc; border-radius: 10px; padding: 2px;">Calculate</span> |



## Buffer Cache Size Advice



- Change in physical reads for various cache sizes
- ✖ Current cache size

Cache Size (MB) 156

⌚ TIP You can click on the curve in the graph to set new value.

# Dynamic Performance Statistics

...  
Access Adv  
Memory  
> Stats  
Invalid Obj

## Systemwide

V\$SYSTAT  
• statistic#  
• name  
• class  
• value  
• stat\_id

## Session specific

V\$SESSTAT  
• sid  
• statistic#  
• value

## Service specific

V\$SERVICE\_STATS  
• service\_name\_hash  
• service\_name  
• stat\_id  
• stat\_name  
• value

## V\$SYSTEM\_EVENT

- event
- total\_waits
- total\_timeouts
- time\_waited
- average\_wait
- time\_waited\_micro

## V\$SESSION\_EVENT

- sid
- event
- total\_waits
- total\_timeouts
- time\_waited
- average\_wait
- max\_wait
- time\_waited\_micro
- event\_id

## 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

# 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

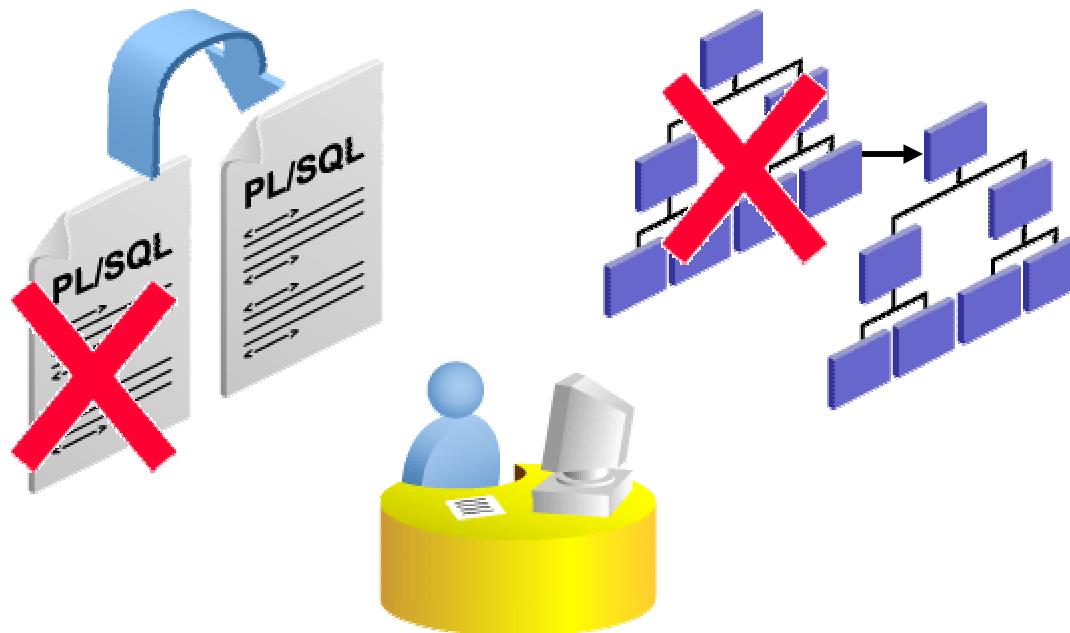
## Contention

V\$LOCK  
V\$UNDOSTAT  
V\$WAITSTAT  
V\$LATCH

# Invalid and Unusable Objects

## Effect on Performance:

- PL/SQL code objects are recompiled.
- Indexes are rebuilt.



# **Summary**

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

- **Use Enterprise Manager to monitor performance**
- **Tune SQL using the SQL Tuning Advisor**
- **Tune SQL using the SQL Access Advisor**
- **Use Automatic Shared Memory Management**
- **Use the Memory Advisor to size memory buffers**
- **View performance-related dynamic views**
- **Troubleshoot invalid and unusable objects**

# **Practice Overview: Monitoring and Improving Performance**

**This practice covers the following topics:**

- Detecting and repairing unusable indexes**
- Using the SQL Tuning Advisor**
- Using the Performance page in Enterprise Manager**

# 14

## Backup and Recovery Concepts

# Objectives

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

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

# Part of Your Job

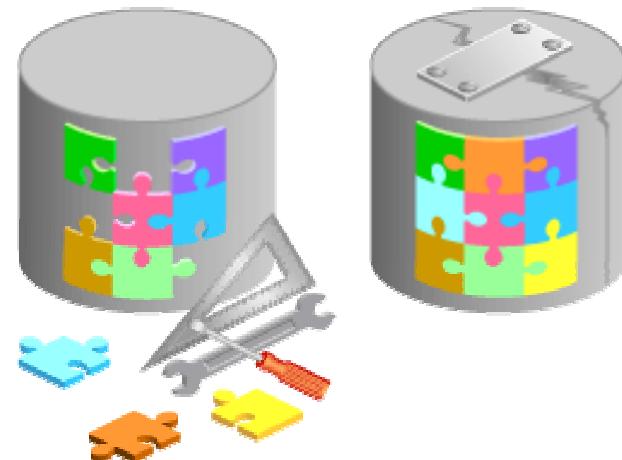
The administrator's duties are to:

- Protect the database from failure wherever possible
- Increase the Mean-Time-Between-Failures (MTBF)
- Decrease the Mean-Time-To-Recover (MTTR)
- Minimize the loss of data

# Categories of Failures

**Failures can generally be divided into the following categories:**

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



# Statement Failure

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

# 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. |  <p>Watch for trends.</p>                                         |

# 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.                 |

# User Error

| Typical Causes                                 | Possible Solutions                           |
|------------------------------------------------|----------------------------------------------|
| A user inadvertently deletes or modifies data. | Roll back or use flashback query to recover. |
| A user drops a table.                          | Recover table from the recycle bin.          |



Oracle LogMiner

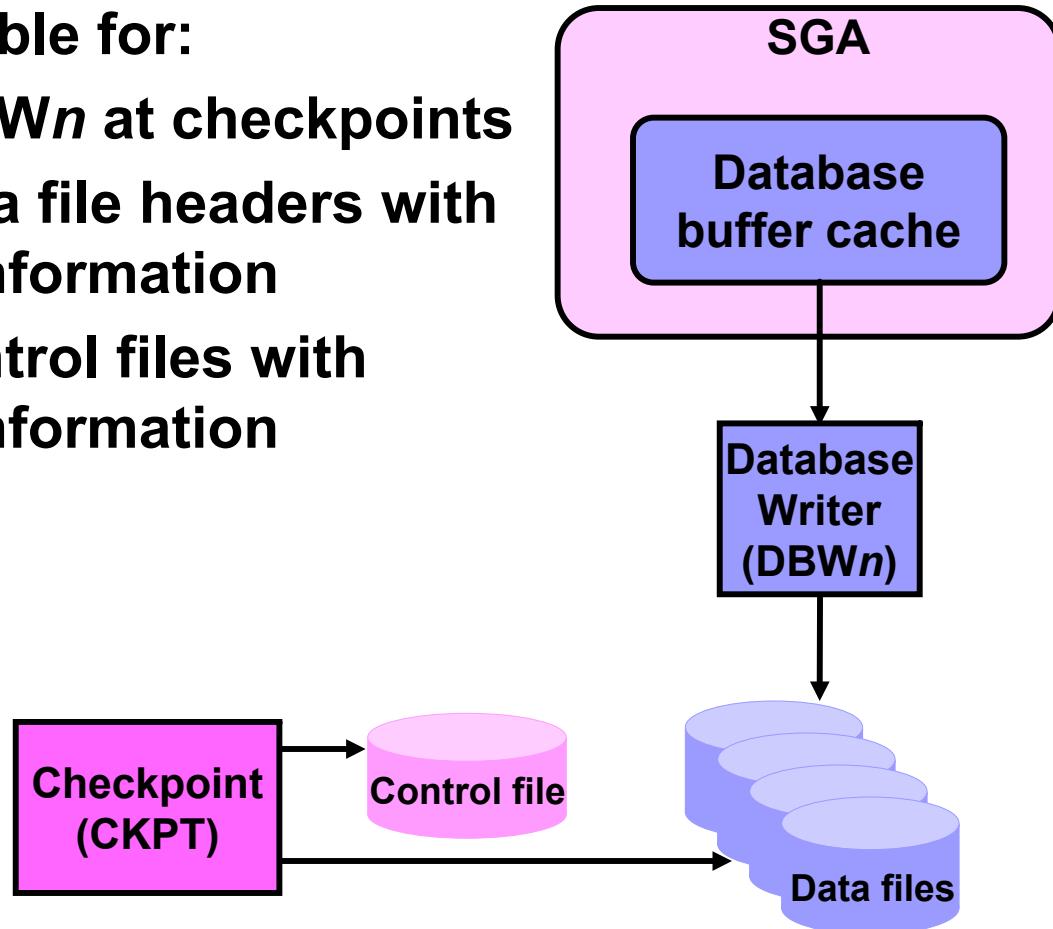
# Instance Failure

| 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. |
| Hardware failure                           |                                                                                                                                                                                                            |
| Failure of one of the background processes |                                                                                                                                                                                                            |
| Emergency shutdown procedures              | Investigate the causes of failure by using the alert log, trace files, and Enterprise Manager.                                                                                                             |

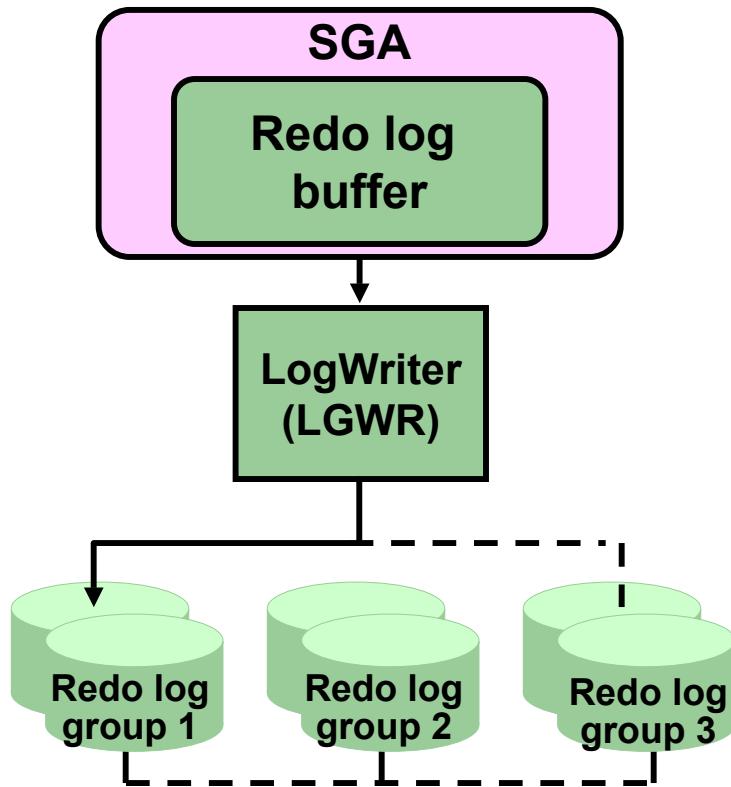
# Background Processes and Recovery: Checkpoint (CKPT)

**CKPT is responsible for:**

- **Signaling DBW $n$  at checkpoints**
- **Updating data file headers with checkpoint information**
- **Updating control files with checkpoint information**



# Background Processes and Recovery: Redo Log Files and LogWriter



## Redo log files:

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

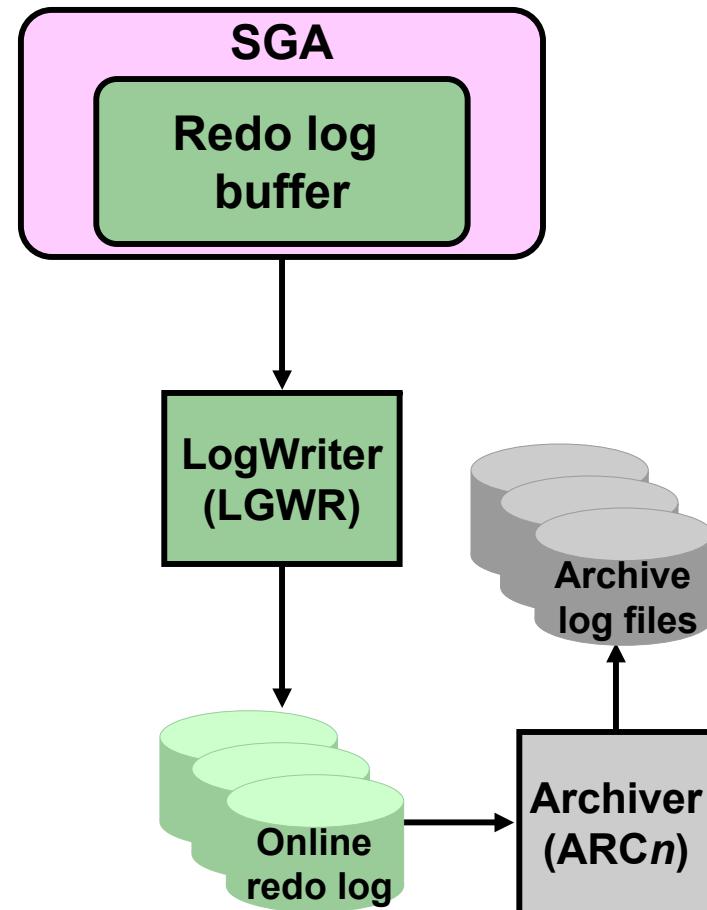
## LogWriter writes:

