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COMPLETE SLIDES

Introduction to Database Administration

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Introduction to Database Administration

Defining Data, Information & Database

Defining Data, Information & Database

Data, Information
From Data to Information

- For Knowledge
- For Business Intelligence

Defining Data, Information & Database

Data

- Anything which is not necessarily meaningful to human being.
- Raw facts/Un-processed information.

Defining Data, Information & Database

Examples of Data

The numbers 10, 22, and 119 are data

Some one can think these are lengths and other may think room numbers

Similarly, 1.5, 2.5, 31.5, … MAY represent lengths of some iron rods

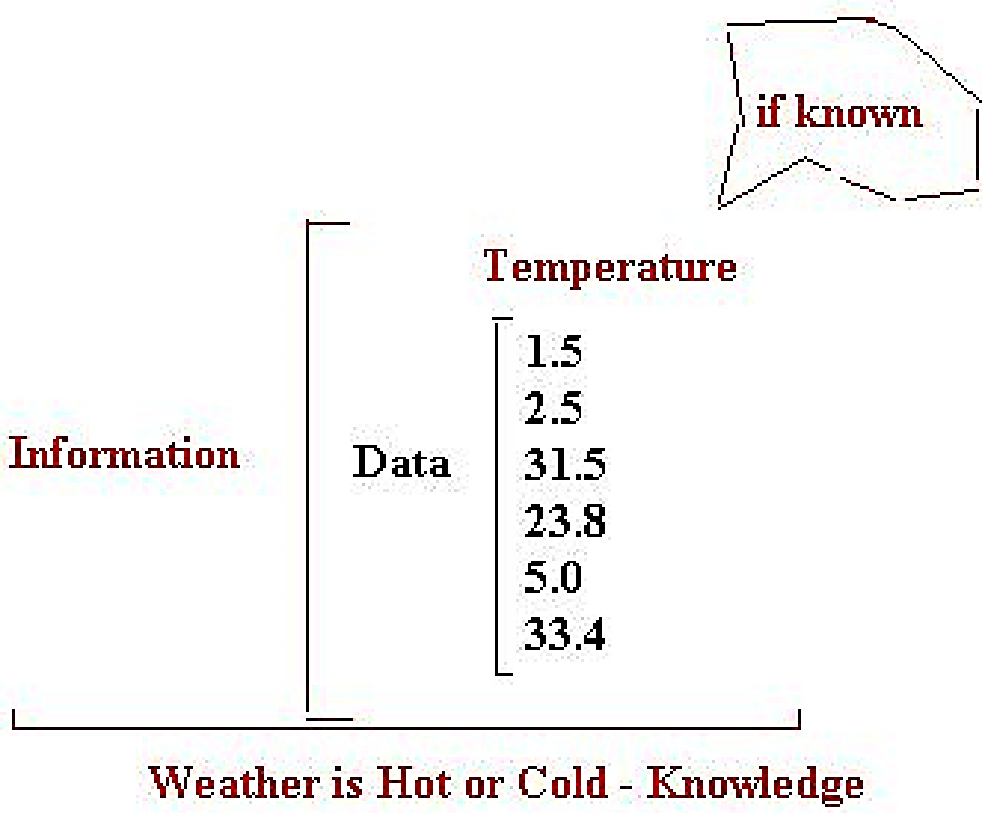
Defining Data, Information & Database

Information

Data Processed to reveal its meaning

- Information is meaningful
- In today's world, accurate, relevant and timely information is the key to good decision making
- Good decision making is key to survival in today's competitive and global environment

Defining Data, Information & Database



Examples of Information

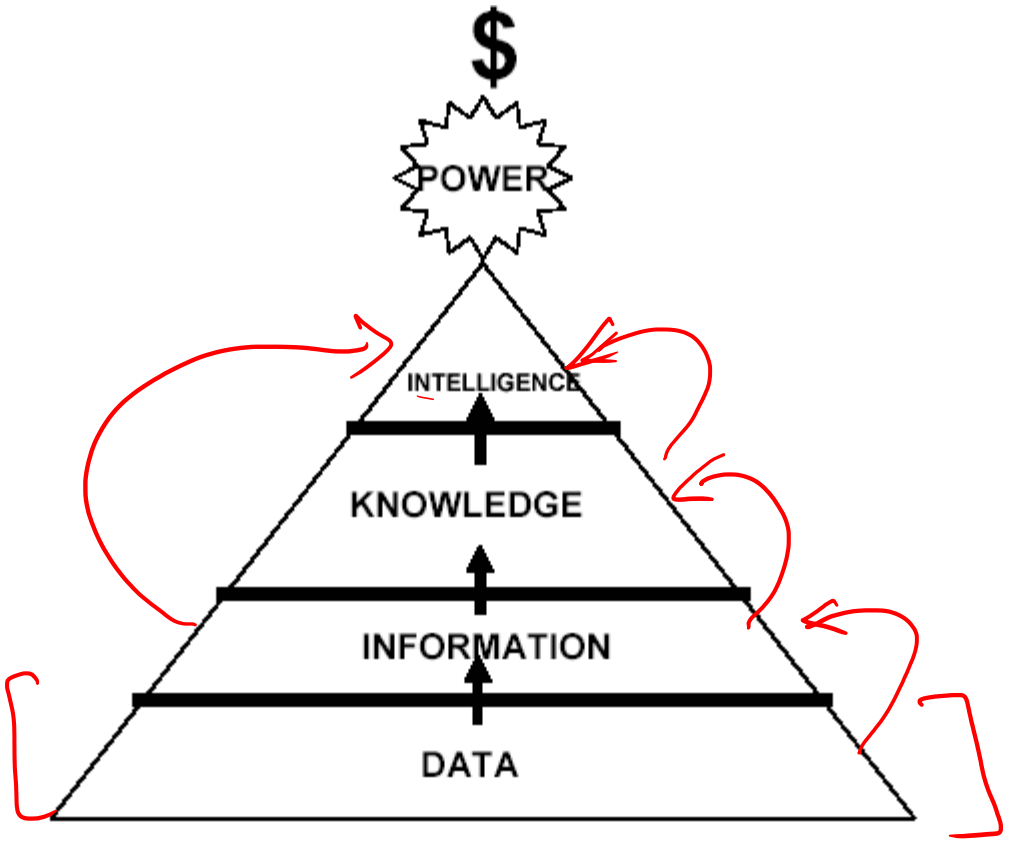
Software Engineer designed some system

- May be monthly reports are not ok
- Reports are giving wrong information, etc.

This means DESIGN is not ok

Defining Data, Information & Database

Aim of Data & Information



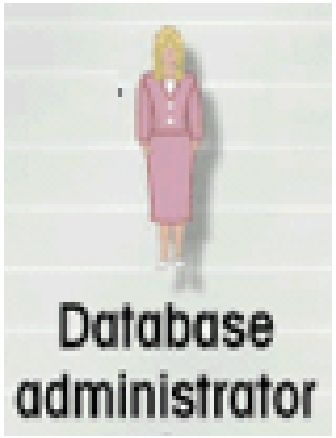
Functional

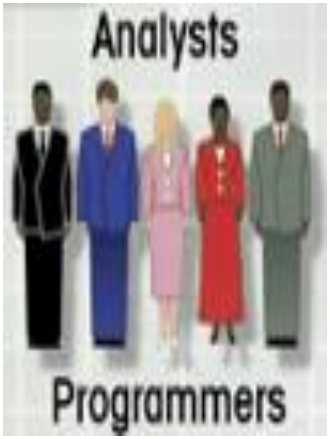
Many user data Proc/Unproc

Defining Data, Information & Database

Who Builds Useful Information

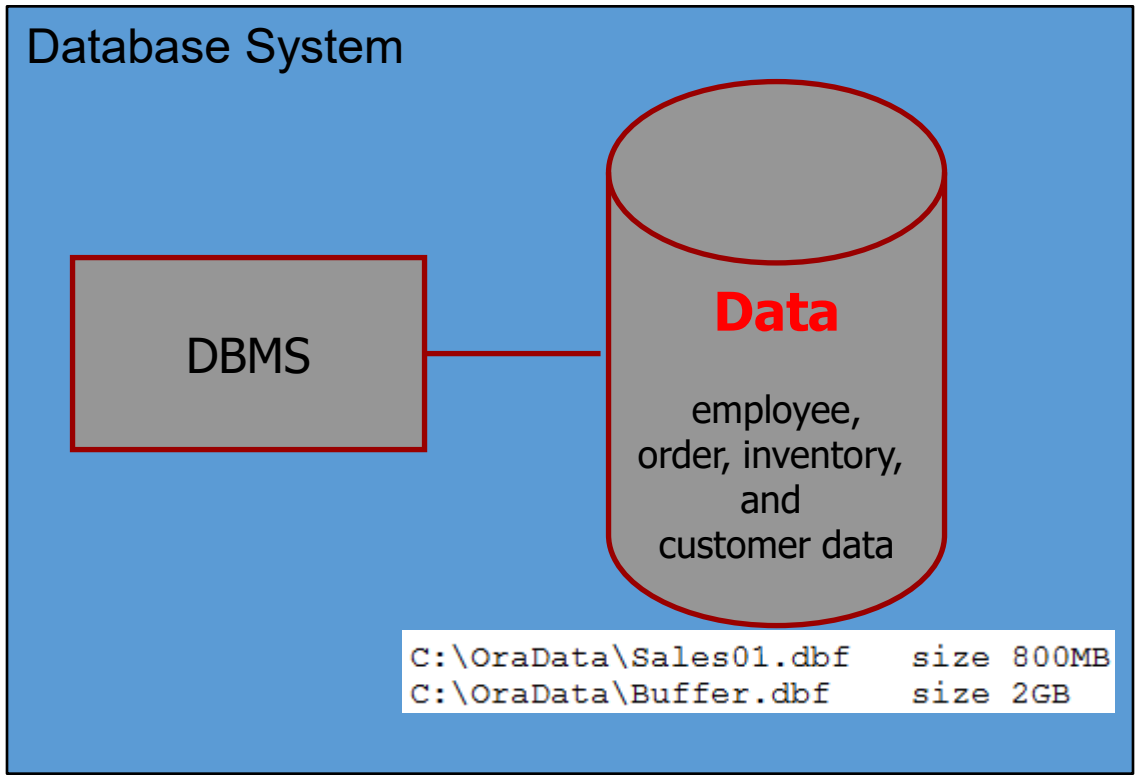
Data → Information





Defining Data, Information & Database

A database is collection of stored operational data used by application systems of some particular enterprise (C.J. Date)



Database & DBMS Package

Introduction to Database Administration

Introduction to DBMS & its environment for DBA

Introduction to DBMS & its environment for DBA

DBMS, Role of DBA with Database

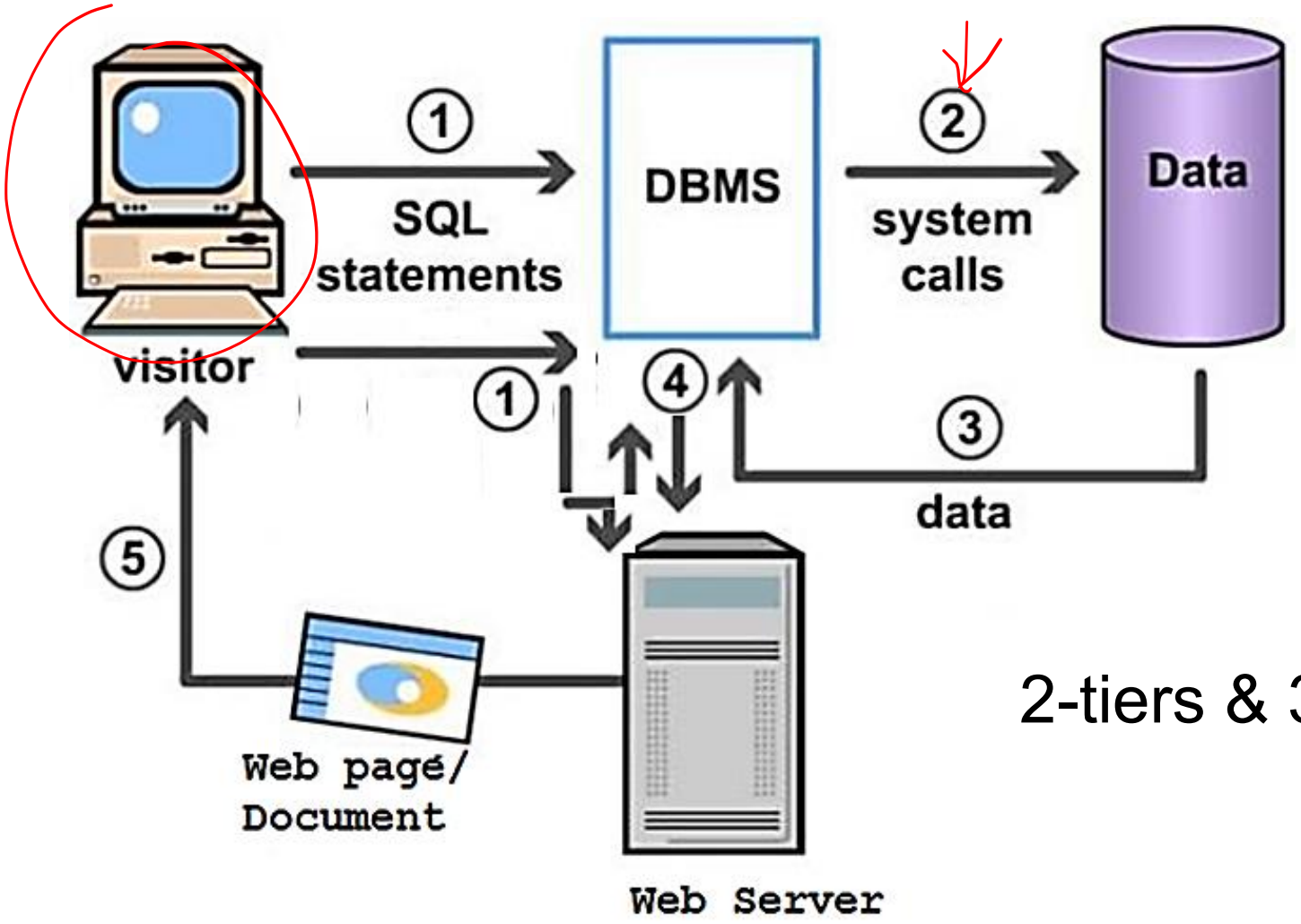
- Examples of DBMS
- Data Accessing using DBMS
- Forms, Reports & Queries
- DBMS Language
- DBMS & its Sub Schemas
- Role/ Jobs in DB Environment
- Components of DBMS Environment
- Interaction of DBMS with DB Files

Introduction to DBMS & its environment for DBA

Examples of DBMS

- Oracle
- IBM DB2
- Ingress
- Teradata
- MS SQL Server
- MS Access
- MySQL etc.

Introduction to DBMS & its environment for DBA

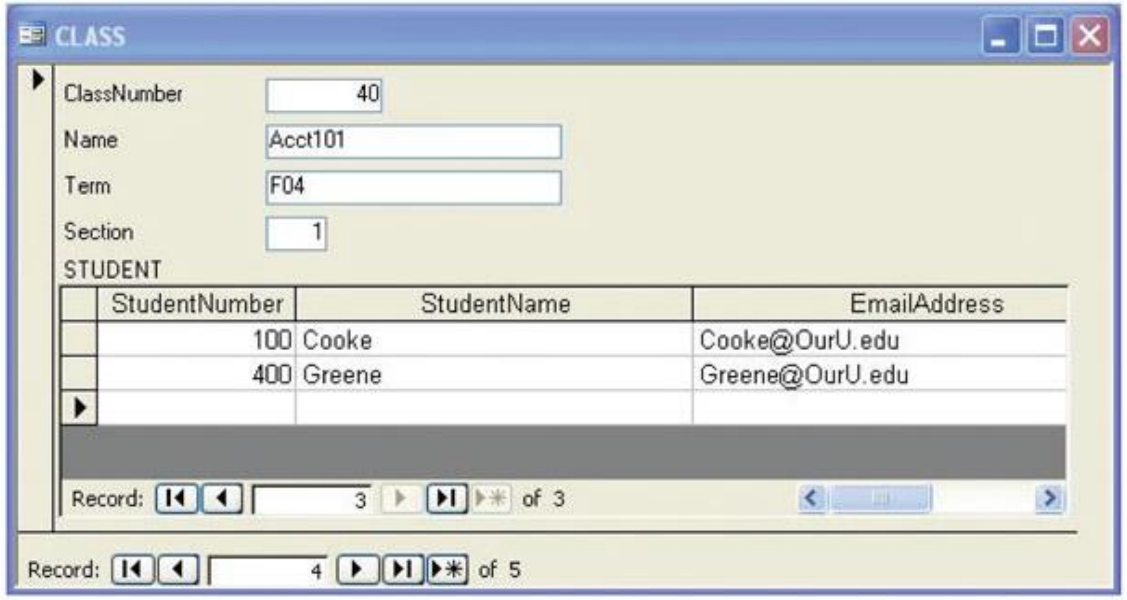


Data Accessing using DBMS

2-tiers & 3-tiers Architectures

Introduction to DBMS & its environment for DBA

Forms, Reports & Queries



PART

Number	*PartName*	*SalesPrice*	*ROQ*	*QOH*	*CompanyName*	*City*	*Country*
1000	*Cedar Shakes*	*$22.00*	*100*	*200*			
					Bristol Systems	Machester	England
					ERS Systems	Vancouver	Canada
					Forrest Supplies	Denver	US
2000	*Garage Heater*	*$1,750.00*	*3*	*4*			
					Bristol Systems	Machester	England
					ERS Systems	Vancouver	Canada
					Kyoto Importers	Kyoto	Japan
					Forrest Supplies	Denver	US
3000	*Utility Cabinet*	*$55.00*	*7*	*3*			
					Ajax Manufacturing	Sydney	Australia

```
SQL> SELECT empno, ename, sal
  2  FROM EMP;

     EMPNO ENAME                SAL
---------- ---------- ----------
      7369 SMITH                800
      7499 ALLEN               1600
```

Introduction to DBMS & its environment for DBA

DBMS Language

A Software Package that enables users to define, create, maintain, and control access to the database.

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Control access (DCL):
  - Security, integrity, concurrent access, recovery, support for data communication, etc.
- Utility services (DCL)
  - File import/export, monitoring facilities, code generator, report writer, etc.

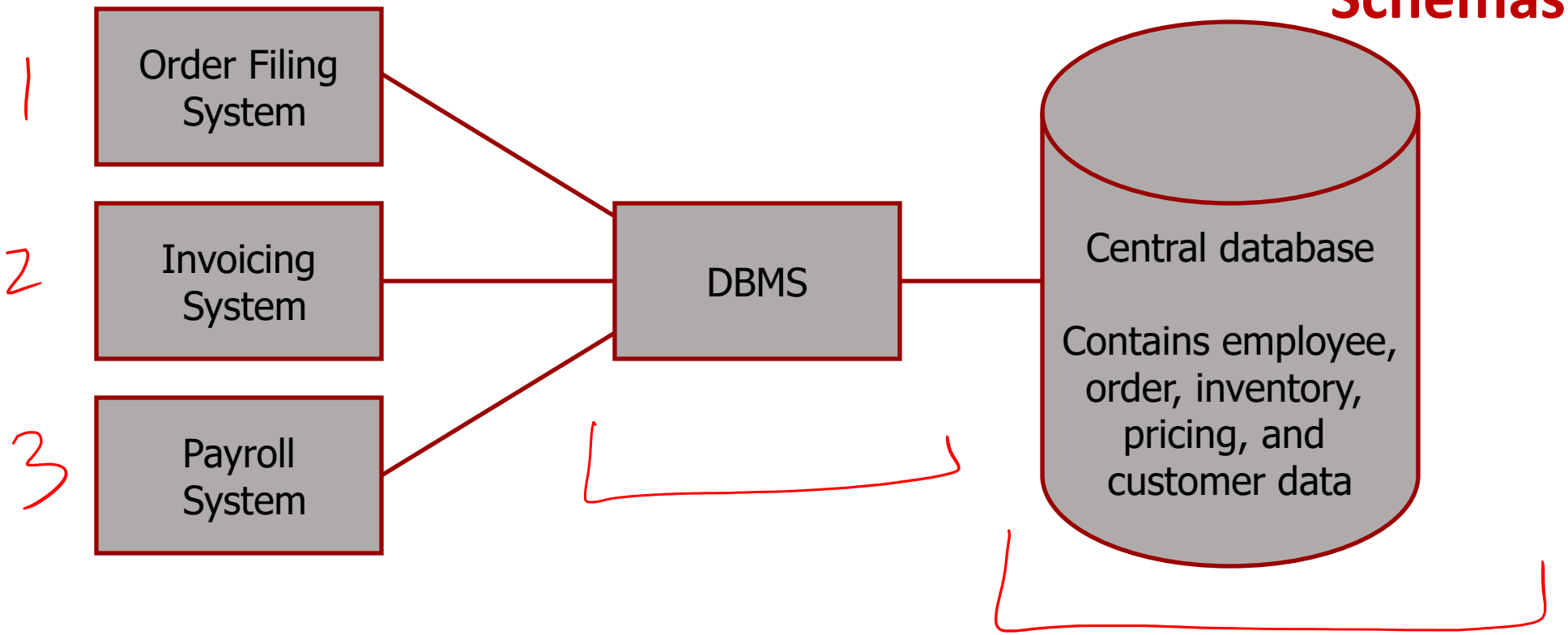
Support Ad Hoc queries

Database Languages are DML, DDL, DCL in SQL.

Introduction to DBMS & its environment for DBA

A software system that is used to create, maintain, and provide controlled access to user databases

DBMS and its Sub Schemas



DBMS manages data resources like an operating system manages hardware resources

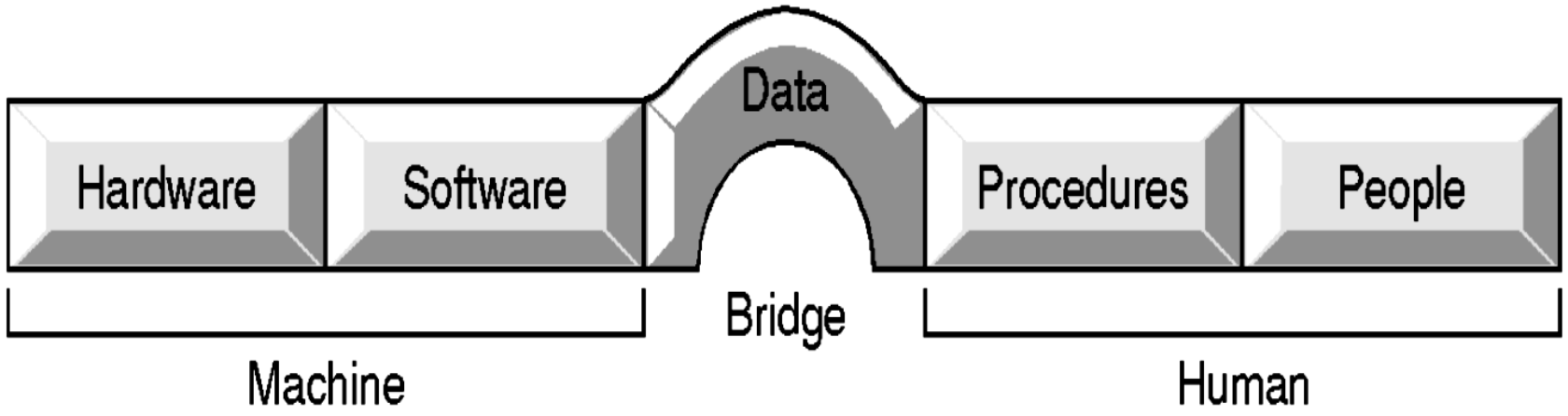
Introduction to DBMS & its environment for DBA

Roles/ Jobs in the Database Environment

- Data Administrator (DA)
- Database Administrator (DBA)
- Database Designers (Logical and Physical)
- Applications Programmer
- Database Developer
- Database Analyst
- End users (Naive and sophisticated)

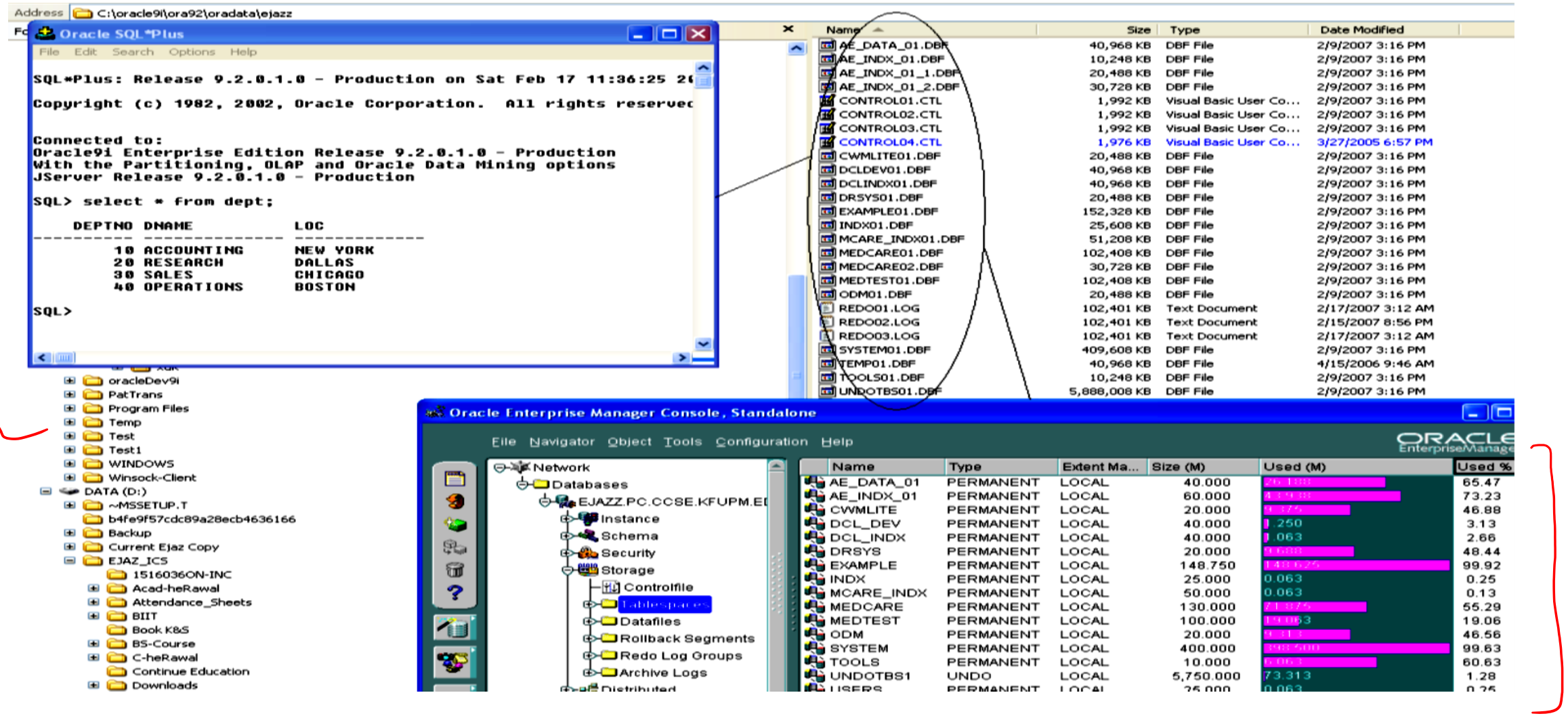
Introduction to DBMS & its environment for DBA

Components of DBMS Environment



Introduction to DBMS & its environment for DBA

Interaction of DBMS with DB Files



Introduction to Database Administration

Introduction to DBMS
Components & Architecture

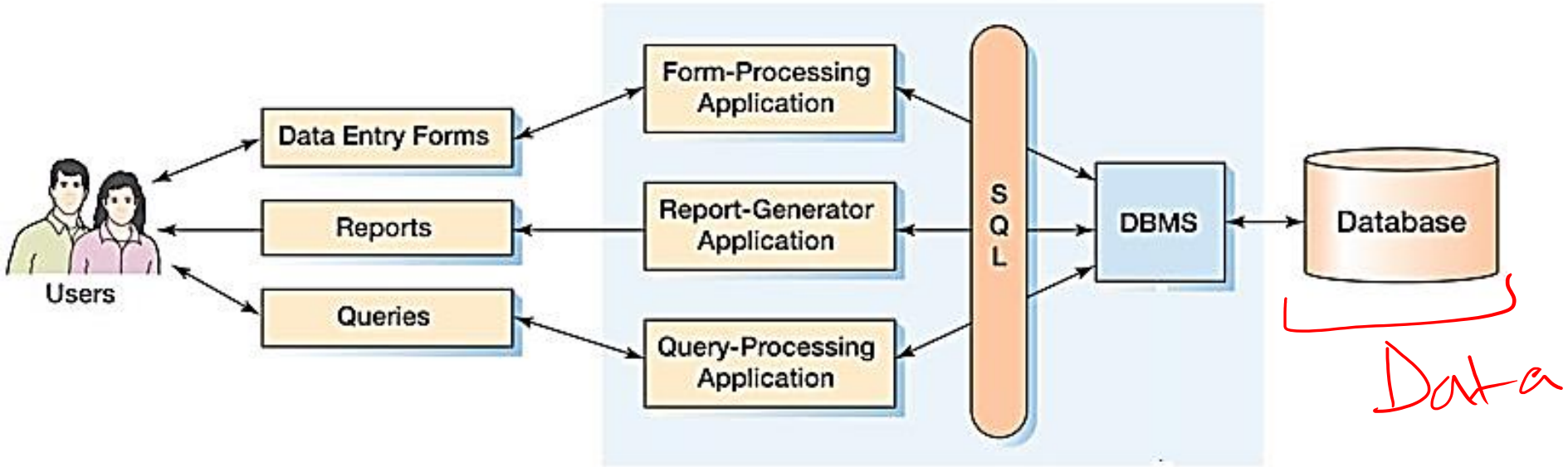
Introduction to DBMS Components & Architecture

DBMS Components & Architecture

- Interaction of users with DBMS
- ANSI Spark three level architecture
- Multi user DBMS Architecture
- Teleprocessing
- DBMS Client-Server Architecture (2-tiers)
- DBMS Client-Server Architecture (3-tiers)
- Alternate Client-Server Architectures
- Paradigm of Database System

Introduction to DBMS Components & Architecture

Interaction of users with DBMS



Form Processing & Report Processing Applications are build by using VB, DOT Net or PHP programming. Reports can be developed by using Crystal Reports tool. Query Processing can be managed by using vendors SQL tool or 3rd party tools such As TOAD, SQL Developer etc.

Introduction to DBMS Components & Architecture

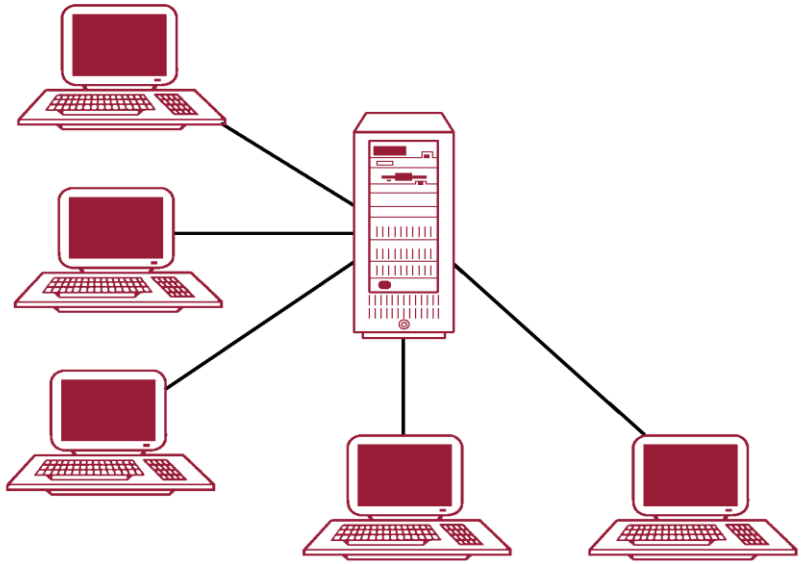
Multi user DBMS Architecture

- Teleprocessing
- File-Server
- Client-Server (2-tiers, 3 tiers)

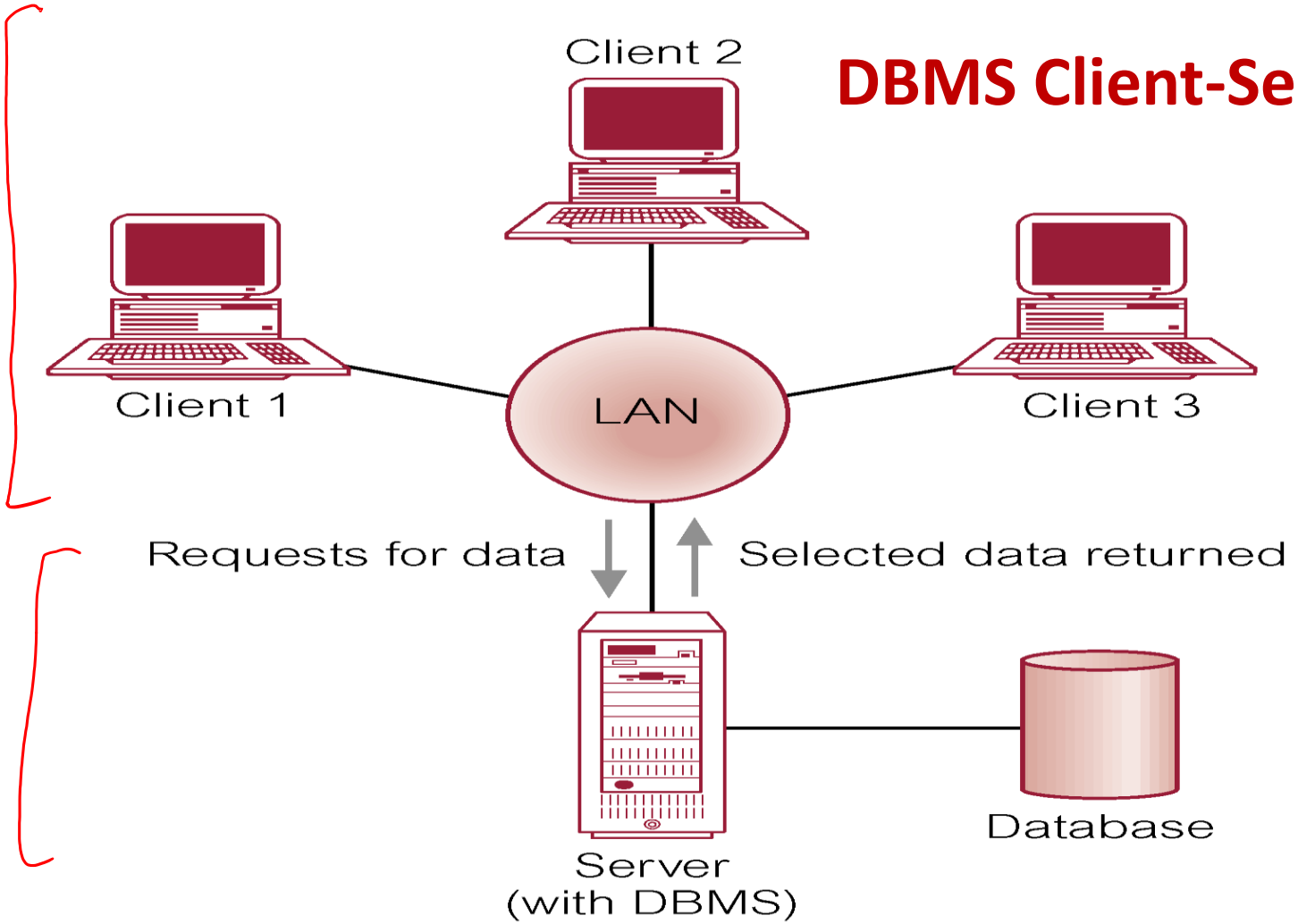
Introduction to DBMS Components & Architecture

Teleprocessing

- Traditional architecture
- Single mainframe with a number of terminals attached
- Trend is now towards downsizing



Introduction to DBMS Components & Architecture

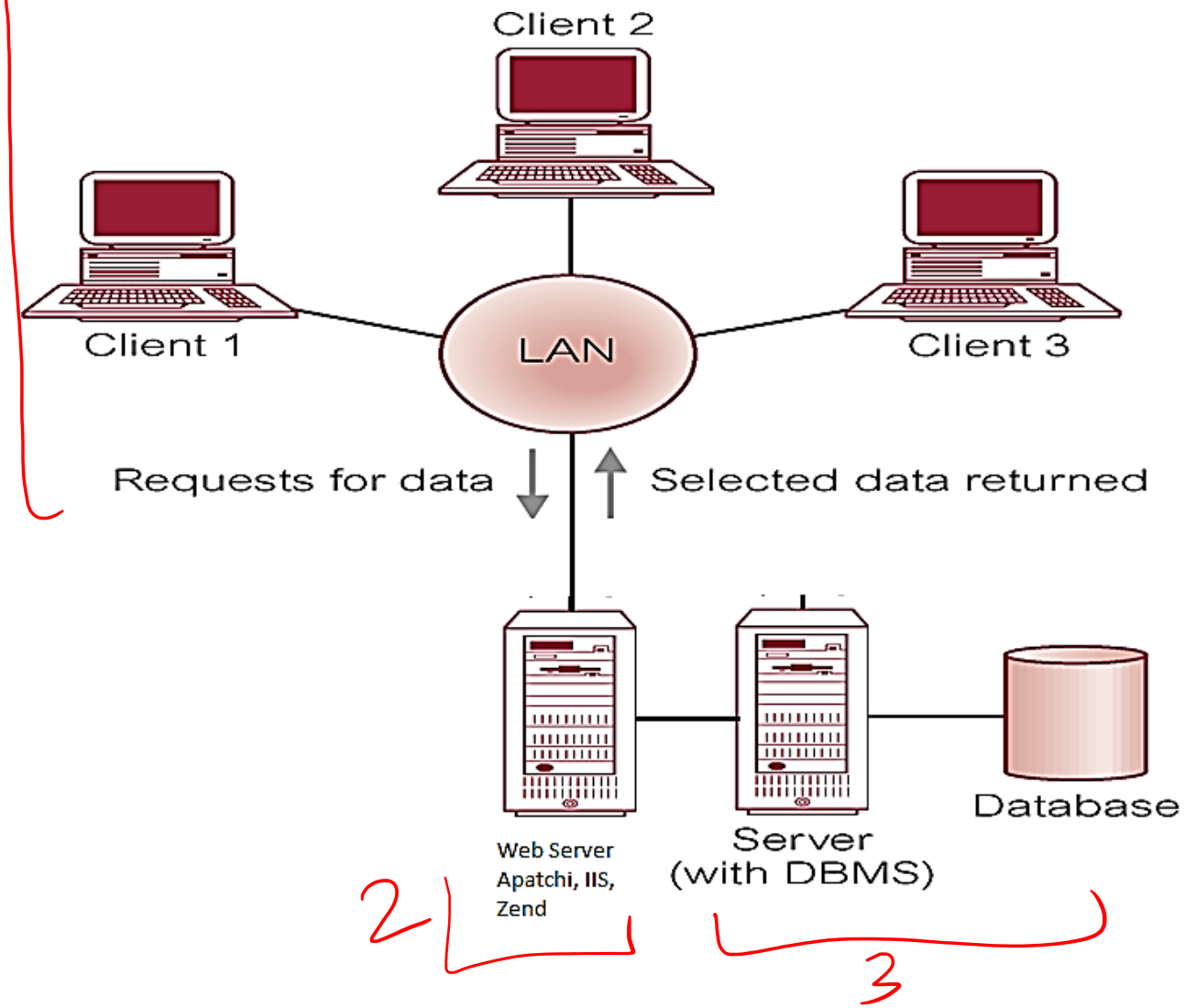


DBMS Client-Server Architecture (2-tiers)

DB Connections can be managed by ODBC, JDBC

Introduction to DBMS Components & Architecture

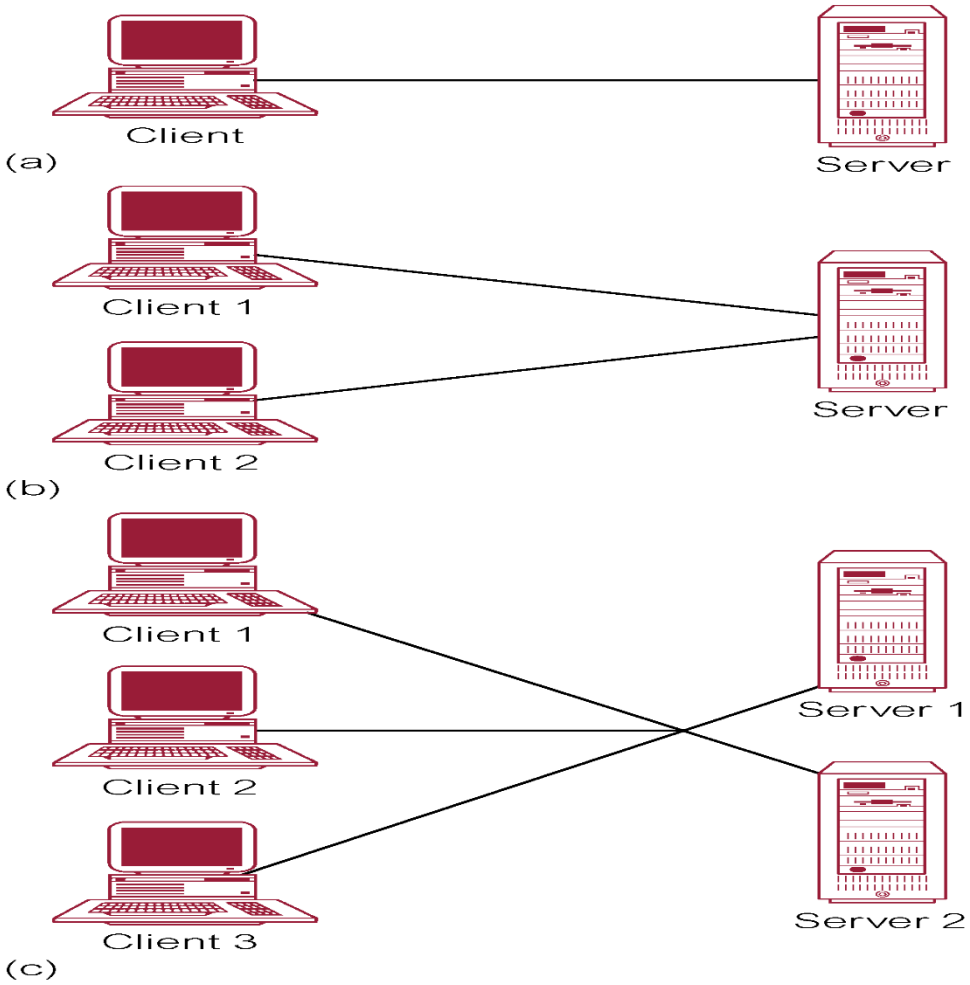
DBMS Client-Server Architecture (3-tiers)



DB Connections can be managed by using MS ODBC, JDBC

Introduction to DBMS Components & Architecture

Alternate Client-Server Architectures



Introduction to DBMS Components & Architecture

Paradigm of Database System

- Logical/ Conceptual Database Design
  - How should the transactional data be modeled (OLTP)?
  - Designing the data warehouse schema (OLAP)
- Query Processing
  - Analysis queries are hard to answer efficiently
  - What techniques are available to the DBMS?

Introduction to DBMS Components & Architecture

Paradigm of Database System

- Physical Database Design (DBA)
  - How should the data be organized on disk?
  - What data structures should be used?
- Data Mining
  - What use is all this data?
  - Which questions should we ask our data warehouse OLAP?
- Data Science/Big Data

END

Introduction to Database Administration

Introduction to Three Levels ANSI SPARC Architecture

Introduction to DBMS Three Levels Architecture

DBMS Three Levels Architecture

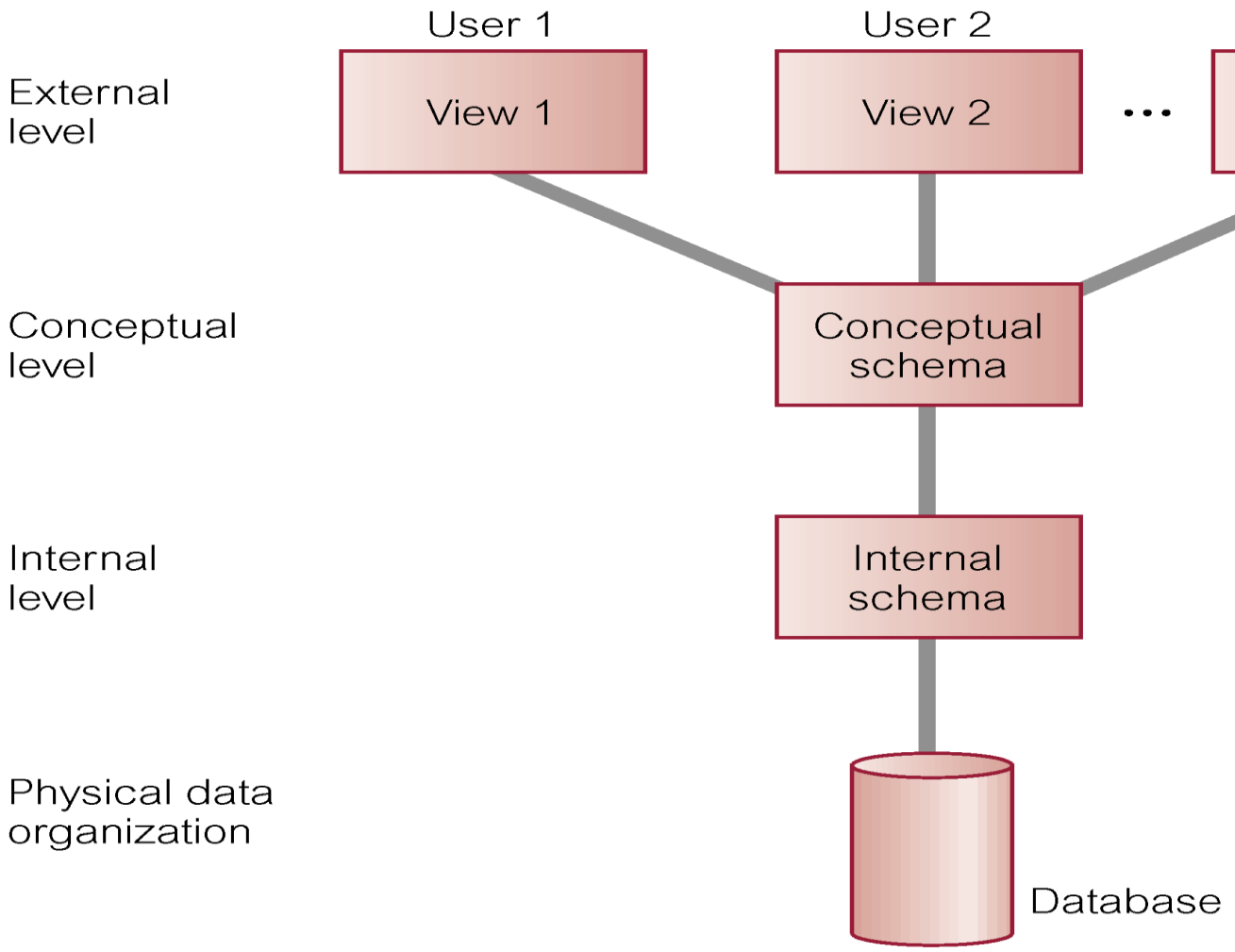
- DBMS Three Levels Architecture
- ANSI-SPARC Three-Level Architecture
- Data Independence
- Degrees of Data Abstraction
- Schema & Instance
- Schema Objects
- Database State

Introduction to DBMS Three Levels Architecture

DBMS Three Levels Architecture

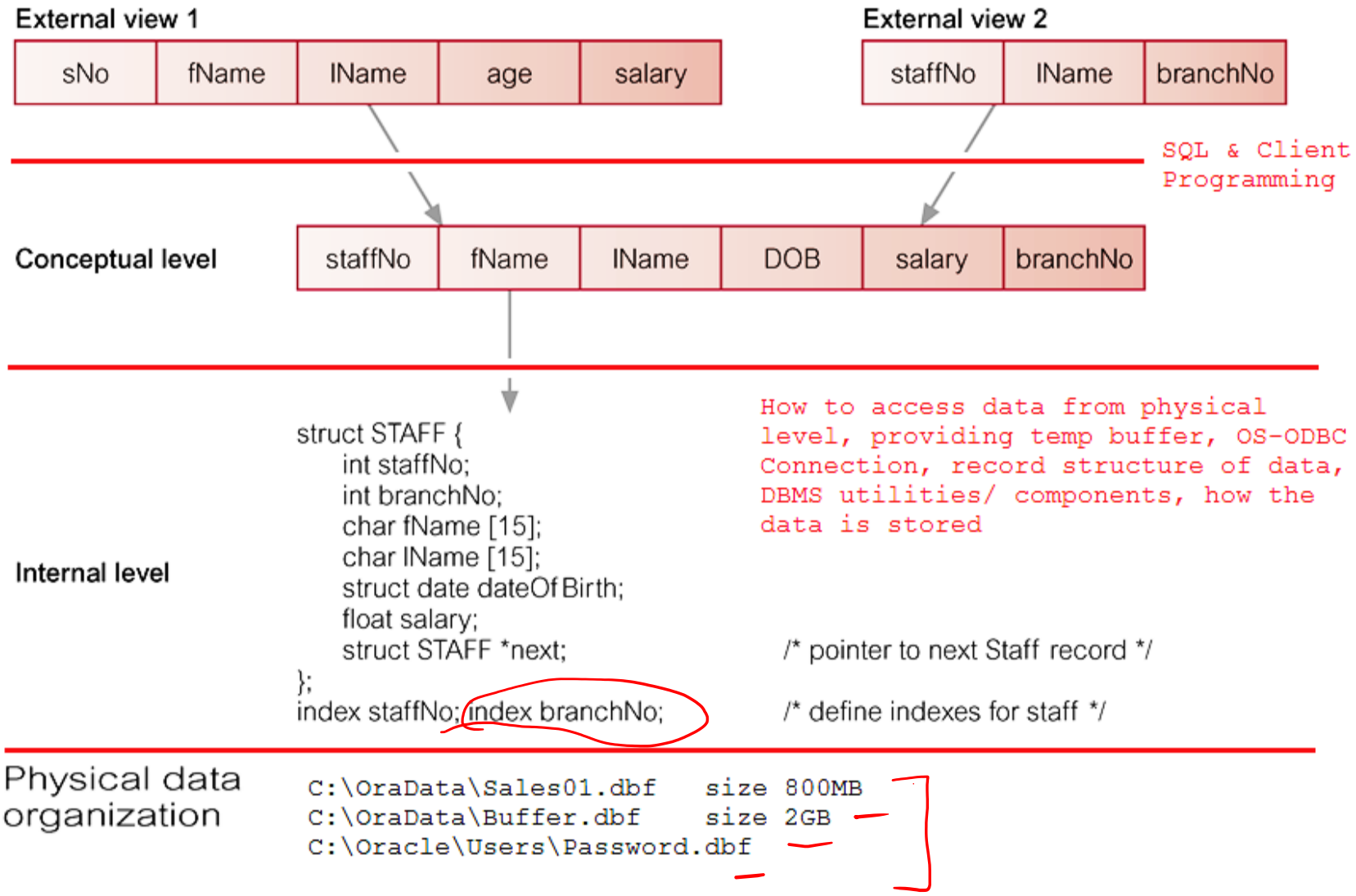
- **External Level**
  - User's view of the database
  - Describes that part of database that is relevant to a particular user
- **Conceptual Level**
  - Community view of the database
  - Describes what data is stored in database and relationships among the data
- **Internal Level**
  - Physical representation of the database on the computer
  - Describes how the data is stored in the database

Introduction to DBMS Three Levels Architecture



ANSI-SPARC Three-Level Architecture

Introduction to DBMS Three Levels Architecture



ANSI-SPARC Three-Levels Architecture

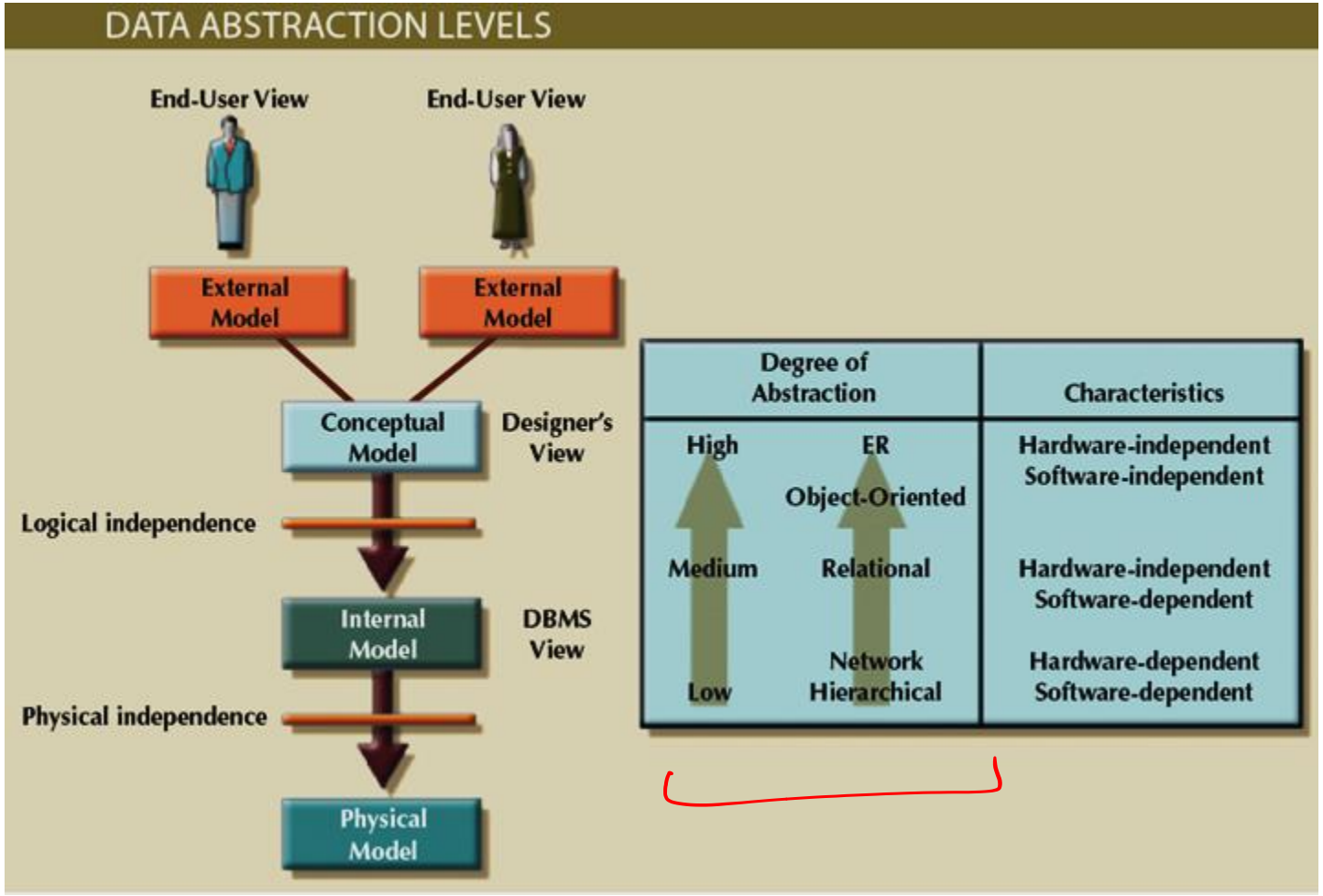
Introduction to DBMS Three Levels Architecture

Data Independence

- Logical Data Independence
  - Refers to immunity of external schemas to changes in conceptual schema
  - Conceptual schema changes (e.g. addition/removal of entities)
  - Should not required changes to external schema or rewrites of application programs

Introduction to DBMS Three Levels Architecture

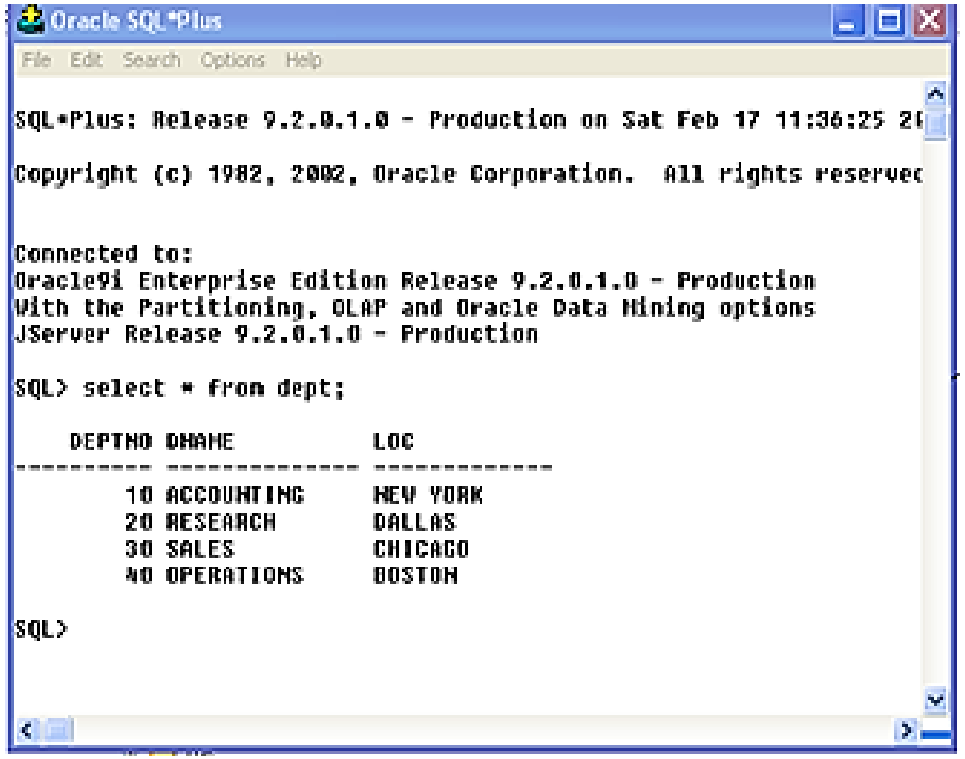
Degrees of Data Abstraction



Introduction to DBMS Three Levels Architecture

- Similar to types and variables in programming languages
- Schema – the logical structure of the database
  - E.g., the database consists of information about a set of customers and accounts and the relationship between them
  - Analogues to type information of a variable in a program
  - **Physical schema:** database design at the physical level
  - **Logical schema:** database design at the logical level
  - **Sub-Schema:** there may be several of these at the view level, each a different view of database
- **Instance –** the actual content of the database at a particular point in time
  - Analogous to the value of the variable

Schema & Instance



Introduction to DBMS Three Levels Architecture

Schema Objects

1. Tables
2. Indexes
3. Constraints
4. Sequences
5. Views
6. Clusters
7. Triggers
8. Links

Introduction to DBMS Three Levels Architecture

Schema Objects

9. User Defined
10. Types
11. Synonym
12. Dimensions
13. Procedural Program codes in PL/SQL, Java, C etc.

Introduction to DBMS Three Levels Architecture

Database State

STUDENT	Name	StudentNumber	Class	Major
	Smith	17	1	CS
	Brown	8	2	CS

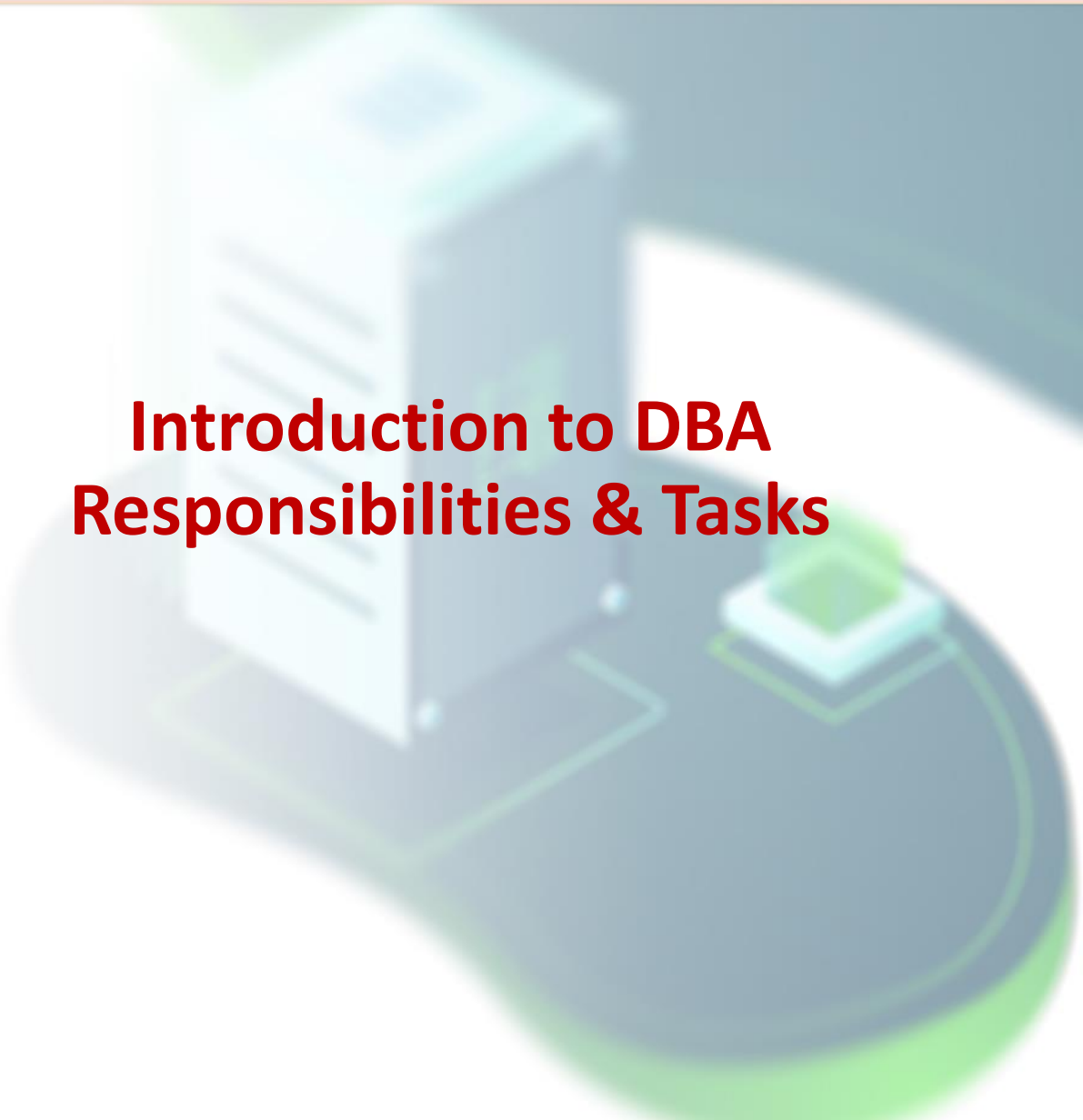
COURSE	CourseName	CourseNumber	CreditHours	Department
	Intro to Computer Science	CS1310	4	CS
	Data Structures	CS3320	4	CS
	Discrete Mathematics	MATH2410	3	MATH
	Database	CS3380	3	CS

SECTION	SectionIdentifier	CourseNumber	Semester	Year	Instructor
	85	MATH2410	Fall	98	King
	92	CS1310	Fall	98	Anderson
	102	CS3320	Spring	99	Knuth
	112	MATH2410	Fall	99	Chang
	119	CS1310	Fall	99	Anderson
	135	CS3380	Fall	99	Stone

GRADE_REPORT	StudentNumber	SectionIdentifier	Grade
	17	112	B
	17	119	C
	8	85	A
	8	92	A
	8	102	B
	8	135	A

PREREQUISITE	CourseNumber	PrerequisiteNumber
	CS3380	CS3320
	CS3380	MATH2410
	CS3320	CS1310

Introduction to Database Administration



Introduction to DBA Responsibilities & Tasks

Introduction to DBA Responsibilities & Tasks

DBA Roles and Responsibilities

- Who is DBA?
- DBA & Databases
- Network Administrator
- Application Developers
- DBA's Tasks
- DBA's Responsibilities

Introduction to DBA Responsibilities & Tasks

Who is DBA?

- A Database Administrator (DBA) is a person or a group of person who are responsible for managing all the activities related to database system.
- DBA job requires a high level of expertise by a person or group of persons.
- There are very rare chances that only a single person can manage all the database system activities so companies always have a group of people who take care of database system.

Introduction to DBA Responsibilities & Tasks

DBA & Databases

- Each database requires at least one database administrator (DBA).
- A Database system can be large and can have many users.
- A database administration is sometimes not a one-person job, but a job for a group of DBAs who share responsibility.

Introduction to DBA Responsibilities & Tasks

Network Administrator

- Network administrator coordinates with the DBA for database connections and other issues such as storage, OS and hardware.
- Some sites have one or more network administrators. A network administrator, for example, administers Oracle networking products, such as Oracle Net Services.

Introduction to DBA Responsibilities & Tasks

Application Developers

- Designing and developing the database application
- Designing the database structure for an application
- Estimating storage requirements for an application
- Specifying modifications of the database structure for an application

Introduction to DBA Responsibilities & Tasks

Application Developers

- Relaying this information to a database administrator
- Tuning the application during development
- Establishing security measures for an application during development
- Database Server Programming using Oracle PL/SQL

Introduction to DBA Responsibilities & Tasks

DBA's Tasks

Task 1: Evaluate the Database Server Hardware

Task 2: Install the Oracle Database Software

Task 3: Plan the Database

Task 4: Create and Open the Database

Task 5: Back Up the Database

Task 6: Enroll System Users

Task 7: Implement the Database Design

Introduction to DBA Responsibilities & Tasks

DBA's Tasks

Task 8: Back Up the Fully Functional Database

Task 9: Tune Database Performance

Task 10: Download and Install Patches

Task 11: Roll Out to Additional Hosts

Introduction to DBA Responsibilities & Tasks

DBA's Responsibilities

- Installing and upgrading the Oracle Database server and application tools
- Allocating system storage and planning future storage requirements for the database system
- Creating primary database storage structures (tablespaces) after application developers have designed an application

Introduction to DBA Responsibilities & Tasks

DBA's Responsibilities

- Creating primary objects (tables, views, indexes) once application developers have designed an application
- Modifying the database structure, as necessary, from information given by application developers

Introduction to DBA Responsibilities & Tasks

DBA's Responsibilities

- Enrolling users and maintaining system security
- Ensuring compliance with Oracle license agreements
- Controlling and monitoring user access to the database
- Monitoring and optimizing the performance of the database

Introduction to DBA Responsibilities & Tasks

DBA's Responsibilities

- Planning for backup and recovery of database information
- Maintaining archived data on tape
- Backing up and restoring the database
- Contacting Oracle for technical support

END

Overview of Physical Database Design

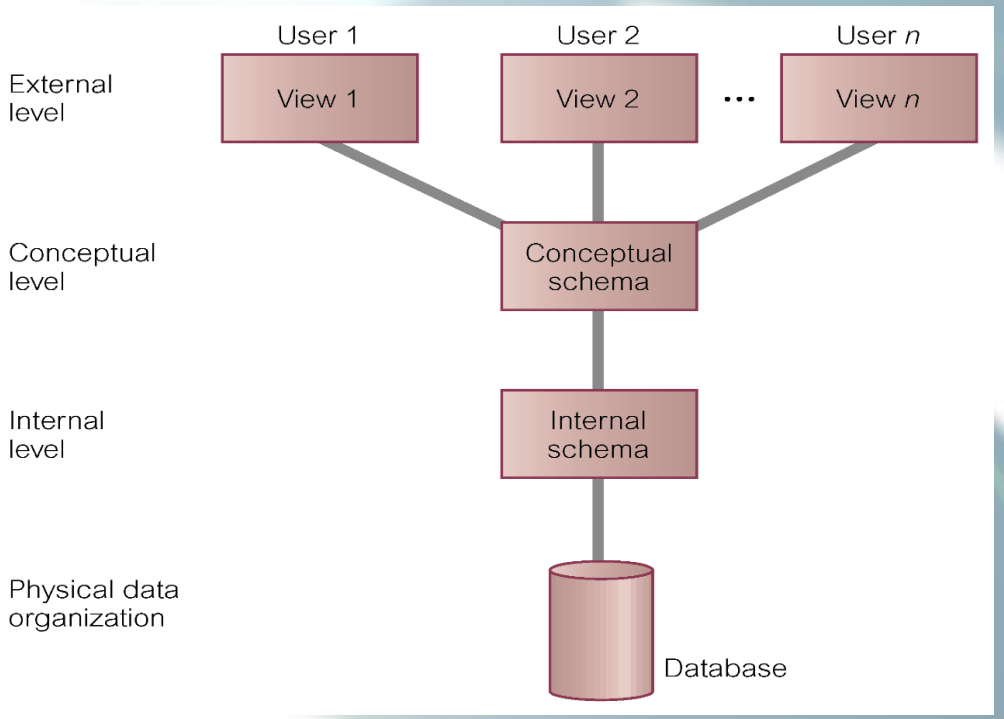
Overview of Physical Database Design

Physical Database Design

- Physical level in ANSI SPARC Arch.
- Purposes of Physical Database Design
- Factors that influence Physical Database Design
- Design decisions about Indexing
- Performance & Tuning
- Tuning Indexes

Overview of Physical Database Design

Physical Level in ANSI SPARC Architecture



Ref. DBA-4 (4)

Overview of Physical Database Design

Purposes

Meeting the expectations of Database Designer for the database, following are two main purposes of Physical Database Design for a DBA.

- Managing Storage Structure for database or DBMS
- Performance & Tuning

Overview of Physical Database Design

Factor (A): Analyzing the database queries and transactions

For each query, the following information is needed.

- The files that will be accessed by the query
- The attributes on which any selection conditions for the query are specified;
- The attributes on which any join conditions or conditions to link multiple tables or objects for the query are specified
- The attributes whose values will be retrieved by the query.

Overview of Physical Database Design

Factor (A): Analyzing the database queries and transactions

For each **update** transaction or operation, the following information is needed.

- The files that will be updated;
- The type of operation on each file (insert, update or delete);
- The attributes on which selection conditions for a delete or update operation are specified;
- The attributes whose values will be changed by an update operation.

Overview of Physical Database Design

Factor (B): Frequency with Queries and Transactions

- The expected frequency information, along with the attribute information collected on each query and transaction, is used to compile a cumulative list of expected frequency of use for all the queries and transactions.
- It is expressed as the expected frequency of using each attribute in each file as a selection attribute or join attribute, over all the queries and transactions.

Overview of Physical Database Design

Factor (C): Time constraints of queries & transactions

- Performance constraints place further priorities on the attributes that are candidates for access paths.

- The selection attributes used by queries and transactions with time constraints become higher-priority candidates for primary access structure.

Overview of Physical Database Design

Factor (D): Expected frequencies of update operations

A minimum number of **access paths** should be specified for a file that is updated frequently.

Overview of Physical Database Design

Factor (E): Uniqueness constraints on attributes

Access paths should be specified on all candidate key attributes

or set of attributes

that are either the primary key or constrained to be unique.

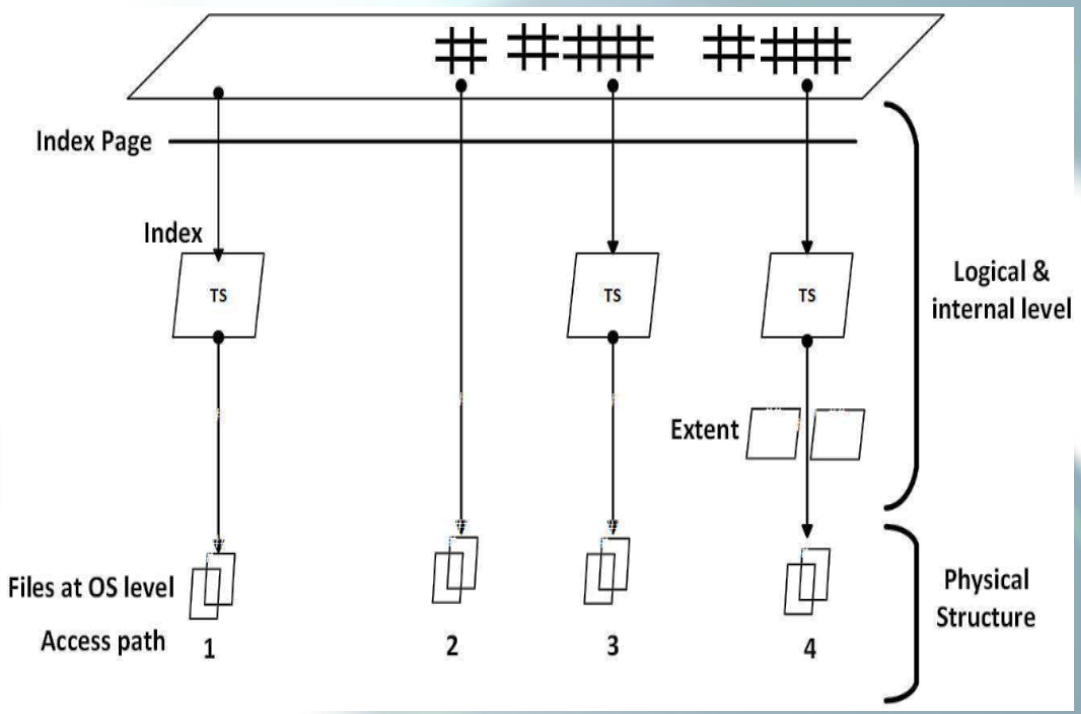
Overview of Physical Database Design

Design Decisions About Indexing

1. Whether to index an attribute?
2. What attribute or attributes to index on?
3. Whether to set up a clustered index?
4. Whether to use a hash index over a tree index?
5. Whether to use dynamic hashing for the file?

Overview of Physical Database Design

Access Path & Storage



END

Introduction to Database Tuning

Introduction to Database Tuning

Database Tuning

- Tuning & goals
- Tuning indexes
- Overview of database tuning
- Problems in tuning
- Dynamically changes processing requirements
- Changes in Database Design
- Tuning queries

Introduction to Database Tuning

Tuning & Goals

Tuning:

- The process of continuing to revise/adjust the physical database design by monitoring resource utilization as well as internal DBMS processing to reveal bottlenecks such as contention for the same data or devices.

Introduction to Database Tuning

Tuning & Goals

Goal:

- To make application run faster
- To lower the response time of queries/ transactions
- To improve the overall throughput of transactions

Introduction to Database Tuning

Tuning Indexes

Reasons to tuning indexes

- Certain queries may take too long to run for lack of an index;
- Certain indexes may not get utilized at all;
- Certain indexes may be causing excessive overhead because the index is on an attribute that undergoes frequent changes

Introduction to Database Tuning

Tuning Indexes

Options to tuning indexes

- Drop or/and build new indexes
- Change a non-clustered index to a clustered index (and vice versa)
- Rebuilding the index

Introduction to Database Tuning

Overview of Database Tuning

Statistics obtained from monitoring:

- Storage statistics
- I/O and device performance statistics
- Query/transaction processing statistics
- Locking/logging related statistics
- Index statistics

Introduction to Database Tuning

Overview of Database Tuning

Statistics internally collected in DBMSs:

Size of individual tables

Number of distinct values in a column

The number of times a particular query or transaction is submitted/executed in an interval of time

The times required for different phases of query and transaction processing

Introduction to Database Tuning

Problems in Tuning

- How to avoid excessive lock contention?
- How to minimize overhead of logging and unnecessary dumping of data?
- How to optimize buffer size and scheduling of processes?
- How to allocate resources such as disks, RAM and processes for most efficient utilization?

Introduction to Database Tuning

Dynamically Changed Processing Requirements

Need to be addressed by making changes to the conceptual schema if necessary and to reflect those changes into the logical schema and physical design.

Introduction to Database Tuning

Changes in Database Design

- Existing tables may be joined (de-normalized) because certain attributes from two or more tables are frequently needed together.
- For the given set of tables, there may be alternative design choices, all of which achieve 3NF or BCNF. One may be replaced by the other.

Introduction to Database Tuning

Changes in Database Design

- A relation of the form R(K, A, B, C, D, …) that is in BCNF can be stored into multiple tables that are also in BCNF by replicating the key K in each table.
- Attribute(s) from one table may be repeated in another even though this creates redundancy and potential anomalies.
- Apply **horizontal partitioning** as well as **vertical partitioning** if necessary.

Introduction to Database Tuning

Tuning Queries

- **Indications for tuning queries**
  - A query issues too many disk accesses
  - The query plan shows that relevant indexes are not being used.

Introduction to Database Tuning

Tuning Queries

- **Typical instances for query tuning**
  1. Many query optimizers do not use indexes in the presence of arithmetic expressions, numerical comparisons of attributes of different sizes and precision, NULL comparisons, and sub-string comparisons.
  2. Indexes are often not used for nested queries using IN;

Introduction to Database Tuning

Tuning Queries

3. Some *DISTINCT*s may be redundant and can be avoided without changing the result.
4. Unnecessary use of temporary result tables can be avoided by collapsing multiple queries into a single query unless the temporary relation is needed for some intermediate processing.
5. If multiple options for join condition are possible, choose one that uses a clustering index and avoid those that contain string comparisons.

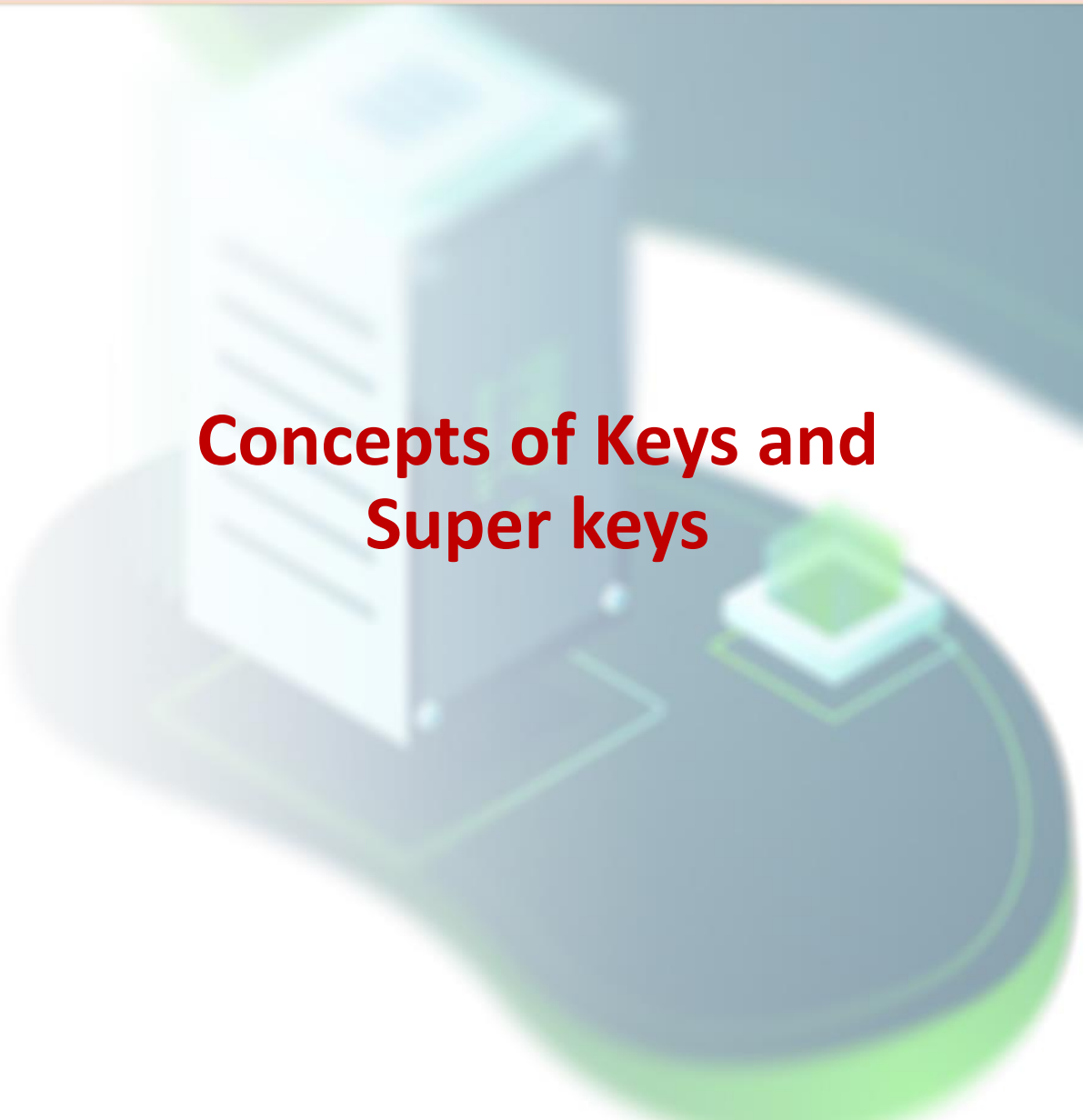
Introduction to Database Tuning

END

Tuning Queries

6. In some situations involving using of correlated queries, temporaries are useful.
7. The order of tables in the *FROM* clause may affect the join processing.
8. Some query optimizers perform worse on nested queries compared to their equivalent un-nested counterparts.
9. Many applications are based on views that define the data of interest to those applications. Sometimes these views become an overkill.

Introduction to Database Administration



Concepts of Keys and Super keys

Concepts of Keys & Super Keys

Keys & Super Keys

- Concepts of Keys
- Super Keys
- Example – 1
- Example – 2

Concepts of Keys & Super Keys

Concepts of Keys

- A **key** is a combination of one or more columns that is used to identify rows in a relation

- A **composite key** is a key that consists of two or more columns

Concepts of Keys & Super Keys

Super Keys

- A super key is a combination of columns that uniquely identifies any row within a relational database management system (RDBMS) table.

Roll#	FirstName	LastName	Address	City	NIC#	Deptno
...						
12i-2565	...					CS
	Ali					CS
	Ali					EE
...						

{Roll#}, {Roll#, NIC#}, {NIC#}, {Roll#, FirstName, LastName}
{Roll#, FirstName, LastName, Address, City, NIC#, Deptno}

Concepts of Keys & Super Keys

Super Keys Example - 1

Roll Number	First Name	Last Name
CSU0001	Shabbir	Bhimani
CSU0002	Jain	Rao
CSU0003	Nitin	Uday

Now we have the following as super keys

Roll Number	First Name	
Roll Number	**First Name**	**Last Name**

Concepts of Keys & Super Keys

Super Keys Example - 2

Following table consists of four columns

EmployeeID, Name, Job, DeptID

- Examples of superkeys in this table would be {employeeID, Name}, {employeeID, Name, job}, and
  {employeeID, Name, job, departmentID}

- In a real database we don't need values for all of those columns to identify a row

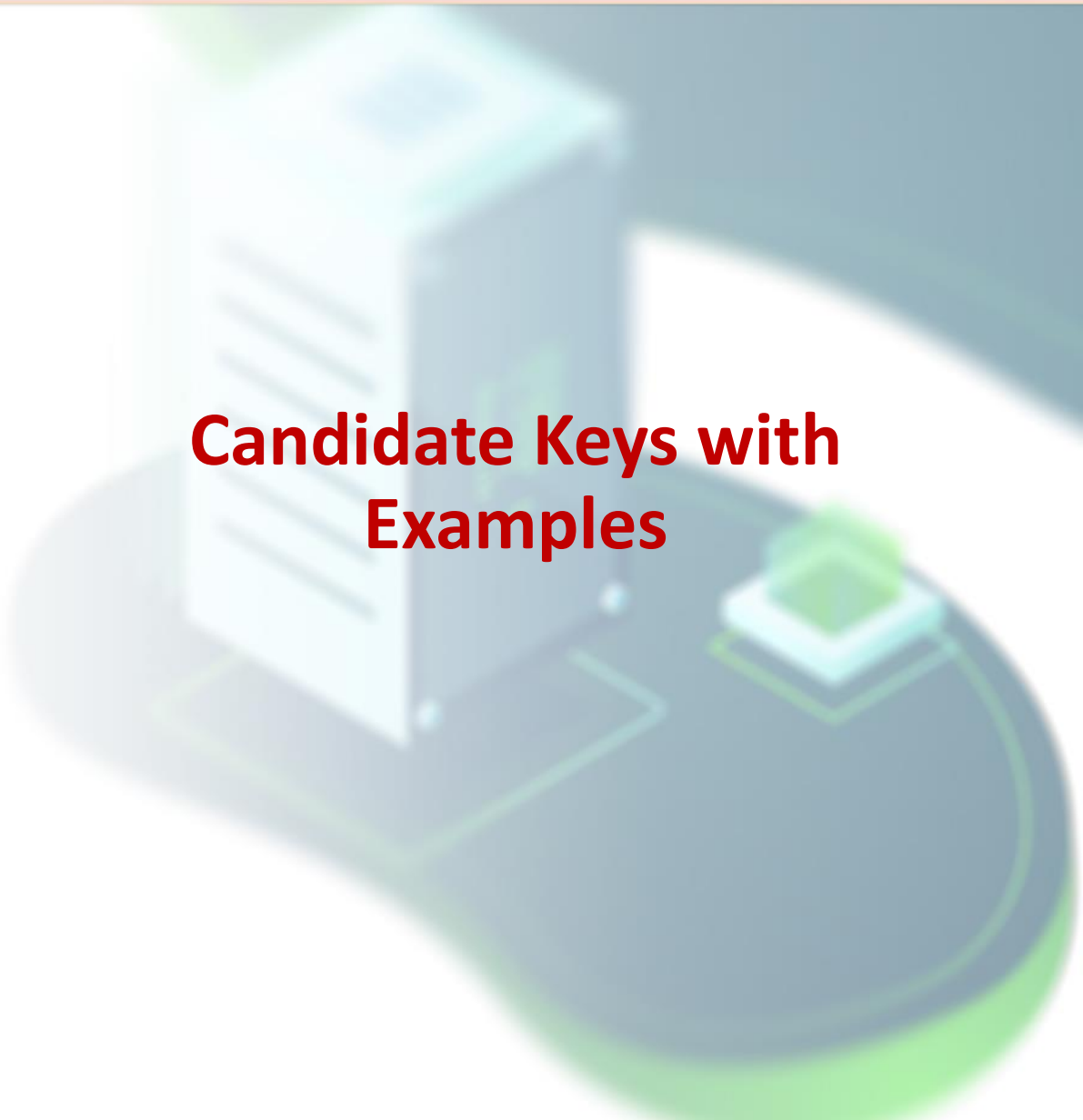
Concepts of Keys & Super Keys

Super Keys Example - 2

- We only need, per our example, the set {EmployeeID}.
  - This is a minimal superkey
  - So, employeeID is a candidate key.
  - EmployeeID can also uniquely identify the tuples.

END

Introduction to Database Administration



Candidate Keys with Examples

Candidate Keys with Examples

Candidate Keys

- Candidate Key Definition
- Example (Invoice)
- Example (Bank, PTCL, NADRA)

Candidate Keys with Examples

Candidate Key Definition

- A **candidate key** is a key that determines all of the other columns in a relation
- Candidate key columns help in searching fewer duplicated or unique records.
- Examples

In PRODUCT relation

Prod# is a candidate key

Prod_Name is also a candidate key

In ORDER_PROD

(OrderNumber, Prod#) is a candidate key

(Candidate key can be called as Alternate Key)

Candidate Keys with Examples

Candidate Key Example Invoice (Buying Items)

Items are sold to Customers

Customer should buy Items with Invoice

Same items can be sold on many invoices

Invoice# and Item# will identifying exact record, what other columns are required

If some one tells you inv# and Qty, can you find exact product

Candidate Keys with Examples

END

Candidate Key Examples

For a Bank as an Enterpise: AccountHolder (or Customer)

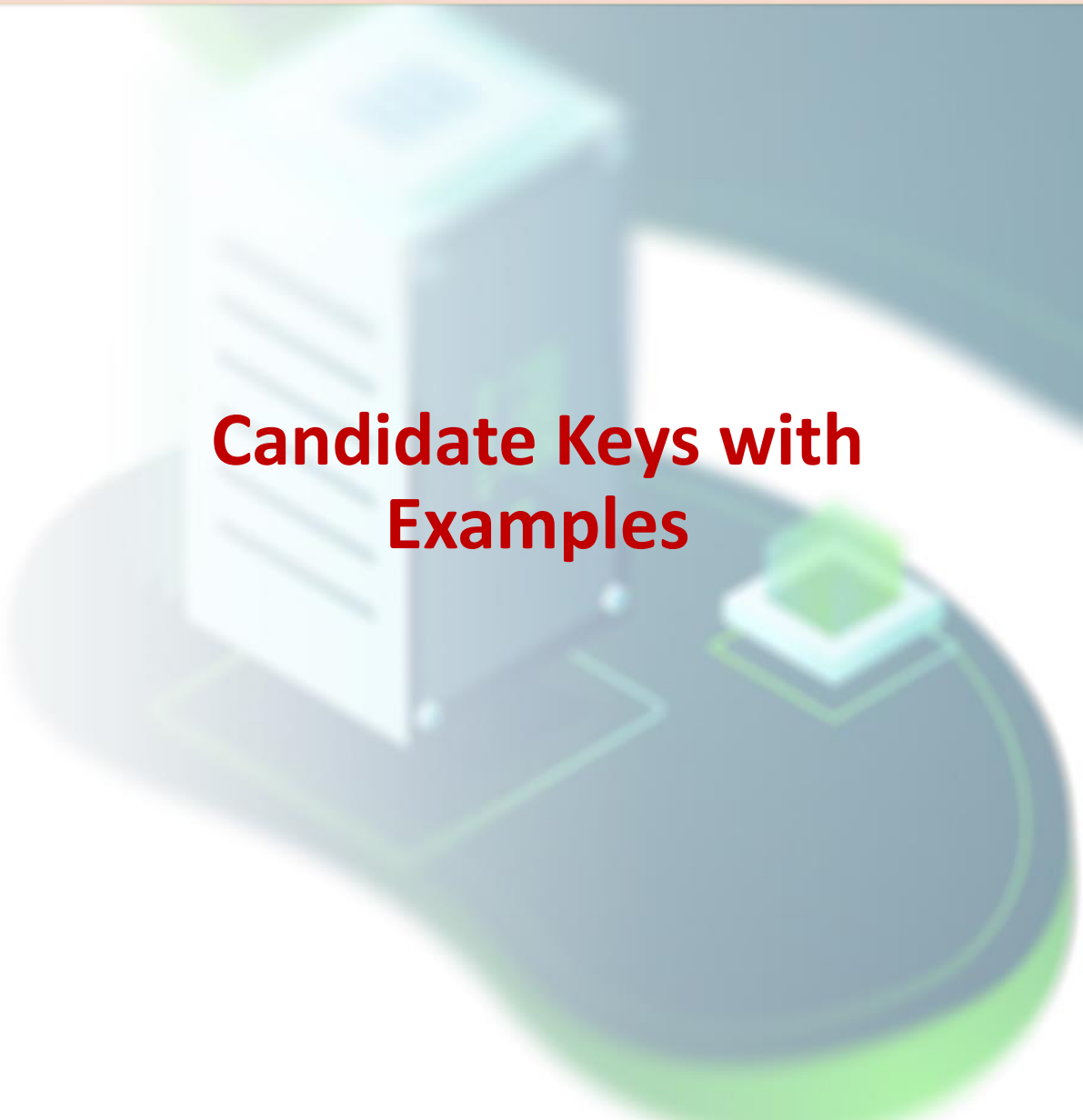
ACC#, Fname, Lname, DOB, CNIC#, Addr, City, TelNo, Mobile#, DriveLic#

For PTCL: Customer (single telno holders)

Consumer#, Fname, Lname, DOB, CNIC#, Addr, City, TelNo, Mobile#

For NADRA: Citizen (CNIC#, Fname, Lname, FatherName, DOB, OldCNIC#, PAddr, PCity, TAddr, TCity, TelNo, Mobile#)

Introduction to Database Administration



Candidate Keys with Examples

Candidate Keys with Examples

Candidate Keys Continued

- Candidate Key examples
- Exercises
- Candidate key for search purpose

Candidate Keys with Examples

Candidate Key Examples

Example-1: Branch (branch-name, assets, branch-city)

Candidate Key: {branch-name}

Example-2: Customer (cname, natid, address, city, telno)

cname, address, city can be duplicated individually and cannot determine a record.

Candidate Keys with Examples

Candidate Key Examples

The following combinations distinguish customer records or tuples.

{cname, telno}, {natid}

{natid, cname}

As {natid} $\subseteq$ {natid, cname}, then {natid, cname} is not candidate key and {natid} is a candidate key

Example-3: Employee(empno, name, birth_date, address, city, telno, citizenship_id)

empno, telno, citizenship_id are possible candidate keys

Candidate Keys with Examples

Exercises

Course (cid, cname, deptno)

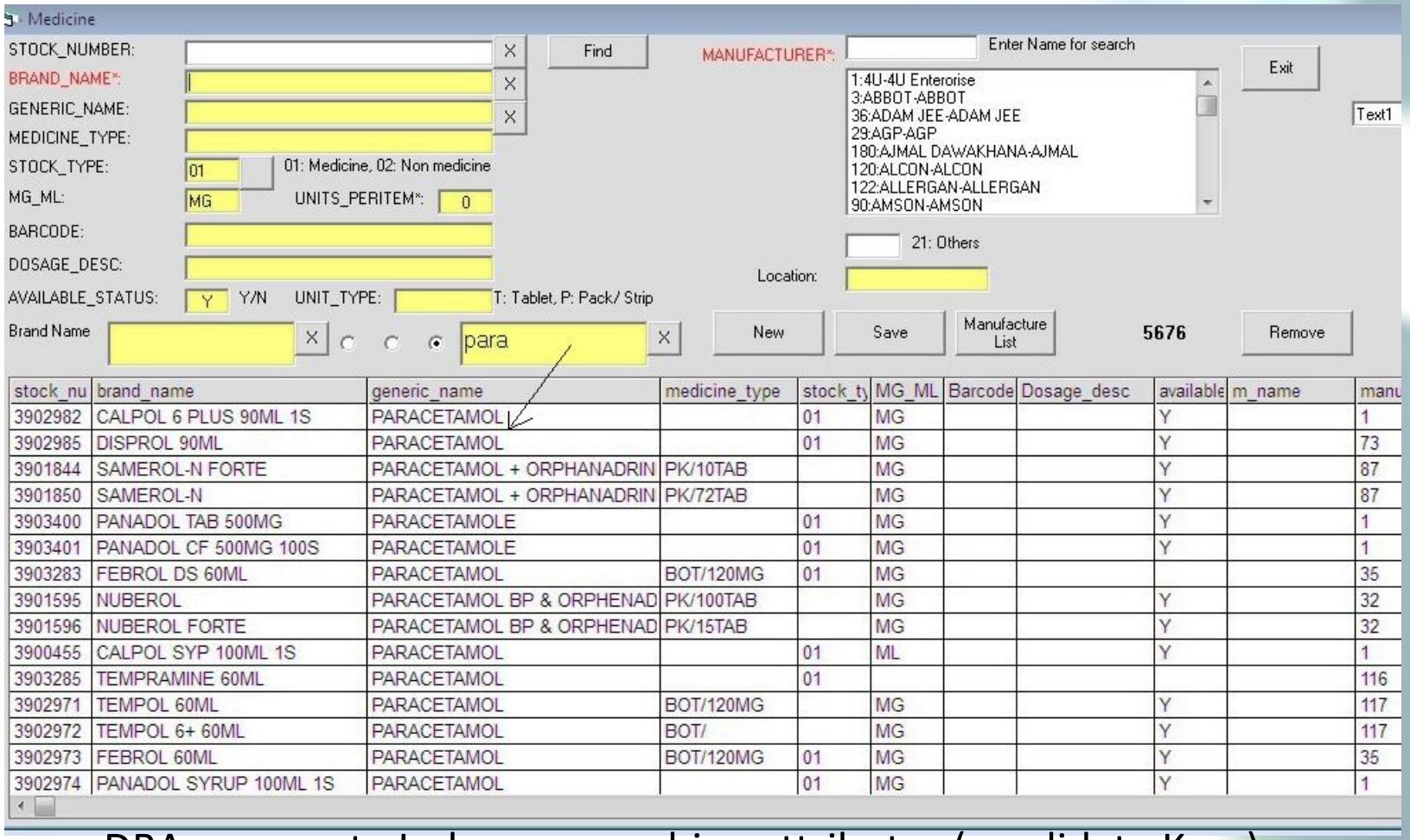
Semester (sid, syear, startdate)

ClassAllocation (sid, cid, sec#, building#, room#)

Identify candidate keys in each of the above relations

Candidate Keys with Examples

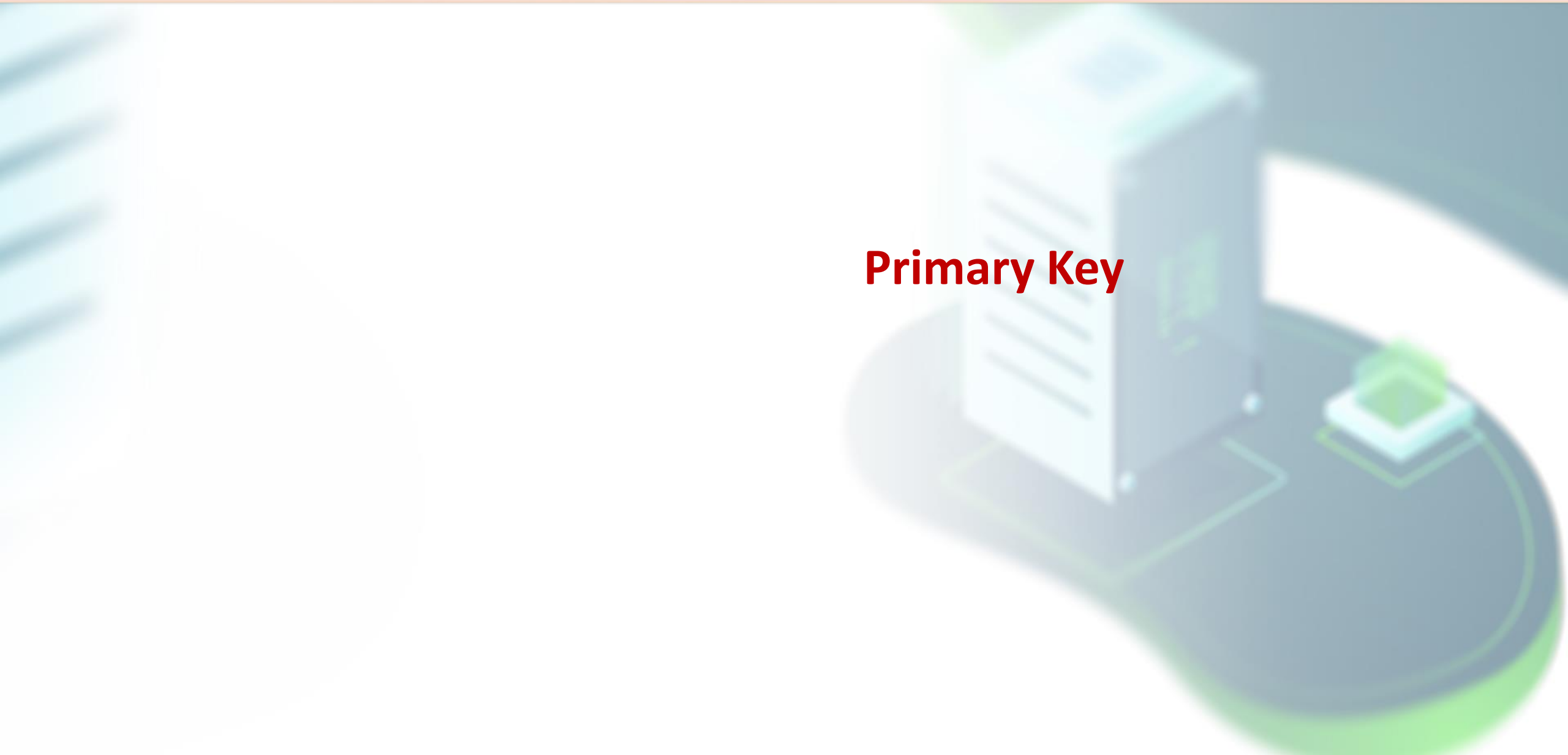
Candidate Key for Search purpose



stock_nu	brand_name	generic_name	medicine_type	stock_ty	MG_ML	Barcode	Dosage_desc	available	m_name	manu
3902982	CALPOL 6 PLUS 90ML 1S	PARACETAMOL		01	MG			Y		1
3902985	DISPROL 90ML	PARACETAMOL		01	MG			Y		73
3901844	SAMEROL-N FORTE	PARACETAMOL + ORPHANADRIN	PK/10TAB		MG			Y		87
3901850	SAMEROL-N	PARACETAMOL + ORPHANADRIN	PK/72TAB		MG			Y		87
3903400	PANADOL TAB 500MG	PARACETAMOLE		01	MG			Y		1
3903401	PANADOL CF 500MG 100S	PARACETAMOLE		01	MG			Y		1
3903283	FEBROL DS 60ML	PARACETAMOL	BOT/120MG	01	MG					35
3901595	NUBEROL	PARACETAMOL BP & ORPHENAD	PK/100TAB		MG			Y		32
3901596	NUBEROL FORTE	PARACETAMOL BP & ORPHENAD	PK/15TAB		MG			Y		32
3900455	CALPOL SYP 100ML 1S	PARACETAMOL		01	ML			Y		1
3903285	TEMPRAMINE 60ML	PARACETAMOL		01						116
3902971	TEMPOL 60ML	PARACETAMOL	BOT/120MG		MG			Y		117
3902972	TEMPOL 6+ 60ML	PARACETAMOL	BOT/		MG			Y		117
3902973	FEBROL 60ML	PARACETAMOL	BOT/120MG	01	MG			Y		35
3902974	PANADOL SYRUP 100ML 1S	PARACETAMOL		01	MG			Y		1

DBA can create Index on searching attributes (candidate Keys)

Introduction to Database Administration



Primary Key

Primary Key

Primary Keys

- Primary key definition
- An alternate definition
- Primary key examples & issues

Primary Key

Primary Key Definition

A **primary key** is a candidate key selected as the primary means of identifying rows in a relation:

- There is one and only one primary key per relation
- The primary key is NOT NULL, UNIQUE
- The ideal primary key is short, numeric(alpha), indexed, fixed length and never changes
- Key that has its ownership of an Enterprise

The primary key may be a composite key

Primary Key

Primary key
An Alternate Definition

A primary key is a minimal identifier that is used to identify tuples uniquely.

This means that no subset of the primary key is sufficient to provide unique identification of tuples.
NULL values is not allowed in primary key attribute.

Primary Key

Primary key - Example & Issues

Example:

- STU_ID

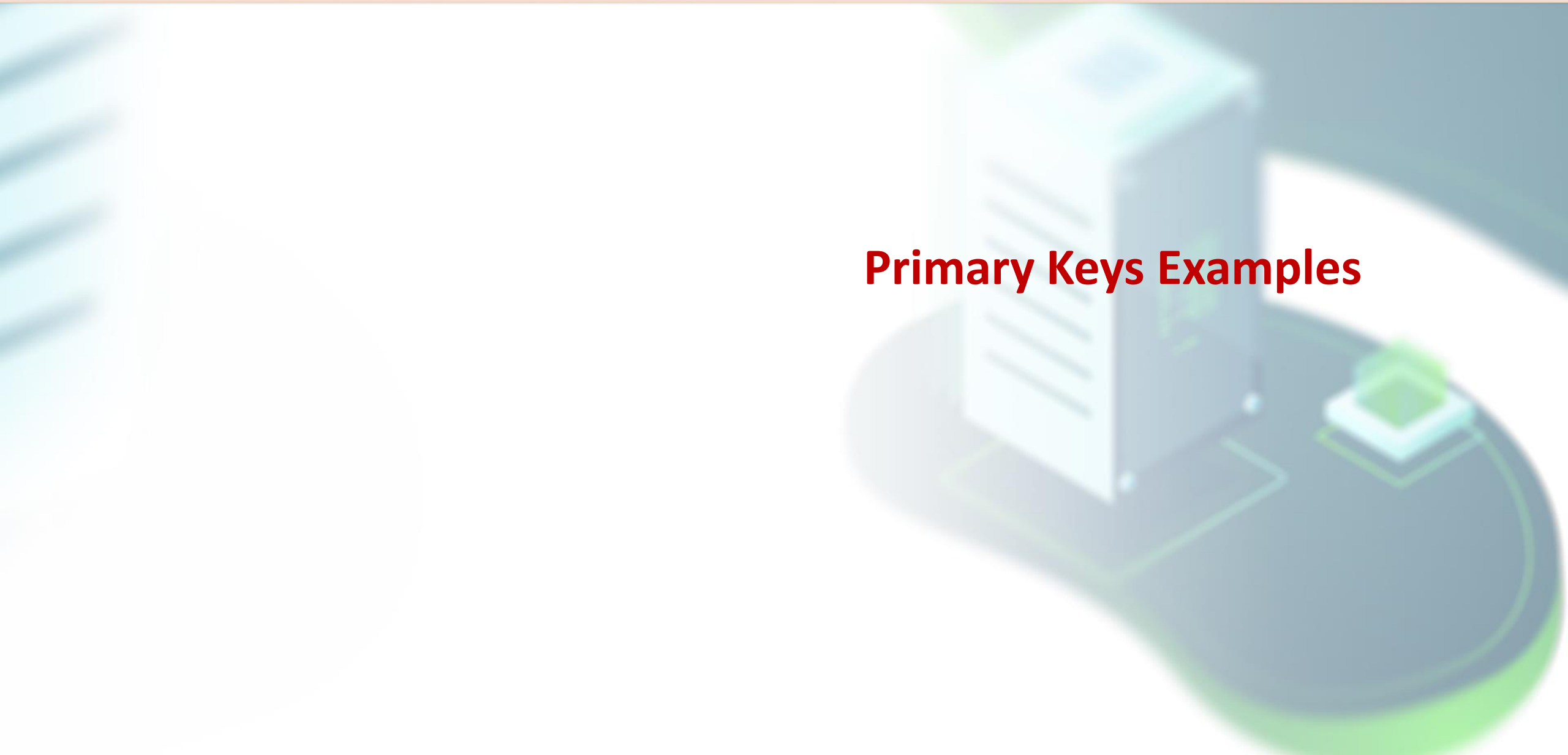
(Practically PK must have UNIQUE, NOT NULL, INDEXED on an attribute)

STUDENT

STU_ID	NAME	CID_ID	DOB	DEPTCODE

Although, candidate keys are STU_ID, CIT_ID. Organization ITSELF issues its own identifier PK. PK is a property of an organization. Driving license# is a property of Ministry of Motors/ transportation, it must not be used PK in university or other organizations. It is a candidate key for other organization for search purposes.

Note: It is not recommended to create PKs for columns like Quantity, Salary, Price and column that has datatype DATE



Primary Keys Examples

Primary Keys Examples

Primary Keys

- Primary Key – student
- Primary Key - More Examples

Primary Keys Examples

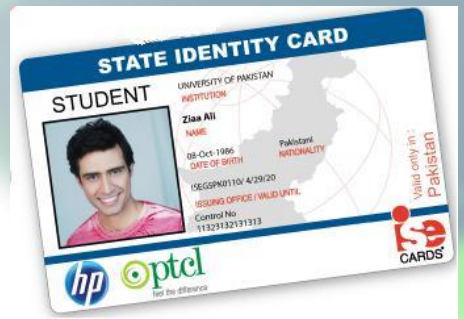
Primary key - Student

Example-1:

STUDENT(StuID, FirstName, FamilyName, DOB, …)

Example-2: Building (B#, BName, Location, Region),

B# is a primary key. Although, BName is unique, not null but it is not short.



Primary Keys Examples

Primary key - More Examples

Example-3: Customer (cname, citizenid, address, city, telno)

This relation indicates the information about personal details. There is a chance that cname is duplicated, some may have citizenid and telno as null. This forces us to introduce new a attribute such as cust# that would be a primary key.

Customer (cust#, cname, citizenid, address, city, telno)

Primary Keys Examples

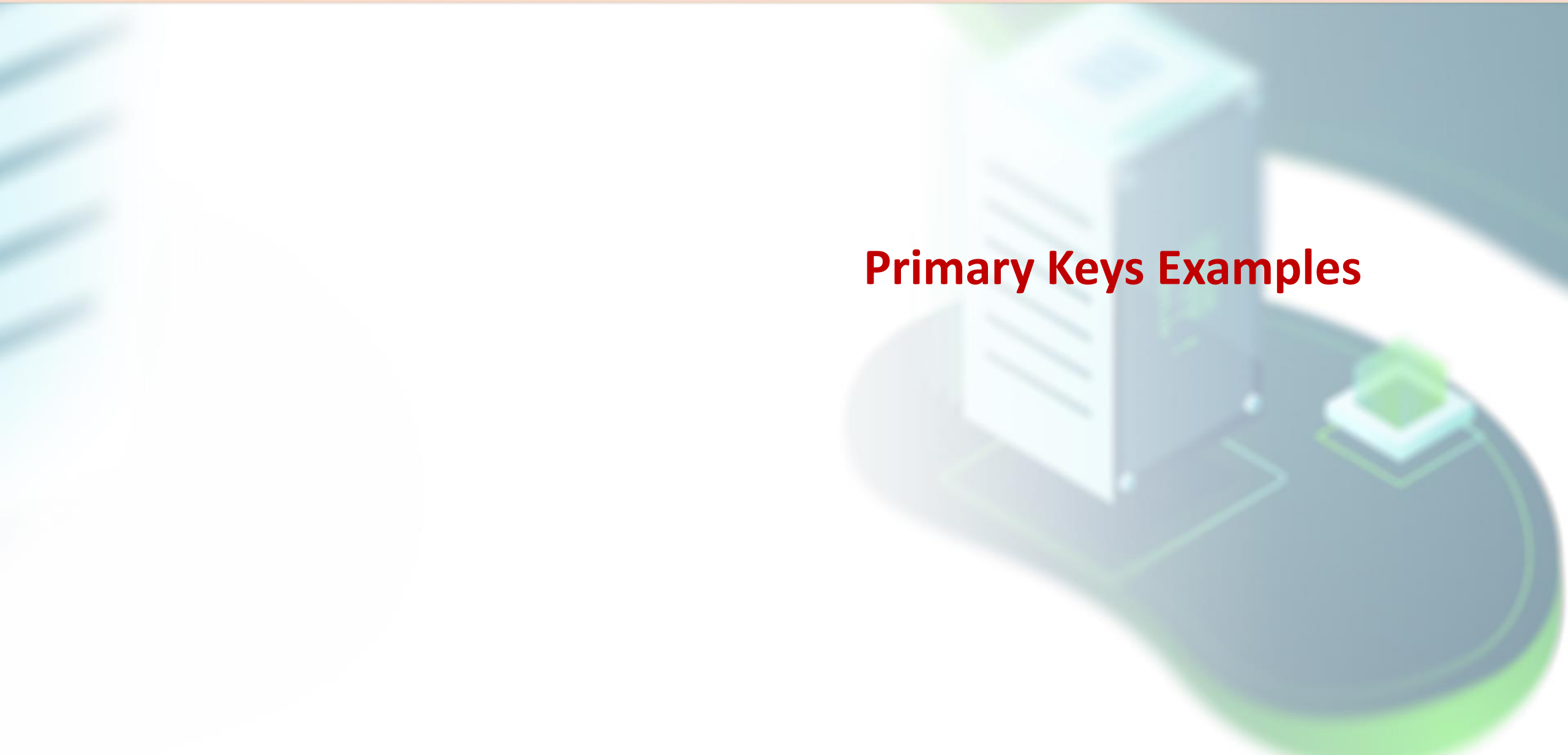
Primary key - More Examples

Example-4:

BankBranch(Branch-Name, City, TotalAsset)

- What will be a PK that you will suggest?
- What is a candidate key?
- Which attribute is unique?
- There may be many branches in one city then finalize this relation with possible constraints

End



Primary Keys Examples

Primary Keys Examples

Primary Keys

- Primary key instances
- Fixed length examples
- Indexing

Primary Keys Examples

Primary key Instances

512235665 Social Security Number

610112654 (By Birth Asian, European, HomeLand)

200338900 Student ID (With Registration year)

LHR051 Product ID (with Manufacturing Loc

31266885 Bank Acc# (followed by Branch Code)

Primary Keys Examples

Primary key Instances

Serial# starts with 1 and incremented by 1

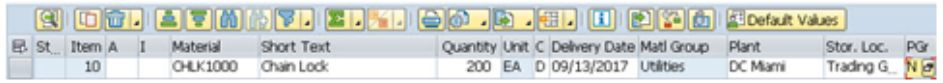
005384 Company has many branch codes
005

007004 invoices issued from branches

Primary Keys Examples

Primary key Fixed Length

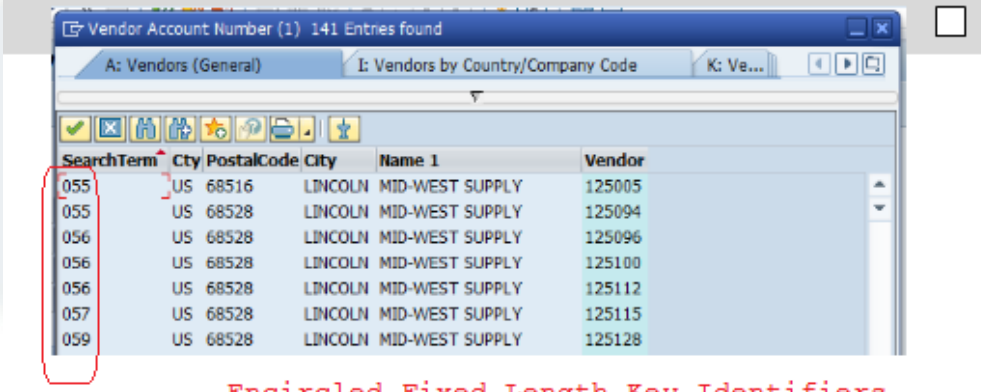
After clicking on compare your screen with the one below.



Then, click on to save your purchase requisition. The system will create a unique document number.

Purchase requisition number 0010000000 created

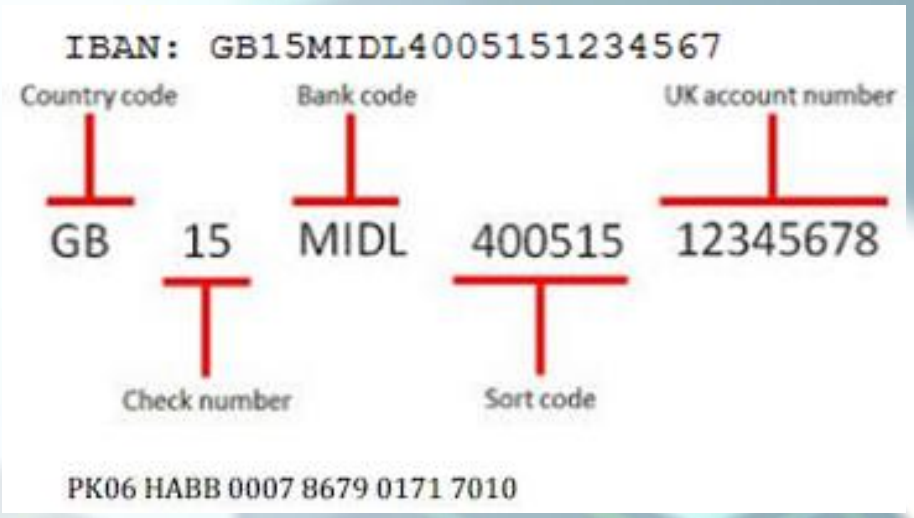
Click on the exit icon to return to the SAP Easy Access screen



Encircled Fixed Length Key Identifiers

Primary Keys Examples

Primary key - Fixed Length



Primary Keys Examples

Primary key - Indexing

```
Table: PATIENT_VISIT
Index: Yes, PK
Test Query execution time:less than 1 second

Table: PATIENT_VISIT1
Index: NO
Test Query execution time:12 seconds

SQL> select count(*) Total_Records
  2  from PATIENT_VISIT;

  Total_Records
---------------
     625721

Elapsed: 00:00:00.04
```

```
SQL> select PATIENT_ID, max(PATIENT_VISITNO)
  2  from PATIENT_VISIT1
  3  where PATIENT_VISITNO = (select max(PATIENT_VISITNO)
  4     from PATIENT_VISIT1
  5     where DEPEND_SNO='0')
  6  group by PATIENT_ID
  7  having count(*)>=1;

PATIENT_ID MAX(PATIENT_VISITNO)
---------- --------------------
9999993                    1316

Elapsed: 00:00:11.54
```

```
  PRIMARY KEY ( PATIENT_ID, DEPEND_SNO, PATIENT_VISITNO )
```

Primary Key Formats

Primary Keys Formats

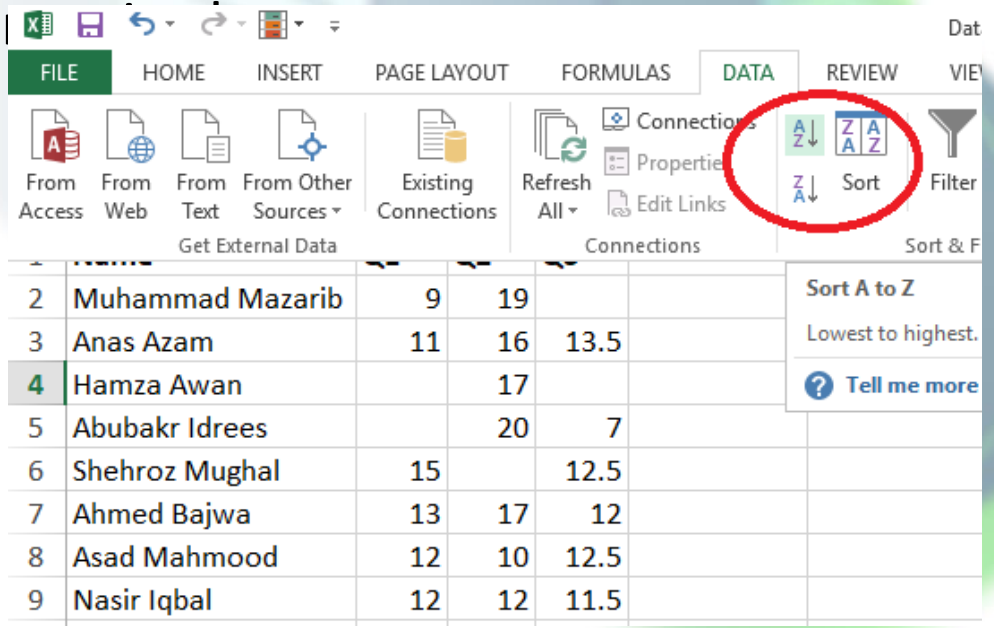
Primary Keys

- Primary key Indexing
- Basics of indexing
- Indexing on DBMS
- Who will decide?

Primary Keys Formats

Basics of Indexing

Paging a key's data to access fast.
It may includes sorting from A to Z or Z to A.
Indexing is applied on non-key columns where mostly search is



Primary Keys Formats

Primary key – Indexing on DBMS

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  4     from PATIENT_VISIT1
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  6  group by PATIENT_ID
  7  having count(*)>=1;

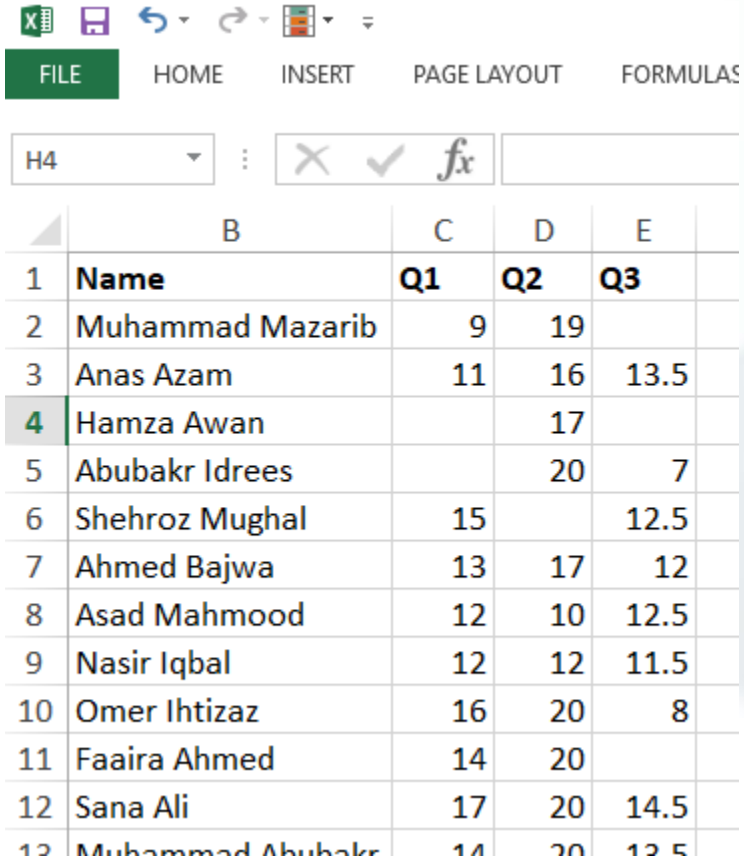
PATIENT_ID MAX(PATIENT_VISITNO)
---------- --------------------
9999993                    1316

Elapsed: 00:00:11.54
```

```
PRIMARY KEY ( PATIENT_ID, DEPEND_SNO, PATIENT_VISITNO )
```

Primary Keys Formats

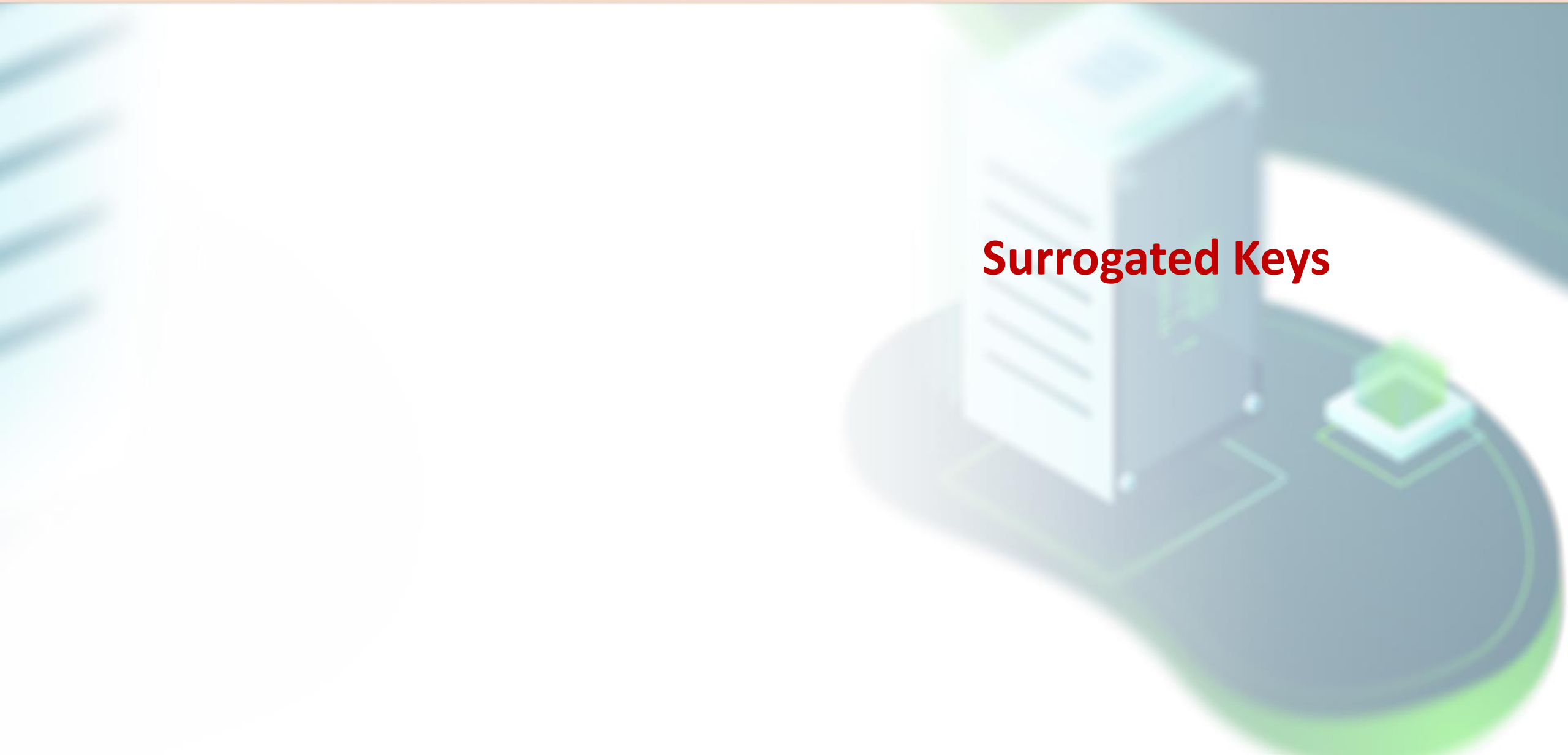
Primary key – Who will decide?



	B	C	D	E
1	**Name**	**Q1**	**Q2**	**Q3**
2	Muhammad Mazarib	9	19	
3	Anas Azam	11	16	13.5
4	Hamza Awan		17	
5	Abubakr Idrees		20	7
6	Shehroz Mughal	15		12.5
7	Ahmed Bajwa	13	17	12
8	Asad Mahmood	12	10	12.5
9	Nasir Iqbal	12	12	11.5
10	Omer Ihtizaz	16	20	8
11	Faaira Ahmed	14	20	
12	Sana Ali	17	20	14.5

Roll# is issued by some University or college Format or instance, meaningful column for PK

Introduction to Database Administration



Surrogated Keys

Surrogated Keys

Surrogated Keys

- Definition
- Examples
- Exercises

Surrogated Keys

Surrogated Key Definition

A **surrogate key** as an artificial column added to a relation to serve as a primary key:

- DBMS supplied
- Short, numeric and never changes – an ideal primary key!
- Has artificial values that are meaningless to users
- Normally hidden in forms and reports

Surrogated Keys

Example

- RENTAL_PROPERTY without surrogate key:

  RENTAL_PROPERTY (Street, City, State/Province, Zip/PostalCode, Country, Rental_Rate)

- RENTAL_PROPERTY with surrogate key:

  RENTAL_PROPERTY (PropertyID, Street, City, State/Province, Zip/PostalCode, Country, Rental_Rate)

Surrogated Keys

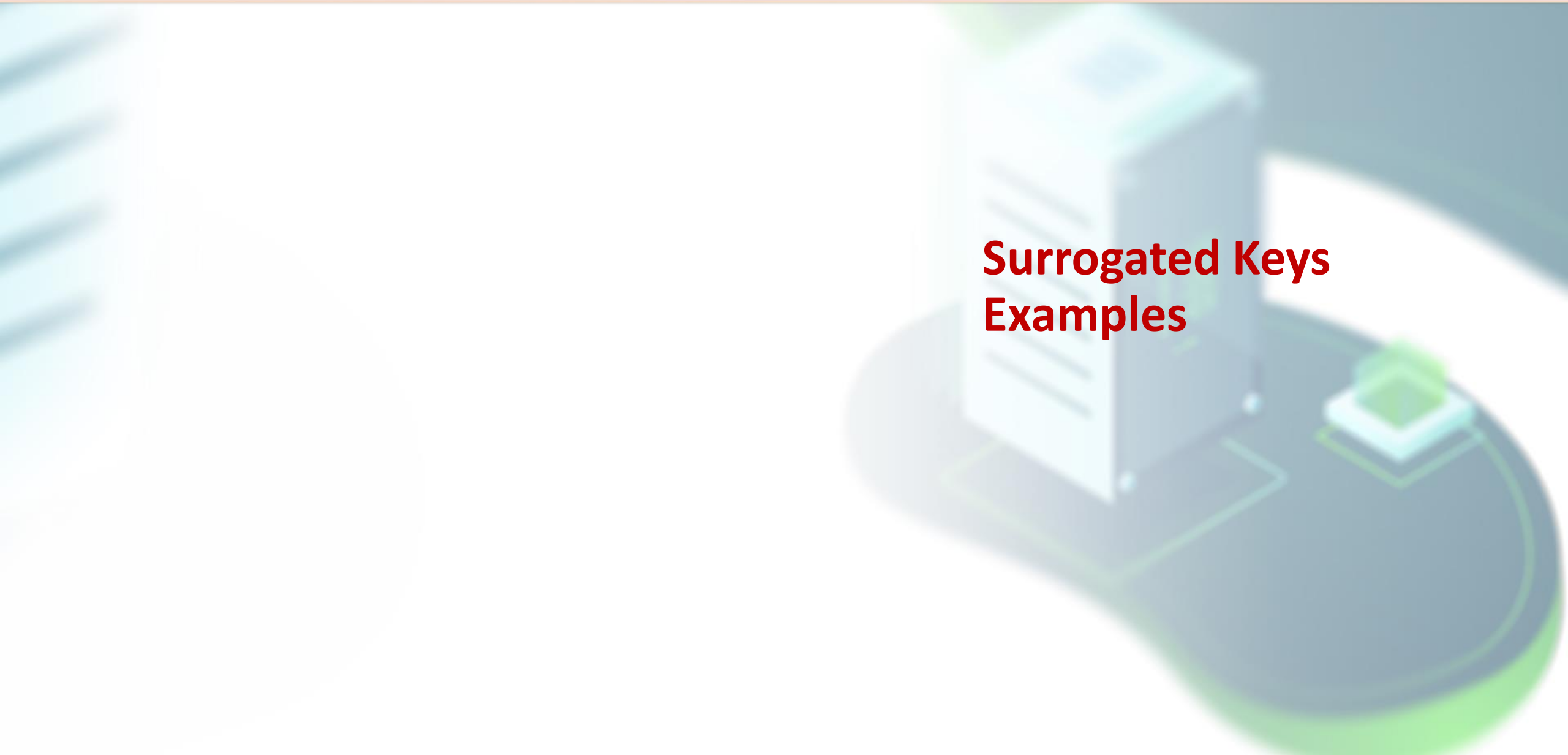
Exercises

Lets solve following examples

- When to put up a complaint by using phone?
- ComplaintRef# is normally generated
- Needs attributes?

End

Introduction to Database Administration



Surrogated Keys Examples

Surrogated Keys Examples

Surrogated Keys Examples

- More Examples
- Insurance & ATM Transaction
- Keys columns with order
- Interesting example

Surrogated Keys Examples

More Examples

ATMTransaction
(Card#, Serial#, Amount, DrawDate)

Need more attributes

Machine#, Type, Status, LimitBalance

Surrogated Keys Examples

More Examples

InsurancePaid
(Policy#, PaidYear, PaidDate, Amount)

Need more attributes

DueDate, DueAmount, Balance, Charges

Surrogated Keys Examples

Keys with order in columns

PatientID	Visit#	Visit Date
558741	1	...
558741	2	
558741	3	
...		
589210	1	
589210	2	
599211	1	
599211	2	
...		

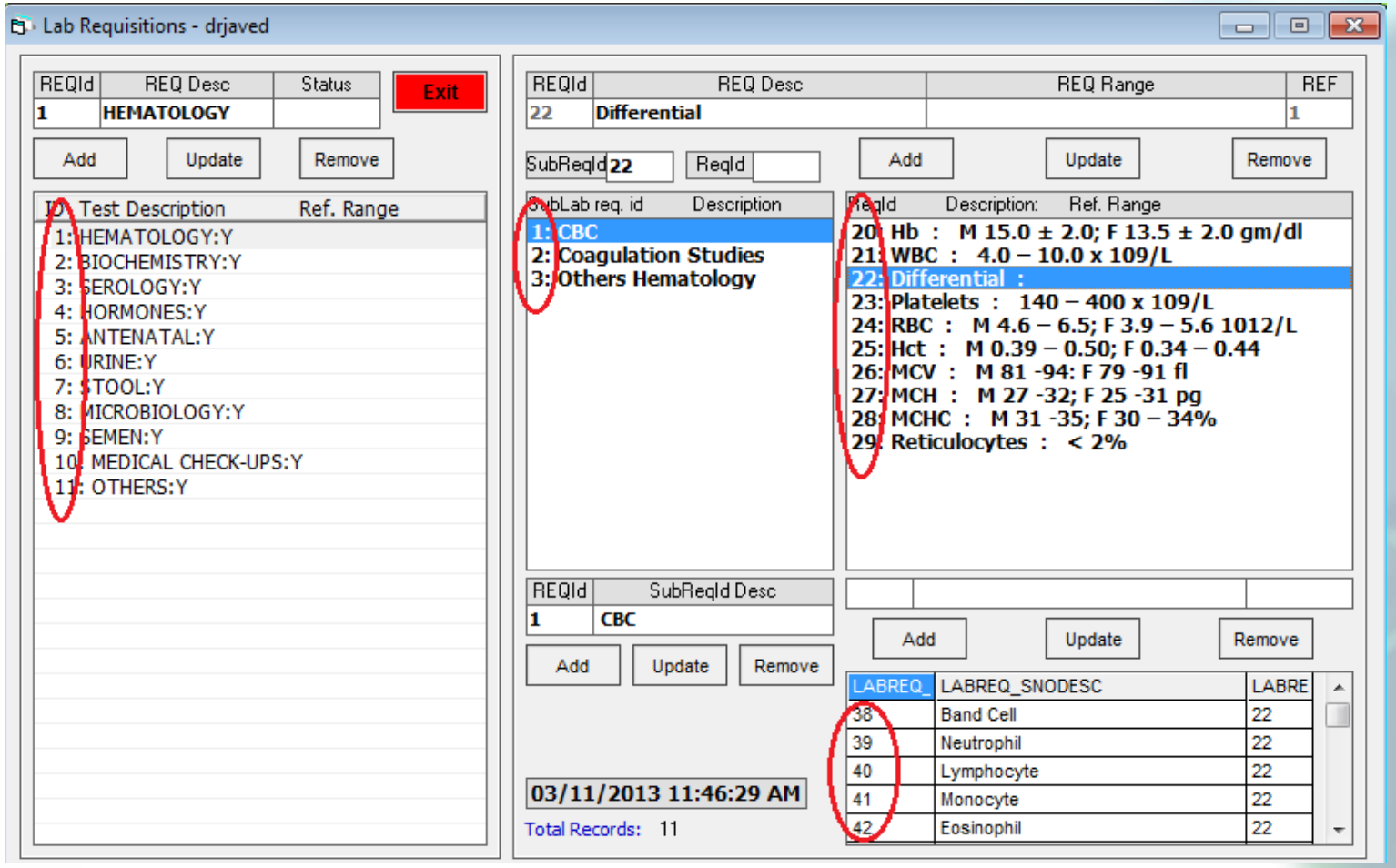
Better Solution
using composite keys

PatientID	Visit#	Visit Date
558741	1	...
558741	2	
558741	3	
589210	4	
589210	5	
599211	6	
599211	7	
...	...	

830000 and more

Surrogated Keys Examples

Interesting example



Surrogated Keys Examples

Surrogated Keys Examples

Surrogated Keys

- Solving example-1
- Solving example-2

Surrogated Keys Examples

Solving Example-1

Let us choose

Invoice, when buying some items

Surrogated Keys Examples

Solving Example-2

Let us discuss

We visit some wedding hall to book some event.

How staff of hall will store event's details?

Which columns are required.

Surrogated Keys Examples

Surrogated Keys Examples

Surrogated Keys

- Solving example-1
- Solving example-2
- Comparisons of Keys

Surrogated Keys Examples

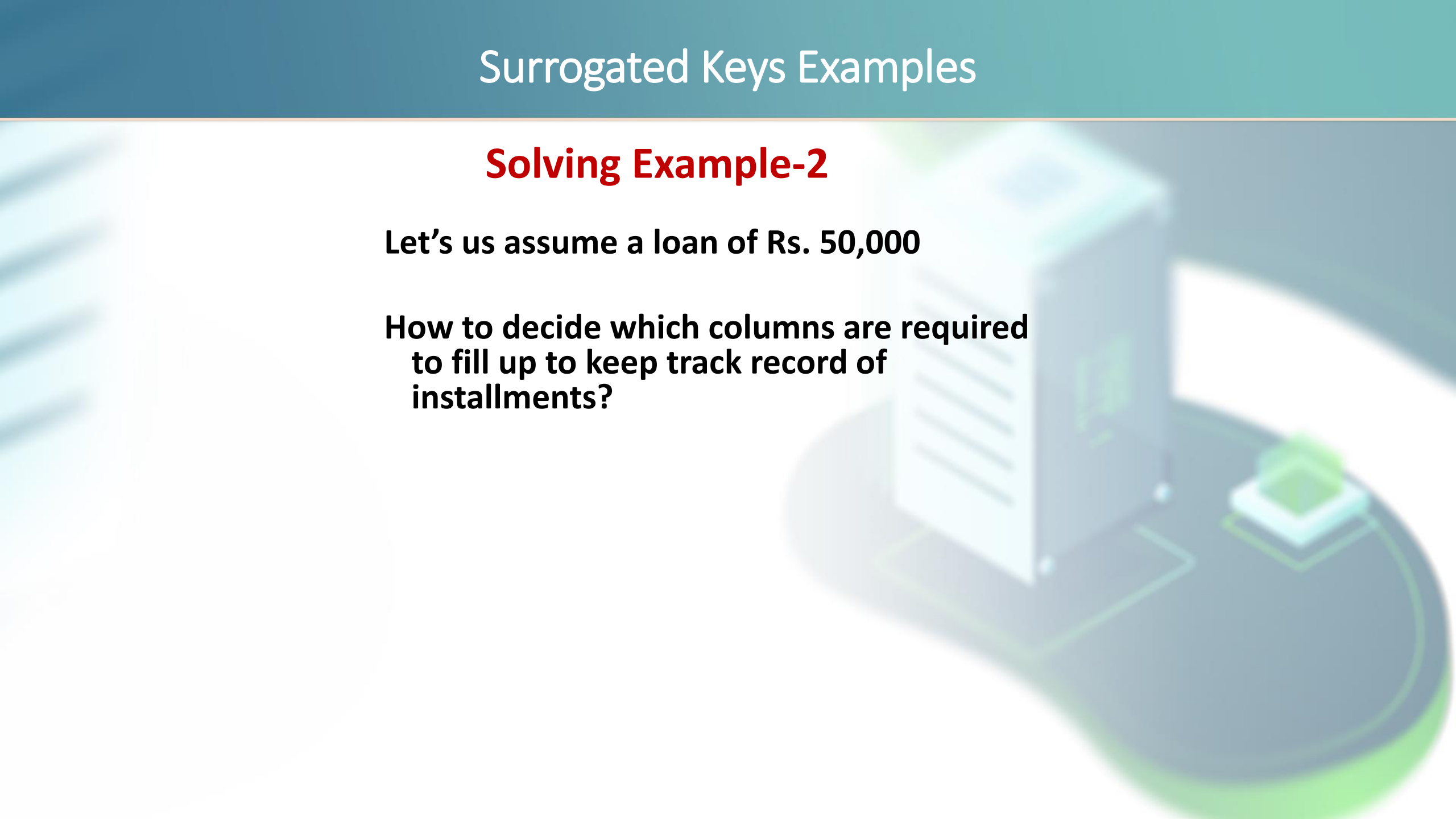
Solving Example-1 (Saving blogs)

Surrogated Keys Examples

Solving Example-2

Let’s us assume a loan of Rs. 50,000

How to decide which columns are required to fill up to keep track record of installments?



Surrogated Keys Examples

Comparisons of keys

Let us discuss

What is difference between PK & surrogated key

What is difference between PK & unique key

Give three more examples of surrogated keys from real-life.

End

Introduction to Database Administration

Foreign Keys

Foreign Keys

Foreign Keys

- Definition
- Example-1
- Example-2

Foreign Keys

Definition

A **foreign key** is an attribute that refers to a primary key of same or different relation to form a link (constraint) between the relations:

- A foreign key can be a single column or a composite key
- The term refers to the fact that key values are *foreign* to the relation in which they appear as foreign key values
- Ideally Data type, Length/ Size of FK and referring PK must be same

Foreign Keys

Example-1

DEPARTMENT (DeptID, DepartmentName, BudgetCode, ManagerName)

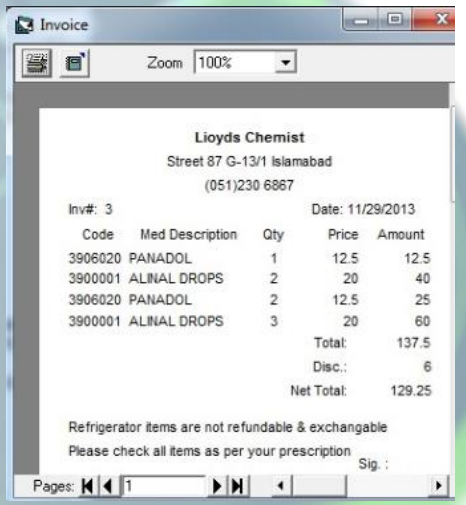
EMPLOYEE (EmpNumber, EmpName, *DeptID*)

Name of FK column may be different from the name of referencing PK

Foreign Keys

Example-2

CUSTOMER(CustId, Name, Address, Telno, Email)
ORDERS(Invoice#, InvType, InvDate, *CustomerId*)
Does Invoice# always contain serial numbers?



End

Foreign Keys Examples

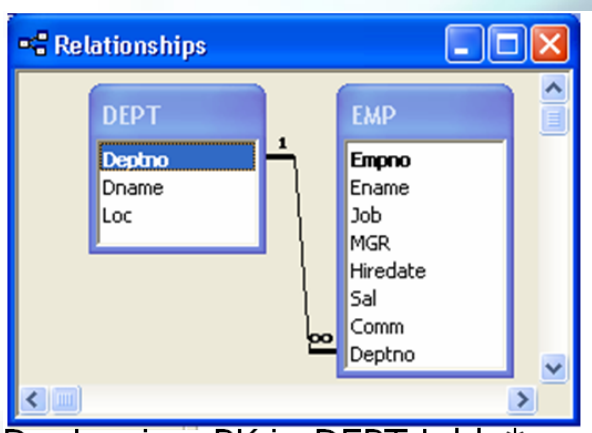
Foreign Keys Examples

Foreign Key Examples

- Relationship details
- FK & Recursive Relationship
- Logical link between tables

Foreign Keys Examples

Relationship details



Deptno is a PK in DEPT table*

Empno is a PK in EMP table

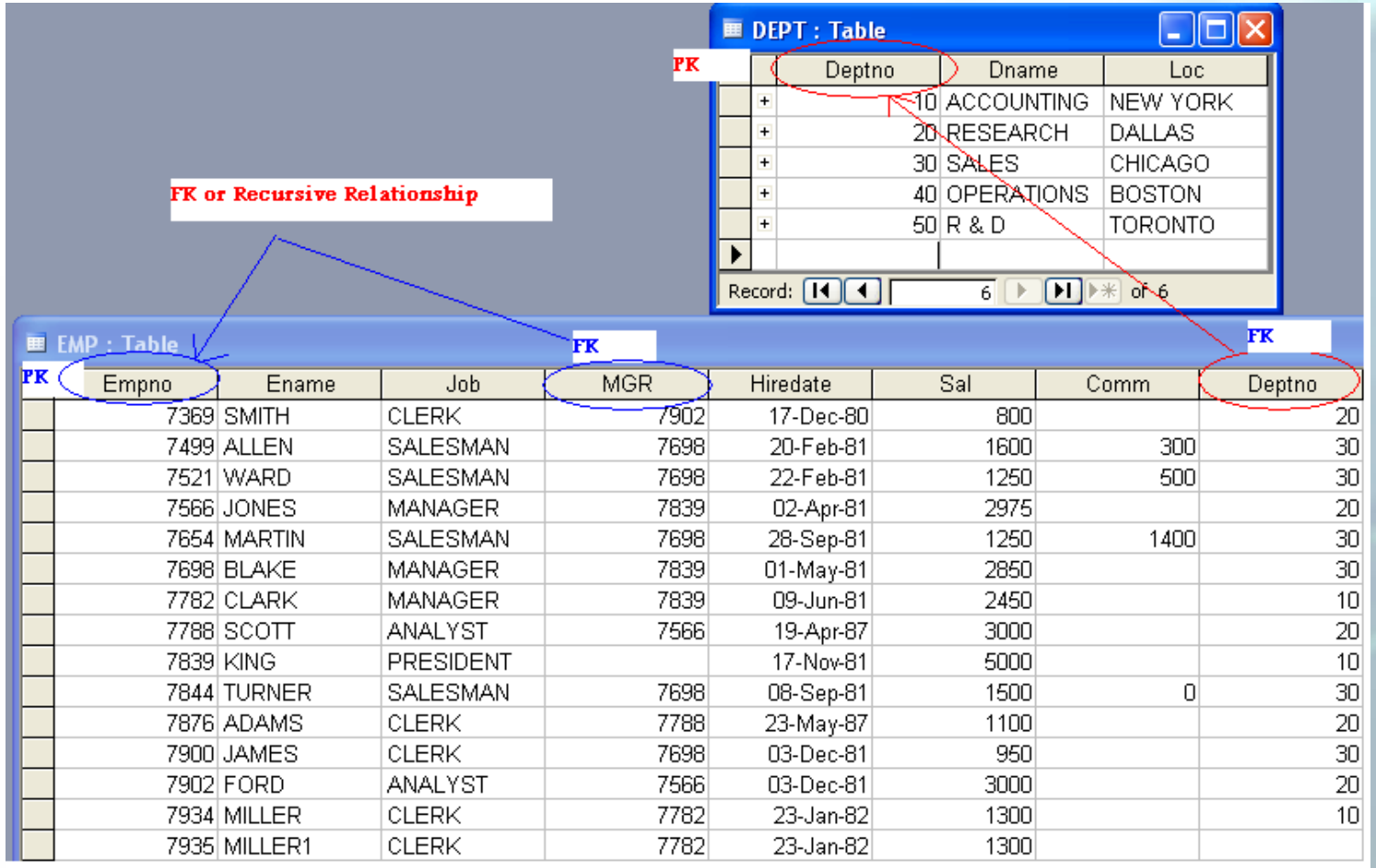
Deptno is a FK in EMP table*

(it references to an attribute Deptno of DEPT table)

NOTE: An attribute within one relation that matches the key (Primary/same) in the same relation, is called recursive relation

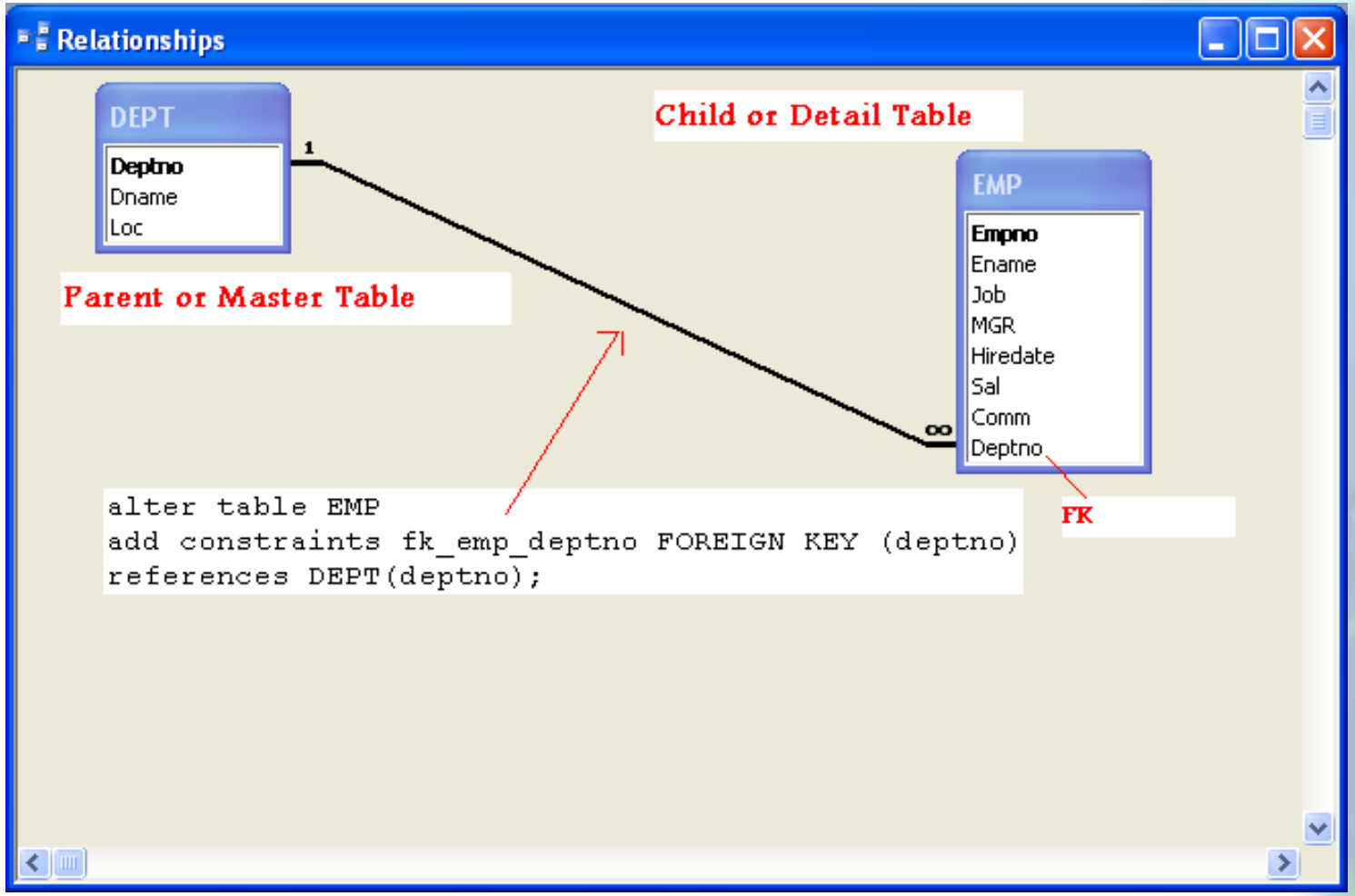
Foreign Keys Examples

FK & Recursive Relationships



Foreign Keys Examples

Logical link between tables



Foreign Keys Examples

Foreign Keys Examples

Foreign Keys Examples

- FK is a part of composite key
- Logical link between tables
- Recursive Relationship

Foreign Keys Examples

FK is a part of Composite keys

NOTE: PK column is underlined

ITEM (Item#, Item_Name, Department, Buyer)

ORDER_ITEM (OrderNumber, *Item#*, Quantity, Price, ExtendedPrice)

Where ORDER_ITEM.ITEM# must exist in ITEM.ITEM#

OrderNumber is an alternate name of InvoiceNumber

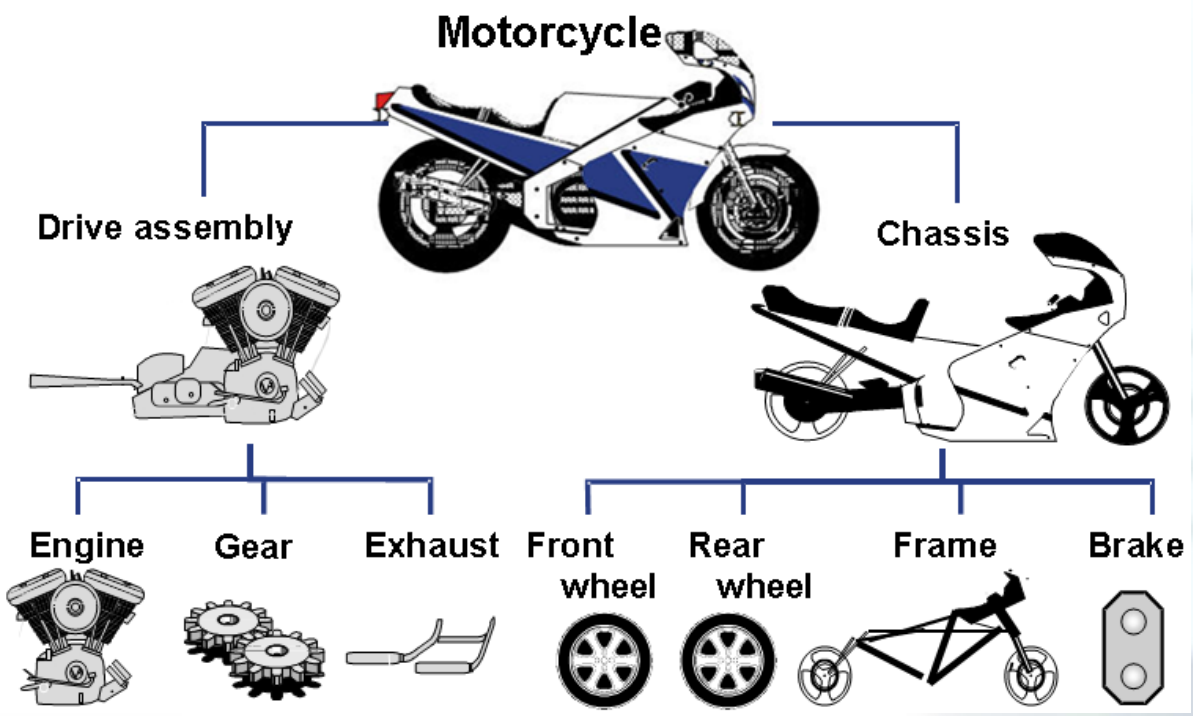
Foreign Keys Examples

Referential Integrity Constraint

A **referential integrity constraint** is a statement that limits the values of the foreign key to those already existing as primary key values in the corresponding relation

Foreign Keys Examples

Recursive Relationship



Part (<u>Part#</u>, PName, Weight, MakeYear, Price, PType, *RefPart#*)

PType: Assembled product/ parts (e.g., Motorcycle) or single part

Foreign Keys Examples

Foreign Keys Examples

Foreign Keys Examples

- Integrity rules
- Referential with cascade
- Integrity Example

Foreign Keys Examples

Integrity Rules

- **Entity integrity**
  - No two rows with the same primary key value
  - No null values in a primary key
- **Referential integrity**
  - Foreign keys must match candidate key of source table
  - Foreign keys in some cases can be null
  - The database must not contain any unmatched foreign key values.
  - If B references A, A must exist.

Foreign Keys Examples

Referential with cascade

- When we update a tuple from a table, say S, that is *referenced* by another table, say SP,
- There are similar choices of *referential actions for update and delete*:
  - ON UPDATE CASCADE
  - ON UPDATE RESTRICT
- There could be other choices besides these three. , e.g.,
  - ON UPDATE SET DEFAULT.
  - ON UPDATE SET NULL.

Foreign Keys Examples

Integrity Example

S

S#	SNAME	STATUS	CITY
S1	Smith	20	London
S2	Jones	10	Paris
S3	Blake	30	Paris
S4	Clark	20	London
S5	Adams	30	Athens

P

P#	PNAME	COLOR	WEIGHT	CITY
P1	Nut	Red	12	London
P2	Bolt	Green	17	Paris
P3	Screw	Blue	17	Rome
P4	Screw	Red	14	London
P5	Cam	Blue	12	Paris
P6	Cog	Red	19	London

SP

S#	P#	QTY
S1	P1	300
S1	P2	200
S1	P3	400
S1	P4	200
S1	P5	100
S1	P6	100
S2	P1	300
S2	P2	400
S3	P2	200
S4	P2	200
S4	P4	300
S4	P5	400

Introduction to Database Administration

Composite Keys

Composite Keys

Composite Keys

- Definition
- Basic examples
- Other Examples

Composite Keys

Definition of Composite Key

Combination of primary keys in a relation of selected attributes gives the concept of composite key.

- Composite key is an extended form of a primary key.
- All the characteristics of PK applies on Composite Keys more than one columns

Composite Keys

Basic Example of Composite Keys

During ATM Transaction, amounts can be drawn several times on one ATM Card.

We need follow the issues

How much amount will be withdrawn?

When amount was drawn?

Which machine has been used?

What are the types of transaction?

Card#, Amount, DrawDate, Machine#, TransType are the attributes for transaction

Composite Keys

Other Examples of Composite Keys

Can we say Card# will be a primary key? NO

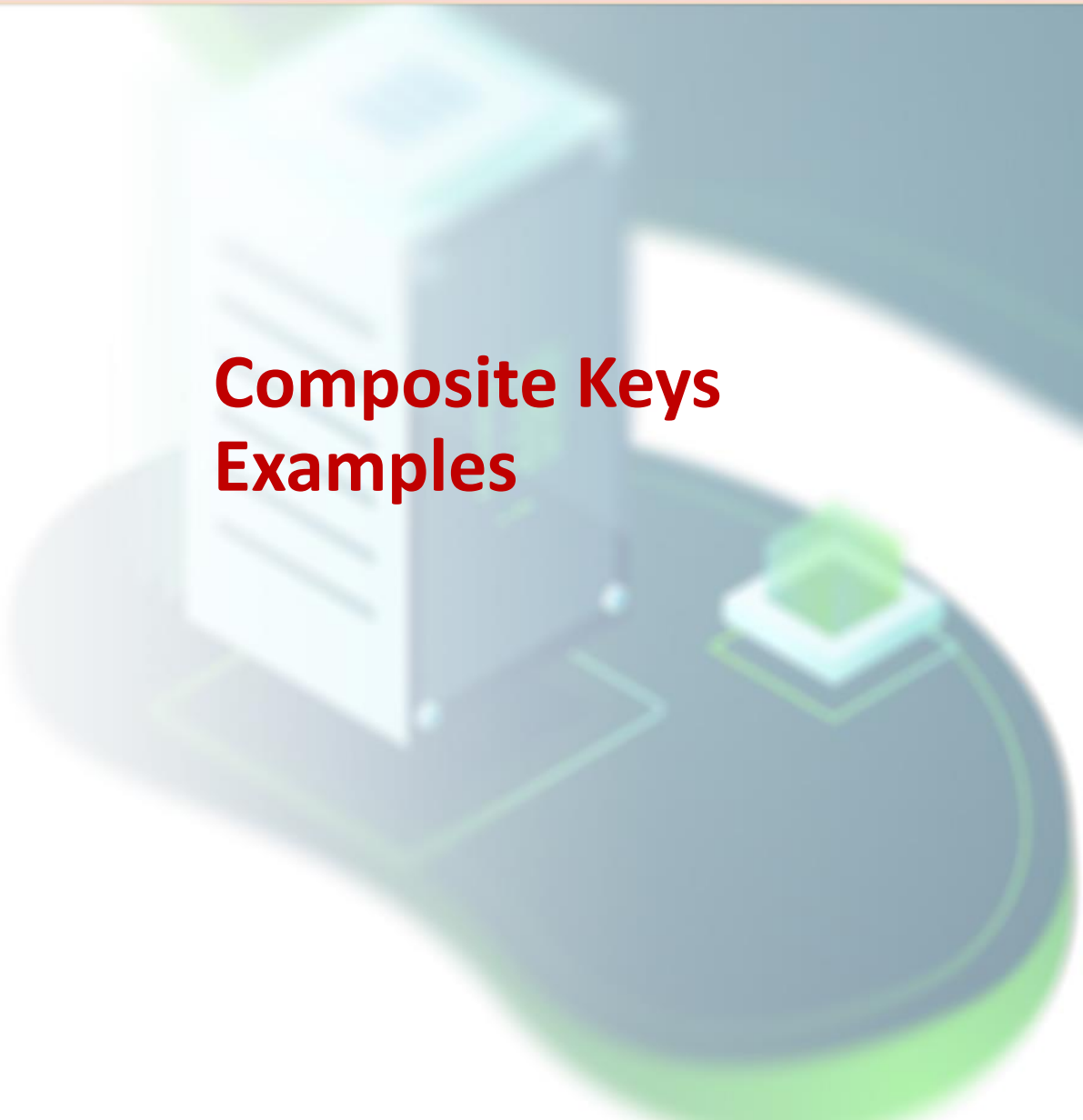
Can DrawDate will be a key with Card#? NO

Then what to do? Add Surrogated key which is TransNo

ATMTransaction(Card#, TransNo, Amount, DrawDate, Machine#, TransType)

- Date includes time in seconds as well.
- Many transactions are managed on same date.

Introduction to Database Administration



Composite Keys Examples

Composite Keys Examples

Composite Key

- Preparing Dataset for Composite Keys
- Hospital Related Example
- What about Excluding Composite Keys?

Composite Keys Examples

Preparing Dataset for Composite Key

Card(Card#, CardHolderName, ExpiryDate, IssueDate, Acc#)

ATMTransaction(Card#, TransNo, Amount, DrawDate, Machine#, TransType)

Do we need most closed related table?

What are PK and FK?

Composite Keys Examples

Hospital Related Example

PatientVisit(PatID, VisitSNO, Vdate, DocID, Diagnosis,…)

LabTest(*PatID*, *VisitSNO*, TestID, Tdate, …)

LabTest has FKs ***PatID, VisitSNO***, referring to same corresponding composite keys in PatientVisit

Which lab table needs to be considered?

Composite Keys Examples

What about Excluding Composite Key?

Card(Card#, CardHolderName, ExpiryDate, IssueDate, Acc#)

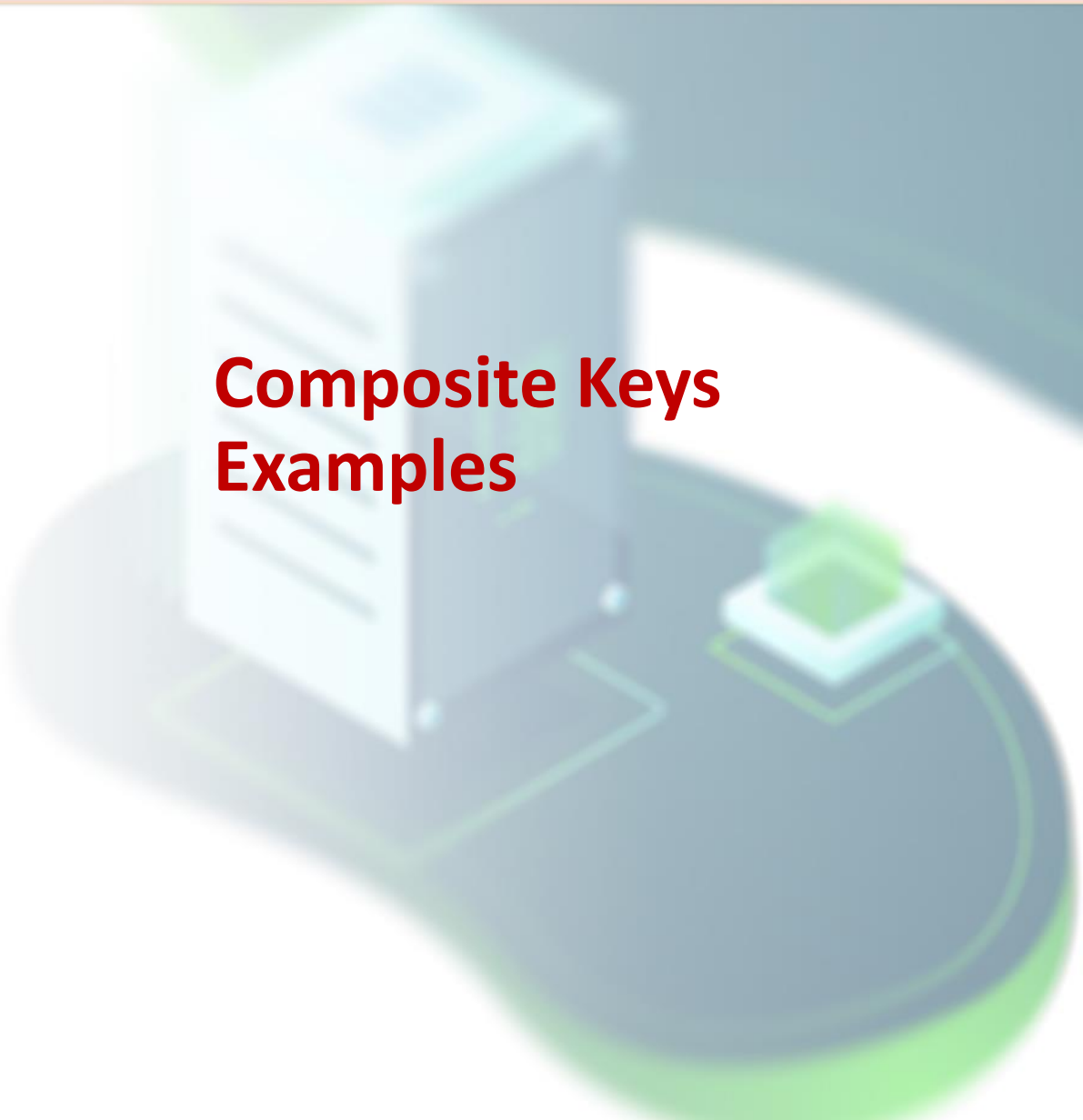
ATMTransaction(ID, Card#, TransNo, Amount, DrawDate, Machine#, TransType)

Do we need most closed related table?

What is a drawback of using ID as Surrogated Key in ATMTransaction?

What are PK and FK?

Introduction to Database Administration

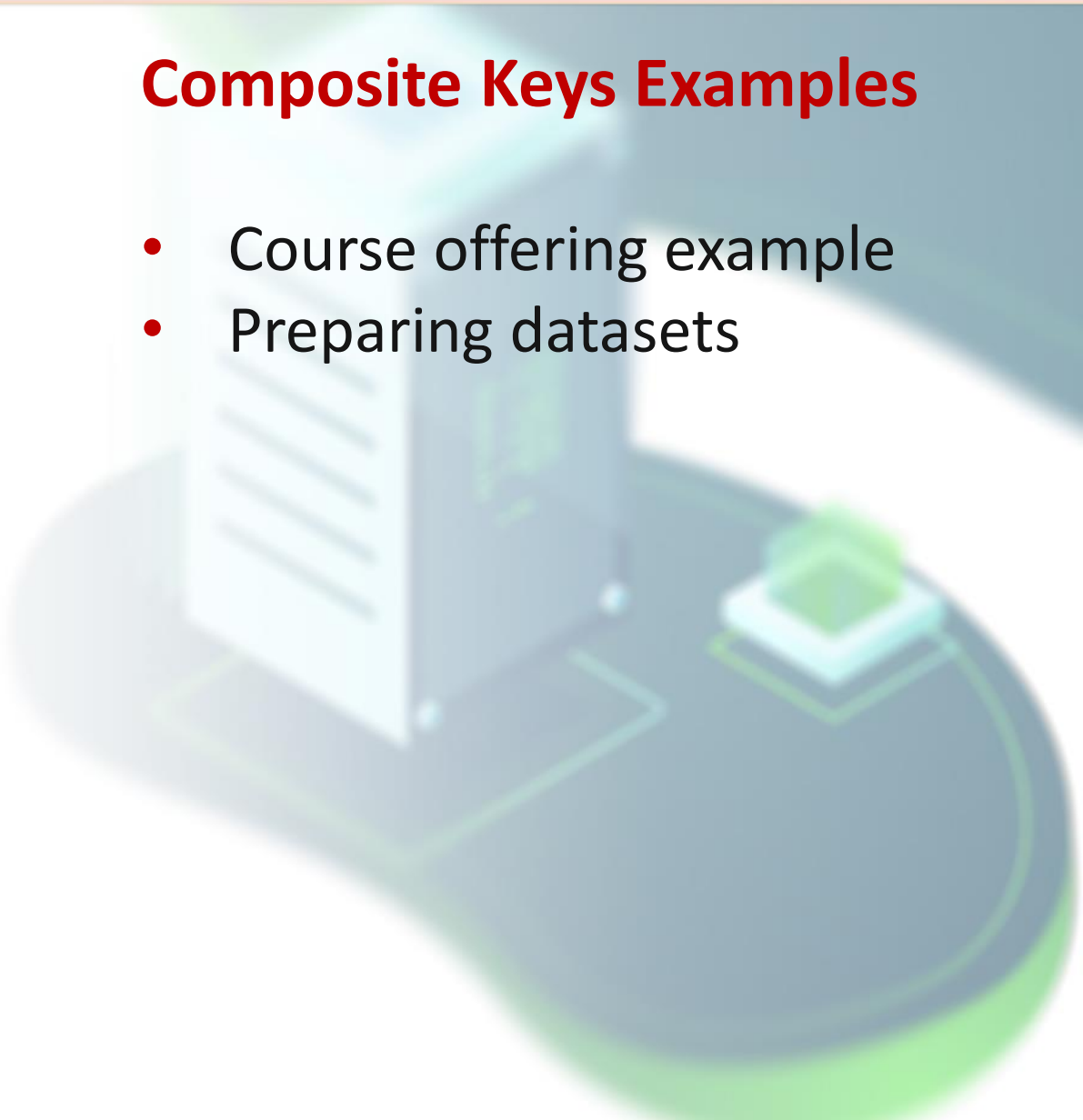


Composite Keys Examples

Composite Keys Examples

Composite Keys Examples

- Course offering example
- Preparing datasets



Composite Keys Examples

Course Offering Example

Let’s us assume, there are 1000 number of courses in a table or list.

Students want to register in courses.

Can they register by looking at 1000 courses? NO

What to do?

Offer selected courses?

Composite Keys Examples

Course Offering Example

Offering course table

CrsOffer(SemID, CrsID, Sec, InstrName, B#, R#)

What to do for keys, PK or Composite Key?

CrsOffer(SemID, CrsID, Sec, InstrName, B#, R#)

CrsReg(SemID, Roll#, CrsID, Sec, TotMarks, Grade)

Composite Keys Examples

Preparing Dataset for Composite Keys

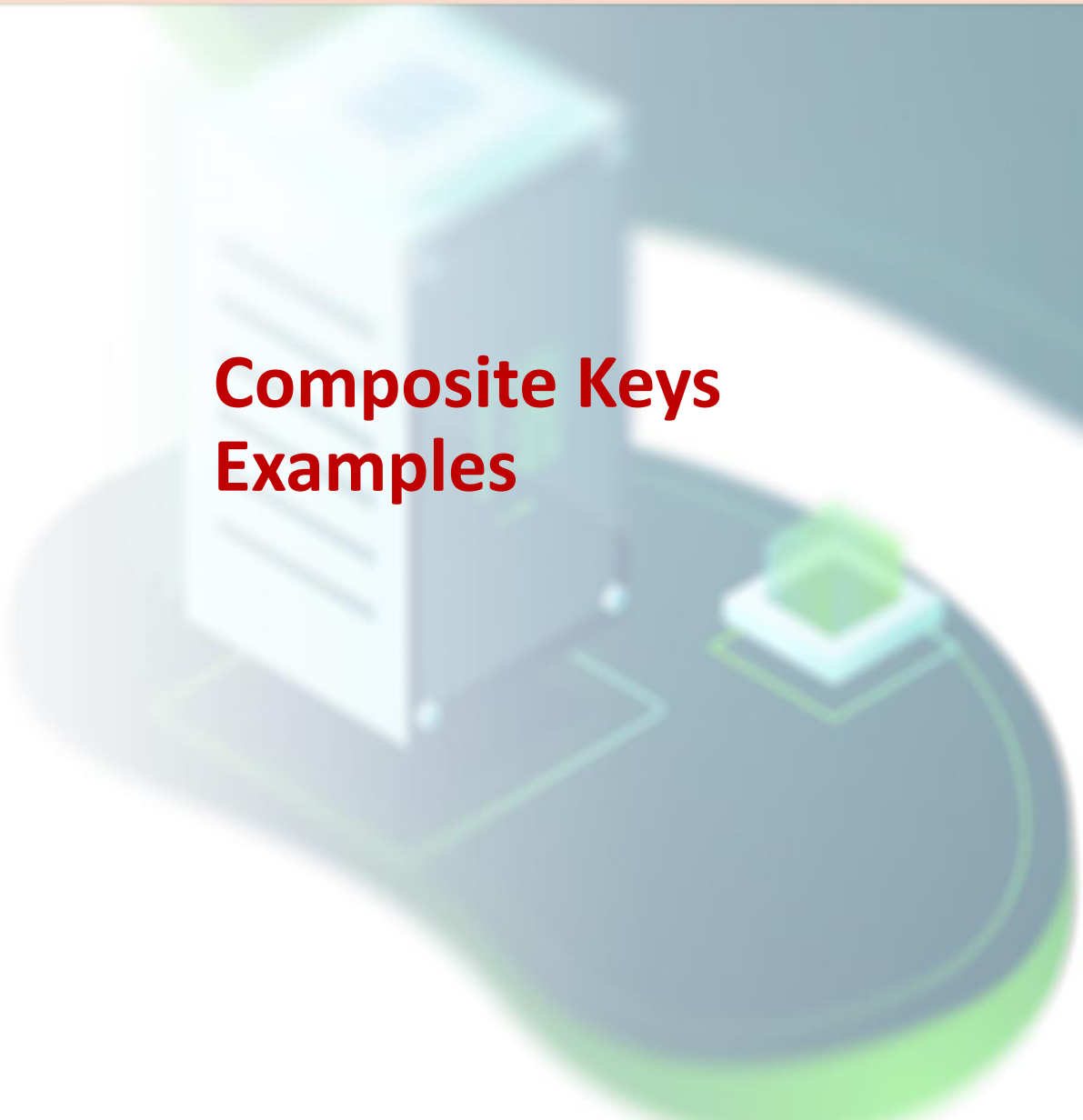
CrsOffer(SemID, CrsID, Sec, InstrName, Building#, Room#)

CrsReg(SemID, Roll#, CrsID, Sec, TotMarks, Grade)

Do we need most closed related tables?

What are PK and FK?

Introduction to Database Administration



Composite Keys Examples

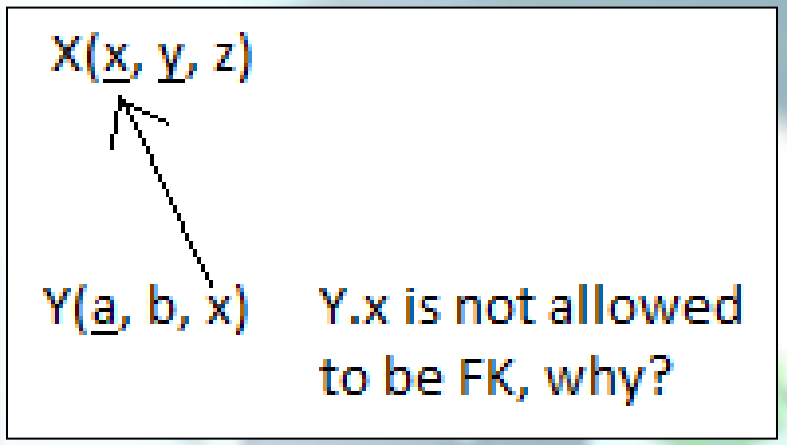
Composite Keys Examples

Composite Keys Examples

- Meaningful learning-1
- Meaningful learning-2
- Wrong composite key
- Indexing columns

Composite Keys Examples

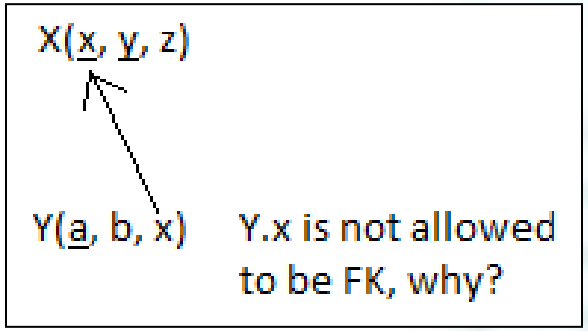
Meaningful learning-1

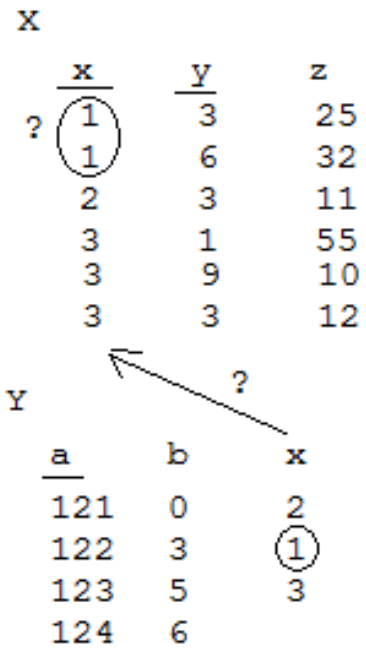


Composite Keys Examples

Meaningful learning-2

- Analysis and Semantics
- Evaluations





Semantics: Creating two tables with relevant data
Analysis: Y.x=1 cannot be mapped exactly with X.x records 1, 3 or 1, 6

Evaluations: Default FK Y.x cannot be created. Trigger can be created on Y.x to make sure Y.x will be a subset of X.x. Otherwise, data can be put in Y.x which does not belong to or mapped to X.x.

Composite Keys Examples

Wrong composite key

Composite Keys Examples

Indexing columns

PATIENT_VISIT Without Indexing

PATIENT_ID	DEPEND_SN	PATIENT_VIS	EMP_ID	DOCTOR_SN	VISIT_DATE	VISIT_NOTE
0222082	0	13	6772356	35	12/27/2005 1:36:08 PM	
0257421	0	2	7033244	102	12/27/2005 3:23:10 PM	
1840190	6	7	685026			
1976193	0	2	694108			
6901319	0	1	689156			
6900626	0	1	694108			
6911102	0	1	694108			
0213919	0	1	702403			
1731899	0	1	689156			
6781521	8	2	691026			
RS00079	2	1	694108			
0207842	0	1	677235			
6781521	0	1	691026			
1770371	0	1	701263			
0227638	0	1	697135			
1926081	1	2	694108			
6751368	2	3	690055			

PATIENT_VISIT Keys/ Indexed

PATIENT_ID	DEPEND_SN	PATIENT_VIS	EMP_ID	DOCTOR_SN	VISIT_DATE	VISIT_N
0204531	0	15	6772356	28	10/3/2007 12:15:51 PM	
0204531	0	16	7073498	19	4/29/2008 1:40:11 PM	
0204531	0	17	6772356	37	4/29/2008 2:09:45 PM	
0204531	0	18	7024037	16	5/31/2008 9:20:18 AM	
0204531	0	19	7024037	4	8/5/2008 1:00:34 PM	
0204531	0	20	6772356	15	8/9/2008 8:36:01 AM	
0204531	0	21	7024037	4	8/11/2008 8:38:44 AM	
0204531	0	22	7073498	16	8/25/2008 1:01:39 PM	
0204531	0	23	6772356	7	10/26/2008 2:32:56 PM	
0204531	0	24	6772356	7	10/28/2008 8:56:20 AM	
0204531	0	25	7024037	39	11/10/2008 1:27:23 PM	
0204532	0	1	6850269	30	9/11/2005 7:17:21 PM	
0204532	0	3	7024037	50	10/5/2005 2:13:42 PM	
0204532	0	4	6850269	50	12/14/2005 2:46:16 PM	
0204532	0	5	6850269	59	1/24/2006 9:41:49 PM	
0204532	1	1	6850269	41	8/6/2005 2:55:29 PM	
0204532	1	2	7043508	31	9/6/2005 2:59:43 PM	
0204532	1	3	7043508	27	9/7/2005 3:25:09 PM	
0204532	1	4	6900551	12	9/8/2005 11:19:55 AM	
0204532	1	6	6971354	12	9/12/2005 11:12:52 AM	
0204532	1	7	6850269	57	1/24/2006 9:27:27 PM	
0204532	1	8	7024037	26	2/7/2006 2:56:09 PM	
0204532	2	1	7033244	3	10/22/2005 3:34:27 PM	
0204532	2	2	6971354	44	1/18/2006 2:54:51 PM	
0204573	0	1	7024037	35	1/21/2006 11:02:11 AM	

Introduction to Database Administration

Additional or Other Constraints

Additional or Other Constraints

Other constraints

- What are additional or other constraints?
- Null
- Domain constraint

Additional or Other Constraints

What are additional or other constraints?

Other Constraints means additional constraints in addition to the standard constraints PK, FK, Composite Key, Surrogated key

For example, NOT NULL, CHECK, DEFAULT, UNIQUE etc.

Additional or Other Constraints

Null

Represents a value of an attribute that is currently unknown or is no applicable for this tuple, means nothing.

Cannot compute anything with the Null

Additional or Other Constraints

Domain constraint

Specifies that the value of attribute A must be an atomic value from the domain ***DOM(A).*** E.g., Width of column or Check on column.

Domain constraints must be Atomic means no two mobile numbers saved in one cell of a domain. Size of column must be appropriate.

S.	RollNo	Name	Total:	20	20	10
30	18I-0599	Saifullah Dar		16	16	8
31	18I-0645	Muzammil Shakir		15	10	7.5

Additional Constraints using Tables

Additional Constraints using Tables

Other constraints

- CHECK constraint
- Unique & Default constraints
- Composite unique constraints
- Example of Trigger

Additional Constraints using Tables

CHECK constraints

The **check** clause in SQL permits domains to be restricted:

- Use **check** clause to ensure that an hourly-wage domain allows only values greater than a specified value.
- **create domain** *hourly-wage* **numeric(5,2) constraint** *value-test* **check**(*value* > = 4.00)
- The domain *hourly-wage* is declared to be a decimal number with 5 digits, 2 of which are after the decimal point

Additional Constraints using Tables

CHECK constraints

```
create table account
(branch-name  Varchar(15),
acc-number    Char(10) not null,
balance       integer,
……)
```

```
alter table account
add constraint ck1 check (bal > 0);
```

```
alter table emp
add constraint ck1_deptno
check (deptno in (10,20,30));
```

Additional Constraints using Tables

UNIQUE & Default constraints

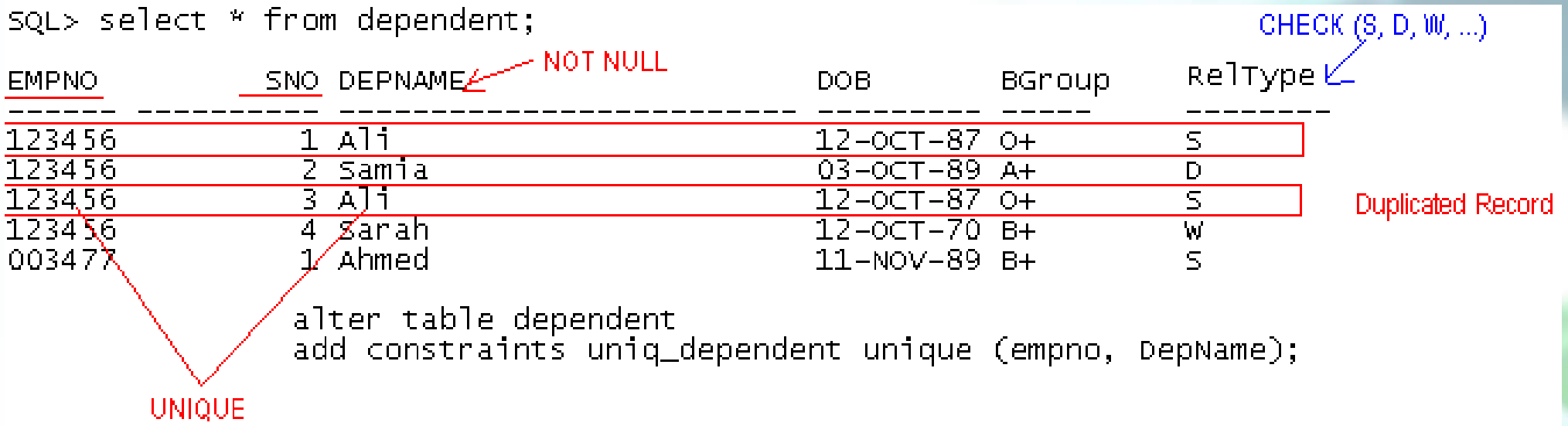
```
create table Dependent
(empno          CHAR(6),
SNO             Number(2),
DepName         varchar2(25) NOT NULL,
DOB             Date,
BloodGroup      VARCHAR2(5),
RelType         CHAR(1) Default 'W');

alter table dependent
add constraints pk_dep_empnoSNO primary key
(empno, sno);

alter table dependent
add constraints uniq_dependent unique (empno,
DepName);
```

Additional Constraints using Tables

Composite UNIQUE constraints



HECK (Max_Participants>=Enrolled_Participants)

CHECK (Deptno>0)

CHECK (RelType IN ('S', 'D', 'W'))

Default 'Y‘

Database Triggers

Additional Constraints using Tables

Example of Trigger

```
CREATE OR REPLACE TRIGGER display_salary_changes
BEFORE DELETE OR INSERT OR UPDATE ON EMP
FOR EACH ROW
WHEN (NEW.EMPNO > 0)
DECLARE
   sal_diff number;
BEGIN
   sal_diff := :NEW.sal  - :OLD.sal;
   dbms_output.put_line('Old salary: ' || :OLD.sal);
   dbms_output.put_line('New salary: ' || :NEW.sal);
   dbms_output.put_line('Salary difference: ' ||
sal_diff);
END;
/
```

Additional Constraints using DDL Alter SQL

Additional Constraints using DDL Alter SQL

Constraints with DDL Alter SQL

- PK constraint on table
- FK constraint on table
- Composite unique & PK constraints

Additional Constraints using DDL Alter SQL

Primary key constraint on table

```
create table customer
(cid        char(10),
Name     varchar2(100) Not null,
address  varchar2(100),
city        varchar2(20)
);

alter table customer
add constraints pk_cid primary key(cid);
```

Additional Constraints using DDL Alter SQL

Foreign key constraint on table

```
create table orders
(ordNo          CHAR(5),
OrdType         CHAR(1) not null,
OrdDate         Date,
TotalPrice      Number(10,2),
cid             CHAR(10)
);
alter table orders
add constraints pk_ordNo primary key(ordNo);
alter table orders
add constraints fk_cid foreign key (cid)
references customer(cid); --already created
```

Additional Constraints using DDL Alter SQL

Composite unique & PK constraints

```
create table Dependent
(empno          CHAR(6),
SNO             Number(2),
DepName         varchar2(25) NOT NULL,
DOB             Date,
BloodGroup      VARCHAR2(5),
RelType         CHAR(1) Default 'W');
alter table dependent
add constraints pk_dep_empnoSNO primary key (empno, sno);
alter table dependent
add constraints uniq_dependent unique (empno, DepName);
```

Additional Constraints using DDL Alter SQL

Additional Constraints using DDL Alter SQL

Constraints with DDL Alter SQL

- Alter constraints ADD & Modify
- Alter constraints using CHECK
- Create table with multiple CHECK
- Cascade and drop constraints

Additional Constraints using DDL Alter SQL

Alter constraints Add & Modify

Following constraints can be applied for an existing EMP table:

```
alter table emp
modify
(sal constraint nt_null_emp_sal NOT NULL);

alter table emp
add (constraint ck1_emp check (deptno>0));
```

Additional Constraints using DDL Alter SQL

Alter constraints using CHECK

Following constraints can be applied for an existing EMP table:

```
alter table emp
add (constraint ck2_emp check
(sal + NVL(comm,0)<=6000));

--Null is allowed, if column is not null
alter table emp
add constraint ck1_emp check
(deptno in (10,20,30));
```

Additional Constraints using DDL Alter SQL

Create table with multiple CHECK

```
create table AirTraveller
(TicketNo CHAR(10),
FirstName VARCHAR2(20),
FamilyName VARCHAR2(20) NOT NULL,
Nationality VARCHAR2(25),
BirthDate   DATE,
FlyCode     Number,
CONSTRAINTS ch_natval CHECK (Nationality
IN ('Canadian','UK','Pakistan','Bahrain')),
CONSTRAINTS ch_dob CHECK (BirthDate LIKE
'[1-2][0-9][0-9][0-9]'),
CONSTRAINTS ch_flycode CHECK (FlyCode
between 3 and 9));
```

Additional Constraints using DDL Alter SQL

Cascade & drop constraints

Cascade drops the FK of child table EMP
emp.deptno references to dept.deptno

Alter table dept

drop constraint pk_deptno cascade;

Introduction to Database Administration

Keys & Constraints
Revisions

Keys & Constraints Revisions

Constraints Revisions

Standard constraints are

- Super Key
- Candidate Key
- Primary Key (PK)
- Surrogated Key
- Foreign Key (FK)
- Composite Key
- Additional constraints are

Not Null, Check, Unique, Default, DOM Constraints using triggers

Keys & Constraints Revisions

Super Key and Candidate Key

Super Key describes concepts to find unique records, can be null & indexed

{Roll#, FullName} gives unique when FullName can be duplicated

{CNIC}, {Barcode} are also a super keys

Candidate key gives fewer records in search.

Candidate keys can be used for searching purposes

{CNIC}, {Roll#} and {MedName} are candidate keys

Keys & Constraints Revisions

Primary Key

Gives unique record with conditions NOT NULL, UNIQUE and INDEXED

Fixed length, ownership and not frequently changed, Descriptive/ well defined key

Roll#, Empno, Item#, PatientID etc.

2019004, 16K-1005 etc.

Avoid PKs Price, Quantity, Rates

Keys & Constraints Revisions

Surrogated Key

Just like a PK but it is artificial key. Decided by the designer from set of attributes and meaningless to the user.

SerialNo or Card# with TransNo

Try to avoid Column with datatype DATE

Keys & Constraints Revisions

Foreign Key

Referencing key and also called referential integrity constraint

Dept(DNO, Dname, Loc)

Emp(Empno, Ename, Sal, DOB, DNO)

Emp.DNO is a FK references to Dept.DNO

FK is also Recursive Key!

Keys & Constraints Revisions

Composite Key

Collection of PKs in a relation

PatientVisit(PatID, VisitSNO, Vdate, DocID, Diagnosis,…)

LabTest(*PatID*, *VisitSNO*, TestID, Tdate, …)

Columns with red text are surrogated keys

Keys & Constraints Revisions

Additional Constraints

NOT NULL

DOMAIN

CHECK

UNIQUE

DEFAULT and TRIGGER

End

Script of Referential Integrity Constraints SQL

Script of Referential Integrity Constraints SQL

Script of Referential Integrity

- Primary key with table
- Primary & Foreign Key with table
- Employee Prepares Order
- Item Table
- Sold Table & FKs

Script of Referential Integrity Constraints SQL

Primary key with Table

Follow up all DDL in a given order of slides

```
create table Customer
(custID          CHAR(10),
CustName         VARCHAR2(25) NOT NULL,
Address          VARCHAR2(50),
City             VARCHAR2(50),
TelNo            VARCHAR2(15),
Email            VARCHAR2(50));

Alter table Customer
add constraint PK_Custid primary key
(CustID);
```

Script of Referential Integrity Constraints SQL

Primary & Foreign keys

```
Create table Orders
(InvoiceNo      Varchar2(12),
InvType         CHAR(1),
InvDate         Date NOT NULL,
TotalPrice      Number(6,2),
CustID          CHAR(8),
SalesEmpID      CHAR(5));

Alter table Orders
add constraint PK_InvNo primary key
(InvoiceNO);

Alter table Orders
add constraint FK_Cust_CustID foreign key
(custID) references Customer(CustID);
```

Script of Referential Integrity Constraints SQL

Employee Prepares Order

```
create table Employee
(EmpID          CHAR(3),
EmpName         VARCHAR2(25) NOT NULL,
Address         VARCHAR2(50),
City            VARCHAR2(50),
TelNo           VARCHAR2(15) UNIQUE,
Email           VARCHAR2(50));

Alter table Employee
add constraint PK_EmpID primary key
(EmpID);

Alter table Orders
add constraint FK_Emp_EmpID foreign
key (SalesEmpID) references
Employee(EmpID);
```

Script of Referential Integrity Constraints SQL

Item Table

```
Create table Item
(ItemID          CHAR(5),
ItemName         VARCHAR2(50) NOT NULL,
PPrice           NUMBER(10,2),
TotQty           NUMBER(5),
Status           CHAR(1)
);

Alter table Item
add constraint PK_ItemID primary key
(ItemID);
```

Script of Referential Integrity Constraints SQL

Sold Table & FKs

```
Create table Sold
(ItemID          CHAR(5),
InvoiceNo        CHAR(12),
SPrice           NUMBER(10,2) Not Null,
SQty             NUMBER(10,2) Not Null
);

Alter table Sold
add constraint PK_Sold primary key
(ItemID, InvoiceNo); --Composite Key
```

Script of Referential Integrity Constraints SQL

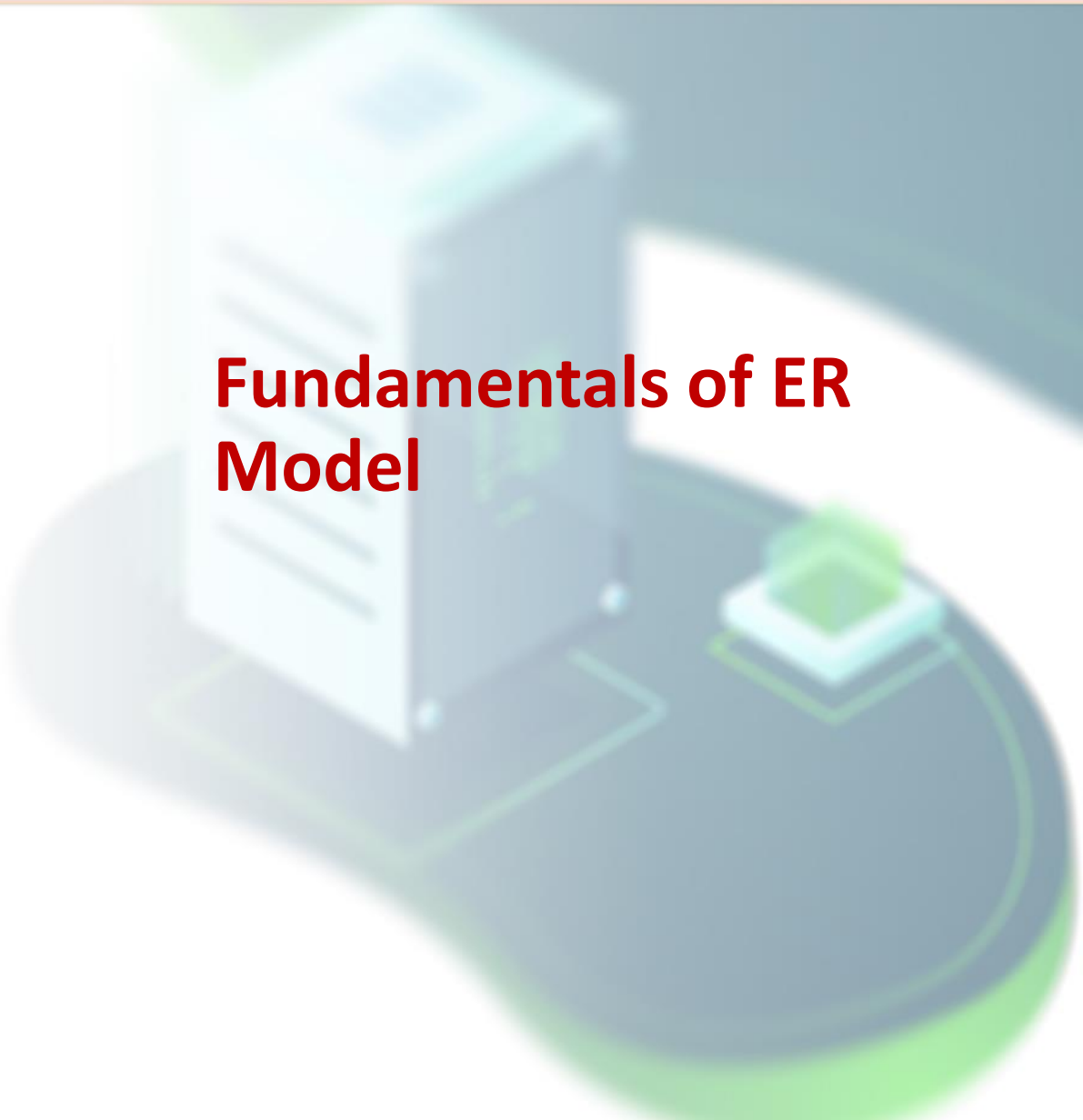
Sold Table & FKs