- At commit
- When one-third full
- Every three seconds
- Before DBW $n$  writes

# Background Processes and Recovery: Archiver (ARCn)

## Archiver (ARCn):

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



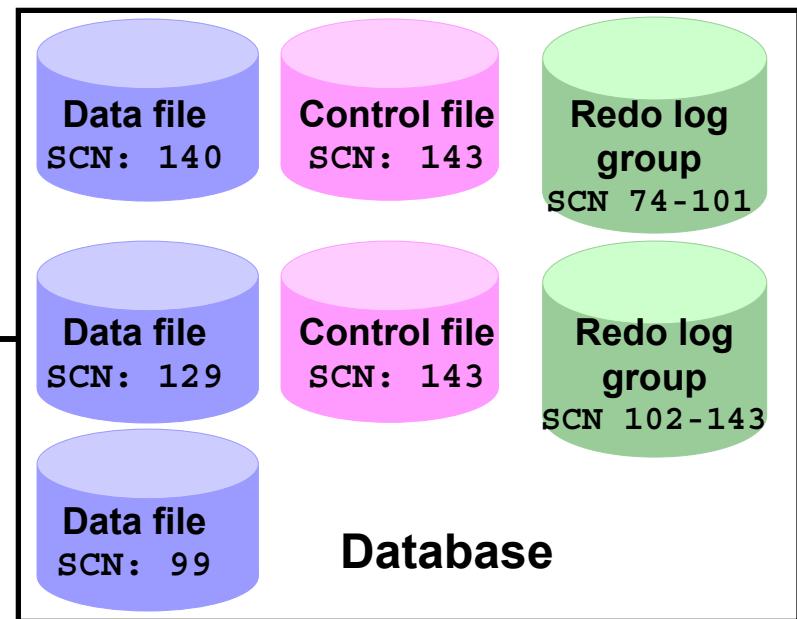
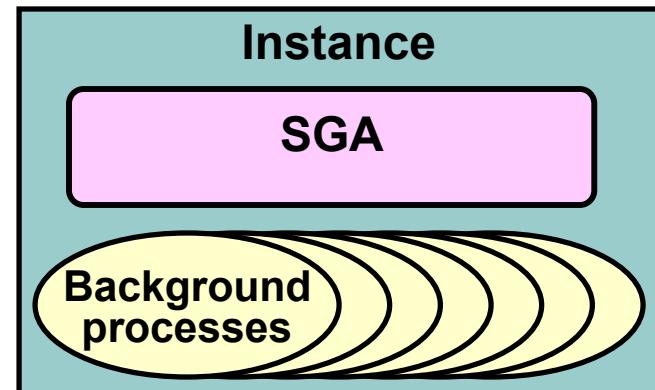
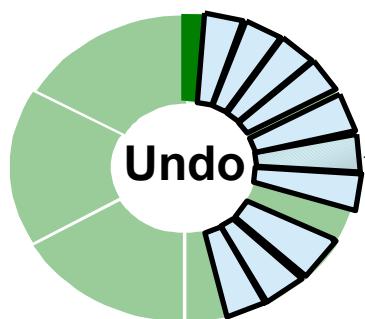
# Instance Recovery

## Instance or crash recovery:

- Is caused by attempts to open a database whose files are not synchronized on shutdown
- Is automatic
- Uses information stored in redo log groups to synchronize files
- Involves two distinct operations:
  - Rolling forward: Data files are restored to their state before the instance failed.
  - Rolling back: Changes made but not committed are returned to their original state.

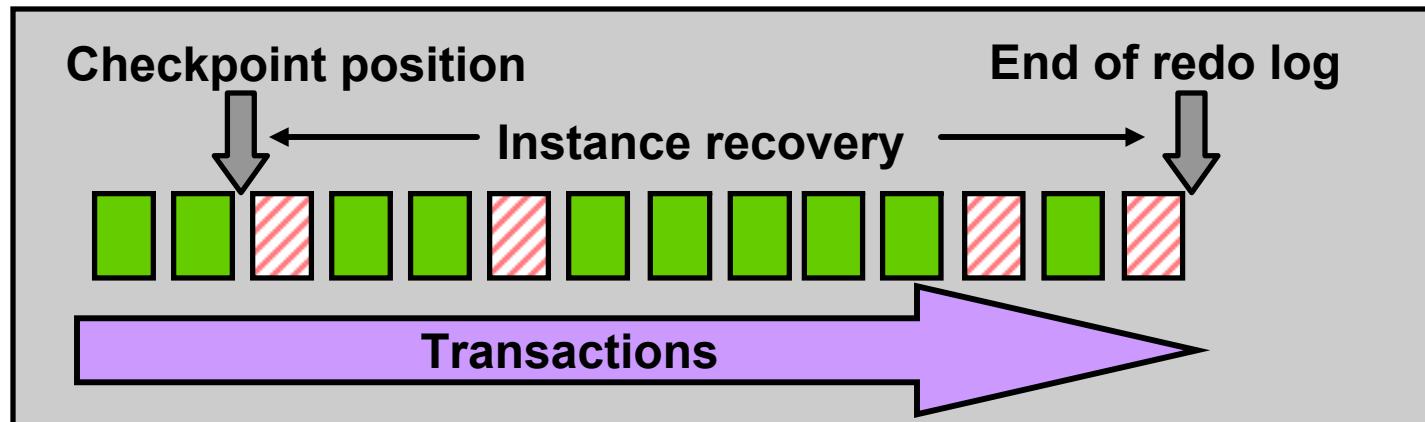
# Phases of Instance Recovery

1. Data files out of sync
2. Roll forward (redo)
3. Committed and noncommitted data in files
4. Roll back (undo)
5. Committed data in files



# 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.



# 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).**

**Advisor Central**

Page Refreshed Jun 4, 2005 2:50:50 PM PDT [Refresh](#)

**Advisors**

|                                 |                                    |                                    |
|---------------------------------|------------------------------------|------------------------------------|
| <a href="#">ADDM</a>            | <a href="#">Memory Advisor</a>     | <a href="#">MTTR Advisor</a>       |
| <a href="#">Segment Advisor</a> | <a href="#">SQL Access Advisor</a> | <a href="#">SQL Tuning Advisor</a> |
| <a href="#">Undo Management</a> |                                    |                                    |

**Instance Recovery**

The FAST\_START\_MTTR\_TARGET initialization parameter specifies the number of seconds estimated for crash recovery. Oracle converts this number into a set of internal parameters and sets the recovery time as close as possible to these parameters. Setting FAST\_START\_MTTR\_TARGET to 0 will disable this functionality.

Current Estimated Mean Time To Recover (seconds) **13**

Desired Mean Time To Recover  Minutes

# Media Failure

| Typical Causes                          | Possible Solutions                                              |
|-----------------------------------------|-----------------------------------------------------------------|
| Failure of disk drive                   | 1. Restore the affected file from backup.                       |
| Failure of disk controller              | 2. If necessary, inform the database about a new file location. |
| Deletion or corruption of database file | 3. If necessary, recover the file by applying redo information. |

# **Configuring for Recoverability**

**To configure your database for maximum recoverability, you must:**

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

# Control Files

**Protect against database failure by multiplexing control files. It is suggested that your database has:**

- **At least two copies (Oracle recommends three) of the control file**
- **Each copy on a separate disk**
- **At least one copy on a separate disk controller**



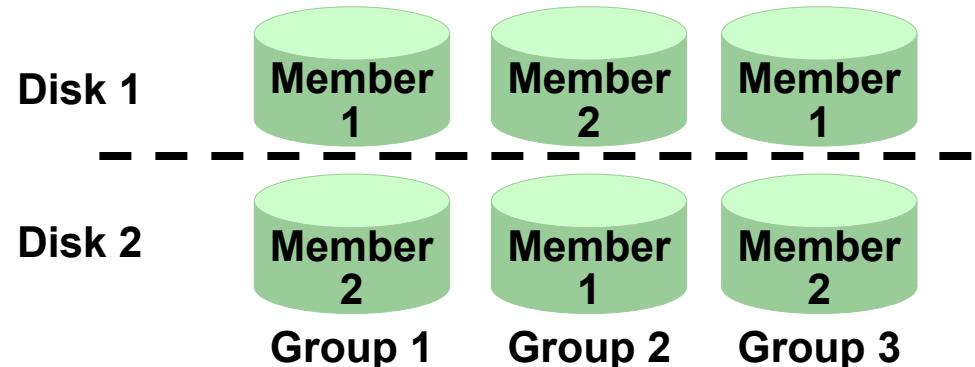
**Control files**

# Redo Log Files

**Multiplex redo log groups to protect against media failure and loss of data. It is suggested that redo log groups have:**

- At least two members (files) per group
- Each member on a separate disk drive
- Each member on a separate disk controller

**Note: Performance  
is heavily  
influenced  
by writing to  
redo logs.**



# Multiplexing the Redo Log

The screenshot shows the Oracle Enterprise Manager Database Console interface. The title bar reads "ORACLE Enterprise Manager". The main navigation path is "Database: orcl.us.oracle.com > Redo Log Groups > Edit Redo Log Group: 1: Add Redo Log Member". The page title is "Edit Redo Log Group: 1: Add Redo Log Member". There are two input fields: "File Name" containing "redo01b.log" and "File Directory" containing "/oracle/oradata/orcl/". A checkbox labeled "Reuse File" is unchecked. At the bottom, there are links for "Database", "Setup", "Preferences", "Help", and "Logout". Copyright information at the bottom left states "Copyright © 1996, 2003, Oracle. All rights reserved." and "About Oracle Enterprise Manager Database Console".

Database: orcl.us.oracle.com > Redo Log Groups > Edit Redo Log Group: 1: Add Redo Log Member

Edit Redo Log Group: 1: Add Redo Log Member

\* File Name

\* File Directory

Reuse File

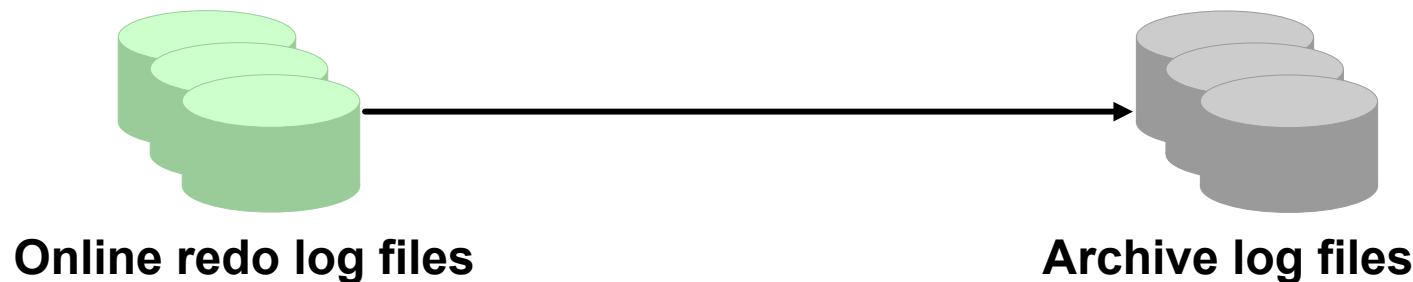
Database | Setup | Preferences | Help | Logout

Copyright © 1996, 2003, Oracle. All rights reserved.  
About Oracle Enterprise Manager Database Console

# Archive Log Files

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

1. Specify archive log file naming convention.
2. Specify one or more archive log file locations.
3. Switch the database to ARCHIVELOG mode.



# Archive Log File: Naming and Destinations

## Media Recovery

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

ARCHIVELOG Mode<sup>\*</sup>

Log Archive Filename Format<sup>\*</sup> %t\_%s\_%r.dbf

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

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

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

 TIP You can specify up to 10 archive log destinations.

# **ARCHIVELOG Mode**

- **To place the database in ARCHIVELOG mode, perform the following steps:**
  1. Select the ARCHIVELOG Mode check box.
  2. Click Apply. The database can be set to ARCHIVELOG mode only from the MOUNT state.
  3. Click Yes when asked whether you want to restart the database.
  4. Back up your database.
- **Databases in ARCHIVELOG mode have access to the full range of backup and recovery options.**

# Summary

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

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

# **Practice Overview: Configuring for Recoverability**

**This practice covers the following topics:**

- Multiplexing control files**
- Multiplexing redo log groups**
- Placing your database in ARCHIVELOG mode**
- Ensuring that redundant archive logs are created**

# **15** **Performing Database Backups**

# Objectives

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

- **Create consistent database backups**
- **Back up your database without shutting it down**
- **Create incremental backups**
- **Automate database backups**
- **Monitor the flash recovery area**

# **Backup Solutions: Overview**

**Backups can be performed by using:**

- **Recovery Manager**
- **Oracle Secure Backup**
- **A user-managed scenario**



# 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.

# User-Managed Backup

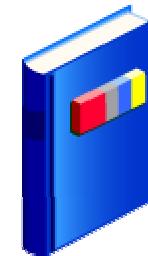
**A user-managed scenario:**

- Is a manual process of tracking backup needs and status.
- Requires the DBA to write scripts.
- Requires that database files be put in the correct mode for backup.
- Relies on operating system commands to make backups of files.



# Terminology

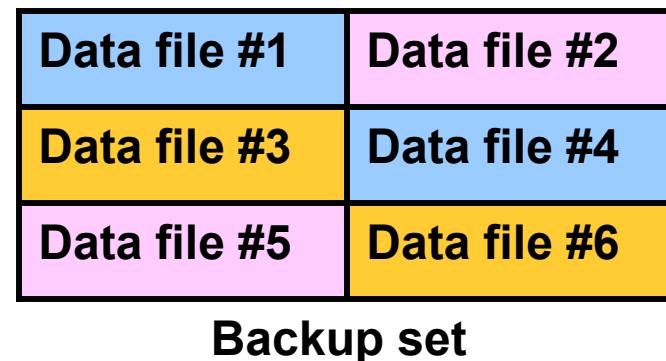
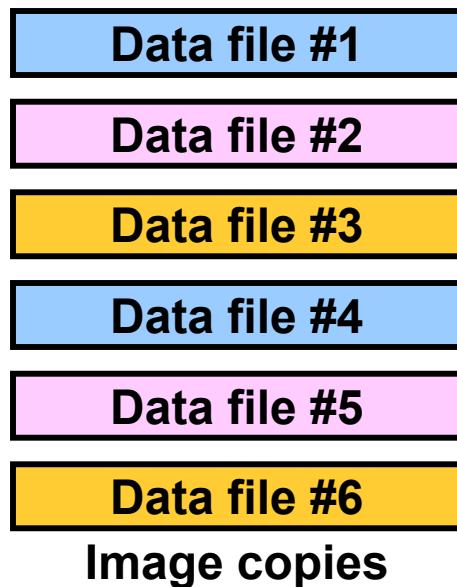
- **Backup strategy may include:**
  - The entire database (whole)
  - A portion of the database (partial)
- **Backup type may indicate inclusion of:**
  - All information from all data files (full)
  - Only information that has changed since some previous backup (incremental)
- **Backups mode may be:**
  - Offline (consistent, cold)
  - Online (inconsistent, hot)



# Terminology

**Backups may be stored as:**

- **Image copies**
- **Backup sets**



# Recovery Manager (RMAN)

- Enterprise Manager uses Recovery Manager (RMAN) to perform backup and recovery operations.
- RMAN:
  - Is a command-line client for advanced functions
  - Has powerful control and scripting language
  - Has a published API that enables interface with most popular backup software
  - Backs up data, control, archived log, and server parameter files
  - Backs up files to the disk or tape

# Configuring Backup Settings

**Backup Settings**

**Device** **Backup Set** **Policy**

**Disk Settings**

Parallelism  Concurrent streams to disk drives

Disk Backup Location

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

Disk Backup Type  **Backup Set**  
An Oracle backup file format that allows for more efficient backups by interleaving multiple backup files into one output file.