```
Alter table Sold
add constraint FK_Sold_ItemID
foreign key (ItemID) references
Item(ItemID);

Alter table Sold
add constraint FK_Sold_InvoiceNo
foreign key (InvoiceNo) references
Invoice(InvoiceNo);
```

End

Introduction to Database Administration



Fundamentals of ER Model

Fundamentals of ER Model

Fundamentals of Entity Relationship (ER) Model

- Semantic Modeling
- Chen ER Model
- System Development & DBA
- Database Development
- Conceptual Model
- Conceptual Design

Fundamentals of ER Model

Semantic Modeling

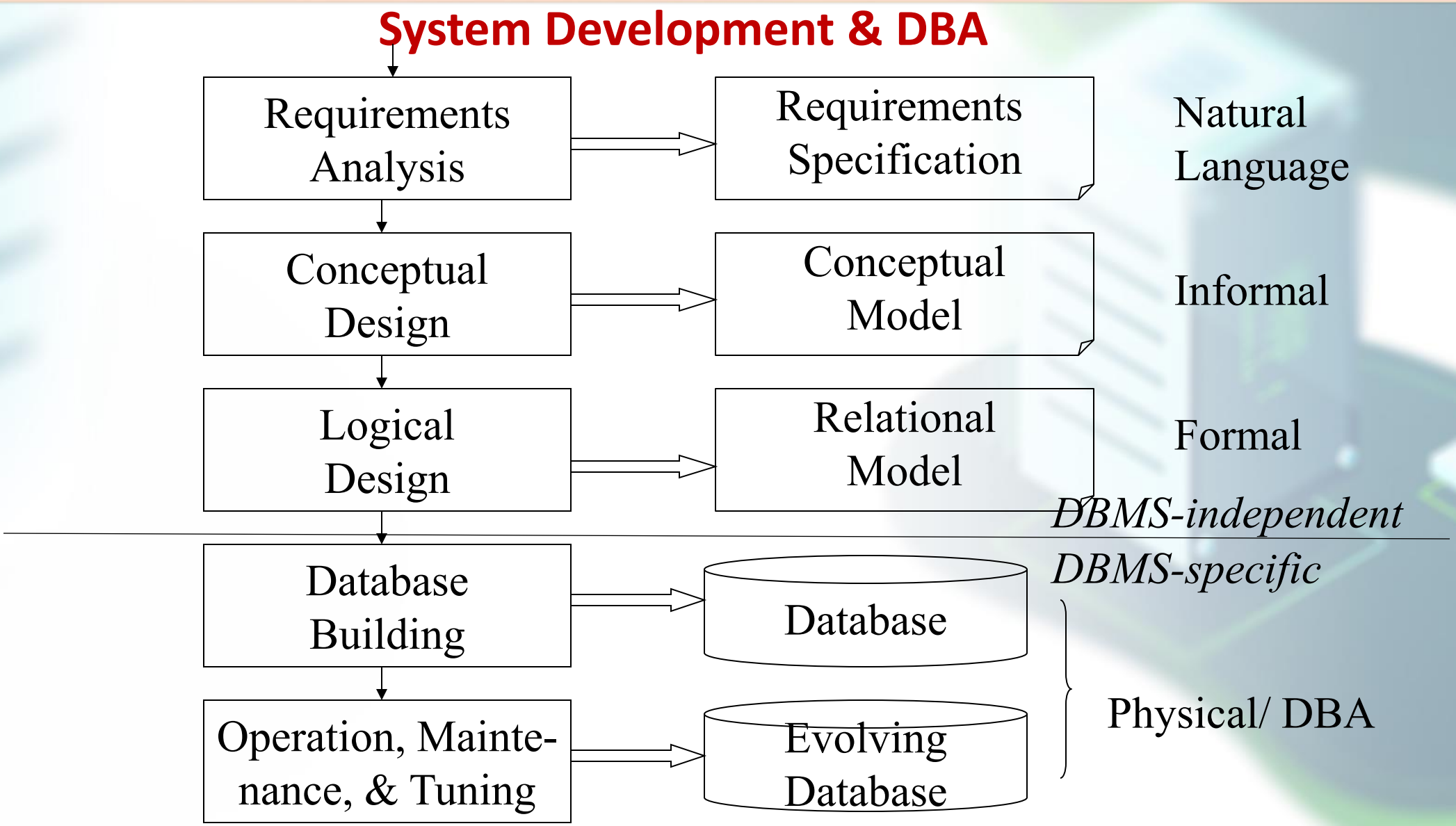
- A class of data models
- Conveys semantic meaning
- Implements databases more intelligently
- Support more sophisticated user interfaces (SQL queries, forms & reports)
- Research started in 1970s and early 1980s
- Other names are data modeling, E/R modeling, E-modeling

Fundamentals of ER Model

Chen ER Model

- Chen in 1976 introduced the E/R model
- The E/R model allows us to sketch the design of a database informally.
- Designs are pictures called *entity-relationship diagrams*.
- Fairly mechanical ways to convert E/R diagrams to real implementations like relational databases exist.

Fundamentals of ER Model



Fundamentals of ER Model

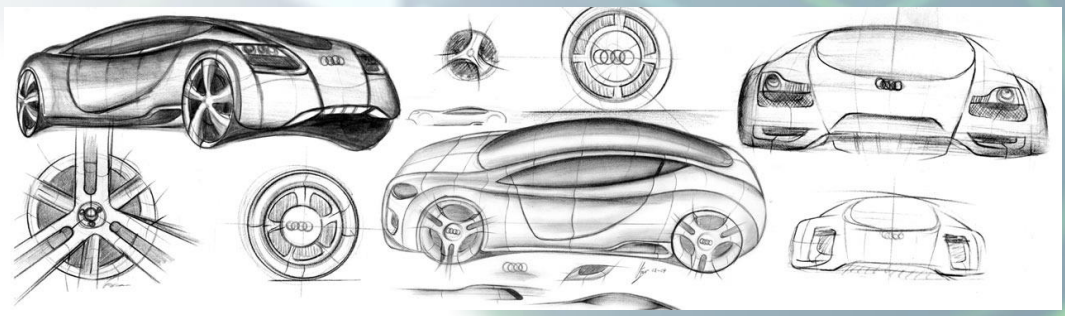
Database Development

- **Requirements Analysis**
  - Collect and Analyze the requirements of the users, e.g., Functional Specification, Prototyping.
- **Conceptual Design**
  - Design a conceptual model (schema), e.g., ER model, ER Mapping.
- **Logical Design**
  - Translate the ER model into a relational model (schema), DDL Scripts.
  - Normalization
- **Database Building**
  - Build the database and write application programs for specific DBMS & S/W Appls/ Tools.
- **Operation, Maintenance & Tuning**
  - Use/ Training, Installations, maintain and "tune" the database.

Fundamentals of ER Model

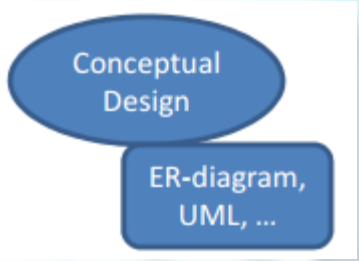
Conceptual Model

- Highest conceptual grouping of ideas
  - Data tends to naturally cluster with data from the same or similar categories relevant to the organization
- The major relationships between subjects have been defined
  - Least amount of detail



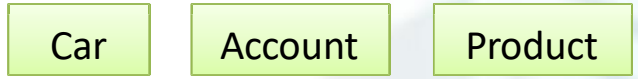
Fundamentals of ER Model

Conceptual Design



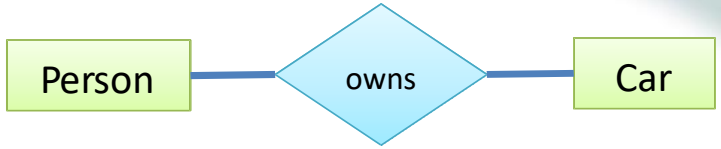
– Entity-Relationship (ER) Modeling

- Entities - "things" in the real world
  - E.g. Car, Account, Product



- Attributes – property of an entity, entity type, or relationship type
  - E.g. color of a car, balance of an account, price of a product

- Relationships – between entities there can be relationships, which also can have attributes
  - E.g. Person owns Car



Introduction to Database Administration

ER Diagram & Attributes Display

ER Diagram & Attributes Display

Attributes Display

- For Logical Design
- Symbols/ Notations
- Motivational Example
- Entity or Entity Type
- Simple or Single Attributes
- Composite Attributes
- Multi valued Attributes
- Derived or Stored Attributes
- Complex Attributes

ER Diagram & Attributes Display

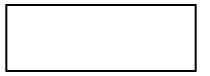
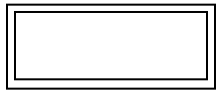
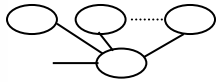
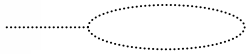
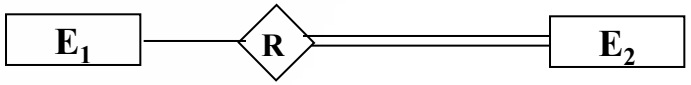
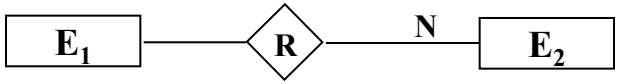
For Logical Design

- Translate an ER schema into a relational schema.
  - Entity
  - Relationship
  - Attribute
  - Subtype

- **Normalization**
  - To ensure you have a “good” design (Testing of your model).

ER Diagram & Attributes Display

Symbols/ Notations

Symbol	Meaning
	ENTITY TYPE
	WEAK ENTITY TYPE
	RELATIONSHIP TYPE
	IDENTIFYING RELATIONSHIP TYPE
	ATTRIBUTE
	KEY ATTRIBUTE
	MULTIVALUED ATTRIBUTE
	COMPOSITE ATTRIBUTE
	DERIVED ATTRIBUTE
	TOTAL PARTICIPATION OF E_2 IN R
	CARDINALITY RATIO 1:N FOR E_1:E_2 IN R
	STRUCTURAL CONSTRAINT (min, max) ON PARTICIPATION OF E IN R

ER Diagram & Attributes Display

Motivational Example

Consider building a course management system (**CMS**):

- Students
- Courses
- Professors

Entities

- Who takes what?
- Who teaches what?

Relationships

What about Sales Items System?

ER Diagram & Attributes Display

Entity or Entity Type

An entity is an object or a concept that is identified by the enterprise as having an independent existence.

There are two types of entities:

- Physical entities
  - Example: car, house, employee, part, supplier, building
- Conceptual entities
  - Example: job, university course, sale, work experience, CourseReg

ER Diagram & Attributes Display

Simple or Single Attributes

A simple attribute:

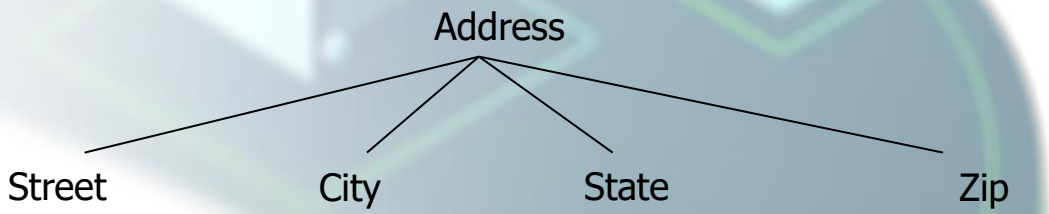
- Consists of a single component with an independent existence.
  - Example: The **Sex or Gender** attribute of an EMPLOYEE entity
  - Example: **Blood Group** of a student

ER Diagram & Attributes Display

Composite Attributes

A composite attribute:

- Consists of multiple components each with an independent existence.
  - Example: The **Address** attribute of an EMPLOYEE entity can be divided into Street, City, State, Zip.



ER Diagram & Attributes Display

Multivalued Attributes

An attribute that holds more than one value for a single entity.

- Example: The **Color** attribute of a CAR entity, more than college **degrees** taken by students
- Example: Multiple Phone numbers

ER Diagram & Attributes Display

Derived & Stored Attributes

Is an attribute that represents a value that is derived from the value of a related attribute or set of attributes not necessarily in the same entity.

- Example 1: The value of the A**ge** attribute of the EMPLOYEE entity can be derived from the today's date and the value of the employee BirthDate.
- Example 2: The **NumberofEmployees** attribute of a DEPARTMENT entity can be derived from the EMPLOYEE table by counting the number of employees who work in that department.

ER Diagram & Attributes Display

Complex Attributes

Is an attribute that is a nested combination of composite and multi-valued attributes in an arbitrary way.

- Example: The complex attribute AddressPhone.

{AdressPhone({Phone(AreaCode, PhoneNumber)},

Address(StreetAddress(Number, Name, HouseNo), City, State, Zip))}

Note

- Comma is used for separating the components
- {} Represents multi-valued attributes

Introduction to Database Administration

Fundamental Notations of ER Diagram

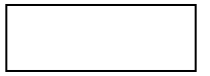
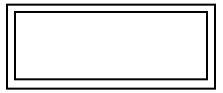
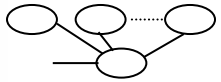
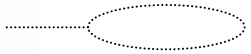
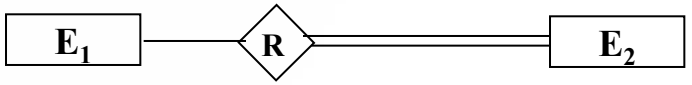
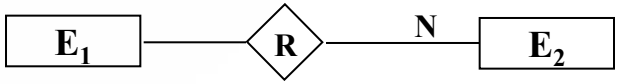
Fundamental Notations of ER Diagram

Attributes Display

- Symbol/ Notations
- Entity Employee
- Entity Department
- Entity Project
- Entities Department & Employee

Fundamental Notations of ER Diagram

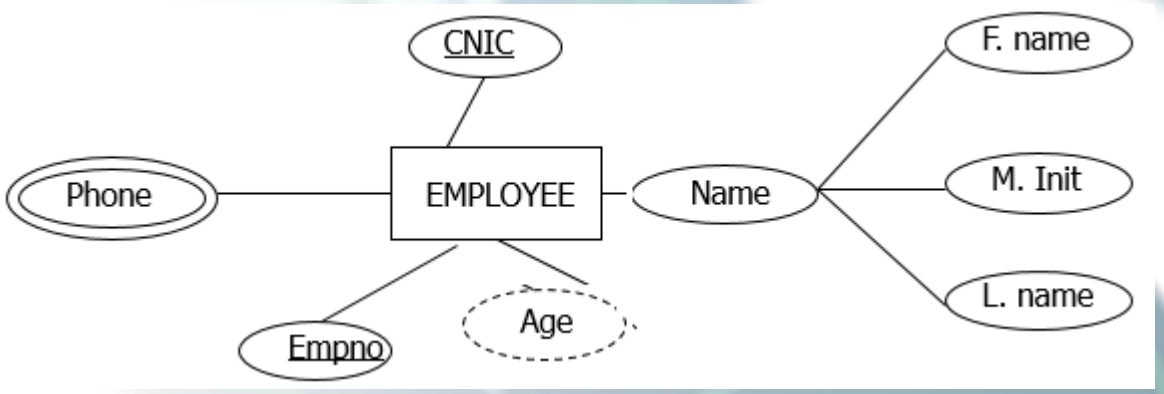
Symbols/ Notations

Symbol	Meaning
	ENTITY TYPE
	WEAK ENTITY TYPE
	RELATIONSHIP TYPE
	IDENTIFYING RELATIONSHIP TYPE
	ATTRIBUTE
	KEY ATTRIBUTE
	MULTIVALUED ATTRIBUTE
	COMPOSITE ATTRIBUTE
	DERIVED ATTRIBUTE
	TOTAL PARTICIPATION OF E_2 IN R
	CARDINALITY RATIO 1:N FOR E_1:E_2 IN R
	STRUCTURAL CONSTRAINT (min, max) ON PARTICIPATION OF E IN R

Fundamental Notations of ER Diagram

Entity Employee

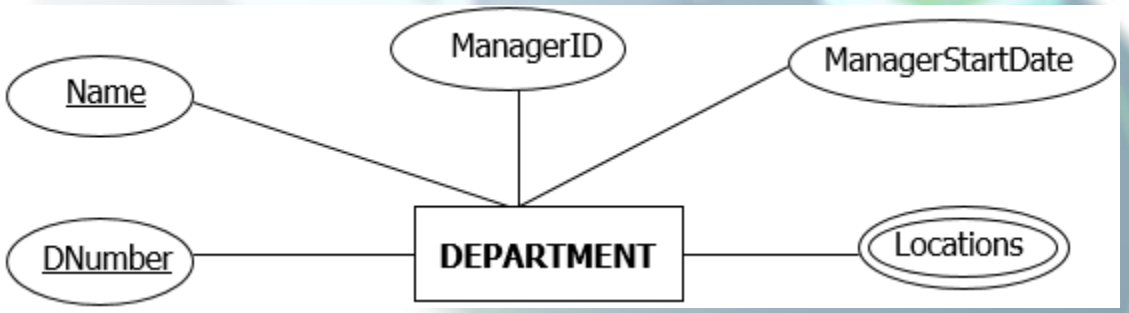
- Underlined are Key Identifiers
- There is no PK and FK are shown in ER Diagram



Fundamental Notations of ER Diagram

Entity Department

- Underlined are Key Identifiers
- There is no PK and FK are shown in ER Diagram
- Double oval represents multi-valued

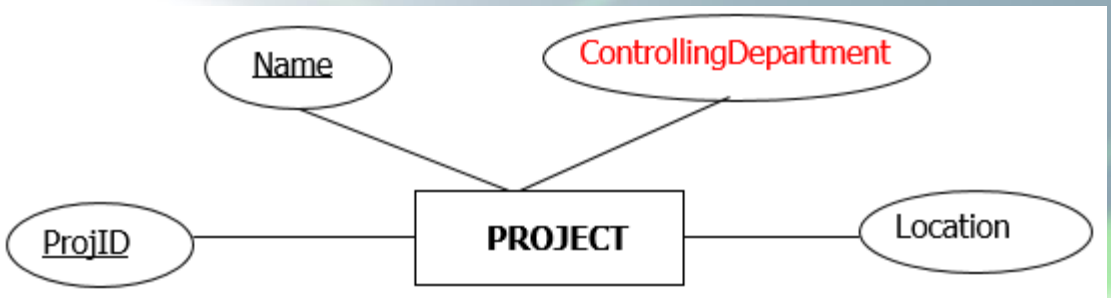


Fundamental Notations of ER Diagram

Entity Project

An entity type PROJECT has attributes:

- ProjID (key identifier)
- Name (key identifier)
- DNumber (key identifier)
- Location
- ControllingDepartment
- Budget
- Start Date
- End Dates



Fundamental Notations of ER Diagram

Entities Department & Employee

- Consider Employees are working in departments:

  - Department
  - Employee
  - Manager/ Boss??

  } *Entities*

Relationships

- Employees are belong to Departments
- Some employees are managers of department
- Employee may work in more than one dept
- Some are managers of other employees

Introduction to Database Administration

ER Diagram with Relationship one to many

ER Diagram with Relationship one to many

Attributes Display

- Example-1 (1-M)
- Example-2 (1-M)
- Example-3 (1-M)
- Example-4 (1-1)
- Exercise

ER Diagram with Relationship one to many

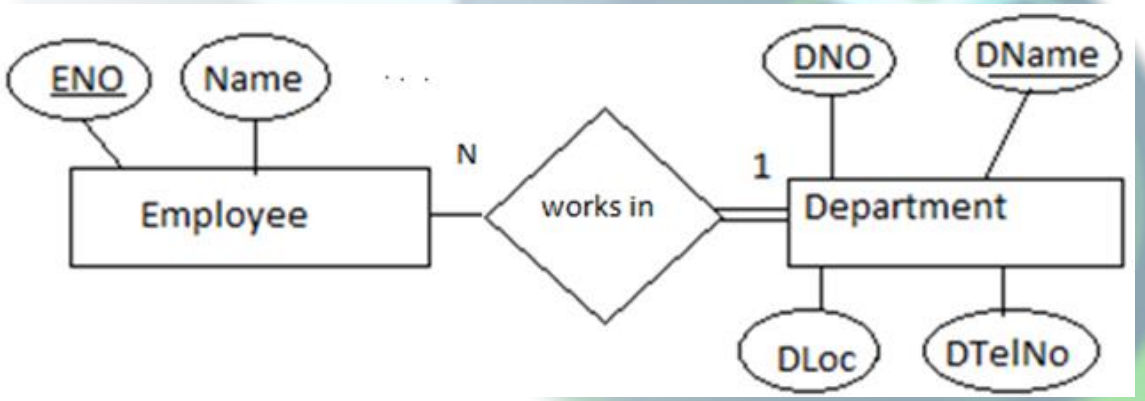
Example-1 (one-many)

- Any Employee has his/ her own department, where works in
- One department has many employees or
- Employee belongs to department

ER Diagram with Relationship one to many

Example-2 (one-many)

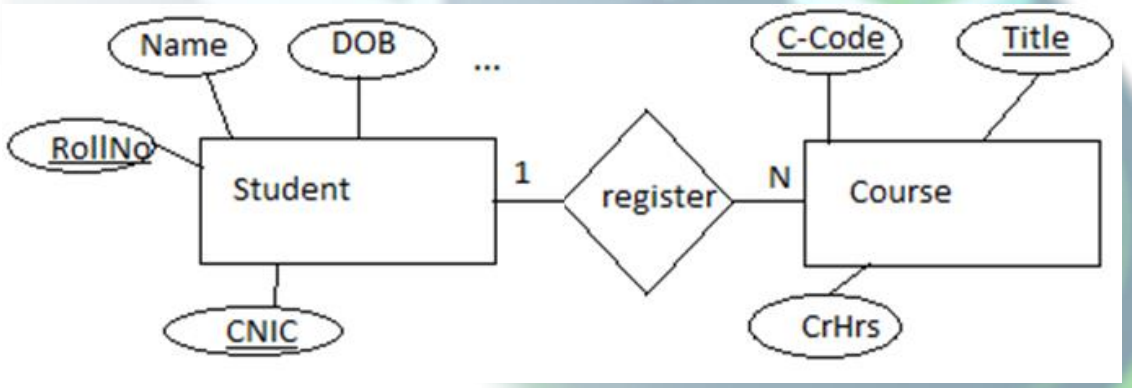
- Any Employee has his/ her own department, where works in
- Any one department has at least ONE or many employees
- Employee belongs to department



ER Diagram with Relationship one to many

Example-3 (one-many)

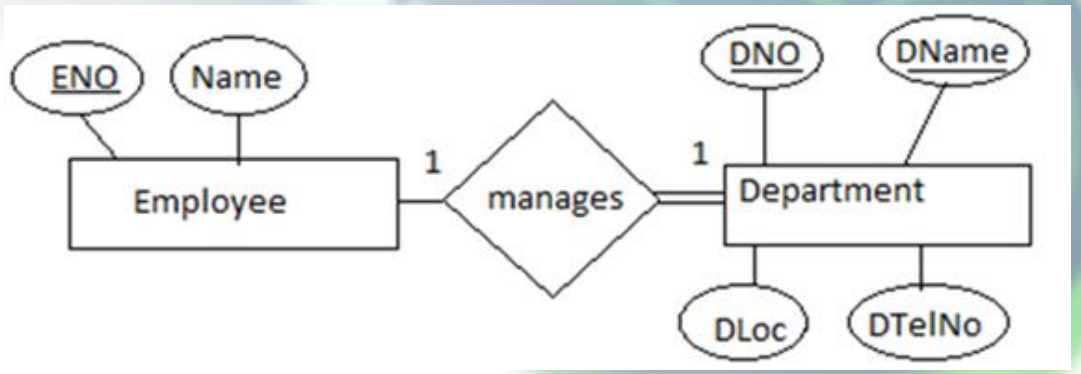
- Below diagram is NOT correct.
- Any one student can takes or registers many courses
- But any one course is taken by many students



ER Diagram with Relationship one to many

Example-4 (one-one)

- Some of employees will be a manager of departments.
- Any one employee will be a manager of any one department but at the same time cannot be a manager of multiple departments
- Any one department has one manager as an employee.



ER Diagram with Relationship one to many

Exercise

Combining ER Diagrams of both one to one and one to many
Entities are Department & Employee

Introduction to Database Administration

ER Diagram with Relationship many to many

ER Diagram with Relationship many to many

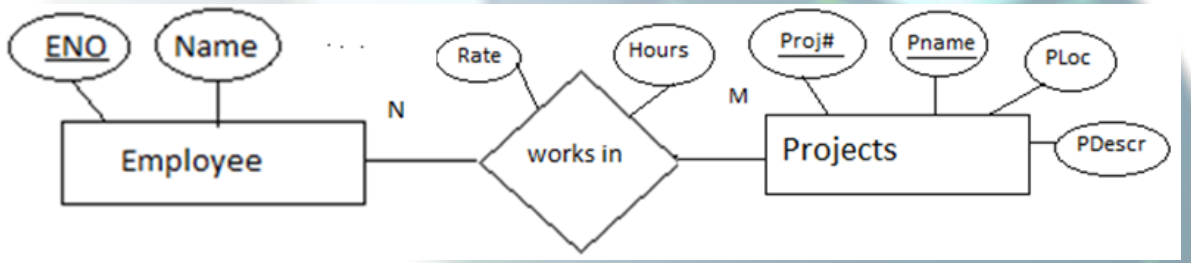
Attributes Display

- Example-1 (M-N)
- Example-2 (M-N)
- Example-3 (M-N)
- Example-4 (M-N)
- Exercise

ER Diagram with Relationship many to many

Example-1 (many-many)

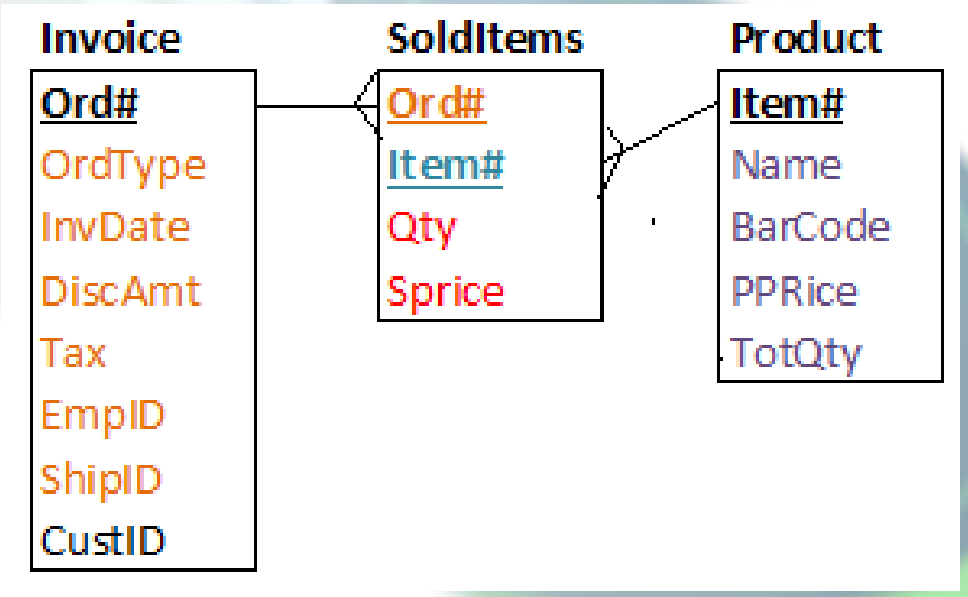
- Any Employee has his/ her own department, where works in as full time employee.
- Additionally, Employee works in a Project with number of hours and rate per hour



ER Diagram with Relationship many to many

Example-2 (many-many)

- Customer buys items with invoice.
- Any one invoice contains many products/ items and same product is sold on many invoices.



ER Diagram with Relationship many to many

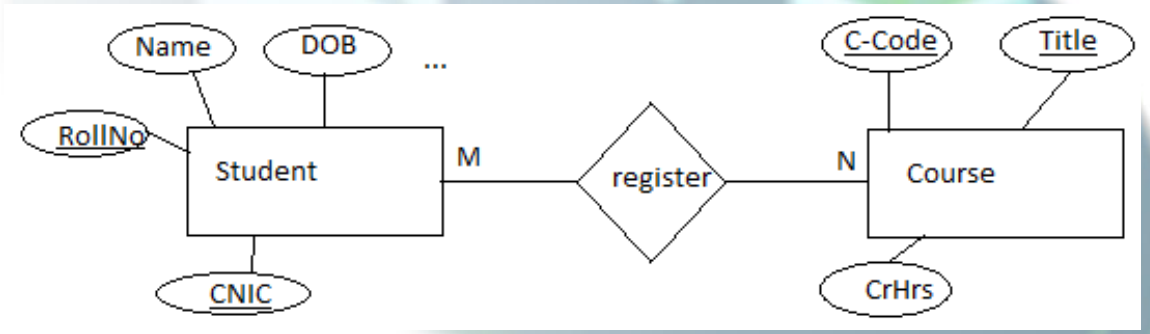
Example-3 (many-many)

- Every course is offered with book as its recommended and reference books.
- Any book can referred in many courses.

ER Diagram with Relationship many to many

Example-4 (many-many)

- Below diagram is no longer be valid if student re-enrolled in course again.
- Enrollment requires semester as well.



ER Diagram with Relationship many to many

Exercise

Exercise-4 needs to be drawn with correctness, using semester entity after course offering. Such diagram is called ternary ER relationship.

ER Diagram with Identifying & Weakness Relationship

ER Diagram with Identifying & Weakness Relationship

Attributes Display

- Identifying & Weakness
- Identifying & Identified entities
- Example-1
- Example-2

ER Diagram with Identifying & Weakness Relationship

Identifying and weakness

- An entity whose existence depends on some other entity type is called a weak entity type. Other wise it is called a strong entity type.
- There is a chance of records' duplications on non-key attributes in weak entity types.
- Child entity depends on other parent entity. Parent entity is identifying the child entity.
- Weakness can be reduced only.

ER Diagram with Identifying & Weakness Relationship

Identifying and identified entities

- All ID-Dependent (identified) entities MAY BE considered weak.
- Examples are

  Employee & Family Members

  ATM Card & Transactions,

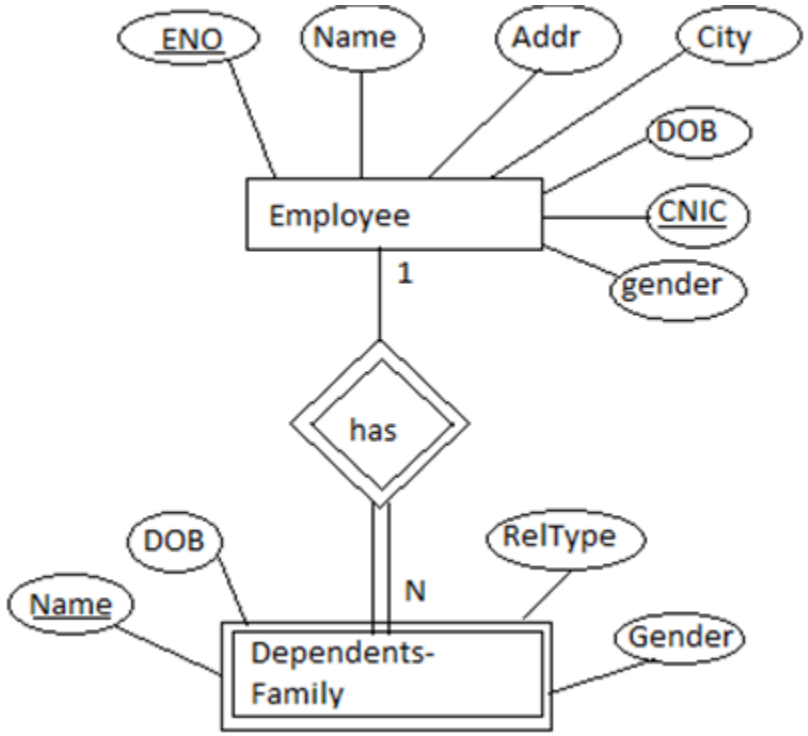
  Patient and Patient visits,

  Patient & Issue Medicines,

  Loan and its Installments

ER Diagram with Identifying & Weakness Relationship

Example-1

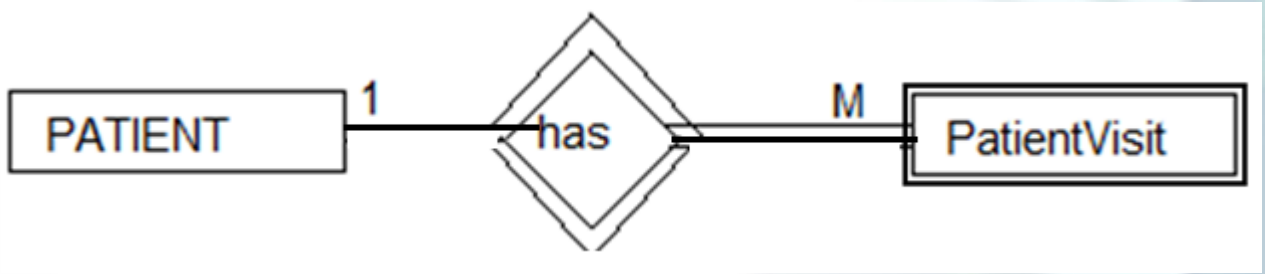


EMPLOYEE(ENO, Name, Gender, DOB, Addr, City, CNIC)
Dependent(ENO, SNO, Name, Gender, DOB, RelType)

ER Diagram with Identifying & Weakness Relationship

Exercise

Scenario: Identifying & Weak relationship



Scenario: Identifying & Strong relationship

Introduction to Database Administration

ER Diagram with Mapping

ER Diagram with Mapping

ER Diagram with Mapping

- Relational Schema - Implementation Datasets
- Example-1: Mapping 1-1
- Example-2: Mapping 1-N
- Example-3: Mapping M-N
- Example-4: Mapping of Ternary Relationship
- Mapping of Schema

ER Diagram with Mapping

Relational Schema – Implementation
PKs, FKs are required

Course

CourseID	Title	CrHrs	Pre-Req
CS203	Database System	3-3-3	CS201
CS201	Data Structure	3-0-3	CS101
CS303	Software Engineering	3-0-0	

CrsOffer

SemID	CourseID	Sec	Instr	B#	Room#	MasStu
F2018	CS201	A	Ali Hassan	2	203	40
F2018	CS201	B	Jamil	3	301	40
S2019	CS203	A	Ejaz	2	203	55
S2019	CS303	A	Jamil	1	101	50
~~S2019~~	~~CS407~~	~~A~~		~~3~~		~~40~~

Our ER gives relational schema tables similar to above …

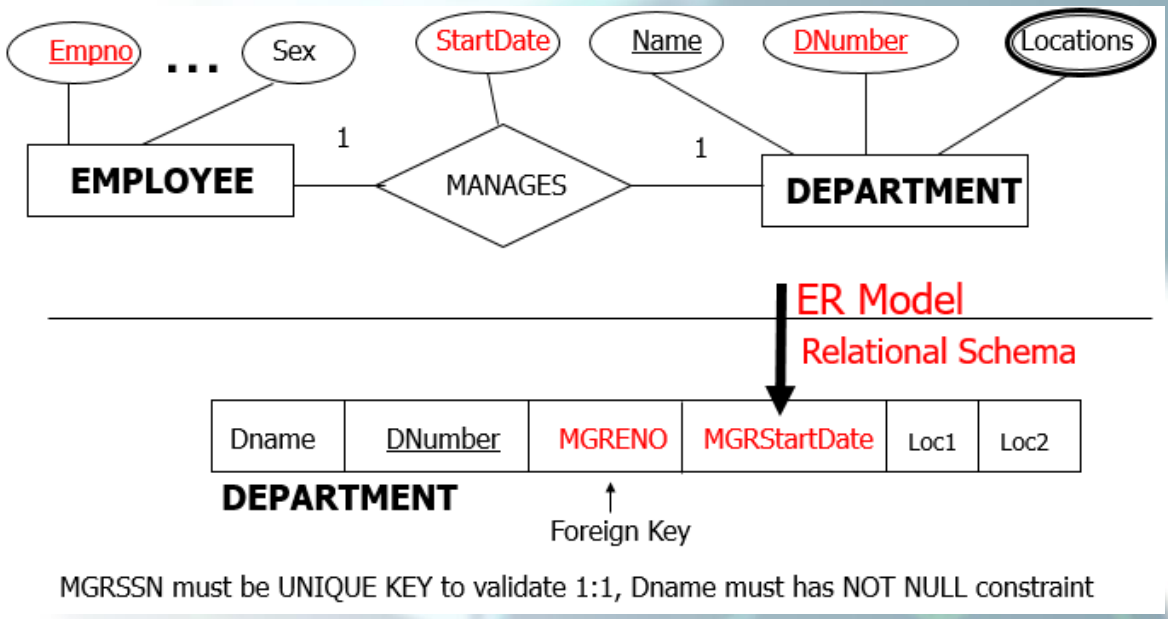
Applying Knowledge – Do able artifacts (Implementation)

Each mapped table will have fewer records

Records should be referenced with the possible variations in tables

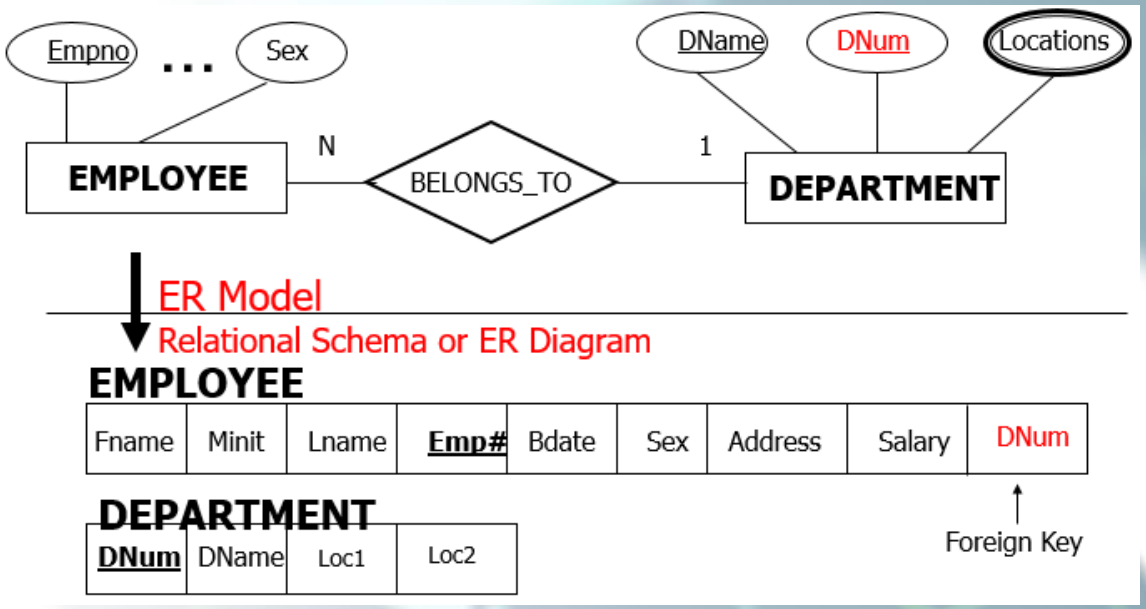
ER Diagram with Mapping

Example-1: Mapping 1-1



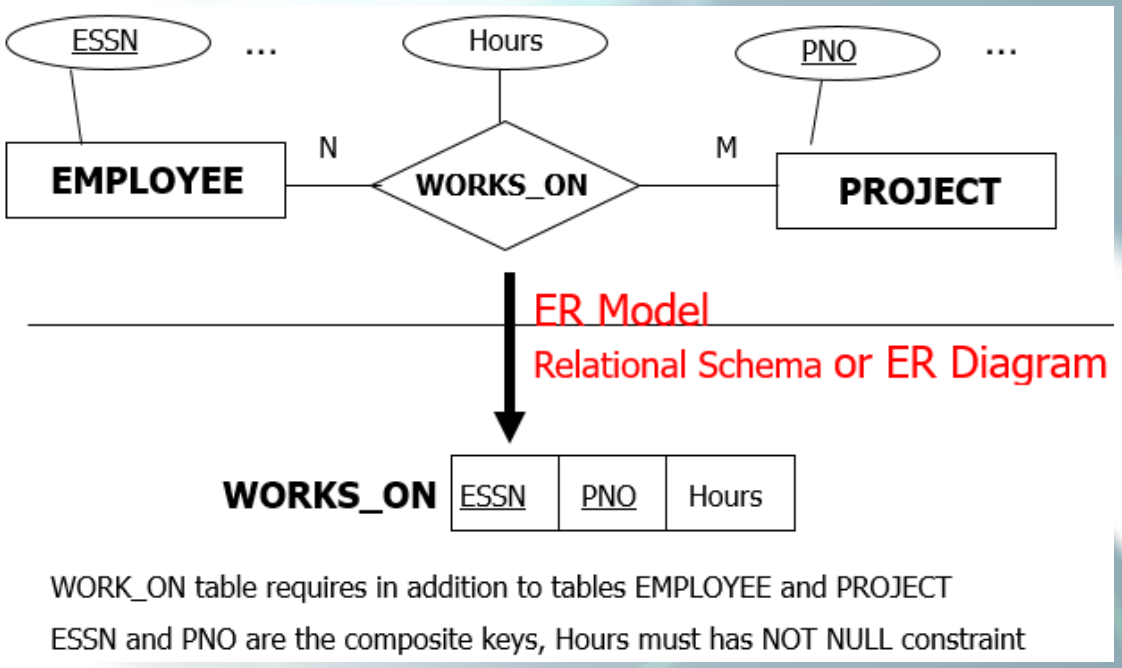
ER Diagram with Mapping

Example-2: Mapping 1-N



ER Diagram with Mapping

Example-3: Mapping M-N

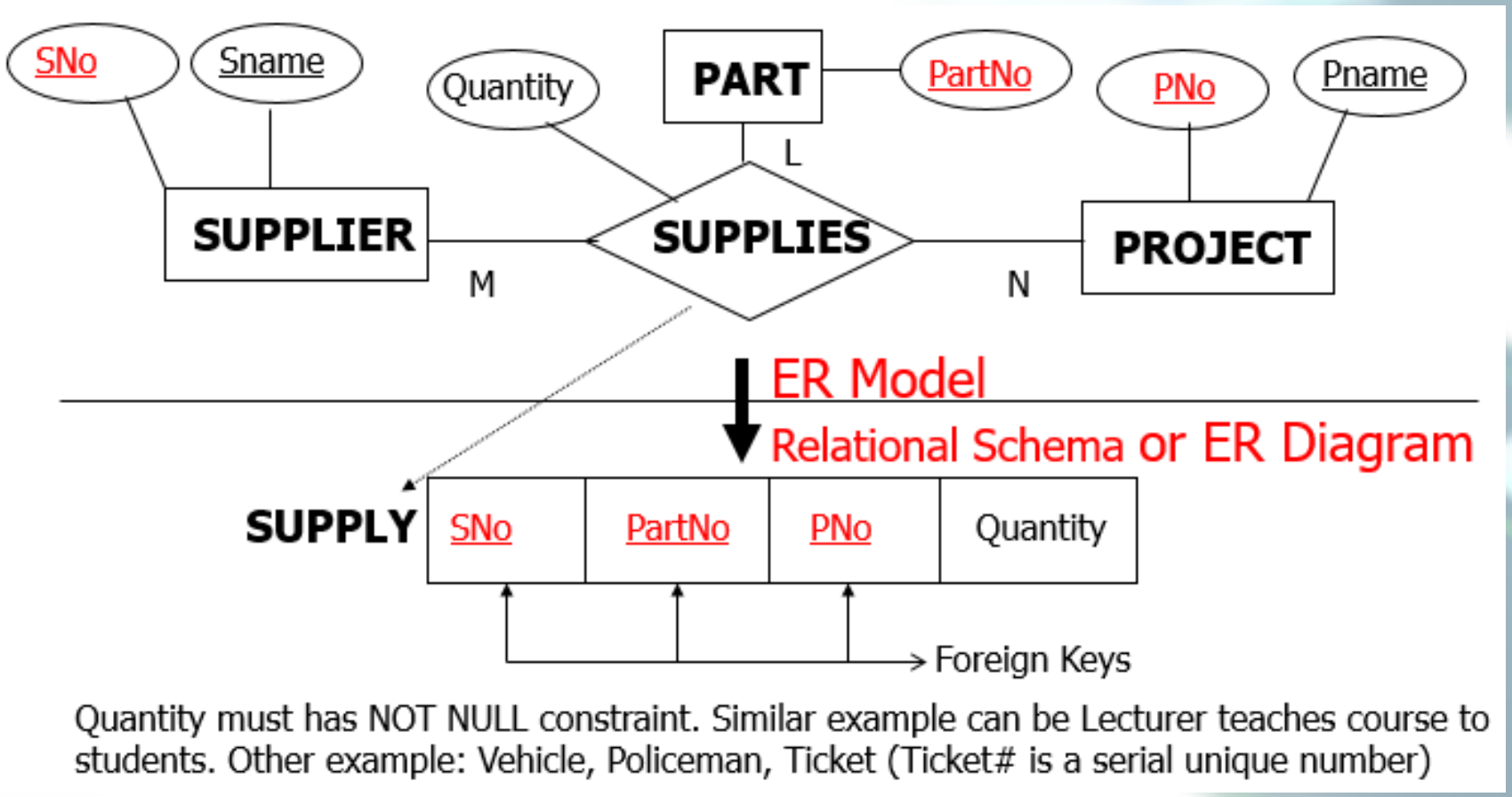


WORK_ON table requires in addition to tables EMPLOYEE and PROJECT

ESSN and PNO are the composite keys, Hours must has NOT NULL constraint

ER Diagram with Mapping

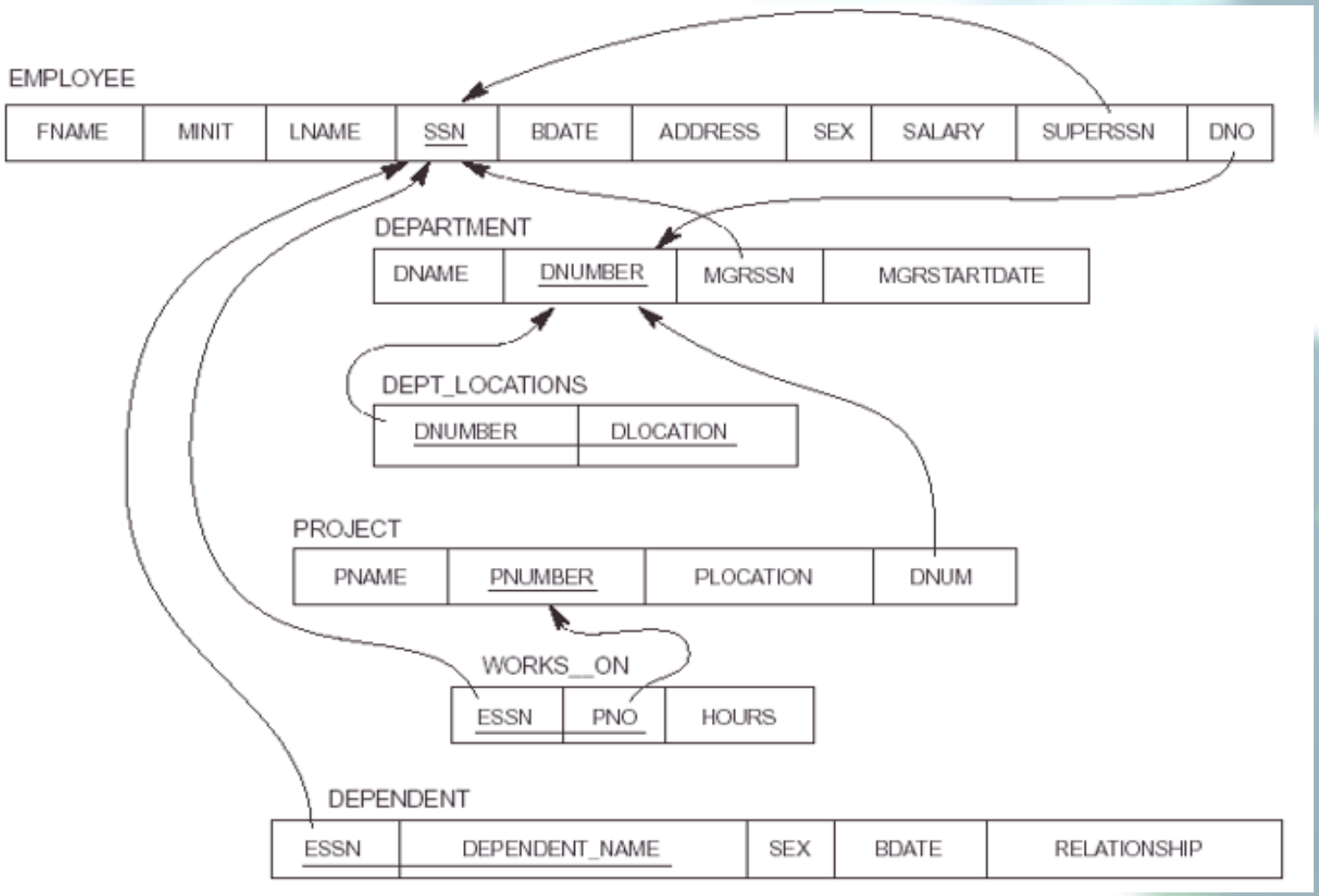
Example-4: Mapping of Ternary Relationship



Quantity must has NOT NULL constraint. Similar example can be Lecturer teaches course to students. Other example: Vehicle, Policeman, Ticket (Ticket# is a serial unique number)

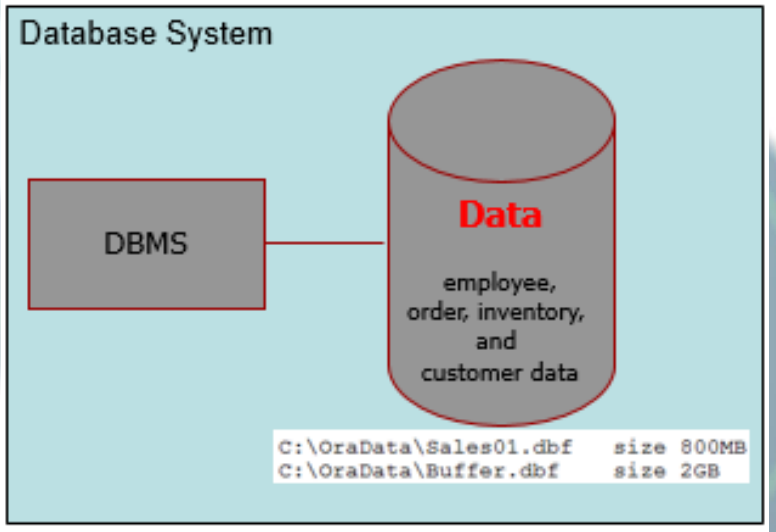
ER Diagram with Mapping

Mapping of Schema



Introduction to Database Administration

Oracle DBMS



Oracle DBMS

Oracle DBMS

- Definition
- Relational Model
- Relational DB Elements
- How data is organized?
- RDBMS Operations
- Oracle DBMS Quick History

Oracle DBMS

Definition

Database Management System (DBMS) is a software package that controls the storage, organization, and retrieval of data, a DBMS has the following elements:

- Kernal code (manages memory and storage)
- Repository of metadata (data dictionary)
- Query Language (accessing data)

Oracle DBMS

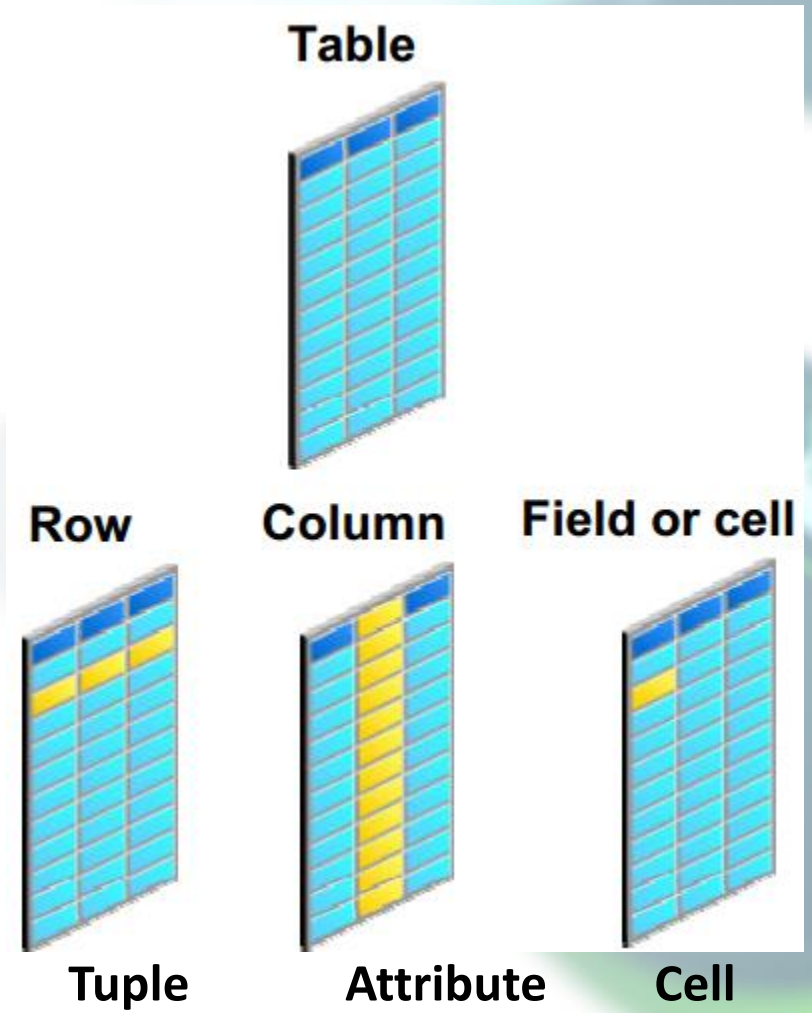
Relational Model

Scientist E. F. Codd defined relational model based on mathematical theory, called relational model. The relational model has the following major aspects:

- Structures (Well-defined objects store or access the data)
- Operations (data manipulation)
- Integrity rules (constraints or restrictions)

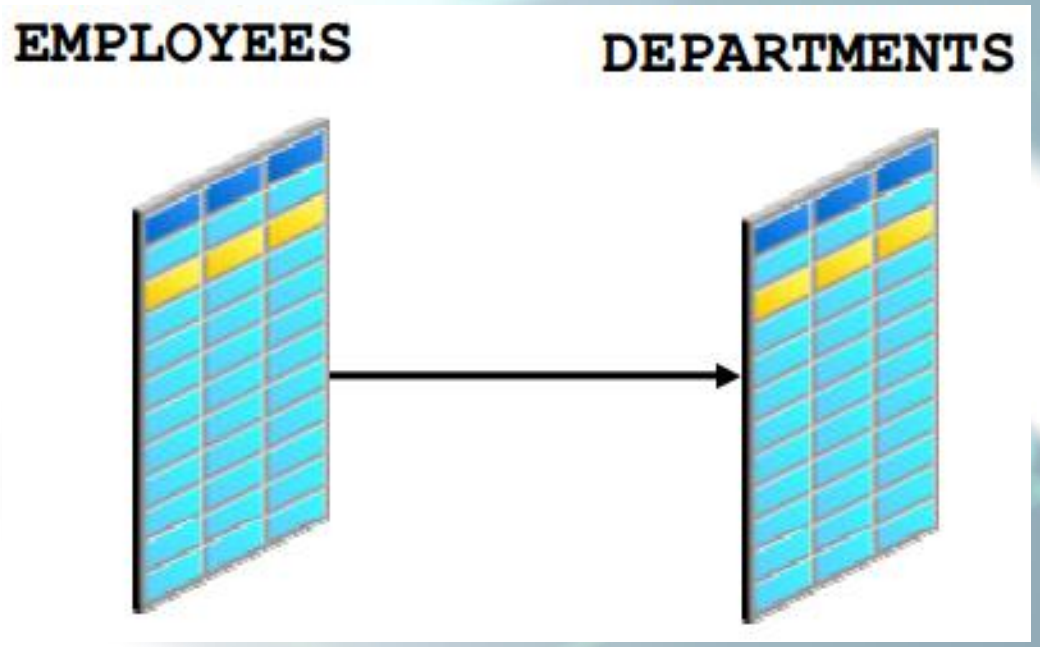
Oracle DBMS

Relational Database Elements



Oracle DBMS

How data is organized?



Oracle DBMS

RDBMS Operations

- **Logical operations**

An application specifies what content is required. For example, an application requests an employee name or adds an employee record to a table. Execution of DDL in an application or schema of DBMS.

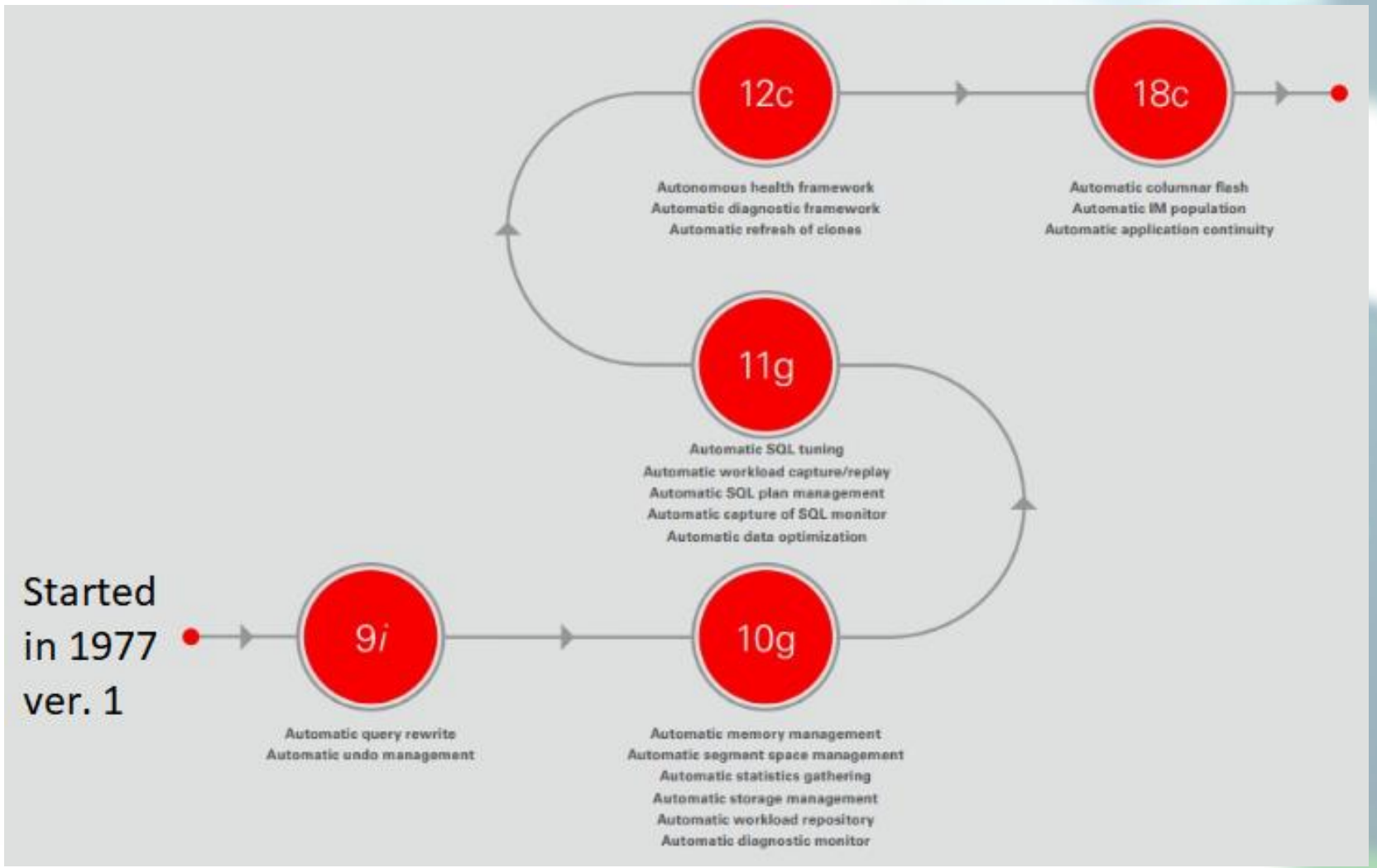
- **Physical operations**

RDBMS determines how things should be done and carries out the operation. For example, after an application queries a table, the database may use an index to find the requested rows and read the data into memory etc. before returning result.

Both operations are independent to each other

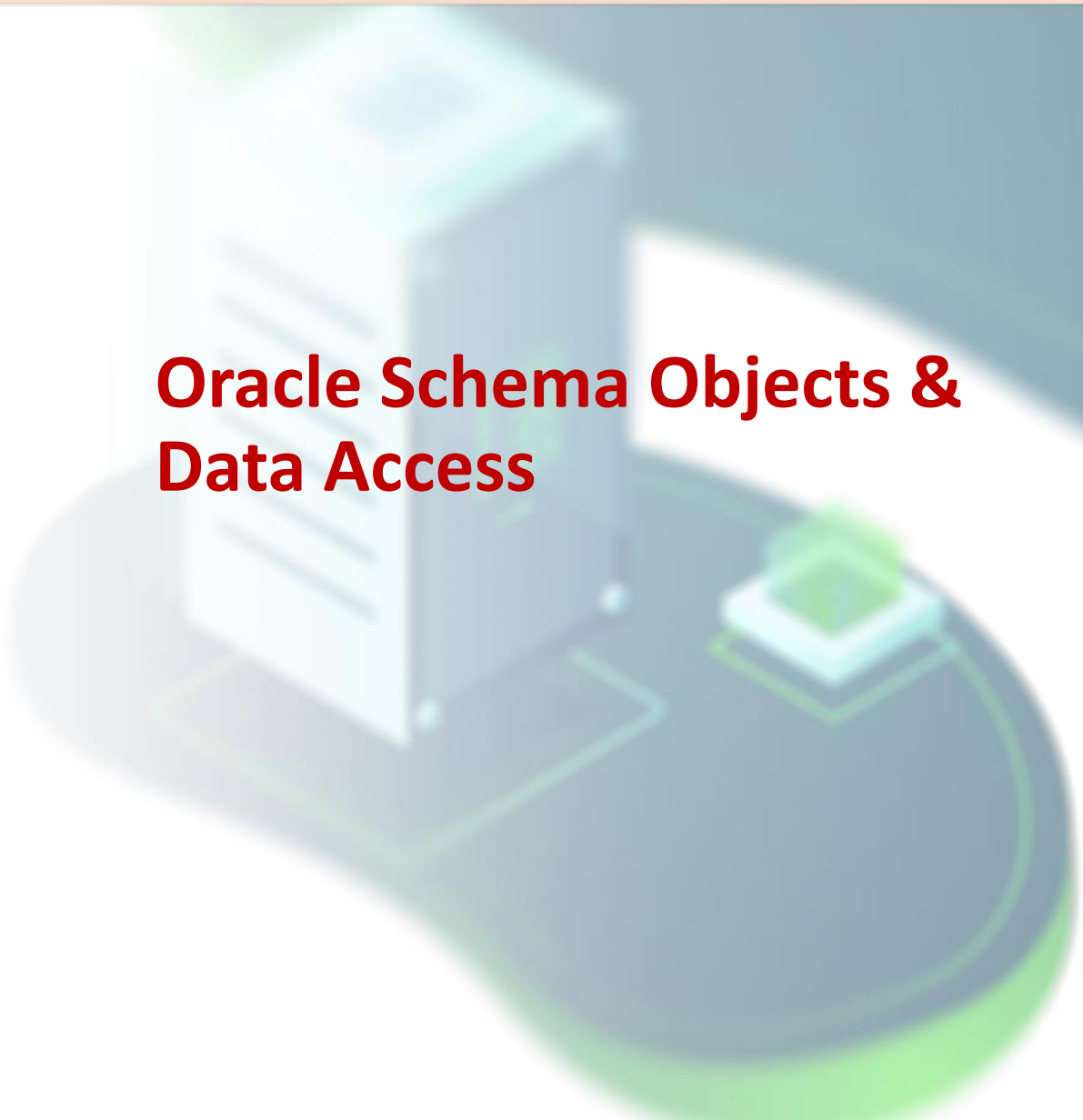
Oracle DBMS

Oracle DBMS Quick History



www.oracle.com

Introduction to Database Administration



Oracle Schema Objects & Data Access

Oracle Schema Objects & Data Access

Oracle Schema Objects & Data Access

- Schema Objects
- Types of Schema Objects
- Tables
- Indexes
- Tables & Indexes in a Schema
- Views, Sequences & Synonym
- Data Access

Oracle Schema Objects & Data Access

Schema Objects

- Physical data storage is independent from logical data structures
- Schema is a collection of data structures, or schema objects
- Schema is owned by the database user name.
- Schema objects such as tables, views, indexes and sequences etc. are user-created structures that directly refer to the data (files) in the database.
- BMS created objects are data dictionary views, user's roles etc.

Oracle Schema Objects & Data Access

Types of Schema Objects

- Tables
- Indexes
- Constraints
- Sequences
- Views
- Triggers
- Sequences
- Synonym
- PL/SQL subprograms and packages, Java Classes etc.

Oracle Schema Objects & Data Access

Tables

- Basic storage unit or schema object for storing data in structured form
- Table consists rows and columns with specific data types of columns
- Maximum number of columns are 255 and unlimited number of rows or tuples in a table
- Every table is uniquely identified in a schema
- Integrity constraints such as NOT NULL, CHECK and PKs etc. are applied on table's columns

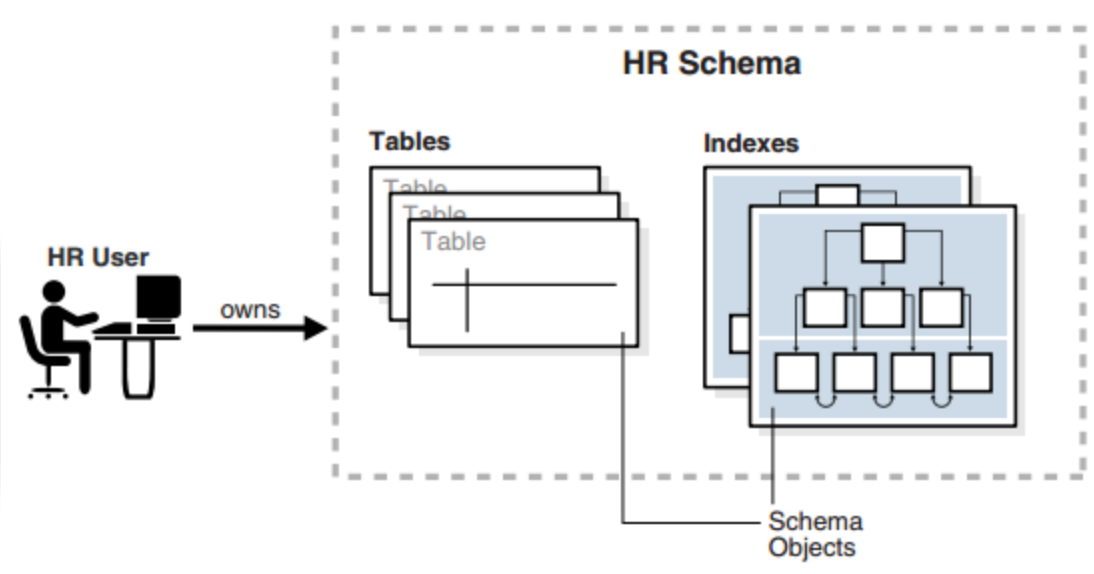
Oracle Schema Objects & Data Access

Indexes

- An index is an optional data structure that can be created on one or more columns of a table.
- Index can increase performance of data retrieval
- Index can be created on searching columns
- Indexes are physically and logically independent

Oracle Schema Objects & Data Access

Tables & Indexes in a Schema



Oracle Schema Objects & Data Access

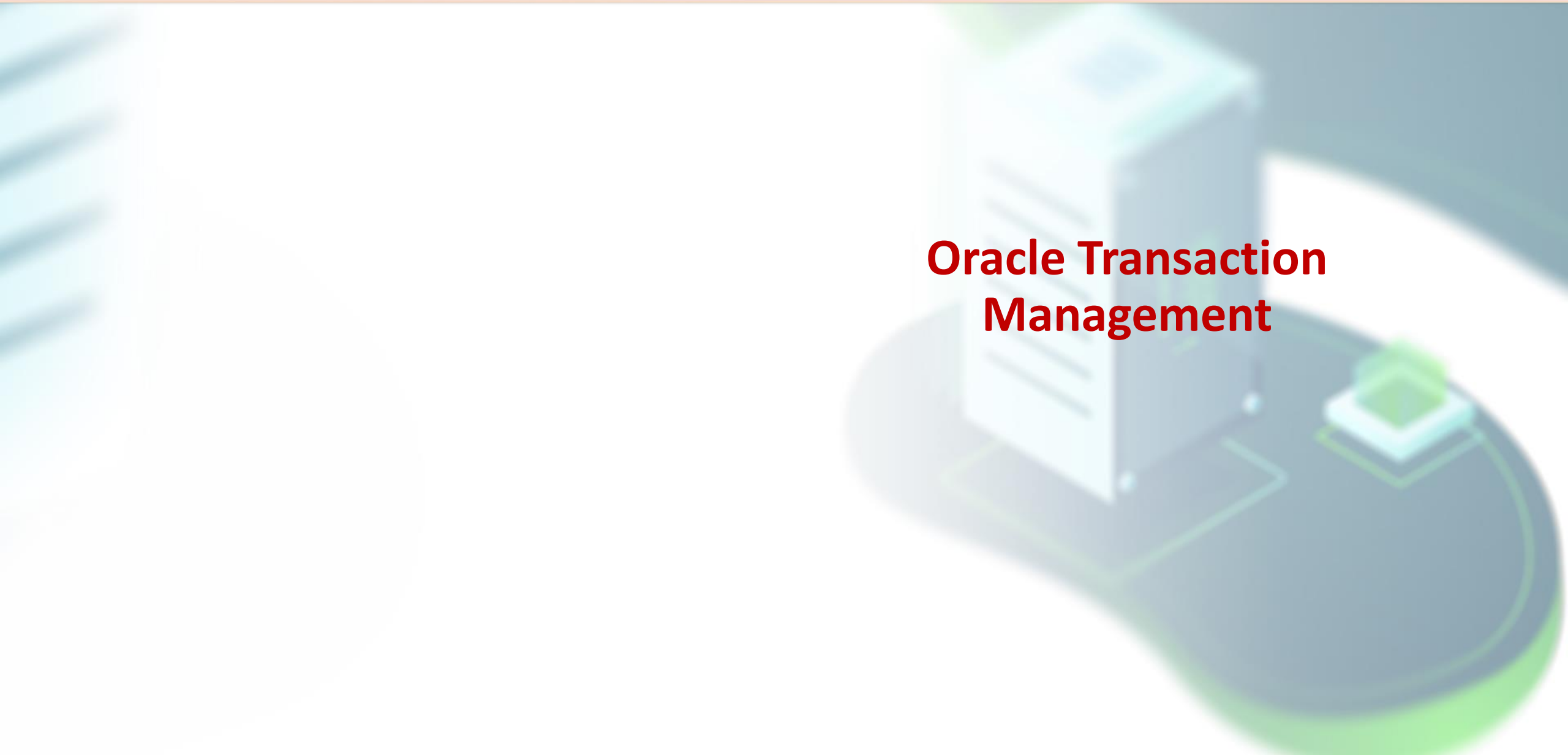
Views, Sequences & Synonym

- Stored queries are called Views. Views do not keep separate data rather they extract data from tables
- A Sequence is a user-created object that can be shared by multiple users. It can be ised for PK column.
- A Synonym is an alias for another schema object and does not require separate storage

Oracle Schema Objects & Data Access

Data Access

- Data is accessed by SQL from DBMS.
- PL/SQL, Java are also used to access the data from DBMS
- Data is accessed by sub languages DML and DCL.
- Data is accessed in logical schema from physical data files through internal schema. Access paths for data access may varied.



Oracle Transaction Management

Oracle Transaction Management

Oracle Transaction Management

- Transaction management
- Multi-user Environment
- Transactions
- Example of Funds Transfer
- All or Nothing Transaction
- PL/SQL Transaction Example

Oracle Transaction Management

Transaction Management

Oracle Database is designed as a multiuser database. The database must ensure that multiple users can work concurrently without corrupting one another's data.

Oracle Transaction Management

Multi-user Environment

Oracle Database is designed as a multiuser database. The database must ensure that multiple users can work concurrently without corrupting one another's data.

Oracle Transaction Management

Transactions

SQL is initiated at user level (client) and it executes on Server (central Database) at a distant, may be from one city to another.

A transaction is a logical, atomic unit of work (block) that contains one or more SQL statements.
Either transaction is done (committed) or not done (rolled back). No partial execution of transaction is allowed.

Oracle Transaction Management

Example of Funds Transfer

A transaction is a funds transfer from a saving account to a checking account. The transfer consists of the following separate operations:

1. Decrease the saving account
2. Increase the checking account
3. Record the transaction in the transaction journal

Oracle Transaction Management

Example of Funds Transfer

Oracle Database guarantees that all three operations succeed or fail as a unit. In case of failure, all three operations will be rolled back.

Oracle Transaction Management

All or Nothing Transactions

If you perform an atomic operation that updates several files, and if the system fails halfway through, then the files will not be consistent. In contrast, a transaction moves an Oracle Database from one consistent state to another

All or nothing, basic principle of atomic execution of a transaction

Oracle Transaction Management

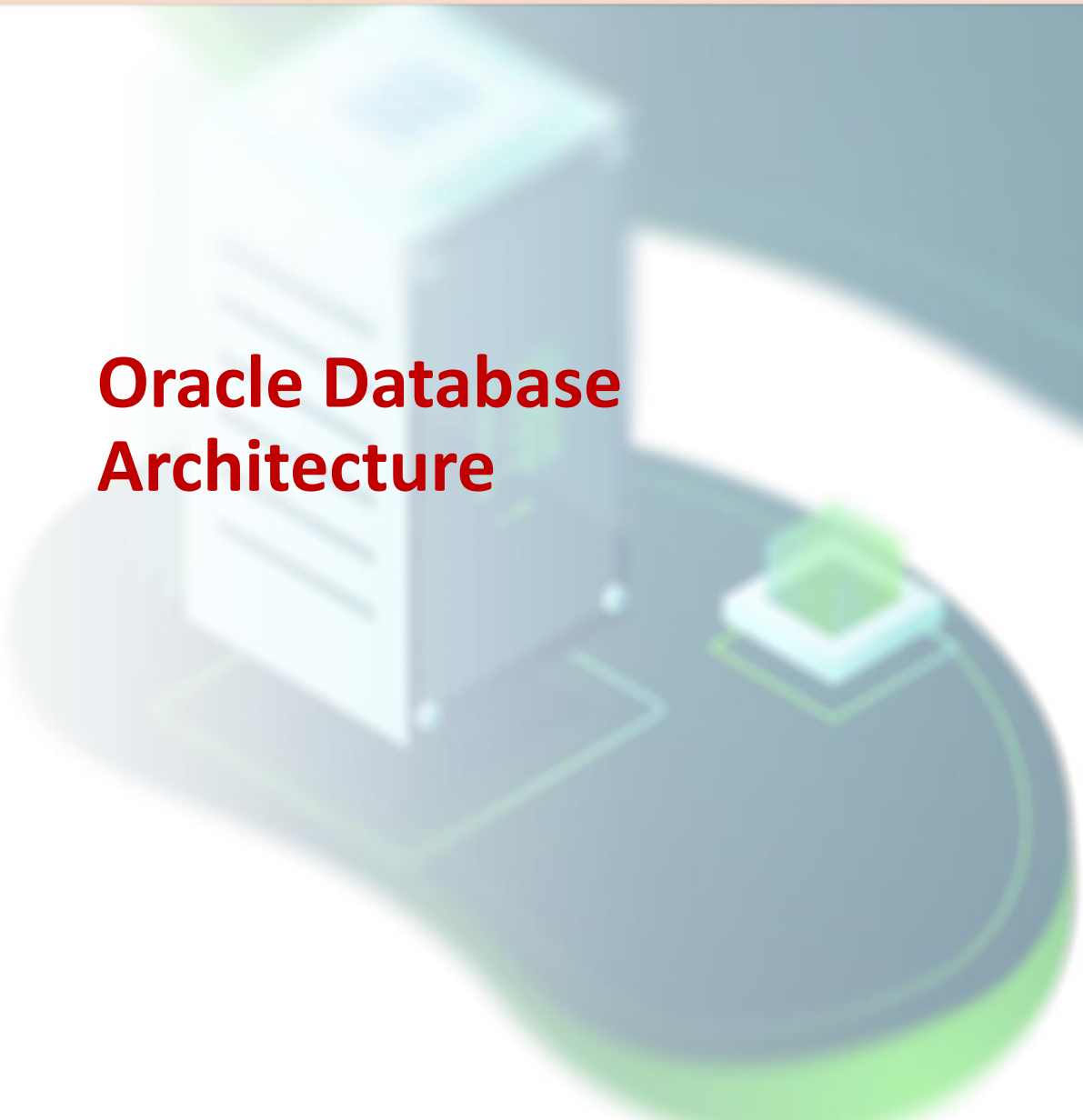
PL/SQL Transactions Example

```
BEGIN
     update emp
     set sal = 500
     where empno = 7988;

     delete from emp
     where empno = 7414;

     COMMIT;
EXCEPTION
    WHEN OTHERS THEN
    ROLLBACK;
END;
/
```

Introduction to Database Administration



Oracle Database Architecture

Oracle Database Architecture

Oracle Database Architecture

- Database Architecture
- Database & Instance
- Oracle DB Server Architecture
- Instance DB Configuration
- Database Physical Storage Structure
- Database Logical Storage Structure

Oracle Database Architecture

Database Architecture

- A database server is the key to information management
- In general, a server reliably manages a large amount of data in a multiuser environment so that users can concurrently access the same data
- A database server also prevents unauthorized access and provides efficient solutions for failure recovery.

Oracle Database Architecture

Database & Instance

- A database is a set of files, located on disk, that store data. These files can exist independently of a database instance.
- An instance is a set of memory structures that manage database files. The instance consists of a shared memory area, called the system global area (SGA), and a set of background processes. An instance can exist independently of database files.

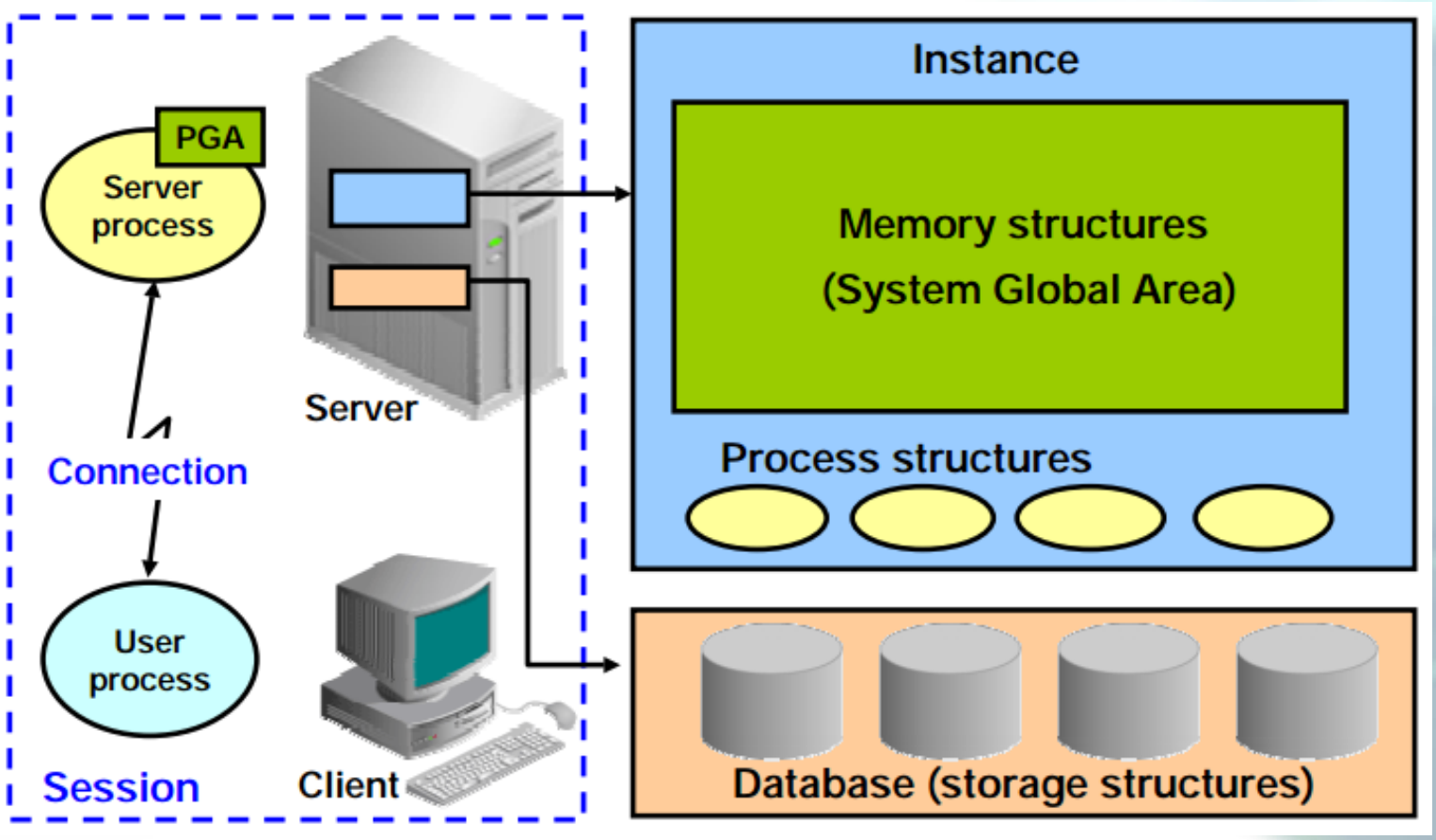
Oracle Database Architecture

Database & Instance

- Each client process is associated with its own server process. The server process has its own private session memory, known as the program global area (PGA).

Oracle Database Architecture

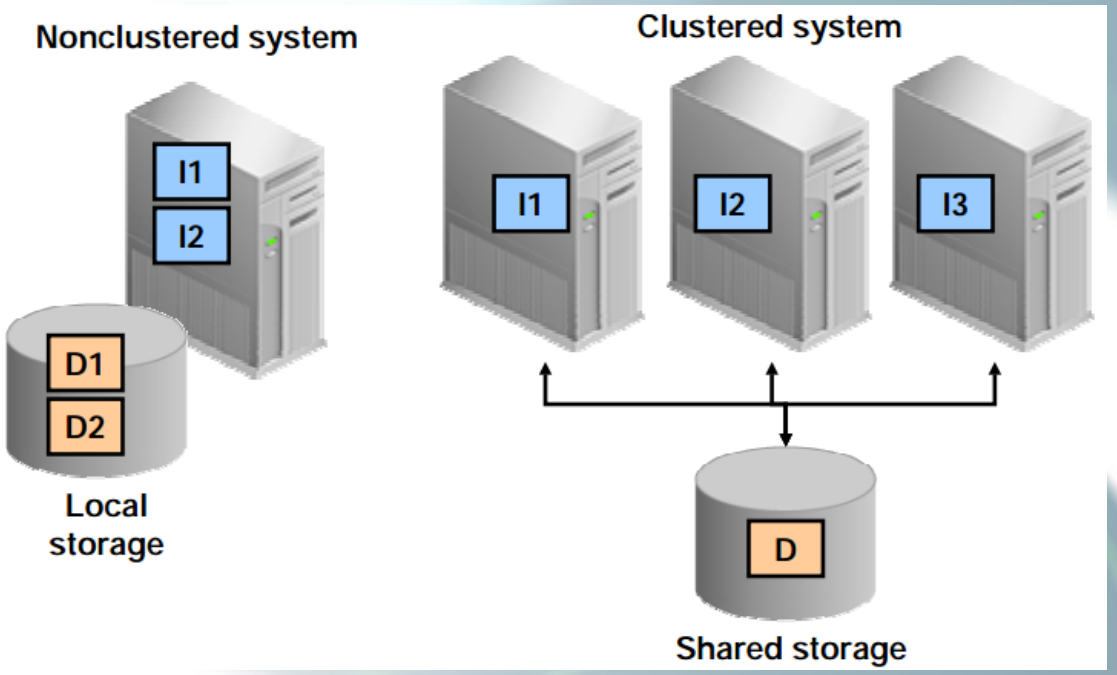
Oracle DB Server Architecture



Each client process is associated with its own server process. The server process has its own private session memory, known as the program global area (PGA).

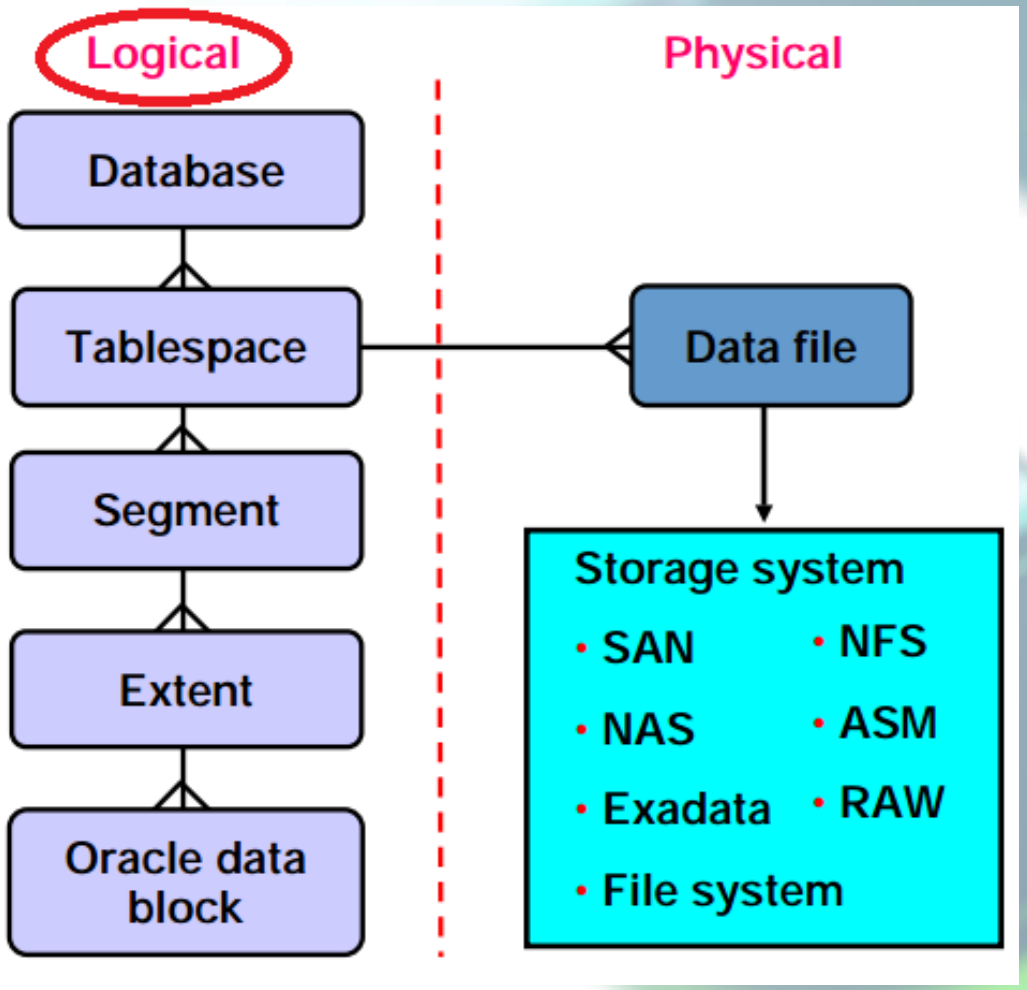
Oracle Database Architecture

Instance DB Configuration



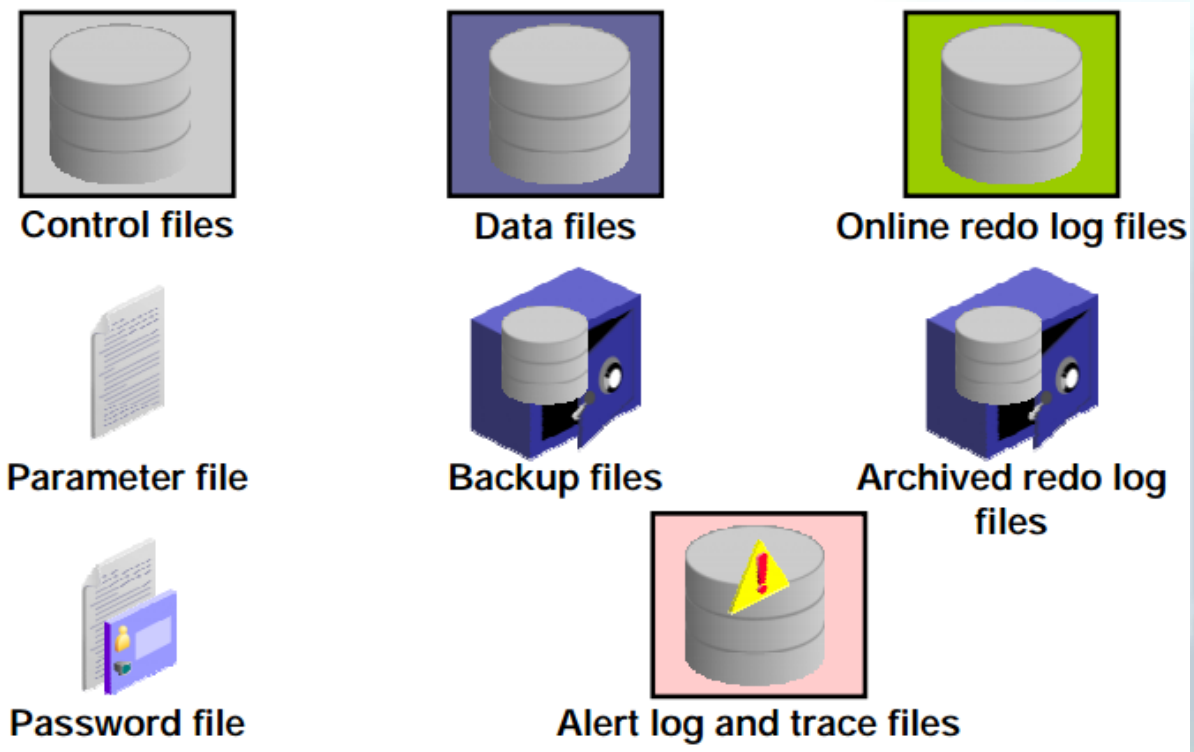
Oracle Database Architecture

Database Logical Storage Structure



Oracle Database Architecture

Database Physical Storage Structure



Introduction to Database Administration

Oracle11g Installation

Oracle11g Installation

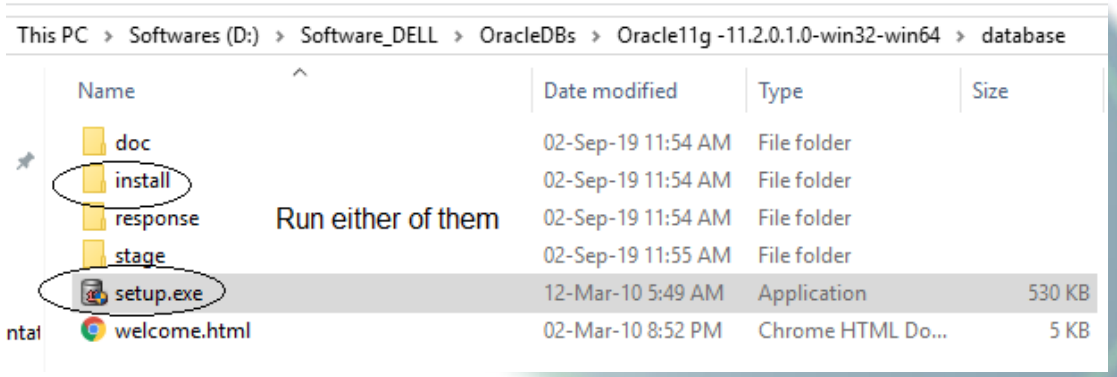
Installation Steps

- Installation Startup
- Installation …
- Login with Oracle Database Manager
- OS Services
- How to un-install Oracle?

Oracle11g Installation

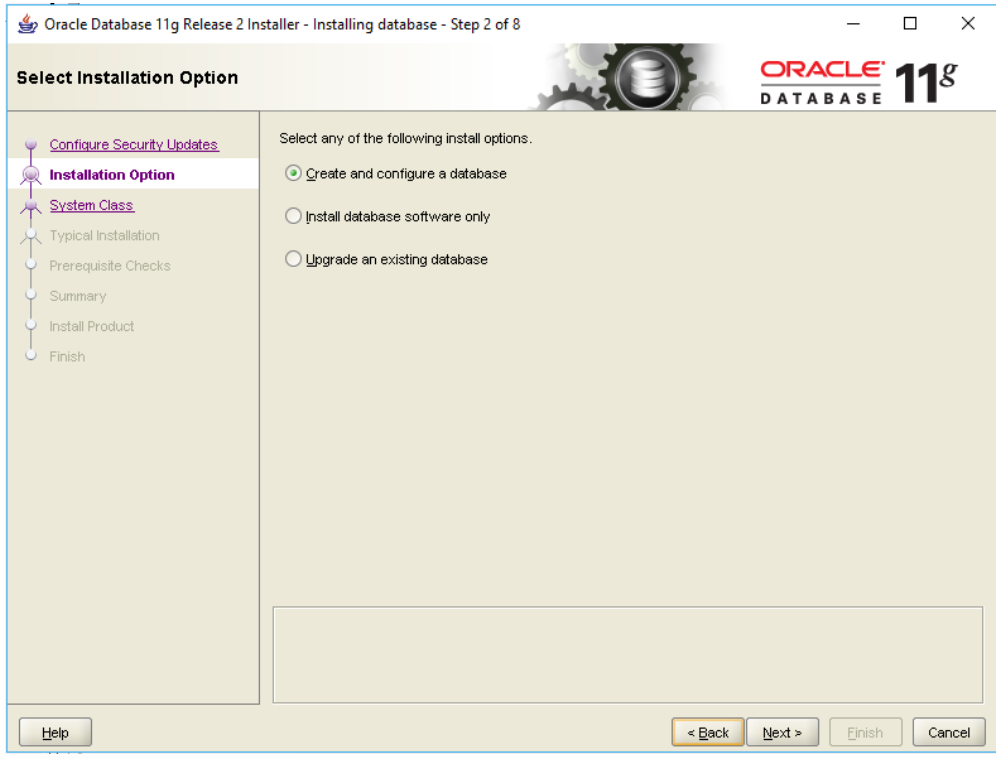
Installation Startup

Before Installing Oracle, you must installed complete OS windows with all patches and Activations (Install Java JDK 1.5 (e.g., jre-1_5_0-windows-i586.exe)
Run SETUP.EXE to start Oracle Universal Installer



Oracle11g Installation

Installation Startup

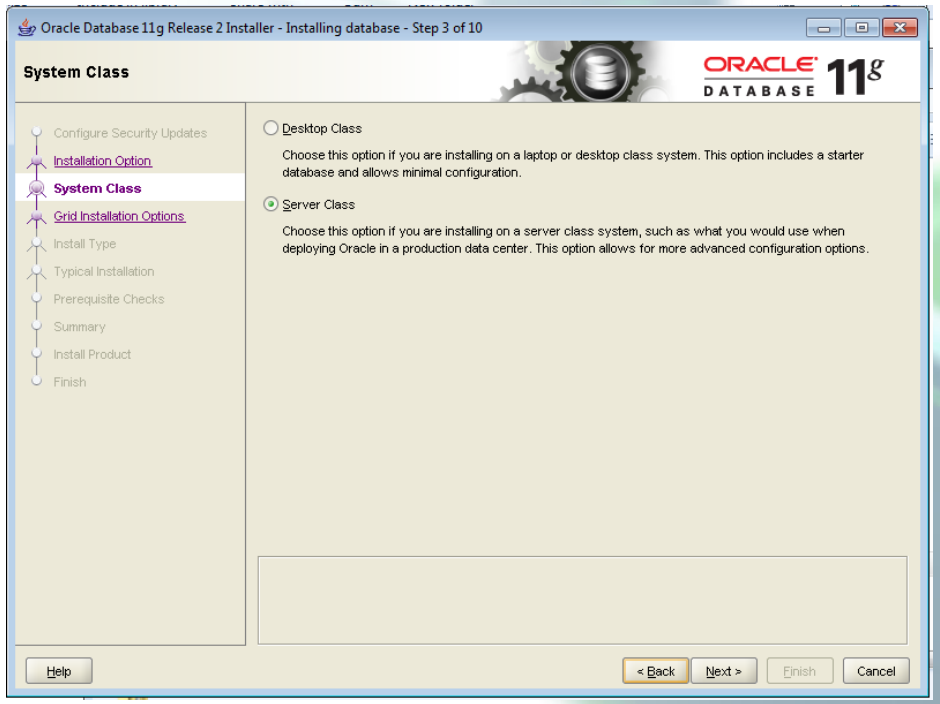


Before Installing Oracle, you must install complete OS windows with all patches and activations. You may get this pop up in case if you have oracle previous Installation, other proceed with next choice.

Oracle11g Installation

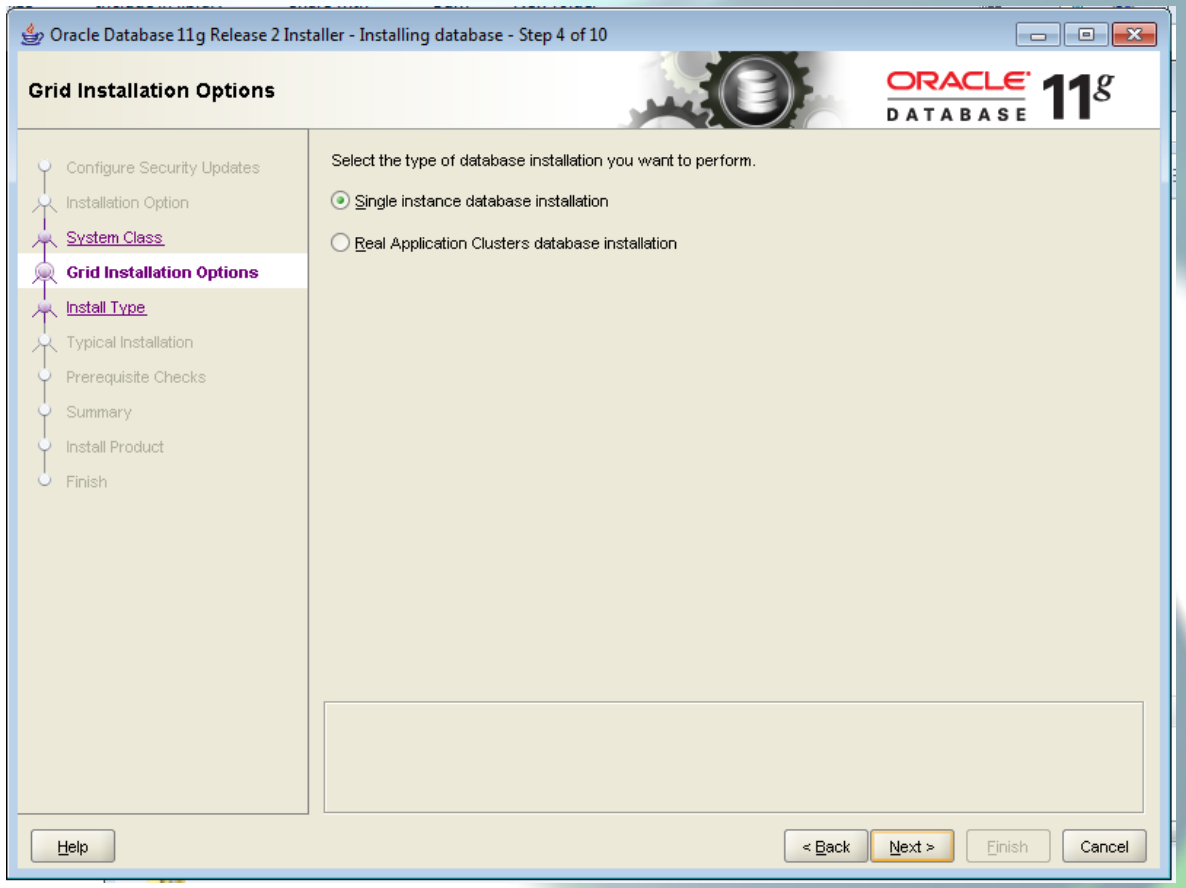
Installation Startup

Before Installing Oracle, you must installed complete OS windows with all patches and activations
Run SETUP.EXE to start Oracle Universal Installer



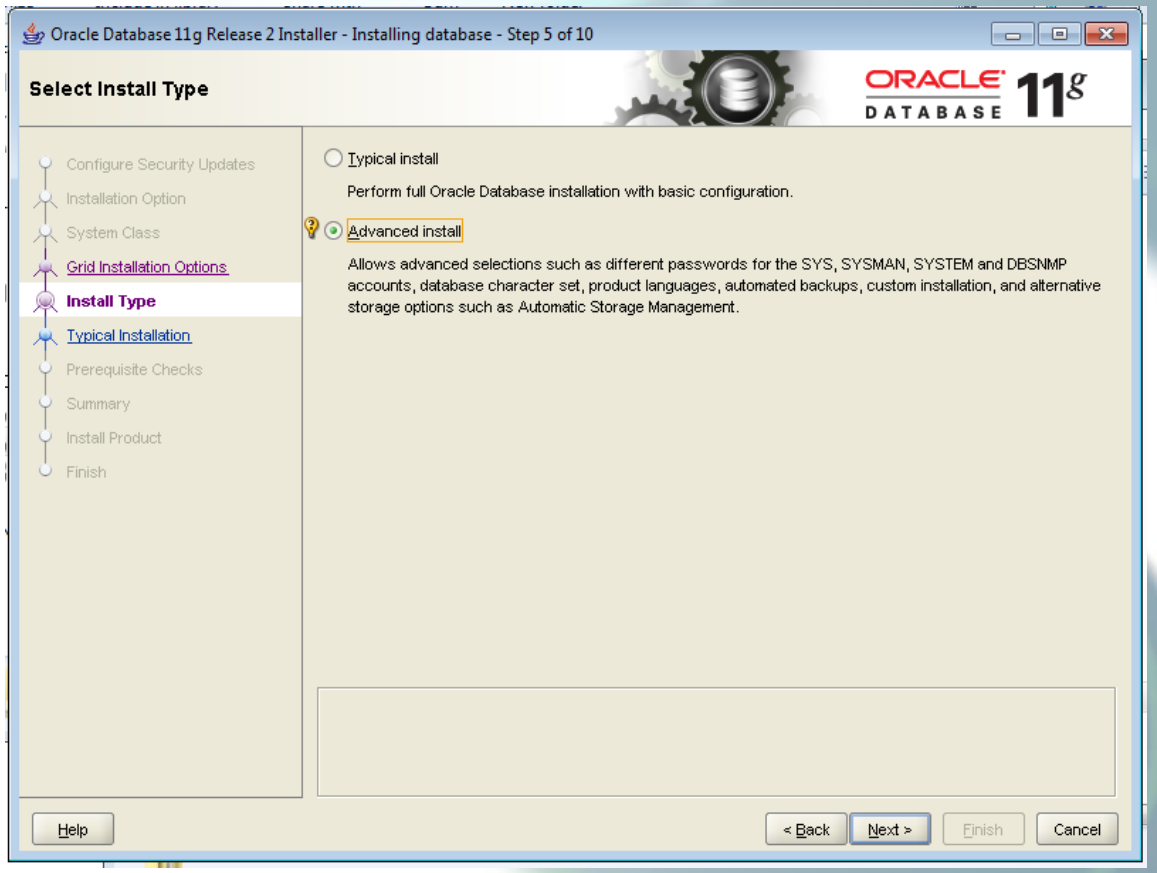
Oracle11g Installation

Installation



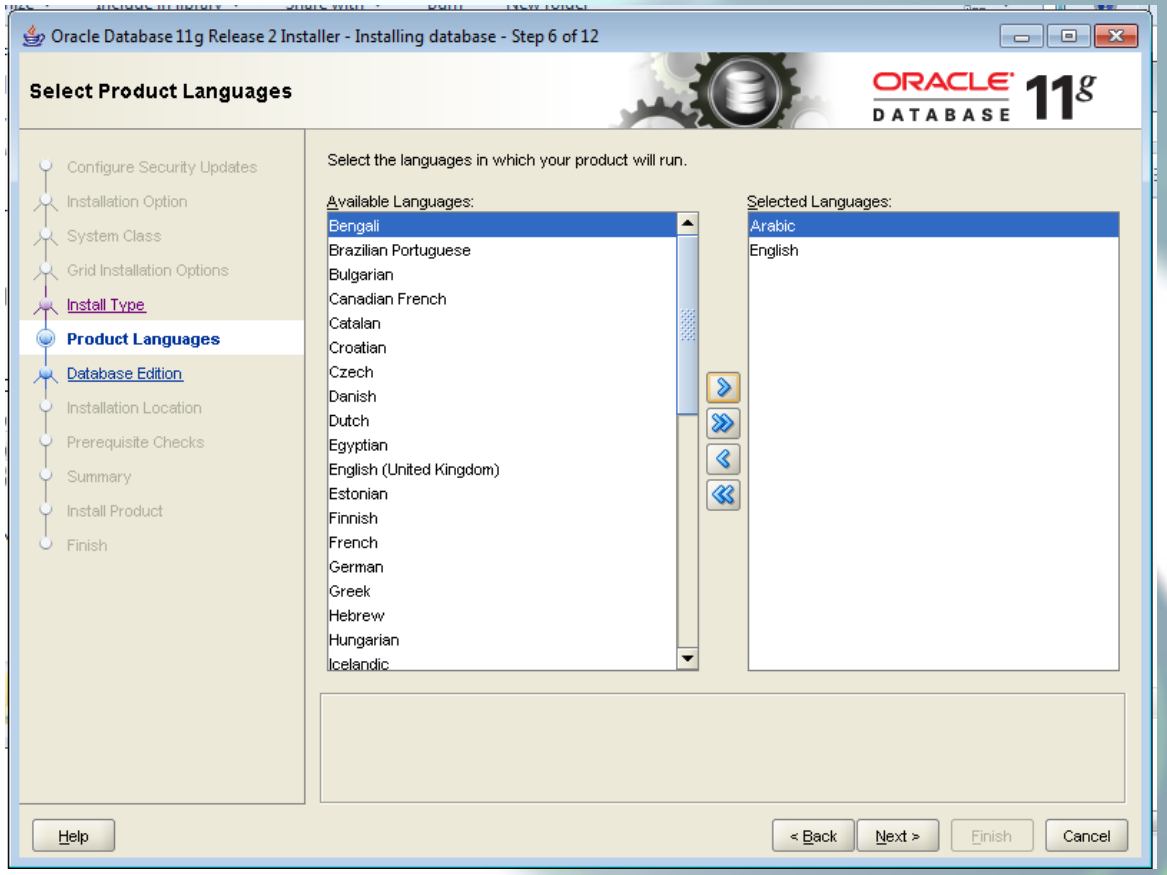
Oracle11g Installation

Installation



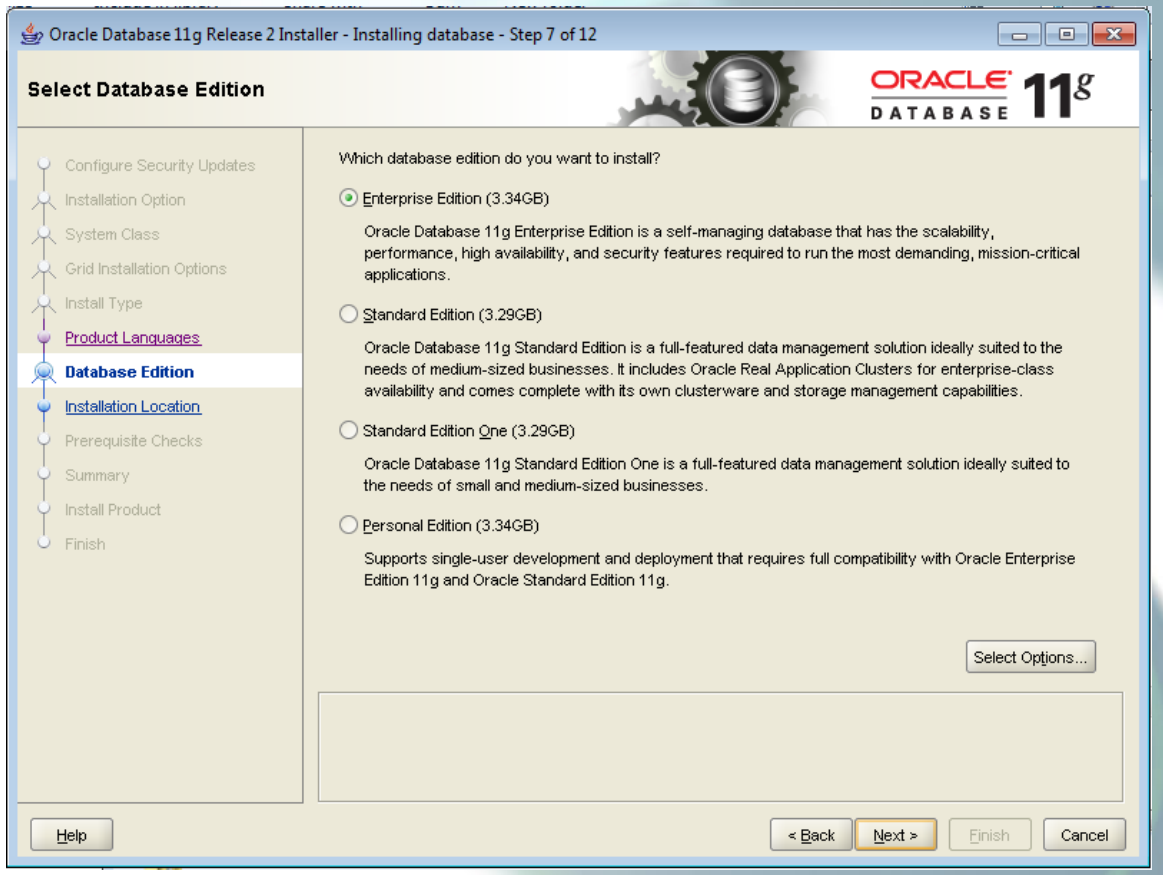
Oracle11g Installation

Installation



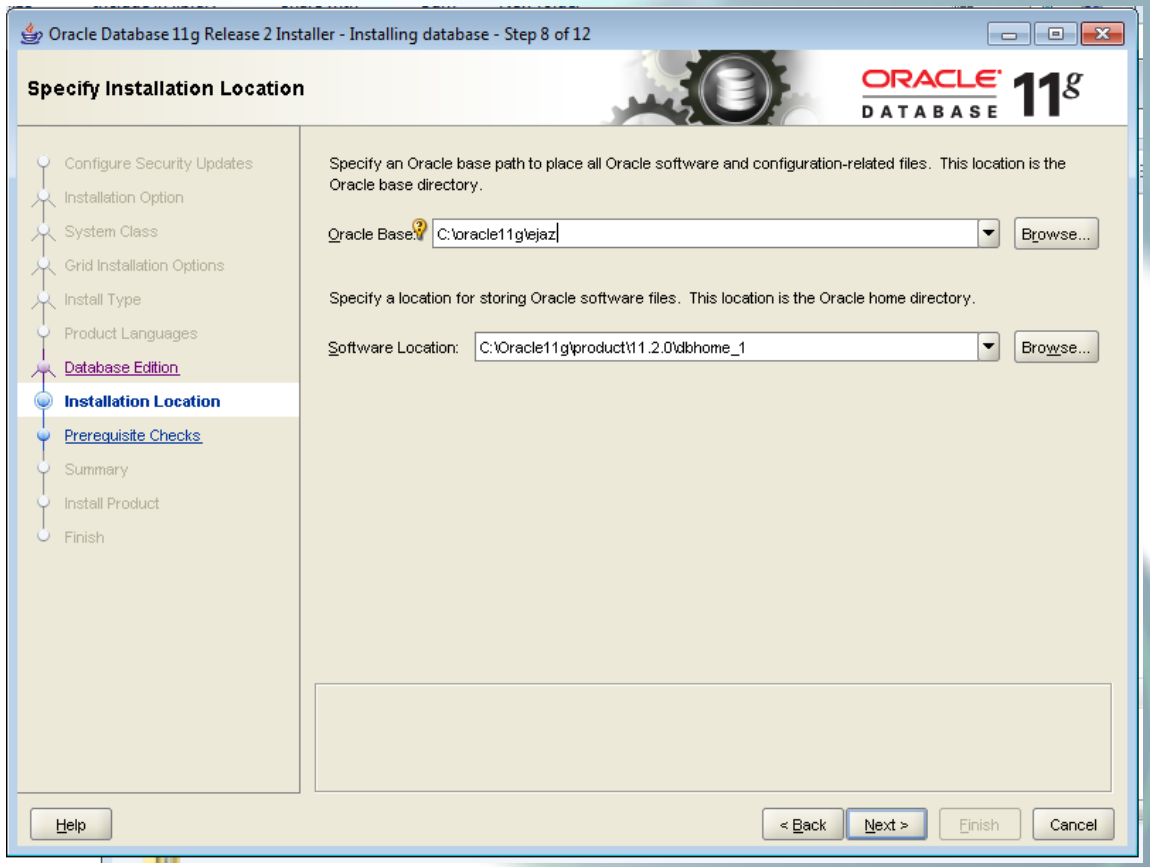
Oracle11g Installation

Installation



Oracle11g Installation

Installation



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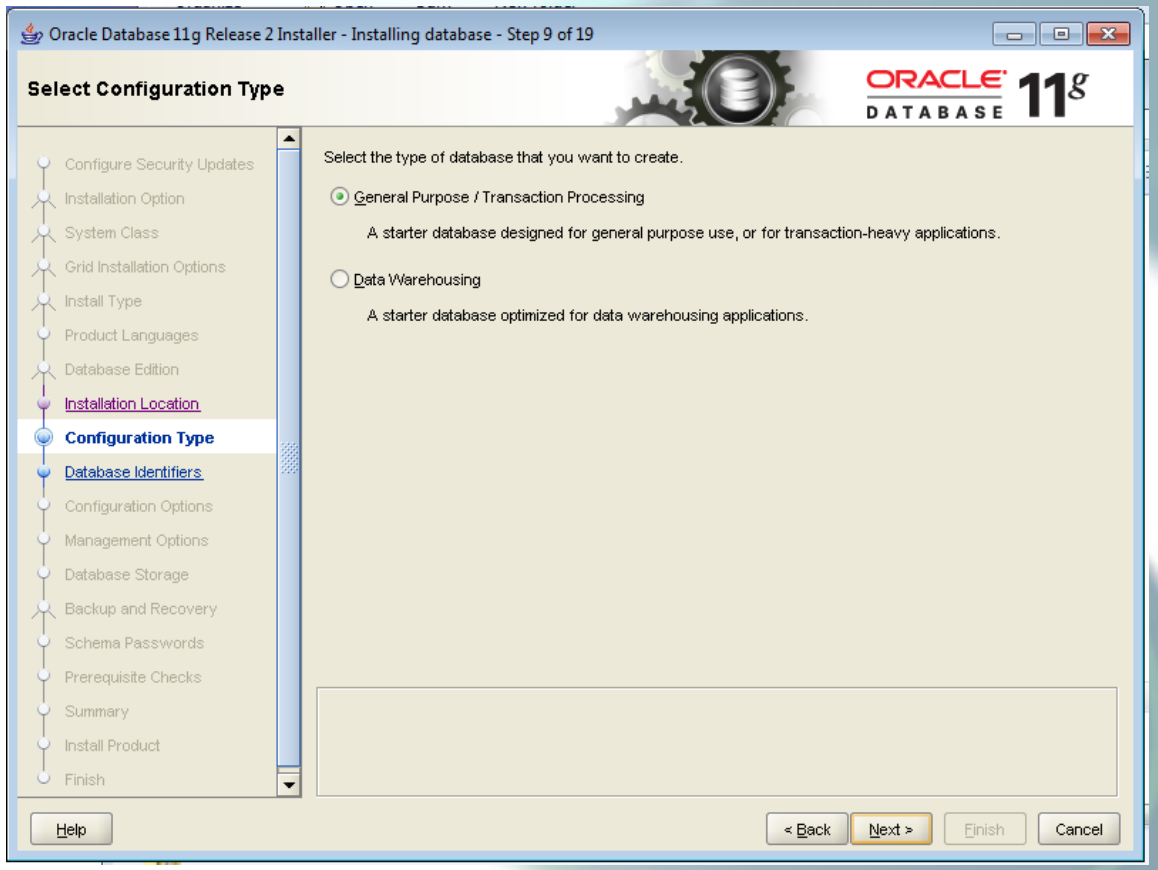

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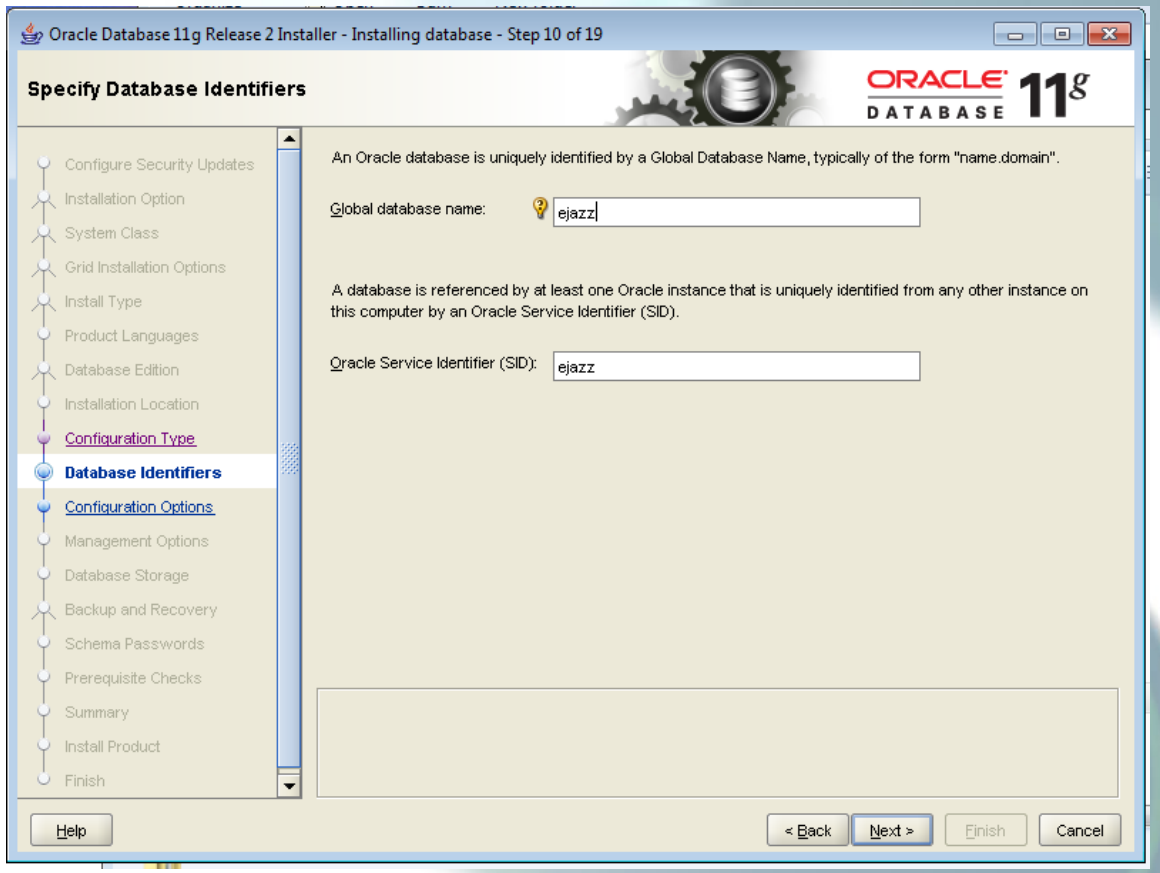
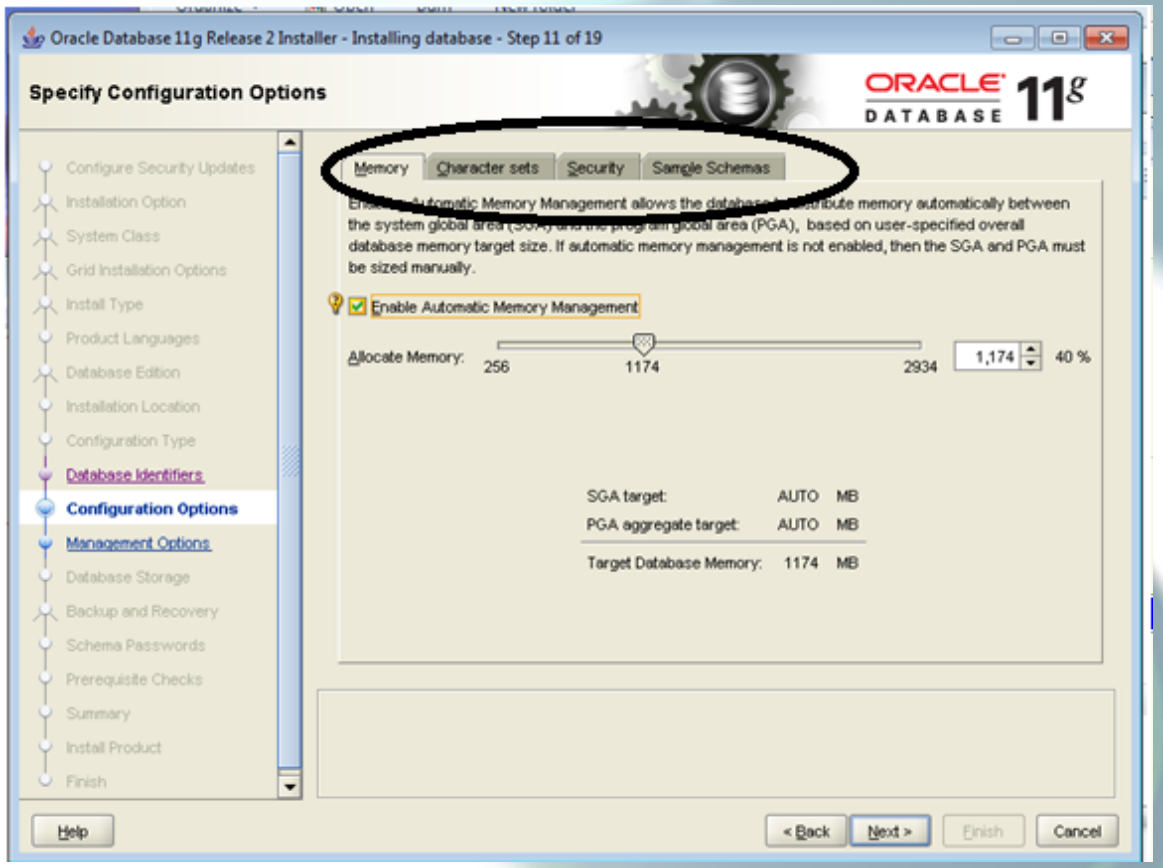


Oracle11g Installation

Installation



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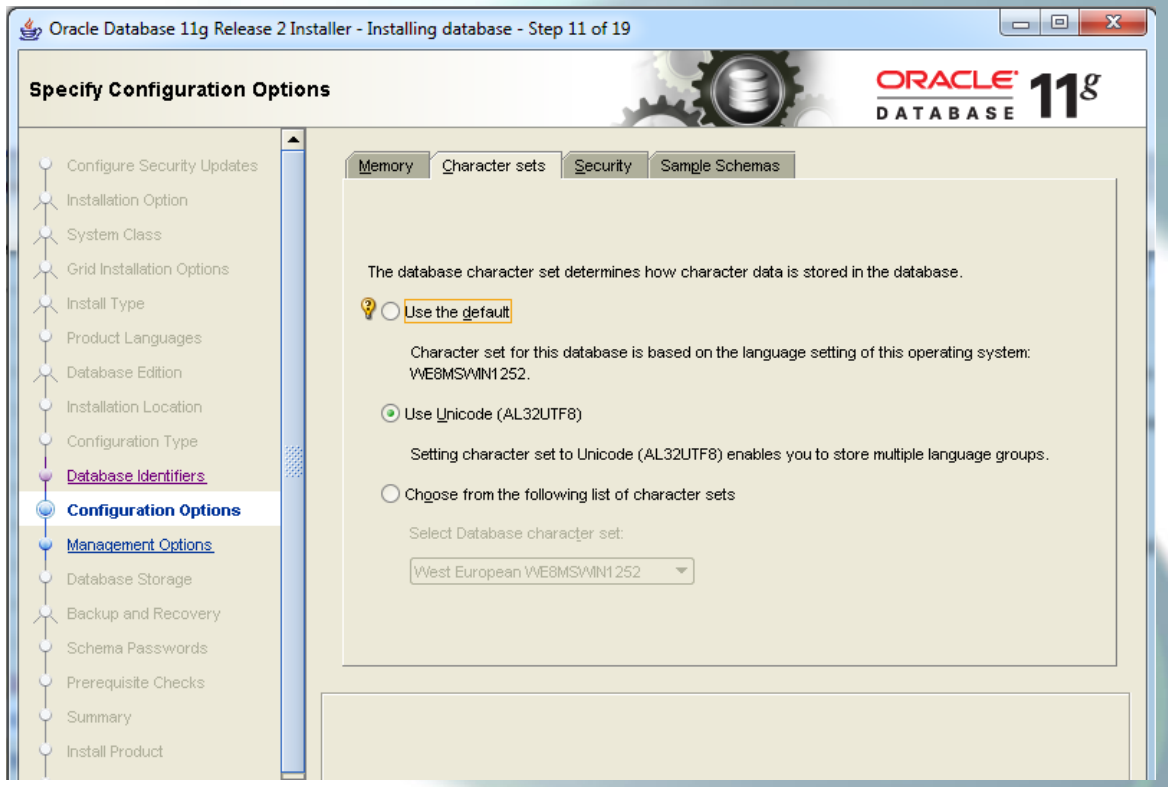
Installation



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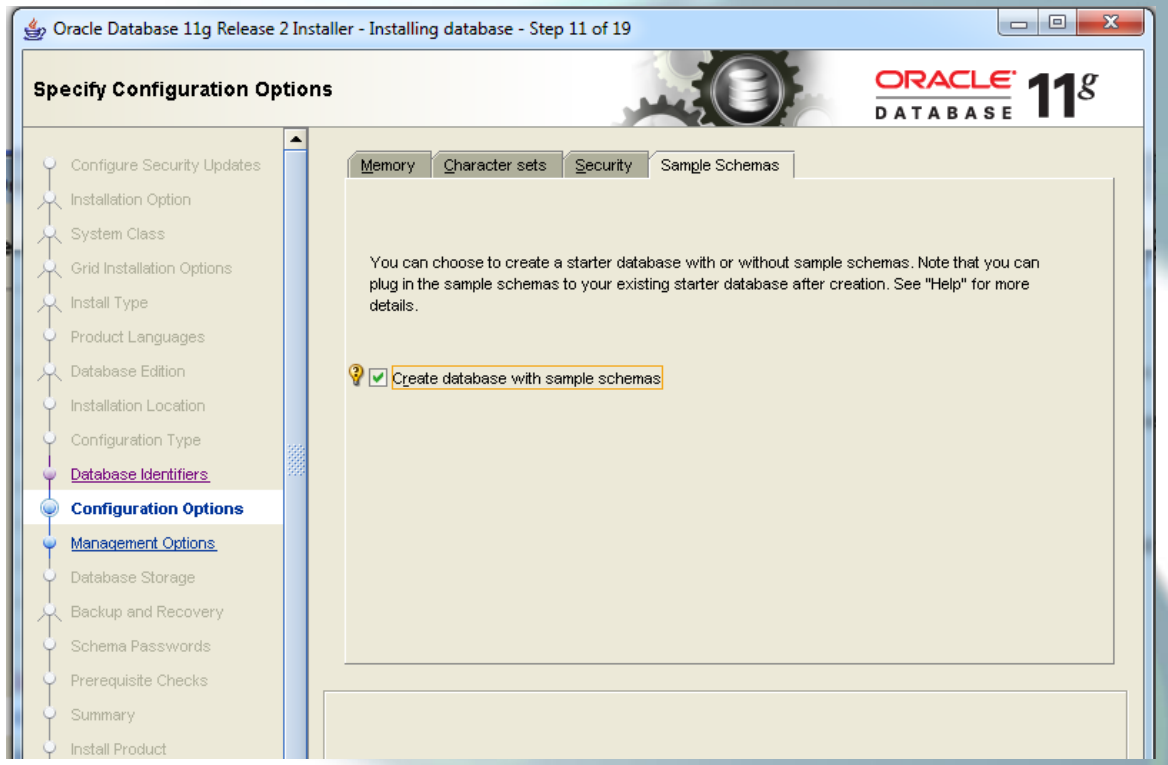
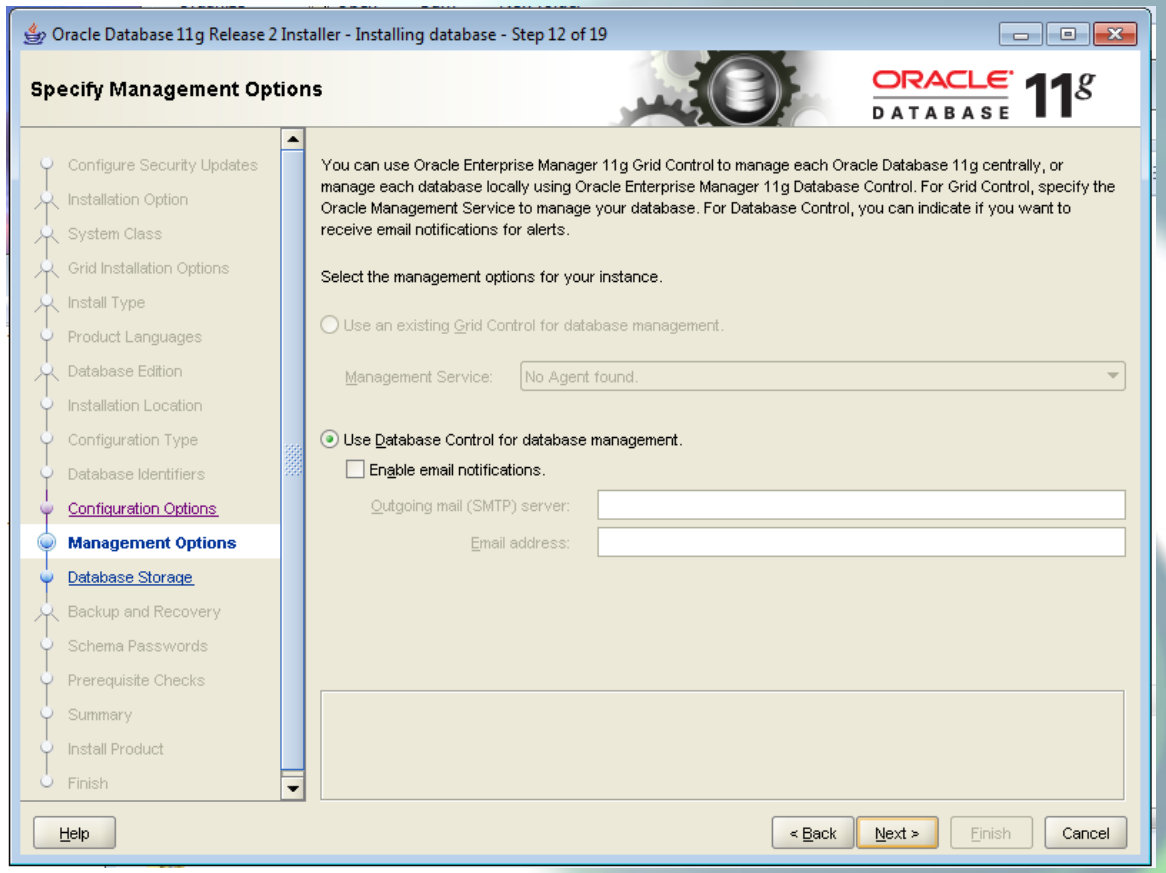


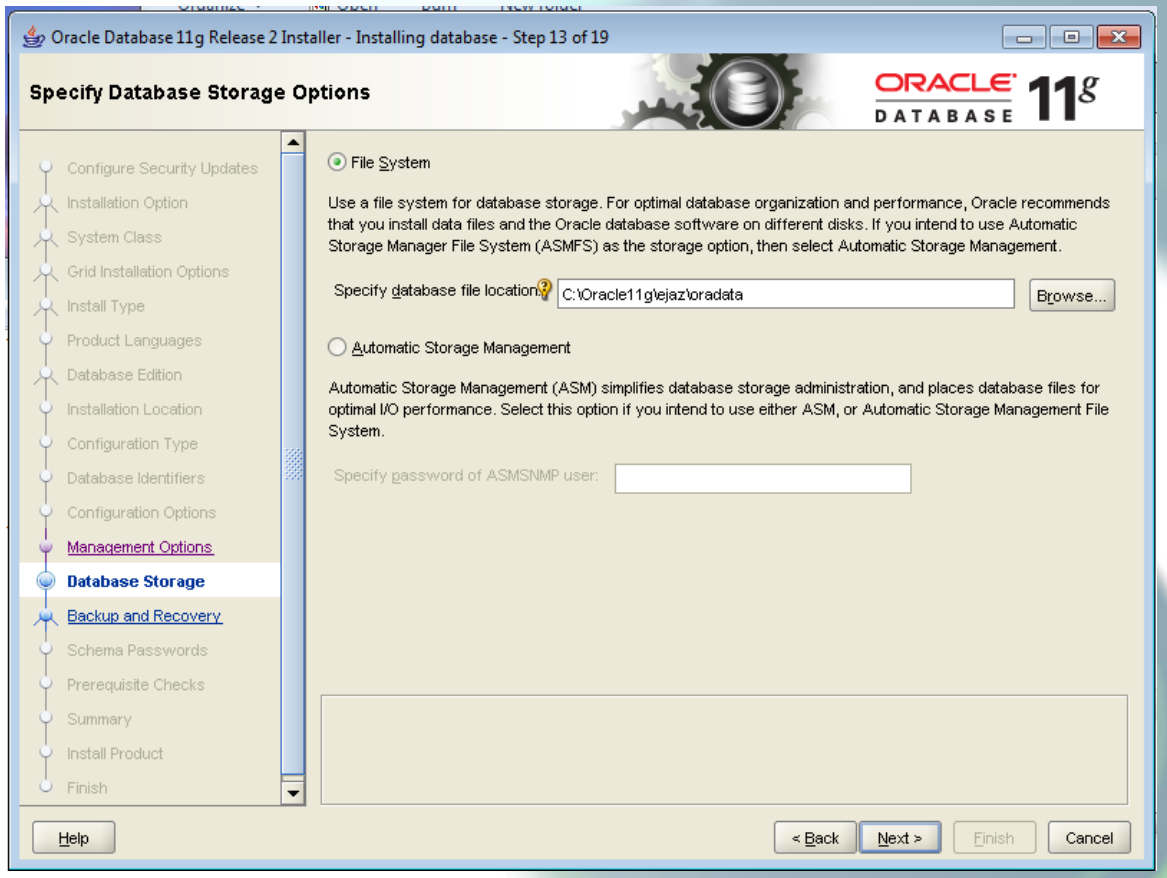
Oracle11g Installation

Installation



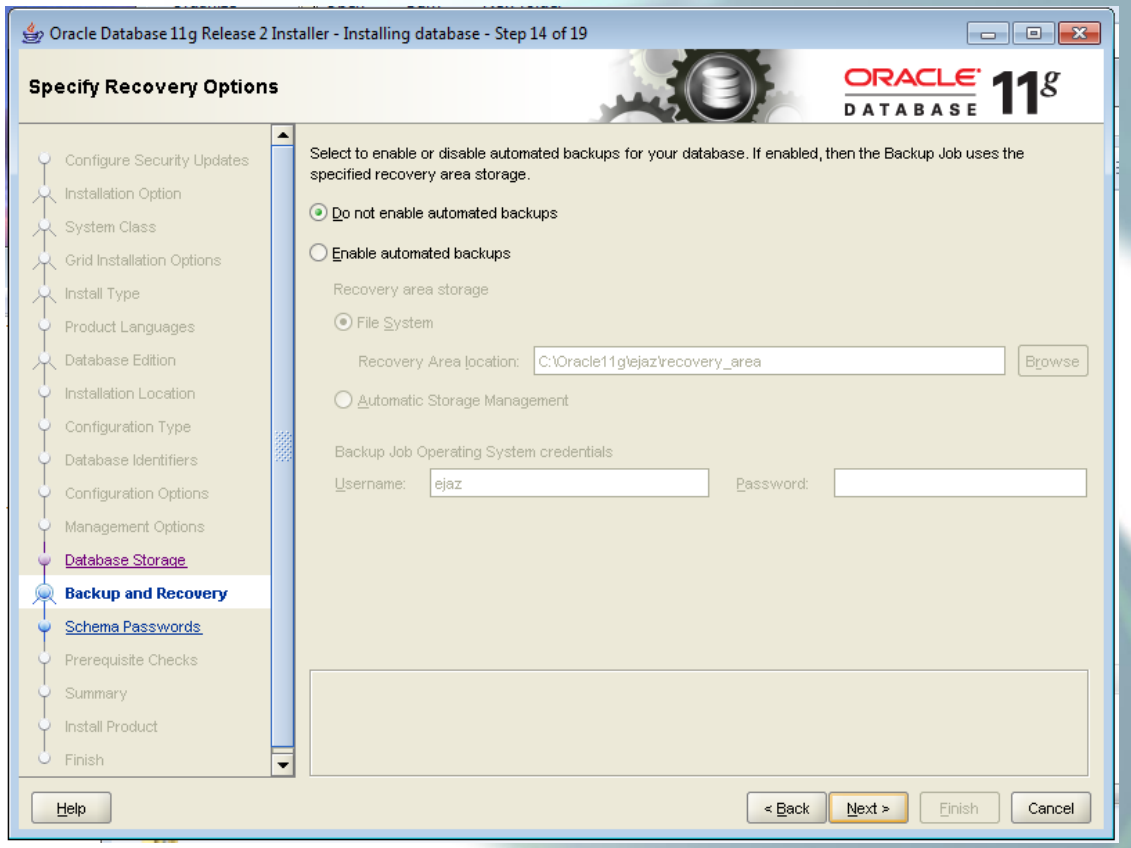
Oracle11g Installation

Installation



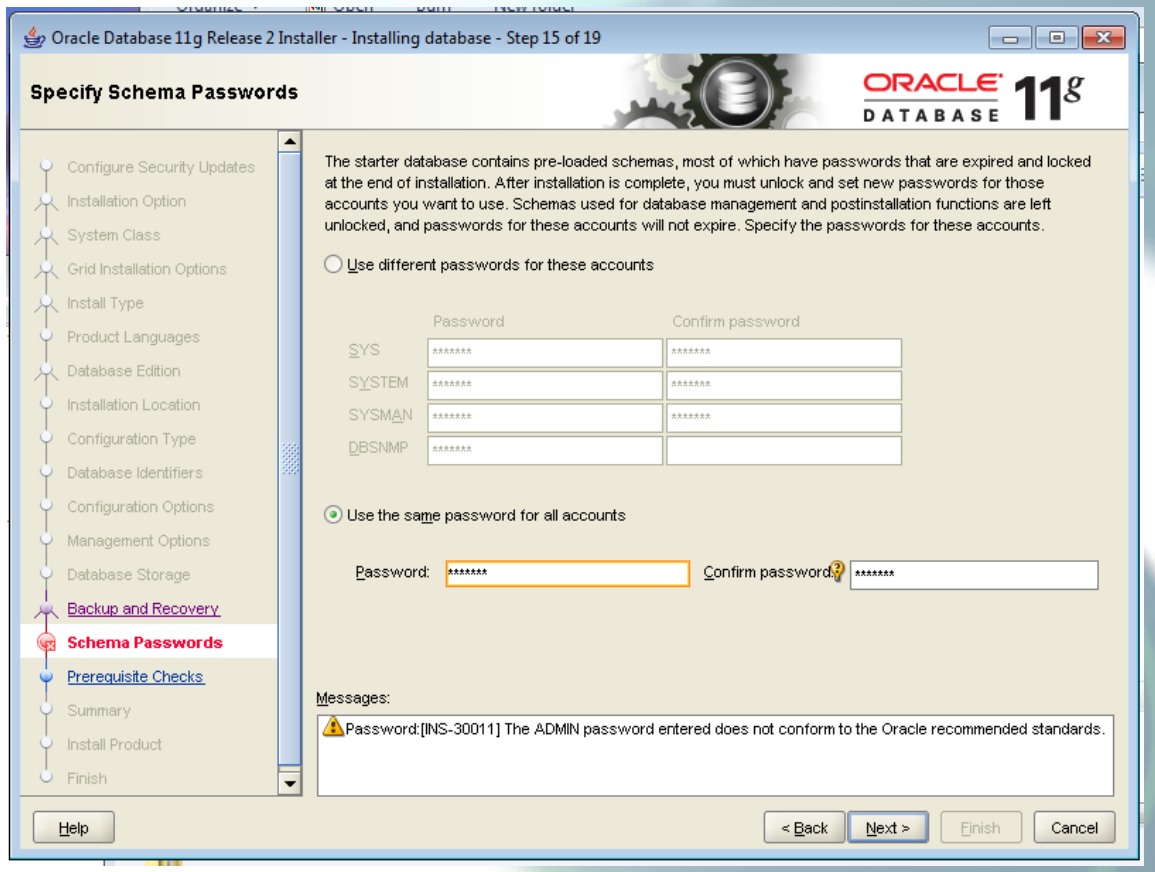
Oracle11g Installation

Installation



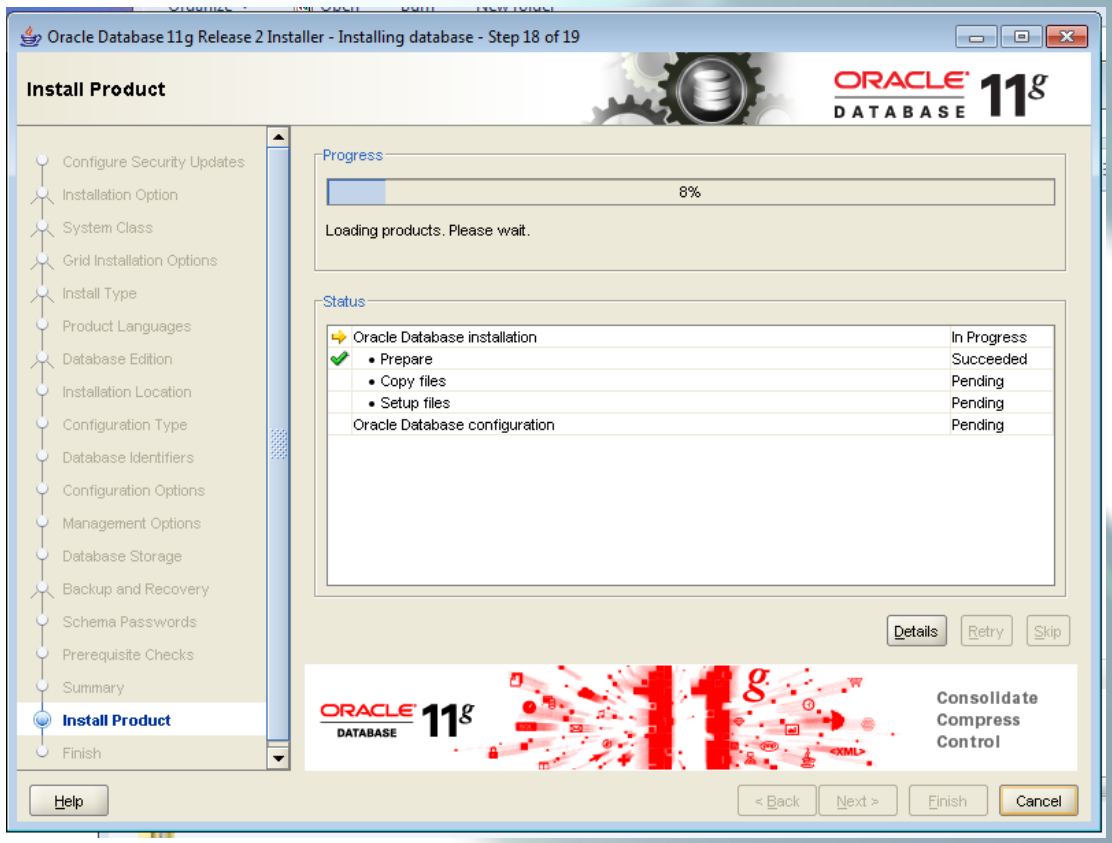
Oracle11g Installation

Installation



Oracle11g Installation

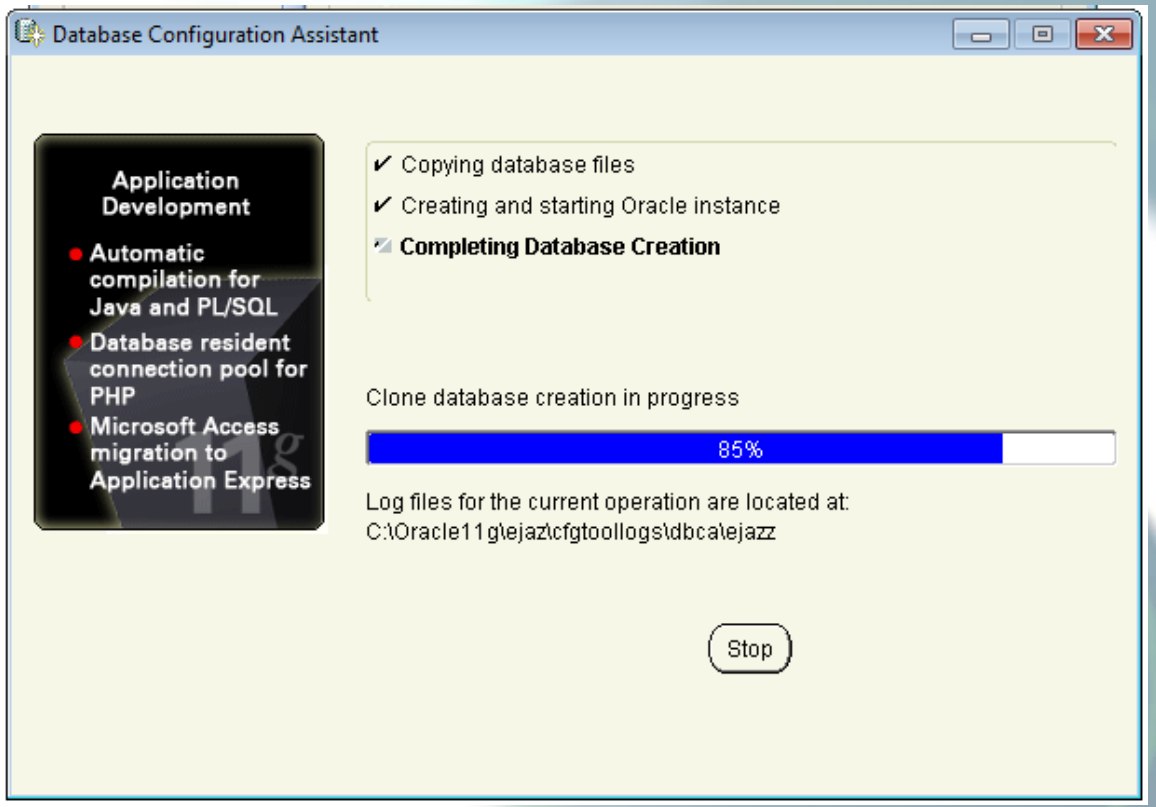
Installation



In case if any process failed, press Retry button.
If NetConfig error displays then press continue

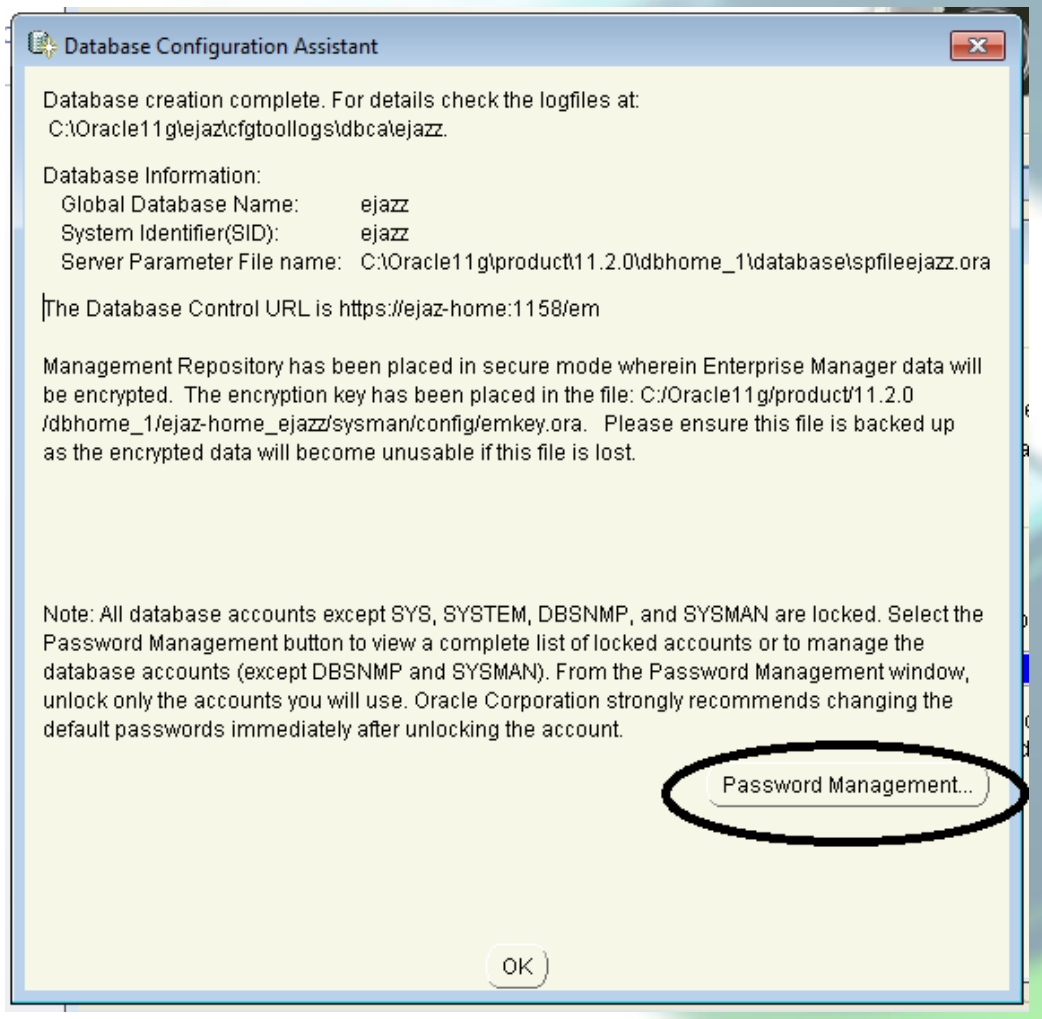
Oracle11g Installation

Installation



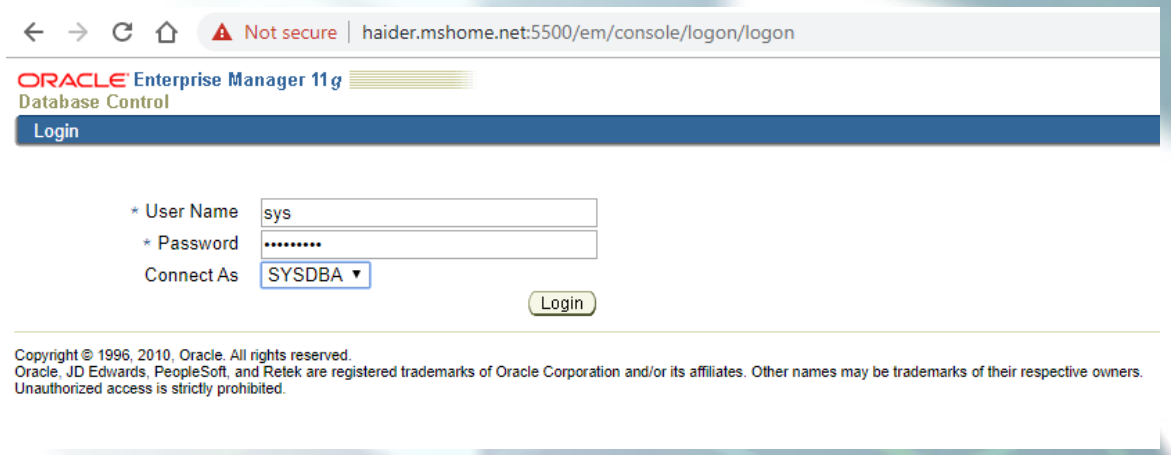
Oracle11g Installation

Installation



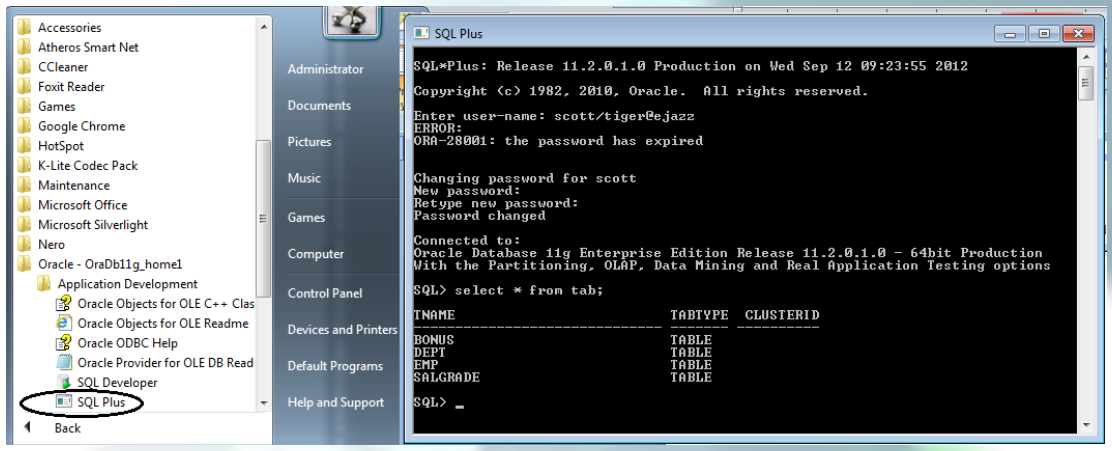
Oracle11g Installation

Login with Oracle Database Manager



Oracle11g Installation

Installation



HOW TO LOGIN USING sys?

In User Name input box or prompt, type the following

sys / as sysdba then press enter key and type password as

password@ejazz (you will see like ******)

you can try without typing SID @ejazz

if you connection failed

Oracle11g Installation

Installation

How to unlock any user (like scott, your test user)
user: sys / as sysdba (press enter key)
give password that has been set during the installation

SQL>alter user scott account unlock;

Oracle11g Installation

Installation

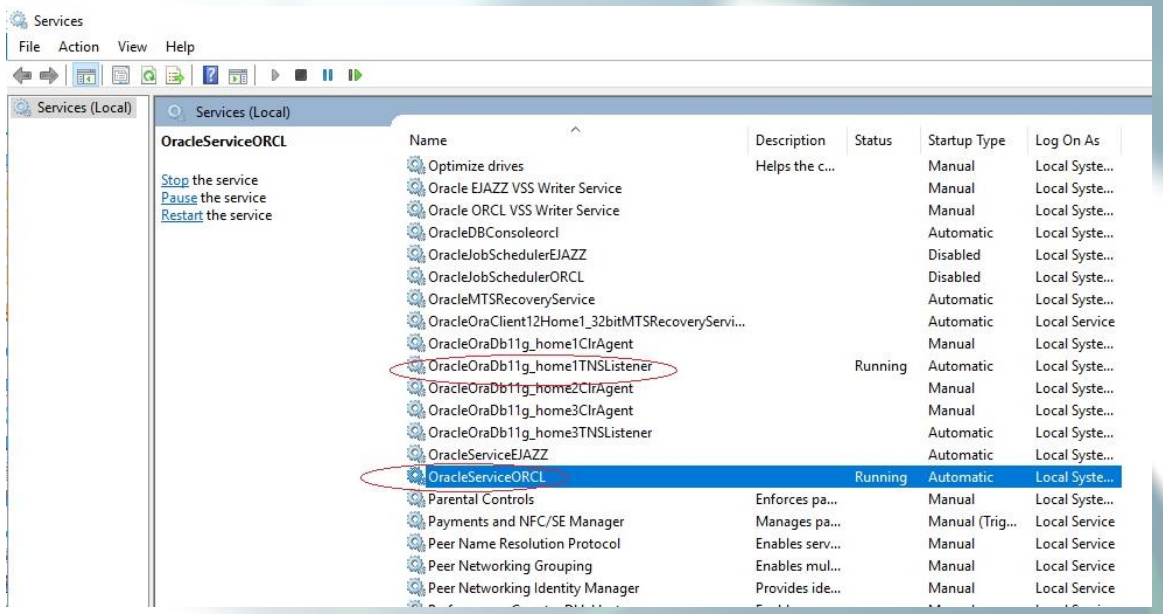
How to change password:
SQL>Alter user st110145 identified by newpassword;

Alternatively Login:
Start SQL*Plus and log in as the SYS user, connecting
as SYSDBA:
$ORACLE_HOME/bin/sqlplus SQL>
CONNECT SYS as SYSDBA
Enter password: sys_password

Oracle11g Installation

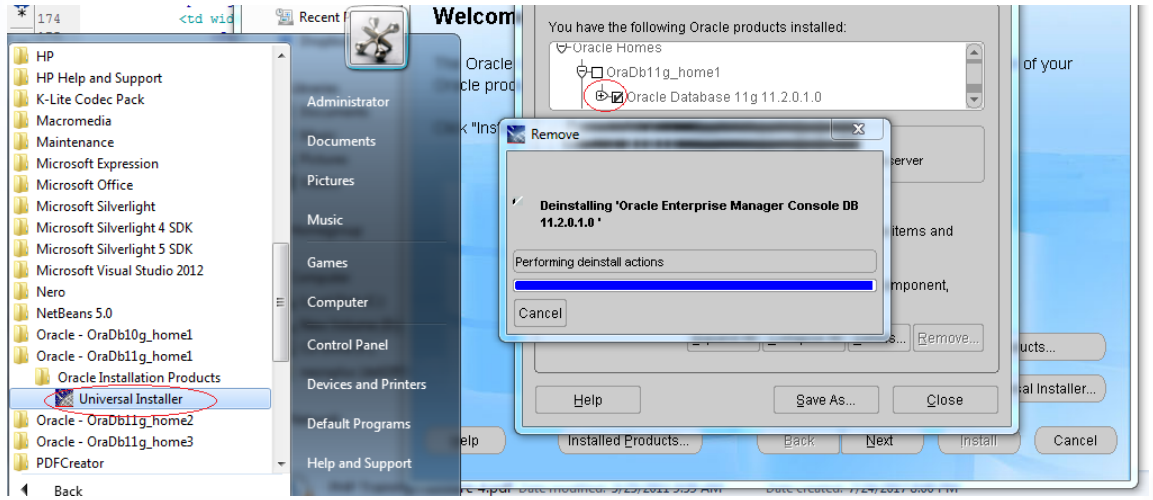
OS Services

Control Panel → Admin Tools → Services



Oracle11g Installation

Installation



To un-install oracle, follow press Oracle Installation Products→Oracle Installer, choose oracle home and press Remove button

Once De-installation process is completed. Restart your Computer or Server, remove all oracle folders. Then install Oracle again.

Introduction to Database Administration

MS SQL Server Installation

MS SQL Server Installation

Installation Steps

- Editions of MS SQL Server 2017
- Installation …
- Installation by Giving Password
- Installation in Progress
- Installation Complete

MS SQL Server Installation

Editions of MS SQL Server 2017

Enterprise: Comprehensive, high-end capacities for commanding database and business intelligence essentials.
Standard: Core data management and business intelligence abilities for non-critical workloads with minimal IT support.
Express: This is a free version with limited SQL Server features.
Developer: This is a free version to build, test, and demo apps in non-production environments. All Enterprise Edition features are included.
Web: SQL Server Web edition is a low-cost version for Web features

MS SQL Server Installation

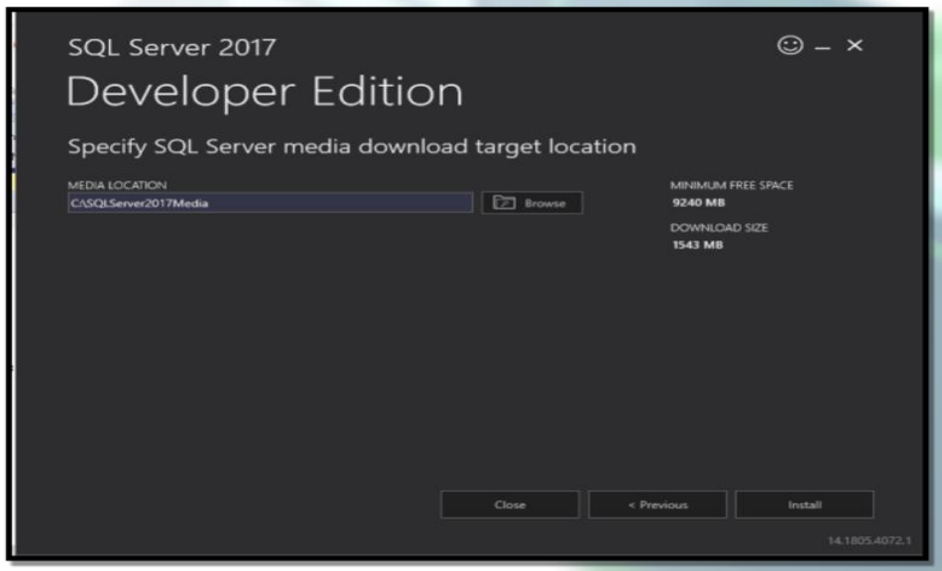
Installation …

Once SQL Server 2017 Developer edition is downloaded, double click on it to launch.

MS SQL Server Installation

Installation …

Specify the Media Location where we want to save the SQL Server media. The drive should have at minimum free space of 9240 MB in order to extract the media.



MS SQL Server Installation

Installation …

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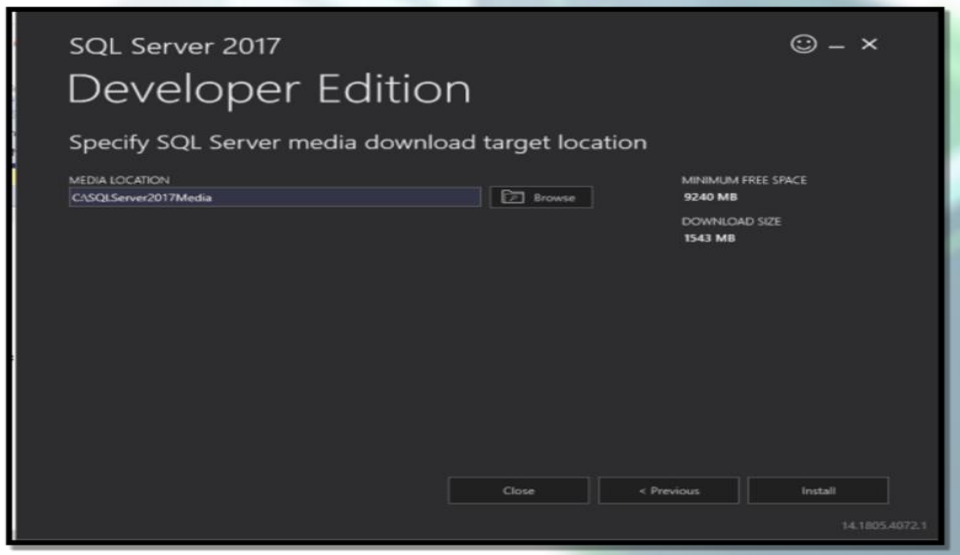
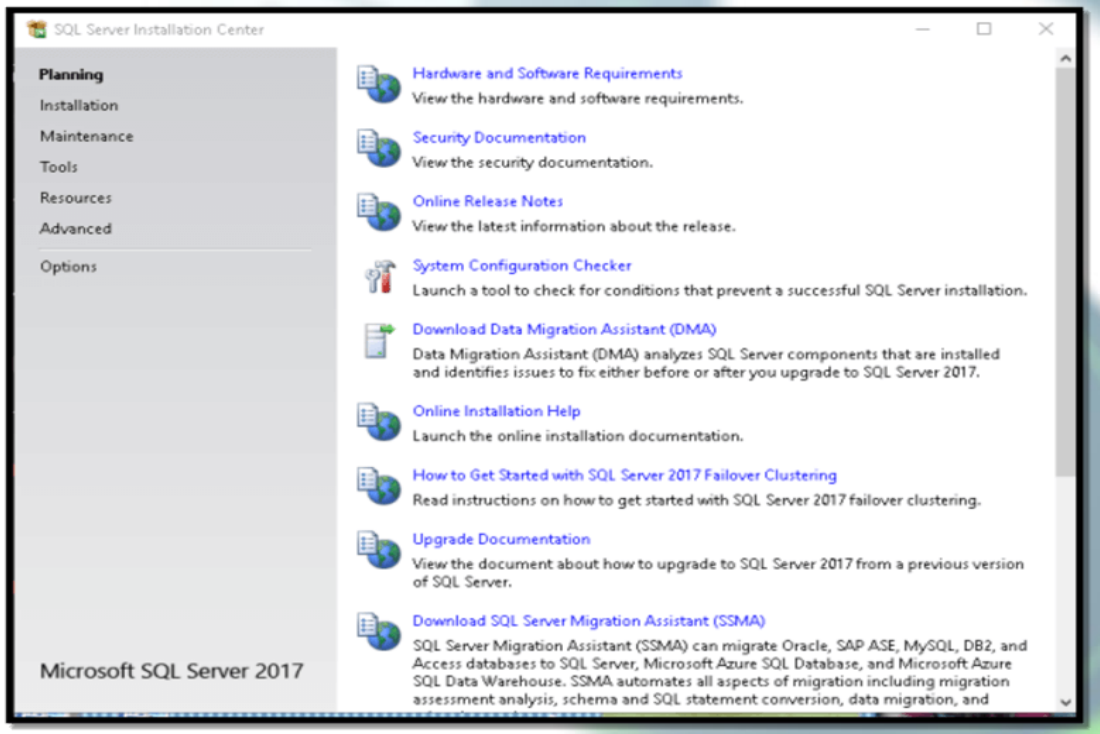


MS SQL Server Installation

Installation …

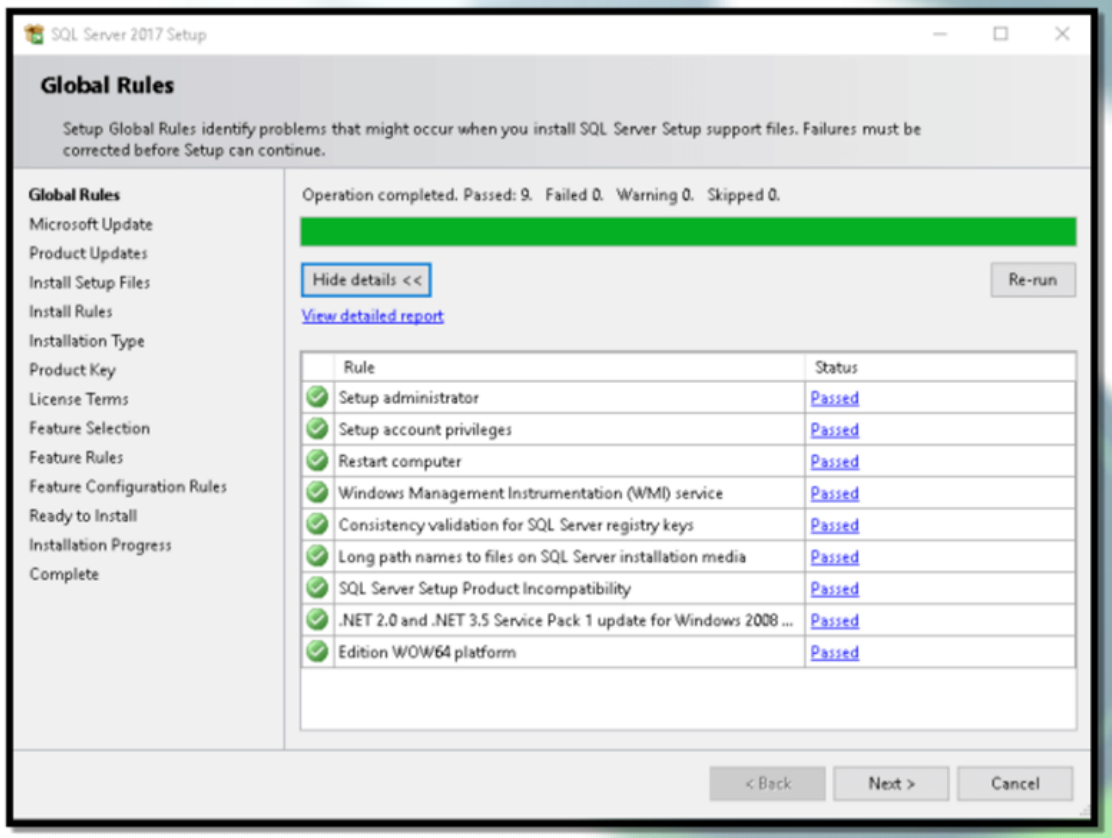
Click on New SQL Server stand-alone installation and you will get this message.



MS SQL Server Installation

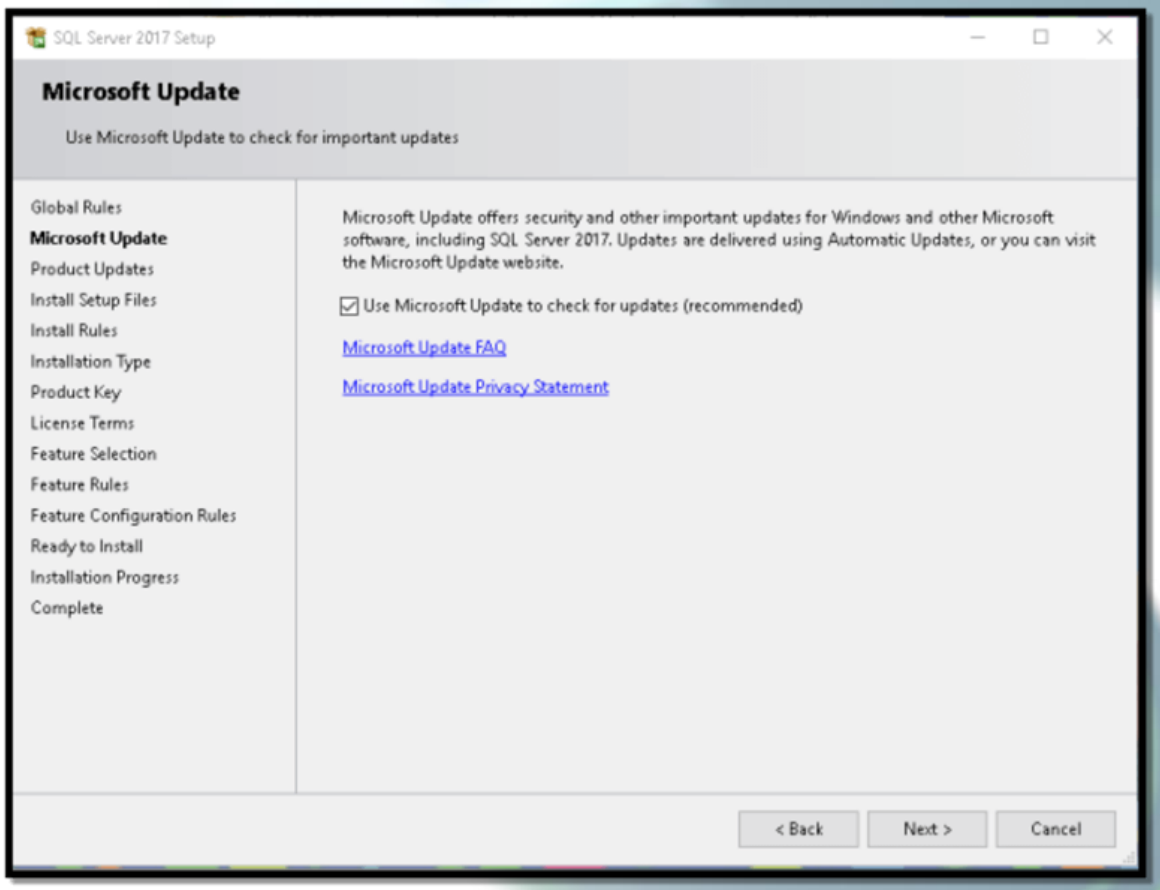
Installation …

Make sure all Global rules are passed



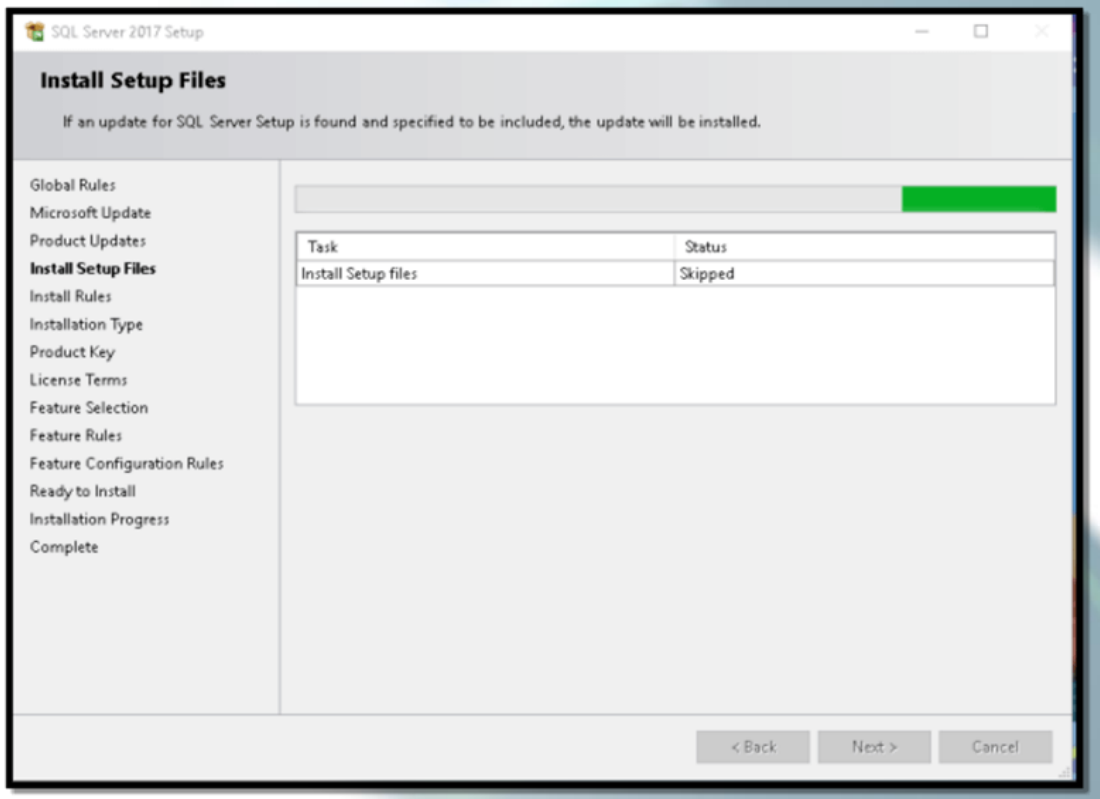
MS SQL Server Installation

Installation …



MS SQL Server Installation

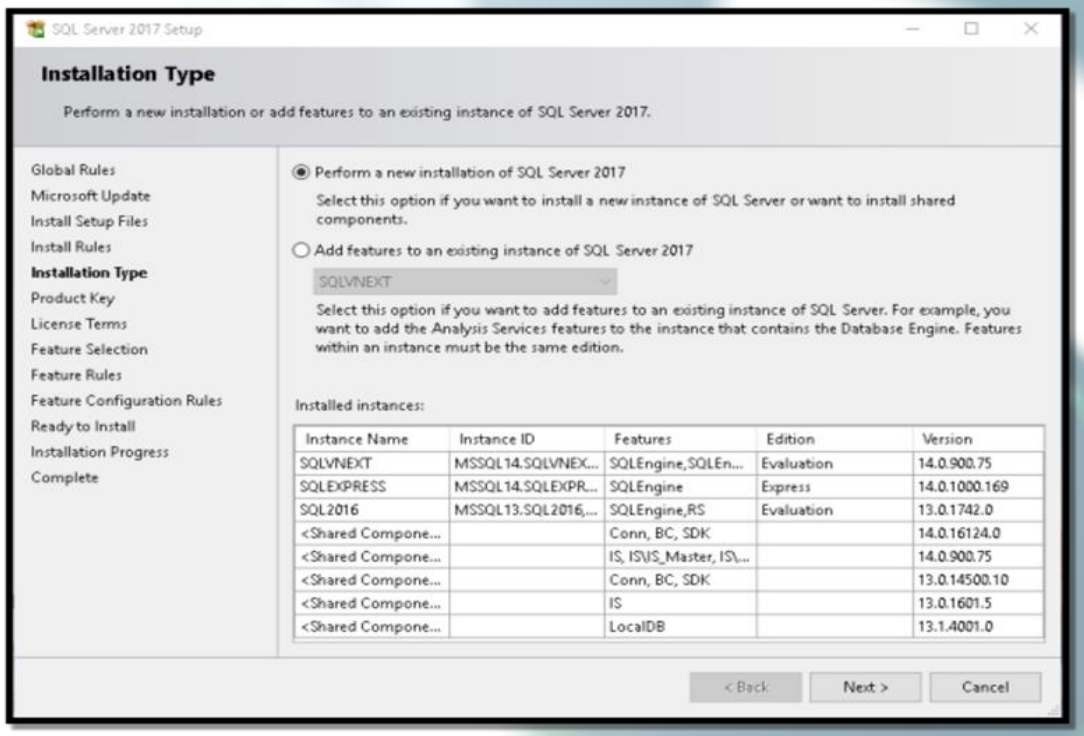
Installation …



MS SQL Server Installation

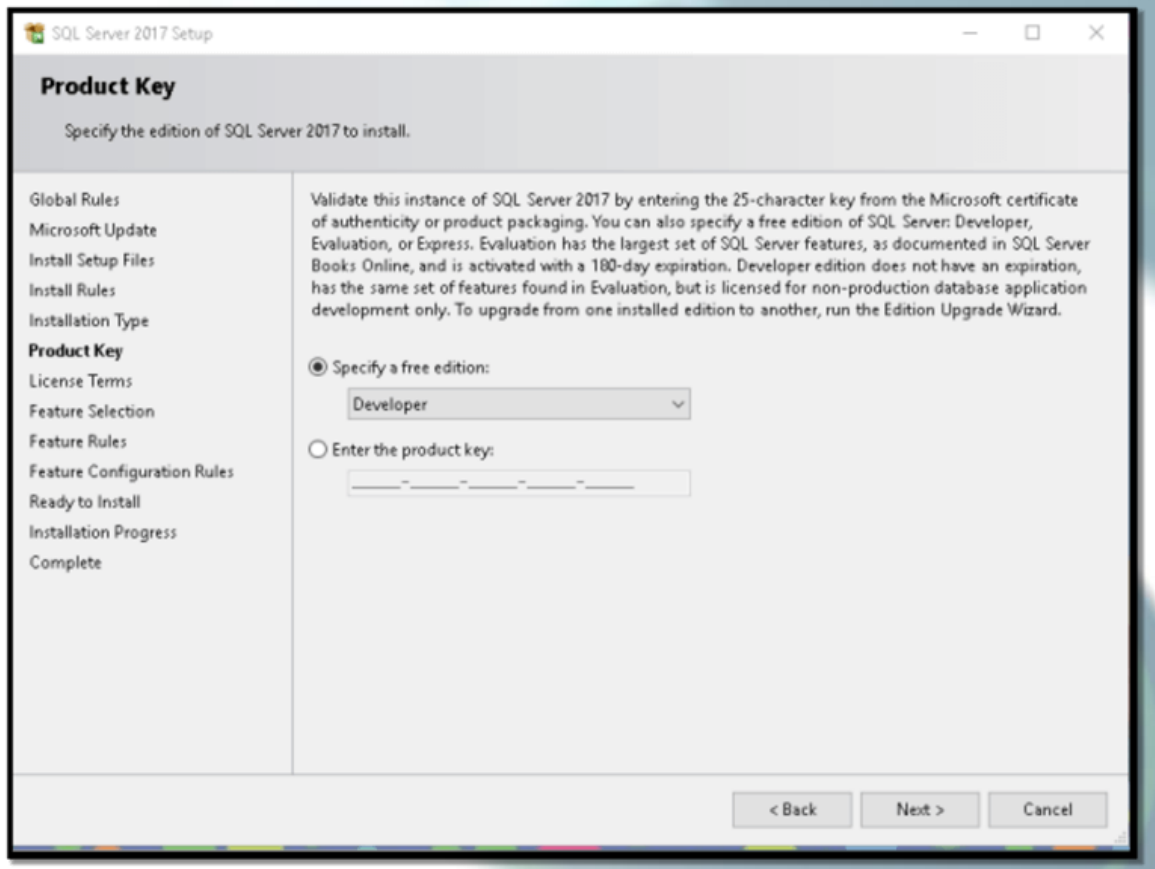
Installation …

Provide product key of license



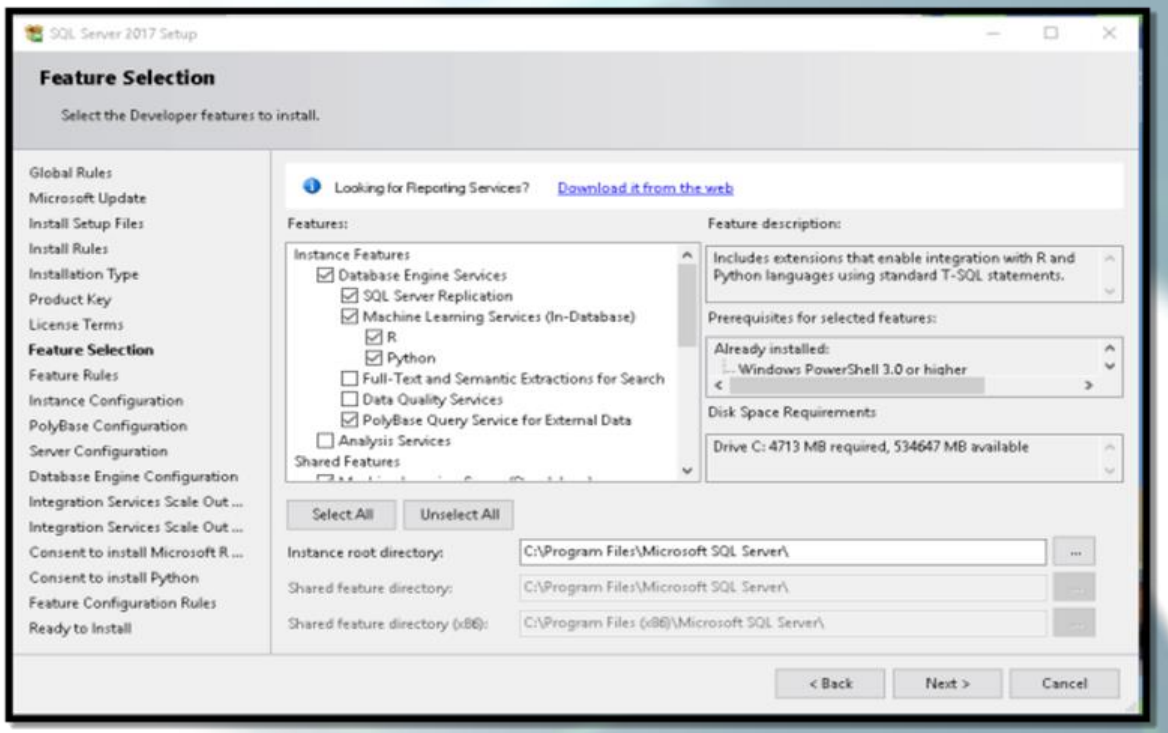
MS SQL Server Installation

Installation …



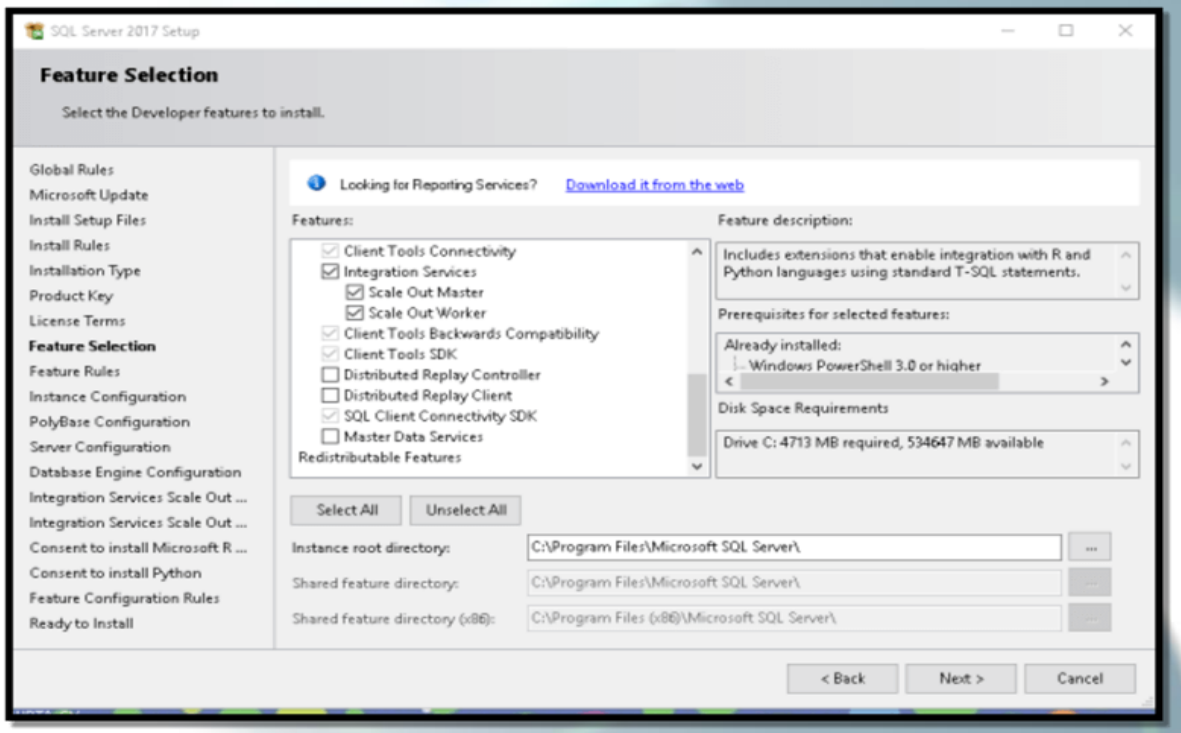
MS SQL Server Installation

Installation …



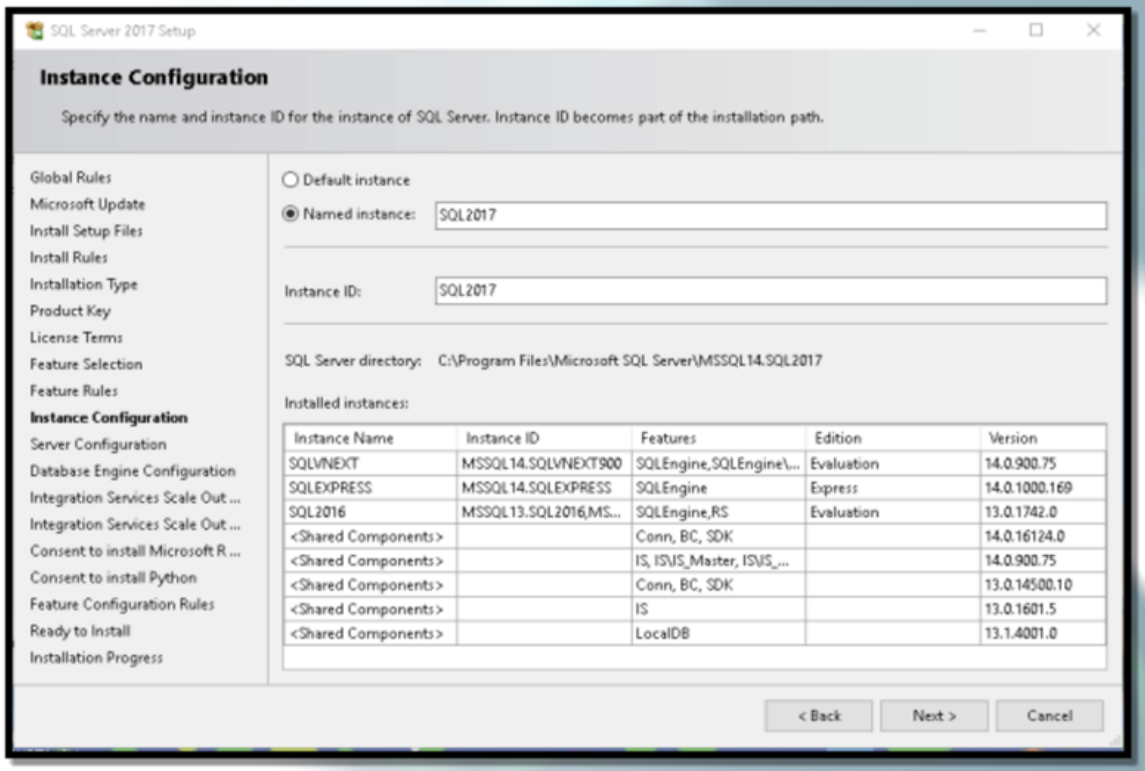
MS SQL Server Installation

Installation …



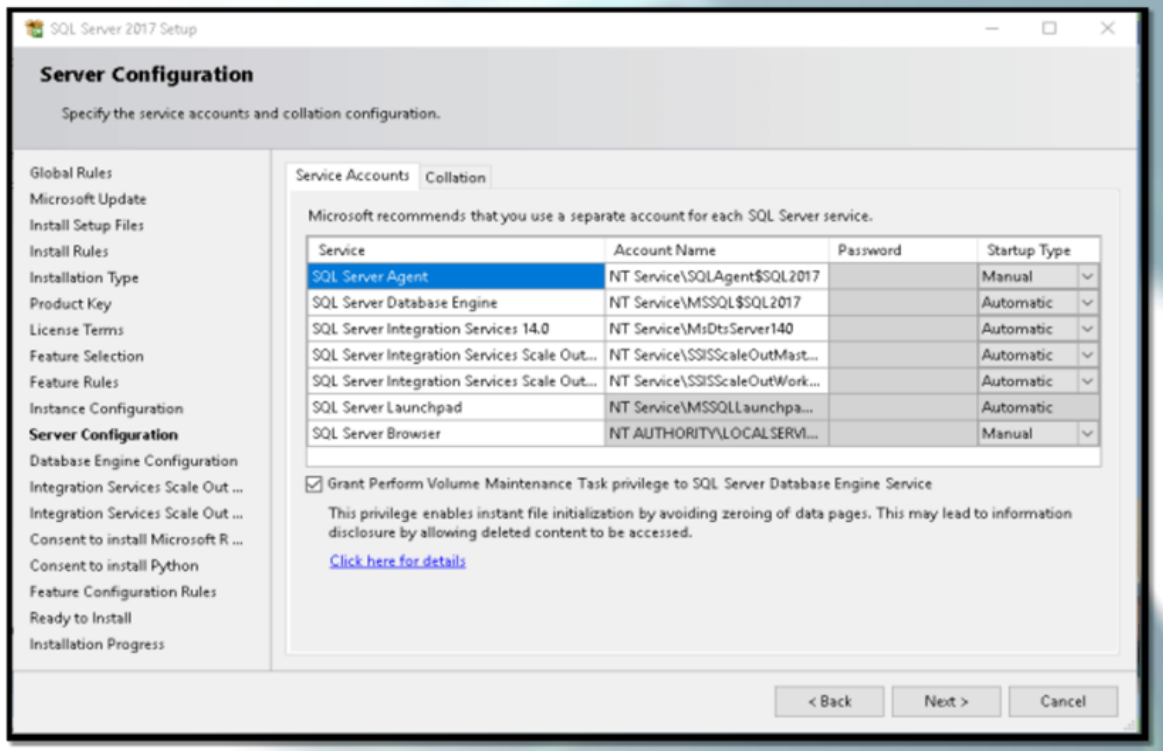
MS SQL Server Installation

Installation …



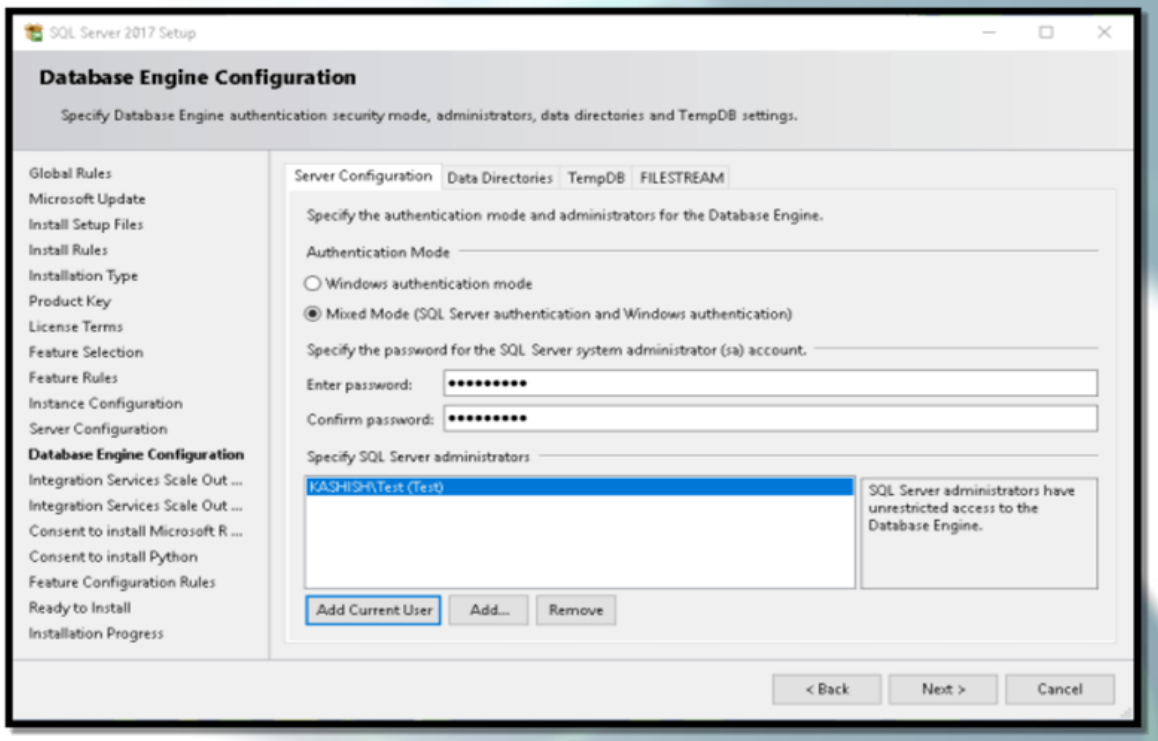
MS SQL Server Installation

Installation …



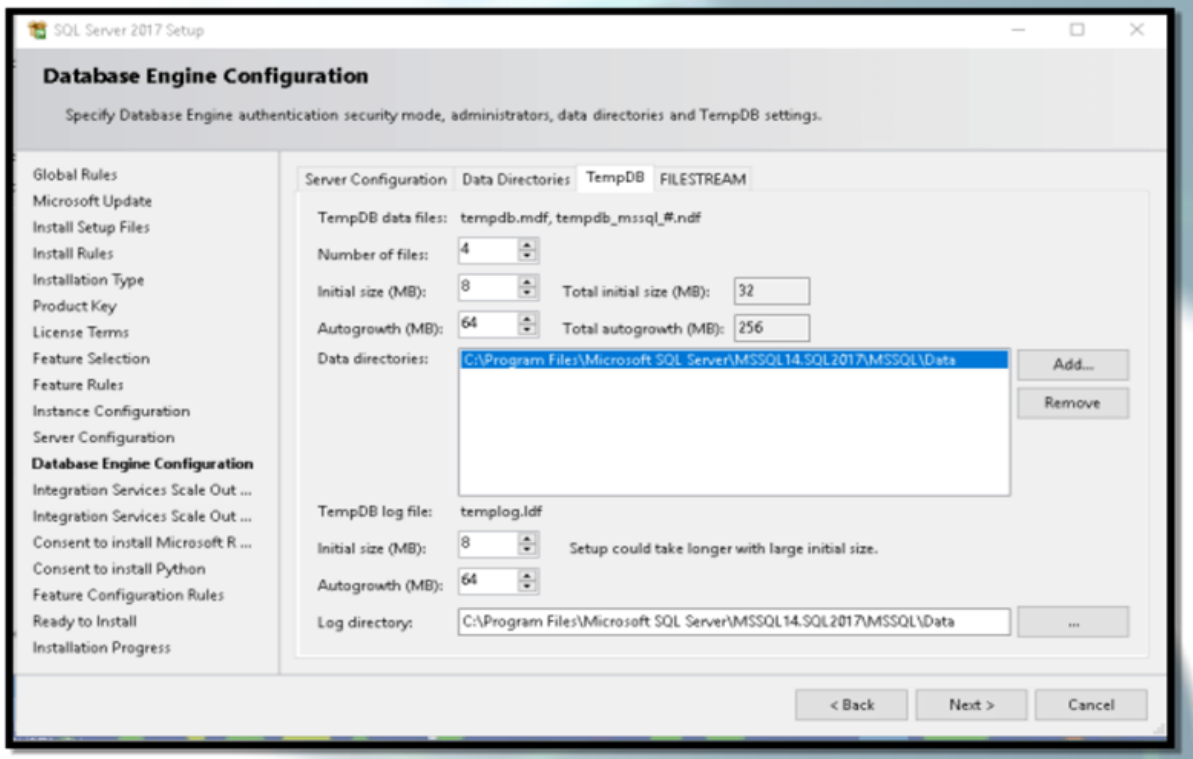
MS SQL Server Installation

Installation by Giving Password



MS SQL Server Installation

Installation …

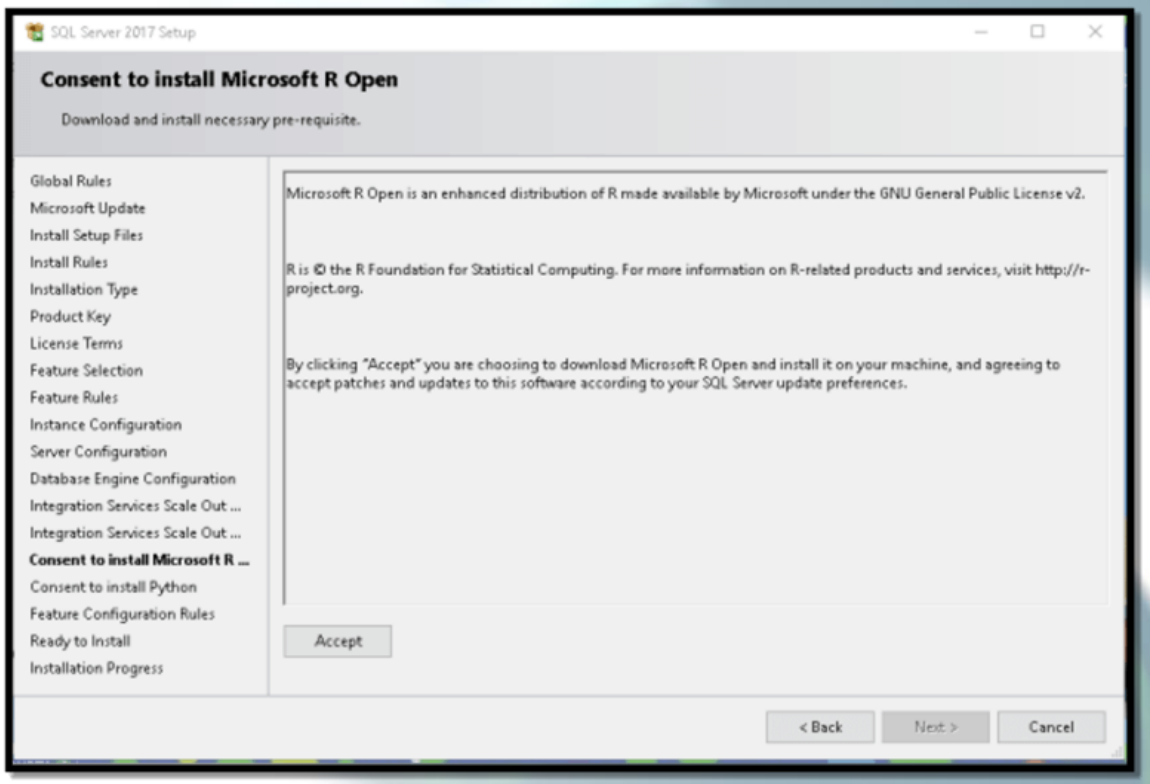


MS SQL Server Installation

Installation …

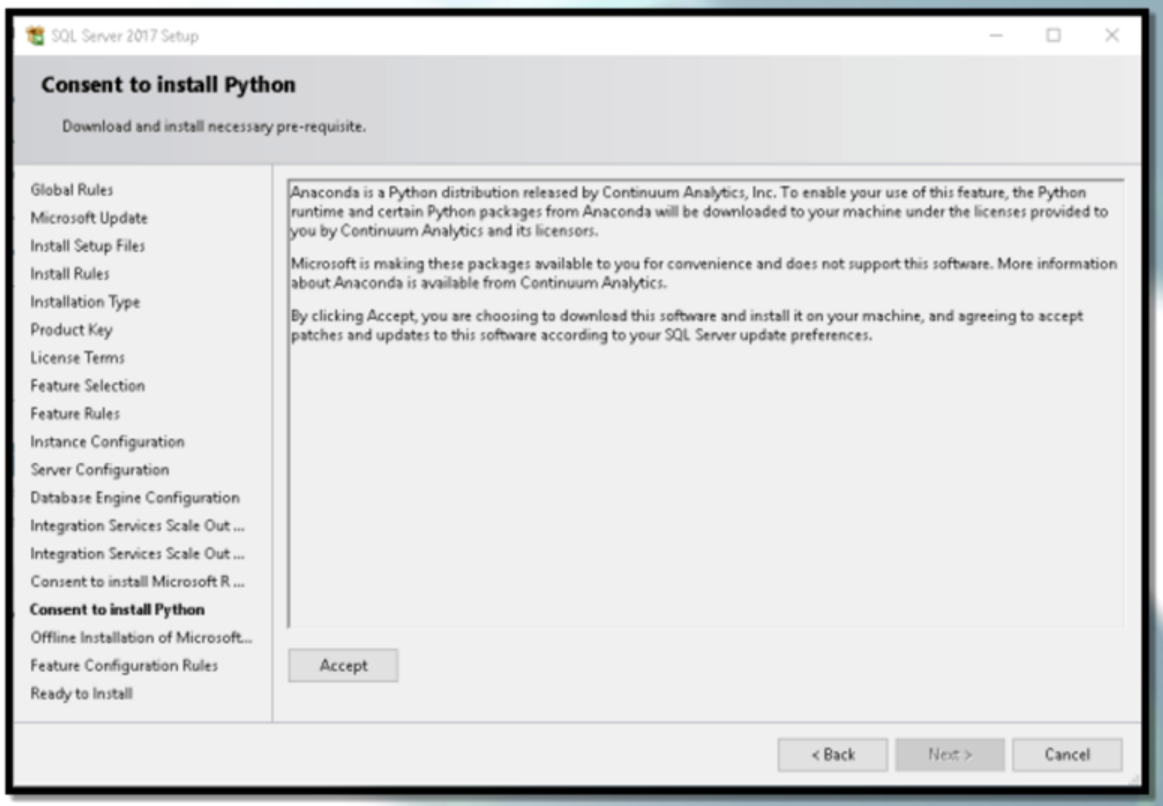
MS SQL Server Installation

Installation …



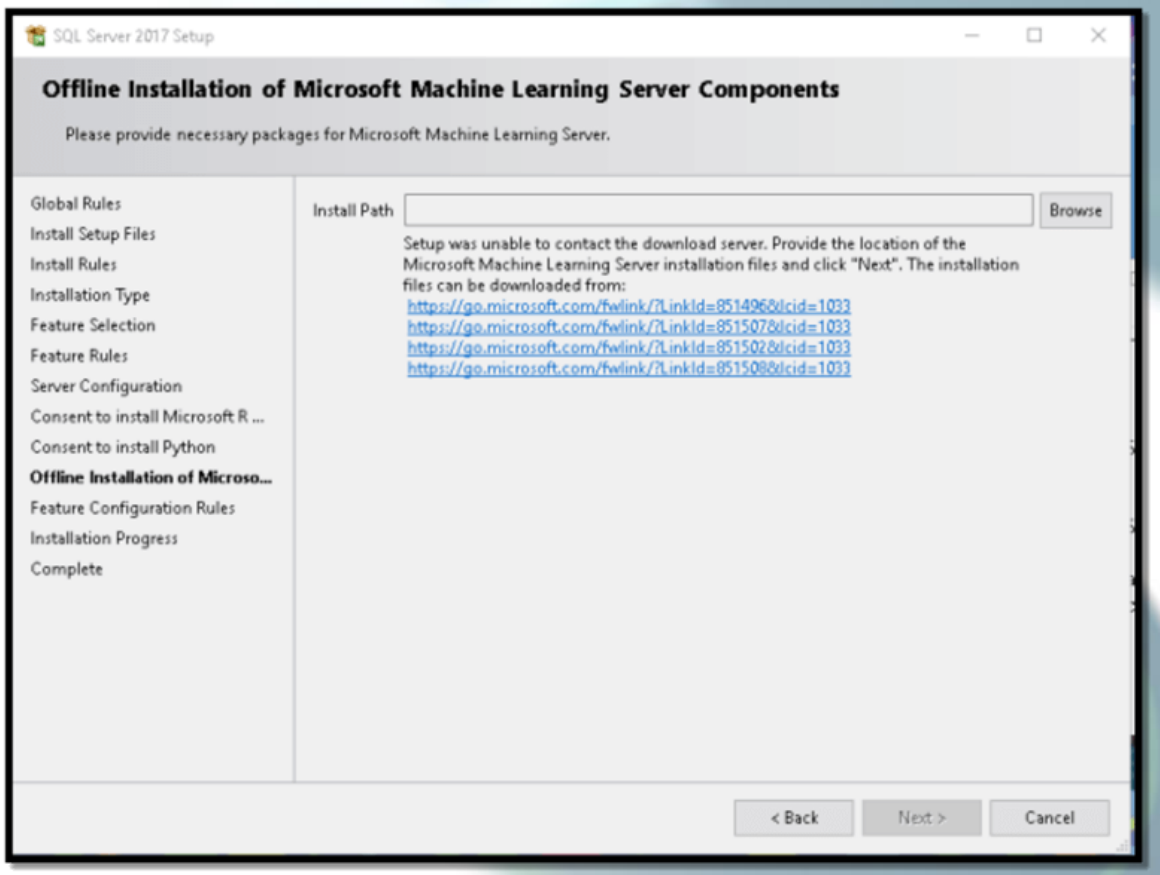
MS SQL Server Installation

Installation …



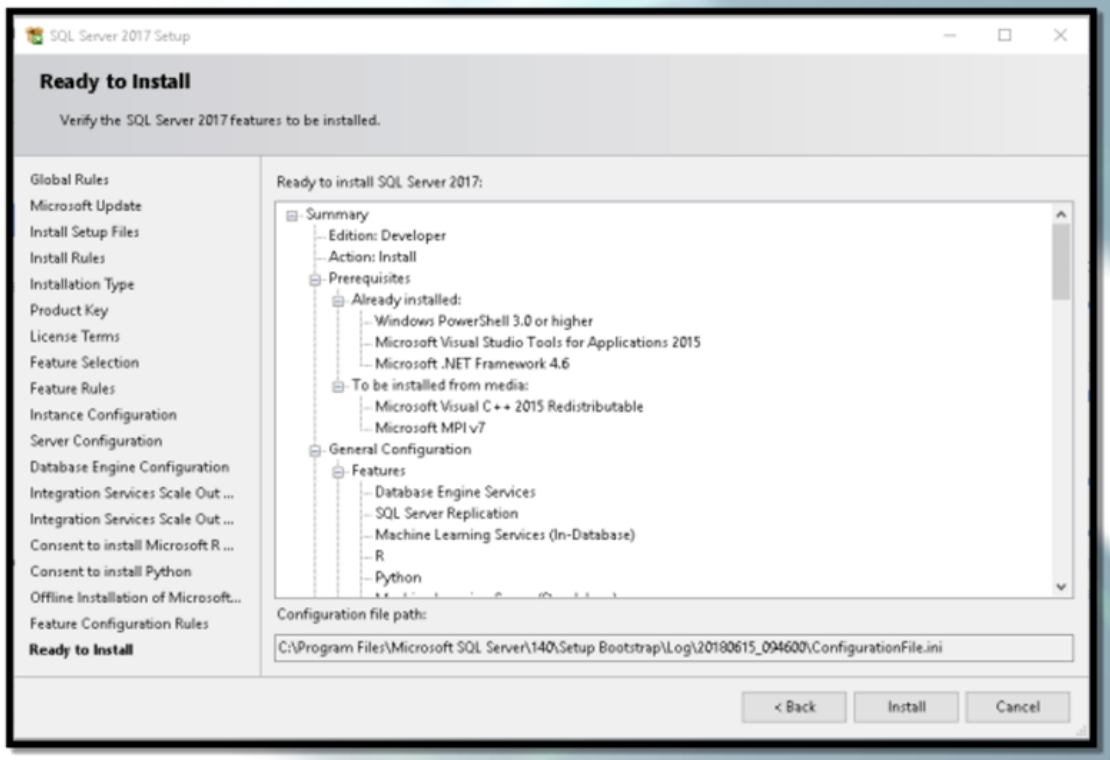
MS SQL Server Installation

Installation



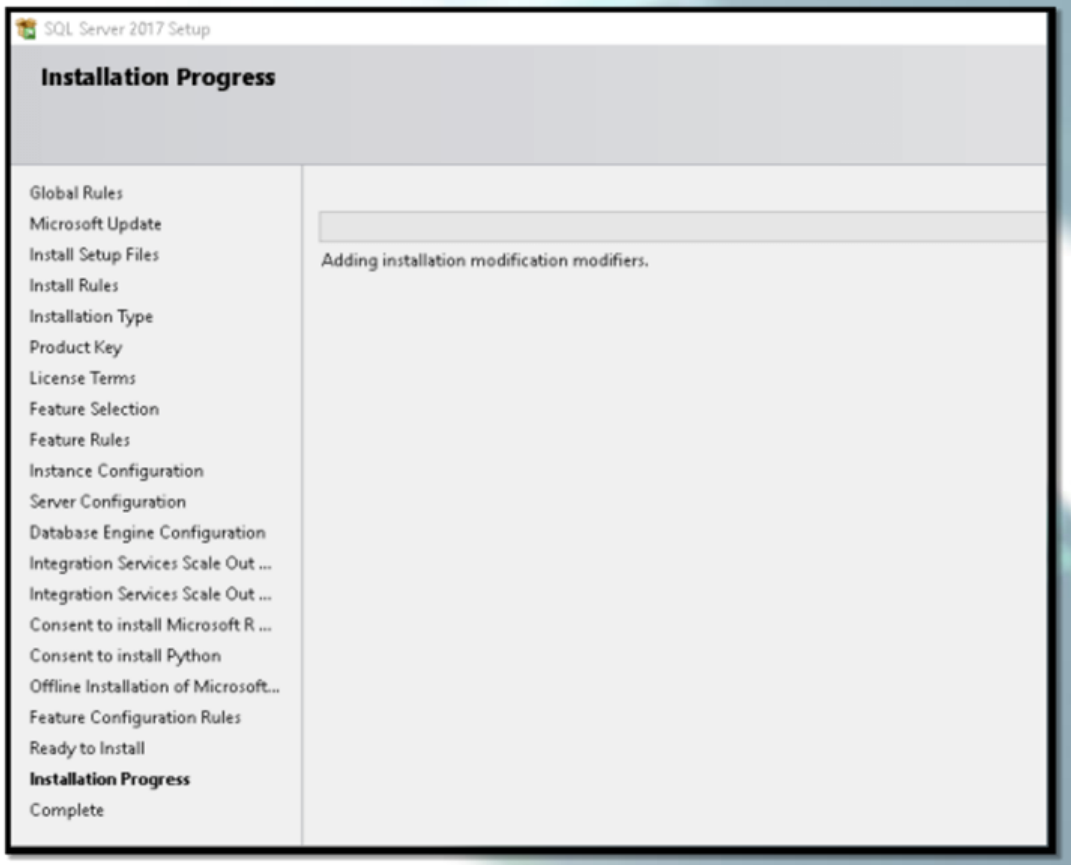
MS SQL Server Installation

Installation



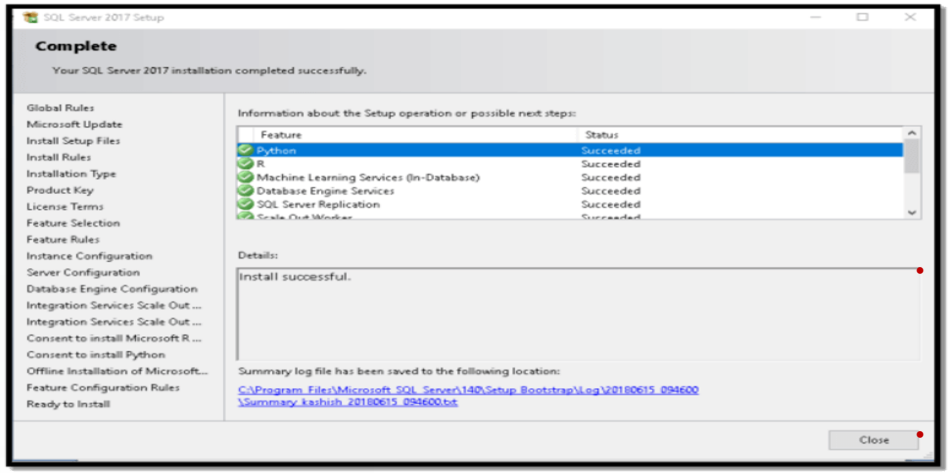
MS SQL Server Installation

Installation in Progress



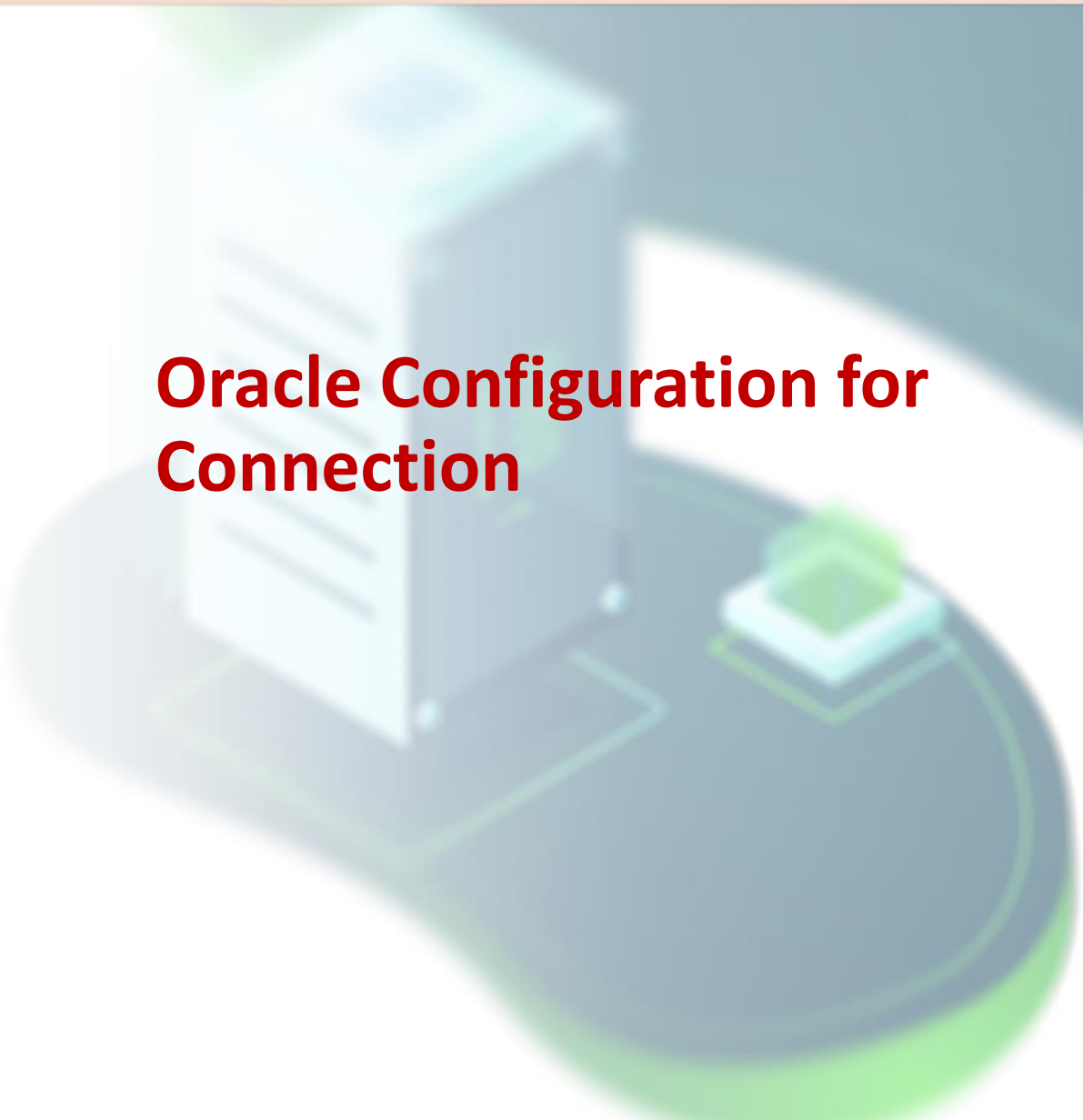
MS SQL Server Installation

Installation Complete



- Install SQL Server Management Studio 17.x to connect to the database server.
- Download and install SQL Server Data Tools to build SQL Server relational databases, Azure SQL databases, Analysis Services (AS) data models, Integration Services (IS) packages, and Reporting Services (RS) reports.
- Go through these other SQL Server 2017 tips.

Introduction to Database Administration



Oracle Configuration for Connection

Oracle Configuration for Connection

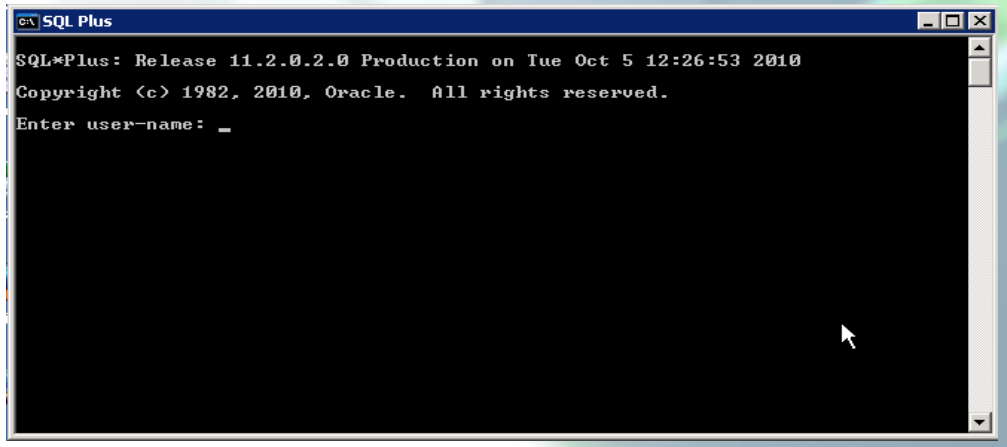
Configuration for connection

- Connect using SQL*Plus
- Connect using SQL Developer
- Manual Connect using tnsnames.ora
- Oracle Client & Oracle Net

Oracle Configuration for Connection

Connect using SQL*Plus

Click on SQL*Plus icon and login with your user id
and password with database name (SID) that you
have given during installation.



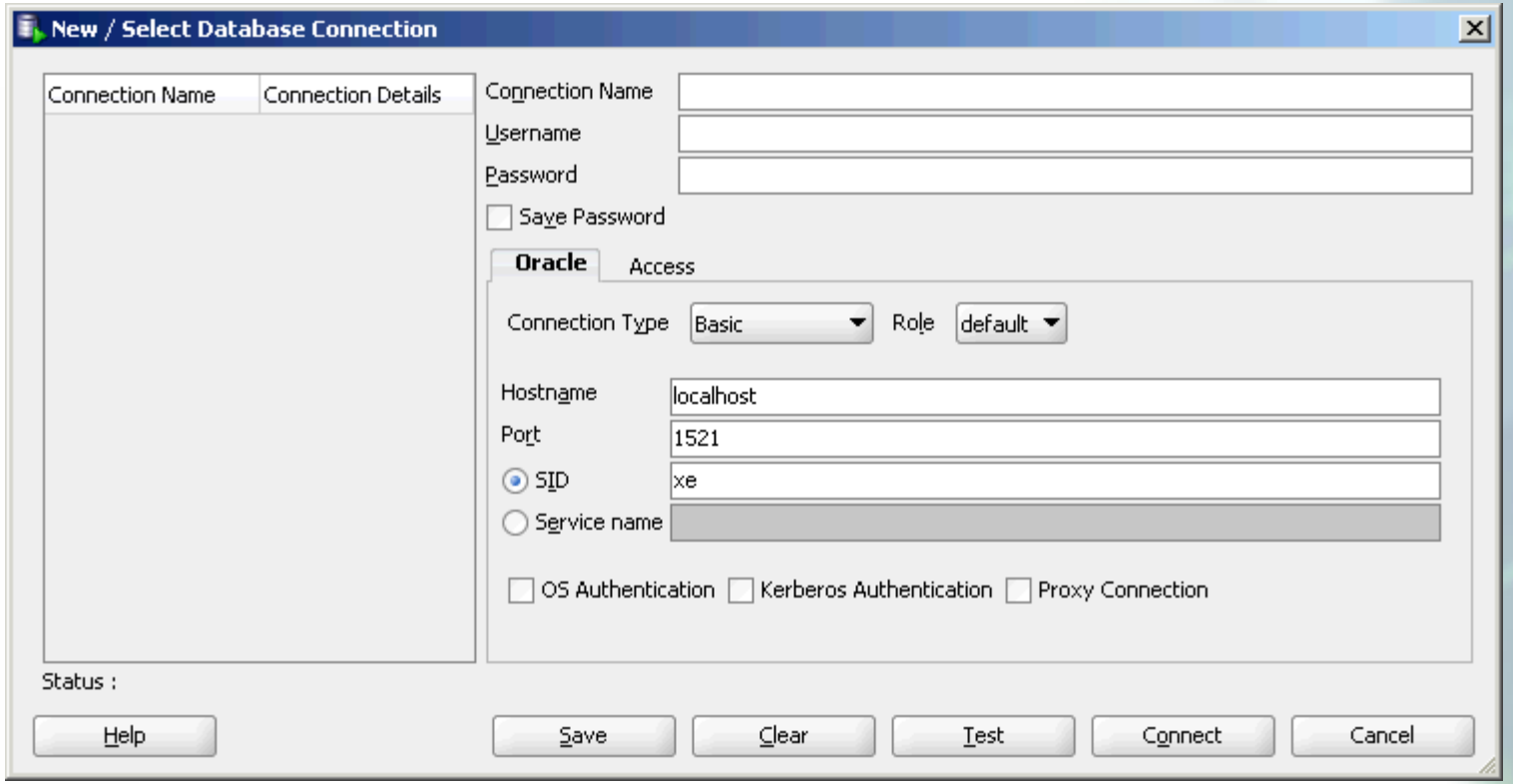
SQL>CONNECT username @ "hostname[:port][/DBname]"

Oracle Configuration for Connection

Connect using SQL Developer

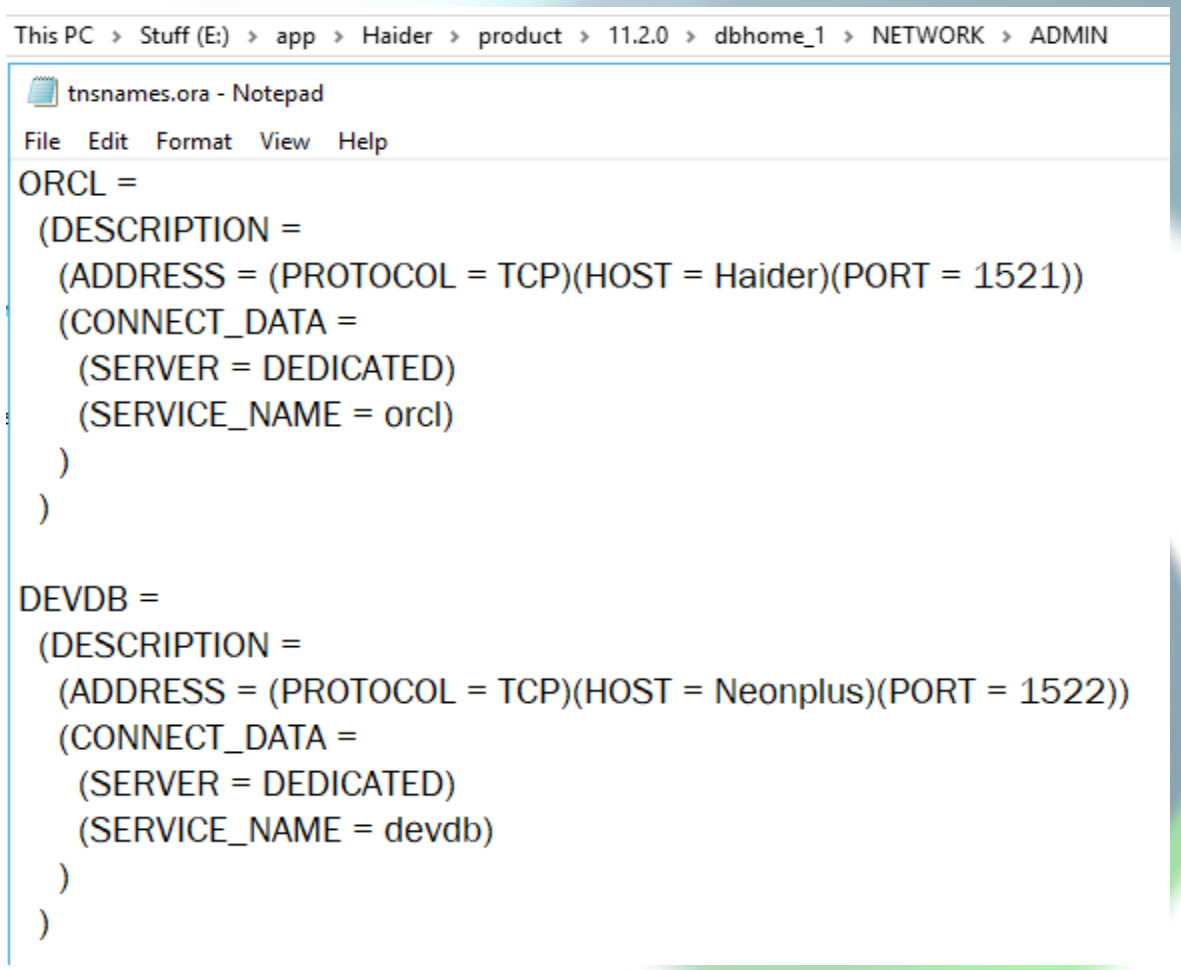
Right click Connection and choose New

The New/Select Database Connection dialog appears



Oracle Configuration for Connection

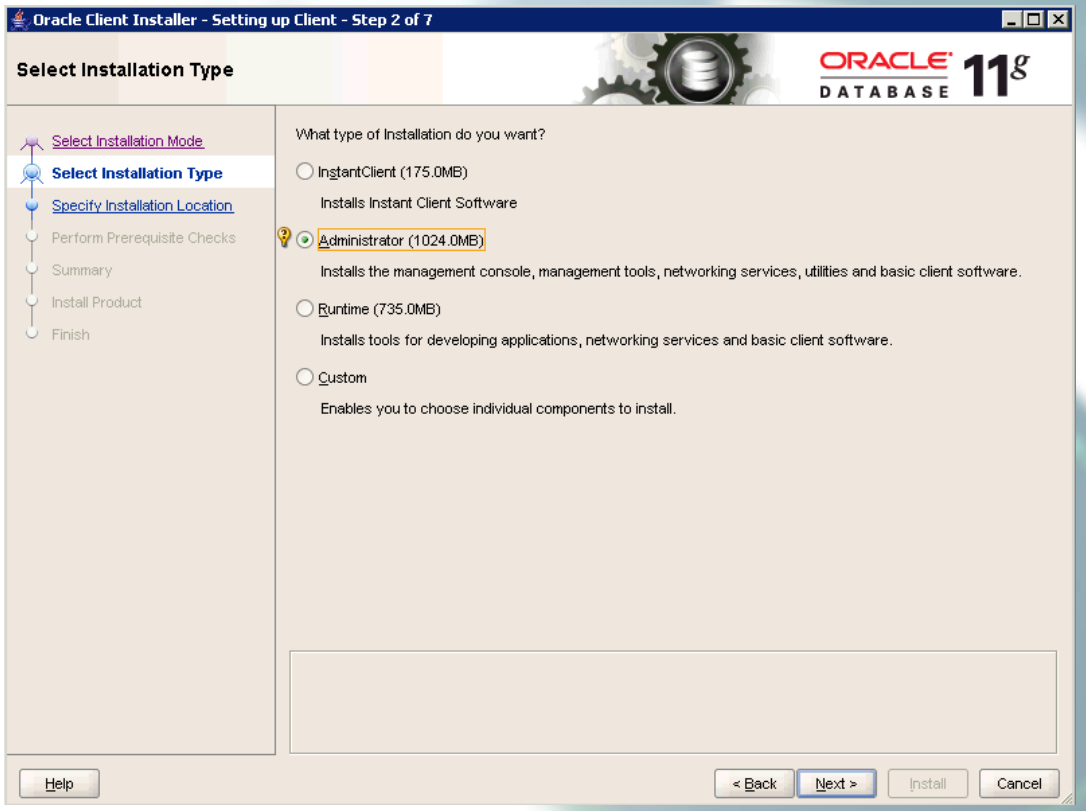
Manual Connect using tnsname.ora file



Oracle Configuration for Connection

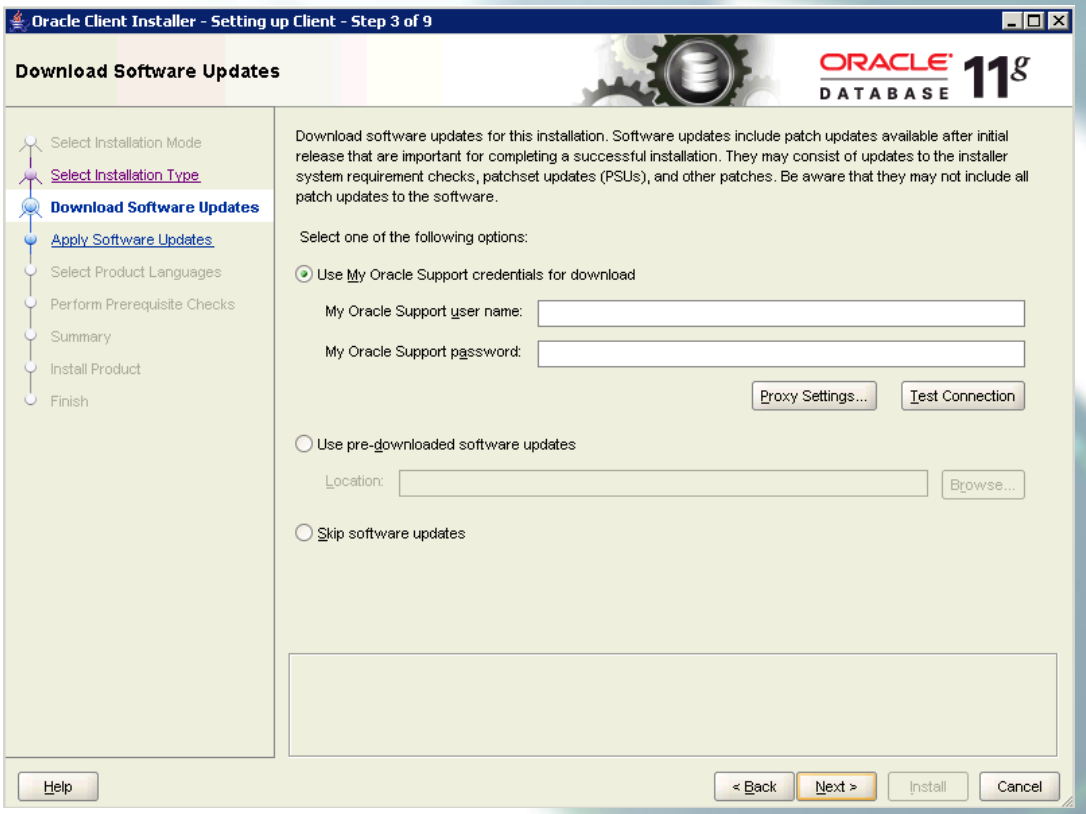
Oracle Client & Oracle Net

Run SETUP.EXE to start Oracle Universal Installer



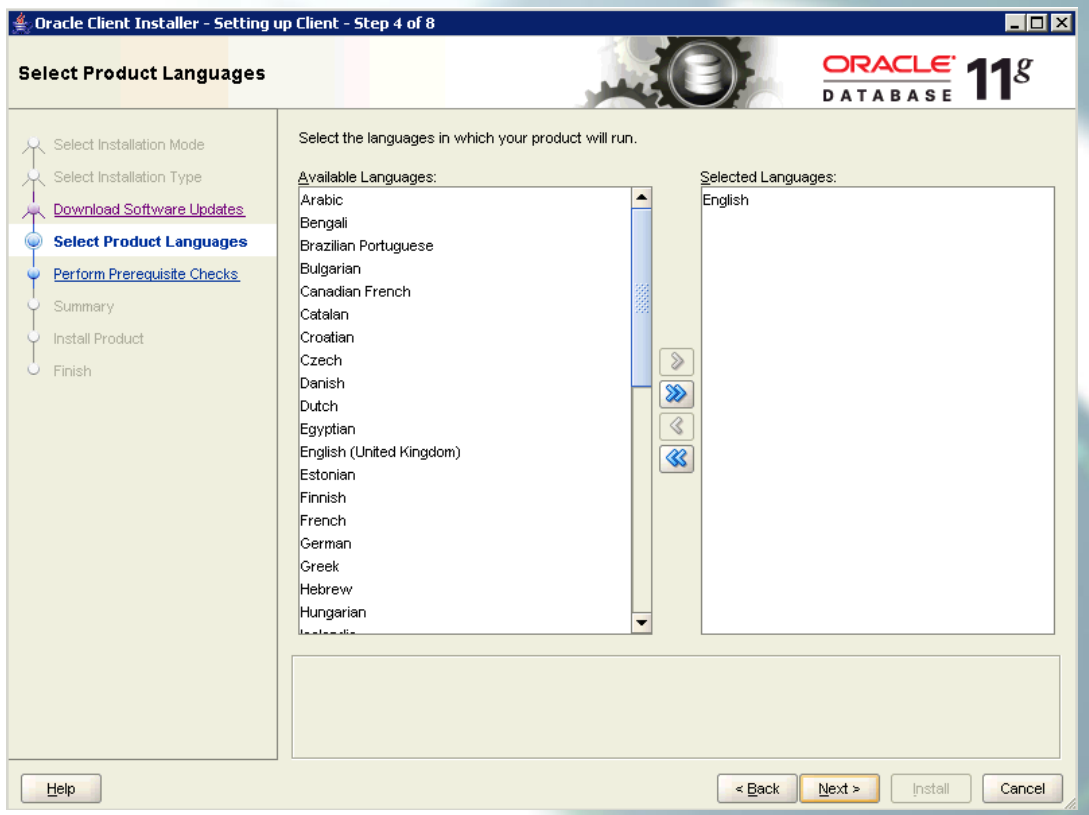
Oracle Configuration for Connection

Oracle Client & Oracle Net



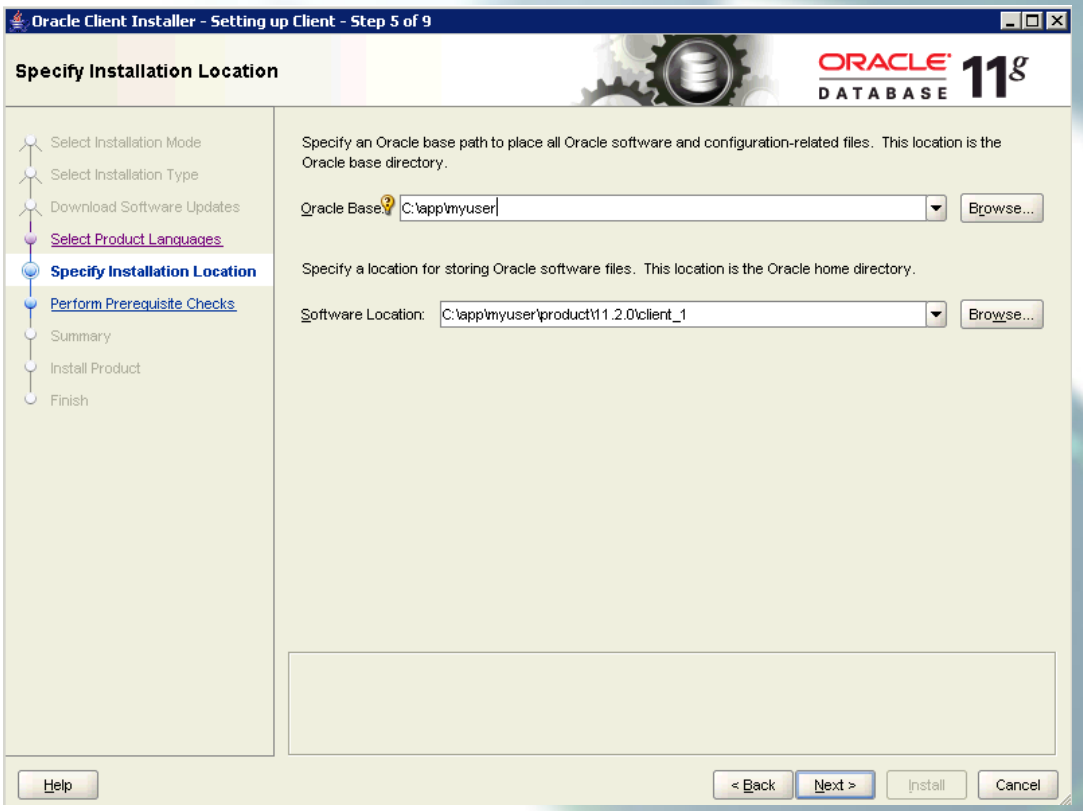
Oracle Configuration for Connection

Oracle Client & Oracle Net



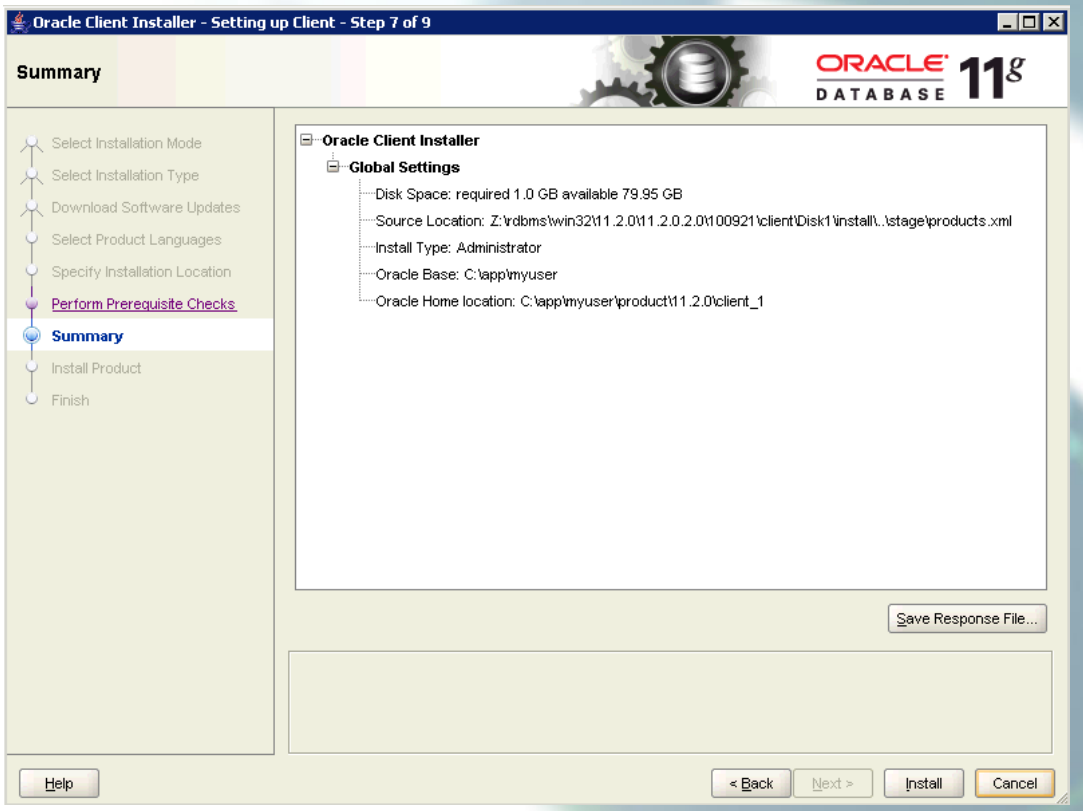
Oracle Configuration for Connection

Oracle Client & Oracle Net



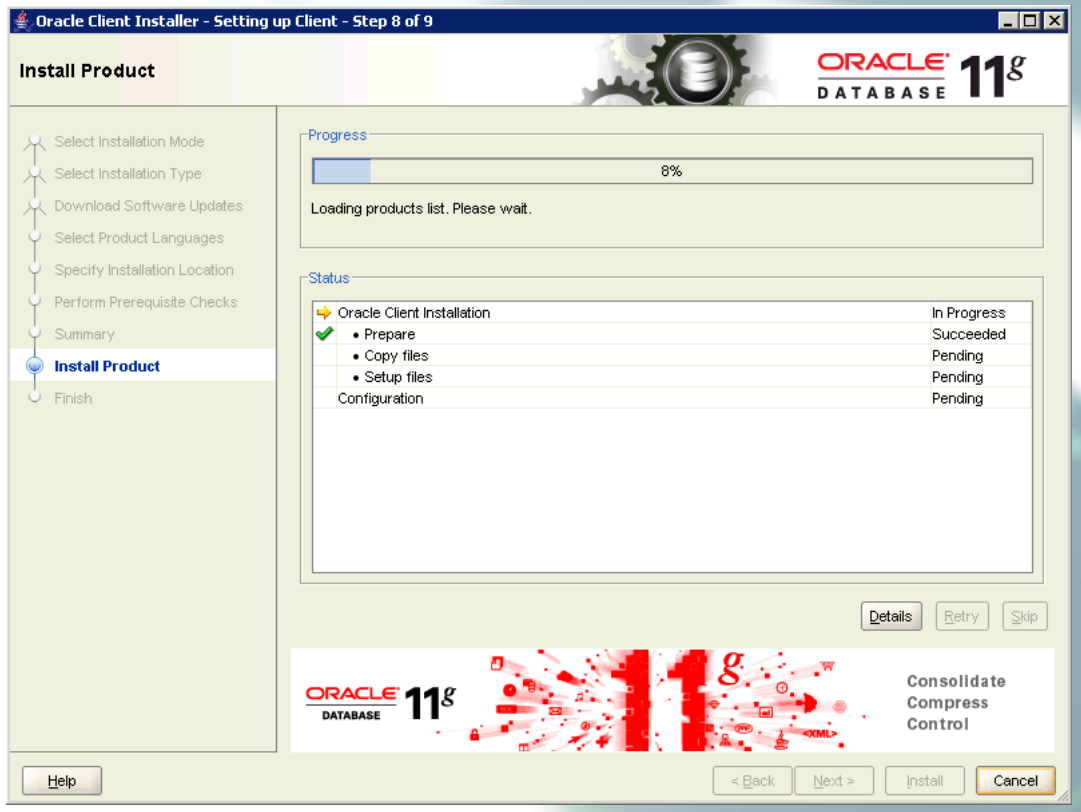
Oracle Configuration for Connection

Oracle Client & Oracle Net



Oracle Configuration for Connection

Oracle Client & Oracle Net

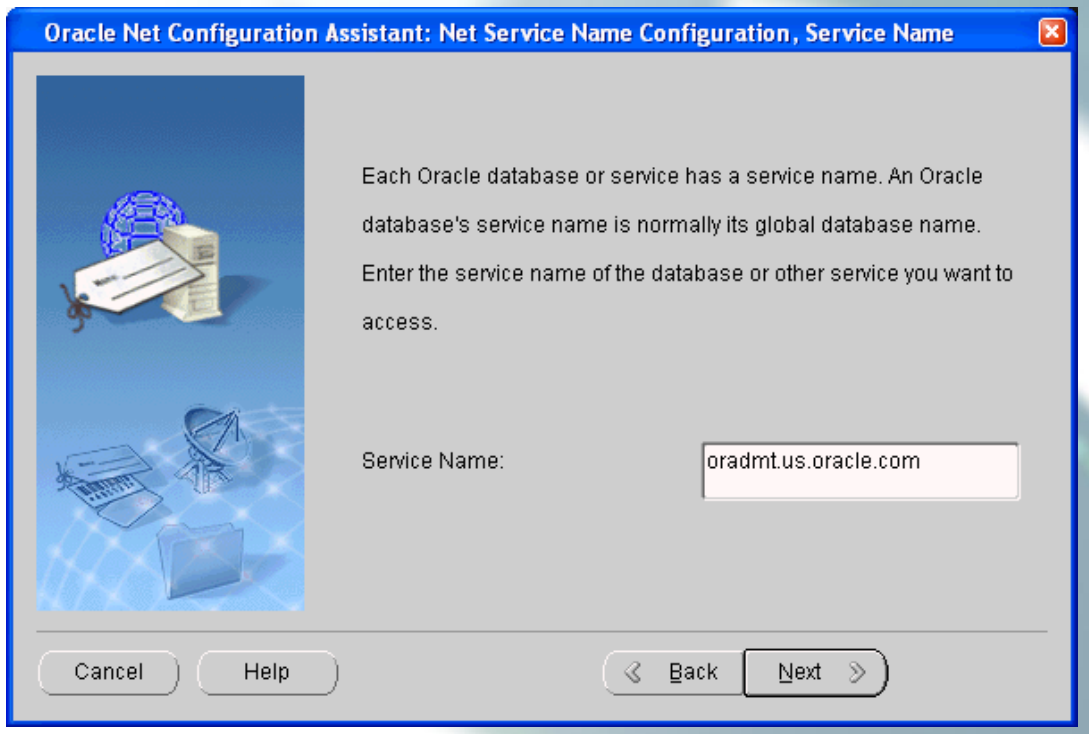


Oracle Configuration for Connection

Oracle Client & Oracle Net

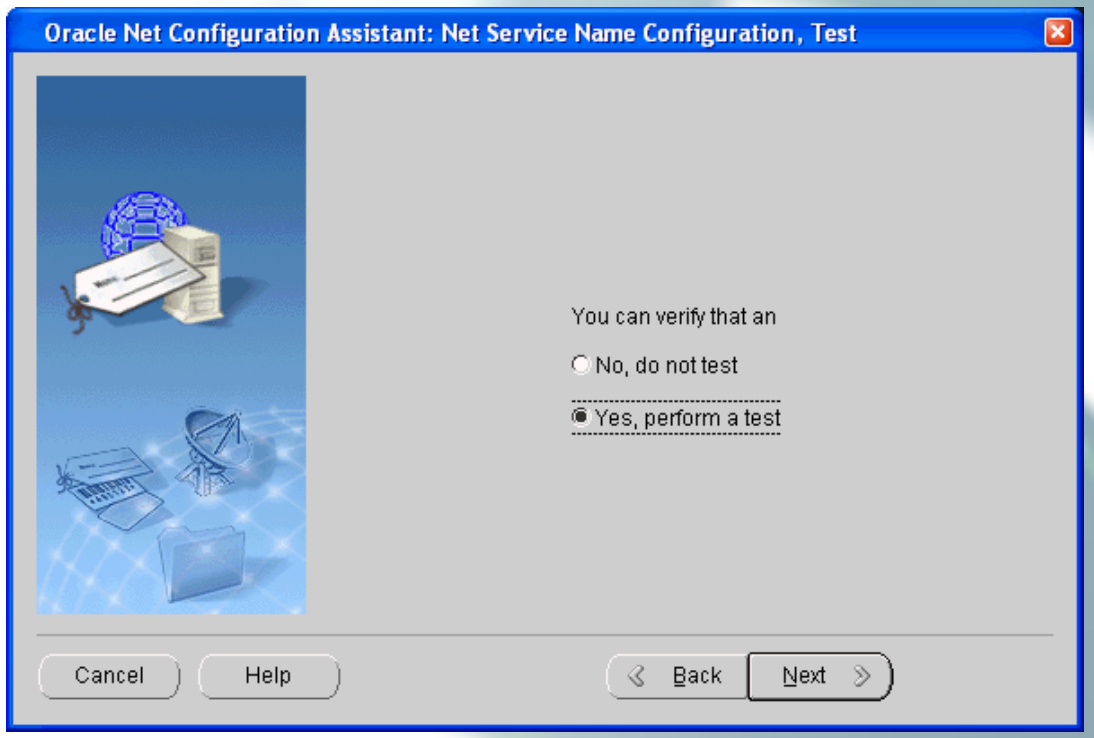
Oracle Configuration for Connection

Oracle Client & Oracle Net



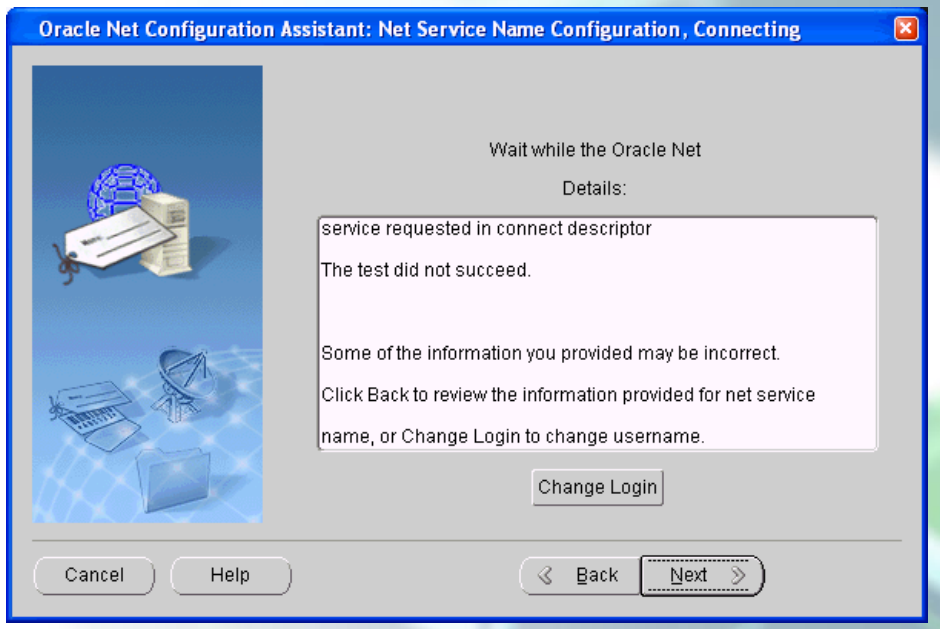
Oracle Configuration for Connection

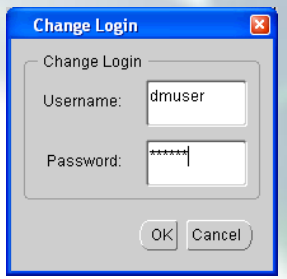
Oracle Client & Oracle Net



Oracle Configuration for Connection

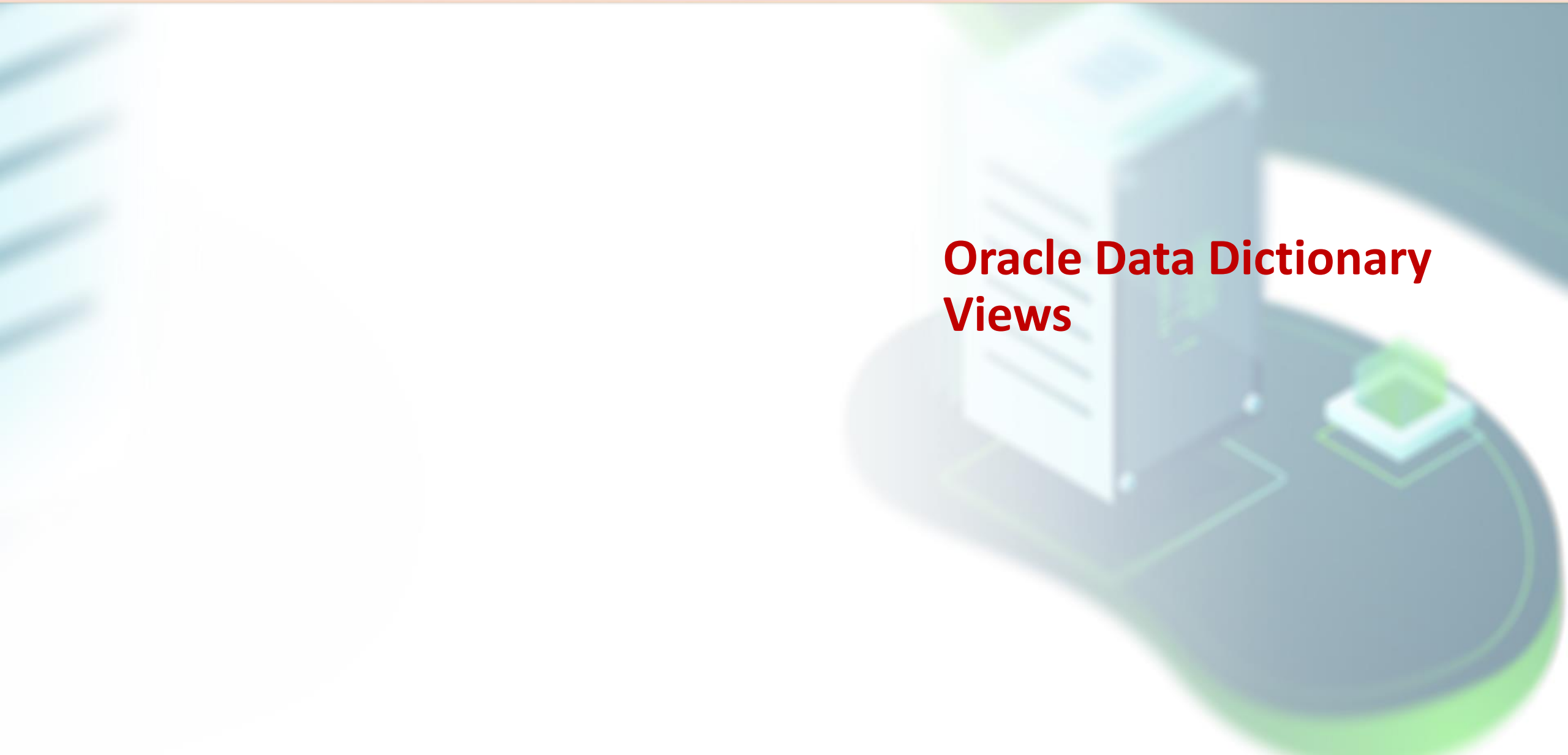
Oracle Client & Oracle Net





End

Introduction to Database Administration



Oracle Data Dictionary Views

Oracle Data Dictionary Views

Data Dictionary Views (Metadata)

- Metadata
- Data Dictionary
- Data Dictionary Contents
- Data Dictionary View Sets
- How to use Data Dictionary?

Oracle Data Dictionary Views

Metadata

Repository of information (metadata) describing the data in the database.

Data about data is called Metadata

Oracle metadata is managed by Data Dictionary (Read only access)

Data Dictionary is managed by using SQL

Catalogue, Repository are alternate names
SQL>desc dict

Oracle Data Dictionary Views

Data Dictionary

- Schema objects in the database including default values for columns and integrity constraints
- Show up of amount of space or storage allocated by objects
- Show up of database users, privileges and roles of users.

Oracle Data Dictionary Views

Data Dictionary Contents

- Base Tables

These underlying tables store information about the database. Only Oracle database should write to and read these tables.

- Views

These views decode the base table data into useful information, such as user or table names, using joins and WHERE clauses to simplify the information. These views contain the names and description of all objects in the data dictionary.

Oracle Data Dictionary Views

Data Dictionary View Sets

Prefix	User Access	Contents	Notes
DBA_	Database administrators	All objects	Some DBA_ views have additional columns containing information useful to the administrator.
ALL_	All users	Objects to which user has privileges	Includes objects owned by user. These views obey the current set of enabled roles.
USER_	All users	Objects owned by user	Views with the prefix USER_ usually exclude the column OWNER. This column is implied in the USER_ views to be the user issuing the query.

```
SELECT OWNER, OBJECT_NAME, OBJECT_TYPE
FROM   ALL_OBJECTS
ORDER BY OWNER, OBJECT_NAME;
```

```
SELECT OBJECT_NAME, OBJECT_TYPE
FROM   USER_OBJECTS
ORDER BY OBJECT_NAME;
```

```
SQL> SELECT ((3*4)+5)/3 FROM DUAL;

((3*4)+5)/3
-----------
 5.66666667
```

Oracle Data Dictionary Views

See columns of table emp and their data types

```
SQL> desc emp
 Name                                      Null?    Type
 ----------------------------------------- -------- ------------
 EMPNO                                     NOT NULL NUMBER(4)
 ENAME                                              VARCHAR2(10)
 JOB                                                VARCHAR2(9)
 MGR                                                NUMBER(4)
 HIREDATE                                           DATE
 SAL                                                NUMBER(7,2)
 COMM                                               NUMBER(7,2)
 DEPTNO                                             NUMBER(2)

SQL> select empno, hiredate, deptno, sal
  2  from emp;

     EMPNO HIREDATE      DEPTNO        SAL
---------- --------- ---------- ----------
      7369 17-DEC-80         20        800
      7499 20-FEB-81         30       1600
      7521 22-FEB-81         30       1250
      7566 02-APR-81         20       2975
      7654 28-SEP-81         30       1250
      7698 01-MAY-81         30       2850
      7782 09-JUN-81         10       2450
      7788 19-APR-87         20       3000
      7839 17-NOV-81         10       5000
      7844 08-SEP-81         30       1500
      7876 23-MAY-87         20       1100

     EMPNO HIREDATE      DEPTNO        SAL
---------- --------- ---------- ----------
      7900 03-DEC-81         30        950
      7902 03-DEC-81         20       3000
      7934 23-JAN-82         10       1300

14 rows selected.

SQL>
```

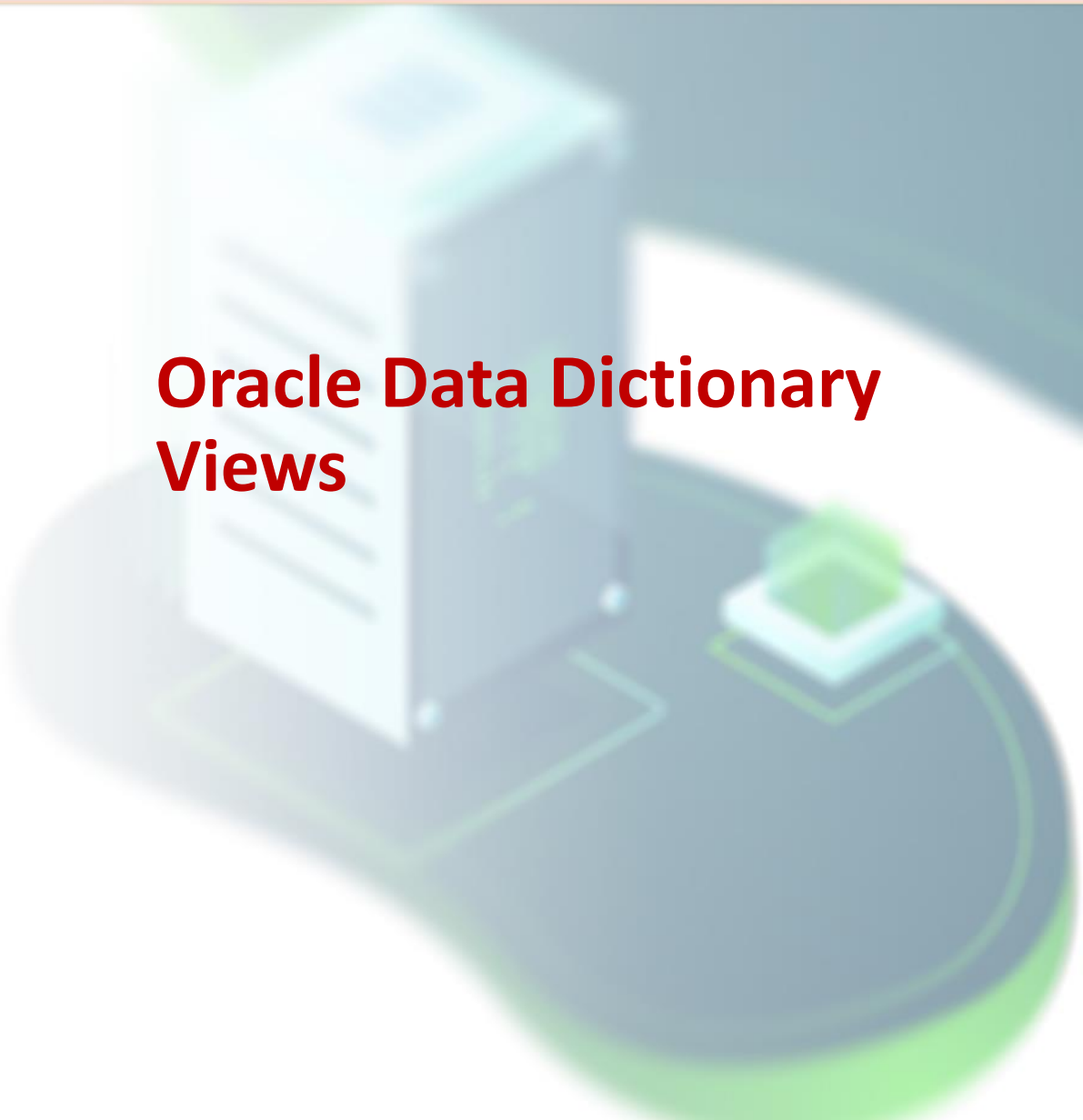
Start writing SQL by looking at above columns

How to use Data Dictionary?

Login with Sys / as sysdba

SQL> desc Dict

Introduction to Database Administration



Oracle Data Dictionary Views

Oracle Data Dictionary Views

Data Dictionary Views (Metadata)

- Example-1: Data Dictionary
- Example-2: Data Dictionary
- Dynamic Performance Views

Oracle Data Dictionary Views

Example-1: Data Dictionary

```
Desc dict

select table_name
from dict
where table_name like
'%CONSTRAINT%';

desc user_constraints
```

Oracle Data Dictionary Views

Example-1: Data Dictionary

To see constraints of table EMP:

```
select constraint_name, table_name,
R_constraint_name
from user_constraints
where table_name='EMP';
```

Oracle Data Dictionary Views

Example-1: Data Dictionary

To see constraints of table EMP:

```
select constraint_name, table_name,
R_constraint_name
from user_constraints
where table_name='EMP';
```

Oracle Data Dictionary Views

Example-2: Data Dictionary

To see the size of table EMP in KB
--login with user scott

```
select sum(bytes)/1024/1024
from dba_segments
where segment_name ='EMP';

select segment_name,
sum(bytes)/1024/1024
from USER_segments
group by segment_name;
```

Oracle Data Dictionary Views

Dynamic Performance Views

These views are called dynamic performance views because they are continuously updated while a database is open and in use. The views, also sometimes called V$ views, contain

- System and session parameters
- Memory usage and allocation
- File states (including RMAN backup files)

Oracle Data Dictionary Views

Dynamic Performance Views

- Progress of jobs and tasks
- SQL execution
- Statistics and metrics

e.g., V$SESSION, V$DATAFILE etc.

End

Introduction to Database Administration

Memory Management & Memory Architecture Overview

Memory Management & Memory Architecture Overview

Memory & Architecture

- Oracle Memory Management
- Automatic Memory Management
- Adjust Memory Target Manually
- Enable Automatic Shared Memory

Memory Management & Memory Architecture Overview

Oracle Memory Management

- Memory management involves maintaining optimal sizes for the Oracle Database instance memory structures as demands on the database change.
- The memory structures that must be managed are the system global area (SGA) and the instance program global area (instance PGA).

Memory Management & Memory Architecture Overview

Oracle Memory Management

- Oracle recommends that you enable the method known as automatic memory management.

Memory Management & Memory Architecture Overview

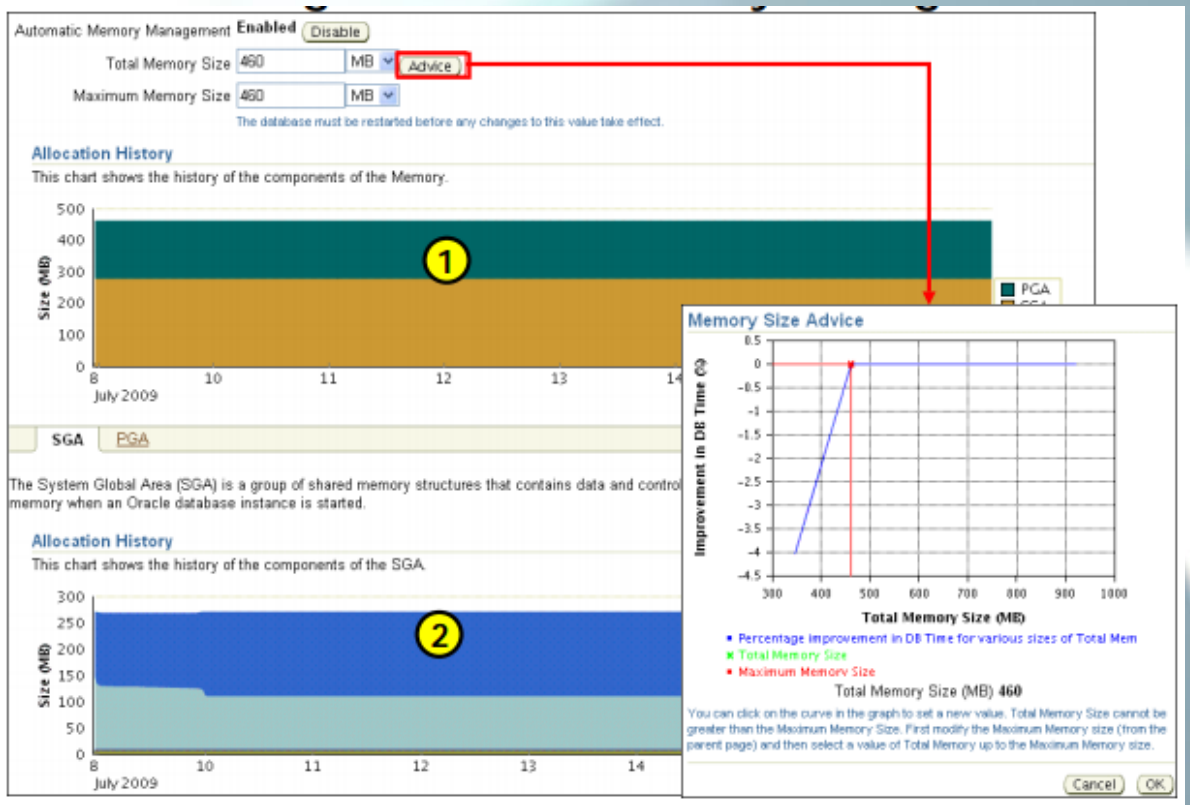
Automatic Memory Management

You designate only the total memory size to be used by the instance, and Oracle Database dynamically exchanges memory between the SGA and the instance PGA as needed to meet processing demands.

If you prefer to exercise more direct control over the sizes of individual memory components, you can disable automatic memory management and configure the database for manual memory management

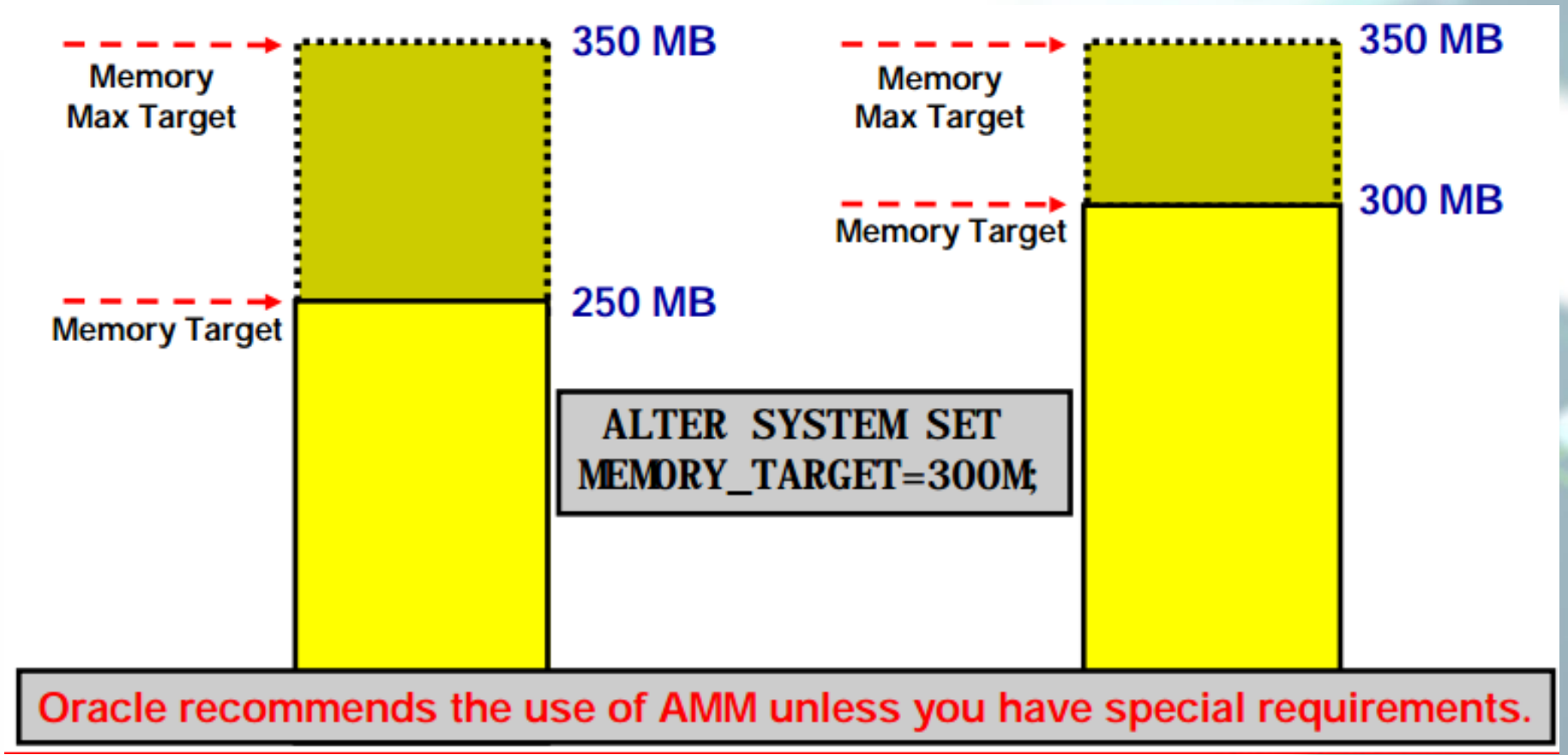
Memory Management & Memory Architecture Overview

Automatic Memory Management



Memory Management & Memory Architecture Overview

Adjust Memory Target Manually



Memory Management & Memory Architecture Overview

Enable Automatic Shared Memory

To enable ASMM from manual shared memory management:

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

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

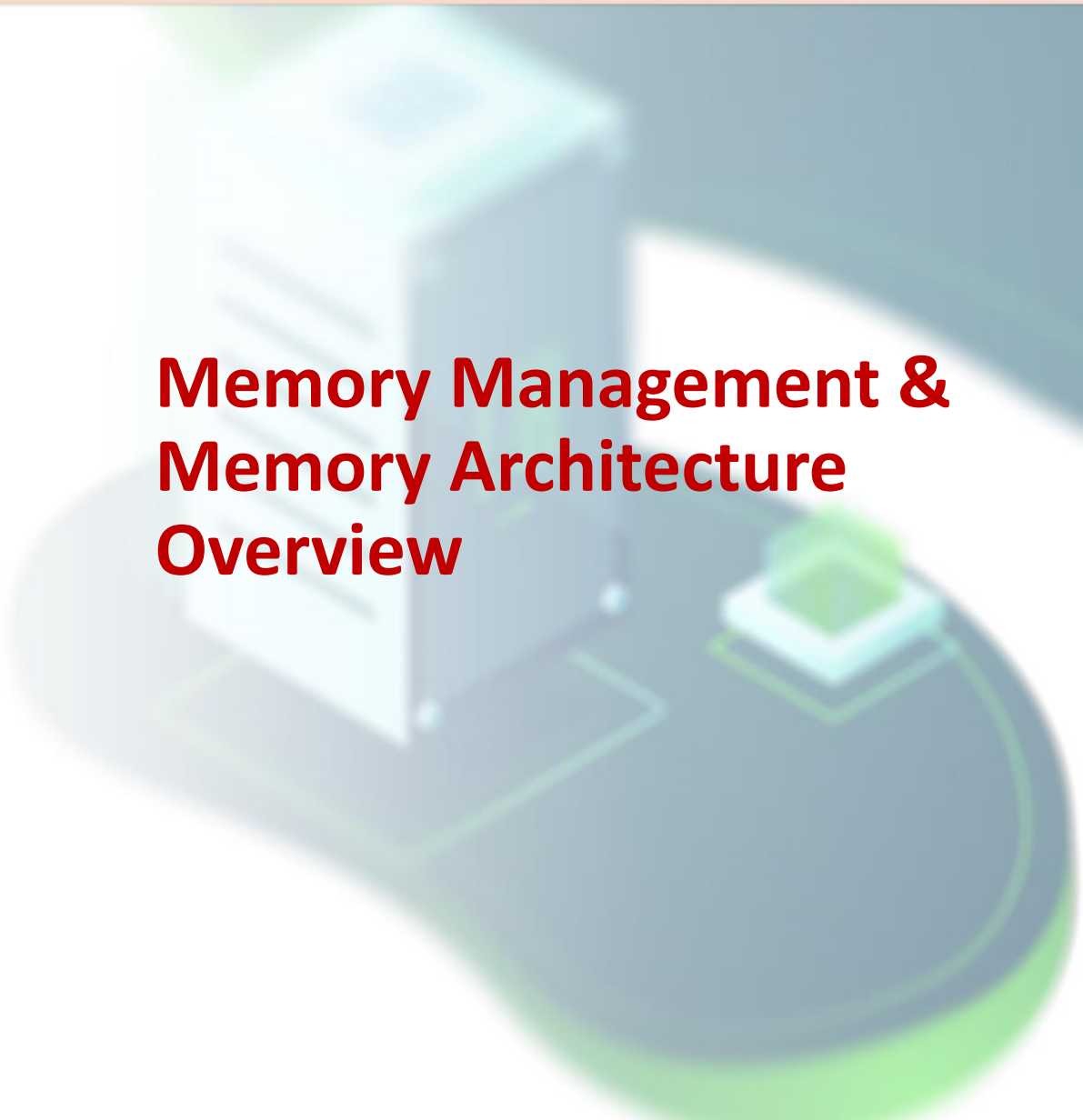
2. Use that value to set **SGA_TARGET**.
3. Set the values of the automatically sized SGA components to 0.

To switch to ASMM from Automatic Memory Management:

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

End

Introduction to Database Administration



Memory Management & Memory Architecture Overview

Memory Management & Memory Architecture Overview

Memory Management & Architecture

- Memory Architecture Overview
- Oracle Database Memory Structure
- Current Sizes of SGA_TARGET and SGA_AGGREGATE_TARGET
- V$MEMORY_TARGET_ADVICE provides tuning advice for the MEMORY_TARGET
- V$PGASTAT

Memory Management & Memory Architecture Overview

Memory Architecture Overview

- System Global Area (SGA)

The SGA is shared by all server and background processes. Examples of data stored in the SGA include cached data blocks and shared SQL areas.

Memory Management & Memory Architecture Overview

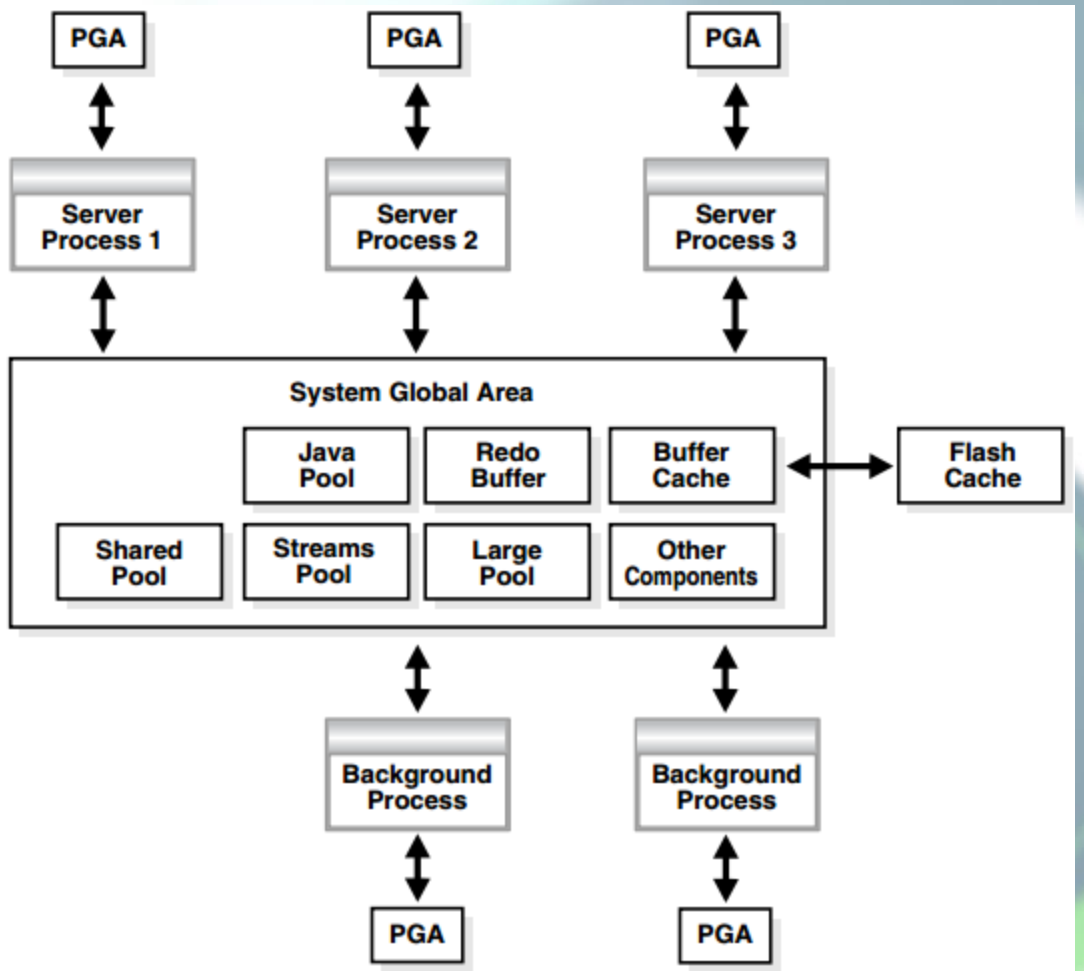
Memory Architecture Overview

- Program Global Area (PGA)

A PGA is a memory region that contains data and control information for a server process. It is non shared memory created by Oracle Database when a server process is started. Access to the PGA is exclusive to the server process. There is one PGA for each server process.

Memory Management & Memory Architecture Overview

Oracle Database Memory Structure



Memory Management & Memory Architecture Overview

Current Sizes of SGA_TARGET and SGA_AGGREGATE_TARGET

SHOW PARAMETER TARGET

```
NAME                                 TYPE        VALUE
------------------------------------ ----------- ----------------
archive_lag_target                   integer     0
db_flashback_retention_target        integer     1440
fast_start_io_target                 integer     0
fast_start_mttr_target               integer     0
memory_max_target                    big integer 0
memory_target                        big integer 0
parallel_servers_target              integer     16
pga_aggregate_target                 big integer 90M
sga_target                           big integer 272M
```

Run the following query to determine the maximum instance PGA allocated since the database was started:

```
select value from v$pgastat where name='maximum PGA allocated';
```

Compute the maximum value between the query result from step 2b and PGA_AGGREGATE_TARGET. Add SGA_TARGET to this value.

```
memory_target = sga_target + max(pga_aggregate_target, maximum PGA
allocated)
```

Memory Management & Memory Architecture Overview

V$MEMORY_TARGET_ADVICE provides tuning advice for the MEMORY_TARGET

```
SQL>  select * from v$memory_target_advice order by memory_size;

MEMORY_SIZE MEMORY_SIZE_FACTOR ESTD_DB_TIME ESTD_DB_TIME_FACTOR    VERSION
----------- ------------------ ------------ ------------------- ----------
        180                .5          458               1.344          0
        270               .75          367              1.0761          0
        360                 1          341                   1          0
        450              1.25          335               .9817          0
        540               1.5          335               .9817          0
        630              1.75          335               .9817          0
```

Memory Management & Memory Architecture Overview

V$PGASTAT

```
select value
from v$pgastat
where name='maximum PGA allocated';
```

For example, if SGA_TARGET is 272M and PGA_AGGREGATE_TARGET is 90M as shown above, and if the maximum PGA allocated is determined to be 120M, then MEMORY_TARGET should be at least 392M (272M + 120M).

End

Introduction to Database Administration

Memory Architecture Overview (SGA)

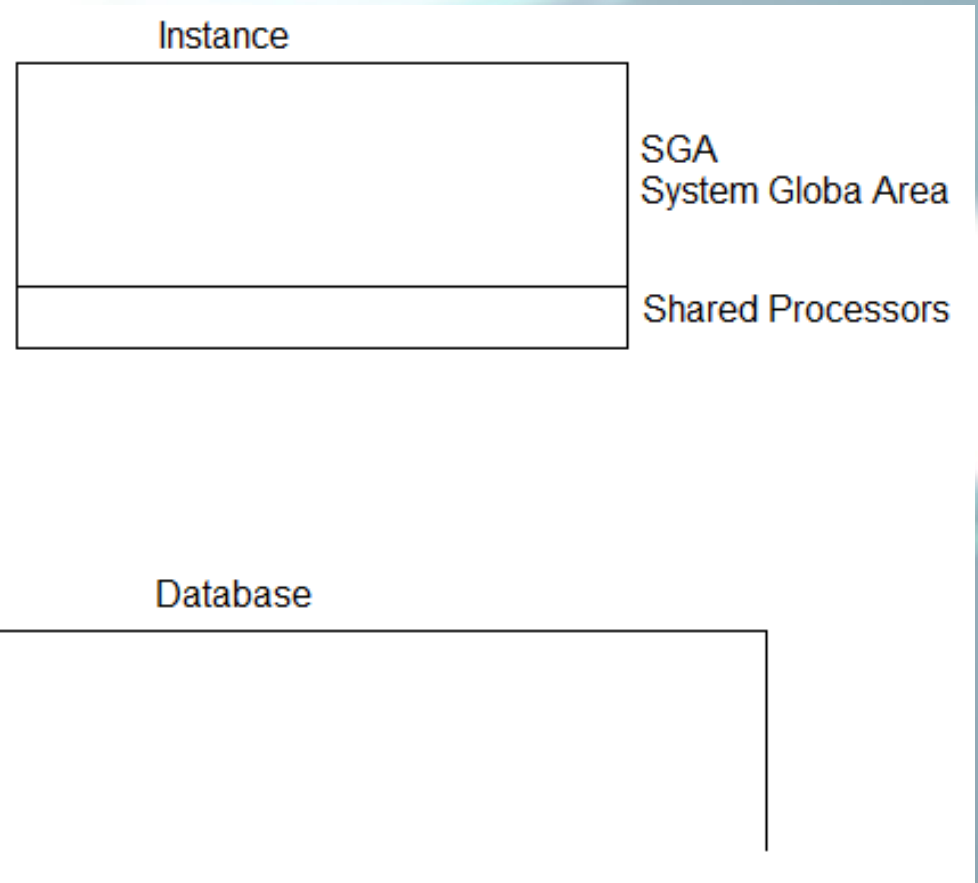
Memory Architecture Overview

Memory Management & Architecture

- Instance & Database
- Overview of SGA
- Overview of SGA & Database

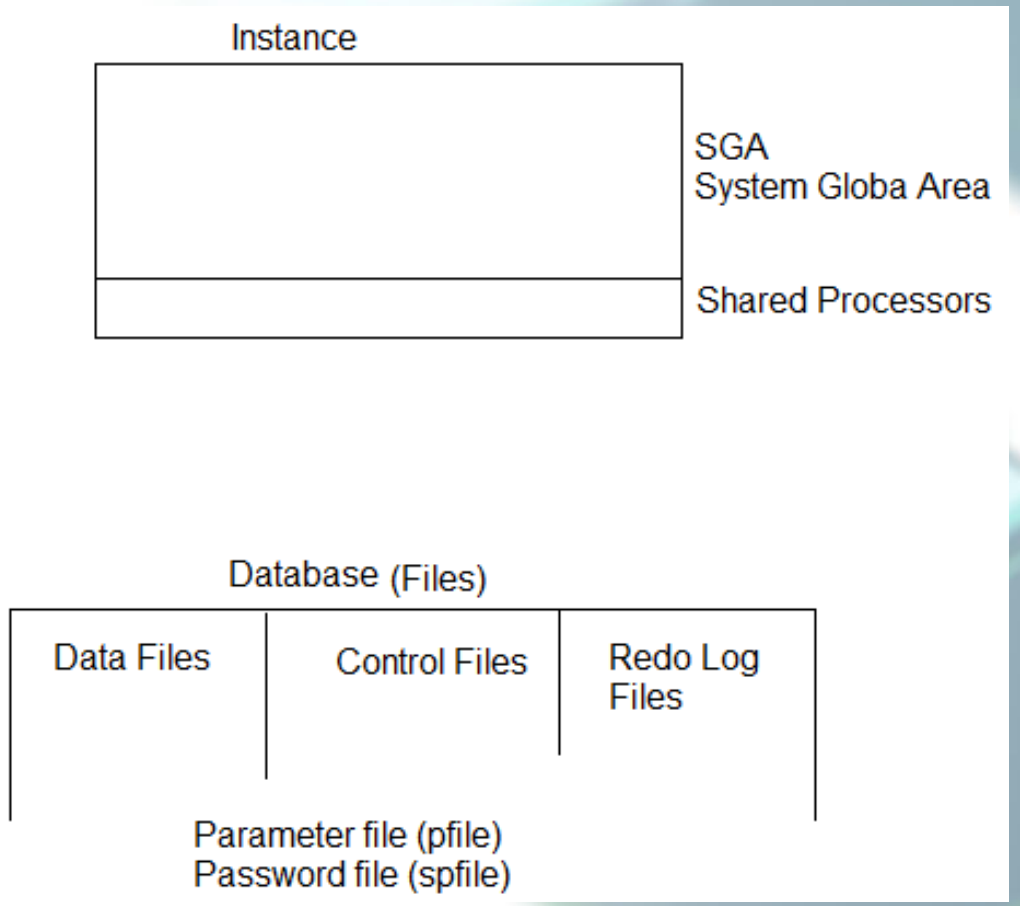
Memory Architecture Overview

Instance & Database



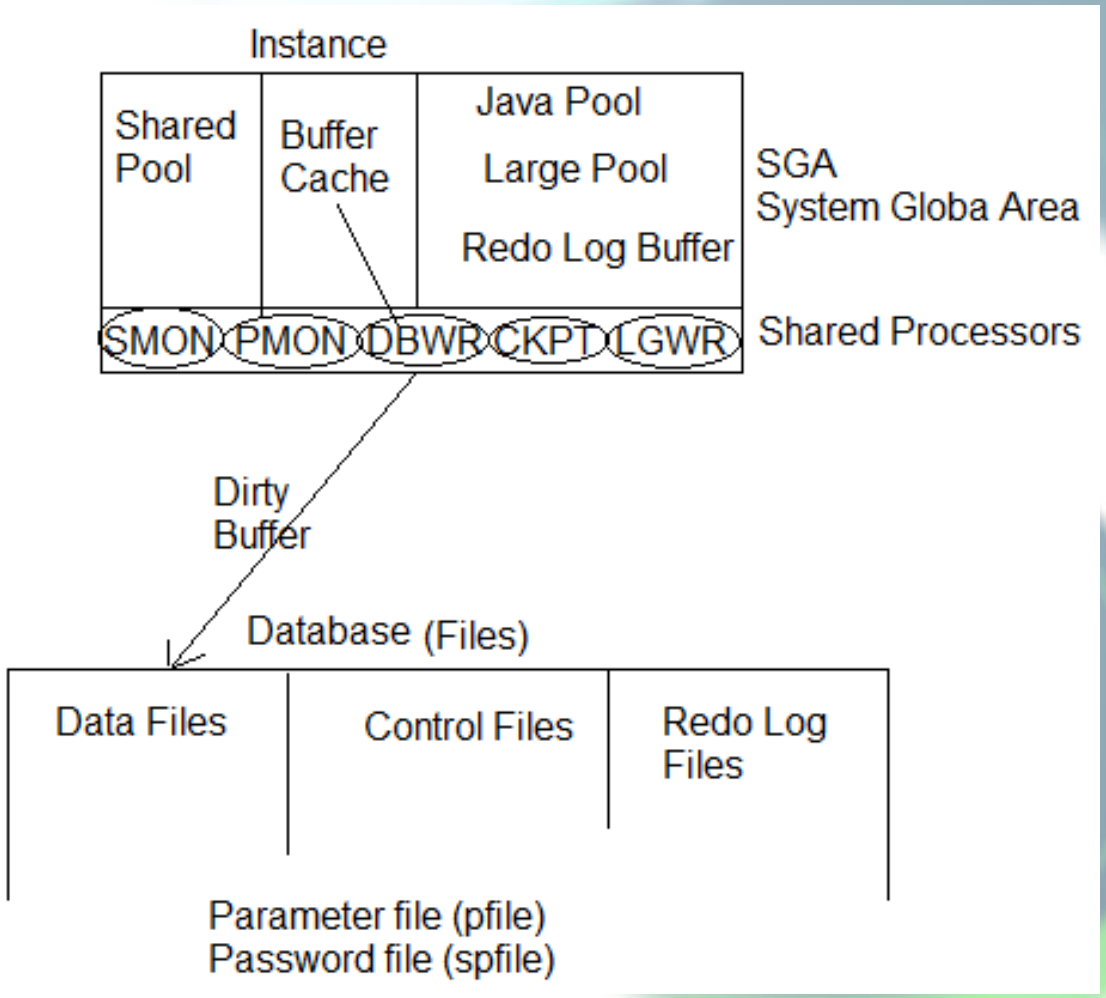
Memory Architecture Overview

Overview of SGA



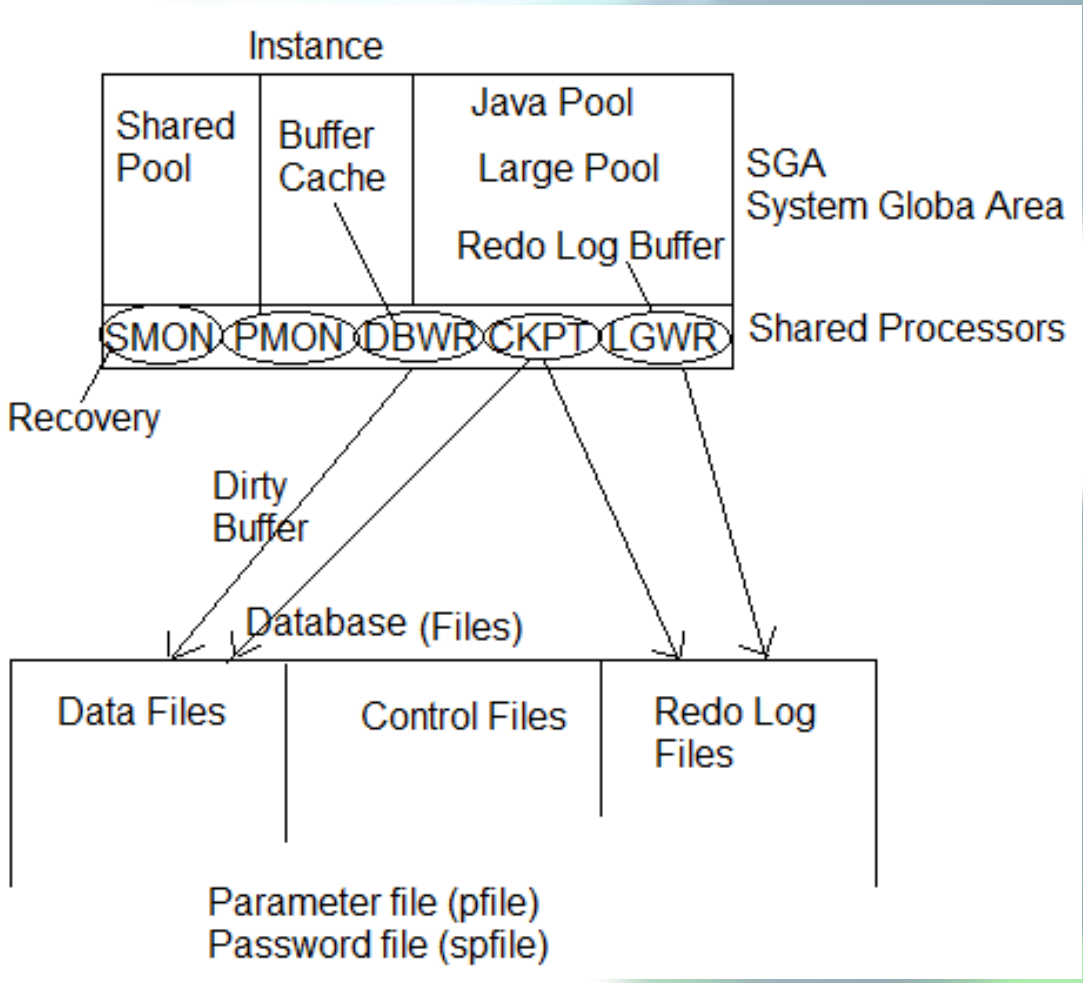
Memory Architecture Overview

Overview of SGA & Database



Memory Architecture Overview

Overview of SGA & Database



End

Configuring Memory

Configuring Memory

Configuring Memory with SGA

- Fundamentals of Configuration
- Granules
- Granule Size
- SGA Memory Size
- SGA_MAX_SIZE
- Setting SGA Target Size
- Manual Shared Memory Management

Configuring Memory

Fundamentals of Configuration

Disable automatic memory management of SGA set target and maximum sizes for the SGA With automatic shared memory management

The database then sets the total size of the SGA to your designated target, and dynamically tunes the sizes of many SGA components.

Configuring Memory

Fundamentals of Configuration

Set the sizes of several individual SGA components with manual shared memory management, thereby determining the overall SGA size. You then manually tune these individual SGA components on an ongoing basis.

Similarly, for the instance PGA, there is automatic/ manual PGA memory management, in which you set a target size for the instance PGA.

Configuring Memory

Granules

SGA memory components include

- the shared pool (used to allocate memory for SQL and PL/SQL execution),
- the java pool (used for java objects and other java execution memory), and
- the buffer cache (used for caching disk blocks).

Configuring Memory

Granules

All SGA components allocate and deallocate space in units of granules.

The granule size is based on the value of the SGA_MAX_SIZE initialization parameter.

Configuring Memory

Granule Size

SGA Memory Amount	Granule Size
Less than or equal to 1 GB	4 MB
Greater than 1 GB and less than or equal to 8 GB	16 MB
Greater than 8 GB and less than or equal to 16 GB	32 MB
Greater than 16 GB and less than or equal to 32 GB	64 MB
Greater than 32 GB and less than or equal to 64 GB	128 MB
Greater than 64 GB and less than or equal to 128 GB	256 MB
Greater than 128 GB	512 MB

Using V$SGAINFO view to see the granule size that is being used by an instance

Configuring Memory

SGA Memory Size

```
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> startup open
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             713032144 bytes
Database Buffers          352321536 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
```

```
SQL> select name, sum(value)
  2  from v$SGA
  3  group by name;

NAME                 SUM(VALUE)
-------------------- ----------
Database Buffers      352321536
Redo Buffers            4603904
Variable Size         713032144
Fixed Size              1375792
```

Configuring Memory

SGA_MAX_SIZE

- The SGA_MAX_SIZE initialization parameter specifies the maximum size of the System Global Area for the lifetime of the instance.
- If you do not specify SGA_MAX_SIZE, then Oracle Database selects a default value that is the sum of all components specified or defaulted at initialization time.

Configuring Memory

Setting SGA Target Size

- You enable the automatic shared memory management feature by setting the SGA_TARGET parameter to a nonzero value. This parameter sets the total size of the SGA.
- It replaces the parameters that control the memory allocated for a specific set of individual components, which are now automatically and dynamically resized (tuned) as needed.

Configuring Memory

Setting SGA Target Size

SGA Component	Initialization Parameter
The shared pool	SHARED_POOL_SIZE
The large pool	LARGE_POOL_SIZE
The Java pool	JAVA_POOL_SIZE
The buffer cache	DB_CACHE_SIZE
The Streams pool	STREAMS_POOL_SIZE

Configuring Memory

Setting SGA Target Size

SGA Component	Initialization Parameter
The log buffer	LOG_BUFFER
The keep and recycle buffer caches	DB_KEEP_CACHE_SIZE DB_RECYCLE_CACHE_SIZE
Nonstandard block size buffer caches	DB_*n*K_CACHE_SIZE

In addition to setting SGA_TARGET to a nonzero value, set to zero all initialization parameters of first Table to enable full automatic tuning of the automatically sized SGA components.

Configuring Memory

Manual Shared Memory Management

SHARED_POOL_SIZE = 200M

DB_CACHE_SIZE = 500M

LARGE_POOL_SIZE=200M

Also assume the following query results:

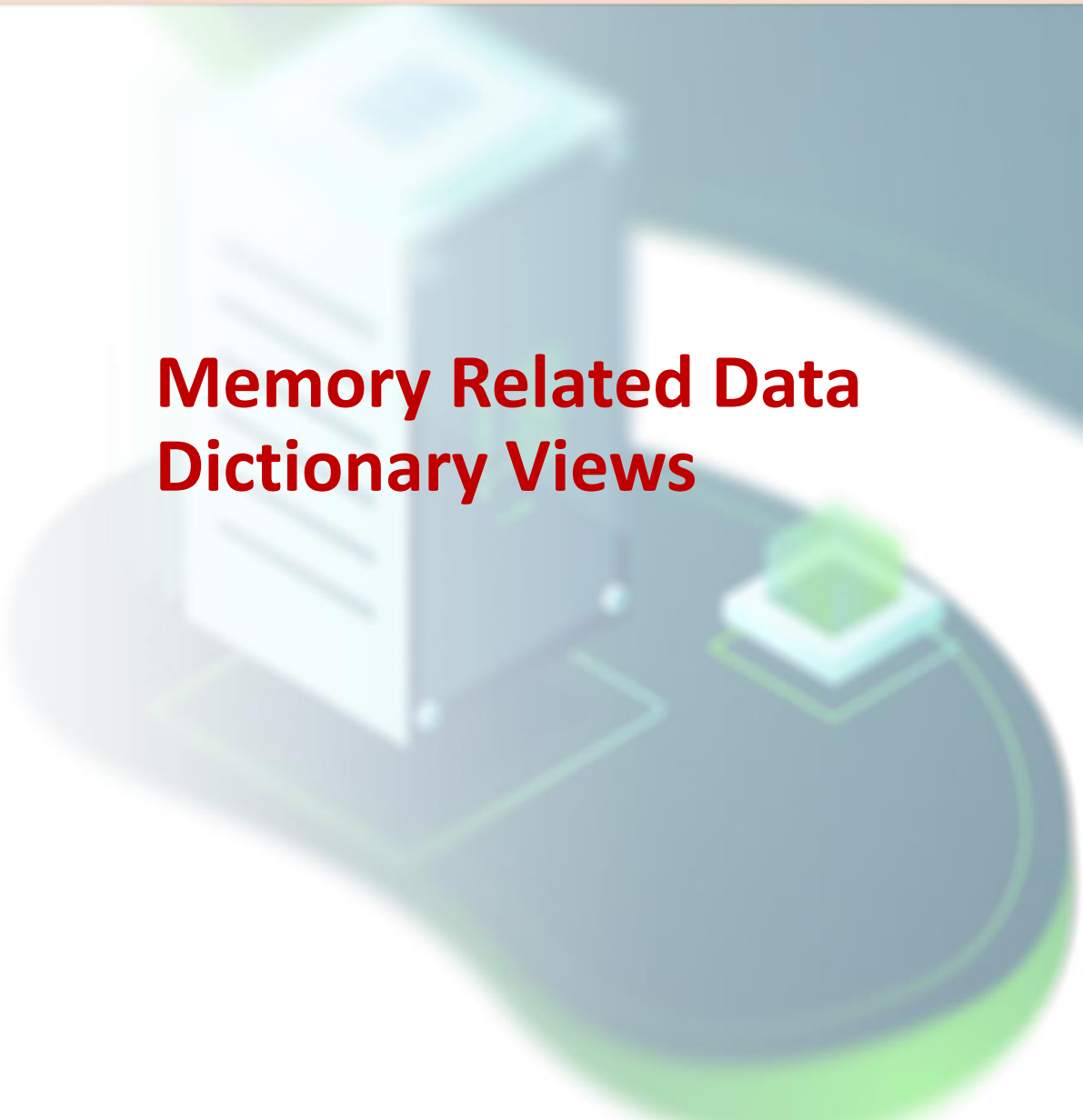
Query	Result
SELECT SUM(value) FROM V$SGA	1200M
SELECT CURRENT_SIZE FROM V$SGA_DYNAMIC_FREE_MEMORY	208M

```
ALTER SYSTEM SET SGA_TARGET = 992M;
ALTER SYSTEM SET SHARED_POOL_SIZE = 0;
ALTER SYSTEM SET LARGE_POOL_SIZE = 0;
ALTER SYSTEM SET JAVA_POOL_SIZE = 0;
ALTER SYSTEM SET DB_CACHE_SIZE = 0;
ALTER SYSTEM SET STREAMS_POOL_SIZE = 0;
```

where 992M = 1200M minus 208M.

End

Introduction to Database Administration



Memory Related Data Dictionary Views

Memory Related Data Dictionary Views

Memory Data Dictionary Views

- Memory Parameters
- Memory Target & SPFILE
- Tune SGA Target
- PGA related Queries
- Table Size
- Blocks & Extents Sizes
- Database Block Size
- Extent and PCT_FREE Sizes
- Maximum Size of Data File
- Maximum Size of Data File with Blocks

Memory Related Data Dictionary Views

Memory Parameters

```
SQL> show parameter memory

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------
hi_shared_memory_address             integer     0
memory_max_target                    big integer 1232M
memory_target                        big integer 1232M
shared_memory_address                integer     0
SQL> show memory_target
```

```
SQL> show parameter SGA

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------
lock_sga                             boolean     FALSE
pre_page_sga                         boolean     FALSE
sga_max_size                         big integer 1G
sga_target                           big integer 0
```

Memory Related Data Dictionary Views

Memory Parameters

```
SQL> show parameter target

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------
archive_lag_target                   integer     0
db_flashback_retention_target        integer     1440
fast_start_io_target                 integer     0
fast_start_mttr_target               integer     0
memory_max_target                    big integer 1232M
memory_target                        big integer 1232M
parallel_servers_target              integer     16
pga_aggregate_target                 big integer 0
sga_target                           big integer 0
SQL>
```

```
SQL> set linesize 200
SQL> select substr(name,1,10) fname, substr(value,1,100) fvalue
  2  from v$parameter
  3  where name='spfile';

FNAME      FVALUE
---------- ----------------------------------------------------------------------
spfile     E:\APP\HAIDER\PRODUCT\11.2.0\DBHOME_1\DATABASE\SPFILEORCL.ORA
```

Memory Related Data Dictionary Views

Memory Target & SPFILE

```
create
pfile='E:\app\Haider\admin\orcl\pfile
\ init.ora.862016235218‘ from
'E:\app\Haider\product\11.2.0\dbho
me_1\dbs\init.ora';

Alter system set memory_target=1021
M scope=spfile;
```

Memory Related Data Dictionary Views

Memory Target & SPFILE

```
Alter system set SGA_TARGET=0
scope=spfile;
Alter system set
PGA_AGGREGATE_TARGET=0
scope=spfile;

shutdown immediate
Show parameter memory
```

Memory Related Data Dictionary Views

Tune SGA Target

Desc V$SGA_TARGET_ADVICE

select sga_size,estd_db_time
from V$SGA_TARGET_ADVICE;

```
  SGA_SIZE ESTD_DB_TIME
---------- ------------
       404       100326
       606        97377
       808        96681
      1010        96333
      1212        96323
      1414        96323
      1616        96323

7 rows selected.
```

Memory Related Data Dictionary Views

PGA related Queries

```
select low_optimal_size/1024 low_kb,
(high_optimal_size+1)/1024 high_kb,
optimal_executions,
onepass_executions,
multipasses_executions
from v$sql_workarea_histogram
where total_executions <> 0;
```

LOW_KB	HIGH_KB	OPTIMAL_EXECUTIONS	ONEPASS_EXECUTIONS	MULTIPASSES_EXECUTIONS
2	4	354667	0	0
64	128	626	0	0
128	256	190	0	0
256	512	532	0	0
512	1024	3728	0	0
1024	2048	110	0	0
2048	4096	210	0	0
4096	8192	10	0	0
8192	16384	1	0	0

9 rows selected.

Memory Related Data Dictionary Views

Table Size

Login with scott/tiger

Desc dba_segments

```
select sum(bytes)/1024/1024
Table_size_MB
from dba_segments
where segment_name ='EMP';
```

```
TABLE_SIZE
----------
     .0625
```

Memory Related Data Dictionary Views

Blocks & Extents Sizes

```
select distinct tablespace_name,
blocks, extents
from dba_segments;
```

TABLESPACE_NAME	BLOCKS	EXTENTS
WRK_NOVUS	512	4
SYSTEM	1536	27
PIND_TSDEV	24	3
PIND_TSDEV	128	1
PIND_TSDEV	512	4
WRK_NOVUS	1792	7
SYSAUX	408	5
UNDOTBS1	144	3
SYSTEM	896	22
SYSTEM	16	2
SYSAUX	112	14

Memory Related Data Dictionary Views

Database Block Size

Show parameter (to see db_block_size)
or
select value
from v$parameter
where name = 'db_block_size';

Value

8192

Means 8KB block size

Memory Related Data Dictionary Views

Extent and PCT_FREE Sizes

```
select avg_space, initial_extent, PCT_FREE
from ALL_TABLES
where table_name = 'EMP';
```

AVG_SPACE	INITIAL_EXTENT	PCT_FREE
0	65536	10

Memory Related Data Dictionary Views

Maximum Size of Data File

How to see block size and max file size with DBA_DATA_FILES (4 Millions data blocks)

Find db block size from v$parameter

4194304 * db_block_size

Memory Related Data Dictionary Views

Maximum Size of Data File

If your db_block_size is 8kb, then your maximum datafile size is:

4194304 * 8192 = 34359738368 / 1024 / 1024 / 1024 = 32GB.

```
select file_name, tablespace_name, blocks
from dba_data_files;
```

Memory Related Da0ta Dictionary Views

Maximum Size of Data File with Blocks

Each Oracle datafile can contain maximum 4194303 (4 Million) data blocks.

Block Size | Maximum Datafile Size

———————————————————

2k 4194303 * 2k = 8 GB

4k 4194303 * 4k = 16 GB

8k 4194303 * 8k = 32 GB

16k 4194303 * 16k = 64 GB

32k 4194303 * 32k = 128 GB

In Oracle Database 10g, BIGFILE tablespace was introduced.

(4 billion) data blocks.

Block Size | Maximum Datafile Size

———————————————————

2k 4294967295 * 2k = 8 TB

4k 4294967295 * 4k = 16 TB

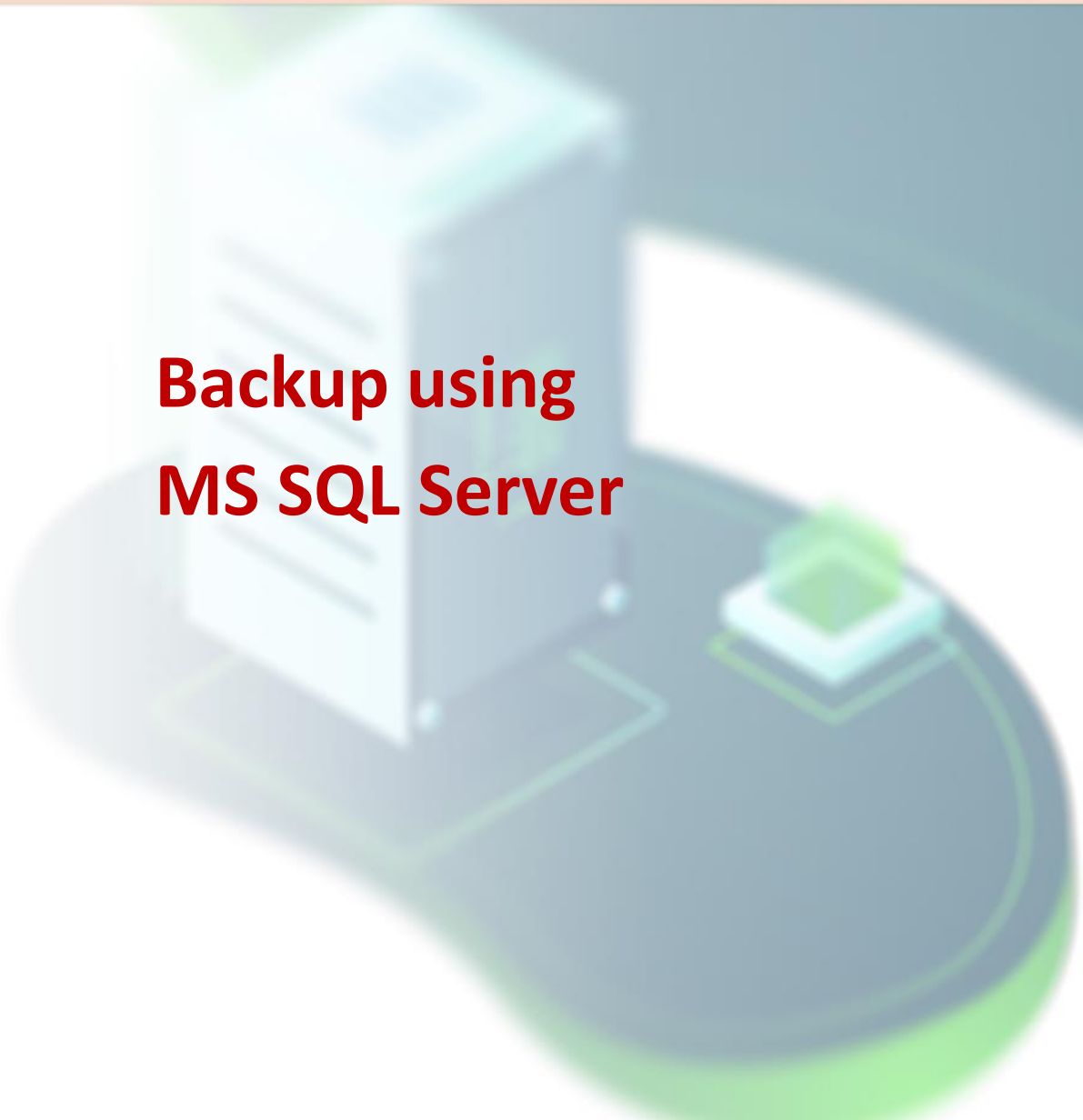
8k 4294967295 * 8k = 32 TB

16k 4294967295 * 16k = 64 TB

32k 4294967295 * 32k = 128 TB

End

Introduction to Database Administration



Backup using
MS SQL Server

Backup using MS SQL Server

Backup using MS SQL Server

- Terminologies
- Failures of Database
- Create a Full Backup
- Create a Simple test database
- Backup using MSSMS
- Steps of Backup using MSSMS
- Backup on non-default Location

Backup using MS SQL Server

Terminologies

- Back up [verb]
  The process of creating a backup [noun] by copying data records from a SQL Server database, or log records from its transaction log.

- Backup [noun]
  A copy of data that can be used to restore and recover the data after a failure. Backups of a database can also be used to restore a copy the database to a new location.

Backup using MS SQL Server

Terminologies

- Backup device or media
  A disk or tape device to which SQL Server backups are written and from which they can be restored. SQL Server backups can also be written to an Azure Blob storage service, and URL format is used to specify the destination and the name of the backup file

Backup using MS SQL Server

Terminologies

- Full backup
  A data backup that contains all the data in a specific database or set of file groups or files, and also enough log to allow for recovering that data.

Backup using MS SQL Server

Failures of Database

- Media failure.
- User errors, for example, dropping a table by mistake.
- Hardware failures, for example, a damaged disk drive or permanent loss of a server.

Backup using MS SQL Server

Failures of Database

- Natural disasters. By using SQL Server Backup to Azure Blob storage service, you can create an off-site backup in a different region than your on-premises location, to use in the event of a natural disaster affecting your on-premises location.

Backup using MS SQL Server

Create a Full Backup

- Security
  TRUSTWORTHY is set to OFF on a database backup

- Permission
  BACKUP DATABASE and BACKUP LOG permissions default to members of the sysadmin fixed server role and the db_owner and db_backupoperator fixed database roles.

Backup using MS SQL Server

Create a Sample Test Database

```
USE [master]
GO

CREATE DATABASE [SQLTestDB]
GO

USE [SQLTestDB]
GO
CREATE TABLE SQLTest
   (
      ID INT NOT NULL PRIMARY KEY,
      c1 VARCHAR(100) NOT NULL,
      dt1 DATETIME NOT NULL DEFAULT getdate()
   );
GO

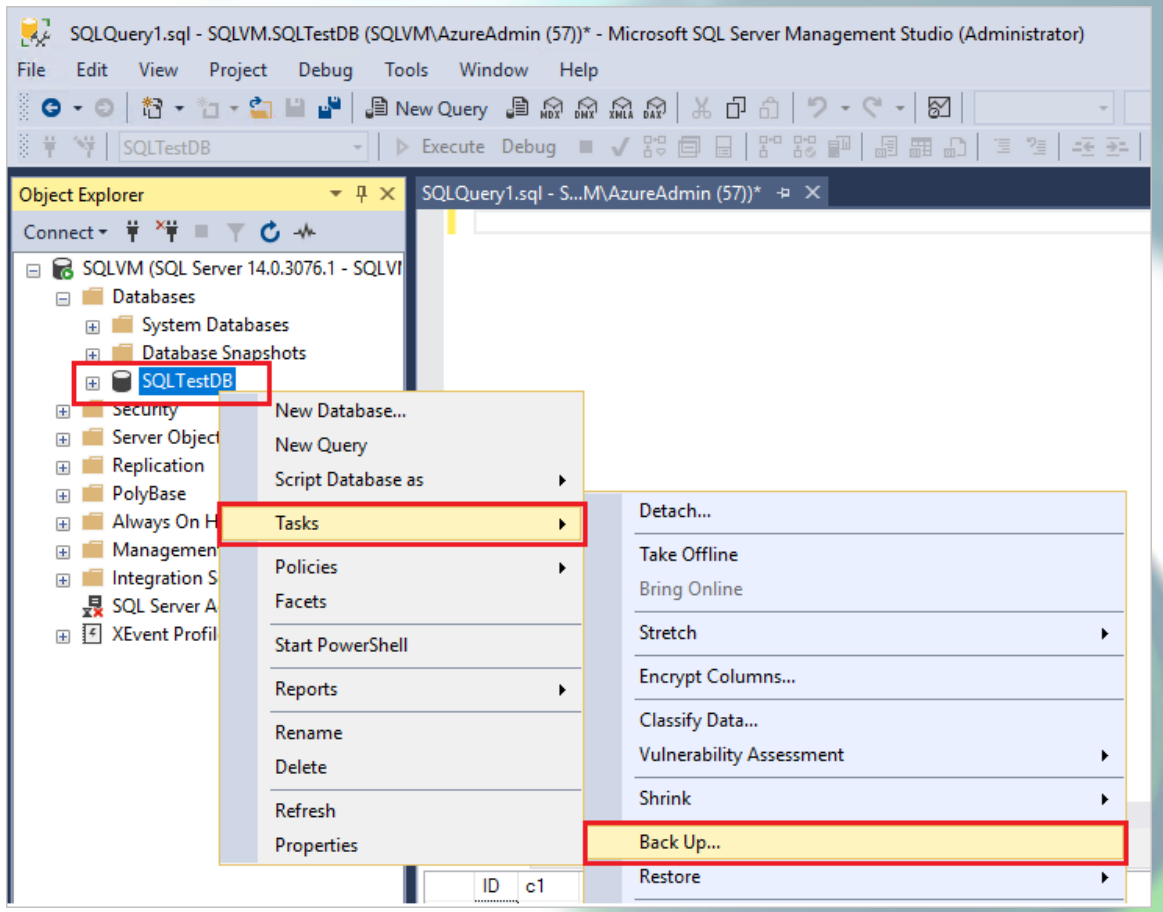
USE [SQLTestDB]
GO

INSERT INTO SQLTest (ID, c1) VALUES (1, 'test1')
INSERT INTO SQLTest (ID, c1) VALUES (2, 'test2')
INSERT INTO SQLTest (ID, c1) VALUES (3, 'test3')
INSERT INTO SQLTest (ID, c1) VALUES (4, 'test4')
INSERT INTO SQLTest (ID, c1) VALUES (5, 'test5')
GO

SELECT * FROM SQLTest
GO
```

Backup using MS SQL Server

Back up using MSSMS



Backup using MS SQL Server

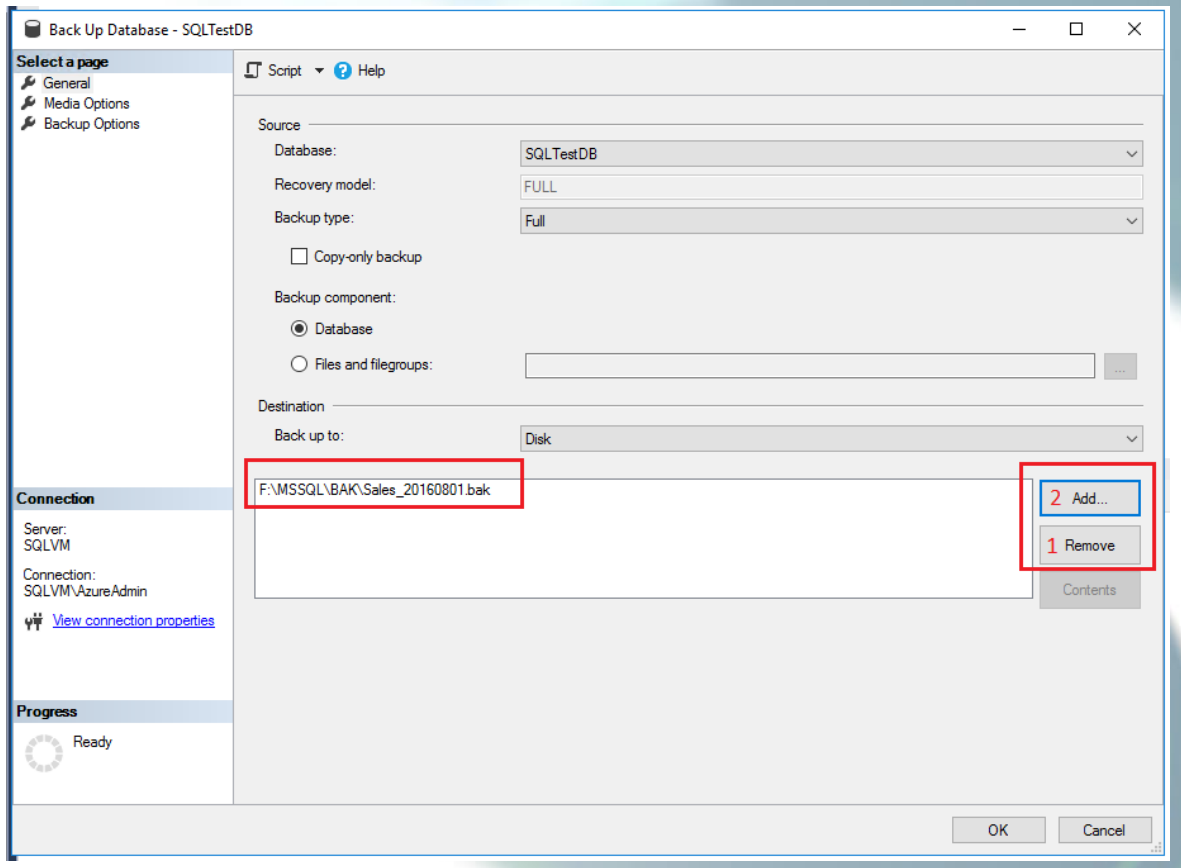
Steps of Back up using MSSMS

In this example, the `SQLTestDB` database will be backed up to disk at a location of your choice.

1. After connecting to the appropriate instance of the Microsoft SQL Server Database Engine, in **Object Explorer**, expand the server tree.
2. Expand **Databases**, right-click `SQLTestDB`, point to **Tasks**, and then click **Back Up...**.
3. On the **General** page in the **Destination** section select **Disk** from the **Back up to:** drop-down list.
4. Select **Remove** until all existing backup files have been removed.
5. Select **Add** and the **Select Backup Destination** dialog box will open.
6. Enter a valid path and file name in the **File name** text box and use **.bak** as the extension to simplify the classification of this file.
7. Click **OK** and then click **OK** again to initiate the backup.
8. When the backup completes successfully, click **OK** to close the SQL Server Management Studio dialog box.

Backup using MS SQL Server

Back up on non-default Location



What are Control Files & Creating Control Files

Creating Control Files

Control Files

- What is Control Files?
- Managing Control Files
- Back up Control Files
- Creating Control Files
- Multiplex Copying of Control Files

Creating Control Files

What is Control Files?

Control file contains

- The database name
- Names and locations of associated data files and redo log files
- The timestamp of the database creation
- The current log sequence number
- Checkpoint information

Creating Control Files

Managing Control Files?

- DB server writes into control file when DB is open.
- DB is mounted for recovery with control file.
- More control files can be created

Creating Control Files

Back up Control Files?

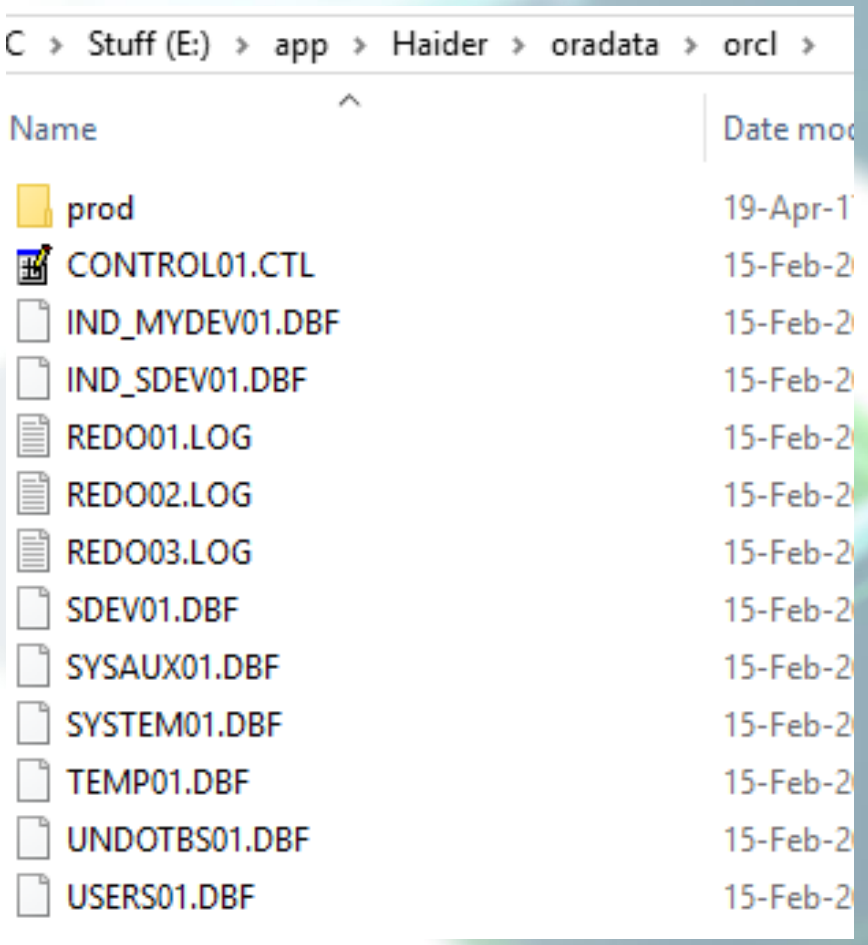
- Adding, dropping, or renaming datafiles
- Adding or dropping a tablespace, or altering the read/write state of the tablespace
- Adding or dropping redo log files or groups

Creating Control Files

Creating Control Files?

- Creating Initial Control Files
- Creating Additional Copies, Renaming, and Relocating Control Files
- Creating New Control Files
- Initial Control Files are

CONTROL_FILES =
(/u01/oracle/prod/control01.ctl,
/u02/oracle/prod/control02.ctl,
/u03/oracle/prod/control03.ctl)



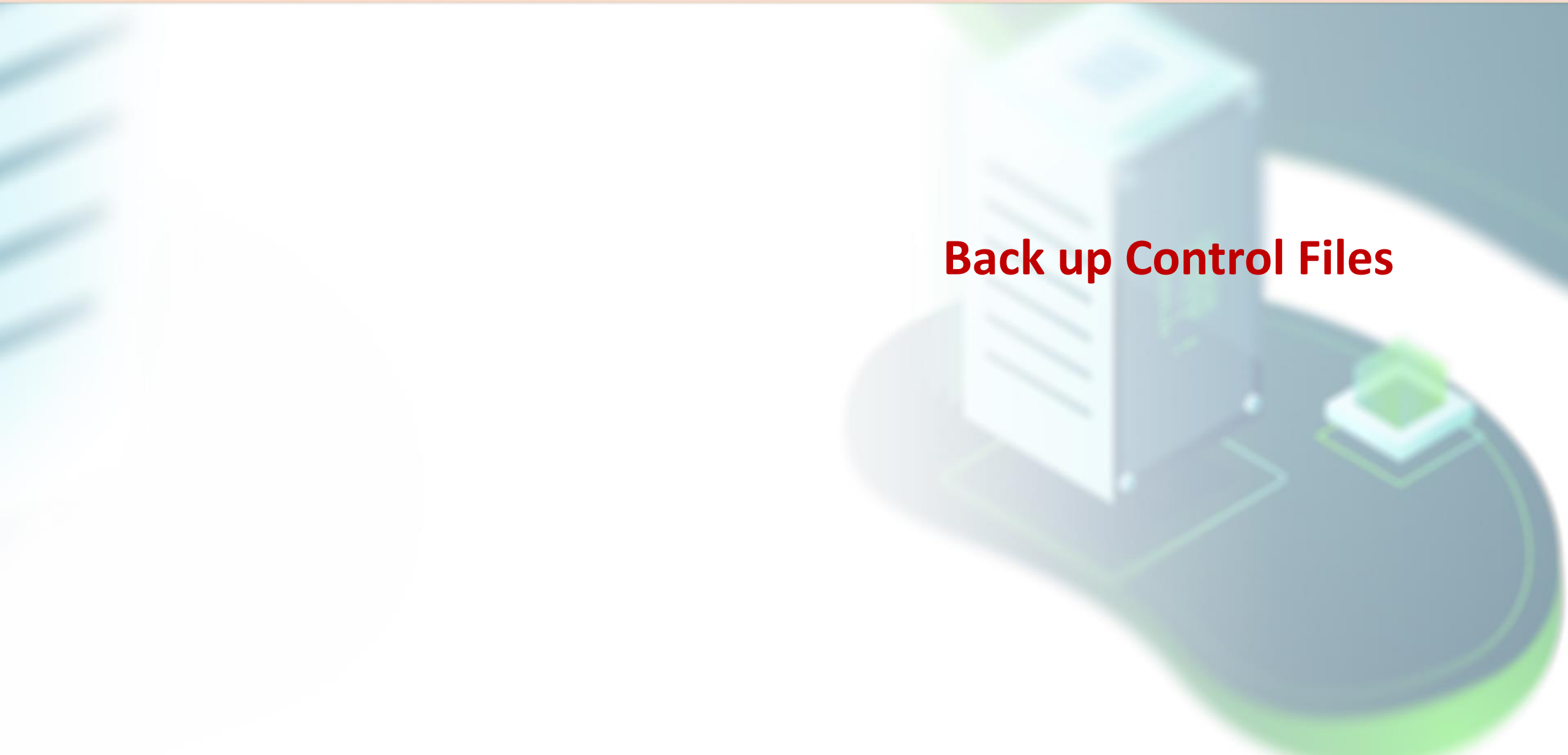
Creating Control Files

Multiplex copying of Control Files

To add a multiplexed copy of the current control file or to rename a control file:

- Shut down the database.
- Copy an existing control file to a new location, using operating system commands.
- Edit the CONTROL_FILES parameter in the database initialization parameter file to add the new control file name, or to change the existing control filename.
- Restart the database.

End



Back up Control Files

Back up Control Files

Back up and New Control Files

- When to Create Control Files?
- Create Control File Statement
- Data Dictionary Views for Control Files?
- Using Data Dictionary Views with user sys
- SQL of V$LOGFILE
- SQL of V$DATAFILE
- SQL of V$CONTROLFILE
- SQL of V$PARAMETER
- Backing up Control Files?
- Steps in creating new Control Files?

Back up Control Files

When to Create Control Files?

- All control files for the database have been permanently damaged and you do not have a control file backup.
- You want to change the database name.

Back up Control Files

Create Control File Statement

```
CREATE CONTROLFILE
   SET DATABASE prod
   LOGFILE GROUP 1 ('/u01/oracle/prod/redo01_01.log',
                    '/u01/oracle/prod/redo01_02.log'),
           GROUP 2 ('/u01/oracle/prod/redo02_01.log',
                    '/u01/oracle/prod/redo02_02.log'),
           GROUP 3 ('/u01/oracle/prod/redo03_01.log',
                    '/u01/oracle/prod/redo03_02.log')
   RESETLOGS
   DATAFILE '/u01/oracle/prod/system01.dbf' SIZE 3M,
            '/u01/oracle/prod/rbs01.dbs' SIZE 5M,
            '/u01/oracle/prod/users01.dbs' SIZE 5M,
            '/u01/oracle/prod/temp01.dbs' SIZE 5M
   MAXLOGFILES 50
   MAXLOGMEMBERS 3
   MAXLOGHISTORY 400
   MAXDATAFILES 200
   MAXINSTANCES 6
   ARCHIVELOG;
```

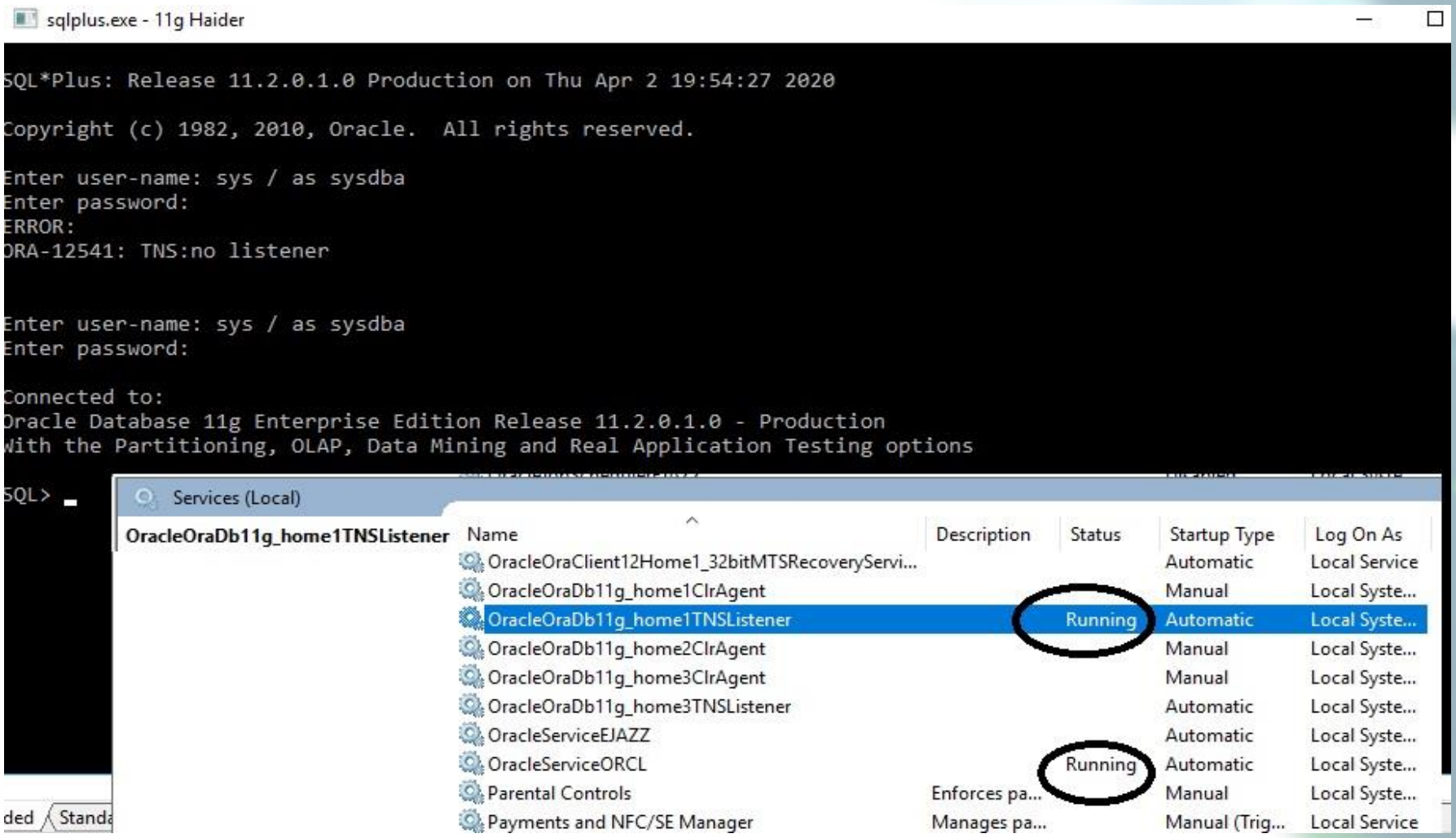
Back up Control Files

Data Dictionary Views for Control Files?

- SELECT MEMBER FROM V$LOGFILE;
- SELECT NAME FROM V$DATAFILE;
- SELECT VALUE FROM V$PARAMETER WHERE NAME = 'control_files'

Back up Control Files

Using Data Dictionary Views with user sys



Back up Control Files

SQL of V$LOGFILE

```
SQL> SELECT MEMBER FROM V$LOGFILE;

MEMBER
-------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG
E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG
E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG

SQL>
```

Back up Control Files

SQL of V$DATAFILE

```
SQL> SELECT NAME FROM V$DATAFILE;

NAME
------------------------------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\SYSTEM01.DBF
E:\APP\HAIDER\ORADATA\ORCL\SYSAUX01.DBF
E:\APP\HAIDER\ORADATA\ORCL\UNDOTBS01.DBF
E:\APP\HAIDER\ORADATA\ORCL\USERS01.DBF
E:\APP\HAIDER\ORADATA\ORCL\IND_MYDEV01.DBF
E:\APP\HAIDER\ORADATA\ORCL\SDEV01.DBF
E:\APP\HAIDER\ORADATA\ORCL\IND_SDEV01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PDEV01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PDEV02.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PDEV03.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PIND_DEV.DBF

NAME
------------------------------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\PROD\PTSIMG01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PTSIMG02.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PTSIMG03.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PTSIMG04.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PSTUCRSREG01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PSTUCRSREG02.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PEMARKS01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\PEMARKS02.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\TSIMG01.DBF
E:\APP\HAIDER\ORADATA\ORCL\PROD\TSIMG02.DBF
E:\APP\HAIDER\PRODUCT\11.2.0\DBHOME_1\ORADATA\NOVUS01.DBF
```

Back up Control Files

SQL of V$CONTROLFILE

With default installation, oracle contains only two control files

```
SQL> SELECT NAME FROM V$CONTROLFILE;

NAME
--------------------------------------------------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\CONTROL01.CTL
E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\CONTROL02.CTL

SQL>
```

Back up Control Files

SQL of V$PARAMETER

```
SQL>
SQL> SELECT VALUE
  2  FROM V$PARAMETER
  3  WHERE NAME = 'control_files';

VALUE
--------------------------------------------------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\CONTROL01.CTL, E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL
\CONTROL02.CTL
```

```
SQL> show parameter control_files

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
control_files                        string      E:\APP\HAIDER\ORADATA\ORCL\CON
                                                 TROL01.CTL, E:\APP\HAIDER\FLAS
                                                 H_RECOVERY_AREA\ORCL\CONTROL02
                                                 .CTL
```

Back up Control Files

Backing up Control Files?

- Back up the control file to a binary file (duplicate of existing control file) using the following statement:

```
ALTER DATABASE BACKUP
CONTROLFILE TO
'/oracle/backup/control.bkp';
```

- Produce SQL statements that can later be used to re-create your control file:

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

Back up Control Files

Steps in creating new Control Files?

- Shut down the database.
  If the database is open, shut down the database normally if possible. Use the IMMEDIATE or ABORT clauses only as a last resort.
- Back up all data files and redo log files of the database.

Back up Control Files

Steps in creating new Control Files?

- Start up a new instance, but do not mount or open the database: STARTUP NOMOUNT
- Create a new control file for the database using the CREATE CONTROLFILE statement.

Back up Control Files

Executing steps in creating new Control Files?

login sqlplus with user: sys / as sysdba
select name from v$controlfile;
Alter database backup controlfile to trace as 'E:\APP\HAIDER\ORADATA\ORCL\control.bkp';

Back up Control Files

Executing steps in creating new Control Files?

```
alter system set
control_files='E:\APP\HAIDER\ORADATA\ORCL\control01.ctl',
'E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\control02.ctl',
'E:\APP\HAIDER\ORADATA\ORCL\control03.ctl' scope=spfile;
shutdown immediate
exit
```

Back up Control Files

Executing steps in creating new Control Files?

Use copy-past file in windows file explorer or use DOS command
E:\APP\HAIDER\ORADATA\ORCL>copy control01.ctl control03.ctl

Back up Control Files

Executing steps in creating new Control Files?

sqlplus
Enter user-name: sys / as sysdba
Enter password:
Connected to an idle instance.

SQL> startup
ORACLE instance started.
shutdown immediate
exit

Back up Control Files

Executing steps in creating new Control Files?

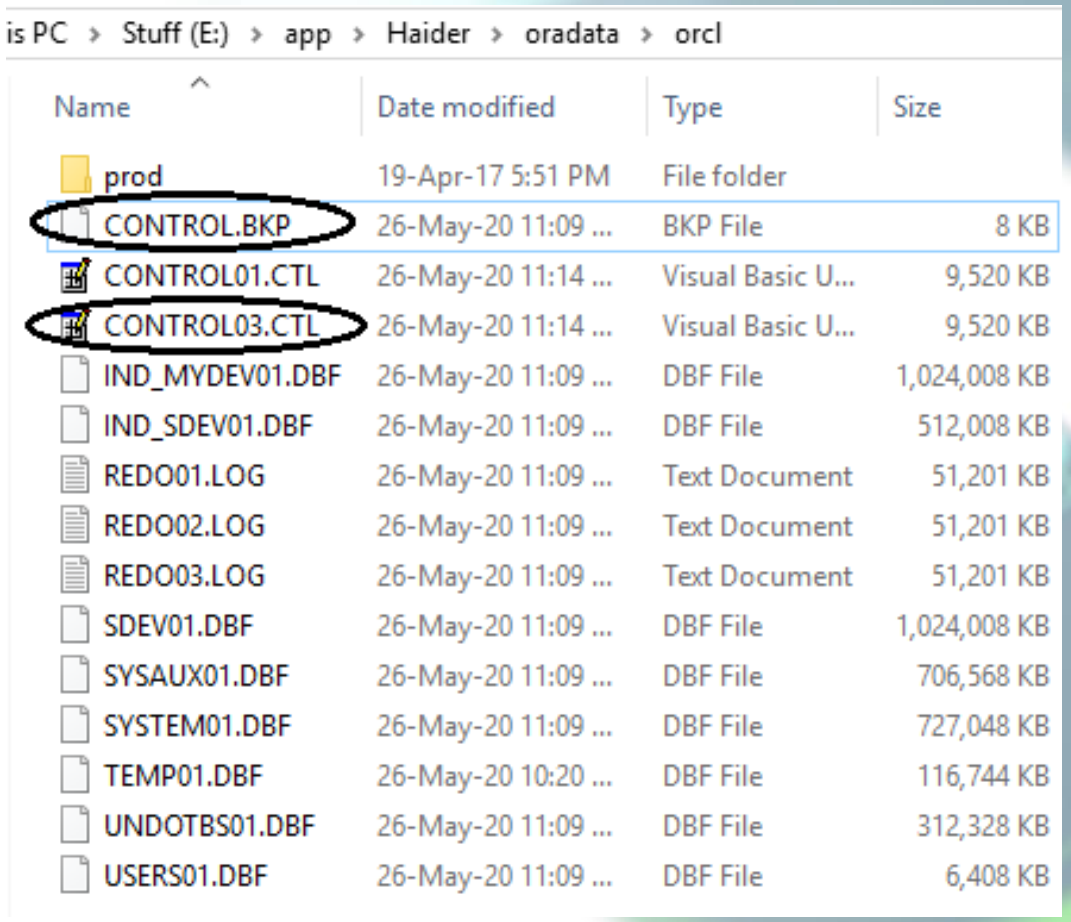
SQL>select name from v$controlfile;

NAME

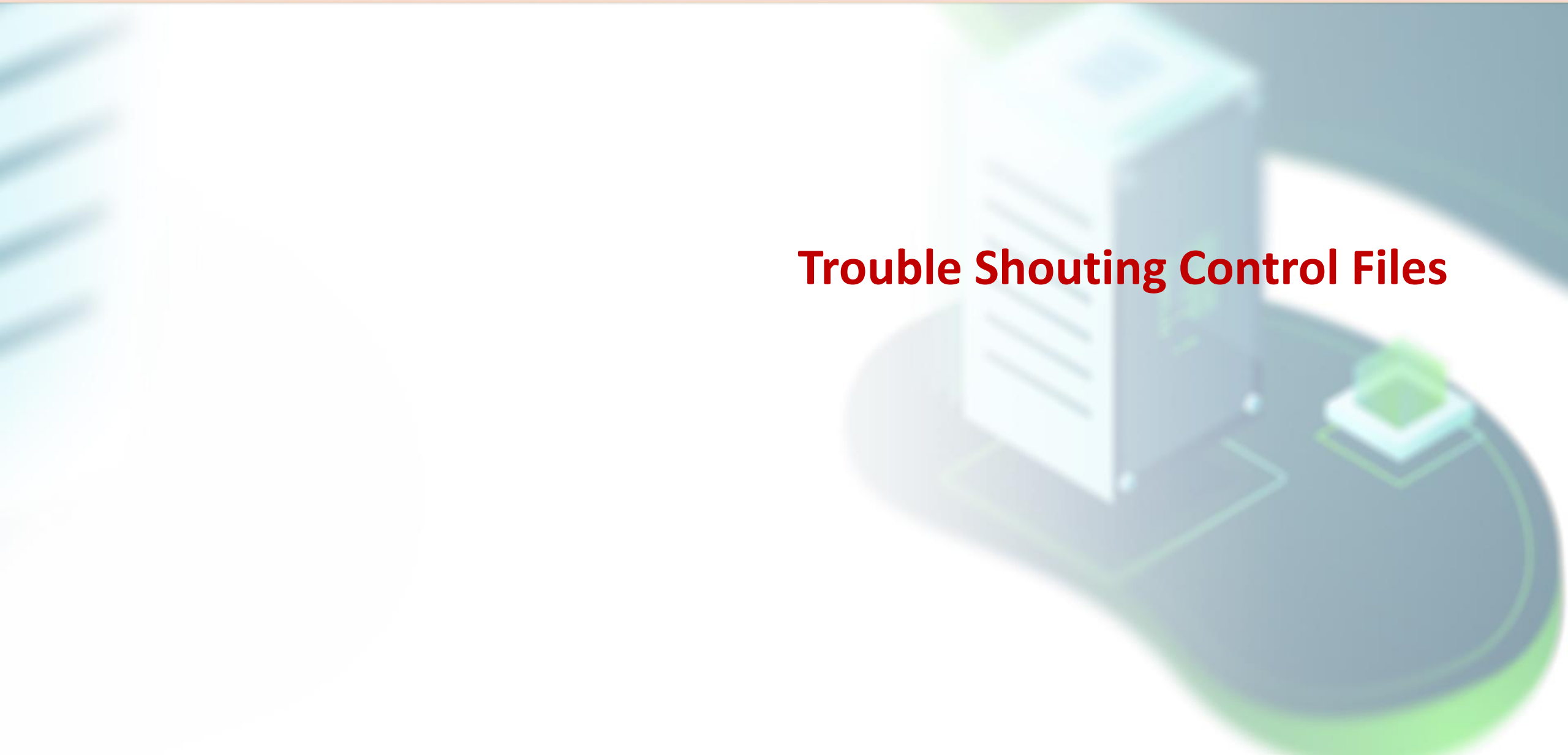
E:\APP\HAIDER\ORADATA\ORCL\CONTROL01.CTL
E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\CONTROL02.CTL
E:\APP\HAIDER\ORADATA\ORCL\CONTROL03.CTL

Back up Control Files

Executing steps in creating new Control Files?



End



Trouble Shouting Control Files

Trouble Shouting Control Files

Trouble Shouting Control Files

- SQL of V$CONTROLFILE
- Executing steps in creating new Control Files
- Steps in creating new Control Files
- Executing Commands on SQL
- Executing steps in creating new Control Files
- Backup Control Files using Startup Mount

Trouble Shouting Control Files

Trouble Shouting Control Files

- Alter System Set Command & initialization File
- Executing steps in creating new

Trouble Shouting Control Files

Trouble Shouting Control Files

- Control Files using SQL
- Use of Database MOUNT & NO MOUNT
- Database is in normal mode (consistent database)
- Executing steps in creating new Control Files
- Warning for storing Control Files

Trouble Shouting Control Files

When to Create Control Files?

- All control files for the database have been permanently damaged and you do not have a control file backup.
- You want to change the database name.

Trouble Shouting Control Files

SQL of V$CONTROLFILE

With default installation, oracle contains only two control files

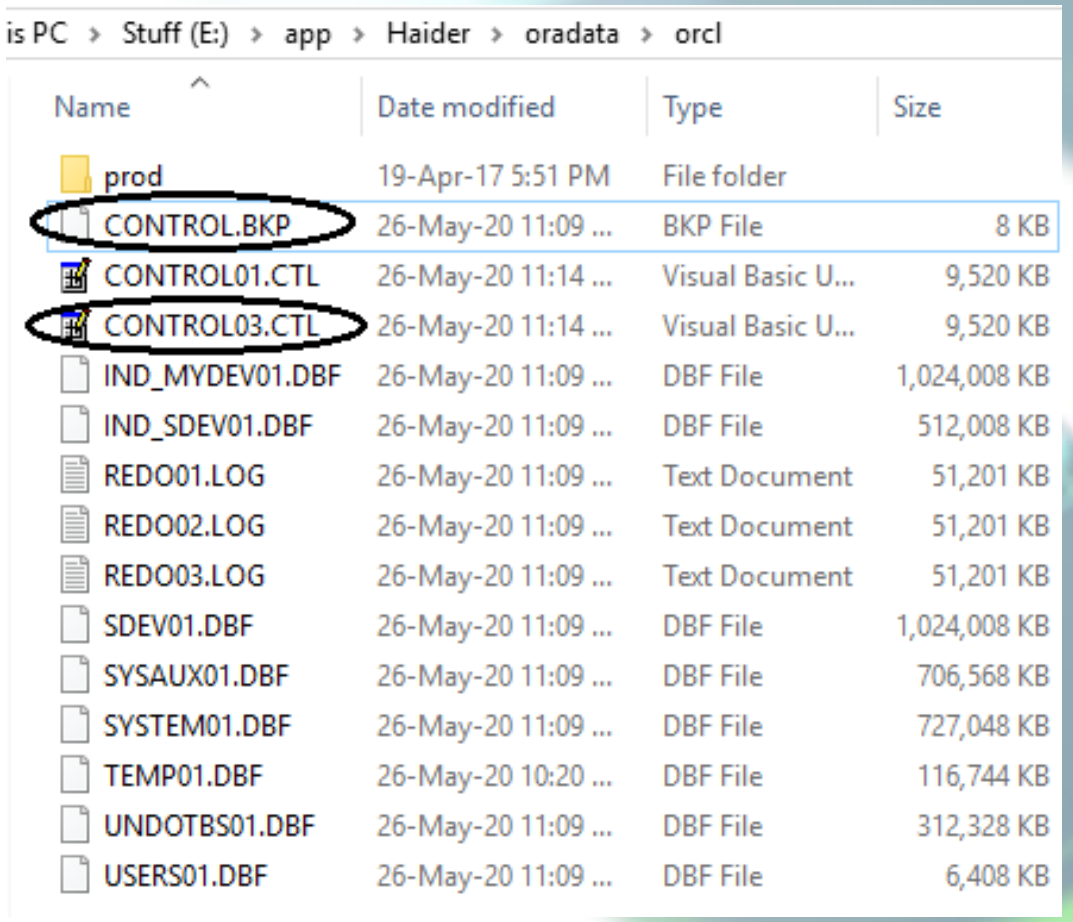
```
SQL> SELECT NAME FROM V$CONTROLFILE;

NAME
--------------------------------------------------------------------------------
E:\APP\HAIDER\ORADATA\ORCL\CONTROL01.CTL
E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\CONTROL02.CTL

SQL>
```

Trouble Shouting Control Files

Executing steps in creating new Control Files



Trouble Shouting Control Files

Steps in creating new Control Files

- Shut down the database.
  If the database is open, shut down the database normally if possible.
  Use the
  IMMEDIATE or ABORT clauses only as a last resort.
- Back up all data files and redo log files of the database.

Trouble Shouting Control Files

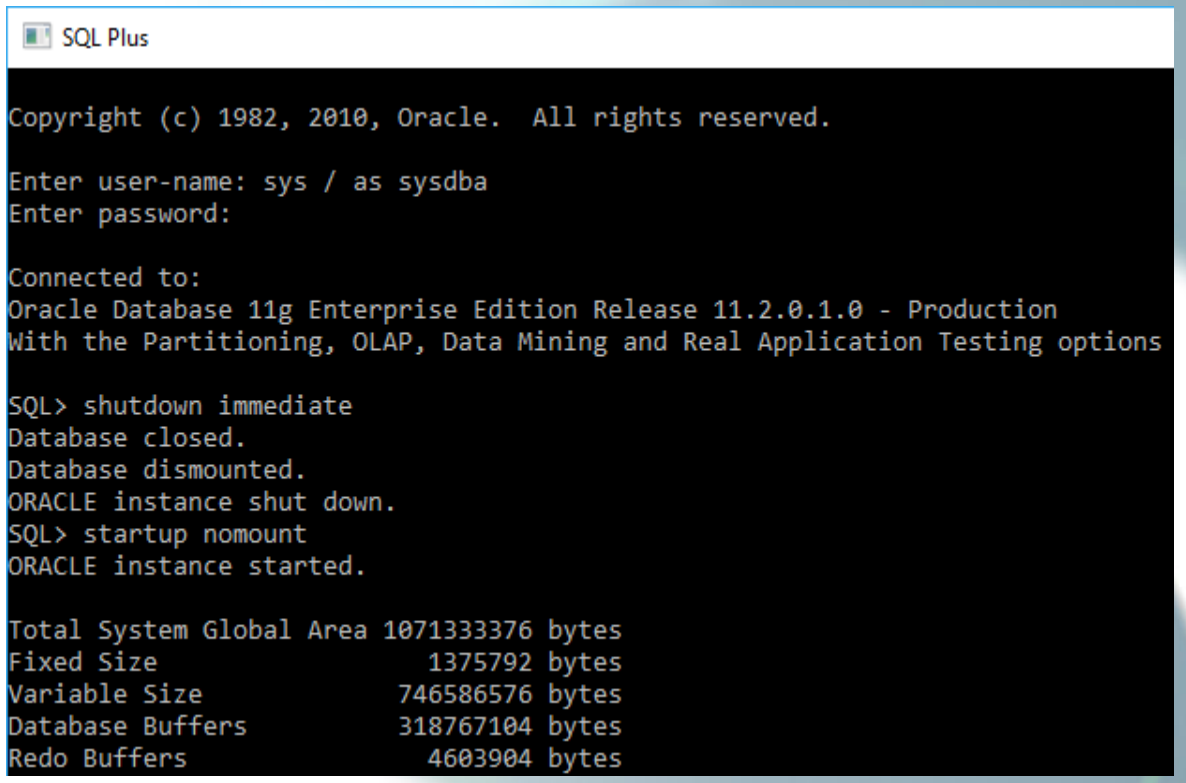
Steps in creating new Control Files

- Start up a new instance, but do not mount or open the database:
  STARTUP NOMOUNT

- Create a new control file for the database using the CREATE CONTROLFILE statement.

Trouble Shouting Control Files

Executing Commands on SQL



Trouble Shouting Control Files

Executing steps in creating new Control Files

login sqlplus with user: sys / as sysdba
select name from v$controlfile;
Alter database backup controlfile to trace as
'E:\APP\HAIDER\ORADATA\ORCL\control.bkp';

Trouble Shouting Control Files

Executing steps in creating new Control Files

```
Alter system set
control_files='E:\APP\HAIDER\ORADATA\ORCL\control01.ctl',
'E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\control02.ctl',
'E:\APP\HAIDER\ORADATA\ORCL\control03.ctl' scope=spfile;
shutdown immediate
exit
```

Trouble Shouting Control Files

Backup Control Files using Startup Mount

```
SQL> shutdown immediate
ORA-01507: database not mounted


ORACLE instance shut down.
SQL> startup mount
ORACLE instance started.

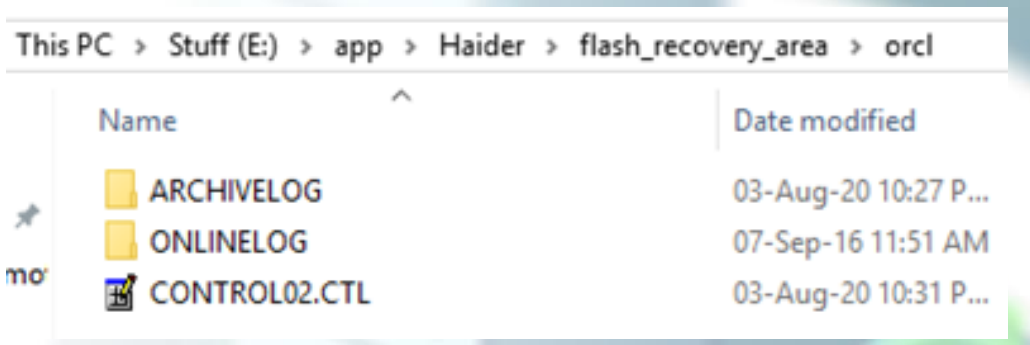
Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             746586576 bytes
Database Buffers          318767104 bytes
Redo Buffers                4603904 bytes
Database mounted.
SQL> Alter database backup controlfile to trace as 'E:\APP\HAIDER\ORADATA\ORCL\control.bkp';
Alter database backup controlfile to trace as 'E:\APP\HAIDER\ORADATA\ORCL\control.bkp'
*
ERROR at line 1:
ORA-01277: file 'E:\APP\HAIDER\ORADATA\ORCL\CONTROL.BKP' already exists

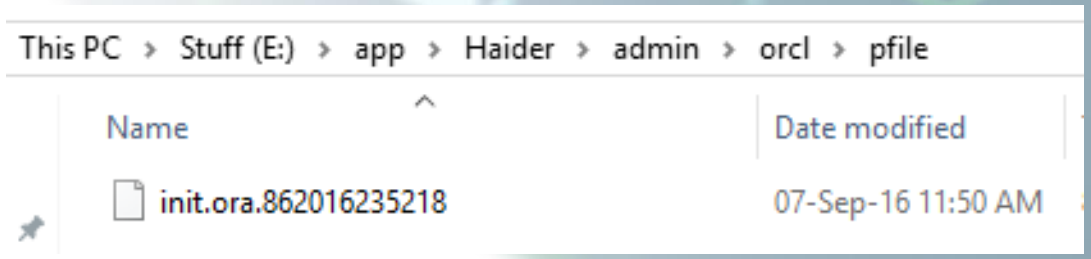

SQL>
SQL> Alter database backup controlfile to trace as 'E:\APP\HAIDER\ORADATA\ORCL\control1.bkp';

Database altered.
```

Trouble Shouting Control Files

Alter System Set Command & initialization File





Trouble Shouting Control Files

Executing steps in creating new Control Files using SQL

Use copy-past file in windows file explorer or use DOS command

```
E:\APP\HAIDER\ORADATA\ORCL>copy control01.ctl  control03.ctl
```

Trouble Shouting Control Files

Executing steps in creating new Control Files using SQL

sqlplus
Enter user-name: sys / as sysdba
Enter password:
Connected to an idle instance.

SQL> startup
ORACLE instance started.
shutdown immediate
exit

Trouble Shouting Control Files

Use of Database MOUNT & NO MOUNT

In NOMOUNT, Backup of existing control files and redo log files is required

In MOUNT, run Alter database backup …

Trouble Shouting Control Files

Database is in normal mode (consistent database)

```
SQL> shutdown immediate
ORA-01109: database not open


Database dismounted.
ORACLE instance shut down.
SQL> startup
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             746586576 bytes
Database Buffers          318767104 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
SQL>
```

Trouble Shouting Control Files

Executing steps in creating new Control Files

SQL>select name from v$controlfile;

NAME

E:\APP\HAIDER\ORADATA\ORCL\CONTROL01.CTL
E:\APP\HAIDER\FLASH_RECOVERY_AREA\ORCL\CONTROL02.CTL
E:\APP\HAIDER\ORADATA\ORCL\CONTROL03.CTL

Trouble Shouting Control Files

Warning for Storing Control Files

You may want to ensure that control files are created on separate physical devices

End

Introduction to Database Administration

Recover & Dropping Control Files

Recover & Dropping Control Files

Recover & Dropping Control Files

- Checking for Missing or Extra Files
- Handling Errors During CREATE CONTROLFILE
- ORA Error - A Sample
- Different Locations of Control Files
- Executing Commands on SQL
- Backing up Control Files

Recover & Dropping Control Files

Recover & Dropping Control Files

- Viewing Alert Log using Data Dictionary
- Viewing Alert Log using Enterprise Manager
- Finding Trace Files
- Recovery from Permanent Media Failure
- Dropping Control Files

Recover & Dropping Control Files

Checking for Missing or Extra Files

- Dropped control files are still shown through data dictionary.
- MISSINGnnnn is a flag in control file, gives status of file when seen by the data dictionary but actually does not exist on disk.

Recover & Dropping Control Files

Checking for Missing or Extra Files

- If the actual data file corresponding to MISSINGnnnn is read-only or offline normal, then you can make the data file accessible by renaming MISSINGnnnn to the name of the actual data file.

Recover & Dropping Control Files

Checking for Missing or Extra Files

- If MISSINGnnnn corresponds to a data file that was not read-only or offline normal, then you cannot use the rename operation to make the data file accessible, because the data file requires media recovery that is precluded by the results of RESETLOGS.

Recover & Dropping Control Files

Checking for Missing or Extra Files

- In this case, you must drop the tablespace containing the data file.
- Conversely, if a data file listed in the control file is not present in the data dictionary, then the database removes references to it from the new control file. Refers to Alert log in any case.

Recover & Dropping Control Files

Handling Errors During CREATE CONTROLFILE

If Oracle Database sends you an error (usually error ORA-01173, ORA-01176, ORA-01177, ORA-01215, or ORA-01216) when you attempt to mount and open the database after creating a new control file, the most likely cause is that you omitted a file from the CREATE CONTROLFILE statement or included one that should not have been listed.

Recover & Dropping Control Files

ORA Error – A Sample

Oracle Error: ORA-01173
Error Description:
Data dictionary indicates missing data file from system tablespace

Error Cause:
Either the database has been recovered to a point in time in the future of the control file or a datafile from the system tablespace was omitted from the create control file command previously issued.

Recover & Dropping Control Files

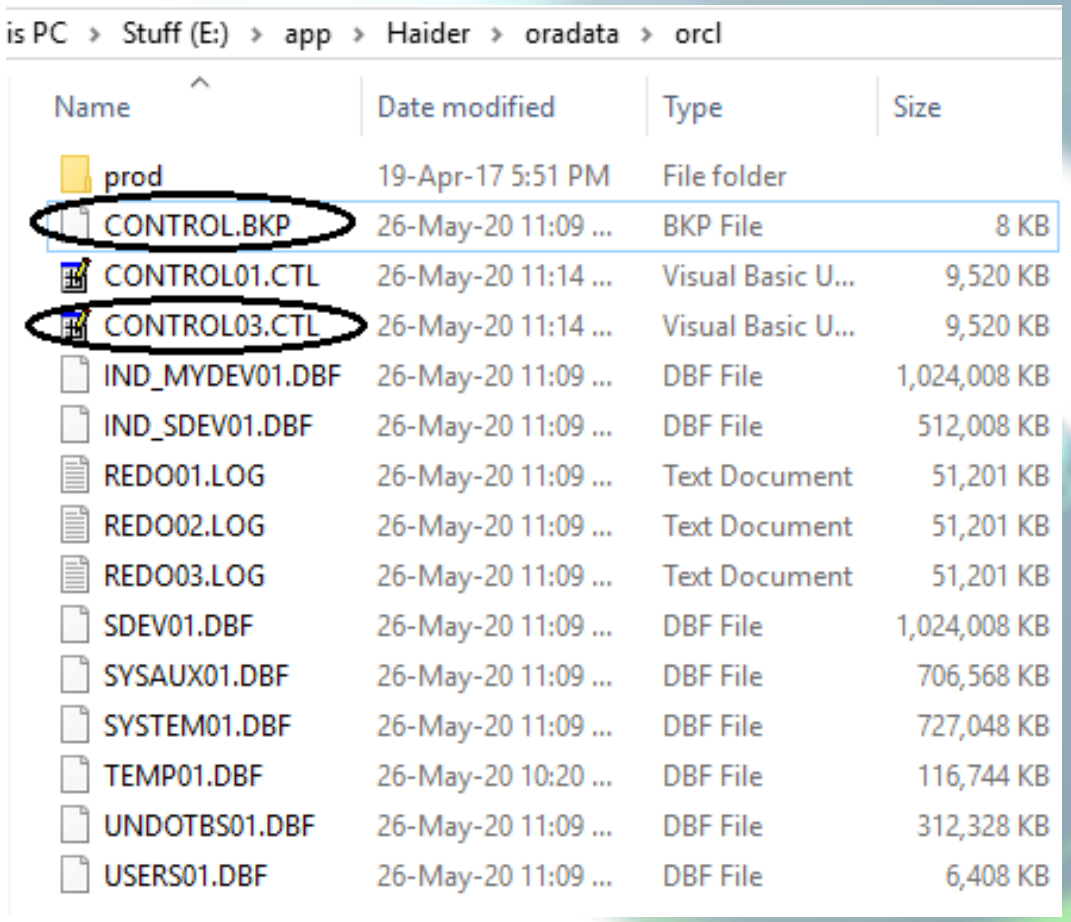
ORA Error – A Sample

Action:

For the former problem you need to recover the database from a more recent control file. For the later problem, simply recreate the control file checking to be sure that you include all the datafiles in the system tablespace.

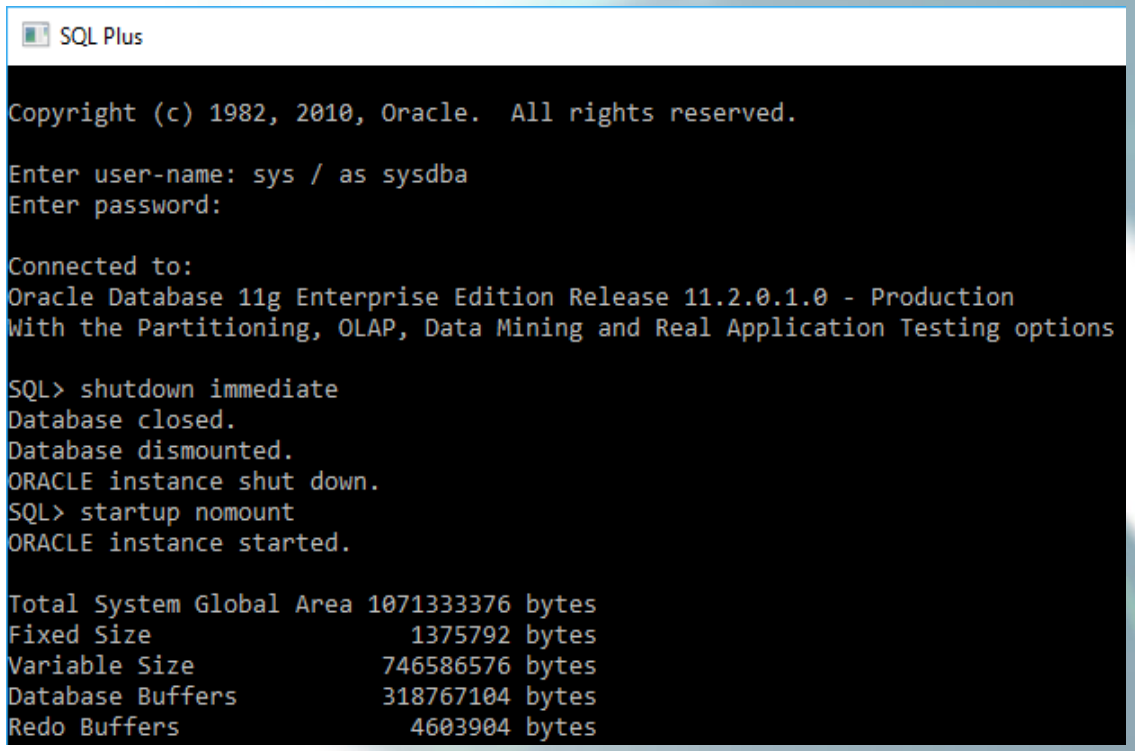
Recover & Dropping Control Files

Different Locations of Control Files



Recover & Dropping Control Files

Executing Commands on SQL



Recover & Dropping Control Files

Backing up Control Files

login sqlplus with user: sys / as sysdba

select name from v$controlfile;
Alter database backup controlfile to trace as 'E:\APP\HAIDER\ORADATA\ORCL\control.bkp';

Recover & Dropping Control Files

Backing up Control Files

Produce SQL statements that can later be used to re-create your control file:

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

Recover & Dropping Control Files

Backing up Control Files

- This command writes a SQL script to a trace file where it can be captured and edited to reproduce the control file.
- View the alert log to determine the name and location of the trace file.

Recover & Dropping Control Files

Viewing Alert Log using Data Dictionary

```
SQL> SELECT substr(Inst_id,1, 3),
  2  substr(name, 1, 25) Diag_name,
  3  substr(value, 1, 100) Diag_value
  4  from V$DIAG_INFO;

SUB DIAG_NAME                 DIAG_VALUE
--- ------------------------- ----------------------------------------------------------------
----------
1   Diag Enabled              TRUE
1   ADR Base                  e:\app\haider
1   ADR Home                  e:\app\haider\diag\rdbms\orcl\orcl
1   Diag Trace                e:\app\haider\diag\rdbms\orcl\orcl\trace
1   Diag Alert                e:\app\haider\diag\rdbms\orcl\orcl\alert
1   Diag Incident             e:\app\haider\diag\rdbms\orcl\orcl\incident
1   Diag Cdump                e:\app\haider\diag\rdbms\orcl\orcl\cdump
1   Health Monitor            e:\app\haider\diag\rdbms\orcl\orcl\hm
1   Default Trace File        e:\app\haider\diag\rdbms\orcl\orcl\trace\orcl_ora_25104.trc
1   Active Problem Count      0
1   Active Incident Count     0

11 rows selected.
```

Recover & Dropping Control Files

Viewing Alert Log using Enterprise Manager

- Access the Database Home page in Enterprise Manager.
- Under Related Links, click Alert Log Contents.
- The View Alert Log Contents page appears.
- Select the number of entries to view, and then click Go

Recover & Dropping Control Files

Finding Trace Files

Trace files are stored in the Automatic Diagnostic Repository (ADR), in the trace
directory under each ADR home.

- To find the trace file for your current session:

```
SELECT VALUE FROM V$DIAG_INFO
WHERE NAME = 'Default Trace File';
```

Recover & Dropping Control Files

Finding Trace Files

- To find all trace files for the current instance:

```
SELECT VALUE FROM V$DIAG_INFO
WHERE NAME = 'Diag Trace';
```

The path to the ADR trace directory for the current instance is returned.

Recover & Dropping Control Files

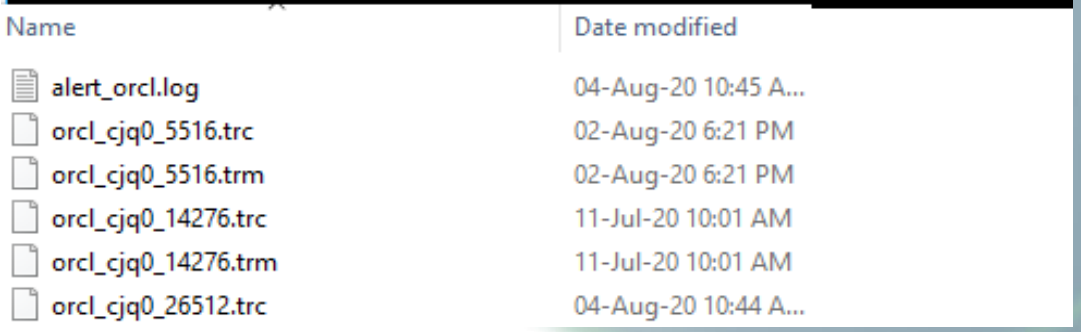
Finding Trace Files

- To determine the trace file for each Oracle Database process:

SELECT PID, PROGRAM, TRACEFILE FROM V$PROCESS;

```
SQL> SELECT VALUE FROM V$DIAG_INFO WHERE NAME = 'Diag Trace';

VALUE
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
e:\app\haider\diag\rdbms\orcl\orcl\trace
```



Recover & Dropping Control Files

Recovery from Permanent Media Failure

- With the instance shut down, use an operating system command of copy

% cp /u01/oracle/prod/control01.ctl /u04/oracle/prod/control03.ctl

Recover & Dropping Control Files

Recovery from Permanent Media Failure

- Edit the CONTROL_FILES parameter in the initialization parameter file to replace the bad location with the new location:

```
CONTROL_FILES =
        (/u01/oracle/prod/control01.ctl,
        /u02/oracle/prod/control02.ctl,
        /u04/oracle/prod/control03.ctl)
```

- SQL> STARTUP

Recover & Dropping Control Files

Dropping Control Files

Database should have at least two control files at all times.

- Shut down the database.
- Edit the CONTROL_FILES parameter in the database initialization parameter file to delete the old control file name.
- Restart the database.

End

What are Redo Log Files?

What are Redo Log Files?

Redo Log Files?

- What is the Redo Log?
- Redo Threads
- Redo Log Contents
- Writing to Redo Log Files
- Active & In-active Redo Log Files
- Overwriting Redo Log Files

What are Redo Log Files?

What is the Redo Log?

- The most crucial structure for recovery operations is the redo log
- The structure consists of two or more pre-allocated files that store all changes made to the database as they occur.

What are Redo Log Files?

What is the Redo Log?

- Every instance of an Oracle Database has an associated redo log to protect the database in case of an instance failure.
- Redo Log files stores all the change information for the database and are used by Oracle during Database recovery

What are Redo Log Files?

Redo Threads?

- When speaking in the context of multiple database instances, the redo log for each database instance is also referred to as a redo thread.
- In typical configurations, only one database instance accesses an Oracle Database, so only one thread is present.

What are Redo Log Files?

Redo Log Contents?

- Redo log files are filled with redo records or redo entry, is made up of a group of change vectors, each of which is a description of a change made to a single block in the database.

What are Redo Log Files?

Redo Log Contents?

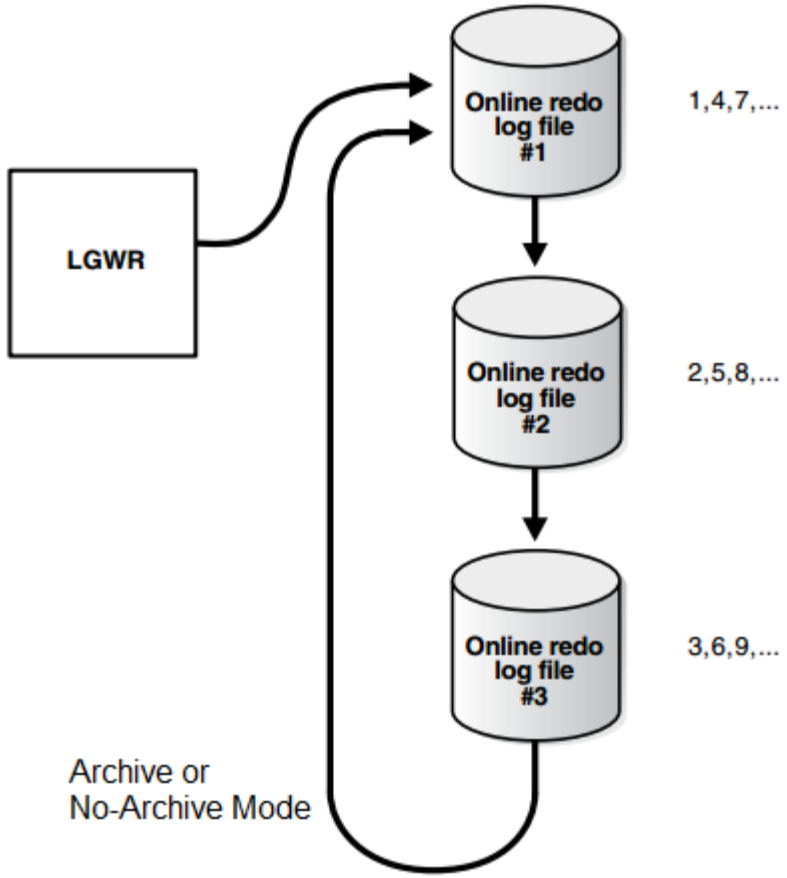
- For example, if you change a salary value in an employee table, you generate a redo record containing change vectors that describe changes to the data segment block for the table, the undo segment data block, and the transaction table of the undo segments.
- Redo records are buffered in a circular fashion in the redo log buffer of the SGA.

What are Redo Log Files?

Redo Log Contents?

- Redo records are written to one of the redo log files by the Log Writer (LGWR)database background process.
- Whenever a transaction is committed, LGWR writes the transaction redo records from the redo log buffer of the SGA to a redo log file, and assigns a system change number (SCN) to identify the redo records for each committed transaction.
- Transactions are committed when redo records are written to the disk safely.

What are Redo Log Files?



Writing to Redo Log files

- LGWR writes to redo log files in a circular fashion. When the current redo log file fills,
- LGWR begins writing to the next available redo log file. When the last available redo log file is filled, LGWR returns to the first redo log file and writes to it, starting the cycle again.

What are Redo Log Files?

Active & In-Active Redo Log files

- Oracle Database uses only one redo log file at a time to store redo records written from the redo log buffer.
- The redo log file that LGWR is actively writing to is called the current redo log file.

What are Redo Log Files?

Active & In-Active Redo Log files

- Redo log files that are required for instance recovery are called active redo log files.
- Redo log files that are no longer required for instance recovery are called inactive redo log files.

What are Redo Log Files?

Overwriting Redo Log files

- If you have enabled archiving (the database is in ARCHIVELOG mode), then the database cannot reuse or overwrite an active online log file until one of the archiver background processes (ARCn) has archived its contents.

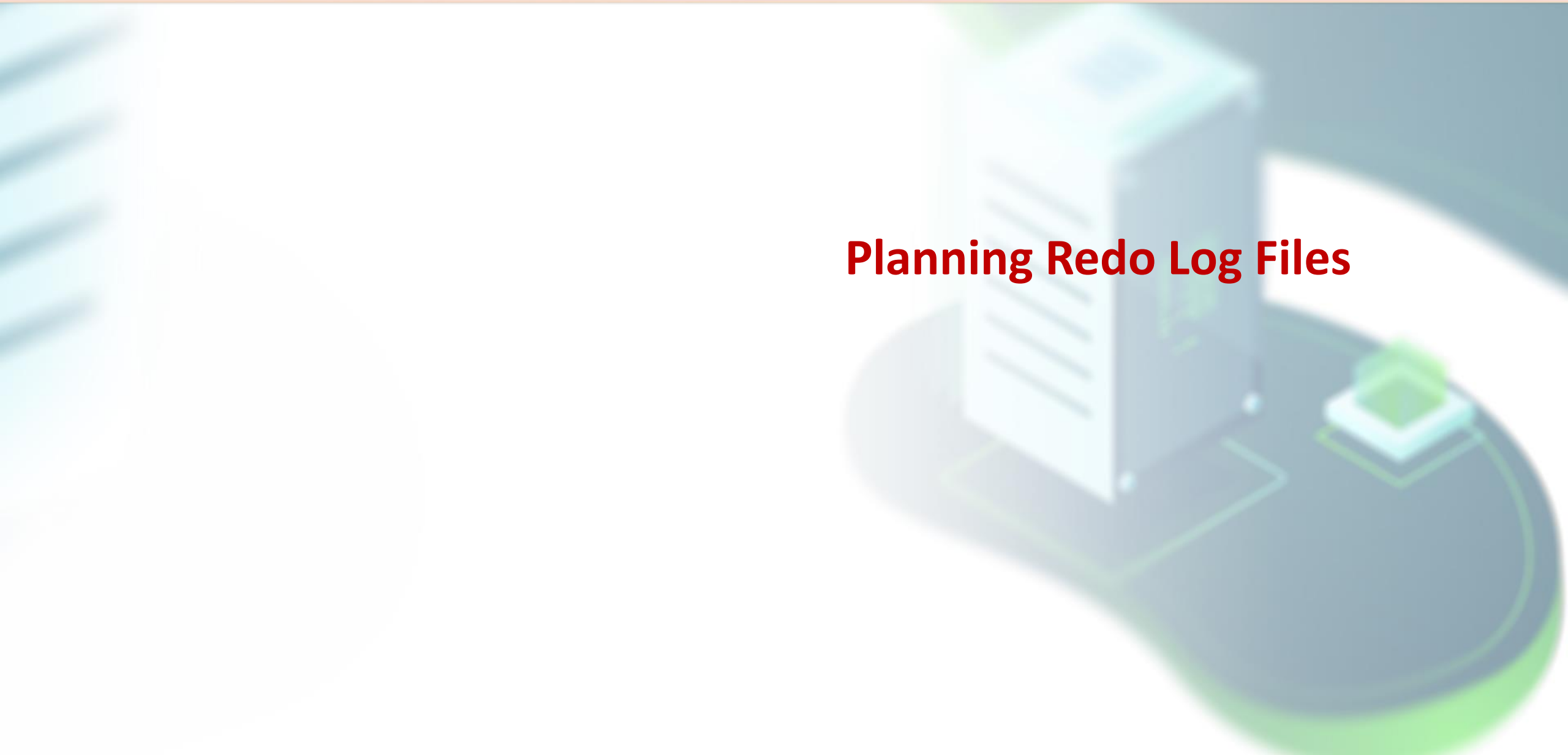
What are Redo Log Files?

Overwriting Redo Log files

- A log switch is the point at which the database stops writing to one redo log file and begins writing to another. Normally, a log switch occurs when the current redo log file is completely filled and writing must continue to the next redo log file.

- Oracle Database assigns each redo log file a new log sequence number every time a log switch occurs and LGWR begins writing to it.

End



Planning Redo Log Files

Planning Redo Log Files

Planning Log Files

- Multiplexing Redo Log Files?
- Example of Multiplexing
- Legal & Illegal Multiplexed Redo Log Configuration
- Placing Redo Logs on Different Locations
- Adding Redo Log Files to a Group

Planning Redo Log Files

Multiplexing Redo Log Files

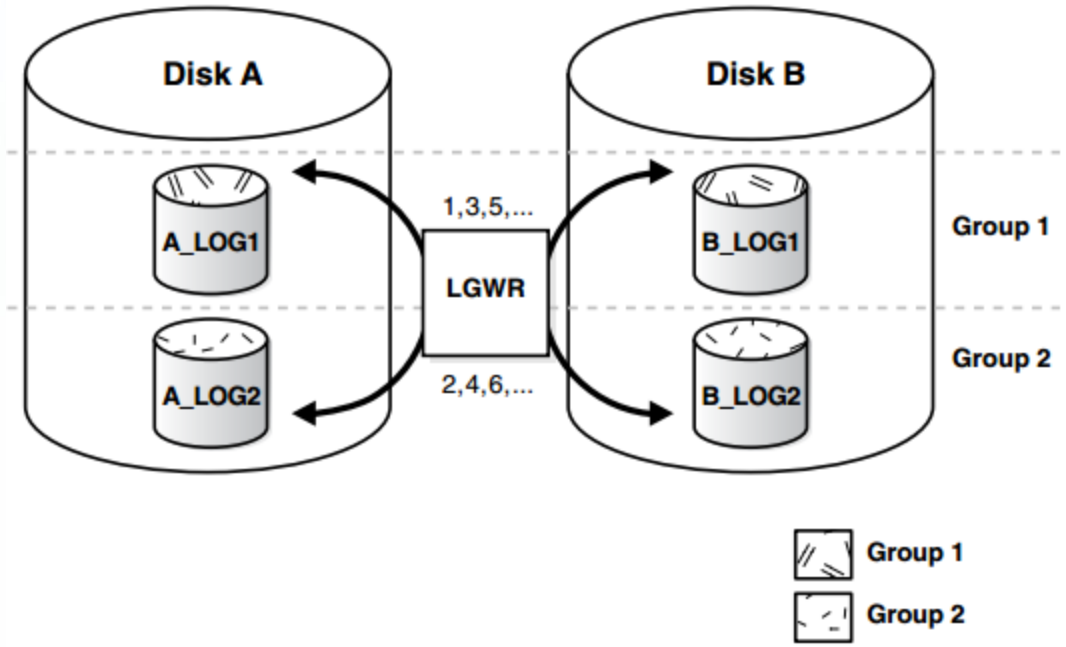
- To protect the failure of Redo Log Files
- Two or more identical copies of Redo Log Files maintained in separate locations.
- Files at same location can cause I/O errors, file corruption etc.

Planning Redo Log Files

Multiplexing Redo Log Files

- LGWR concurrently writes the same information to multiple identical Redo Log files
- A group consists of a Redo Log file and its multiplexed copies.
- Each identical copy is said to be a member of the group. Groups can be group 1, group 2 and so on

Planning Redo Log Files

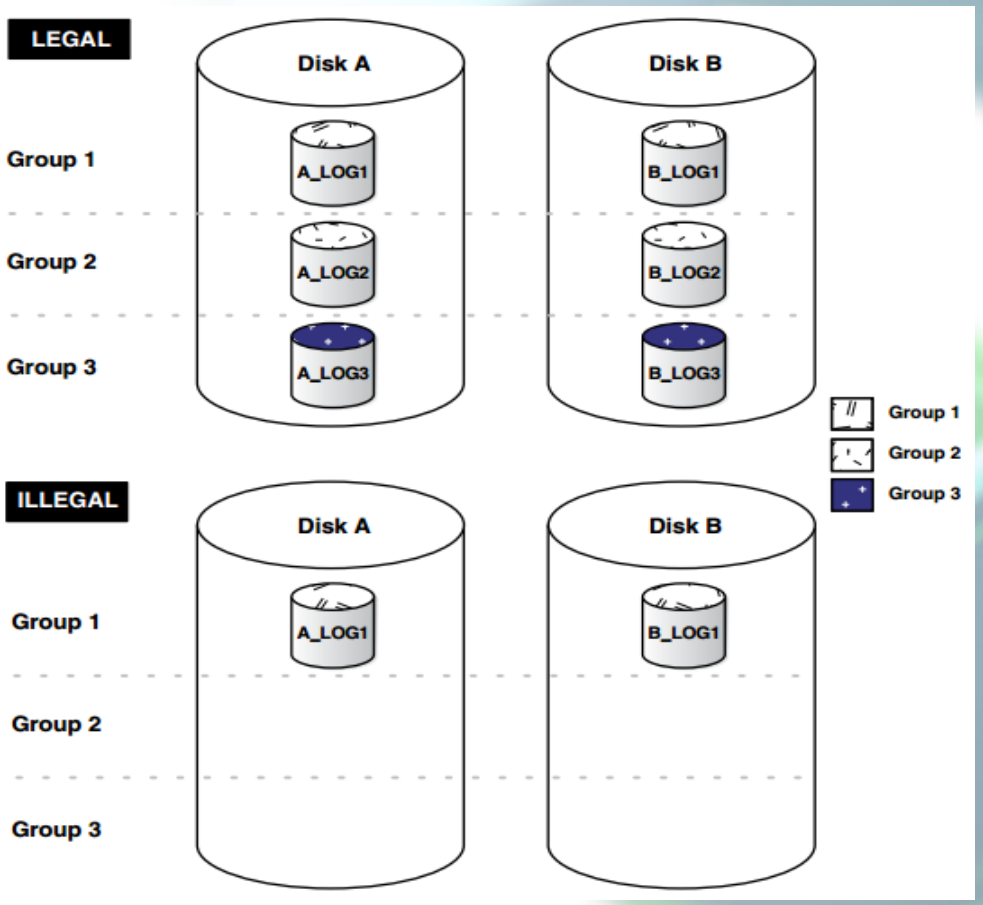


Example of Multiplexing

First LGWR writes concurrently to both A_LOG1 and B_LOG1. Then it writes concurrently to both A_LOG2and B_LOG2, and so on. LGWR never writes concurrently to members of different groups (for example, to A_LOG1and B_LOG2)

Planning Redo Log Files

Legal & Illegal Multiplexed Redo Log Configuration



Planning Redo Log Files

Placing Redo Log on Different Locations?

- When setting up a multiplexed redo log, place members of a group on different physical disks. If a single disk fails, then only one member of a group becomes unavailable to LGWR and other members remain accessible to LGWR, so the instance can continue to function.
- Minimum size permitted to Redo Log File is 4MB.

Planning Redo Log Files

```
SQL> SELECT name, value FROM v$sysstat WHERE name = 'redo wastage';

NAME                                                                  VALUE
---------------------------------------------------------------- ----------
redo wastage                                                       4700476
```

Planning the Block Size of Redo Log Files

- Unlike the database block size, which can be between 2K and 32K, redo log files always default to a block size that is equal to the physical sector size of the disk. Historically, this has typically been 512 bytes (512B).
- Some newer high-capacity disk drives offer 4Kbyte (4K) sector sizes for both increased ECC capability and improved format efficiency.

Planning Redo Log Files

Adding Redo Log File to a Group

```
ALTER DATABASE orcl ADD LOGFILE
GROUP 4
('/u01/logs/orcl/redo04a.log',
'/u01/logs/ orcl/redo04b.log')
SIZE 100M BLOCKSIZE 512 REUSE;
```

```
SQL> select group#, members, BLOCKSIZE FROM V$LOG;

    GROUP#    MEMBERS  BLOCKSIZE
---------- ---------- ----------
         1          1        512
         2          1        512
         3          1        512

SQL>
```

End

Creating Redo Log Files Groups

Creating Redo Log Files Groups

Creating Redo Log Files Groups & Members

- Creating Redo Log Files Groups
- Specify the number with a Group
- Creating Redo Log Members
- Alternate way of Creating Redo Log Members

Creating Redo Log Files Groups

Creating Redo Log Files Groups

- To create a new group of redo log files, use the SQL statement ALTER DATABASE with the ADD LOGFILE clause.
- The following statement adds a new group of redo logs to the database:

```
ALTER DATABASE
ADD LOGFILE
('/oracle/dbs/log1c.rdo',
'/oracle/dbs/log2c.rdo')
SIZE 100M;
```

Creating Redo Log Files Groups

Specify the number with a Group

- To a group number of redo log files, use the SQL statement ALTER DATABASE with the ADD LOGFILE clause.