**Compressed Backup Set**  
An Oracle backup set in which the data is compressed to reduce its size.

**Image Copy**  
A bit-by-bit copy of database files that can be used as-is to perform recovery.

**Test Disk Backup**

**Host Credentials**

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

\* Username

\* Password

Save as Preferred Credential

# Configuring Backup Settings

## Backup Policy

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

Autobackup Disk Location

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

- Optimize the whole database backup by skipping unchanged files such as read-only and offline datafiles that have been backed up  
 Enable block change tracking for faster incremental backups

Block Change Tracking File

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

## Tablespaces Excluded From Whole Database Backup

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

Add

| Select | Tablespace Name   | Tablespace Number | Status | Contents |
|--------|-------------------|-------------------|--------|----------|
|        | No Items Selected |                   |        |          |

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

## Retention Policy

- Retain All Backups

You must manually delete any backups

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

Days   
Recovery Window

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

Backups   
Redundancy

# Scheduling Backups: Strategy

**Select whole or partial database backup.**

## 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.

[Schedule Customized Backup](#)

- Whole Database
- Tablespaces
- Datafiles
- Archivelogs
- All Recovery Files on Disk

These files include all archivelogs and disk backups that are not already backed up to tape

# Scheduling Backups: Options

**Schedule Customized Backup: Options**

|                 |                          |
|-----------------|--------------------------|
| Database        | <b>orcl.oracle.com</b>   |
| Backup Strategy | <b>Customized Backup</b> |
| Object Type     | <b>Whole Database</b>    |

**Cancel** **Step 1 of 4** **Next**

**Backup Type**

**Full Backup**

Use as the base of an incremental backup strategy

**Incremental Backup (Level 1)**

Level 1 incremental backup includes all the changed blocks since the most recent level 0 backup (cumulative).

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

# Scheduling Backups: Settings

**Schedule Customized Backup: Settings**

Database **orcl**  
Backup Strategy **Customized Backup** Object Type **Whole Database**

Cancel Back Step 2 of 4 Next

These are the settings for your current backup job. You can select your backup destination directly from this page. You can also view the default settings or override the settings by clicking the buttons below.

Disk  
Disk Backup Location **/u01/app/oracle/flash\_recovery\_area**

Tape  
Media Management Vendor(MMV) Library Parameters **not specified**

# Scheduling Backups: Schedule

**Schedule**

Time Zone

**Start**

Immediately  
 Later

Date    (example: Jun 7, 2005)

Time      AM  PM

**Repeat**

One Time Only  
 Interval

Frequency  Minutes

Monthly  
 Yearly

**Repeat Until**

Indefinite  
 Custom

Date    (example: Jun 7, 2005)

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

# Scheduling Backups: Review

Schedule Customized Backup: Review

Database **orcl**  
Backup Strategy **Customized Backup** Edit RMAN Script Cancel Back Step 4 of 4 Submit Job

Object Type **Whole Database**



Schedule Customized Backup: Review: Edit RMAN Script

Cancel Submit Job

You can modify the RMAN script before submitting it. However, you will not be able to go back to previous wizard pages if you modify the script.

```
backup device type disk tag "%TAG" database include current controlfile;  
backup device type disk tag "%TAG" archivelog all not backed up;
```

**Click Edit RMAN Script to review RMAN commands.**

# Backing Up the Control File to a Trace File

Control files have an additional backup option.

The screenshot shows the 'Control Files' section of the Oracle Database configuration interface. At the top, there are tabs for 'General', 'Advanced', and 'Record Section'. A red box highlights the 'Backup To Trace' button, which is located in the bottom right corner of the main content area. Below the button, the text reads: 'Control File Mirror Images. Oracle strongly recommends that your database has a minimum of two control files and that they are located on separate disks. If a control file is damaged due to a disk failure, it could be restored using the intact copy of the control file from the other disk. You can specify their location in the database's initialization parameter file.' A table below lists three control files: control01.ctl, control02.ctl, and control03.ctl, all located in /u01/app/oracle/oradata/orcl/. At the bottom of the interface, there are tabs for 'General', 'Advanced', and 'Record Section'.

| Valid | File Name     | File Directory                |
|-------|---------------|-------------------------------|
| VALID | control01.ctl | /u01/app/oracle/oradata/orcl/ |
| VALID | control02.ctl | /u01/app/oracle/oradata/orcl/ |
| VALID | control03.ctl | /u01/app/oracle/oradata/orcl/ |

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

# 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

Select All | Select None

| Select                   | Key | Tag                             | Completion Time ▾       | Contents                             | Device Type | Status    | Obsolete | Keep | Pieces |
|--------------------------|-----|---------------------------------|-------------------------|--------------------------------------|-------------|-----------|----------|------|--------|
| <input type="checkbox"/> | 3   | BACKUP_ORCL_000006_120303103223 | Dec 3, 2003 10:48:48 AM | <u>ARCHIVED LOG</u>                  | DISK        | AVAILABLE | NO       | NO   | 1      |
| <input type="checkbox"/> | 2   | BACKUP_ORCL_000006_120303103223 | Dec 3, 2003 10:41:41 AM | <u>DATAFILE, SPFILE, CONTROLFILE</u> | DISK        | AVAILABLE | NO       | NO   | 1      |

# Flash Recovery Area

**Monitor the flash recovery area to:**

- **Configure flashback logging**
- **Size the recovery area**
- **View current space consumption**

**Flash Recovery Area**

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

Flash Recovery Area Location

Flash Recovery Area Size  GB

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

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

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

Flashback Retention Time  Hours

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

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

Flashback Time **n/a**

**Flash Recovery Area Usage**

|                    |
|--------------------|
| Control File (0%)  |
| Online Log (0%)    |
| Archive Log (0%)   |
| Backup Piece (0%)  |
| Image Copy (0%)    |
| Flashback Log (0%) |
| Usable (100%)      |

# 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**
- **Monitor the flash recovery area**

# **Practice Overview: Creating Database Backups**

**This practice covers the following topics:**

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

# **16**

## **Performing Database Recovery**

# Objectives

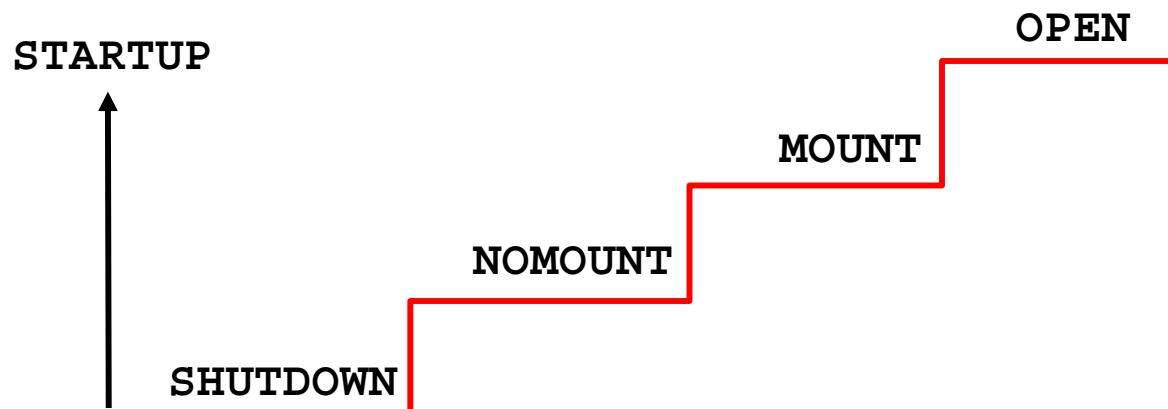
**After completing this lesson, you should be able to recover from the loss of a:**

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

# Opening a Database

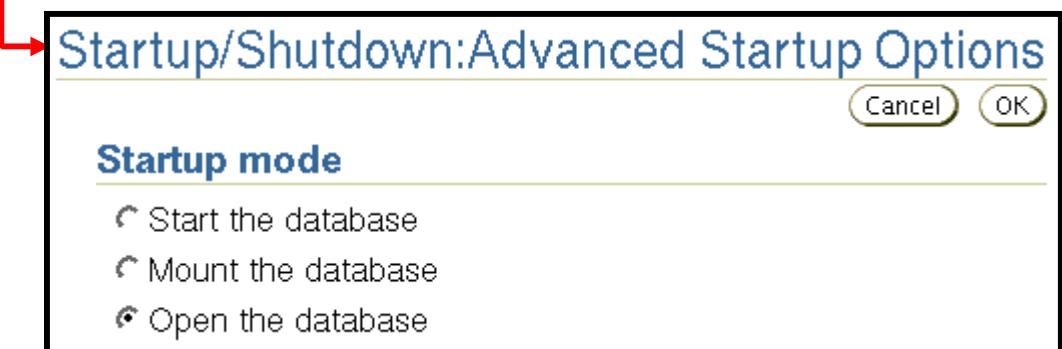
To open a database:

- 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



# Changing Instance Status

**Use Database Control to alter the instance's status.**



# Keeping a Database Open

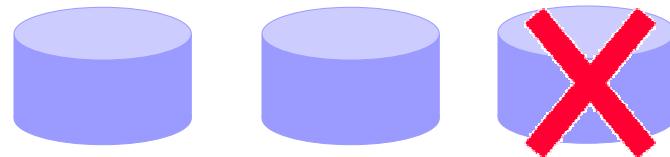
**After the instance is open, it fails in the case of the loss of:**

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

# **Loss of a Control File**

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

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



**Control files**

# **Loss of a Redo Log File**

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

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

# **Loss of a Data File in NOARCHIVELOG Mode**

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

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



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# Loss of a Noncritical Data File in ARCHIVELOG Mode

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

**Object Level Recovery**

Object Type

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



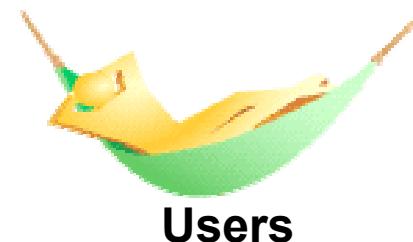
**Users**

**ORACLE®**

# **Loss of a System-Critical Data File in ARCHIVELOG Mode**

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

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



# **Summary**

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

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

# **Practice Overview: Performing Database Recovery**

**This practice covers recovering from the loss of a:**

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

# 17

## Performing Flashback

# Objectives

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

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

# Flashback Technology: Benefits

> [Overview](#)  
[Database](#)  
[Table](#)  
[Drop](#)  
[Query](#)  
[Versions](#)  
[Transaction](#)

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

# When to Use the Flashback Technology

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

# Flashing Back Any Error

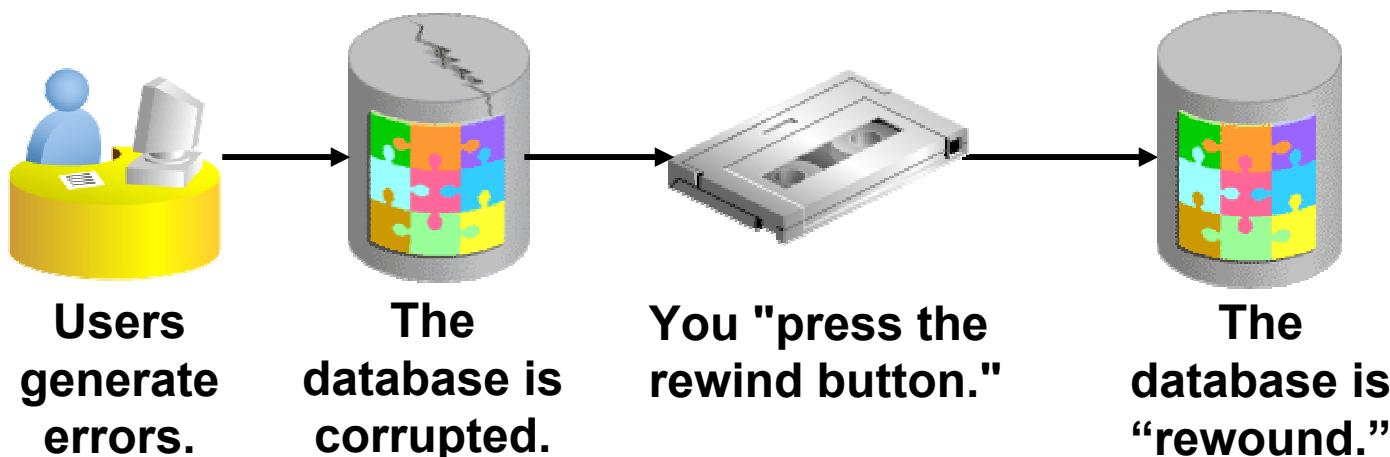
- **Flashback Database** brings the database to an earlier point in time by undoing all changes made since that time.
- **Flashback Table** recovers a table to a point in time in the past without having to restore from a backup.
- **Flashback Drop** restores accidentally dropped tables.