```
ALTER DATABASE
ADD LOGFILE GROUP 10
('/oracle/dbs/log1c.rdo',
'/oracle/dbs/log2c.rdo')
SIZE 100M BLOCKSIZE 512;
```

Creating Redo Log Files Groups

Specify the number with a Group

- Group number must be between 1 and MAXLOGFILES. Do not skip redo log file group, you will consume unnecessary space in the control files of the database.

Creating Redo Log Files Groups

Creating Redo Log Members

- To create new redo log members for an existing group, use the SQL statement ALTER DATABASE with the ADD LOGFILE MEMBER clause. The following statement adds a new redo log member to redo log group number 2:

```
ALTER DATABASE
ADD LOGFILE MEMBER
'/oracle/dbs/log2b.rdo' TO GROUP 2;
```

Creating Redo Log Files Groups

Creating Redo Log Members

- Sometimes, some members of groups dropped due to disk failure, you can add new members. Use the following SQL

```
ALTER DATABASE
ADD LOGFILE MEMBER
'/oracle/dbs/log2b.rdo'
TO GROUP 2;
```

Creating Redo Log Files Groups

Alternate way of Creating Redo Log Members

- When using the ALTER DATABASE statement, you can alternatively identify the target group by specifying all of the other members of the group in the TO clause, as shown in the following example:

```
ALTER DATABASE ADD LOGFILE MEMBER
'/oracle/dbs/log2c.rdo'
TO ('/oracle/dbs/log2a.rdo',
'/oracle/dbs/log2b.rdo');
```

End

Relocating and Renaming Redo Log Members

Relocating and Renaming Redo Log Members

Relocating and Renaming Redo Log Members

- Reasons for Relocating Logs
- Renaming Redo Log Members
- What to do before Relocation?
- Steps for Relocating Logs
- Metadata of Redo Logs

Relocating and Renaming Redo Log Members

Reasons for Relocating Redo Log

- You can use operating system commands to relocate redo logs, then use the ALTER DATABASE statement to make their new names (locations) known to the database.
- This procedure is necessary, for example, if the disk currently used for some redo log files is going to be removed, or if data files and several redo log files are stored on the same disk and should be separated to reduce contention.

Relocating and Renaming Redo Log Members

Renaming Redo Log Members

- To rename redo log members, you must have the ALTER DATABASE system privilege.
- Additionally, you might also need operating system privileges to copy files to the desired location and privileges to open and back up the database.

Relocating and Renaming Redo Log Members

What to do before Relocations?

- Before relocating your redo logs, or making any other structural changes to the database, completely BACKUP the database in case you experience problems while performing the operation. As a precaution, after renaming or relocating a set of redo log files, immediately back up the database control file.

Relocating and Renaming Redo Log Members

Steps for Relocating Redo Logs?

- The log files are located on two disks: disk a and disk b.
- The redo log is duplexed: one group consists of the members /diska/logs/log1a.rdo and /diskb/logs/log1b.rdo, and the second group consists of the members /diska/logs/log2a.rdo and /diskb/logs/log2b.rdo.

Relocating and Renaming Redo Log Members

Steps for Relocating Redo Logs?

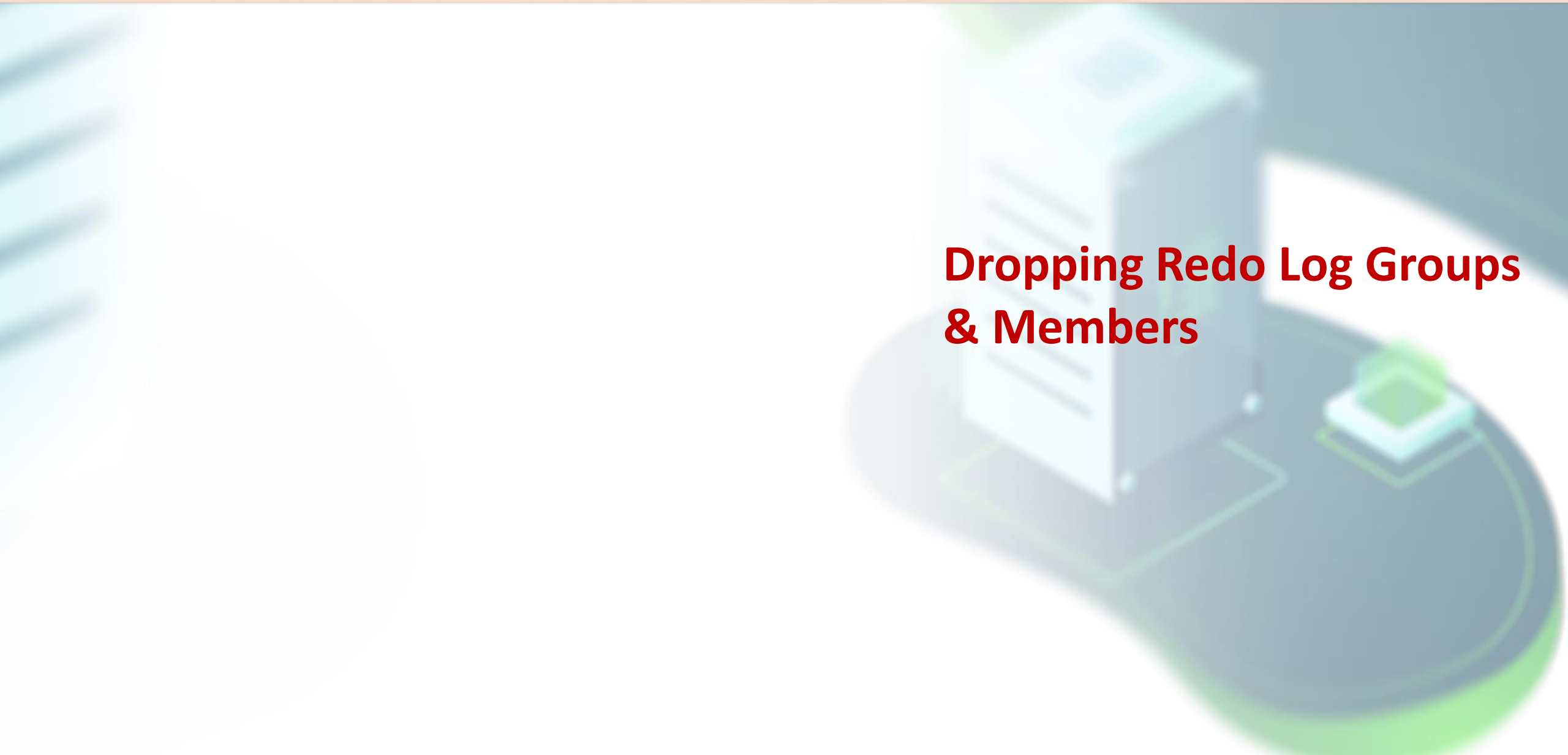
- The redo log files located on disk a must be relocated to disk c. The new filenames will reflect the new location: /diskc/logs/log1c.rdo and /diskc/logs/log2c.rdo

Relocating and Renaming Redo Log Members

End

Metadata of Redo Logs?

- The redo records have all relevant metadata for the change, including the following:
- SCN and time stamp of the change
- Transaction ID of the transaction that generated the change
- SCN and time stamp when the transaction committed (if it committed)
- Type of operation that made the change
- Name and type of the modified data segment: SCN: System Change Number



Dropping Redo Log Groups & Members

Dropping Redo Log Groups & Members

Dropping Redo Log Groups & Members

- Cases What to Do?
- Dropping Redo Log Groups
- Dropping Redo Log Members

Dropping Redo Log Groups & Members

Cases What to Do?

- In some cases, you may want to drop an entire group of redo log members. For example, you want to reduce the number of groups in an instance redo log.
- In a different case, you may want to drop one or more specific redo log members. For example, if a disk failure occurs, you may need to drop all the redo log files on the failed disk so that the database does not try to write to the inaccessible files.

Dropping Redo Log Groups & Members

Cases What to Do?

- In other situations, particular redo log files become unnecessary. For example, a file might be stored in an inappropriate location.

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

- To drop a redo log group, you must have the ALTER DATABASE system privilege. Before dropping a redo log group, consider the following restrictions and precautions:
- An instance requires at least two groups of redo log files, regardless of the number of members in the groups. (A group comprises one or more members.)

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

- You can drop a redo log group only if it is inactive. If you must drop the current group, then first force a log switch to occur.

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

- Make sure a redo log group is archived (if archiving is enabled) before dropping it.
- To see whether this has happened, use the V$LOGview.

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

SELECT GROUP#, ARCHIVED, STATUS FROM V$LOG;

GROUP#	ARC	STATUS
1	YES	ACTIVE
2	NO	CURRENT
3	YES	INACTIVE
4	YES	INACTIVE

Drop a redo log group with the SQL statement ALTER DATABASE with the DROP LOGFILE clause.

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

- Drop a redo log group with the SQL statement ALTER DATABASEwith the DROP LOGFILE clause.
- The following statement drops redo log group number 3:

Dropping Redo Log Groups & Members

Dropping Redo Log Groups?

ALTER DATABASE DROP LOGFILE GROUP 3;

After dropping a redo log group, ensure that the drop completed successfully, and then use the appropriate operating system command to delete the dropped redo log files.

Dropping Redo Log Groups & Members

Dropping Redo Log Members?

Consider the following restrictions and precautions before dropping individual redo log members:

- It is permissible to drop redo log files so that a multiplexed redo log becomes temporarily asymmetric. For example, if you use duplexed groups of redo log files, you can drop one member of one group, even though all other groups have two members each.

Dropping Redo Log Groups & Members

Dropping Redo Log Members?

However, you should rectify this situation immediately so that all groups have at least two members, and thereby eliminate the single point of failure possible for the redo log.

Dropping Redo Log Groups & Members

Dropping Redo Log Members?

- An instance always requires at least two valid groups of redo log files, regardless of the number of members in the groups. (A group comprises one or more members.) If the member you want to drop is the last valid member of the group, you cannot drop the member until the other members become valid.
- To see a redo Forcing Log Switches log file status, use the V$LOGFILE view.

Dropping Redo Log Groups & Members

Dropping Redo Log Members?

- You can drop a redo log member only if it is not part of an active or current group. o drop a member of an active group, first force a log switch to occur.
- Make sure the group to which a redo log member belongs is archived (if archiving is enabled) before dropping the member. To see whether this has happened, use the V$LOG view.

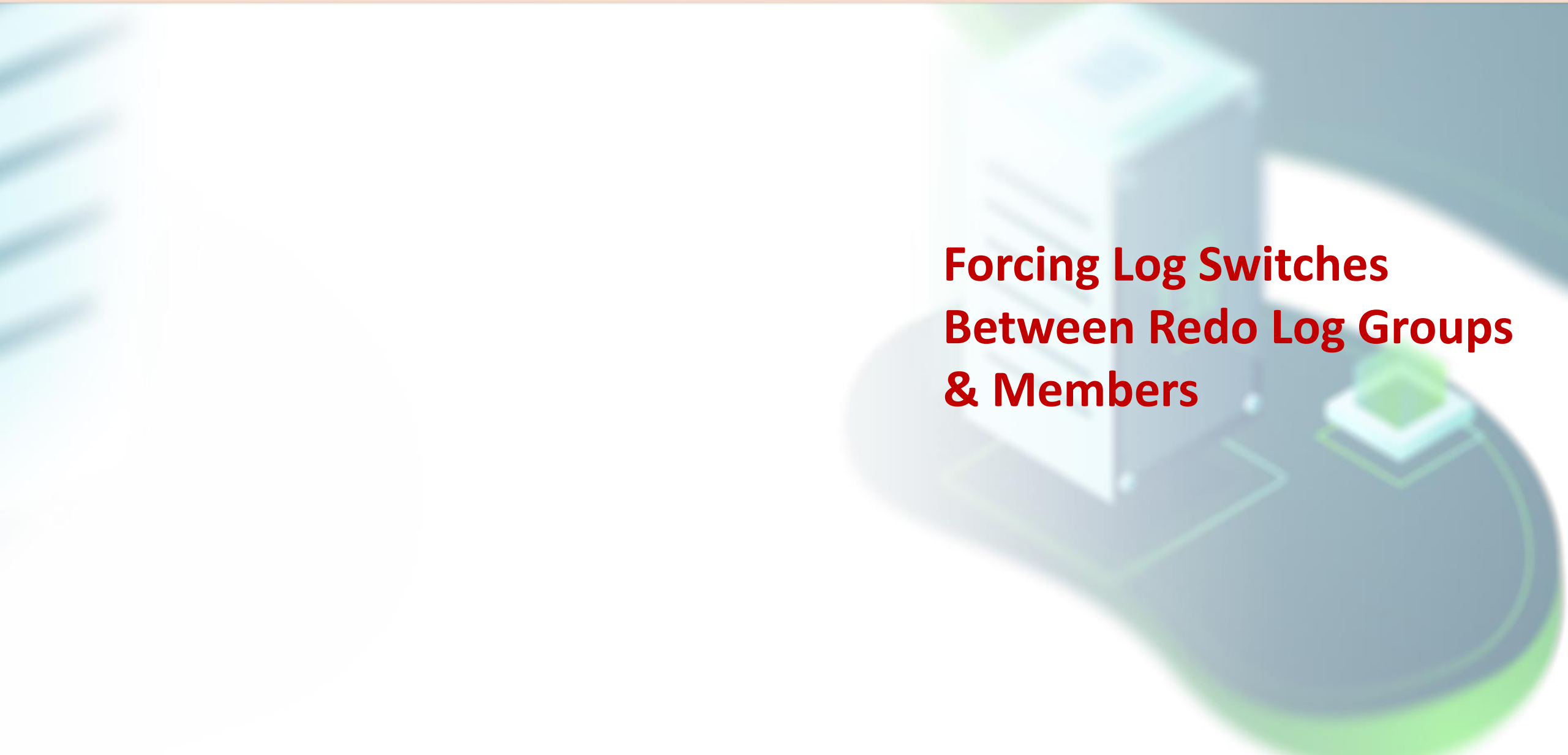
Dropping Redo Log Groups & Members

Dropping Redo Log Members?

- To drop specific inactive redo log members, use the following statement:

```
ALTER DATABASE DROP LOGFILE MEMBER
'/oracle/dbs/log3c.rdo';
```

End



Forcing Log Switches Between Redo Log Groups & Members

Forcing Log Switching Between Groups & Members

Forcing Log Switches

- Log Switching
- Log Switching – An Example
- Verifying Blocks in Redo Log Files

Forcing Log Switching Between Groups & Members

Log Switching

- A log switch occurs when LGWR stops writing to one redo log group and starts writing to another. By default, a log switch occurs automatically when the current redo log file group fills.
- You can force a log switch to make the currently active group inactive and available for redo log maintenance operations. For example, you want to drop the currently active group, but are not able to do so until the group is inactive.

Forcing Log Switching Between Groups & Members

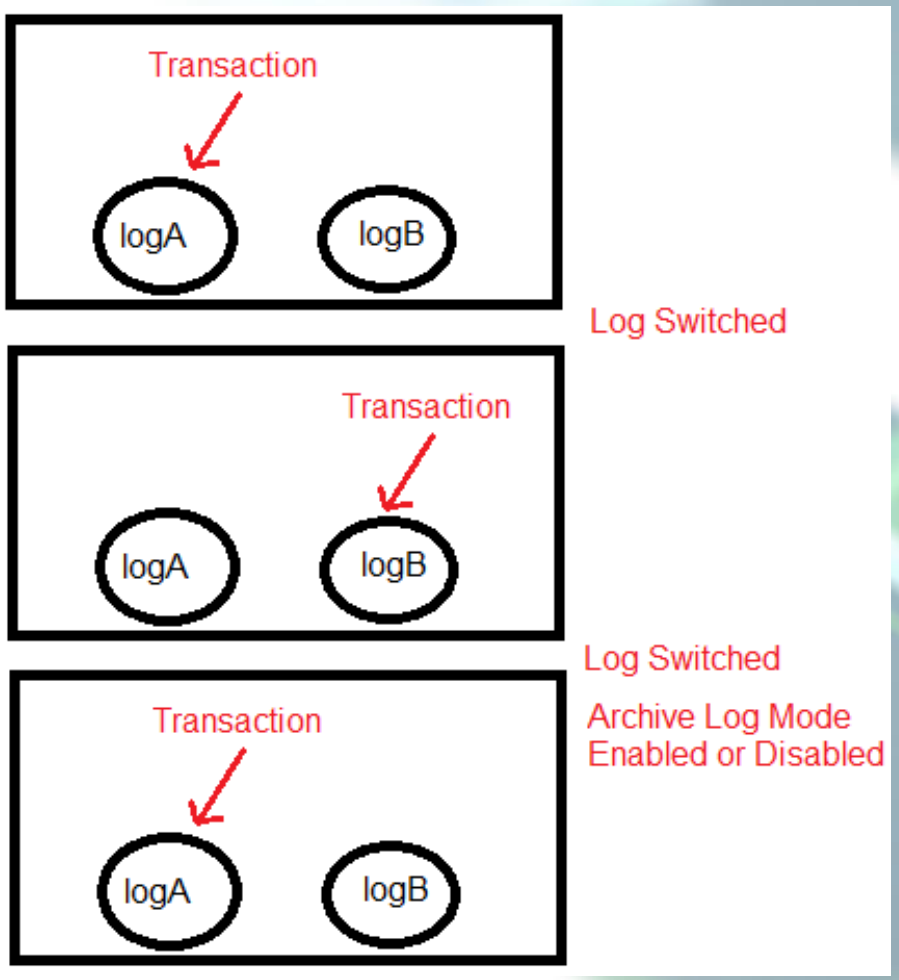
Log Switching

- You may also want to force a log switch if the currently active group must be archived at a specific time before the members of the group are completely filled. This option is useful in configurations ith large redo log files that take a long time to fill.
- The following statement forces a log switch:

```
ALTER SYSTEM SWITCH LOGFILE;
```

Forcing Log Switching Between Groups & Members

Log Switching – An Example



Forcing Log Switching Between Groups & Members

Verifying Blocks in Redo Log Files

- You can configure the database to use checksums to verify blocks in the redo log files.
- If you set the initialization parameter DB_BLOCK_CHECKSUM to TYPICAL(the default), the database computes a check sum for each database block when it is written to disk, including each redo log block as it is being written to the current log.
- The checksum is stored header's block.

Forcing Log Switching Between Groups & Members

Verifying Blocks in Redo Log Files

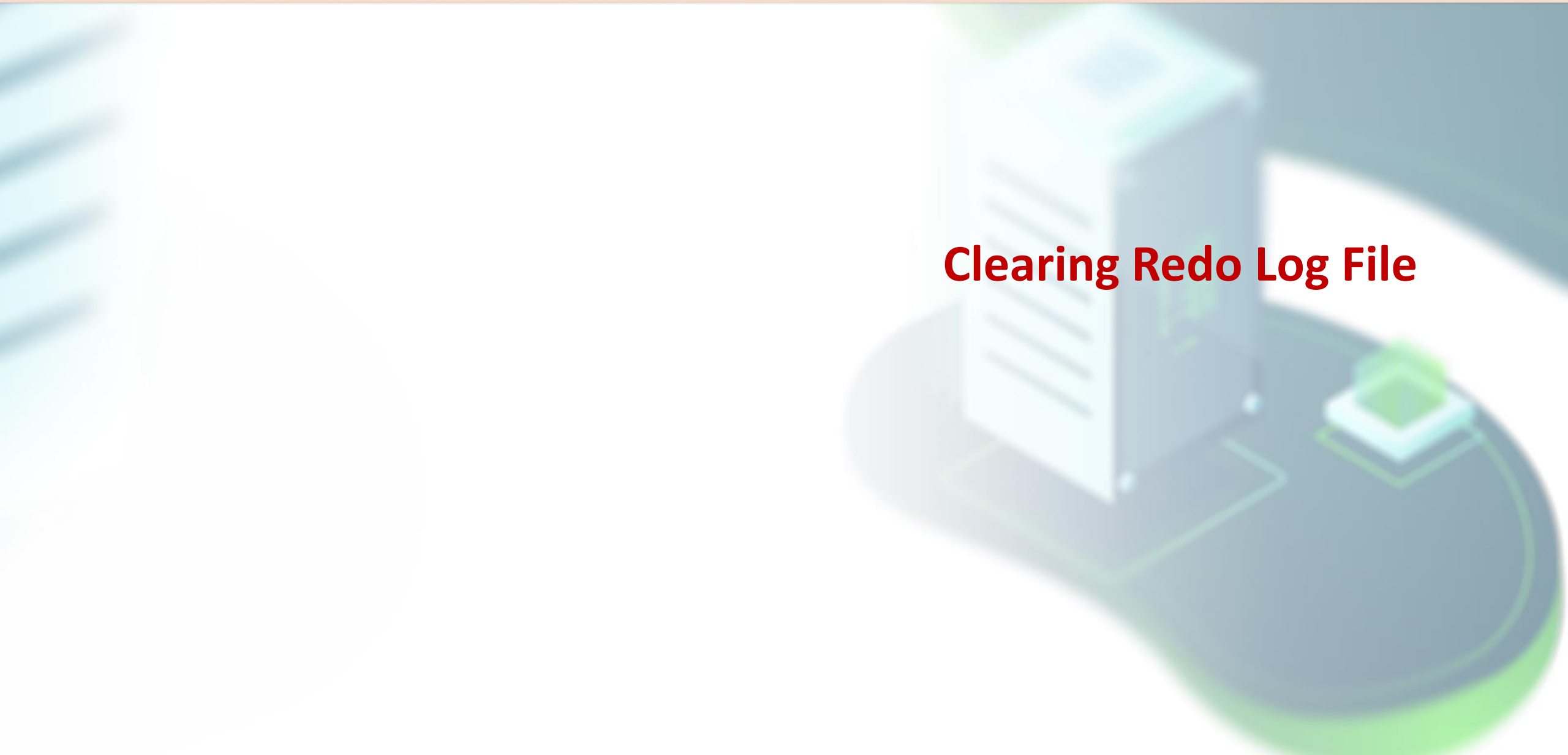
- Oracle Database uses the checksum to detect corruption in a redo log block.
- The database verifies the redo log block when the block is read from an archived log during recovery and when it writes the block to an archive log file. An error is raised and written to the alert log if corruption is detected.

Forcing Log Switching Between Groups & Members

end

Verifying Blocks in Redo Log Files

- If corruption is detected in a redo log block while trying to archive it, the system attempts to read the block from another member in the group.
- If the block is corrupted in all members of the redo log group, then archiving cannot proceed.
- The value of the DB_BLOCK_CHECKSUM parameter can be changed dynamically using the ALTER SYSTEM statement.



Clearing Redo Log File

Clearing Redo Log File

Clearing Redo Log Files

- How to clear Redo Log Files?
- Error in clearing Redo Log Files
- Dropping Redo Log File
- Creating Redo Log File

Clearing Redo Log File

How to clear Redo Log Files?

- A redo log file might become corrupted while the database is open, and ultimately stop database activity because archiving cannot continue. In this situation the ALTER DATABASE CLEAR LOGFILE statement can be used to reinitialize the file without shutting down the database.
- The following statement clears the log files in redo log group number 3:

```
ALTER DATABASE CLEAR LOGFILE GROUP
3;
```

Clearing Redo Log File

How to clear Redo Log Files?

- If you clear a log file that is needed for recovery of a backup, then you can no longer recover from that backup. The database writes a message in the alert log describing the backups from which you cannot recover.
- To clear an unarchived redo log that is needed to bring an offline tablespace online, use the UNRECOVERABLE DATAFILE clause in the ALTER DATABASE CLEAR LOGFILE statement.

Clearing Redo Log File

Error in clearing Redo Log Files

```
SQL> alter database drop logfile group 1;
alter database drop logfile group 1
*
ERROR at line 1:
ORA-01624: log 1 needed for crash recovery
of instance SBIP18DB (thread 1)
ORA-00312: online log 1 thread 1:
'/SIBIP16/SBIP18DB/SBIP18DB/redo01.log'
```

Clearing Redo Log File

Error in clearing Redo Log Files

```
select l.group#, l.thread#,
substr(f.member,1,50) f_name,
l.archived,
l.status,
(bytes/1024/1024) fsize
from
v$log l, v$logfile f
where f.group# = l.group#
order by 1,2;
```

D#	F_NAME	ARC	STATUS	FSIZE
1	E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG	NO	CURRENT	50

Clearing Redo Log File

#	F_NAME	ARC	STATUS	FSIZE
1	E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG	NO	CURRENT	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG	NO	ACTIVE	50

Error in clearing Redo Log Files

We can see the though the redolog group 1 has been archived, its status is ACTIVE. i.e this redolog is required for crash recovery or block recovery.
So to change the status from ACTIVE to INACTIVE, switch logfile multiple times, till the status is INACTIVE.

alter system **switch** logfile;
--for inactive status
alter database drop logfile group 2;

Clearing Redo Log File

```
D# F_NAME                                  ARC STATUS    FSIZE
-- --------------------------------------- --- ---------------
 1 E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG NO  ACTIVE        50
 1 E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG NO  CURRENT       50
 1 E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG NO  INACTIVE      50
```

Error in clearing Redo Log Files?

We can see the though the redolog group 1 has been archived, its status is ACTIVE. i.e this redolog is required for crash recovery or block recovery.
So to change the status from ACTIVE to INACTIVE, switch logfile multiple times, till the status is INACTIVE.

alter system **switch** logfile;
--for inactive status
alter database drop logfile group 3;

Clearing Redo Log File

Dropping Redo Log File

You shutdown and startup database after dropping on redo group 3. Drop REDO03.LOG from folder.

```
SQL> alter database drop logfile group 3;

Database altered.

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

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             713032144 bytes
Database Buffers          352321536 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
SQL>
```

Clearing Redo Log File

Creating Redo Log File

alter database add logfile group 3
'E:\app\Haider\oradata\orcl\REDO03.log'
size 50m;

D#	F_NAME	ARC	STATUS	FSIZE
1	E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG	NO	CURRENT	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG	YES	UNUSED	50

Metadata Views of Redo Log File

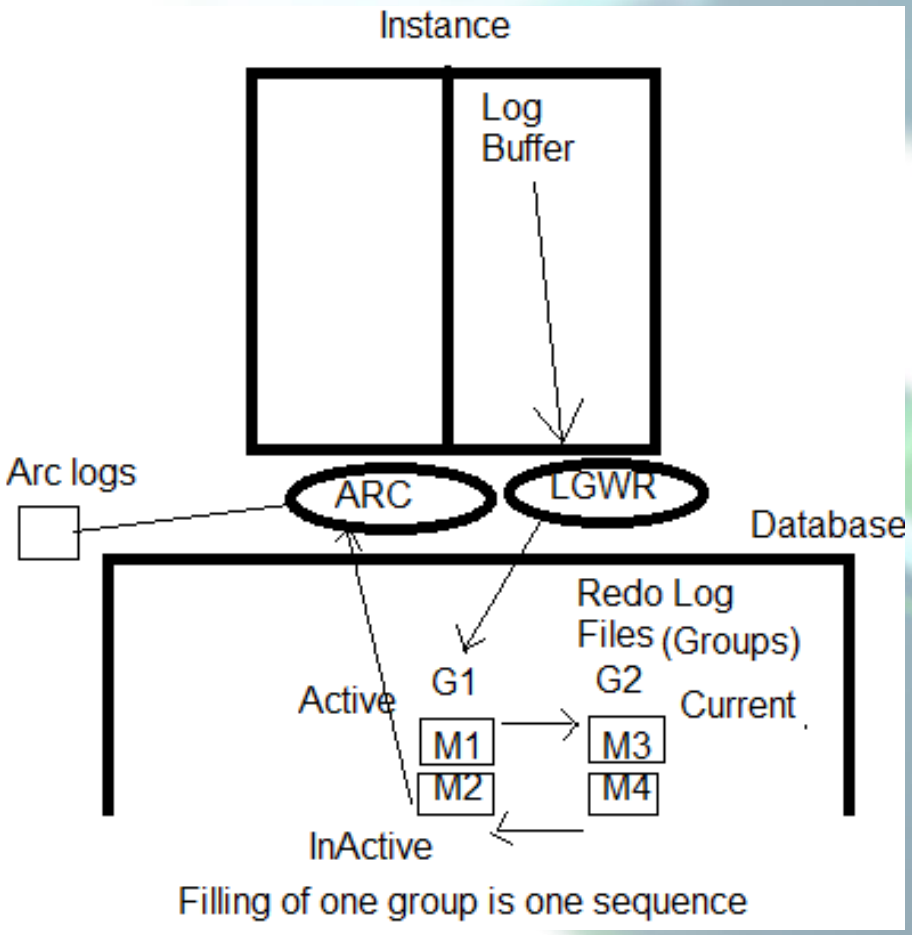
Metadata Views of Redo Log File

Metadata View of Redo Log Files

- Instance & Database Log Buffer
- Significant Views?
- Control File Information
- Log History Information
- Log of Members of Group
- Log History Information
- Use of Members of Group with Status

Metadata Views of Redo Log File

Instance & Database Log Buffer



Metadata Views of Redo Log File

Significant of Views

View	Description
V$LOG	Displays the redo log file information from the control file
V$LOGFILE	Identifies redo log groups and members and member status
V$LOG_HISTORY	Contains log history information

Metadata Views of Redo Log File

Control File Information

```
SELECT * FROM V$LOG;

GROUP# THREAD#   SEQ   BYTES  MEMBERS  ARC STATUS     FIRST_CHANGE# FIRST_TIM
------ ------- ----- -------  -------  --- ---------  ------------- ---------
     1       1 10605 1048576        1  YES ACTIVE         11515628 16-APR-00
     2       1 10606 1048576        1  NO  CURRENT        11517595 16-APR-00
     3       1 10603 1048576        1  YES INACTIVE       11511666 16-APR-00
     4       1 10604 1048576        1  YES INACTIVE       11513647 16-APR-00
```

Metadata Views of Redo Log File

Members of Group

```
SELECT * FROM V$LOG;

GROUP# THREAD#   SEQ   BYTES  MEMBERS  ARC STATUS     FIRST_CHANGE# FIRST_TIM
------ ------- ----- -------  -------  --- ---------  ------------- ---------
     1       1 10605 1048576        1  YES ACTIVE         11515628 16-APR-00
     2       1 10606 1048576        1  NO  CURRENT        11517595 16-APR-00
     3       1 10603 1048576        1  YES INACTIVE       11511666 16-APR-00
     4       1 10604 1048576        1  YES INACTIVE       11513647 16-APR-00
```

Metadata Views of Redo Log File

Log History Information

```
SQL> select Stamp, Thread#, First_change#, First_time, Resetlogs_change#
  2  from  v$log_history
  3  where rownum<=10;

    STAMP    THREAD# FIRST_CHANGE# FIRST_TIM RESETLOGS_CHANGE#
--------- --------- ------------- --------- ----------------
951399757         1       9079208 07-AUG-17           940976
951473702         1       9104778 07-AUG-17           940976
951559221         1       9132765 08-AUG-17           940976
951645623         1       9157391 09-AUG-17           940976
951732023         1       9182645 10-AUG-17           940976
952077284         1       9204703 11-AUG-17           940976
952085754         1       9217064 15-AUG-17           940976
952164052         1       9247525 15-AUG-17           940976
952303136         1       9278762 16-AUG-17           940976
952339592         1       9307368 18-AUG-17           940976
```

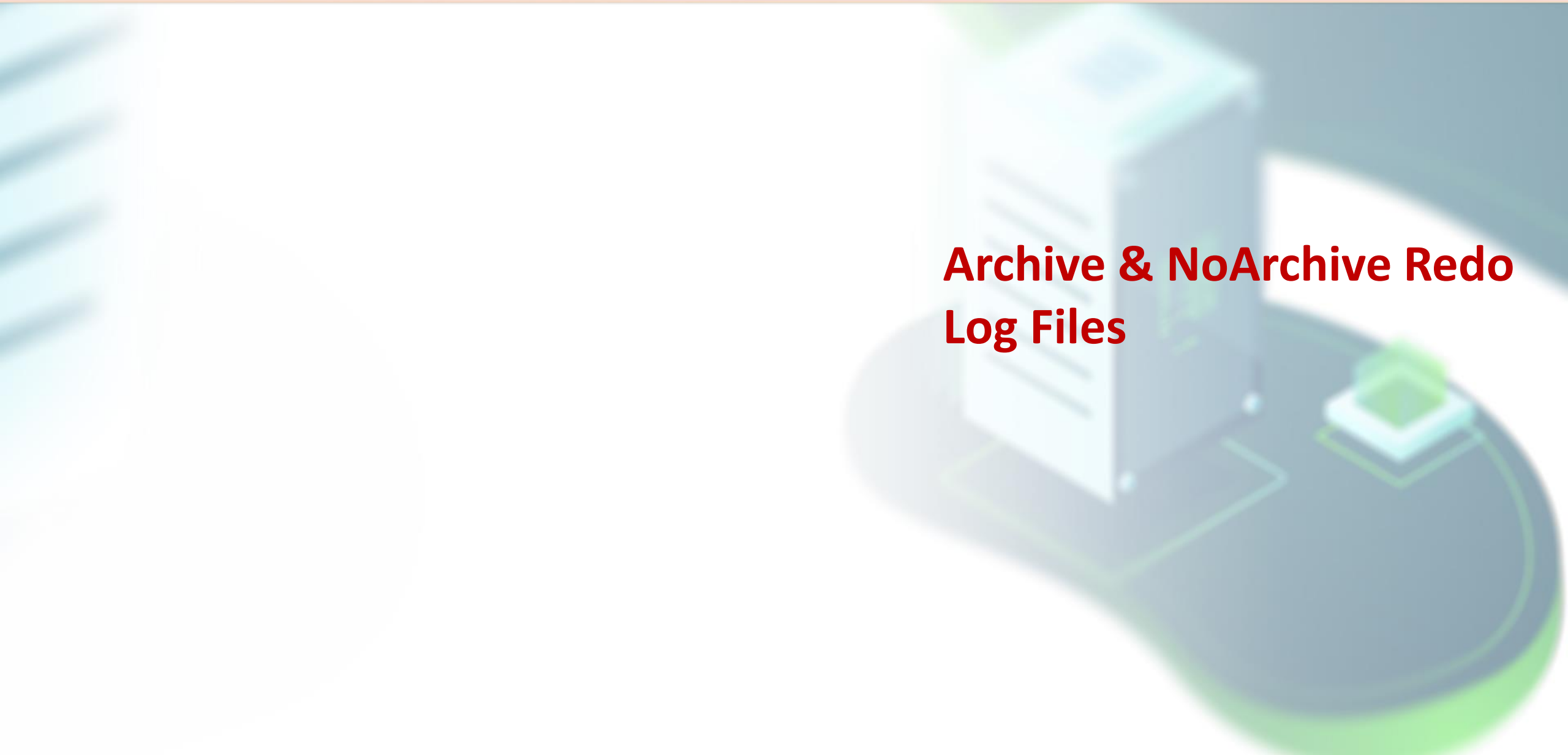
Metadata Views of Redo Log File

Use of member with status

```
select l.group#, l.thread#,
substr(f.member,1,50) f_name,
l.archived,
l.status,
(bytes/1024/1024) fsize
from
v$log l, v$logfile f
where f.group# = l.group#
order by 1,2;
```

O#	F_NAME	ARC	STATUS	FSIZE
1	E:\APP\HAIDER\ORADATA\ORCL\REDO01.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO02.LOG	NO	INACTIVE	50
1	E:\APP\HAIDER\ORADATA\ORCL\REDO03.LOG	NO	CURRENT	50

End



Archive & NoArchive Redo Log Files

Archive and NoArchive Redo Log Files

Archive & NoArchive of Redo Log Files

- Archived Redo Log
- Archived Redo Log Usage
- Archived Redo Log Mode
- Archived Redo Log Disabled to Enabled
- Archived Redo Log Enabled to Disabled
- Redo Logs Use in ARCHIVELOG Mode

Archive and NoArchive Redo Log Files

Archived Redo Log

- Oracle Database lets you save filled groups of redo log files to one or more offline destinations, known collectively as the archived redo log.
- The process of turning redo log files into archived redo log files is called archiving. This process is only possible if the database is running in ARCHIVELOG mode.
- You can choose automatic or manual archiving

Archive and NoArchive Redo Log Files

Archived Redo Log

- An archived redo log file is a copy of one of the filled members of a redo log group with log sequence number.
- For example, if you are multiplexing your redo log, and if group 1 contains identical member files a_log1and b_log1, then the archiver process (ARCn) will archive one of these member files.

Archive and NoArchive Redo Log Files

Archived Redo Log

- Should a_log1 become corrupted, then ARCn can still archive the identical b_log1. The archived redo log contains a copy of every group created since you enabled archiving.

Archive and NoArchive Redo Log Files

Archived Redo Log

- When the database is running in ARCHIVELOG mode, LGWR cannot reuse and hence overwrite a redo log group until it has been archived.
- The background process RCn automates archiving operations when automatic archiving is enabled. The database starts multiple archiver processes as needed to ensure that the archiving of filled redo logs does not fall behind.

Archive and NoArchive Redo Log Files

Archived Redo Log Usage

You can use archived redo logs to:

- Recover a database
- Update a standby database
- Get information about the history of a database using the LogMiner utility

Archive and NoArchive Redo Log Files

Archived Redo Log Mode

Display DB Archive Mode Disable or Enable
Login with sys / as sysdba.
We will discuss archival files backup later

```
SQL> archive log list
Database log mode              No Archive Mode
Automatic archival             Disabled
Archive destination            USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence     759
Current log sequence           761
SQL>
```

```
SQL> SHOW PARAMETER DB_RECOVERY_FILE_DEST

NAME                           TYPE        VALUE
------------------------------ ----------- ------------------------------
db_recovery_file_dest          string      E:\app\Haider\flash_recovery_a
                                           rea
db_recovery_file_dest_size     big integer 3852M
SQL>
```

Archive and NoArchive Redo Log Files

Archived Redo Log Disabled to Enabled

```
SQL> shutdown immediate
ORA-01507: database not mounted


ORACLE instance shut down.
SQL> startup mount
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             713032144 bytes
Database Buffers          352321536 bytes
Redo Buffers                4603904 bytes
Database mounted.
SQL> Alter database archivelog;

Database altered.

SQL> archive log list
Database log mode              Archive Mode
Automatic archival             Enabled
Archive destination            USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence     760
Next log sequence to archive   762
Current log sequence           762
```

```
SQL> shutdown immediate
ORA-01109: database not open


Database dismounted.
ORACLE instance shut down.
SQL> startup open
ORACLE instance started.

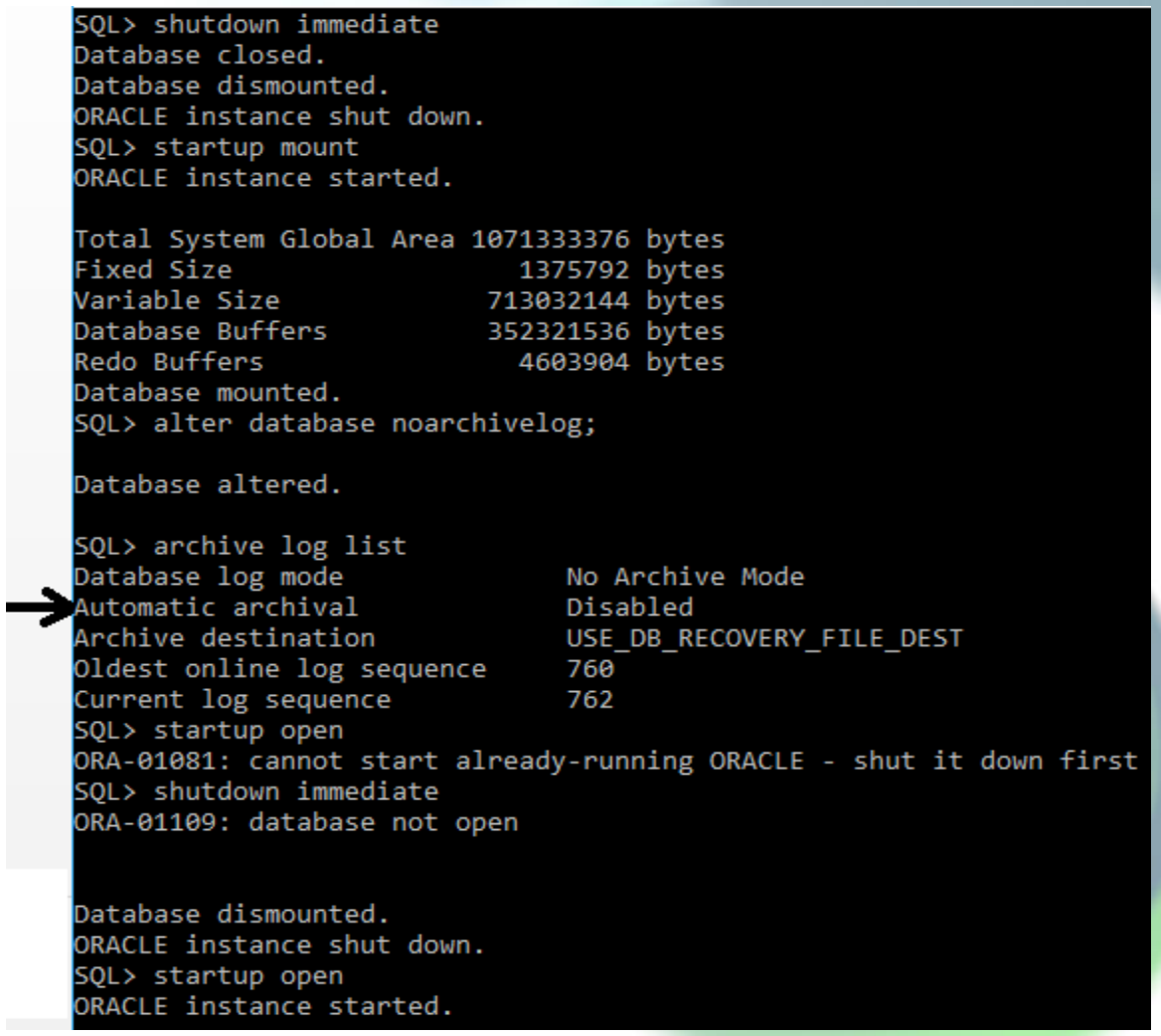
Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             713032144 bytes
Database Buffers          352321536 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
```

Using SQL sys to convert Archivelog Disabled to Enabled & Vice Versa

During recovery Oracle ask you to use Alter database open instead of startup open

Archive and NoArchive Redo Log Files

Archived Redo Log Enabled to Disabled



```
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> startup mount
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             713032144 bytes
Database Buffers          352321536 bytes
Redo Buffers                4603904 bytes
Database mounted.
SQL> alter database noarchivelog;

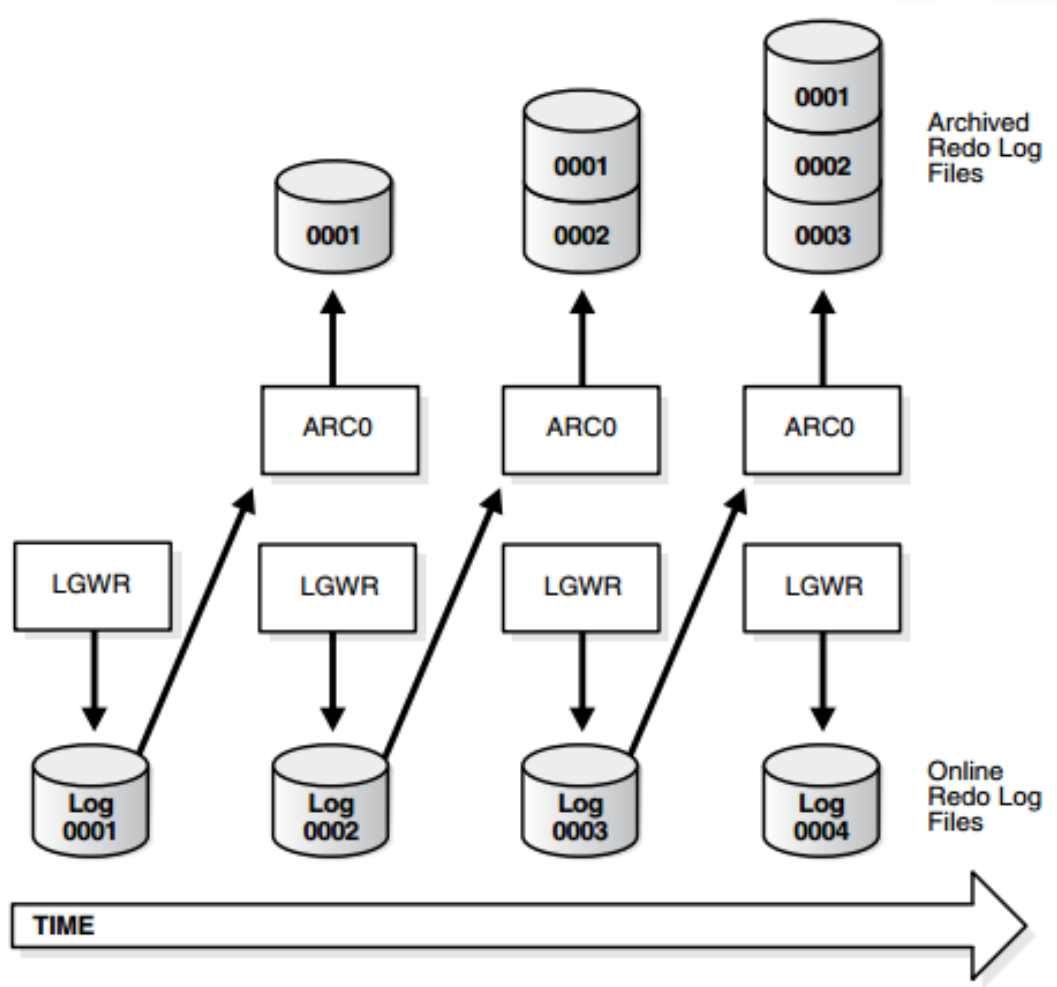
Database altered.

SQL> archive log list
Database log mode              No Archive Mode
Automatic archival             Disabled
Archive destination            USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence     760
Current log sequence           762
SQL> startup open
ORA-01081: cannot start already-running ORACLE - shut it down first
SQL> shutdown immediate
ORA-01109: database not open


Database dismounted.
ORACLE instance shut down.
SQL> startup open
ORACLE instance started.
```

Archive and NoArchive Redo Log Files

Redo Logs Use in ARCHIVELOG Mode



Introduction to Database Administration

Controlling Archiving

Controlling Archiving

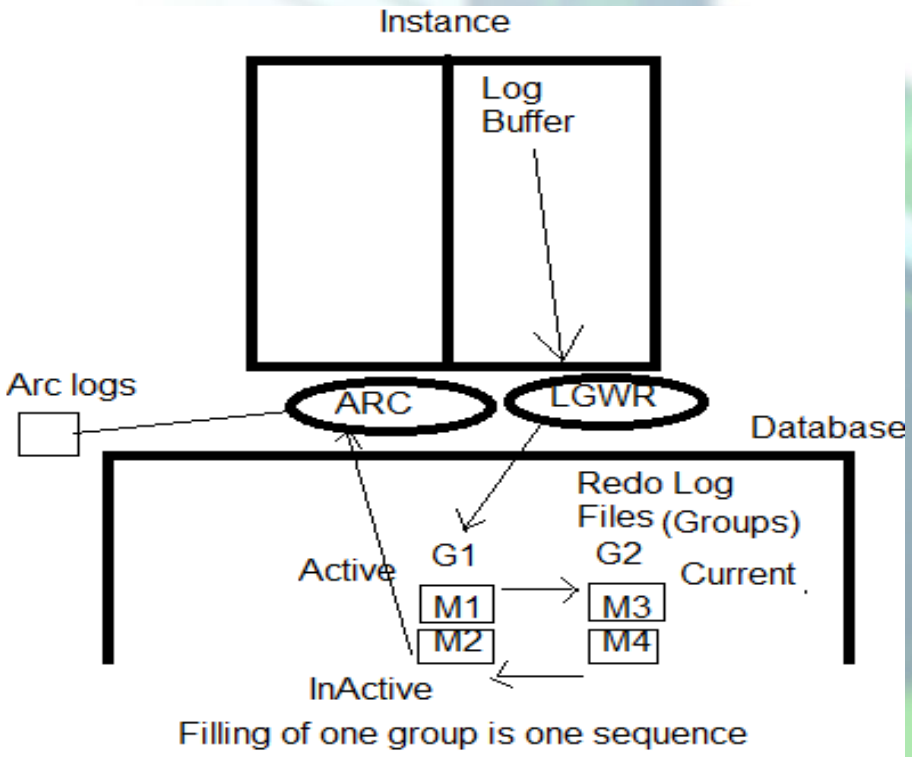
Controlling Archive of Redo Log

- What is Oracle Archiving?
- Setting the Initial Database Archiving Mode
- Changing the Database Archiving Mode
- Performing Manual Archiving
- Adjusting the Number of Archiver Processes

Controlling Archiving

What is Oracle Archiving?

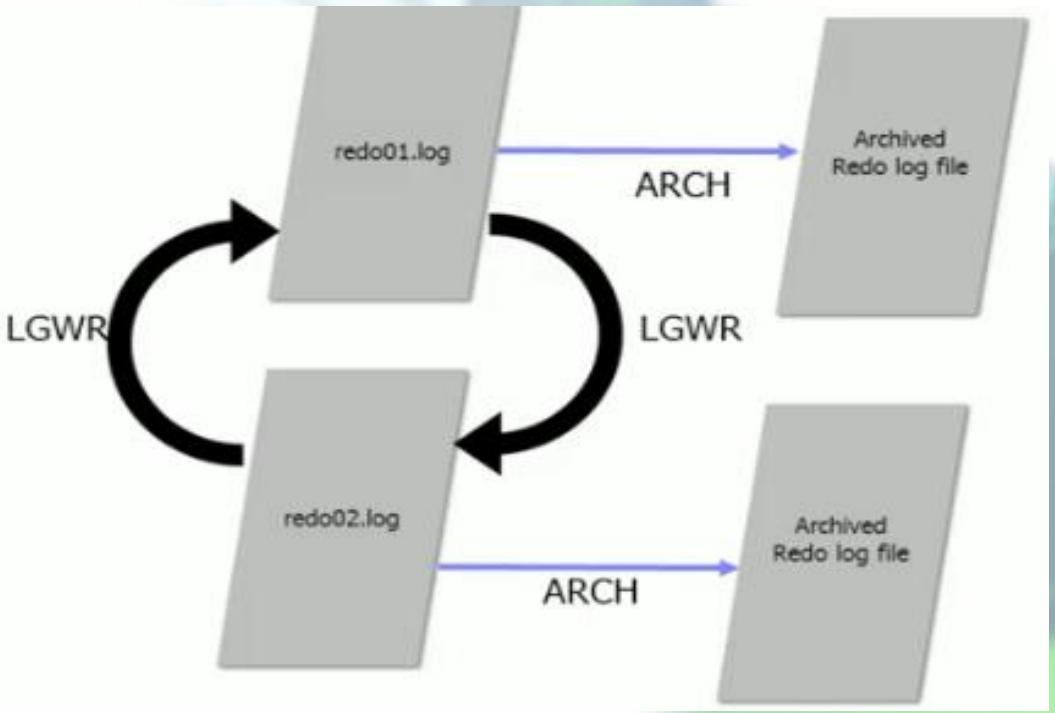
Archiving: After a switch, a copy of the Redo Log file is sent to Archive Destination



Controlling Archiving

What is Oracle Archiving?

Archiving: After a switch, a copy of the Redo Log file is sent to Archive Destination



Controlling Archiving

Setting the Initial Database Archiving Mode

- Usually, you can use the default of NOARCHIVELOG mode at database creation because there is no need to archive the redo information generated by that process.
- After creating the database, decide whether to change the initial archiving mode.

Controlling Archiving

Setting the Initial Database Archiving Mode

- If you specify ARCHIVELOG mode, you must have initialization parameters set that specify the destinations for the archived redo log files

Controlling Archiving

Changing Archiving Mode

- Start a new instance and mount, but do not open, the database.

  STARTUP MOUNT
- To enable or disable archiving, the database must be mounted but not open.

Controlling Archiving

Changing Archiving Mode

- Change the database archiving mode. Then open the database for normal operations.

```
ALTER DATABASE ARCHIVELOG;
ALTER DATABASE OPEN;
```

- Shut down the database.

```
SHUTDOWN IMMEDIATE
```

- Back up the database.

Controlling Archiving

Changing Archiving Mode Manual

- Start a new instance and mount, but do not open, the database.
  STARTUP MOUNT
- Change the database archiving mode. Then open the database for normal operations.
  ALTER DATABASE ARCHIVELOG MANUAL;
  ALTER DATABASE OPEN;
  ALTER SYSTEM ARCHIVELOG ALL;
- Shut down the database.
  SHUTDOWN IMMEDIATE
- Back up the database.

Controlling Archiving

Adjusting the Number of Archiver Processes

- The LOG_ARCHIVE_MAX_PROCESSES initialization parameter specifies the number of ARCn processes that the database initially starts. The default is four processes.
- To avoid any run-time overhead of starting additional ARCn processes, you can set the LOG_ARCHIVE_MAX_PROCESSES

Controlling Archiving

Adjusting the Number of Archiver Processes

- Initialization parameter to specify that up to 30 ARCn
  ALTER SYSTEM SET
  LOG_ARCHIVE_MAX_PROCESSES=6;

End

Specifying Archive Destinations

Specifying Archive Destinations

Specifying Archive Destinations

- Specifying Archive Destinations
- Archive Destinations Status

Specifying Archive Destinations

Specifying Archive Destinations

- You can choose to archive redo logs to a single destination or to multiple destinations.
- Destinations can be local—within the local file system or an Oracle Automatic Storage Management (Oracle ASM) disk group—or remote.

Specifying Archive Destinations

Specifying Archive Destinations

- When you archive to multiple destinations, a copy of each filled redo log file is written to each destination. These redundant copies help ensure that archived logs are always available in the event of a failure at one of the destinations.

Specifying Archive Destinations

Specifying Archive Destinations

- To archive to only a single destination, specify that destination using the LOG_ARCHIVE_DEST initialization parameter.
- To archive to multiple destinations, you can choose to archive to two or more locations using the

Specifying Archive Destinations

Specifying Archive Destinations

- LOG_ARCHIVE_DEST_n initialization parameters, or to archive only to a primary and secondary destination using the LOG_ARCHIVE_DEST and LOG_ARCHIVE_DUPLEX_DEST initialization parameters.

Specifying Archive Destinations

Specifying Archive Destinations

Method	Initialization Parameter	Host	Example
1	LOG_ARCHIVE_DEST_*n* where: *n* is an integer from 1 to 31. Archive destinations 1 to 10 are available for local or remote locations. Archive destinations 11 to 31 are available for remote locations only.	Local or remote	LOG_ARCHIVE_DEST_1 = 'LOCATION=/disk1/arc' LOG_ARCHIVE_DEST_2 = 'LOCATION=/disk2/arc' LOG_ARCHIVE_DEST_3 = 'SERVICE=standby1'
2	LOG_ARCHIVE_DEST and LOG_ARCHIVE_DUPLEX_DEST	Local only	LOG_ARCHIVE_DEST = '/disk1/arc' LOG_ARCHIVE_DUPLEX_DEST = '/disk2/arc'

Specifying Archive Destinations

End

Archive Destinations Status

- Valid/Invalid: indicates whether the disk location or service name information is specified and valid
- Enabled/Disabled: indicates the availability state of the location and whether the database can use the destination
- Active/Inactive: indicates whether there was a problem accessing the destination

Introduction to Database Administration

Managing Archive Destination Failure & Controlling Trace

Managing Archive Destination Failure & Controlling Trace

Managing Archive Destination Failure & Controlling Trace

- Rearchiving to a Failed Destination
- Controlling Trace Output
- Initialization Parameter
- Archived Redo Log Views

Managing Archive Destination Failure & Controlling Trace

Rearchiving to a Failed Destination

- Use the REOPEN attribute of the LOG_ARCHIVE_DEST_n parameter to specify whether and when ARCn should attempt to rearchive to a failed destination following an error. REOPEN applies to all errors, not just OPEN errors.

Managing Archive Destination Failure & Controlling Trace

Rearchiving to a Failed Destination

- REOPEN=n sets the minimum number of seconds before ARCn should try to reopen a failed destination. The default value for n is 300 seconds. A value of 0 is the same as turning off the REOPEN attribute; ARCn will not attempt to archive after a failure.
- If you do not specify the REOPEN keyword, ARCn will never reopen a destination following an error.

Managing Archive Destination Failure & Controlling Trace

Rearchiving to a Failed Destination

- If you do not specify the REOPEN keyword, ARCn will never reopen a destination following an error.
- You cannot use REOPEN to specify the number of attempts ARCn should make to reconnect and transfer archived logs. The REOPEN attempt either succeeds or fails.
- You cannot use REOPEN to specify the number of attempts ARCn should make to reconnect and transfer archived logs. The REOPEN attempt

Managing Archive Destination Failure & Controlling Trace

Rearchiving to a Failed Destination

When you specify REOPEN for an OPTIONAL destination, the database can overwrite online logs if there is an error. If you specify REOPEN for a MANDATORY destination, the database stalls the production database when it cannot successfully archive.

Managing Archive Destination Failure & Controlling Trace

Rearchiving to a Failed Destination

In this situation, consider the following options:

- Archive manually to the failed destination.
- Change the destination by deferring the destination, specifying the destination as optional, or changing the service.
- Drop the destination.

Managing Archive Destination Failure & Controlling Trace

Controlling Trace Output

Background processes always write to a trace file when appropriate. In the case of the archive log process, you can control the output that is generated to the trace file. You do this by setting the LOG_ARCHIVE_TRACE initialization parameter to specify a trace level.

The following values can be specified on next slide:

Managing Archive Destination Failure & Controlling Trace

Initialization Parameter

Trace Level	Meaning
0	Disable archivelog tracing. This is the default.
1	Track archival of redo log file.
2	Track archival status for each archivelog destination.
4	Track archival operational phase.
8	Track archivelog destination activity.
16	Track detailed archivelog destination activity.
32	Track archivelog destination parameter modifications.
64	Track ARC*n* process state activity.
128	Track FAL (fetch archived log) server related activities.
256	Supported in a future release.
512	Tracks asynchronous LGWR activity.
1024	RFS physical client tracking.
2048	ARC*n*/RFS heartbeat tracking.
4096	Track real-time apply
8192	Track redo apply activity (media recovery or physical standby)

Managing Archive Destination Failure & Controlling Trace

End

Archived Redo Log Views

Dynamic Performance View	Description
V$DATABASE	Shows if the database is in ARCHIVELOG or NOARCHIVELOG mode and if MANUAL (archiving mode) has been specified.
V$ARCHIVED_LOG	Displays historical archived log information from the control file. If you use a recovery catalog, the RC_ARCHIVED_LOG view contains similar information.
V$ARCHIVE_DEST	Describes the current instance, all archive destinations, and the current value, mode, and status of these destinations.
V$ARCHIVE_PROCESSES	Displays information about the state of the various archive processes for an instance.
V$BACKUP_REDOLOG	Contains information about any backups of archived logs. If you use a recovery catalog, the RC_BACKUP_REDOLOG contains similar information.
V$LOG	Displays all redo log groups for the database and indicates which need to be archived.
V$LOG_HISTORY	Contains log history information such as which logs have been archived and the SCN range for each archived log.

```
SELECT GROUP#, ARCHIVED
   FROM SYS.V$LOG;

GROUP#     ARC
--------   ---
       1   YES
       2   NO
```

Introduction to Database Administration

Database Physical Design

Database Physical Design

Physical Design

- Definition & Concepts
- Criteria for Physical Design
- Analyzing DB Queries & Transactions
- Time Constraints of Queries & Transactions
- Physical DB Design Decisions
- Physical Database Design for Tuning
- Analyzing Database Queries & Transactions

Database Physical Design

Definition & Concepts

- Physical database design is the process of choosing specific storage structures and access paths for the database files to achieve good performance for the various database applications.

Database Physical Design

Definition & Concepts

- Each DBMS offers a variety of options for file organization and access path. Each DBMS includes various types of indexing, clustering of related records on disk blocks, link related records via pointers and various types of hashing/ partitions.

Database Physical Design

Definition & Concepts

- For example, Oracle gives the concept of partitions as TableSpaces & MS SQL Server provides concept of sub databases

Database Physical Design

Criteria for Physical Design

- Response Time: Elapse time between submitting a database transaction for execution and receiving a response. Response time is also influenced by factors not under control of DBMS, factors are communication, scheduling and operating system etc.

Database Physical Design

Criteria for Physical Design

- Space Utilization: An amount of storage space used by the database files and their access path structure on disk including indexes.
- Transaction Throughput: Average number of transactions processed per minute. It is measured at peak conditions on the system

Database Physical Design

Analyzing DB Queries & Transactions

- The files that will be accessed by the query.
- Whether the selection condition is an equality, inequality, or a range condition.
- The attributes whose values will be retrieved by the query.
- The attributes on which any selection conditions for the queries are specified.

Database Physical Design

Analyzing DB Queries & Transactions

- The attributes on which any join conditions or conditions to link multiple tables or objects for the query are specified.
- The files that will be modified.
- The attributes on which selection conditions for a delete or update is specified.

Database Physical Design

Time Constraints of Queries & Transactions

- Some queries and transactions may stringent performance constraints.
- For example, a transaction may have the constraint that it should terminate within 5 seconds on 95 percent of the occasions when it is invoked than it would never take more than 20 seconds.
- The type of operations on each file (insert, delete and update)

Database Physical Design

Physical DB Design Decisions

- Design decisions about indexing: Attributes that are joint on equality, inequality or range conditions.
- Whether to index an attribute.
- What attribute(s) to index on. (Composite keys or one of attributes in key and other is non-key)

Database Physical Design

Physical DB Design Decisions

- Whether to set up a Clustered index.
- Whether to use hash index over tree index.
- Whether to use dynamic hashing for the file (files are very volatiles).
- Apply de-normalization: separate the logically related attributes into tables to minimize redundancy.

Database Physical Design

Physical Database Design for Tuning

- Size of individual tables
- Number of distinct values in a column
- Time of query submission and its execution
- Storage statistics: Partitions, index space and buffer pool
- I/O & performance statistics: Total read/write activity

Database Physical Design

Physical Database Design for Tuning

- Locking/ logging related statistics: Rates of issuing different types of locks, transaction throughput rates, and log records activity
- Index statistics: Number of levels in an index, number of non-contiguous leaf pages.

Database Physical Design

Analyzing Database Queries & Transactions

- The files that will be accessed by the query
- The attributes on which any selection condition (WHERE) for the query are specified
- The attributes on which any join conditions are specified

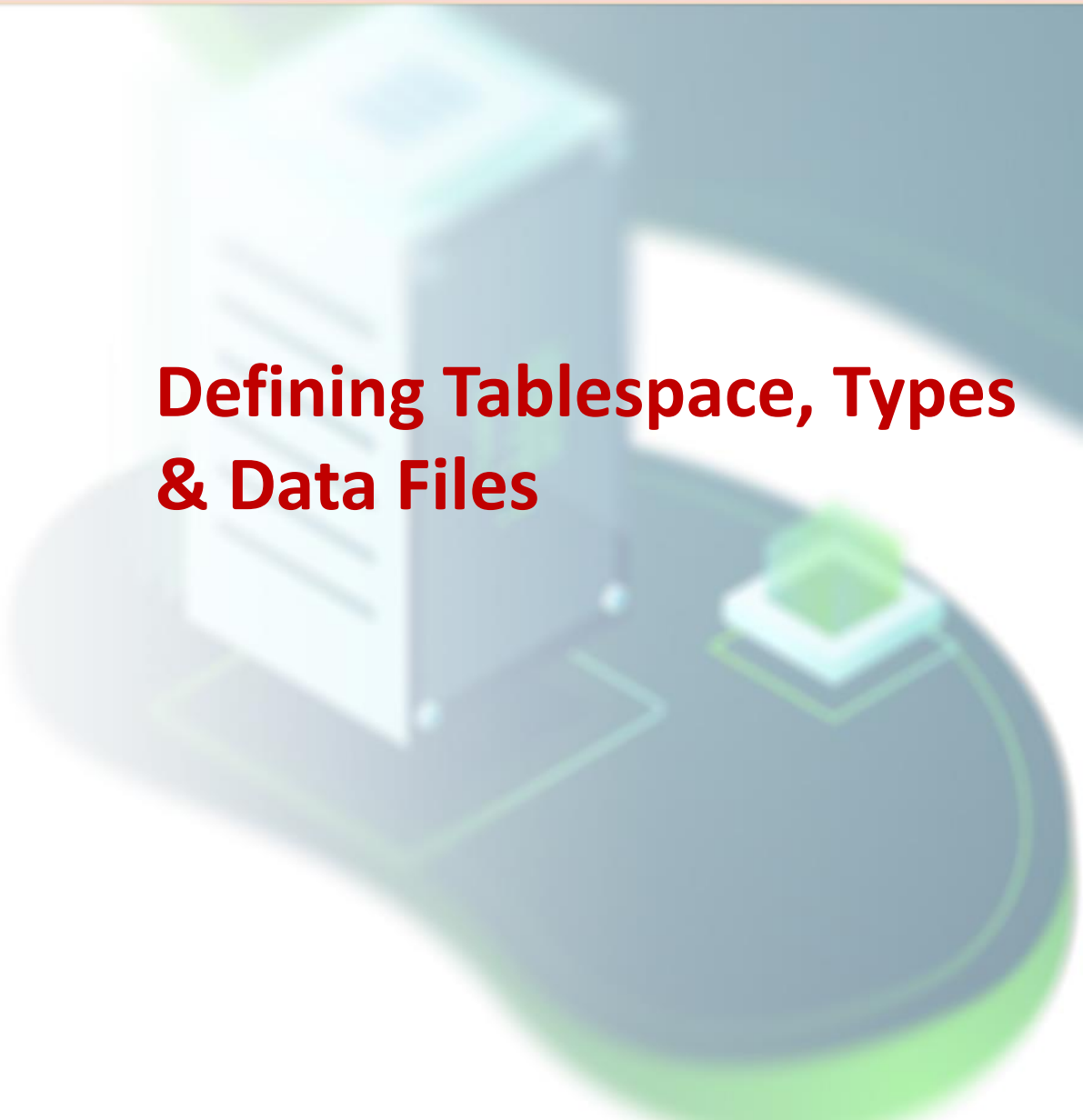
Database Physical Design

Analyzing Database Queries & Transactions

- The attributes whose values will retrieved by the queries
- The files that will be updated
- Type of operations on files (INSERT, DELETE, UPDATE)
- The attributes whose values will be changed by an update operation

End

Introduction to Database Administration



Defining Tablespace, Types & Data Files

Defining Tablespace, Types & Data Files

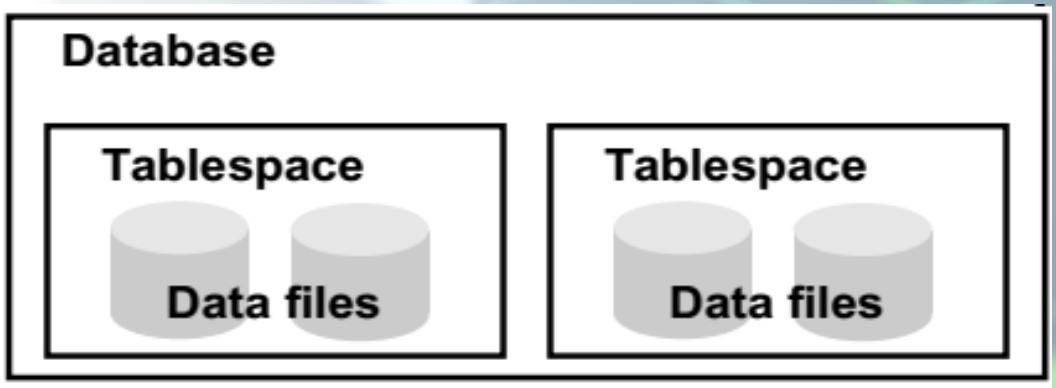
Tablespace & Data Files

- Definition & Concepts
- Benefits of using Multiple Tablespaces
- Assigning Tablespace Quotas to Users
- Types of Tablespaces

Defining Tablespace, Types & Data Files

Definition & Concepts

- An Oracle database consists of one or more logical storage units called tablespaces, which collectively store all of the database's data.
- For example, Enterprise’s data tablespace, temporary tablespace, index tablespace etc.



Defining Tablespace, Types & Data Files

Definition & Concepts

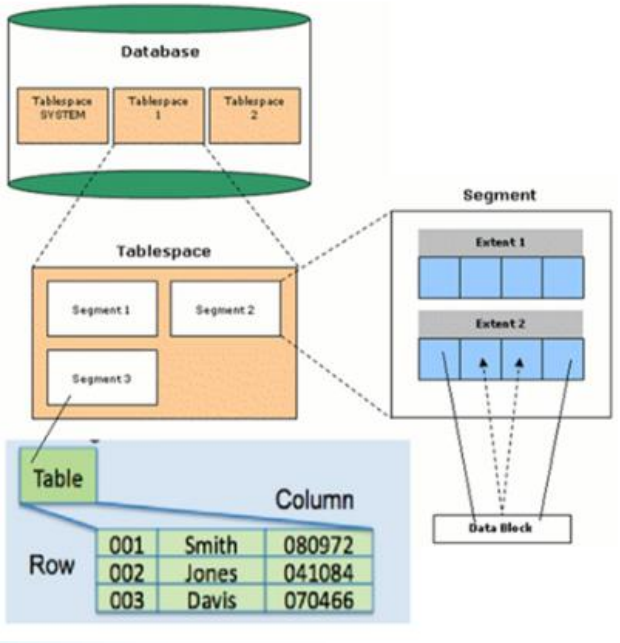
Tablespaces (Logical Level)

- Can belong to only one database at a time
- Consists of one or more data files
- Are further divided into logical units of storage

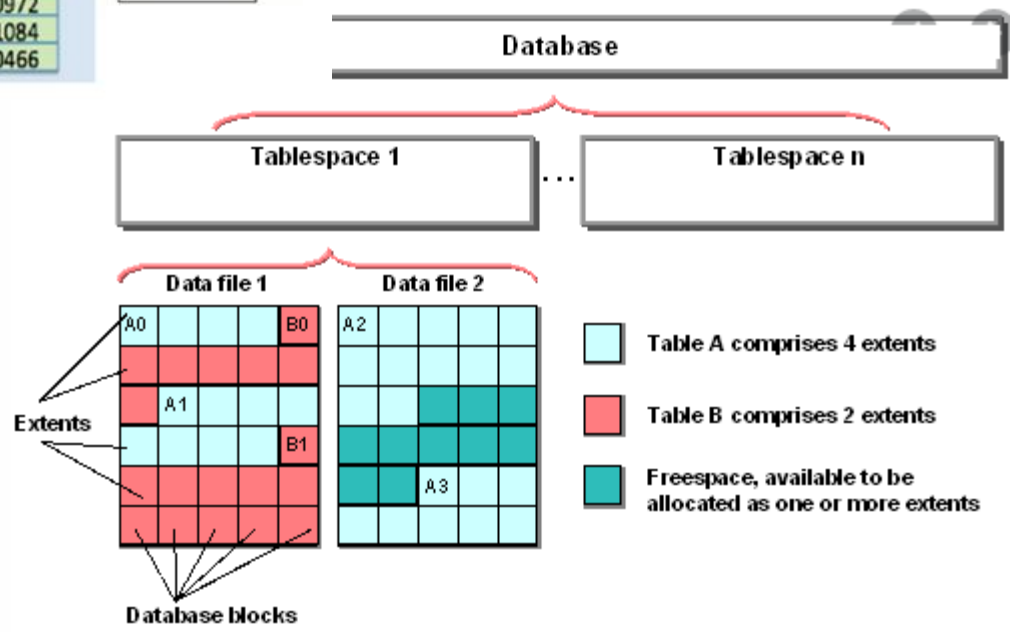
Data Files (Physical Level)

- Can belong to only one tablespace and one database
- Are a repository for schema object data

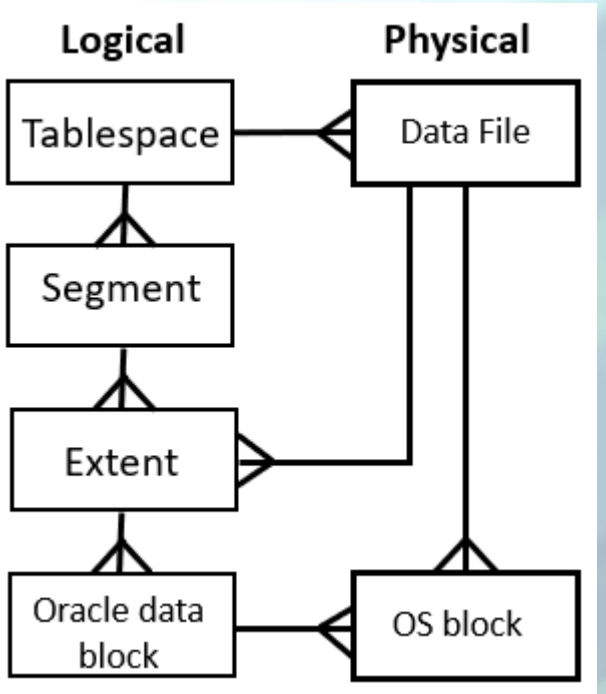
Defining Tablespace, Types & Data Files

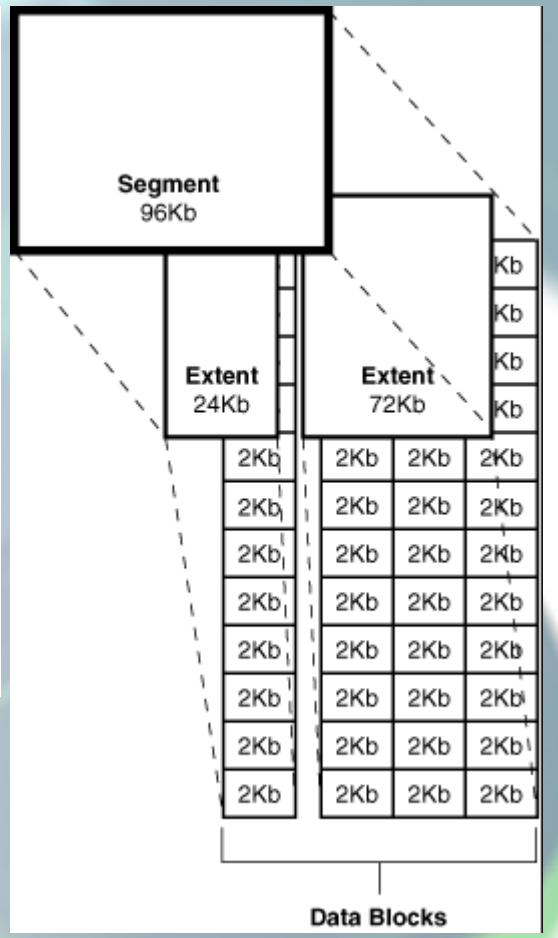


An extent is a logical unit of database storage space allocation made up of a number of contiguous data blocks. One or more extents in turn make up a segment. When the existing space in a segment is completely used, Oracle allocates a new extent for the segment.



Tablespaces & Extents





Defining Tablespace, Types & Data Files

Benefits of using Multiple Tablespaces

- Separate user data from data dictionary data to reduce I/O contention.
- Separate data of one application from the data of another to prevent multiple applications for offline purpose.
- Store the data files of different tablespaces on different disk drives to reduce I/O contention.
- Take individual tablespaces offline while others remain online, providing better overall availability.

Defining Tablespace, Types & Data Files

Benefits of using Multiple Tablespaces

- Optimizing tablespace use by reserving a tablespace for a particular type of database use, such as high update activity, read-only activity, or temporary segment storage.
- Back up individual tablespaces.

Note: Some operating system can affect the number of tablespaces that can simultaneously online.

Defining Tablespace, Types & Data Files

Assigning Tablespace Quotas to Users

Grant to users who will be creating tables, clusters, materialized views, indexes, and other objects the privilege to create the object and a quota(space allowance or limit) in the tablespace intended to hold the object segment.

Defining Tablespace, Types & Data Files

Assigning Tablespace Quotas to Users

For PL/SQL objects such as packages, procedures, and functions, users only need the privileges to create the objects. No explicit tablespace quota is required to create these PL/SQL objects

Defining Tablespace, Types & Data Files

Name	Type	Extent Ma...	Size (M)	Used (M)	Used %
AE_DATA_01	PERMANENT	LOCAL	40.000	26.188	65.47
AE_INDX_01	PERMANENT	LOCAL	60.000	43.938	73.23
CWMLITE	PERMANENT	LOCAL	20.000	9.375	46.88
DCL_DEV	PERMANENT	LOCAL	40.000	1.250	3.13
DCL_INDX	PERMANENT	LOCAL	40.000	1.063	2.66
DRSYS	PERMANENT	LOCAL	20.000	9.688	48.44
EXAMPLE	PERMANENT	LOCAL	148.750	148.625	99.92
INDX	PERMANENT	LOCAL	25.000	0.063	0.25
MCARE_INDX	PERMANENT	LOCAL	50.000	0.063	0.13
MEDCARE	PERMANENT	LOCAL	130.000	71.875	55.29
MEDTEST	PERMANENT	LOCAL	100.000	19.063	19.06
ODM	PERMANENT	LOCAL	20.000	9.313	46.56
SYSTEM	PERMANENT	LOCAL	400.000	398.500	99.63
TOOLS	PERMANENT	LOCAL	10.000	6.063	60.63
UNDOTBS1	UNDO	LOCAL	5,750.000	73.313	1.28
USERS	PERMANENT	LOCAL	25.000	0.063	0.25

Types of Tablespaces

SYSTEM tablespace

- Created with the database
- Contains the data dictionary
- Contains the SYSTEM undo segment

Non-SYSTEM tablespace

- Separate segments
- Eases space administration
- Controls amount of space of a user

Creating Tablespaces

Creating Tablespaces

Creating Tablespaces

- Creating Tablespace Syntax
- Creating Tablespace using SQL
- How a user uses Tablespace?
- Space Management in Tablespace
- Locally-Managed Tablespaces
- Dictionary-Managed Tablespaces
- Create UNDO Tablespace
- Create Temporary Tablespace
- Creating a default Temporary Tablespace
- Restrictions

Creating Tablespaces

Creating Tablespace Syntax

```
CREATE TABLESPACE tablespace
    [DATAFILE clause]
    [MINIMUM EXTENT integer[K|M]]
    [BLOCKSIZE integer [K]]
    [LOGGING|NOLOGGING]
    [DEFAULT storage_clause ]
    [ONLINE|OFFLINE]
    [PERMANENT|TEMPORARY]
    [extent_management_clause]
    [segment_management_clause]
```

Oracle Internal &

Creating Tablespaces

Creating Tablespace using SQL

Windows Platform:

```
CREATE TABLESPACE WORK
datafile
'C:\Oracle11g\ordata\wrk01.dbf'
size 500M online;
```

Unix/ Linux Platform:

```
CREATE TABLESPACE WORK
datafile '/u01/ordata/wrk01.dbf'
size 500M online;
```

Creating Tablespaces

How a user uses Tablespace?

Create user ejaz identified by pwd
default tablespace WORK temporary
tablespace TEMP;

--Assigning default roles to
user(owner)
Grant connect, resource to ejaz;

Grant create table to ejaz;
Grant create view to ejaz;

Creating Tablespaces

Space Management in Tablespace

Tablespaces allocate space in extents. Tablespaces can be created to use one of the following two different methods of keeping track of free and used space:

Locally managed tablespaces: The extents are managed within the tablespace via bitmaps. Each bit in the bitmap corresponds to a block or a group of blocks.

Creating Tablespaces

Space Management in Tablespace

When an extent is allocated or freed for reuse, the Oracle server changes the bitmap values to show the new status of the blocks. Locally managed is the default beginning Oracle.

Dictionary-managed tablespaces: The extents are managed by the data dictionary. The Oracle server updates the appropriate tables in the data dictionary whenever an extent is allocated or deallocated.

Creating Tablespaces

Locally-Managed Tablespaces

- Reduced contention on data dictionary tables
- No undo generated when space allocation or deallocation occurs
- No coalescing required

```
CREATE TABLESPACE userdata
datafile 'C:\Ora11g\ordata\usr01.dbf'
size 500M
EXTENT MANAGEMENT LOCAL
UNIFORM SIZE 128K;
```

Creating Tablespaces

Dictionary-Managed Tablespaces

- Extents are managed in the data dictionary
- Each segment stored in the tablespace can have a different storage clause.
- No coalescing required

```
CREATE TABLESPACE userdata
datafile 'C:\Ora11g\ordata\usr01.dbf'
size 500M EXTENT MANAGEMENT
DICTIONARY DEFAULT STORAGE
(Initial 1M NEXT 1M PCTINCREASE 0);
```

Creating Tablespaces

Create UNDO Tablespace

- Used to store undo segments
- Cannot contain any other objects
- Extents are locally managed
- Can only use the DATAFILE and EXTENT MANAGEMENT Clause

```
CREATE UNDO TABLESPACE undo01
datafile
'C:\Oracle11g\ordata\undo01.dbf'
size 40M;
```

Creating Tablespaces

Create Temporary Tablespace

- Used for sort operations
- Can be shared by multiple users
- Cannot contain any permanent objects
- Locally managed extents recommended

```
CREATE Temporary TABLESPACE temp1
datafile
'C:\Oracle11g\ordata\temp101.dbf'
size 20M
EXTENT MANAGEMENT LOCAL
UNIFORM SIZE 4M;
```

Creating a default Temporary Tablespace

- After database creation:

  ALTER DATABASE
  DEFAULT TEMPORARY TABLESPACE
  default_temp1;

- To see default temporary tablespace, use

  Select property_name
  from database_properties;

Creating Tablespaces

Restrictions

Default temporary tablespace cannot be:

- Dropped until after a new default is made available
- Taken offline
- Alter to a permanent tablespace

End

Specifying Non Standard Block Sizes for Tablespaces

Specifying Non Standard Block Sizes for Tablespaces

Block Sizes for Tablespaces

- Bigfile Tablespaces
- Creating Bigfile Tablespaces
- VIEWS for Bigfile Tablespaces
- Non Standard Block Sizes for Tablespaces
- Creating Non Standard Tablespaces

Specifying Non Standard Block Sizes for Tablespaces

Bigfile Tablespaces

A bigfile tablespace is a tablespace with a single, but potentially very large (up to 4G blocks) data file. Traditional small file tablespaces, in contrast, can contain multiple data files, but the files cannot be as large.

Specifying Non Standard Block Sizes for Tablespaces

Bigfile Tablespaces

The benefits of bigfile tablespaces are as follows:

- A bigfile tablespace with 8K blocks can contain a 32 terabyte data file. A bigfile tablespace with 32K blocks can contain a 128 terabyte data file. The maximum number of data files in an Oracle Database is limited (usually to 64K files). Therefore, bigfile tablespaces can significantly enhance the storage capacity of an Oracle DB

Specifying Non Standard Block Sizes for Tablespaces

Bigfile Tablespaces

- Bigfile tablespaces can reduce the number of data files needed for a database. An additional benefit is that the DB_FILES initialization parameter and MAXDATAFILES parameter of the CREATE DATABASE and CREATE CONTROLFILE statements can be adjusted to reduce the amount of SGA space required for data file information and the size of the control file.

Specifying Non Standard Block Sizes for Tablespaces

Bigfile Tablespaces

- Bigfile tablespaces simplify database management by providing data file transparency. SQL syntax for the ALTER TABLESPACE statement lets you perform operations on tablespaces, rather than the underlying individual data files.

Specifying Non Standard Block Sizes for Tablespaces

Creating Bigfile Tablespaces

```
CREATE BIGFILE TABLESPACE bigtbs
DATAFILE '/u02/oracle/data/bigtbs01.dbf'
SIZE 50G
...
```

- You can specify SIZE in kilobytes (K), megabytes (M),gigabytes (G), or terabytes (T).

- If the default tablespace type was set to BIGFILE at database creation then bigfile tablespace will be created by default.

Specifying Non Standard Block Sizes for Tablespaces

VIEWS for Bigfile Tablespaces

- DBA_TABLESPACES
- USER_TABLESPACES
- V$TABLESPACE

Specifying Non Standard Block Sizes for Tablespaces

Non Standard Block Sizes for Tablespaces

- You can create tablespaces with block sizes different from the standard database block size, which is specified by the DB_BLOCK_SIZE initialization parameter. This feature lets you transport tablespaces with unlike block sizes between databases.

Specifying Non Standard Block Sizes for Tablespaces

Non Standard Block Sizes for Tablespaces

- Use the BLOCKSIZE clause of the CREATE TABLESPACE statement to create a tablespace with a block size different from the database standard block size. In order for the BLOCKSIZE clause to succeed, you must have already set the DB_CACHE_SIZE and at least one DB_nK_CACHE_SIZE initialization parameter.

Specifying Non Standard Block Sizes for Tablespaces

Non Standard Block Sizes for Tablespaces

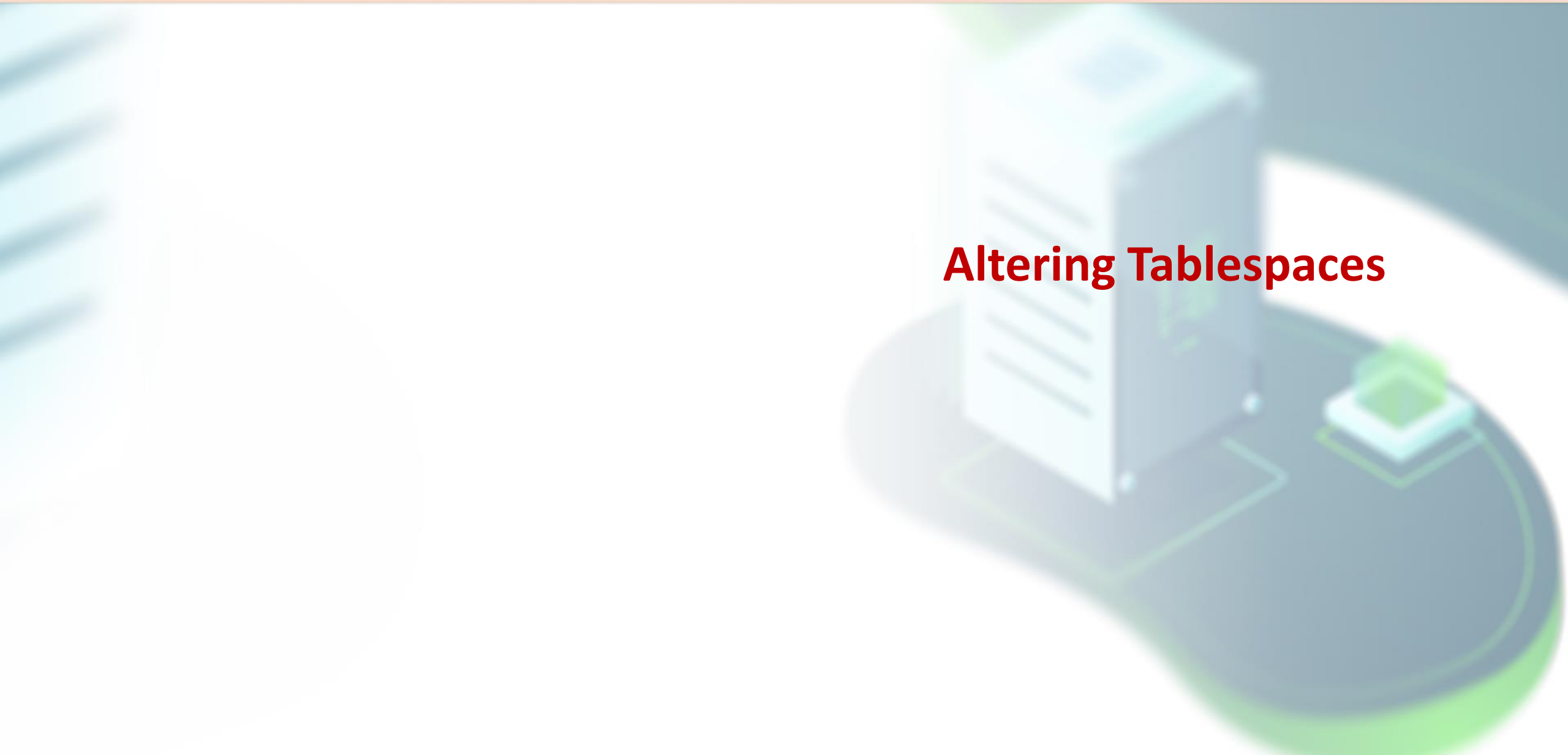
- Further, and the integer you specify in the BLOCKSIZE clause must correspond with the setting of one DB_nK_CACHE_SIZE parameter setting. Although redundant, specifying a BLOCK SIZE equal to the standard block size, as specified by the DB_BLOCK_SIZE initialization parameter, is allowed.

Specifying Non Standard Block Sizes for Tablespaces

Creating Non Standard Tablespaces

```
CREATE TABLESPACE lmtbsb
DATAFILE
'/u02/oracle/data/lmtbsb01.dbf'
SIZE 50M
EXTENT MANAGEMENT LOCAL
UNIFORM SIZE 128K
BLOCKSIZE 8K;
```

End



Altering Tablespaces

Altering Tablespaces

Altering Tablespaces

- Altering Tablespaces Availability
- Taking Tablespaces Offline
- Tablespaces cannot Offline
- Altering Tablespace SQL
- Owner of Tablespace
- Making Tablespace Readonly
- Dictionary View for use of Altering Tablespace
- Wait for Altering Tablespace to Readonly

Altering Tablespaces

Altering Tablespaces Availability

Before you can make a tablespace read-only, the following conditions must be met

- You can take an online tablespace offline so that it is temporarily unavailable for genera use.
- The rest of the database remains open and available for users to access data.

Altering Tablespaces

Altering Tablespaces Availability

- Conversely, you can bring an offline tablespace online to make the schema objects within the tablespace available to database users.
- The database must be open to alter the availability of a tablespace.

Altering Tablespaces

Taking Tablespaces Offline

- To make a portion of the database unavailable while allowing normal access to the remainder of the database
- To perform an offline tablespace backup (even though a tablespace can be backed up while online and in use)

Altering Tablespaces

Taking Tablespaces Offline

- To make an application and its group of tables temporarily unavailable while updating or maintaining the application
- To rename or relocate tablespace data files

Altering Tablespaces

Tablespaces cannot Offline

- SYSTEM
- The undo tablespace
- Temporary tablespaces

Altering Tablespaces

Altering Tablespace SQL

- Here are sample examples

```
ALTER TABLESPACE users OFFLINE;

ALTER TABLESPACE users ONLINE;

ALTER TABLESPACE work
add datafile
'C:\oracle11g\oradata\wrk02.dbf' size
500M;
```

Altering Tablespaces

Owner of Tablespace

Following SQL statement assigns tablespace to a particular user:

```
CREATE USER meduser
Identified by pwd
default tablespace WORK
temporary tablespace TEMP;
```

Altering Tablespaces

Making Tablespace Read only

- The tablespace must be online. This is necessary to ensure that there is no undo information that must be applied to the tablespace.
- The tablespace cannot be the active undo tablespace or SYSTEM tablespace.

Altering Tablespaces

Making Tablespace Read only

- The tablespace must not currently be involved in an online backup, because the end of a backup updates the header file of all data files in the tablespace.
- The tablespace cannot be a temporary tablespace.

Altering Tablespaces

Dictionary View for use of Altering Tablespace

```
SELECT SQL_TEXT, SADDR
    FROM V$SQLAREA,V$SESSION
    WHERE V$SQLAREA.ADDRESS = V$SESSION.SQL_ADDRESS
        AND SQL_TEXT LIKE 'alter tablespace%';

SQL_TEXT                                          SADDR
------------------------------------------------- --------
alter tablespace tbs1 read only                   80034AF0
```

Altering Tablespaces

Dictionary View for use of Altering Tablespace

```
SELECT SES_ADDR, START_SCNB
    FROM V$TRANSACTION
    ORDER BY START_SCNB;

SES_ADDR START_SCNB
-------- ----------
800352A0       3621   --> waiting on this txn
80035A50       3623   --> waiting on this txn
80034AF0       3628   --> this is the ALTER TABLESPACE statement
80037910       3629   --> don't care about this txn
```

End

Readonly & Online Status of Tablespaces

Readonly & Online Status of Tablespaces

Readonly & Online Status of Tablespaces

- Steps to Create Readonly Tablespaces
- SQL Alter Tablespace Command
- Delaying the opening of Data Files
- Side Effect of Delaying the opening of Data Files
- Important Issues of Delaying the opening of Data Files

Readonly & Online Status of Tablespaces

Steps to Create Readonly Tablespaces

- Create a writable tablespace on another device. Create the objects that belong in the tablespace and insert your data.
- Alter the tablespace to make it read-only.
- Copy the data files of the tablespace onto the WORM device. Use operating system commands to copy the files.
- Take the tablespace offline.

Readonly & Online Status of Tablespaces

Steps to Create Readonly Tablespaces

- Rename the data files to coincide with the names of the data files you copied onto your WORM device. Use ALTER TABLESPACE with the RENAME DATAFILE clause.
- Renaming the data files changes their names in the control file.
- Bring the tablespace back online.

Readonly & Online Status of Tablespaces

SQL Alter Tablespace Command

ALTER TABLESPACE userdata READ ONLY;

- Causes a checkpoint
- Data available only for read operations
- Objects can be dropped from tablespace

Readonly & Online Status of Tablespaces

SQL Alter Tablespace Command

```
RMAN>
SQL 'ALTER TABLESPACE hr READ ONLY';
CONVERT TABLESPACE hr
TO PLATFORM 'Solaris[tm] OE (64-bit)'
FORMAT
'/tmp/transport_to_solaris/%U';;
```

We will discuss RMAN later.

Readonly & Online Status of Tablespaces

Delaying the opening of Data Files

- When substantial portions of a very large database are stored in read-only tablespaces that are located on slow-access devices or hierarchical storage, you should consider setting the READ_ONLY_OPEN_DELAYED initialization parameter to TRUE.

Readonly & Online Status of Tablespaces

Delaying the opening of Data Files

- This speeds certain operations, primarily opening the database, by causing data files in read-only tablespaces to be accessed for the first time only when an attempt is made to read data stored within them.

Readonly & Online Status of Tablespaces

Side Effect of Delaying the opening of Data Files

Setting READ_ONLY_OPEN_DELAYED=TRUE has the following side-effects

- A missing or bad read-only file is not detected at open time. It is only discovered when there is an attempt to access it.

Readonly & Online Status of Tablespaces

Side Effect of Delaying the opening of Data Files

- ALTER SYSTEM CHECK DATAFILESdoes not check read-only files.
- ALTER TABLESPACE...ONLINE and ALTER DATABASE DATAFILE...ONLINE do not check read-only files. They are checked only upon the first access.

Readonly & Online Status of Tablespaces

Side Effect of Delaying the opening of Data Files

- V$RECOVER_FILE, V$BACKUP, and V$DATAFILE_HEADER do not access read-only files.
- Read-only files are indicated in the results list with the error "DELAYED OPEN", with zeroes for the values of other columns.

Readonly & Online Status of Tablespaces

Side Effect of Delaying the opening of Data Files

- V$DATAFILE does not access read-only files. Read-only files have a size of "0" listed.
- V$RECOVERY_LOG does not access read-only files. Logs they could need for recovery are not added to the list.

Readonly & Online Status of Tablespaces

Side Effect of Delaying the opening of Data Files

- ALTER DATABASE NOARCHIVELOG does not access read-only files. It proceeds even if there is a read-only file that requires recovery.

Readonly & Online Status of Tablespaces

Important Issues of Delaying the opening of Data Files

- RECOVER DATABASE and ALTER DATABASE OPEN RESETLOGS continue to access all read-only data files regardless of the parameter value. To avoid accessing read-only files for these operations, take those files offline.

Readonly & Online Status of Tablespaces

Important Issues of Delaying the opening of Data Files

- If a backup control file is used, the read-only status of some files may be inaccurate. This can cause some of these operations to return unexpected results. Care should be taken in this situation.

End

Introduction to Database Administration

Altering & Maintaining Tablespaces

Altering & Maintaining Tablespaces

Maintaining Tablespaces

- Altering a Locally Managed Tablespace
- Add a bigfile Tablespace
- Altering a Locally Managed Temporary Tablespace
- Shrinking a Locally Managed Temporary Tablespace

Altering & Maintaining Tablespaces

Altering a Locally Managed Tablespace

- You cannot alter a locally managed tablespace to a locally managed temporary tablespace, nor can you change its method of segment space management. Coalescing free extents is unnecessary for locally managed tablespaces. However, you can use the ALTER TABLESPACE statement on locally managed tablespaces for some operations, including the following:

Altering & Maintaining Tablespaces

Altering a Locally Managed Tablespace

- Adding a data file. For example:

```
ALTER TABLESPACE lmtbsb
ADD DATAFILE
'/u02/oracle/data/lmtbsb02.dbf' SIZE 1M;
```

Altering & Maintaining Tablespaces

Altering a Locally Managed Tablespace

Altering tablespace availability (ONLINE/OFFLINE).

- Making a tablespace read-only or read/write
- Renaming a data file, or enabling or disabling the autoextension of the size of a data file in the tablespace.

Altering & Maintaining Tablespaces

Add a bigfile Tablespace

Two clauses of the ALTER TABLESPACE statement support data file transparency when you are using bigfile tablespaces:
RESIZE: The RESIZE clause lets you resize the single data file in a bigfile tablespace to an absolute size, without referring to the data file. For example:
ALTER TABLESPACE bigtbs RESIZE 80G;
AUTOEXTEND(used outside of the ADD DATAFILE clause):

Altering & Maintaining Tablespaces

Add a bigfile Tablespace

With a bigfile tablespace, you can use the AUTOEXTEND clause outside of the ADD DATAFILEclause.
For example:
ALTER TABLESPACE bigtbs AUTOEXTEND ON NEXT 20G;

An error is raised if you specify an ADD DATAFILE clause for a bigfile tablespace.

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

You can use ALTER TABLESPACE to add a temp file, take a temp file offline, or bring a temp file online, as illustrated in the following examples:

```
ALTER TABLESPACE lmtemp
ADD TEMPFILE
'/u02/oracle/data/lmtemp02.dbf' SIZE 18M
REUSE;
```

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

ALTER TABLESPACE lmtemp TEMPFILE OFFLINE;

ALTER TABLESPACE lmtemp TEMPFILE ONLINE;

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

The ALTER DATABASE statement can be used to alter temp files.
The following statements take offline and bring online temp files. They behave identically to the last two ALTER TABLESPACE statements in the previous example.

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

```
ALTER DATABASE TEMPFILE
'/u02/oracle/data/lmtemp02.dbf'
OFFLINE;
ALTER DATABASE TEMPFILE
'/u02/oracle/data/lmtemp02.dbf'
ONLINE;
```

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

The following statement resizes a temp file:

```
ALTER DATABASE TEMPFILE
'/u02/oracle/data/lmtemp02.dbf'
RESIZE 18M;
```

Altering & Maintaining Tablespaces

Altering a Locally Managed Temporary Tablespace

The following statement drops a temp file and deletes its operating system file:

```
ALTER DATABASE TEMPFILE
'/u02/oracle/data/lmtemp02.dbf'
DROP INCLUDING DATAFILES;
```

The tablespace to which this temp file belonged remains. A message is written to the alert log for the temp file that was deleted.

Altering & Maintaining Tablespaces

Shrinking a Locally Managed Temporary Tablespace

Large sort operations performed by the database may result in a temporary tablespace growing and occupying a considerable amount of disk space. After the sort operation completes, the extra space is not released; it is just marked as free and available for reuse.

Altering & Maintaining Tablespaces

Shrinking a Locally Managed Temporary Tablespace

Therefore, a single large sort operation might result in a large amount of allocated temporary space that remains unused after the sort operation is complete.
For this reason, the database enables you to shrink locally managed temporary tablespaces and release unused space.

Altering & Maintaining Tablespaces

Shrinking a Locally Managed Temporary Tablespace

ALTER TABLESPACE lmtemp1 SHRINK SPACE KEEP 20M;

The following example shrinks the temp file lmtemp02.dbf of the locally managed temporary tablespace lmtmp2.

ALTER TABLESPACE lmtemp2 SHRINK TEMPFILE '/u02/oracle/data/lmtemp02.dbf'

End

Introduction to Database Administration

Renaming & Dropping Tablespaces

Renaming & Dropping Tablespaces

Renaming & Dropping Tablespaces

- Renaming Tablespaces
- Affects of Renaming Tablespaces
- Dropping Tablespaces
- Dropping Tablespaces - Example
- Segments in a Tablespace

Renaming & Dropping Tablespaces

Renaming Tablespaces

Using the RENAME TO clause of the ALTER TABLESPACE, you can rename a permanent or temporary tablespace. For example, the following statement renames the users tablespace:

```
ALTER TABLESPACE users RENAME TO usersts;
```

Renaming & Dropping Tablespaces

Renaming Tablespaces

When you rename a tablespace the database updates all references to the tablespace name in the data dictionary, control file, and (online) data file headers.

To confirm use DBA_USERS.

Renaming & Dropping Tablespaces

Affects of Renaming Tablespaces

- The COMPATIBLE parameter must be set to 10.0.0 or higher.
- If the tablespace being renamed is the SYSTEM tablespace or the SYSAUX tablespace, then it will not be renamed.
- If any data file or the tablespace is offline then the tablespace is not renamed.

Renaming & Dropping Tablespaces

Affects of Renaming Tablespaces

- If the tablespace is read only, then data file headers are not updated. This should not be regarded as corruption; instead, it causes a message to be written to the alert log indicating that data file headers have not been renamed. The data dictionary and control file are updated.

Renaming & Dropping Tablespaces

Affects of Renaming Tablespaces

- If the tablespace is the default temporary tablespace, then the corresponding entry in the database properties table is updated and the DATABASE_PROPERTIES view shows the new name.

Renaming & Dropping Tablespaces

Affects of Renaming Tablespaces

- If the tablespace is an undo tablespace and if the following conditions are met, then the tablespace name is changed to the new tablespace name in the server parameter file (SPFILE).

The server parameter file was used to start up the database.

The tablespace name is specified as the UNDO_TABLESPACE for any instance.

Renaming & Dropping Tablespaces

Dropping Tablespaces

- You can drop a tablespace and its contents (the segments contained in the tablespace) from the database if the tablespace and its contents are no longer required. You must have the DROP TABLESPACE system privilege to drop a tablespace.

Renaming & Dropping Tablespaces

Dropping Tablespaces

- When you drop a tablespace, the file pointers in the control file of the associated database are removed. You can optionally direct Oracle Database to delete the operating system files (data files) that constituted the dropped tablespace.
- Off line tablespace before dropping it.

Renaming & Dropping Tablespaces

Dropping Tablespaces

- You cannot drop a tablespace that contains any active segments.
- For example, if a table in the tablespace is currently being used or the tablespace contains undo data needed to roll back uncommitted transactions, you cannot drop the tablespace.

Renaming & Dropping Tablespaces

Dropping Tablespaces

- To drop a tablespace, use the DROP TABLESPACE statement. The following statements drops the users tablespace, including the segments in the tablespace:

```
Alter tablespace users offline;
DROP TABLESPACE users
INCLUDING    CONTENTS;
```

Renaming & Dropping Tablespaces

Dropping Tablespaces

To delete the data files associated with a tablespace at the same time that the tablespace is dropped, use the INCLUDING CONTENTS AND DATAFILES clause. The
following statement drops the users tablespace and its associated data files:

```
DROP TABLESPACE users INCLUDING
CONTENTS AND DATAFILES;
```

Renaming & Dropping Tablespaces

Dropping Tablespaces - Example

```
create tablespace test
datafile 'E:\app\Haider\oradata\tst01.dbf'
size 100M;

Tablespace created.

create user usr1 identified by xyz
default tablespace test
temporary tablespace temp;

grant connect, resource to usr1;
grant create table to usr1;
```

Renaming & Dropping Tablespaces

Dropping Tablespaces - Example

alter tablespace test offline;

shutdown immediate
startup open

DROP TABLESPACE test including contents;

Renaming & Dropping Tablespaces

Dropping Tablespaces - Example

```
conn usr1/xyz
SQL> create table AA
  2     (id number);
create table
*
ERROR at line 1:
ORA-00959: tablespace 'TEST' does
not exist
```

Renaming & Dropping Tablespaces

Segments in a Tablespace

```
SQL> set linesize 200;
SQL> select segment_name, segment_type
  2  from dba_segments
  3  where tablespace_name='WRK_NOVUS';

SEGMENT_NAME                                SEGMENT_TYPE
------------------------------------------- --------------
PATIENT                                     TABLE
PATIENT_VISIT                               TABLE
PK_EMP_ID                                   INDEX
PK_PATVISIT_PAT_VSNO                        INDEX
IX_PATVISIT_PID_VDATE                       INDEX
IX_PATVISIT_PID_DPNSNO                      INDEX
IX_PATVISIT_EMPID_VDATE                     INDEX
IX_PATIENT_VISIT_CREATE_DATE                INDEX

8 rows selected.
```

End

Introduction to Database Administration

Managing SYSAUX Tablespaces

Managing SYSAUX Tablespaces

SYSAUX Tablespaces

- Introduction
- Monitoring Occupants
- Benefits of using SYSAUX Tablespace
- Controlling the Size of the SYSAUX Tablespace - Guidelines

Managing SYSAUX Tablespaces

Introduction

- The SYSAUX tablespace was installed as an auxiliary tablespace to the SYSTEM tablespace when you created your database.
- Some database components that formerly created and used separate tablespaces now occupy the SYSAUX tablespace.
- SYSAUX tablespace is used to reduce the load managed by SYSTEM tablespace.

Managing SYSAUX Tablespaces

Introduction

- If the SYSAUX tablespace becomes unavailable, core database functionality will remain operational.
- The database features that use the SYSAUX tablespace could fail, or function with limited capability.
- SYSTEM tablespace will continue running for the users to work on if some problem occurs in SYSAUX tablespace.

Managing SYSAUX Tablespaces

Introduction

- SYSAUX tablespace mainly used for performance and comparison purposes

Managing SYSAUX Tablespaces

Monitoring Occupants

You can monitor the occupants of the SYSAUX tablespace using the V$SYSAUX_OCCUPANTS view. This view lists the following information about the occupants of the SYSAUX tablespace:

- Name of the occupant
- Occupant description
- Schema name
- Move procedure
- Current space usage

Managing SYSAUX Tablespaces

Monitoring Occupants

Another major occupant of the SYSAUX tablespace is the embedded Oracle Enterprise Manager repository. This repository is used by Oracle Enterprise Manager Database Control to store its metadata. The size of this repository depends on database activity and on configuration-related information stored in the repository.

Managing SYSAUX Tablespaces

Benefits of using SYSAUX Tablespace

- The SYSAUX tablespace is always created at database creation.
- The SYSAUX tablespace serves as an auxiliary tablespace to the SYSTEM tablespace. Because it is the default tablespace for many Oracle Database features and products that previously required their own tablespaces, it reduces the number of tablespaces required by the database.
- It also reduces the load on the SYSTEM tablespace.

Managing SYSAUX Tablespaces

Controlling the Size of the SYSAUX Tablespace

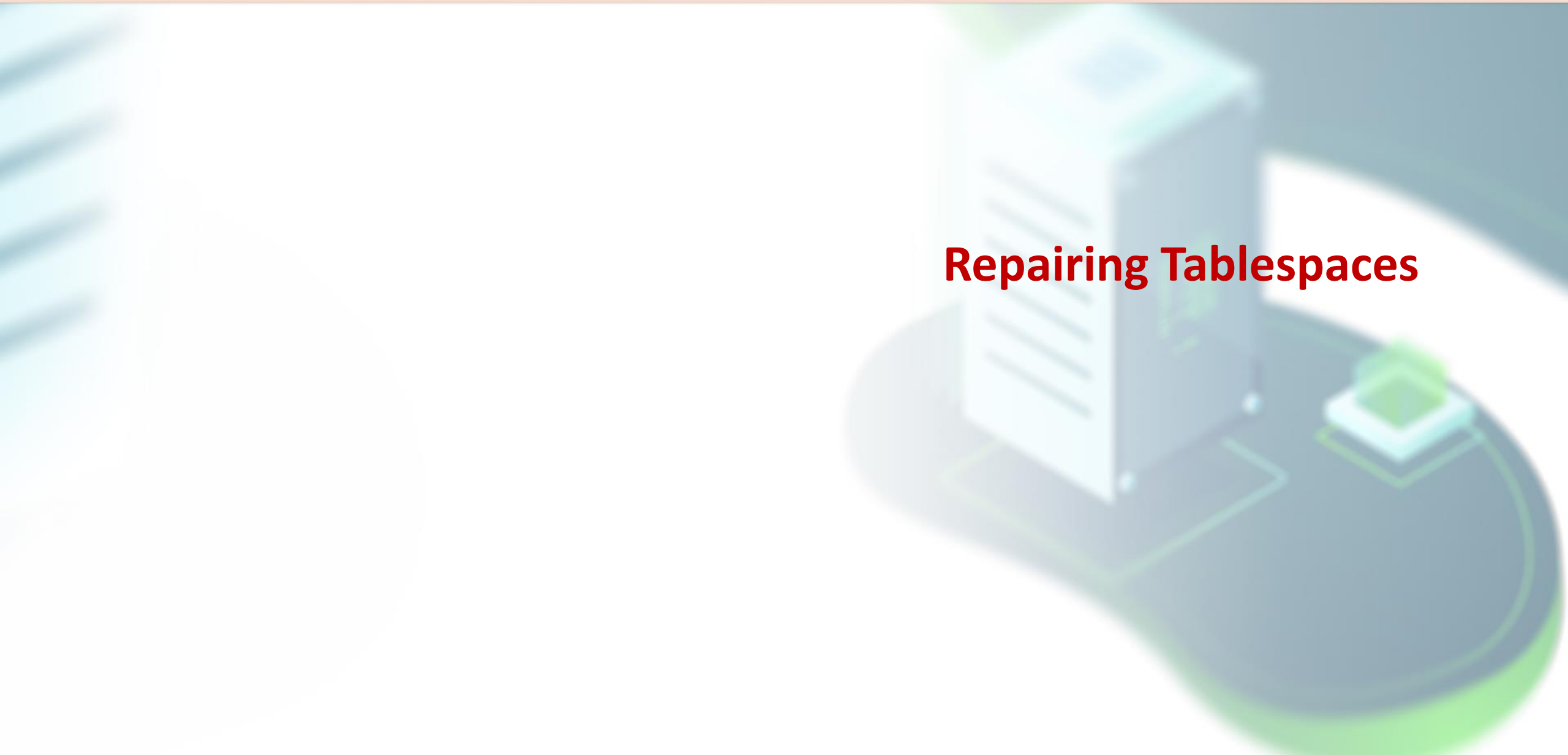
- The SYSAUX tablespace is occupied by several database components, and its total size is governed by the space consumed by those components.
- The space consumed by the components, in turn, depends on which features or functionality are being used and on the nature of the database workload.

Managing SYSAUX Tablespaces

Controlling the Size of the SYSAUX Tablespace - Guidelines

Parameter/Recommendation	Small	Medium	Large
Number of CPUs	2	8	32
Number of concurrently active sessions	10	20	100
Number of user objects: tables and indexes	500	5,000	50,000
Estimated SYSAUX size at steady state with default configuration	500 MB	2 GB	5 GB

End



Repairing Tablespaces

Repairing Tablespaces

Repairing Tablespaces

- Repairing Locally Managed Tablespace
- Diagnosing using DBMS_SPACE_ADMIN package
- Scenario-1
- Scenario-2
- Scenario-3
- Scenario-4
- Scenario-5

Repairing Tablespaces

DROP_EMPTY_SEGMENTS	Drops segments from empty tables or table partitions and dependent objects
MATERIALIZE_DEFERRED_SEGMENTS	Materializes segments for tables and table partitions with deferred segment creation and their dependent objects.
SEGMENT_CORRUPT	Marks the segment corrupt or valid so that appropriate error recovery can be done
SEGMENT_DROP_CORRUPT	Drops a segment currently marked corrupt (without reclaiming space)

Repairing Locally Managed Tablespace

Oracle Database includes the DBMS_SPACE_ADMIN package, which is a collection of aids for diagnosing and repairing problems in locally managed tablespaces.

Following are the some of DBMS_SPACE_ADMIN Package Procedures

Repairing Tablespaces

Diagnosing using DBMS_SPACE_ADMIN package

The following scenarios describe typical situations in which you can use the DBMS_SPACE_ADMIN package to diagnose and resolve problems.

Note: Some of these procedures can result in lost and unrecoverable data if not used properly. You should work with Oracle Support Services if you have doubts about these procedures.

Repairing Tablespaces

Scenario-1

Fixing Bitmap When Allocated Blocks are Marked Free out these procedures.

The TABLESPACE_VERIFY procedure discovers that a segment has allocated blocks that are marked free in the bitmap, but no overlap between segments is reported.

In this scenario, perform the following tasks:

1. Call the SEGMENT_DUMP procedure to dump the ranges that the administrator allocated to the segment.
2. For each range, call the TABLESPACE_FIX_BITMAPS procedure with the TABLESPACE_EXTENT_MAKE_USED option to mark the space as used.
3. Call TABLESPACE_REBUILD_QUOTAS to rebuild quotas.

Repairing Tablespaces

Scenario-2

Dropping a corrupted segment:
In this scenario, perform the following tasks:
1. Call the SEGMENT_VERIFY procedure with the SEGMENT_VERIFY_EXTENTS_GLOBAL option. If no overlaps are reported, then proceed with steps 2 through 5.
2. Call the SEGMENT_DUMP procedure to dump the DBA ranges allocated to the segment.
3. For each range, call TABLESPACE_FIX_BITMAPS with the TABLESPACE_EXTENT_MAKE_FREE option to mark the space as free.
4. Call SEGMENT_DROP_CORRUPT to drop the SEG$ entry.
5. Call TABLESPACE_REBUILD_QUOTAS to rebuild quotas

Repairing Tablespaces

Scenario-3

Fixing Bitmap Where Overlap is Reported:
The TABLESPACE_VERIFY procedure reports some overlapping. Some of the real data must be sacrificed based on previous internal errors.
After choosing the object to be sacrificed, in this case say, table t1, perform the
following tasks:
1. Make a list of all objects that t1 overlaps.
2. Drop table t1. If necessary, follow up by calling the SEGMENT_DROP_CORRUPT procedure.
3. Call the SEGMENT_VERIFY procedure on all objects that t1overlapped. If necessary, call the TABLESPACE_FIX_BITMAPS procedure to mark appropriate bitmap blocks as used.
4. Rerun the TABLESPACE_VERIFY procedure to verify that the problem is resolved

Repairing Tablespaces

Scenario-4

Correcting Media Corruption of Bitmap Blocks
A set of bitmap blocks has media corruption.
In this scenario, perform the following tasks:
1. Call the TABLESPACE_REBUILD_BITMAPSprocedure, either on all bitmap blocks, or on a single block if only one is corrupt.
2. Call the TABLESPACE_REBUILD_QUOTAS procedure to rebuild quotas.
3. Call the TABLESPACE_VERIFY procedure to verify that the bitmaps are consistent.

Repairing Tablespaces

Scenario-5

Assume that the database block size is 2K and the existing extent sizes in tablespace tbs_1 are 10, 50, and 10,000 blocks (used, used, and free). The MINIMUM EXTENT value is 20K (10 blocks). Allow the system to choose the bitmap allocation unit. The value of 10 blocks is chosen, because it is the highest common denominator and does not exceed MINIMUM EXTENT.

The statement to convert tbs_1 to a locally managed tablespace is as follows:

```
EXEC DBMS_SPACE_ADMIN.TABLESPACE_MIGRATE_TO_LOCAL ('tbs_1');
```

If you choose to specify an allocation unit size, it must be a factor of the unit size calculated by the system.

Migrating the System Tablespace

Migrating the System Tablespaces

Migrating the System Tablespace

- Introduction
- Other tablespaces
- Pre-requisites of migration
- Command for migration
- Importing and exporting data of tablespaces

Migrating the System Tablespaces

Introduction

What is SYSTEM tablespace

- It is required when database is created and when database is getting start using.
- Pre bundled code and data dictionary-managed tablespace.
- It contains System Objects, your objects and Users/ Privileges.
- It contains AWR: Automatic Workload Repository

Migrating the System Tablespaces

Other Tablespaces

Following tablespaces are required with the SYSTEM tablespace

- UNDO TS
  - User ability to rollback
  - old values of DML changes
  - Read Consistency of Data
- Temporary TS
  - contents are temp stored in TS
  - order by, distinct, Index --> PGA is active
  - Kind rough work area

Migrating the System Tablespaces

Other Tablespaces

- USERS TS
  - Create users, which users will use which TS information

Migrating the System Tablespaces

Pre-requisites of Migration

Before performing the migration the following conditions must be met:

- The database has a default temporary tablespace that is not SYSTEM.
- There are no rollback segments in the dictionary-managed tablespace.
- There is at least one online rollback segment in a locally managed tablespace, or if using automatic undo management, an undo tablespace is online.

Migrating the System Tablespaces

Pre-requisites of Migration

- All tablespaces other than the tablespace containing the undo space (that is, the tablespace containing the rollback segment or the undo tablespace) are in read-only mode.
- The SYSAUX tablespace is offline.
- The system is in restricted mode.
- There is a cold backup of the database.

Migrating the System Tablespaces

Command for Migration

The following statement performs the migration:

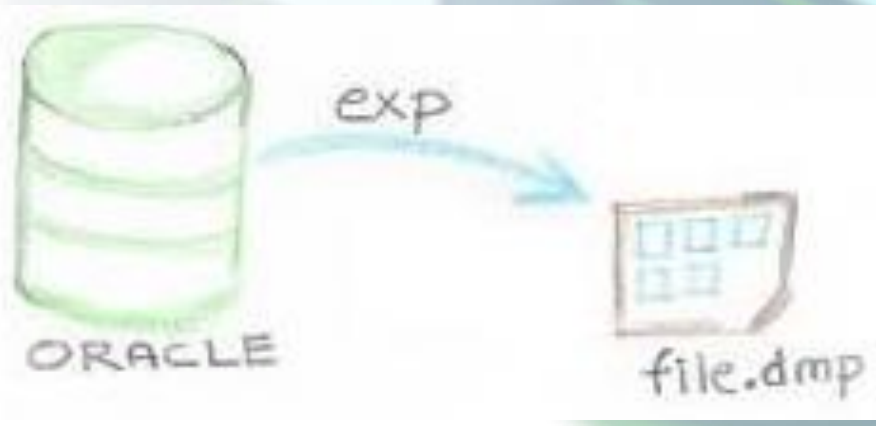
```
SQL> EXECUTE
DBMS_SPACE_ADMIN.TABLESPACE_MIGRATE
_TO_LOCAL('SYSTEM');
```

Migrating the System Tablespaces

Importing & Exporting Data of Tablespaces

Use following command of export on source database

C:\>exp usr/pwd file=c:\test\f1.dmp



Migrating the System Tablespaces

Importing & Exporting Data of Tablespaces

Following are two tablespaces of source database. We will create sure same tablespaces in the target tablespace.

```
Create tablespace MedCare Datafile
    'D:\oracle9i\ora92\oradata\MCare01.dbf' Size 150M online
    MINIMUM EXTENT 64K
    DEFAULT STORAGE (INITIAL 64K NEXT 64K);

CREATE TABLESPACE MCare_indx
DATAFILE 'D:\oracle9i\ora92\oradata\MCare_indx01.dbf' SIZE 100M
MINIMUM EXTENT 64K
DEFAULT STORAGE (INITIAL 64K NEXT 64K);
```

Use following command of import on target database

C:\>exp usr/pwd file=c:\test\f1.dmp

Migrating the System Tablespaces

Importing & Exporting Data of Tablespaces

Alternatively, use export/ import data pump command. For example,

```
E:\app\Haider\product\11.2.0\dbhome_1\BIN>expdp

Export: Release 11.2.0.1.0 - Production on Wed Aug 12 11:02:54 2020

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Username: scott/tiger

Connected to: Oracle Database 11g Enterprise Edition Release 11.2.0.1.
With the Partitioning, OLAP, Data Mining and Real Application Testing
Starting "SCOTT"."SYS_EXPORT_SCHEMA_01":  scott/********
Estimate in progress using BLOCKS method...
. . exported "SCOTT"."STAGE_MIGRLOG"                                0 KB
Master table "SCOTT"."SYS_EXPORT_SCHEMA_01" successfully loaded/unloac
******************************************************************************
Dump file set for SCOTT.SYS_EXPORT_SCHEMA_01 is:
  E:\APP\HAIDER\ADMIN\ORCL\DPDUMP\EXPDAT.DMP
Job "SCOTT"."SYS_EXPORT_SCHEMA_01" successfully completed at 11:03:47
```

End

Creating Alternate TEMP Tablespace

Creating Alternate TEMP Tablespace

Creating Alternate TEMP Tablespace

- What is Temporary Tablespace?
- Creating TEMP Tablespace
- Verifying TEMP Tablespace
- Create Temporary Tablespace Group
- Temporary Tablespace Files

Creating Alternate TEMP Tablespace

What is TEMP Tablespace?

What is SYSTEM tablespace

- It is required when database is created and when database is getting start using.

Creating Alternate TEMP Tablespace

Creating TEMP Tablespace

Create a new tablespace and then drop an existing temp tablespace

```
CREATE
    TEMPORARY TABLESPACE "TEMP_DEFAULT2" TEMPFILE
    'D:\ORACLE9I\ORA92\ORADATA\MEDCARE\TEMP_DEFAULT2.DBF' SIZE
    1000M EXTENT MANAGEMENT LOCAL UNIFORM SIZE 1M;

ALTER DATABASE DEFAULT TEMPORARY TABLESPACE "TEMP_DEFAULT2";
```

Creating Alternate TEMP Tablespace

Creating TEMP Tablespace

shutdown and startup database,
run complicated query to see whether new tablespace getting filled or not

see file alert.log for more details

To check default tablespace is created or DONE or NOT:

select * from database_properties;

Creating Alternate TEMP Tablespace

Creating TEMP Tablespace

- Tablespace must be empty before dropping off
- Drop tablespace temp
- including contents and datafiles;
- Shutdown and startup database again
- Drop related files from folder like TEMP01.DBF

Creating Alternate TEMP Tablespace

Verifying TEMP Tablespace

```
SQL> select property_name from database_properties;

PROPERTY_NAME
------------------------------
DICT.BASE
DEFAULT_TEMP_TABLESPACE
DEFAULT_PERMANENT_TABLESPACE
DEFAULT_EDITION
Flashback Timestamp TimeZone
TDE_MASTER_KEY_ID
DST_UPGRADE_STATE
DST_PRIMARY_TT_VERSION
DST_SECONDARY_TT_VERSION
DEFAULT_TBS_TYPE
NLS_LANGUAGE
```

Creating Alternate TEMP Tablespace

Create Temporary Tablespace Group

- Temporary Tablespace Groups allow an Oracle database to write to multiple temp tablespaces simultaneously.
- A user is assigned to a group of temp tablespaces instead of a single temporary tablespace
- It allows a single SQL operation to use multiple Temporary Tablespaces for sorting

Creating Alternate TEMP Tablespace

Create Temporary Tablespace Group

Create Temporary Tablespace temp1
tempfile 'C:\Oracle\Oradata\temp01.dbf'
size 50M
tablespace group tempgroup1;

```
SQL> select *
  2  from database_properties
  3  where property_name like '%TABLESPACE%';

PROPERTY_NAME
------------------------------
PROPERTY_VALUE
--------------------------------------------------
--------------------------------------------------
DESCRIPTION
--------------------------------------------------
--------------------------------------------------
DEFAULT_TEMP_TABLESPACE
TEMP
Name of default temporary tablespace

DEFAULT_PERMANENT_TABLESPACE
USERS
Name of default permanent tablespace
```

Creating Alternate TEMP Tablespace

Temporary Tablespace Files

Using data dictionary view;

```
SQL> select tablespace_name
  2  from dba_temp_files;

TABLESPACE_NAME
------------------------------
TEMP
```

End

Viewing Tablespace using Data Dictionary Views

Viewing Tablespaces using Data Dictionary Views

Data Dictionary Views of Tablespace

- Dictionary Views of Tablespaces
- V$Tablespaces
- DBA_DATA_FILES
- DBA_TEMP_FILES
- Finding Used Size of Tablespaces
- Finding Free Space of Tablespaces

Viewing Tablespaces using Data Dictionary Views

Dictionary Views of Tablespaces

Use Dictionary to display views:

```
SQL> select table_name
  2  from dict
  3  where table_name like '%TABLESPACE%';

TABLE_NAME
------------------------------
DBA_FILE_GROUP_TABLESPACES
DBA_HIST_TABLESPACE_STAT
DBA_TABLESPACES
DBA_TABLESPACE_GROUPS
DBA_TABLESPACE_THRESHOLDS
DBA_TABLESPACE_USAGE_METRICS
USER_FILE_GROUP_TABLESPACES
USER_TABLESPACES
ALL_FILE_GROUP_TABLESPACES
V$TABLESPACE
GV$ENCRYPTED_TABLESPACES

TABLE_NAME
------------------------------
V$ENCRYPTED_TABLESPACES
GV$TABLESPACE

13 rows selected.
```

Viewing Tablespaces using Data Dictionary Views

V$Tablespaces

To display columns of V$Tablespaces:

```
SQL> set linesize60
SQL> desc v$tablespace
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------
 TS#                                                NUMBER
 NAME                                               VARCHAR2(30)
 INCLUDED_IN_DATABASE_BACKUP                        VARCHAR2(3)
 BIGFILE                                            VARCHAR2(3)
 FLASHBACK_ON                                       VARCHAR2(3)
 ENCRYPT_IN_BACKUP                                  VARCHAR2(3)
```

Viewing Tablespaces using Data Dictionary Views

V$Tablespaces

Select column name V$Tablespaces:

```
SQL> select name
  2  from v$tablespace;

NAME
------------------------------
SYSTEM
SYSAUX
UNDOTBS1
USERS
TEMP
IND_TSMYDEV
TSNDEV
IND_TSNDEV
PTSDEV
PIND_TSDEV
PTSIMG

NAME
------------------------------
PTS_STUCRSREG
PTS_EMARKS
TSIMG
WRK_NOVUS

15 rows selected.
```

Viewing Tablespaces using Data Dictionary Views

DBA_DATA_FILES

Display name and data file size in MB:

```
SQL> select tablespace_name, file_name,
  2  bytes/1024/1024 size_MB
  3  from dba_data_files
  4  where tablespace_name='&tablespace_name';
Enter value for tablespace_name: WRK_NOVUS
old   4: where tablespace_name='&tablespace_name'
new   4: where tablespace_name='WRK_NOVUS'

TABLESPACE_NAME
------------------------------
FILE_NAME
--------------------------------------------------------------------------------
   SIZE_MB
----------
WRK_NOVUS
E:\APP\HAIDER\PRODUCT\11.2.0\DBHOME_1\ORADATA\NOVUS01.DBF
       800
```

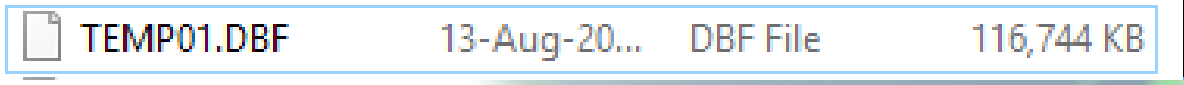
Viewing Tablespaces using Data Dictionary Views

DBA_TEMP_FILES

Display name and data file size in MB:

```
SQL> select file_name,
  2  bytes/1024/1024 size_MB
  3  from dba_temp_files;

FILE_NAME
--------------------------------------------------------------------------------
   SIZE_MB
----------
E:\APP\HAIDER\ORADATA\ORCL\TEMP01.DBF
       114
```



Viewing Tablespaces using Data Dictionary Views

Finding Used Data Size of Tablespaces

Using data dictionary view DBA_SEGMENTS :

```
SQL> SELECT TABLESPACE_NAME,
  2    ROUND(SUM(BYTES)/(1024*1024), 2)||' MB' AS USED_SIZE
  3    FROM DBA_SEGMENTS
  4    --WHERE TABLESPACE_NAME='EDRDBA'
  5    GROUP BY TABLESPACE_NAME;

TABLESPACE_NAME                USED_SIZE
------------------------------ ------------------------------
PIND_TSDEV                     197.31 MB
SYSAUX                         648.5 MB
TSIMG                          1120.5 MB
UNDOTBS1                       21.69 MB
TSNDEV                         643.56 MB
PTS_EMARKS                     48 MB
WRK_NOVUS                      703.75 MB
USERS                          4.19 MB
SYSTEM                         707.63 MB
PTSDEV                         364.63 MB
PTSIMG                         62 MB

TABLESPACE_NAME                USED_SIZE
------------------------------ ------------------------------
PTS_STUCRSREG                  480 MB
IND_TSNDEV                     .06 MB

13 rows selected.
```

Viewing Tablespaces using Data Dictionary Views

Finding Free Space of Tablespaces

Using data dictionary view DBA_FREE_SPACE

```
SQL>    SELECT TABLESPACE_NAME,
  2     ROUND(SUM(BYTES)/(1024*1024), 2)||' MB' AS FREE_SIZE
  3     FROM DBA_FREE_SPACE
  4     GROUP BY TABLESPACE_NAME;

TABLESPACE_NAME                FREE_SIZE
------------------------------ ------------------------------
IND_TSMYDEV                    999 MB
PIND_TSDEV                     301.75 MB
SYSAUX                         50.5 MB
UNDOTBS1                       282.31 MB
TSIMG                          925.5 MB
TSNDEV                         531.44 MB
PTS_EMARKS                     1950 MB
WRK_NOVUS                      367.25 MB
USERS                          3.56 MB
SYSTEM                         1.38 MB
IND_TSNDEV                     498.94 MB

TABLESPACE_NAME                FREE_SIZE
------------------------------ ------------------------------
PTSDEV                         2704.5 MB
PTSIMG                         4030 MB
PTS_STUCRSREG                  1518 MB

14 rows selected.
```

End

Introduction to Database Administration

Logical Storage Structure & Hierarchy

Logical Storage Structure & Hierarchy

Logical Storage Structure & Hierarchy

- Physical & Logical Database
- Tablespace
- Database Block
- Database Block, Extents and Segments
- Database Block, Extents and Segments within Database

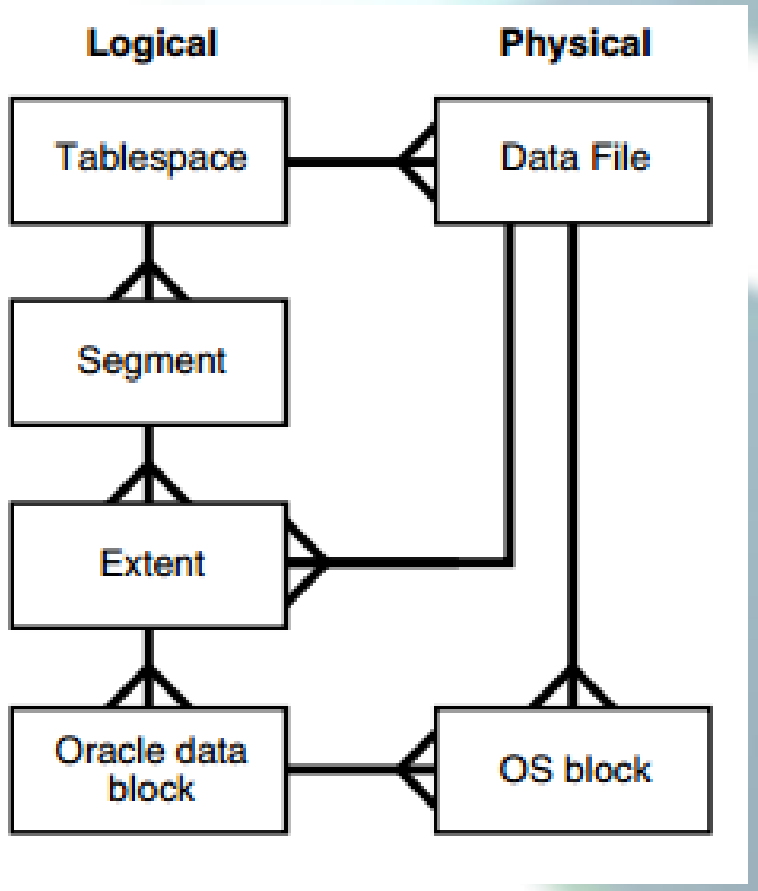
Logical Storage Structure & Hierarchy

Physical & Logical Database

- Physical Database
  - Control Files
  - Redo Log Files
  - Data Files
- Logical Database
  - Tablespace
    - Segments
    - Extents
    - DB Blocks

Logical Storage Structure & Hierarchy

Physical & Logical Database



Logical Storage Structure & Hierarchy

Tablespace

- Tablespace stores space logically to create logical objects such as Tables, Indexes and other objects.
- Tablespace’s physically space stored in associated files.

Logical Storage Structure & Hierarchy

Database Block

- Logical minimum storage unit is called database block.
- Its size is decided during database creation.
- 5 default sizes: 2K, 4K, 8K, 16K, 32K (K: Kilobytes)

Logical Storage Structure & Hierarchy

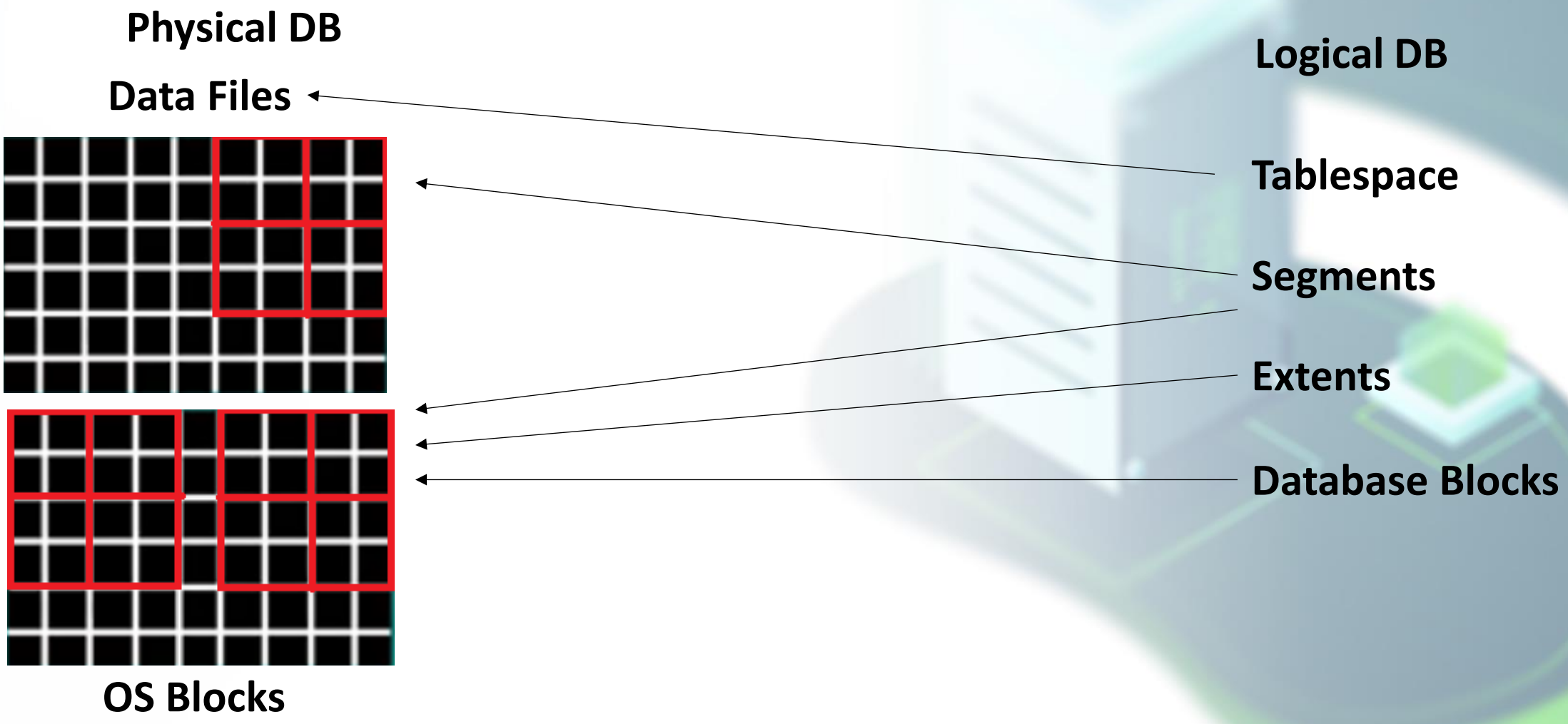
Database Block, Extents and Segments

Logical Storage Structure & Hierarchy

Database Block, Extents and Segments

Logical Storage Structure & Hierarchy

Database Block, Extents and Segments



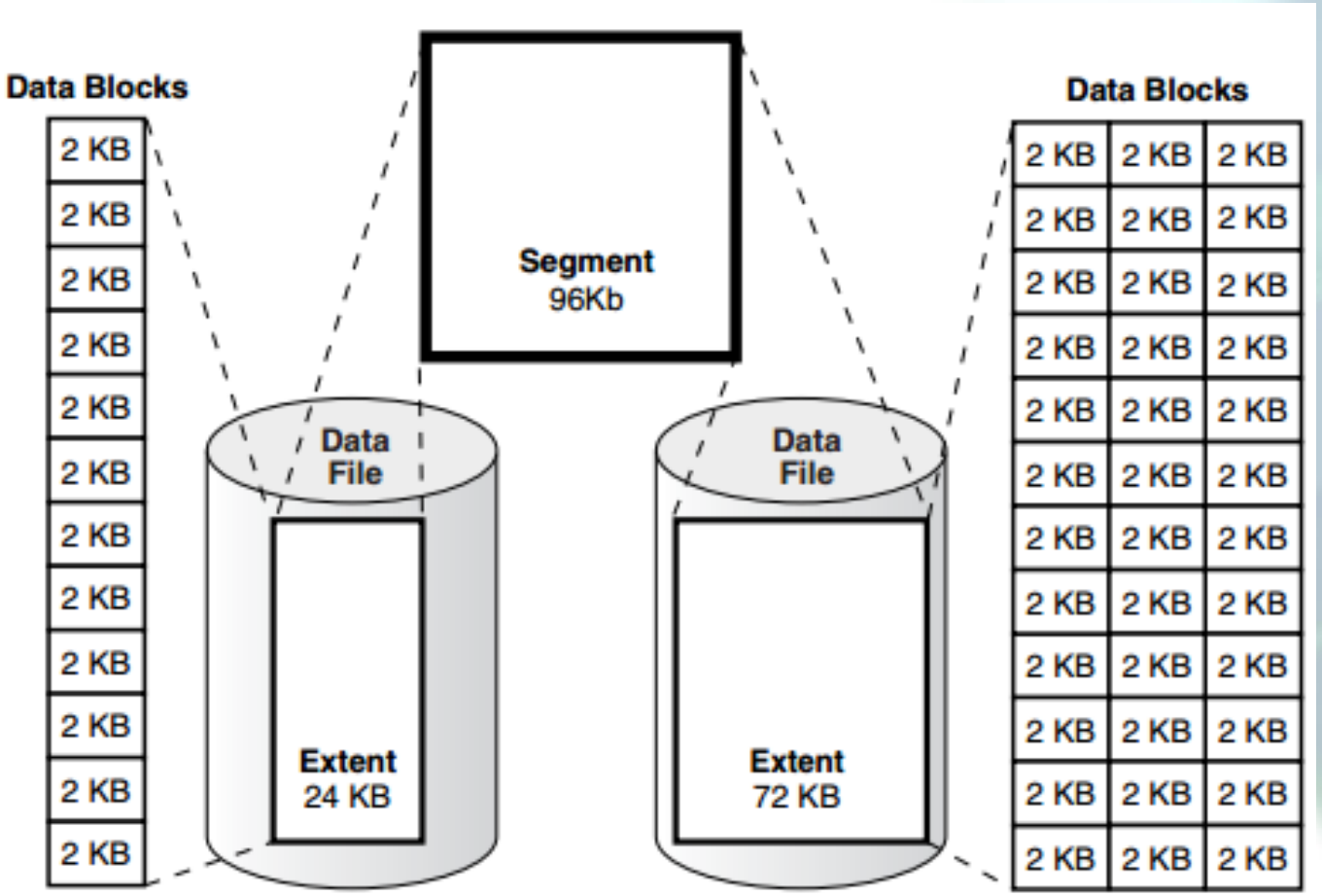
Logical Storage Structure & Hierarchy

Database Block, Extents and Segments within Database

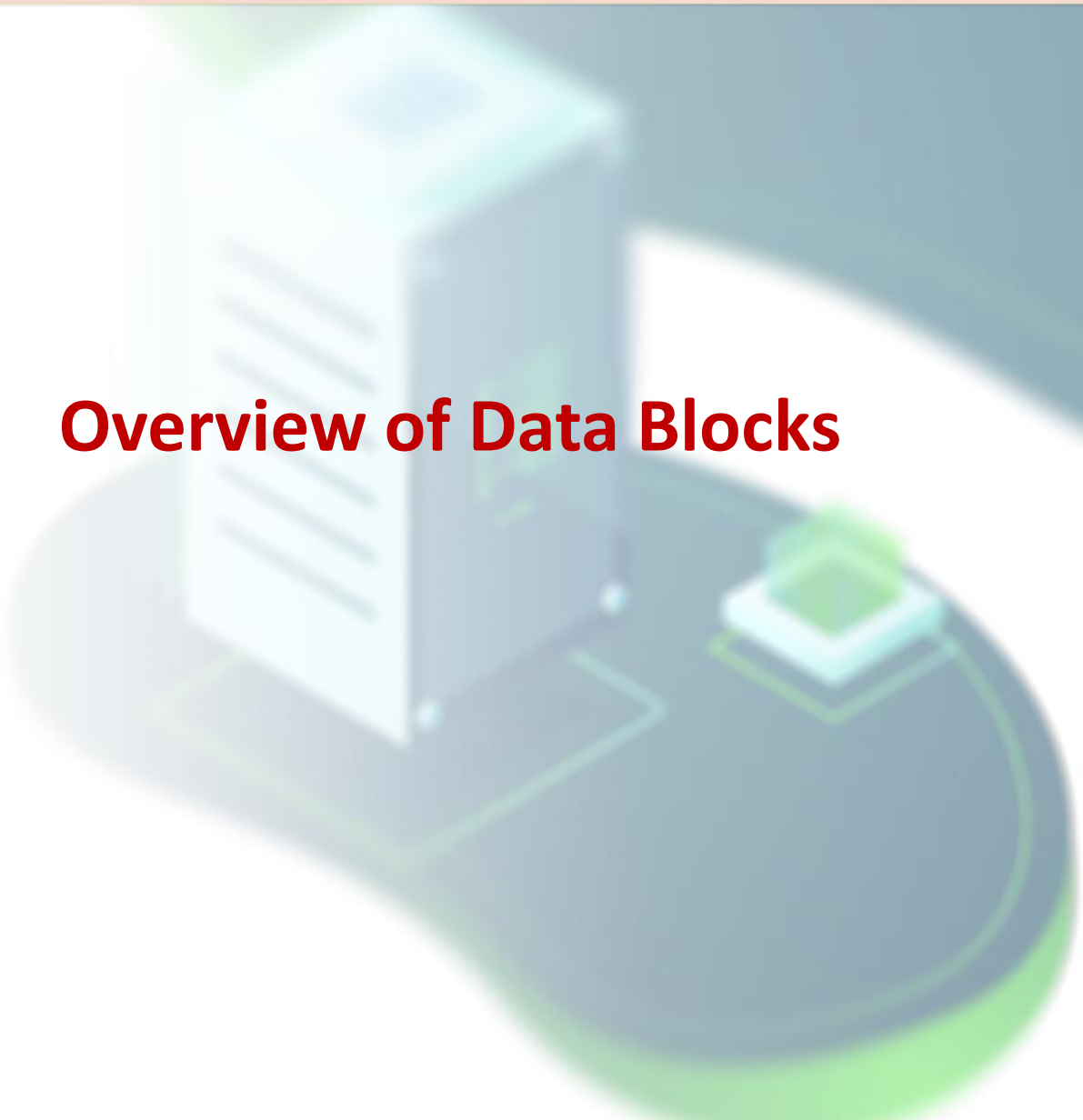
- At the finest level of granularity, Oracle Database stores data in data blocks.
- One logical data block corresponds to a specific number of bytes of physical disk space. Block sizes can be 2 KB, 4KB or more.
- Data block is the smallest unit of storage that Oracle Database can use or allocate.

Logical Storage Structure & Hierarchy

Database Block, Extents and Segments within Database



Introduction to Database Administration



Overview of Data Blocks

Overview of Data Blocks

Overview of Database Blocks

- What is Data Block?
- Data Blocks & OS Blocks
- Interaction of Data Blocks & OS Blocks
- Database Block Size
- Data Block Format
- Row Format
- RowID Pseudocolumn

Overview of Data Blocks

What is Data Block?

Oracle Database manages the logical storage space in the data files of a database in units called data blocks, also called Oracle blocks or pages. A data block is the minimum unit of database I/O.

Overview of Data Blocks

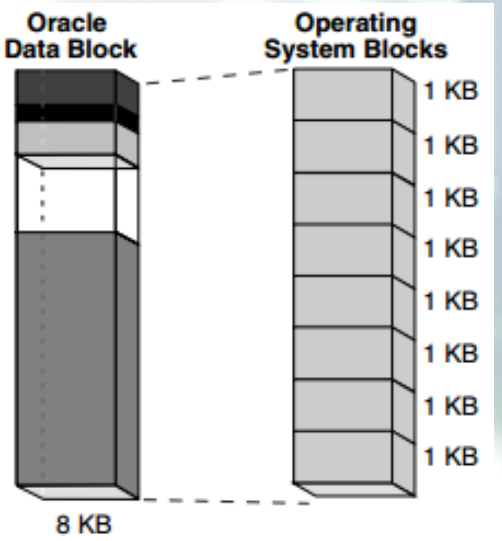
Data Blocks & OS Blocks

- At the physical level, database data is stored in disk files made up of operating system blocks.
- An operating system block is the minimum unit of data that the operating system can read or write.
- In contrast, an Oracle block is a logical storage structure whose size and structure are not known to the operating system.

Overview of Data Blocks

Data Blocks & OS Blocks

Figure shows that operating system blocks may differ in size from data blocks. The database requests data in multiples of data blocks, not operating system blocks.



Overview of Data Blocks

Interaction of Data Blocks & OS Blocks

When the database requests a data block, the operating system translates this operation into a requests for data in permanent storage. The logical separation of data blocks from operating system blocks has the following implications:

- Applications do not need to determine the physical addresses of data on disk.
- Database data can be striped or mirrored on multiple physical disks.

Overview of Data Blocks

Database Block Size

- Every database has a database block size. The DB_BLOCK_SIZE initialization parameter sets the data block size for a database when it is created.
- The size is set for the SYSTEM and SYSAUX tablespaces and is the default for all other tablespaces.
- The database block size cannot be changed except by re-creating the database.

Overview of Data Blocks

Database Block Size

- If DB_BLOCK_SIZE is not set, then the default data block size is operating system-specific. The standard data block size for a database is4 KB or 8 KB.
- If the size differs for data blocks and operating system blocks, then the data block size must be a multiple of the operating system block size

Overview of Data Blocks

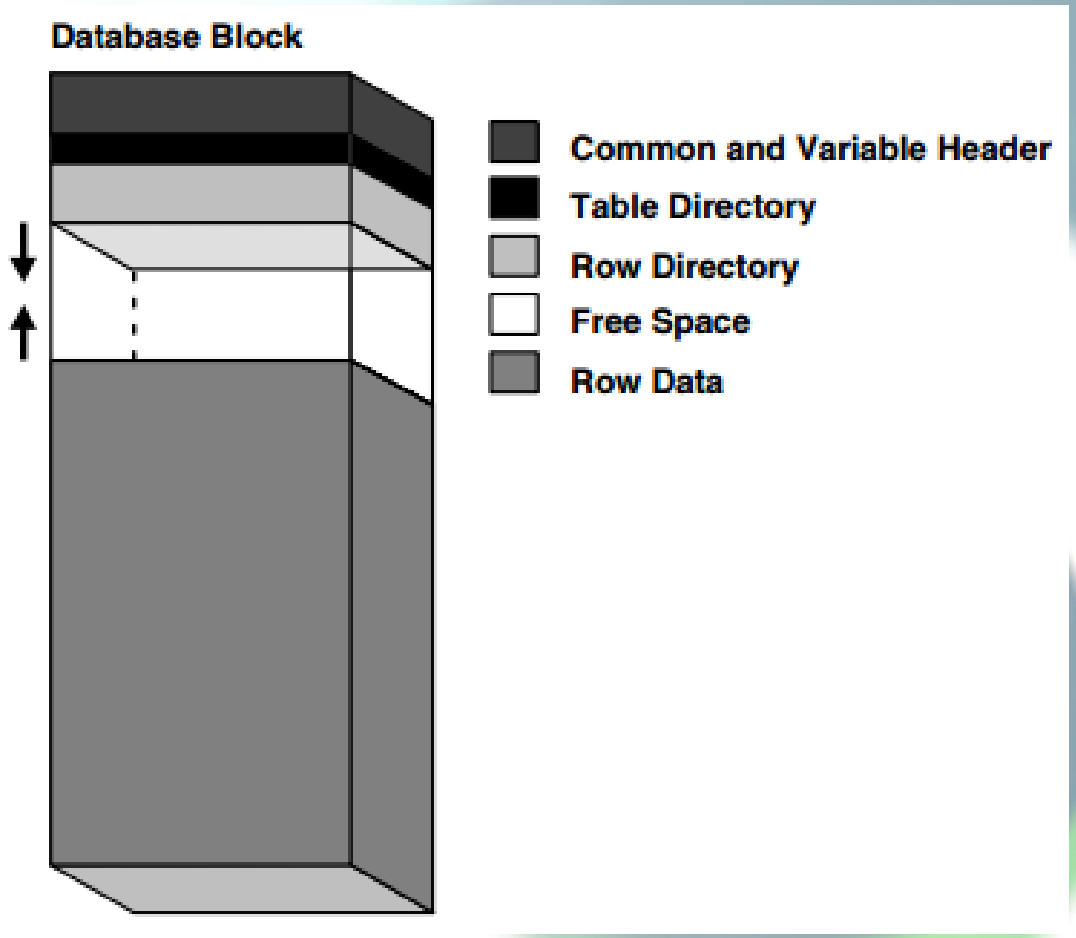
Database Block Size

- You can create individual tablespaces whose block size differs from the DB_BLOCK_SIZE setting.
- A nonstandard block size can be useful when moving a transportable tablespace to a different platform.

Overview of Data Blocks

Data Block Format

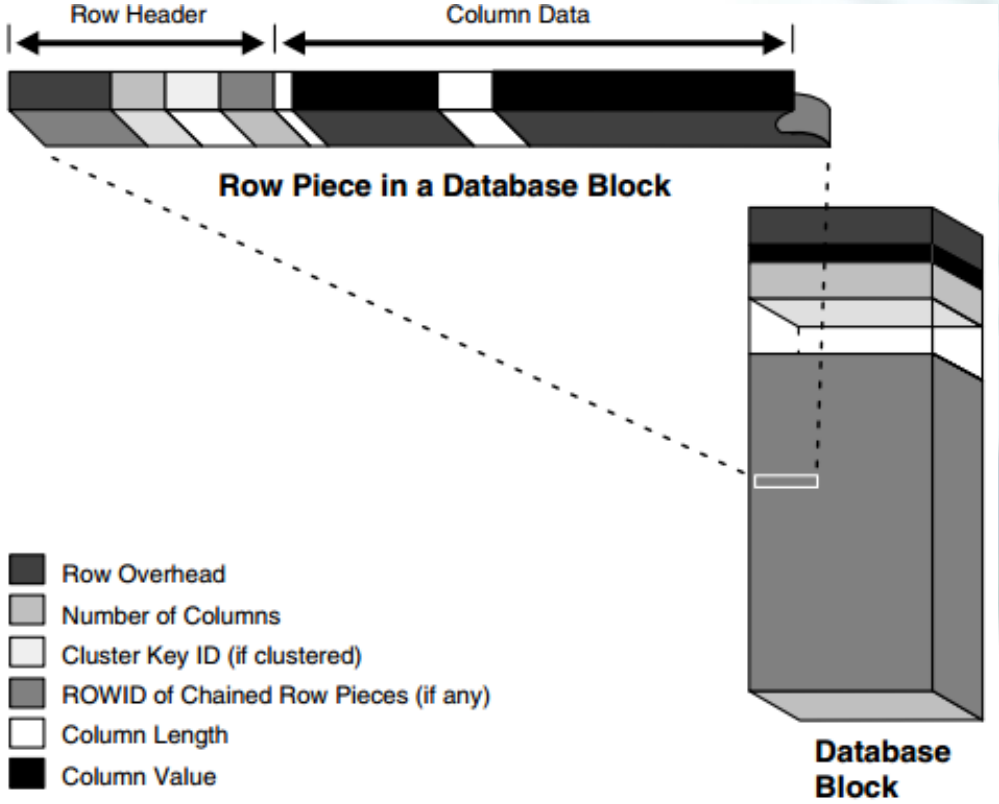
Every data block has a format or internal structure that enables the database to track the data and free space in the block. This format is similar whether the data block contains table, index, or table cluster data



Overview of Data Blocks

Row Format

The row data part of the block contains the actual data, such as table rows or index key entries. Just as every data block has an internal format, every row has a row format that enables the database to track the data in the row.



Overview of Data Blocks

RowID Pseudocolumn

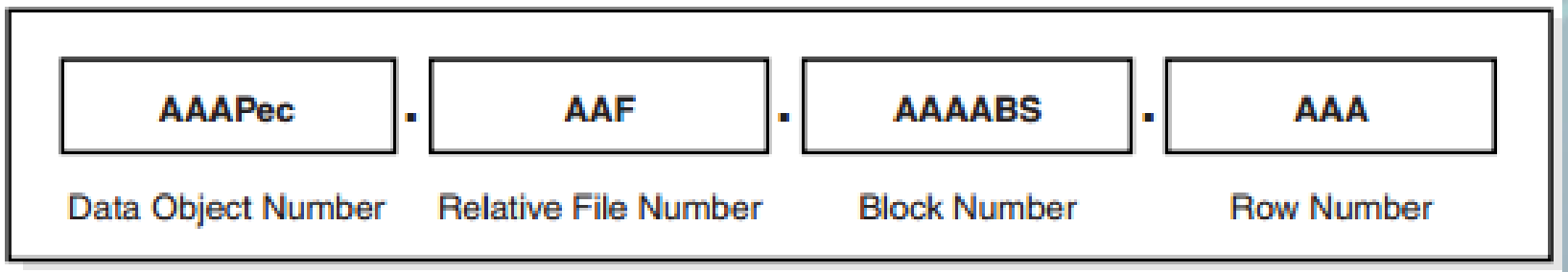
Queries the ROWID pseudocolumn to show the extended rowid of the row in the employee stable for employee 100

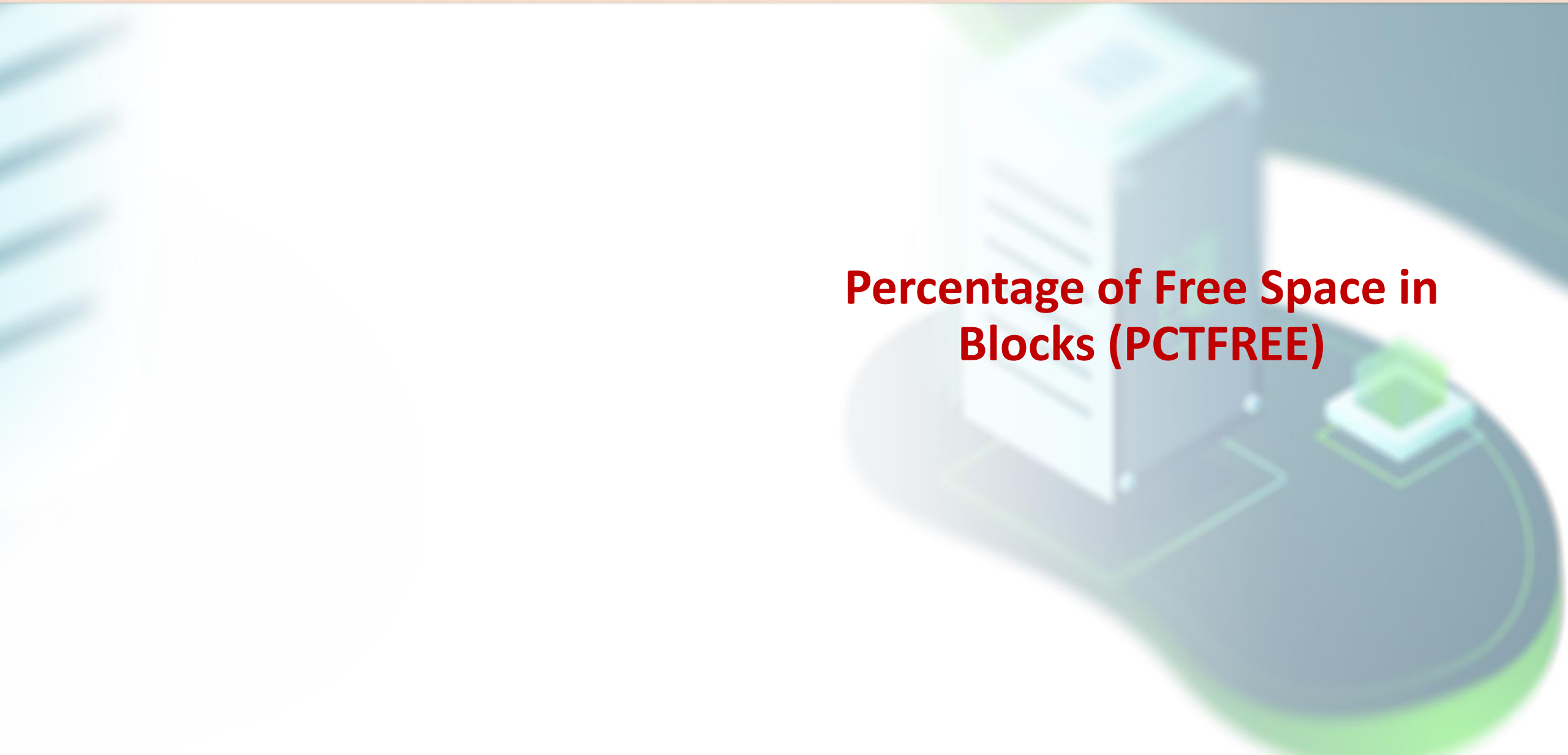
```
SQL> SELECT ROWID FROM employees WHERE employee_id = 100;

ROWID
------------------
AAAPecAAFAAAABSAAA
```

Figure 12–8 illustrates the format of an extended rowid.

Figure 12–8 ROWID Format





Percentage of Free Space in Blocks (PCTFREE)

Percentage of Free Space in Blocks

Percentage of Free Space Blocks

- What is Free Space in Data Block?
- Data Blocks & OS Blocks
- Percentage of Free Space in Data Blocks
- PCTFREE Space in Data Block
- Optimizing of Free Space
- Reuse of Index Space
- Row Migration

Percentage of Free Space in Blocks

What is Free Space in Data Block?

- As the database fills a data block from the bottom up, the amount of free space between the row data and the block header decreases. This free space can also shrink during updates, as when changing a trailing null to a non-null value.
- The database manages free space in the data block to optimize performance and avoid wasted space (Tuning Feature).

Percentage of Free Space in Blocks

Data Blocks & OS Blocks

- At the physical level, database data is stored in disk files made up of operating system blocks.
- An operating system block is the minimum unit of data that the operating system can read or write.
- In contrast, an Oracle block is a logical storage structure whose size and structure are not known to the operating system.

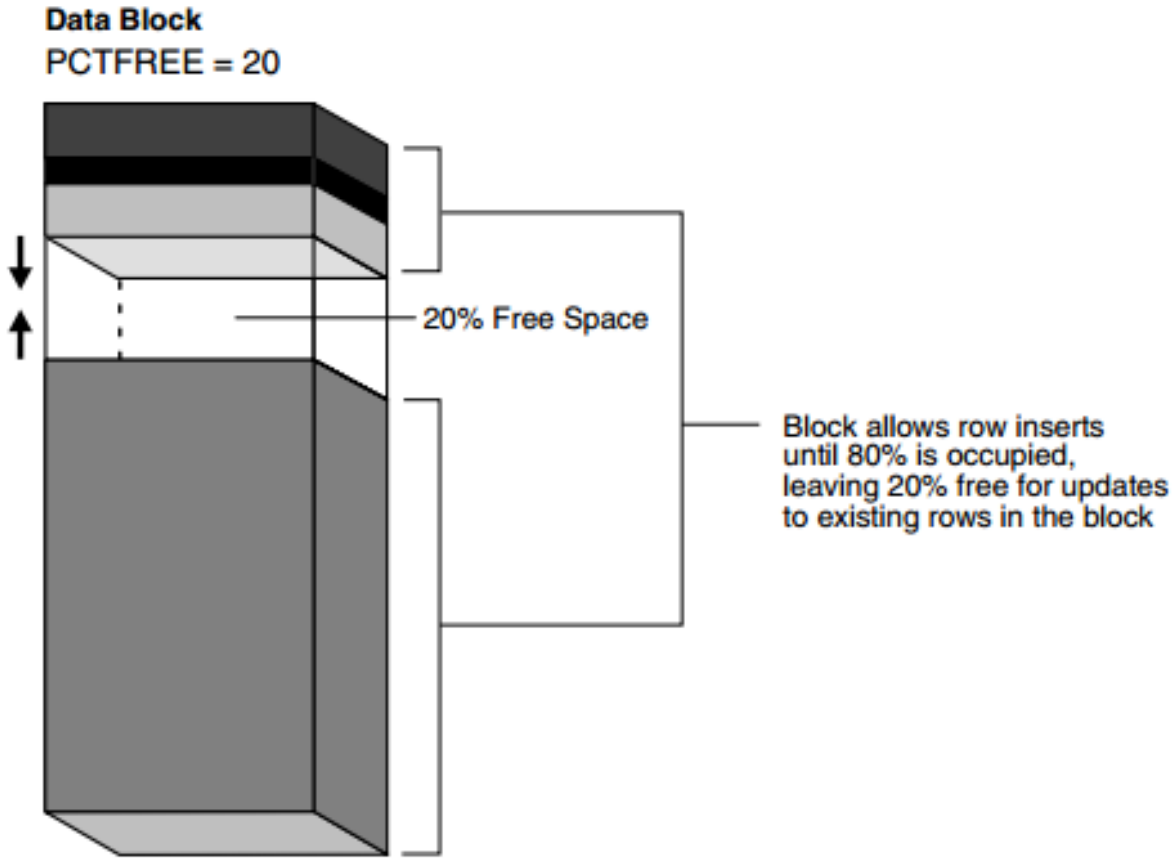
Percentage of Free Space in Blocks

Percentage of Free Space in Data Blocks

- The PCTFREE storage parameter is essential to how the database manages free space. This SQL parameter sets the minimum percentage of a data block reserved as free space for updates to existing rows.
- PCTFREE is important for preventing row migration and avoiding wasted space.

Percentage of Free Space in Blocks

PCTFREE Space in Data Block




```
CREATE TABLESPACE userdata
datafile 'C:\Ora11g\ordata\usr01.dbf'
size 500M
EXTENT MANAGEMENT DICTIONARY
DEFAULT STORAGE
(Initial 1M NEXT 1M PCTINCREASE 0);
```

PCTFREE parameter does not applied on LOB Datatypes

Percentage of Free Space in Blocks

Optimizing of Free Space

- While the percentage of free space cannot be less than PCTFREE, the amount of free space can be greater. For example, a PCTFREE setting of 20% prevents the total amount of free space from dropping to 5% of the block, but permits 50% of the block to be free space.

Percentage of Free Space in Blocks

Optimizing of Free Space

The following SQL statements can increase free space:

- DELETE statements
- UPDATE statements that either update existing values to smaller values or increase existing values and force a row to migrate
- INSERT statements on a table that uses OLTP compression. If inserts fill a block with data, then the database invokes block compression, which may result in the block having more free space.

Percentage of Free Space in Blocks

Optimizing of Free Space

The space released is available for INSERT under the following conditions:
If the INSERT statement is in the same transaction and after the statement that frees space, then the statement can use the space.
If the INSERT statement is in a separate transaction from the statement that frees space (perhaps run by another user), then the statement can use the space made available only after the other transaction commits and only if the space is needed.

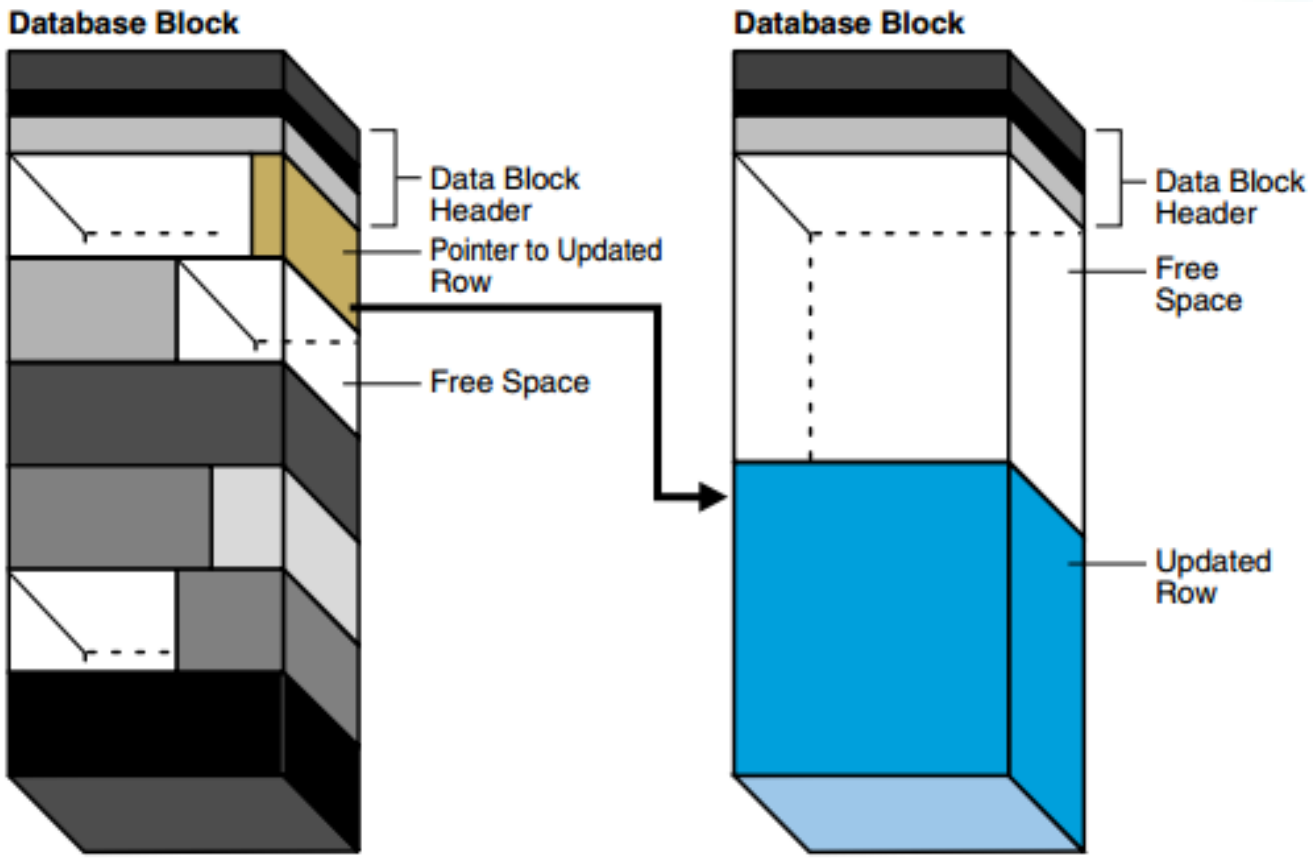
Percentage of Free Space in Blocks

Reuse of Index Space

The database can reuse space within an index block.
For example, if you insert a value into a column and delete it, and if an index exists on this column, then the database can reuse the index slot when a row requires it

Percentage of Free Space in Blocks

Row Migration



The left block contains a row that is updated so that the row is now too
large for the block. The database moves the entire row to the right block and leaves a pointer to the migrated row in the left block

Introduction to Database Administration

Overview of Extents

Overview of Extents

Overview of Extents

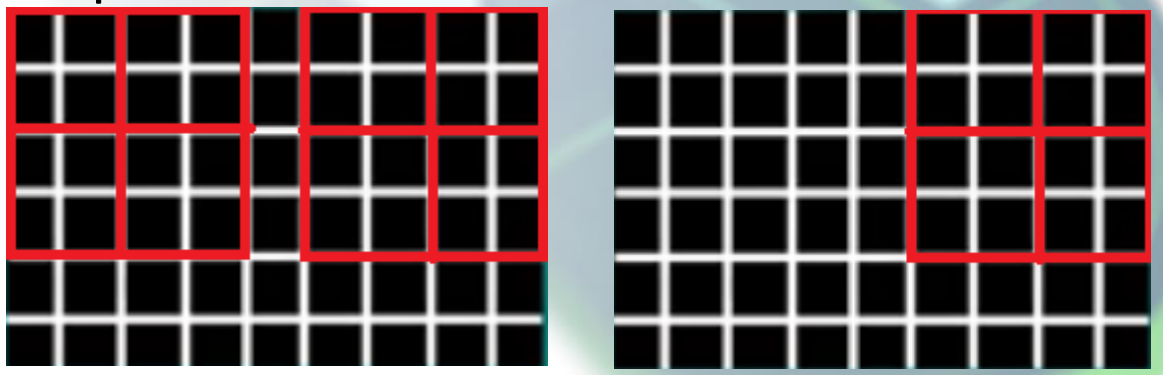
- What is Extent?
- Incremental Extents of Segment
- Deallocation of Extents
- Manually Deallocate Space
- Sample SQL DDL using Extent

Overview of Extents

What is Extent?

An extent is a logical unit of database storage space allocation made up of contiguous data blocks. Data blocks in an extent are logically contiguous but can be physically spread out on disk because of RAID striping and file system implementations.

Data Files



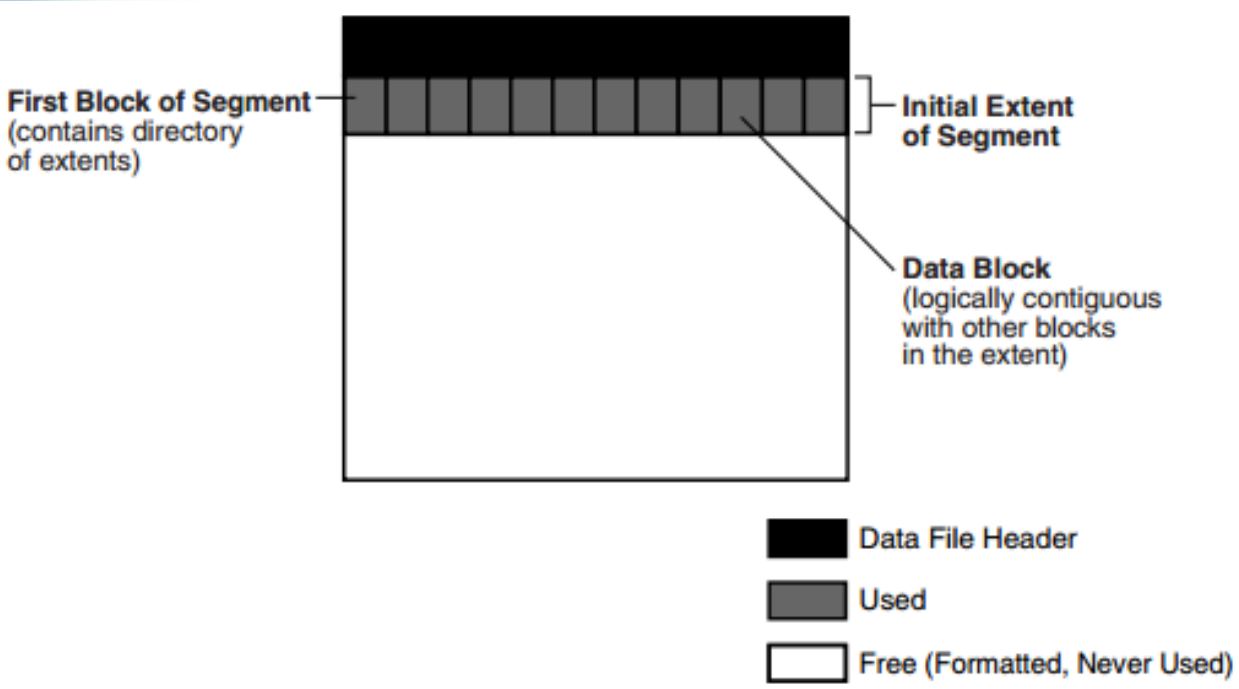
Overview of Extents

What is Extent?

An extent is a logical unit of database storage space allocation made up of contiguous data blocks. Data blocks in an extent are logically contiguous but can be physically spread out on disk because of RAID striping and file system implementations.

Overview of Extents

What is Extents?



By default, the database allocates an initial extent for a data segment when the segment is created. An extent is always contained in one data file.

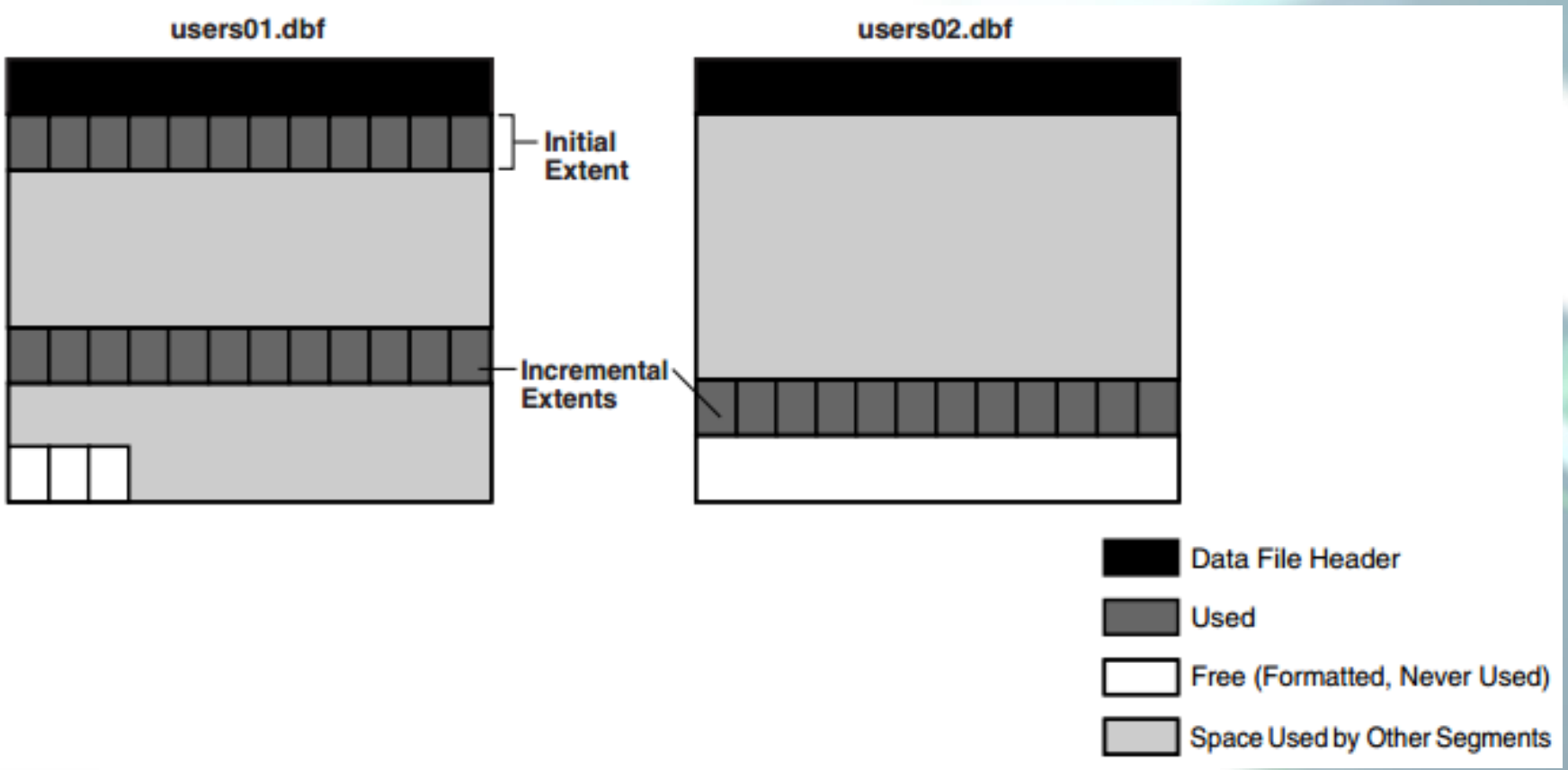
Although no data has been added to the segment, the data blocks in the initial extent are reserved for this segment exclusively.

The first data block of every segment contains a directory of the extents in the segment.

Figure shows the initial extent in a segment in a data file that previously contained no data.

Overview of Extents

Incremental Extents of Segment



Overview of Extents

Deallocation of Extents

In general, the extents of a user segment do not return to the tablespace unless you drop the object using a DROP command. In Oracle Database 11g Release 2, you can also drop the segment using the DBMS_SPACE_ADMIN package.

For example, if you delete all rows in a table, then the database does not reclaim the data blocks for use by other objects in the tablespace.

Overview of Extents

Manually Deallocate Space

Following techniques can deallocate extents

- You can use an online segment shrink to reclaim fragmented space in a segment. Segment shrink is an online, in-place operation.
- You can move the data of a non partitioned table or table partition into a new segment, and optionally into a different tablespace for which you have quota.

Overview of Extents

Manually Deallocate Space

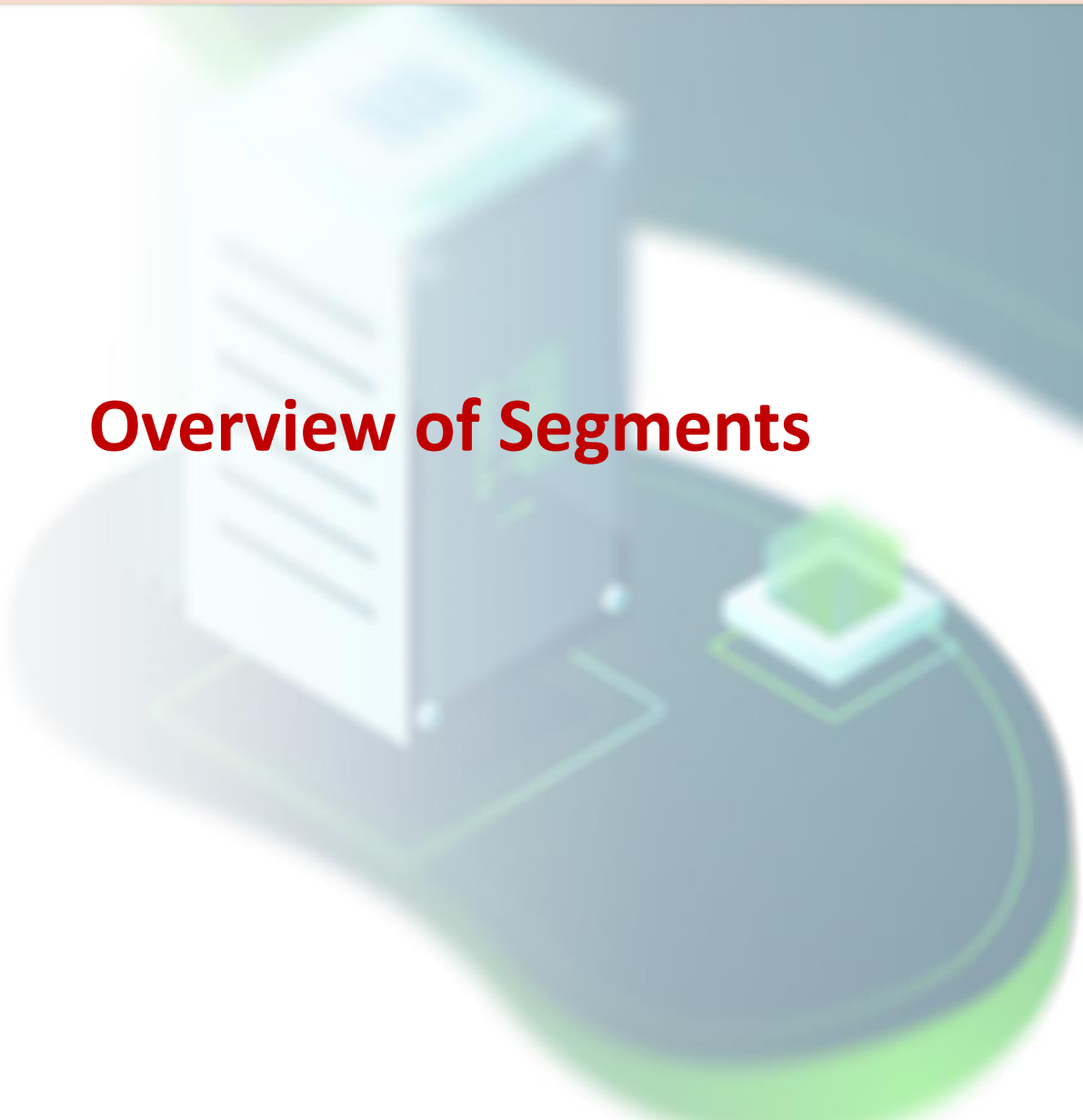
- You can rebuild or coalesce the index
- You can truncate a table or table cluster, which removes all rows. By default, Oracle Database deallocates all space used by the removed rows except that specified by the MINEXTENTS storage parameter.
- You can deallocate unused space, which frees the unused space at the high water mark end of the database segment and makes the space available for other segments in the tablespace

Overview of Extents

Sample SQL DDL using Extent

```
CREATE TABLESPACE MCare_indx
DATAFILE 'D:\oracle11g\ora11g\oradata\MCare_indx01.dbf'
SIZE 100M
MINIMUM EXTENT 64K
DEFAULT STORAGE (INITIAL 64K NEXT 64K);
```

Introduction to Database Administration



Overview of Segments

Overview of Segments

Overview of Segments

- What is Segment?
- Segment & Data Files
- User Segments
- User Segments Creation
- Creation of Multiple Segments
- SQL DDL for Segments under Tablespace
- Temporary Segments
- UNDO Segments
- Tablespace with Segments

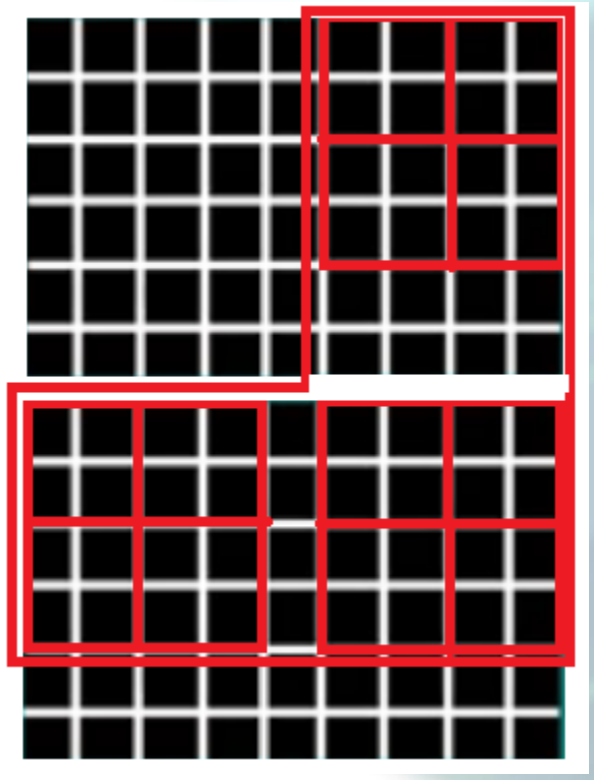
Overview of Segments

What is Segment?

A segment is a set of extents that contains all the data for a logical storage structure within a tablespace. For example, Oracle Database allocates one or more extents to form the data segment for a table. The database also allocates one or more extents to form the index segment for a table implementations.

Overview of Segments

Segment & Data Files



Data Files

For example, Patient table consists of three segments from two data files

Overview of Segments

User Segments

A single data segment in a database stores the data for one user object. There are different types of segments. Examples of user segments include:

- Table, table partition, or table cluster
- LOB or LOB partition
- Index or index partition

Each non partitioned object and object partition is stored in its own segment. For example, if an index has five partitions, then five segments contain the index data.

Overview of Segments

User Segments Creation

By default, the database uses deferred segment creation to update only database metadata when creating tables and indexes.

When a user inserts the first row into a table or partition, the database creates segments for the table or partition, its LOB columns, and its indexes.

Deferred segment creation enables you to avoid using database resources unnecessarily.

Overview of Segments

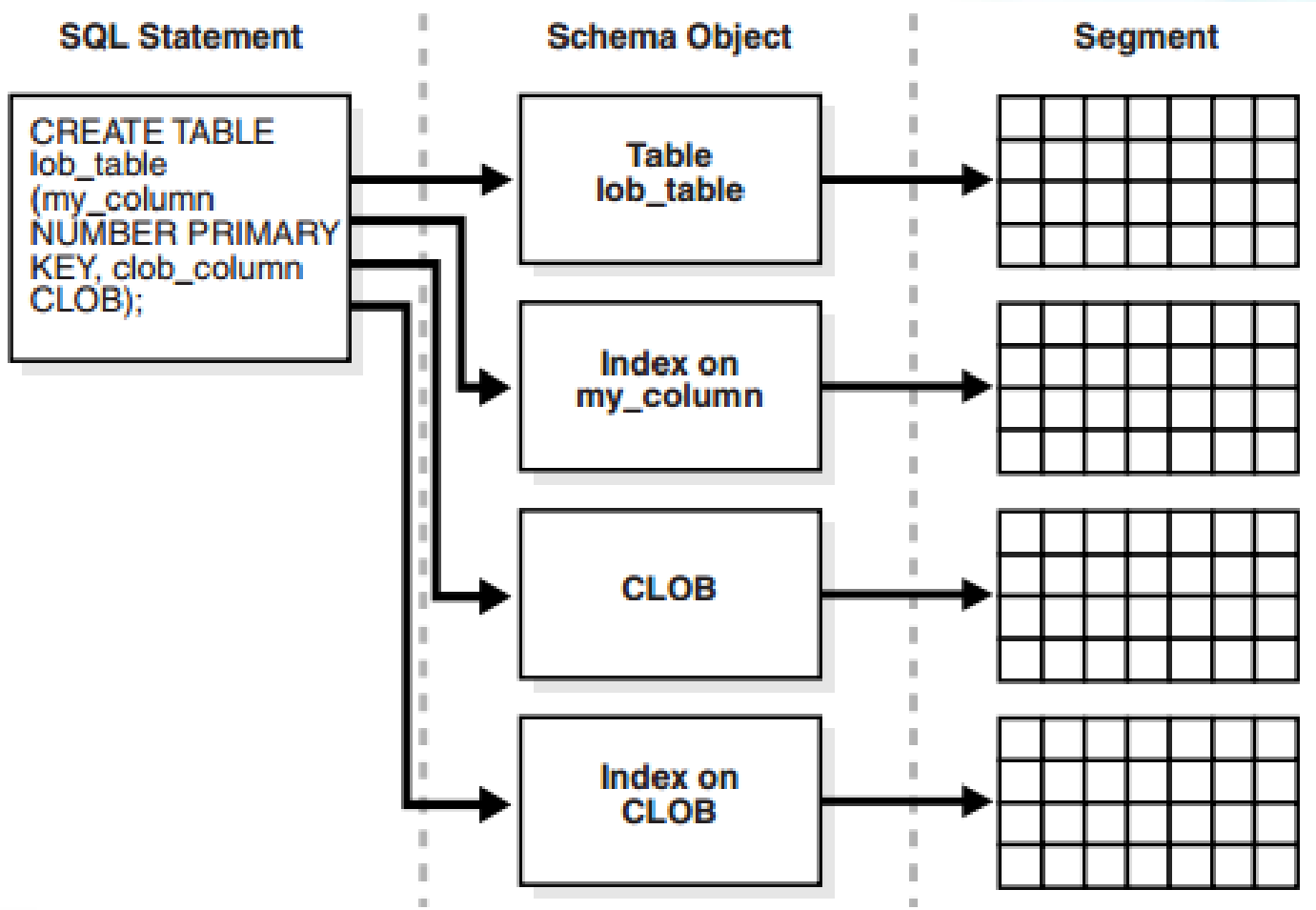
User Segments Creation

For example, installation of an application can create thousands of objects, on consuming significant disk space. Many of these objects may never be used.

You can use the DBMS_SPACE_ADMIN package to manage segments for empty objects.

Overview of Segments

Creation of Multiple Segments



Overview of Segments

SQL DDL for Segments under Tablespace

```
CREATE TABLE PATIENT_HISTORY
(PATIENT_ID CHAR (007),
DEPEND_SNO VARCHAR2 (002),
ALLERGY_DESC VARCHAR2 (250) NOT NULL,
HISTORY_DESC LONG
) tablespace MCare;

ALTER TABLE PATIENT_HISTORY
ADD constraint PK_PATHIST_ID PRIMARY KEY (PATIENT_ID,DEPEND_SNO)
USING INDEX TABLESPACE MCare_indx;
```

Overview of Segments

Temporary Segments

When processing a query, Oracle Database often requires temporary workspace for intermediate stages of SQL statement execution.
Typical operations that may require a temporary segment include sorting, hashing, and merging bitmaps. While creating an index, Oracle Database also places index segments into temporary segments and then converts them into permanent segments when the index is complete

Overview of Segments

UNDO Segments

Oracle Database maintains records of the actions of transactions, collectively known as undo data.

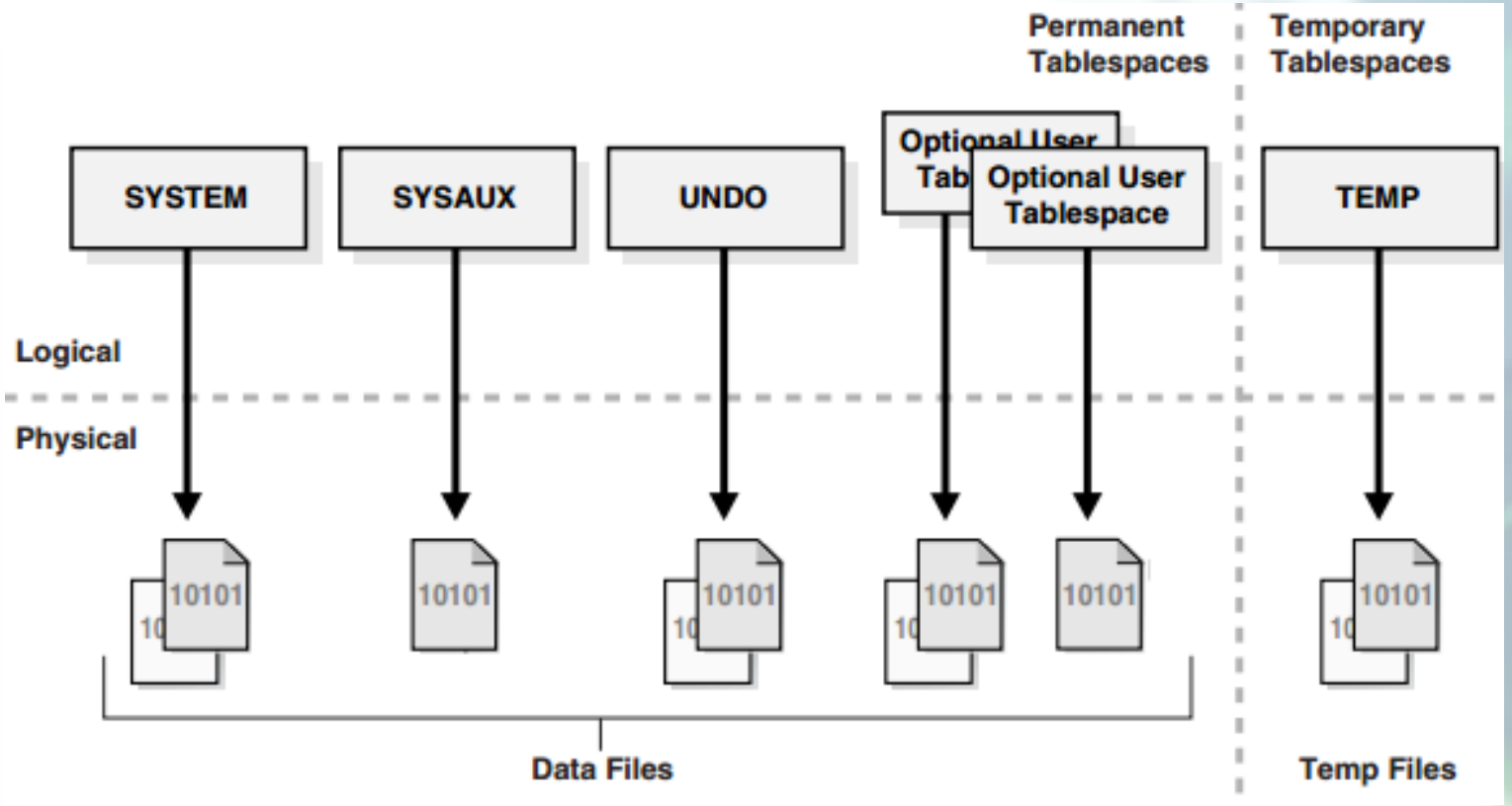
Oracle Database uses undo to do the following:

- Roll back an active transaction
- Recover a terminated transaction
- Provide read consistency
- Perform some logical flashback operations

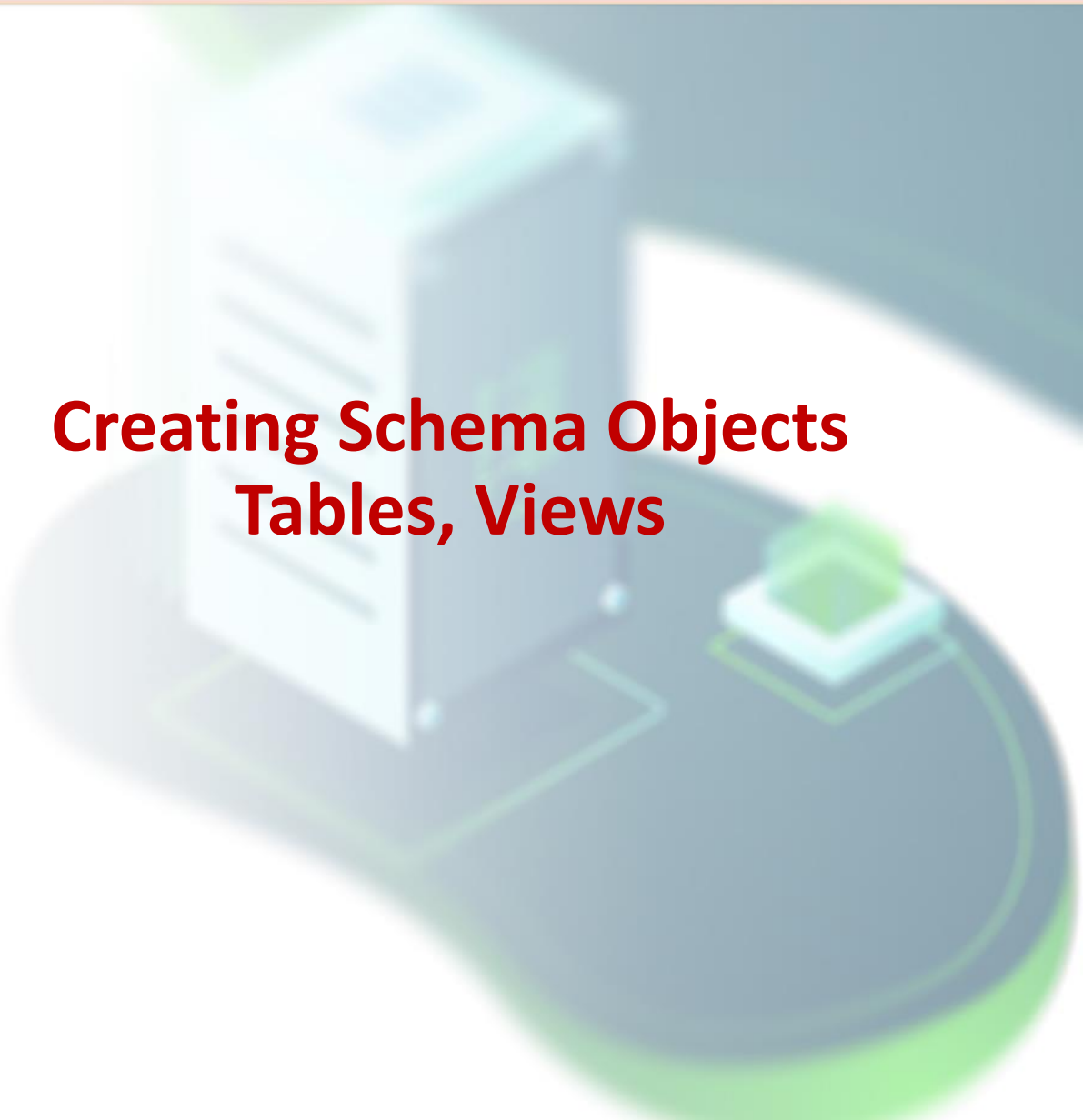
Overview of Segments

Tablespace with Segments

A tablespace is a logical storage container for segments. Segments are database objects, such as tables and indexes, that consume storage space. At the physical level, a tablespace stores data in one Or more data files or temp files.



Introduction to Database Administration



Creating Schema Objects
Tables, Views

Creating Schema Objects, Tables and Views

Overview of Segments

- Introduction to Schema Objects
- User & Schema Objects
- Schema Objects Types
- Overview of Views
- Use of Views
- SQL to Create View
- View of Base Table

Creating Schema Objects, Tables and Views

Introduction to Schema Objects

- A database schema is a logical container for data structures, called schema objects.
- Examples of schema objects are tables, views, sequences and indexes etc.
- Schema objects are created and manipulated with SQL

Creating Schema Objects, Tables and Views

Introduction to Schema Objects

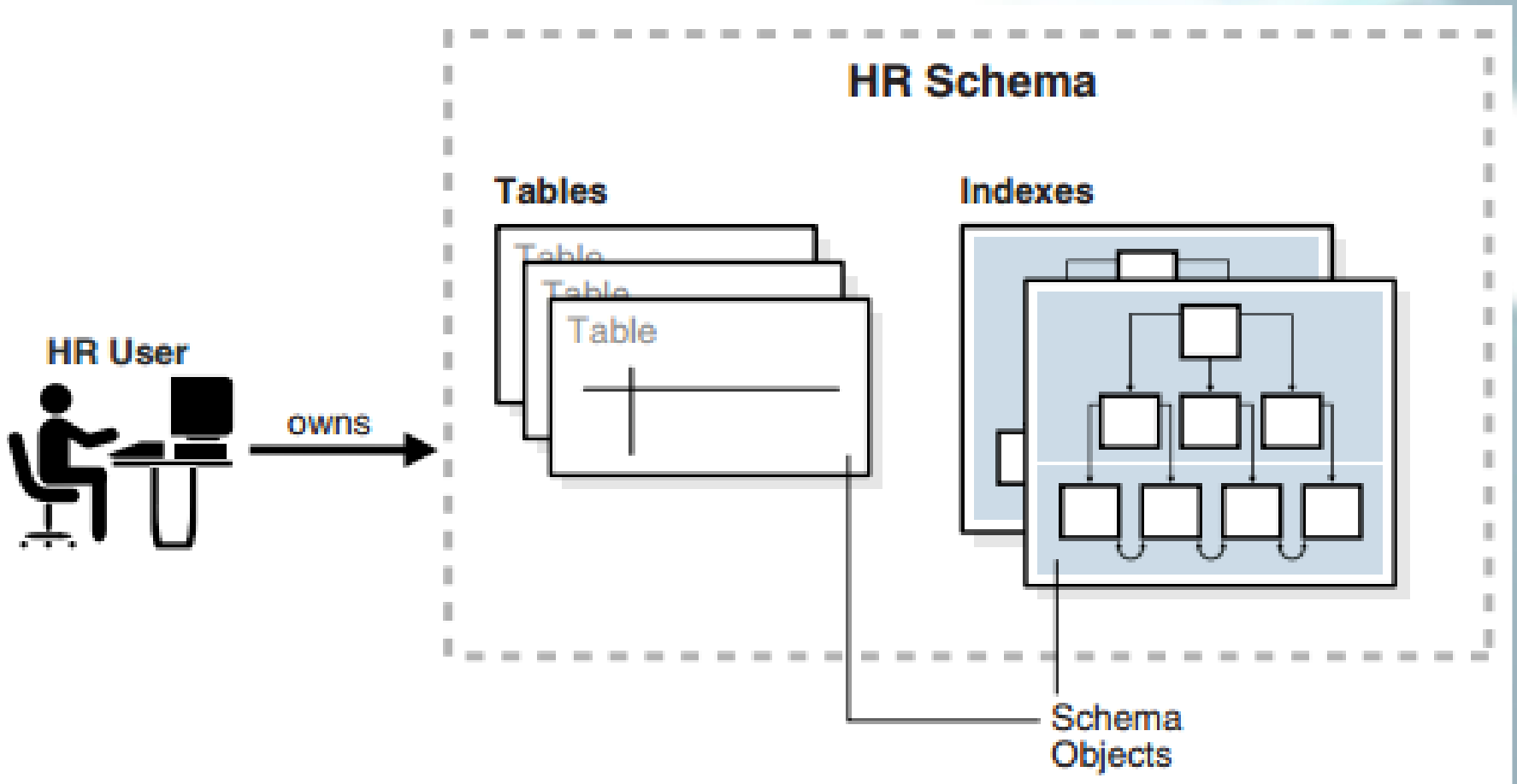
A database user has a password and various database privileges. Each user owns a single schema, which has the same name as the user.

The schema contains the data for the user owning the schema. For example, the hr user owns the hr schema, which contains schema objects such as the employees table.

In a production database, the schema owner usually represents a database application rather than a person.

Creating Schema Objects, Tables and Views

User & Schema Objects



Creating Schema Objects, Tables and Views

Schema Objects Types

- Tables
  Storing data in rows of tables
- Indexes
  Indexes are schema objects that contains an entry for each indexed row of the table
  or table cluster and provide direct, fast access to rows.
- Partitions
  Partitions are pieces of large tables and indexes.

Creating Schema Objects, Tables and Views

Schema Objects Types

- Partitions

  Partitions are pieces of large tables and indexes.
- Views

  Views are customized presentations of data in one or more tables or other views.
- Sequences

  A sequence is a user-created object that can be shared by multiple users to generate integers.

Creating Schema Objects, Tables and Views

Schema Objects Types

- Dimensions
  A dimension defines a parent-child relationship between pairs of column sets,
  where all the columns of a column set must come from the same table.
- Synonyms
  A synonym is an alias for another schema object.
- PL/SQL Programs
  Procedural server programming

Creating Schema Objects, Tables and Views

Overview of Views

- A view is a logical representation of one or more tables.
- In essence, a view is a stored query.
- A view derives its data from the tables on which it is based, called base tables.
- Base tables can be tables or other views.
- All operations performed on a view actually affect the base tables.
- You can use views in most places where tables are used.

Creating Schema Objects, Tables and Views

Use of Views

- Provide an additional level of table security by restricting access to a predetermined set of rows or columns of a table
- Hide data complexity
- Present the data in a different perspective from that of the base table For example, the columns of a view can be renamed without affecting the tables on which the view is based.
- Isolate applications from changes in definitions of base tables used.

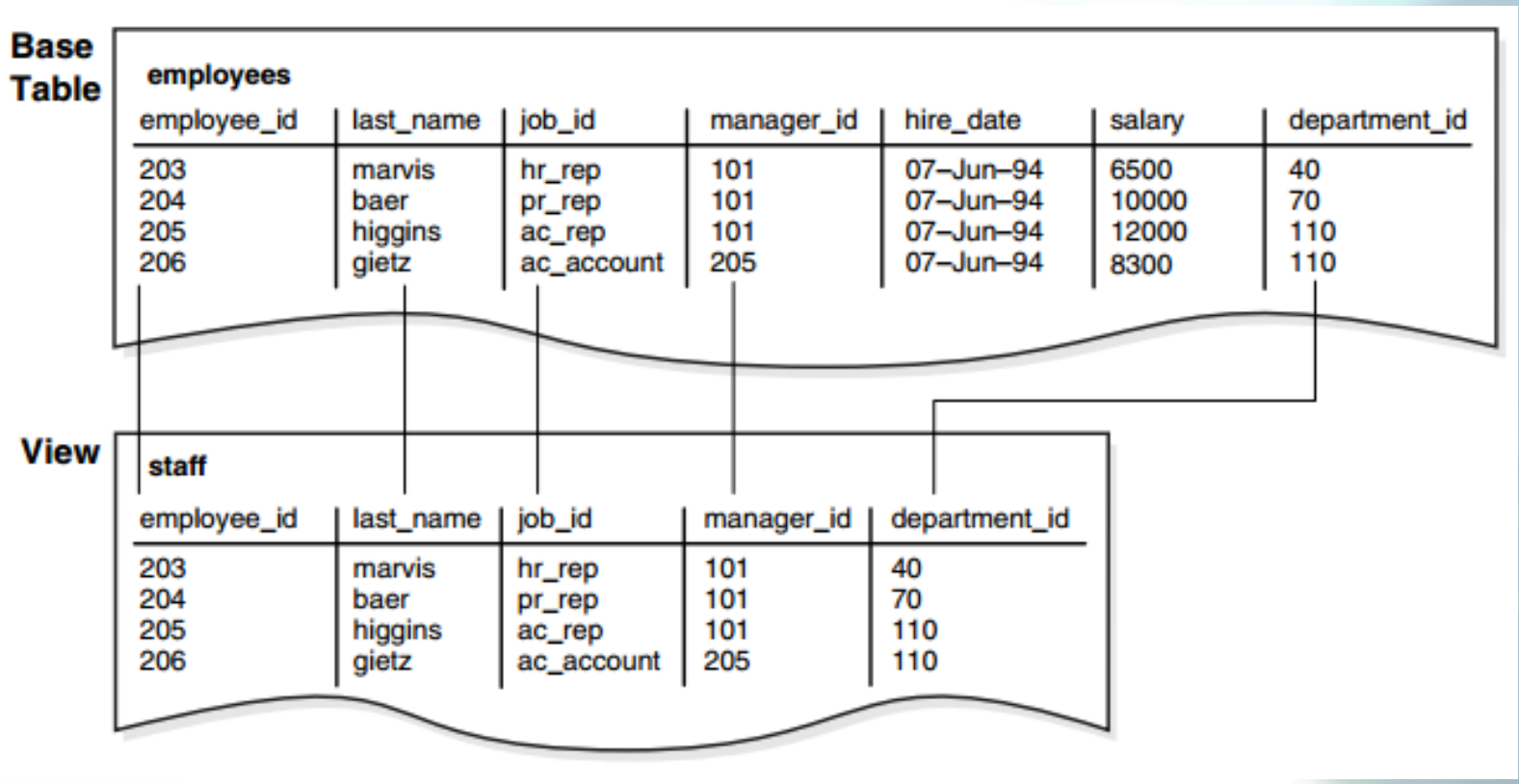
Creating Schema Objects, Tables and Views

SQL to Create View

```
CREATE VIEW staff AS
SELECT employee_id, last_name, job_id,
manager_id, department_id
FROM employees;
```

Creating Schema Objects, Tables and Views

View of Base Table



Introduction to Database Administration

Analyzing Tables, Indexes & Clusters

Analyzing Tables, Indexes & Clusters

Analyzing Tables, Indexes & Clusters

- Overview of Table Clusters
- Cluster Key
- Overview of Indexed Clusters
- DDL for Indexed Clusters
- Overview of Indexes
- Composite Indexes

Analyzing Tables, Indexes & Clusters

Overview of Table Clusters

- A table cluster is a group of tables that share common columns and store related data in the same blocks. When tables are clustered, a single data block can contain rows from multiple tables.
- For example, a block can store rows from both the employees and Departments tables rather than from only a single table.

Analyzing Tables, Indexes & Clusters

Cluster Key

- The cluster key is the column or columns that the clustered tables have in common.
- For example, the employees and departments tables share the department_id column.
- You specify the cluster key when creating the table cluster and when creating every table added to the table cluster.

Analyzing Tables, Indexes & Clusters

Cluster Key Value

- The cluster key value is the value of the cluster key columns for a particular set of rows. All data that contains the same cluster key value, such as department_id=20, is physically stored together. Each cluster key value is stored only once in the cluster and the cluster index, no matter how many rows of different tables contain the value

Analyzing Tables, Indexes & Clusters

Overview of Indexed Clusters

An indexed cluster is a table cluster that uses an index to locate data. The cluster index is a B-tree index on the cluster key. A cluster index must be created before any rows can be inserted into clustered tables

Analyzing Tables, Indexes & Clusters

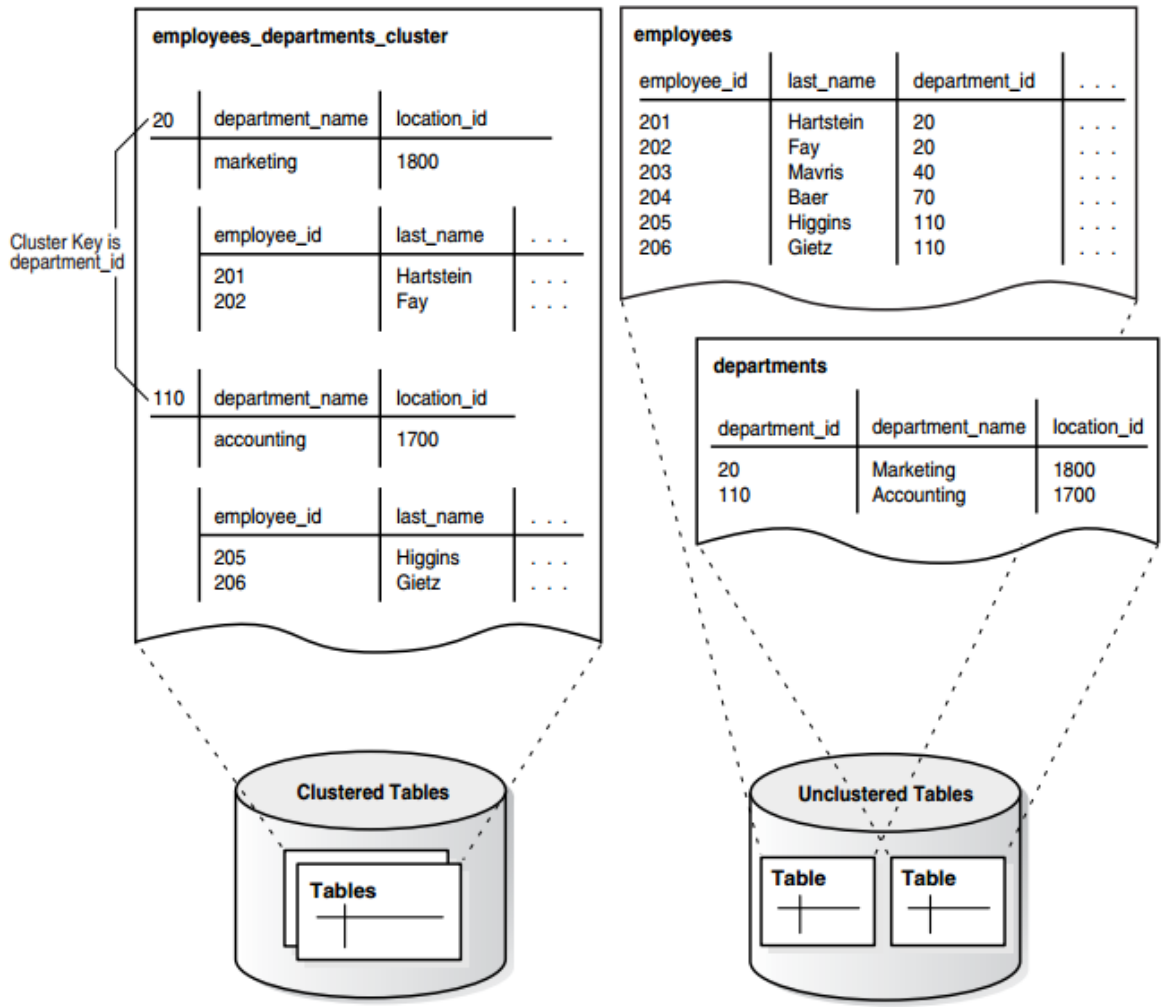
DDL for Indexed Clusters

```
CREATE CLUSTER emp_dept_cluster
(department_id NUMBER(4))
SIZE 512;

CREATE INDEX idx_emp_dept_cluster ON
CLUSTER emp_dept_cluster;
```

Analyzing Tables, Indexes & Clusters

DDL for Indexed Clusters



Analyzing Tables, Indexes & Clusters

Overview of Indexes

An index is an optional structure, associated with a table or table cluster, that can sometimes speed data access. By creating an index on one or more columns of a table, you gain the ability in some cases to retrieve a small set of randomly distributed rows from the table.

Indexes are one of many means of reducing disk I/O.

Analyzing Tables, Indexes & Clusters

Composite Indexes

An index is an optional structure, associated with a table or table cluster, that can sometimes speed data access. By creating an index on one or more columns of a table, you gain the ability in some cases to retrieve a small set of randomly distributed rows from the table.

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Analyzing Tables, Indexes & Clusters

Composite Indexes

A composite index, also called a concatenated index, is an index on multiple columns in a table. Columns in a composite index should appear in the order that makes the most sense for the queries that will retrieve data and need not be adjacent in the table.

```
CREATE INDEX employees_ix
ON employees (last_name, job_id, salary);
```

End

Introduction to Database Administration

Managing Integrity Constraints-1

Managing Integrity Constraints-1

Integrity Constraints

- Data Integrity
- Techniques for Data Integrity
- Advantages of Integrity Constraints
- Types of Integrity Constraints

Managing Integrity Constraints-1

Data Integrity

- Business rules specify conditions and relationships that must always be true or must always be false. For example, each company defines its own policies about salaries, employee numbers, inventory tracking, and so on.

- It is important that data maintain data integrity, which is adherence to these rules, as determined by the database administrator or application developer.

Managing Integrity Constraints-1

Techniques for Data Integrity

Following are possible options:

- Enforcing business rules with triggered stored database procedures
- Using stored procedures to completely control access to data
- Enforcing business rules in the code of a database application
- Using Oracle Database integrity constraints, which are rules defined at the column or object level that restrict values in the database

Managing Integrity Constraints-1

Advantages of Integrity Constraints

An integrity constraint is a schema object that is created and dropped using SQL.

Advantages of integrity constraints over alternatives for enforcing data integrity include:

- Declarative ease
- Centralized rules
- Flexibility when loading data

Managing Integrity Constraints-1

Advantages of Integrity Constraints

- Declarative ease
  Because you define integrity constraints using SQL DDL statements.
- Centralized rules
  Integrity constraints are defined for tables and are stored in the data dictionary
- Flexibility when loading data
  You can disable integrity constraints temporarily to avoid performance overhead when loading large amounts of data.

Managing Integrity Constraints-1

Types of Integrity Constraints

Oracle Database enables you to apply constraints both at the table and column level. A constraint specified as part of the definition of a column or attribute is called an inline specification.

NOT NULL
UNIQUE
CHECK
DEFAULT
PK/ FK: Standard Integrity Constraints

End

Introduction to Database Administration

Managing Integrity Constraints-2

Managing Integrity Constraints-2

Integrity Constraints

- NOT NULL Constraint
- UNIQUE Constraint
- CHECK Constraint
- DEFAULT Constraint
- FK CASCADE Constraints
- FK CASCADE Constraints – Example
- Trigger's Constraint
- ENABLE/ DISABLE or Drop Constraints

Managing Integrity Constraints-2

NOT NULL Constraint

- A NOT NULL constraint requires that a column of a table contain no null values. A null is the absence of a value. By default, all columns in a table allow nulls.
- By default, FK is NULL.

```
Create table Student(
(RollNo          CHAR(10),
FullName         VARCHAR2(50) NOT NULL,
….. );
```

Managing Integrity Constraints-2

UNIQUE Constraint

- A unique key (Null able) constraint requires that every value in a column or set of columns be unique. No rows of a table may have duplicate values in a column (the unique key) or set of columns (the composite unique key) with a unique key constraint.

```
Create table Medicine(
(ItemNo          CHAR(10),
Name   VARCHAR2(50) NOT NULL UNIQUE,
….. );
```

Managing Integrity Constraints-2

CHECK Constraint

- A check constraint on a column or set of columns requires that a specified condition be true or unknown for every row. If DML results in the condition of the constraint evaluating to false, then the SQL statement is rolled back.

```
Alter table Medicine
Add constraint chk_medType
CHECK (MedType IN ('S','P'));
```

Managing Integrity Constraints-2

DEFAULT Constraint

- A default constraint on a column requires that a specified value be true when null value is entered.

```
Create table Medicine(
(ItemNo          CHAR(10),
Name             VARCHAR2(50) NOT NULL,
Status           CHAR(1) default 'Y‘,
….. );
```

Managing Integrity Constraints-2

FK CASCADE Constraints

- CASCADE is applied with INSERT, DELETE or UPDATE.
- For example, a foreign key with cascade delete means that if a record in the parent table is deleted, then the corresponding records in the child table will automatically be deleted. This is called a cascade delete in Oracle.

Managing Integrity Constraints-2

FK CASCADE Constraints - Example

```
CREATE TABLE supplier
( supplier_id numeric(10) not null,
  supplier_name varchar2(50) not null,
  contact_name varchar2(50),
  CONSTRAINT supplier_pk PRIMARY KEY (supplier_id));

CREATE TABLE products
( product_id numeric(10) not null,
  supplier_id numeric(10) not null,
  CONSTRAINT fk_supplier FOREIGN KEY (supplier_id)
    REFERENCES supplier(supplier_id)  ON DELETE CASCADE);
```

Managing Integrity Constraints-2

Trigger's Constraints

```
CREATE TRIGGER cascade_del_stu_record
BEFORE DELETE ON STUDENT
FOR EACH ROW
BEGIN
  DELETE FROM RECORD
  WHERE RECORD.SID = :OLD.SID;
END;
```

Managing Integrity Constraints-2

Trigger's Constraints

```
CREATE TRIGGER cascade_del_stu_record
BEFORE DELETE ON STUDENT
FOR EACH ROW
BEGIN
  DELETE FROM RECORD
  WHERE RECORD.SID = :OLD.SID;
END;
```

Managing Integrity Constraints-2

End

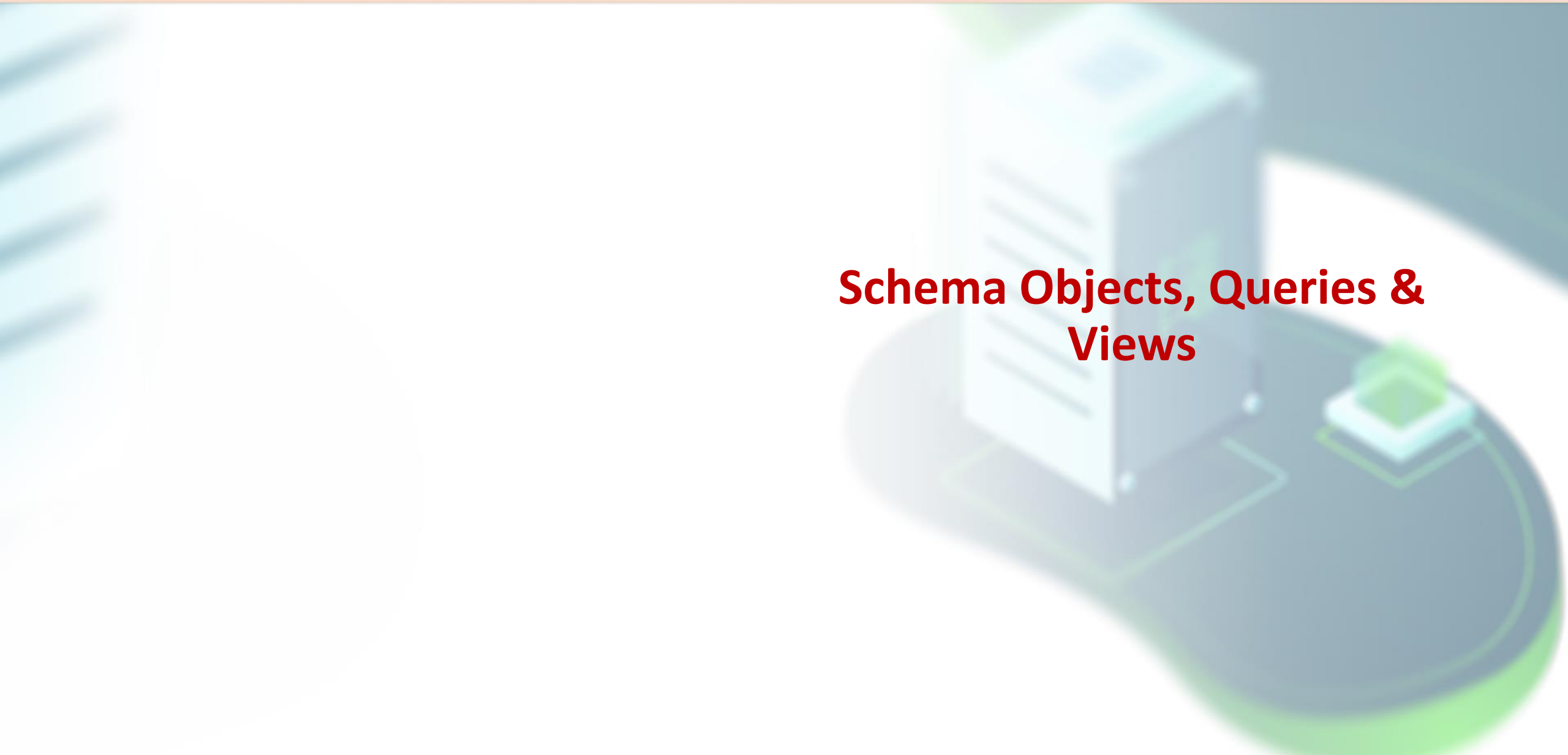
ENABLE/ DISABLE or Drop Constraints

Existing constraints on table can be

- Enabled
- Disabled
- Dropped

For example,
Alter table Invoice
DROP constraint fk_custid;

Introduction to Database Administration



Schema Objects, Queries & Views

Schema Objects, Queries & Views

Schema Objects

- How a Schema is Created?
- How a Schema is Implemented?
- Simple & Complex Views
- Creating Tables
- Creating Sequence or AutoNumber
- Data Dictionary for Tables & Views

Schema Objects, Queries & Views

How a Schema is Created

- We have studied that DBA has to create default Tablespace and assign temporary Tablespace with storage in terms of data files.
- Create first user (owner of schema) with grants such as rights and privileges.
- We will cover schema objects Tables and Views.
- Ref. DBA-73

Schema Objects, Queries & Views

How a Schema is Implemented?

- A view is a logical representation of a table or combination of tables.
- In essence, a view is a stored query.
- A view derives its data from the tables on which it is based.
- These tables are called base tables. Base tables might in turn be actual tables or might be views themselves.
- All operations performed on a view actually affect the base table of the view.

Schema Objects, Queries & Views

How a Schema is Implemented?

- You can use views in almost the same way as tables. You can query, update, insert into, and delete from views, just as you can standard tables.
- Views can provide a different representation (such as subsets or supersets) of the data that resides within other tables and views.
- Views can be Simple or Complex
- Views can be used for security purposes
- View does not contain its own data

Schema Objects, Queries & Views

Simple & Complex Views

```
CREATE VIEW sales_staff AS
SELECT empno, ename, deptno
FROM emp
WHERE deptno = 10;
```

```
CREATE VIEW sales_staff AS
SELECT job, count(*)
FROM emp
WHERE deptno = 10
Group by job;
```

Schema Objects, Queries & Views

Simple & Complex Views

```
CREATE OR REPLACE VIEW division1_staff
AS
SELECT ename, empno, job, dname
FROM emp, dept
WHERE emp.deptno IN (10, 30)
AND emp.deptno = dept.deptno;
```

Insert, delete and update operations for base tables are applied on simple views.

Schema Objects, Queries & Views

Creating Tables

```
CREATE TABLE dept (
deptno NUMBER(4) PRIMARY KEY,
dname VARCHAR2(14),
loc VARCHAR2(13));

CREATE TABLE emp (
empno NUMBER(4) PRIMARY KEY,
ename VARCHAR2(10),
…
deptno NUMBER(2);
…
```

Schema Objects, Queries & Views

Creating Sequence or AutoNumber

```
CREATE SEQUENCE emp_sequence
INCREMENT BY 1
START WITH 1
NOMAXVALUE
NOCYCLE
CACHE 10;
```

Schema Objects, Queries & Views

Data Dictionary for Tables & Views

SELECT COLUMN_NAME, UPDATABLE
FROM USER_UPDATABLE_COLUMNS
WHERE TABLE_NAME = 'EMP_DEPT';

```
SELECT COLUMN_NAME, UPDATABLE
       FROM USER_UPDATABLE_COLUMNS
       WHERE TABLE_NAME = 'EMP_DEPT';

COLUMN_NAME                    UPD
------------------------------ ---
EMPNO                          YES
ENAME                          YES
DEPTNO                         YES
SAL                            YES
DNAME                          NO
LOC                            NO
```

End

Introduction to Database Administration

Creating Tables & Alter Tables

Creating Tables & Alter Tables

Creating & Alter Tables

- What is a Table?
- Design Table Guidelines
- Heap-Organized Table
- Clustered Table
- Indexed-Organized Table
- Partitioned Table
- Storage Location of a Table
- Alter Table
- Tables with Segment Creation

Creating Tables & Alter Tables

What is a Table?

- Tables are the basic unit of data storage in an Oracle Database. Data is stored in rows and columns. You define a table with a table name, such as employees, and a set of columns.
- You give each column a column name, such as emp_id, last_name, and job_id; a data type, such as VARCHAR2, DATE, or NUMBER; and a width. The width can be predetermined by the data type, as in DATE.

Creating Tables & Alter Tables

What is a Table?

- If columns are of the NUMBER data type, define precision and scale instead of width. A row is a collection of column information corresponding to a single record.
- You can specify rules for each column of a table. These rules are called integrity constraints. One example is a NOT NULL integrity constraint. This constraint forces the column to contain a value in every row.
- Some column types, such as LOBs, varrays, and nested tables, are stored in their own segments. LOBs and varrays are stored in LOB segments, while nested tables are stored in storage tables.

Creating Tables & Alter Tables

Design Table Guidelines

- Use descriptive names for tables, columns, indexes, and clusters.
- Be consistent in abbreviations and in the use of singular and plural forms of table names and columns.
- Document the meaning of each table and its columns with the COMMENT command.
- Normalize each table.

Creating Tables & Alter Tables

Design Table Guidelines

- Select the appropriate datatype for each column. Consider whether your applications would benefit from adding one or more virtual columns to some tables.
- Define columns that allow nulls last, to conserve storage space.
- Cluster tables whenever appropriate, to conserve storage space and optimize performance of SQL statements.

Creating Tables & Alter Tables

Heap-Organized Table

- This is the basic, general purpose type of table which is the primary subject of this chapter. Its data (heap).

Creating Tables & Alter Tables

Clustered Table

- A clustered table is a table that is part of a cluster. A cluster is a group of tables that share the same data blocks because they share common columns and are often used together

Creating Tables & Alter Tables

Indexed-Organized Table

- Unlike an ordinary (heap-organized) table, data for an index-organized table is stored in a B-tree index structure in a primary key sorted manner.
- Besides storing the primary key column values of an index-organized table row, each index entry in the B-tree stores the non key column values as well

Creating Tables & Alter Tables

Partitioned Table

- Partitioned tables enable your data to be broken down into smaller, more manageable pieces called partitions, or even subpartitions. Each partition can have separate physical attributes, such as compression enabled or disabled, type of compression, physical storage settings, and tablespace, thus providing a structure that can be better tuned for availability and performance.

Creating Tables & Alter Tables

Partitioned Table

- In addition, each partition can be managed individually, which can simplify and reduce the time required for backup and administration.

Creating Tables & Alter Tables

Storage Location of a Table

- It is advisable to specify the TABLESPACE clause in a CREATE TABLE statement to identify the tablespace that is to store the new table.
- For partitioned tables, you can optionally identify the tablespace that is to store each partition. Ensure that you have the appropriate privileges and quota on any tablespaces that you use.
- If you do not specify a tablespace in a CREATE TABLE statement, the table is created in your default tablespace.

Creating Tables & Alter Tables

Alter Table

- Alter table command applies when table is already exist in a schema.
- We can add constraints, columns and modifications operations on table using Alter table DDL statements.

Creating Tables & Alter Tables

Tables with Segment Creation

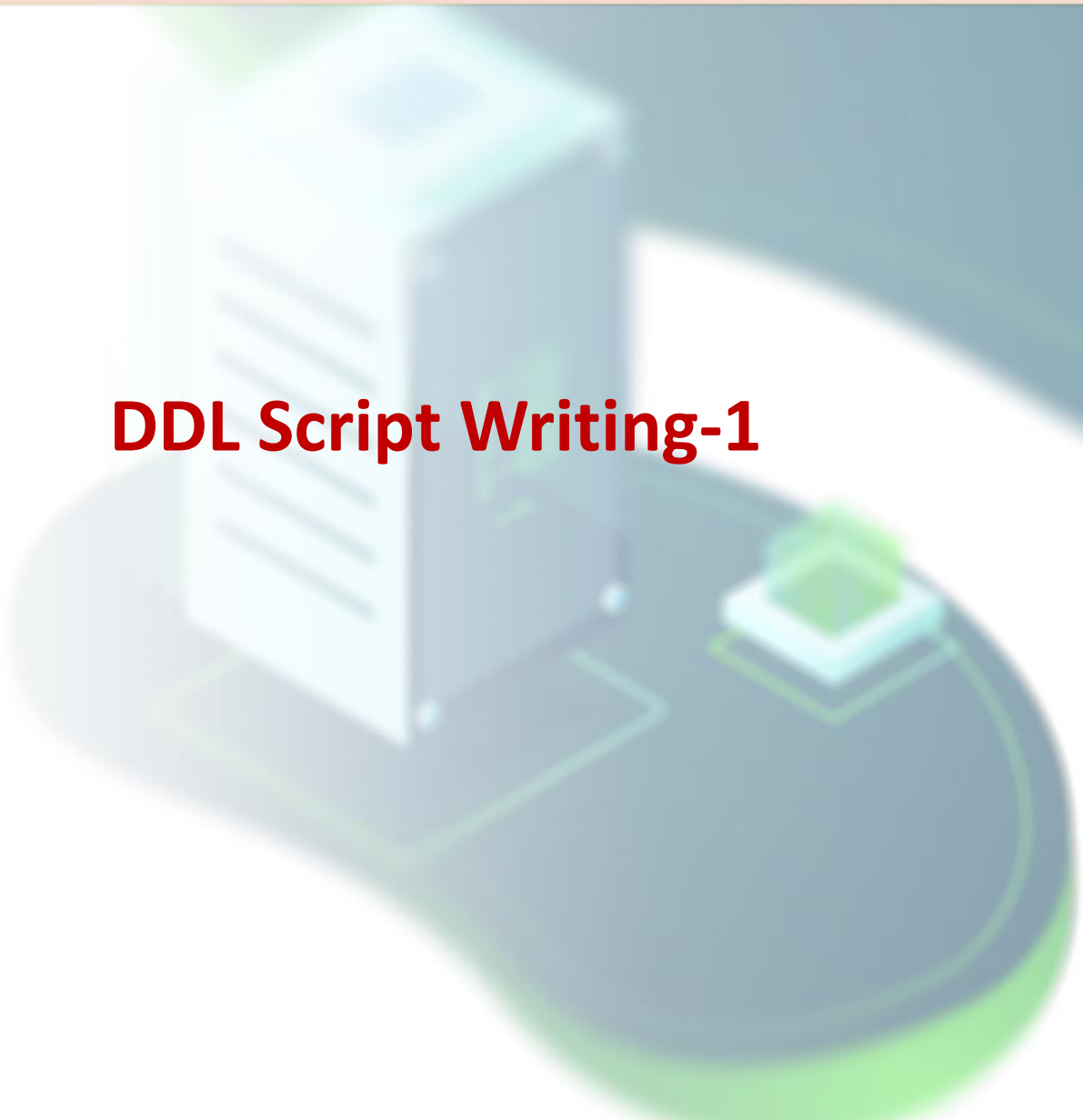
```
CREATE TABLE part_time_employees (
    empno NUMBER(8),
    name VARCHAR2(30),
    hourly_rate NUMBER (7,2)
    )
    SEGMENT CREATION DEFERRED;

CREATE TABLE hourly_employees (
    empno NUMBER(8),
    name VARCHAR2(30),
    hourly_rate NUMBER (7,2)
    )
   SEGMENT CREATION IMMEDIATE
   PARTITION BY RANGE(empno)
    (PARTITION empno_to_100 VALUES LESS THAN (100),
    PARTITION empno_to_200 VALUES LESS THAN (200));
```

```
SELECT segment_name, partition_name FROM user_segments;

SEGMENT_NAME          PARTITION_NAME
--------------------- ------------------------------
HOURLY_EMPLOYEES      EMPNO_TO_100
HOURLY_EMPLOYEES      EMPNO_TO_200
```

Introduction to Database Administration



DDL Script Writing-1

DDL Script Writing-1

Script Writing

- What is a Script?
- A Sample DDL in a Script?
- Creating Temporary Tables
- Table with TEMP Tablespace
- Bulk Data Load in a Table
- Alter Table
- Index with Tablespace
- DDL Partition Table

DDL Script Writing-1

What is a Script?

- Normally writing or generating DDL commands to create/ alter tables, views, constraints and storages etc., in an order in plain text using Notepad or text files
- Mostly scripts contain structure of tables. Sometimes, DML commands are also put in scripts as per management requirement.
- Scripts can be with Create, Alter and Drop Tables

DDL Script Writing-1

A Sample DDL in a Script

```
CREATE TABLE hr.admin_emp (
         empno       NUMBER(5) PRIMARY KEY,
         ename       VARCHAR2(15) NOT NULL,
         ssn         NUMBER(9) ENCRYPT USING 'AES256',
         job         VARCHAR2(10),
         mgr         NUMBER(5),
         hiredate    DATE DEFAULT (sysdate),
         photo       BLOB,
         sal         NUMBER(7,2),
         hrly_rate   NUMBER(7,2) GENERATED ALWAYS AS (sal/2080),
         comm        NUMBER(7,2),
         deptno      NUMBER(3) NOT NULL
                      CONSTRAINT admin_dept_fkey REFERENCES hr.departments
                      (department_id))
   TABLESPACE admin_tbs
   STORAGE ( INITIAL 50K);

COMMENT ON TABLE hr.admin_emp IS 'Enhanced employee table';
```

DDL Script Writing-1

Creating Temporary Tables

Temporary tables are useful in applications where a result set is to be buffered (temporarily persisted), perhaps because it is constructed by running multiple DML operations.
For example, consider the following:

```
CREATE GLOBAL TEMPORARY TABLE admin_work_area
        (startdate DATE,
         enddate DATE,
         class CHAR(20))
      ON COMMIT DELETE ROWS;
```

DDL Script Writing-1

Table with TEMP Tablespace

```
CREATE TEMPORARY TABLESPACE tbs_t1
    TEMPFILE 'tbs_t1.f' SIZE 50m REUSE AUTOEXTEND ON
    MAXSIZE UNLIMITED
    EXTENT MANAGEMENT LOCAL UNIFORM SIZE 64K;

CREATE GLOBAL TEMPORARY TABLE admin_work_area
        (startdate DATE,
         enddate DATE,
         class CHAR(20))
      ON COMMIT DELETE ROWS
      TABLESPACE tbs_t1;
```

DDL Script Writing-1

Bulk Data Load in a Table

```
FORALL i IN 1..numrecords
  INSERT /*+ APPEND_VALUES */ INTO orderdata
  VALUES(ordernum(i), custid(i), orderdate(i),shipmode(i), paymentid(i));
COMMIT;
```

DDL Script Writing-1

Alter Table

```
ALTER TABLE hr.admin_emp MOVE
      STORAGE ( INITIAL 20K
                NEXT 40K
                MINEXTENTS 2
                MAXEXTENTS 20
                PCTINCREASE 0 )
  TABLESPACE hr_tbs;

ALTER TABLE hr.admin_emp
      ADD (bonus NUMBER (7,2));
```

DDL Script Writing-1

Index with Tablespace

```
CREATE INDEX int_sales_index ON
int_salestable
(s_saledate, s_productid, s_custid)
TABLESPACE tbs_low_freq;
```

DDL Script Writing-1

DDL Partition Table

```
CREATE TABLE salestable
(s_productid NUMBER,
s_saledate DATE,
s_custid NUMBER,
s_totalprice NUMBER)
TABLESPACE users
PARTITION BY RANGE(s_saledate)
(PARTITION sal03q1 VALUES LESS THAN (TO_DATE('01-APR-2003', 'DD-MON-YYYY')),
PARTITION sal03q2 VALUES LESS THAN (TO_DATE('01-JUL-2003', 'DD-MON-YYYY')),
PARTITION sal03q3 VALUES LESS THAN (TO_DATE('01-OCT-2003', 'DD-MON-YYYY')),
PARTITION sal03q4 VALUES LESS THAN (TO_DATE('01-JAN-2004', 'DD-MON-YYYY')));
```

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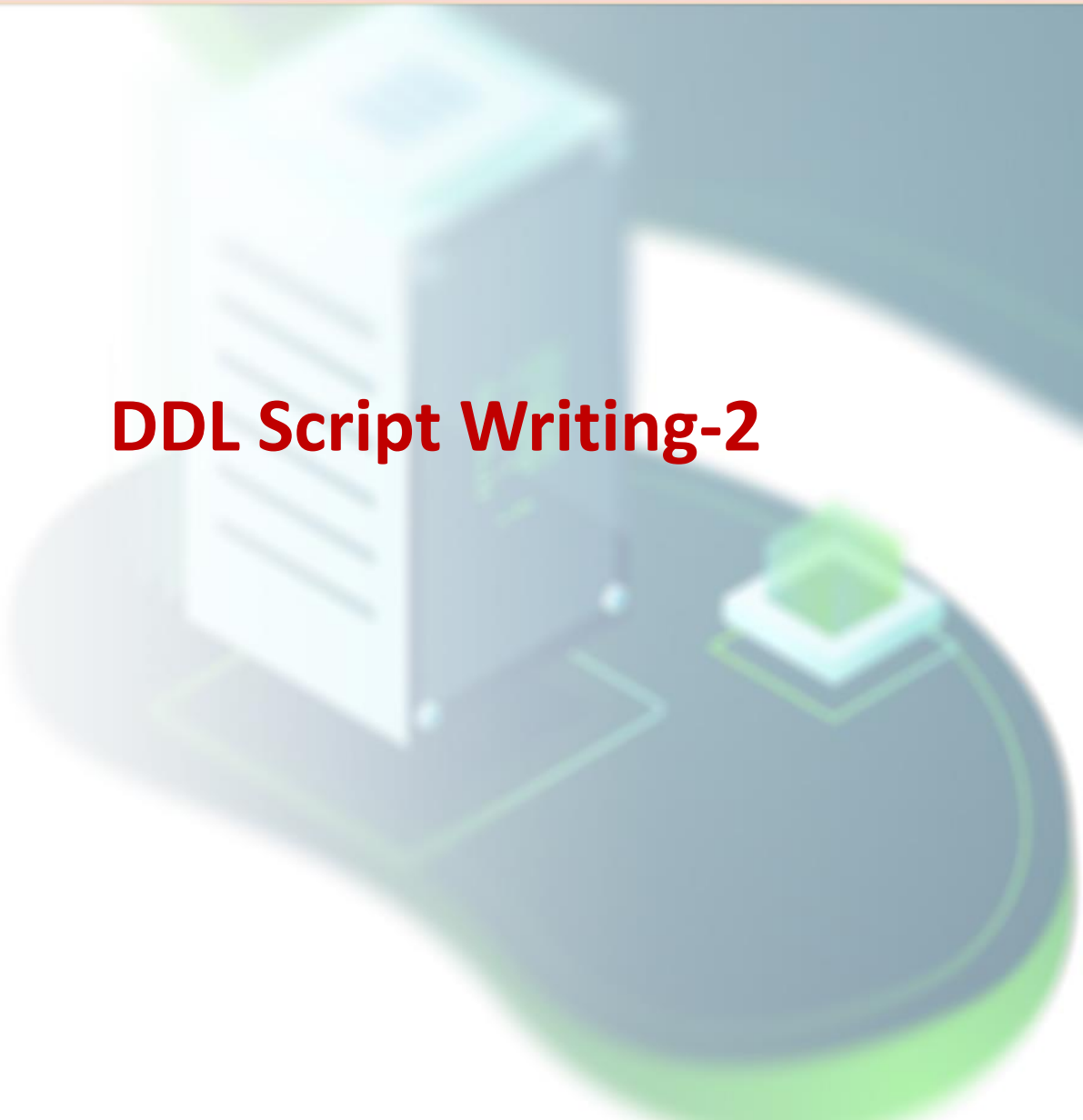


DDL Script Writing-2

DDL Script Writing-2

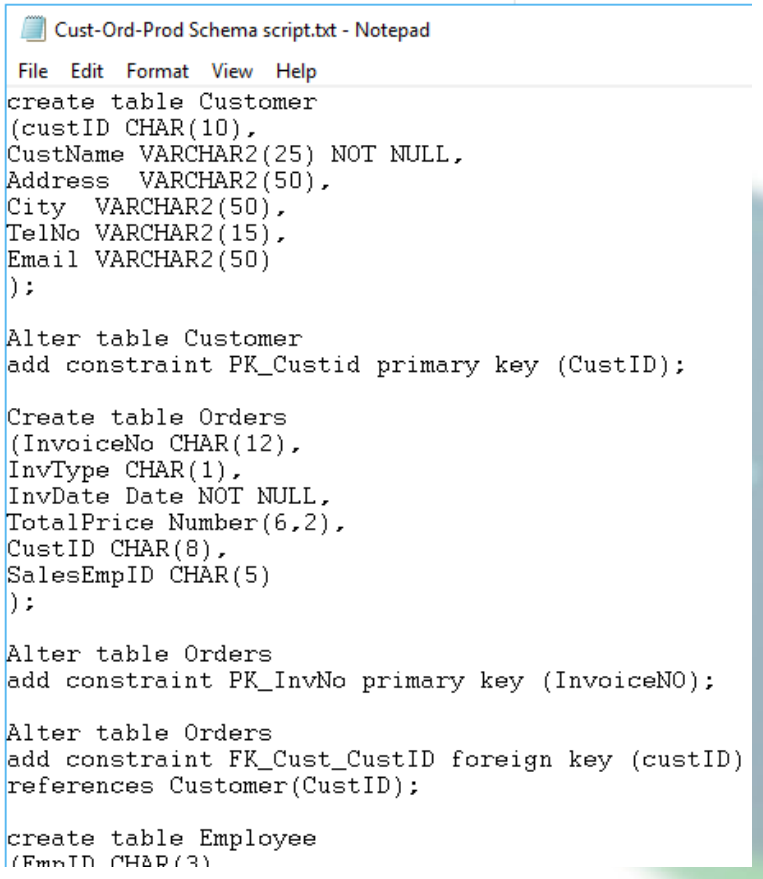
Script Writing

- Writing Script using Notepad
- Tables in an Order
- Drop Tables in an Order
- Other Schema Objects

DDL Script Writing-2

Writing Script using Notepad

- Script is a plain text structure of schema



DDL Script Writing-2

Tables in an Order

```
create table Customer
(custID          CHAR(10),
CustName         VARCHAR2(25) NOT NULL,
Address          VARCHAR2(50),
City             VARCHAR2(50),
TelNo            VARCHAR2(15),
Email            VARCHAR2(50) UNIQUE)
tablespace TS_Sales;

Alter table Customer
add constraint PK_Custid primary key (CustID);
```

DDL Script Writing-2

Tables in an Order

```
Create table Orders
(InvoiceNo      CHAR(12),
InvType         CHAR(1),
InvDate         Date NOT NULL,
TotalPrice      Number(6,2),
SalesEmpID      CHAR(5),
CustID          CHAR(8))
tablespace TS_Sales;

Alter table Orders
add constraint PK_InvNo primary key (InvoiceNO)
USING INDEX TABLESPACE Sale_indx;

Alter table Orders
add constraint FK_Cust_CustID foreign key (custID)
references Customer(CustID);
```

DDL Script Writing-2

Tables in an Order

```
create table Employee
(EmpID          CHAR(3),
EmpName         VARCHAR2(25) NOT NULL,
Address         VARCHAR2(50),
City            VARCHAR2(50),
TelNo           VARCHAR2(15),
Email           VARCHAR2(50) UNIQUE)
tablespace TS_Sales;

Alter table Employee
add constraint PK_EmpID primary key (EmpID)
USING INDEX TABLESPACE Sale_indx;

Alter table Orders
add constraint FK_Emp_EmpID foreign key (SalesEmpID)
references Employee(EmpID)
USING INDEX TABLESPACE Sale_indx;
```

DDL Script Writing-2

Tables in an Order

```
Create table Item
(ItemID          CHAR(5),
ItemName         VARCHAr2(50) NOT NULL,
PPrice           NUMBER(10,2),
TotQty           NUMBER(5),
Status           CHAR(1))
tablespace TS_Stock;

Alter table Item
add constraint PK_ItemID primary key (ItemID)
USING INDEX TABLESPACE Sale_indx;
```

DDL Script Writing-2

Tables in an Order

```
Create table Sold
(
ItemID          CHAR(5),
InvoiceNo       CHAR(12),
SPrice          NUMBER(10,2) Not Null,
SQty            NUMBER(10,2) Not Null)
tablespace TS_ItemSold;

Alter table Sold
add constraint PK_Sold primary key (ItemID, InvoiceNo)
USING INDEX TABLESPACE Sold_indx;

Alter table Sold
add constraint FK_Sold_ItemID foreign key (ItemID)
references Item(ItemID);

Alter table Sold
add constraint FK_Sold_InvoiceNo foreign key (InvoiceNo)
references Invoice(InvoiceNo);
```

DDL Script Writing-2

Drop Tables in an Order

```
Drop table Sold;
Drop table employee;
Drop table orders;
Drop table customer;
Drop table Item;
```

DDL Script Writing-2

Other Schema Objects

Script may contains other objects such as

Views
Sequences
Synonym
PL/SQL Triggers & Code
DML for sample data

End

Introduction to Database Administration

Drop Tables & Recycle Bin

Drop Tables & Recycle Bin

Overview of Segments

- Drop Tables
- Drop Tables Precautions
- Drop Tables Commands
- What is the Recycle Bin?
- Object Naming in Recycle Bin
- Enable & Disable the Recycle Bin
- Purging is the Recycle Bin
- Data Dictionary Views for Recycle Bin

Drop Tables & Recycle Bin

Drop Tables

- To drop a table that you no longer need, use the DROP TABLE statement. The table must be contained in your schema or you must have the DROP ANY TABLE system privilege.

Drop Tables & Recycle Bin

Drop Tables Precautions

- Dropping a table removes the table definition from the data dictionary. All rows of the table are no longer accessible.
- All indexes and triggers associated with a table are dropped.
- All views and PL/SQL program units dependent on a dropped table remain, yet become invalid (not usable).
- All synonyms for a dropped table remain, but return an error when used.

Drop Tables & Recycle Bin

Drop Tables Precautions

- All extents allocated for a table that is dropped are returned to the free space of the tablespace and can be used by any other object requiring new extents or new objects. All rows corresponding to a clustered table are deleted from the blocks of the cluster

Drop Tables & Recycle Bin

Drop Tables Commands

DROP TABLE hr.int_admin_emp;

- If the table to be dropped contains any primary or unique keys referenced by foreign keys of other tables and you intend to drop the FOREIGN KEY constraints of the child tables, then include the CASCADE clause in the DROP TABLE statement

DROP TABLE hr.admin_emp CASCADE CONSTRAINTS;

Drop Tables & Recycle Bin

Drop Tables Commands

If you should want to immediately release the space associated with the table at the time you issue the DROP TABLE statement, include the PURGE clause as shown in the following statement:

```
DROP TABLE hr.admin_emp PURGE;
```

Drop Tables & Recycle Bin

What is the Recycle Bin?

- The recycle bin is actually a data dictionary table containing information about dropped objects.
- Dropped tables and any associated objects such as indexes, constraints, nested tables, and the likes are not removed and still occupy space.
- They continue to count against user space quotas, until specifically purged from the recycle bin.
- SELECT * FROM RECYCLEBIN;

Drop Tables & Recycle Bin

```
SQL> select * from tab;

TNAME                          TABTYPE  CLUSTERID
------------------------------ ------- ----------
BIN$hllPRYaURGeQBtlLS4/DHg==$0 TABLE
BIN$pgI7NTBnRKSh+170M90xHg==$0 TABLE
BLOBS                          TABLE
BONUS                          TABLE
```

Object Naming in Recycle Bin

- The renaming convention is as follows:

  BIN$unique_id$version

- unique_id is a 26-character globally unique identifier for this object, which makes the recycle bin name unique across all databases
- Version is a version number assigned by the database

Drop Tables & Recycle Bin

Enable & Disable the Recycle Bin

To disable the recycle bin:

1. Issue one of the following statements:

```
ALTER SESSION SET recyclebin = OFF;

ALTER SYSTEM SET recyclebin = OFF SCOPE = SPFILE;
```

2. If you used `ALTER SYSTEM`, restart the database.

To enable the recycle bin:

1. Issue one of the following statements:

```
ALTER SESSION SET recyclebin = ON;

ALTER SYSTEM SET recyclebin = ON SCOPE = SPFILE;
```

2. If you used `ALTER SYSTEM`, restart the database.

Drop Tables & Recycle Bin

Purging is the Recycle Bin

- If you decide that you are never going to restore an item from the recycle bin, you can use the PURGE statement to remove the items and their associated objects from the recycle bin and release their storage space.

```
PURGE TABLE "BIN$jsleilx392mk2=293$0";
PURGE TABLESPACE example;
PURGE RECYCLEBIN;
```

Drop Tables & Recycle Bin

Data Dictionary Views for Recycle Bin

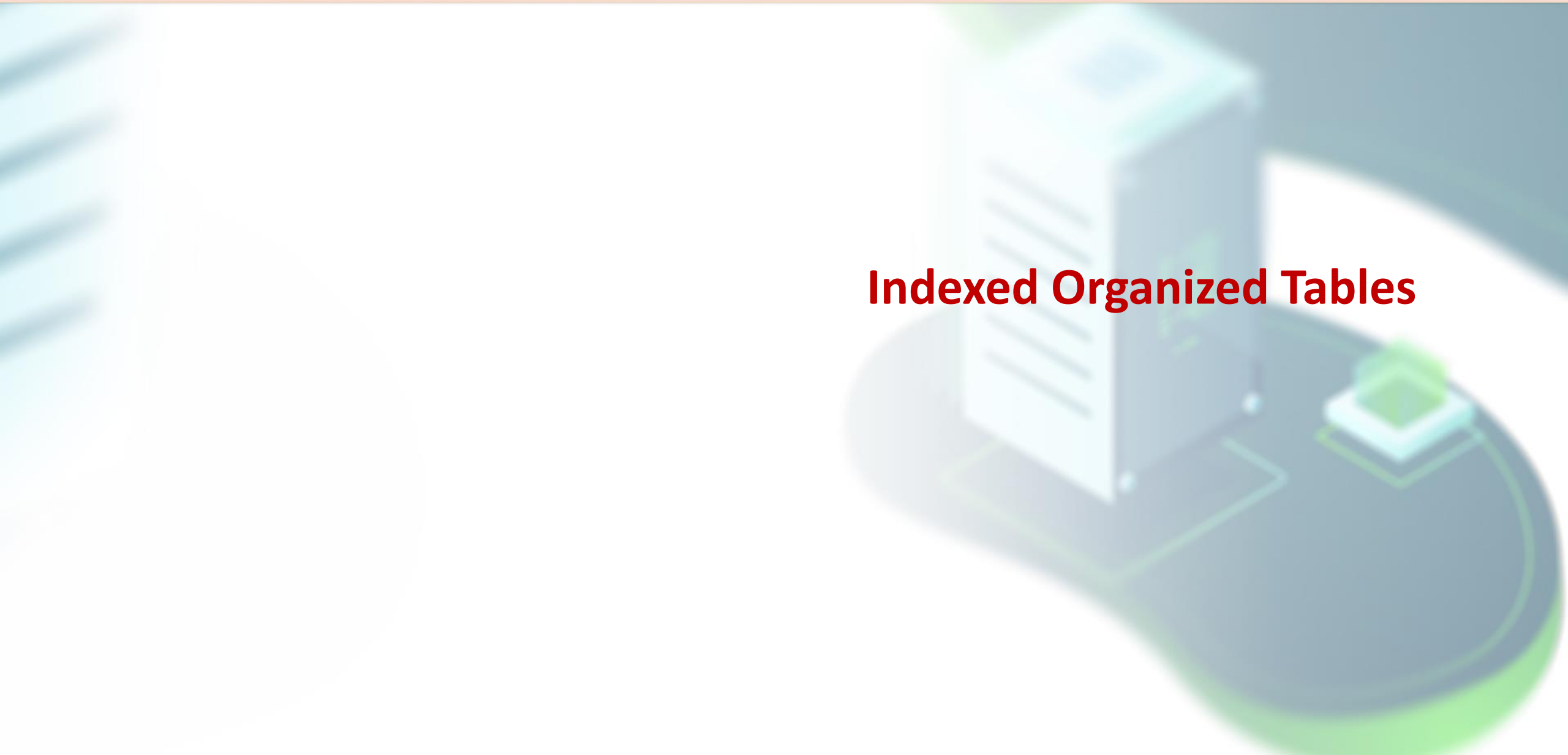
```
SELECT object_name, original_name FROM dba_recyclebin
   WHERE owner = 'HR';

OBJECT_NAME                    ORIGINAL_NAME
------------------------------ --------------------------------
BIN$yrMKlZaLMhfgNAgAIMenRA==$0 EMPLOYEES
```

You can also view the contents of the recycle bin using the SQL*Plus command `SHOW RECYCLEBIN`.

```
SQL> show recyclebin

ORIGINAL NAME    RECYCLEBIN NAME                OBJECT TYPE  DROP TIME
---------------- ------------------------------ ------------ -------------------
EMPLOYEES        BIN$yrMKlZaVMhfgNAgAIMenRA==$0 TABLE        2003-10-27:14:00:19
```



Indexed Organized Tables

Indexed Organized Tables

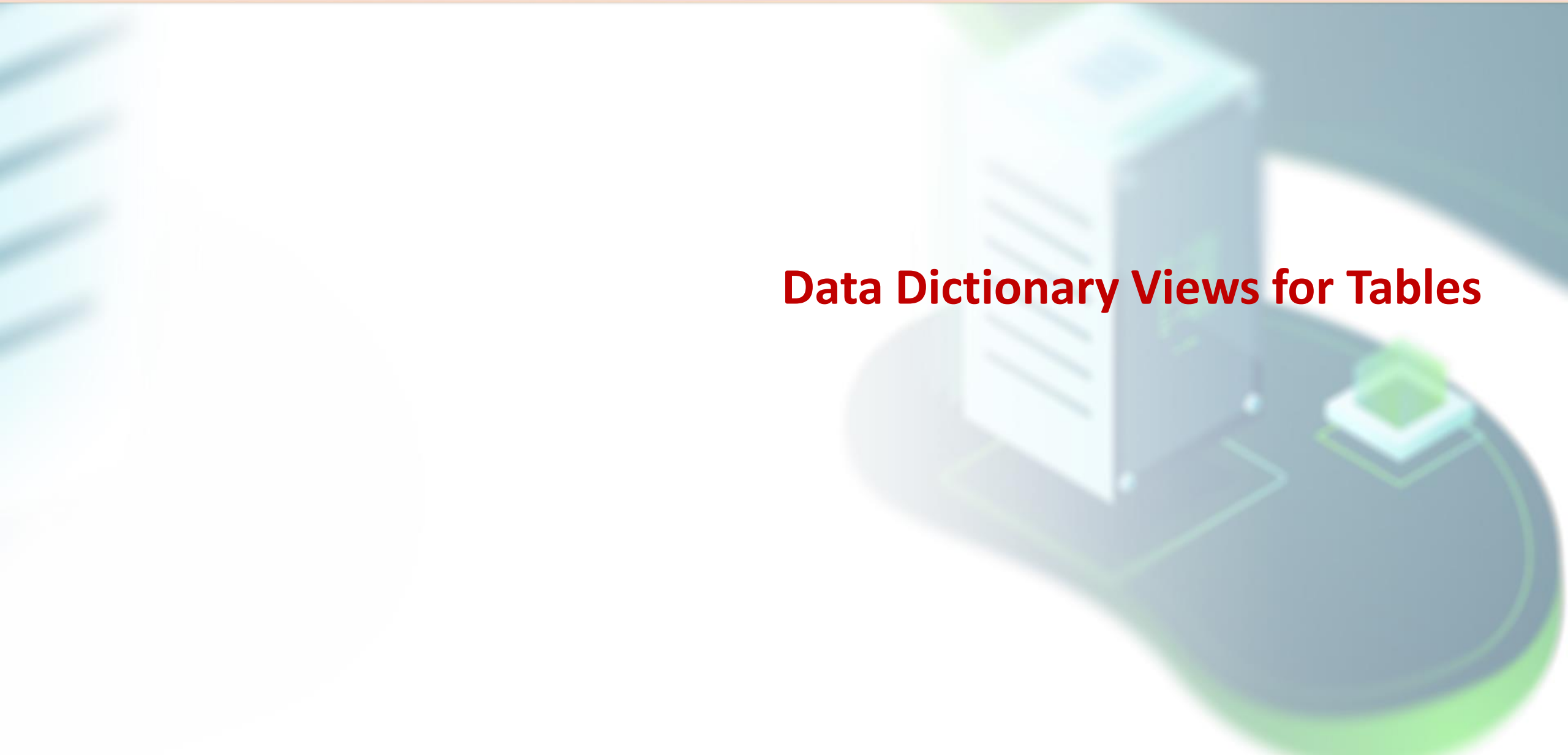
Overview of Segments

- Drop Tables

Indexed Organized Tables

Drop Tables

- To drop a table that you no longer need, use the DROP TABLE statement. The table must be contained in your schema or you must have the DROP ANY TABLE system privilege.



Data Dictionary Views for Tables

Data Dictionary Views for Tables

Integrity Constraints

- Three Types of Views
- Displaying Views for Tables
- Size of a Table
- Displaying Table's Constraints
- Displaying Table's Columns Details

Data Dictionary Views for Tables

Three Types of Views

- There are three types of Views to manage Tables related information:

  DBA_
  ALL_
  USER_

Data Dictionary Views for Tables

Displaying Views for Tables

- SQL statement to display Tables related Views:

```
Select Table_name
From Dict
Where Table_name like '%TAB%‘;
```

You can use following choices for more views:

```
Table_name like '%COL%'
Table_name like '%EXTERNAL%‘
Table_name like '%CONSTRAINT%'
```

Data Dictionary Views for Tables

Size of a Table

- To find size of table in MB

```
select sum(bytes)/1024/1024 SizeMB
from dba_segments
where segment_name ='EMP';
```

Data Dictionary Views for Tables

Displaying Table's Constraints

```
select u.constraint_name, u.CONSTRAINT_TYPE, substr(c.column_name,1,30) col_name
from user_constraints u, USER_CONS_COLUMNS c
where u.table_name='EMP'
and u.CONSTRAINT_TYPE = 'P'
and (u.table_name=c.table_name
and c.constraint_name=u.constraint_name);


CONSTRAINT_NAME                C COL_NAME
------------------------------ - ------------------------------
PK_EMP                         P EMPNO
```

Data Dictionary Views for Tables

Displaying Table's Columns Details

Column information, such as name, data type, length, precision, scale, and default data values can be listed using one of the views ending with the _COLUMNS suffix. For example, the following query lists all of the default column values for the emp and dept tables:

```
SELECT TABLE_NAME, COLUMN_NAME, DATA_TYPE, DATA_LENGTH, LAST_ANALYZED
FROM DBA_TAB_COLUMNS
WHERE OWNER = 'HR'
ORDER BY TABLE_NAME;
```

TABLE_NAME	COLUMN_NAME	DATA_TYPE	DATA_LENGTH	LAST_ANALYZED
COUNTRIES	COUNTRY_ID	CHAR	2	05-FEB-03
COUNTRIES	COUNTRY_NAME	VARCHAR2	40	05-FEB-03
COUNTRIES	REGION_ID	NUMBER	22	05-FEB-03
DEPARTMENTS	DEPARTMENT_ID	NUMBER	22	05-FEB-03

Introduction to Database Administration

Creating & Altering an Index

Creating & Altering an Index

Creating & Altering Index

- Altering Indexes
- Creating Indexes
- Creating & Alter Indexes
- Rebuild Index
- Making Index Visible/ Invisible
- Making Index Useable

Creating & Altering an Index

Altering Indexes

To alter an index, your schema must contain the index or you must have the ALTER ANY INDEX system privilege. With the ALTER INDEX statement, you can:

- Rebuild or coalesce an existing index
- Deallocate unused space or allocate a new extent Specify parallel execution (or not) and alter the degree of parallelism
- Alter storage parameters or physical attributes Specify LOGGING or NOLOGGING

Creating & Altering an Index

Creating Indexes

- Enable or disable key compression
- Mark the index unusable
- Make the index invisible
- Rename the index
- Start or stop the monitoring of index usage

Creating & Altering an Index

Creating Indexes

```
CREATE INDEX emp_ename ON
emp(ename)
TABLESPACE users
STORAGE (INITIAL 20K NEXT 20k);

CREATE UNIQUE INDEX
dept_unique_index ON dept (dname)
TABLESPACE indx;
```

Creating & Altering an Index

Creating & Alter Indexes

```
CREATE TABLE emp (
empno NUMBER(5) PRIMARY KEY,
age       INTEGER)
ENABLE PRIMARY KEY
USING INDEX TABLESPACE Work_Indx;

ALTER INDEX emp_ename
STORAGE (NEXT 40);
```

Creating & Altering an Index

Rebuild Index

You have the option of rebuilding the index online. Rebuilding online enables you to update base tables at the same time that you are rebuilding.
The following statement rebuilds the emp_name index online:

```
ALTER INDEX emp_name REBUILD ONLINE;
```

Creating & Altering an Index

Making Index Visible/ Invisible

An invisible index is ignored by the optimizer unless you explicitly set the OPTIMIZER_USE_INVISIBLE_INDEXES initialization parameter to TRUE at the session or system level. Making an index invisible is an alternative to making it unusable or dropping it.

ALTER INDEX *index* INVISIBLE;

ALTER INDEX *index* VISIBLE;

Creating & Altering an Index

Making Index Visible/ Invisible

An invisible index is ignored by the optimizer unless you explicitly set the OPTIMIZER_USE_INVISIBLE_INDEXES initialization parameter to TRUE at the session or system level. Making an index invisible is an alternative to making it unusable or dropping it.

ALTER INDEX *index* INVISIBLE;

ALTER INDEX *index* VISIBLE;

Creating & Altering an Index

Making Index Useable

Query the data dictionary to determine whether an existing index or index partition is usable or unusable.

```
SELECT INDEX_NAME AS "INDEX OR PART NAME",
STATUS, SEGMENT_CREATED
FROM USER_INDEXES
UNION ALL
SELECT PARTITION_NAME AS "INDEX OR PART NAME",
STATUS, SEGMENT_CREATED
FROM USER_IND_PARTITIONS;
```

INDEX OR PART NAME	STATUS	SEG
I_EMP_ENAME	N/A	N/A
JHIST_EMP_ID_ST_DATE_PK	VALID	YES
JHIST_JOB_IX	VALID	YES
JHIST_EMPLOYEE_IX	VALID	YES
JHIST_DEPARTMENT_IX	VALID	YES
EMP_EMAIL_UK	VALID	NO

.

Introduction to Database Administration

Recycle Bin

Recycle Bin

Schema Recycle Bin

- What is the Recycle Bin?
- What is the Recycle Bin?
- Object Naming the Recycle Bin
- Recycle Bin Tables
- Enable or Disable Recycle Bin
- Purging Objects in the Recycle Bin
- Restoring Objects From Recycle Bin
- Enable or Disable Recycle Bin

Recycle Bin

What is the Recycle Bin?

- The recycle bin is actually a data dictionary table containing information about dropped objects.
- Dropped tables and any associated objects such as indexes, constraints, nested tables, and the likes are not removed and still occupy space.

Recycle Bin

What is the Recycle Bin?

- They continue to count against user space quotas, until specifically purged from the recycle bin or the unlikely situation where they must be purged by the database because of tablespace space constraints.
- Each user can be thought of as having his own recycle bin, because, unless a user has the SYSDBA privilege.

SELECT * FROM RECYCLEBIN;

Recycle Bin

Object Naming the Recycle Bin

When a dropped table is moved to the recycle bin, the table and its associated objects are given system-generated names. This is necessary to avoid name conflicts that may arise if multiple tables have the same name. circumstances are:

- A user drops a table, re-creates it with the same name, then drops it again.
- Two users have tables with the same name, and both users drop their tables.

BIN$*unique_id*$*version*

Recycle Bin

Recycle Bin Tables

```
SQL> select * from tab;

TNAME                          TABTYPE  CLUSTERID
------------------------------ ------- ----------
BIN$hqQXpmBGSHeVHay6wPyUlQ==$0 TABLE
BIN$n4XwANZSS3mT8l+SHf6gGA==$0 TABLE
BONUS                          TABLE
DEPT                           TABLE
EMP                            TABLE
SALGRADE                       TABLE

6 rows selected.
```

Recycle Bin

Enable or Disable Recycle Bin

To disable the recycle bin:

1. Issue one of the following statements:

```
ALTER SESSION SET recyclebin = OFF;

ALTER SYSTEM SET recyclebin = OFF SCOPE = SPFILE;
```

2. If you used `ALTER SYSTEM`, restart the database.

To enable the recycle bin:

1. Issue one of the following statements:

```
ALTER SESSION SET recyclebin = ON;

ALTER SYSTEM SET recyclebin = ON SCOPE = SPFILE;
```

2. If you used `ALTER SYSTEM`, restart the database.

Ref. DBA E25494 Oracle11g.pdf pp. 20-58

Recycle Bin

Purging Objects in the Recycle Bin

If you decide that you are never going to restore an item from the recycle bin, you can use the PURGE statement to remove the items and their associated objects from the recycle bin and release their storage space. You need the same privileges as if you were dropping the item.

```
PURGE TABLE "BIN$jsleilx392mk2=293$0";
PURGE TABLESPACE example;
PURGE TABLESPACE example USER oe;
```

Recycle Bin

Restoring Objects From Recycle Bin

The following example restores int_admin_emp table and assigns to it a new name:

```
FLASHBACK TABLE int_admin_emp TO
BEFORE DROP
RENAME TO
int2_admin_emp;
```

Recycle Bin

Enable or Disable Recycle Bin

```
SELECT object_name, original_name FROM dba_recyclebin
   WHERE owner = 'HR';

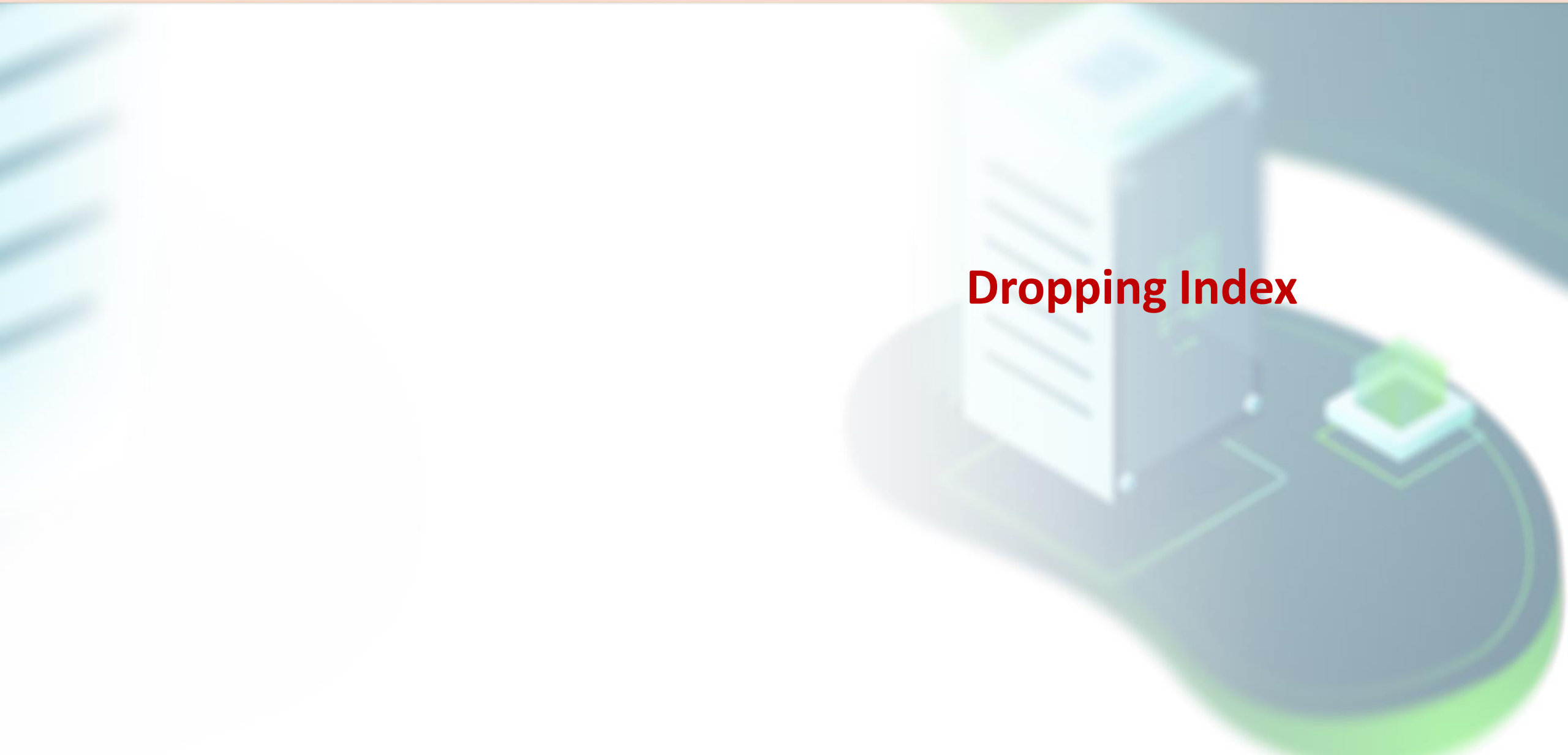
OBJECT_NAME                    ORIGINAL_NAME
------------------------------ --------------------------------
BIN$yrMKlZaLMhfgNAgAIMenRA==$0 EMPLOYEES
```

You can also view the contents of the recycle bin using the SQL*Plus command SHOW RECYCLEBIN.

```
SQL> show recyclebin

ORIGINAL NAME    RECYCLEBIN NAME                OBJECT TYPE  DROP TIME
---------------- ------------------------------ ------------ -------------------
EMPLOYEES        BIN$yrMKlZaVMhfgNAgAIMenRA==$0 TABLE        2003-10-27:14:00:19
```

Ref. DBA E25494 Oracle11g.pdf pp. 20-59



Dropping Index

Dropping Index

Dropping Index

- Dropping Index
- Reasons for Dropping Index
- Extents for Index
- SQL for Dropping Index
- When not to Drop Index

Dropping Index

Dropping Index

To drop an index, the index must be contained in your schema, or you must have the DROP ANY INDEX system privilege.

Dropping Index

Reasons for Dropping Index

Some reasons for dropping an index include:

- The index is no longer required.
- The index is not providing anticipated performance improvements for queries issued against the associated table. For example, the table might be very small, or there might be many rows in the table but very few index entries.

Dropping Index

Reasons for Dropping Index

- Applications do not use the index to query the data.
- The index has become invalid and must be dropped before being rebuilt.
  The index has become too fragmented and must be dropped before being rebuilt.

Dropping Index

Extents for Index

- When you drop an index, all extents of the index segment are returned to the containing tablespace and become available for other objects in the tablespace.

Dropping Index

SQL for Dropping Index

The following statement drops the emp_ename index:

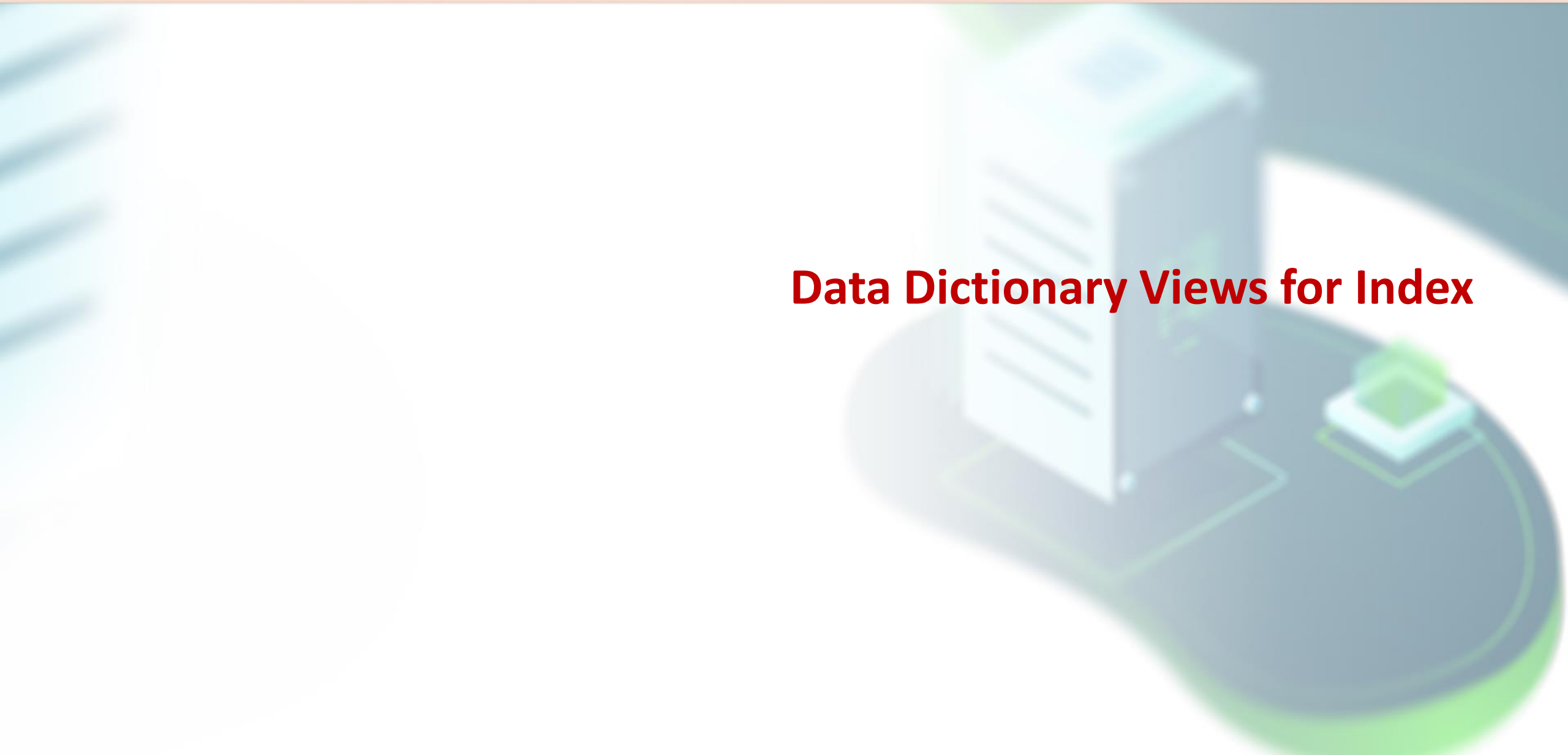
```
DROP INDEX emp_ename;
```

Dropping Index

When not to Drop Index

You cannot drop only the index associated with an enabled UNIQUE key or PRIMARY KEY constraint. To drop a constraints associated index, you must disable or drop the constraint itself.

End



Data Dictionary Views for Index

Data Dictionary Views for Index

Data Dictionary Views

- Three Types of Views
- Displaying Views for Indexes
- Display Index Name
- Displaying Index on Table's Column
- Displaying Index's Columns Details

Data Dictionary Views for Index

Three Types of Views

- There are three types of Views to manage Index related information:

  DBA_
  ALL_
  USER_

Data Dictionary Views for Index

Displaying Views for Indexes

- SQL statement to display Indexes related Views:

```
Select Table_name
From Dict
Where Table_name like '%IND%';
```

You can use following views as well:
INDEX_STATS
INDEX_HISTOGRAM
V$OBJECT_USAGE

Data Dictionary Views for Index

Display Index Name

- To find table which contains Index

```
SQL> set linesize100
SQL> select index_name, index_type, Table_name
  2  from user_indexes
  3  where Table_name = 'EMP';

INDEX_NAME                     INDEX_TYPE                  TABLE_NAME
------------------------------ --------------------------- -----------
PK_EMP                         NORMAL                      EMP
```

Data Dictionary Views for Index

Displaying Index on Table's Column

```
SQL> select i.index_name, i.index_type, substr(c.column_name, 1, 20) col_name
  2  from user_indexes i, user_ind_columns c
  3  where i.Table_name = 'EMP'
  4  and i.table_name=c.table_name;

INDEX_NAME                     INDEX_TYPE                     COL_NAME
------------------------------ ------------------------------ --------------------
PK_EMP                         NORMAL                         EMPNO
```

Data Dictionary Views for Index

Displaying Index's Columns Details

```
create index ind_name on EMP(ename);

select i.index_name, i.index_type, substr(c.column_name, 1, 20) col_name
from user_indexes i, user_ind_columns c
where i.Table_name = 'EMP'
and i.table_name=c.table_name
and i.index_name=c.index_name;
```

INDEX_NAME	INDEX_TYPE	COL_NAME
IND_NAME	NORMAL	ENAME
PK_EMP	NORMAL	EMPNO

Defining Clusters

Defining Clusters

Clusters

- What is a Cluster?
- Cluster Key
- Choosing Appropriate Tables for Cluster
- Appropriate Column for Cluster

Defining Clusters

What is a Cluster?

A cluster provides an optional method of storing table data. A cluster is made up of a group of tables that share the same data blocks. The tables are grouped together because they share common columns and are often used together.
For example, the
emp and dept table share the deptno column. When you cluster the emp and dept tables, Oracle stores all rows for each department from both the emp and dept tables in the same data blocks.

Defining Clusters

What is a Cluster?

A cluster provides an optional method of storing table data. A cluster is made up of a group of tables that share the same data blocks. The tables are grouped together because they share common columns and are often used together.
For example, the
emp and dept table share the deptno column. When you cluster the emp and dept tables, Oracle stores all rows for each department from both the emp and dept tables in the same data blocks.

Defining Clusters

Cluster Key

The **cluster key** is the column, or group of columns, that the clustered tables have in common. You specify the columns of the cluster key when creating the cluster.

You subsequently specify the same columns when creating every table added to the cluster. Each cluster key value is stored only once each in the cluster and the cluster index, no matter how many rows of different tables contain the value.

Defining Clusters

Cluster Key

- After creating a cluster, you can create tables in the cluster. However, before any rows can be inserted into the clustered tables, a cluster index must be created.
- Using clusters does not affect the creation of additional indexes on the clustered tables; they can be created and dropped as usual.

Defining Clusters

Choosing Appropriate Tables for Cluster

- Use clusters for tables for which the following conditions are true:
- The tables are primarily queried--that is, tables that are *not* predominantly inserted into or updated.
- Records from the tables are frequently queried together or joined.

Defining Clusters

Appropriate Column for Cluster

- Choose cluster key columns carefully. If multiple columns are used in queries that join the tables, make the cluster key a composite key.
- In general, the characteristics that indicate a good cluster index are the same as those for any index.

End

Introduction to Database Administration

Create & Alter Clusters

Create & Alter Clusters

- Creating a Cluster
- SQL DDL Command for Cluster
- Creating a Table in a Cluster
- Creating Cluster using SQL
- Altering Clusters
- Dropping Clusters

Create & Alter Clusters

Creating a Cluster

To create a cluster in your schema, you must have the CREATE CLUSTER system privilege and a quota for the tablespace intended to contain the cluster or the UNLIMITED TABLESPACE system privilege.

To create a cluster in another user's schema you must have the CREATE ANY CLUSTER system privilege, and the owner must have a quota for the tablespace intended to contain the cluster or the UNLIMITED TABLESPACE system privilege.

Create & Alter Clusters

SQL DDL Command for Cluster

```
CREATE CLUSTER emp_dept
(deptno NUMBER(3))
SIZE 600
TABLESPACE users
STORAGE (INITIAL 200K NEXT 300K
MINEXTENTS 2 PCTINCREASE 33);
```

Create & Alter Clusters

Creating a Table in a Cluster

To create a table in a cluster, you must have either the CREATE TABLE or CREATE ANY TABLE system privilege. You do not need a tablespace quota or the UNLIMITED TABLESPACE system privilege to create a table in a cluster.

Create & Alter Clusters

Creating Cluster using SQL

```
CREATE TABLE emp (
empno NUMBER(5) PRIMARY KEY,
ename VARCHAR2(15) NOT NULL,
. . .
deptno NUMBER(3) REFERENCES dept)
CLUSTER emp_dept (deptno);

CREATE TABLE dept (
deptno NUMBER(3) PRIMARY KEY, . . . )
CLUSTER emp_dept (deptno);
```

Create & Alter Clusters

Altering Clusters

- To alter a cluster, your schema must contain the cluster or you must have the ALTER ANY CLUSTER system privilege. You can alter an existing cluster to change the following settings:
- Physical attributes (INITRANS and storage characteristics)
- The average amount of space required to store all the rows for a cluster key value (SIZE)
- The default degree of parallelism

Create & Alter Clusters

Altering Clusters

- To alter a cluster, your schema must contain the cluster or you must have the ALTER ANY CLUSTER system privilege. You can alter an existing cluster to change the following settings:
- Physical attributes (INITRANS and storage characteristics)
- The average amount of space required to store all the rows for a cluster key value (SIZE)
- The default degree of parallelism

Create & Alter Clusters

Dropping Clusters

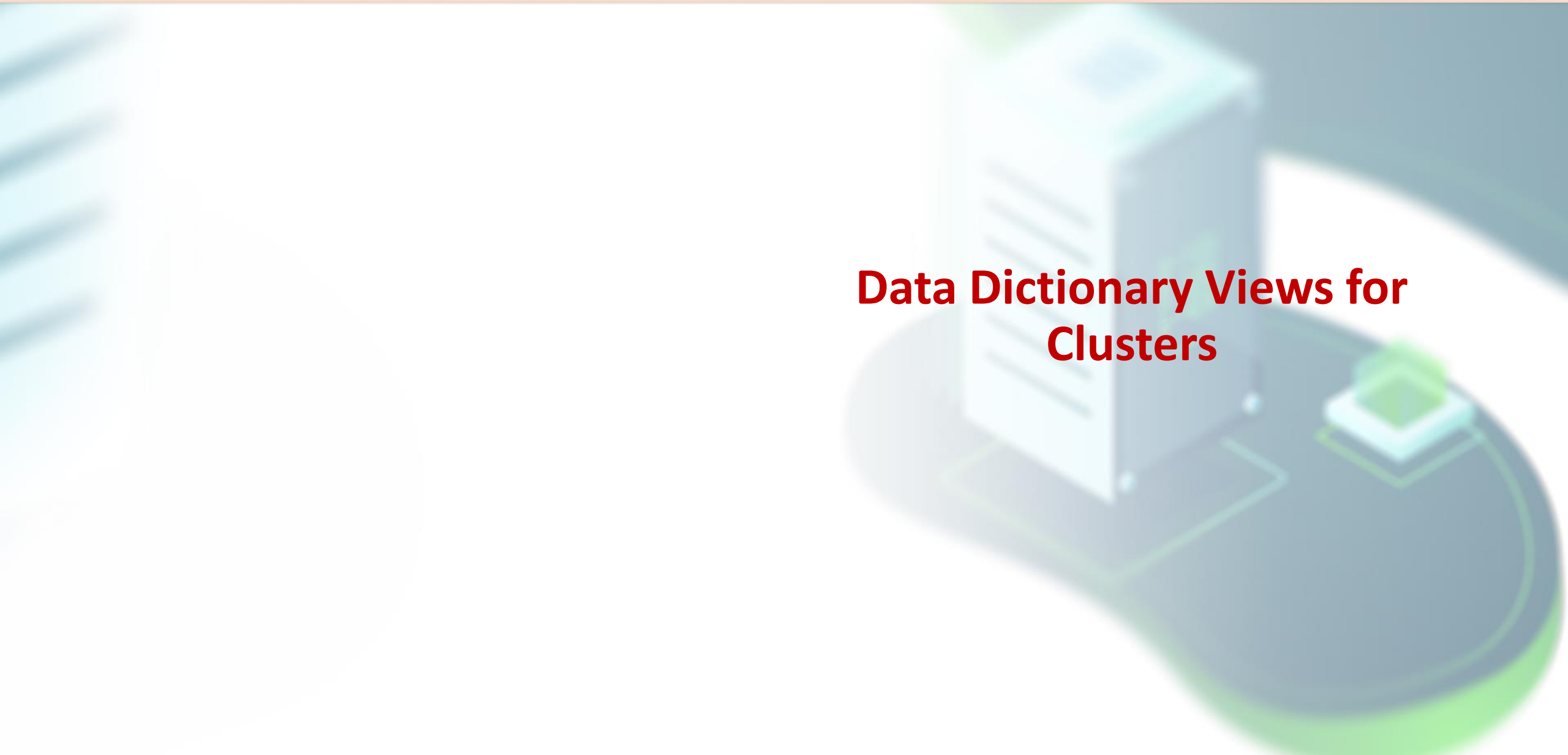
- To alter a cluster, your schema must contain the cluster or you must have the ALTER ANY CLUSTER system privilege. You can alter an existing cluster to change the following settings:
- Physical attributes (INITRANS and storage characteristics)
- The average amount of space required to store all the rows for a cluster key value (SIZE)
- The default degree of parallelism

Create & Alter Clusters

Dropping Clusters

- DROP CLUSTER emp_dept INCLUDING TABLES;
- DROP CLUSTER emp_dept INCLUDING TABLES CASCADE CONSTRAINTS;

End



Data Dictionary Views for Clusters

Data Dictionary Views for Clusters

Data Dictionary Views

- Three Types of Views
- Displaying Views for Clusters
- Display Cluster's Details
- Displaying Cluster on Table's Column

Data Dictionary Views for Clusters

Three Types of Views

- There are three types of Views to manage Cluster related information:

  DBA_
  ALL_
  USER_

Data Dictionary Views for Clusters

Displaying Views for Clusters

- SQL statement to display Indexes related Views:

```
Select Table_name
From Dict
Where Table_name like '%CLU%';
```

You can use following views as well:
DBA_CLU_COLUMNS
USER_CLU_COLUMNS

Data Dictionary Views for Clusters

Display Cluster's Details

- To find cluster's information

```
SQL> conn sys / as sysdba
Enter password:
Connected.
SQL> select cluster_name, Tablespace_name, cache
  2  from user_clusters;

CLUSTER_NAME                   TABLESPACE_NAME                CACHE
------------------------------ ------------------------------ -----
C_USER#                        SYSTEM                             N
C_TS#                          SYSTEM                             N
C_TOID_VERSION#                SYSTEM                             N
C_RG#                          SYSTEM                             N
C_OBJ#_INTCOL#                 SYSTEM                             N
C_OBJ#                         SYSTEM                             N
C_MLOG#                        SYSTEM                             N
C_FILE#_BLOCK#                 SYSTEM                             N
C_COBJ#                        SYSTEM                             N
SMON_SCN_TO_TIME_AUX           SYSAUX                             N

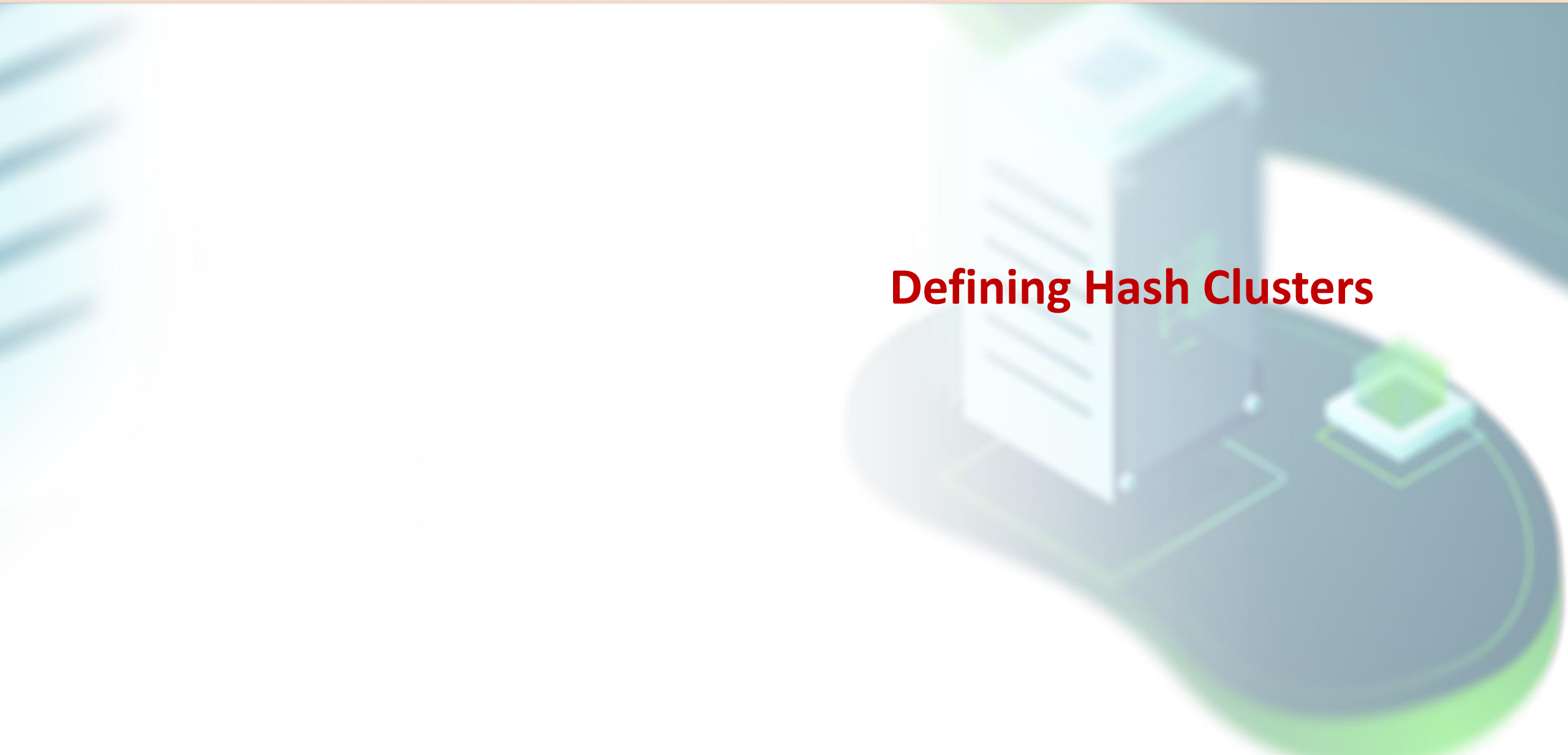
10 rows selected.
```

Data Dictionary Views for Clusters

Displaying Cluster on Table's Column

```
SQL> select c.cluster_name, c.Tablespace_name, c.cluster_name, cc.clu_column_name
  2  from user_clusters c, user_clu_columns cc
  3  where c.cluster_name=cc.cluster_name;

CLUSTER_NAME                   TABLESPACE_NAME                CLUSTER_NAME                   CLU_COLUMN_NAME
------------------------------ ------------------------------ ------------------------------ ---------------
---
C_COBJ#                        SYSTEM                         C_COBJ#                        OBJ#
C_COBJ#                        SYSTEM                         C_COBJ#                        OBJ#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGFILE#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGBLOCK#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 TS#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGFILE#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGBLOCK#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 TS#
```



Defining Hash Clusters

Defining Hash Clusters

Hash Clusters

- What is a Hash Cluster?
- Finding Rows in Index or Cluster?
- Situation where useful Hashing
- Creating Hash Clusters
- Querying Hash Clusters

Defining Hash Clusters

What is a Hash Cluster?

- Storing a table in a hash cluster is an optional way to improve the performance of data retrieval.
- A hash cluster provides an alternative to a non-clustered table with an index or an index cluster.
- With an indexed table or index cluster, Oracle Database locates the rows in a table using key values that the database stores in a separate index.

Defining Hash Clusters

What is a Hash Cluster?

- To use hashing, you create a hash cluster and load tables into it. The database physically stores the rows of a table in a hash cluster and retrieves them according to the results of a **hash function**.
- Oracle Database uses a hash function to generate a distribution of numeric values, called **hash values**, that are based on specific cluster key values.

Defining Hash Clusters

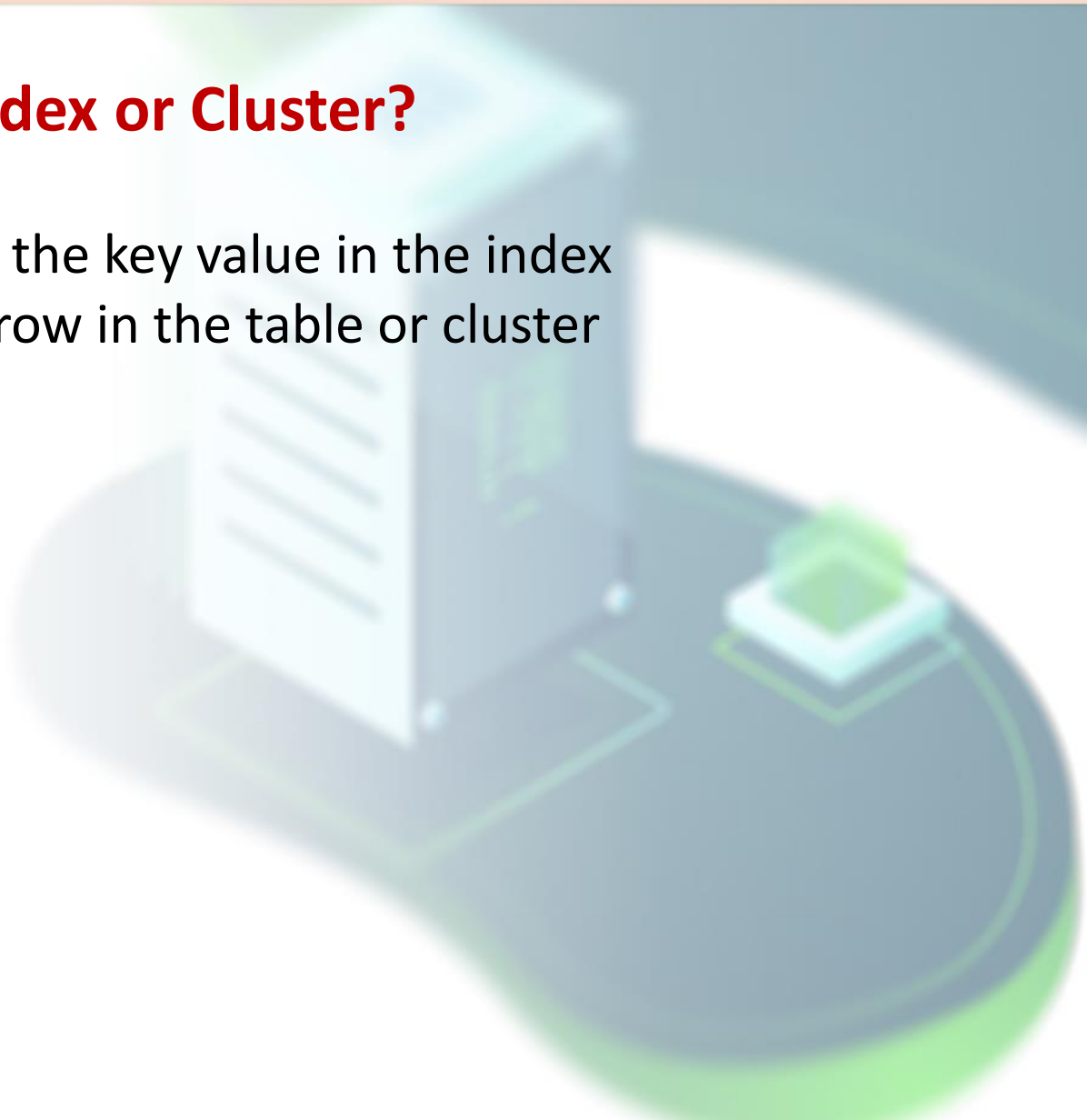
What is a Hash Cluster?

- The key of a hash cluster, like the key of an index cluster, can be a single column or composite key (multiple column key).
- To find or store a row in a hash cluster, the database applies the hash function to the cluster key value of the row.
- The resulting hash value corresponds to a data block in the cluster, which the database then reads or writes on behalf of the issued statement.

Defining Hash Clusters

Finding Rows in Index or Cluster?

- One or more I/Os to find or store the key value in the index
- Another I/O to read or write the row in the table or cluster



Defining Hash Clusters

Situation where useful Hashing

- Most queries are equality queries on the cluster key:

```
SELECT ... WHERE cluster_key = ...;
```

In such cases, the cluster key in the equality condition is hashed, and the corresponding hash key is usually found with a single read. In comparison, for an indexed table the key value must first be found in the index, and then the row is read from the table (another read).

Defining Hash Clusters

Situation where useful Hashing

- The tables in the hash cluster are primarily static in size so that you can determine the number of rows and amount of space required for the tables in the cluster. If tables in a hash cluster require more space than the initial allocation for the cluster, performance degradation can be substantial because overflow blocks are required.

Defining Hash Clusters

Creating Hash Clusters

```
CREATE CLUSTER trial_cluster ( trialno
NUMBER(5,0) )
TABLESPACE users
STORAGE ( INITIAL 250K
          NEXT 50K
          MINEXTENTS 1
          MAXEXTENTS 3
          PCTINCREASE 0 )
HASH IS trialno
HASHKEYS 150;
```

Defining Hash Clusters

Creating Hash Clusters

The following statement creates the trial table in the trial_cluster hash cluster:

```
CREATE TABLE trial (
trialno NUMBER(5,0) PRIMARY KEY,
...
)
CLUSTER trial_cluster (trialno);
```

Defining Hash Clusters

Querying Hash Clusters

```
TELEPHONE_NUMBER CALL_TIMESTAMP CALL_DURATION OTHER_INFO
---------------- -------------- ------------- --------------------------
      6505551212              0             9 misc info
      6505551212              1            17 misc info
      6505551212              2             5 misc info
      6505551212              3            90 misc info

Execution Plan
----------------------------------------------------------
Plan hash value: 2118876266

-------------------------------------------------------------------------
| Id  | Operation         | Name        | Rows  | Bytes | Cost (%CPU)|
-------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |             |     1 |    56 |     0   (0)|
|*  1 |  TABLE ACCESS HASH| CALL_DETAIL |     1 |    56 |            |
-------------------------------------------------------------------------
```

Creating & Altering Hash Clusters

Creating & Altering Hash Clusters

- Creating Hash Clusters
- Querying Hash Clusters
- Estimating Hash Clusters Size
- Altering Hash Clusters
- Dropping Hash Clusters

Creating & Altering Hash Clusters

Creating Hash Clusters

```
CREATE CLUSTER trial_cluster ( trialno
NUMBER(5,0) )
TABLESPACE users
STORAGE ( INITIAL 250K
          NEXT 50K
          MINEXTENTS 1
          MAXEXTENTS 3
          PCTINCREASE 0 )
HASH IS trialno
HASHKEYS 150;
```

Creating & Altering Hash Clusters

Creating Hash Clusters

The following statement creates the trial table in the trial_cluster hash cluster:

```
CREATE TABLE trial (
trialno NUMBER(5,0) PRIMARY KEY,
...
)
CLUSTER trial_cluster (trialno);
```

Creating & Altering Hash Clusters

Querying Hash Clusters

```
TELEPHONE_NUMBER CALL_TIMESTAMP CALL_DURATION OTHER_INFO
---------------- -------------- ------------- --------------------------
      6505551212              0             9 misc info
      6505551212              1            17 misc info
      6505551212              2             5 misc info
      6505551212              3            90 misc info

Execution Plan
----------------------------------------------------------
Plan hash value: 2118876266

-------------------------------------------------------------------------
| Id  | Operation          | Name        | Rows  | Bytes | Cost (%CPU)|
-------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |             |     1 |    56 |     0   (0)|
|*  1 |  TABLE ACCESS HASH| CALL_DETAIL |     1 |    56 |            |
-------------------------------------------------------------------------
```

Creating & Altering Hash Clusters

Estimating Hash Clusters Size

Example:

```
STORAGE (INITIAL 100K
         NEXT 150K
         MINEXTENTS 1
         PCTINCREASE 0)
SIZE 1500
HASHKEYS 100
```

In this example, only one hash key can be assigned for each data block. Therefore, the initial space required for the hash cluster is at least 100*2K or 200K.

Creating & Altering Hash Clusters

Altering Hash Clusters

You can alter a hash cluster with the ALTER CLUSTER statement:

ALTER CLUSTER emp_dept . . . ;

The implications for altering a hash cluster are identical to those for altering an index cluster, described in. However, the SIZE, HASHKEYS, "Altering Clusters" on page 22-6 and HASH IS parameters cannot be specified in an ALTER CLUSTER statement. To change these parameters, you must re-create the cluster, then copy the data from the original cluster.

Creating & Altering Hash Clusters

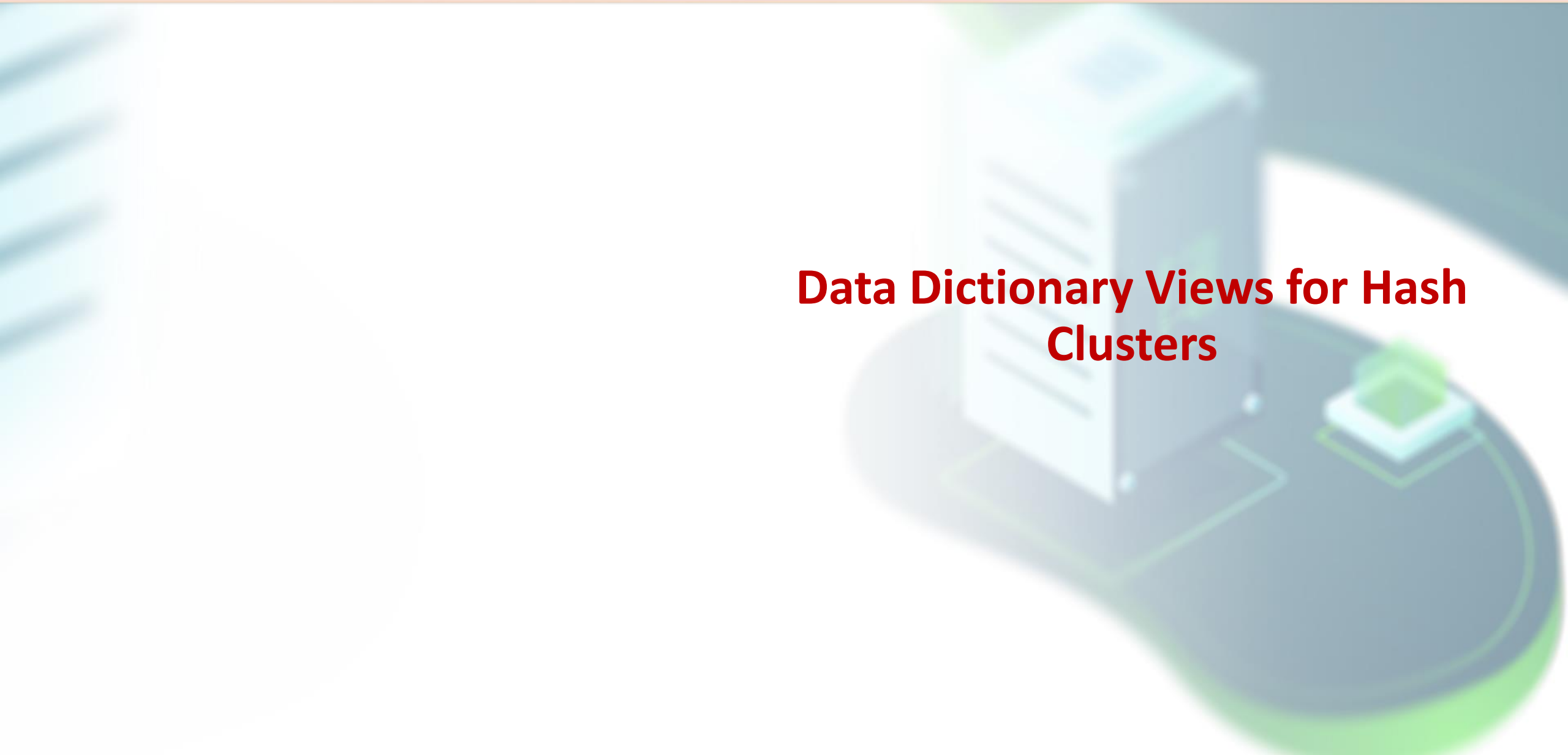
Dropping Hash Clusters

You can drop a hash cluster using the DROP CLUSTER statement:

DROP CLUSTER emp_dept;

A table in a hash cluster is dropped using the DROP TABLE statement. The implications of dropping hash clusters and tables in hash clusters are the same as those for dropping index clusters.

End



Data Dictionary Views for Hash Clusters

Data Dictionary Views for Hash Clusters

Data Dictionary Views

- Three Types of Views
- Displaying Views for Hash Clusters
- Display Hash or just Cluster's Details
- Displaying Cluster on Table's Column

Data Dictionary Views for Hash Clusters

Three Types of Views

- There are three types of Views to manage Hash Cluster related information:

  DBA_
  ALL_
  USER_

Data Dictionary Views for Hash Clusters

Displaying Views for Hash Clusters

- SQL statement to display Indexes related Views:

```
Select Table_name
From Dict
Where Table_name like '%SYN%';
```

You can use following views as well:
DBA_UPDATABLE_COLUMNS
ALL_UPDATABLE_COLUMNS
USER_UPDATABLE_COLUMNS

Data Dictionary Views for Hash Clusters

Display Hash or just Cluster's Details

- To find cluster's information

```
SQL> conn sys / as sysdba
Enter password:
Connected.
SQL> select cluster_name, Tablespace_name, cache
  2  from user_clusters;

CLUSTER_NAME                   TABLESPACE_NAME                CACHE
------------------------------ ------------------------------ -----
C_USER#                        SYSTEM                             N
C_TS#                          SYSTEM                             N
C_TOID_VERSION#                SYSTEM                             N
C_RG#                          SYSTEM                             N
C_OBJ#_INTCOL#                 SYSTEM                             N
C_OBJ#                         SYSTEM                             N
C_MLOG#                        SYSTEM                             N
C_FILE#_BLOCK#                 SYSTEM                             N
C_COBJ#                        SYSTEM                             N
SMON_SCN_TO_TIME_AUX           SYSAUX                             N

10 rows selected.
```

Data Dictionary Views for Hash Clusters

Displaying Cluster on Table's Column

```
SQL> select c.cluster_name, c.Tablespace_name, c.cluster_name, cc.clu_column_name
  2  from user_clusters c, user_clu_columns cc
  3  where c.cluster_name=cc.cluster_name;

CLUSTER_NAME                   TABLESPACE_NAME                CLUSTER_NAME                   CLU_COLUMN_NAME
------------------------------ ------------------------------ ------------------------------ ---------------
---
C_COBJ#                        SYSTEM                         C_COBJ#                        OBJ#
C_COBJ#                        SYSTEM                         C_COBJ#                        OBJ#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGFILE#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGBLOCK#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 TS#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGFILE#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 SEGBLOCK#
C_FILE#_BLOCK#                 SYSTEM                         C_FILE#_BLOCK#                 TS#
```

Introduction to Database Administration

Defining & Managing Views

Defining & Managing Views

- How a Schema is Created?
- How a Schema is Implemented?
- Simple & Complex Views
- SQL Practices on Views

Defining & Managing Views

How a Schema is Created?

- We have studied that DBA has to create default Tablespace and assign temporary Tablespace with storage in terms of data files.
- Create first user (owner of schema) with grants such as rights and privileges.
- We will cover schema objects Tables and Views.
- Ref. DBA-73

Defining & Managing Views

How a Schema is Implemented?

- A view is a logical representation of a table or combination of tables.
- In essence, a view is a stored query.
- A view derives its data from the tables on which it is based.
- These tables are called base tables. Base tables might in turn be actual tables or might be views themselves.
- All operations performed on a view actually affect the base table of the view.

Defining & Managing Views

How a Schema is Implemented?

- You can use views in almost the same way as tables. You can query, update, insert into, and delete from views, just as you can standard tables.
- Views can provide a different representation (such as subsets or supersets) of the data that resides within other tables and views.
- Views can be Simple or Complex
- Views can be used for security purposes
- View does not contain its own data

Defining & Managing Views

Simple & Complex Views

```
CREATE VIEW sales_staff AS
SELECT empno, ename, deptno
FROM emp
WHERE deptno = 10;
```

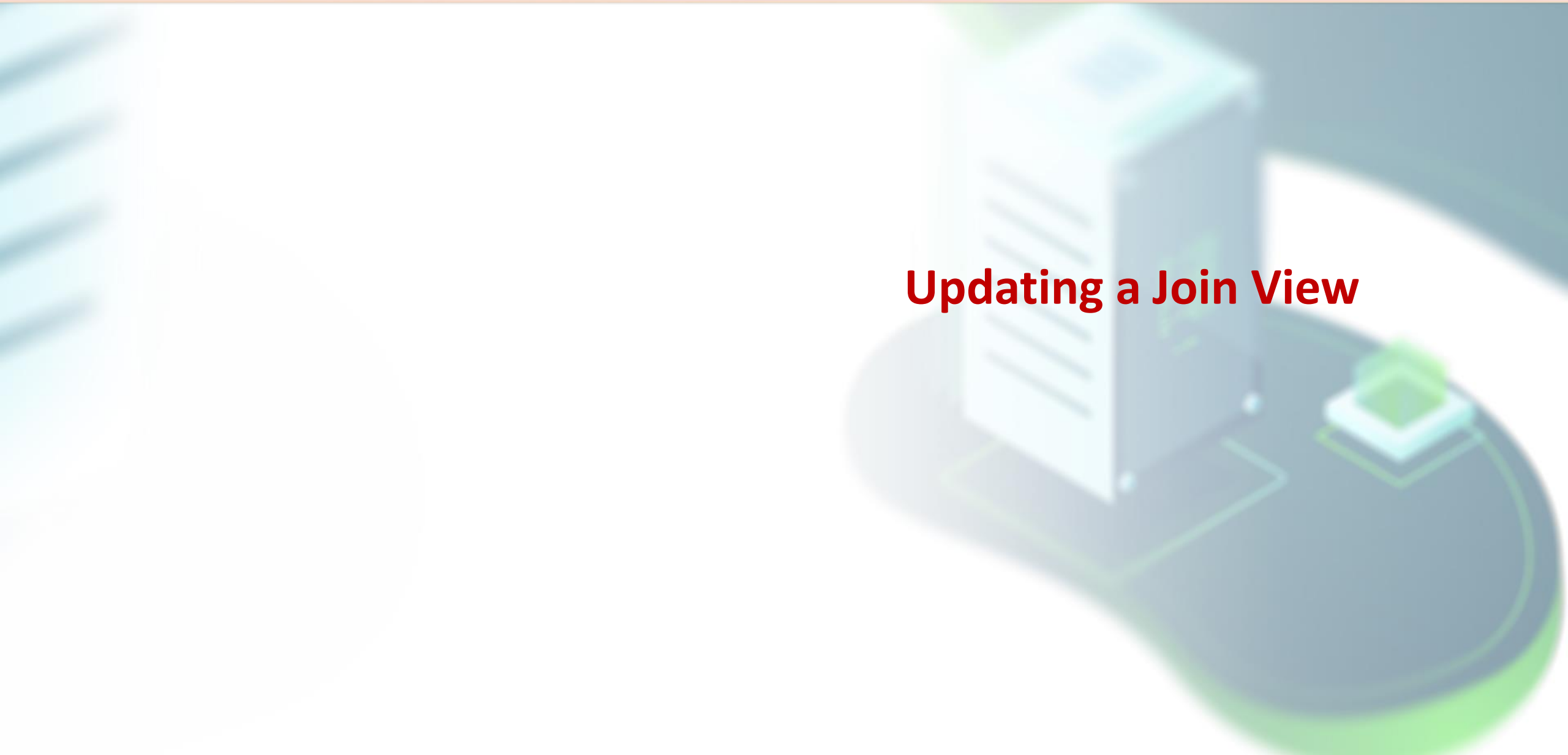
```
CREATE VIEW sales_staff AS
SELECT job, count(*)
FROM emp
WHERE deptno = 10
Group by job;
```

Defining & Managing Views

SQL Practices on Views

We can apply Insert, delete and update operations on simple views. for base tables

End



Updating a Join View

Updating a Join View

Updating a Join View

- Introduction
- Rules for Updating Join Views
- Example-1 of a Join View
- Example-2 of a Join View
- Data Dictionary View for Join Views

Updating a Join View

Introduction

An updatable join view (also referred to as a **modifiable join view**) is a view that contains multiple tables in the top-level FROM clause of the SELECT statement, and is not restricted by the WITH READ ONLY clause.

Updating a Join View

Rules for Updating Join Views

The rules for updatable join views are shown in the following table. Views that meet these criteria are said to be inherently updatable.

Rule	Description
General Rule	Any `INSERT`, `UPDATE`, or `DELETE` operation on a join view can modify only one underlying base table at a time.
`UPDATE` Rule	All updatable columns of a join view must map to columns of a **key-preserved table**. See "Key-Preserved Tables" on page 24-7 for a discussion of key-preserved tables. If the view is defined with the `WITH CHECK OPTION` clause, then all join columns and all columns of repeated tables are not updatable.
`DELETE` Rule	Rows from a join view can be deleted as long as there is exactly one key-preserved table in the join. The key preserved table can be repeated in the `FROM` clause. If the view is defined with the `WITH CHECK OPTION` clause and the key preserved table is repeated, then the rows cannot be deleted from the view.
`INSERT` Rule	An `INSERT` statement must not explicitly or implicitly refer to the columns of a **non-key-preserved table**. If the join view is defined with the `WITH CHECK OPTION` clause, `INSERT` statements are not permitted.

DBA E25494 Oracle11g.pdf pp. 24-6

Updating a Join View

Example-1 of a Join View

```
CREATE VIEW emp_dept AS
SELECT emp.empno, emp.ename, emp.deptno, emp.sal, dept.dname, dept.loc
FROM emp, dept
WHERE emp.deptno = dept.deptno
AND
dept.loc IN ('DALLAS', 'NEW YORK', 'BOSTON');
```

EMPNO	ENAME	DEPTNO	DNAME	LOC
7782	CLARK	10	ACCOUNTING	NEW YORK
7839	KING	10	ACCOUNTING	NEW YORK
7934	MILLER	10	ACCOUNTING	NEW YORK
7369	SMITH	20	RESEARCH	DALLAS
7876	ADAMS	20	RESEARCH	DALLAS

Updating a Join View

Example-1 of a Join View

```
CREATE VIEW emp_dept AS
SELECT emp.empno, emp.ename, emp.deptno, emp.sal, dept.dname, dept.loc
FROM emp, dept
WHERE emp.deptno = dept.deptno
AND
dept.loc IN ('DALLAS', 'NEW YORK', 'BOSTON');
```

```
UPDATE emp_dept
     SET sal = sal * 1.10
     WHERE deptno = 10;
```

```
UPDATE emp_dept
     SET deptno = 10
     WHERE ename = 'SMITH';
ORA-01779 cannot modify a column
```

```
UPDATE emp_dept
     SET loc = 'BOSTON'
     WHERE ename = 'SMITH';
ORA-01779 cannot modify a column which mapsto a non key-preserved table
```

Updating a Join View

Example-2 of a Join View

```
CREATE VIEW emp_mgr AS
SELECT e1.ename, e2.ename mname
FROM emp e1, emp e2
WHERE e1.mgr = e2.empno
WITH CHECK OPTION;
```

Following statement works successfully:

```
INSERT INTO emp_dept (ename, empno, deptno)
VALUES ('KURODA', 9010, 40);
```

Updating a Join View

Example-2 of a Join View

The following INSERT statements would fail with an error (ORA-01776 cannot modify more than one base table through a join view):

```
INSERT INTO emp_dept (ename, empno, deptno)
VALUES ('KURODA', 9010, 77); --FK value not found in department table

INSERT INTO emp_dept (empno, ename, loc)
VALUES (9010, 'KURODA', 'BOSTON'); --cannot insert data in two tables
```

Updating a Join View

Data Dictionary View for Join Views

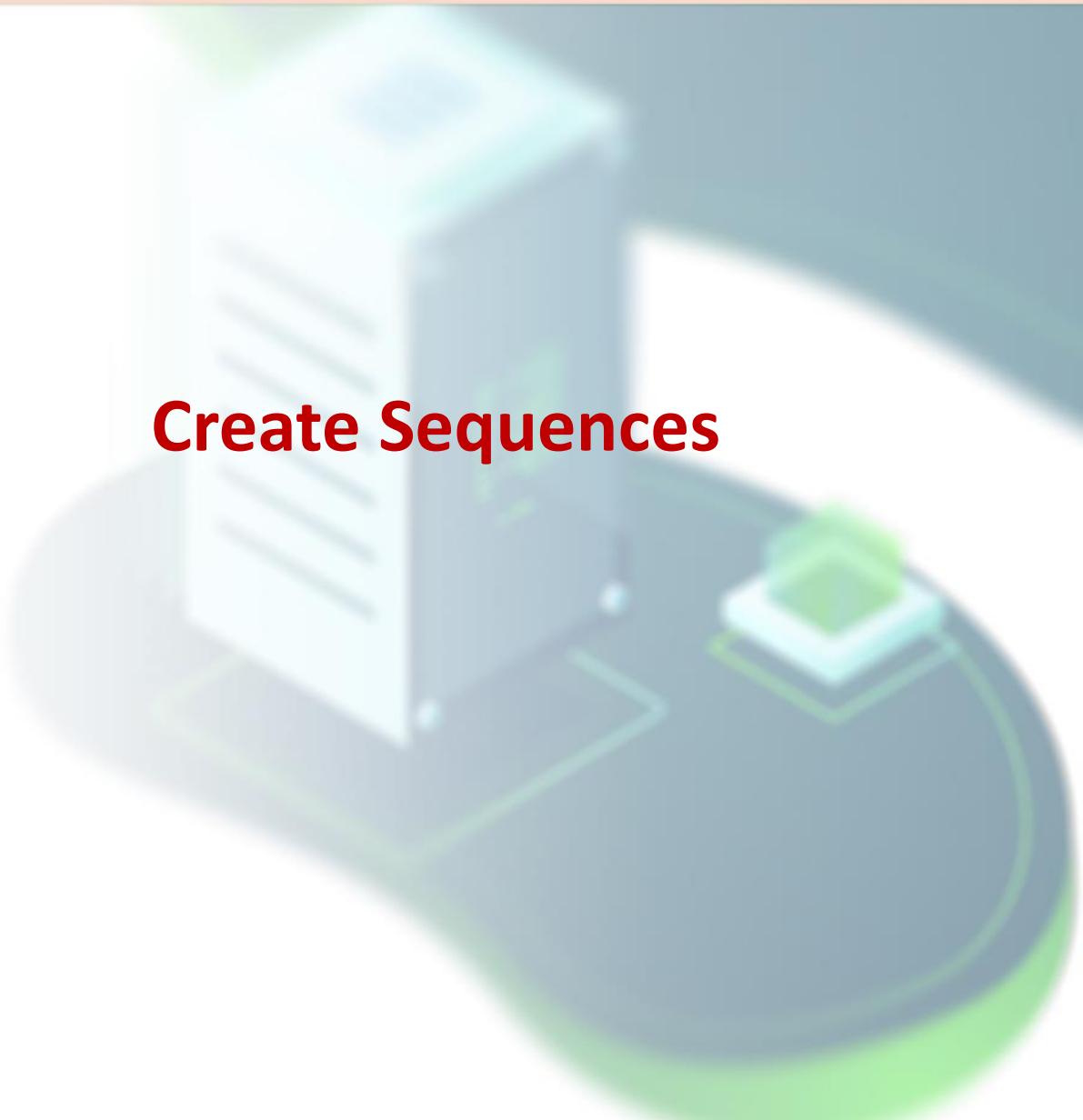
If you are in doubt whether a view is modifiable, then you can select from the USER_UPDATABLE_COLUMNS view to see if it is. For example:

```
SELECT owner, table_name, column_name, updatable FROM USER_UPDATABLE_COLUMNS
     WHERE TABLE_NAME = 'EMP_DEPT_VIEW';
```

This returns output similar to the following:

```
OWNER          TABLE_NAME     COLUMN_NAM     UPD
---------- ---------- ---------- ---
SCOTT          EMP_DEPT_V     EMPNO          NO
SCOTT          EMP_DEPT_V     ENAME          NO
SCOTT          EMP_DEPT_V     DEPTNO         NO
SCOTT          EMP_DEPT_V     DNAME          NO
SCOTT          EMP_DEPT_V     LOC            NO
5 rows selected.
```

Introduction to Database Administration



Create Sequences

Create Sequences

Create Sequences

- An Overview
- Sequence Characteristics
- Sequence Example-1
- Concurrent Access to Sequence
- Sequence Syntax
- Sequence Example-2
- Data Dictionary Views for Sequence

Create Sequences

An Overview

A **sequence (Autonumber)** is a schema object from which multiple users can generate unique integers. A sequence generator provides a highly scalable and well-performing method to generate surrogate keys for a number data type.

Create Sequences

Sequence Characteristics

A sequence definition indicates general information, such as the following:

- The name of the sequence
- Whether the sequence ascends or descends The interval between numbers
- Whether the database should cache sets of generated sequence numbers in memory
- Whether the sequence should cycle when a limit is reached

Create Sequences

Sequence Example-1

```
CREATE SEQUENCE customers_seq
START WITH 1000
INCREMENT BY 1
NOCACHE
NOCYCLE;
```

Create Sequences

Concurrent Access to Sequence

- The same sequence generator can generate numbers for multiple tables. In this way, the database can generate primary keys automatically and coordinate keys across multiple rows or tables.
- For example, a sequence can generate primary keys for an orders table and a customers table.

Create Sequences

Sequence Syntax

```
CREATE SEQUENCE user.sequence_name
[INCREMENT BY interval]
[START WITH first_number]
[MAXVALUE max_value | NOMAXVALUE]
[MINVALUE min_value | NOMINVALUE]
[CYCLE | NOCYCLE]
[CACHE cache_size | NOCACHE]
[ORDER | NOORDER];
```

Create Sequences

Sequence Example-2

```
CREATE SEQUENCE id_seq
    INCREMENT BY 10
    START WITH 10
    MINVALUE 10
    MAXVALUE 100
    CYCLE
    CACHE 2;
```

To get the next value of the sequence, you use the NEXTVAL pseudo-column:

```
SELECT id_seq.NEXTVAL
FROM dual;
```

Create Sequences

Sequence Example-2

```
INSERT INTO tasks(id, title)
VALUES(seq.NEXTVAL, 'Create Sequence in Oracle');

SELECT id_seq.NEXTVAL FROM dual;
```

Create Sequences

Data Dictionary Views for Sequence

USER_SEQUENCES
ALL_SEQUENCES
SEQ

End

Introduction to Database Administration

Alter & Drop Sequences

Alter & Drop Sequences

Alter & Drop Sequences

- An Overview
- NEXTVAL & CURRVAL
- Caching Sequence Number
- Dropping Sequences

Alter & Drop Sequences

An Overview

- To alter a sequence, your schema must contain the sequence, you must have the ALTER object privilege on the sequence, or you must have the ALTER ANY SEQUENCE system privilege.
- You can alter a sequence to change any of the parameters that define how it generates sequence numbers except the sequence starting number. To change the starting point of a sequence, drop the sequence and then re-create it.

Alter & Drop Sequences

An Overview

Alter a sequence using the ALTER SEQUENCE statement. For example, the following statement alters the emp_seq:

```
ALTER SEQUENCE emp_seq
INCREMENT BY 10
MAXVALUE 10000
CYCLE
CACHE 20;
```

Alter & Drop Sequences

NEXTVAL & CURRVAL

CURRVAL and NEXTVAL cannot be used in the following places:

- A subquery
- A view query or materialized view query
- A SELECT statement with the DISTINCT operator
- A SELECT statement with a GROUP BY or ORDER BY clause

Alter & Drop Sequences

NEXTVAL & CURRVAL

- A SELECT statement that is combined with another SELECT statement with the UNION, INTERSECT, or MINUS set operator
- The WHERE clause of a SELECT statement
- The condition of a CHECK constraint

Alter & Drop Sequences

Caching Sequence Number

Follow these guidelines for fast access to all sequence numbers:

- Be sure the sequence cache can hold all the sequences used concurrently by your applications.
- Increase the number of values for each sequence held in the sequence cache.

Alter & Drop Sequences

Dropping Sequences

You can drop any sequence in your schema. To drop a sequence in another schema, you must have the DROP ANY SEQUENCE system privilege. If a sequence is no longer required, you can drop the sequence using the DROP SEQUENCE statement.

Alter & Drop Sequences

Dropping Sequences

For example, the following statement drops the order_seq sequence:

```
DROP SEQUENCE order_seq;
```

When a sequence is dropped, its definition is removed from the data dictionary. Any synonyms for the sequence remain, but return an error when referenced.

Defining Synonyms

Defining Synonyms

Defining Sequences

- An Overview
- Public & Private Synonyms
- Securable Synonyms
- DDL Create Synonyms
- Select script for all Tables

Defining Synonyms

An Overview

- A synonym is an alias for a schema object.
- Synonyms can provide a level of security by masking the name and owner of an object and by providing location transparency for remote objects of a distributed database.
- Also, they are convenient to use and reduce the complexity of SQL statements for database users.

Defining Synonyms

An Overview

- Synonyms allow underlying objects to be renamed or moved, where only the synonym must be redefined and applications based on the synonym continue to function without modification.
- User u1 can access table of user scott as
  Select * from scott.emp;
  But we want u1 uses statement as
  Select * from emp;
  User scott should create emp synonym with the same name

Defining Synonyms

Public & Private Synonyms

You can create both public and private synonyms.

- A **public** synonym is owned by the special user group named PUBLIC and is accessible to every user in a database.
- A **private** synonym is contained in the schema of a specific user and available only to the user and to grantees for the underlying object.

Defining Synonyms

Securable Synonyms

Synonyms themselves are not securable. When you grant object privileges on a synonym, you are really granting privileges on the underlying object, and the synonym is acting only as an alias for the object in the GRANT statement.

Defining Synonyms

Securable Synonyms

To create a private synonym in your own schema, you must have the CREATE SYNONYM privilege.

To create a private synonym in another user's schema, you must have the CREATE ANY SYNONYM privilege.

To create a public synonym, you must have the CREATE PUBLIC SYNONYM system privilege.

Defining Synonyms

DDL Create Synonyms

Following sample DDL command is required to create public synonym:

```
CREATE PUBLIC SYNONYM public_emp
FOR ejaz.emp
```

Creating synonym inside same user's schema

```
create synonym syn_emp for scott.emp;
```

Defining Synonyms

Select Script for all Tables

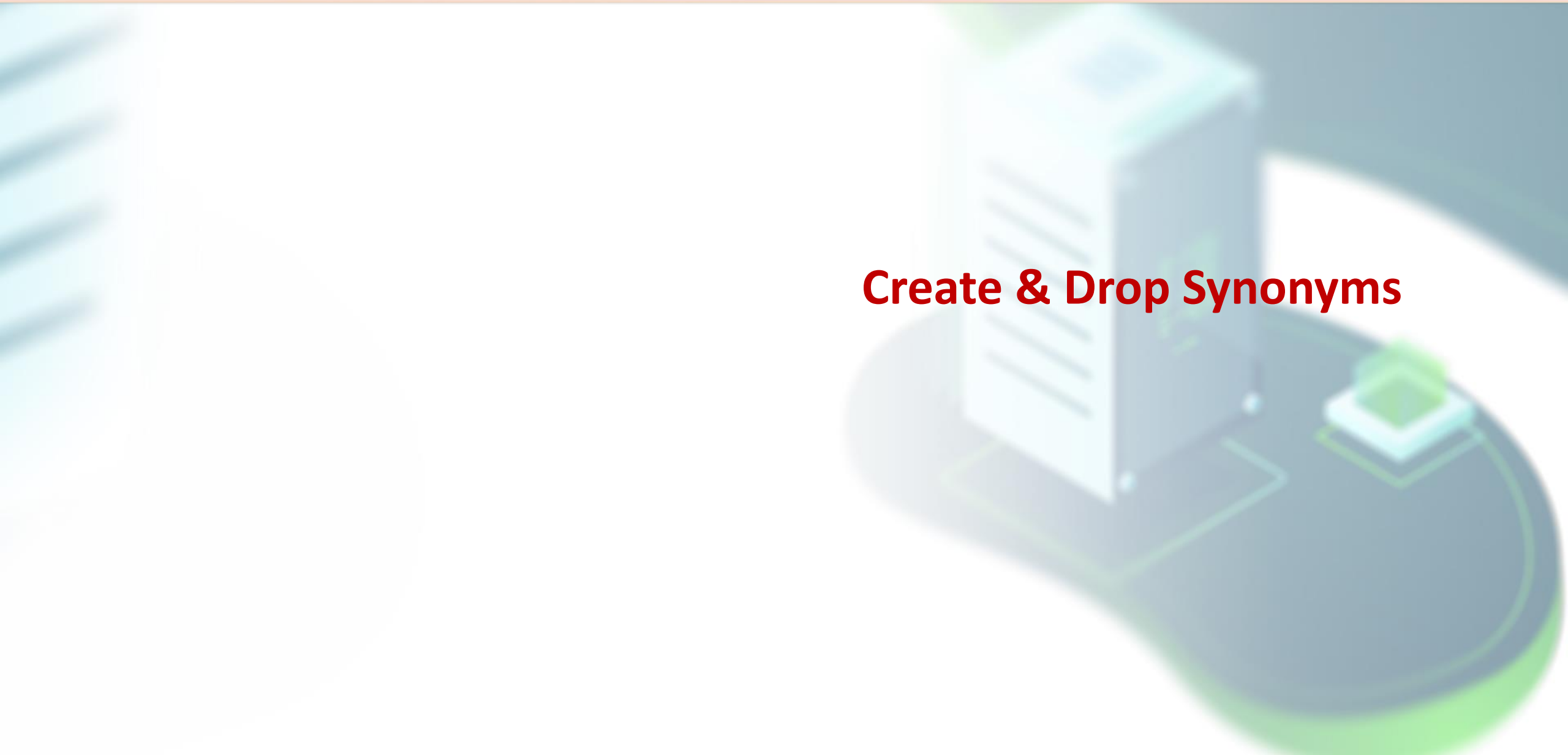
```
select 'create synonym '||tname||' for u1.'||tname||';'
from tab;
```

```
'CREATESYNONYM'||TNAME||'FORU1.'||TNAME||';'
--------------------------------------------------
create synonym BONUS for u1.BONUS;
create synonym DEPT for u1.DEPT;
create synonym DUMMY for u1.DUMMY;
create synonym EMP for u1.EMP;
create synonym PROJASSIGN for u1.PROJASSIGN;
create synonym PROJECT for u1.PROJECT;
create synonym SALGRADE for u1.SALGRADE;

7 rows selected.

SQL>
```

Introduction to Database Administration



Create & Drop Synonyms

Create & Drop Synonyms

Create & Drop Sequences

- Specifying Schema
- FOR Clause
- Create Synonym for Objects
- Create Synonym Examples
- Accessing Synonym
- Drop Synonym
- Synonym Syntax

Create & Drop Synonyms

Specifying Schema

- Specify the schema to contain the synonym. If you omit schema, then Oracle Database creates the synonym in your own schema. You cannot specify a schema for the synonym if you have specified PUBLIC.

Create & Drop Synonyms

FOR Clause

Specify the object for which the synonym is created. The schema object for which you are creating the synonym can be of the following types:

- Table or object table
- View or object view
- Sequence
- Stored procedure, function, or package
- Materialized view
- Java class schema object
- User-defined object type & Synonym

Create & Drop Synonyms

Create Synonym for Objects

Specify the object for which the synonym is created. The schema object for which you are creating the synonym can be of the following types:

- Table or object table
- View or object view
- Sequence
- Stored procedure, function, or package
- Materialized view
- Java class schema object
- User-defined object type & Synonym

Create & Drop Synonyms

Create Synonym Examples

To define the synonym offices for the table locations in the schema hr, issue the following statement:

```
CREATE SYNONYM offices
  FOR hr.locations;
```

Create & Drop Synonyms

Create Synonym Examples

To create a PUBLIC synonym for the emp table in the schema hr on the remote database, you could issue the following statement:

```
CREATE PUBLIC SYNONYM emp_table
  FOR hr.emp@remote.us.oracle.com;
```

Create & Drop Synonyms

Accessing Synonym

If the user hr's schema does not contain an object named customers, and if hr has select permission on oe.customers, then hr can access the customers table in oe's schema by using the public synonym customers:

```
SELECT COUNT(*) FROM customers;
```

Create & Drop Synonyms

Drop Synonym

Following commands can be used to drop synonyms

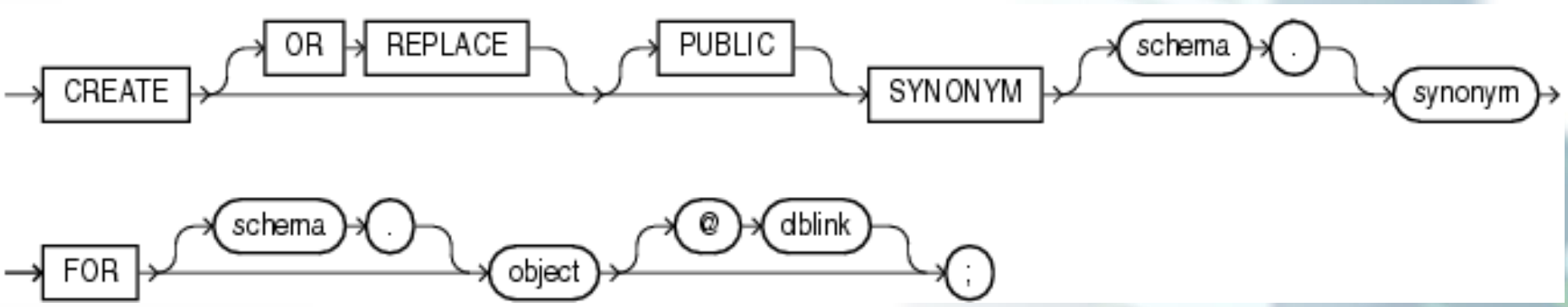
```
drop synonym dept;
drop synonym emp;

drop Public synonym customer;
```

Create & Drop Synonyms

Synonym Syntax

Following is a complete syntax of creating Synonym



Ref: docs.oracle.com

Introduction to Database Administration

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Synonyms, Views & Sequences

Create & Drop Sequences

- Three Types of Views
- Displaying Views
- Data Dictionary Views for Synonym
- Data Dictionary Views for Sequence
- Data Dictionary Views for VIEWS

Data Dictionary Views for Synonyms, Views & Sequences

Three Types of Views

- There are three types of Views to manage Hash Cluster related information:

  DBA_
  ALL_
  USER_

Data Dictionary Views for Synonyms, Views & Sequences

Displaying Views

- SQL statement to display Indexes related Views:

```
Select Table_name
From Dict
Where Table_name like '%SYN%';
```

Or use ('%VIEW%' or '%SEQ%')

You can use following views as well:

DBA_UPDATABLE_COLUMNS

ALL_UPDATABLE_COLUMNS

USER_UPDATABLE_COLUMNS

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Synonym

Following views can be used to see synonyms

```
Select object_name, object_type
from user_objects
where object_type='SYNONYM';
```

```
Select * from TAB;
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Synonym

Following view can be used to see synonyms

```
select synonym_name, table_owner,
table_name
from user_synonyms;
```

```
SQL> select synonym_name, table_owner, table_name
  2  from user_synonyms;

SYNONYM_NAME                   TABLE_OWNER                    TABLE_NAME
------------------------------ ------------------------------ ----------
SYN_EMP                        SCOTT                          EMP
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Sequence

Following sequence is created:

```
CREATE SEQUENCE customers_seq
START WITH 1000
INCREMENT BY 1
NOCACHE
NOCYCLE;
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Sequence

Following view can be used to see synonyms

```
select object_name, object_type
from user_objects
where object_type='SEQUENCE';
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for Sequence

Following view can be used to see synonyms

```
select sequence_name, cycle_flag,
cache_size, last_number
from user_sequences;
```

```
SEQUENCE_NAME                  C CACHE_SIZE LAST_NUMBER
------------------------------ - ---------- -----------
CUSTOMERS_SEQ                  N          0        1000
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for VIEWS

```
grant create view to scott;

create view v_emp
AS
select job, count(*) Count_EMP
from emp
group by job;
```

Data Dictionary Views for Synonyms, Views & Sequences

Data Dictionary Views for VIEWS

Following view can be used to see synonyms

```
SQL> select view_name, text
  2  from user_views;

VIEW_NAME
------------------------------
TEXT
--------------------------------------------------------------------------------
V_EMP
select job, count(*) Count_EMP
from emp
group by job


SQL>
```

End

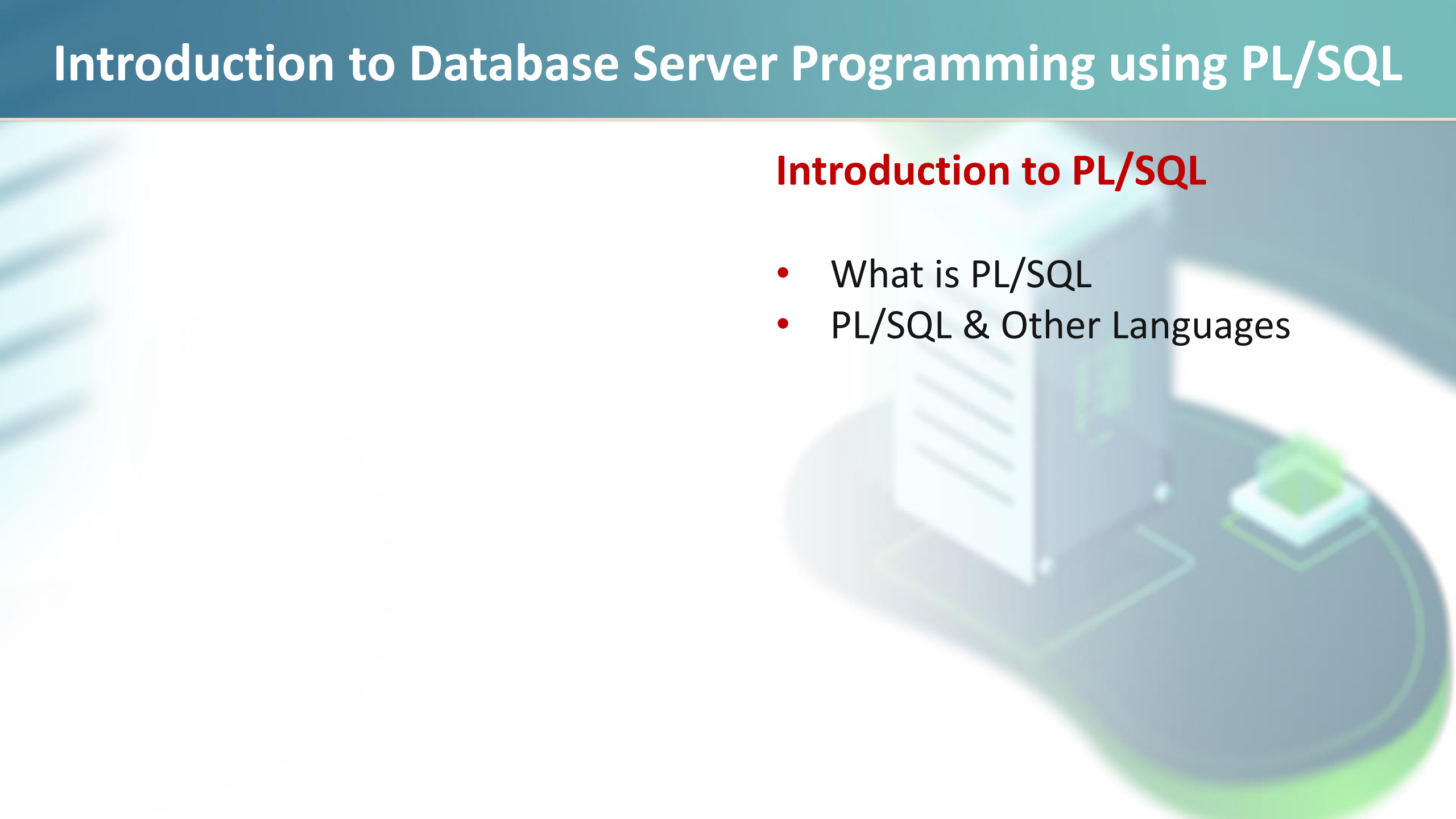
Introduction to Database Administration

Introduction to Database Server Programming using PL/SQL

Introduction to Database Server Programming using PL/SQL

Introduction to PL/SQL

- What is PL/SQL
- PL/SQL & Other Languages



Introduction to Database Server Programming using PL/SQL

What is PL/SQL

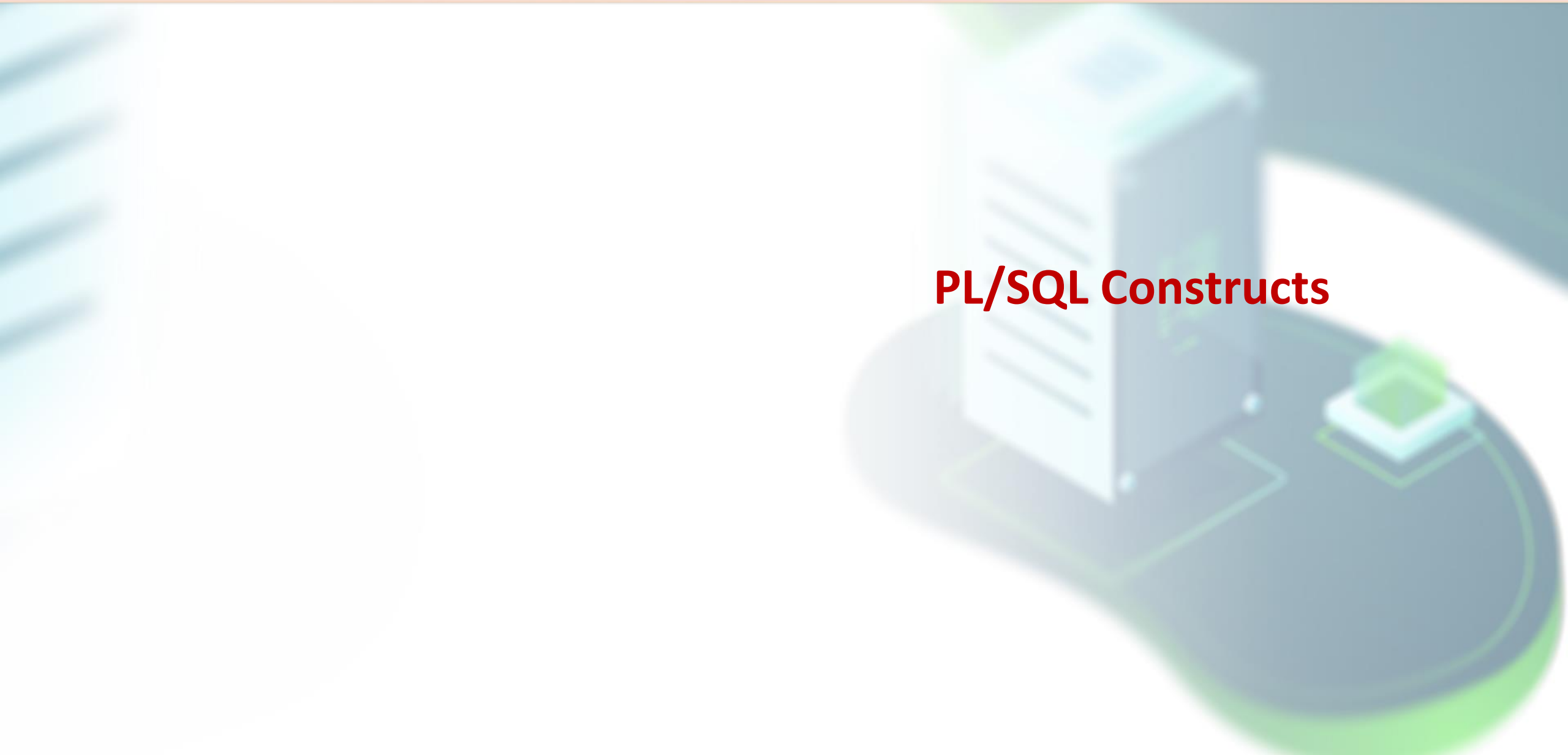
- Embedded structured programming
- Performed on Server Machine
- Centrally accessible from single database
- Executed on server without any network overhead

Introduction to Database Server Programming using PL/SQL

PL/SQL & Other Languages

- Embedded SQL (PL/SQL, JAVA/ VB & DB)
- Database Server Level Programming(PL/SQL, Transact-SQL, IBM DB2-Cobol, ProC, ProCobol)
- (Front end programming can be changed without affecting Server programming)
- Database Client Programming (Developer 9i, JDeveloper 9i, Java (J2EE), VB, .Net)

Introduction to Database Administration



PL/SQL Constructs

PL/SQL Constructs

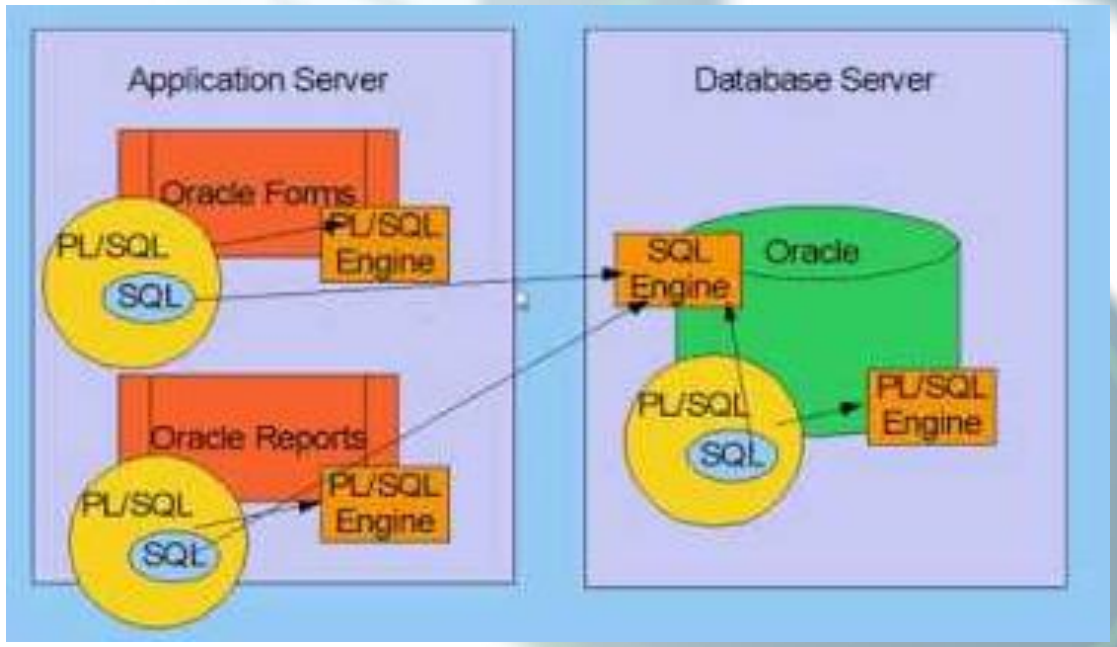
PL/SQL Constructs

- SQL & PL/SQL
- PL/SQL Data Types
- PL/SQL Contents

PL/SQL Constructs

SQL & PL/SQL

SQL & PL/SQL on Application & Server Sides

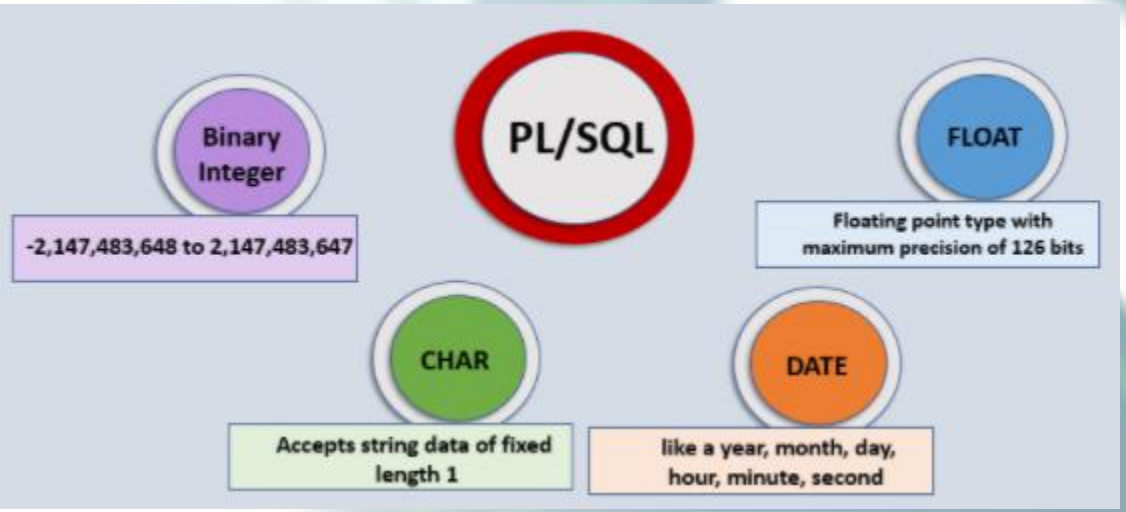


Ref: SQL ZeroToPro.com

PL/SQL Constructs

PL/SQL Data Types

Following main data types are used in PL/SQL



PL/SQL Constructs

PL/SQL Contents

- Benefits
- Basic Constructs
- Anonymous blocks
- Procedures
- Functions
- Packages
- Triggers
- Cursors
- Dynamic SQL

End

Introduction to Database Administration

PL/SQL Benefits & Basic Constructs

PL/SQL Benefits & Basic Constructs

- PL/SQL Benefits
- PL/SQL Basic Constructs

PL/SQL Benefits & Basic Constructs

PL/SQL Benefits

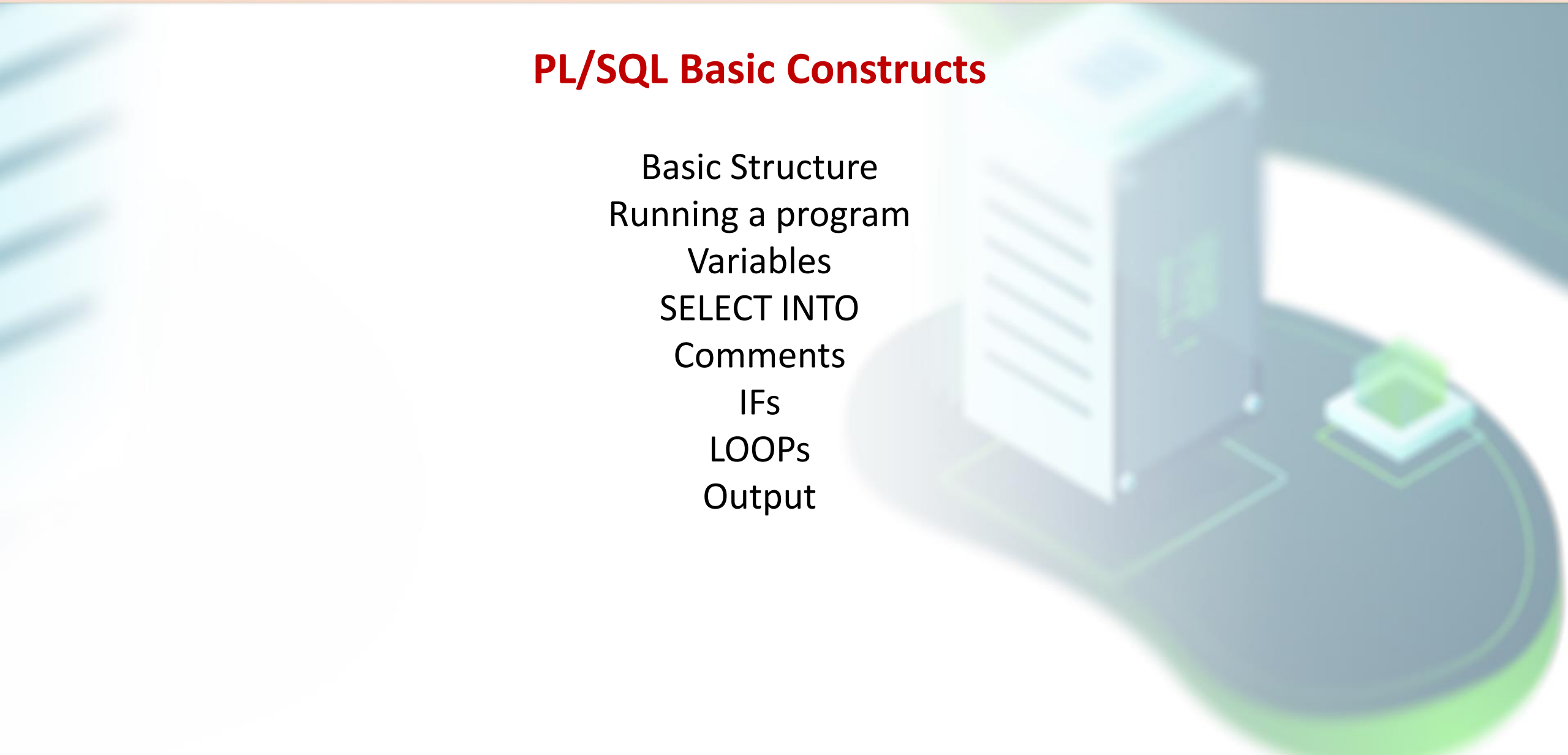
More powerful than pure SQL because it combines the power of SQL and

- Iteration (loops)
- Selection (Ifs)
- Cursors
- Block Structures
- Stored Procedures
- etc.

PL/SQL Benefits & Basic Constructs

PL/SQL Basic Constructs

Basic Structure
Running a program
Variables
SELECT INTO
Comments
IFs
LOOPs
Output



Introduction to Database Administration

Basic Program Block Structure and Display output

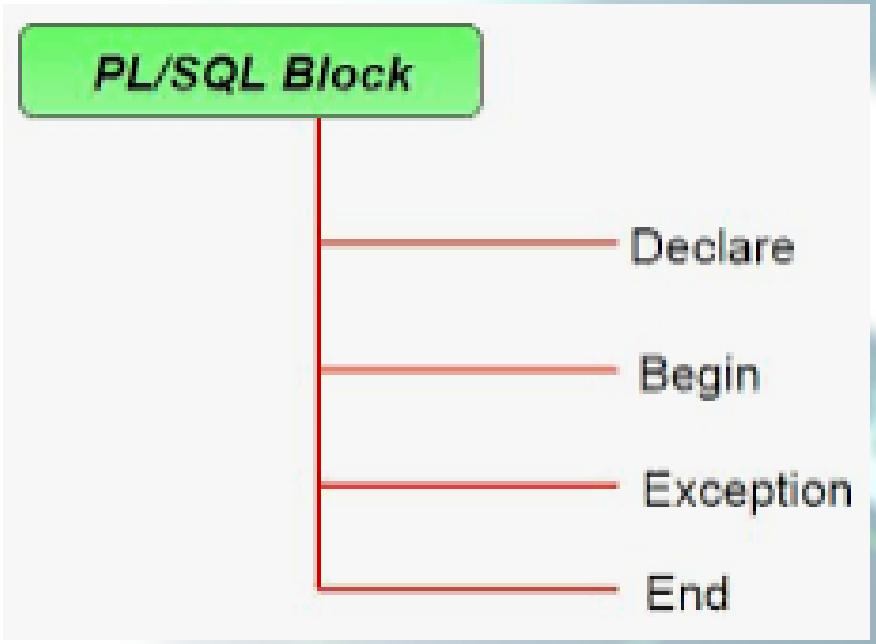
Basic Program Block Structure and Display output

Basic Program Structure

- Nested Basic Structures
- First PL/SQL Program
- First PL/SQL Program with Declaration

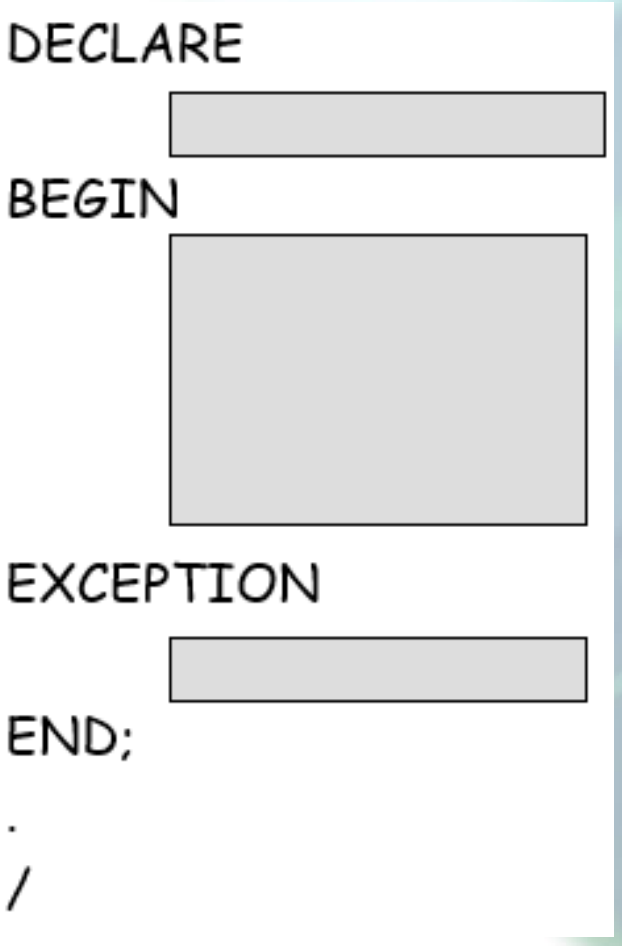
Basic Program Block Structure and Display output

Basic Structure



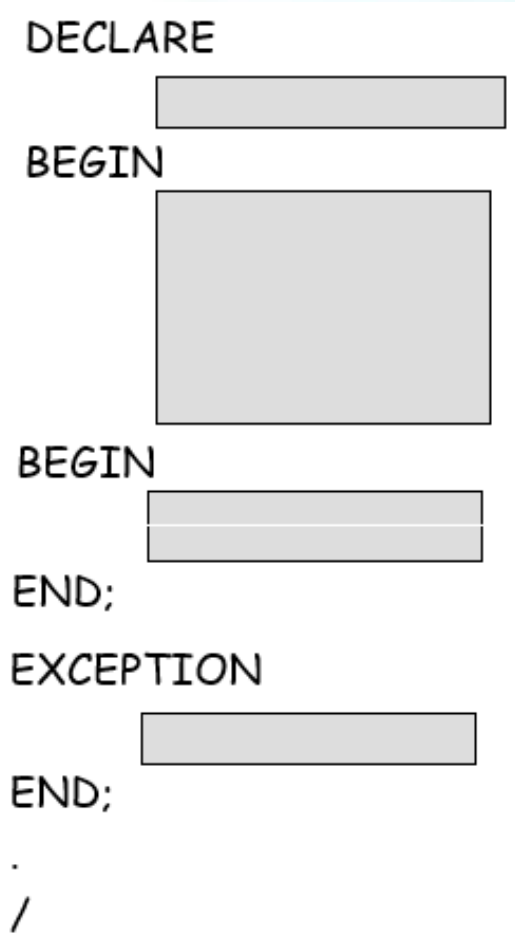
Basic Program Block Structure and Display output

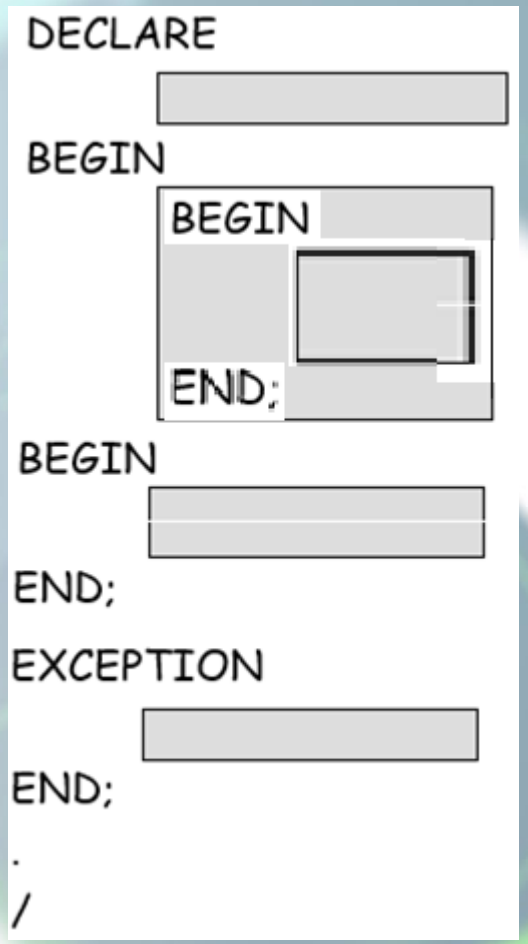
Basic Structure



Basic Program Block Structure and Display output

Nested Basic Structures





Basic Program Block Structure and Display output

First PL/SQL Program

```
SET SERVEROUTPUT ON;

BEGIN
    DBMS_OUTPUT.PUT_LINE('This is my first program');
END;
/
```

Before executing code that contains DBMS_OUTPUT.PUT_LINE,
must run (in a current session) at SQL prompt: set serveroutput on.
System Package DBMS_OUTPUT exists in Oracle Dictionary. It accepts and return SINGLE argument.

Basic Program Block Structure and Display output

First PL/SQL Program with Declaration

```
SET SERVEROUTPUT ON;  --if not runing already

DECLARE
    msg varchar2(40) := 'I love Oracle Programing' ;
BEGIN
    dbms_output.put_line(msg);
END;
/
```

```
SQL> DECLARE
  2        msg varchar2(40) := 'I love Oracle Programing' ;
  3  BEGIN
  4        dbms_output.put_line(msg);
  5  END;
  6  /
I love Oracle Programing

PL/SQL procedure successfully completed.

SQL>
```

Introduction to Database Administration

Basic Programs Block Structure with more examples

Basic Program Block Structures with More Examples

Basic Program Structure

- Program Execution with an error
- Program Fixing of an error
- Program Compilation

Basic Program Block Structures with more Examples

Program Execution with an Error

Following program declarations, assigned values and display result:

```
SQL> Declare
  2  -- declare variable x, y and z of datatype number
  3  x number(5);
  4  y number(5);
  5  z number(7);
  6  Begin
  7  -- Here we Assigning 10 into x
  8  x:=10;
  9  -- Assigning 20 into x
 10  y:=20;
 11  -- Assigning sum of x and y into z
 12  z:=x+y;
 13  --Print the Result
 14  dbms_output.put_line('Sum is '||z);
 15  End;
 16  /
Sum is 30
```

Basic Program Block Structures with more Examples

Program Fixing of an Error

Following program terminates:

```
SQL> Declare
  2  -- declare variable x, y and z of datatype number
  3  x varchar2(5);
  4  y number(5);
  5  z number(5);
  6  Begin
  7  -- Here we Assigning 10 into x
  8  x:=10;
  9  -- Assigning 20 into x
 10  y:=2V0;
 11  -- Assigning sum of x and y into z
 12  z:=x+y;
 13  --Print the Result
 14  dbms_output.put_line('Sum is '||z);
 15  End;
 16  /
y:=2V0;
    *
ERROR at line 10:
ORA-06550: line 10, column 5:
PLS-00103: Encountered the symbol "V0" when expecting one of the following:
* & = - + ; < / > at in is mod remainder not rem
<an exponent (**)> <> or != or ~= >= <= <> and or like like2
like4 likec between || multiset member submultiset
The symbol "*" was substituted for "V0" to continue.
```

Basic Program Block Structures with more Examples

Program Compilation

Following program (Anonymous Block) executes with error due to compile & execute together

```
SQL> Declare
  2  -- declare variable x, y and z of datatype number
  3  x varchar2(5);
  4  y number(5);
  5  z number(5);
  6  Begin
  7  -- Here we Assigning 10 into x
  8  x:=10;
  9  -- Assigning 20 into x
 10  y:=2V0;
 11  -- Assigning sum of x and y into z
 12  z:=x+y;
 13  --Print the Result
 14  dbms_output.put_line('Sum is '||z);
 15  Exception
 16          WHEN OTHERS THEN
 17  dbms_output.put_line('Error in program');
 18  End;
 19  /
y:=2V0;
    *
ERROR at line 10:
ORA-06550: line 10, column 5:
PLS-00103: Encountered the symbol "V0" when expecting one of th
* & = - + ; < / > at in is mod remainder not rem
```

Introduction to Database Administration

Basic Programs Block Structure with more examples

Basic Program Block Structures with More Examples

Basic Program Structure

- Program execution with an error
- Program fixing of an error
- Program with SELECT INTO

Basic Program Block Structures with more Examples

Program execution with an error

Following program executes with an error during compilation/ execution:

```
SQL> DECLARE
  2         -- taking input for variable a
  3         a number := &a;
  4         -- taking input for variable b
  5         b varchar2(30) := &b;
  6  BEGIN
  7         c := a + b ;
  8        dbms_output.put_line('Sum of '||a||' and '||b||' is = '||c);
  9  END;
 10  /
Enter value for a: 4
old   3:        a number := &a;
new   3:        a number := 4;
Enter value for b: 9
old   5:        b varchar2(30) := &b;
new   5:        b varchar2(30) := 9;
      c := a + b ;
      *
ERROR at line 7:
ORA-06550: line 7, column 7:
PLS-00201: identifier 'C' must be declared
ORA-06550: line 7, column 7:
PL/SQL: Statement ignored
```

Basic Program Block Structures with more Examples

Program fixing of an error

Following program executes successfully:

```
SQL> DECLARE
  2         -- taking input for variable a
  3         a number := &a;
  4         -- taking input for variable b
  5         b varchar2(30) := &b;
  6         c integer;
  7  BEGIN
  8         c := a + b ;
  9        dbms_output.put_line('Sum of '||a||' and '||b||' is = '||c);
 10  END;
 11  /
Enter value for a: 4
old   3:         a number := &a;
new   3:         a number := 4;
Enter value for b: 9
old   5:         b varchar2(30) := &b;
new   5:         b varchar2(30) := 9;
Sum of 4 and 9 is = 13

PL/SQL procedure successfully completed.
```

Basic Program Block Structures with more Examples

Program with SELECT INTO

Following program executes successfully with the retrieval of single record

```
SQL> DECLARE
  2       v_id     INTEGER;
  3       v_empno  NUMBER;
  4  BEGIN
  5      v_id := 7369;
  6      SELECT EMPNO
  7         INTO V_EMPNO
  8         FROM  EMP
  9         WHERE empno = v_id;
 10      DBMS_OUTPUT.PUT_LINE('Value is '||v_empno);
 11  EXCEPTION
 12      WHEN NO_DATA_FOUND THEN
 13       DBMS_OUTPUT.PUT_LINE('No record exists');
 14  END;
 15  /
Value is 7369

PL/SQL procedure successfully completed.
```

Basic Program Block Structures with more Examples

Program with SELECT INTO

Following program is terminated with the retrieval of single record

```
SQL> DECLARE
  2        v_id      INTEGER;
  3        v_empno   NUMBER;
  4  BEGIN
  5      v_id := 7777; --employee does not exists
  6      SELECT EMPNO
  7         INTO V_EMPNO
  8         FROM  EMP
  9         WHERE empno = v_id;
 10      DBMS_OUTPUT.PUT_LINE('Value is '||v_empno);
 11  END;
 12  /
DECLARE
*
ERROR at line 1:
ORA-01403: no data found
ORA-06512: at line 6
```

Basic Program Block Structures with more Examples

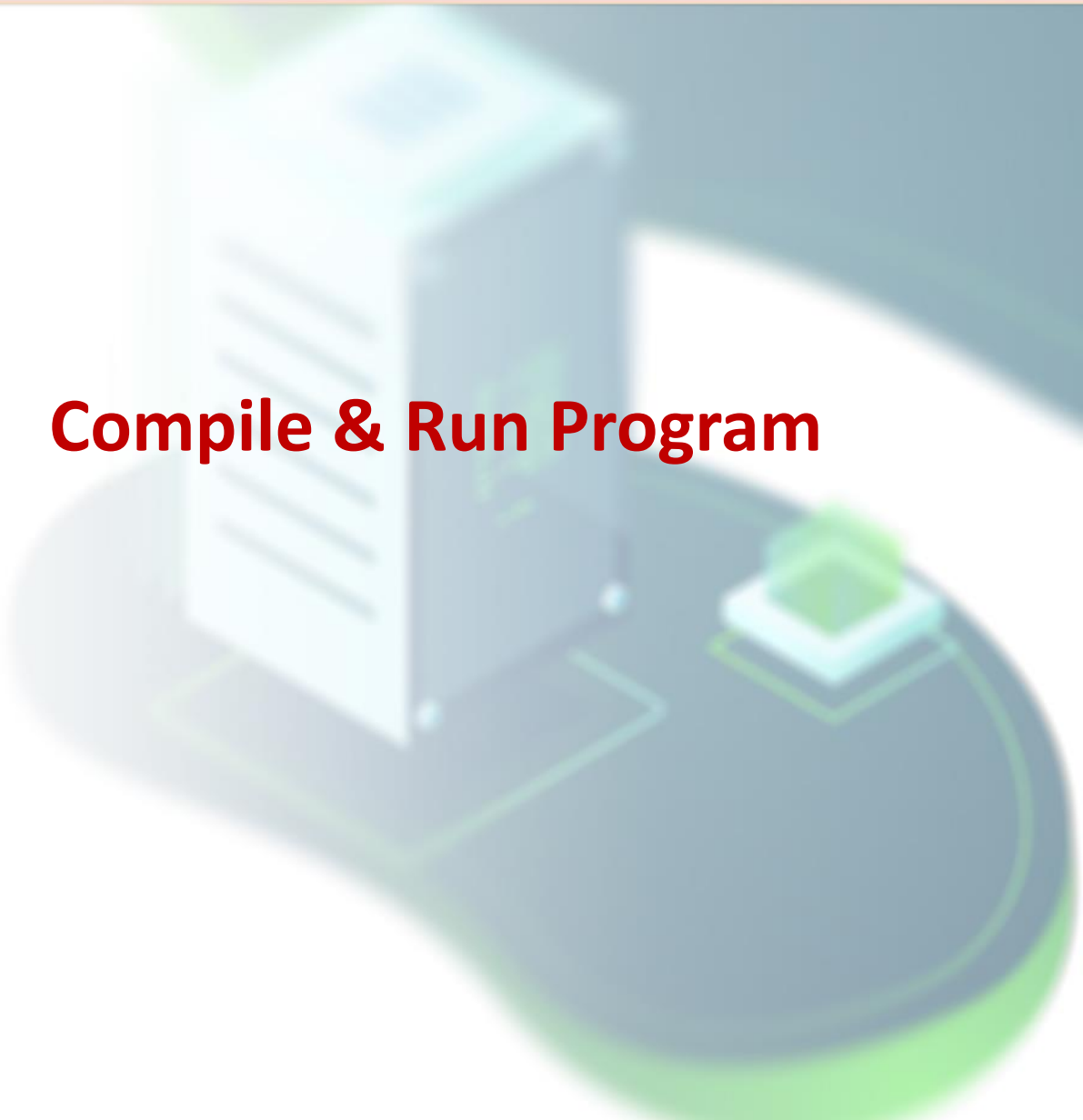
Program with SELECT INTO

Following program is successfully executed with the retrieval of single record and exception raised.

```
SQL> DECLARE
  2       v_id     INTEGER;
  3       v_empno  NUMBER;
  4  BEGIN
  5      v_id := 7777; --employee does not exists
  6      SELECT EMPNO
  7         INTO V_EMPNO
  8         FROM  EMP
  9         WHERE empno = v_id;
 10      DBMS_OUTPUT.PUT_LINE('Value is '||v_empno);
 11  EXCEPTION
 12      WHEN NO_DATA_FOUND THEN
 13       DBMS_OUTPUT.PUT_LINE('No record exists');
 14  END;
 15  /
No record exists

PL/SQL procedure successfully completed.
```

Introduction to Database Administration



Compile & Run Program

Compile & Run Program

Compile & Run Program

- Program Compilation & Execution
- Program execution with an error
- Run Program using SQL Developer
- Compile Program using SQL Developer

Compile & Run Program

Program Compilation & Execution

Following program compile and executes on SQL prompt:

```
DECLARE

BEGIN



EXCEPTION

END;
/
```

Compile & Run Program

Program Compilation & Execution

Following program run without compiling and execution on SQL prompt:

```
DECLARE

BEGIN



EXCEPTION

END;
.
```

Compile & Run Program

Program execution with an error

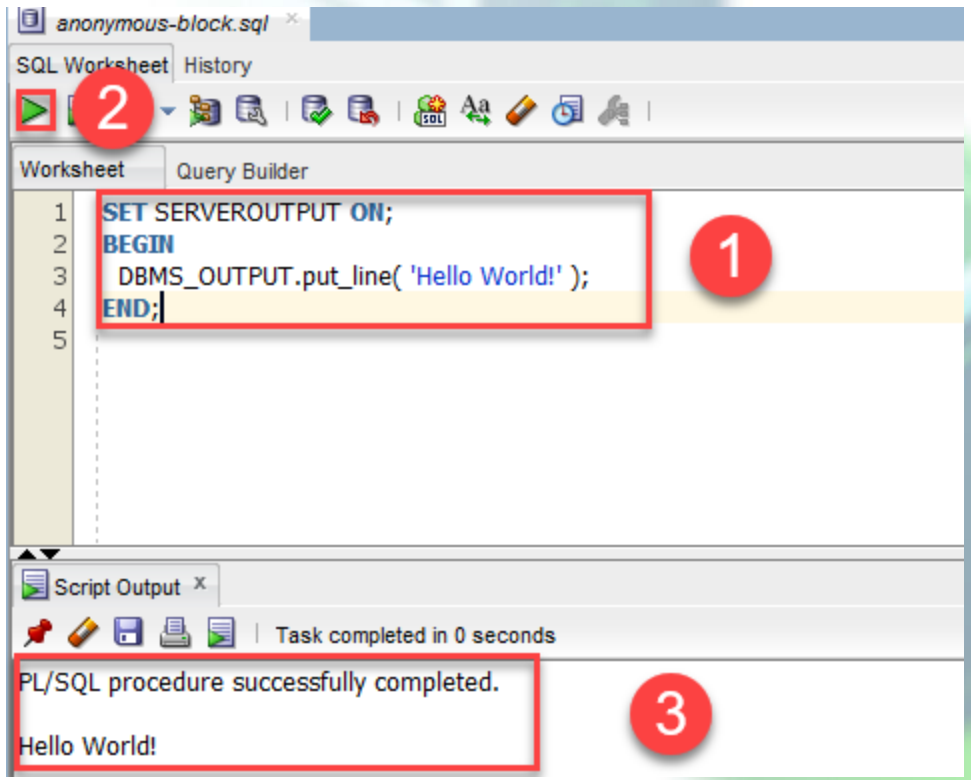
Following program executes with an error during compilation/ execution:

```
SQL> DECLARE
  2         -- taking input for variable a
  3         a number := &a;
  4         -- taking input for variable b
  5         b varchar2(30) := &b;
  6   BEGIN
  7         c := a + b ;
  8        dbms_output.put_line('Sum of '||a||' and '||b||' is = '||c);
  9   END;
 10   /
Enter value for a: 4
old   3:         a number := &a;
new   3:         a number := 4;
Enter value for b: 9
old   5:         b varchar2(30) := &b;
new   5:         b varchar2(30) := 9;
      c := a + b ;
      *
ERROR at line 7:
ORA-06550: line 7, column 7:
PLS-00201: identifier 'C' must be declared
ORA-06550: line 7, column 7:
PL/SQL: Statement ignored
```

Compile & Run Program

Run Program using SQL Developer

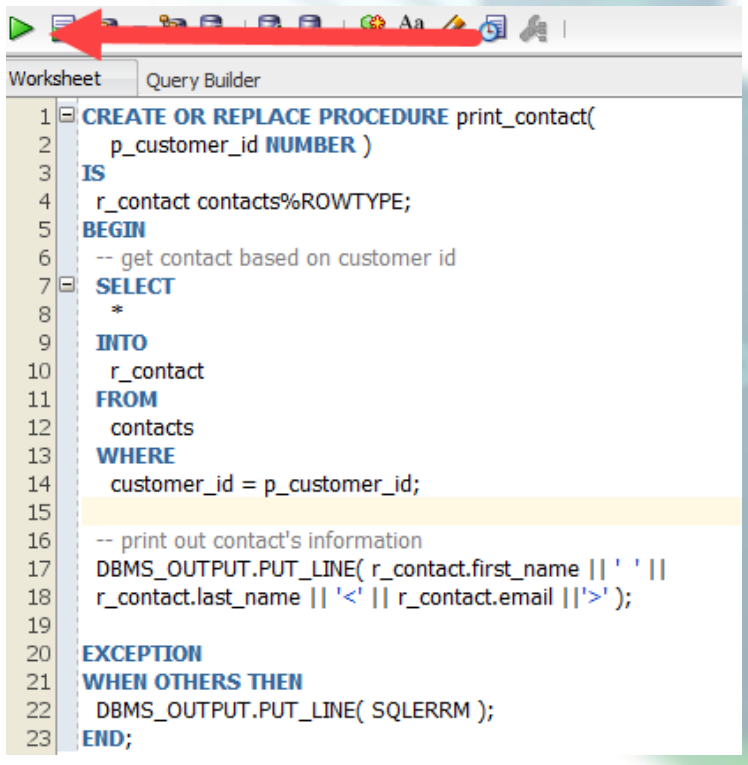
To compile the procedure, you click the Run Statement button:



Compile & Run Program

Run Program using SQL Developer

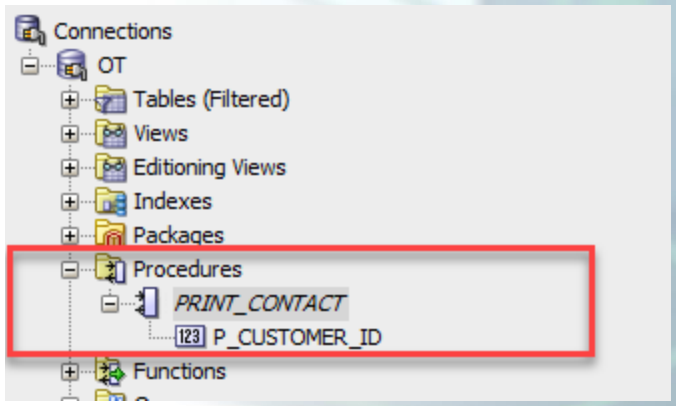
To compile the procedure, you click the Run Statement button:



Compile & Run Program

Run Program using SQL Developer

If the procedure is compiled successfully, you will find the new procedure under the Procedures node as shown below:



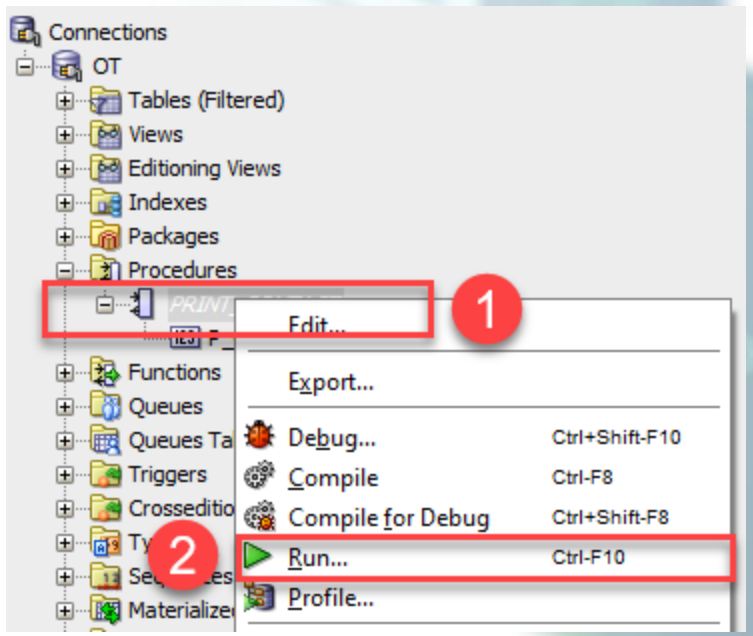
EXEC procedure_name(arguments);

This link or path is not available for blocks codes without name

Compile & Run Program

Run Program using SQL Developer

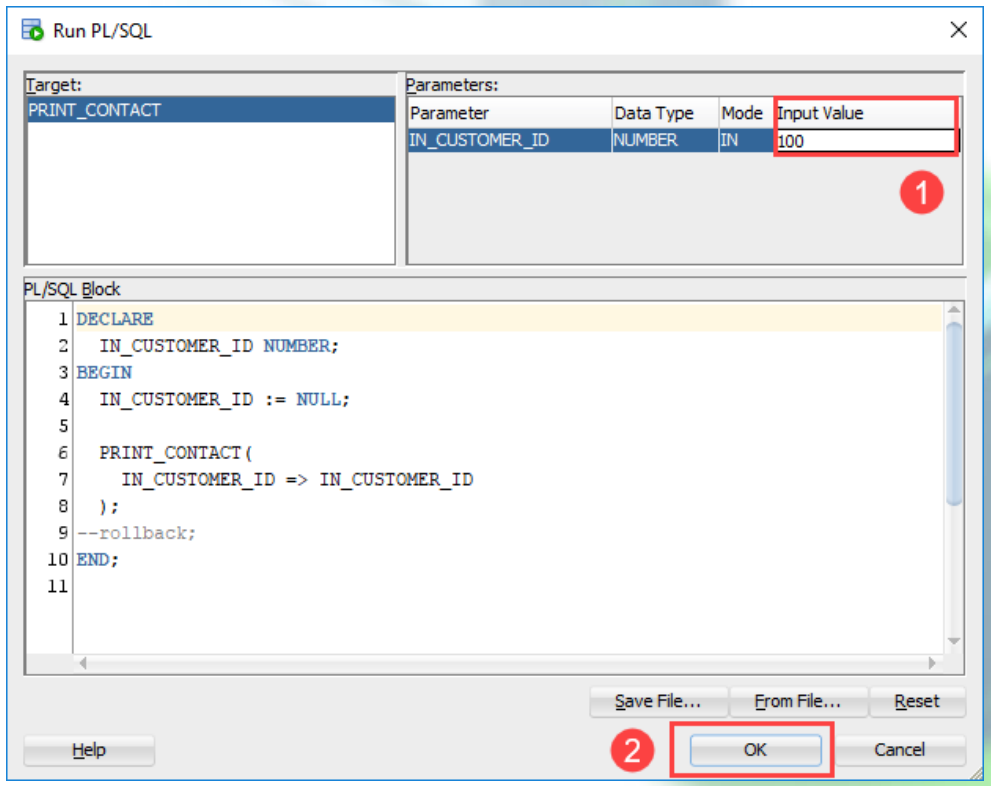
Right-click the procedure name and choose Run ... menu item:



Compile & Run Program

Run Program using SQL Developer

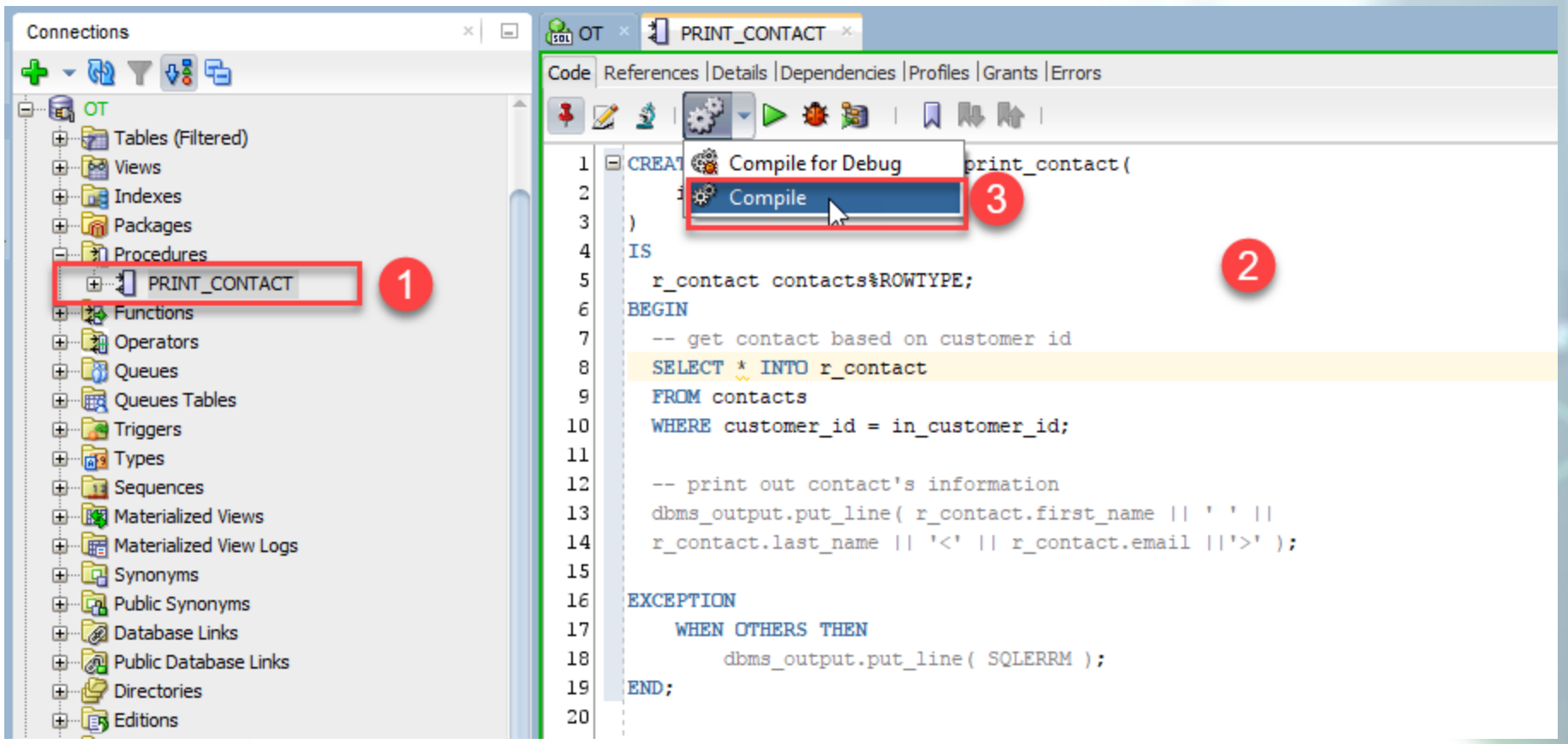
Enter a value for the in_customer_id parameter and click OK button:



Compile & Run Program

Compile Program using SQL Developer

Compiling program with selection steps as shown:



https://www.oracletutorial.com/plsql-tutorial/plsql-procedure/

Introduction to Database Administration

Data Types & Select INTO Clause

Data Types & Select INTO Clause

- Introduction
- Scalar Data Types Families
- Numeric Data Types
- Boolean Data Types
- Character or String Data Types
- DateTime Data Types
- Composite Data Types
- Data Types Synonyms

Data Types & Select INTO Clause

Introduction

- Each value in PL/SQL such as a constant, variable and parameter has a data type that determines the storage format, valid values, and allowed operations.
- PL/SQL has two kinds of data types: scalar and composite.

Data Types & Select INTO Clause

Scalar Data Types Families

- Number
- Boolean
- Character
- Datetime

A scalar data type may have subtypes. A subtype is a data type that is a subset of another data type, which is its base type. A subtype further defines a base type by restricting the value or size of the base data type.

Data Types & Select INTO Clause

Numeric Data Types

- The numeric data types represent real numbers, integers, and floating-point numbers. They are stored as NUMBER, IEEE floating-point storage types (BINARY_FLOAT and BINARY_DOUBLE), and PLS_INTEGER.

- The data types NUMBER, BINARY_FLOAT, and BINARY_DOUBLE are SQL data types.
- The PLS_INTEGER datatype is specific to PL/SQL. It represents signed 32 bits int.

Data Types & Select INTO Clause

Boolean Data Types

- The BOOLEAN datatype has three data values: TRUE, FALSE, and NULL. Boolean values are typically used in control flow structure such as IF-THEN, CASE, and loop statements like LOOP, FOR LOOP, and WHILE LOOP.