# Flashback Database: Overview

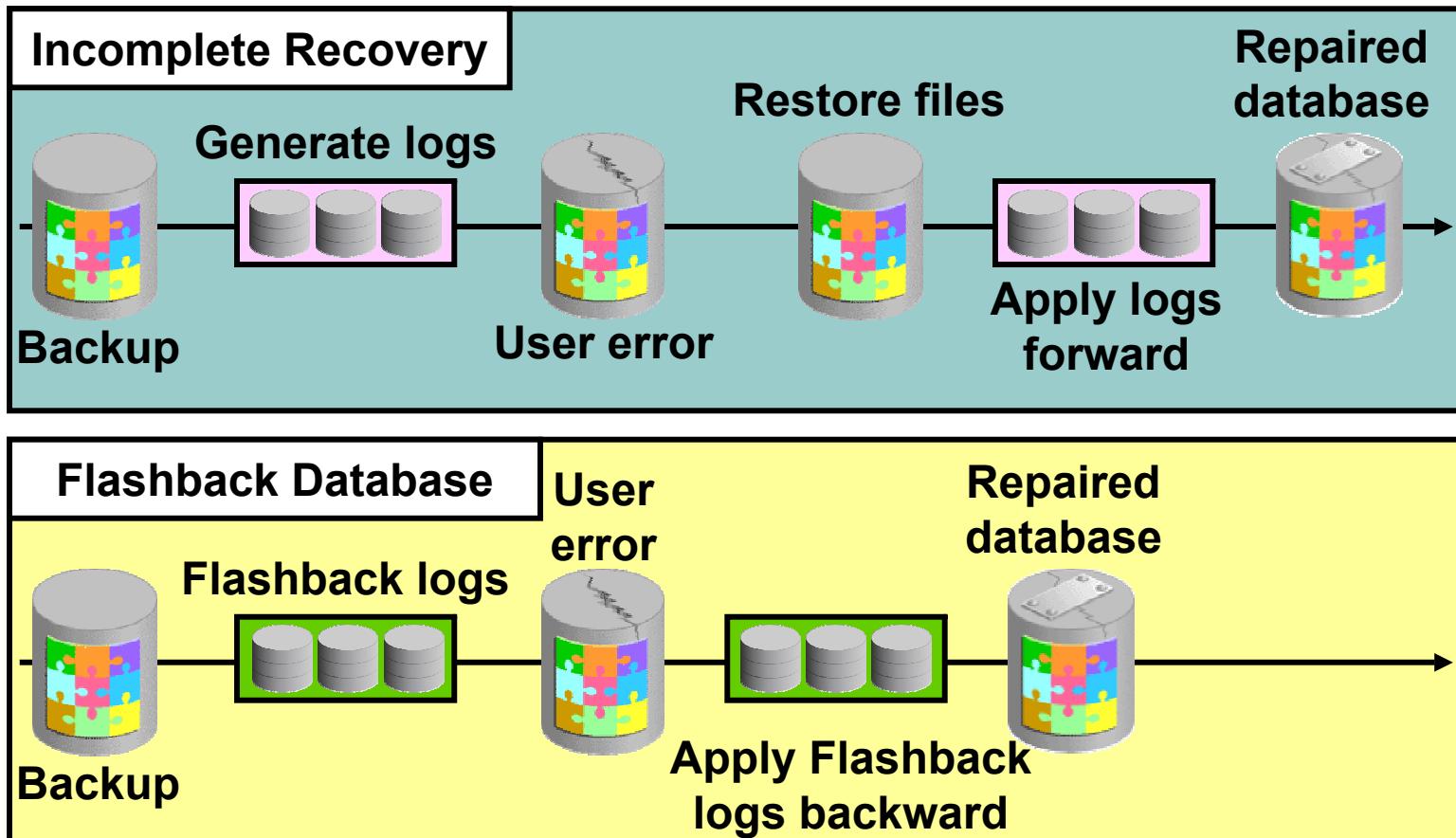
Overview  
> **Database**  
Table  
Drop  
Query  
Versions  
Transaction

## The Flashback Database operation:

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



# Flashback Database: Reducing Restore Time



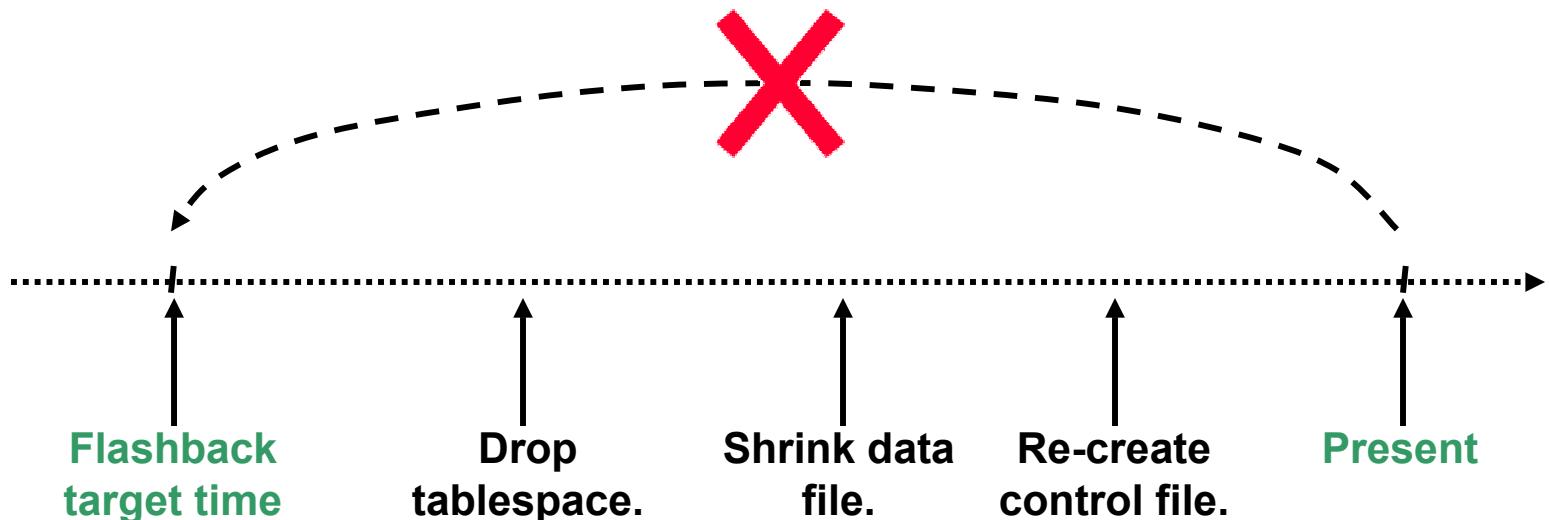
# Flashback Database: Considerations

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

# Flashback Database: Limitations

You cannot use Flashback Database in the following situations:

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



# Enabling Flashback Database

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

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

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

Flashback Retention Time  Hours ▾

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

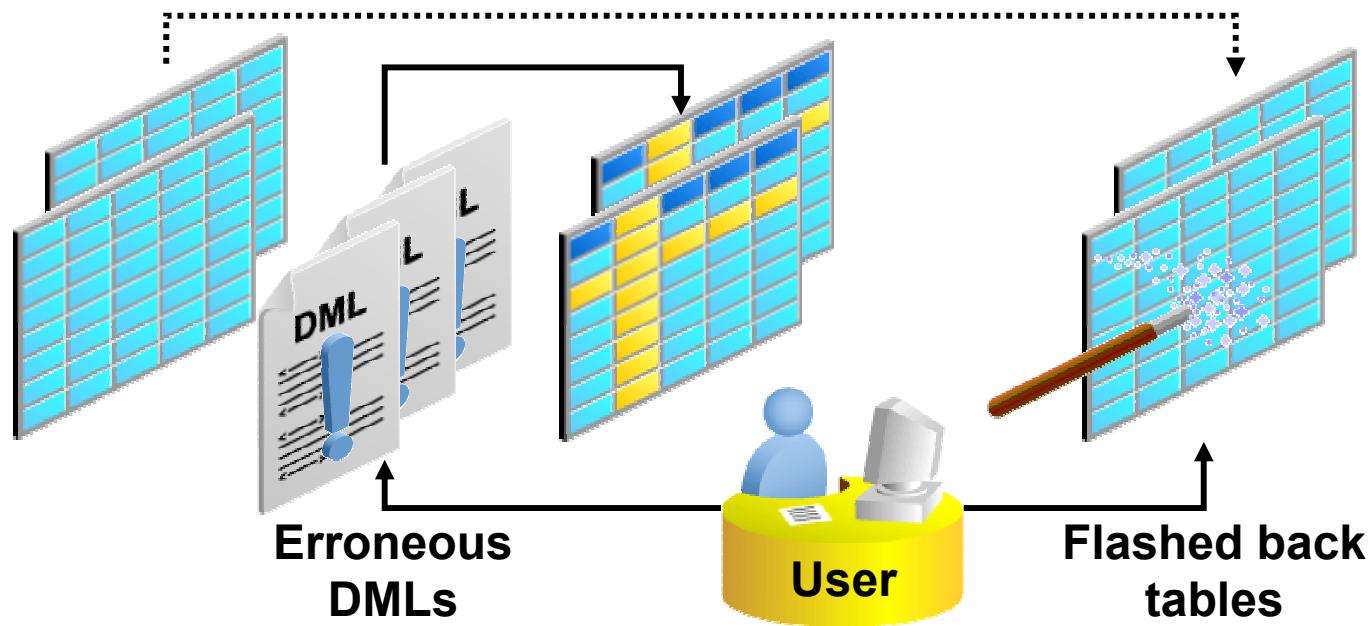
Lowest SCN in the flashback data **n/a**

Flashback Time **n/a**

# Flashback Table: Overview

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

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



# **Flashback Table**

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

# Enabling Row Movement on a Table

Edit Table: HR.EMPLOYEES

Actions Create Like Go Show SQL Revert Apply

General Constraints Segments Storage Options Statistics Indexes

Enable Row Movement Yes

Parallel - Use multiple threads when creating this object or when executing DML against this object.  
Parallel Degree  Default  Value

Cache - Place frequently accessed data to the top of the buffer cache.

General Constraints Segments Storage Options Statistics Indexes

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

# Performing Flashback Table

## Perform Object Level Recovery: Point-in-time

Cancel

Step 1 of 7

Next

Object Type **Tables**

Operation Type **Flashback Existing Tables**

Specify the point in time to which to recover.

Evaluate row changes and transactions to decide on a point in time

\* Table

HR.EMPLOYEES



Example: SCOTT.EMP

Flashback to a timestamp

Date

May 5, 2005



Time

05



32



AM

PM

Example: Mar 19, 2003

Flashback to a known SCN

SCN

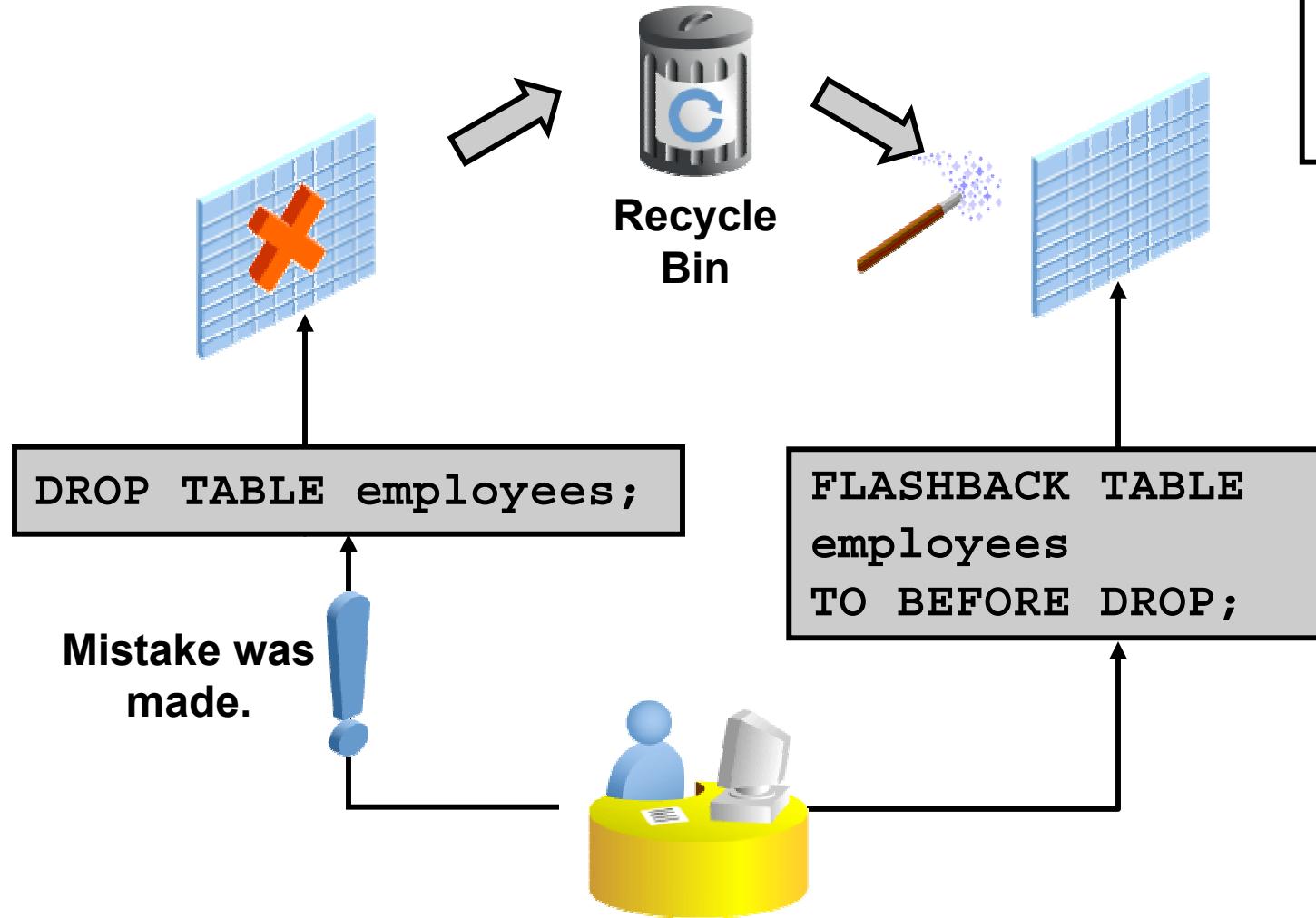
```
FLASHBACK TABLE hr.employees TO TIMESTAMP  
TO_TIMESTAMP('2005-05-05 05:32:00',  
'YYYY-MM-DD HH24:MI:SS');
```

# Flashback Table: Considerations

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

# Flashback Drop: Overview

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



# Flashing Back Dropped Tables Through Enterprise Manager

**Results**

Select All | Select None | Expand All | Collapse All

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

Dependent bitmap index will also be flashed back.

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

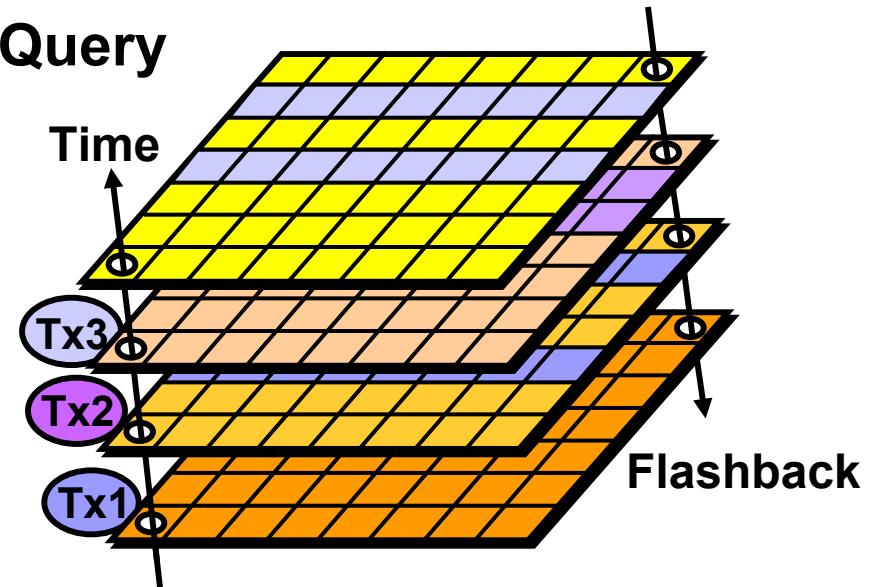
# Flashback Drop: Considerations

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

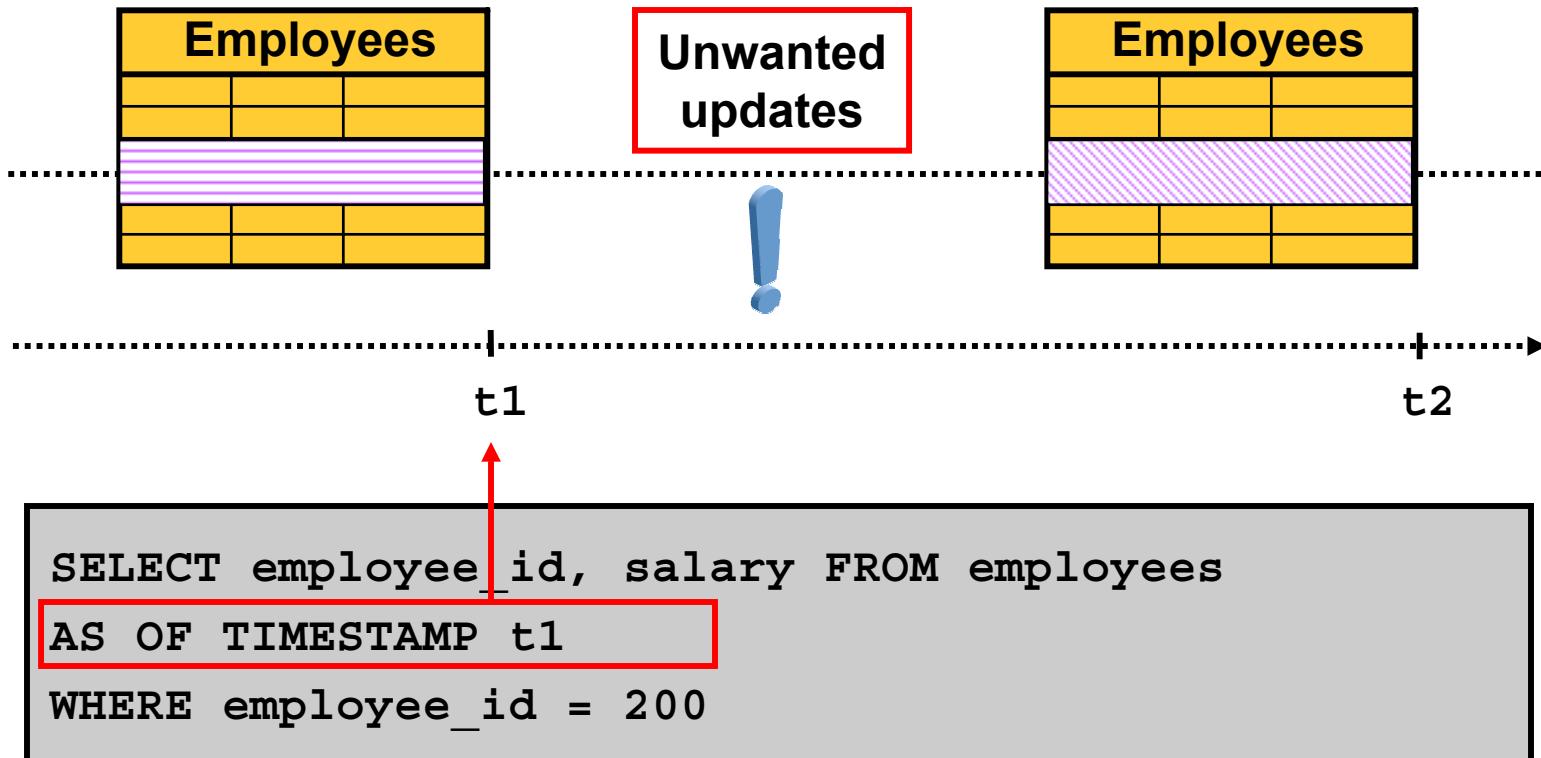
# Flashback Time Navigation

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

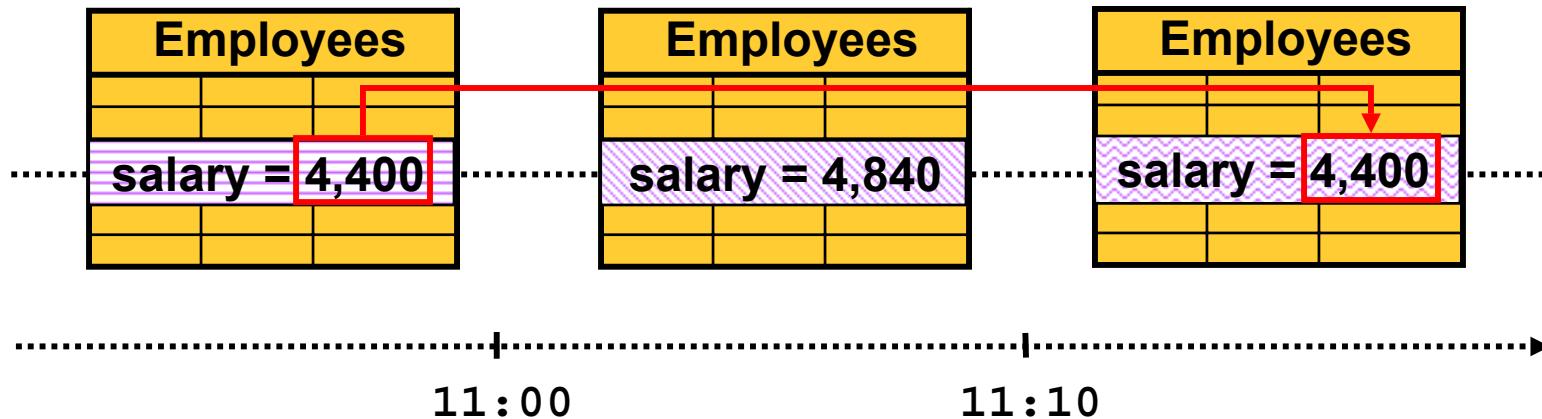
- **Flashback Query**
  - Query all data at a specified point in time.
- **Flashback Versions Query**
  - See all versions of a row between two times.
  - See the transactions that changed the row.
- **Flashback Transaction Query**
  - See all changes made by a transaction.



# Flashback Query: Overview



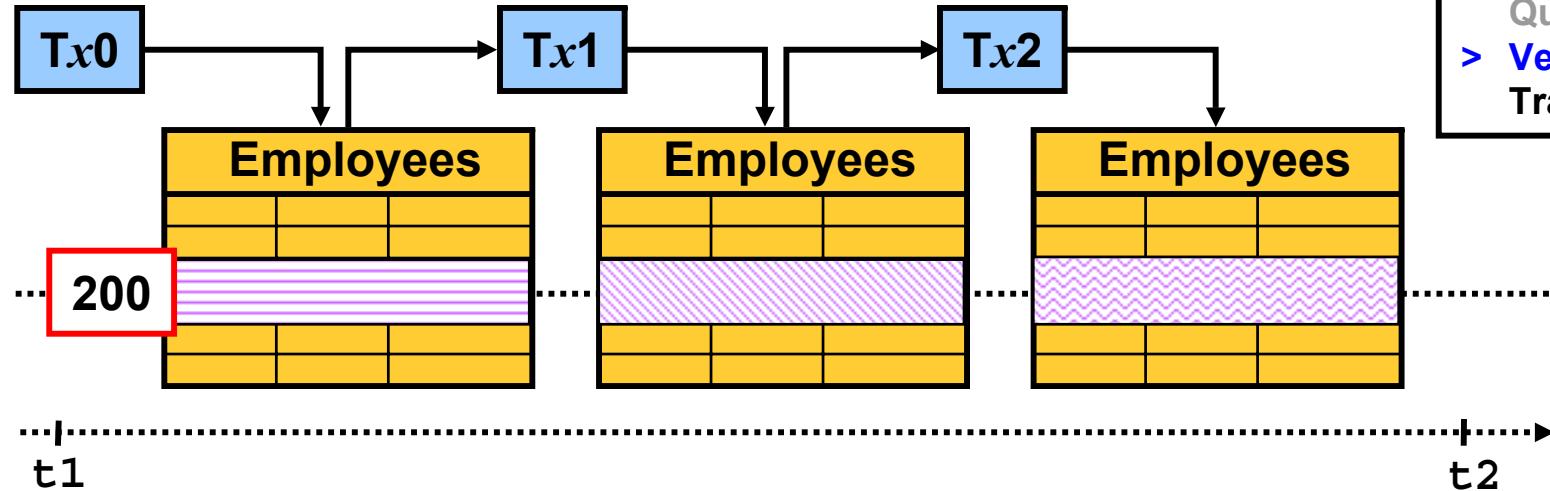
# Flashback Query: Example



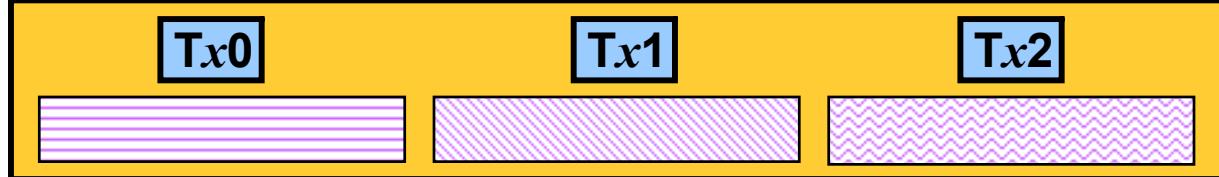
```
UPDATE employees SET salary =
  (SELECT salary FROM employees
   AS OF TIMESTAMP TO_TIMESTAMP
   ('2005-05-04 11:00:00', 'yyyy-mm-dd hh24:mi:ss')
   WHERE employee_id = 200)
WHERE employee_id = 200
```

# Flashback Versions Query: Overview

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



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



# Flashback Versions Query Through Enterprise Manager

Perform Object Level Recovery: Flashback Versions Query Filter

Cancel Show Flashback Versions Query SQL Back Step 2 of 7 Next

Object Type Tables  
Operation Type Flashback Existing Tables  
Table Name hr.jobs

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

**Step 1. Choose Columns**

| Available Columns |            | Selected Columns |            |
|-------------------|------------|------------------|------------|
| JOB_TITLE         | >          | JOB_ID           | >          |
| MIN_SALARY        | Move       | MAX_SALARY       | Move All   |
|                   | Move All   |                  | Remove     |
|                   | Remove     |                  | Remove All |
|                   | Remove All |                  |            |

**Flashback Versions Query Result**

| Select                           | Flashback SCN | Flashback Timestamp     | Transaction ID   | Operation | JOB_ID  | MAX_SALARY |
|----------------------------------|---------------|-------------------------|------------------|-----------|---------|------------|
| <input checked="" type="radio"/> | 531132        | May 5, 2005 10:50:44 AM | 080002007C010000 | UPDATE    | IT_PROG | 13200      |
| <input type="radio"/>            | 531111        | May 5, 2005 10:50:20 AM | 030029007E010000 | UPDATE    | IT_PROG | 11000      |