- SQL does not have the BOOLEAN data type, you can assign data type NUMBER(1) or CHAR(1)

Data Types & Select INTO Clause

Character or String Data Types

- The character data types represent alphanumeric text. PL/SQL uses the SQL character data types such as
- CHAR, VARCHAR2, LONG, RAW, LONG RAW, ROWID, and UROWID
- CHAR is used for fixed length columns such primary keys or boolean

Data Types & Select INTO Clause

DateTime Data Types

- The datetime data types represent dates, timestamp with or without time zone and intervals. PL/SQL datetime data types are DATE, TIMESTAMP, TIMESTAMP WITH TIME ZONE, TIMESTAMP WITH LOCAL TIME ZONE, INTERVAL YEAR TO MONTH, and INTERVAL DAY TO SECOND

Data Types & Select INTO Clause

Composite Data Types

- TableName.Column%TYPE is a composite data type. For example, EMP.sal%TYPE
- It will follow same data type and size of column of a table.
- In case if size or type of column is changed then there is no need to re-compile the program

Data Types & Select INTO Clause

Data Types Synonyms

Data Type	Synonyms
NUMBER	DEC, DECIMAL, DOUBLE PRECISION, FLOAT, INTEGER, INT, NUMERIC, REAL, SMALLINT
CHAR	CHARACTER, STRING
VARCHAR2	VARCHAR

Data Types & Select INTO Clause

SELECT INTO Clause

We cannot use simple SQL Select clause statement, rather we use Select INTO by storing values in variables with condition of choosing single record

```
DECLARE
        v_salary    EMP.sal%TYPE;
        v_deptno  NUMBER(3);
BEGIN
        SELECT sal, deptno
        INTO v_salary, v_deptno
        FROM EMP
        WHERE empno = 7369;
...
END;
/
```

Introduction to Database Administration

Program Examples

Program Examples

Program Examples with Select INTO Clause

- Program-1 without Exception
- Program-2 using Exception
- Program-3 using Constant identifier with Exception

Program Examples

Program-1 without Exception

```
declare
  v_ename              emp.ename%TYPE;
  v_sal                emp.sal%TYPE;
begin
   Select ename, sal
   INTO v_ename, v_sal
   from emp
   where empno = '7844'; --This id exists

     DBMS_OUTPUT.PUT_LINE('solution is:'||v_ename||' has '||v_sal);

end;
/
```

Before executing code that contains DBMS_OUTPUT.PUT_LINE,
must run at SQL prompt: set serveroutput on

Program Examples

Program-2 using Exception

```
declare
  v_ename              emp.ename%TYPE;
  v_sal                emp.sal%TYPE;
begin
   Select ename, sal
   INTO v_ename, v_sal
   from emp
   where empno = '7844'; --This id exists

     DBMS_OUTPUT.PUT_LINE('solution is:'||v_ename||' has '||v_sal);

exception
  When others then
   DBMS_OUTPUT.PUT_LINE('no record found');
end;
/
```

Program Examples

Program-3 using Constant identifier with Exception

```
declare
  v_ename           emp.ename%TYPE;
  v_sal             emp.sal%TYPE;
  v_empno           emp.empno%TYPE := '7844'; --Constant identifier
begin
   Select ename, sal
   INTO v_ename, v_sal
   from emp
   where empno = v_empno; --This id exists

     DBMS_OUTPUT.PUT_LINE('solution is:'||v_ename||' has salary '||v_sal);

exception
  When others then
   DBMS_OUTPUT.PUT_LINE('no record found');
end;
/
```

Control IF Conditions

Control IF Conditions

PL/SQL Control IF-THEN-ELSE Conditions

- IF THEN Condition
- Structure of IF THEN Condition
- Example of IF THEN Condition
- Structure of IF THEN ELSE Condition
- Example of IF THEN ELSE Condition
- Structure of IF THEN ELSIF Condition
- Example of IF THEN ELSIF Condition

Control IF Conditions

IF THEN Condition

There are three ways to write IF condition:

- IF – END IF
- IF – ELSE – END IF
- IF – ELSIF – ELSE – END IF

Control IF Conditions

Structure of IF THEN Condition

There are three ways to write IF condition:

```
IF condition THEN
   statements;
END IF;
```

For example:

```
IF v_sal > 2000 Then
   total_sal := v_sal + 5000;
END IF;
```

Control IF Conditions

Example of IF THEN Condition

```
DECLARE
   v_sal EMP.SAL%TYPE;
BEGIN
   Select sal INTO v_sal
   From emp
   Where ename = 'SMITH';

   IF v_sal < 850 THEN
    DBMS_OUTPUT.PUT_LINE('Low paid salary person');
   END IF;
END;
/
```

Control IF Conditions

Structure of IF THEN ELSE Condition

There are three ways to write IF condition:

```
IF condition THEN
   statements;
ELSE
   statements;
END IF;
```

Control IF Conditions

Example of IF THEN ELSE Condition

```
DECLARE
   v_sal EMP.SAL%TYPE;
BEGIN
   Select sal INTO v_sal
   From emp
   Where ename = 'SMITH';

   IF v_sal < 850 THEN
    DBMS_OUTPUT.PUT_LINE('Low paid salary person');
   ELSE
    DBMS_OUTPUT.PUT_LINE('Higly paid salary person');
   END IF;
END;
/
```

Control IF Conditions

Structure of IF THEN ELSIF Condition

There are three ways to write IF condition:

```
IF condition THEN
   statements;
ELSIF
   statements;
ELSE
   statements;
END IF;
```

Control IF Conditions

Example of IF THEN ELSIF Condition

```
DECLARE
   v_sal EMP.SAL%TYPE;
BEGIN
   Select sal INTO v_sal
   From emp
   Where ename = 'SMITH';

   IF v_sal < 850 THEN
     DBMS_OUTPUT.PUT_LINE('Low paid salary person');
   ELSIF (v_sal >= 850 AND v_sal <=1000) THEN
     DBMS_OUTPUT.PUT_LINE('Average paid salary person');
   ELSE
     DBMS_OUTPUT.PUT_LINE('Higly paid salary person');
   END IF;
END;
/
```

Introduction to Database Administration

FOR & WHILE Loops

FOR & WHILE Loops

LOOPS, FOR & WHILE Loops

- LOOPS
- Loop with EXIT
- FOR Loop
- FOR Loop Syntax
- FOR Loop - Example
- FOR Loop - Bulk Data Insertion
- WHILE Loop
- WHILE Loop - Example
- WHILE Loop Syntax

FOR & WHILE LOOPS

LOOPS

- LOOP – EXIT WHEN – END LOOP
- FOR – LOOP – END LOOP
- WHILE – LOOP – END LOOP

FOR & WHILE LOOPS

Loop with EXIT

Following is its example (Repeat until LOOP):

```
DECLARE
      ...
      v_deptno   dept.deptno%TYPE   := 50;
        v_counter  integer := 1;
       ...
BEGIN
       ...
       LOOP
          INSERT INTO dept(deptno)
                      VALUES(v_deptno);
          v_counter := v_counter + 1;
          v_deptno := v_deptno + 10;
          EXIT WHEN v_counter > 5;
      END LOOP;
      ...
END;
/
```

FOR & WHILE LOOPS

FOR Loop

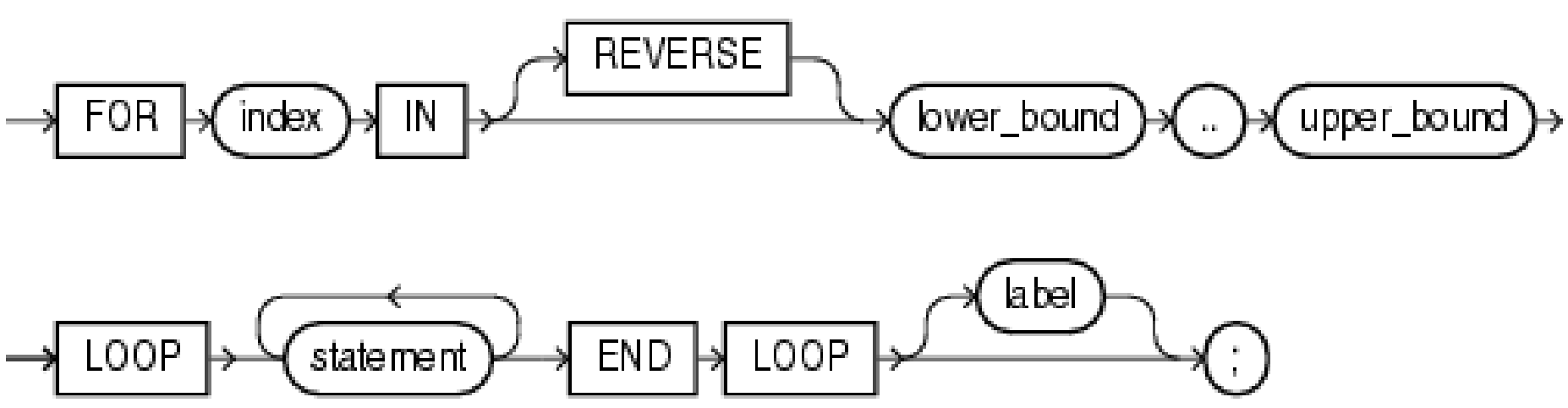
Following is its Syntax:

```
FOR index IN lower_bound .. upper_bound
LOOP
    statements;
END LOOP;
```

FOR & WHILE LOOPS

FOR Loop Syntax

Following is its generic syntax:



FOR & WHILE LOOPS

FOR Loop - Example

Following example displays serial numbers:

```
BEGIN
  FOR l_counter IN 1..5
  LOOP
    DBMS_OUTPUT.PUT_LINE( l_counter );
  END LOOP;
END;
/
```

FOR & WHILE LOOPS

FOR Loop - Example

Following example displays serial numbers in reverse:

```
BEGIN
  FOR l_counter IN REVERSE 1..3
  LOOP
    DBMS_OUTPUT.PUT_LINE( l_counter );
  END LOOP;
END;
/
```

FOR & WHILE LOOPS

FOR Loop - Bulk Data Insertion

Following example displays serial numbers in reverse:

```
BEGIN
  FOR i IN 55..70
  LOOP
    insert into dept(deptno, dname, loc)
    values (i, 'Dummy Dept-'||i, 'No Loc');
    DBMS_OUTPUT.PUT_LINE( i );
  END LOOP;
  Commit;
END;
/
```

```
 DEPTNO DNAME          LOC
------- -------------- -------------
     55 Dummy Dept-55  No Loc
     56 Dummy Dept-56  No Loc
     57 Dummy Dept-57  No Loc
     58 Dummy Dept-58  No Loc
     59 Dummy Dept-59  No Loc
     60 Dummy Dept-60  No Loc
     10 ACCOUNTING     NEW YORK
```

FOR & WHILE LOOPS

WHILE Loop

Following is its Syntax:

```
WHILE condition
LOOP
   statements;
END LOOP;
```

FOR & WHILE LOOPS

WHILE Loop - Example

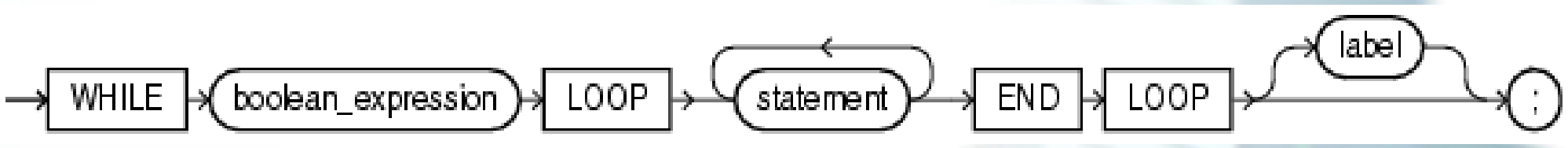
Following is its example:

```
DECLARE
  n_counter NUMBER := 1;
BEGIN
  WHILE n_counter <= 5
  LOOP
    DBMS_OUTPUT.PUT_LINE( 'Counter : ' || n_counter );
    n_counter := n_counter + 1
  END LOOP;
END;
/
```

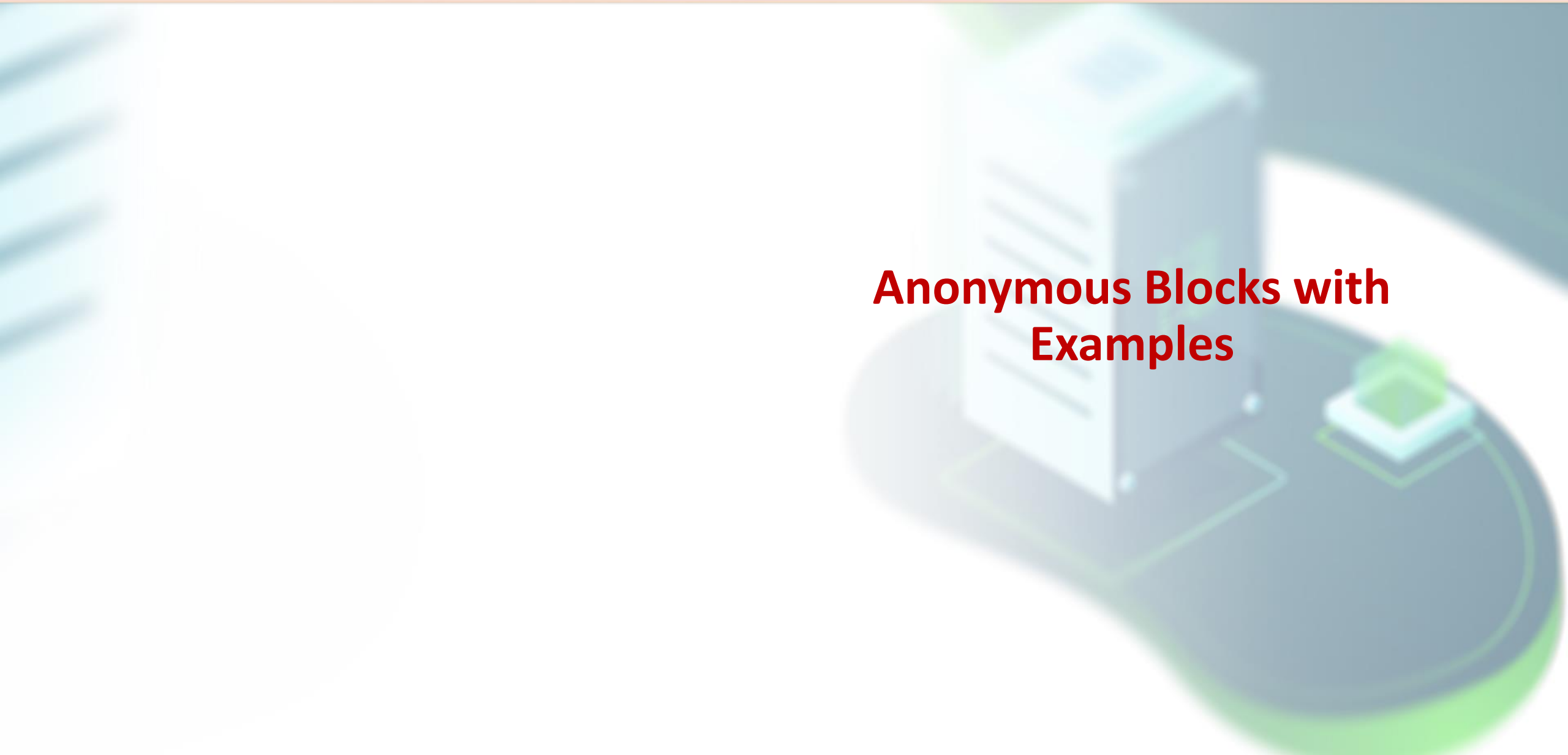
FOR & WHILE LOOPS

WHILE Loop Syntax

Following is its generic syntax:



Introduction to Database Administration



Anonymous Blocks with Examples

Anonymous Blocks with Examples

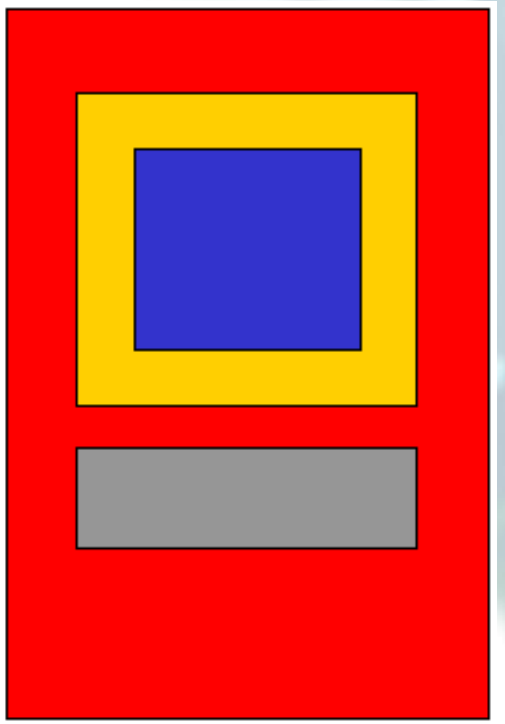
Anonymous Blocks with Examples

- Nesting Anonymous Blocks
- Nesting Anonymous Blocks – Example
- Repeat Until LOOP - Example

Anonymous Blocks with Examples

Nesting Anonymous Blocks

Blocks within blocks give the concept of Nested blocks



Anonymous Blocks with Examples

Repeat Until LOOP - Example

This loop executes once first time. It is same as DO-WHILE Loop.

```
LOOP
   monthly_value := daily_value * 31;
   EXIT WHEN monthly_value > 4000;
END LOOP;
```

Anonymous Blocks with Examples

Nesting Anonymous Blocks - Example

```
DECLARE
  n_counter NUMBER := 1;
BEGIN
  DBMS_OUTPUT.PUT_LINE('**************----Outer Block----**************');
  FOR i IN 55..70
  LOOP
    DBMS_OUTPUT.PUT_LINE( 'Outer Block Counter : ' || i );
  END LOOP;
  BEGIN
        WHILE n_counter <= 5
        LOOP
        DBMS_OUTPUT.PUT_LINE( 'Inner Block Counter : ' || n_counter );
        n_counter := n_counter + 1;
  END LOOP;
  END; --inner block end
END; --outer block end
/
```

Introduction to Database Administration

Exception Handlings-1

Exception Handlings-1

PL/SQL Exception Handlings

- PL/SQL Exception
- PL/SQL Exception Usage
- PL/SQL Exception - Example-1
- PL/SQL Exception - Example-2

Exception Handlings-1

PL/SQL Exception

- PL/SQL treats all errors that occur in an anonymous block, procedure, or function as exceptions.
- The exceptions can have different causes such as coding mistakes, bugs, even hardware failures.
- It is not possible to anticipate all potential exceptions, however, you can write code to handle exceptions to enable the program to continue running as normal.

Exception Handlings-1

PL/SQL Exception

- The code that you write to handle exceptions is called an exception handler.
- A PL/SQL block can have an exception-handling section, which can have one or more exception handlers.

Exception Handlings-1

PL/SQL Exception Usage

```
BEGIN
   -- executable section ...
   -- exception-handling section
   EXCEPTION
      WHEN e1 THEN
         -- exception_handler1
      WHEN e2 THEN
         -- exception_handler1
      WHEN OTHERS THEN
         -- other_exception_handler
END;
/
```

Exception Handlings-1

PL/SQL Exception – Example-1

Following program will terminate without successfully execution when employee no does not exist in table EMP.

```
DECLARE
    v_ename EMP.ename%TYPE;
    v_empno EMP.empno%TYPE := &empno;
BEGIN
    -- get the employee name by id
    SELECT ename INTO v_ename
    FROM EMP
    WHERE empno = v_empno;

    -- show the customer ename
    dbms_output.put_line('Employee name is ' || v_ename);
END;
/
```

Exception Handlings-1

PL/SQL Exception – Example-1

Following program will execute successfully when employee no does not exist in table EMP.

```
DECLARE
    v_ename EMP.ename%TYPE;
    v_empno EMP.empno%TYPE := &empno;
BEGIN
    -- get the employee name by id
    SELECT ename INTO v_ename
    FROM EMP
    WHERE empno = v_empno;

    -- show the customer ename
    dbms_output.put_line('Employee name is ' || v_ename);
EXCEPTION
        WHEN NO_DATA_FOUND THEN
          dbms_output.put_line('Employee ID' || v_empno ||   ' does not exist');
END;
/
```

Exception Handlings-1

PL/SQL Exception – Example-2

Following program will execute successfully using multiple Exceptions.

```
DECLARE
    v_ename EMP.ename%TYPE;
    v_job EMP.job%TYPE := &job;
BEGIN
    -- get the employee name by id
    SELECT ename INTO v_ename
    FROM EMP
    WHERE job = v_job;

    -- show the customer ename
    dbms_output.put_line('Employee name is ' || v_ename);
EXCEPTION
        WHEN NO_DATA_FOUND THEN
          dbms_output.put_line('Employee ID' || v_ename ||   ' does not exist');
        WHEN TOO_MANY_ROWS THEN
          dbms_output.put_line('Database returns many employees');
END;
/
```

```
Enter value for job: 'CLERK'
old   3:     v_job EMP.job%TYPE := &job;
new   3:     v_job EMP.job%TYPE := 'CLERK';
Database returns many employees

PL/SQL procedure successfully completed.
```

Introduction to Database Administration

Exception Handlings-2

Exception Handlings-2

PL/SQL Exception Handlings

- Raise Exception
- User-Defined Exception
- Affecting PL/SQL Exception
- Other Exceptions

Exception Handlings-2

Raise Exception

Exceptions are raised by the database server automatically whenever there is any internal database error, but exceptions can be raised explicitly by the programmer by using the command **RAISE**. Following is the simple syntax for raising an exception:

```
DECLARE
   exception_name EXCEPTION;
BEGIN
   IF condition THEN
      RAISE exception_name;
   END IF;
EXCEPTION
   WHEN exception_name THEN
   statement;
END;
/
```

Exception Handlings-2

User-Defined Exception

```
DECLARE
   v_empno EMP.empno%type := &cv_empno;
   v_name  EMP.ename%type;
   v_job EMP.job%type;
   -- user defined exception
   ex_invalid_empno  EXCEPTION;
BEGIN
   IF v_empno <= 0 THEN
      RAISE ex_invalid_empno;
   ELSE
      SELECT  ename, job INTO  v_name, v_job
      FROM EMP
      WHERE empno = v_empno;
      DBMS_OUTPUT.PUT_LINE ('Name: '||  v_name);
      DBMS_OUTPUT.PUT_LINE ('job: ' || v_job);
   END IF;

EXCEPTION |
   WHEN ex_invalid_empno THEN
      dbms_output.put_line('empno must be greater than zero!');
   WHEN no_data_found THEN
      dbms_output.put_line('No such employee!');
   WHEN others THEN
      dbms_output.put_line('Error!');
END;
/
```

Exception Handlings-2

Affecting PL/SQL Exception

One exception does not affect the rest of program

```
DECLARE
v_tname varchar2(100);
BEGIN
 BEGIN
  select tname into v_tname
  from tab
  where tname='CMG_EFFORTT';
  DBMS_OUTPUT.PUT_LINE('table name:'||v_tname);
  exception
    when no_data_found then
    DBMS_OUTPUT.PUT_LINE('No data');
 END;
 select tname into v_tname
  from tab
  where tname='CMG_EFFORT';
  DBMS_OUTPUT.PUT_LINE('table name:'||v_tname);
 exception
 when no_data_found then
    DBMS_OUTPUT.PUT_LINE('No data second exception');
 --go to 1;
END;
/
```

Exception Handlings-2

Other Exceptions

Examples are
NO_DATA_FOUND, ZERO_DIVIDE, OTHERS

Raise some exception

```
WHEN NO_DATA_FOUND THEN
    raise_application_error(-20011,'Invalid FK value');
```

Raise My_Excep;

To display details of oracle standard error message

```
EXCEPTION
    WHEN OTHERS THEN
        DBMS_OUTPUT.PUT_LINE('Error detail is: '||SQLERRM)
```

Introduction to Database Administration

PL/SQL Procedure

PL/SQL Procedure

PL/SQL Procedure

- What is a Procedure in PL/SQL?
- Procedure - Example
- Compiling & Executing Procedure
- Invoking a Procedure in a Block
- Executing a Procedure & Show Errors
- Data Dictionary for Procedures
- Managing Procedure using SQL Developer

PL/SQL Procedure

What is a Procedure in PL/SQL?

- Is a block with a name
- The DECLARE key word is not used
- Parameters can be
  - IN
  - OUT
  - IN OUT
- Is stored (USER_SOURCE)

PL/SQL Procedure

What is Procedure in PL/SQL?

Writing PL/SQL procedure

```
CREATE OR REPLACE PROCEDURE pname(                ) IS
        
BEGIN
        
EXCEPTION
        
END;
/
```

PL/SQL Procedure

Procedure – Example

```
SET SERVEROUTPUT ON;

CREATE OR REPLACE PROCEDURE
    proc_test(p_empno IN VARCHAR2)  IS
       v_job      EMP.job%TYPE;
       v_sal      EMP.sal%TYPE;
BEGIN
         SELECT job, sal
         INTO  v_job,v_sal
         FROM  emp
         WHERE  empno = p_empno;
         DBMS_OUTPUT.PUT_LINE('job is '||v_job);
EXCEPTION
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...');
END;
/
```

PL/SQL Procedure

Compiling & Executing Procedure

```
SQL> Show errors


SQL> execute proc_test(5893);
```

PL/SQL Procedure

Invoking a Procedure in a Block

```
DECLARE
    …
BEGIN
    …
    proc_test('23');
    …
END;
/

Or
SQL> exec proc_test('1123')
```

PL/SQL Procedure

Executing a Procedure & Show Errors

```
  1  create or replace procedure test_proc is
  2       v_id  INTEGER;
  3      v_empno emp.empno%TYPE;
  4  BEGIN
  5      v_id := 1234567;
  6      select empno into v_empno
  7      FROM  EMP
  8      WHERE empno = v_id;
  9  EXCEPTION
 10      WHEN NO_DATA_FOUND THEN
 11       DBMS_OUTPUT.PUT_LINE('No record exists');
 12*   END;
SQL> /

Procedure created.

SQL> exec test_proc
No record exists

PL/SQL procedure successfully completed.

SQL> show errors                (to see errors for procedures, functions)
```

PL/SQL Procedure

Data Dictionary for Procedures

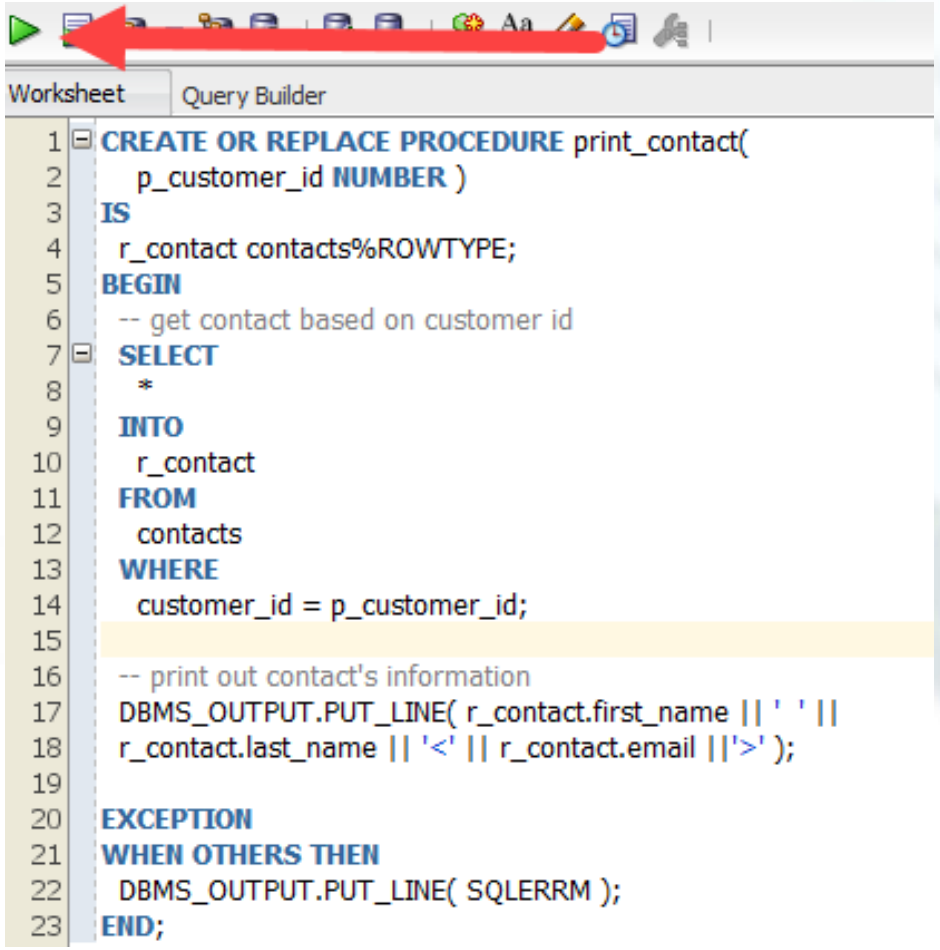
```
SQL> select Text from user_source
  2  where name='PROC_TEST';

TEXT
--------------------------------------------------
PROCEDURE
    proc_test(p_empno IN VARCHAR2)  IS
       v_job  EMP.job%TYPE;
       v_sal  EMP.sal%TYPE;
BEGIN
 SELECT job, sal
 INTO  v_job,v_sal
 FROM  emp
         WHERE  empno = p_empno;
 DBMS_OUTPUT.PUT_LINE('job is '||v_job);
EXCEPTION

TEXT
--------------------------------------------------
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...');
END;
```

PL/SQL Procedure

Managing Procedure using SQL Developer



PL/SQL Function

PL/SQL Function

PL/SQL Function

- What is Function in PL/SQL?
- Function - Example
- Compiling & Executing Function
- Executing a Function & Show Errors
- Data Dictionary for Function

PL/SQL Function

What is Function in PL/SQL?

- Is a block with a name
- Returns one value only.
- The DECLARE key word is not used
- Parameters can only be IN
- Is stored (USER_SOURCE)

PL/SQL Function

What is Function in PL/SQL?

Writing PL/SQL Function

```
CREATE OR REPLACE FUNCTION fname( [          ] )
RETURN datatype IS
        [          ]
BEGIN
        [          ]
        [          ]
EXECPTION
        [          ]
END;
/
```

PL/SQL Function

Function - Example

```
CREATE OR REPLACE FUNCTION
    func_test(p_empno IN VARCHAR2)  RETURN NUMBER IS
       v_job      EMP.job%TYPE;
       v_sal      EMP.sal%TYPE;
BEGIN
         SELECT job, sal
         INTO  v_job,v_sal
         FROM  emp
         WHERE  empno = p_empno;
         DBMS_OUTPUT.PUT_LINE('job is '||v_job);
         return v_sal;
EXCEPTION
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...');
END;
/

SQL> Show errors
```

PL/SQL Function

Compiling & Executing Function

```
SET SERVEROUTPUT ON;
DECLARE
   …
   v_sal     emp.sal%TYPE;
   …
BEGIN
    …
    v_sal := func_test(3477);

DBMS_OUTPUT.PUT_LINE(TO_CHAR(v_sal)
);
    …
END;
/
```

PL/SQL Function

Executing a Function & Show Errors

```
SQL> CREATE OR REPLACE FUNCTION
  2      func_test(p_empno IN VARCHAR2)  RETURN NUMBER IS
  3         v_job  EMP.job%TYPE;
  4         v_sal  EMP.sal%TYPE;
  5  BEGIN
  6   SELECT job, sal
  7   INTO  v_job,v_sal
  8   FROM  emp
  9           WHERE  empno = p_empno;
 10   DBMS_OUTPUT.PUT_LINE('job is '||v_job);
 11           return v_sal;
 12  EXCEPTION
 13       WHEN OTHERS THENv_sal;
 14           DBMS_OUTPUT.PUT_LINE('ERROR...');
 15  END;
 16  /

Warning: Function created with compilation errors.

SQL> show error
Errors for FUNCTION FUNC_TEST:

LINE/COL ERROR
-------- -----------------------------------------------------------------
13/18    PLS-00103: Encountered the symbol "THENV_SAL" when expecting one
         of the following:
         then or
         The symbol "then" was substituted for "THENV_SAL" to continue.
```

PL/SQL Function

Data Dictionary for Function

```
SQL> select text from user_source
  2  where name='FUNC_TEST';

TEXT
--------------------------------------------------------------------------------
FUNCTION
    func_test(p_empno IN VARCHAR2)  RETURN NUMBER IS
       v_job  EMP.job%TYPE;
       v_sal  EMP.sal%TYPE;
BEGIN
 SELECT job, sal
 INTO  v_job,v_sal
 FROM  emp
         WHERE  empno = p_empno;
 DBMS_OUTPUT.PUT_LINE('job is '||v_job);
         return v_sal;

TEXT
--------------------------------------------------------------------------------
EXCEPTION
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...');
END;
```

End

Introduction to Database Administration

Calling Procedures & Functions

Calling Procedures & Functions

- Calling Procedure
- Calling Function
- Calling Procedure with Parameters

Calling Procedures & Functions

Calling Procedure

Procedure can be called after compilation in some other function, procedure, block or package. For example,

```
DECLARE
   …
BEGIN
   …
   proc_test('23');
   …
END;
/

Or
SQL> exec proc_test('1123')
```

Calling Procedures & Functions

Calling Function

Function can be called after compilation in some other function, procedure, block or package by assigning it to variable.

```
DECLARE
   ...
   v_sal        emp.sal%TYPE;
   ...
BEGIN
   ...
   v_sal := func_test(3477);
   DBMS_OUTPUT.PUT_LINE(TO_CHAR(v_sal));
   ...
END;
/
```

Calling Procedures & Functions

Calling Procedure with Parameters

```
create or replace procedure proc_inout
                            (p_empno in number,
                             p_sal out number) is
BEGIN
   select sal
   into p_sal
   from emp
     where empno=p_empno;
END;
/

create or replace procedure proc_out is
  v_sal EMP.SAL%TYPE;
BEGIN
    proc_inout(7369,v_sal);
    DBMS_OUTPUT.PUT_LINE('salary is :'||v_sal);
END;
/

SQL> exec proc_out
salary is :2000

PL/SQL procedure successfully completed.
```

Introduction to Database Administration

Exercises of Functions

Exercises of Functions

- Compiling & Executing Function
- Function - Exercise-1
- Function - Exercise-2

Exercises of Functions

Compiling & Executing Function

```
SET SERVEROUTPUT ON;
DECLARE
   …
   v_sal     emp.sal%TYPE;
   …
BEGIN
    …
    v_sal := func_test(3477);

DBMS_OUTPUT.PUT_LINE(TO_CHAR(v_sal)
);
    …
END;
/
```

Exercises of Functions

Function – Exercise-1

```
CREATE OR REPLACE FUNCTION
    func_MaxSal(p_deptno IN NUMBER)  RETURN NUMBER IS
       v_MaxSal          EMP.sal%TYPE;
BEGIN
         SELECT max(sal)
         INTO  v_MaxSal
         FROM  emp
         where deptno = p_deptno;
         DBMS_OUTPUT.PUT_LINE('Highest Salary is '||v_MaxSal);
         return v_MaxSal;
EXCEPTION
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...'||SQLERRM);
END;
/
```

```
SQL> DECLARE
  2    vv_MaxSal EMP.SAL%TYPE;
  3  BEGIN
  4    vv_MaxSal := func_MaxSal(10);
  5    DBMS_OUTPUT.PUT_LINE('Calling from block:'||vv_MaxSal);
  6  END;
  7  /
Highest Salary is 5000
Calling from block:5000
```

Exercises of Functions

Function – Exercise-2

```
CREATE OR REPLACE FUNCTION fact(x number)
RETURN number IS
   f number;
BEGIN
   IF x=0 THEN
      f := 1;
   ELSE
      f := x * fact(x-1);
   END IF;
RETURN f;
END;
/

DECLARE
   num number;
   factorial number;
BEGIN
   num:= 6;
   factorial := fact(num);
   dbms_output.put_line(' Factorial '|| num || ' is ' || factorial);
END;
/
```

```
Factorial 6 is 720

PL/SQL procedure successfully completed.
```

Introduction to Database Administration

Exercises of Procedures

Exercises of Procedures

Exercises of Procedures

- Compiling & Executing Function
- Procedure Exercise-I

Exercises of Procedures

Compiling & Executing Procedure

```
DECLARE
    …
BEGIN
    …
    proc_test('23');
    …
END;
/
```

Or

```
SQL> exec proc_test(‘1123’)
```

Exercises of Procedures

Procedure – Exercise-1

```
CREATE OR REPLACE PROCEDURE
    proc_MaxSal(p_deptno IN NUMBER, p_MaxSal OUT NUMBER) IS
       v_MaxSal         EMP.sal%TYPE;
BEGIN
         SELECT max(sal)
         INTO  v_MaxSal
         FROM  emp
         where deptno = p_deptno;
         DBMS_OUTPUT.PUT_LINE('Highest Salary is '||v_MaxSal);
         p_MaxSal := v_MaxSal;
EXCEPTION
     WHEN OTHERS THEN
         DBMS_OUTPUT.PUT_LINE('ERROR...'||SQLERRM);
END;
/

CREATE OR REPLACE PROCEDURE proc_CALLING(p_dno IN NUMBER) IS
  vv_MaxSal EMP.SAL%TYPE;
BEGIN
  proc_MaxSal(p_dno, vv_MaxSal);
  DBMS_OUTPUT.PUT_LINE('Calling from block:'||vv_MaxSal);
END;
/


SQL> execute proc_CALLING(20);
```

```
SQL> execute proc_CALLING(20);
Highest Salary is 3400
Calling from block:3400

PL/SQL procedure successfully completed.
```

Introduction to Database Administration

PL/SQL Package-1

PL/SQL Package-1

PL/SQL Package-1

- Purpose of PL/SQL Package
- PL/SQL Package contains …
- Schematic Diagram of Package
- PL/SQL Package Specification
- PL/SQL Package Body
- Package Specification & its Body

PL/SQL Package-1

Purpose of PL/SQL Package

- In PL/SQL, a package is a schema object that contains definitions for a group of related functionalities.
- A package includes variables, constants, cursors, exceptions, procedures, functions, and subprograms.
- It is compiled and stored in the Oracle Database.

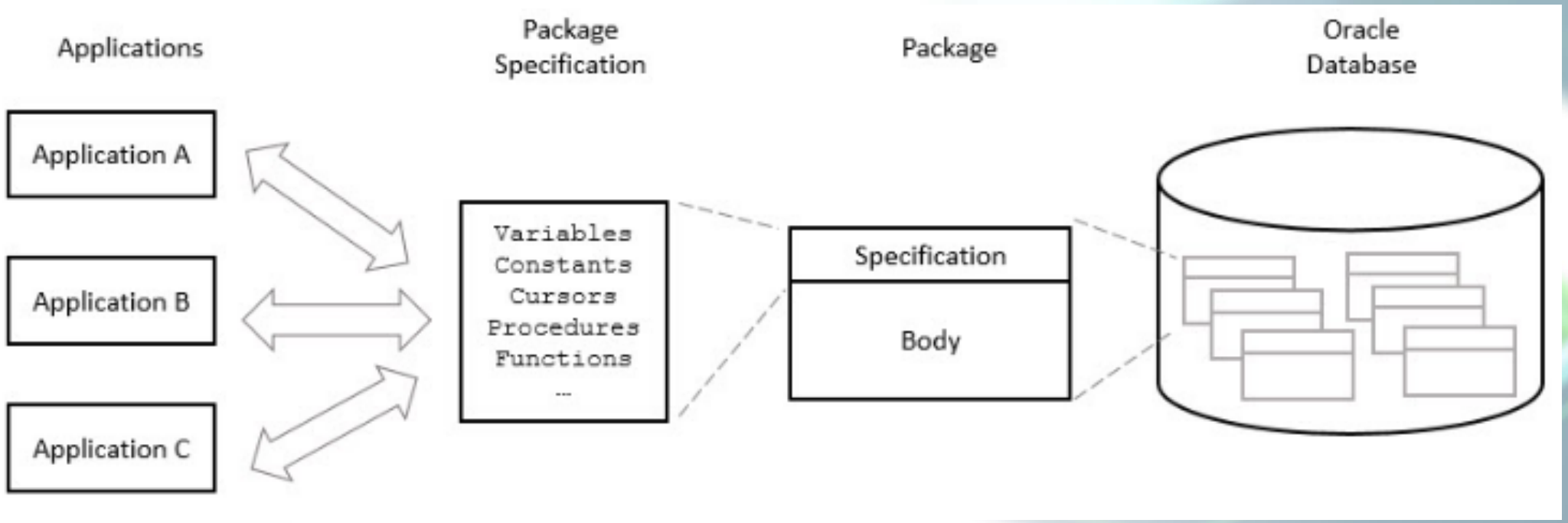
PL/SQL Package-1

PL/SQL Package contains …

- Typically, a package has a specification and a body. A package specification is mandatory while the package body can be required or optional, depending on the package specification.

PL/SQL Package-1

Schematic Diagram of Package



https://www.oracletutorial.com/plsql-tutorial/plsql-package/

PL/SQL Package-1

PL/SQL Package Specification

- The package specification declares the public objects that are accessible from outside the package.
- If a package specification whose public objects include cursors and subprograms, then it must have a body which defines queries for the cursors and code for the subprograms.

PL/SQL Package-1

PL/SQL Package Body

- A package body contains the implementation of the cursors or subprograms declared in the package specification. In the package body, you can declare or define private variables, cursors, etc., used only by package body itself.

PL/SQL Package-1

PL/SQL Package Body

- A package body can have an initialization part whose statements initialize variables or perform other one-time setups for the whole package.
- A package body can also have an exception-handling part used to handle exceptions.

PL/SQL Package-1

Package Specification & its Body

```
CREATE OR REPLACE PACKAGE emp_info IS



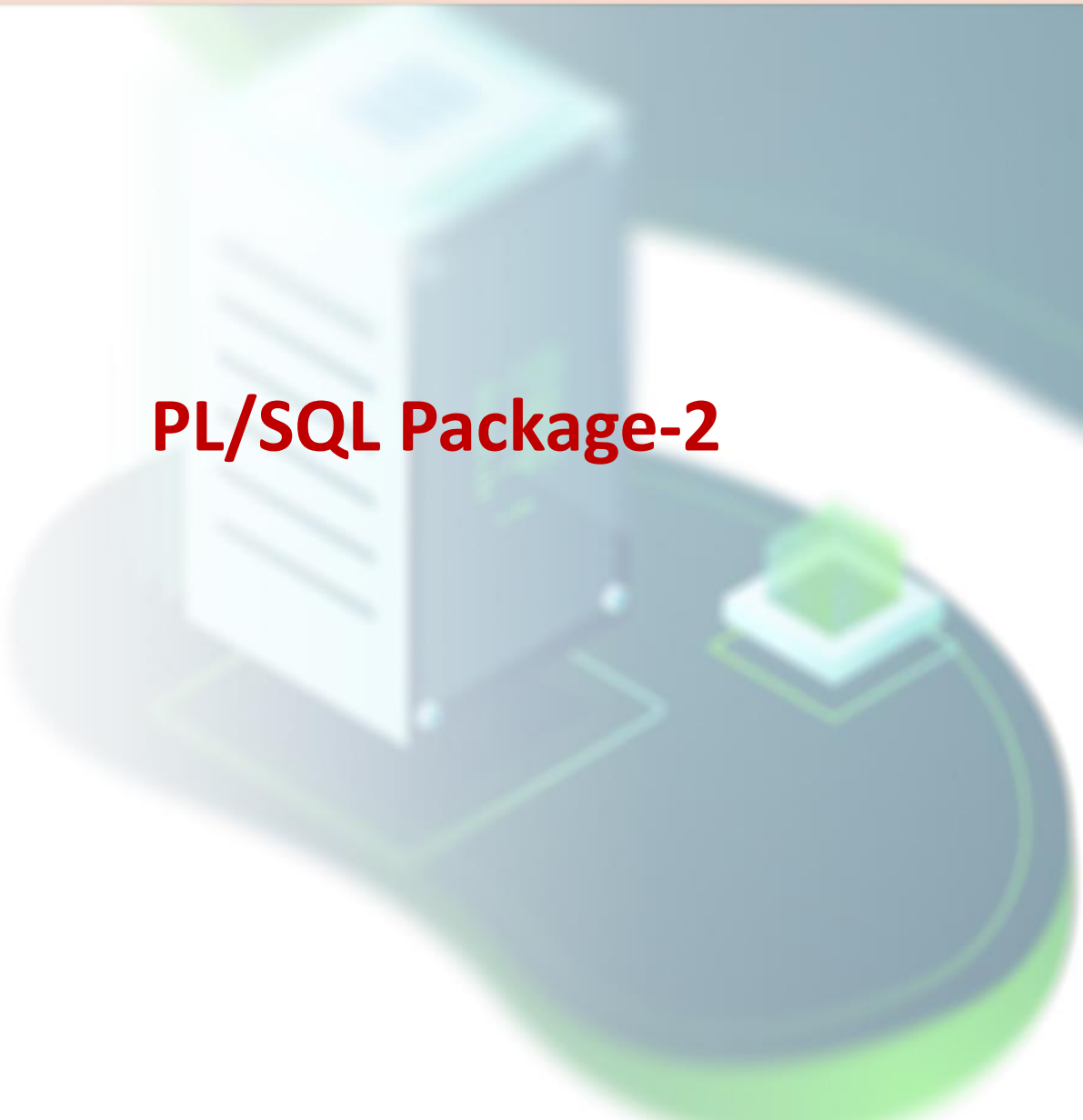
END emp_info;
/

CREATE OR REPLACE PACKAGE BODY emp_info is



END emp_info; --end of package body
/
```

Introduction to Database Administration



PL/SQL Package-2

PL/SQL Package-2

- What is a Package in PL/SQL?
- Package Specification
- Package Body
- Add in a Package Body by hiding from User Specification
- Invoking Package Subprogram

PL/SQL Package-2

What is a Package in PL/SQL?

Selected and purposeful collection of procedures, functions and variables is managed in package.

- Package
  - Package Specification
  - Package Body
- Invoking Package subprogram
- Abstract Programming
- To avoid spreading of procedures & functions
- Is stored (USER_SOURCE)

PL/SQL Package-2

Package Specification

```
CREATE OR REPLACE PACKAGE emp_info IS

   v_count   INTEGER;  --global variable for all sub programs inside package

   PROCEDURE insert_record( p_empno IN NUMBER
                          , p_ename IN VARCHAR2
                          , p_job IN VARCHAR2
                          , p_sal IN NUMBER
                          , p_comm IN NUMBER
                          , p_deptno IN VARCHAR2);

   PROCEDURE delete_record(p_empno IN NUMBER);

   FUNCTION sum_dept_sal( p_deptno IN dept.deptno%TYPE) RETURN is dept.sal%TYPE;

END emp_info;
/
```

PL/SQL Package-2

Package Body

```
CREATE OR REPLACE PACKAGE BODY emp_info is

PROCEDURE insert_record(p_empno IN NUMBER,p_ename IN VARCHAR2,
p_job IN VARCHAR2,p_sal IN NUMBER,
p_comm IN NUMBER,p_deptno IN VARCHAR2) IS
BEGIN
      INSERT INTO EMP(empno,ename,job,sal,comm,deptno)
      VALUES(p_empno,p_ename,p_job,p_sal,p_comm,p_deptno);
END insert_record;

PROCEDURE delete_record(p_empno IN NUMBER) IS
BEGIN
    DELETE FROM EMP
    WHERE empno=p_empno;
END delete_record;

 FUNCTION  sum_dept_sal(p_deptno IN NUMBER) RETURN emp.sal%TYPE IS
 v_sum_sal    emp.sal%TYPE;
 BEGIN
    SELECT SUM(sal)
    INTO v_sum_sal
     FROM emp
     WHERE deptno = p_deptno;
    RETURN v_sum_sal;
END;

END emp_info; --end of package body
/
```

PL/SQL Package-2

Purpose of PL/SQL Package

Following are its main purposes:

- Make code more modular
- Hide implementation details
- Improve application performance
- Minimize unnecessary recompiling code
- Manage authorization easily

PL/SQL Package-2

Add in a Package Body by hiding from User Specification

```
Procedure call_from_out is
   v_empno EMP.empno%TYPE;
   v_ename EMP.ename%TYPE;
   v_job   EMP.job%TYPE;
   v_sal   EMP.sal%TYPE;
   v_comm  EMP.comm%TYPE;
   v_deptno EMP.dept%TYPE;
begin

   v_empno := 8899;
   v_ename := 'ALI';
   v_job   := 'MANAGER';
   v_sal   := 8000;
   v_comm  := 300;
   v_deptno := 10;

   insert_record(  v_empno, v_ename, v_job, v_sal, v_comm,v_deptno);
    commit;
EXCEPTION
   WHEN OTHERS THEN
     DBMS_OUTPUT.PUT_LINE('Except call_from_out:'||SQLERRM);
end;
/
```

PL/SQL Package-2

Invoking Package Subprogram

```
DECLARE
    v_sum_sal    emp.sal%TYPE;
BEGIN
    ...
    v_sum_sal := emp_info.sum_dept_sal(10);
    ...
    emp_info.delete_record(1234567);
    ...
END;
/
```

Or

```
SQL> exec emp_info.insert_record(...,...)
```

Execution of Packages

Execution of Packages

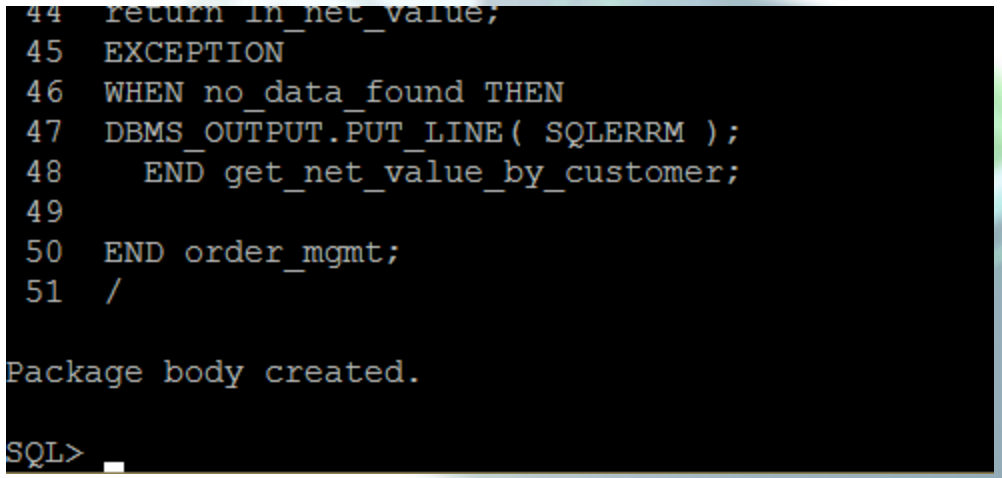
Execution of Packages

- Compiling a Package using SQL*Plus
- Compiling a Package using Oracle Developer
- Compiling a Package using Files on SQL*Plus
- Calling Function and Procedure from Package

Execution of Packages

Compiling a Package using SQL*Plus

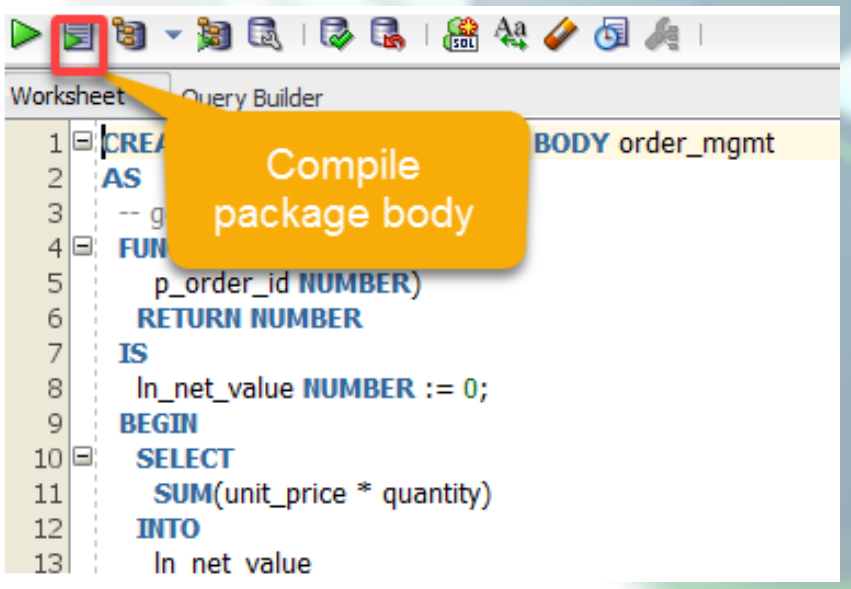
If you use SQL*Plus for compiling and creating a package body, you type forward slash (/) as follows:



Execution of Packages

Compiling a Package using Oracle Developer

From PL/SQL Developer, you click the **Run Script** button to compile the package body.



Execution of Packages

Compiling a Package using Files on SQL*Plus

If you manage package specification & body using separate files, you can compile separately using the following commands:

```
SQL> @path_to_packge_body_file
```

```
SQL > @path_to_package_body_file
2 /
```

Execution of Packages

Calling Function and Procedure from Package

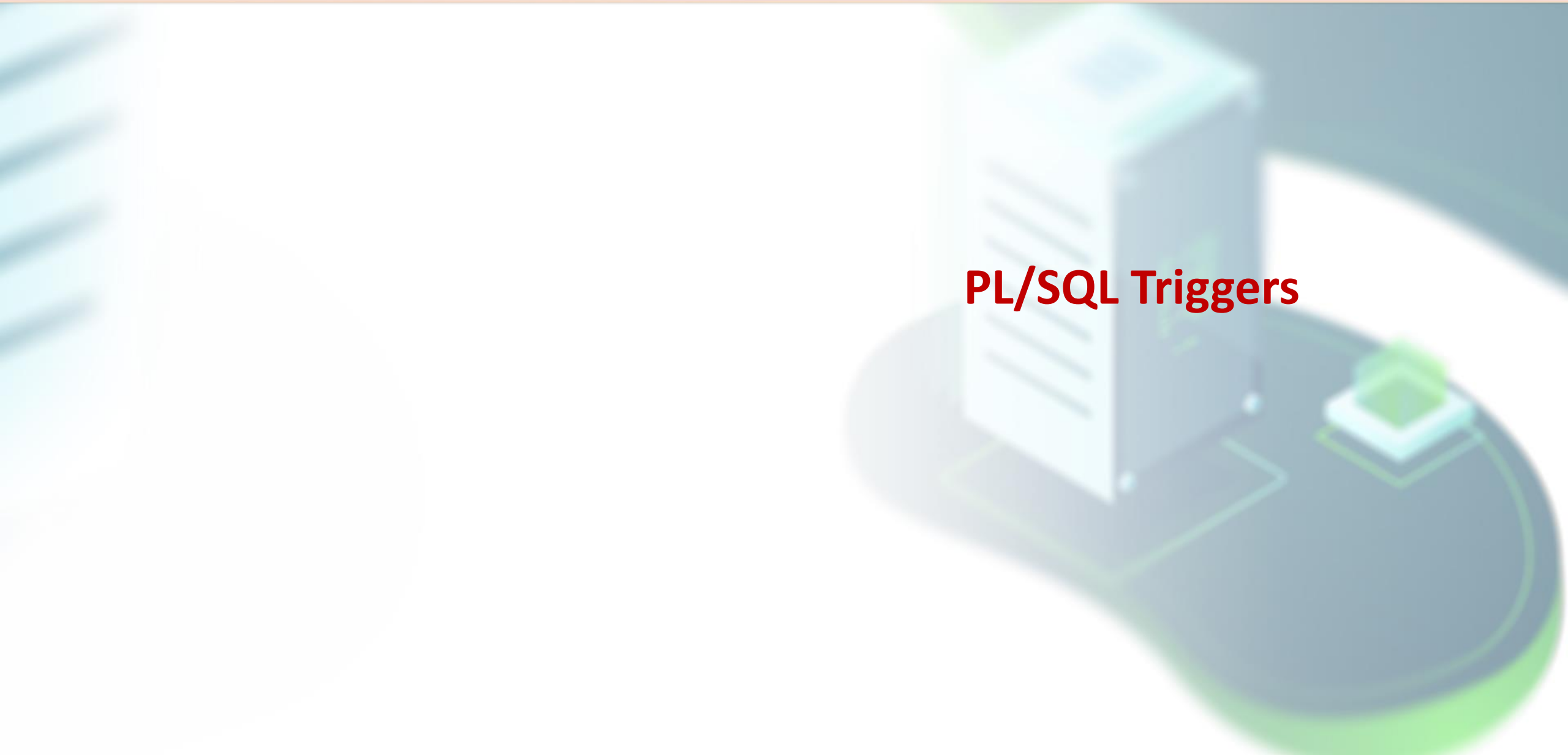
```
DECLARE
   v_sum_sal    emp.sal%TYPE;
BEGIN
   ...
   v_sum_sal := emp_info.sum_dept_sal(10);
   ...
   emp_info.delete_record(1234567);
   ...
END;
/
```

Or

SQL> exec emp_info.insert_record(...,...)

End

Introduction to Database Administration



PL/SQL Triggers

PL/SQL Triggers

PL/SQL Triggers

- What is an Oracle Triggers?
- Oracle Trigger Usage
- Oracle Trigger Syntax
- Oracle Trigger Header
- Oracle Trigger Body
- Create or Replace a Trigger

PL/SQL Triggers

What is an Oracle Triggers?

- A trigger is a named PL/SQL block stored in the Oracle Database and executed automatically when a triggering event takes place. The event can be any of the following:

- A data manipulation language (DML) statement executed against a table e.g., INSERT, UPDATE, or DELETE.

PL/SQL Triggers

What is an Oracle Triggers?

- For example, if you define a trigger that fires before an INSERT statement on the customers table, the trigger will fire once before a new row is inserted into the customers table.
- A data definition language (DDL) statement executes e.g., CREATE or ALTER statement. These triggers are often used for auditing purposes to record changes of the schema.

PL/SQL Triggers

What is an Oracle Trigger?

- A system event such as startup or shutdown of the Oracle Database.
- A user event such as login or logout.
- The act of executing a trigger is also known as firing a trigger. We say that the trigger is fired.

PL/SQL Triggers

Oracle Trigger Usage

Oracle triggers are useful in many cases such as the following:

- Enforcing complex business rules that cannot be established using integrity constraint such as UNIQUE, NOT NULL, and CHECK.
- Preventing invalid transactions.

PL/SQL Triggers

Oracle Trigger Usage

- Gathering statistical information on table accesses.
- Generating value automatically for derived columns.
- Auditing sensitive data.

PL/SQL Triggers

Oracle Trigger Syntax

- Following is its syntax

```
CREATE [OR REPLACE] TRIGGER trigger_name
{BEFORE | AFTER } triggering_event ON table_name
[FOR EACH ROW]
[FOLLOWS | PRECEDES another_trigger]
[ENABLE / DISABLE ]
[WHEN condition]
DECLARE
    declaration statements
BEGIN
    executable statements
EXCEPTION
    exception_handling statements
END;
/
```

PL/SQL Triggers

Oracle Trigger Header

```
CREATE [OR REPLACE] TRIGGER trigger_name
   {BEFORE | AFTER } triggering_event ON table_name
   [FOR EACH ROW]
   [FOLLOWS | PRECEDES another_trigger]
   [ENABLE / DISABLE ]
   [WHEN condition]
```

PL/SQL Triggers

Oracle Trigger Body

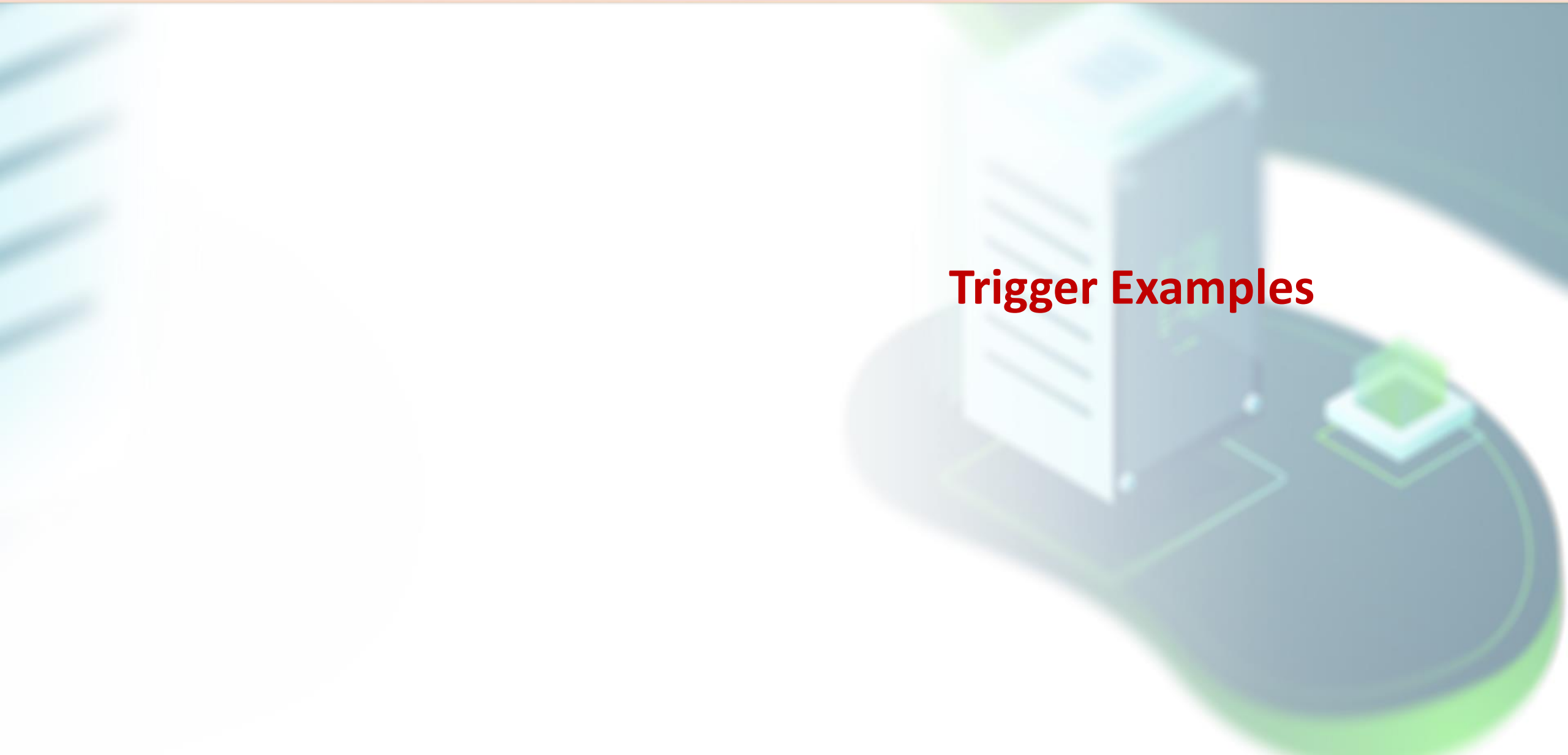
```
DECLARE
   declaration statements
BEGIN
   executable statements
EXCEPTION
   exception_handling statements
END;
```

PL/SQL Triggers

End

Create or Replace a Trigger

- The CREATE keyword specifies that you are creating a new trigger. The OR REPLACE keywords are optional. They are used to modify an existing trigger.
- Even though the OR REPLACE keywords are optional, they appear with the CREATE keyword in most cases.



Trigger Examples

Trigger Examples

Trigger Examples

- Trigger Example-1
- Execution of Trigger Example-1
- Trigger Example-2
- Trigger & Function Example-3

Trigger Examples

Trigger Example-1

Display difference of salary when salary of employee is changed

```
CREATE OR REPLACE TRIGGER display_salary_changes
BEFORE DELETE OR INSERT OR UPDATE ON EMP
FOR EACH ROW
WHEN (NEW.EMPNO > 0)
DECLARE
   sal_diff number;
BEGIN
   sal_diff := :NEW.sal  - :OLD.sal;
   dbms_output.put_line('Old salary: ' || :OLD.sal);
   dbms_output.put_line('New salary: ' || :NEW.sal);
   dbms_output.put_line('Salary difference: ' || sal_diff);
END;
/
```

Trigger Examples

Execution of Trigger Example-1

Display difference of salary when salary of employee is changed

```
SQL> CREATE OR REPLACE TRIGGER display_salary_changes
  2  BEFORE DELETE OR INSERT OR UPDATE ON EMP
  3  FOR EACH ROW
  4  WHEN (NEW.EMPNO > 0)
  5  DECLARE
  6     sal_diff number;
  7  BEGIN
  8     sal_diff := :NEW.sal  - :OLD.sal;
  9     dbms_output.put_line('Old salary: ' || :OLD.sal);
 10     dbms_output.put_line('New salary: ' || :NEW.sal);
 11     dbms_output.put_line('Salary difference: ' || sal_diff);
 12  END;
 13  /

Trigger created.

SQL> set serveroutput on
SQL> update emp
  2  set sal=777
  3  where ename='SMITH';
Old salary: 800
New salary: 777
Salary difference: -23

1 row updated.
```

Trigger Examples

Trigger Example-2

Keeping log of old data into a log table

```
CREATE OR REPLACE TRIGGER del_emp
BEFORE DELETE ON emp
FOR EACH ROW
DECLARE
   x number(2);
BEGIN
     INSERT INTO emp_audit
            VALUES(:NEW.empno, USER, sysdate);
END;
/

--Other forms can be BEFORE INSERT OR UPDATE
--OF salary ON EMP
--Need to create table emp_audit
--select * from emp_audit;
```

Trigger Examples

Trigger & Function Example-3

```
create table emp1
as select * from emp;
```

```
alter table emp1
add bonus number(6,2);
CREATE OR REPLACE  FUNCTION "BONUS_CALC"
                    (p_sal IN NUMBER) RETURN NUMBER IS
BEGIN
    return(p_sal/600);
   dbms_output.put_line(' ***** THE RECORD HAS SUCCESSFULLY BEEN INSERTED *****');
END;
/


CREATE OR REPLACE TRIGGER "UPDATE_BONUS" before INSERT OR UPDATE  OF SAL ON "EMP1" FOR EACH ROW
BEGIN
    --AFTER option gives error of mutating
    --select Bonus_Calc(:New.sal) into :New.bonus from dual;
    --Or use the following asignment statement
    :New.bonus := Bonus_Calc(:New.sal);

   dbms_output.put_line(' ***** THE RECORD HAS SUCCESSFULLY BEEN INSERTED *****');
end;
/

Update emp1
set sal=1600
where ename in ('ALLEN');
```

Introduction to Database Administration

Trigger Exercises

Trigger Exercises

Trigger Exercises

- Exercise-1 (Off day DML Restriction)
- Exercise-2 (for Data Entry)
- Trigger’s Disable/ Enable
- Trigger’s Disable/ Enable using SQL Developer
- Exercise-3 (Mutating Error)
- Fired Triggers
- Updating & Deleting on Table with specific Columns

Trigger Exercises

Exercise-1 (Off day DML Restriction)

This is a statement trigger on the EMP table, and it fires before an INSERT, UPDATE, or DELETE statement is issued. First, the trigger determines the day of the week. If the day is Saturday or Sunday, an error message is generated.

Trigger Exercises

Exercise-1 (Off day DML Restriction)

```
SQL> CREATE OR REPLACE TRIGGER EMP_ModifyIssue
  2  BEFORE INSERT OR UPDATE OR DELETE ON EMP
  3  DECLARE
  4     v_day VARCHAR2(10);
  5  BEGIN
  6     v_day := RTRIM(TO_CHAR(SYSDATE, 'DAY'));
  7     IF v_day LIKE ('S%') THEN
  8   RAISE_APPLICATION_ERROR (-20000, 'A table cannot be modified during off hours');
  9  END IF;
 10  END;
 11  /

Trigger created.

SQL>
SQL> update emp
  2  set sal=700
  3  where ename='SMITH';
update emp
       *
ERROR at line 1:
ORA-20000: A table cannot be modified during off hours
ORA-06512: at "SCOTT.EMP_MODIFYISSUE", line 6
ORA-04088: error during execution of trigger 'SCOTT.EMP_MODIFYISSUE'
```

Trigger Exercises

Exercise-2 (for Data Entry)

```
CREATE OR REPLACE TRIGGER Derived
BEFORE INSERT OR UPDATE OF Ename ON Emp

/* Before updating the ENAME field, derive the values for
   the UPPERNAME and SOUNDEXNAME fields. Restrict users
   from updating these fields directly: */
FOR EACH ROW
BEGIN
  :NEW.Uppername := UPPER(:NEW.Ename);
  :NEW.Soundexname := SOUNDEX(:NEW.Ename);
END;
/
```

Trigger Exercises

Trigger's Disable/ Enable

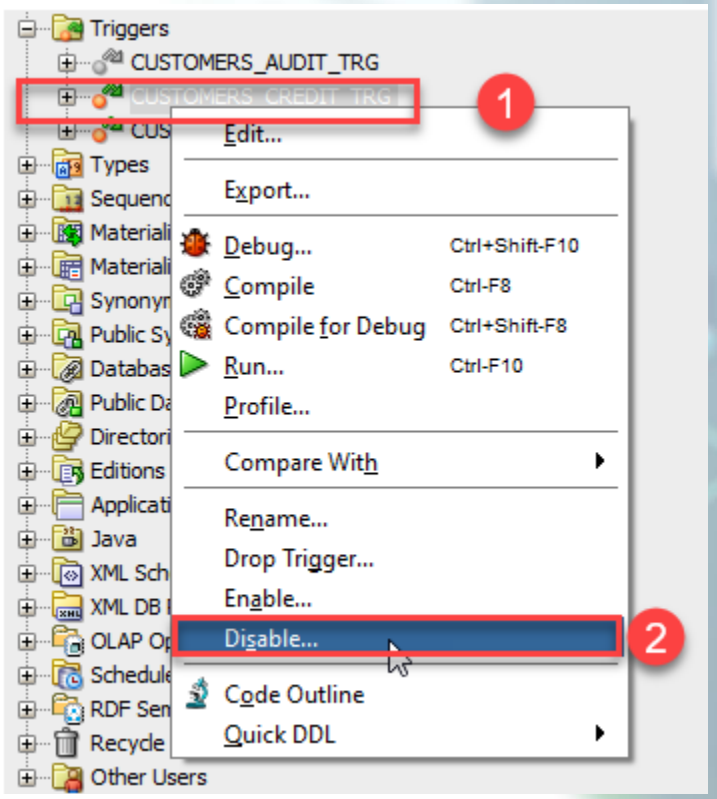
Sometimes, you may want to disable a trigger for testing and troubleshooting purposes. To disable a trigger, you use the ALTER TRIGGER DISABLE statement:

```
ALTER TRIGGER trigger_name DISABLE;
```

```
ALTER TABLE table_name DISABLE ALL TRIGGERS;
```

Trigger Exercises

Trigger's Disable/ Enable using SQL Developer



Trigger Exercises

Exercise-3 (Mutating Error)

```
SQL> CREATE OR REPLACE TRIGGER Update_EmpDeptno
  2  BEFORE INSERT OR UPDATE ON EMP
  3  FOR EACH ROW
  4  DECLARE
  5  v_cnt Number(3);
  6  BEGIN
  7  IF :NEW.deptno IS NOT NULL THEN
  8  BEGIN
  9  SELECT count(*)
 10  INTO v_cnt
 11  FROM EMP
 12  WHERE deptno = :NEW.deptno;
 13  EXCEPTION
 14  WHEN NO_DATA_FOUND THEN
 15  RAISE_APPLICATION_ERROR
 16  (-20001, 'This is not a valid deptno');
 17  END;
 18  END IF;
 19  END;
 20  /

Trigger created.

SQL> Update emp
  2  set deptno = 11
  3  where deptno=10;
Update emp
       *
ERROR at line 1:
ORA-04091: table SCOTT.EMP is mutating, trigger/function may not see it
ORA-06512: at "SCOTT.UPDATE_EMPDEPTNO", line 6
ORA-04088: error during execution of trigger 'SCOTT.UPDATE_EMPDEPTNO'
```

Trigger Exercises

Exercise-3 (Resolving Mutating Error)

```
CREATE OR REPLACE TRIGGER Update_EmpDeptno
BEFORE INSERT OR UPDATE ON EMP
FOR EACH ROW
DECLARE
v_cnt Number(3);
BEGIN
   IF :NEW.deptno IS NOT NULL THEN
   BEGIN
        SELECT count(*)
        INTO v_cnt
        FROM dept
        WHERE deptno = :NEW.deptno;
        DBMS_OUTPUT.PUT_LINE(:NEW.deptno);
   EXCEPTION
   WHEN NO_DATA_FOUND THEN
   RAISE_APPLICATION_ERROR (-20001, 'This is not a valid deptno');
   END;
   END IF;
END;
/
```

Trigger Exercises

Fired Triggers

Need to see which trigger names are fired on commands such as

```
SQL> update emp
  2  set deptno=11
  3  where deptno=10;
11
Old salary:
New salary:
Salary difference:
11
Old salary: 4000
New salary: 4000
Salary difference: 0
11
Old salary: 2450
New salary: 2450
Salary difference: 0
```

```
select distinct name
from user_source
where type='TRIGGER';

drop trigger DEL_EMP;
drop trigger UPDATE_EMPDEPTNO;
```

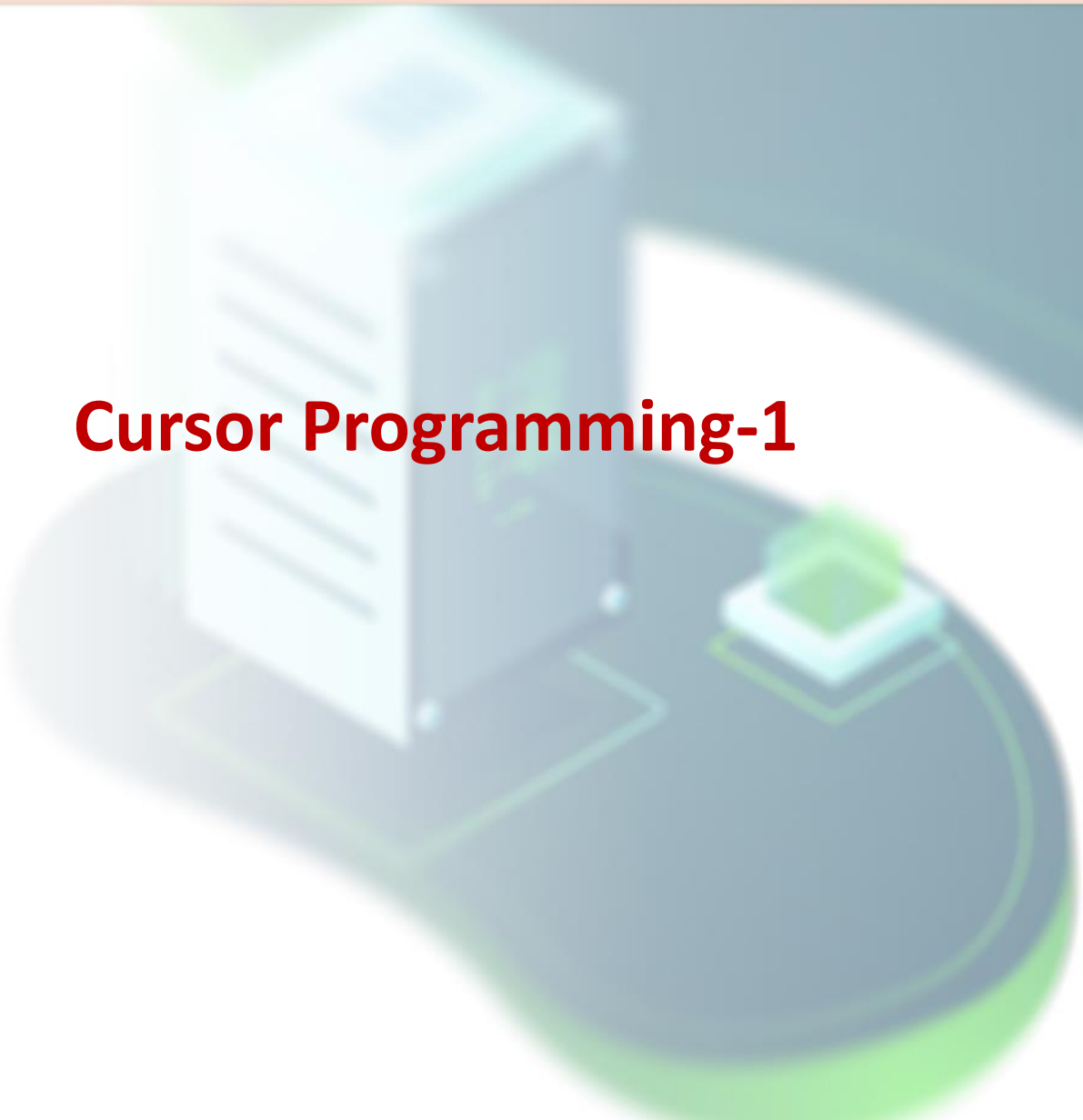
Trigger Exercises

Updating & Deleting on Table with specific Columns

```
CREATE OR REPLACE TRIGGER Updating_EMP
  BEFORE
    INSERT OR
    UPDATE OF sal, deptno OR
    DELETE
  ON EMP
BEGIN
  CASE
    WHEN INSERTING THEN
      DBMS_OUTPUT.PUT_LINE('Inserting');
    WHEN UPDATING('sal') THEN
      DBMS_OUTPUT.PUT_LINE('Updating sal');
    WHEN UPDATING('deptno') THEN
      DBMS_OUTPUT.PUT_LINE('Updating department ID');
    WHEN DELETING THEN
      DBMS_OUTPUT.PUT_LINE('Deleting');
  END CASE;
END;
/

update emp
set sal=2000
where ename='SMITH';
```

Introduction to Database Administration



Cursor Programming-1

Cursor Programming-1

- What is a Cursor?
- Implicit Cursor
- Execution Cycle of Explicit Cursor
- Cursor’s usage
- Explicit Cursor Attributes

Cursor Programming-1

What is a Cursor?

- A cursor is a pointer that points to a result of a query.
- It is mainly used with tables which return more than one row.
- It is handled implicitly and explicitly.

Cursor Programming-1

Implicit Cursor

- Whenever Oracle executes an SQL statement such as SELECT INTO, INSERT, UPDATE, and DELETE, it automatically creates an implicit cursor.
- Oracle internally manages the whole execution cycle of implicit cursors and reveals only the cursor's information and statuses such as SQL%ROWCOUNT, SQL%ISOPEN, SQL%FOUND, and SQL%NOTFOUND.

Cursor Programming-1

Implicit Cursor

- The implicit cursor is not elegant when the query returns zero or multiple rows which cause NO_DATA_FOUND or TOO_MANY_ROWS exception respectively.

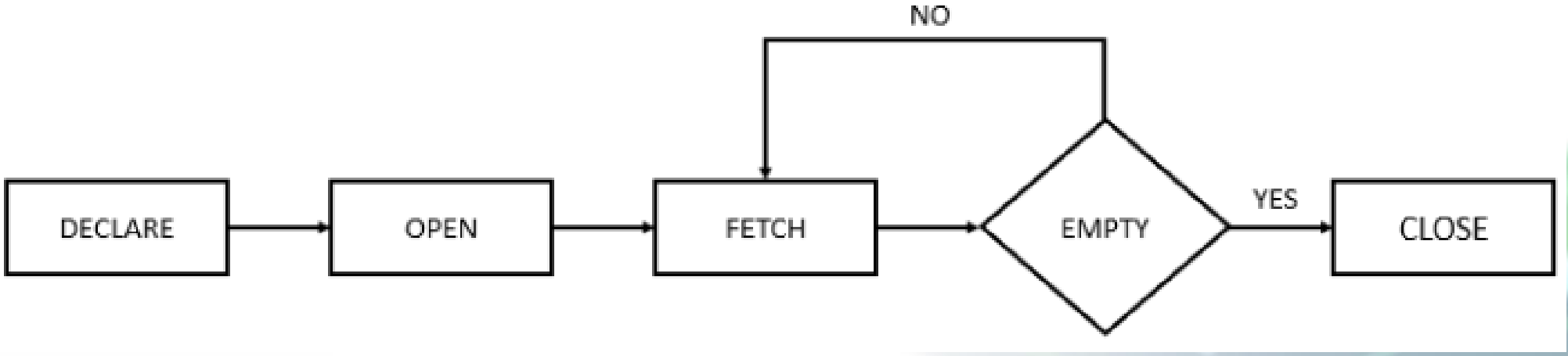
Cursor Programming-1

Explicit Cursor

- An explicit cursor is an SELECT statement declared explicitly in the declaration section of the current block or a package specification.
- For an explicit cursor, you have control over its execution cycle from OPEN, FETCH, and CLOSE.
- Oracle defines an execution cycle that executes an SQL statement and associates a cursor with it.

Cursor Programming-1

Execution Cycle of Explicit Cursor



Cursor Programming-1

Cursor's usage

- **Declare a cursor**

  CURSOR cursor_name IS query;

- **Open a cursor**

  OPEN cursor_name;

Cursor Programming-1

Cursor's usage

- **Fetch from a cursor**
  The FETCH statement places the contents of the current row into var.

  FETCH cursor_name INTO variable_list;

  To retrieve all rows in a result set, you need to fetch each row till the last one.

- **Closing a cursor**

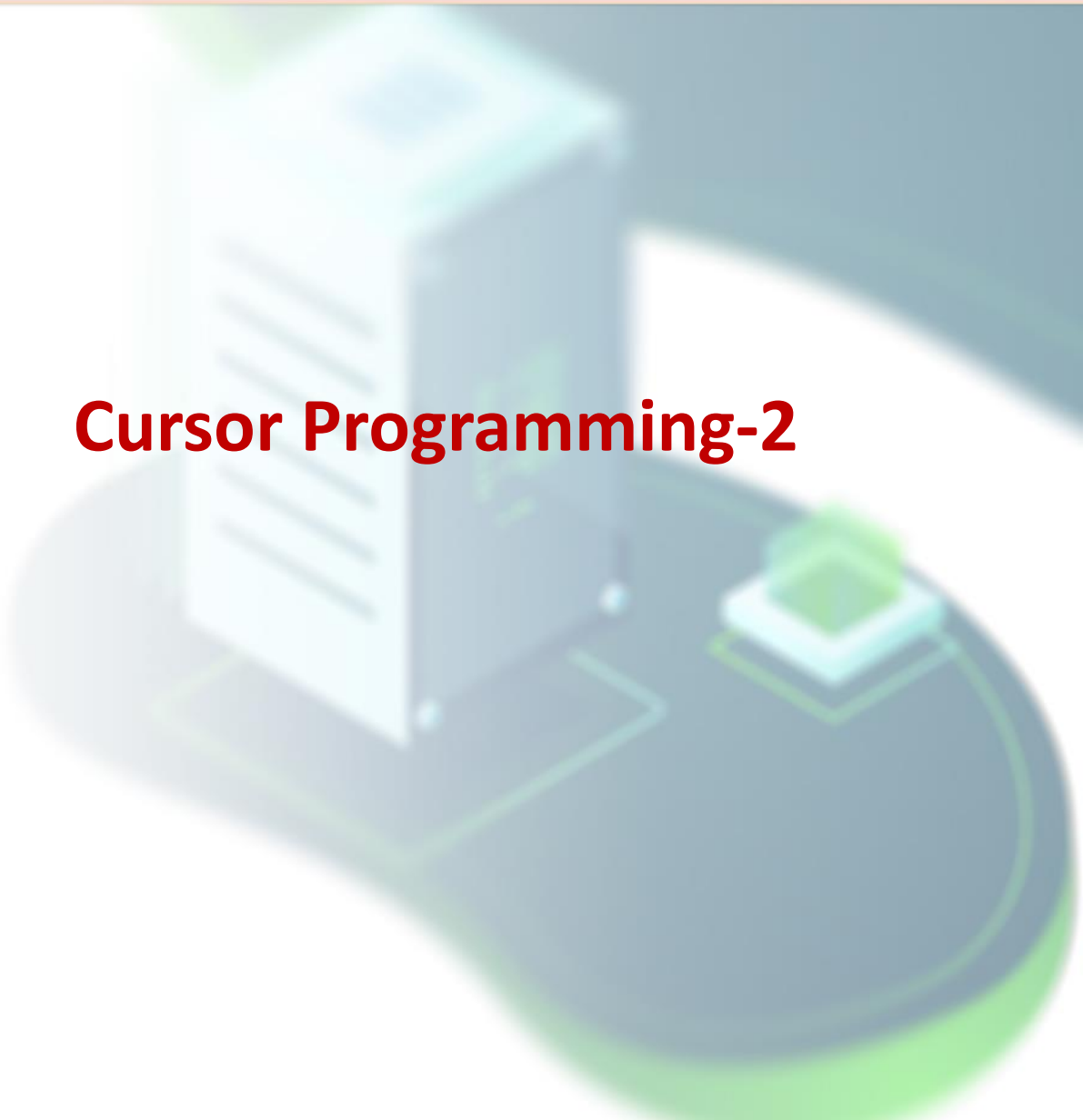
  CLOSE cursor_name;

Cursor Programming-1

Explicit Cursor Attributes

- %ISOPEN
- %FOUND
- %NOTFOUND
- %ROWCOUNT

Introduction to Database Administration



Cursor Programming-2

Cursor Programming-2

- Explicit Cursor Attributes
- Implicit Cursor - Record Type
- ROWTYPE Example - 1
- ROWCOUNT Example
- How to Declare Cursor?
- %ISOPEN, %FOUND, FETCH Example

Cursor Programming-2

Explicit Cursor Attributes

- %ISOPEN
- %FOUND
- %NOTFOUND
- %ROWCOUNT

Cursor Programming-2

Implicit Cursor – Record Type

- A record is a composite data structure, which means that it is composed of one or more elements.
- Records are very much like a row of a database table, but each element of the record does not stand on its own. PL/SQL supports three kinds of records: table-based, cursor-based, and programmer-defined.

```
v_EmpRec   EMP%TYPE;
```

Cursor Programming-2

Implicit Cursor – Record Type

```
CURSOR c_emp  IS
SELECT  empno, ename, job
FROM    emp
WHERE  deptno = 20;

vr_emp    c_emp%ROWTYPE;
```

Cursor Programming-2

ROWTYPE Example - 1

```
DECLARE
   v_emp  EMP%ROWTYPE;
BEGIN
   SELECT *
   INTO v_emp
   FROM EMP
   WHERE ename='SMITH';
   DBMS_OUTPUT.PUT_LINE('Records columns are '
   ||v_emp.empno||','||v_emp.ename);
EXCEPTION
WHEN NO_DATA_FOUND THEN
     DBMS_OUTPUT.PUT_LINE('The Employee '
     ||'is not in the database');
END;
/
```

Cursor Programming-2

ROWTYPE Example - 2

```
DECLARE
CURSOR c_emp IS
    SELECT *
    FROM EMP;
    vr_emp c_emp%ROWTYPE;
BEGIN
OPEN c_emp;
LOOP
FETCH c_emp INTO vr_emp;
EXIT WHEN c_emp%NOTFOUND;
DBMS_OUTPUT.PUT_LINE(vr_emp.empno||
' '||vr_emp.ename||' '||vr_emp.sal);
END LOOP;
END;
/
```

Cursor Programming-2

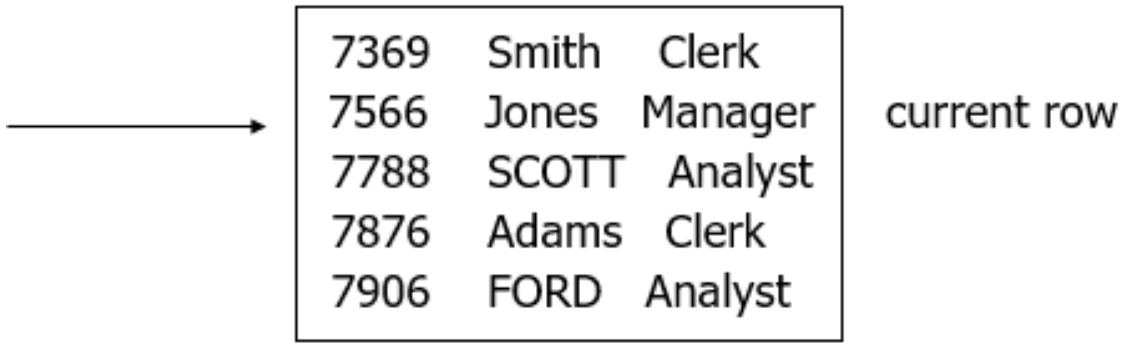
ROWCOUNT Example

```
DECLARE
    v_job EMP.job%type;
BEGIN
    SELECT job
    INTO v_job
    FROM EMP
    WHERE empno = 7698;
  IF SQL%ROWCOUNT = 1 THEN
    DBMS_OUTPUT.PUT_LINE(v_job ||' has a '||
    'Empno of 7698');
  ELSIF SQL%ROWCOUNT = 0 THEN
    DBMS_OUTPUT.PUT_LINE('The Empno 7698 is '||
    ' not in the database');
  ELSE
    DBMS_OUTPUT.PUT_LINE('Stop... ');
  END IF;
END;
/
```

Cursor Programming-2

How to Declare Cursor?

```
CURSOR c_emp  IS
SELECT  empno, ename, job
FROM    emp
WHERE  deptno = 20;
```

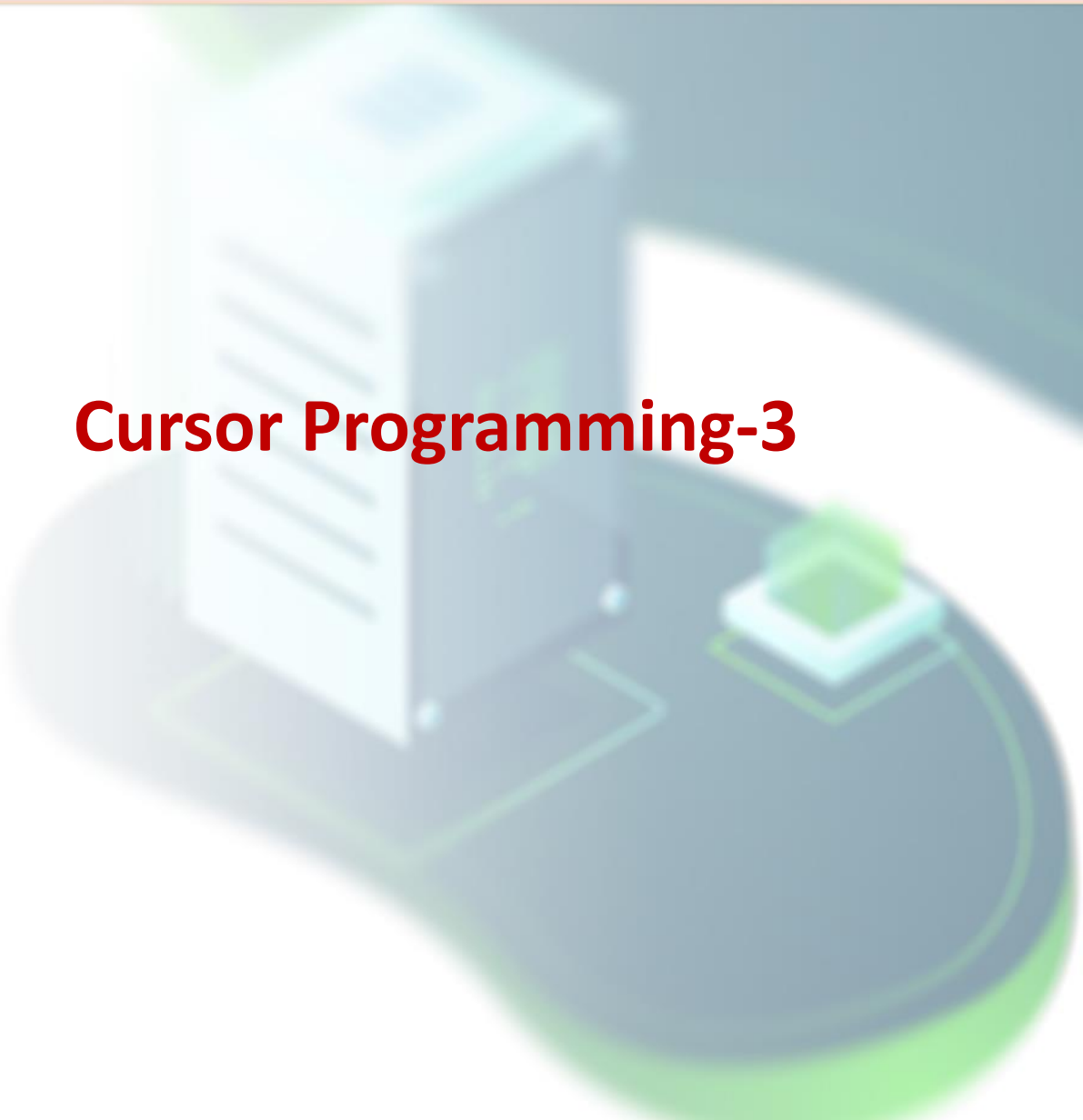


Cursor Programming-2

%ISOPEN, %FOUND, FETCH Example

```
DECLARE
        v_empno EMP.Empno%TYPE;
        CURSOR c_EMP IS
        SELECT Empno
          FROM EMP
          WHERE Empno > 1000;
BEGIN
        OPEN c_EMP;
        LOOP
        FETCH c_EMP INTO v_empno;
        IF c_EMP%FOUND THEN
           DBMS_OUTPUT.PUT_LINE('Just FETCHED row '
           ||TO_CHAR(c_EMP%ROWCOUNT)||' EMP ID: '||v_empno);
        ELSE
           EXIT;
        END IF;
        END LOOP;
        CLOSE c_EMP;
        EXCEPTION
        WHEN OTHERS THEN
           IF c_EMP%ISOPEN
        THEN
           CLOSE c_EMP;
        END IF;
END;
/
```

Introduction to Database Administration



Cursor Programming-3

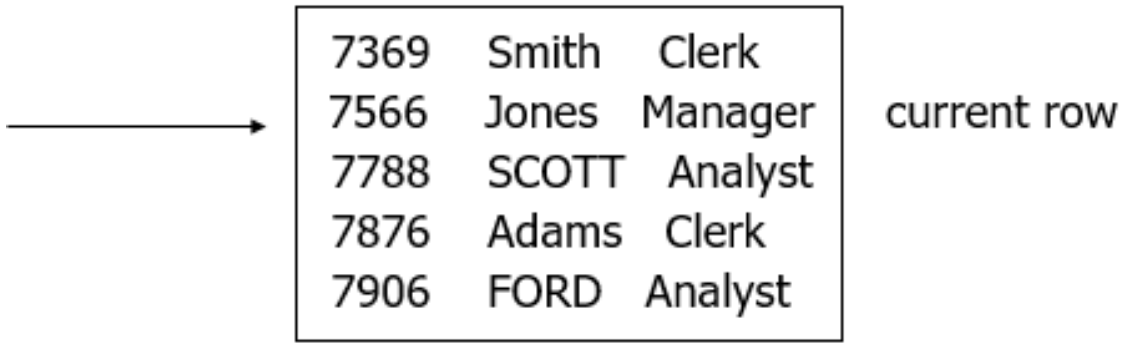
Cursor Programming-3

- How to Declare Cursor?
- Sample Program using Cursor
- Cursor for DML Insert
- Cursor with Parameters
- Cursor Program-1
- Cursor Program-1 (Solution)

Cursor Programming-3

How to Declare Cursor?

```
CURSOR c_emp  IS
SELECT  empno, ename, job
FROM    emp
WHERE  deptno = 20;
```



Cursor Programming-3

Sample Program using Cursor

```
DECLARE

    CURSOR c_emp IS
    SELECT  empno, ename, job
    FROM    emp
    WHERE  deptno = 20;

BEGIN

     FOR v_c IN c_emp  LOOP
      ...
       DBMS_OUTPUT.PUT_LINE(v_c.ename);
      ...
     END LOOP;
   ...
end;
/
```

Cursor Programming-3

Cursor for DML Insert

```
DECLARE
   CURSOR c_emp IS
   SELECT empno, ename, job
   FROM EMP
   WHERE empno > 1100;
BEGIN
   FOR r_emp IN c_emp
   LOOP
      INSERT INTO table_log
      VALUES(r_emp.ename);
   END LOOP;
END;
/
```

Cursor Programming-3

Cursor with Parameters

```
DECLARE
  CURSOR c_emp (p_job IN EMP.job%TYPE) IS
  SELECT *
  FROM EMP
  WHERE job = p_job;
BEGIN
  FOR r_emp IN c_emp('CLERK')
  LOOP
        DBMS_OUTPUT.PUT_LINE(r_emp.ename||'--'||r_emp.job);
  END LOOP;
END;
/
```

Cursor Programming-3

Cursor Program-1

Given a table with first three columns are composite keys. Write a PL/SQL program using cursor to update cat_template1 with LONG column cat_template. Assuming this tables contains more than 40,000 records.

```
SQL> desc patient_visit
 Name                                      Null?    Type
 ----------------------------------------- -------- --------------
 PATIENT_ID                                NOT NULL CHAR(7)
 DEPEND_SNO                                NOT NULL VARCHAR2(2)
 PATIENT_VISITNO                           NOT NULL NUMBER(4)
 EMP_ID                                             CHAR(7)
 DOCTOR_SNO                                         NUMBER(3)
 VISIT_DATE                                         DATE
 VISIT_NOTE                                         VARCHAR2(50)
 CAT_TEMPLATE                                       LONG
 MEDICATION                                         VARCHAR2(500)
 CHECKUP_STATUS                                     CHAR(1)
 SUB_CAT_ID                                         NUMBER(6)
 CAT_TEMPLATE1                                       VARCHAR2(3000)
```

Cursor Programming-3

Cursor Program-1 (Solution)

```
declare
  v_count number(7);
cursor c1 is
   select  PATIENT_ID,DEPEND_SNO,PATIENT_VISITNO,CAT_TEMPLATE
    from patient_visit;
begin
  v_count := 0;
  for v_c in c1 LOOP
    update  patient_visit
    set  CAT_TEMPLATE1   = v_c.CAT_TEMPLATE
    where PATIENT_ID = v_c.PATIENT_ID
        and DEPEND_SNO = v_c.DEPEND_SNO
        and PATIENT_VISITNO = v_c.PATIENT_VISITNO;
    If v_count = 300 Then
      v_count := 0;
      --DBMS_OUTPUT.PUT_LINE('commit test');
    else
      v_count := v_count + 1;
    end if;
  end LOOP;
  commit;
end;
/
```

Programming using an Array

Programming using an Array

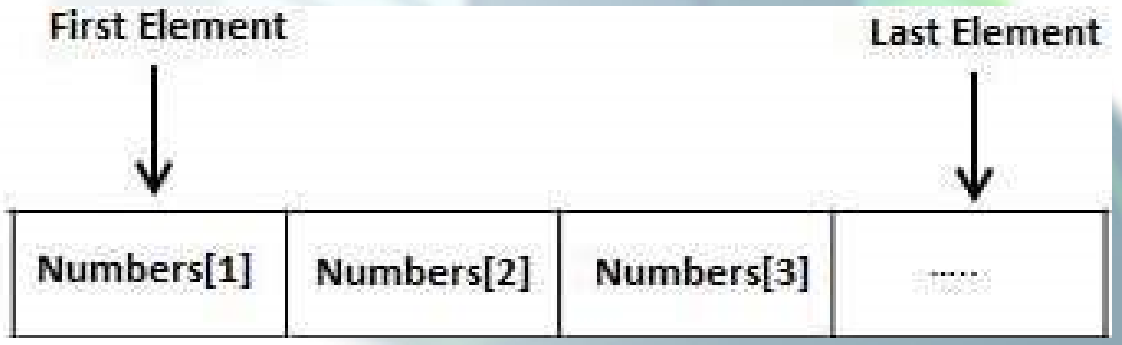
Programming using an Array

- What is an Array?
- Declaration of an Array
- Basic Example of an Array
- Associative Array
- Associative Array - An Example
- Use of Array with an Exception
- Array Null and Empty Collection

Programming using an Array

What is an Array?

All VARRAYS consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.



https://www.tutorialspoint.com/plsql/plsql_collections.htm

Programming using an Array

Declaration of an Array

A varray type is created with the **CREATE TYPE** statement. You must specify the maximum size and the type of elements stored in the varray.

```
CREATE Or REPLACE TYPE namearray AS
VARRAY(3) OF VARCHAR2(10);
/
```

Programming using an Array

Basic Example of an Array

```
DECLARE
   CURSOR c_emp is
   SELECT  ename FROM EMP;
   TYPE c_list is varray (20) of EMP.ename%type;
   ename_list c_list := c_list();
   counter integer :=0;
BEGIN
   FOR n IN c_emp LOOP
      counter := counter + 1;
      ename_list.extend;
      ename_list(counter)  := n.ename;
      dbms_output.put_line('Employee('||counter ||'):'
      ||ename_list(counter));
   END LOOP;
END;
/
```

Programming using an Array

Associative Array

An index-by table is a set of key-value pairs. Each key is unique and is used to locate the corresponding value. The key can be either an integer or a string.

TYPE type_name IS TABLE OF element_type [NOT NULL] INDEX BY subscript_type;

table_name type_name;

Programming using an Array

Associative Array – An Example

```
DECLARE
   TYPE salary IS TABLE OF NUMBER INDEX BY VARCHAR2(20);
   salary_list salary;
   name   VARCHAR2(20);
BEGIN
   -- adding elements to the table
   salary_list('Sarah') := 62000;
   salary_list('Jamil') := 75000;
   salary_list('Wisal') := 100000;
   salary_list('Umar') := 78000;

   -- printing the table
   name := salary_list.FIRST;
   WHILE name IS NOT null LOOP
      dbms_output.put_line
      ('Salary of ' || name || ' is ' || TO_CHAR(salary_list(name)));
      name := salary_list.NEXT(name);
   END LOOP;
END;
/
```

Programming using an Array

Use of Array with an Exception

```
SQL> DECLARE
  2    CURSOR name_cur IS
  3    SELECT ename
  4    FROM EMP
  5    WHERE rownum <= 10;
  6    TYPE ename_type IS TABLE OF EMP.ename%TYPE
  7    INDEX BY BINARY_INTEGER;
  8    ename_tab ename_type;
  9    v_counter INTEGER := 0;
 10  BEGIN
 11    FOR name_rec IN name_cur LOOP
 12  v_counter := v_counter + 1;
 13  ename_tab(v_counter) := name_rec.ename;
 14  DBMS_OUTPUT.PUT_LINE ('ename('||v_counter||'): '||
 15  ename_tab(v_counter));
 16    END LOOP;
 17    DBMS_OUTPUT.PUT_LINE ('ename(11): '|| ename_tab(11));
 18  EXCEPTION
 19    WHEN NO_DATA_FOUND THEN
 20    DBMS_OUTPUT.PUT_LINE(SQLERRM);
 21  END;
 22  /
ename(1):
ename(2): ABC
ename(3): XYZ
ename(4): SMITH
ename(5): ALLEN
ename(6): WARD
ename(7): JONES
ename(8): MARTIN
ename(9): BLAKE
ename(10): CLARK
ORA-01403: no data found
```

Programming using an Array

Array Null and Empty Collection

```
DECLARE
   TYPE integer_type IS TABLE OF INTEGER;
   integer_tab integer_type;

   v_counter integer := 1;
BEGIN
   DBMS_OUTPUT.PUT_LINE (integer_tab(v_counter));
END;

DECLARE
*
ERROR at line 1:
ORA-06531: Reference to uninitialized collection
ORA-06512: at line 7
```

```
DECLARE
   TYPE integer_type IS TABLE OF INTEGER;
   integer_tab integer_type := integer_type();

   v_counter integer := 1;
BEGIN
   DBMS_OUTPUT.PUT_LINE (integer_tab(v_counter));
END;

DECLARE
*
ERROR at line 1:
ORA-06533: Subscript beyond count
ORA-06512: at line 7
```

Introduction to Database Administration

Examples with Advance Topics

Examples with Advance Topics

Examples with Advance Topics

- Use of Records Arrays
- Use of PRAGMA Exception
- PL/SQL Dynamic SQL
- PL/SQL Dynamic SQL - Example-1
- PL/SQL Dynamic SQL - Example-2

Examples with Advance Topics

Use of Records Arrays

```
Declare
Cursor c1 is
  select sal
  from emp;
TYPE sal_type IS VARRAY(20) OF Integer;
v_col sal_TYPE := sal_type();
k number := 0;
Begin
  for i in C1 LOOP
    k := k+1;
    v_col.extend; --collection method
    v_col(k) := i.sal;
  end loop;
  for j in 1..4 LOOP
    DBMS_OUTPUT.PUT_LINE('sal is col('||j||') '
    ||v_col(j));
  end loop;
End;
```

Examples with Advance Topics

Use of PRAGMA Exception

```
CREATE OR REPLACE TRIGGER Employee_permit_changes
  BEFORE INSERT OR DELETE OR UPDATE ON EMP
DECLARE
  Dummy              INTEGER;
  Not_on_weekends    EXCEPTION;
  Nonworking_hours   EXCEPTION;
  PRAGMA EXCEPTION_INIT (Not_on_weekends, -4097);
  PRAGMA EXCEPTION_INIT (Nonworking_hours, -4099);
BEGIN
   -- Check for weekends:
   IF (TO_CHAR(Sysdate, 'DAY') = 'SAT' OR
     TO_CHAR(Sysdate, 'DAY') = 'SUN') THEN
       RAISE Not_on_weekends;
   END IF;
  -- Check for work hours (8am to 6pm):
  IF (TO_CHAR(Sysdate, 'HH24') < 8 OR
    TO_CHAR(Sysdate, 'HH24') > 18) THEN
      RAISE Nonworking_hours;
  END IF;
EXCEPTION
  WHEN Not_on_weekends THEN
    Raise_application_error(-20324,'Might not change '
      ||'employee table during the weekend');
  WHEN Nonworking_hours THEN
    Raise_application_error(-20326,'Might not change '
     ||'emp table during Nonworking hours');
END;
/
```

Examples with Advance Topics

PL/SQL Dynamic SQL

- Dynamic SQL is a programming methodology for generating and running SQL statements at run time.
- It is useful when writing general-purpose and flexible programs like ad hoc query systems, when writing programs that must run database definition language (DDL) statements, or when you do not know at compilation time the full text of a SQL statement or the number or data types of its input and output variables.

Examples with Advance Topics

PL/SQL Dynamic SQL – Example-1

Creating a table during run-time.

```
BEGIN
   execute immediate 'create table MyTable('
                                          ||'ID CHAR(3),'
                                          ||'Name VARCHAR2(50))';
END;
/
```

Note: grant create table to <user> is required

Examples with Advance Topics

PL/SQL Dynamic SQL - Example-2

Set to Null a column at run time

```
CREATE TABLE EMP_temp AS SELECT * FROM EMP;
/

DECLARE
  -- Set to NULL automatically at run time
  a_null  CHAR(1);
BEGIN
  EXECUTE IMMEDIATE 'UPDATE EMP_TEMP SET sal = :x'
    USING a_null;
END;
/
```

End

Introduction to Database Administration

Concepts of Oracle Instance-1

Concepts of Oracle Instance-1

- Introduction
- Configuration Option
- Instance Structure
- Database Instance Framework

Concepts of Oracle Instance-1

Introduction

- A database instance is a set of memory structures that manage database files.
- A Database is a set of physical files on disk created by the CREATE DATABASE statement.

Concepts of Oracle Instance-1

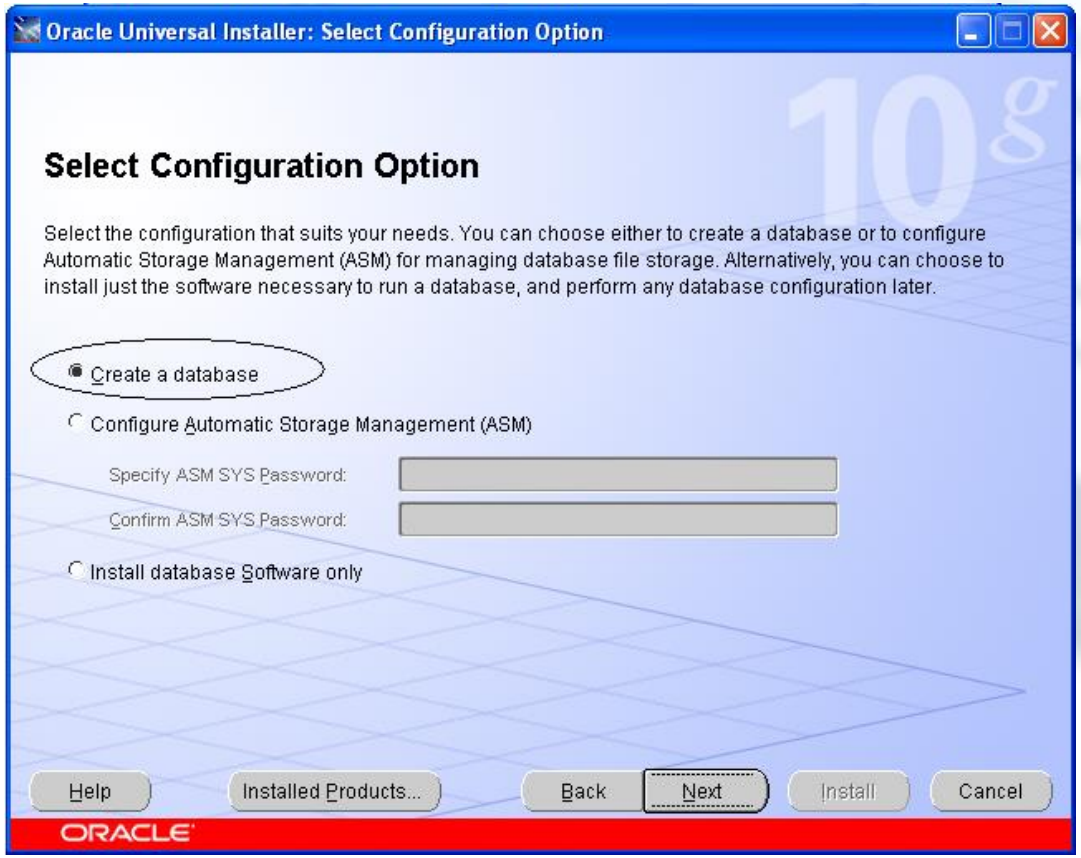
Introduction

- The instance manages its associated data and serves the users of the database.
- Every running Oracle database is associated with at least one Oracle database instance. Because an instance exists in memory and a database exists on disk, an instance can exist without a database and a database can exist without an instance.

Concepts of Oracle Instance-1

Configuration Option

During installation, oracle has an option to install instance, database or both



Concepts of Oracle Instance-1

Instance Structure

When an instance is started, Oracle Database allocates a memory area called the system global area (SGA)and starts one or more background processes. The SGA serves various purposes, including the following:

- Maintaining internal data structures that are accessed by many processes and threads concurrently
- Caching data blocks read from disk
- Buffering redo data before writing it to the online redo log files

Concepts of Oracle Instance-1

Instance Structure

- Storing SQL execution plans

The SGA is shared by the Oracle processes, which include server processes and background processes, running on a single computer. The way in which Oracle processes are associated with the SGA varies according to operating system

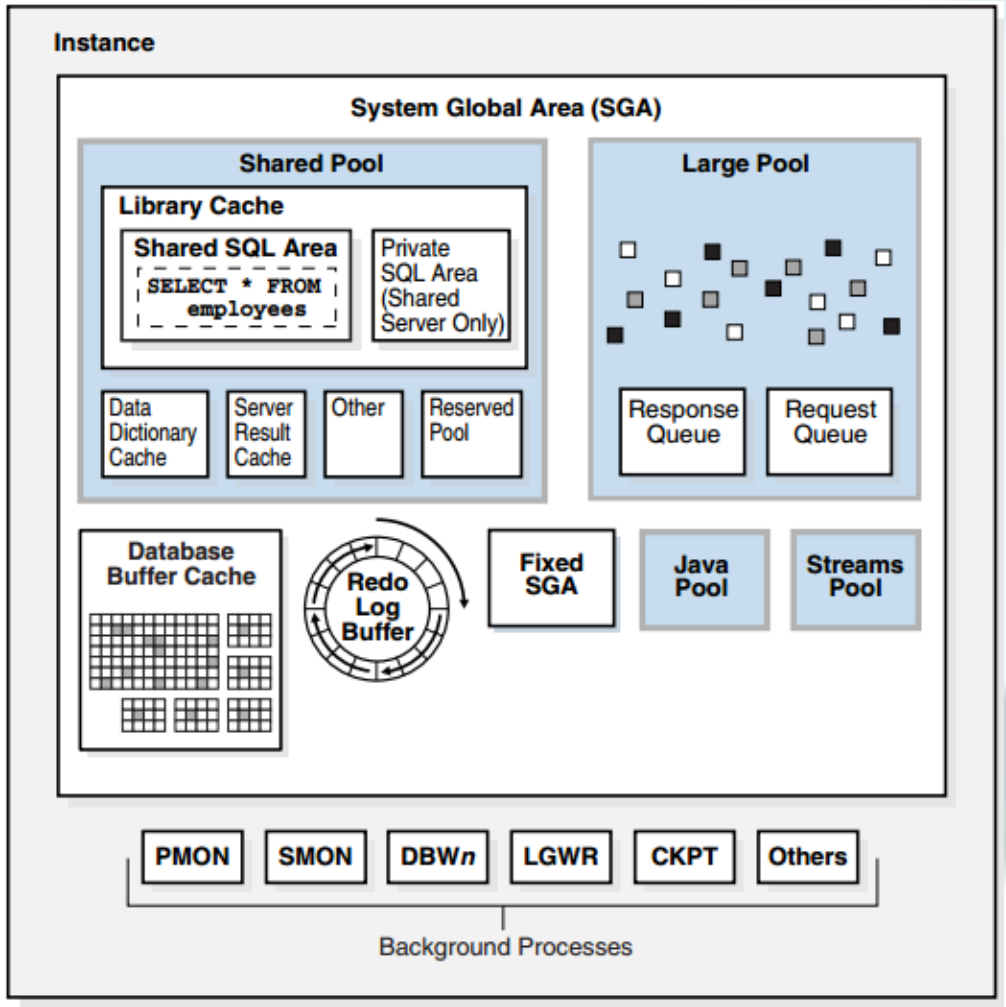
Concepts of Oracle Instance-1

Instance Structure

- A database instance includes background processes. Server processes, and the process memory allocated in these processes, also exist in the instance. The instance continues to function when server processes terminate.

Concepts of Oracle Instance-1

Database Instance Framework



Introduction to Database Administration

Concepts of Oracle Instance-2

Concepts of Oracle Instance-2

- Database Instance Configuration
- Database Instance Configuration
- Database Single & RAC Instance Configuration

Concepts of Oracle Instance-2

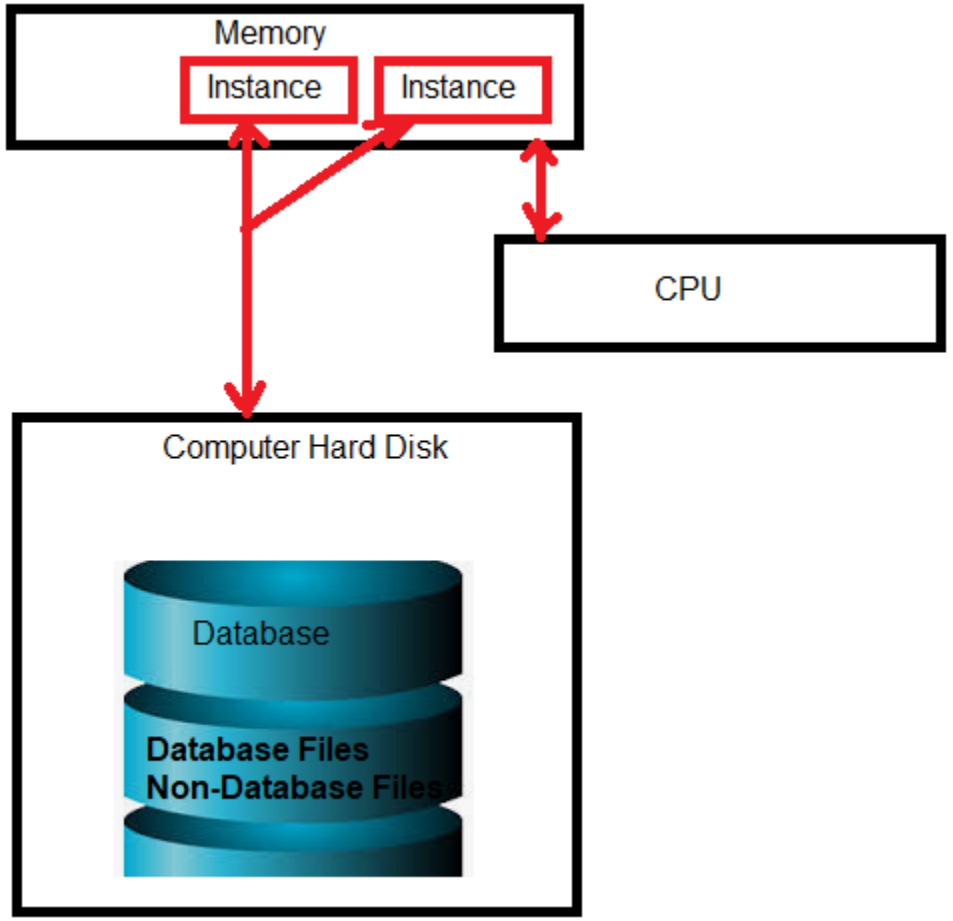
Database Instance Configuration

You can run Oracle Database in either of the following mutually exclusive configurations:

- Single-instance configuration
  A one-to-one relationship exists between the database and an instance.
- Oracle Real Application Clusters (Oracle RAC) configuration
  A one-to-many relationship exists between the database and instances.

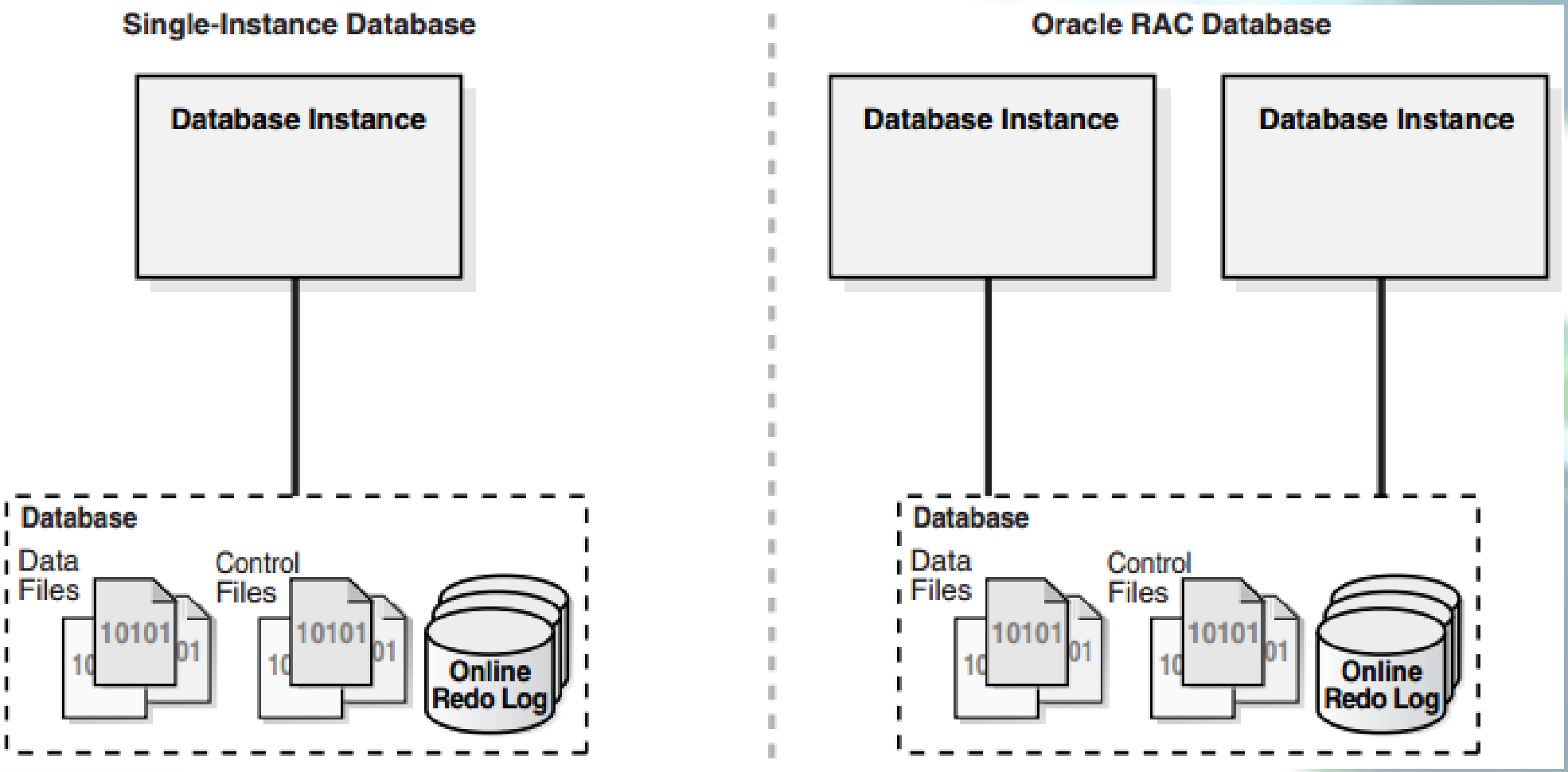
Concepts of Oracle Instance-2

Database Instance Configuration



Concepts of Oracle Instance-2

Database Single & RAC Instance Configuration



Introduction to Database Administration

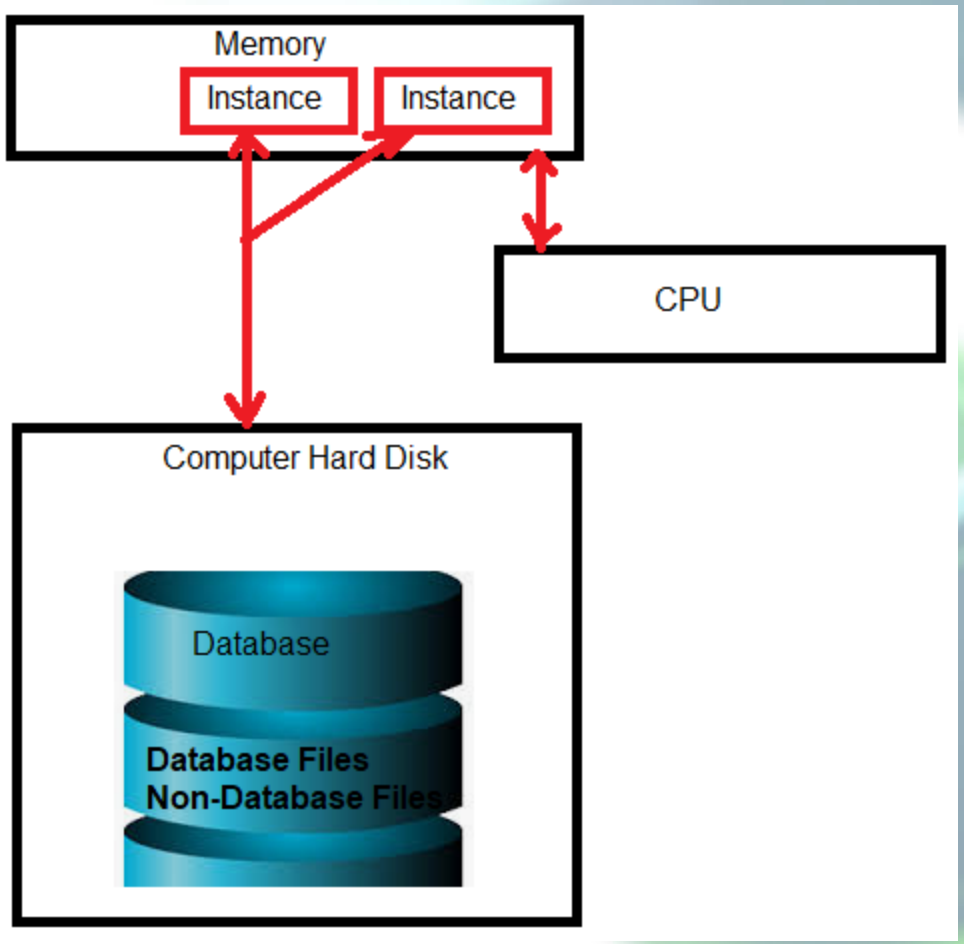
Concepts of Oracle Instance-3

Concepts of Oracle Instance-3

- Database Instance Configuration
- Duration of an Instance
- Instance Startup
- Instance Shutdown & Startup
- Instance & SID
- Oracle Home & SID at Windows OS
- Display Instance Name using Data Dictionary View

Concepts of Oracle Instance-3

Database Instance Configuration



Concepts of Oracle Instance-3

Duration of an Instance

- An instance begins when it is created with the STARTUP command and ends when it is terminated. During this period, an instance can associate itself with one and only one database.
- Furthermore, the instance can mount a database only once, close it only once, and open it only once. After a database has been closed or shut down, you must start a different instance to mount and open this database.

Concepts of Oracle Instance-3

Instance Startup

- Login with user sys / as sysdba
- After shutdown database, run the following:

```
SQL> STARTUP
ORACLE instance started.

Total System Global Area  468729856 bytes
Fixed Size                  1333556 bytes
Variable Size             440403660 bytes
Database Buffers           16777216 bytes
Redo Buffers               10215424 bytes
Database mounted.
Database opened.
```

Concepts of Oracle Instance-3

Instance Startup

This query shows the time that the current instance was started:

```
SQL> SELECT
  2  TO_CHAR(STARTUP_TIME,'MON-DD-RR HH24:MI:SS')
  3  AS "Inst Start Time" FROM V$INSTANCE;

Inst Start Time
------------------
SEP-30-20 20:56:54
```

Concepts of Oracle Instance-3

Instance Shutdown & Startup

This query shows the time that the current instance was started:

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

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             696254928 bytes
Database Buffers          369098752 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
SQL> SELECT
  2  TO_CHAR(STARTUP_TIME,'MON-DD-RR HH24:MI:SS')
  3  AS "Inst Start Time" FROM V$INSTANCE;

Inst Start Time
------------------
OCT-01-20 08:48:52
```

Concepts of Oracle Instance-3

Instance & SID

- The system identifier (SID)is a unique name for an Oracle database instance on a specific host. On UNIX and Linux, Oracle Database uses the SID and Oracle home values to create a key to shared memory.
- Also, the SID is used by default to locate the parameter file, which is used to locate relevant files such as the database control files.

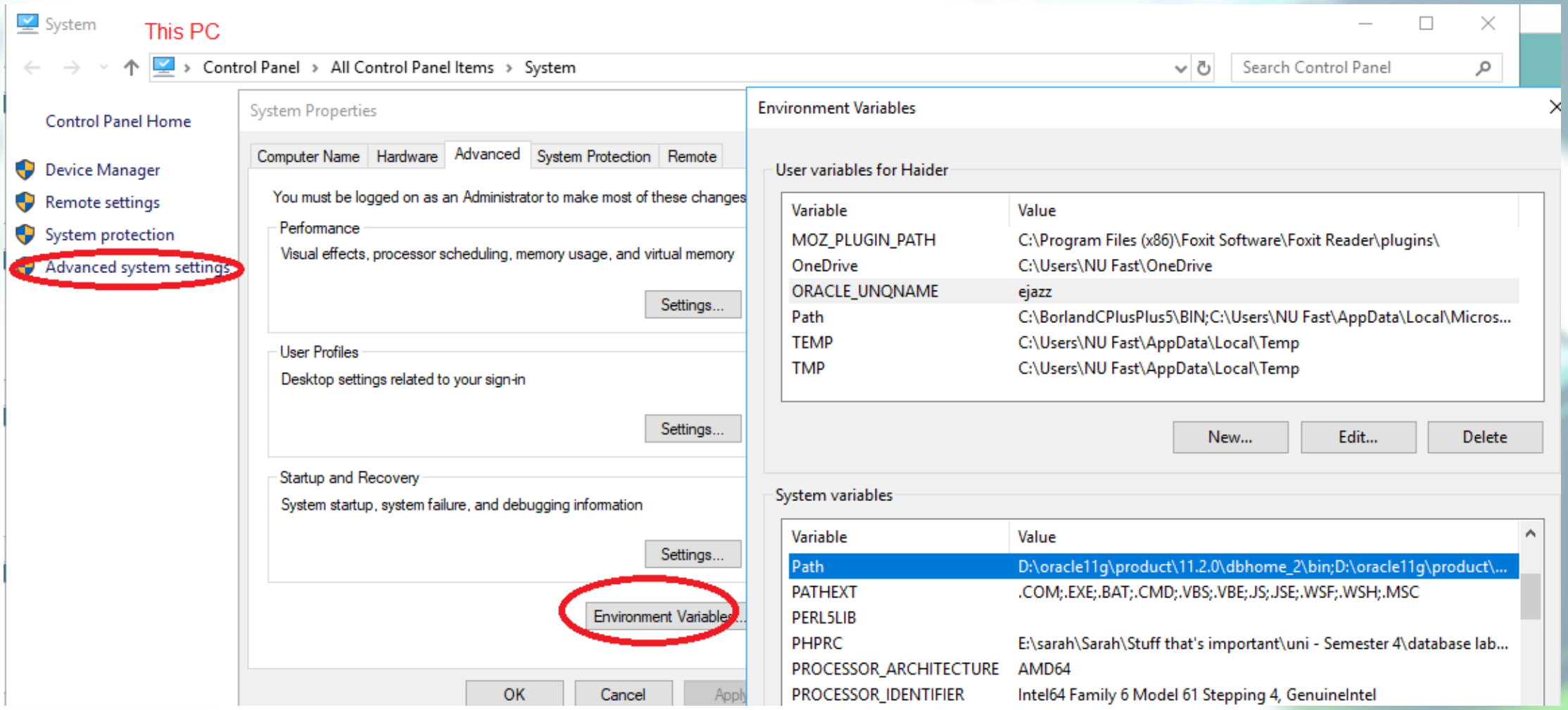
Concepts of Oracle Instance-3

Instance & SID

- On most platforms, the ORACLE_SID environment variable sets the SID, whereas the ORACLE_HOME variable sets the Oracle home.
- When connecting to an instance, clients can specify the SID in an Oracle Net connection or use a net service name.
- Oracle Database converts a service name into an ORACLE_HOME and ORACLE_SID.

Concepts of Oracle Instance-3

Oracle Home & SID at Windows OS



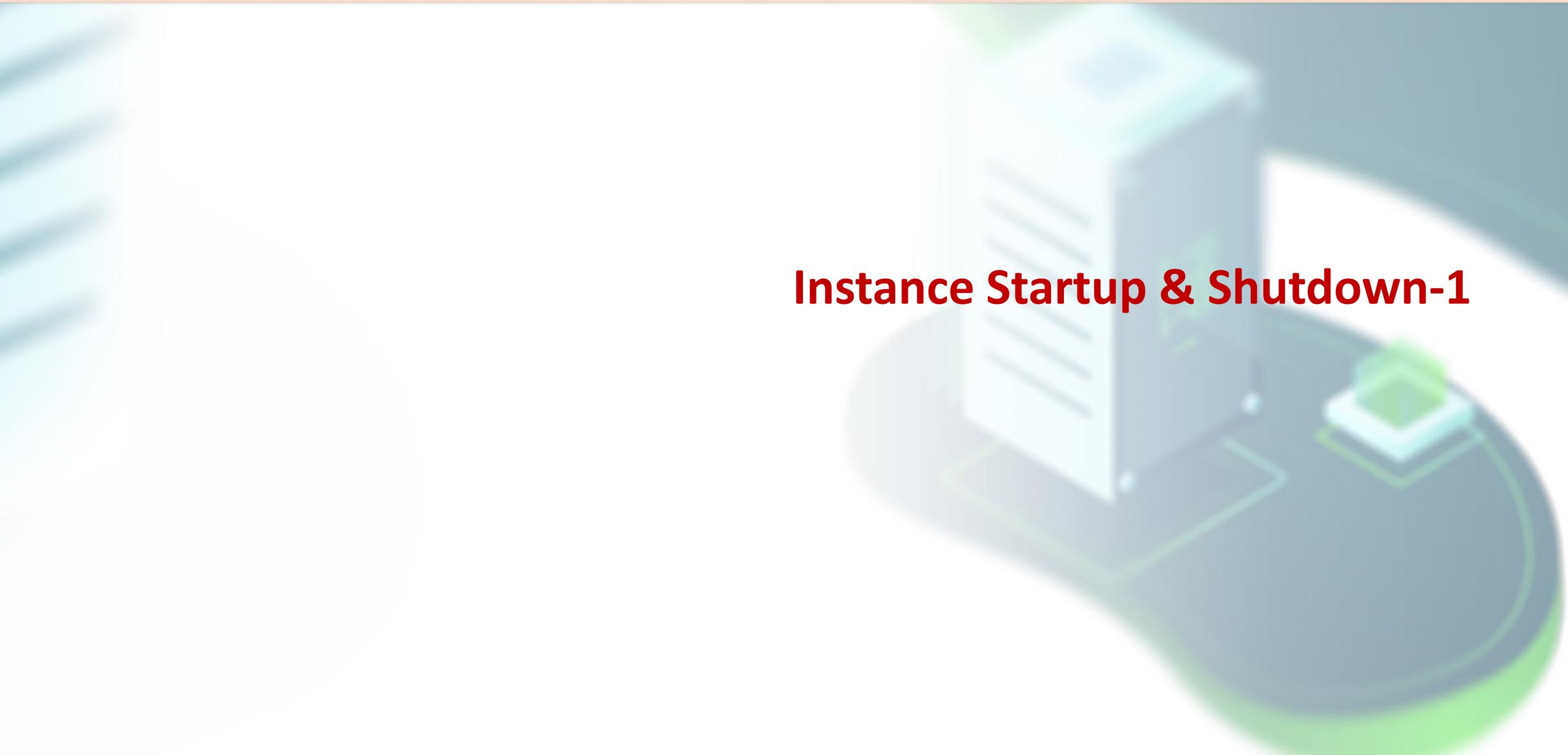
Concepts of Oracle Instance-3

Display Instance Name using Data Dictionary View

```
SQL> SELECT TO_CHAR(STARTUP_TIME,'MON-DD-RR HH24:MI:SS') AS "Inst Start Time",
  2  Instance_name , substr(Host_name,1,20)
  3  FROM V$INSTANCE;

Inst Start Time     INSTANCE_NAME    SUBSTR(HOST_NAME,1,2
------------------- ---------------- --------------------
OCT-01-20 08:48:52 orcl             HAIDER
```

Introduction to Database Administration



Instance Startup & Shutdown-1

Instance Startup & Shutdown-1

- Overview of Instance and Database Startup
- SVRCTL Utility Help
- Example - SVRCTL command
- Progress from Shutdown & Startup OPEN
- Instance Startup
- Instance Startup MOUNT
- Instance Startup NOMOUNT

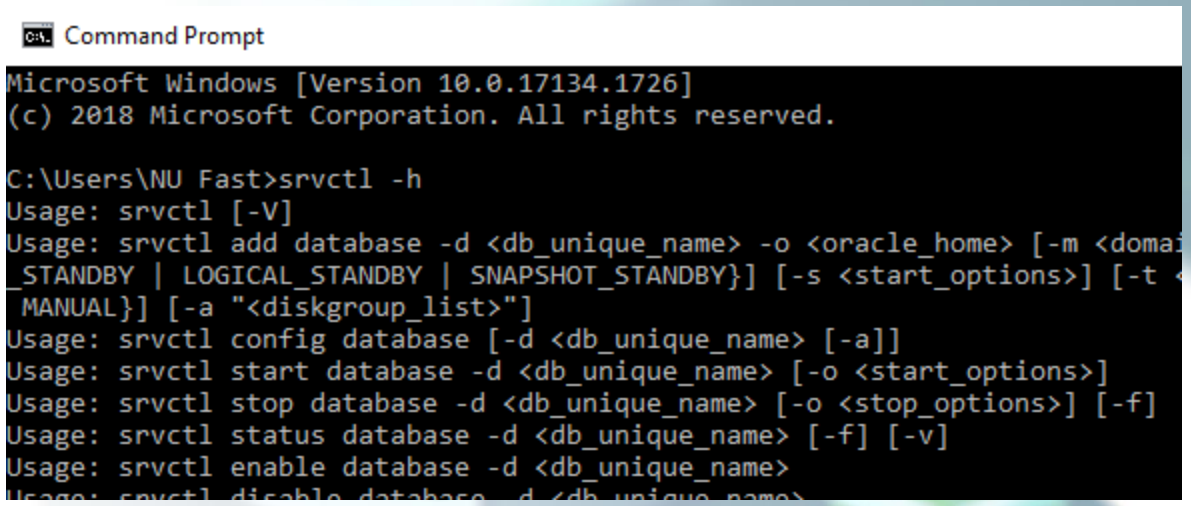
Instance Startup & Shutdown-1

Overview of Instance and Database Startup

- A database instance provides user access to a database.
- In a typical use case, you manually start an instance and then mount and open the database, making it available for users. You can use the SQL*Plus STARTUP command, Oracle Enterprise Manager (Enterprise Manager), or the SRVCTL utility to perform these steps.

Instance Startup & Shutdown-1

SVRCTL Utility Help



Instance Startup & Shutdown-1

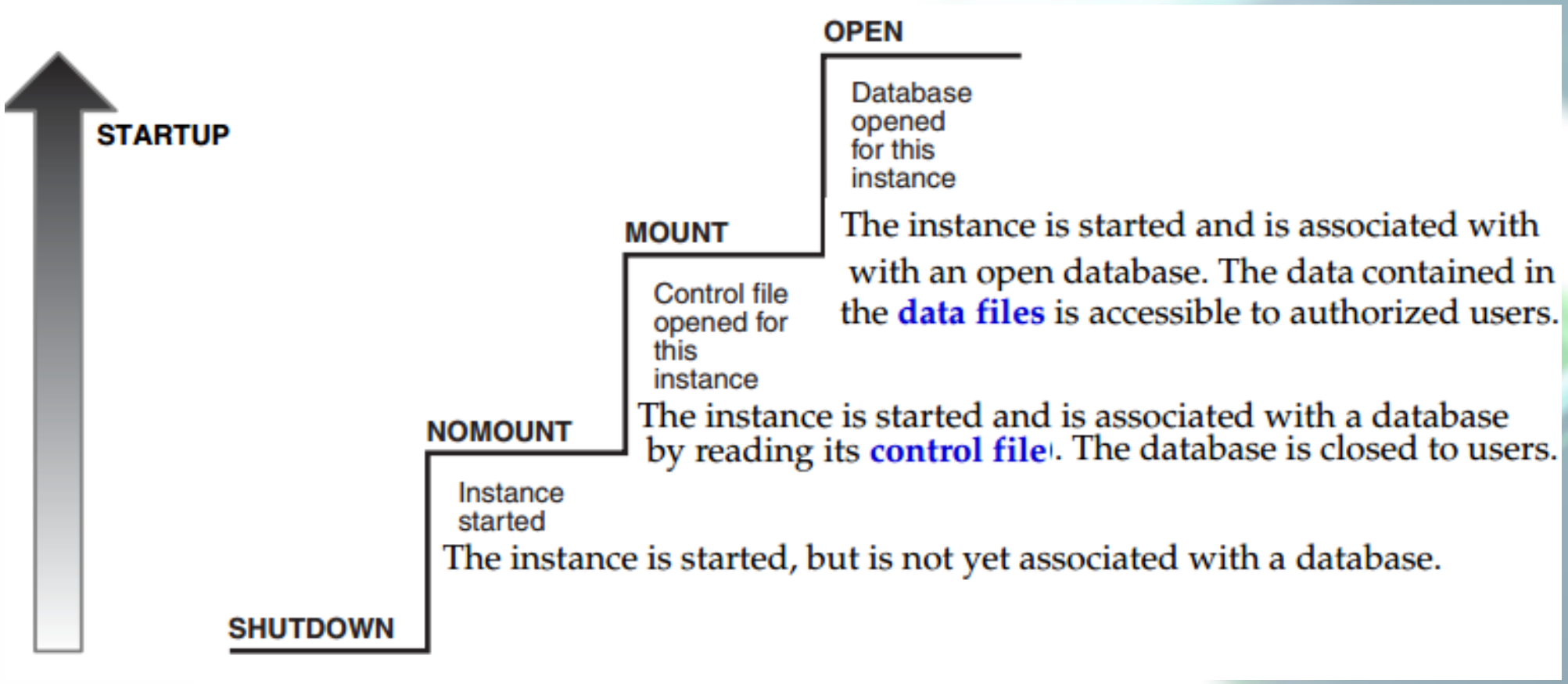
Example - SVRCTL command

Syntax to add a named service to a database with preferred instances in list one and available instances in list two, using basic failover for the available instances:

```
srvctl add  service -d crm -s sales -r crm01,crm02 -a crm03
```

Instance Startup & Shutdown-1

Progress from Shutdown & Startup OPEN



Instance Startup & Shutdown-1

Instance Startup

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Database Buffers           16777216 bytes
Redo Buffers               10215424 bytes
Database mounted.
Database opened.
```

Instance Startup & Shutdown-1

Instance Startup

This query shows the time that the current instance was started:

```
SQL> SELECT
  2  TO_CHAR(STARTUP_TIME,'MON-DD-RR HH24:MI:SS')
  3  AS "Inst Start Time" FROM V$INSTANCE;

Inst Start Time
------------------
SEP-30-20 20:56:54
```

Instance Startup & Shutdown-1

Instance Startup MOUNT

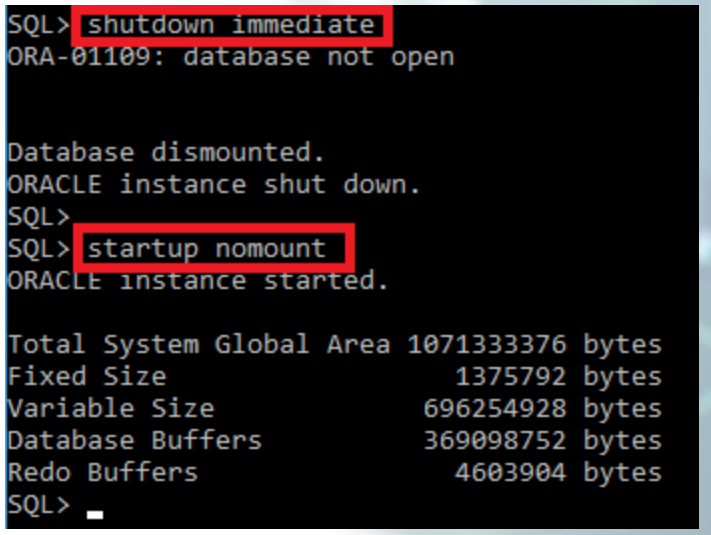
First perform shutdown immediate then startup mount:

```
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL>
SQL> startup mount
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             696254928 bytes
Database Buffers          369098752 bytes
Redo Buffers                4603904 bytes
Database mounted.
```

Instance Startup & Shutdown-1

Instance Startup NOMOUNT

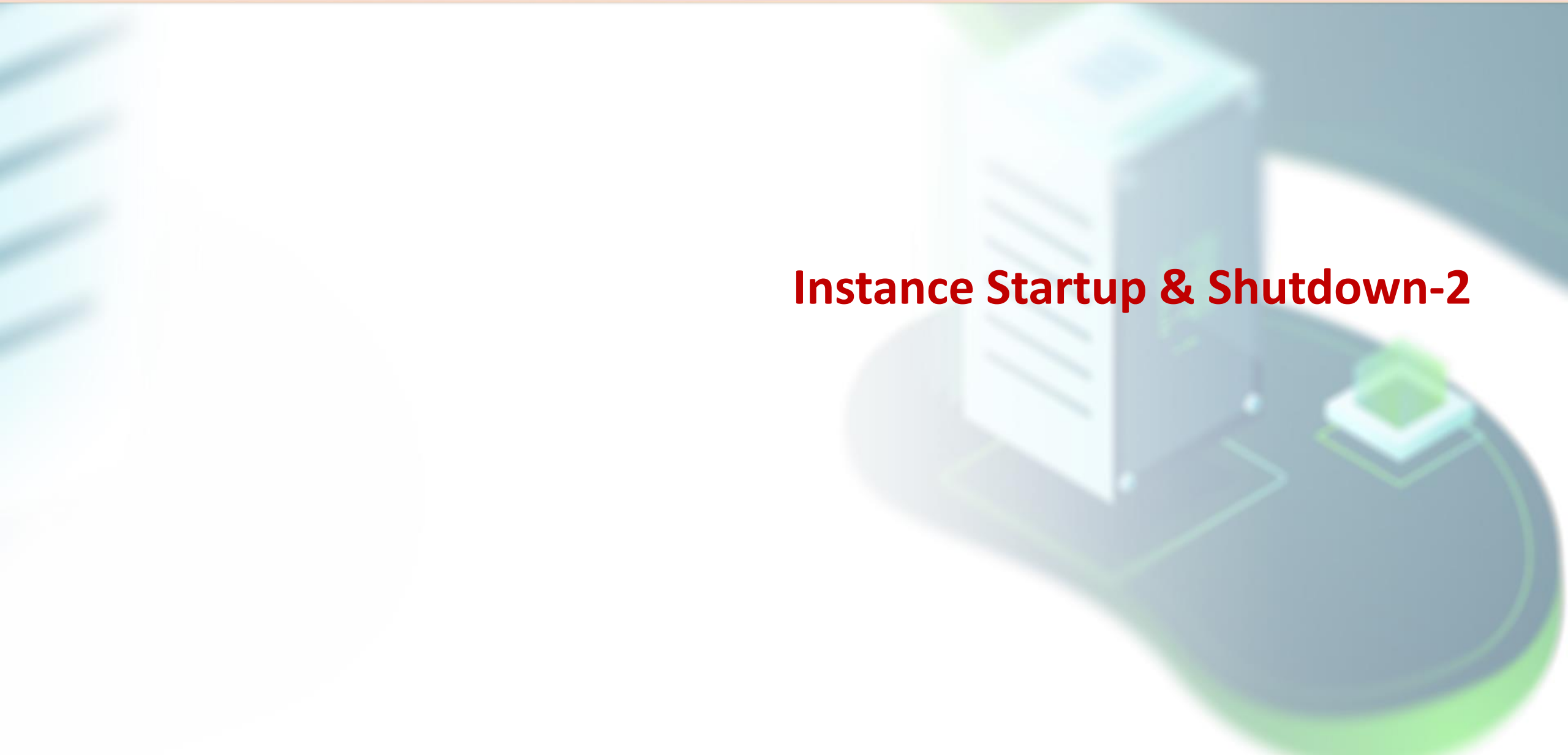
First perform shutdown immediate then startup nomount:



End

Database creation and certain backup & recovery operations are performed.

Introduction to Database Administration



Instance Startup & Shutdown-2

Instance Startup & Shutdown-2

- Connection with Administrator Privileges
- Instance Started to perform steps
- How Database is Mounted?
- How Database is opened?
- Read-only Opened Database
- Progress from Shutdown & Startup OPEN

Instance Startup & Shutdown-2

Connection with Administrator Privileges

- Database startup and shutdown are powerful administrative options that are restricted to users who connect to Oracle Database with administrator privileges.
- Normal users do not have control over the current status of an Oracle database.

Instance Startup & Shutdown-2

Connection with Administrator Privileges

- Depending on the operating system, one of the following conditions establishes administrator privileges for a user:
- The operating system privileges of the user enable him or her to connect using administrator privileges.

Instance Startup & Shutdown-2

Connection with Administrator Privileges

- The user is granted the SYSDBA or SYSOPER system privileges and the database uses password files to authenticate database administrators over the network.
- When you connect with the SYSDBA system privilege, you are in the schema owned by SYS. When you connect as SYSOPER, you are in the public schema.

Instance Startup & Shutdown-2

Instance Started to perform steps

- Searches for a server parameter file in a platform-specific default location and, if not found, for a text initialization parameter file(specifying STARTUP with the SPFILE or PFILE parameters overrides the default behavior)
- Reads the parameter file to determine the values of initialization parameters

Instance Startup & Shutdown-2

Instance Started to perform steps

- Allocates the SGA based on the initialization parameter settings
- Starts the Oracle background processes
- Opens the alert log and trace files and writes all explicit parameter settings to the alert login valid parameter syntax

Instance Startup & Shutdown-2

How Database is Mounted?

- The instance mounts a database to associate the database with this instance. To mount the database, the instance obtains the names of the database control files specified in the CONTROL_FILES initialization parameter and opens the files.

Instance Startup & Shutdown-2

How Database is Mounted?

- Oracle Database reads the control files to find the names of the data files and the online redo log files that it will attempt to access when opening the database.
- In a mounted database, the database is closed and accessible only to database administrators.

Instance Startup & Shutdown-2

How Database is Mounted?

- Administrators can keep the database closed while completing specific maintenance operations. However, the database is not available for normal operations

Instance Startup & Shutdown-2

How Database is opened?

- Opening a mounted database makes it available for normal database operations
- Opens the online data files in tablespaces other than undo tablespaces
- Acquires an undo tablespace
- Opens the online redo log files
- By default, the database opens in read/write mode.

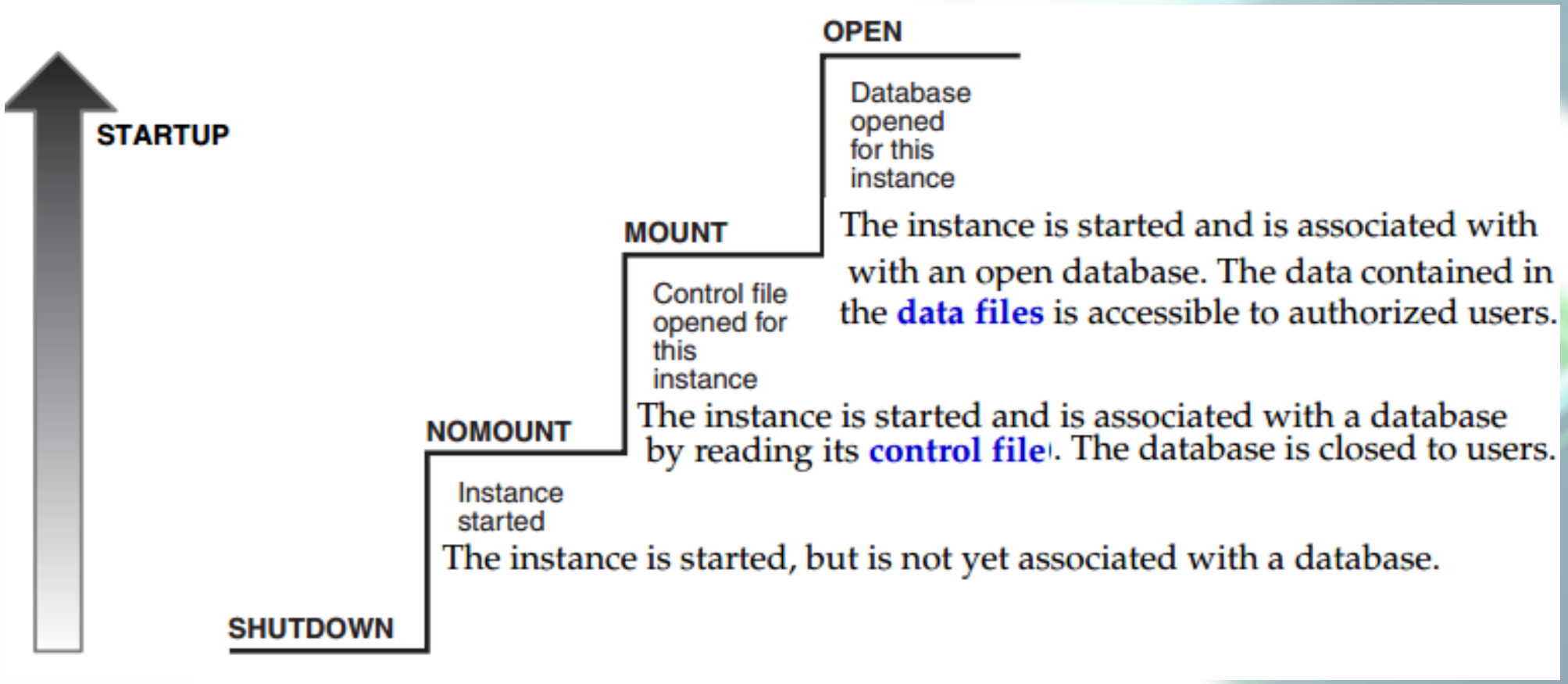
Instance Startup & Shutdown-2

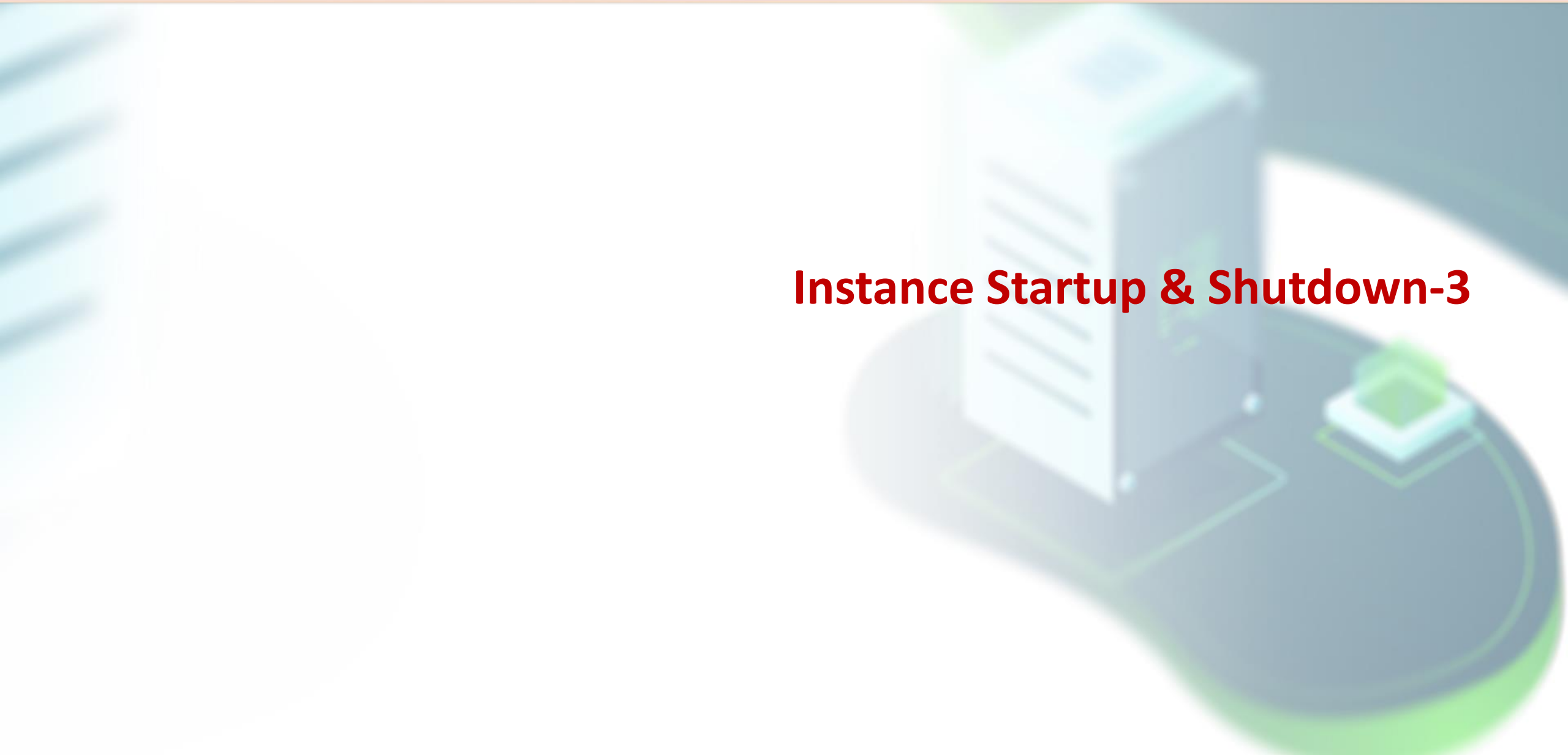
Read-only Opened Database

- Data files can be taken offline and online. However, you cannot take permanent tablespaces offline.
- Offline data files and tablespaces can be recovered.
- The control file remains available
- Temporary tablespaces created with the CREATE TEMPORARY TABLESPACE statement are read/write.
- Writes to operating system audit trails, trace files, and alert logs can continue.

Instance Startup & Shutdown-2

Progress from Shutdown & Startup OPEN





Instance Startup & Shutdown-3

Instance Startup & Shutdown-3

- Database with Shutdown Instance
- Progress from OPEN to Shutdown
- Steps to perform Database Shutdown
- Shutdown ABORT
- Shutdown IMMEDIATE
- Shutdown TRANSACTIONAL
- Shutdown NORMAL
- Shutdown Modes Summary

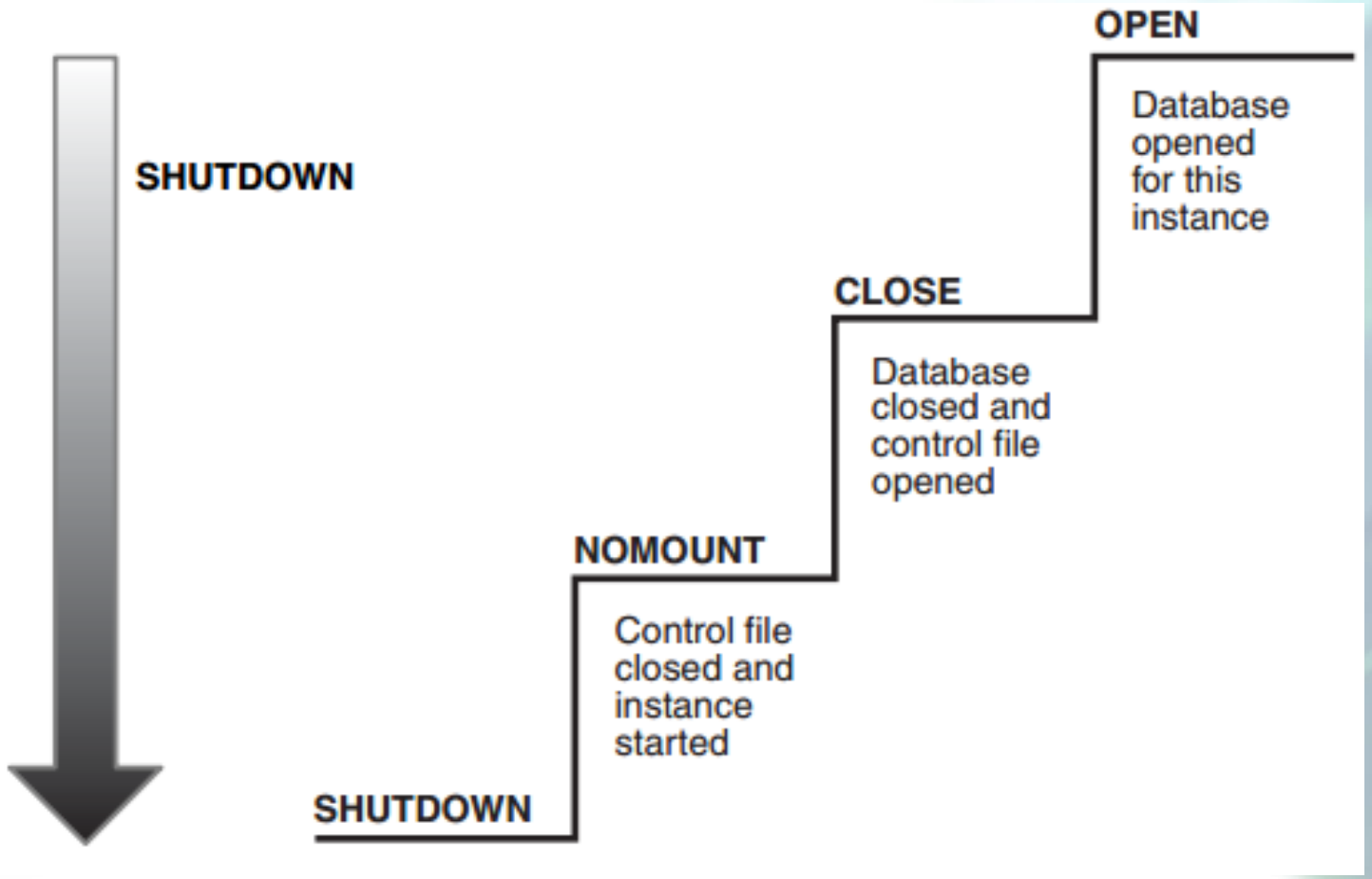
Instance Startup & Shutdown-3

Database with Shutdown Instance

- In a typical use case, you manually shut down the database, making it unavailable for users while you perform maintenance or other administrative tasks.
- You can use the SQL*Plus SHUTDOWN command or Enterprise Manager to perform these steps.

Instance Startup & Shutdown-3

Progress from OPEN to Shutdown



Instance Startup & Shutdown-3

Steps to perform Database Shutdown

- Database closed
  The database is mounted, but online data files and redo log files are closed.

- Database unmounted
  The instance is started, but is no longer associated with the control file of the database.
- Database instance shut down
  The database instance is no longer started.

Instance Startup & Shutdown-3

Steps to perform Database Shutdown

Oracle Database does not go through all of the preceding steps in an instance failure or SHUTDOWN ABORT, which immediately terminates the instance.

Instance Startup & Shutdown-3

Shutdown ABORT

Used in emergency situation. Shuting down instance may take substantially longer. SHUTDOWN ABORT does not checkpoint the open data files

Instance Startup & Shutdown-3

Shutdown IMMEDIATE

Fastest way to manage. Active transactions are terminated and uncommitted changes are rolled back.

Instance Startup & Shutdown-3

Shutdown TRANSACTIONAL

This mode prevents users from starting new transactions, but waits for all current transactions to complete before shutting down.

Instance Startup & Shutdown-3

Shutdown NORMAL

This is the default mode of shutdown. The database waits for all connected users to disconnect before shutting down.

Instance Startup & Shutdown-3

Shutdown Modes Summary

A database administrator with SYSDBA or SYSOPER privileges can shut down the database using the SQL*Plus SHUTDOWN command or Enterprise Manager.

Database Behavior	ABORT	IMMEDIATE	TRANSACTIONAL	NORMAL
Permits new user connections	No	No	No	No
Waits until current sessions end	No	No	No	Yes
Waits until current transactions end	No	No	Yes	Yes
Performs a checkpoint and closes open files	No	Yes	Yes	Yes

Introduction to Database Administration

Overview of Checkpoints

Overview of Checkpoints

Overview of Checkpoints

- What is a Checkpoint?
- Purpose of Checkpoint?
- Recovery without Checkpoints
- Recovery using Checkpoints

Overview of Checkpoints

What is a Checkpoint?

- A checkpoint is a crucial mechanism in consistent database shutdowns, instance recovery, and Oracle Database operation generally.
- A data structure that indicates the checkpoint position, which is the SCN in the redo stream where instance recovery must begin The checkpoint position is determined by the oldest dirty buffer in the database buffer cache.

Overview of Checkpoints

What is Checkpoint?

- The checkpoint position acts as a pointer to the redo stream and is stored in the control file and in each data file header.
- The writing of modified database buffers in the database buffer cache to disk.

Whenever checkpoint happens all the dirty buffers of DB buffer cache (volatile storage) moves into data files (Non volatile storage)

Overview of Checkpoints

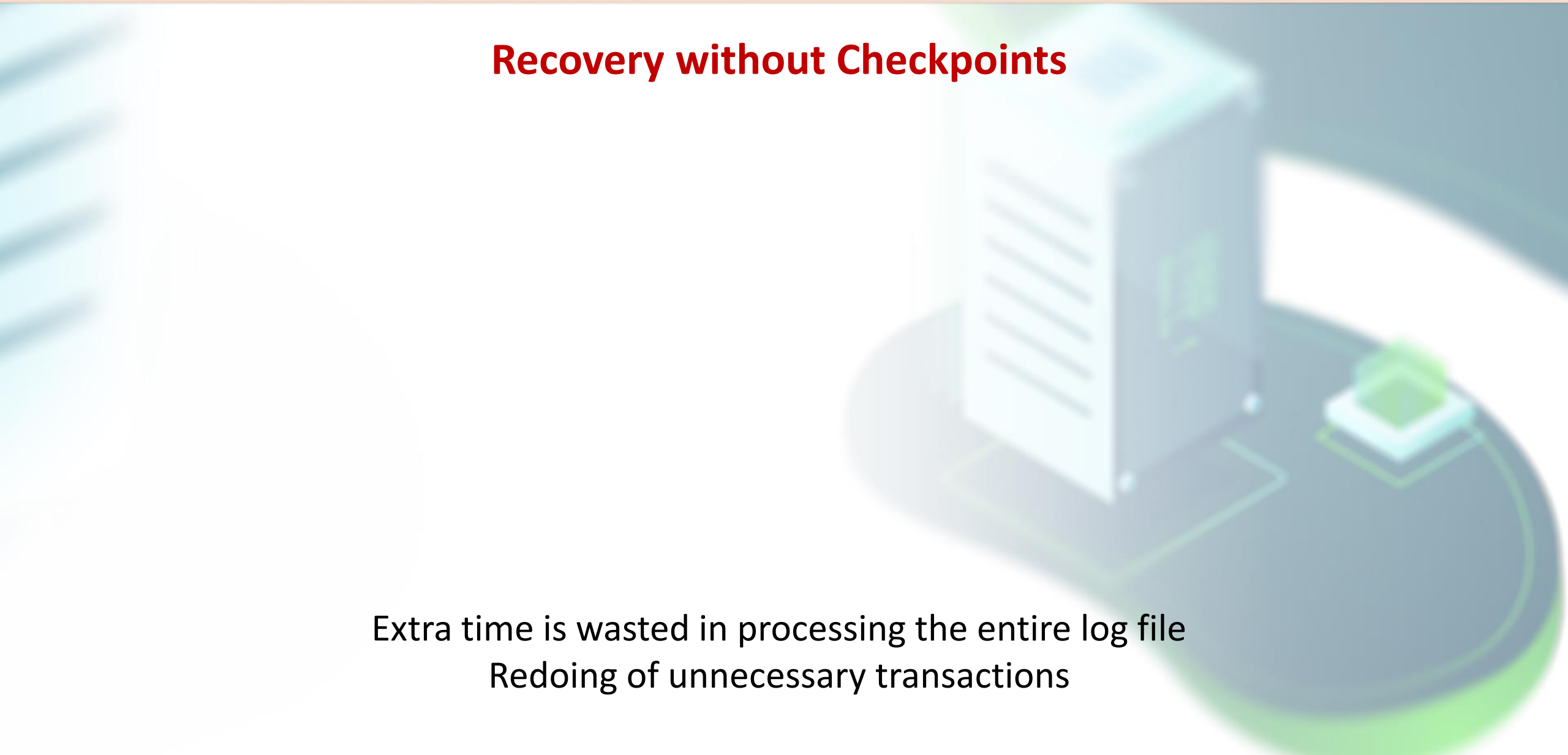
Purpose of Checkpoint?

Oracle Database uses checkpoints to achieve the following goals:

- Reduce the time required for recovery incase of an instance or media failure
- Ensure that dirty buffers in the buffer cache are written to disk regularly
- Ensure that all committed data is written to disk during a consistent shutdown
- Establish data consistency

Overview of Checkpoints

Recovery without Checkpoints

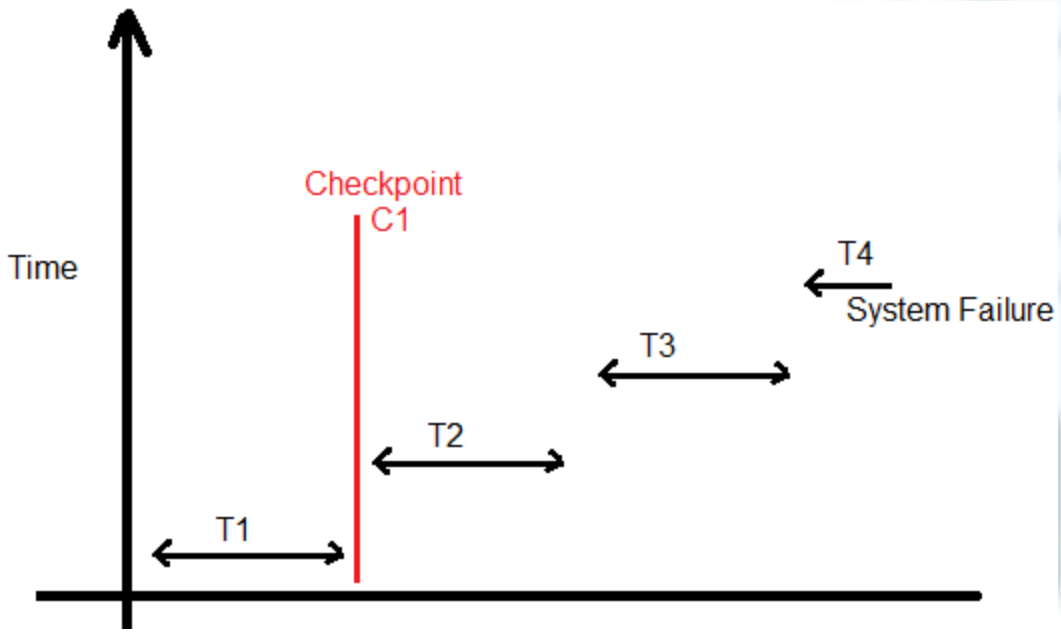


Extra time is wasted in processing the entire log file
Redoing of unnecessary transactions

Overview of Checkpoints

Recovery using Checkpoints

Checkpoint is a mechanism in which all the previous logs are removed from the system and are stored permanently in the storage disk.



Introduction to Database Administration

Initiate Checkpoints

Initiate Checkpoints

Initiate Checkpoints

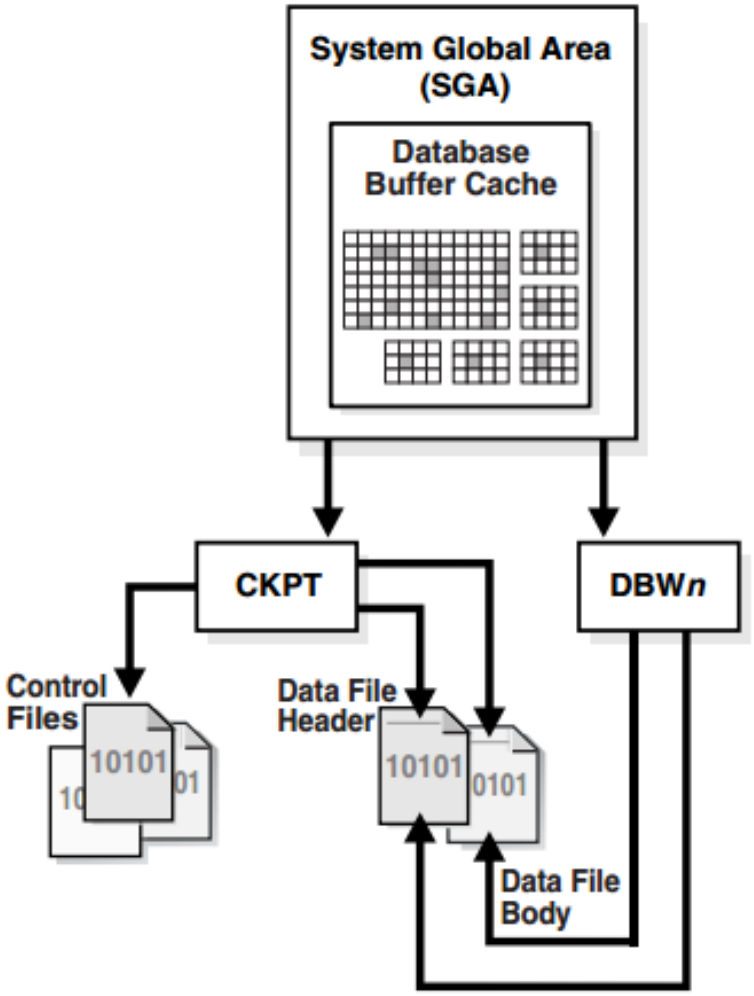
- When to initiate Checkpoint
- Checkpoint Process
- Thread Checkpoints Type
- Tablespace and Data File Checkpoints Type
- Incremental Checkpoints Type
- Checkpoints Processor and Database files

Initiate Checkpoints

When to initiate Checkpoint

The checkpoint process (CKPT) is responsible for writing checkpoints to the data file headers and control file.
Checkpoints occur in a variety of situations

Initiate Checkpoints



Checkpoint Process

The checkpoint process (CKPT)updates the control file and data file headers with checkpoint information and signals DBWn to write blocks to disk. Checkpoint information includes the checkpoint position, SCN, location in online redo log to begin recovery, and so on.

Initiate Checkpoints

Thread Checkpoints Type

The database writes to disk all buffers modified by redo in a specific thread before a certain target. The set of thread checkpoints on all instances in a database is a database checkpoint. Thread checkpoints occur in the following situations:

- Consistent database shutdown
- ALTER SYSTEM CHECKPOINT statement
- Online redo log switch
- ALTER DATABASE BEGIN BACKUP statement

Initiate Checkpoints

Tablespace and Data File Checkpoints Type

The database writes to disk all buffers modified by redo before a specific target. A tablespace checkpoint is a set of data file checkpoints, one for each data file in the tablespace. These checkpoints occur in a variety of situations, including making a tablespace read-only or taking it offline normal, shrinking a data file, or executing

ALTER TABLESPACE BEGIN BACKUP;

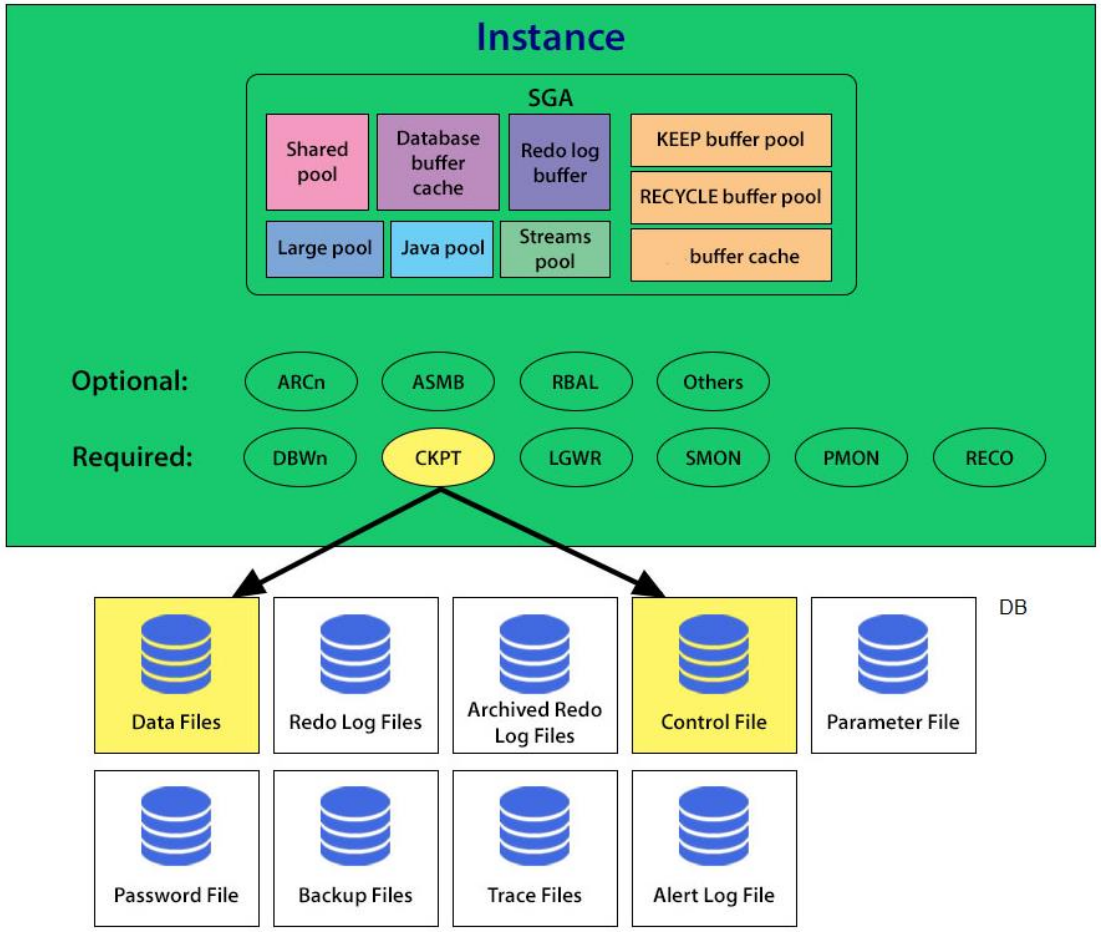
Initiate Checkpoints

Incremental Checkpoints Type

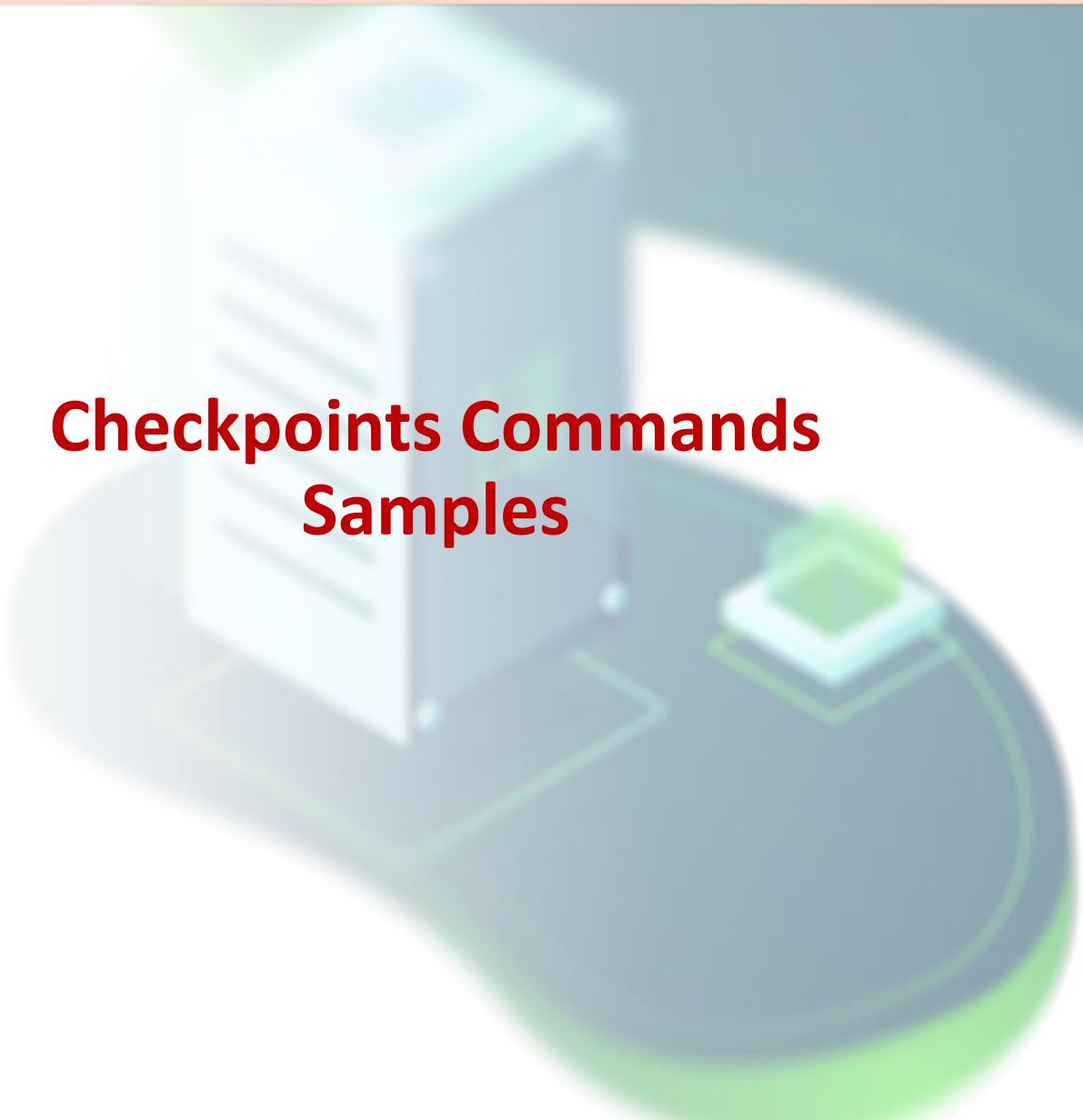
- An incremental checkpoint is a type of thread checkpoint partly intended to avoid writing large numbers of blocks at online redo log switches. DBWn checks at least every three seconds to determine whether it has work to do.
- When DBWn writes dirty buffers, it advances the checkpoint position, causing CKPT to write the checkpoint position to the control file, but not to the data file headers.

Initiate Checkpoints

Checkpoints Processor and Database files



Introduction to Database Administration



Checkpoints Commands Samples

Checkpoints Commands Samples

Checkpoints Commands Samples

- Checkpoints Commands Samples
- When will a Checkpoint occur
- Checkpoint Occurring Command
- Data Dictionary View for Checkpoint
- SCN is Changed After another Checkpoint
- SCN is not Changed After Switch Logfile

Checkpoints Commands Samples

When will a Checkpoint occur

- At each switch of the redo log files
- Once the number of seconds defined in the LOG_CHECKPOINT_TIMEOUT is reached Once the current redo log file reaches the size
  LOG Checkpoint Interval x size of IO-OS blocks, Example 10000*512=5MB

- Directly by the Alter System switch Logfile command
- Directly by the Alter System Checkpoint command

Checkpoints Commands Samples

Checkpoint Occurring Command

- Run the following command with sys user

Alter system checkpoint;

Checkpoints Commands Samples

Data Dictionary View for Checkpoint

```
SQL> select Checkpoint_change#, TO_CHAR(checkpoint_time, 'DD/MM/YYYY HH:MI:SS AM') CHKP_Time,
  2  Bytes/1024/1024
  3  from v$datafile;

CHECKPOINT_CHANGE# CHKP_TIME              BYTES/1024/1024
------------------ ---------------------- ---------------
          19352187 02/10/2020 10:06:26 AM             710
          19352187 02/10/2020 10:06:26 AM             710
          19352187 02/10/2020 10:06:26 AM             305
          19352187 02/10/2020 10:06:26 AM            8.75
          19352187 02/10/2020 10:06:26 AM            1000
          19352187 02/10/2020 10:06:26 AM            1000
```

```
SQL> select Checkpoint_change#, checkpoint_time, sum(Bytes)/1024/1024 DataSize
  2  from v$datafile
  3  group by Checkpoint_change#, checkpoint_time;

CHECKPOINT_CHANGE# CHECKPOIN   DATASIZE
------------------ --------- -----------
          19352187 02-OCT-20   18749.75
```

Checkpoints Commands Samples

SCN is Changed After another Checkpoint

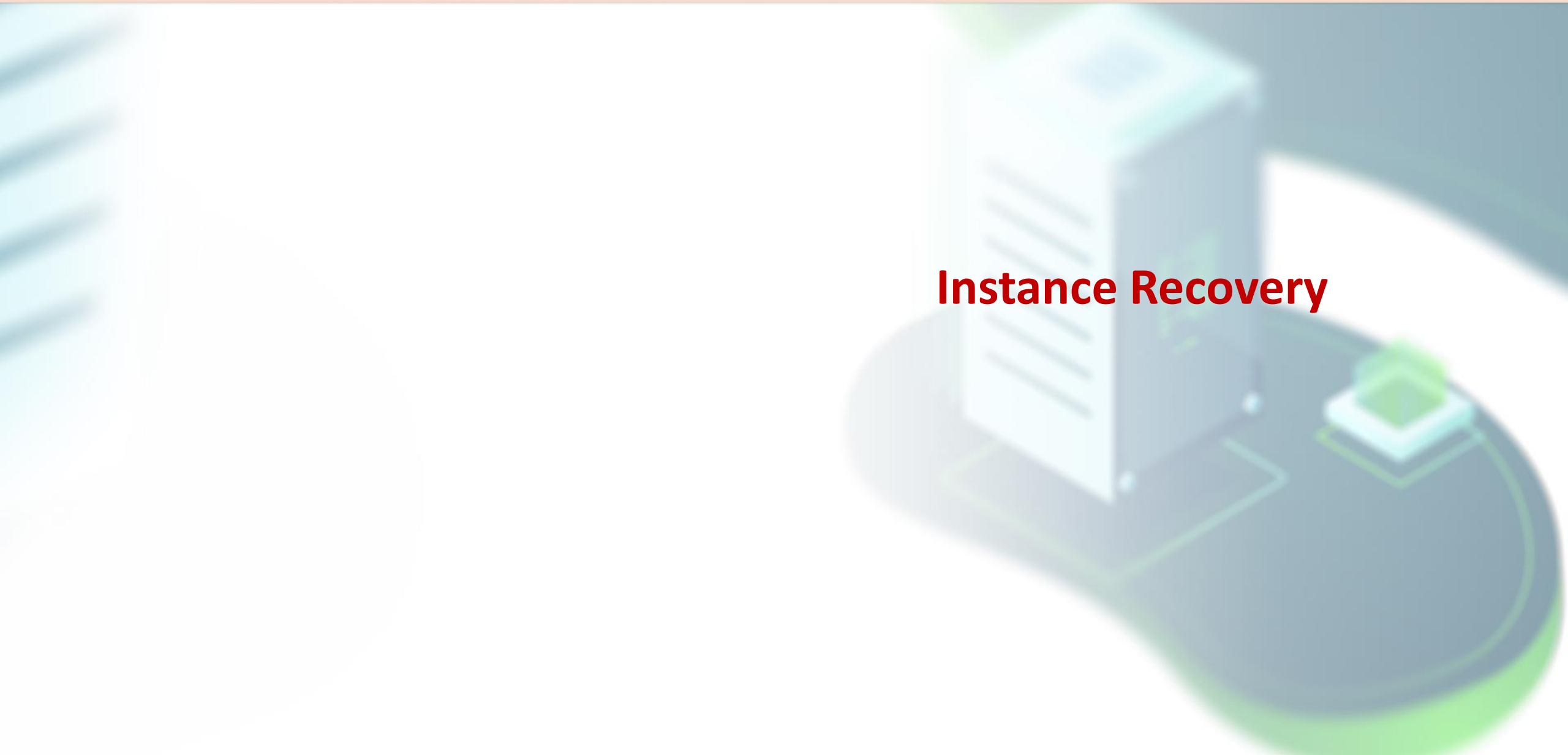
```
        19352187 02-OCT-20   18749.75

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

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             696254928 bytes
Database Buffers          369098752 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
SQL> select Checkpoint_change#, TO_CHAR(checkpoint_time, 'DD/MM/YYYY HH:MI:SS AM') CHKP_Time,
  2  Bytes/1024/1024
  3  from v$datafile;

CHECKPOINT_CHANGE# CHKP_TIME              BYTES/1024/1024
------------------ ---------------------- ---------------
        19352722 02/10/2020 10:19:42 AM             710
        19352722 02/10/2020 10:19:42 AM             710
        19352722 02/10/2020 10:19:42 AM             305
        19352722 02/10/2020 10:19:42 AM            8.75
        19352722 02/10/2020 10:19:42 AM            1000
        19352722 02/10/2020 10:19:42 AM            1000
        19352722 02/10/2020 10:19:42 AM             500
```

Checkpoints Commands Samples

SCN is not Changed After Switch Logfile

```
          19353247 02/10/2020 10:25:15 AM             1024
          19353247 02/10/2020 10:25:15 AM              800

22 rows selected.

SQL>
SQL> Alter System switch Logfile;

System altered.

SQL> select Checkpoint_change#, checkpoint_time, sum(Bytes)/1024/1024 DataSize
  2  from v$datafile
  3  group by Checkpoint_change#, checkpoint_time;

CHECKPOINT_CHANGE# CHECKPOIN   DATASIZE
------------------ --------- ----------
          19353247 02-OCT-20   18749.75
```

Introduction to Database Administration



Instance Recovery

Instance Recovery

Instance Recovery

- Overview of Instance Recovery
- Purpose of Instance Recovery
- How Instance Recovery is Performed?

Instance Recovery

Overview of Instance Recovery

- Instance recovery is the process of applying records in the online redo log to data files to reconstruct changes made after the most recent checkpoint.
- Instance recovery occurs automatically when an administrator attempts to open a database that was previously shut down inconsistently.

Instance Recovery

Overview of Instance Recovery

- Instance recovery occurs automatically when an administrator attempts to open a database that was previously shut down inconsistently.