**Step 2. Bind The Row Value**

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

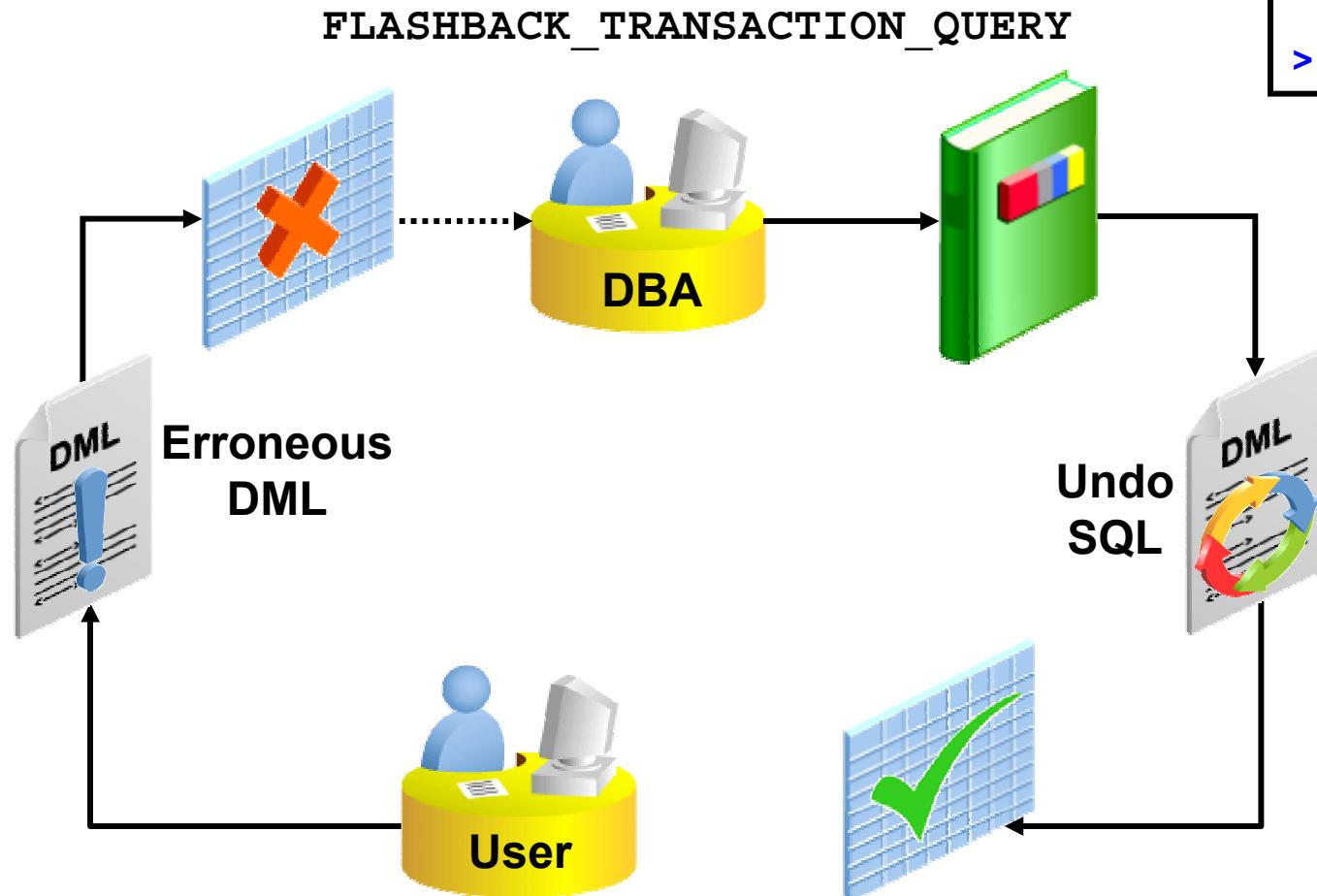
```
where job_id = 'IT_PROG'
```

# Flashback Versions Query: Considerations

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

# Flashback Transaction Query: Overview

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



# Flashback Transaction Query Through Enterprise Manager

| Flashback Versions Query Result |               |                            |                  |           |         |            |
|---------------------------------|---------------|----------------------------|------------------|-----------|---------|------------|
| Select                          | Flashback SCN | Flashback Timestamp        | Transaction ID   | Operation | JOB_ID  | MIN_SALARY |
| C                               | 489358        | Aug 5, 2005<br>11:54:29 AM | 090003002D010000 | UPDATE    | AD_PRES | 30000      |
| C                               | 489347        | Aug 5, 2005<br>11:54:11 AM | 0A001C00CF000000 | UPDATE    | AD_PRES | 25000      |
| C                               | 489318        | Aug 5, 2005<br>11:53:17 AM | 0800110002010000 | UPDATE    | AD_PRES | 22000      |



| Choose SCN: Transaction Details   |                         |            |                                                                                      |
|-----------------------------------|-------------------------|------------|--------------------------------------------------------------------------------------|
| <input type="button" value="OK"/> |                         |            |                                                                                      |
| Transaction ID                    | 0A001C00CF000000        |            |                                                                                      |
| User                              | HR                      |            |                                                                                      |
| Commit SCN                        | 489348                  |            |                                                                                      |
| Commit Time                       | Aug 5, 2005 12:00:00 AM |            |                                                                                      |
| Operation                         | Table Owner             | Table Name | Undo SQL                                                                             |
| UPDATE                            | HR                      | JOBS       | update "HR"."JOBS" set "MIN_SALARY" = '22000'<br>where ROWID = 'AAAMg1AAFAAAABIAAA'; |
| UPDATE                            | HR                      | EMPLOYEES  | update "HR"."EMPLOYEES" set "SALARY" = '4400'<br>where ROWID = 'AAAMg3AAFAAAABUAAC'; |

# **Flashback Transaction Query: Considerations**

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

# Summary

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

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

# **Practice Overview: Using Flashback**

**This practice covers the following topics:**

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

# 18

## Moving Data

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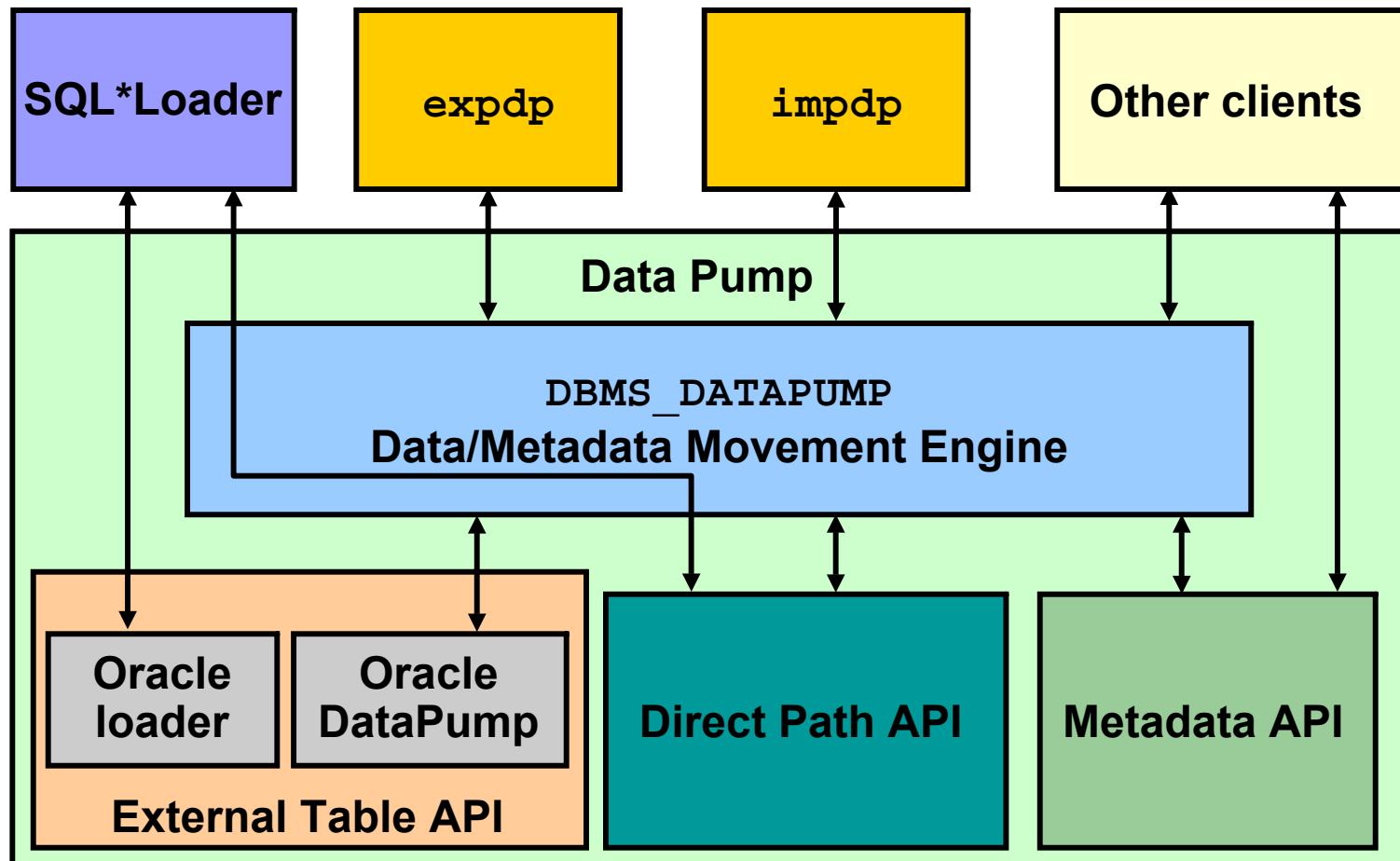
# Objectives

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

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

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

# Moving Data: General Architecture



# Directory Object: Overview

## Directory Objects

### Search

Object Name

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

Selection Mode

Actions

| Select                           | Name                          | Path                                                                  |
|----------------------------------|-------------------------------|-----------------------------------------------------------------------|
| <input checked="" type="radio"/> | <a href="#">ADMIN_DIR</a>     | /ade/aime_10.2_Inx_push/oracle/md/admin                               |
| <input type="radio"/>            | <a href="#">DATA FILE DIR</a> | /u01/app/oracle/product/10.2.0/db_1/demo/schema/sales_history/        |
| <input type="radio"/>            | <a href="#">DATA PUMP DIR</a> | /u01/app/oracle/product/10.2.0/db_1/rdbms/log/                        |
| <input type="radio"/>            | <a href="#">LOG FILE DIR</a>  | /u01/app/oracle/product/10.2.0/db_1/demo/schema/log/                  |
| <input type="radio"/>            | <a href="#">MEDIA DIR</a>     | /u01/app/oracle/product/10.2.0/db_1/demo/schema/product_media/        |
| <input type="radio"/>            | <a href="#">SUBDIR</a>        | /u01/app/oracle/product/10.2.0/db_1/demo/schema/order_entry//2002/Sep |
| <input type="radio"/>            | <a href="#">WORK DIR</a>      | /ade/aime_10.2_Inx_push/oracle/work                                   |
| <input type="radio"/>            | <a href="#">XMLDIR</a>        | /u01/app/oracle/product/10.2.0/db_1/demo/schema/order_entry/          |

### Schema

#### Database Objects

[Tables](#)

[Indexes](#)

[Views](#)

[Synonyms](#)

[Sequences](#)

[Database Links](#)

[Directory Objects](#)

[Reorganize Objects](#)

# Creating Directory Objects

## Create Directory Object

1

Show SQL

Schedule Job

Cancel

OK

**General**Privileges

\* Name EXTAB\_LOG\_DIR

2

\* Path /home/oracle/labs/extab2

Test File System

## Create Directory Object

3

Show SQL

Cancel

OK

**General****Privileges**

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

5

Add

Remove

**Select**[Select All](#) | [Select None](#)**Select User Name****Read Access****Write Access**

HR



## Show SQL

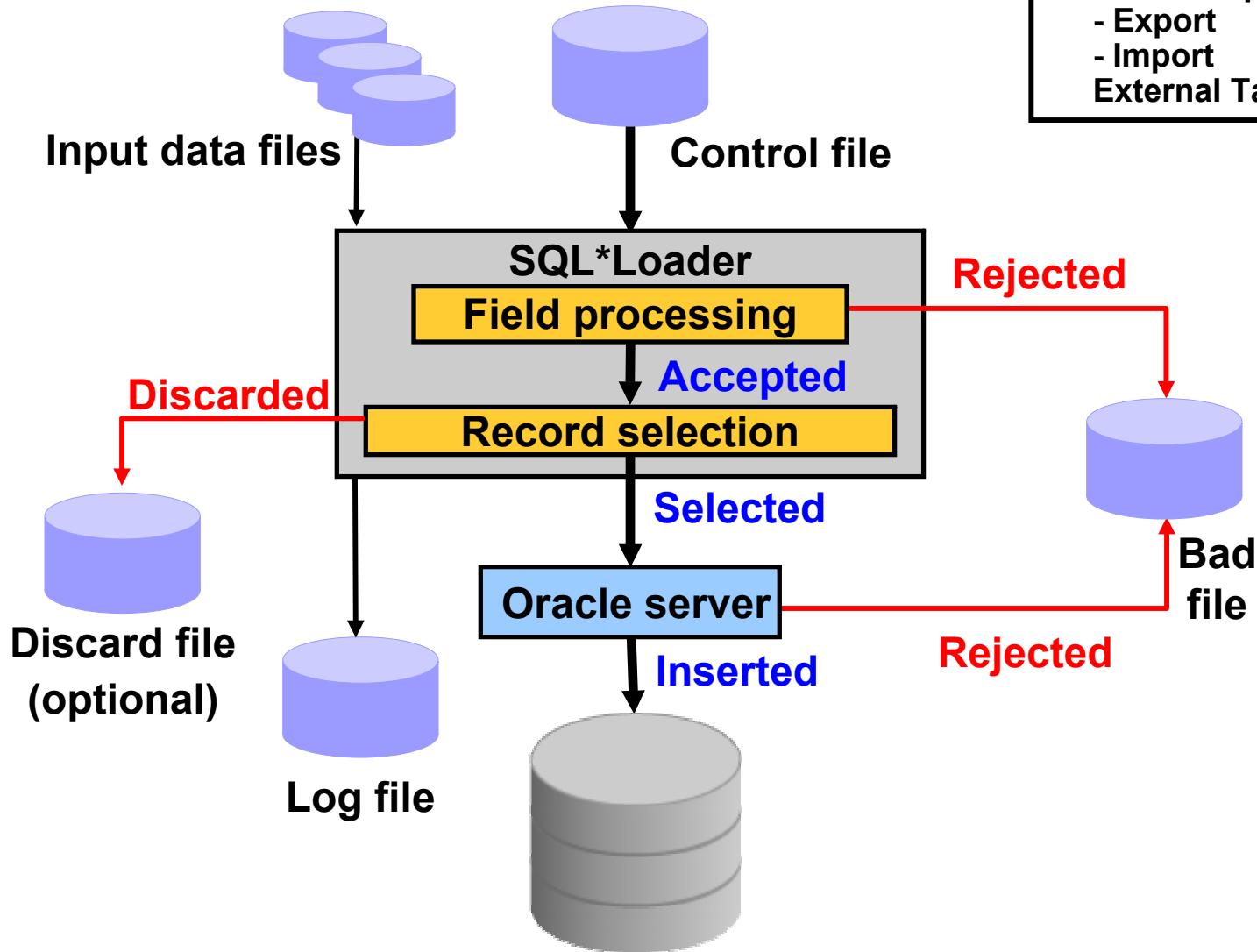
4

Return

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

# SQL\*Loader: Overview

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



# Loading Data with SQL\*Loader

**Data Movement**

**Move Row Data**

- [Export to Export Files](#)
- [Import from Export Files](#)
- [Import from Database](#)
- [Load Data from User Files](#)
- [Monitor Export and Import Jobs](#)

 **Load Data: Generate Or Use Existing Control File**

Database **orcl.oracle.com**

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

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

**Host Credentials**

\* Username

\* Password

Save as Preferred Credential

Control File   Data File   Load Method   Options   Schedule   Review

**Load Data: Control File**

Database **orcl.oracle.com**

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

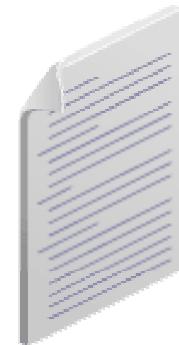


**Cancel** **Finish** **Step 1 of 6** **Next**

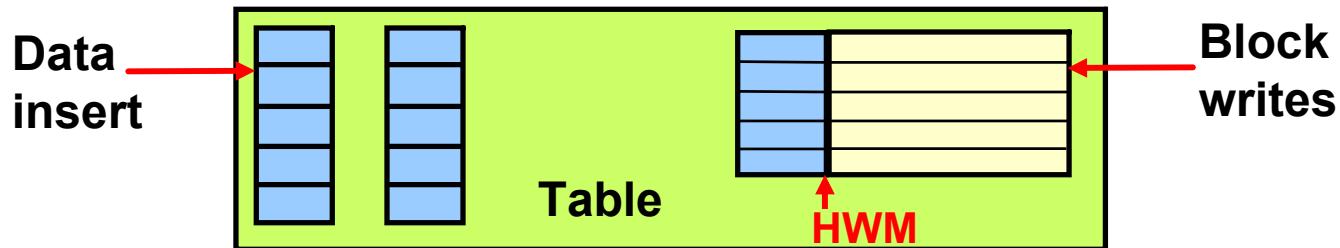
# **SQL\*Loader Control File**

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

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



# 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 |

# Data Pump: Overview

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

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

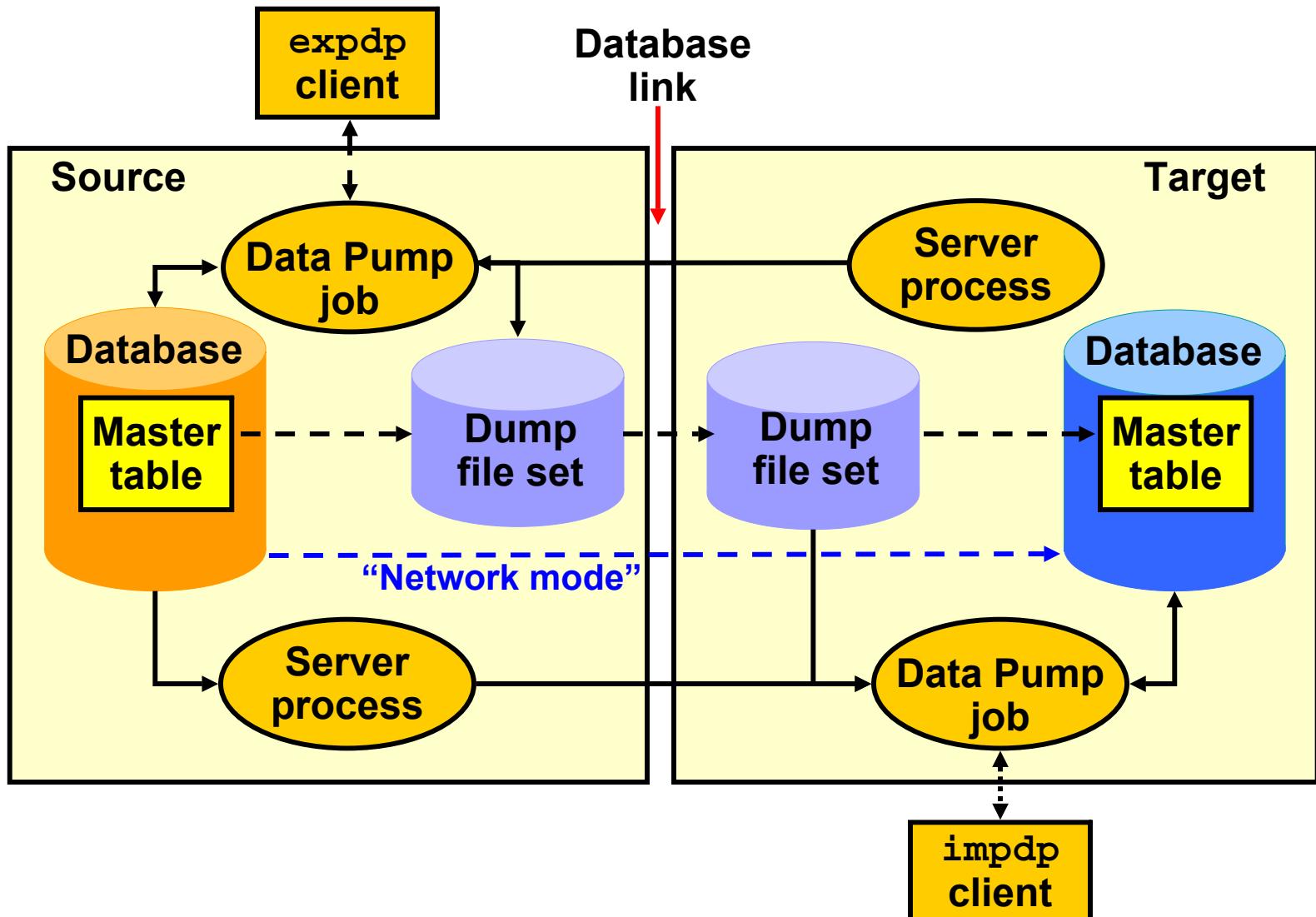
- **Is callable via DBMS\_DATAPUMP**
- **Provides the following tools:**
  - expdp
  - impdp
  - Web-based interface
- **Provides data access methods:**
  - Direct path
  - External tables
- **Detaches from and reattaches to long-running jobs**
- **Restarts Data Pump jobs**



# Data Pump: Benefits

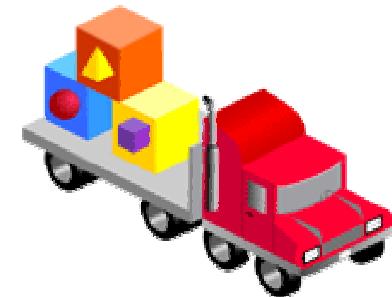
- **Fine-grained object and data selection**
- **Explicit specification of database version**
- **Parallel execution**
- **Estimation of the export job space consumption**
- **Network mode in a distributed environment**
- **Remapping capabilities during import**
- **Data sampling and metadata compression**

# Data Pump Export and Import: Overview



# Data Pump Utility: Interfaces and Modes

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



# Fine-Grained Object Selection

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

## Content

What to Export from the Source Database  All

Export both metadata and data.

Data Only

Export only table row data.

Metadata Only

Export only database object definitions

Export Content

Include All Objects

Include Only Objects Specified Below

Exclude Only Objects Specified Below

### Objects to Include or Exclude

Select Object Type | Object Name Expression

No items found

Add Another Row

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

## Flashback

Export read-consistent view of data

As the specified System Change Number (SCN)

SCN 699783

As the SCN which most closely matches the specified time

Date June 6, 2005 

Time 12  00   AM  PM

## Query

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

Select Predicate Clause Table Name

No items found

Add

# Advanced Feature: Sampling

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

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

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

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

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

# Export Options: Files

Schemas      Options      Files      Schedule      Review

## Export: Options

Database **orcl.oracle.com**

Maximum Number of Threads in Export Job  This option allows you to make tradeoffs between resource consumption and elapsed time. Parallelism is only available in Enterprise Edition.

### Estimate Disk Space

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

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

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

**Estimate Disk Space Now**

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

### Optional File

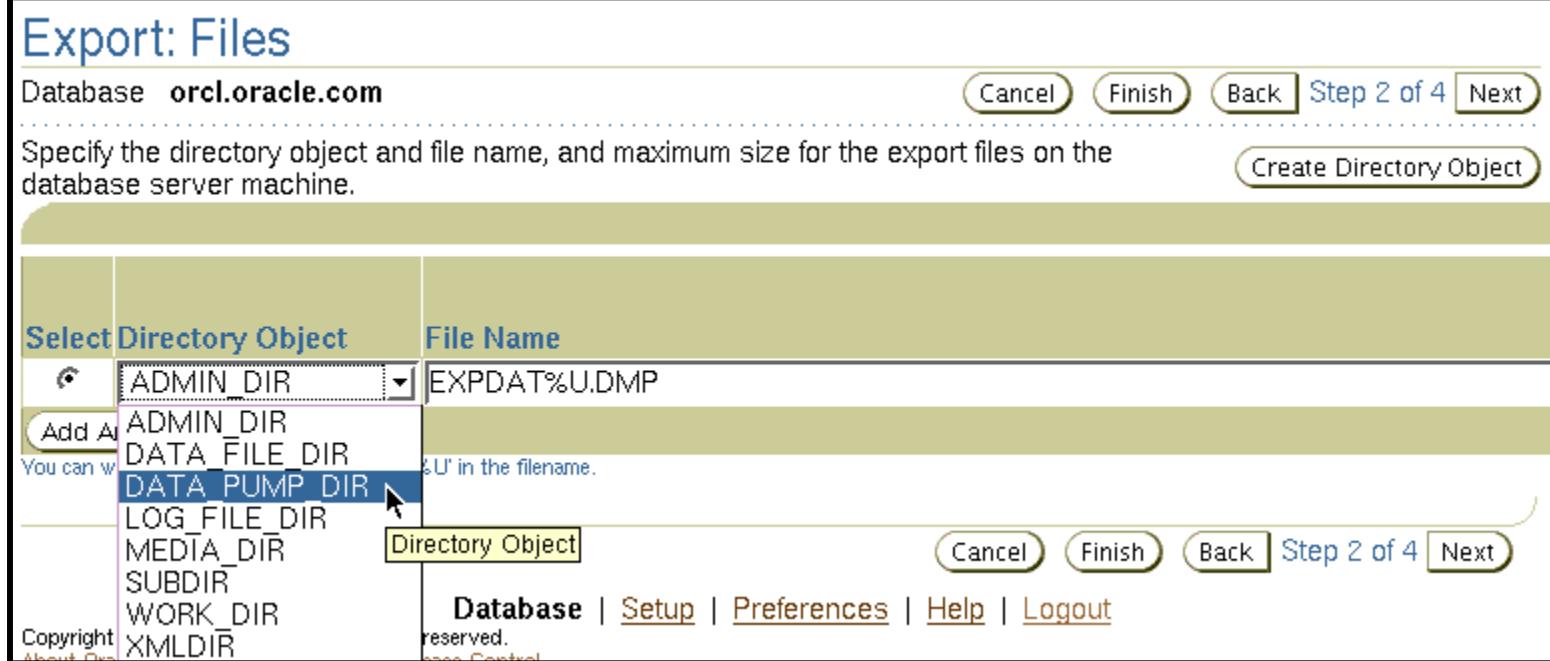
Generate Log File

Directory Object

Log File

Show Advanced Options

# Data Pump File Locations



**The order of precedence of file locations:**

- **Per-file directory**
- **The DIRECTORY parameter**
- **The DATA\_PUMP\_DIR environment variable**
- **DATA\_PUMP\_DIR directory object**

# Scheduling and Running a Job

Options   Files   **Schedule**   Review

## Export: Schedule

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

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

**Job Parameters**

Job Name **hrexp**  
Description Export HR schema

**Job Schedule**

**Start**

Immediately  
 Later

Date  
Time

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

 **Processing**

**Submit job is progressing. This may take some time.**

This may take several minutes. This page will automatically forward to the next page when done.



Process is in progress.

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

# Data Pump File Naming and Size

The screenshot shows the 'Export: Review' step of a Data Pump job. At the top, there is a navigation bar with four steps: Options, Files, Schedule, and Review. The 'Review' step is highlighted with a blue circle. Below the navigation bar, the database name is listed as 'orcl.oracle.com'. On the right side, there are buttons for 'Cancel', 'Back', 'Step 4 of 4', and 'Submit Job'. The main content area displays the export configuration:

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

Below this, there is a section titled 'Export PL/SQL' with a 'Hide PL/SQL' button. A scrollable code editor displays the following PL/SQL code:

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

# Data Pump Import

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

## Import: Files

Database **orcl.oracle.com**

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

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

### Files

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

| Select                                         | Directory Object | File Name    |
|------------------------------------------------|------------------|--------------|
| <input checked="" type="radio"/>               | DATA_PUMP_DIR    | EXPDAT%U.DMP |
| <input type="button" value="Add Another Row"/> |                  |              |

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

### Import Type

- Entire files
- Schemas

Allows you to choose one or more schemas and to import the objects in those schemas.

- Tables

Allows you to choose one or more tables to import from a selected schema.

- Tablespace

Allows you to import the tables from one or more selected tablespaces. Note: the tablespaces themselves will not be imported and must exist in the database.