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

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             696254928 bytes
Database Buffers          369098752 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
```

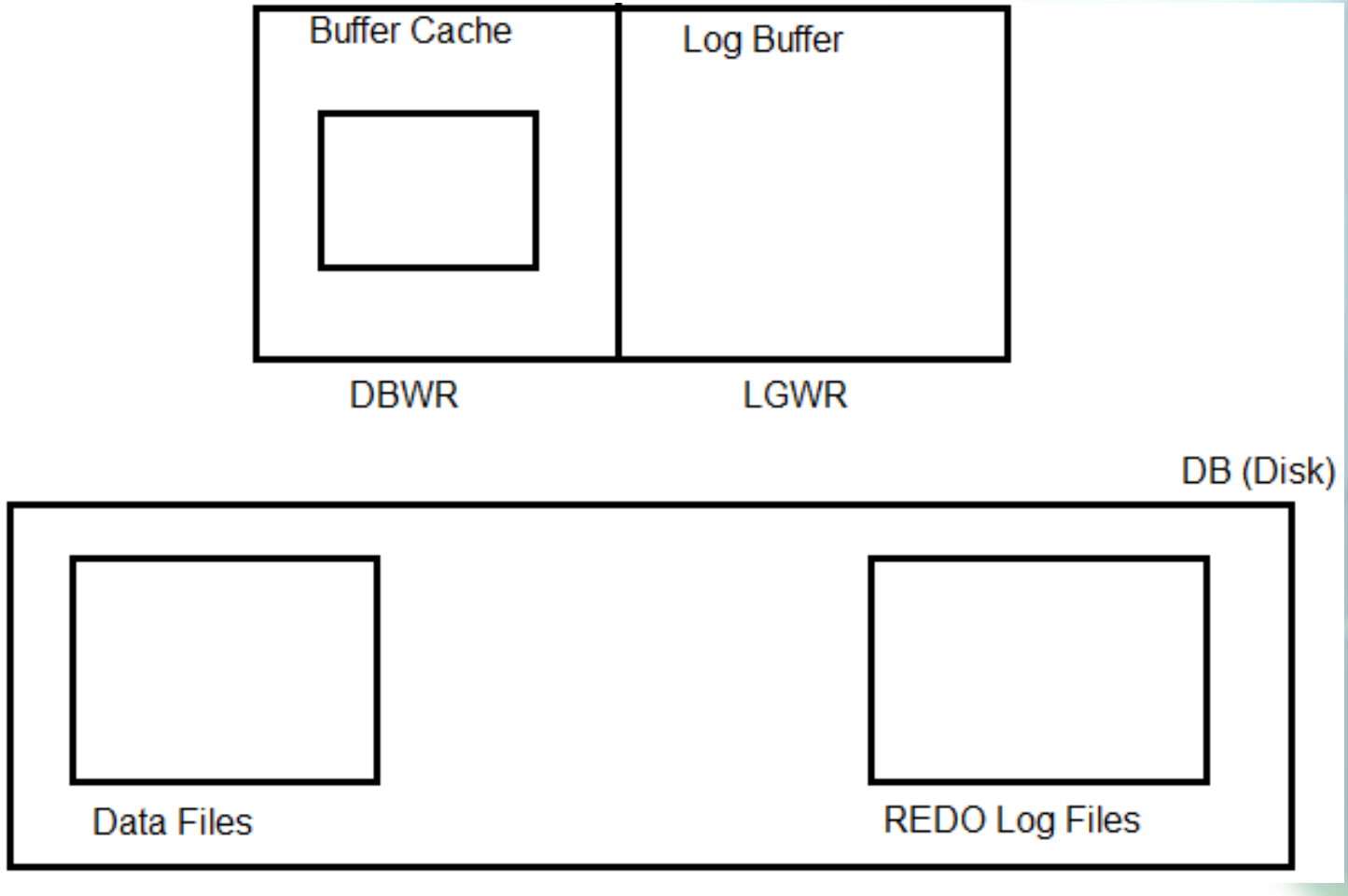
Instance Recovery

Purpose of Instance Recovery

- Instance recovery ensures that the database is in a consistent state after an instance failure.
- The files of a database can be left in an inconsistent state because of how Oracle Database manages database changes.

Instance Recovery

How Instance Recovery is Performed?



Instance Recovery Protocol

Instance Recovery Protocol

Instance Recovery

- Situations for Instance Recovery
- Performing Instance Recovery
- Importance of CKPT for Instance Recovery

Instance Recovery Protocol

Situations for Instance Recovery

If an instance of an open database fails, either because of a SHUTDOWN ABORT statement or abnormal termination, then the following situations can result:

- Data blocks committed by a transaction are not written to the data files and appear only in the online redo log. These changes must be reapplied to the database.

Instance Recovery Protocol

Situations for Instance Recovery

- The data files contains changes that had not been committed when the instance failed. These changes must be rolled back to ensure transactional consistency.

Instance recovery uses only online redo log files and current online data files to synchronize the data files and ensure that they are consistent

Instance Recovery Protocol

Performing Instance Recovery

- Whether instance recovery is required depends on the state of the redo threads. A redo thread is marked open in the control file when a database instance opens in read/write mode, and is marked closed when the instance is shut down consistently.
- If redo threads are marked open in the control file, but no live instances hold the thread enqueues corresponding to these threads, then the database requires instance recovery.

Instance Recovery Protocol

Performing Instance Recovery

Oracle Database performs instance recovery automatically in the following situations:

- The database opens for the first time after the failure of a single-instance database or all instances of an Oracle RAC database. This form of instance recovery is also called crash recovery. Oracle Database recovers the online redo threads of the terminated instances together.

Instance Recovery Protocol

Performing Instance Recovery

- Some but not all instances of an Oracle RAC database fail. Instance recovery is performed automatically by a surviving instance in the configuration.

The SMON background process performs instance recovery, applying online redo automatically. No user intervention is required

Instance Recovery Protocol

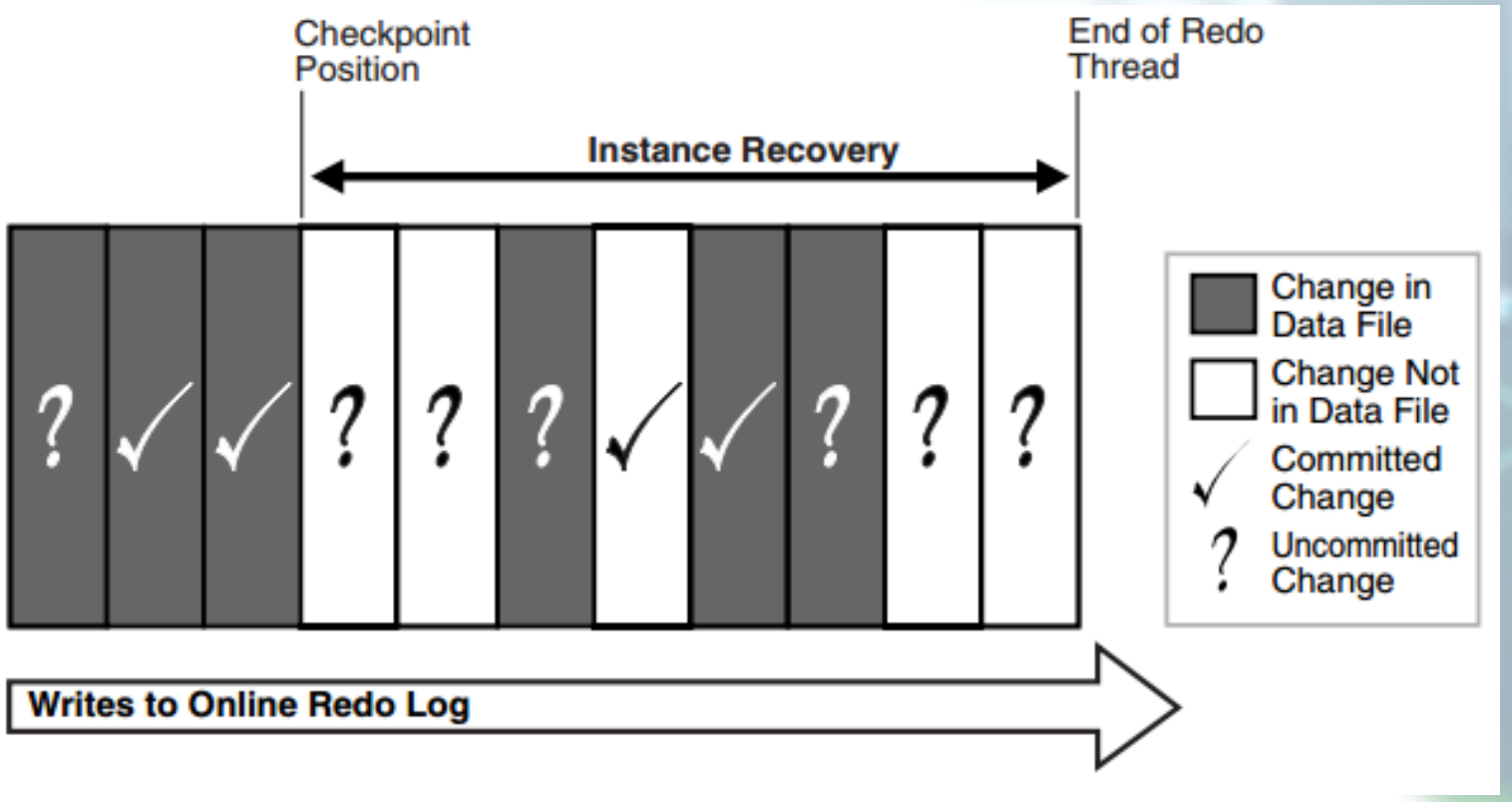
Importance of CKPT for Instance Recovery

- Instance recovery uses checkpoints to determine which changes must be applied to the data files. The checkpoint position guarantees that every committed change with an SCN lower than the checkpoint SCN is saved to the data files.

Instance Recovery Protocol

Importance of CKPT for Instance Recovery

During instance recovery, the database must apply the changes that occur between the checkpoint position and the end of the redo thread.



Introduction to Database Administration

Managing Recovery using MS SQL Server

Managing Recovery using MS SQL Server

MS SQL Server's Recovery

- Restore & Recovery Overview
- Overview of Restore Scenarios
- Steps to Restore a Database
- Accelerated Database Recovery
- Steps to Restore a Database
- Decision to adopt ADR
- To View & Change the Recovery Model
  - Transact SQL
- Without ADR, DB Recovery Follows ARIES
- DB Recovery Follows ARIES using ADR

Managing Recovery using MS SQL Server

Restore & Recovery Overview

To recover a SQL Server database from a failure, a database administrator has to restore a set of SQL Server backups in a logically correct and meaningful restore sequence.:

- The database (a complete database restore)
- The data file (a file restore)
- The data page (Bulk load, restore individual DB)

Managing Recovery using MS SQL Server

Overview of Restore Scenarios

A *restore scenario* in SQL Server is the process of restoring data from one or more backups and then recovering the database. The supported restore scenarios depend on the recovery model of the database and the edition of SQL Server.

- Complete DB Restore
- File Restore (individual files)

Managing Recovery using MS SQL Server

Steps to Restore a Database

To perform a database restore, the Database Engine executes three steps:

- Creates the database and transaction log files if they do not already exist.
- Copies all the data, log, and index pages from the backup media of a database to the database files.
- Applies the transaction log in what is known as the recovery process.

Managing Recovery using MS SQL Server

Accelerated Database Recovery

- Accelerated Database Recovery (ADR) improves database availability, especially in the presence of long running transactions, by redesigning the SQL database engine recovery process. ADR is new in SQL Server 2019.
- ADR is available for Azure SQL Database, Azure SQL Managed Instance and Azure Synapse SQL.

Managing Recovery using MS SQL Server

Steps to Restore a Database

To perform a file restore, the Database Engine executes two steps:

- Creates any missing database file(s).
- Copies the data from the backup devices to the database file(s).

If you restore a file, you cannot recover it and bring it online until it has been rolled far enough forward to be consistent with the database.

Managing Recovery using MS SQL Server

Decision to adopt ADR

The following types of customers should consider enabling ADR:

- Customers that have workloads with long running transactions.
- Customers that have seen cases where active transactions are causing the transaction log to grow significantly.
- Customers that have experienced long periods of database unavailability due to SQL Server long running recovery (such as unexpected SQL Server restart or manual transaction rollback).

Managing Recovery using MS SQL Server

To View & Change the Recovery Model - Transact SQL

Connect to the Database Engine. From the Standard bar, click **New Query**.
Copy and paste the following example into the query window and click **Execute**. This example shows how to query the sys.databases catalog view to learn the recovery model of the **model** database.

SQL

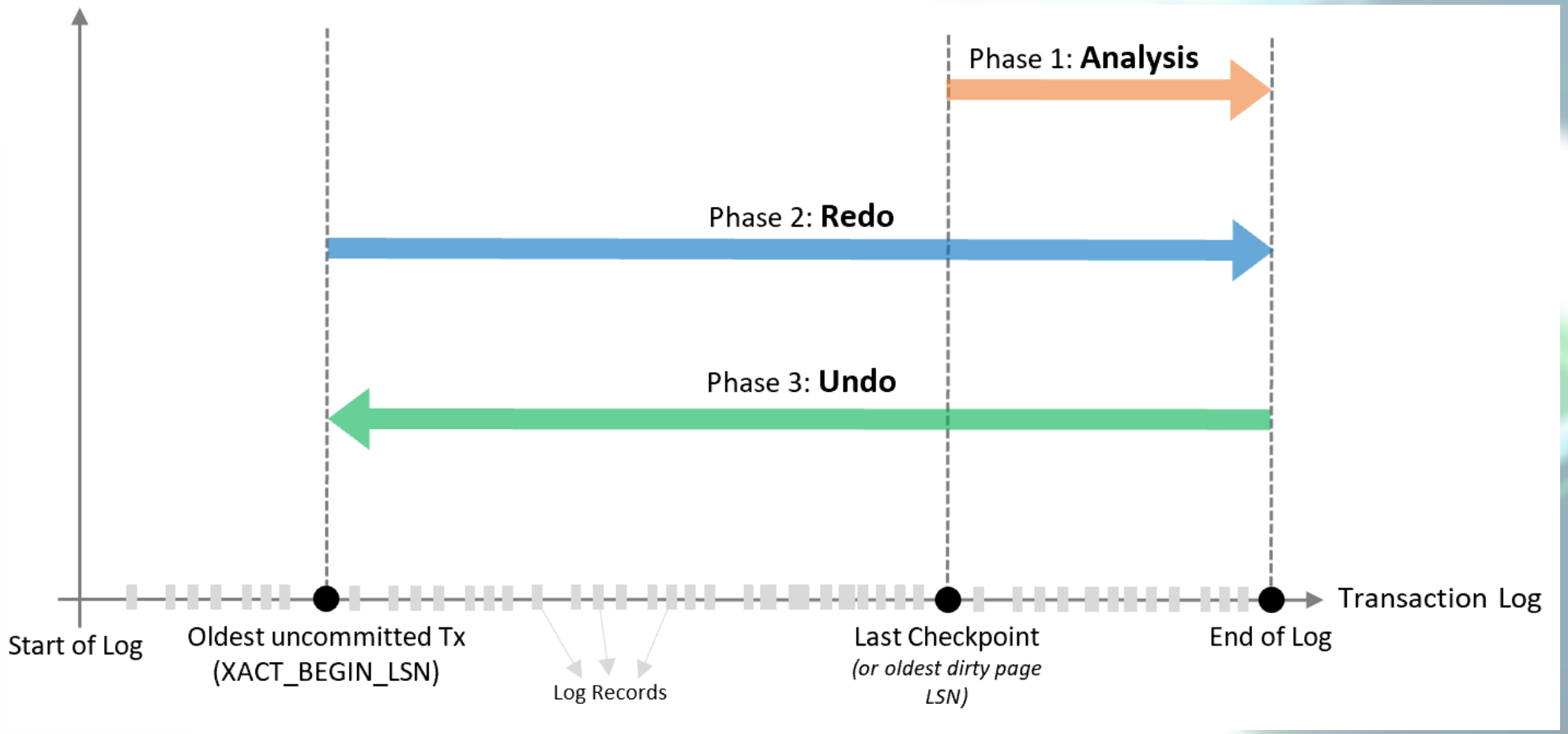
```
SELECT name, recovery_model_desc
   FROM sys.databases
      WHERE name = 'model' ;
GO
```

SQL

```
USE [master] ;
ALTER DATABASE [model] SET RECOVERY FULL ;
```

Managing Recovery using MS SQL Server

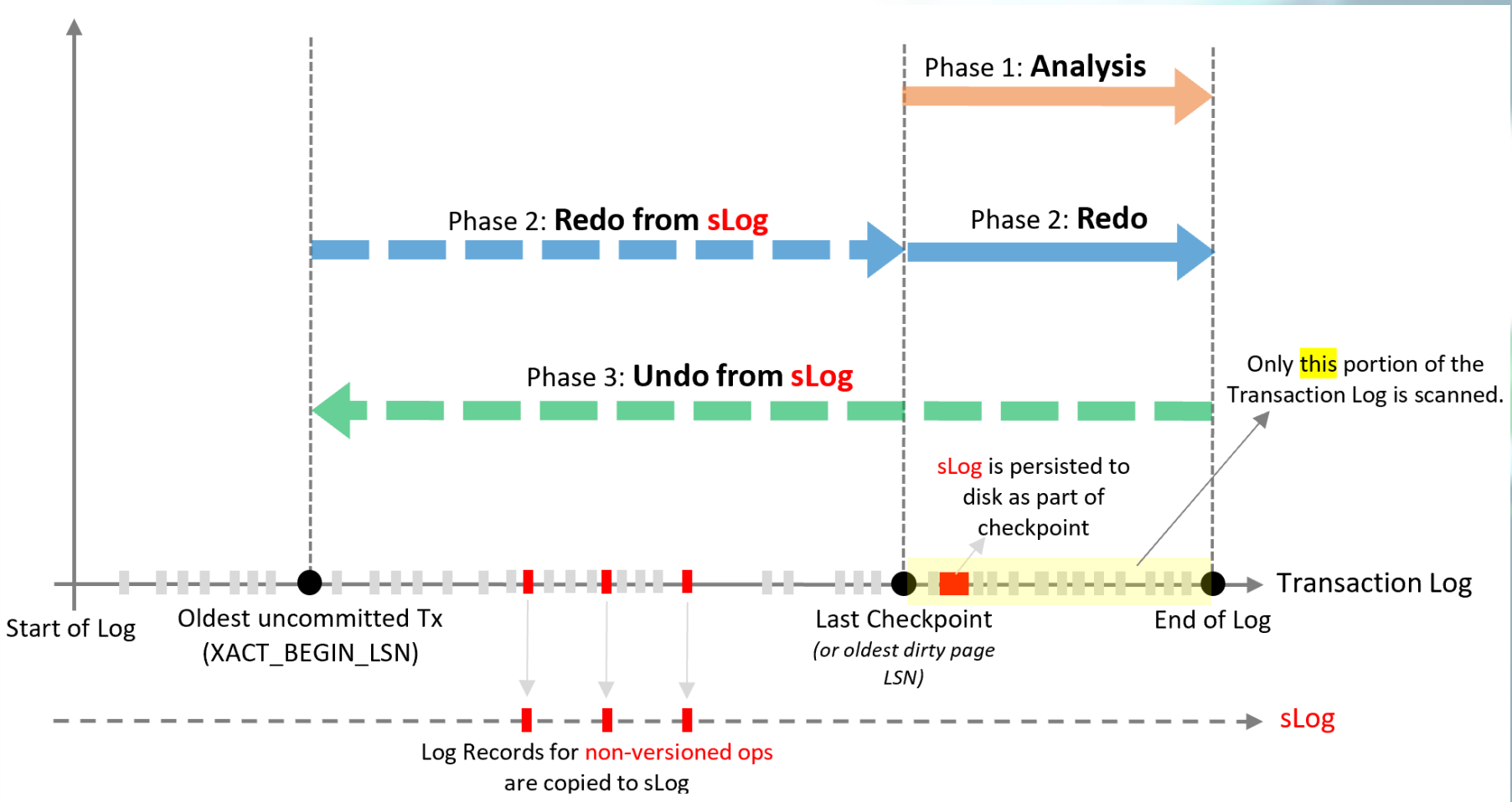
Without ADR, DB Recovery Follows ARIES



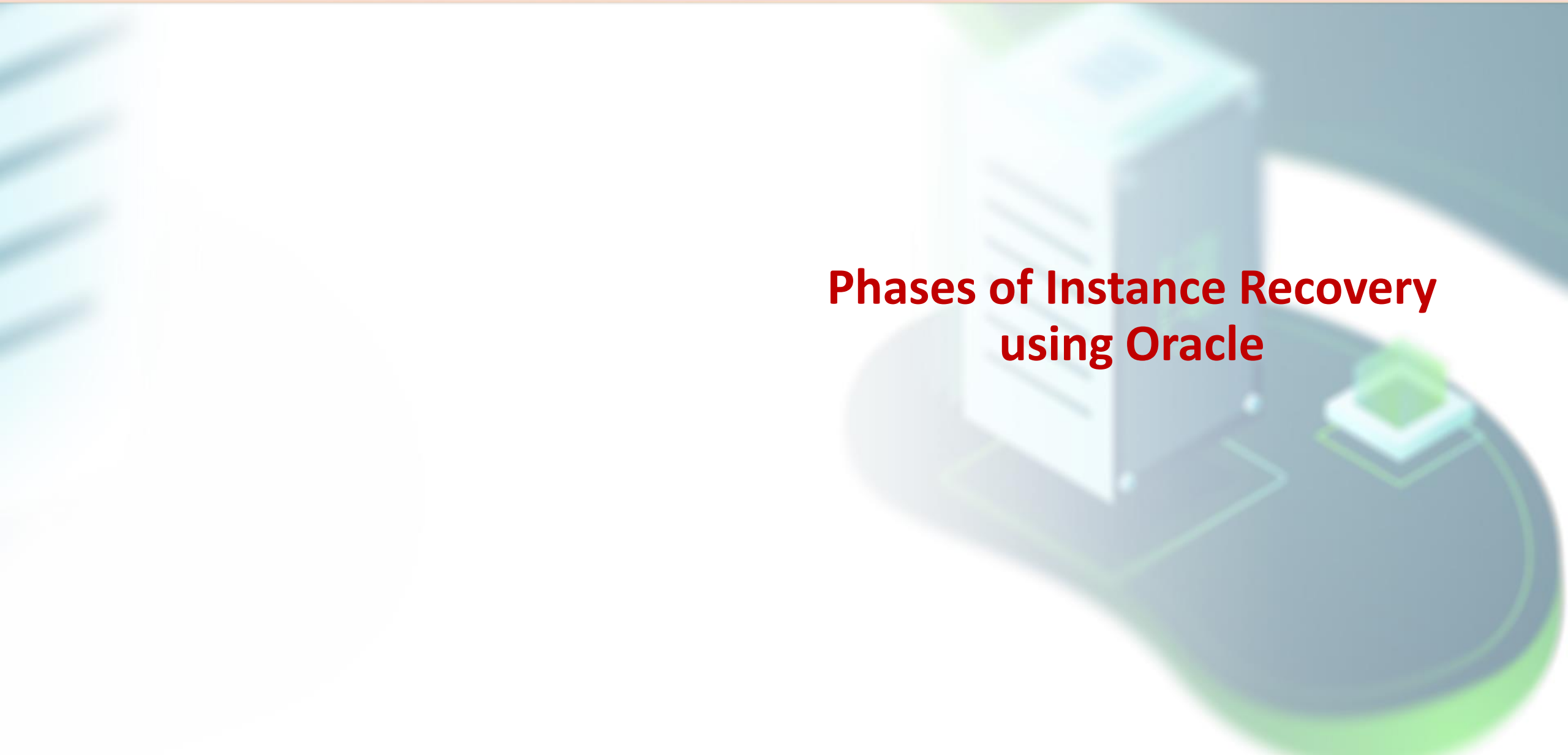
docs.microsoft.com

Managing Recovery using MS SQL Server

DB Recovery Follows ARIES using ADR



docs.microsoft.com



Phases of Instance Recovery using Oracle

Phases of Instance Recovery

Phases of Instance Recovery

- Introduction
- Rolling Forward
- After Roll Forward
- Rolling Forward & Rolling Backward

Phases of Instance Recovery

Introduction

The first phase of instance recovery is called cache recovery or rolling forward, and involves reapplying all of the changes recorded in the online redo log to the data files.

Because rollback data is recorded in the online redo log, rolling forward also regenerates the corresponding undo segments.

Phases of Instance Recovery

Rolling Forward

Rolling forward proceeds through as many online redo log files as necessary to bring the database forward in time.
After rolling forward, the data blocks contain all committed changes recorded in the online redo log files. These files could also contain uncommitted changes that were either saved to the data files before the failure, or were recorded in the online redo log and introduced during cache recovery.

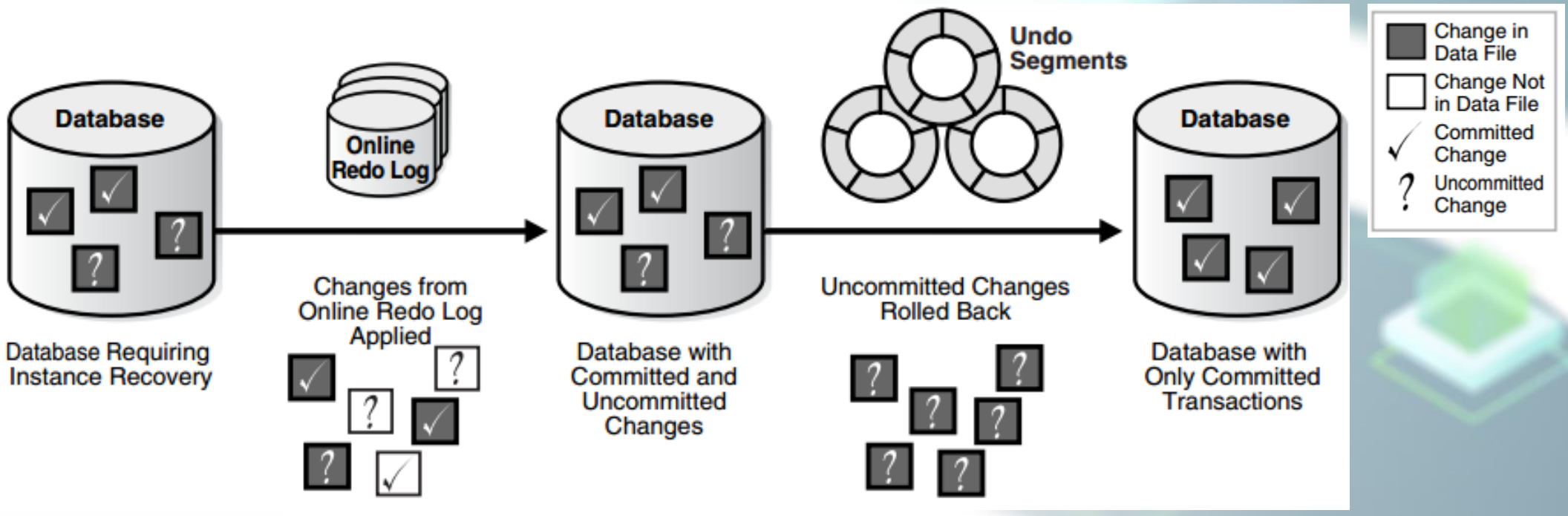
Phases of Instance Recovery

After Roll Forward

After the roll forward, any changes that were not committed must be undone. Oracle Database uses the checkpoint position, which guarantees that every committed change with an SCN lower than the checkpoint SCN is saved on disk. Oracle Database applies undo blocks to roll back uncommitted changes in data blocks that were written before the failure or introduced during cache recovery. This phase is called rolling back or transaction recovery.

Phases of Instance Recovery

Rolling Forward & Rolling Backward



Overview of Parameter Files with commands

Overview of Parameter Files with commands

Overview of Parameter Files with commands

- Introduction
- Initialization Parameters
- Functional Group of Initialization Parameters
- Purpose of Variable Parameters
- Basic Initialization Parameters
- Advance Initialization Parameters
- Parameters during Installation
- Parameters Files spfile and pfile

Overview of Parameter Files with commands

Introduction

To start a database instance, Oracle Database must read either a server parameter file, which is recommended, or a text initialization parameter file, which is a legacy implementation. These files contain a list of configuration parameters.

Overview of Parameter Files with commands

Initialization Parameters

- Initialization parameters are configuration parameters that affect the basic operation of an instance. The instance reads initialization parameters from a file at startup.
- Oracle Database provides many initialization parameters to optimize its operation in diverse environments. Only a few of these parameters must be explicitly set because the default values are adequate in most cases.

Overview of Parameter Files with commands

Functional Group of Initialization Parameters

Most initialization parameters belong to one of the following functional groups:

- Parameters that name entities such as files or directories
- Parameters that set limits for a process, database resource, or the database itself
- Parameters that affect capacity, such as the size of the SGA (these parameters are called variable parameters)

Overview of Parameter Files with commands

Purpose of Variable Parameters

Variable parameters are of particular interest to database administrators because they can use these parameters to improve database performance.

Overview of Parameter Files with commands

Basic Initialization Parameters

In most cases, you must set and tune only the approximately 30 basic parameters to obtain reasonable performance. The basic parameters set characteristics such as the database name,
locations of the control files,
database block size, and
undo tablespace

Overview of Parameter Files with commands

Advance Initialization Parameters

- In rare situations, modification to the advanced parameters may be required for optimal performance.
- The advanced parameters enable expert DBAs to adapt the behavior of the Oracle Database to meet unique requirements

Overview of Parameter Files with commands

Parameters during Installation

Oracle Database provides values in the starter initialization parameter file provided with your database software, or as created for you by the Database Configuration Assistant.

```
db_name=sample
control_files=/disk1/oradata/sample_cf.dbf
db_block_size=8192
open_cursors=52
undo_management=auto
shared_pool_size=280M
pga_aggregate_target=29M
.
.
```

Overview of Parameter Files with commands

Parameters during Installation

create spfile from pfile;

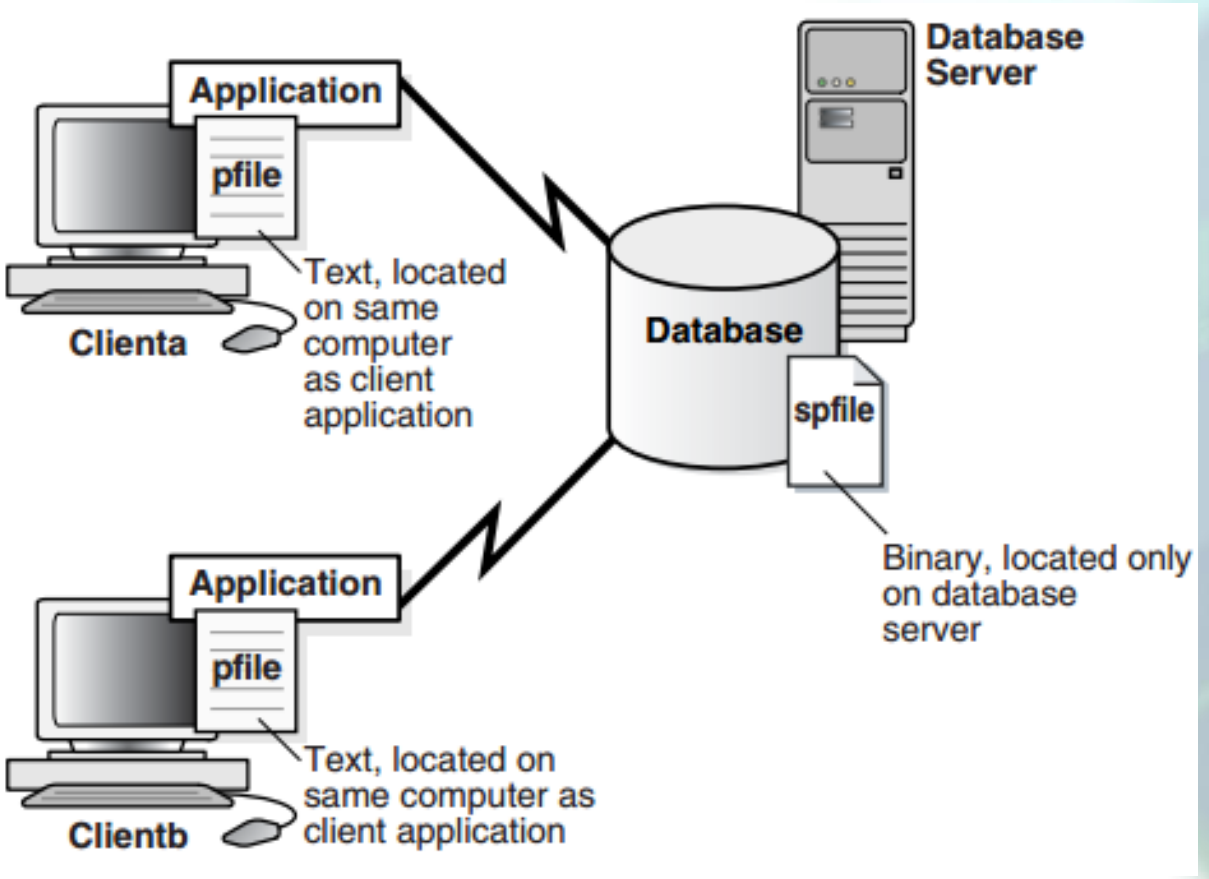
create pfile from spfile;

show parameter processes;

show parameter spfile;

Overview of Parameter Files with commands

Parameters Files spfile and pfile



Initializing Parameter Files

Initializing Parameter Files

- Server's Parameters Characteristics
- Text Parameters File
- Text Parameters Characteristics
- Use of alter system command
- Static and Dynamic Parameters

Initializing Parameter Files

Server's Parameters Characteristics

- Only one server parameter file (spfile) exists for a database. This file must reside on the database host.
- The server parameter file is written to and read by only by Oracle Database, not by client applications.
- The server parameter file is binary and cannot be modified by a text editor.

Initializing Parameter Files

Server's Parameters Characteristics

- Initialization parameters stored in the server parameter file are persistent. Any changes made to the parameters while a database instance is running can persist across instance shutdown and startup.

Initializing Parameter Files

Text Parameters File

- A text initialization parameter file (pfile) is a text file that contains a list of initialization parameters. It is readable and writeable to DBA and its changes are reflected into spfile on Server.
- The text initialization parameter file contains a series of key=value pairs, one per line

Initializing Parameter Files

Text Parameters Characteristics

- When starting up or shutting down a database, the text initialization parameter file must reside on the same host as the client application that connects to the database.
- A text initialization parameter file is text-based, not binary.
- Oracle Database can read but not write to the text initialization parameter file. To change the parameter values you must manually alter the file with a text editor.

Initializing Parameter Files

Text Parameters Characteristics

- Changes to initialization parameter values by ALTER SYSTEM are only in effect for the current instance. You must manually update the text initialization parameter file and restart the instance for the changes to be known.

Initializing Parameter Files

```
global_txn_processes                integer     1
job_queue_processes                 integer     1000
log_archive_max_processes           integer     4
processes                           integer     150
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> startup  open
ORACLE instance started.

Total System Global Area 1071333376 bytes
Fixed Size                  1375792 bytes
Variable Size             696254928 bytes
Database Buffers          369098752 bytes
Redo Buffers                4603904 bytes
Database mounted.
Database opened.
SQL> show parameter processes;

NAME                                 TYPE        VALUE
------------------------------------ ----------- ----------
aq_tm_processes                      integer     0
db_writer_processes                  integer     1
gcs_server_processes                 integer     0
global_txn_processes                 integer     1
job_queue_processes                  integer     1000
log_archive_max_processes            integer     4
processes                            integer     200
SQL>
```

Use of Alter System command

Alter system set processes=200 scope=spfile;

create pfile='E:\app\Haider\product\11.2.0\dbhome_1\database\pfileORCL.ora' from SPFILE;

This change can be seen by opening spfile

Initializing Parameter Files

Static and Dynamic Parameters

Characteristic	Static	Dynamic
Requires modification of the parameter file (text or server)	Yes	No
Requires database instance restart before setting takes affect	Yes	No
Described as "Modifiable" in *Oracle Database Reference* initialization parameter entry	No	Yes
Modifiable only for the database or instance	Yes	No

Static parameters include DB_BLOCK_SIZE, DB_NAME, and COMPATIBLE. Dynamic parameters are grouped into session-level parameters, which affect only the current user session, and system-level parameters, which affect the database and all sessions.

MEMORY_TARGET=system-level & NLS_DATE_FORMAT=session level parameters

Diagnostic Instance Files

Diagnostic Instance Files

Diagnostic Instance Files

- Overview of Diagnostic Files
- Goals of fault Diagnosability Infrastructure
- Automatic Diagnostic Repository
- Problems & Incidence
- DDL & DEBUG Log files - Example
- ADR Directory Structure

Diagnostic Instance Files

Overview of Diagnostic Files

Oracle Database includes a fault diagnosability infrastructure for preventing, detecting, diagnosing, and resolving database problems. Problems include critical errors such as code bugs, metadata corruption, and customer data corruption.

Diagnostic Instance Files

Goals of fault Diagnosability Infrastructure

- Detecting problems proactively
- Limiting damage and interruptions after a problem is detected
- Reducing problem diagnostic and resolution time
- Simplifying customer interaction with Oracle Support

Diagnostic Instance Files

Automatic Diagnostic Repository

Automatic Diagnostic Repository (ADR) is a file-based repository that stores database diagnostic data such as trace files, the alert log, and Health Monitor reports. Key characteristics of ADR include:

- Unified directory structure
- Consistent diagnostic data formats
- Unified tool set

Diagnostic Instance Files

Problems & Incidence

- ADR proactively tracks problems, which are critical errors in the database. Critical errors manifest as internal errors, such as ORA-600, or other severe errors. Each problem has a problem key, which is a text string that describes the problem.

Diagnostic Instance Files

Problems & Incidence

- When a problem occurs multiple times, ADR creates a time-stamped incident for each occurrence. An incident is uniquely identified by a numeric incident ID. When an incident occurs, ADR sends an incident alert to Enterprise Manager. Diagnosis and resolution of a critical error usually starts with an incident alert.
- ADR informs you that a critical error is ongoing without overloading the system with diagnostic data

Diagnostic Instance Files

DDL & DEBUG Log Files - Example

DDL Log: In the alert log file, DDL statements can be recorded when using parameter ENABLE_DDL_LOGGING to TRUE with NOMOUNT startup of database (in Oracle 11g version).
Following commands can be recorded with TRUE option:

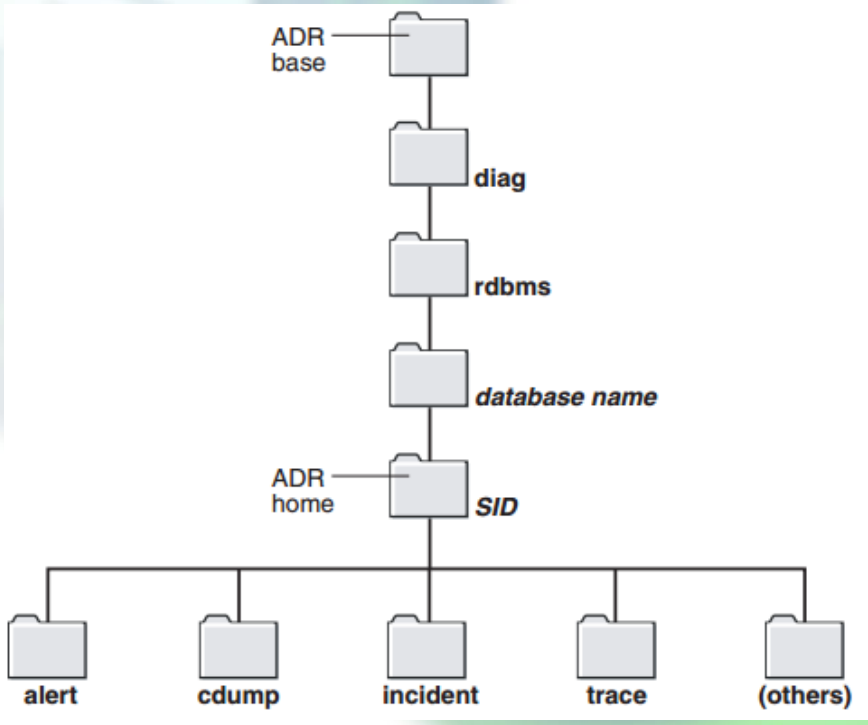
Create Table
Create Index
Create User
Drop Table

Diagnostic Instance Files

ADR Directory Structure

The ADR base is the ADR root directory. The ADR base can contain multiple ADR homes, where each ADR home is the root directory for all diagnostic data—traces, dumps, the alert log, and so on—for an instance of an Oracle product or component.

```
SQL> SELECT substr(NAME,1,30) Diag_name, substr(VALUE, 1, 50) diag_val
  2  FROM V$DIAG_INFO;

DIAG_NAME                      DIAG_VAL
------------------------------ --------------------------------------------------
Diag Enabled                   TRUE
ADR Base                       e:\app\haider
ADR Home                       e:\app\haider\diag\rdbms\orcl\orcl
Diag Trace                     e:\app\haider\diag\rdbms\orcl\orcl\trace
Diag Alert                     e:\app\haider\diag\rdbms\orcl\orcl\alert
Diag Incident                  e:\app\haider\diag\rdbms\orcl\orcl\incident
Diag Cdump                     e:\app\haider\diag\rdbms\orcl\orcl\cdump
Health Monitor                 e:\app\haider\diag\rdbms\orcl\orcl\hm
Default Trace File             e:\app\haider\diag\rdbms\orcl\orcl\trace\orcl_ora_
Active Problem Count           0
Active Incident Count          0

11 rows selected.
```



Introduction to Database Administration

Commands & Log Alerts

Commands & Log Alerts

Commands & Log Alerts

- Overview of Alert File
- Alert Log File
- Alert Log File – Contents
- Alert Log File - Maintenance
- Alert Log File - Location

Commands & Log Alerts

Overview of Alert File

Each database has an alert log, which is an XML and text file containing a chronological log of database messages and errors. The alert log contents include the following:

- Deadlock occurs
- Any error written by Oracle Server process
- Any unexpected messages and corruptions happened
- Any DBA DDL operations are managed

Commands & Log Alerts

Alert Log File

The Alert log file (ALERT.LOG) is a chronological log of messages and errors written out by an Oracle Database

This file should constantly be monitored to detect unexpected messages and corruptions

Commands & Log Alerts

Alert Log File - Contents

- Non default initialization parameter used at startup or
- internal errors (Ora-600)
- Block corruption error (Ora-1578)
- DDL and STARTUP, SHUTDOWN, ARCHIVE LOG, and RECOVER

Commands & Log Alerts

Alert Log File - Contents

The alert log file contains the following information that can be used to aid in tuning the database

- Time to perform archiving
- Instance recovery start and complete times
- Deadlock and timeout errors
- Incomplete checkpoints
- Checkpoint start and end times

Commands & Log Alerts

Alert Log File - Maintenance

As Alert file grows bigger,

- DBA can periodically backup the alert log file and delete the current file

When database attempts to write to the alert file again, it will create a new file

Commands & Log Alerts

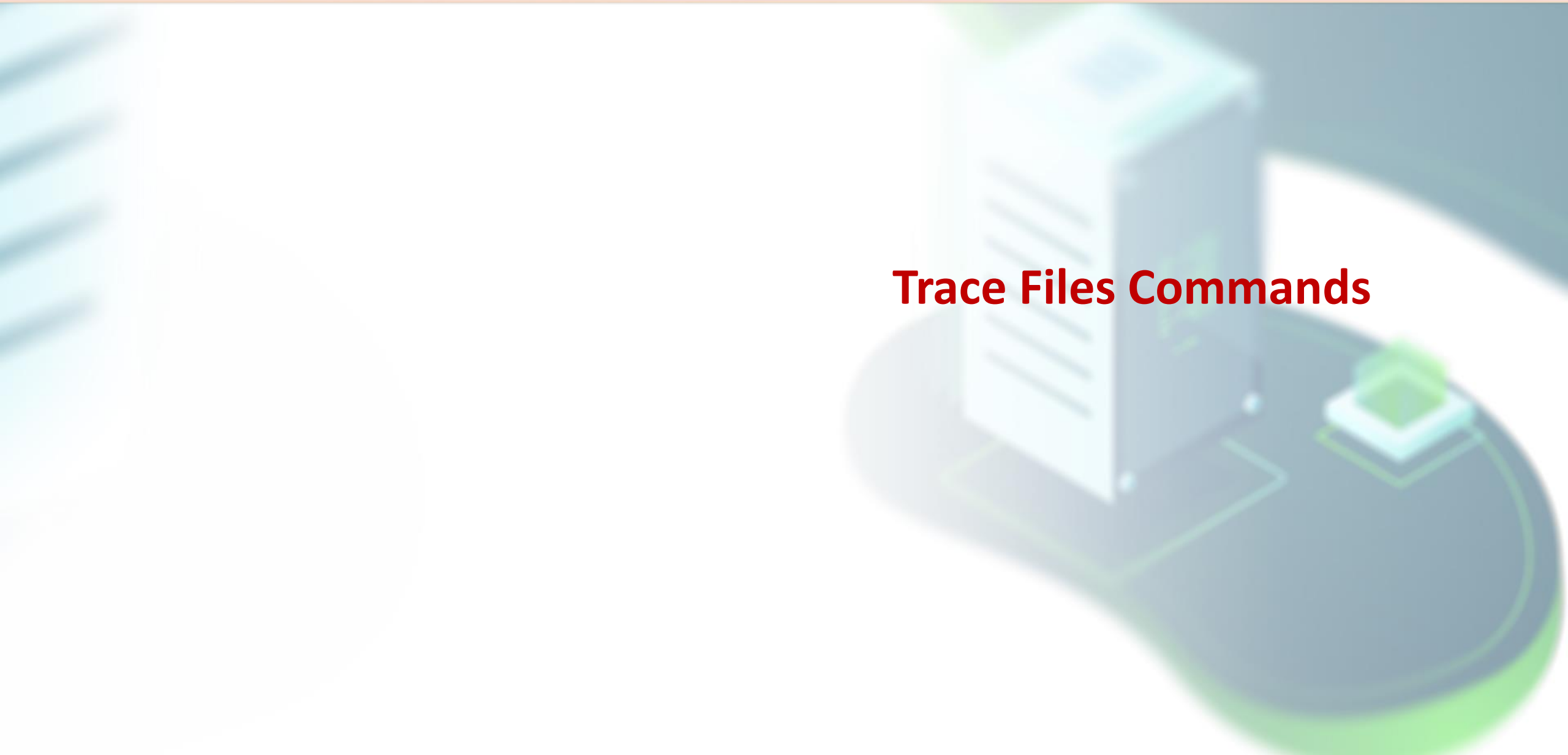
Alert Log File - Location

Each database has an Alert_SID.log file

Resides on Server with the database

Default location
Oracle-
Base/diag/rdbms/DB_Name/SID/trace

End



Trace Files Commands

Trace Files Commands

Trace Files Commands

- Overview of Trace Files
- Types of Trace Files
- Contents of Trace Files
- Locations of Trace Files

Trace Files Commands

Overview of Trace Files

A trace file is an administrative file that contain diagnostic data used to investigate problems. Also, trace files can provide guidance for tuning applications or an instance.

Trace Files Commands

Types of Trace Files

- Each server and background process can periodically write to an associated trace file. The files information on the process environment, status, activities, and errors.
- The SQL trace facility also creates trace files, which provide performance information on individual SQL statements.

Trace Files Commands

Types of Trace Files

- To enable tracing for a client identifier, service, module, action, session, instance, or database, you must execute the appropriate procedures in the DBMS_MONITOR package or use Oracle Enterprise Manager.
- A dump is a special type of trace file. Whereas a trace tends to be continuous output of diagnostic data, a dump is typically a one-time output of diagnostic data in response to an event (such as an incident).

Trace Files Commands

Types of Trace Files

- When an incident occurs, the database writes one or more dumps to the incident directory created for the incident. Incident dumps also contain the incident number in the file name

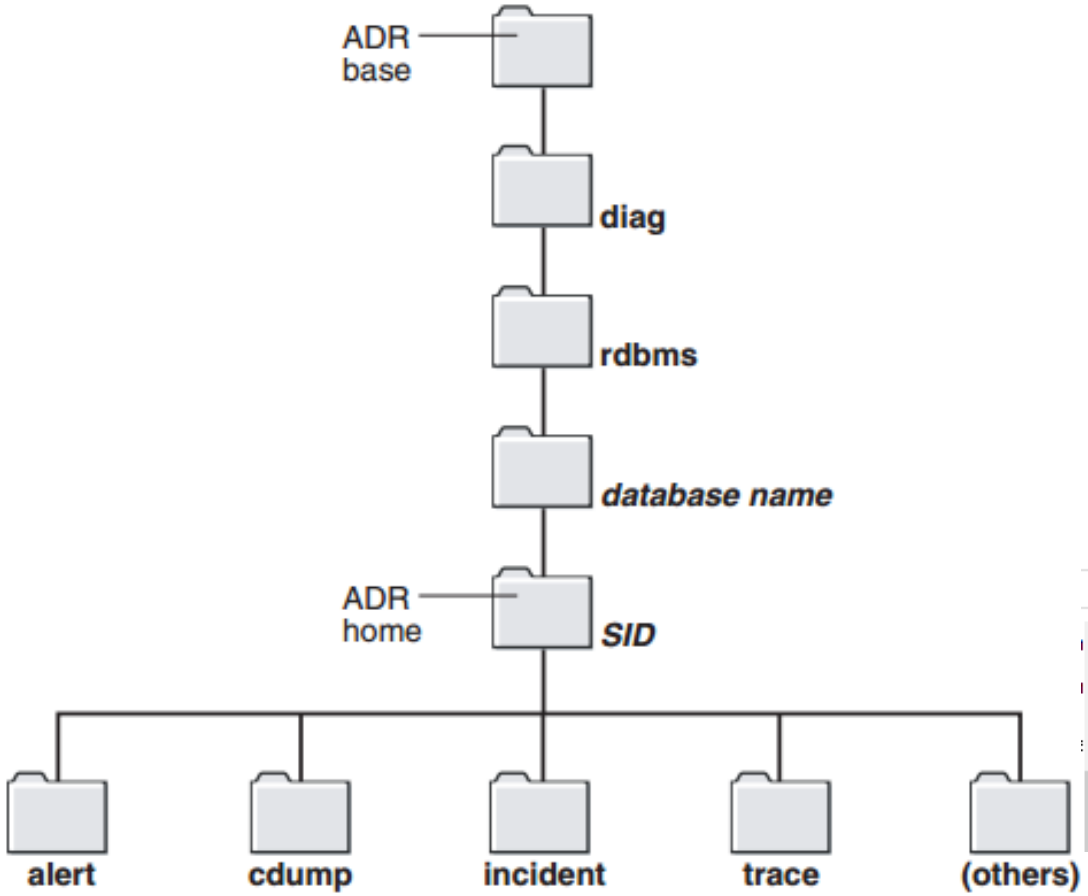
Trace Files Commands

Contents of Trace Files

- Typically, database background process trace file names contain the
- Oracle SID,
- background process name, and
- operating system process number

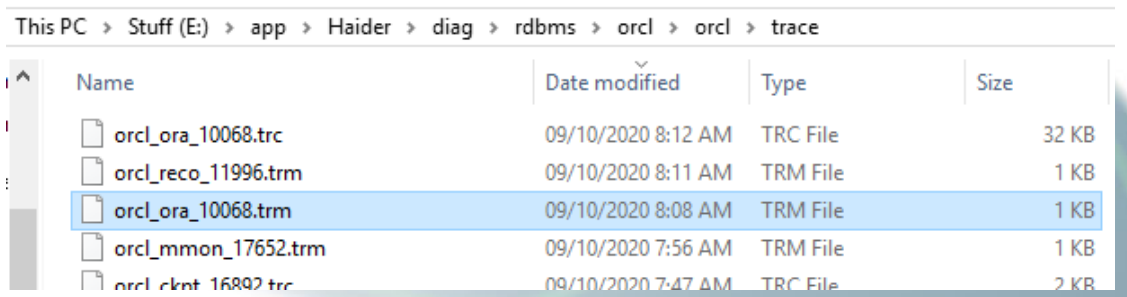
An example of a trace file for the RECO process is mytest_reco_10355.trc

Trace Files Commands

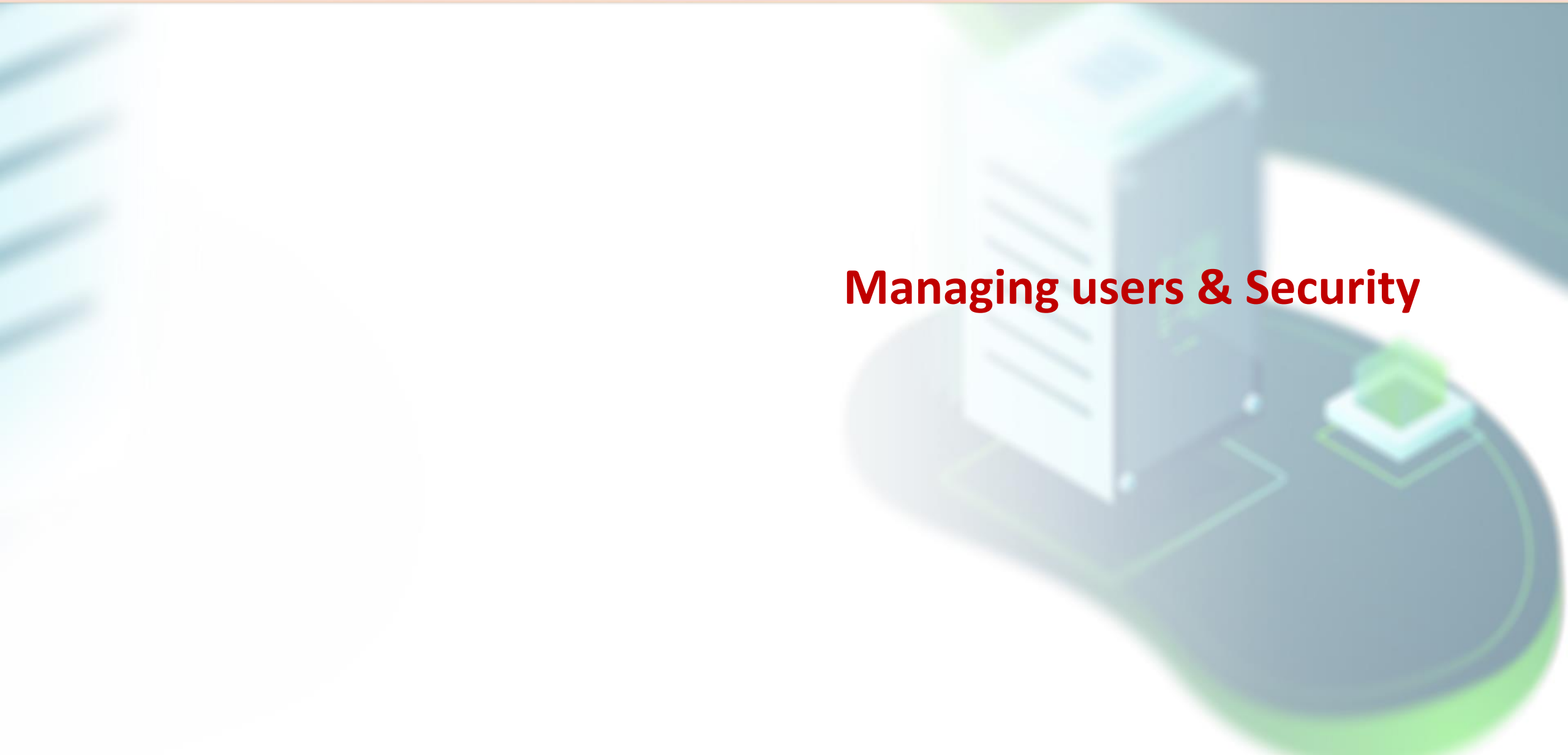


Locations of Trace Files

ADR stores trace files in the trace sub directory, as shown in Figure Trace file names are platform dependent and use the extension .trc.



Introduction to Database Administration



Managing users & Security

Managing users & Security

- Types of Security
- Threats to Databases
- Security Domain
- Schema Objects & User
- User & Database
- Creating Oracle User
- Pre-defined Accounts

Managing users & Security

Types of Security

Following are the database security types and issues

- Legal & Ethical Issues
- Policy Issues in Enterprises
- Systems' related Issues
- Needs of Enterprises

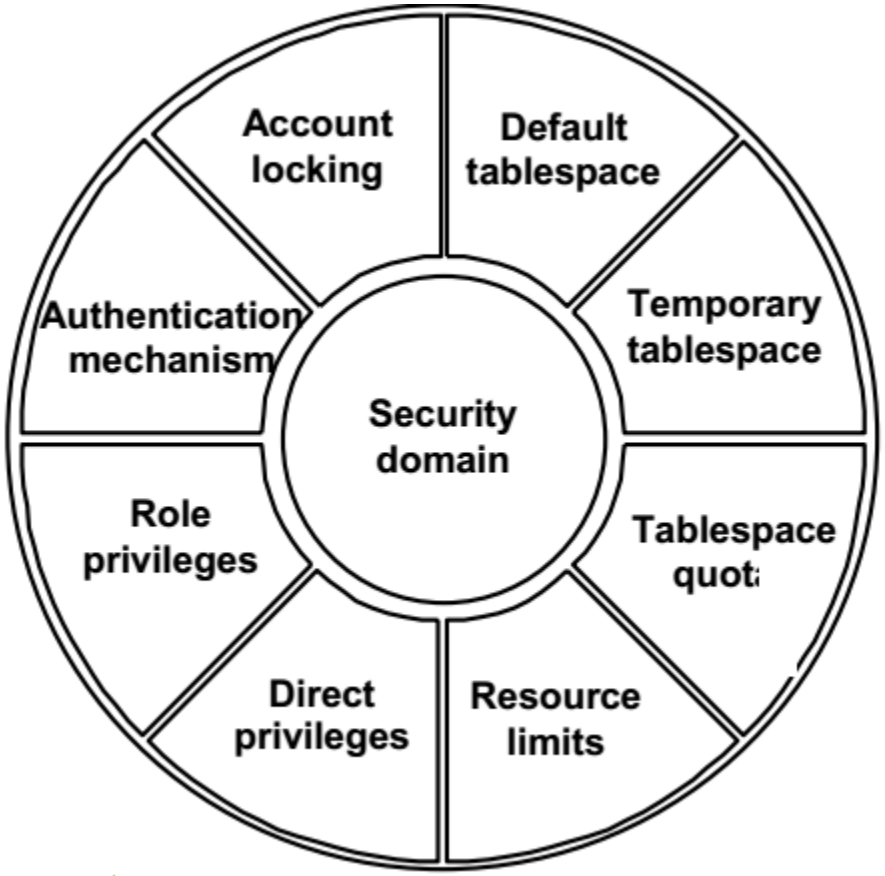
Managing users & Security

Threats to Databases

Following are the database related threats and issues

- Loss of integrity
- Loss of availability
- Loss of Confidentiality

Managing users & Security



Security Domain

The database administrator defines the names of the users who are allowed to access a database. A security domain defines the settings that apply to the user.

Authentication mechanisms are

- Data Dictionary
- Operating System
- Network

Managing users & Security

Schema Objects & User

- A Schema is a collection of objects
- A user is associated (owner) of schema
- Creating schema means creating a user as an owner of schema

Managing users & Security

User & Database

- Accessing Database (connection with the database)
- Specifying database unique user account of ID
- Specifying authentication (roles & privileges) to user account

Allocating space, quota, buffer etc. are additional features in security.

Managing users & Security

Creating Oracle User

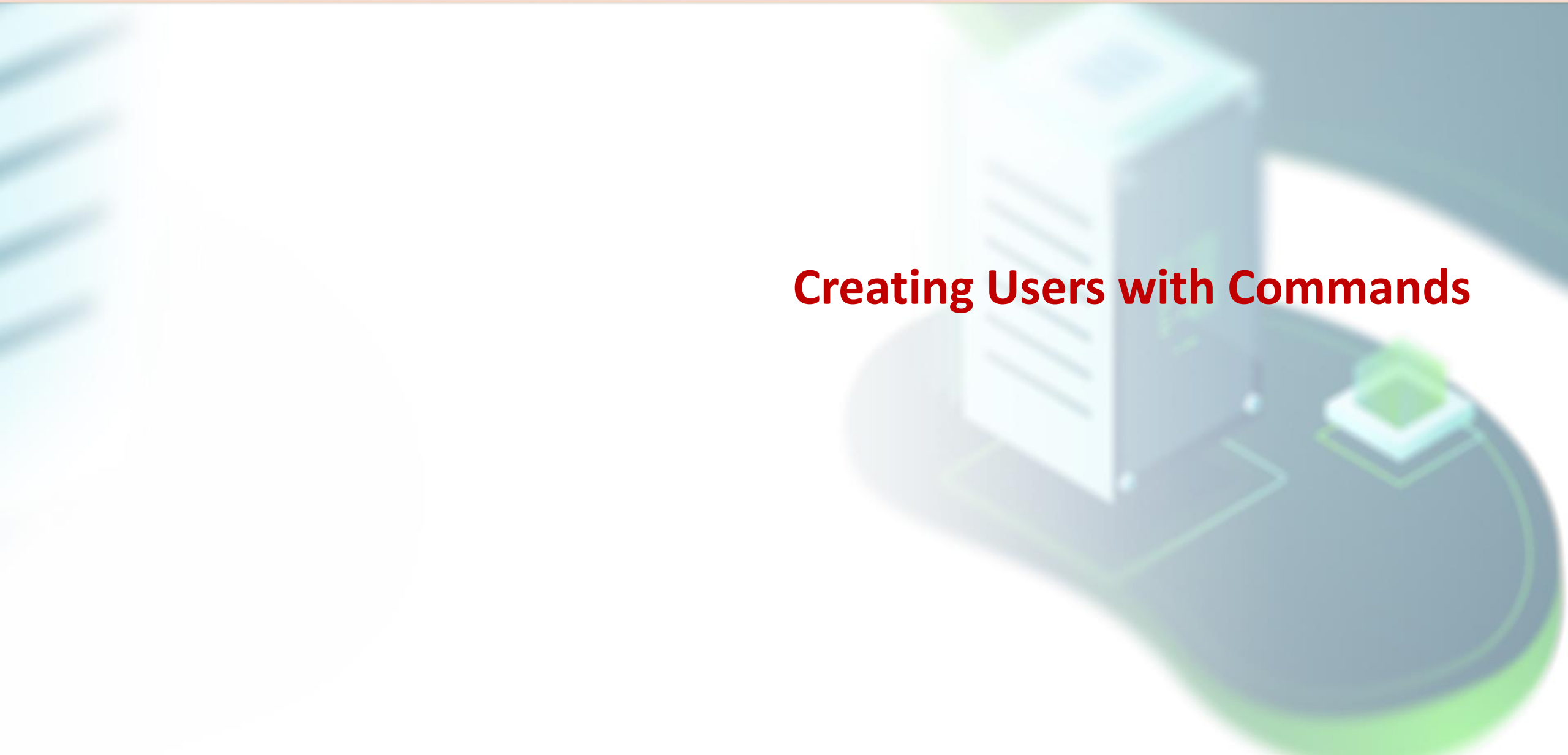
- A unique user name or account
- Authentications (roles/ rights)
- A default tablespace
- A temporary tablespace
- A user profile
- An account status (lock/unlock)

Managing users & Security

Pre-defined Accounts

- SYS account (sys as sysdba)
  - is granted the DBA role
  - has all privileges with ADMIN OPTION
  - is used for startup, shutdown etc.
  - owns the data dictionary
- SYSTEM account is granted the DBA role
  - Normally not used for routine operations

End



Creating Users with Commands

Creating Users with Commands

Creating Users with Commands

- Creating Oracle User
- Syntax for Creating Oracle User
- Data Dictionary View DBA_USERS

Creating Users with Commands

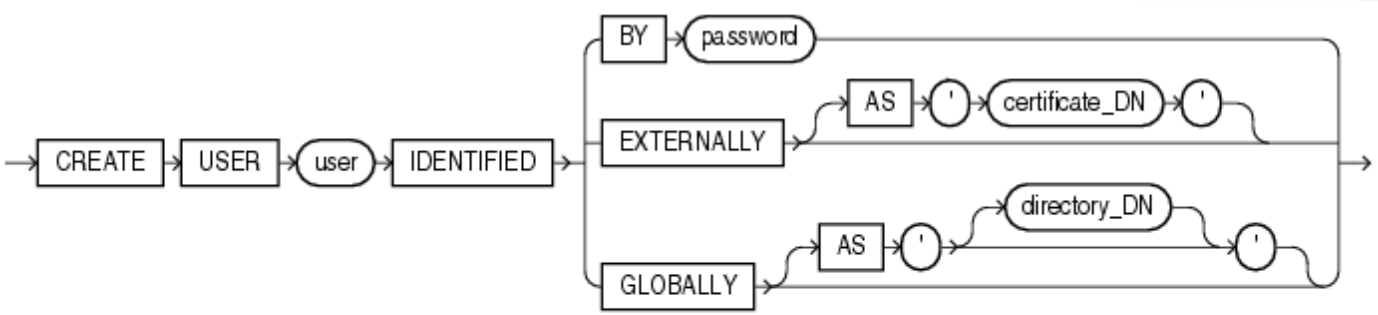
Creating Oracle User

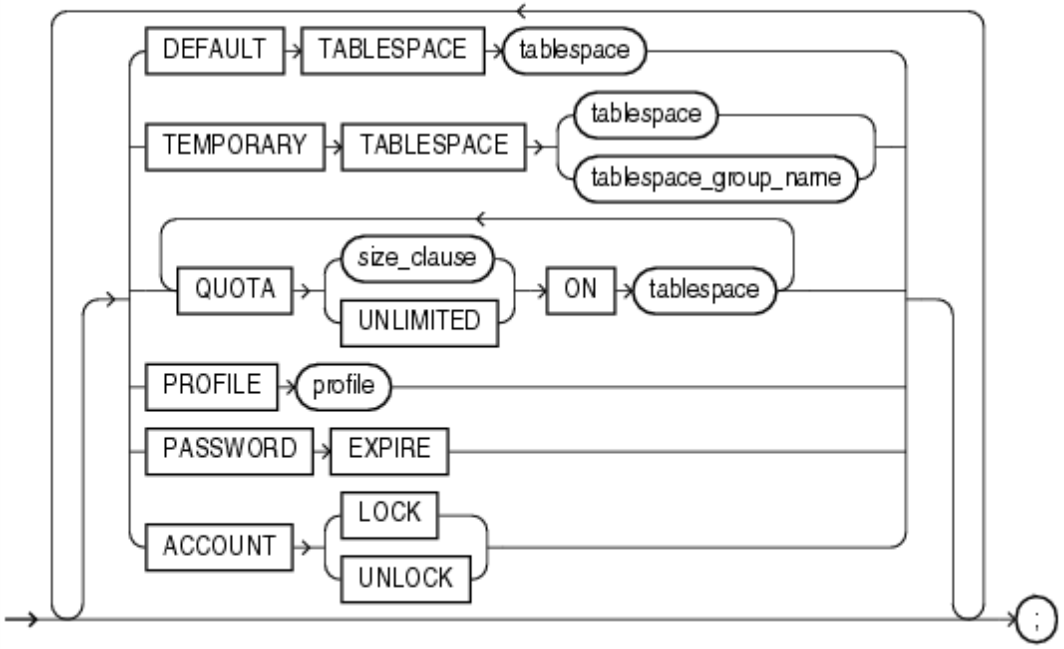
Checklist's clauses

- Tablespaces
- Quota
- Roles/ privileges

Creating Users with Commands

Syntax for Creating Oracle User





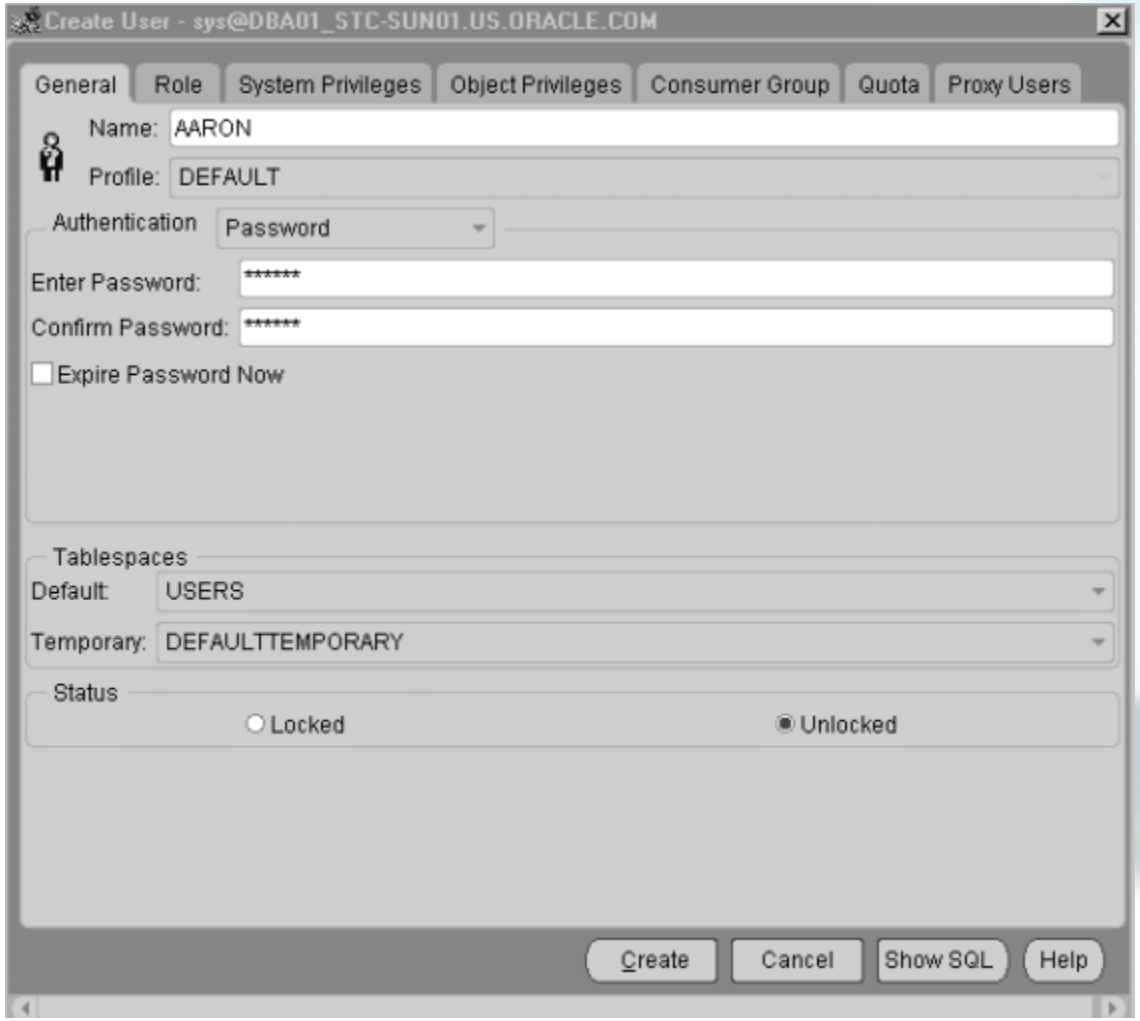

```
CREATE USER sidney
    IDENTIFIED BY out standing1
    DEFAULT TABLESPACE example
    QUOTA 10M ON example
    TEMPORARY TABLESPACE temp
    QUOTA 5M ON system
    PROFILE app_user
    PASSWORD EXPIRE;
```

```
CREATE USER global_user
   IDENTIFIED GLOBALLY AS 'CN=analyst
   DEFAULT TABLESPACE example
   QUOTA 5M ON example;
```

docs.oracle.com

Creating Users with Commands

Creating Oracle User using Oracle-EM



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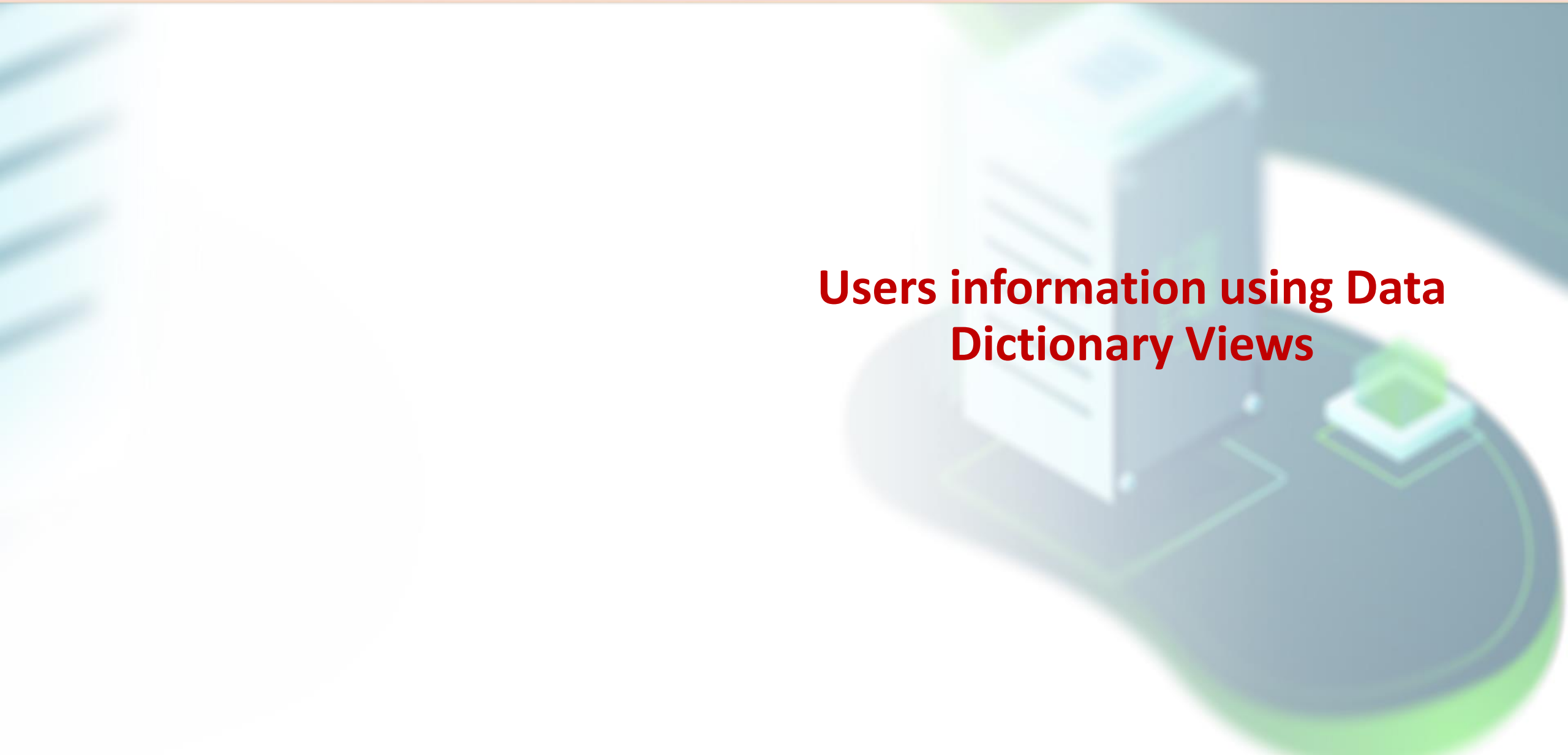
Creating Users with Commands

Data Dictionary View DBA_USERS

```
SQL> select username, account_status, created
  2  from dba_users;

USERNAME                       ACCOUNT_STATUS                   CREATED
------------------------------ -------------------------------- ---------
NOVUS                          OPEN                             18-DEC-17
NOVUSDB                        OPEN                             16-OCT-17
PROD                           OPEN                             19-JUL-17
NOVUSDB2                       OPEN                             13-DEC-17
NEONDEV                        EXPIRED                          23-JAN-17
SCOTT                          OPEN                             02-APR-10
NEONDB                         OPEN                             31-MAY-17
TEST                           OPEN                             14-FEB-17
MDDATA                         EXPIRED                          02-APR-10
ORACLE_OCM                     EXPIRED & LOCKED                 02-APR-10
```

Introduction to Database Administration



Users information using Data Dictionary Views

Users information using Data Dictionary Views

Users information using Data Dictionary Views

- Searching Security Dictionary Views
- Single SQL to Display All Views
- Listing All Tablespace Quotas
- Listing All Profiles & Assigned Limit

Users information using Data Dictionary Views

Searching Security Dictionary Views

Searching Data Dictionary Views closest to security users' information. Search is managed by following SQL LIKE operator: '%QUOTA%', '%PASSWORD%' '%PROFILE%', '%COST%' '%SESS%', '%PROXY%' and *_USERS

Users information using Data Dictionary Views

Single SQL to Display All Views

```
SQL> SELECT *
  2  FROM DICTIONARY
  3  where table_name like '%QUOTA%'
  4  or table_name like '%PASSWORD%'
  5  or table_name like '%PROFILE%'
  6  or table_name like '%COST%'
  7  or table_name like '%SESS%'
  8  or table_name like '%PROXY%';

TABLE_NAME                     COMMENTS
------------------------------ --------------------------------------------------

DBA_HIST_SESS_TIME_S CPU and I/O time for interesting (STREAMS)
TATS                 sessions

DBA_LOGMNR_SESSION
DBA_PROFILES         Display all profiles and their limits
DBA_SQL_PROFILES     set of sql profiles
DBA_TS_QUOTAS        Tablespace quotas for all users
USER_AUDIT_SESSION   All audit trail records concerning CONNECT and
                     DISCONNECT
```

Users information using Data Dictionary Views

Listing All Tablespace Quotas

```
SELECT * FROM DBA_TS_QUOTAS;

TABLESPACE     USERNAME     BYTES      MAX_BYTES     BLOCKS     MAX_BLOCKS
---------      ---------   --------    ----------    -------    ----------
USERS          JFEE                0       512000          0           250
USERS          DCRANNEY            0           -1          0            -1
```

Users information using Data Dictionary Views

Listing All Profiles & Assigned Limit

```
SELECT * FROM DBA_PROFILES
   ORDER BY PROFILE;

PROFILE              RESOURCE_NAME                  RESOURCE   LIMIT
-----------------    ---------------                ---------- ----------
CLERK                COMPOSITE_LIMIT                KERNEL     DEFAULT
CLERK                FAILED_LOGIN_ATTEMPTS          PASSWORD   DEFAULT
CLERK                PASSWORD_LIFE_TIME             PASSWORD   DEFAULT
CLERK                PASSWORD_REUSE_TIME            PASSWORD   DEFAULT
CLERK                PASSWORD_REUSE_MAX             PASSWORD   DEFAULT
CLERK                PASSWORD_VERIFY_FUNCTION       PASSWORD   DEFAULT
CLERK                PASSWORD_LOCK_TIME             PASSWORD   DEFAULT
CLERK                PASSWORD_GRACE_TIME            PASSWORD   DEFAULT
CLERK                PRIVATE_SGA                    KERNEL     DEFAULT
CLERK                CONNECT_TIME                   KERNEL     600
CLERK                IDLE_TIME                      KERNEL     30
```

Introduction to Database Administration

Managing Privileges

Managing Privileges

Managing Privileges

- Types of Oracle User Privileges
- System Privileges
- System Privileges with ADMIN OPTION
- Object Privileges Syntax
- Object Privileges - Examples
- Objects Privileges Options
- Object Privileges using Oracle EM

Managing Privileges

Types of Oracle User Privileges

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

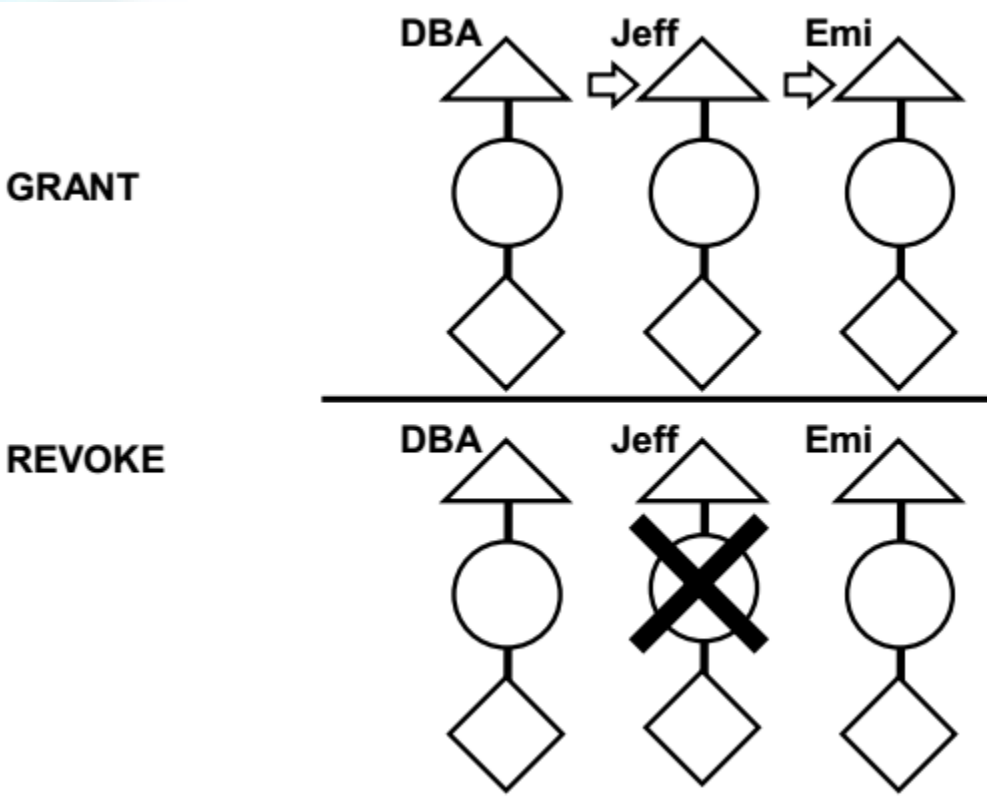
Managing Privileges

System Privileges

- More than 100 distinct system privileges
- ANY keyword in privileges signifies that users have the privilege in any schema
- GRANT command adds a privilege to a user or a group of users
- REVOKE command deletes the privileges

Managing Privileges

System Privileges with ADMIN OPTION



Scenario

1. The DBA grants the `CREATE TABLE` system privilege to Jeff with the `ADMIN OPTION`.
2. Jeff creates a table.
3. Jeff grants the `CREATE TABLE` system privilege to Emi.
4. Emi creates a table.
5. The DBA revokes the `CREATE TABLE` system privilege from Jeff.

The result

Jeff's table still exists, but no new tables can be created.

Emi's table still exists and she still has the `CREATE TABLE` system privilege.

Oracle Internal & OAI

Managing Privileges

Object Privileges Syntax

```
GRANT { object_privilege [(column_list)]
      [, object_privilege [(column_list)] ]...
      |ALL [PRIVILEGES]}
ON    [schema.]object
TO    {user|role|PUBLIC}[, {user|role|PUBLIC} ]
      [WITH GRANT OPTION]
```

Managing Privileges

Object Privileges - Examples

```
grant select on EMP to utest;


grant select, update on DEPT to utest;


grant select on v_emp to utest;

--login with utest
select *
from scott.dept;
```

Managing Privileges

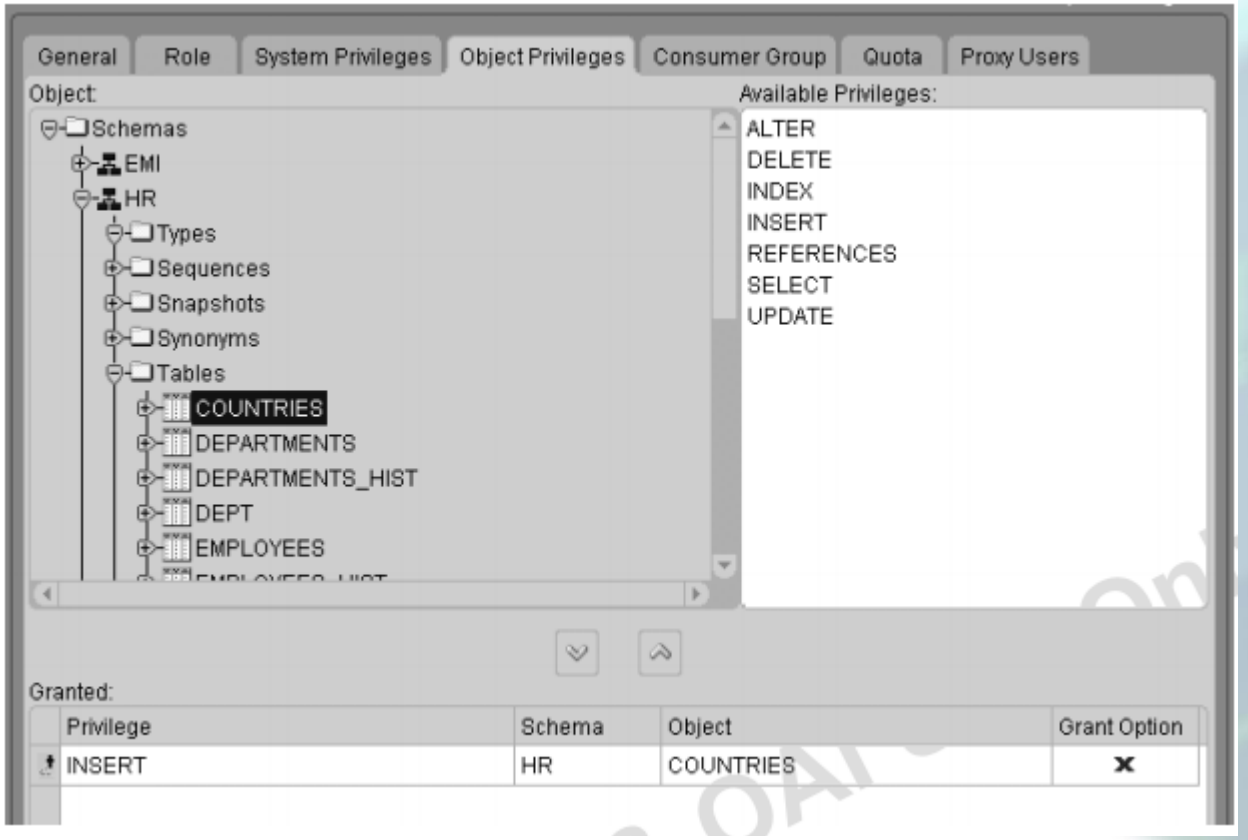
Objects Privileges Options

Object priv.	Table	View	Sequence	Procedure
ALTER	√	√	√	
DELETE	√	√		
EXECUTE				√
INDEX	√	√		
INSERT	√	√		
REFERENCES	√			
SELECT	√	√	√	
UPDATE	√	√		

--scott is the owner of EMP table and granting
GRANT select on EMP to jef;

Managing Privileges

Object Privileges using Oracle EM



System Privileges Commands

System Privileges Commands

System Privileges Commands

- System Privileges
- System Privileges with ADMIN OPTION
- System Privileges - Examples
- System Privileges SYSOPER & SYSDBA
- System Privileges using Oracle EM

System Privileges Commands

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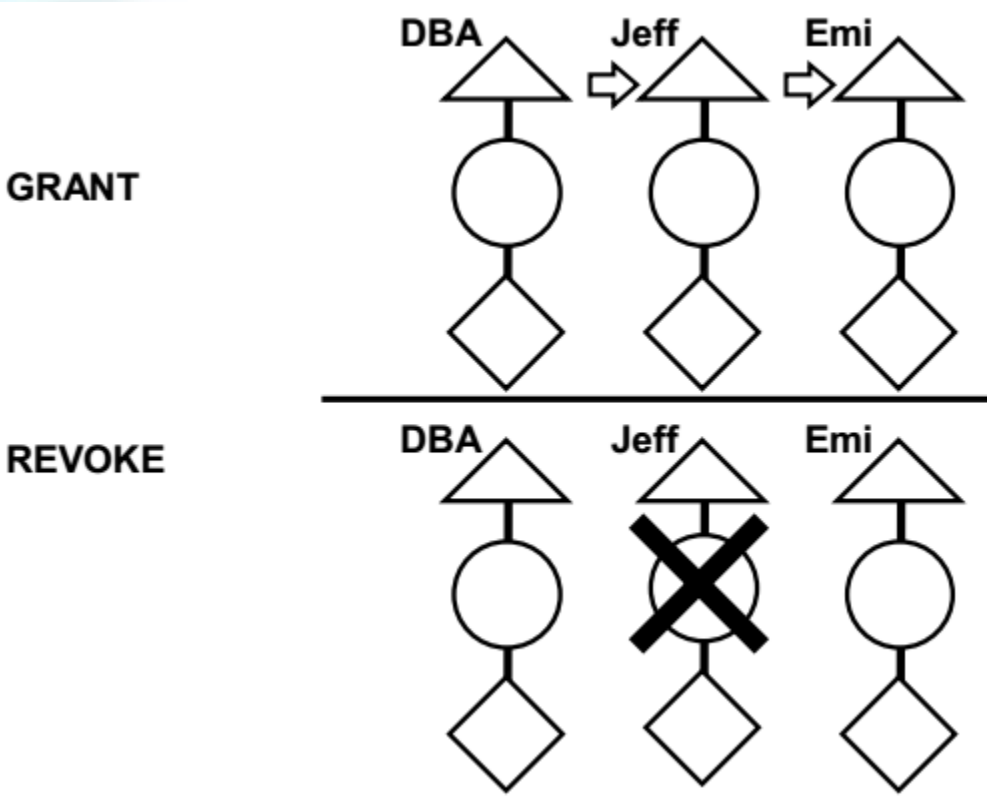
System Privileges Commands

System Privileges with ADMIN OPTION



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Emi's table still exists and she still has the `CREATE TABLE` system privilege.

Oracle Internal & OAI

System Privileges Commands

System Privileges - Examples

Grant create table to utest;

Grant create view, create procedure to utest;

Grant create view to scott;

Revoke create table from utest;

System Privileges Commands

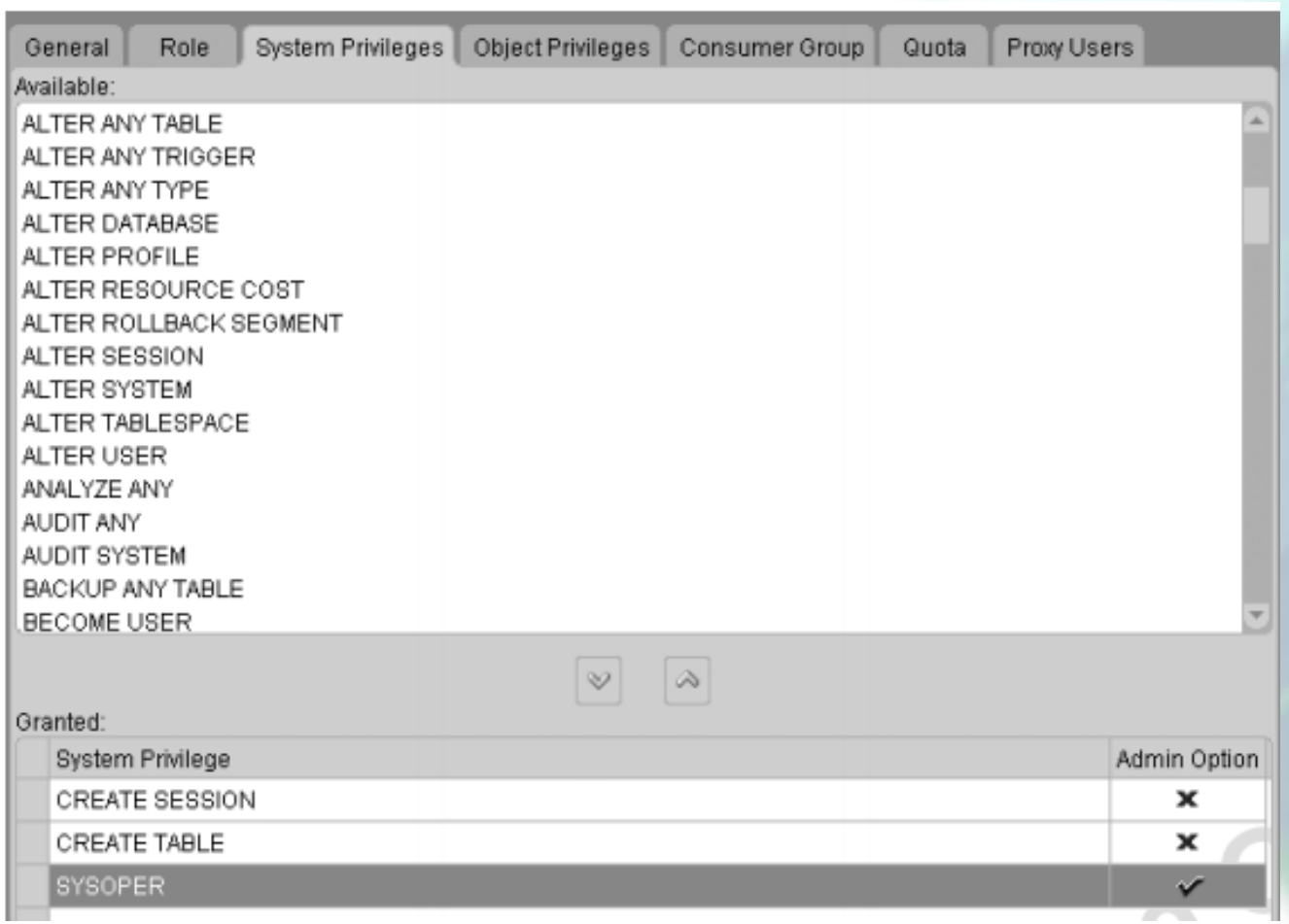
System Privileges SYSOPER & SYSDBA

Category	Examples
SYSOPER	STARTUP SHUTDOWN ALTER DATABASE OPEN | MOUNT ALTER DATABASE BACKUP CONTROLFILE TO RECOVER DATABASE ALTER DATABASE ARCHIVELOG RESTRICTED SESSION
SYSDBA	SYSOPER PRIVILEGES WITH ADMIN OPTION CREATE DATABASE ALTER TABLESPACE BEGIN/END BACKUP RESTRICTED SESSION RECOVER DATABASE UNTIL

--sys is giving grants to utest
GRANT create table, create table to utest;

System Privileges Commands

System Privileges using Oracle EM



System Multiple Privileges Commands

System Multiple Privileges Commands

System Multiple Privileges Commands

- What is User Privileges?
- Giving Privileges to Users
- Script Create Synonym
- Synonym Privileges to Users
- System and Object Privileges

System Multiple Privileges Commands

What is User Privileges?

A user privilege is the right to run a particular type of SQL statement, or the right to access an object that belongs to another user, run a PL/SQL package, and so on.

- System Privileges
- Object Privileges
- Roles

System Multiple Privileges Commands

Giving Privileges to Users

-login sys / as sysdba

create user u1
identified by u1
temporary tablespace temp;

conn u1/u1

--error ...

grant create session, create table to u1;

System Multiple Privileges Commands

Script Create Synonym

Run following SQL in owner's (scott) schema and run each command of script in granting user (say u1). Synonyms will be created in u1 schama.

```
SQL> select 'create synonym '||tname||' for scott.'||tname||';'
  2  from tab;

'CREATESYNONYM'||TNAME||'FORSCOTT.'||TNAME||';'
--------------------------------------------------------------------------------
create synonym BLOBS for scott.BLOBS;
create synonym BONUS for scott.BONUS;
create synonym CAMPUS for scott.CAMPUS;
create synonym CHAINED_ROWS for scott.CHAINED_ROWS;
create synonym CLIENT for scott.CLIENT;
create synonym CUSTOMER for scott.CUSTOMER;
```

System Multiple Privileges Commands

Synonym Privileges to Users

User u1 is using object table as scott.emp, for example

Select * from scott.EMP; --when scott is authorizing select on EMP to u1

User u1 can run the following command
create synonym emp for scott.emp;

select * from tab; --can display EMP as synonym
select * from emp;
(Subject to all assigned privileges)

System Multiple Privileges Commands

System and Object Privileges

SYSTEM PRIVILEGES	OBJECT PRIVILEGES
In System privilege are more than 100 privileges	All DML are come into object privileges.
CREATE SESSION	SELECT
CREATE TABLE	INSERT
CREATE USER	UPDATE
CREATE VIEW	DELETE
CREATE SEQUENCE	REFERENCES
CREATE PROCEDURE	ALTER
CREATE ROLE etc.	INDEX
	EXECUTE

Revoke Privileges

Revoke Privileges

Revoke Privileges

- Data Dictionary for Privileges
- Revoke & Example
- To See Existing Privileges
- Revoke Privileges CASCADE

Revoke Privileges

Data Dictionary for Privileges

We can use string search PRIV to display possible data dictionary views.

For Example,

```
select table_name
from dict
where table_name like '%PRIV%';
```

Revoke Privileges

Data Dictionary for Privileges

We choose following suitable PRIV View:

desc USER_TAB_PRIVS is showing columns

GRANTEE
OWNER
TABLE_NAME
GRANTOR
PRIVILEGE
GRANTABLE
HIERARCHY

Revoke Privileges

Revoke & Example

The REVOKE statement is used to revoke object privileges.

- You previously granted the object privilege to the user or role.
- You possess the GRANT ANY OBJECT PRIVILEGE system privilege that enables you to grant and revoke privileges on behalf of the object owner.

REVOKE REFERENCES ON dept FROM jward CASCADE CONSTRAINTS;

Revoke Privileges

Revoke & Example

Assuming you are the original grantor, the following statement revokes the SELECT and INSERT privileges on the emp table from the users jfee and tsmith:

REVOKE SELECT, insert ON emp FROM jfee, tsmith;

Revoke Privileges

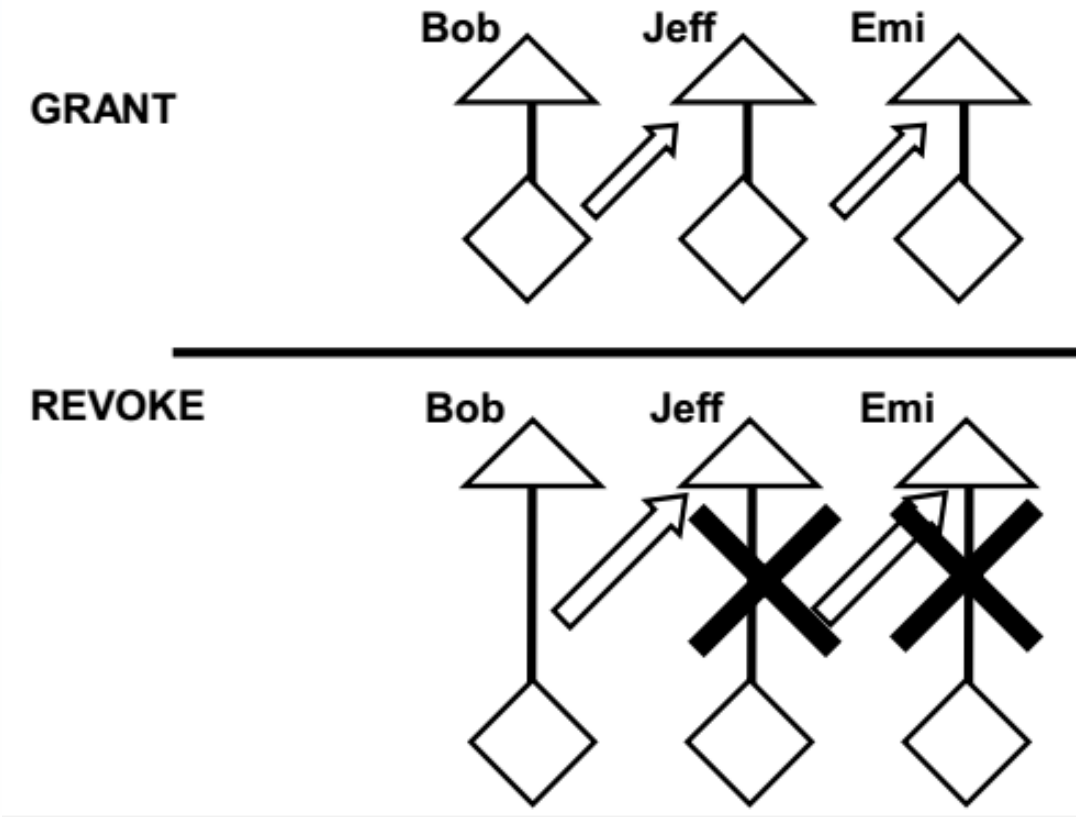
To See Existing Privileges

GRANT select on EMP to u1;

```
SQL> COLUMN OWNER FORMAT A20
SQL> COLUMN GRANTOR FORMAT A20
SQL> COLUMN GRANTEE FORMAT A20
SQL> COLUMN privilege FORMAT A20
SQL> select OWNER, GRANTOR, GRANTEE, privilege
  2  from USER_TAB_PRIVS
  3  where table_name='EMP';

OWNER                GRANTOR              GRANTEE              PRIVILEGE
-------------------- -------------------- -------------------- ----------
SCOTT                SCOTT                U1                   SELECT
```

Revoke Privileges



Revoke Privileges CASCADE

--Login with Bob
Grant select on EMP to Jeff with grant option;
--Login Jeff
Grant select on EMP to Emi;

--Login with Bob
Revoke select on EMP from Jeff;
--This revoke is cascaded to Emi

Introduction to Database Administration

Managing Roles

Managing Roles

- Introduction
- Data Dictionary for Privileges
- Privileges & Roles
- Roles & Users

Managing Roles

Introduction

- Roles are named groups of related privileges or rights.
- Each user can be granted roles and privileges for each role, giving them a tailored set of abilities.
- Roles define what actions the user can take, and privileges specify the targets to which their roles apply.
- You can view the permissions granted by each role, add and remove users, and assign roles and notification profiles to users.

Managing Roles

Data Dictionary for Privileges

We can use string search PRIV to display possible data dictionary views.

For Example,

```
select table_name
from dict
where table_name like '%PRIV%';
```

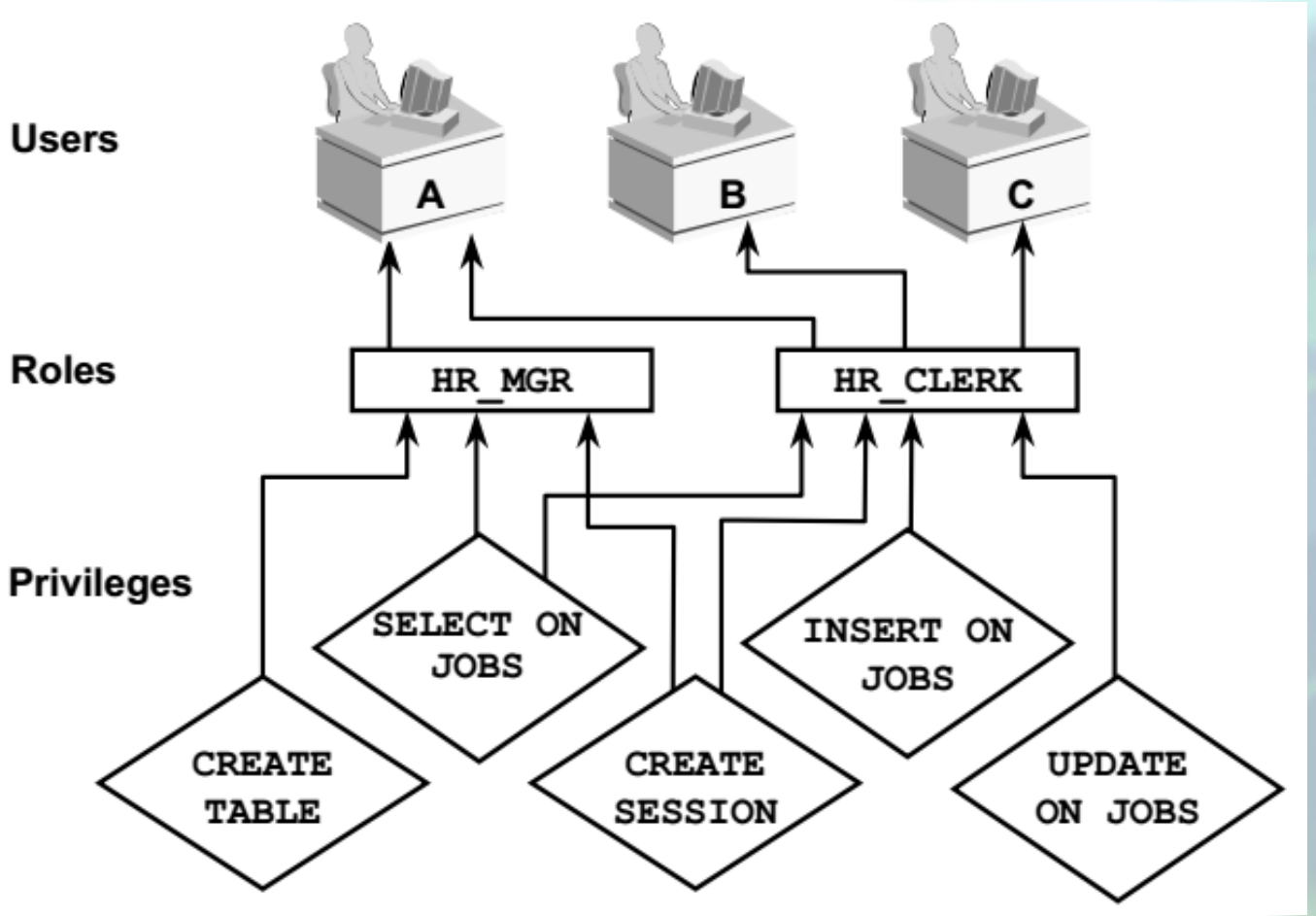
Managing Roles

Privileges & Roles

Type	Description
System privilege	A system-defined privilege usually granted only by administrators. These privileges allow users to perform specific database operations.
Object privilege	A system-defined privilege that controls access to a specific object.
Role	A collection of privileges and other roles. Some system-defined roles exist, but most are created by administrators. Roles group together privileges and other roles, which facilitates the granting of multiple privileges and roles to users.

Managing Roles

Roles & Users



Introduction to Database Administration

Benefits of Roles-1

Benefits of Roles-1

Benefits of Roles-1

- Benefits of Roles
- Standard and Default Roles
- Roles of User SYS
- Analyzing Roles & Privileges to Users

Benefits of Roles-1

Benefits of Roles

- Easier privilege management
- Dynamic privilege management
- Selective availability of privileges
- Can be granted through the operating system

Benefits of Roles-1

Benefits of Roles

Easier privilege management

Use roles to simplify privilege management. Rather than granting the same set of privileges to several users, you can grant the privileges to a role, and then grant that role to each user.

Dynamic privilege management

If the privileges associated with a role are modified, all the users who are granted the role acquire the modified privileges automatically and immediately.

Benefits of Roles-1

Benefits of Roles

Selective availability of privileges

Roles can be enabled or disabled to turn privileges on or off temporarily. Enabling a role can also be used to verify that a user has been granted that role.

Granting through the operating system

Operating system commands or utilities can be used to assign roles to users in the database.

Benefits of Roles-1

Standard and Default Roles

- CONNECT is a role that Enterprise Manager automatically grants to a user when you create a user as shown in "Creating Users". This role has the CREATE SESSION privilege.

- RESOURCE extends the privileges of a user beyond those granted by the CONNECT role. It includes CREATE PROCEDURE, CREATE TRIGGER, and other system privileges.

Benefits of Roles-1

Standard and Default Roles

- DBA is the standard role that can be granted by an administrator to another administrator. It includes all system privileges and should only be granted to the most trusted and qualified of users. Assigning this role to a user enables the user to administer the database.

Benefits of Roles-1

Roles of User SYS

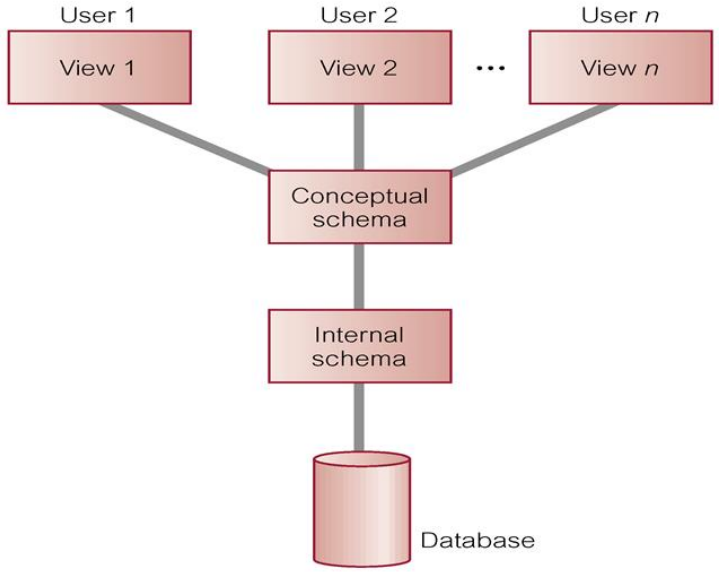
- When you create an Oracle database, the user SYS is automatically created and granted the DBA role.
- All base tables and views for the database data dictionary are stored in the schema SYS. These base tables and views are critical for the operation of Oracle Database.

Benefits of Roles-1

Roles of User SYS

- To maintain the integrity of the data dictionary, tables in the SYS schema are manipulated only by the database. They should never be modified by any user or database administrator.
- Also, you should not create any tables in the schema of user SYS, although you can change the storage parameters of the data dictionary settings if necessary.

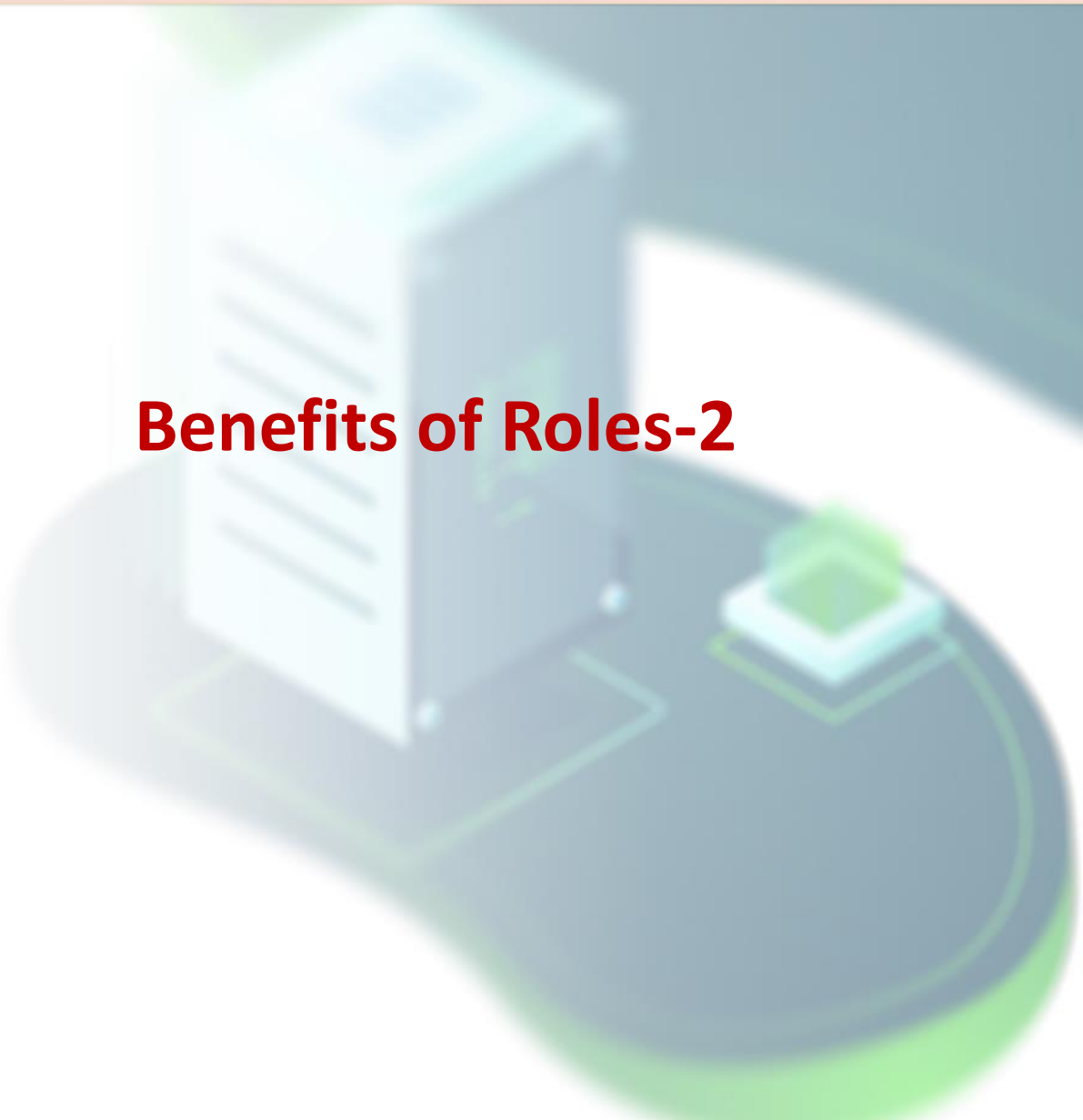
Benefits of Roles-1



Analyzing Roles & Privileges to Users

- Assuming there are three departments in some Enterprise
  - Sales
  - Accounting
  - Human Development & Resource (HR)
- Employees are working as an external users in these departments
- Analyzing how Roles and Privileges are need to be decided
- Users Ali(Sales), Jamil(HR) and Nadeem (Accounting)

Introduction to Database Administration



Benefits of Roles-2

Benefits of Roles-2

Benefits of Roles-2

- Characteristics of Roles
- Roles with Synonyms
- Comparing Roles with Privileges

Benefits of Roles-2

Characteristics of Roles

- Roles can be granted to and revoked from users with the same commands that are used to grant and revoke system privileges.
- Roles can be granted to any user or role. However, a role cannot be granted to itself and cannot be granted circularly.
- A role can consist of both system and object privileges.

Benefits of Roles-2

Characteristics of Roles

- A role can be enabled or disabled for each user who is granted the role.
- A role can be required a password to be enabled.
- Each role name must be unique among existing usernames and role names.
- Roles are not owned by anyone; and they are not in any schema.
- Roles have their description stored in the data dictionary.

Benefits of Roles-2

Roles with Synonyms

- Roles and privileges are assigned to base table or view. Any Synonym will be granted as per base table or view.
- For example,

--Table EMP owner gives grant:

grant select on emp to u1;

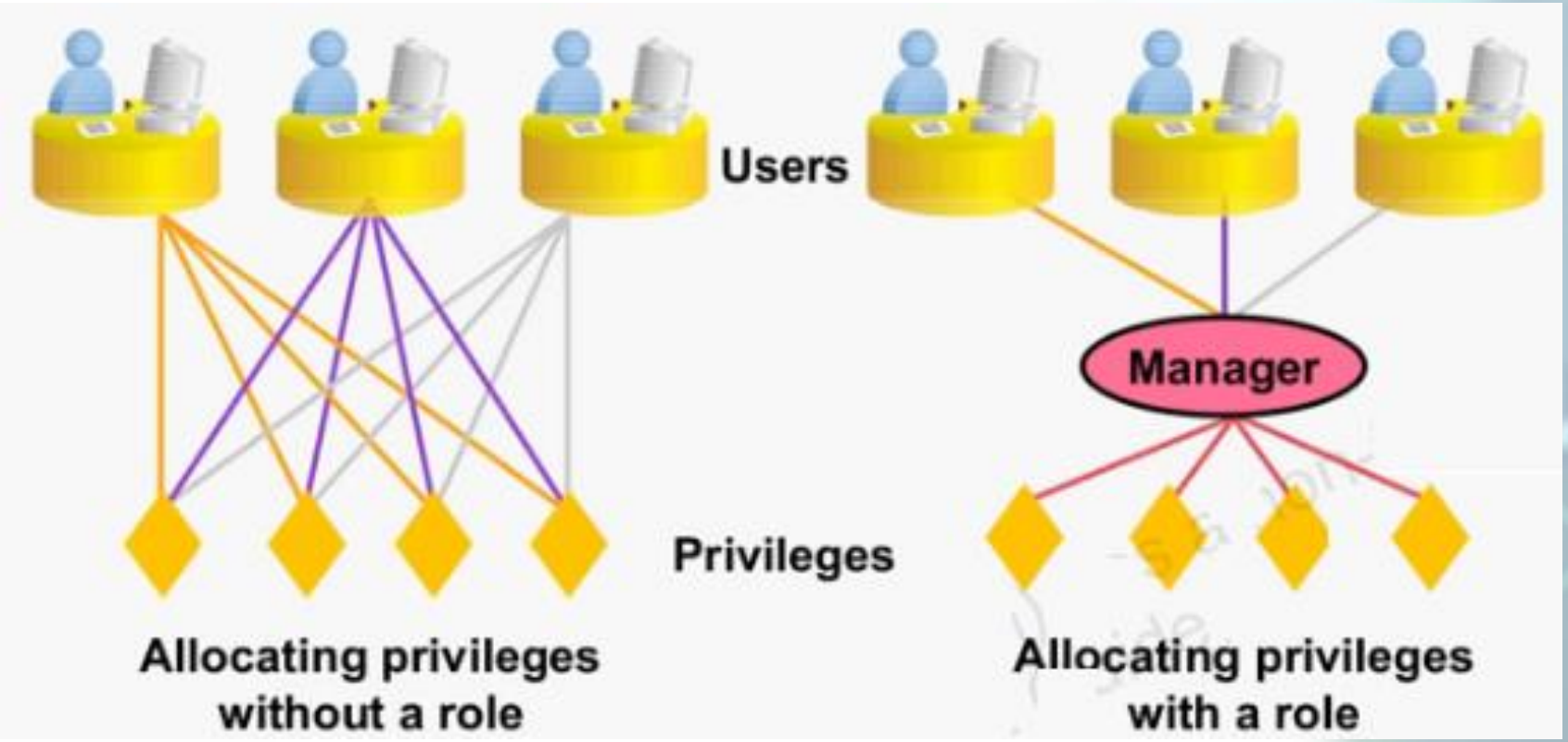
--run in u1's schema

create synonym emp for scott.emp;

select * from emp;

Benefits of Roles-2

Comparing Roles with Privileges



Introduction to Database Administration

Creating Roles

Creating Roles

Creating Roles

- SQL-Create Role
- Syntax of SQL-Create Role
- Roles with ADMIN option
- Syntax of SQL-Create Role using EM

Creating Roles

SQL-Create Role

- Use the CREATE ROLE statement to create roles. You must have the CREATE ROLE system privilege to create roles. When you create a role that is not identified externally or by password, the role is granted with the ADMIN option.
- You need to decide set of privileges to put in one role and a user who will use those privileges by assigning just role.

Creating Roles

Syntax of SQL-Create Role

Use the following command to create a role:

```
CREATE ROLE role [NOT IDENTIFIED | IDENTIFIED
  {BY password | EXTERNALLY | GLOBALLY | USING package}]
```

where:

- `role`: Is the name of the role
- `NOT IDENTIFIED`: Indicates that no verification is required when enabling the role
- `IDENTIFIED`: Indicates that verification is required when enabling the role
- `BY password`: Provides the password that the user must specify when enabling the role
- `USING package`: Creates an application role, which is a role that can be enabled only by applications using an authorized package
- `EXTERNALLY`: Indicates that a user must be authorized by an external service (such as the operating system or a third-party service) before enabling the role
- `GLOBALLY`: Indicates that a user must be authorized to use the role by the enterprise directory service before the role is enabled with the `SET ROLE` statement, or at login.

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Creating Roles

Roles with ADMIN option

- Not identified:

  Create role oe_clerk;

- By password:

  Create role hr_clerk

  IDENTIFIED BY bonus;

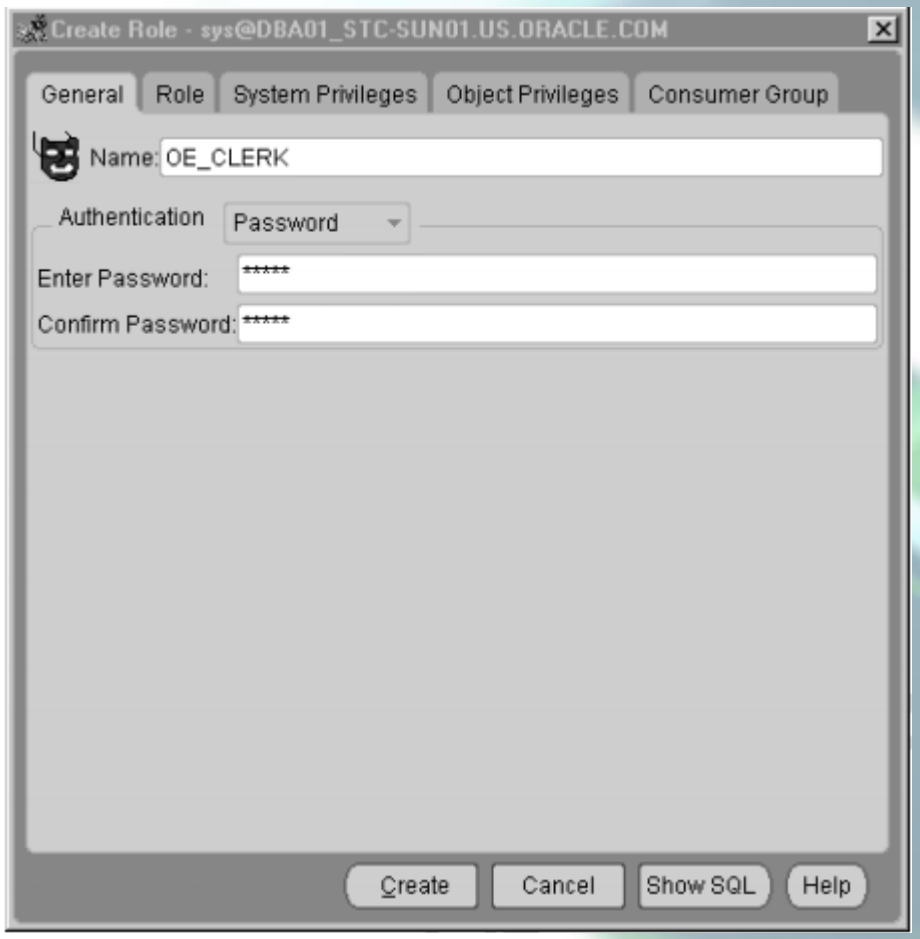
- Identified externally:

  Create role hr_manager

  identified Externally;

Creating Roles

Syntax of SQL-Create Role using EM



End

Pre-defined Roles & Assigning Roles

Pre-defined Roles & Assigning Roles

Pre-defined Roles & Assigning Roles

- Meaning of Pre-defined Roles & Assigning Roles
- Other Special Roles
- List of Pre-defined Roles & Assigning Roles
- Assigning Roles - An Enterprise Example

Pre-defined Roles & Assigning Roles

Meaning of Pre-defined Roles & Assigning Roles

The roles listed are defined automatically for Oracle databases when you run database creation scripts.

CONTENT, RESOURCE, and DBA roles are provided for backward compatibility to earlier versions of the Oracle server.

The EXP_FULL_DATABASE and IMP_FULL_DATABASE roles are provided for convenience in using the Import and Export utilities.

Pre-defined Roles & Assigning Roles

Meaning of Pre-defined Roles & Assigning Roles

The roles DELETE_CATALOG_ROLE, EXECUTE_CATALOG_ROLE, and SELECT_CATALOG_ROLE are provided for accessing data dictionary views and packages.

These roles can be granted to users who do not have the DBA role but who requires an access to the views and tables in the data dictionary.

Pre-defined Roles & Assigning Roles

Other Special Roles

The Oracle server also creates other roles that authorize you to administer the database. On many operating systems, these roles are called OSOPER and OSDBA. Their names may be different on your operating system.

Other roles are defined by SQL scripts provided with the database. For example, AQ_ADMINISTRATOR_ROLE provides privileges to administer advanced queuing. AQ_USER_ROLE is obsolete but is kept mainly for release 8.0 compatibility.

```
SELECT * FROM DBA_SYS_PRIVS;
```

Pre-defined Roles & Assigning Roles

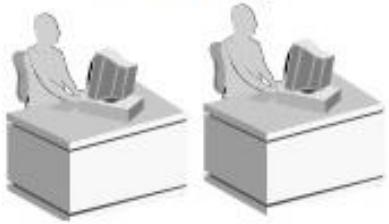
List of Pre-defined Roles & Assigning Roles

Role Name	Description
CONNECT, RESOURCE, DBA	These roles are provided for backward compatibility
EXP_FULL_DATABASE	Privileges to export the database
IMP_FULL_DATABASE	Privileges to import the database
DELETE_CATALOG_ROLE	DELETE privileges on data dictionary tables
EXECUTE_CATALOG_ROLE	EXECUTE privilege on data dictionary packages
SELECT_CATALOG_ROLE	SELECT privilege on data dictionary tables

Pre-defined Roles & Assigning Roles

Assigning Roles – An Enterprise Example

Mumtaz (Manager)
Usma
Admin Dept



Adnan (Manager)
Abbasi
HR Dept

Fida (Manager)
Ali
Accounting Dept

Empno	Name	DOB	CNIC	Address	City	TelNo	Deptno	EmpCard#

Empno	Name	DOB	CNIC	Address	City	TelNo	Salary	Bonus	Deptno

Empno	Name	DOB	CNIC	Address	City	TelNo	BloodGroup	Salary	Bonus	Deptno	EmpCard#

Introduction to Database Administration

Modifying & Align Roles

Modifying & Align Roles

- Alter Role
- Alter Role - Sample SQLs
- Alter Role - Syntax
- Alter Role - EM

Modifying & Align Roles

Alter Role

- ALTER ROLE modifies the authentication method.
- Modifying roles requires the ADMIN option or ALTER ANY ROLE privilege

Modifying & Align Roles

Alter Role – Sample SQLs

- ALTER ROLE oe_clerk
  IDENTIFIED BY order;

- ALTER ROLE hr_clerk
  IDENTIFIED EXTERNALLY;

- ALTER ROLE hr_manager
  NOT IDENTIFIED;

Modifying & Align Roles

Alter Role – Syntax

```
ALTER ROLE role {NOT IDENTIFIED | IDENTIFIED
 {BY password |USING package| EXTERNALLY | GLOBALLY }};
```

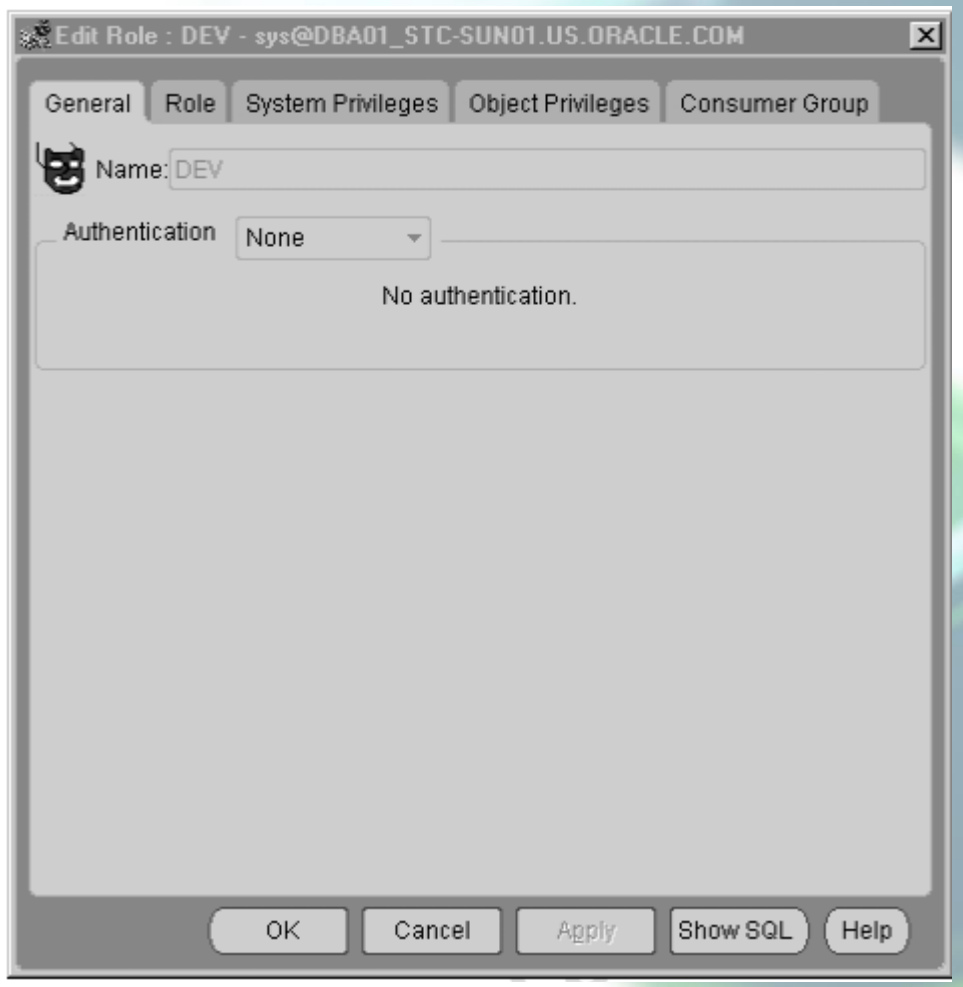
where:

- `role`: Is the name of the role
- `NOT IDENTIFIED`: Indicates that no verification is required when enabling the role
- `IDENTIFIED`: Indicates that verification is required when enabling the role
- `BY password`: Provides the password used when enabling the role
- `EXTERNALLY`: Indicates that a user must be authorized by an external service (such as the operating system or a third-party service) before enabling the role
- `GLOBALLY`: Indicates that a user must be authorized to use the role by the enterprise directory service before the role is enabled with the `SET ROLE` statement, or at login

Oracle Internal & Or

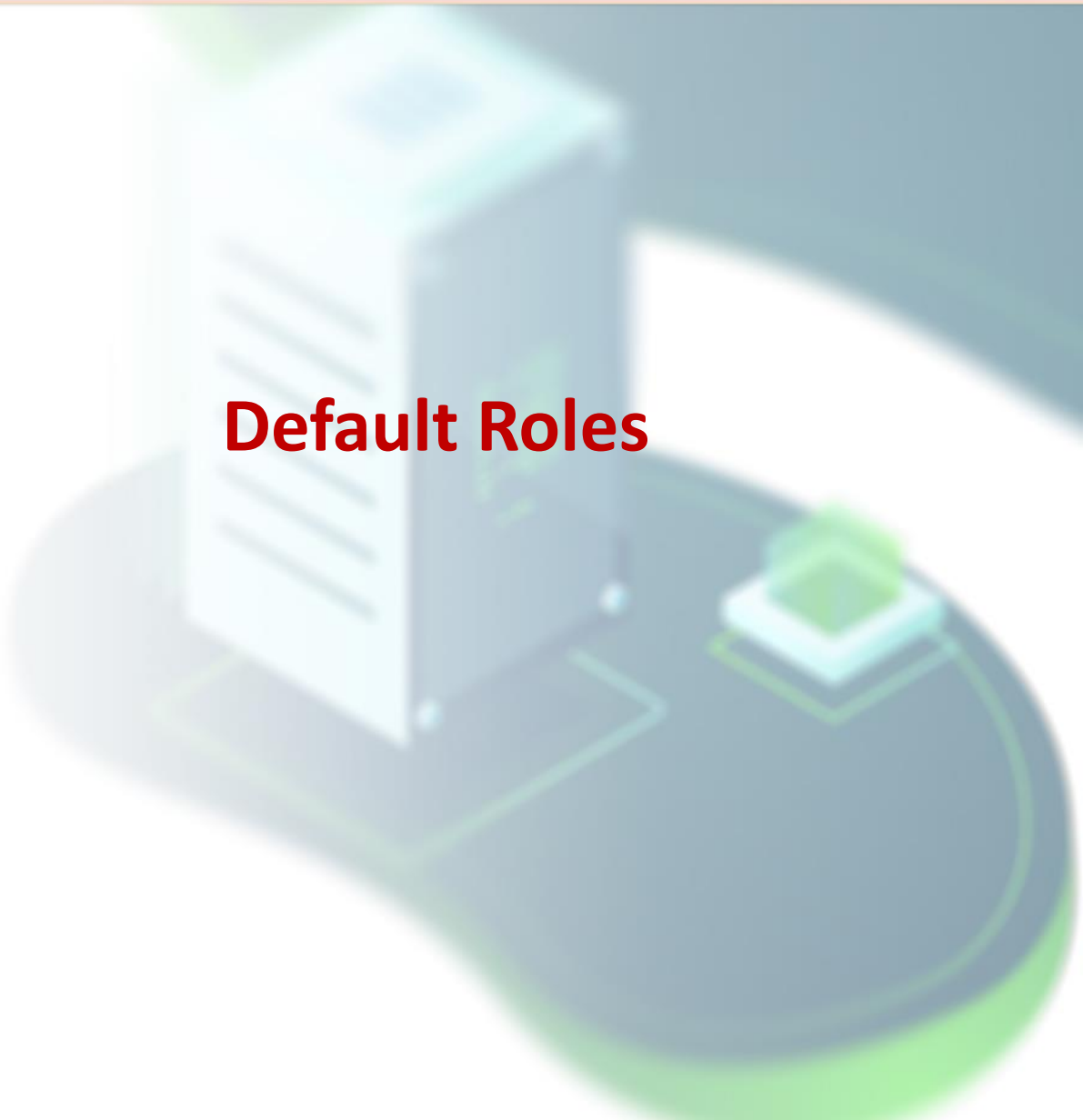
Modifying & Align Roles

Alter Role – EM



End

Introduction to Database Administration



Default Roles

Default Roles

Default Roles

- Default Roles
- Assigning & Disable Roles - Sample SQLs
- Establishing Default Roles

Default Roles

Assigning & Disable Roles – Sample SQLs

- GRANT oe_clerk TO scott;
- GRANT hr_clerk TO hr_manager;
- GRANT hr_manager TO scott WITH ADMIN OPTION;
- Disable role during session of user u1

  SQL> SET ROLE NONE;

Default Roles

Establishing Default Roles

- A user can be assigned many roles.
- A user can be assigned a default role.
- Limit the number of default roles for a user.

```
ALTER USER scott
      DEFAULT ROLE hr_clerk, oe_clerk;
```

```
ALTER USER scott DEFAULT ROLE ALL;
```

```
ALTER USER scott DEFAULT ROLE ALL EXCEPT
      hr_clerk;
```

```
ALTER USER scott DEFAULT ROLE NONE;
```

Default Roles

Establishing Default Roles

A user can be assigned many roles. A default role is a subset of these roles that is automatically enabled when the user logs on. By default, all the roles are assigned to a user are enabled at logon without the need of a password. Limit the default roles for a user with the *ALTER USER* command.

Default Roles

Establishing Default Roles

The DEFAULT ROLE clause applies only to roles that have been granted directly to the user with a GRANT statement. The DEFAULT ROLE clause cannot be used to enable the following:

Roles not granted to the user.

Roles granted through other roles.

Roles managed by an external service (such as the operating system).

Default Roles

End

Establishing Default Roles

Use the following syntax to assign default roles to a user:

ALTER USER user *DEAFULT ROLE*

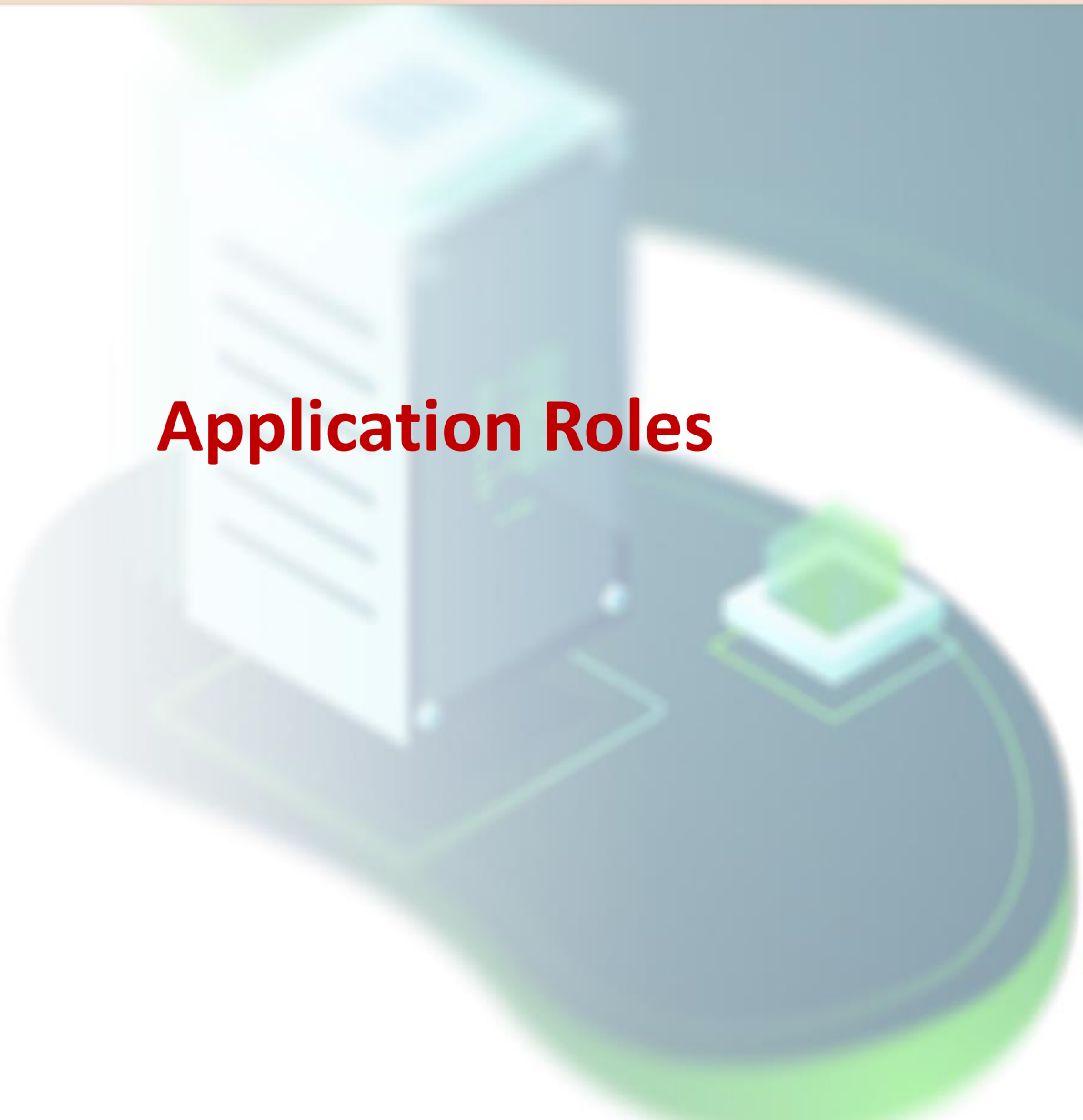
{role [,role]…| ALL [EXCEPT role [,role]…] | NONE}

Where:

User: is the name of the user who is granted the roles

Role: is the role to be made the default role for the user

Introduction to Database Administration



Application Roles

Application Roles

Application Roles

- Application Roles
- Application Roles - SQL

Application Roles

Application Roles

- Application roles can be enabled only by authorized PL/SQL packages

- The USING package clause creates an application role

```
CREATE ROLE admin_role
IDENTIFIED USING hr.employee;
```

Application Roles

Application Roles

- The USING package clause in the CREATE ROLE statement creates an application role. An application role can be enabled only by applications by using an authorized PL/SQL package.
- Application developers do not need to secure a role by embedding passwords inside applications. Instead, they can create an application role and specify which PL/SQL package is authorized to enable the role.

Application Roles

Application Roles - SQL

```
CREATE ROLE admin_role
IDENTIFIED USING hr.employee;
```

In this example, admin_role is an application role and the role can be enabled only by modules that are defined inside the hr.employee PL/SQL package.

End

Enable & Disable Role

Enable & Disable Role

Enable & Disable Role

- Restrictions on Enable & Disable Role
- Specifying Roles to be Enabled
- Restrictions on Enable & Disable Role - Sample
- Restrictions on Enable & Disable Role - Syntax

Enable & Disable Role

Enable & Disable Role

- Disable a role to temporarily revoke the role from a user.
- Enable a role to grant it temporarily.
- The SET ROLE command enables and disables roles
- Default roles are enabled for a user at login.
- A password may be required to enable a role.

Enable & Disable Role

Enable & Disable Roles

- Enable and disable roles to temporarily activate and deactivate the privileges associated with the roles.
- To enable a role, a role must first be granted to the user.

Enable & Disable Role

Enable & Disable Roles

- When a role is enabled, the user can use the privileges granted to that role. If a role is disabled, the user cannot use the privileges associated with that role unless those privileges are granted directly to a user or to another role enabled for that user. Roles are enabled for a session. At the next session, the user's active roles revert to default roles.

Enable & Disable Role

Specifying Roles to be Enabled

- The SET command and the DBMS_SESSION.SET_ROLE procedure enable all of the roles included in the command and disable all other roles. Roles can be enabled from any tool or program that allows PL/SQL commands; however, a role cannot be enabled in a stored procedure.
- You can use the ALTER USER-DEFAULT ROLE command to indicate which roles will be enabled for a user at login. All other roles are disabled.

Enable & Disable Role

Specifying Roles to be Enabled

- A password may be required to enable a role. The password must be included in the SET ROLE command to enable the role.
- Default roles assigned to a user do not require a password; they are enabled at login, the same as a role without a password.

Enable & Disable Role

Restrictions on Enable & Disable Role

- A role cannot be enabled from a stored procedure, because this action may change the security domain (set of privileges) that allowed the procedure to be called in the first place.
- So, in PL/SQL, Role can be enabled and disabled in anonymous blocks and application procedures (for example, client Oracle Forms procedures), but not in stored procedures.

Enable & Disable Role

Restrictions on Enable & Disable Role

- IF a stored procedure contains the command SET ROLE, the following error is generated at run time:

ORA-06565: cannot execute SET ROLE from within stored procedure

Enable & Disable Role

Restrictions on Enable & Disable Role - Sample

```
SET ROLE hr_clerk;
```

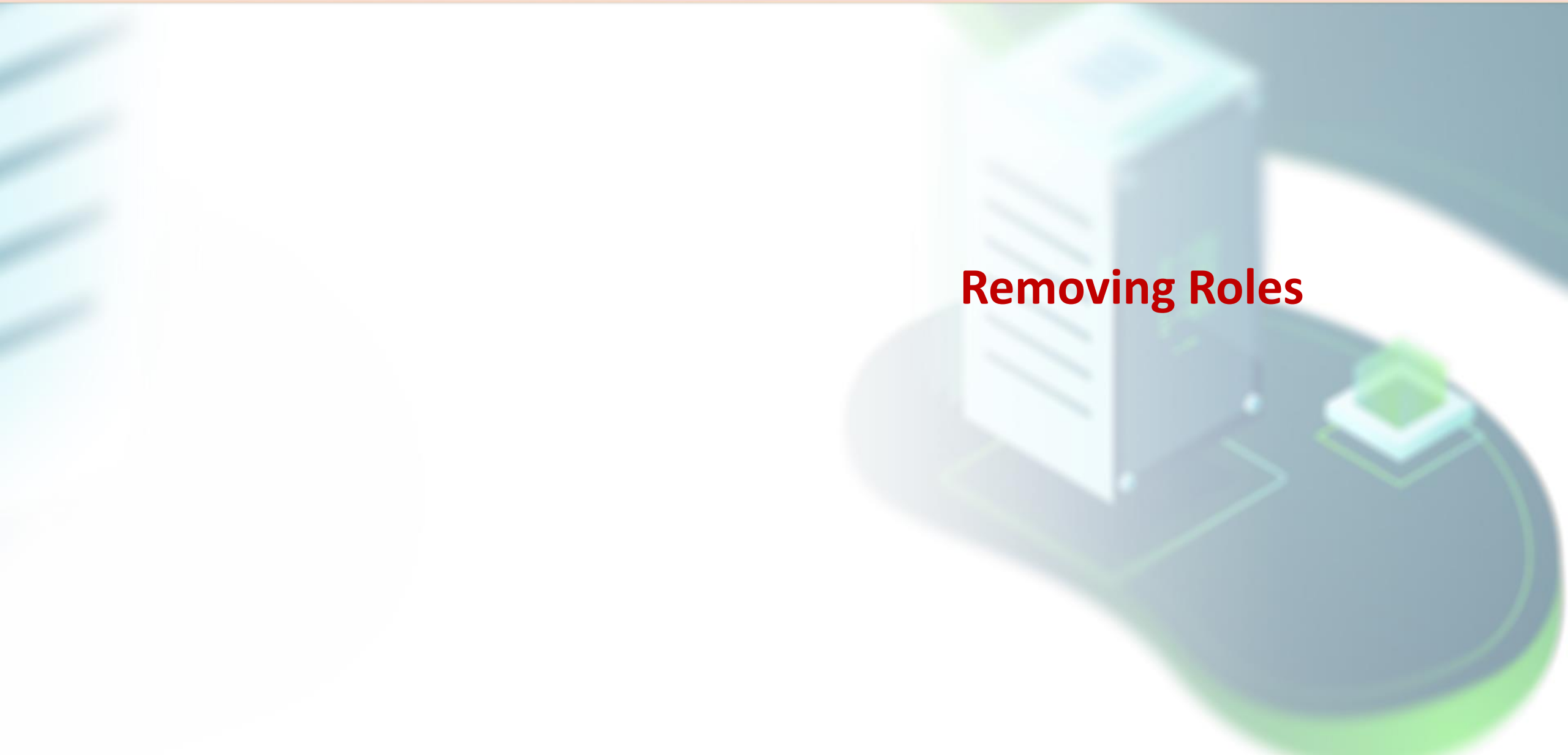
```
SET ROLE oe_clerk IDENTIFIED BY order;
```

```
SET ROLE ALL EXCEPT oe_clerk;
```

Enable & Disable Role

Restrictions on Enable & Disable Role - Syntax

```
SET ROLE {role [ IDENTIFIED BY password ]
    [, role [ IDENTIFIED BY password ]]
    | ALL [ EXCEPT role [, role ]     ]
    | NONE }
```



Removing Roles

Removing Roles

Removing Roles

- Revoke Roles
- Revoke Roles from Users
- Revoke Roles using OEM
- Removing Roles

Removing Roles

Revoke Roles

- Disable a role to temporarily revoke the role from a user.
- Enable a role to grant it temporarily.
- The SET ROLE command enables and disables roles
- Default roles are enabled for a user at login.
- A password may be required to enable a role.

Removing Roles

Revoke Roles from Users

- To revoke a role from a user, use the SQL statement REVOKE. Any user with the admin option for a role can revoke the role from any other database user or role. Also, users with the GRANT ANY ROLE privilege can revoke any role.

Removing Roles

Revoke Roles from Users

```
REVOKE role [, role ]
   FROM {user|role|PUBLIC}
   [, {user|role|PUBLIC} ]
```

where

- role: Is the role to be revoked or the role from which roles are revoked.
- user: is the user from which the system privileges or roles are revoked.
- PUBLIC: Revokes the privilege or role from all users

Removing Roles

Revoke Roles using OEM

Using Oracle Enterprise Manager to Revoke a Role from a User

From the OEM Console:

- Navigate to Security>Users.
- Highlight the user for whom a role is to be revoked.
- Navigate to Roles Granted.
- Select the role to be revoked.
- Select Revoke from the right-mouse menu.
- Select Yes to confirm revocation.

Removing Roles

Removing Roles

To remove a role from the database, use the following syntax:

```
SQL> DROP ROLE role;
```

When you drop a role, the Oracle server revokes it from all users and roles to whom it has been granted and removes it from the database.

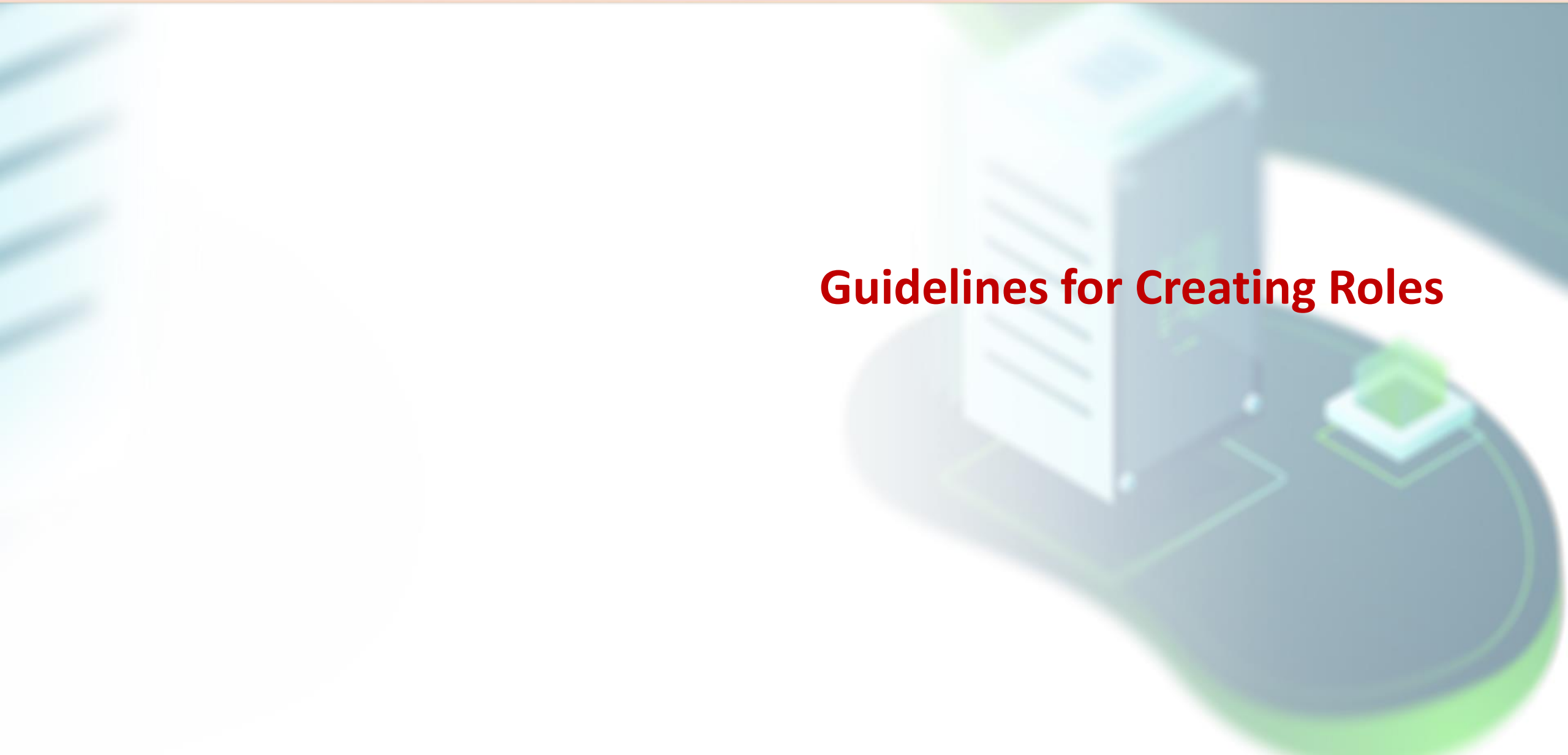
In order to drop the role, you must have been granted the role with ADMIN OPTION or have the DROP ANY ROLE system privilege.

Removing Roles

Removing Roles

- Dropping a role:
  - Removes it from all users and roles it was granted
  - Removes it from the database
- Requires the `ADMIN OPTION` or `DROP ANY ROLE` privilege
- To drop a role:

```
DROP ROLE hr_manager;
```



Guidelines for Creating Roles

Guidelines for Creating Roles

Guidelines for Creating Roles

- Guidelines
- Guidelines for an Example
- Guidelines for Assigning Roles
- Guidelines for using Password and Default Roles
- Roles with Password

Guidelines for Creating Roles

Guidelines

Because a role includes the privileges that are necessary to perform a task, the role name is usually an application task or a job title.

Our example uses both application tasks and job titles for role names.

Guidelines for Creating Roles

Guidelines for an Example

Use the following steps to create, assign, and grant users roles:

- Create a role for each application task. The name of the application role corresponds to a task in the application, such as PAYROLL.
- Assign the privileges necessary to perform the task to the application role.

Guidelines for Creating Roles

Guidelines for an Example

- Create a role for each type of user. The name of the user role corresponds to a job title, such as PAY_CLERK.
- Grant application roles to user's roles.
- Grant user's roles to users.

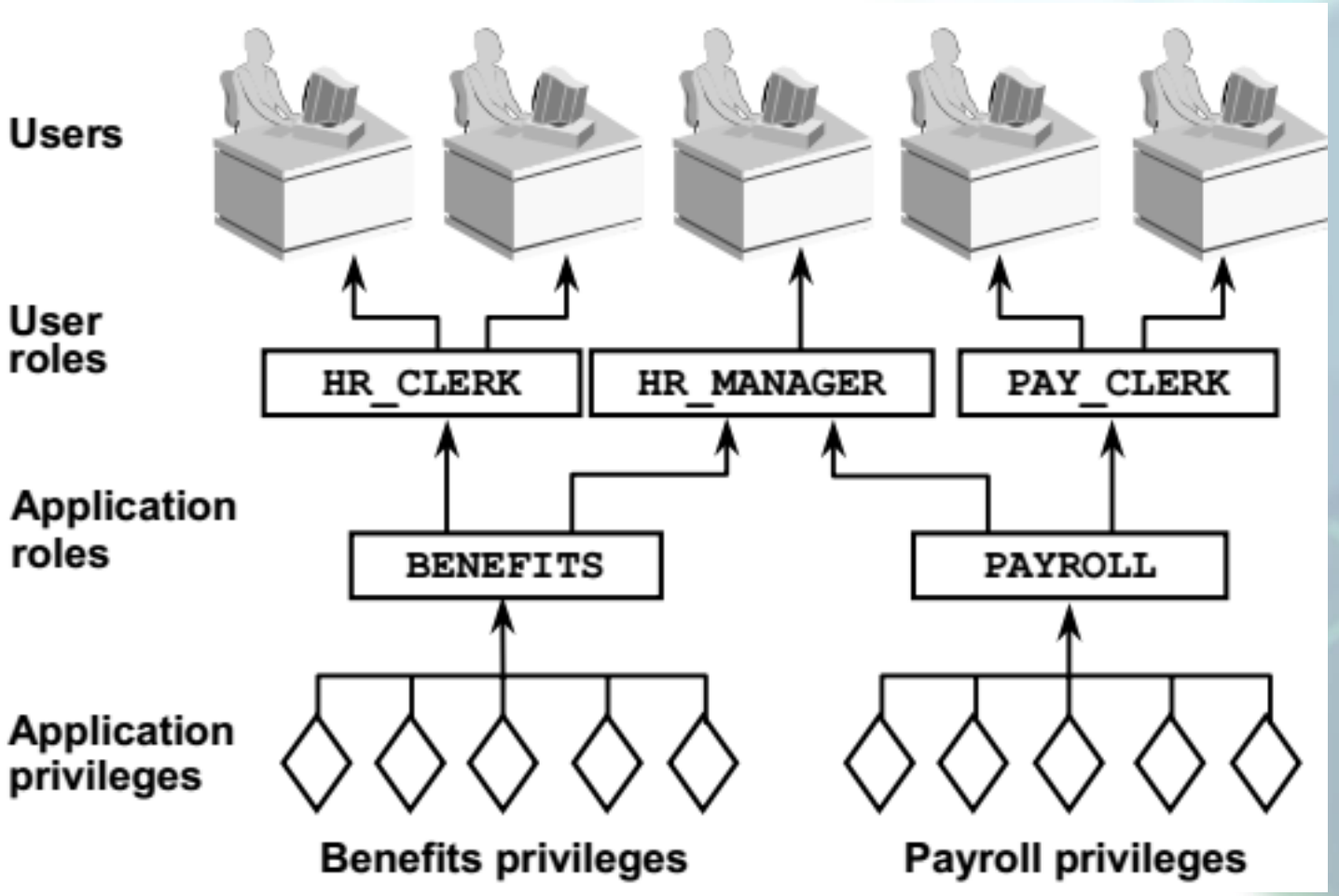
Guidelines for Creating Roles

Guidelines for an Example

If a modification to the application requires that the new privileges are needed to perform the payroll task, then the DBA only needs to assign the new privileges to the PAYROLL application role. All of the users that are currently performing this task will receive the new privileges.

Guidelines for Creating Roles

Guidelines for Assigning Roles



Guidelines for Creating Roles

Guidelines for using Password and Default Roles

Passwords provide an additional level of security when enabling a role.

For example, the application might require a user to enter a password when enabling the PAY_CLERK role, because this role can be used to issue checks.

Guidelines for Creating Roles

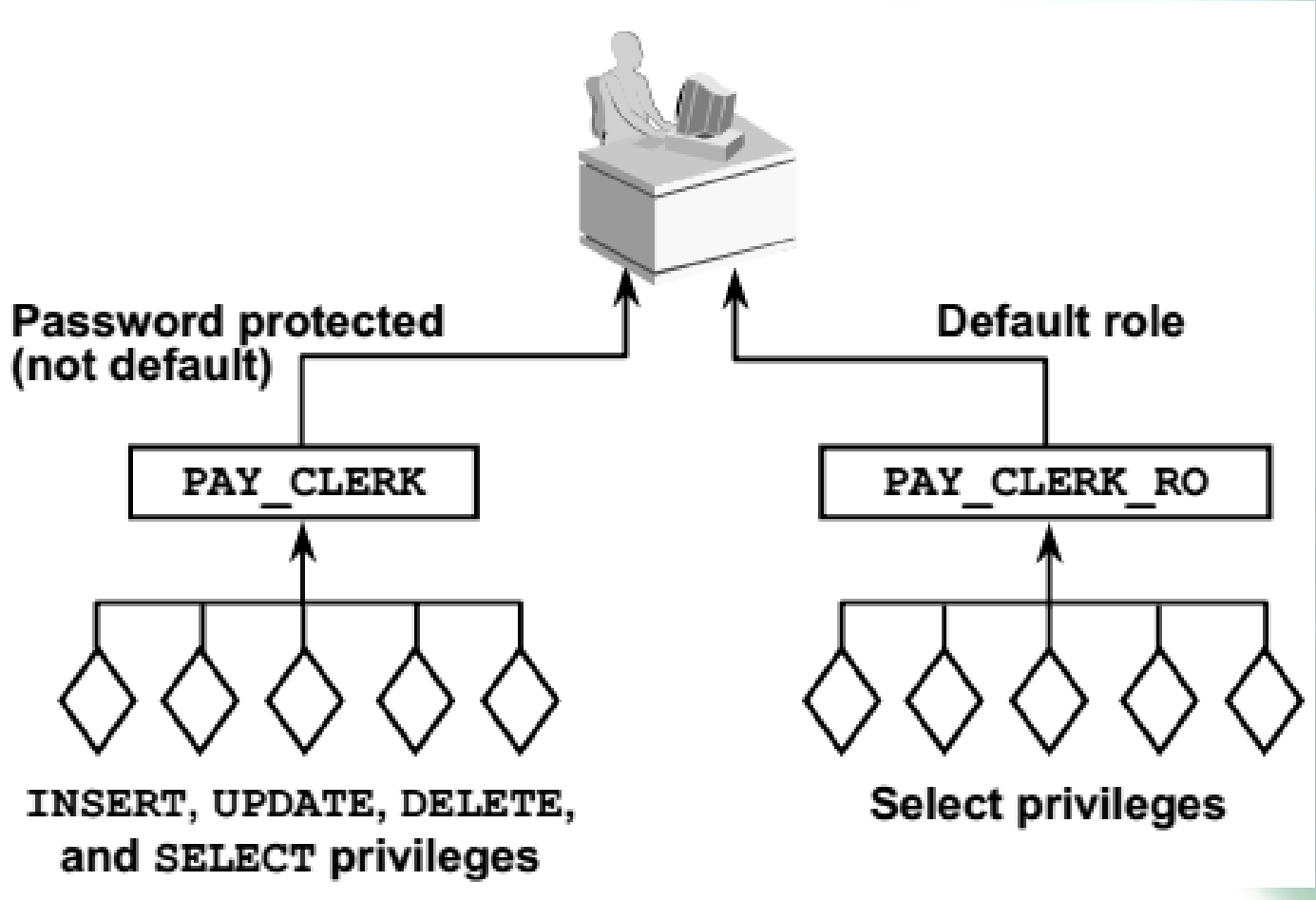
Guidelines for using Password and Default Roles

Passwords allow a role to be enabled only through an application. This technique is shown in the example in the slide.

- The DBA has granted the user two roles, PAY_CLERK and PAY_CLERK_RO.
- The PAY_CLERK has been granted all of the privileges that are necessary to perform the payroll clerk function.

Guidelines for Creating Roles

Roles with Password



Using Roles Data Dictionary Views

Using Roles Data Dictionary Views

Using Roles Data Dictionary Views

- Data Dictionary Views of Roles
- Roles' Views
- Privileges and Roles - An Example

Using Roles Data Dictionary Views

Data Dictionary Views of Roles

Information about roles can be obtained by querying the following SQL

```
select table_name, comments
from DICT
where table_name like '%ROLE%';
```

Using Roles Data Dictionary Views

Roles' Views

DBA_ROLES: All roles that exist in the database

DBA_ROLE_PRIVS: Roles granted to users and roles

ROLE_ROL_PRIVS: Roles that are granted to roles

DBA_SYS_PRIVS: System privileges granted to users and roles

ROLE_SYS_PRIVS: System privileges granted to roles

ROLE_TAB_PRIVS: Object privileges granted to roles

SESSION_ROLES: Roles that the user currently has enabled

Using Roles Data Dictionary Views

Privileges and Roles – An Example

User is u1

Privileges are
select, update for table EMP

Assigning Role EMP_SU

Assigning EMP_SU to user u1

Using Roles Data Dictionary Views

Privileges and Roles – An Example

To user has which roles

```
SQL> select Grantee, granted_role
  2  from DBA_ROLE_PRIVS
  3  where rownum<=10;

GRANTEE                        GRANTED_ROLE
------------------------------ --------------------
U1                             EMP_SU
DBA                            OLAP_DBA
DBA                            XDBADMIN
DBA                            JAVA_ADMIN
DBA                            JAVA_DEPLOY
DBA                            OLAP_XS_ADMIN
DBA                            WM_ADMIN_ROLE
DBA                            SCHEDULER_ADMIN
DBA                            XDB_SET_INVOKER
DBA                            EXP_FULL_DATABASE
```

Introduction to Data Migration & Data Loading

Introduction to Data Migration & Data Loading

Introduction to Data Migration & Data Loading

- Data Migration
- Data Migration - Source to Target Schema
- Data Migration Choices
- Data Migration & Staging Schema

Introduction to Data Migration & Data Loading

Data Migration

Data migration is the process of transferring data from one storage system or computing environment to another.

Non integrated/ distributed data can be integrated through data migration

Introduction to Data Migration & Data Loading

Data Migration

There are many reasons your enterprise might need to undertake a data migration project.

For example, you might be replacing servers or storage devices or consolidating or decommissioning data center.

Data migration is also an essential step in the overall process of migrating on-premises IT infrastructure to a cloud computing environment.

Introduction to Data Migration & Data Loading

Data Migration

Whether you are moving to a public cloud, private cloud, hybrid cloud, or multi-cloud environment, you will need to find a secure, cost-effective, and efficient method of migrating your data to its new storage location.

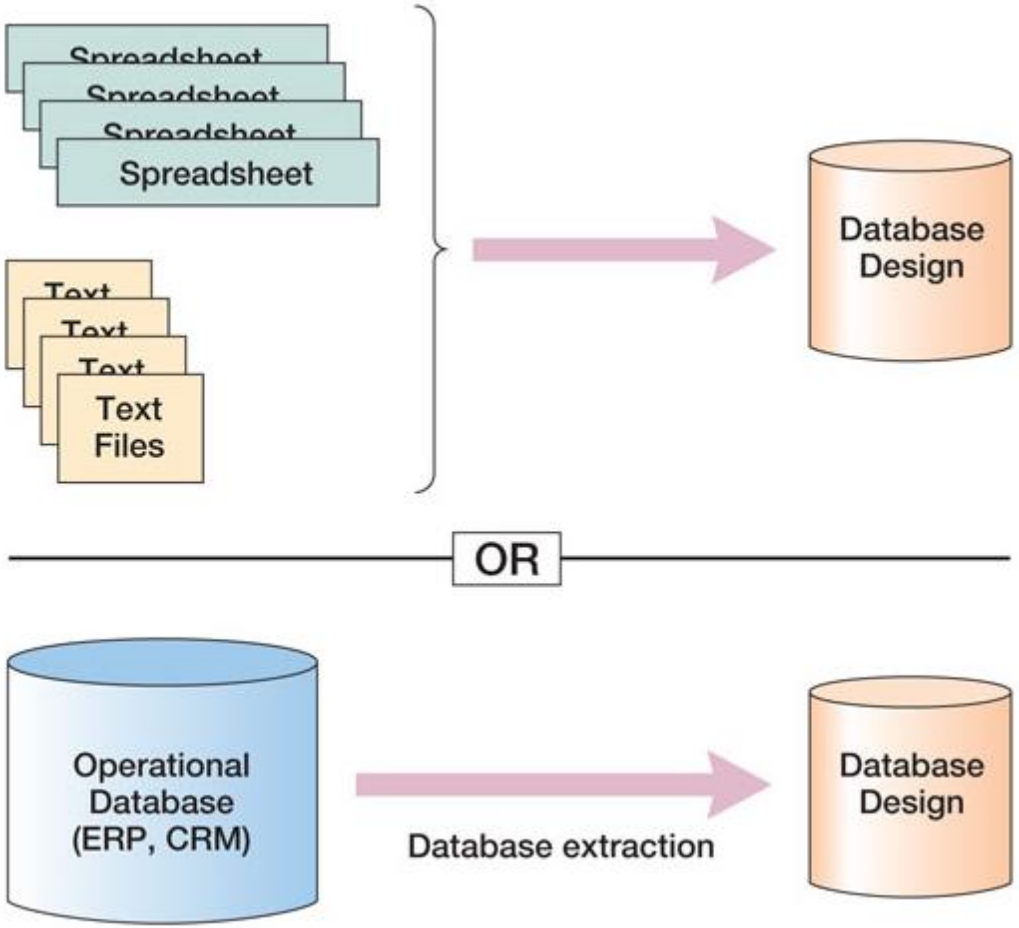
Introduction to Data Migration & Data Loading

Data Migration – Source to Target Schema

Typically, the first step in the database migration process involves converting the source database's schema (if necessary) so that it's compatible with the target database. A database's schema is like a blueprint for how it is organized, controlling its logical architecture and structure. If the target database management system uses a data definition language (DDL) that is not compatible with the source's, the schema will need to be converted.

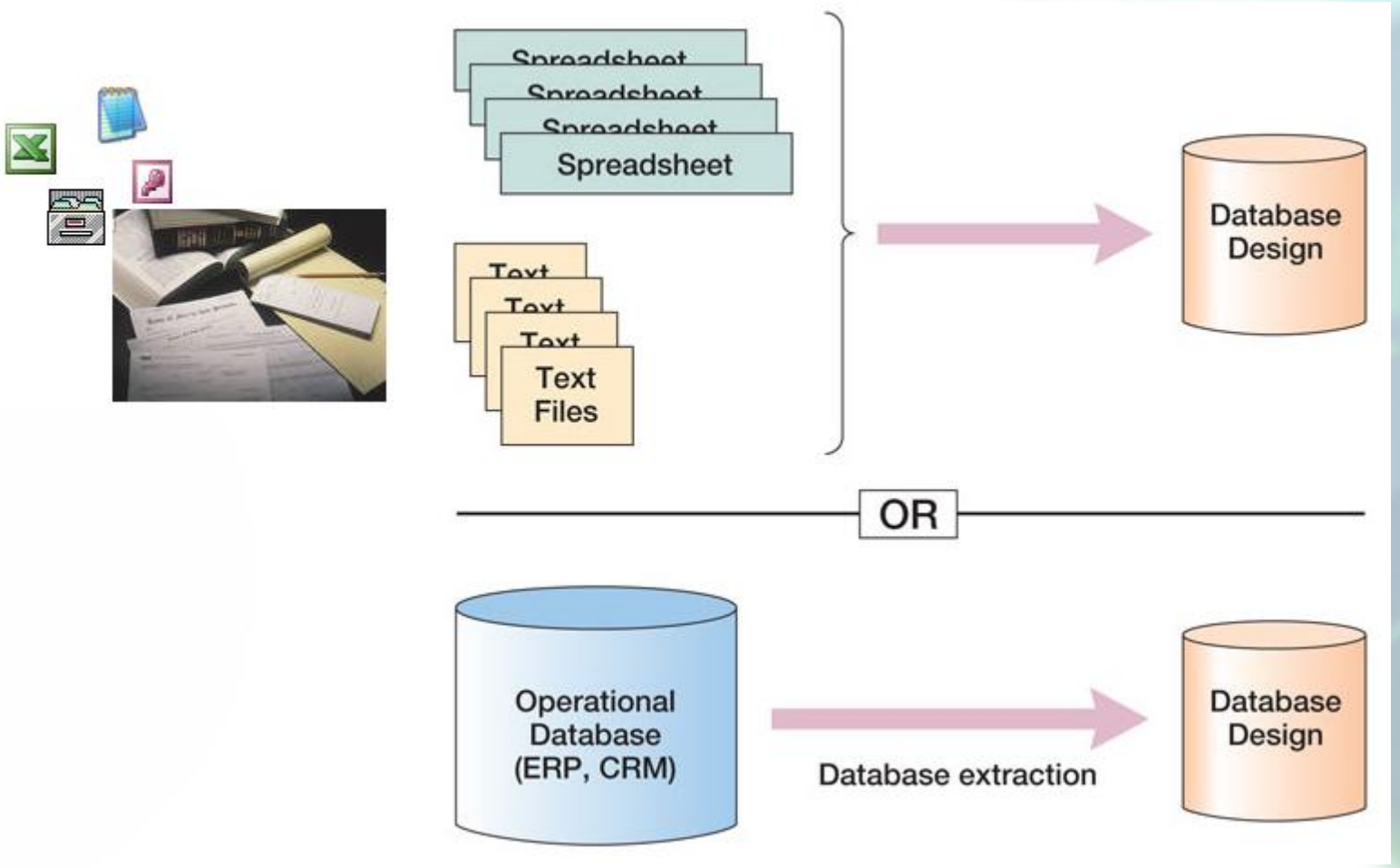
Introduction to Data Migration & Data Loading

Data Migration Choices



Introduction to Data Migration & Data Loading

Data Migration Ways

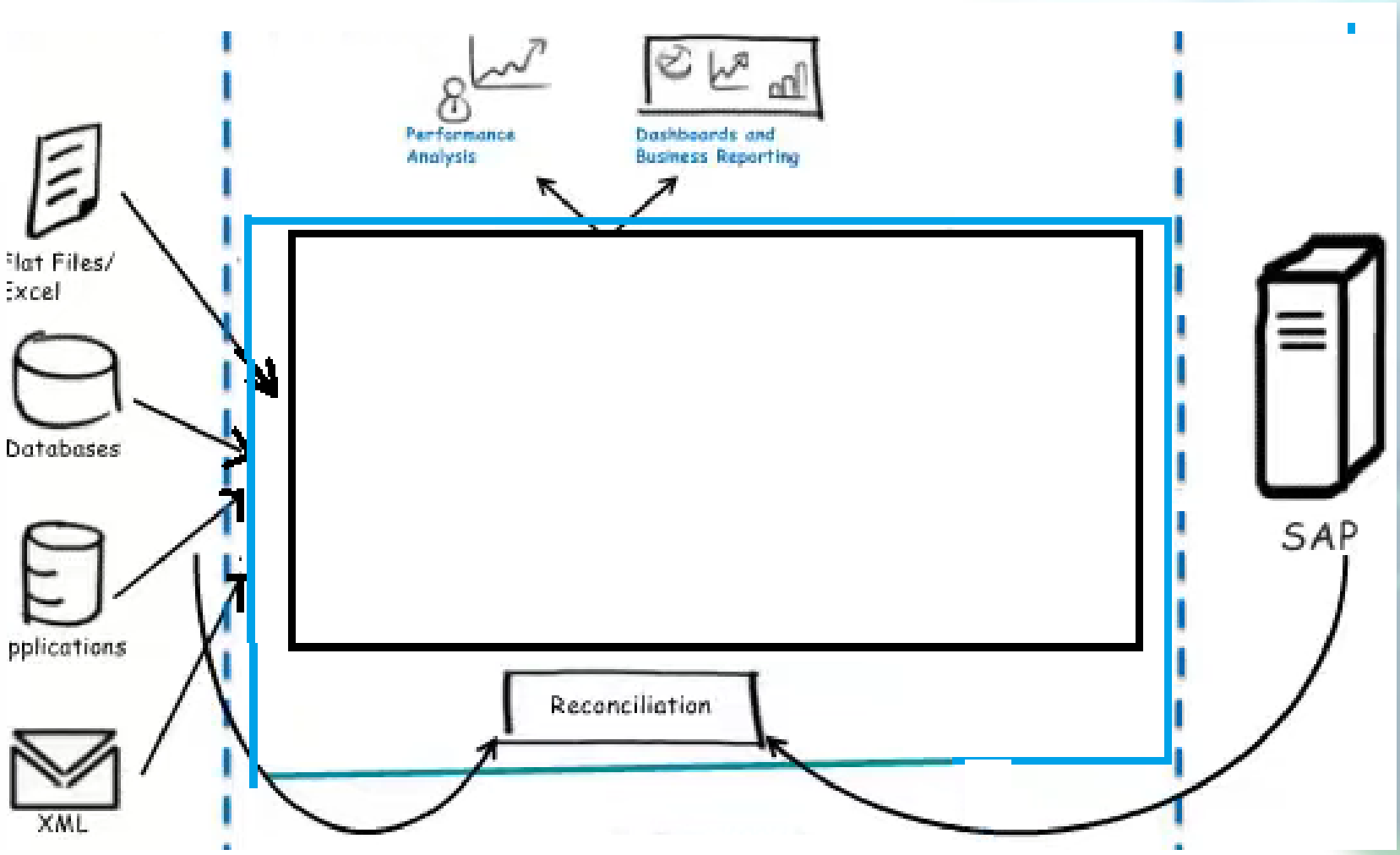


Introduction to Data Migration & Data Loading

Data Migration Ways

Introduction to Data Migration & Data Loading

Data Migration & Staging Schema



Introduction to Database Administration

Data Loading Methods

Data Loading Methods

Data Loading Methods

- Introduction
- SQL*Loader Method
- Direct Load Method
- Oracle Export and Oracle Import

Data Loading Methods

Introduction

Several methods are available for loading data into tables in an Oracle database. Of the methods available, Direct Load insert and SQL*Loader are discussed here.

Data Loading Methods

SQL*Loader Method

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

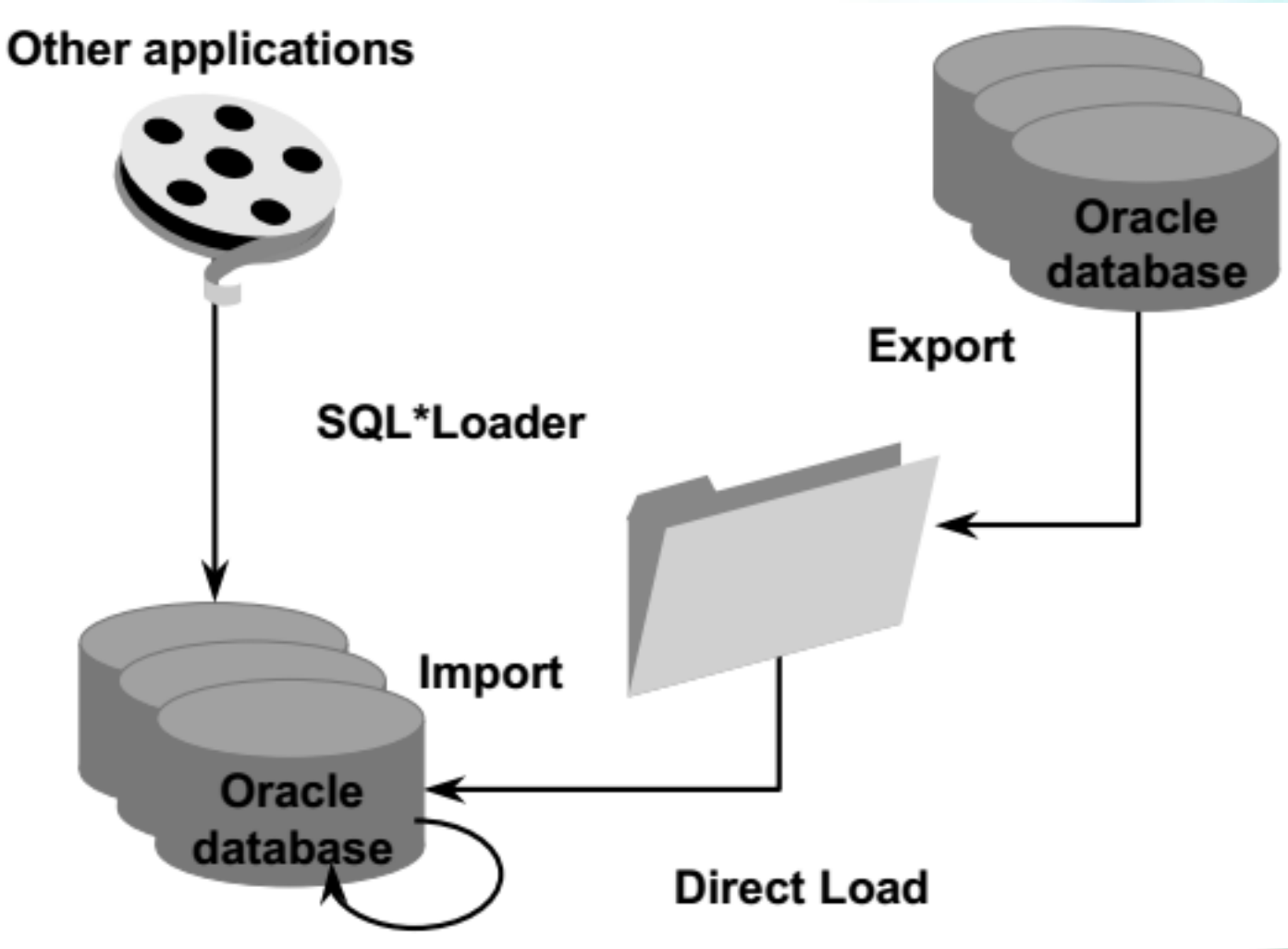
Data Loading Methods

Direct Load Method

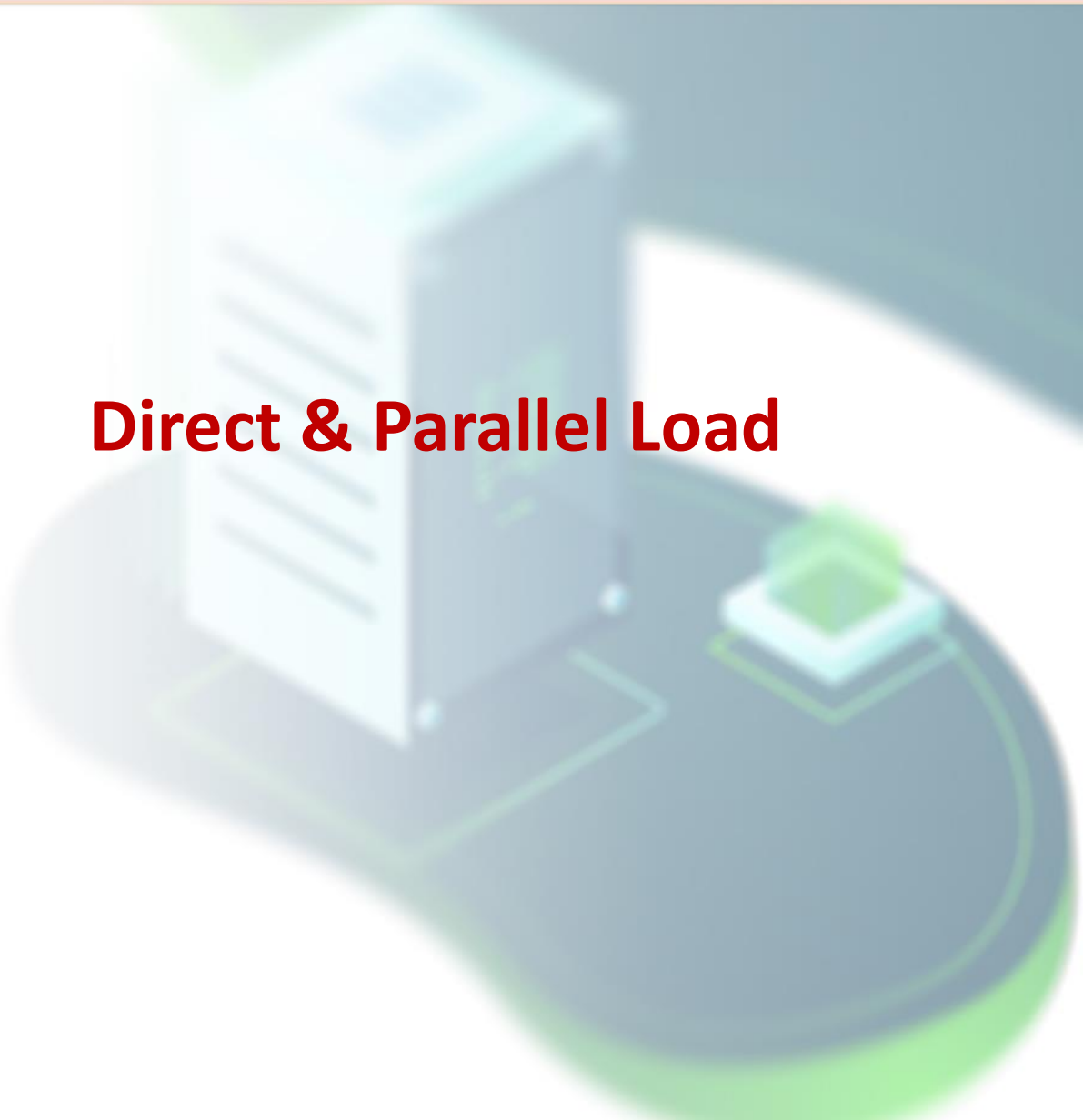
Direct Load insert can be used to copy data from one table to another table within the same database. It speeds up the insert operation, bypassing the database buffer cache and writing data directly into the data files.

Data Loading Methods

Oracle Export and Oracle Import



Introduction to Database Administration



Direct & Parallel Load

Direct & Parallel Load

Direct & Parallel Load

- Direct Load
- Serial Direct Load - Example
- Parallel Direct Load
- Parallel Direct Load - Example

Direct & Parallel Load

Direct Load

Direct Load insert can be performed in the following ways:

- Normal (Serially), or in parallel
- Into partition tables, non-partitioned tables, or single partitions of a table
- With or without logging of redo data

Direct & Parallel Load

Direct Load

Direct Load insert (serial or parallel) can only support the INSERT …

SELECT syntax of an INSERT statement, not the INSERT Values syntax. The parallelism for INSERT

SELECT is determined from either parallel hints or parallel table definition.

Oracle provides syntax extensions that extend the scope of the INSERT SELECT statement, so that you can insert rows into multiple tables as part of a single DML statement.

Direct & Parallel Load

Direct Load

A Direct Load insert can be invoked by using the APPEND hint, as shown in following command:

INSERT /*+APPEND * / INTO [schema.] table [[NO] LOGGING]
sub query;

Where

schema: Is the owner of the table

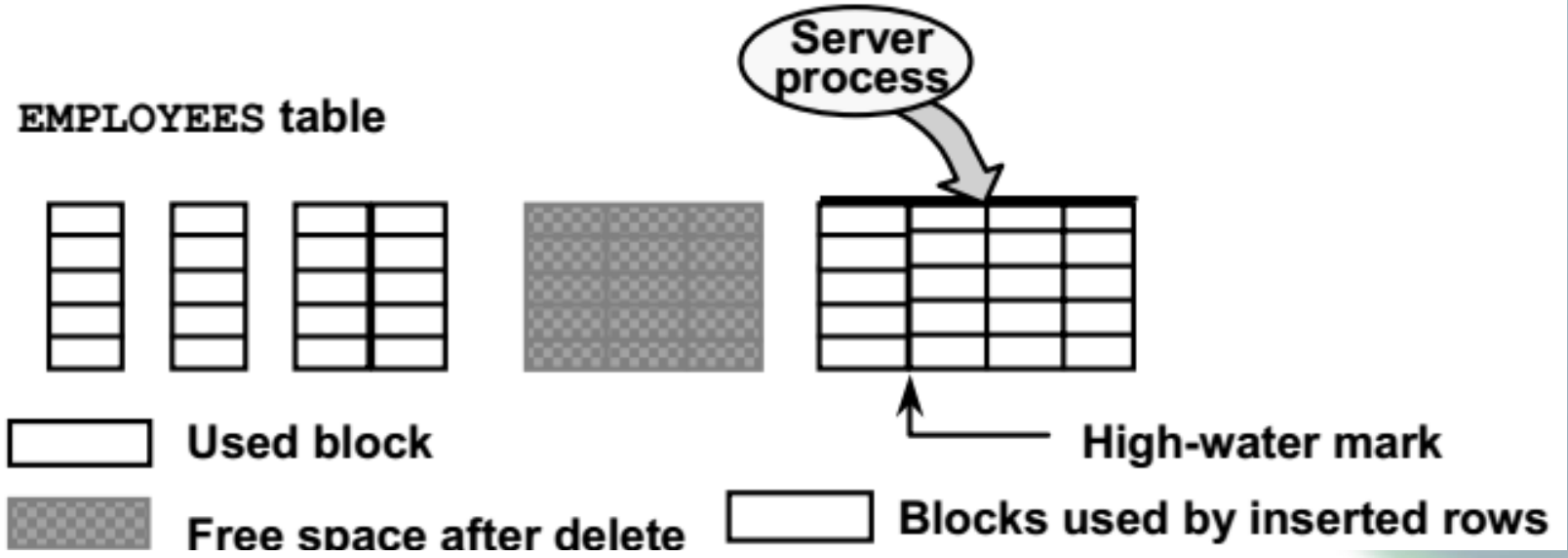
table: Is the name of the table

sub-query: Is the sub-query used to select the columns and rows for insert

Direct & Parallel Load

Serial Direct Load - Example

```
INSERT /*+ APPEND */ INTO emp
NOLOGGING
SELECT * FROM t_employees;
COMMIT;
```



Direct & Parallel Load

Parallel Direct Load

Direct Load inserts can be made in parallel by one of the following methods:

- Using a PARALLEL hint in the INSERT statement, as in the above example
- Creating the table or altering it to specify the PARALLEL clause

When parallel Direct Load inserts are made, the Oracle server uses several processes, known as parallel query slaves, to insert data into the table.

Direct & Parallel Load

Parallel Direct Load

Temporary segments are allocated to store the data inserted by each slave process.

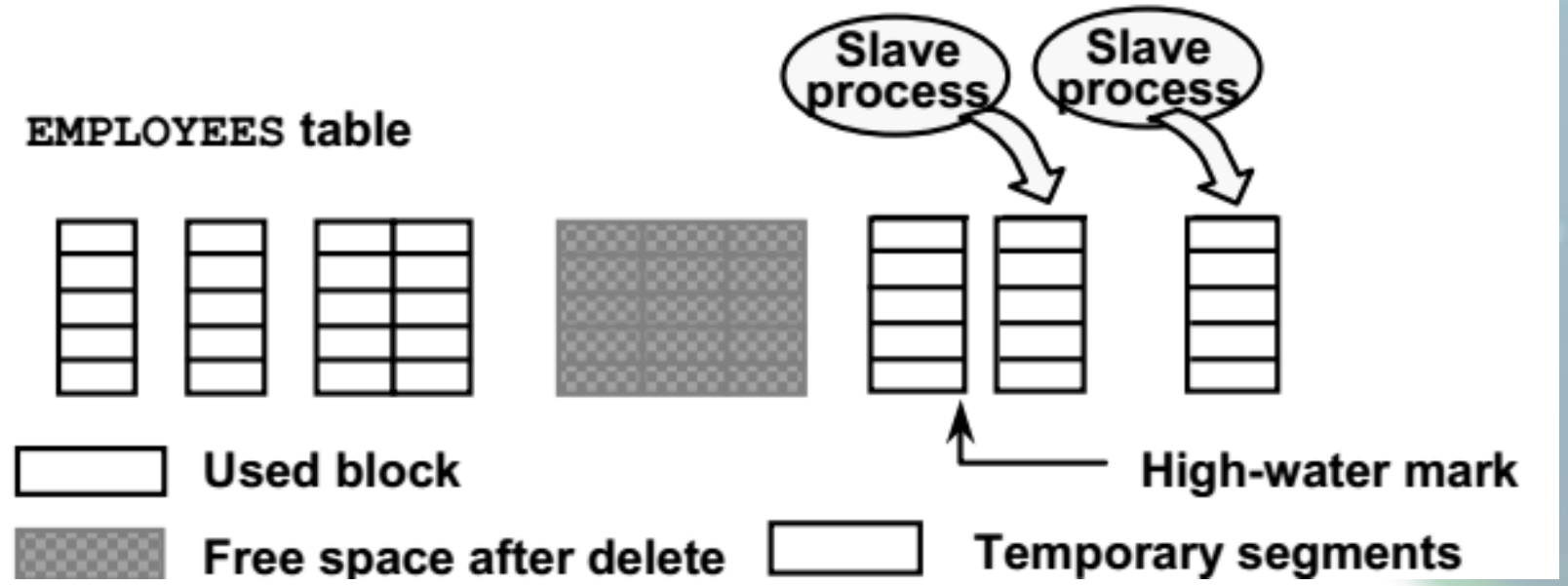
When the transaction commits, the extents in these individual segments become a part of the table in which records are inserted.

- The ALTER SESSION ENABLE PARALLEL DML command must be executed at the beginning of a transaction.
- An object that is modified using parallel Direct Load insert cannot be queried or modified again within the same transaction.

Direct & Parallel Load

Parallel Direct Load - Example

```
ALTER SESSION ENABLE PARALLEL DML;
INSERT /*+PARALLEL(hr.employees,2) */
INTO hr.employees NOLOGGING
SELECT * FROM hr.old_employees;
```



Introduction to Database Administration

SQL*Loader

SQL*Loader

SQL*Loader

- Introduction
- Files used by SQL*Loader
- Using SQL*Loader

SQL*Loader

Introduction

SQL*Loader loads data from external files into tables in an Oracle database.
SQL*Loader has the following features:

- SQL*Loader can use one or more input files.
- Several input records can be combined into one logical record for loading.
- Input fields can be of fixed or variable lengths.
- Input data can be in any format: character, binary, packed decimal, date, and zoned decimal.

SQL*Loader

Introduction

- Data can be loaded from different types of media such as disk, tape, or named pipes.
- Data can be loaded into several tables in one run.
- Options are available to replace or to append to existing data in the tables.
- SQL functions can be applied on the input data before the row is stored in the database.

SQL*Loader

Introduction

- Column values can be auto generated based on rules. For example, a sequential key value can be generated and stored in a column.
- Data can be loaded directly into the table, bypassing the database buffer cache.

SQL*Loader

Files used by SQL*Loader

SQL*Loader uses the following files:

- Loader control file: Specifies the input format, output tables, and optional conditions that can be used to load only part of the records found in the input data files
- Input data files: Contain the data in the format defined in the control file
- Parameter file: Is an optional file that can be used to define the command line parameters for the load

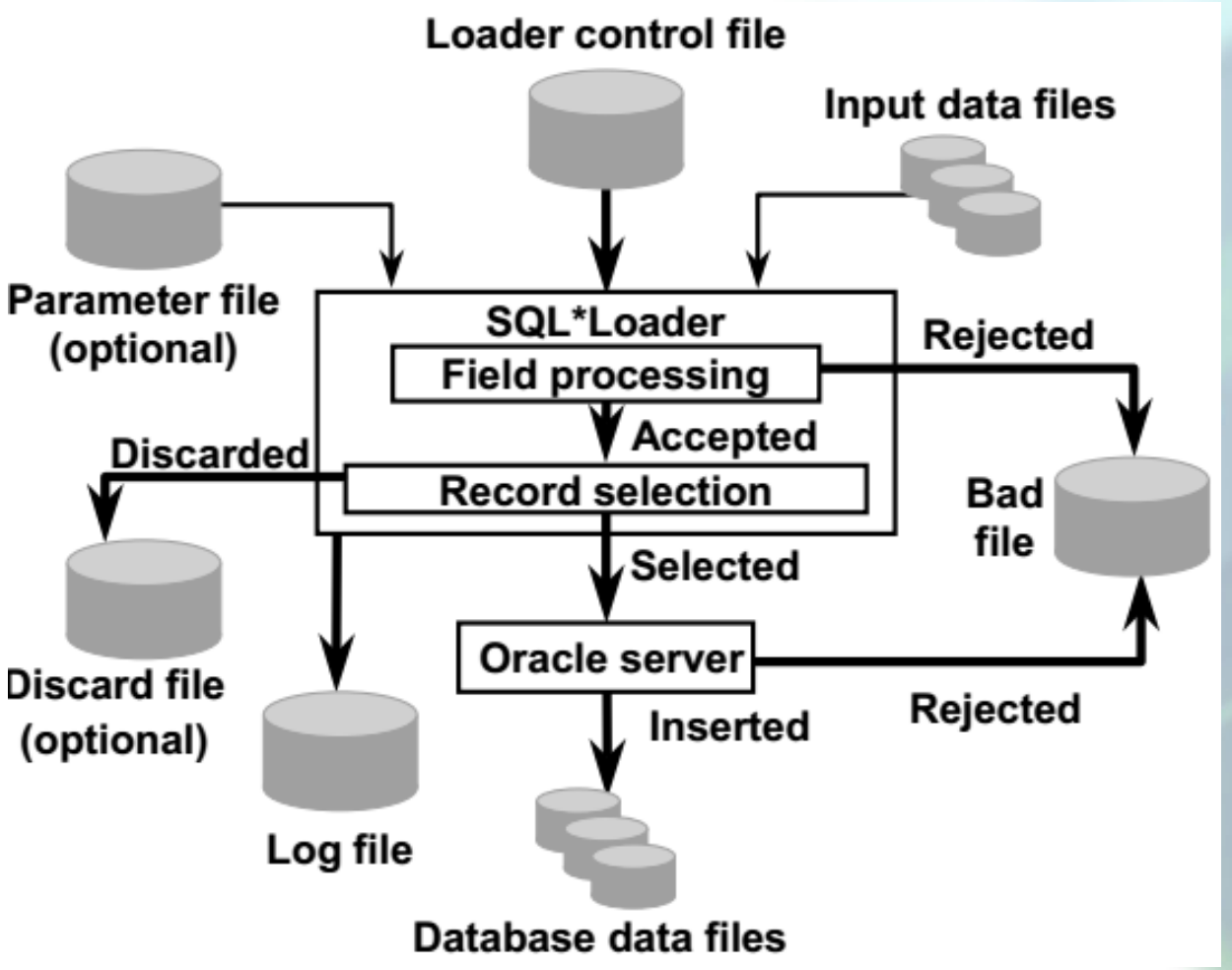
SQL*Loader

Files used by SQL*Loader

- Log file: Is created by SQL*Loader and contains a record of the load
- Bad file: Is used by the utility to write the records that are rejected during the load.
- Discard file: Is a file that can be created, if necessary, to store all records that did not satisfy the selection criteria

SQL*Loader

Files used by SQL*Loader



SQL*Loader

Using SQL*Loader

When you invoke SQL*Loader, you can specify parameters that establish session characteristics. Parameters can be entered in any order, optionally separated by commas.

You can specify values for parameters, or in some cases, you can accept the default without entering a value.

SQL*Loader

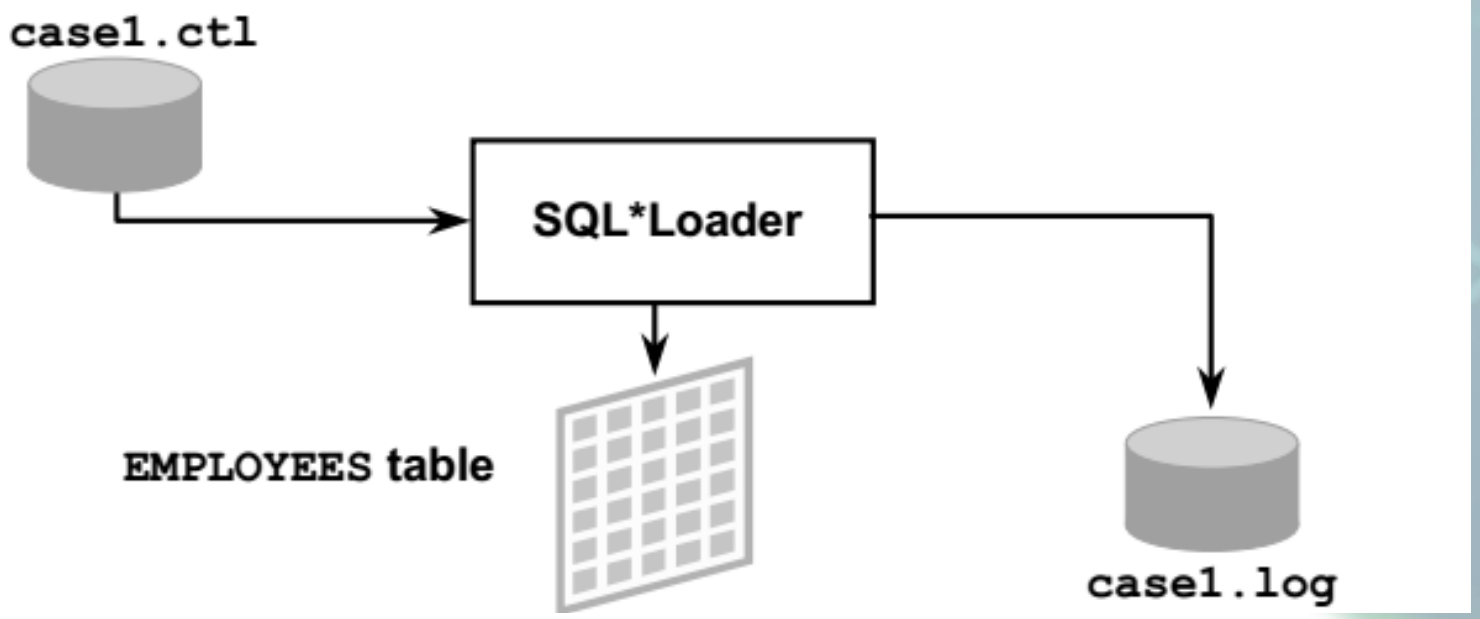
Using SQL*Loader

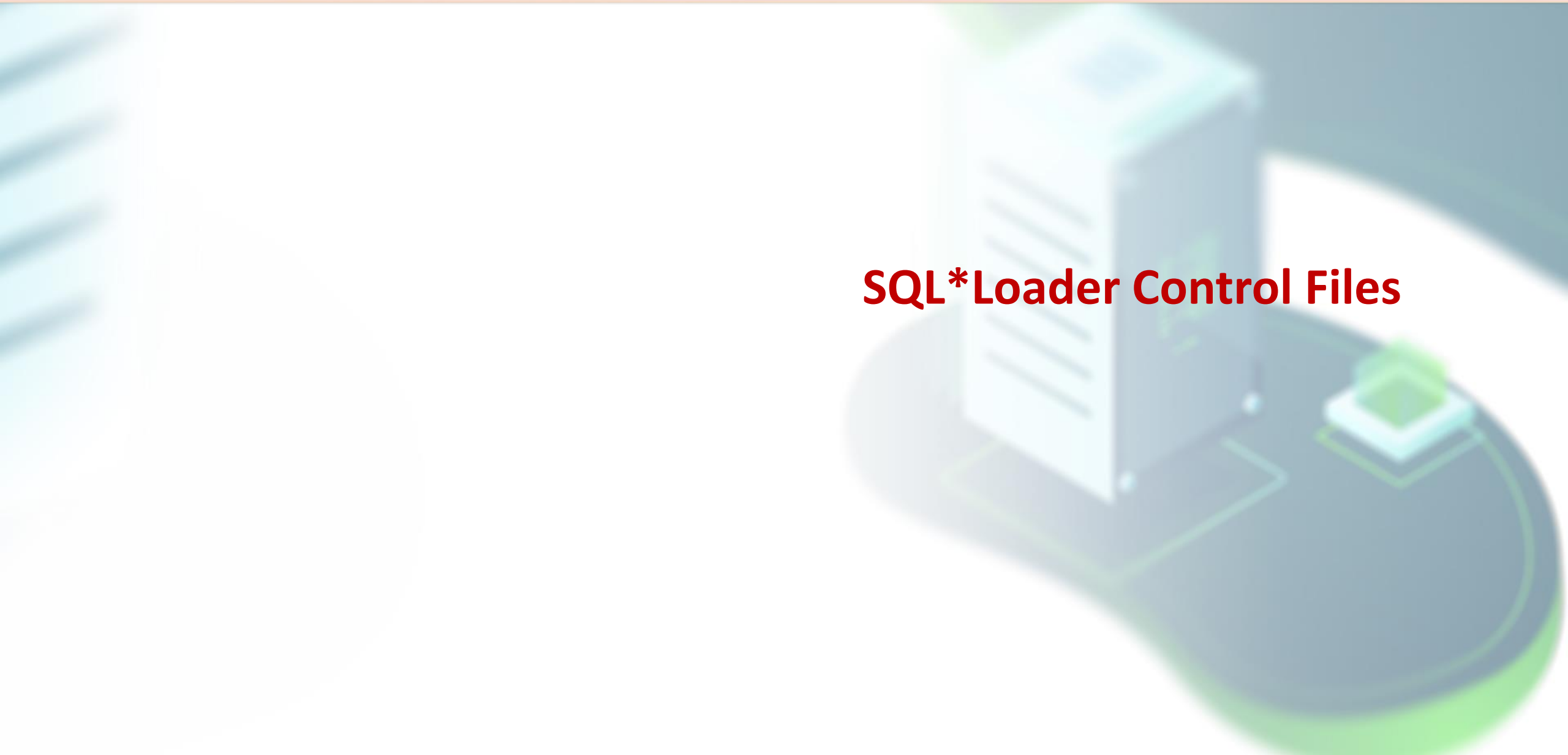
If you invoke SQL*Loader without specifying any parameters, SQL*Loader displays a Help screen that lists the available parameters and their default values.

SQL*Loader

Using SQL*Loader

```
$sqlldr hr/hr \
> control=case1.ctl \
> log=case1.log direct=Y
```





SQL*Loader Control Files

SQL*Loader Control Files

SQL*Loader Control Files

- Introduction
- Three Sections of Control Files
- Sample Control File
- Sample Control File Explanation

SQL*Loader Control Files

Introduction

The loader control file tells SQL*Loader:

- Where to find the load data
- The data format
- Configuration details:
  - Memory management
  - Record rejection
  - Interrupted load handling details
- How to manipulate the data

SQL*Loader Control Files

Introduction

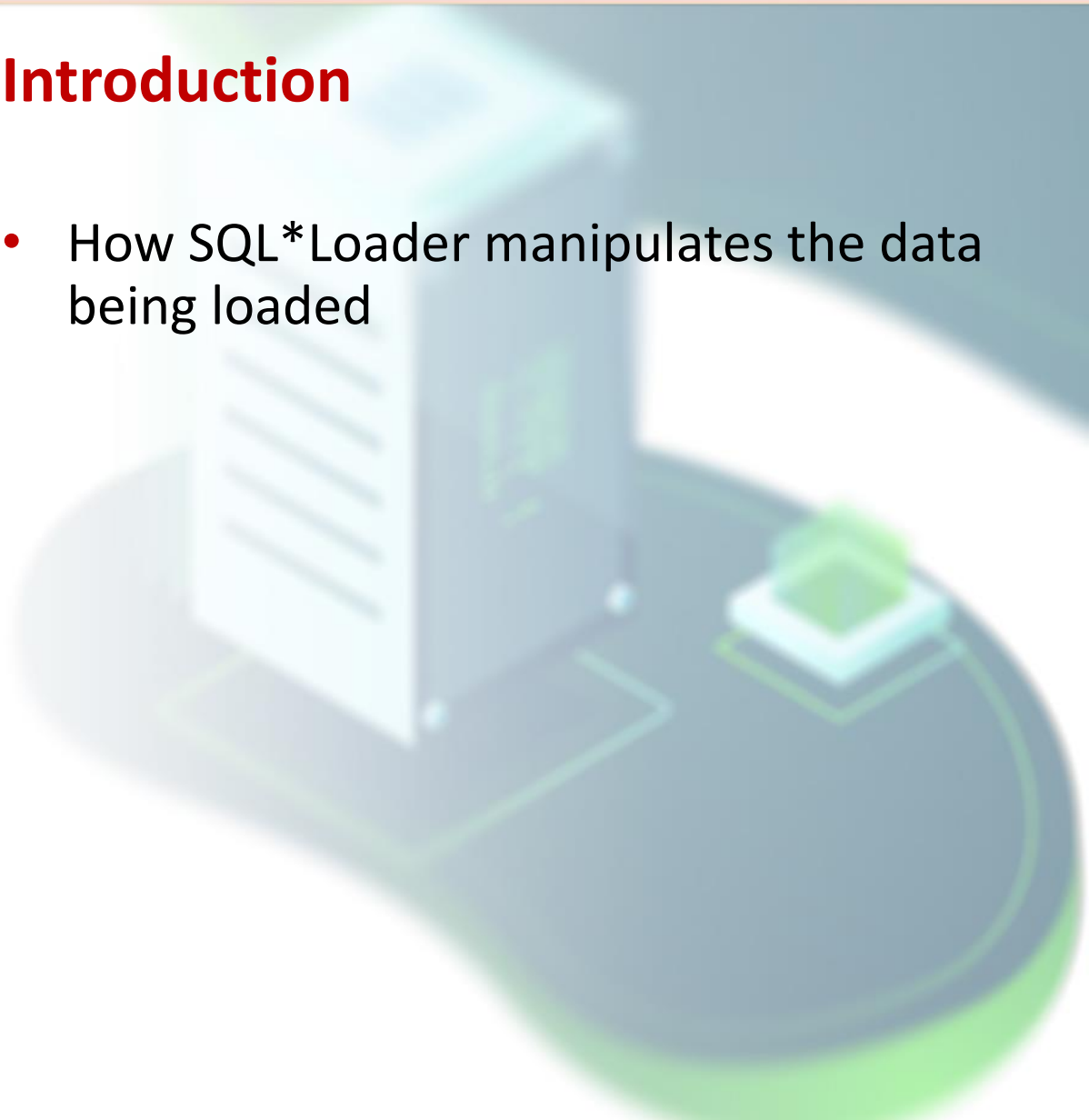
The SQL*Loader control file is a text file that contains DDL instructions. DDL is used to control the following aspects of a SQL*Loader session:

- Where SQL*Loader finds the data to load
- How SQL*Loader expects that data to be formatted
- How SQL*Loader configures (memory management, rejecting records, interrupted load handling, and so on) as it loads the data

SQL*Loader Control Files

Introduction

- How SQL*Loader manipulates the data being loaded



SQL*Loader Control Files

Three Sections of Control Files

- The first section contains session-wide information, for example:
  - Global options such as bind size, rows, records to skip, and so on
  - INFILE clauses to specify where the input data is located
  - How data is to be loaded

SQL*Loader Control Files

Three Sections of Control Files

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

SQL*Loader Control Files

Sample Control File

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

SQL*Loader Control Files

Sample Control File Explanation

- This is how comments are entered in a control file. Comments can appear anywhere in the command section of the file, but they should not appear within the data.
- The LOAD DATA statement tells SQL*Loader that this is the beginning of a new data load. If you were continuing a load that had been interrupted in progress, you would use the CONTINUE LOAD DATA statement.
- The INFILE keyword specifies the name of a data file containing data that you want to load.

SQL*Loader Control Files

Control File Syntax Consideration

The syntax is free-format

Syntax is not case sensitive

Comments extend from the two hyphen (--) that mark the beginning of the comment to the end of the line

The CONSTANT keyword is reserved

SQL*Loader Control Files

Control File Syntax Consideration

- The syntax is free format. (Statements can extend over multiple lines.)
- It is case insensitive; however, strings enclosed in single or double quotation marks are taken literally, including case.
- In control file syntax, comments extend from the two hyphens (—) that mark the beginning of the comment to the end of the line. The optional third section of the control file is interpreted as data rather than as control file syntax; consequently, comments in this section are not supported.
- The CONSTANT keyword has special meaning to SQL*Loader and is therefore reserved. To avoid potential conflicts, do not use the word CONSTANT as a name for any tables or columns.

Introduction to Database Administration

Input & Data Files

Input & Data Files

- Introduction
- Fixed-Record Format
- Variable-Record Format
- Stream-Record Format

Input & Data Files

Introduction

SQL*Loader reads data from one or more files specified in the control file.

From SQL*Loader's perspective, the data in the data file is organized as records.

A data file can be in one of three formats:

- Fixed-record format
- Variable-record format
- Stream-record format

Input & Data Files

Fixed-Record Format

Records in a file are of same byte

Format is specified as

INFILE <data file> "fix n"

Following is a control file contents for two columns

load data

infile 'example.dat' "fix 10"

into table example

fields terminated by ' ' (col1, col2)

Input & Data Files

Fixed-Record Format

example.dat:

0001, abcd

0002, fghi

0003, klmn

Input & Data Files

Variable-Record Format

A file is in variable format when the length of each record in a character field is included at the beginning of each record in the data file.

For example, specifying data file as

INFILE "datafile_name" "var n"

n represents the number of bytes in the record length field

If n is not specified, SQL*Loader assumes a length of 6.

Input & Data Files

Variable-Record Format

In example.dat, record length fields/ columns are 3 bytes long