### Host Credentials

\* Username

\* Password

Save as Preferred Credential

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# Data Pump Import: Transformations

You can remap:

- Data files by using REMAP\_DATAFILE
- Tablespaces by using REMAP\_TABLESPACE
- Schemas by using REMAP\_SCHEMA

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

# Data Pump Import: Transformations

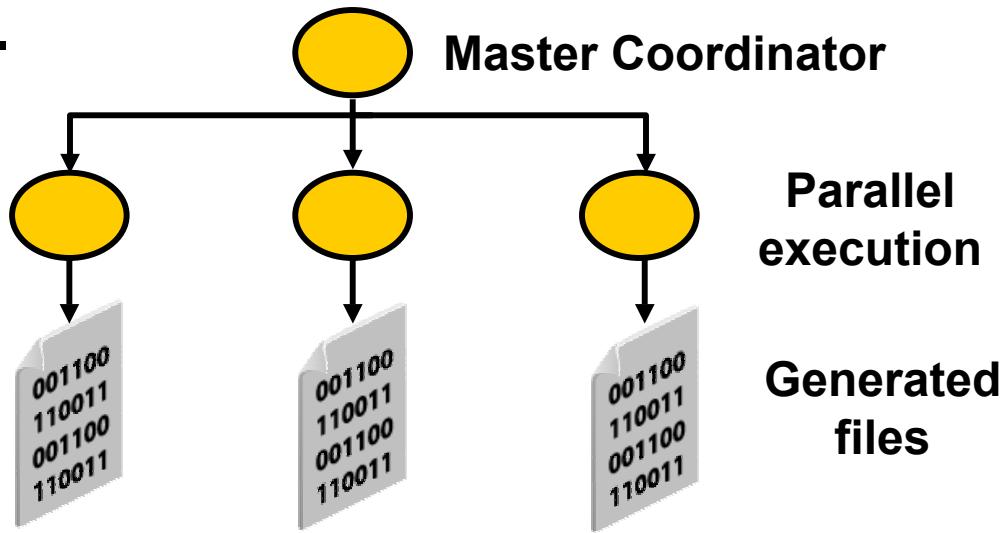
**Using TRANSFORM, you can also :**

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

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

# Data Pump: Performance Consideration

Maximizing job performance with the **PARALLEL** parameter.



Example:

```
expdp hr/hr FULL=y  
DUMPFILE=dp_dir1:full11%U.dmp, dp_dir2:full12%U.dmp  
FILESIZE=2G PARALLEL=3  
LOGFILE=dp_dir1:expfull.log JOB_NAME=expfull
```

# Performance Initialization Parameters

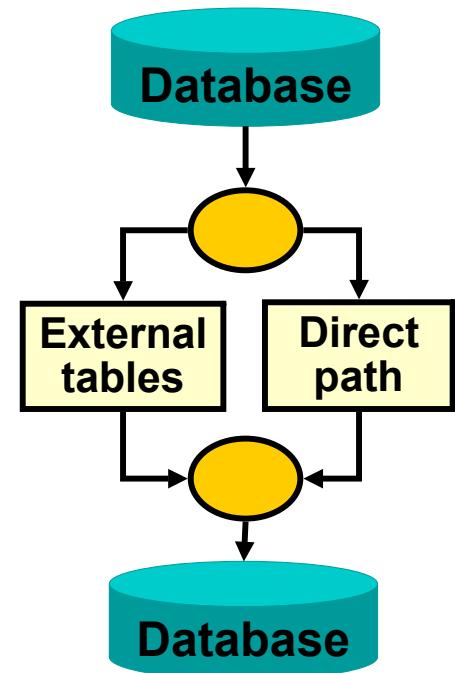
- **Performance of Data Pump can be affected by:**
  - `DISK_ASYNCH_IO=TRUE`
  - `DB_BLOCK_CHECKING=FALSE`
  - `DB_BLOCK_CHECKSUM=FALSE`
- **The following should be set high to allow for maximum parallelism:**
  - `PROCESSES`
  - `SESSIONS`
  - `PARALLEL_MAX_SERVERS`
- **The following should be sized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



# Data Pump Access Path: Considerations

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

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



# Using Enterprise Manager to Monitor Data Pump Jobs

The screenshot shows the Oracle Enterprise Manager 10g Database Control interface. A red box highlights the 'Monitor Export and Import Jobs' link under the 'Data Movement' section of the left sidebar. A red arrow points from this link to the 'Export and Import Jobs' page in the main content area. The main page title is 'Export and Import Jobs'. It includes a message about data pump jobs and a table showing job details.

**Database Instance: EDRSR14P1\_c**

Home Performance Administration Maintenance

The Administration tab displays links that allow you to administer your database. The Maintenance tab displays links that provide functions that control the flow of data.

**High Availability**

**Backup/Recovery**

- Schedule Backup
- Perform Recovery
- Manage Current Backups
- Manage Restore Points
- Backup Reports

**Data Movement**

**Move Row Data**

- Export to Export Files
- Import from Export Files
- Import from Database
- Load Data from User Files

**Monitor Export and Import Jobs**

**ORACLE Enterprise Manager 10g** Database Control

Setup Preferences Help Logout Database

Logged in As SYSTEM

**Export and Import Jobs**

Page Refreshed Feb 9, 2005 6:55:12 AM OK

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

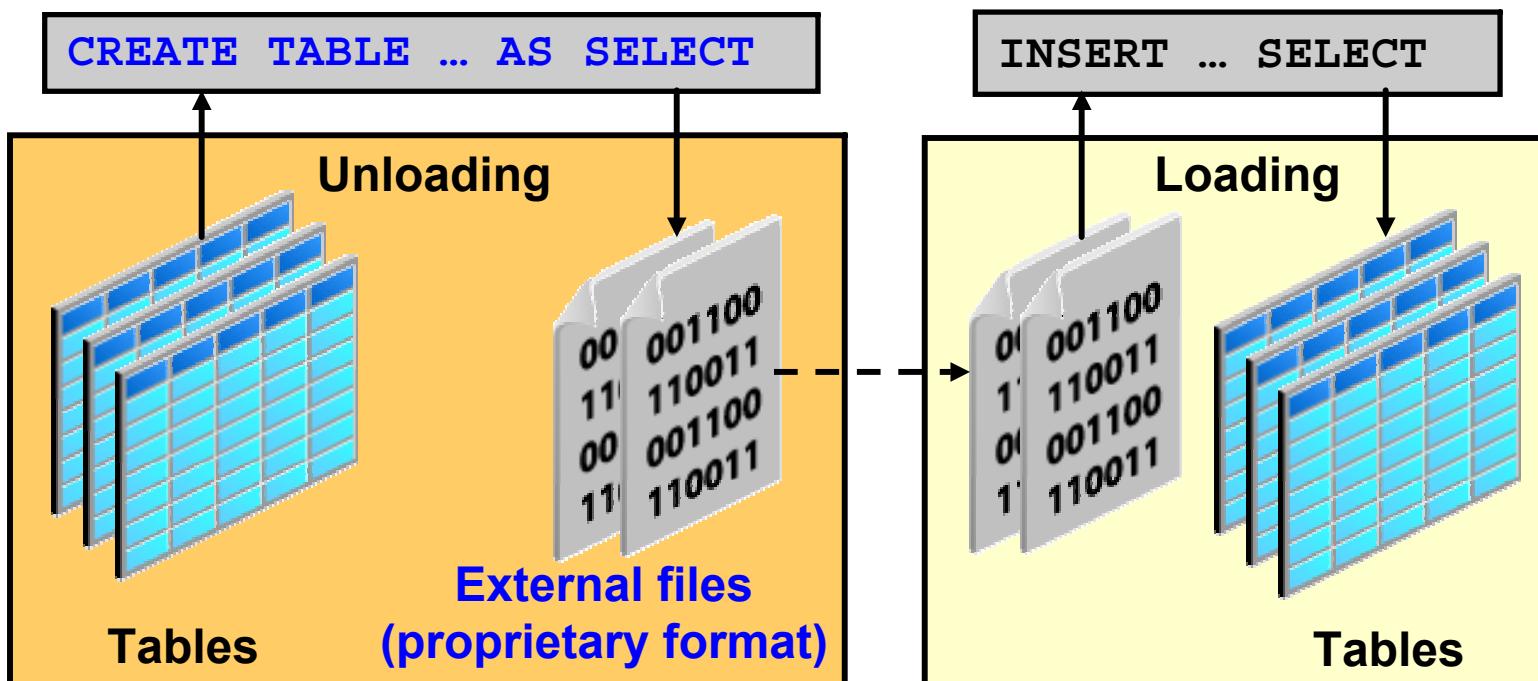
| Data Pump Job | Owner  | Job Status |
|---------------|--------|------------|
| NEW_1         | SYSTEM | DEFINING   |

OK

# External Table Population

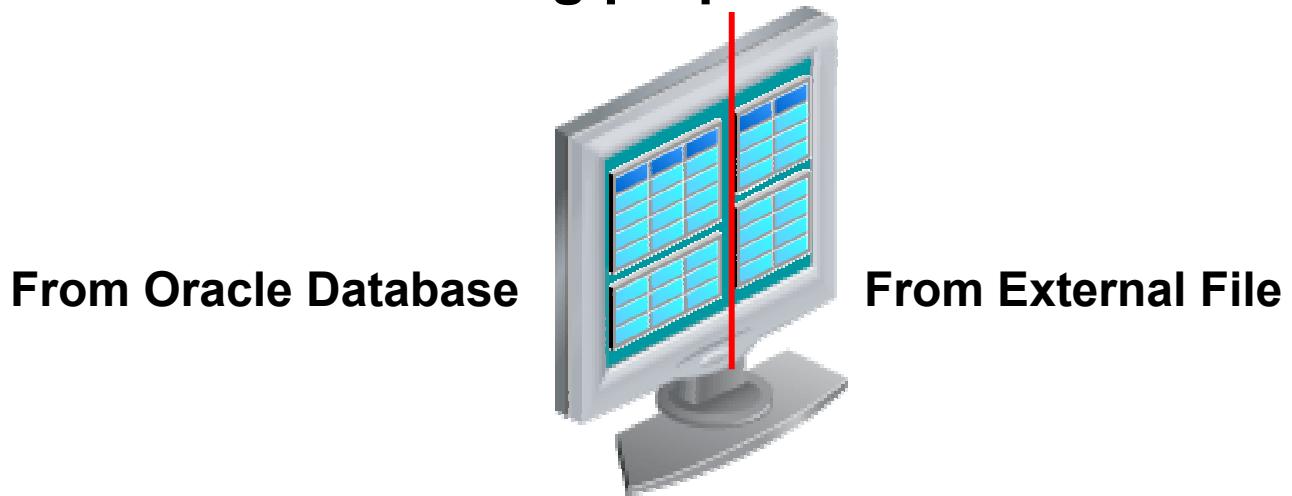
Directory Obj.  
SQL\*Loader  
Data Pump  
- Export  
- Import  
> **External Table**

- **Unloading of data to external files with the ORACLE\_DATAPUMP access driver**
- **No modifications of external tables**



# Using External Tables

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



# External Table Population with ORACLE\_DATAPUMP

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

# External Table Population with ORACLE\_LOADER

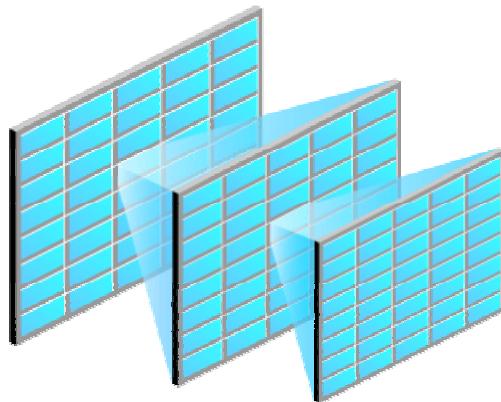
```
CREATE TABLE extab_employees
    (employee_id          NUMBER (4),
     first_name           VARCHAR2 (20),
     last_name            VARCHAR2 (25),
     hire_date             DATE)

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

# Data Dictionary

**View information about external tables in:**

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



# Summary

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

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



# **Practice Overview: Moving Data**

**This practice covers the following topics:**

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



# **Next Steps**

## **Continuing Your Education**

# Where Do You Go from Here?

**“To stay competitive in the tech industry, never stop learning. Always be on the lookout for better ways of doing things and new technologies. Our industry does not reward people who let themselves stagnate”**

**—John Hall, Senior Vice President, Oracle University**

**Here are a few resources to help you with continuing your education.**

# Continuing Education Resources

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

- Oracle University Web site
- Oracle University University Knowledge Center
- Oracle Technology Network:
  - Oracle by Example
  - Oracle Magazine
- Technical support: Oracle *MetaLink*



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  - Oracle Database 10g: Administration Workshop II
  - Oracle Database 10g: SQL Fundamentals I & II
  - Oracle Database 10g: PL/SQL Fundamentals
- **Grid technology specialty courses:**
  - Oracle Enterprise Manager 10g Grid Control
  - Oracle Database 10g: Real Application Clusters
  - Oracle Database 10g: Implement Streams
  - Oracle Database 10g: Data Guard Administration
- **Other specialty courses**

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### "Getting Started with Oracle" page

If you're new to Oracle—whether as a developer or DBA—this page will take you through the initial learning process, step by step.

### Free Software!

Because what better training tool than free software for education and evaluation purposes? The [OTN Development License](#) allows you to use full versions while developing and prototyping your applications.

### Sample Code Tutorials

This page presents a list of tutorials on a variety of Oracle products and technologies. Most of the tutorials are based on working sample applications developed by the Oracle Technology Network.

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**A set of hands-on, step-by-step instructions**
- **Where can I find them?**  
**<http://www.oracle.com/technology/obe>**
- **What is available?**  
**Over 100 database OBEs**

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Select the product area or component you are interested in.

### Product Areas

- |                                         |                                      |                                       |
|-----------------------------------------|--------------------------------------|---------------------------------------|
| * <a href="#">Database</a>              | * <a href="#">Application Server</a> | * <a href="#">Enterprise Manager</a>  |
| * <a href="#">Developer Suite</a>       | * <a href="#">JDeveloper</a>         | * <a href="#">Collaboration Suite</a> |
| * <a href="#">Business Intelligence</a> |                                      |                                       |

### Product Components

- |                                                                 |
|-----------------------------------------------------------------|
| * <a href="#">HTML DB</a>                                       |
| * <a href="#">Reports</a>                                       |
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