```
load data
infile 'example.dat' "var 3"
into table example
fields terminated by ',' optionally enclosed by '"'
(col1 char(5),col2 char(7))
example.dat:
009hello,cd,
010world,im,
012my,name is,
```

Input & Data Files

Stream-Record Format

A file is in stream-record format when records are not specified by size; instead SQL*Loader forms records by scanning for the record terminator. It is flexible but it has performance issues.

For example, specifying data file as

INFILE <datafile_name> ["str terminator_string"]

Input & Data Files

Stream-Record Format

Non printable characters will be

\n new line

\t horizontal tab

\f form feed

\v vertical tab

\r carriage return

Input & Data Files

Stream-Record Format

In example.dat, data loading with stream-record format

```
load data
infile 'example.dat' "str '|\n'"
into table example
fields terminated by ',' optionally enclosed by '"'
(col1 char(5),
col2 char(7))
example.dat:
hello,world,|
james,bond,|
```

Logical Records & Loading Methods

Logical Records & Loading Methods

Logical Records & Loading Methods

- Logical Records
- Using CONCATENATE to Assemble Logical Records
- Using CONTINUEIF to Assemble Logical Records
- Conventional Path Load
- Direct Path Load
- Loading Methods

Logical Records & Loading Methods

Logical Records

SQL*Loader can be instructed to follow one of the following two logical record-forming strategies:

Combine a fixed number of physical records to form each logical record

Combine physical records into logical records while a certain condition is true

Logical Records & Loading Methods

Logical Records

SQL*Loader organizes the input data into physical records, according to the specified record format. By default, a physical record is a logical record. However, for added flexibility, SQL*Loader can be instructed to combine a number of physical records into a logical record. SQL*Loader can do

- Combine fixed number of physical records to form each logical record
- Combine physical records into logical records while a certain condition is true

Logical Records & Loading Methods

Using CONCATENATE to Assemble Logical Records

CONCATENATE is used when SQL*Loader should always add the same number of physical records to form one logical record. For example,

CONCATENATE integer

Means number of physical records to combine

Logical Records & Loading Methods

Using CONTINUEIF to Assemble Logical Records

CONTINUEIF must be used if the number of physical records to be continued varies. The CONTINUEIF keyword is followed by a condition that is evaluated for each physical record as it is read.

For example, two records might be combined if there was a pound sign (#) in character position 80 of the first record.

Logical Records & Loading Methods

Conventional Path Load

Conventional path Load builds an array of rows to be inserted and uses the SQL INSERT statement to load the data. During conventional path loads, input records are parsed based on field specifications, and an array of records is built and inserted into the table specified in the control file.

Records that do not conform to the field specifications are rejected and those records that do not satisfy the selection criteria are discarded.

Logical Records & Loading Methods

Conventional Path Load

Conventional path loads can be used to load data into both the clustered and unclustered tables.

Redo generation is controlled by the logging attribute for the table that is being loaded.

Logical Records & Loading Methods

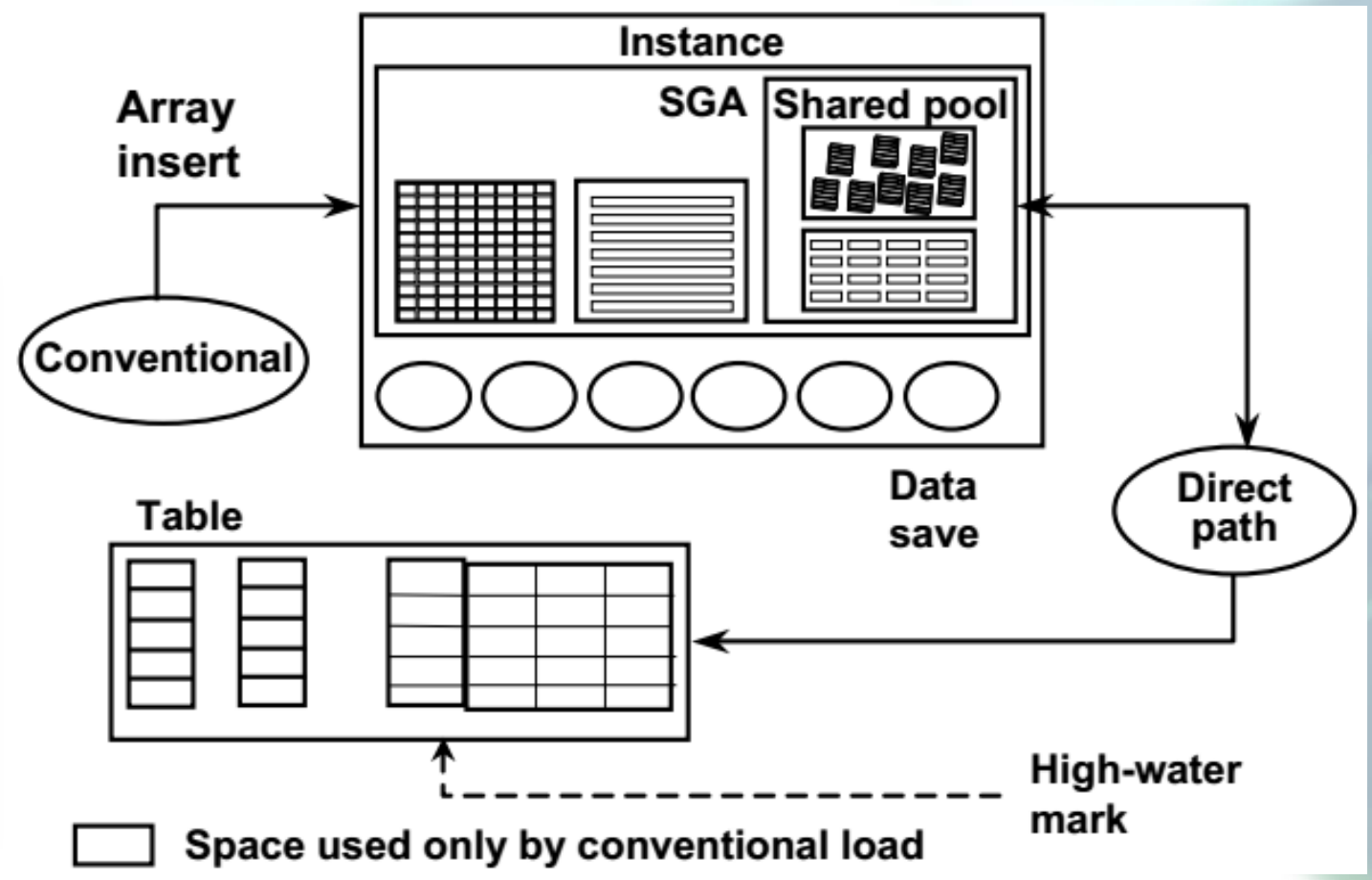
Direct Path Load

A Direct path load builds blocks of data in memory and saves these blocks directly into the extents allocated for the table being loaded. Online redo log file entries are not generated unless the database is in ARCHIVELOG mode.

Direct load path is generally faster than conventional path load.

Logical Records & Loading Methods

Loading Methods



Direct & Conventional Path Loads

Direct & Conventional Path Loads

Direct & Conventional Path Loads

- Method of Saving Data
- Comparison of Conventional and Direct Path Loads
- Logging Changes
- Enforcing Constraints
- Parallel Direct Paths
- Enforcing Constraints

Direct & Conventional Path Loads

Method of Saving Data

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

Direct & Conventional Path Loads

Method of Saving Data

Direct path loads use data saves to write blocks of data to Oracle data files. The following features differentiate a data save from a COMMIT:

During a data save, only full database blocks are written to the database

The blocks are written after the high-water mark of the table

After a data save, the high-water mark is moved

Internal resources are not released after a data save

A data save does not end the transaction

Indexes are not updated at each data save

Direct & Conventional Path Loads

Comparison of Conventional and Direct Path Loads

Conventional Load	Direct Path Load
Uses COMMITs to make changes permanent	Uses data saves
Redo entries always generated	Generates redo only under specific conditions
Enforces all constraints	Enforces only primary key, unique, and NOT NULL
INSERT triggers fire	INSERT triggers do not fire
Can load into clustered tables	Cannot load into clustered tables
Other users can make changes to tables	Other users cannot make changes to tables

Direct & Conventional Path Loads

Logging Changes

Conventional path loading generates redo entries just as any DML statement. When using a Direct path load, redo entries are not generated if:

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

Direct & Conventional Path Loads

Enforcing Constraints

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

- NOT NULL constraints are checked when arrays are built.
- FK and CHECK constraints are disabled
- PK and unique constraints are checked during and at the end of the run and may be disabled

Direct & Conventional Path Loads

Parallel Direct Paths

Multiple SQL*Loader sessions improve the performance of a Direct path load. Three models of concurrency can be used to minimize the time required for data loading:

- Parallel conventional path loads
- Intersegment concurrency with Direct path load method
- Intra segment concurrency with Direct path load method

Direct & Conventional Path Loads

Parallel Direct Paths

- Concurrent conventional path

When trigger or integrity constraints pose a problem

- Intersegment concurrency with Direct path load method

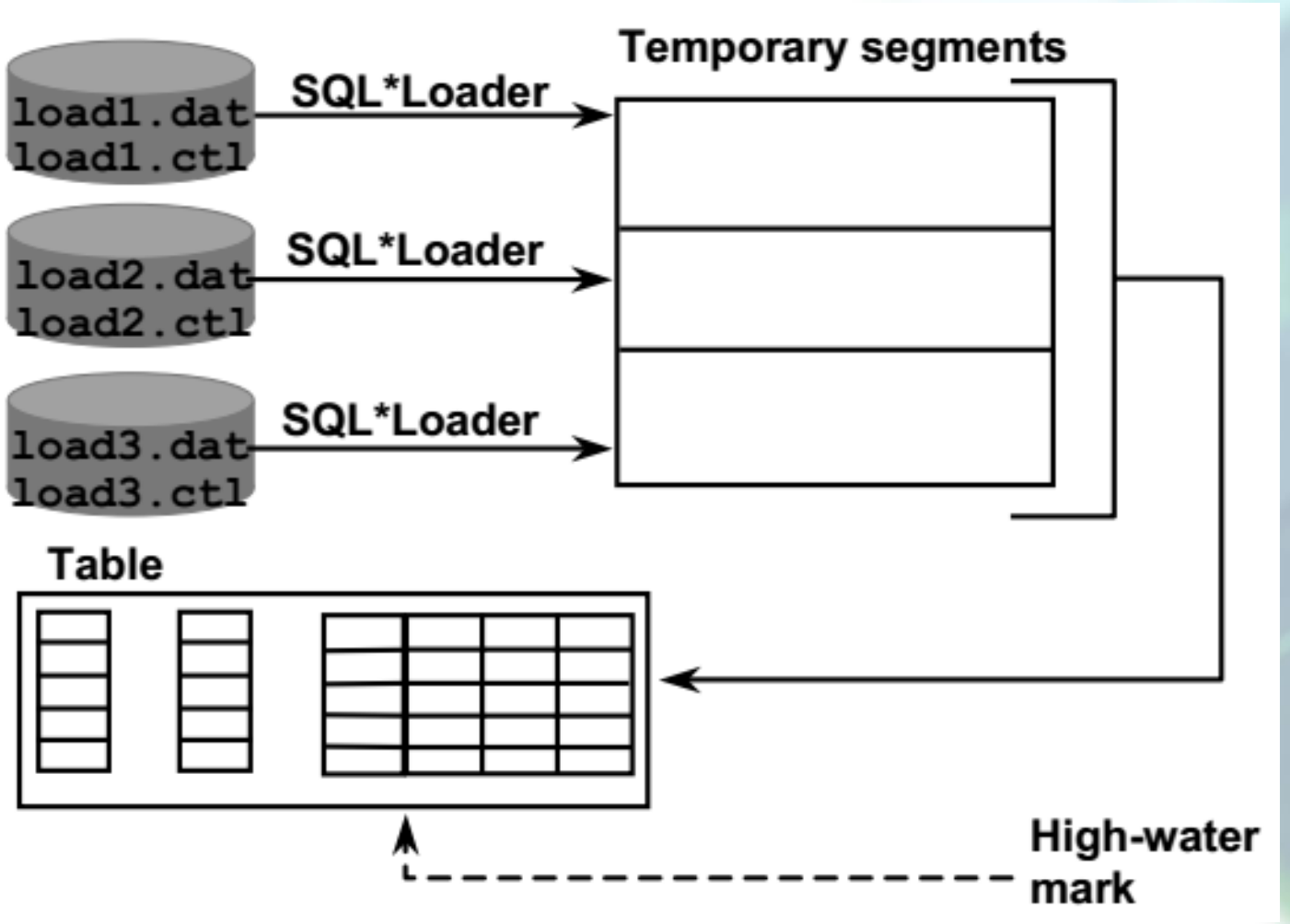
Loading of different objects such as tables and partitions of same table.

- Intra segment concurrency with Direct path load method

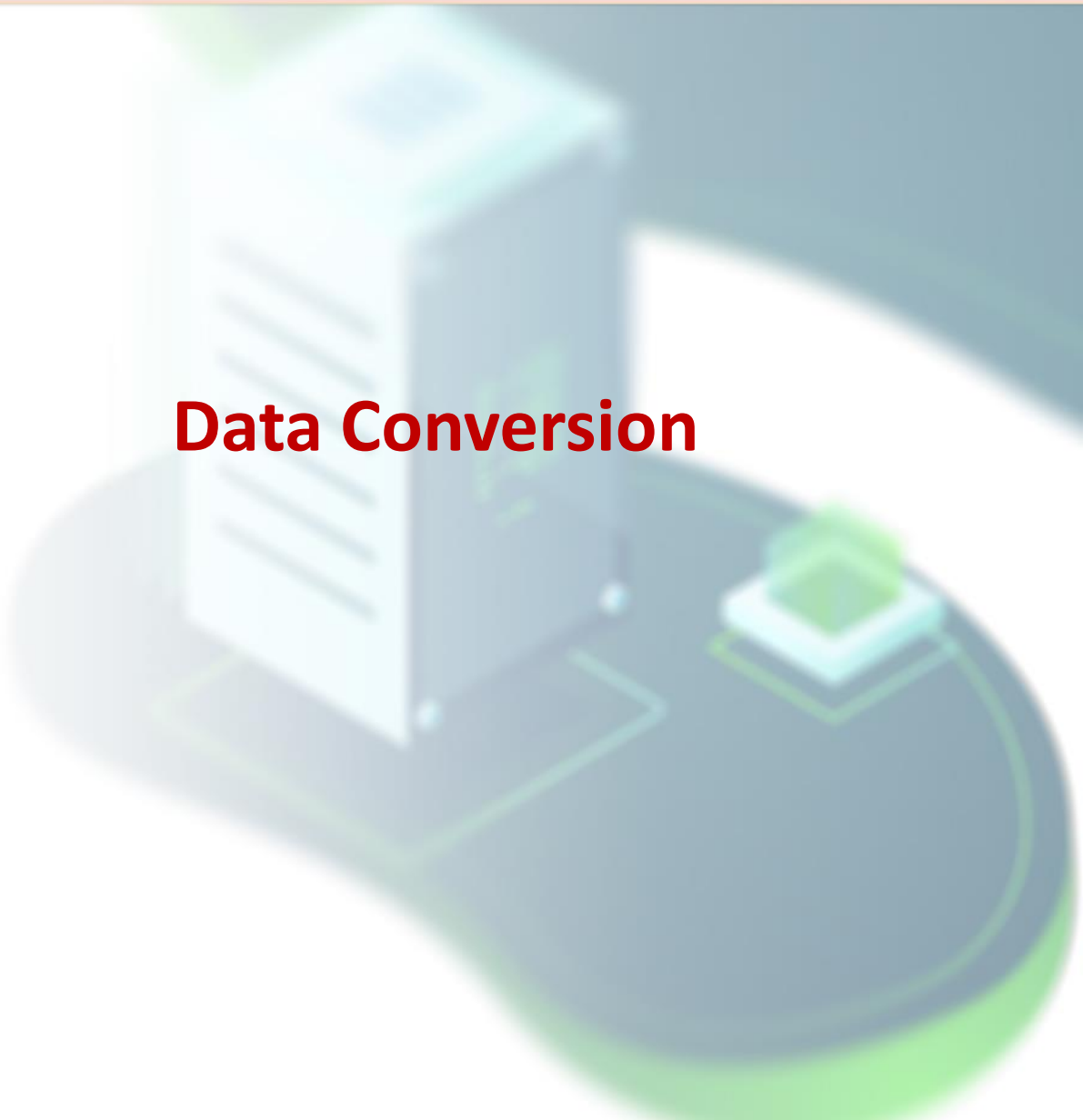
Multiple Direct path load session concurrently into same table or partition

Direct & Conventional Path Loads

Enforcing Constraints



Introduction to Database Administration



Data Conversion

Data Conversion

Data Conversion

- Introduction
- SQL*Loader Rejects
- Discarded or Rejected Records

Data Conversion

Introduction

During a conventional path load, data fields in the data file are converted into columns in the database in two steps:

- The field specifications in the control file are used to interpret the format of the data file and convert it to a SQL INSERT statement using that data.

- The Oracle database server accepts the data and executes the INSERT statement to sore the data in the database

Data Conversion

SQL*Loader Rejects

When input format is invalid

- When delaminated field exceeds its maximum length
- All bad records are saved in bad file
- Oracle determines row is valid or not.
- If row or record is rejected, SQL*Loader puts it in the bad file
- Why row can be rejected?

  (unique or not null constraints)

Data Conversion

Discarded or Rejected Records

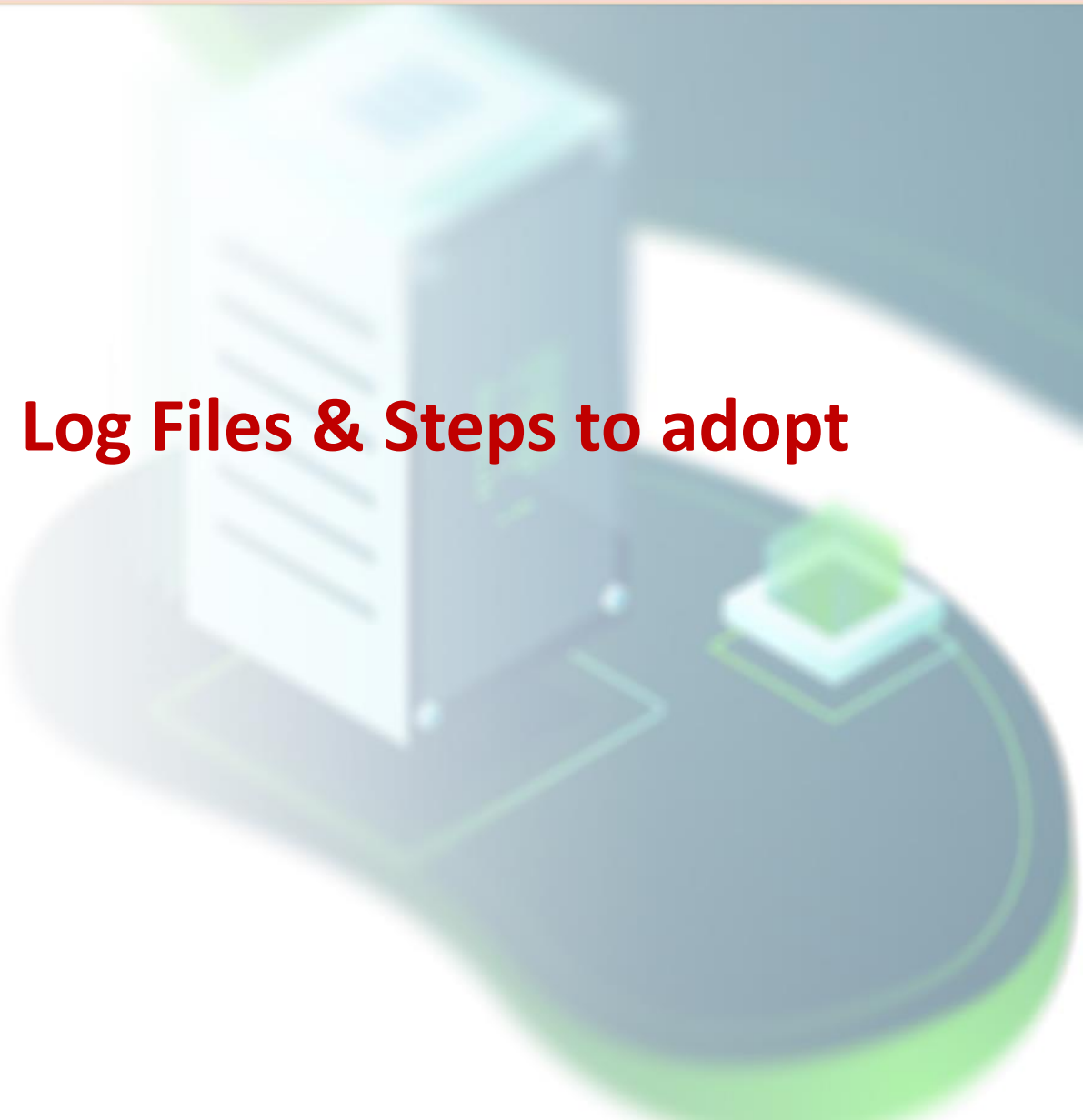
Bad file:

- SQL*Loader rejects records when the input format is invalid.
- If the Oracle database finds that the row is invalid, then the record is rejected and SQL*Loader puts it in the bad file.

Discard file:

- This can be used only if it has been enabled.
- This file contains records that were filtered out because they did not match any record-selection criteria specified in the control file.

Introduction to Database Administration



Log Files & Steps to adopt

Log Files & Steps to adopt

Log File Contents

- Header Information
- Global Information
- Table Information
- Data File Information
- Table Load Information
- Summary Statistics
- Additional statistics for Direct path loads and multithreading Information

Log Files & Steps to adopt

Header Information

Date of the run

Software version number

Log Files & Steps to adopt

Global Information

Name of all input/ output file

Echo of command-line arguments

Continuation character specification

Log Files & Steps to adopt

Table Information

Table Name

Load Conditions

INSERT, APPEND or REPLACE specifications

Columns, length, data type and deliminator

Log Files & Steps to adopt

Data File Information

SQL*Loader and Oracle data record errors

Log Files & Steps to adopt

Table Load Information

Number of rows loaded, rejected, discarded, Null fields discarded

Log Files & Steps to adopt

Summary Statistics

Amount of space used for bind array

Cumulative load statistics for data files, skipped, read and rejected records

Log Files & Steps to adopt

Additional statistics for Direct path loads and multithreading Information

Direct path load of a partitioned table reports per-partition statistics

Conventional-path load cannot report per-partition statistics

Sample Example to Load Data-1

Sample Example to Load Data-1

Example's Contents

- Data Loading
- Data Migration – From File to Database
- Example of Data Loading

Sample Example to Load Data-1

Data Loading

Loading data from files

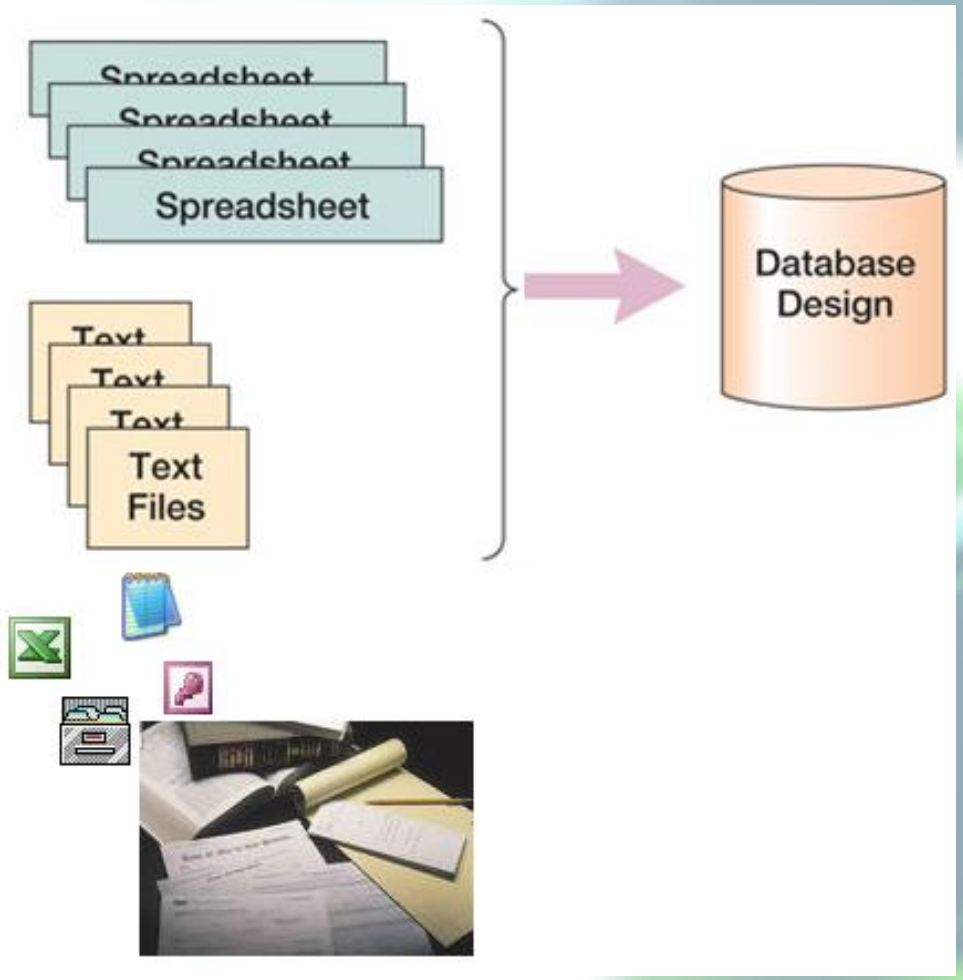
Files can be comma delaminated

Files can be in XML format

Binary files (Oracle to Oracle)

Sample Example to Load Data-1

Data Migration – Files to Database



Sample Example to Load Data-1

Example of Data Loading

```
Login scott
create table TEMP_EMP
(Empno Number(4),
Ename  VARCHAR2(50),
Salary Number(8)
);

c:\test\control.ctl
load data
infile 'c:\test\DBA-EXP-194.csv'
truncate
into table scott.temp_emp
fields terminated by ','
(empno, ename, salary)

cd E:\app\Haider\product\11.2.0\dbhome_1\BIN
c:\test>sqlldr control=c:\test\control.ctl
data=c:\test\DBA-EXP-194.csv log=c:\test\ulcase2.log
```

Sample Example to Load Data-1

Example of Data Loading

```
E:\app\Haider\product\11.2.0\dbhome 1\BIN>sqlldr control=c:\test\control.ctl
                        data=c:\test\DBA-EXP-194.csv log=c:\test\ulcase2.log
Username:scott
Password:
SQL*Loader: Release 11.2.0.1.0 - Production on Wed Nov 4 19:13:30 2020

Copyright (c) 1982, 2009, Oracle and/or its affiliates.  All rights reserved.

Commit point reached - logical record count 6

E:\app\Haider\product\11.2.0\dbhome 1\BIN>
```

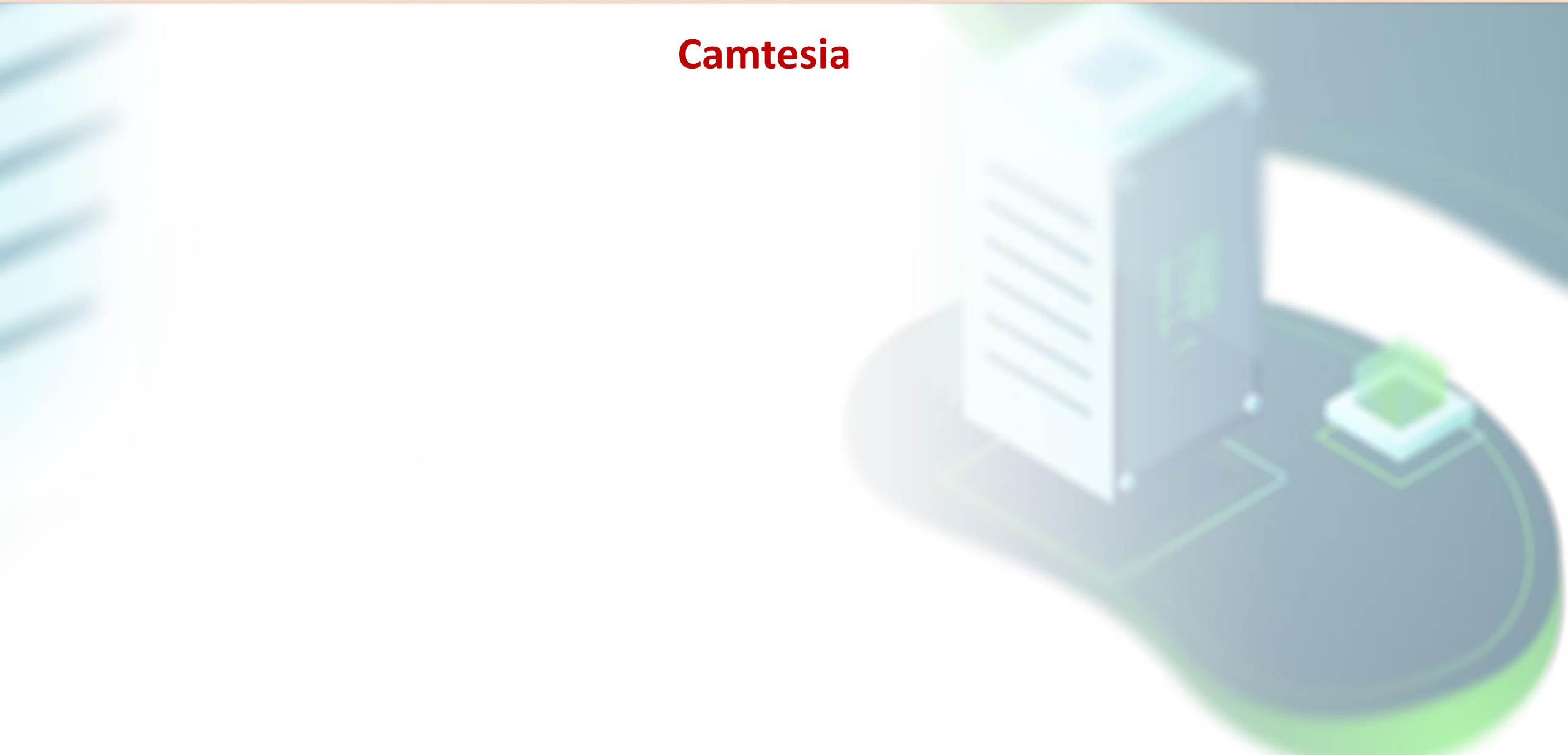
Sample Example to Load Data-1

Example of Data Loading

```
SQL> create table TEMP_EMP
  2  (Empno Number(4),
  3  Ename  VARCHAR2(50),
  4  Salary Number(8)
  5  );

Table created.

SQL> select * from temp_emp;

     EMPNO ENAME                                              SALARY
---------- -------------------------------------------------- ----------
      1001 Ejaz                                                5000
      1002 Ali                                                 3500
      1003 Qadeer                                              3400
      1004 Yaseen                                              4000
      1005 Asim                                                3400
```

Sample Example to Load Data-1

Camtesia



Sample Example to Load Data-2

Sample Example to Load Data-2

Example's Contents

- Material's Data Loading
- Data Migration - Files to Database
- Reasons to Load Data into TEMP_Material
- Required Files Data Loading of Material
- Data Loading Files with Contents

Sample Example to Load Data-2

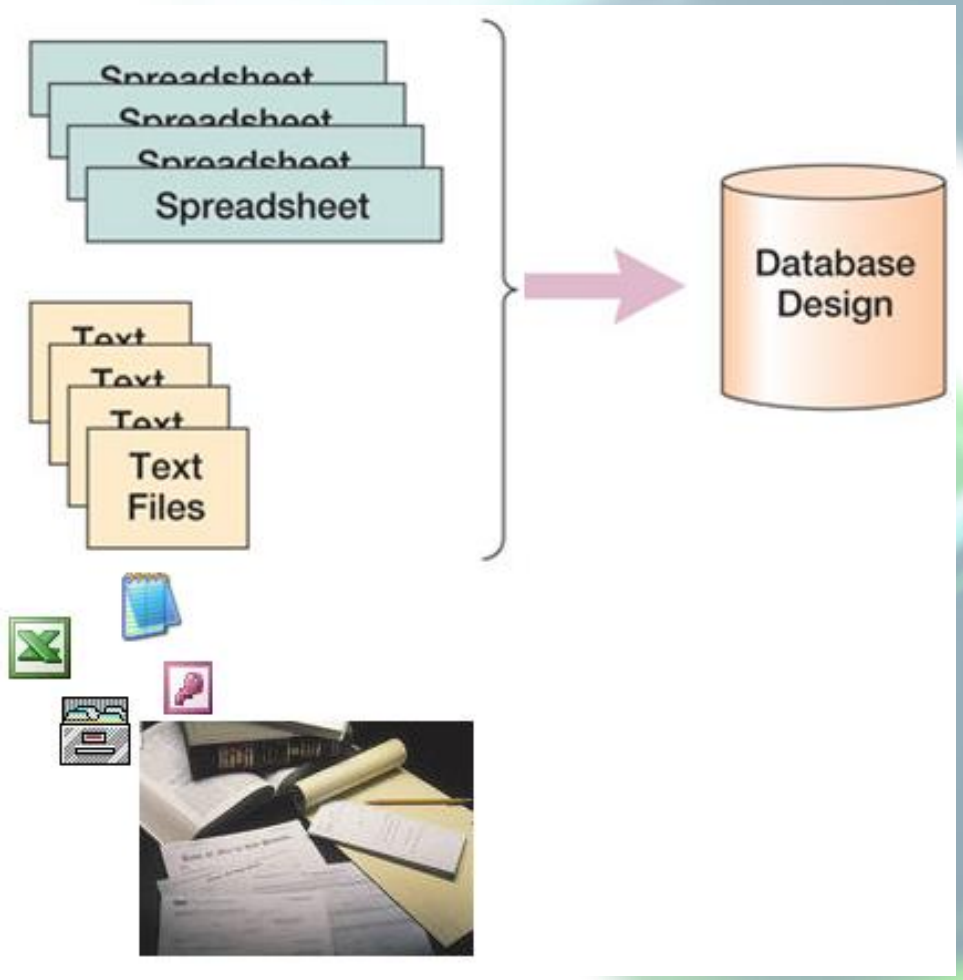
Material's Data Loading

Data is comma delaminated regarding material or products

Need to load into table Material via TMP_Material

Sample Example to Load Data-2

Data Migration – Files to Database



Sample Example to Load Data-2

Reasons to Load Data into TEMP_Material

Try to avoid to load data into bad files

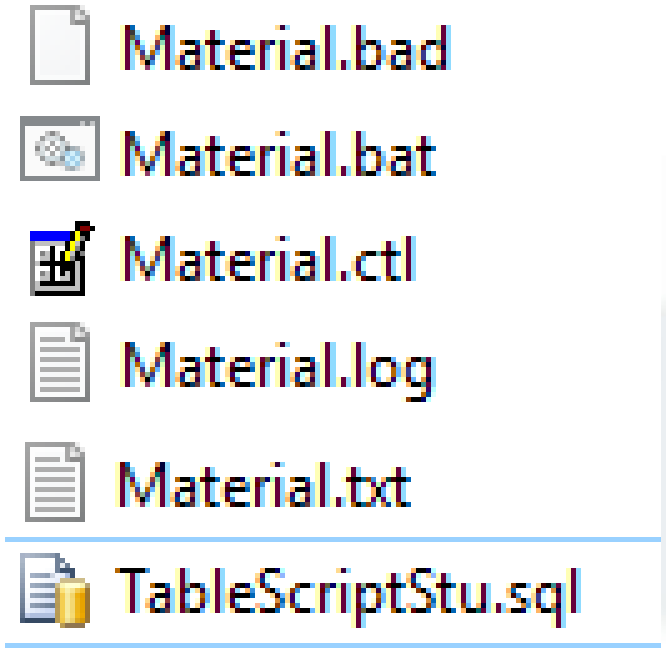
Format of data

For example $ symbol is given with numeric currency column

Size of column may less in the target table

Sample Example to Load Data-2

Required Files Data Loading of Material



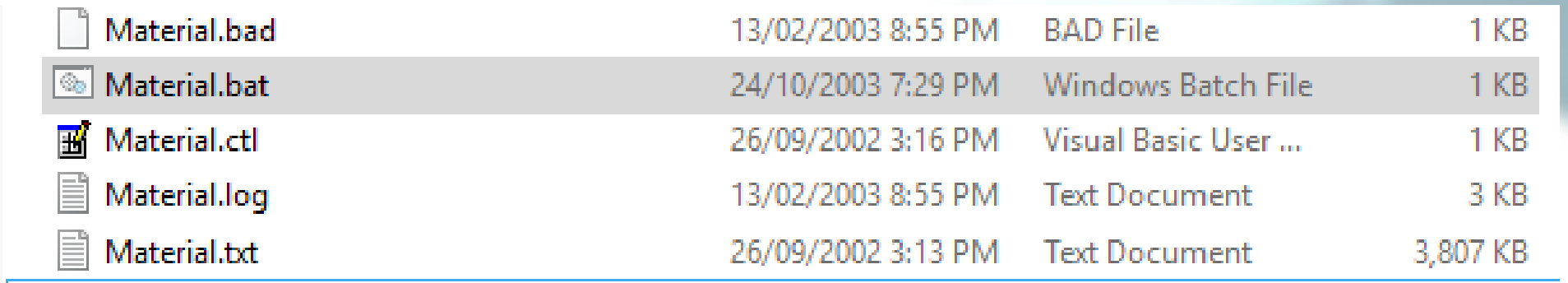
Material.bat - Notepad

File Edit Format View Help

```
SQLLDR user/password CONTROL=c:\test\Material.ctl LOG=c:\test\Material.log BAD=c:\test
\Material.bad DATA=c:\test\Material.txt
```

Sample Example to Load Data-2

Data Loading Files with Contents



Material.bad	13/02/2003 8:55 PM	BAD File	1 KB
Material.bat	24/10/2003 7:29 PM	Windows Batch File	1 KB
Material.ctl	26/09/2002 3:16 PM	Visual Basic User ...	1 KB
Material.log	13/02/2003 8:55 PM	Text Document	3 KB
Material.txt	26/09/2002 3:13 PM	Text Document	3,807 KB

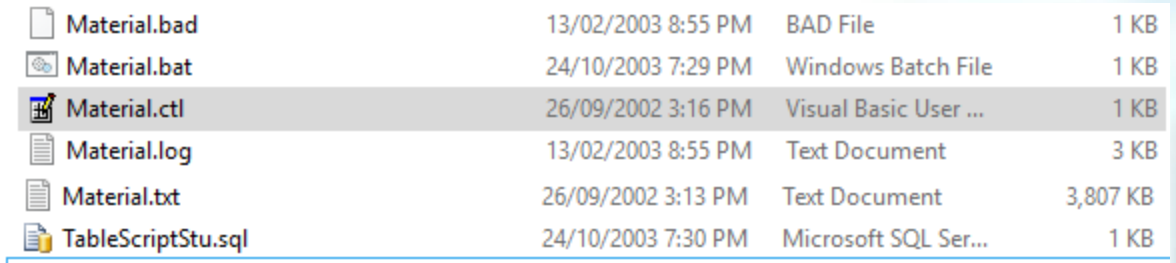
Material.bat - Notepad

File Edit Format View Help

```
SQLLDR user/password CONTROL=c:\test\Material.ctl
LOG=c:\test\Material.log BAD=c:\test
\Material.bad DATA=c:\test\Material.txt
```

Sample Example to Load Data-2

Data Loading Files with Contents



Material.bad	13/02/2003 8:55 PM	BAD File	1 KB
Material.bat	24/10/2003 7:29 PM	Windows Batch File	1 KB
Material.ctl	26/09/2002 3:16 PM	Visual Basic User ...	1 KB
Material.log	13/02/2003 8:55 PM	Text Document	3 KB
Material.txt	26/09/2002 3:13 PM	Text Document	3,807 KB
TableScriptStu.sql	24/10/2003 7:30 PM	Microsoft SQL Ser...	1 KB

Material.ctl - Notepad

File Edit Format View Help

```
LOAD DATA
REPLACE INTO TABLE TMP_Material
FIELDS TERMINATED BY ','
OPTIONALLY ENCLOSED BY '"'
(BDSKU   ,
BDDescrip       ,
BDUPC           ,
BDMainProdGrp   ,
BDProdGroup     ,
BDSubProdGrp    ,
BDDivision,
BDSysCost       ,
BDBasePrice     ,
BDCurrentInv    ,
BDSalesStatus   ,
Remarks         )
```

Sample Example to Load Data-2

Data Loading Files with Contents

Material.bad	13/02/2003 8:55 PM	BAD File	1 KB
Material.bat	24/10/2003 7:29 PM	Windows Batch File	1 KB
Material.ctl	26/09/2002 3:16 PM	Visual Basic User ...	1 KB
Material.log	13/02/2003 8:55 PM	Text Document	3 KB
Material.txt	26/09/2002 3:13 PM	Text Document	3,807 KB
TableScriptStu.sql	24/10/2003 7:30 PM	Microsoft SQL Ser...	1 KB

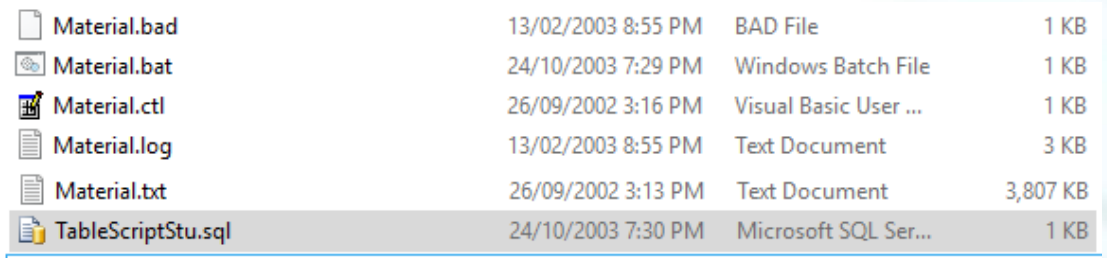
Material.txt - Notepad

File Edit Format View Help

```
" BA-075","       SIDE DISCHARGE GRASS BAG","     028877323220","46610",
$32.47,$0.00,,,"Old"
" DW368",,,,,,,$0.00,$0.00,,,"New"
"1","7 1/4 BULK 40TH CARIBIDE SAW BLADE",,"0","0","0",30,$0.00,$0.00,0,
"1.00E-01","LIDTY STAPLE GUN",,"10000","38000","60400001",30,$0.01,$0.0
"1.00E-07","HAND STAPLE GUN CASE CUT","030007040006","0","0","0",30,$0
"100","8X12 CARPENTER SQ",,"02000","51000","44200000",10,$1.88,$0.00,0,
"1000","4SKU CAR SAW MERCH","067607310000","18000","37000","39300001",1
"1000    E","HAND STAPLE GUN","030007040006","0","0","0",30,$0.00,$0.00
"1000    F","HAND STAPLE GUN",,"0","0","0",30,$0.00,$0.00,0,"0","Old"

"1000/203","OUR OWN PACK","028874015470","0","0","0",30,$0.00,$0.00,0,"
"10000","SANDPAPER PRE PACK","067607410007","18000","37000","39300001"
```

Sample Example to Load Data-2

Data Loading Files with Contents



Material.bad	13/02/2003 8:55 PM	BAD File	1 KB
Material.bat	24/10/2003 7:29 PM	Windows Batch File	1 KB
Material.ctl	26/09/2002 3:16 PM	Visual Basic User ...	1 KB
Material.log	13/02/2003 8:55 PM	Text Document	3 KB
Material.txt	26/09/2002 3:13 PM	Text Document	3,807 KB
TableScriptStu.sql	24/10/2003 7:30 PM	Microsoft SQL Ser...	1 KB

TableScriptStu.sql - Notepad

File Edit Format View Help

```
create table TMP_Material
(BDSKU            VARCHAR2(255),
BDDescrip         VARCHAR2(255),
BDUPC             VARCHAR2(255),
BDMainProdGrp     VARCHAR2(255),
BDProdGroup       VARCHAR2(255),
BDSubProdGrp      VARCHAR2(255),
BDDivision        VARCHAR2(255),
BDSysCost         VARCHAR2(255),
BDBasePrice       VARCHAR2(255),
BDCurrentInv      VARCHAR2(255),
BDSalesStatus     VARCHAR2(255),
Remarks           VARCHAR2(255)
);

create table Material
(BDSKU            VARCHAR2(15),
```

Sample Example to Load Data-2

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Sample Example to Load Data-3

Sample Example to Load Data-3

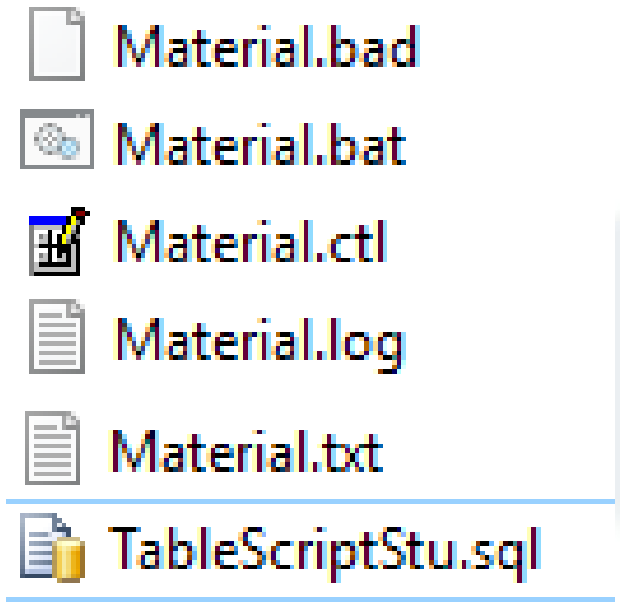
Example's Contents

- Executing Data Loading for Material (for Slide#195)
- Data Migration - Files to Database

Sample Example to Load Data-3

Executing Data Loading for Material

We will execute SQLLDR command to load data of material into scott's schema



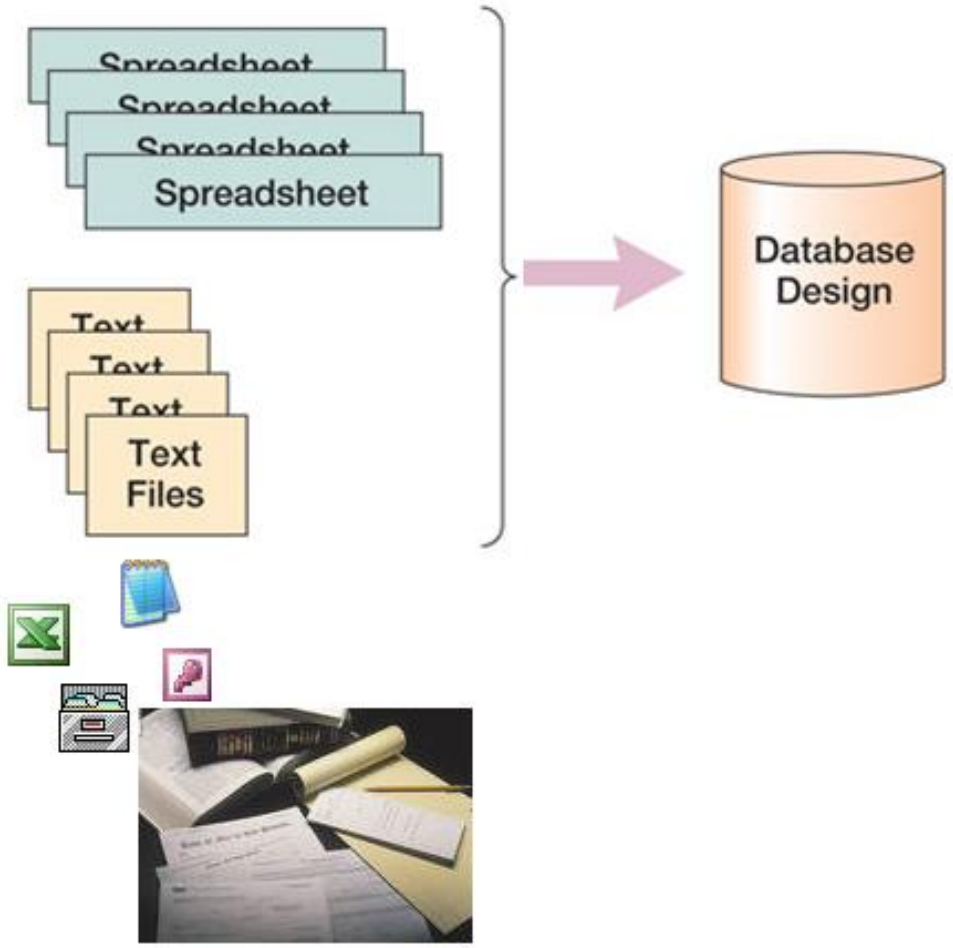
Material.bat - Notepad

File Edit Format View Help

```
SQLLDR user/password CONTROL=c:\test\Material.ctl LOG=c:\test\Material.log BAD=c:\test
\Material.bad DATA=c:\test\Material.txt
```

Sample Example to Load Data-3

Data Migration – Files to Database



Sample Example to Load Data-3

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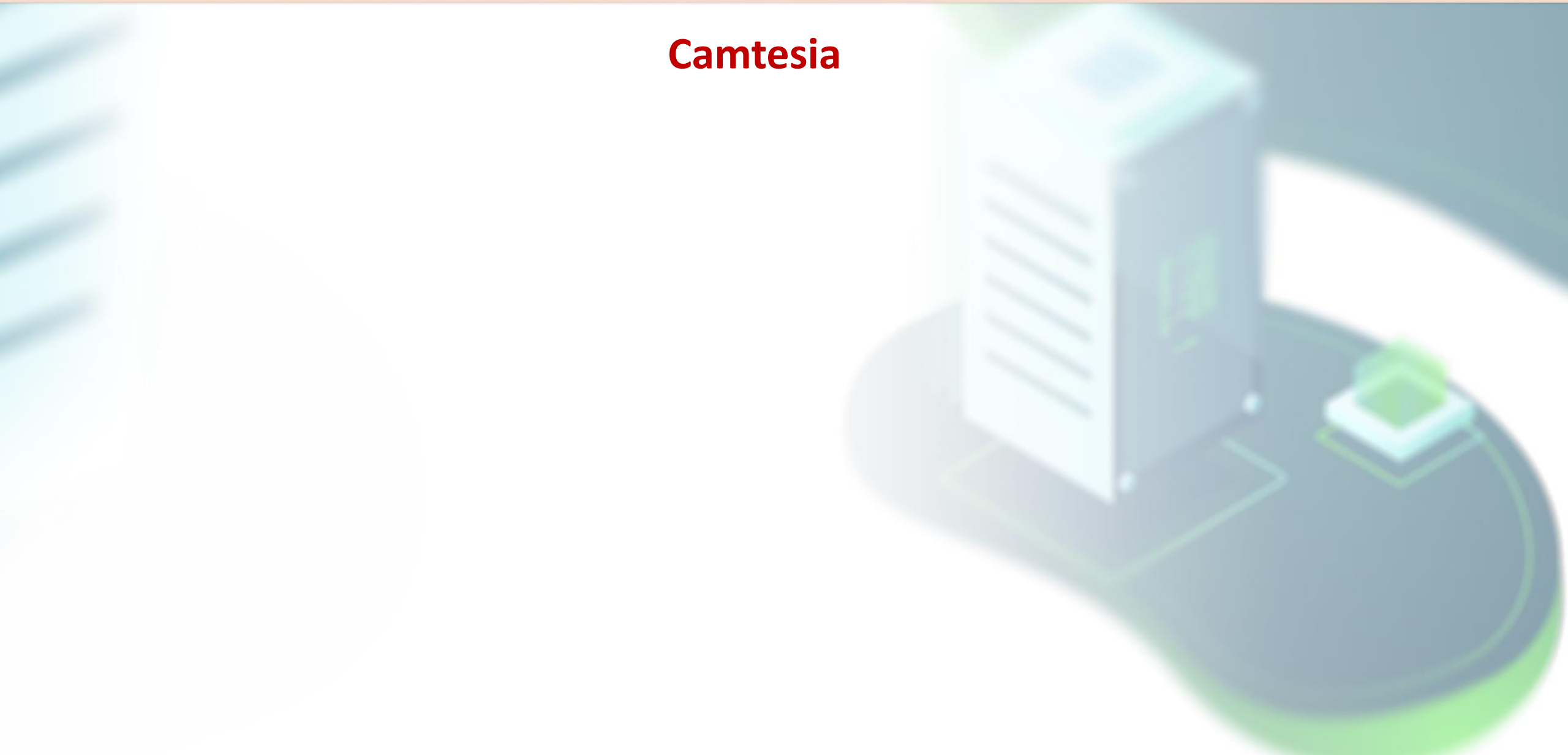

Sample Example to Load Data-4

Sample Example to Load Data-4

Data Loading Tasks in Schema

- Loading data from TEMP to actual Material Table
- Tasks to load data from TEMP to actual Material Table

Sample Example to Load Data-4

Loading data from TEMP to actual Material Table

- You have data in TMP_Material and you want to move or copy data into Material Table

Sample Example to Load Data-4

Tasks to load data from TEMP to actual Material Table

- Use INSERT INTO … SELECT command
- Understand an error
- See where data discrepancies are found
- Run SQL UPDATE statements to fix discrepancies

Sample Example to Load Data-4

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Sample Example to Load Data-5

Sample Example to Load Data-5

Data Loading Tasks using MS Access

- Tasks to Connect MS Access & Oracle
- Choosing MS Access by Connecting with Oracle Schema
- Link Tables of MS Access & Oracle Schema

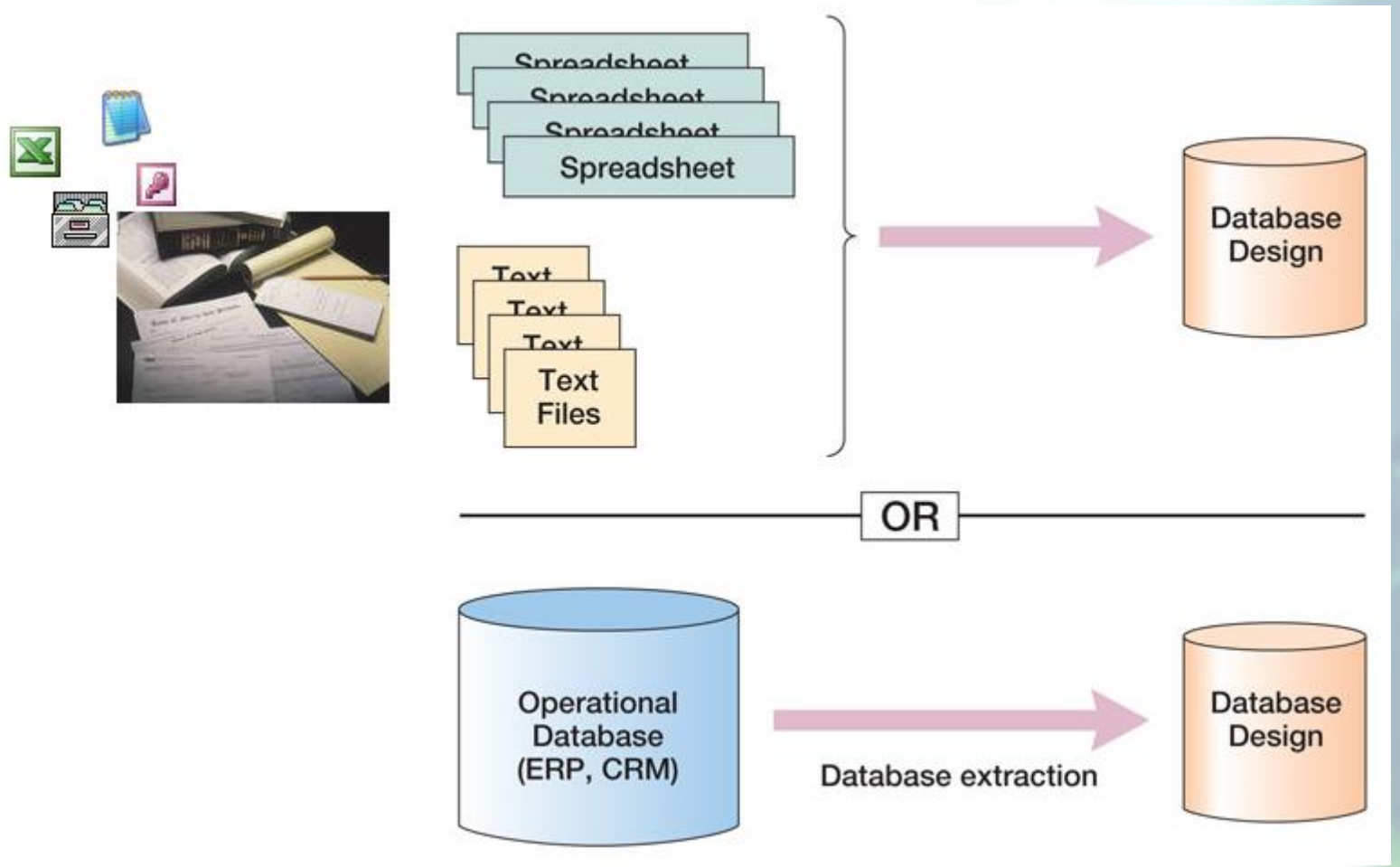
Sample Example to Load Data-5

Tasks to Connect MS Access & Oracle

- Create ODBC data source of Oracle with use scott
- Open sample MS Access File and connect it with ODBC source user scott
- Link or data import is possible in MS Access
- Data can be inserted from MS Access into Oracle schema scott

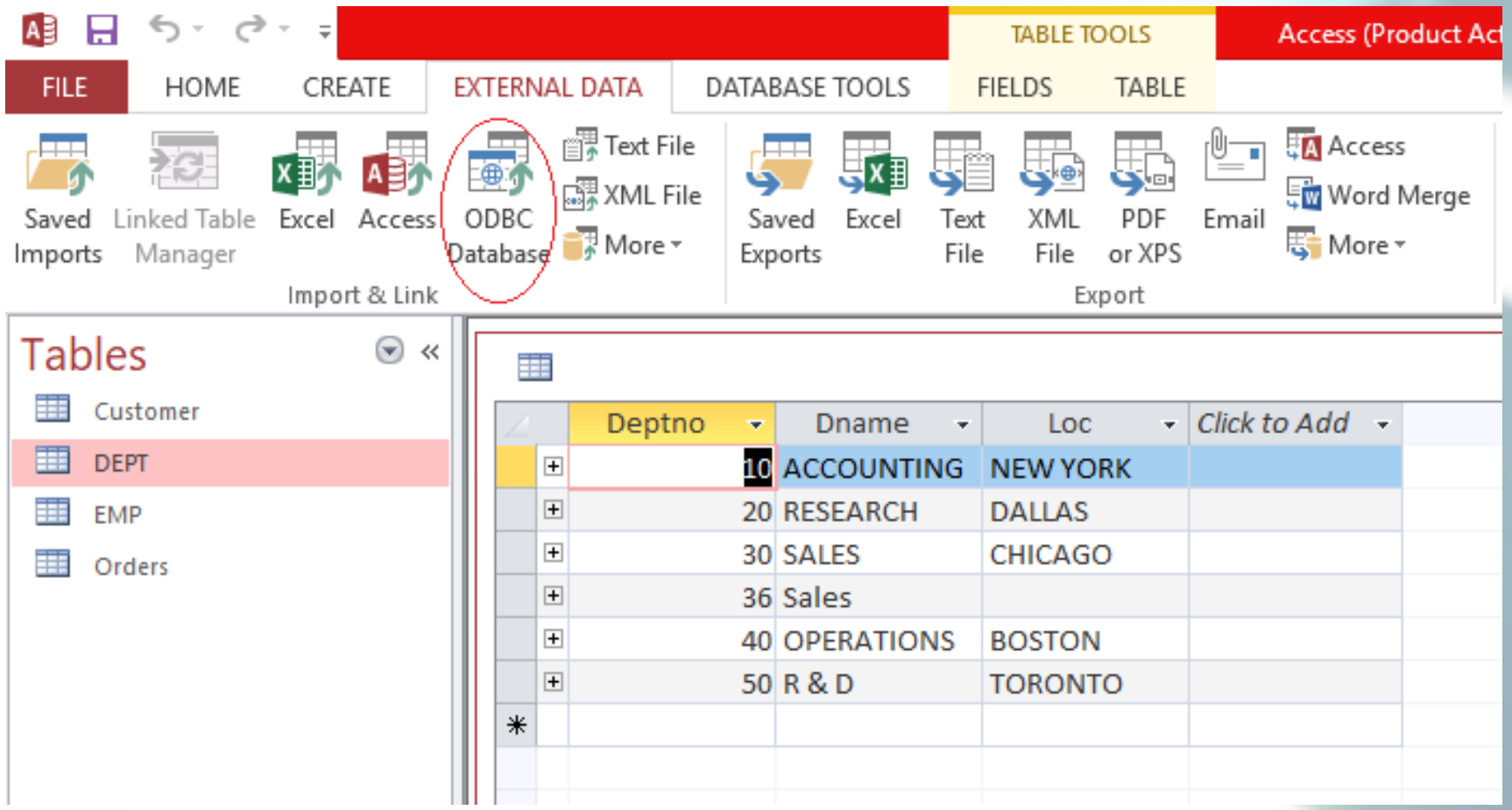
Sample Example to Load Data-5

Choosing MS Access by Connecting with Oracle Schema



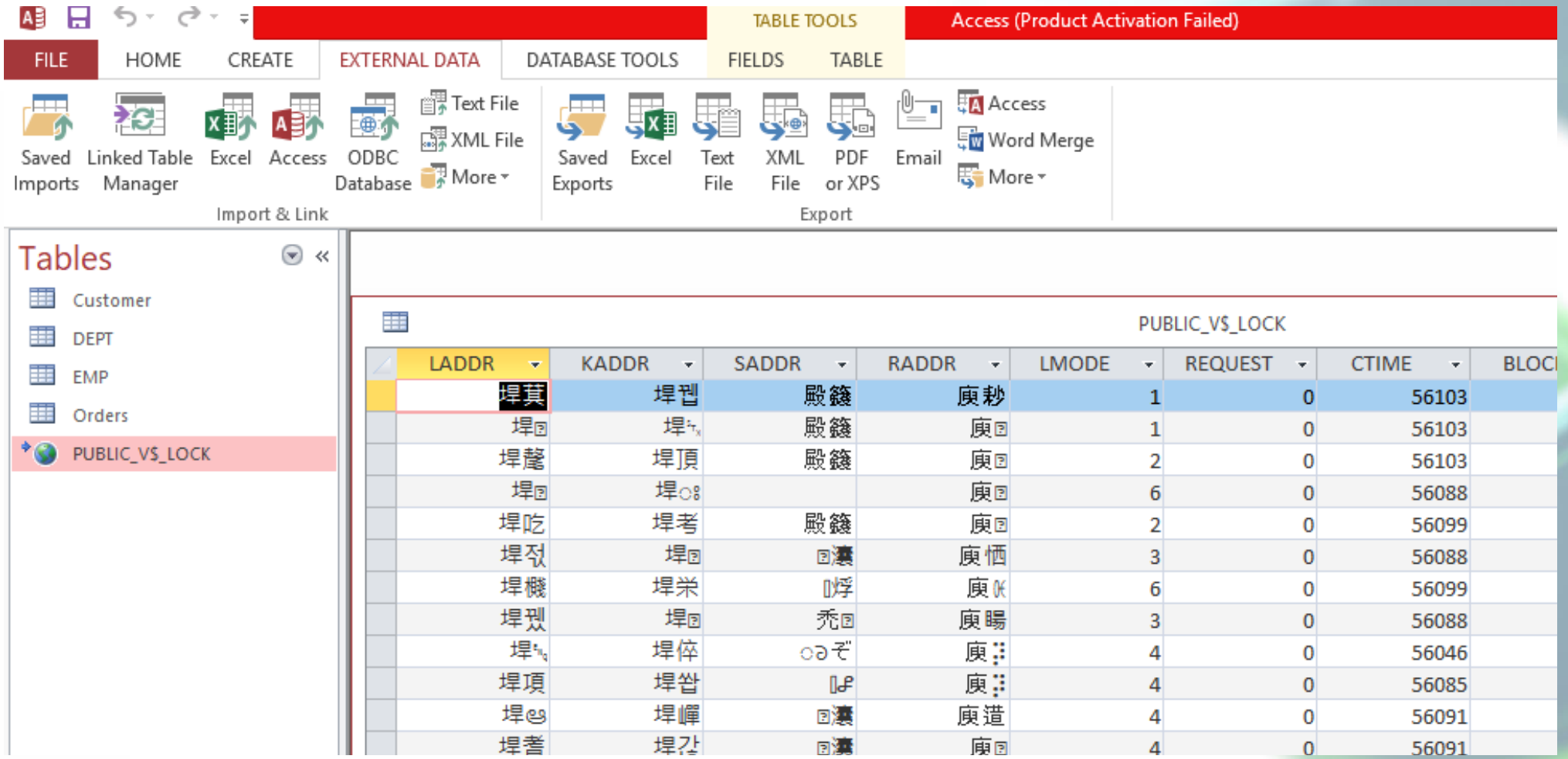
Sample Example to Load Data-5

Link Tables of MS Access & Oracle Schema



Sample Example to Load Data-5

Link Tables of MS Access & Oracle Schema



Sample Example to Load Data-5

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Sample Example to Load Data-6

Sample Example to Load Data-6

Data Loading Tasks for Schema to Schema/ Files using Text Files

- Preparing Spool File of Schema's Table using SQL
- Data Load from Oracle Schema into Files

Sample Example to Load Data-6

Preparing Spool File of Schema's Table using SQL

- In Scott schema
  - Spool c:\test\emp.txt
  - Select … from EMP;
  - Spool off
- Spool file contains comma delaminated rows
- File can be used to load data into any DBMS

Sample Example to Load Data-6

Data Load from Oracle Schema into Files

Sample Example to Load Data-6

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Sample Example to Load Data-7

Sample Example to Load Data-7

Data Preparation for Tasks using XML data

- Preparing Spool File of Schema's Table using XML SQL
- Sample SQL using XML Elements
- Data Load from Oracle Schema into Files
- Output Results of Sample XML SQLs

Sample Example to Load Data-7

Preparing Spool File of Schema's Table using XML SQL

- In Scott schema
  - Spool c:\test\emp.txt
  - XML: Select … from EMP;
  - Spool off
- Spool file contains XML-taged rows
- File can be used to load data into any DBMS

Sample Example to Load Data-7

Sample SQL using XML Elements

```
select xmlelement(name "emp",
      xmlelement(name "eno",empno),
      xmlelement(name "names",ename))
XML_output
from emp
/
```

Sample Example to Load Data-7

Sample SQL using XML Elements

```
create table XML1 as
select xmlelement("EMP",
      xmlelement("empno",e.empno),
      xmlelement("ename",e.ename),
      xmlelement("job", e.job),
      xmlelement("mgr", e.mgr),
      xmlelement("mgr1", e.mgr)) xml_desc
from emp e
where rownum<=1;
```

Sample Example to Load Data-7

Data Load from Oracle Schema into Files

Sample Example to Load Data-7

Output Results of Sample XML SQLs

```
SQL> select xmlelement(name "emp",
  2         xmlelement(name "eno",empno),
  3         xmlelement(name "names",ename)) XML_output
  4  from emp
  5  /

XML_OUTPUT
--------------------------------------------------------
<emp><eno>1234</eno><names></names></emp>
<emp><eno>8822</eno><names>ABC</names></emp>
<emp><eno>3513</eno><names>XYZ</names></emp>
<emp><eno>7369</eno><names>SMITH</names></emp>
<emp><eno>7499</eno><names>ALLEN</names></emp>
<emp><eno>7521</eno><names>WARD</names></emp>
<emp><eno>7566</eno><names>JONES</names></emp>
<emp><eno>7654</eno><names>MARTIN</names></emp>
<emp><eno>7698</eno><names>BLAKE</names></emp>
<emp><eno>7782</eno><names>CLARK</names></emp>
<emp><eno>7788</eno><names>SCOTT</names></emp>
```

```
SQL> create table XML1 as
  2  select xmlelement("EMP",
  3         xmlelement("empno",e.empno),
  4         xmlelement("ename",e.ename),
  5         xmlelement("job", e.job),
  6         xmlelement("mgr", e.mgr),
  7         xmlelement("mgr1", e.mgr)) xml_desc
  8  from emp e
  9  where rownum<=1;

Table created.

SQL> select * from XML1;

XML_DESC
--------------------------------------------------------------------------------
<EMP><empno>1234</empno><ename></ename><job></job><mgr></mgr><mgr1></mgr1></EMP>
```

Sample Example to Load Data-7

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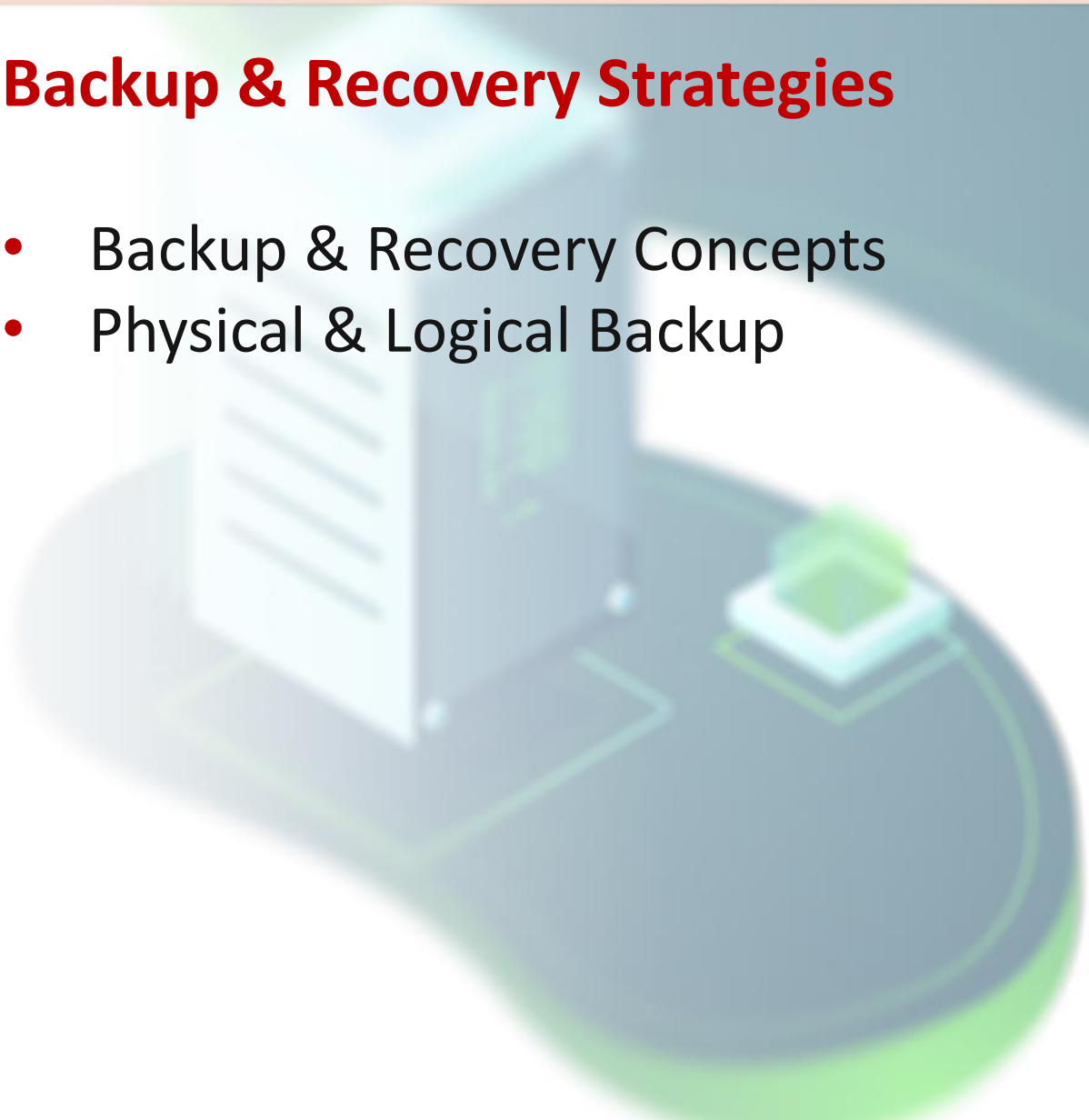
Introduction to Database Administration

Backup & Recovery Strategies

Backup & Recovery Strategies

- Backup & Recovery Concepts
- Physical & Logical Backup



Backup & Recovery Strategies

Back & Recovery Concepts

- Backup and recovery is the set of concepts, procedures, and strategies involved in protecting the database against data loss caused by media failure or users errors.
- In general, the purpose of a backup and recovery strategy is to protect the database against data loss and reconstruct lost data.

Backup & Recovery Strategies

Back & Recovery Concepts

- A backup is a copy of data. A backup can include crucial parts of the database such as data files, the server parameter file, and control file. A sample backup and recovery scenario is a failed disk drive that causes the loss of a data file.
- If a backup of the lost file exists, then you can restore and recover it. Media recovery refers to the operations involved in restoring data to its state before the loss occurred.

Backup & Recovery Strategies

Physical & Logical Backup

- Backups can be divided into physical backups and logical backups.
- Physical backups are backups of the physical files used in storing and recovering your database, such as datafiles, control files, and archived redo logs. Ultimately, every physical backup is a copy of files storing database information to some other location, whether on disk or some offline storage such as tape.

Backup & Recovery Strategies

Physical & Logical Backup

- Logical backups contain logical data (for example, tables or stored procedures) exported from a database with an Oracle export utility and stored in a binary file, for later re-importing into a database using the corresponding Oracle import utility.

Backup & Recovery Strategies

Physical & Logical Backup

- Physical backups are the foundation of any sound backup and recovery strategy.
- Logical backups are a useful supplement to physical backups in many circumstances but are not sufficient protection against data loss without physical backups.

Backup & Recovery Strategies

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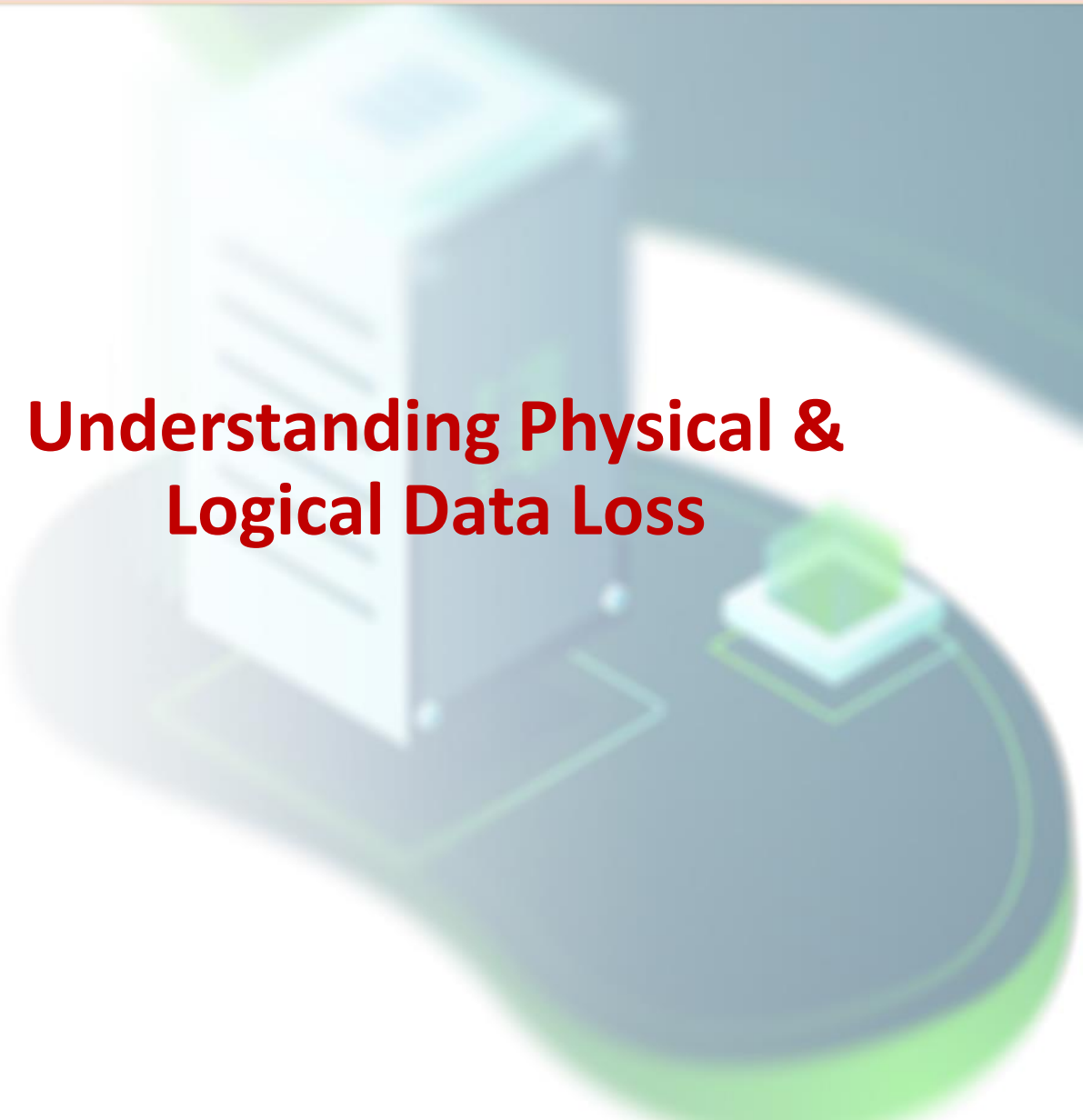
Introduction to Database Administration



Understanding Physical & Logical Data Loss

Understanding Physical & Logical Data Loss

Understanding Physical & Logical Data Loss

- Errors & Failures
- Understanding User Error
- Understanding Media Failure

Understanding Physical & Logical Data Loss

Errors & Failures

- While there are several types of problem that can halt the normal operation of an Oracle database or affect database I/O operations, only two typically require DBA intervention and media recovery: media failure, and user errors.

Understanding Physical & Logical Data Loss

Errors & Failures

- Other failures may require DBA intervention to restart the database (after an instance failure) or allocate more disk space (after statement failure due to, for instance, a full datafile) but these situations will not generally cause data loss or require recovery from backup.

Understanding Physical & Logical Data Loss

Understanding User Error

- User errors occur when, either due to an error in application logic or a manual mis-step, data in your database is changed or deleted incorrectly.
- Data loss due to user error includes such missteps as dropping important tables or deleting or changing the contents of a table.

Understanding Physical & Logical Data Loss

Understanding User Error

- While user training and careful management of privileges can prevent most user errors, your backup strategy determines how gracefully you recover the lost data when user error does cause data loss.

Understanding Physical & Logical Data Loss

Understanding Media Failure

- A **media failure** is the failure of a read or write of a disk file required to run the database, due to a physical problem with the disk such as a head crash. Any database file can be vulnerable to a media failure.
- The appropriate recovery technique following a media failure depends on the files affected and the types of backup available.

Understanding Physical & Logical Data Loss

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Introduction to Database Administration

Full Logical Backup

Full Logical Backup

Full Logical Backup

- Logical Backup
- Logical Backup Entire Applications
- Outcome of Logical Backup
- Periodic Logical Backup

Full Logical Backup

Logical Backup

- A logical backup copies data, but not physical files, from one location to another. A logical backup is used to move or archive a database, tables, or schemas and to verify database structures.

Full Logical Backup

Logical Backup Entire Applications

A full logical backup enables you to copy these items across environments that use different components, such as operating systems:

Entire applications

Data repositories such as the Oracle Hyperion Shared Services Registry and Oracle Essbase cubes

Individual artifacts such as scripts, data forms, and rule files

Full Logical Backup

Outcome of Logical Backup

A logical export backup generates necessary Structured Query Language (SQL) statements to obtain all table data that is written to a binary file.

A logical export backup does not contain database instance-related information, such as the physical disk location, so you can restore the same data on another database machine.

Full Logical Backup

Periodic Logical Backup

Periodic logical export backups (at least weekly) are recommended in case physical backups fail or the database machine becomes unavailable.

Full Logical Backup

Logical Backup using EXPORT

```
E:\app\Haider\product\11.2.0\dbhome_1\BIN>exp

Export: Release 11.2.0.1.0 - Production on Wed Nov 11 19:29:15 2020

Copyright (c) 1982, 2009, Oracle and/or its affiliates.  All rights reserved.


Username: scott/tiger

Connected to: Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 - Production
With the Partitioning, OLAP, Data Mining and Real Application Testing options
Enter array fetch buffer size: 4096 >

Export file: EXPDAT.DMP > c:\t1.dmp

(1)E(ntire database), (2)U(sers), or (3)T(ables): (2)U >
```

Full Logical Backup

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Logical Backup of a Schema/ User

Logical Backup of a Schema/ User

Logical Backup of a Schema/ User

- Logical Backup of Schema
- Export utility for Logical Backup
- Benefits of Export Utility for Logical Backup

Logical Backup of a Schema/ User

Logical Backup of Schema

- A logical backup copies the data in the database and does not records the location of data.
- It can copy the data of schema, database and tables

Logical Backup of a Schema/ User

Export utility for Logical Backup

- The export utility (export and export pump) offered by the Oracle can be used to take logical backup.
- The export utility copies the data and database definitions, and saves in binary OS file in Oracle internal format

Logical Backup of a Schema/ User

Benefits of Export Utility for Logical Backup

- Data block corruption can be detected while exporting data and export procedure will fail.
- If use drops some table and it will recover from import command.
- What data and definition/ structure can be exported?
- Portable backup, can be imported in same or higher version of Oracle database.

Logical Backup of a Schema/ User

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Logical Backup of Schema Contents Tables

Logical Backup of Schema Contents Tables

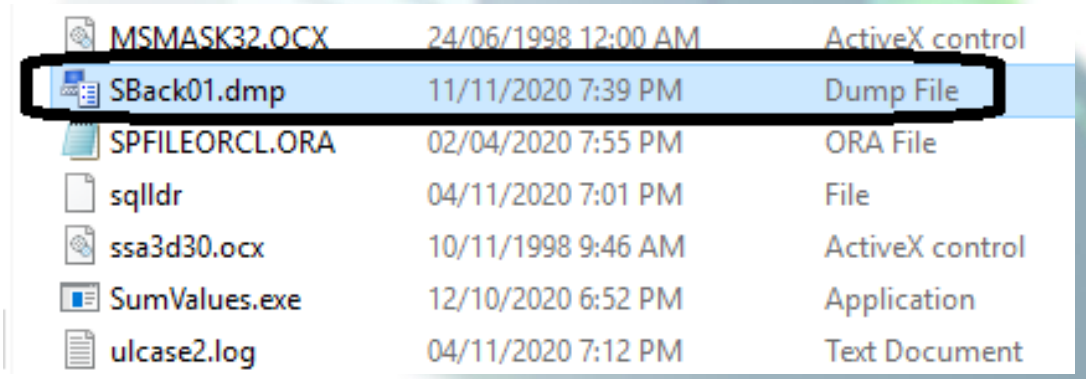
Logical Backup of Schema Contents Tables

- Logical Backup of Schema Contents Tables
- Logical Backup Full/ Tables
- Export using Full Option
- Export with Individual Table

Logical Backup of Schema Contents Tables

Logical Backup Full/ Tables

- Run export command with Full=y option.
- User will be scott/tiger
- Export data of some table



Logical Backup of Schema Contents Tables

Export using Full Option

```
E:\app\Haider\product\11.2.0\dbhome_1\BIN>exp scott/tiger full=y file=c:\test\FBack01.dmp constraints=Y

Export: Release 11.2.0.1.0 - Production on Wed Nov 11 19:49:30 2020

Copyright (c) 1982, 2009, Oracle and/or its affiliates.  All rights reserved.


Connected to: Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 - Production
With the Partitioning, OLAP, Data Mining and Real Application Testing options
Export done in WE8MSWIN1252 character set and AL16UTF16 NCHAR character set

About to export the entire database ...
. exporting tablespace definitions
. exporting profiles
. exporting user definitions
. exporting roles
. exporting resource costs
. exporting rollback segment definitions
. exporting database links
. exporting sequence numbers
. exporting directory aliases
. exporting context namespaces
. exporting foreign function library names
. exporting PUBLIC type synonyms
. exporting private type synonyms
. exporting object type definitions
. exporting system procedural objects and actions
```

Logical Backup of Schema Contents Tables

Export with Individual Table

```
Username: scott/tiger

Connected to: Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 - Production
With the Partitioning, OLAP, Data Mining and Real Application Testing options
Enter array fetch buffer size: 4096 >

Export file: EXPDAT.DMP > c:\test\emp.dmp

(1)E(ntire database), (2)U(sers), or (3)T(ables): (2)U > t

Export table data (yes/no): yes >

Compress extents (yes/no): yes >

Export done in WE8MSWIN1252 character set and AL16UTF16 NCHAR character set

About to export specified tables via Conventional Path ...
Table(T) or Partition(T:P) to be exported: (RETURN to quit) > EMP

. . exporting table                            EMP         17 rows exported
Table(T) or Partition(T:P) to be exported: (RETURN to quit) > DEPT

. . exporting table                           DEPT          4 rows exported
Table(T) or Partition(T:P) to be exported: (RETURN to quit) >

Export terminated successfully without warnings.

F:\app\Haider\product\11.2.0\dbhome_1\BIN>
```

Logical Backup of Schema Contents Tables

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Cold Physical Backup

Cold Physical Backup

Cold Physical Backup

- Cold Physical Backup
- Cold Physical Backup Files
- Performing Cold Backup

Cold Physical Backup

Cold Physical Backup

- Offline or cold backups are performed when the database is completely shutdown.
- The disadvantage of an offline backup is that it cannot be done if the database needs to be run 24/7.
- Additionally, you can only recover the database up to the point when the last backup was made unless the database is running in ARCHIVELOG mode.

Cold Physical Backup

Cold Physical Backup Files

An offline backup consists of physically copying the following files:

- Data files
- Control files
- Init.ora and config.ora files

Warning: If you make a cold backup in ARCHIVELOG mode do not backup redo log files.

Cold Physical Backup

Performing Cold Backup

- Before performing a cold backup, you need to know the location of the files that need to be backed up.
- Because the database structure changes day to day as more files get added or moved between directories, it is always better to query the database to get the physical structure of database before making a cold backup.

Cold Physical Backup

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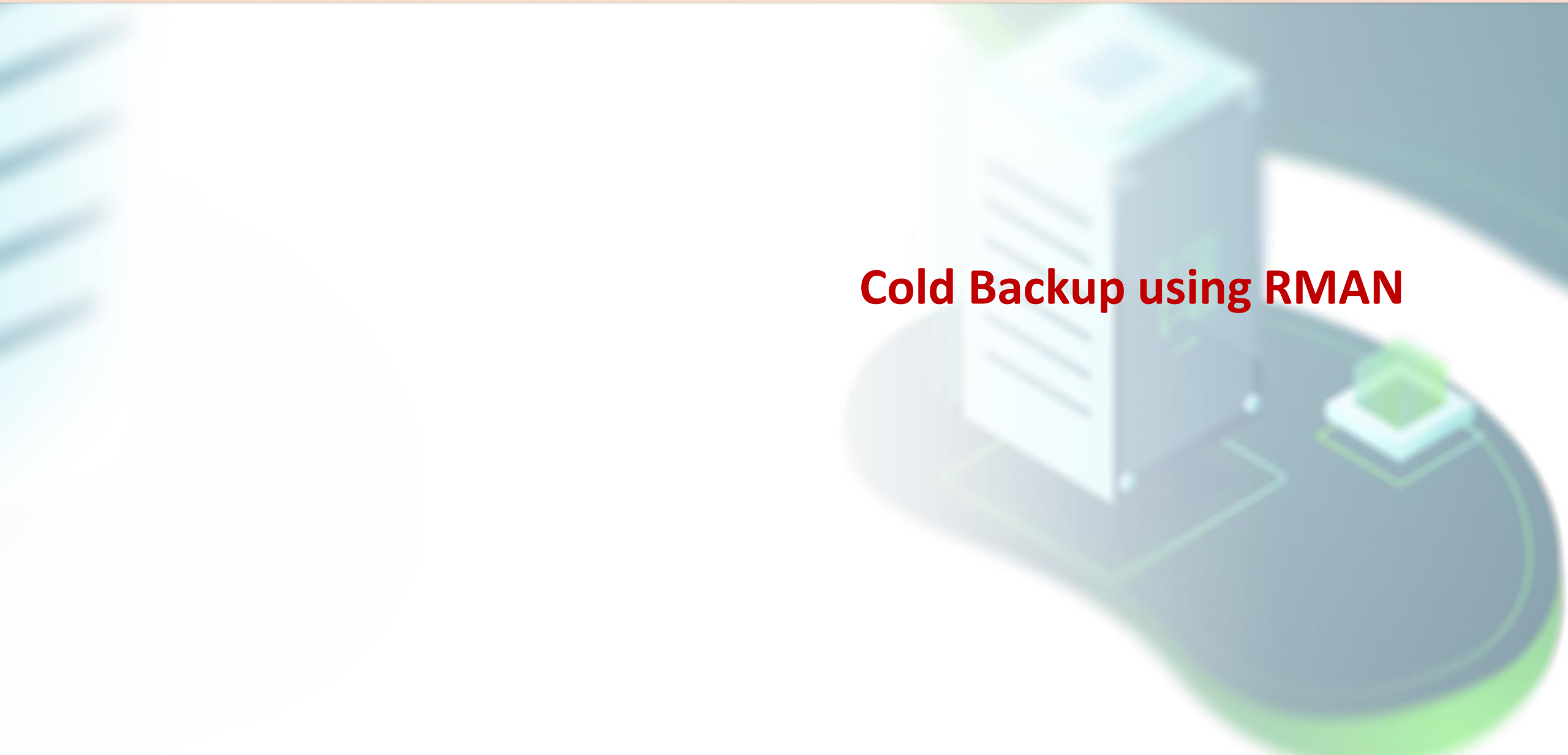

Cold Backup using RMAN

Cold Backup using RMAN

- Cold Backup using RMAN
- Start Backup using RMAN

Cold Backup using RMAN

Cold Backup using RMAN

- Keep Database in Archive Mode
- Go to location where RMAN can run

E:\app\Haider\product\11.2.0\dbhome_1
\BIN>rman target /

RMAN>show all;

Cold Backup using RMAN

Start Backup using RMAN

RMAN> Backup as Backupset database;

```
C:\>dir \rmanbackup\rman
 Volume in drive C has no label.
 Volume Serial Number is 4E83-C14F

 Directory of C:\rmanbackup\rman

11/26/2014  10:16 PM    <DIR>          .
11/26/2014  10:16 PM    <DIR>          ..
11/26/2014  10:16 PM       650,985,472 FULL_0HPOK2RP_17_1
11/26/2014  10:16 PM         7,143,424 FULL_0IPOK2TH_18_1
               2 File(s)    658,128,896 bytes
               2 Dir(s)  447,372,935,168 bytes free
```

Cold Backup using RMAN

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Introduction to Database Administration

Hot Backup Concepts

Hot Backup Concepts

- Hot Backup Concepts
- Startup Archive Mode

Hot Backup Concepts

Hot Backup Concepts

- A hot backup is taken when the database needs to run all the time.
- It is an online backup.
- All files of the database are copied and there may be changes to the database during the copy.

Hot Backup Concepts

Hot Backup Concepts

- An online backup or hot backup is also referred to as ARCHIVE LOG backup. An online backup can only be done when the database is running in ARCHIVELOG mode and the database is open.
- When the database is running in ARCHIVELOG mode, the archiver (ARCH) background process will make a copy of the online redo log file to archive backup location.

Hot Backup Concepts

Hot Backup Concepts

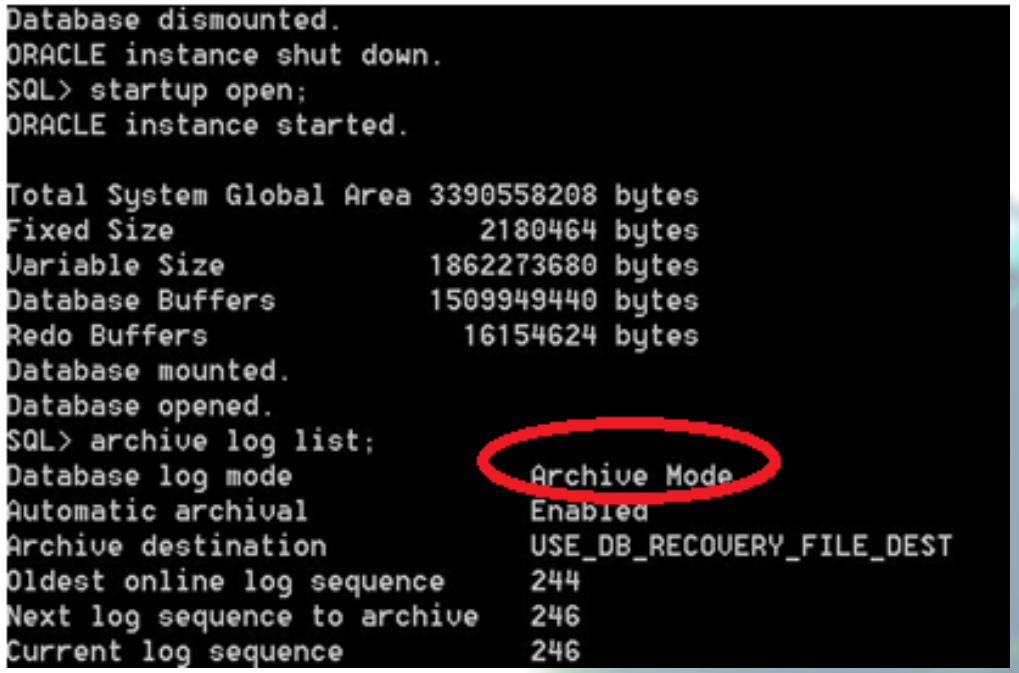
An online backup consists of backing up the following files. But, because the database is open while performing a backup, you have to follow the procedure to backup the following files:

- Data files of each tablespace
- Archived redo log files
- Control file
- Init.ora and config.ora files

Hot Backup Concepts

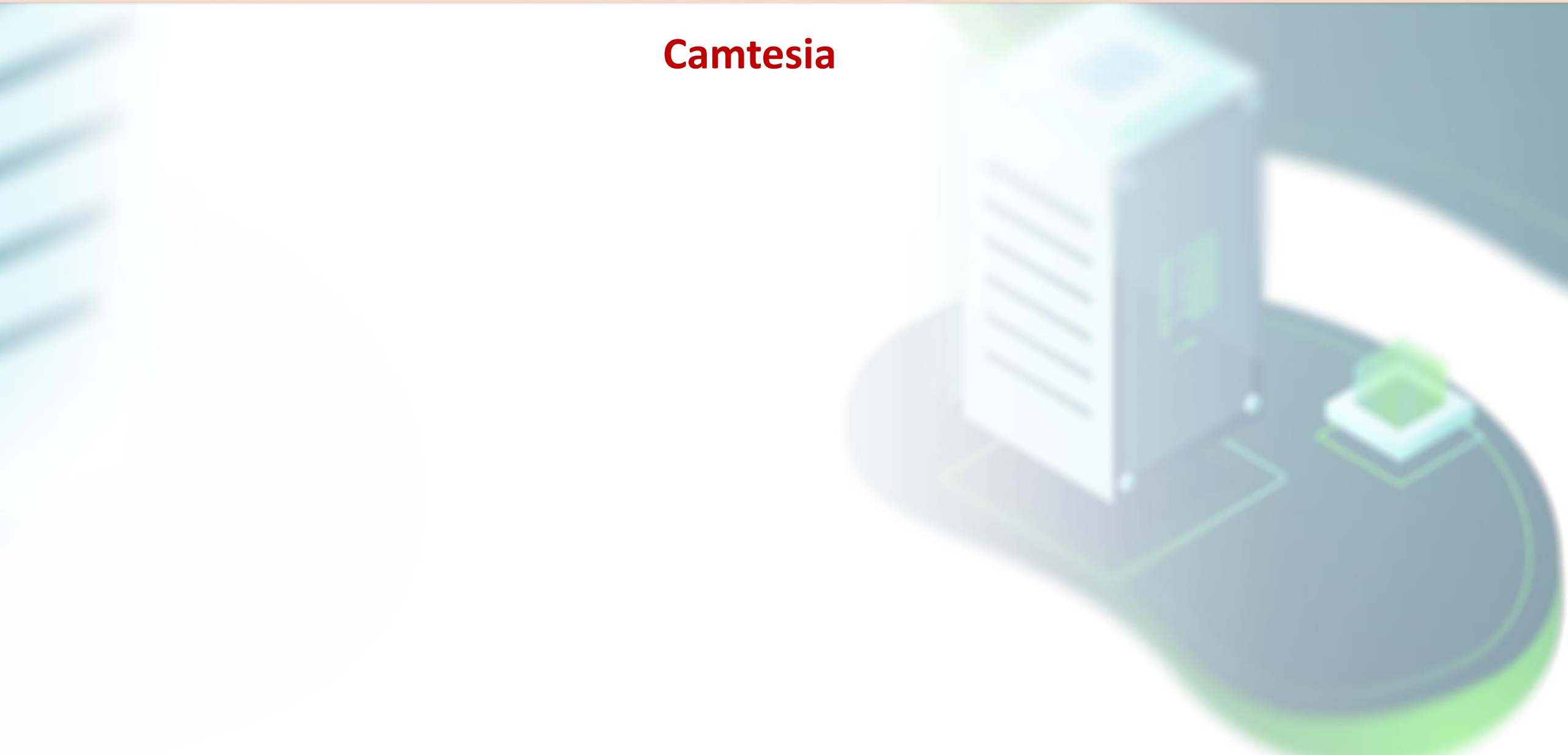
Startup Archive Mode

Shutdown database and startup NoArchive to Archive database process



Hot Backup Concepts

Camtesia



Introduction to Database Administration

Hot Backup Demo

Hot Backup Demo

Hot Backup Demo

- Hot Backup Demo
- Advise for Hot Backup

Hot Backup Demo

Hot Backup Demo

Following steps are required for Hot Backup:

- Put the tablespace in the Backup mode and copy the data files.
- Back up the control and Init.ora files.
- Stop archiving
- Back up the archive files
- Restart the archive process.

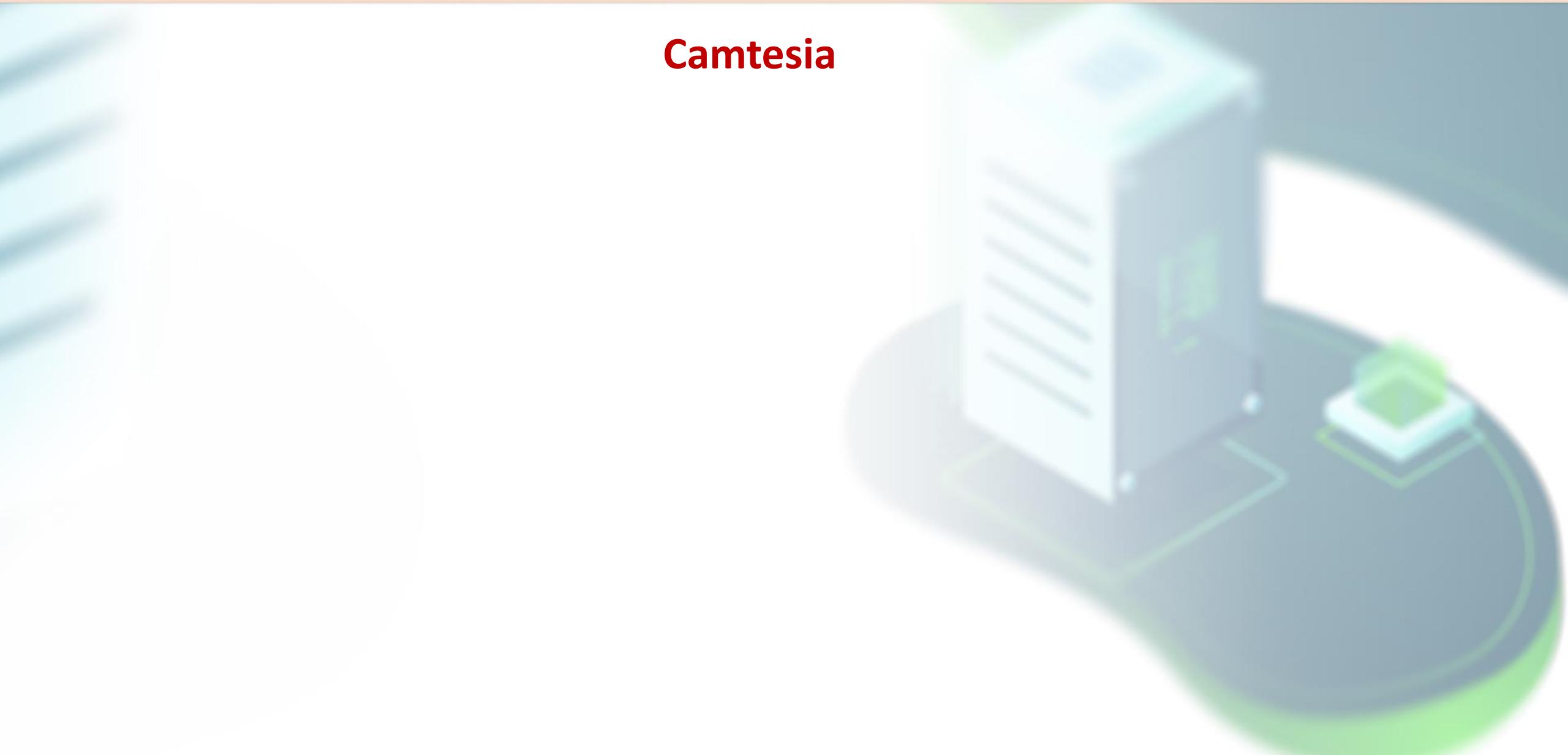
Hot Backup Demo

Advise for Hot Backup

An online backup of a database will keep the database open and functional for 24/7 operations. It is advised to schedule online backups when there is the least user activity on the database, because backing up the database is very I/O intensive and users can see slow response during the backup period. Additionally, if the user activity is very high, the archive destination might fill up very fast.

Hot Backup Demo

Camtesia



Restore from Backup using RMAN

Restore from Backup using RMAN

Restore from Backup using RMAN

- Shutdown database
- Remove files from E:\app\Haider\oradata\orcl
- Startup nomount
- Login with RMAN target /
- Restore controlfile
- Alter database mount;
- Restore database
- Recover database;
- Resetlogs & Recovered Files

Restore from Backup using RMAN

Shutdown Database

Now for recovery first off all shutdown your database using

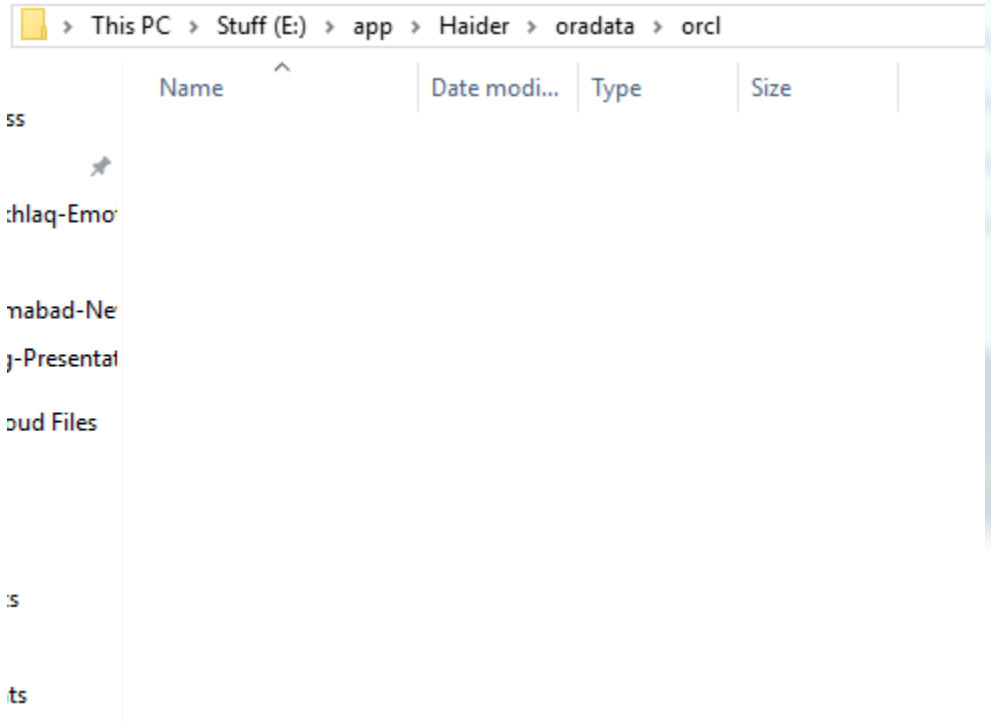
“shutdown abort”

```
RMAN> shutdown abort

using target database control file instead of recovery catalog
Oracle instance shut down
```

Restore from Backup using RMAN

Remove Files from E:\app\Haider\oradata\orcl

Now remove your database or do any change in database, here we physically removed all database files from database



Restore from Backup using RMAN

Startup nomount

```
RMAN> startup nomount;

Oracle instance started

Total System Global Area     293601280 bytes

Fixed Size                     1290208 bytes
Variable Size                146800672 bytes
Database Buffers             138412032 bytes
Redo Buffers                   7098368 bytes

RMAN>
```

Restore from Backup using RMAN

Login with RMAN target /

```
C:\oracle\product\10.2.0\db_1\bin>rman target /

Recovery Manager: Release 10.2.0.3.0 - Production on Thu Nov 27 06:58:55 2014

Copyright (c) 1982, 2005, Oracle.  All rights reserved.

connected to target database (not started)

RMAN>
```

Restore from Backup using RMAN

Restore Control Files

```
RMAN> restore controlfile from 'C:\rmanbackup\rman\FULL_0IPOK2TH_18_1';

Starting restore at 27-NOV-14
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: sid=156 devtype=DISK

channel ORA_DISK_1: restoring control file
channel ORA_DISK_1: restore complete, elapsed time: 00:00:10
output filename=C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\CONTROL01.CTL
output filename=C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\CONTROL02.CTL
output filename=C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\CONTROL03.CTL
Finished restore at 27-NOV-14
```

Restore from Backup using RMAN

Alter Database Mount

```
RMAN> alter database mount;

database mounted
released channel: ORA_DISK_1
```

Restore from Backup using RMAN

Restore Database

```
RMAN> restore database;

Starting restore at 27-NOV-14
Starting implicit crosscheck backup at 27-NOV-14
allocated channel: ORA_DISK_1
channel ORA_DISK_1: sid=156 devtype=DISK
```

Restore from Backup using RMAN

Recover Database

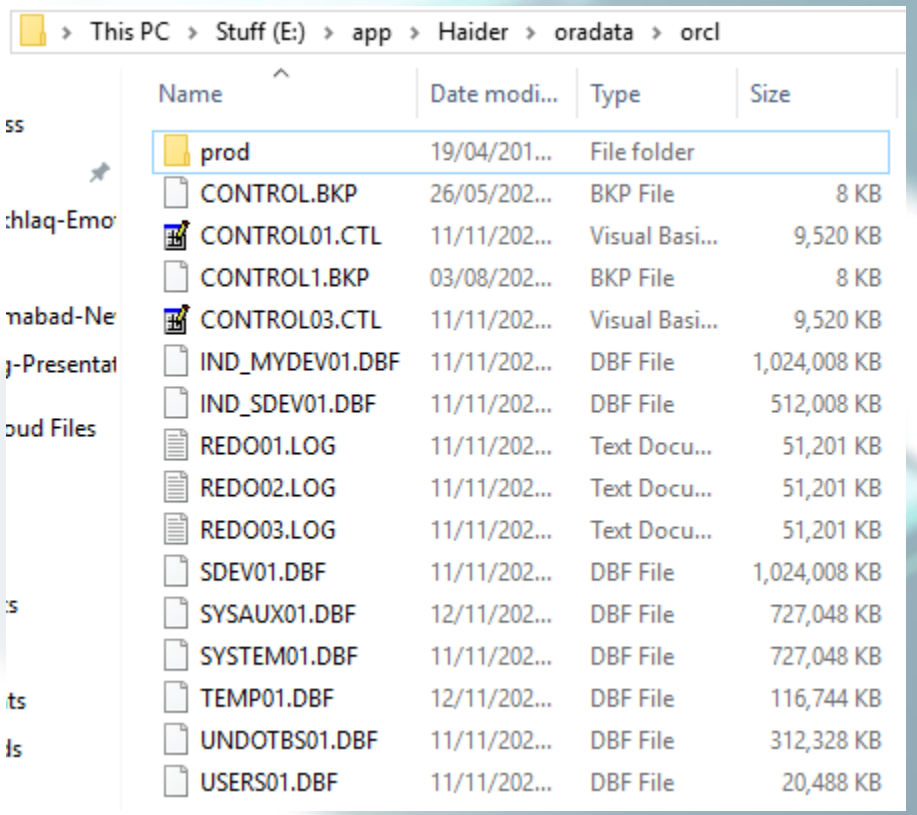
```
restoring datafile 00001 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\SYSTEM01.DBF
restoring datafile 00002 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\UNDOTBS01.DBF
restoring datafile 00003 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\SYSAUX01.DBF
restoring datafile 00004 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\ORCL\USERS01.DBF
restoring datafile 00005 to C:\ORACLE\PRODUCT\10.2.0\DB_1\ORADATA\TBS_PERM_04.DA
T
restoring datafile 00006 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\WORK01.DBF
restoring datafile 00007 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\WORK02.DBF
restoring datafile 00008 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\MCARE_PVISIT01.DBF
restoring datafile 00009 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\MCARE_MEDLAB01.DBF
restoring datafile 00010 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\MCARE_INDX01.DBF
restoring datafile 00011 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\TESTING01.DBF
restoring datafile 00012 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\MED_PHARMA01.DBF
restoring datafile 00013 to C:\ORACLE\PRODUCT\10.2.0\ORADATA\MED_INDX01.DBF
channel ORA_DISK_1: reading from backup piece C:\RMANBACKUP\RMAN\FULL_0HPOK2RP_1
7_1
channel ORA_DISK_1: restored backup piece 1
piece handle=C:\RMANBACKUP\RMAN\FULL_0HPOK2RP_17_1 tag=TAG20141126T221521
channel ORA_DISK_1: restore complete, elapsed time: 00:04:25
Finished restore at 27-NOV-14

RMAN>
```

```
RMAN> recover database;

Starting recover at 27-NOV-14
using channel ORA_DISK_1

starting media recovery
```

Restore from Backup using RMAN

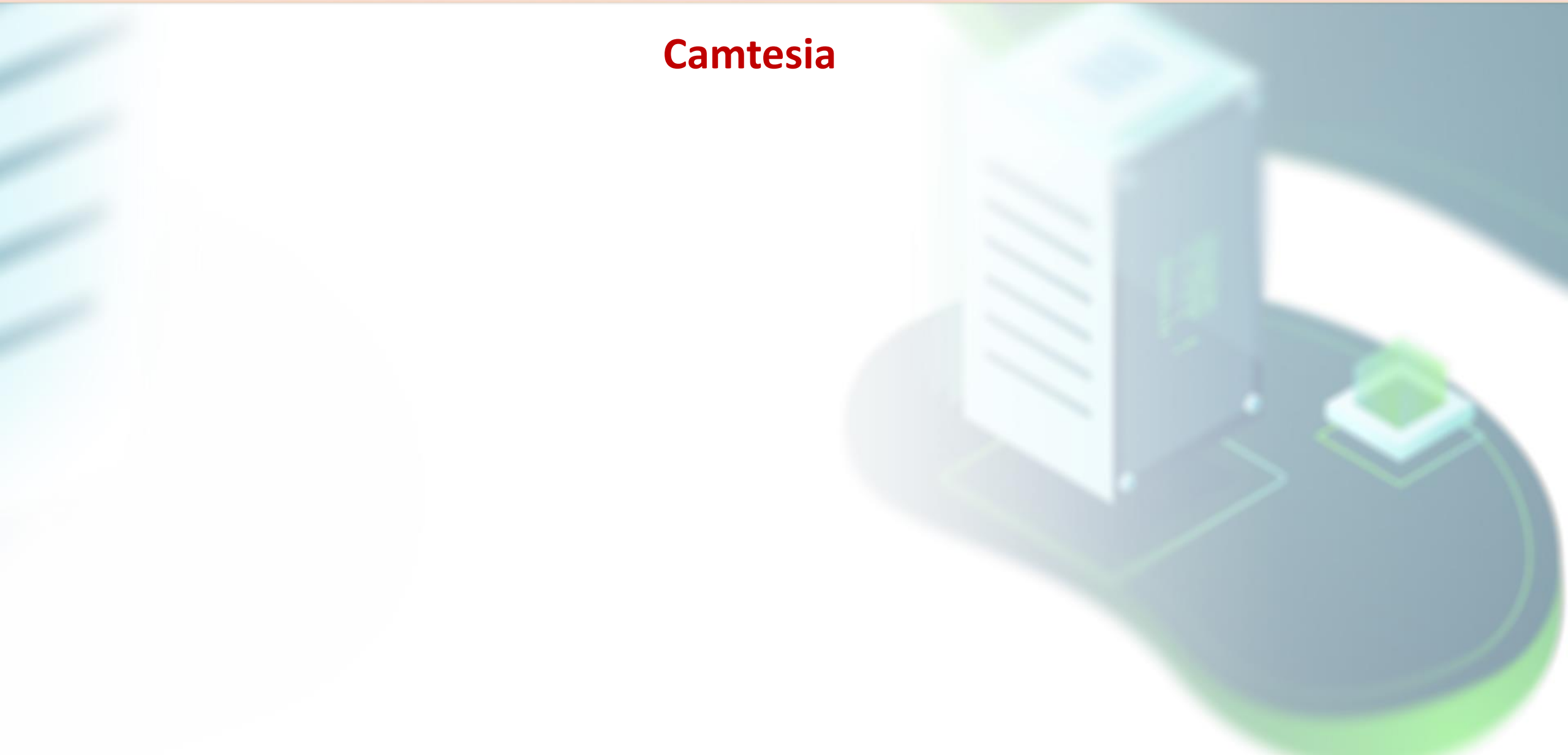
Resetlogs & Recovered Files

```
RMAN> alter database open resetlogs;

database opened

RMAN> _
```



Restore from Backup using RMAN

Camtesia



Partial Restore Logical Backup

Partial Restore Logical Backup

Partial Restore Logical Backup

- Partial Restore Logical Backup
- Steps Partial Restore Logical Backup
- Partial Restore Tablespace
- Restore Archive Logs

Partial Restore Logical Backup

Partial Restore Logical Backup

- A partial database backup includes a subset of the database: individual tablespaces or data files.
- A tablespace backup is a backup of all the data files in a tablespace or in multiple tablespaces.

Partial Restore Logical Backup

Partial Restore Logical Backup

- Tablespace backups, whether consistent or inconsistent, are valid only if the database is operating in ARCHIVELOG mode because redo is required to make the restored tablespace consistent with the rest of the database.

Partial Restore Logical Backup

Steps of Partial Restore Logical Backup

- Before beginning a backup of a tablespace, identify all of the datafiles in the tablespace with the DBA_DATA_FILES data dictionary view:

```
SELECT TABLESPACE_NAME, FILE_NAME
FROM SYS.DBA_DATA_FILES
WHERE TABLESPACE_NAME = 'USERS';
```

Partial Restore Logical Backup

Steps Partial Restore Logical Backup

- Mark the beginning of the online tablespace backup:
- Back up the online datafiles of the online tablespace with operating system commands
- After backing up the datafiles of the online tablespace, run the SQL statement ALTER TABLESPACE with the END BACKUP option

Partial Restore Logical Backup

Steps Partial Restore Logical Backup

- Archive the unarchived redo logs so that the redo required to recover the tablespace backup is archived

Partial Restore Logical Backup

Partial Restore Tablespace

RMAN> restore tablespace users;

RMAN> recover tablespace users;

Partial Restore Logical Backup

Restore Archive Logs

```
mkdir d:\archive
rman target /
RMAN> run {
2> set archivelog destination to
'd:\archive';
3> restore archivelog all;
4> }
```

Partial Restore Logical Backup

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Introduction to Database Administration

Complete & Incomplete Recovery

Complete & Incomplete Recovery

Complete & Incomplete Recovery

- Complete Recovery
- Incomplete Recovery
- Database point-in-time Recovery
- Requirements for DPITR
- Parents, Ancestor & Sibling Incarnations
- Database Incarnation History with Multiple Resetlogs
- DPITR Incarnations
- DPITR Commands

Complete & Incomplete Recovery

Complete Recovery

- Complete recovery applies all redo changes contained in the archived and online logs to a backup. Typically, you perform complete media recovery after a media failure damages data files or the control file. You can perform complete recovery on a database, tablespace, or data file.

Complete & Incomplete Recovery

Incomplete Recovery

- Incomplete recovery, also called database point-in-time recovery, results in a noncurrent version of the database. In this case, you do not apply all of the redo generated after the restored backup. Typically, you perform point-in-time database recovery to undo a user error when Flashback Database is not possible.

Complete & Incomplete Recovery

Incomplete Recovery

- To perform incomplete recovery, you must restore all data files from backups created before the time to which you want to recover and then open the database with the RESETLOGS option when recovery completes. Resetting the logs creates a new stream of log sequence numbers starting with log sequence 1.

Complete & Incomplete Recovery

Database point-in-time Recovery

- **Database point-in-time recovery (DBPITR)** restores the database from backups prior to the target time for recovery, then uses incremental backups and redo to roll the database forward to the target time.
- DBPITR is sometimes called **incomplete recovery** because it does not use all of the available redo or completely recover all changes to your database.

Complete & Incomplete Recovery

Database point-in-time Recovery

- The target SCN can be specified using a date and time, in which case the operation is sometimes called **time-based recovery**.

Complete & Incomplete Recovery

Requirements for DPITR

The requirements for database point-in-time recovery are as follows:

- Your database must be running in ARCHIVELOG mode.
- You must have backups of all data files from before the target SCN for DBPITR and archived redo logs for the period between the SCN of the backups and the target SCN.

Complete & Incomplete Recovery

Parents, Ancestor & Sibling Incarnations

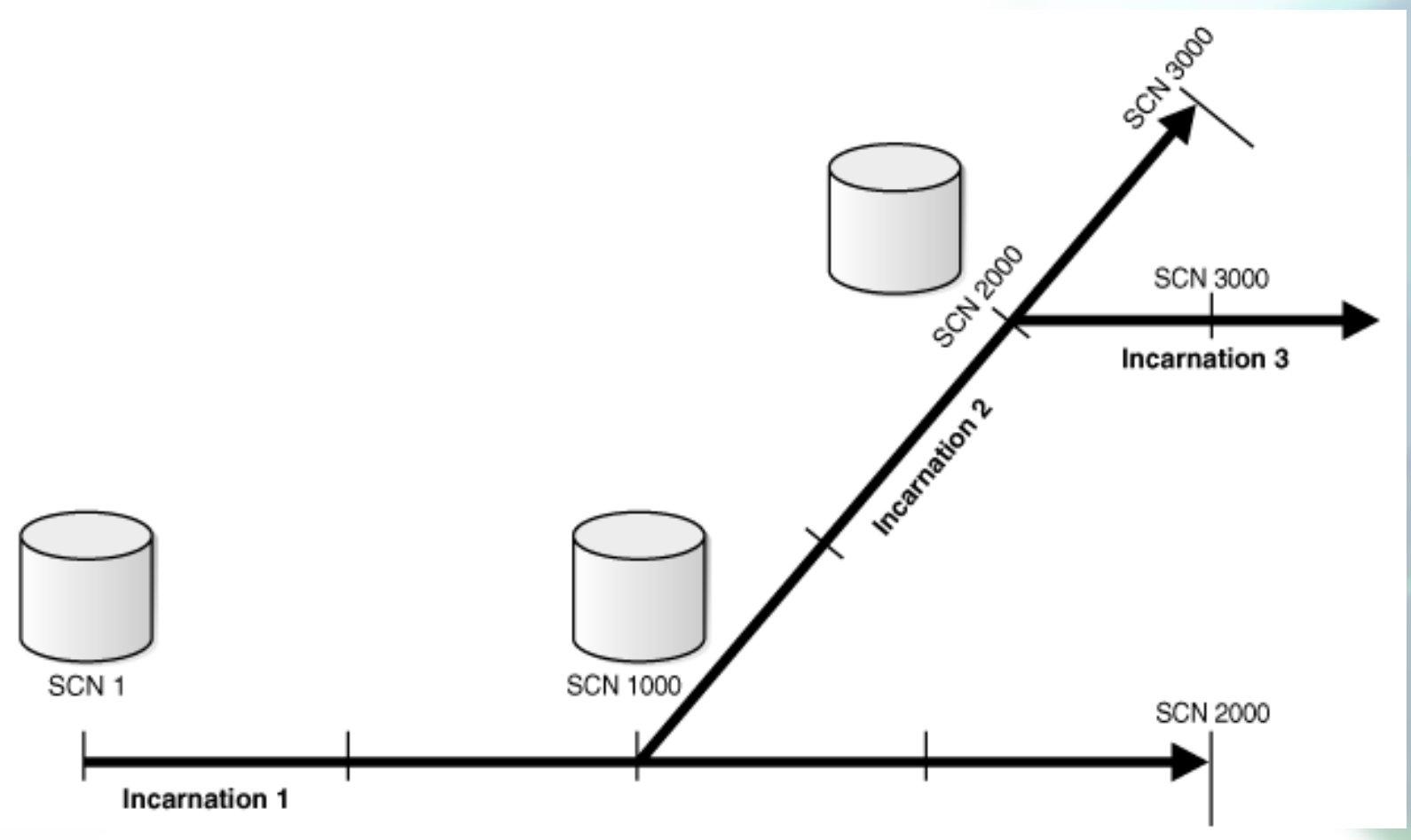
The incarnation from which the current incarnation branched following an OPEN RESETLOGS operation is called the parent incarnation of the current incarnation.

The parent incarnation and all of its parent incarnations are the ancestor incarnations of the current incarnation.

Two incarnations that share a common ancestor are sibling incarnations if neither one is an ancestor of the other.

Complete & Incomplete Recovery

Database Incarnation History with Multiple Resetlogs



Complete & Incomplete Recovery

DPITR Incarnations

The requirements for database point-in-time recovery are as follows:

- Your database must be running in ARCHIVELOG mode.
- You must have backups of all data files from before the target SCN for DBPITR and archived redo logs for the period between the SCN of the backups and the target SCN.

Complete & Incomplete Recovery

DPITR Commands

RMAN> RECOVER DATABASE TO SCN 1500;

RMAN> RESET DATABASE INCARNATION TO 1;

RMAN> RECOVER DATABASE TO SCN 1500;

Complete & Incomplete Recovery

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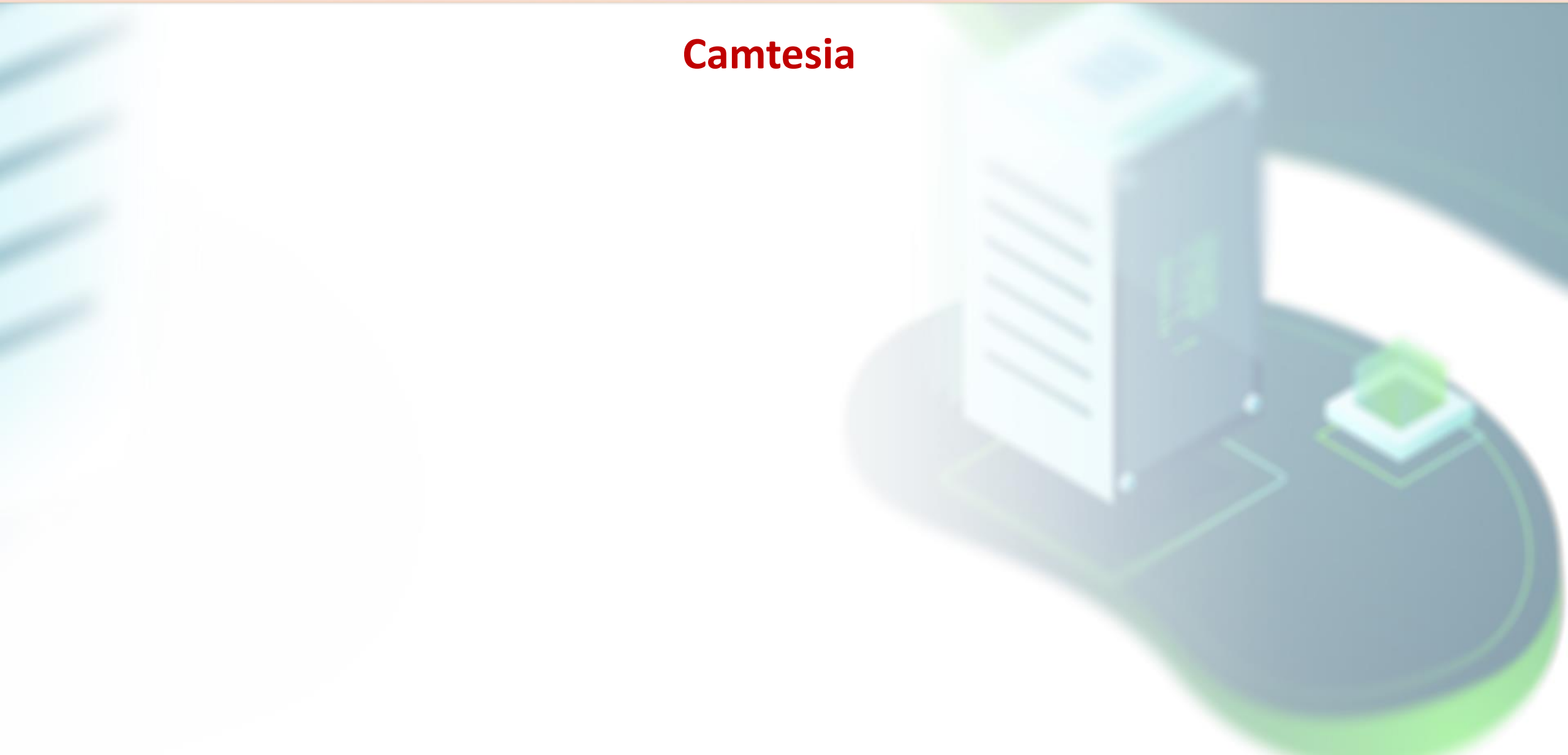


Introduction to Database Administration

Understanding of Import/ Export

Understanding of Import/ Export

Understanding of Import/ Export

- Export Utility
- Export Dump File
- Export Commands
- Import Utility
- Import Ordering
- Export Commands

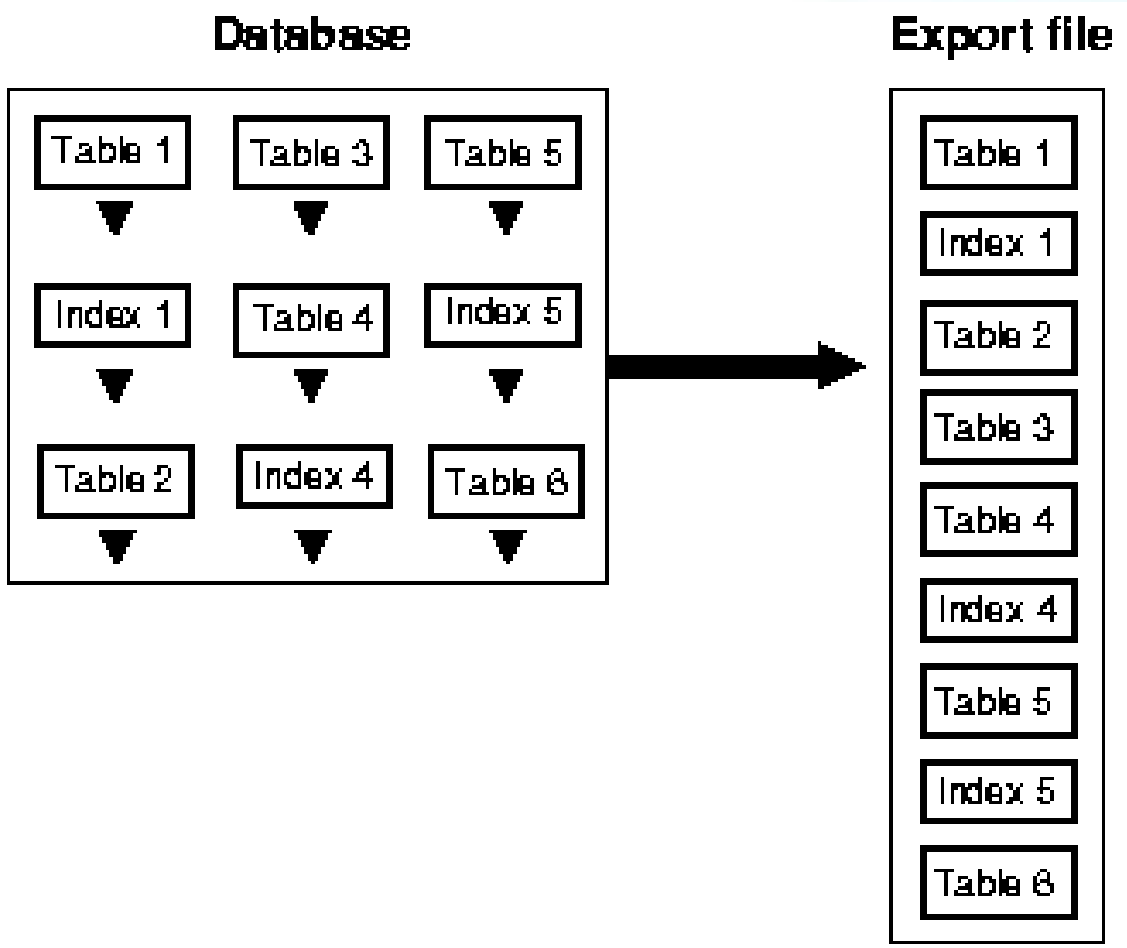
Understanding of Import/ Export

Export Utility

- The Export utility provides a simple way for you to transfer data objects between Oracle databases, even if they reside on platforms with different hardware and software configurations.
- When you run Export against an Oracle database, objects (such as tables) are extracted, followed by their related objects (such as indexes, comments, and grants), if any. The extracted data is written to an Export file.

Understanding of Import/ Export

Export Utility



Understanding of Import/ Export

Export Dump File

- An Export file is an Oracle binary-format dump file that is typically located on disk or tape. The dump files can be transferred using FTP or physically transported (in the case of tape) to a different site. The files can then be used with the Import utility to transfer data between databases that are on systems not connected through a network. The files can also be used as backups in addition to normal backup procedures.

Understanding of Import/ Export

Export Dump File

- Export dump files can only be read by the Oracle Import utility. The version of the Import utility cannot be earlier than the version of the Export utility used to create the dump file.
- You can also display the contents of an export file without actually performing an import. To do this, use the Import SHOW parameter.

Understanding of Import/ Export

Export Commands

exp PARFILE=filename

exp username/password PARFILE=filename

FULL=y FILE=dba.imp GRANTS=y INDEXES=y CONSISTENT=y

exp username/password PARFILE=params.dat INDEXES=n

exp \'username/password AS SYSDBA\'

Understanding of Import/ Export

Import Utility

- The Import utility reads the object definitions and table data from an Export dump file. It inserts the data objects into an Oracle database.

Understanding of Import/ Export

Import Ordering

The export file contains objects in the following order

1. Type definitions
2. Table definitions
3. Table data
4. Table indexes
5. Integrity constraints, views, procedures, and triggers
6. Bitmap, functional, and domain indexes

Understanding of Import/ Export

Export Commands

imp username/password PARAMETER=value

or

imp username/password PARAMETER=(value1,value2,...,valuen)

imp PARFILE=filename

imp username/password PARFILE=filename

FULL=y FILE=dbay INDEXES=y CONSISTENT=y

Introduction to Database Administration

Controlling & Configuring Import/ Export

Controlling & Configuring Import/ Export

Controlling & Configuring Import/ Export

- Error Handling
- Failed Integrity Constraints
- Invalid Data
- Errors Importing Objects
- Object Already Exists
- Sequence
- Partition Level Import

Controlling & Configuring Import/ Export

Error Handling

- If a row is rejected due to an integrity constraint violation or invalid data, Import displays a warning message but continues processing the rest of the table. Some errors, such as "tablespace full," apply to all subsequent rows in the table. These errors cause Import to stop processing the current table and skip to the next table.
- A "tablespace full" error can suspend the import if the RESUMABLE=y parameter is specified.

Controlling & Configuring Import/ Export

Failed Integrity Constraints

A row error is generated if a row violates one of the integrity constraints in force on your system, including:

- NOT NULL constraints
- Uniqueness constraints
- Primary key (not null and unique) constraints
- Referential integrity constraints
- Check constraints

Controlling & Configuring Import/ Export

Invalid Data

- Row errors can also occur when the column definition for a table in a database is different from the column definition in the export file.
- The error is caused by data that is too long to fit into a new table's columns, by invalid datatypes, or by any other INSERT error.

Controlling & Configuring Import/ Export

Errors Importing Objects

- Errors can occur for many reasons when you import database objects.
- When these errors occur, import of the current database object is discontinued. Import then attempts to continue with the next database object in the export file.

Controlling & Configuring Import/ Export

Object Already Exists

- If a database object to be imported already exists in the database, an object creation error occurs. What happens next depends on the setting of the IGNORE parameter.

- If IGNORE=n (the default), the error is reported, and Import continues with the next database object. The current database object is not replaced.

Controlling & Configuring Import/ Export

Object Already Exists

- If IGNORE=y, object creation errors are not reported. The database object is not replaced. If the object is a table, rows are imported into it. Note that only object creation errors are ignored; all other errors (such as operating system, database, and SQL errors) are reported and processing may stop.

Controlling & Configuring Import/ Export

Sequence

- If sequence numbers need to be reset to the value in an export file as part of an import, you should drop sequences.
- If a sequence is not dropped before the import, it is not set to the value captured in the export file, because Import does not drop and re-create a sequence that already exists. If the sequence already exists, the export file's CREATE SEQUENCE statement fails and the sequence is not imported.

Controlling & Configuring Import/ Export

Partition Level Import

- You can import tables, partitions, and sub-partitions in the following ways:
- Table-level Import: imports all data from the specified tables in an Export file.
- Partition-level Import: imports only data from the specified source partitions or sub-partitions.
- You must set the parameter IGNORE=y when loading data into an existing table.

End

Walkthrough Import when Table Data Exist

Walkthrough Import when Table Data Exist

Walkthrough Import when Table Data Exist

- Import When Table Already Exists

Walkthrough Import when Table Data Exist

Import when Table Already Exist

- When tables are manually created before data is imported, the CREATE TABLE statement in the export dump file will fail because the table already exists. To avoid this failure and continue loading data into the table, set the import parameter IGNORE=y. Otherwise, no data will be loaded into the table because of the table creation error or use table_exists_action=append using expdp and impdp

Walkthrough Import when Table Data Exist

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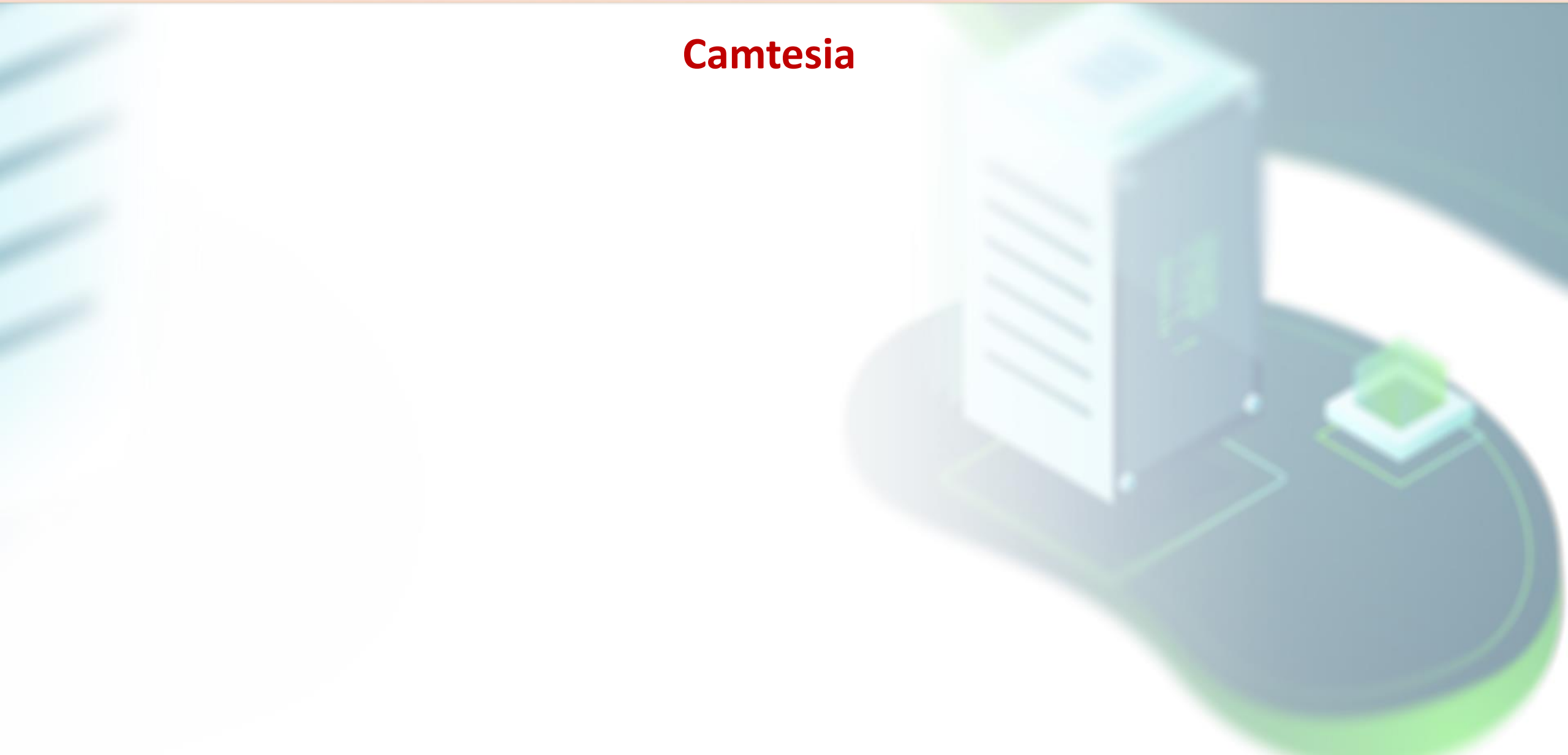


Walkthrough Import with Moving Objects

Walkthrough Import with Moving Objects

Walkthrough Import with Moving Objects

- Portal Import
- Moving Data to the Target System

Walkthrough Import with Moving Objects

Portal Import

- Create transport sets and extract the content of the transport sets to transport tables. Transport sets contain the portal objects that you want to export to your target portal environment. This information is displayed in a manifest. The manifest is a list of objects in a transport set, used to provide a granular level of control over the export. For more information on the export process and using the Transport Sets

Walkthrough Import with Moving Objects

Portal Import

- Move the transport sets from one system (source) to another (target) using the Transport Sets - Acquire Service portlet, or using the Oracle Portal Export and Import command-line scripts if there is an intervening firewall. Moving the transport set from the source to the target system using the Transport Sets

Walkthrough Import with Moving Objects

Portal Import

- Import the objects from the transport tables to the target portal repository using the Import Transport Set portlet.

Walkthrough Import with Moving Objects

Moving Data to the Target System

- To move your content using the Acquire Transport Sets portlet:
- In the Transport Set - Acquire Services portlet, click the Browse Source Portals on the Administer page and check that the source portal you're moving data from is registered on the target instance.
- If the source portal has not previously been registered, from the Acquire Transport Sets portlet, click Register A Source Portal and register. From the Transport Set - Acquire Services portlet, click Acquire Transport Sets to display the Acquire a Transport Set page.

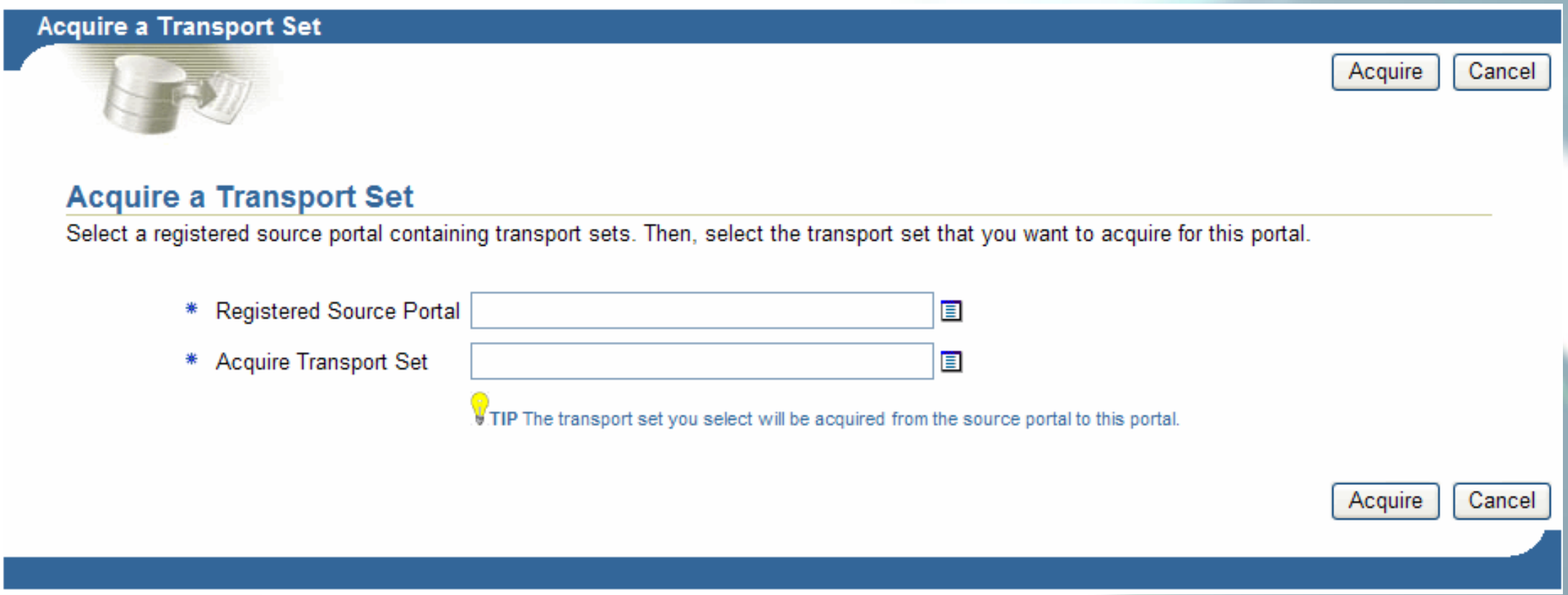
Walkthrough Import with Moving Objects

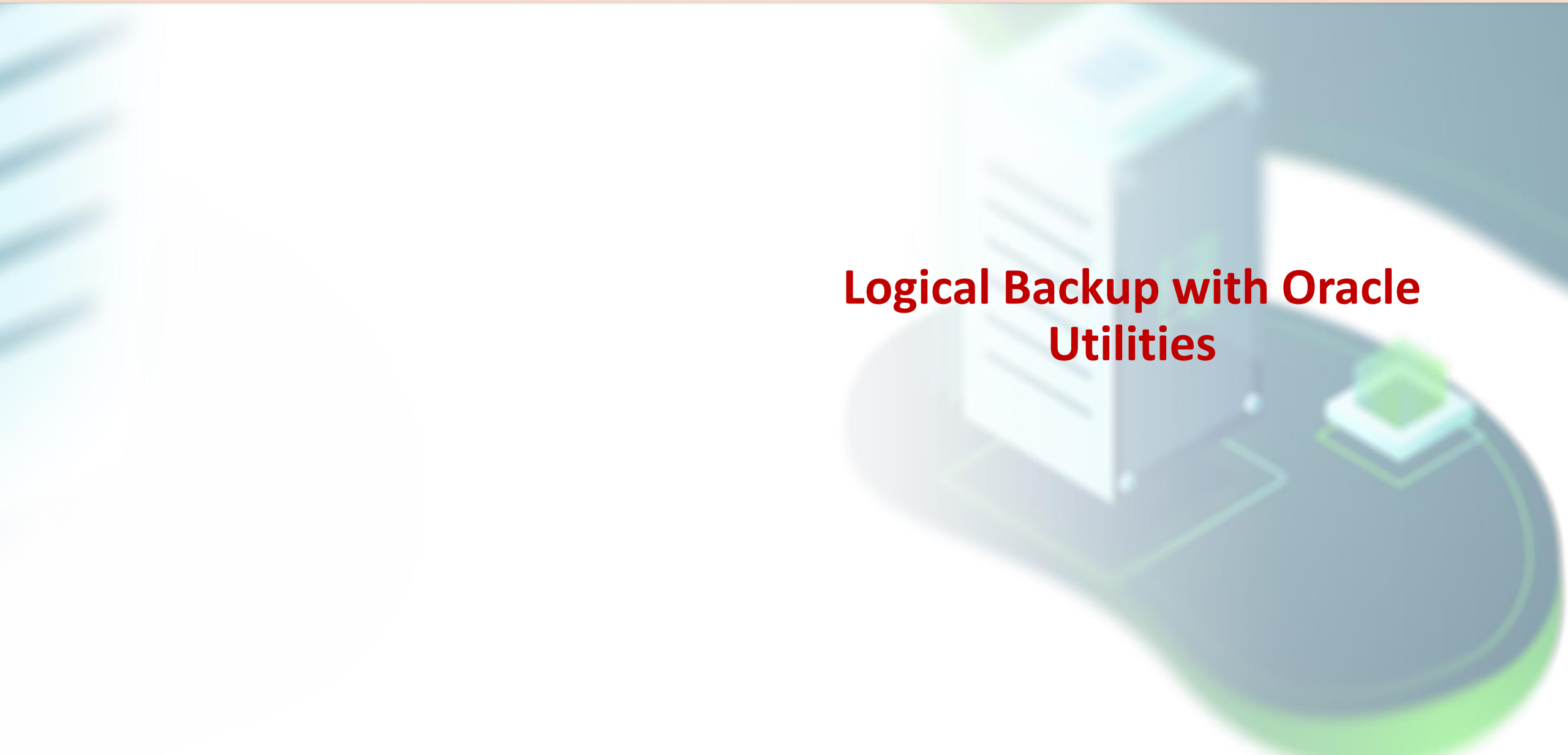
Moving Data to the Target System

- Specify the source portal and the transport set and click **Acquire** to start transferring the data.
- When the transfer is complete, click **Display Manifest** to display the transport set manifest. Click on the explicitly selected object to display the detailed manifest. Click **Tree View** to see the nested dependencies.
- Click **Close** to return to the manifest, and then click **Pre-check Now** to perform a pre-check of the transferred data. The system checks that all object dependencies have been resolved.
- Click **Display Manifest** when the pre-check is complete and check the status column for errors. Resolve any errors before continuing with importing the transport set.

Walkthrough Import with Moving Objects

Moving Data to the Target System





Logical Backup with Oracle Utilities

Logical Backup with Oracle Utilities

Logical Backup with Oracle Utilities

- Logical Backup
- Oracle Data Pump Architecture
- Modes of Data Pump
- Examples of Data Pump

Logical Backup with Oracle Utilities

Logical Backup

- Logical backups are backups in which the export utility (for example Exp) uses SQL to read database data and then export it into a binary file at the operating system level. You can then import the data back into a database using the import utility (Imp).

Logical Backup with Oracle Utilities

Logical Backup

- The Oracle Export Utility can create a file that contains all the objects in a particular schema. The file that is created can then be imported to the same schema to recover from a failure or to a different instance or schema for archiving purposes.

Logical Backup with Oracle Utilities

Oracle Data Pump Architecture

Data Pump consists of the following components:

expdp (Data Pump export utility)

impdp(Data Pump import utility)

DBMS_DATAPUMP PL/SQL package(Data Pump application interface [API])

DBMS_METADATA PL/SQL package (Data Pump Metadata API)

Logical Backup with Oracle Utilities

Modes of Data Pump

- Entire database
- Schema level
- Table level
- Tablespace level
- Transportable tablespace level

Logical Backup with Oracle Utilities

Examples of Data Pump

An example of Export:-

$ expdp mv_maint/foo directory=dp_dir dumpfile=full.dmp logfile=full.log full=y

An example of Import:-

$ impdp mv_maint/foo directory=dp_dir dumpfile=full.dmp logfile=fullimp.log full=y

Walkthrough Export with Moving Objects

Walkthrough Export with Moving Objects

Walkthrough Export with Moving Objects

- Pre-requisite Portal Export & Import
- Command-line Access
- Oracle Export & Import with Character Sets
- Role of Character Sets in Export & Import

Walkthrough Export with Moving Objects

Pre-requisite Portal Export & Import

Oracle Portal instance information:
Before beginning the export and import process, ensure you have the following information:

- System Requirements
- Additional Considerations

Walkthrough Export with Moving Objects

Pre-requisite Portal Export & Import

- Privileges for Exporting and Importing Content
  - Portal schema name.
  - Portal schema password.
  - Portal connect string information.
  - Portal user name.
  - Portal user password.
  - Company name (used only for hosted portal installations). In most cases, this should be left blank.

Walkthrough Export with Moving Objects

Oracle Export & Import with Character Sets

- The Oracle Database exp utility always exports user data, including Unicode data, in the character sets of the export server. The character sets are specified when the database is created.
- The Oracle Database imp utility automatically converts the data to the character sets of the import server.

Walkthrough Export with Moving Objects

Command-line Access

- If you are using the Oracle Portal Export and Import command-line scripts to move the transport sets from one system to another, you must have command-line access to run the shell or command utilities generated by the export import process. The command-line utilities, in turn, access the Oracle Database exp and imp utilities, and the Oracle Portal instance.

Walkthrough Export with Moving Objects

Oracle Export & Import with Character Sets

- Some 8-bit characters can be lost (that is, converted to 7-bit equivalents) when you import an 8-bit character set export file. This occurs if the client system has a native 7-bit character set or if the NLS_LANG operating system environment variable is set to a 7-bit character set. Most often, you notice that accented characters lose their accent marks.

Walkthrough Export with Moving Objects

Oracle Export & Import with Character Sets

- Both the Oracle Database exp and imp utilities alert you of any required character set conversion before exporting or importing the data.

Walkthrough Export with Moving Objects

Role of Character Sets in Export & Import

```
E:\app\Haider\product\11.2.0\dbhome_1\BIN>imp scott/tiger IGNORE=y FILE = c:\test\Scott.d

Import: Release 11.2.0.1.0 - Production on Fri Nov 13 18:54:32 2020

Copyright (c) 1982, 2009, Oracle and/or its affiliates.  All rights reserved.


Connected to: Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 - Production
With the Partitioning, OLAP, Data Mining and Real Application Testing options

Export file created by EXPORT:V11.02.00 via conventional path
import done in WE8MSWIN1252 character set and AL16UTF16 NCHAR character set
Import terminated successfully without warnings.
```

Introduction to Database Administration

General Overview of Database Manager

General Overview of Database Manager

General Overview of Oracle Enterprise Manager (OEM)

- Starting OEM
- Oracle Database Control Login
- OEM Home Page
- OEM - Grant Management Privileges
- OEM - Users Credentials

General Overview of Database Manager

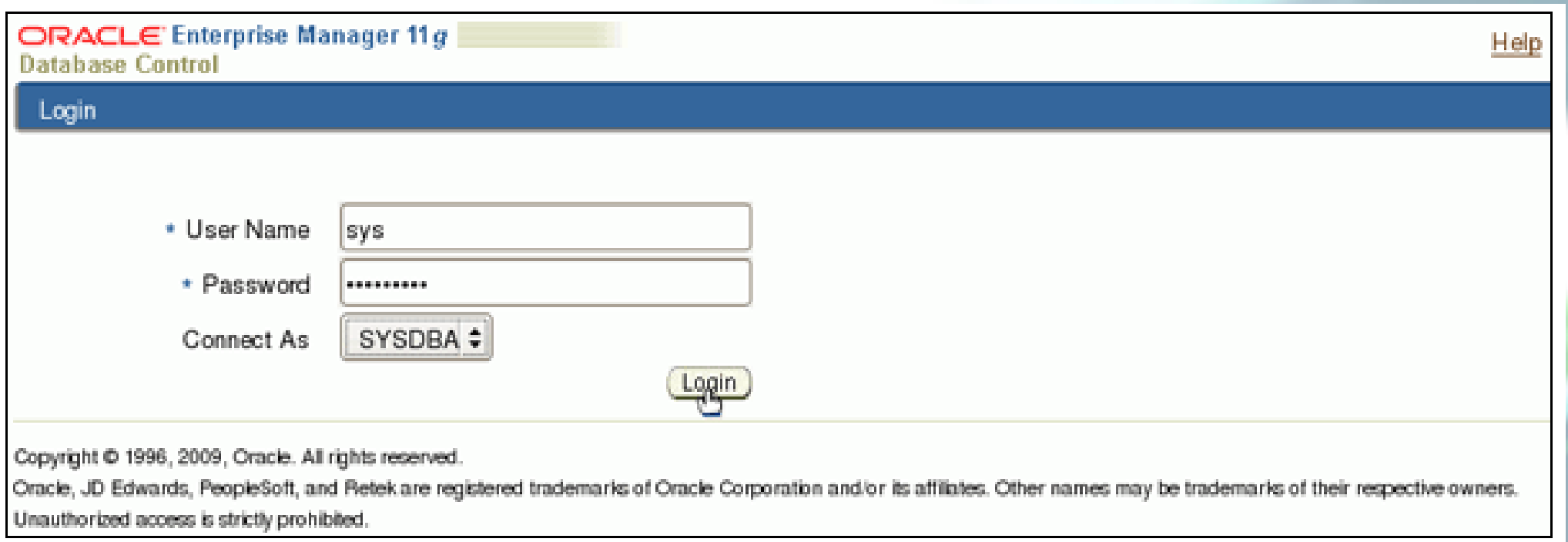
Starting OEM

On cmd (DOS prompt), you may run
set oracle_sid=orcl
emctl stop dbconsole
emctl start dbconsole

In the browser, you can run URL
https://localhost:1158/em

General Overview of Database Manager

Oracle Database Control Login

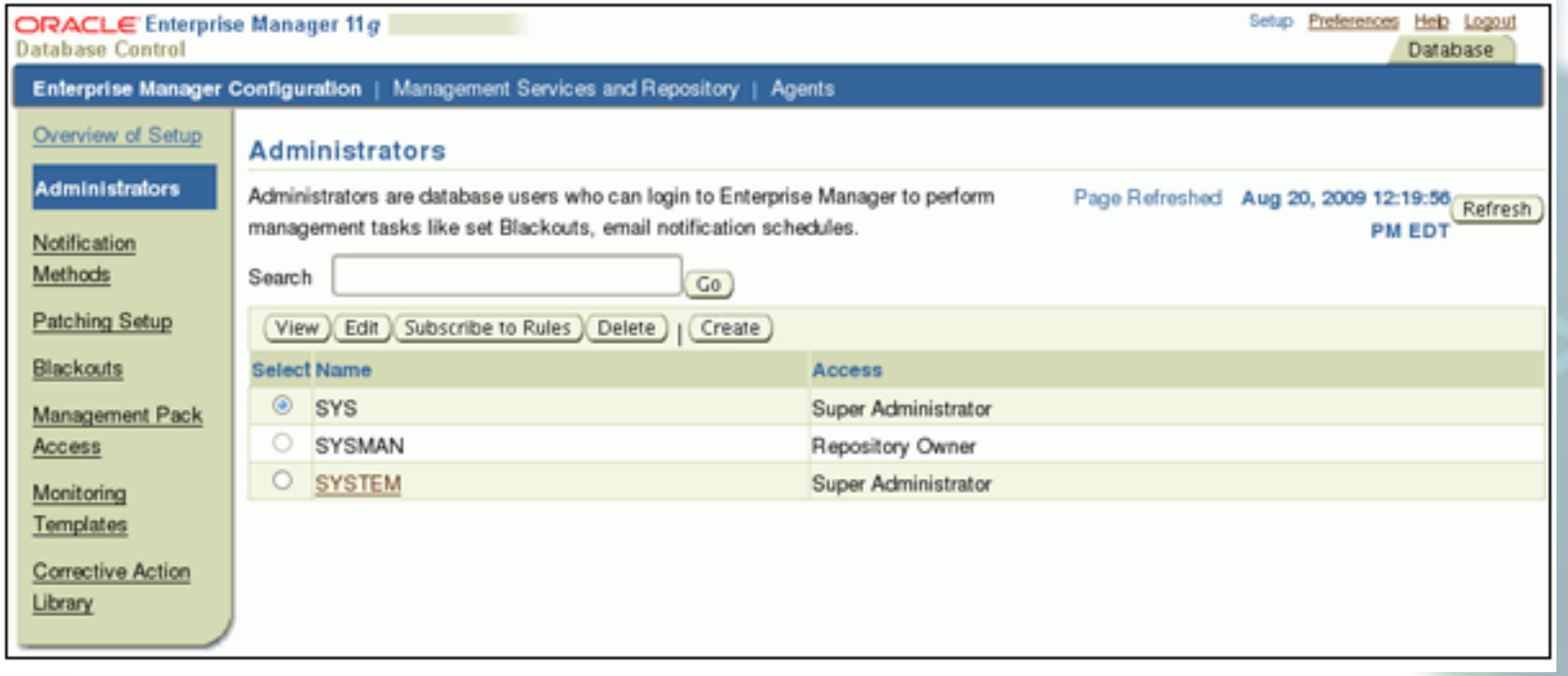


General Overview of Database Manager

OEM Home Page

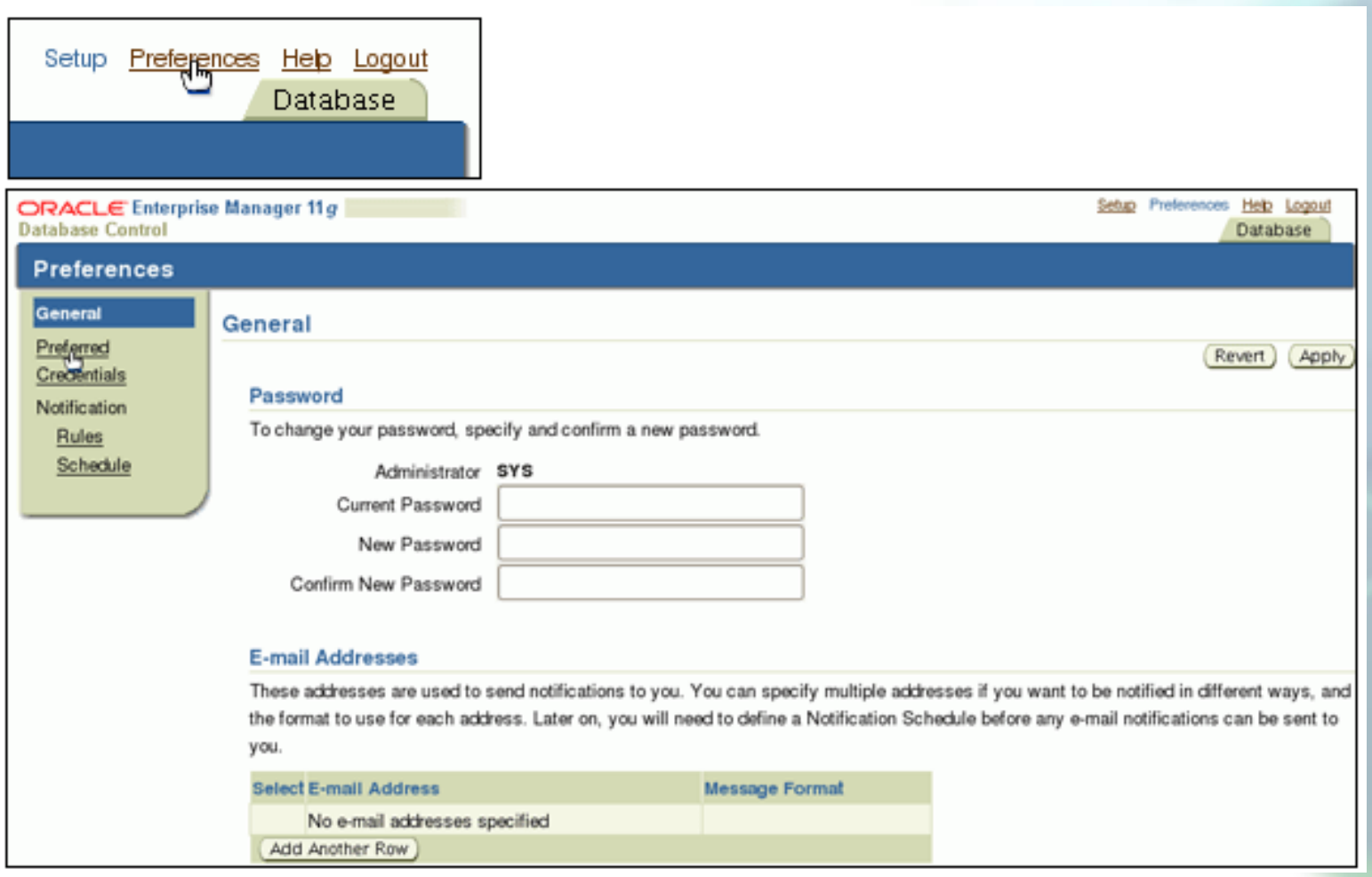
General Overview of Database Manager

OEM – Grant Management Privileges



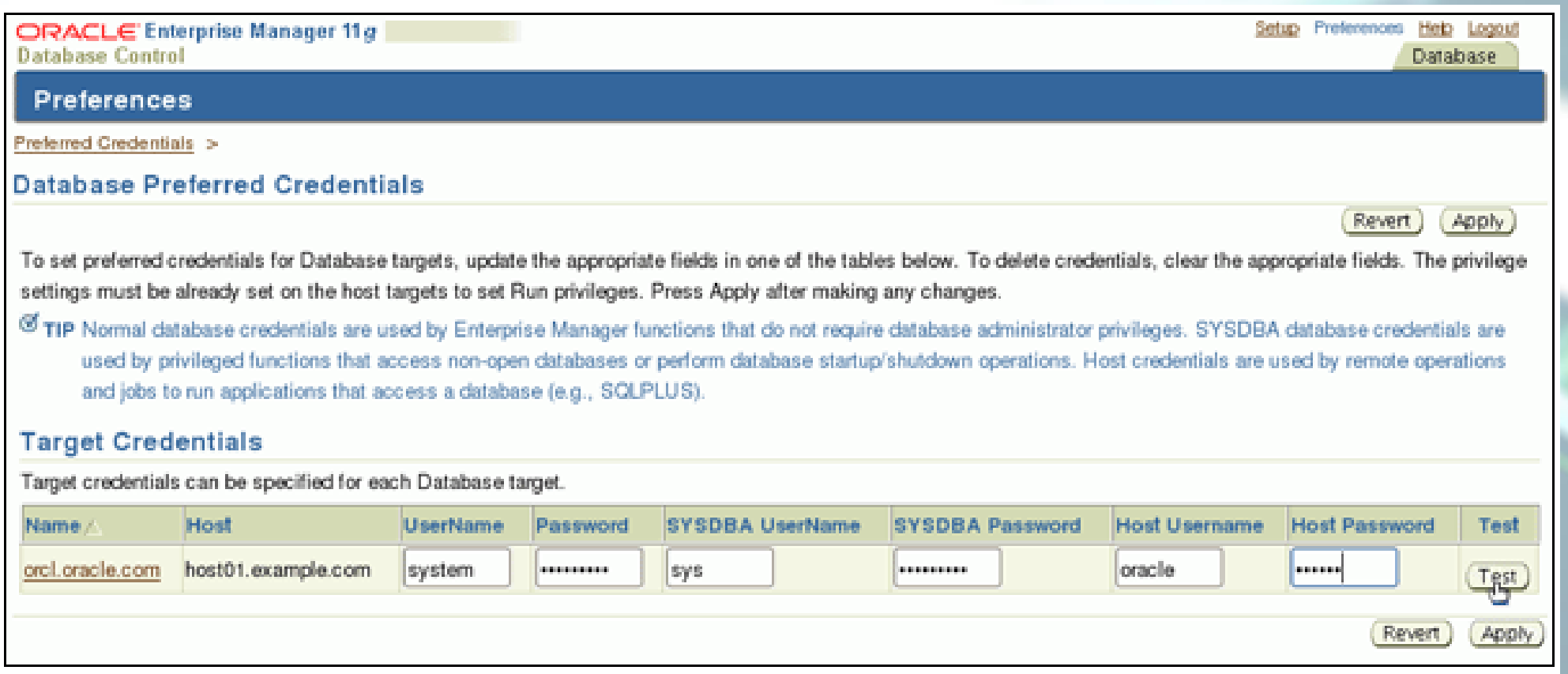
General Overview of Database Manager

OEM – Users Credentials

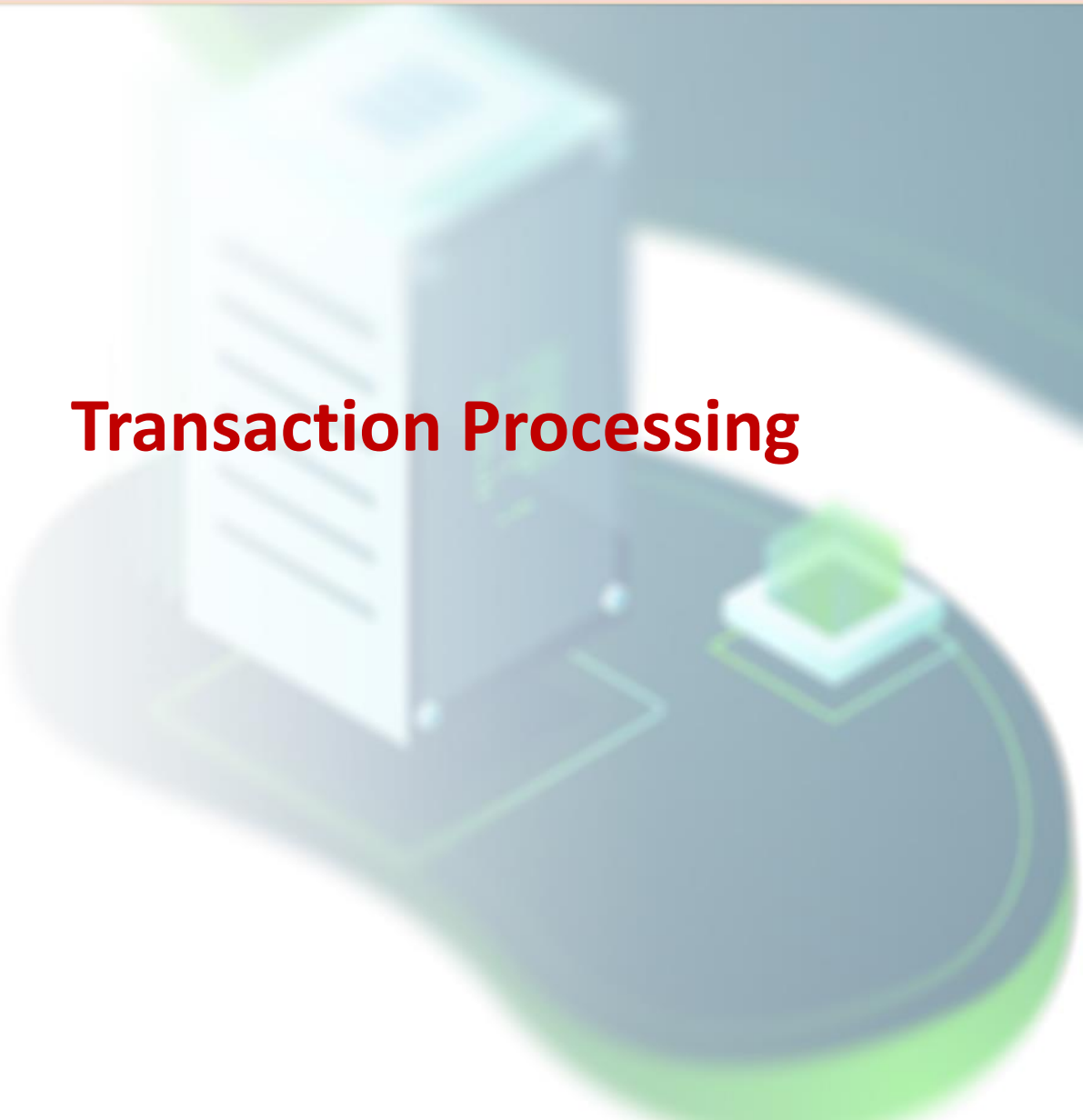


General Overview of Database Manager

OEM – Users Credentials



Introduction to Database Administration



Transaction Processing

Transaction Processing

Transaction Processing

- What is a Transaction?
- Processing of Transactions
- Processing of Transactions in Oracle

Transaction Processing

What is a Transaction?

SQL is initiated at user level (client) with Start-End and it executes on Server (central Database) at a certain distance.

A transaction is a logical, atomic unit of work (block) that contains one or more SQL statements.

Either transaction is done (committed) or not done (rolled back). No partial execution of transaction is allowed.

Transaction Processing

Processing of Transactions

Generally reflects the activities in the real world system

Depositing some amount in an account, will be a transaction

Transferring amount from one account to another; if ok then DB is in consistent state otherwise inconsistent.

One transaction can be calculating GPA in our exam system

Transaction Processing

Processing of Transactions in Oracle

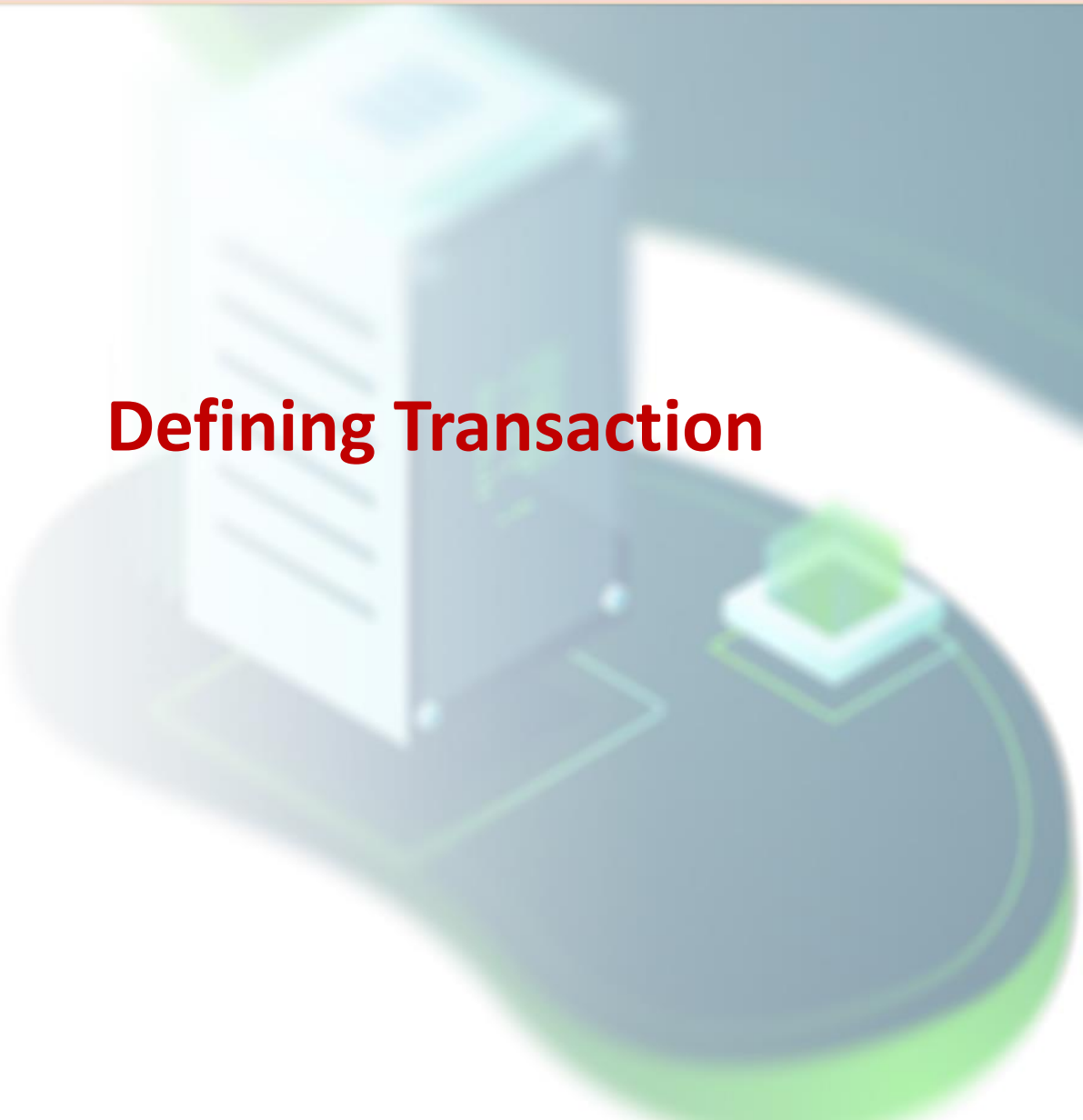
In Oracle Database, each user must see a consistent view of the data, including visible changes made by a user's own transactions and committed transactions of other users.

Transaction Processing

Processing of Transactions in Oracle

- Single-user VS multi-user systems
  - A DBMS is **single-user** if at most one user can use the system at a time
  - A DBMS is **multi-user** if many users can use the system concurrently
- Problem
  - How to make the simultaneous interactions of multiple users with the database safe, consistent, correct, and efficient?

Introduction to Database Administration



Defining Transaction

Defining Transaction

Defining Transaction

- What is a Transaction?
- Transaction with SQL
- Converting SQL into Transaction

Defining Transaction

What is a Transaction?

SQL is initiated at user level (client) with Start-End and it executes on Server (central Database) at a certain distance.

A transaction is a logical, atomic unit of work (block) that contains one or more SQL statements.

Either transaction is done (committed) or not done (rolled back). No partial execution of transaction is allowed.

Defining Transaction

What is a Transaction?

A transaction T is a logical unit of database processing that includes one or more database access operations

- Embedded within an application program
- Specified interactively (e.g., via SQL)

Transaction boundaries:

- Begin/end transaction

Types of transactions

- Read transaction
- write transaction

Defining Transaction

Transaction with SQL

For example, following SQL update will change the salary of some Employee

```
Update EMP
Set sal = 850
Where empno = 7369;
```

Is it statement or a transaction?

Defining Transaction

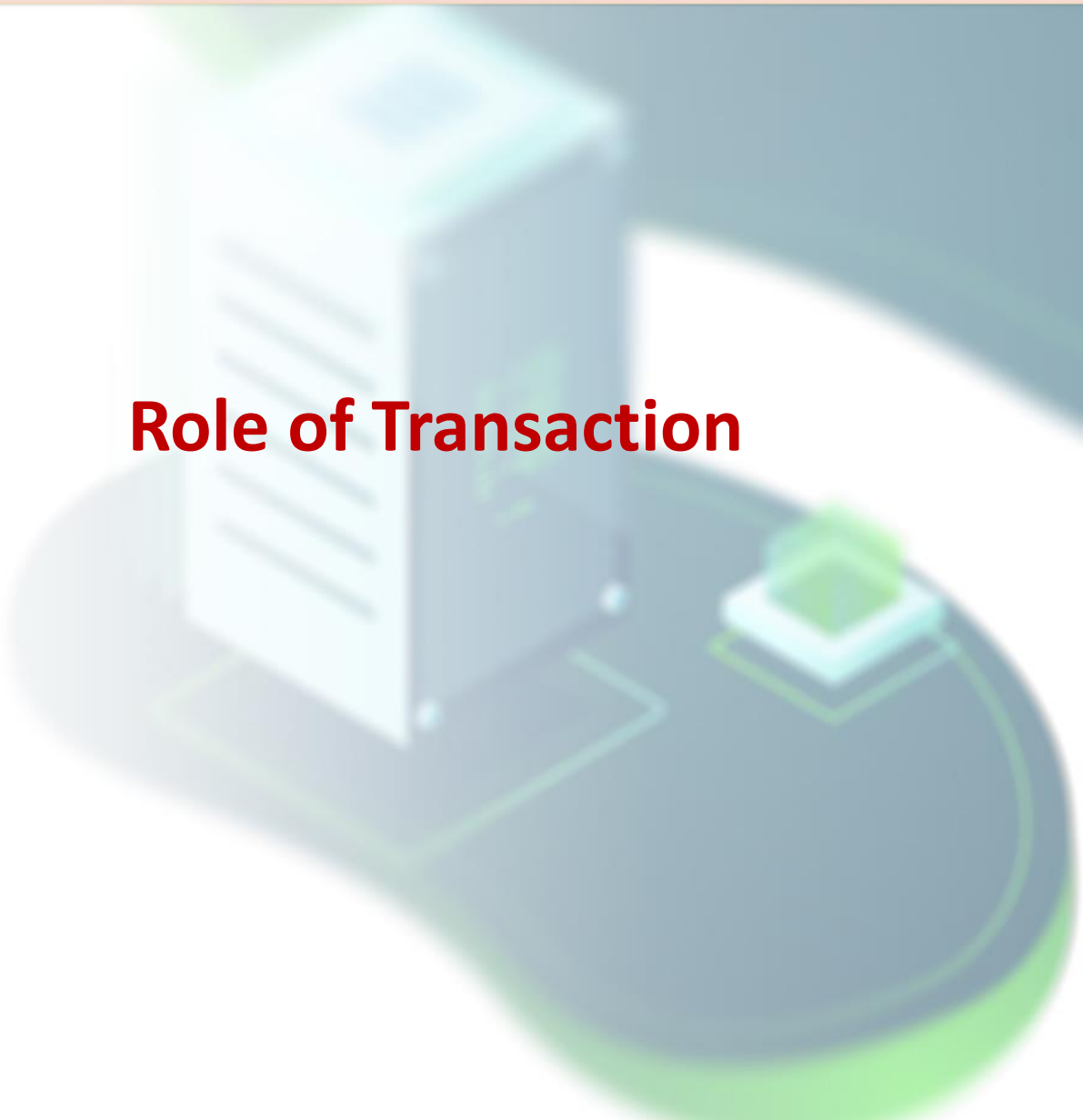
Converting SQL into Transaction

```
begin

    Update EMP
    Set sal = 850
    Where empno = 7369;

end;
/
```

Defining Transaction

Camtesia

Introduction to Database Administration



Role of Transaction

Role of Transaction

Role or Importance of Transactions

- Transaction & SQL
- Importance of Transaction Processing System
- Transaction with Client-Server Environment

Role of Transaction

Transaction & SQL

Transaction is travelled on network, it may have chances of lost and it requires transaction logs for tracing

Can a simple SQL manages logs?

Can transaction in block manageable?

Issues of Multi-user environment.

Issues of Consistent, Correct and Efficiency are important.

Role of Transaction

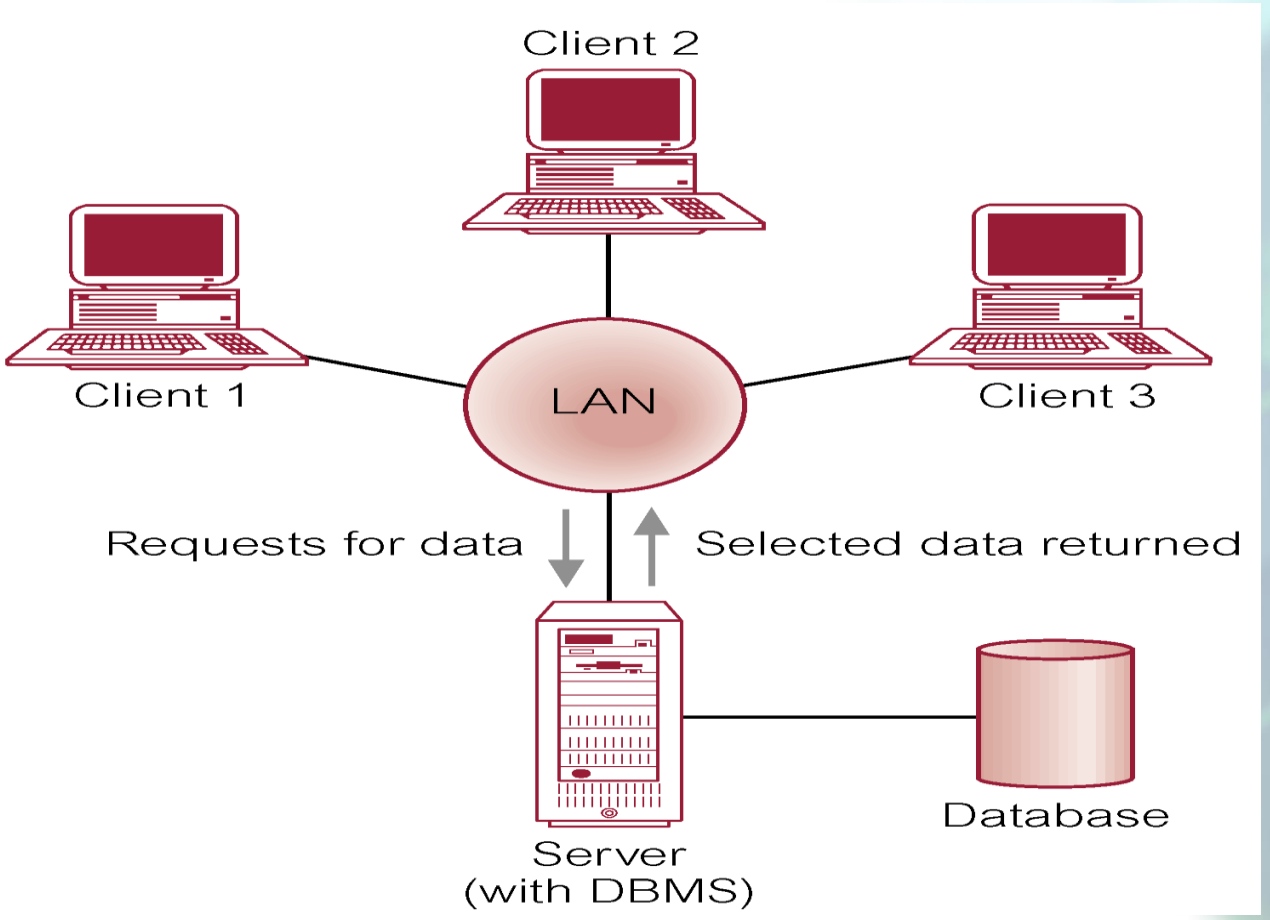
Importance of Transaction Processing System

Transaction processing (TP) systems underlie the online applications. a transaction rate of 15 simple Debit Credit transactions per second was “common”, 50 TPS was a “good” system, 100 TPS was “fast”, and a 400 TPS system was characterized as being a very “lean and mean” system.

Teradata capabilities, usage of parallel databases, configuration and tuning etc.

Role of Transaction

Transaction with Client-Server Environment



Examples of Transactions

Examples of Transactions

Example of Transactions

- Usage of ATM - An Example
- Funds Transfer Concept
- Writing a Transaction

Examples of Transactions

Usage of ATM – An Example

Usage of ATM to draw/ transfer money, to collect currency with dispenser

Examples of Transactions

Funds Transfer Concept

Transfer 400,000 from checking account to savings account

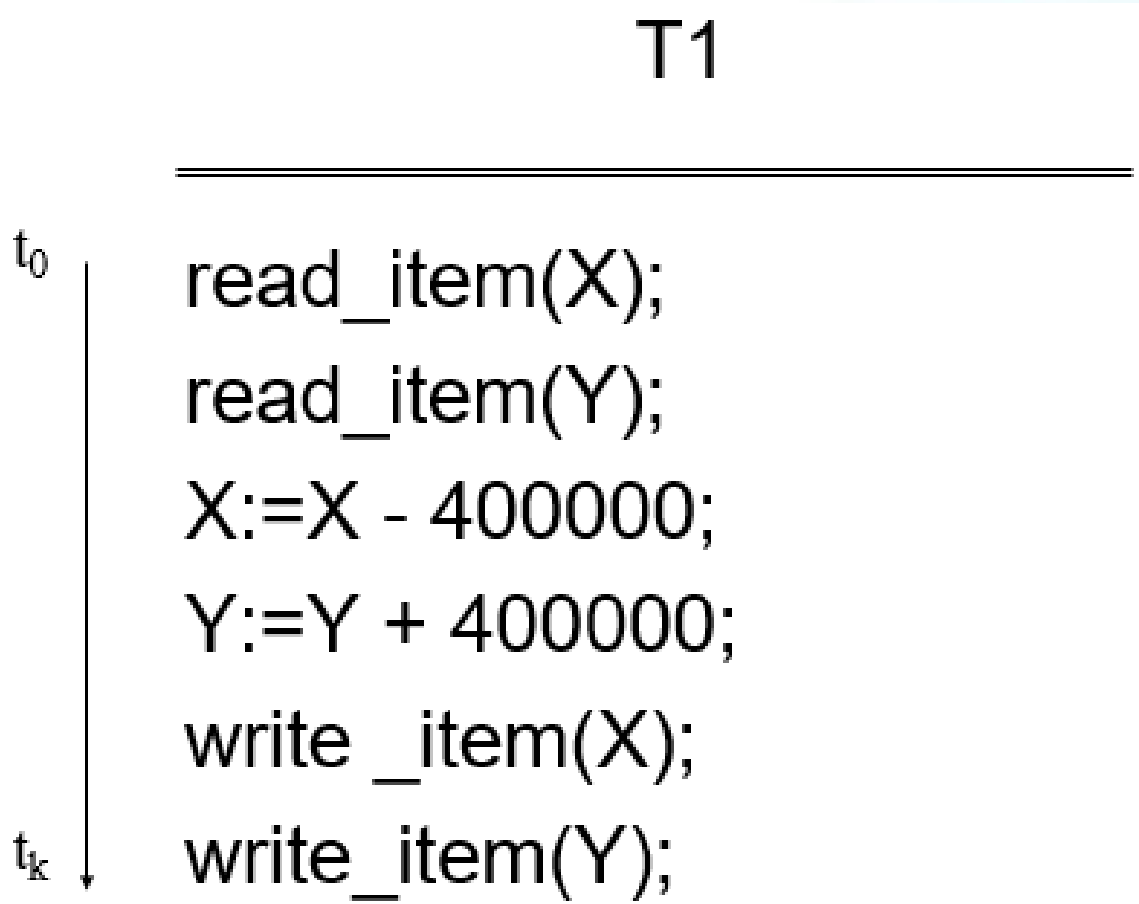
For a user it is one activity

To database:

- Read balance of checking account: read(X)
- Read balance of savings account: read (Y)
- Subtract 400,000 from X
- Add 400,000 to Y
- Write new value of X back to disk
- Write new value of Y back to disk

Examples of Transactions

Writing a Transaction



Examples of Transactions

Examples of Transactions

Example of Transactions

- Retail System - An Example
- Transactions & Their Issues

Examples of Transactions

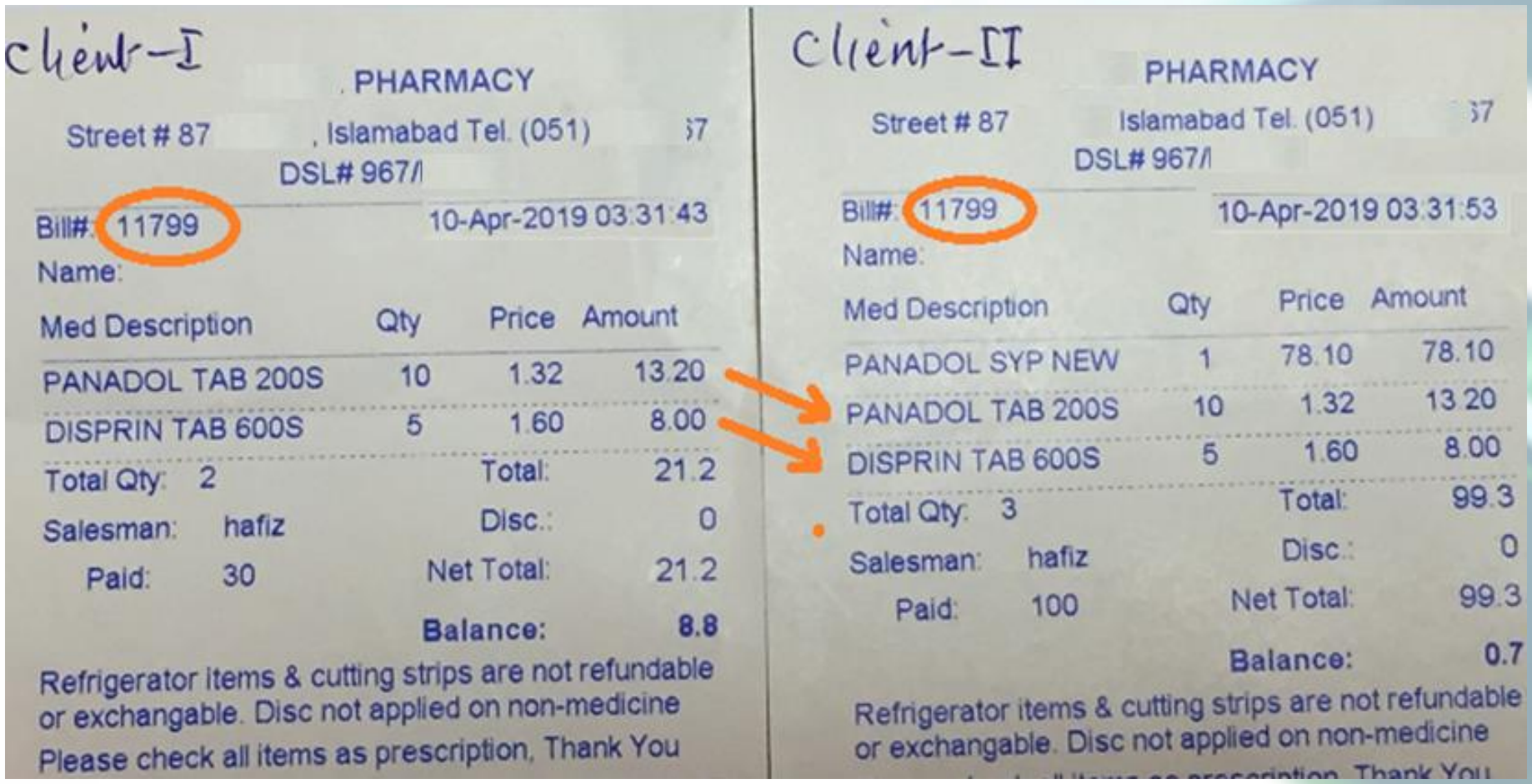
Retail Store – An Example

Invoice is issued a transaction when buying items

What happened multiple invoices are issued in Multi-user environment

Examples of Transactions

Transactions and their Issues



client-I

PHARMACY

Street # 87 , Islamabad Tel. (051) 57

DSL# 967/

Bill#: 11799 10-Apr-2019 03:31:43

Name:

Med Description	Qty	Price	Amount
PANADOL TAB 200S	10	1.32	13.20
DISPRIN TAB 600S	5	1.60	8.00

Total Qty: 2 Total: 21.2

Salesman: hafiz Disc.: 0

Paid: 30 Net Total: 21.2

Balance: 8.8

Refrigerator items & cutting strips are not refundable or exchangable. Disc not applied on non-medicine

Please check all items as prescription, Thank You

client-II

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Street # 87 Islamabad Tel. (051) 57

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Bill#: 11799 10-Apr-2019 03:31:53

Name:

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Total Qty: 3 Total: 99.3

Salesman: hafiz Disc.: 0

Paid: 100 Net Total: 99.3

Balance: 0.7

Refrigerator items & cutting strips are not refundable or exchangable. Disc not applied on non-medicine

Introduction to Database Administration

Transactions Read & Write

Transactions Read & Write

Example of Transactions

- Transaction Read Item
- Transaction Write Item
- Two Transactions

Transactions Read & Write

Transaction Read Item

A database is represented as a collection of named data items

Read-item (X)

- Find the address of the disk block that contains item X
- Copy the disk block into a buffer in main memory
- Copy the item X from the buffer to the program variable named X

Transactions Read & Write

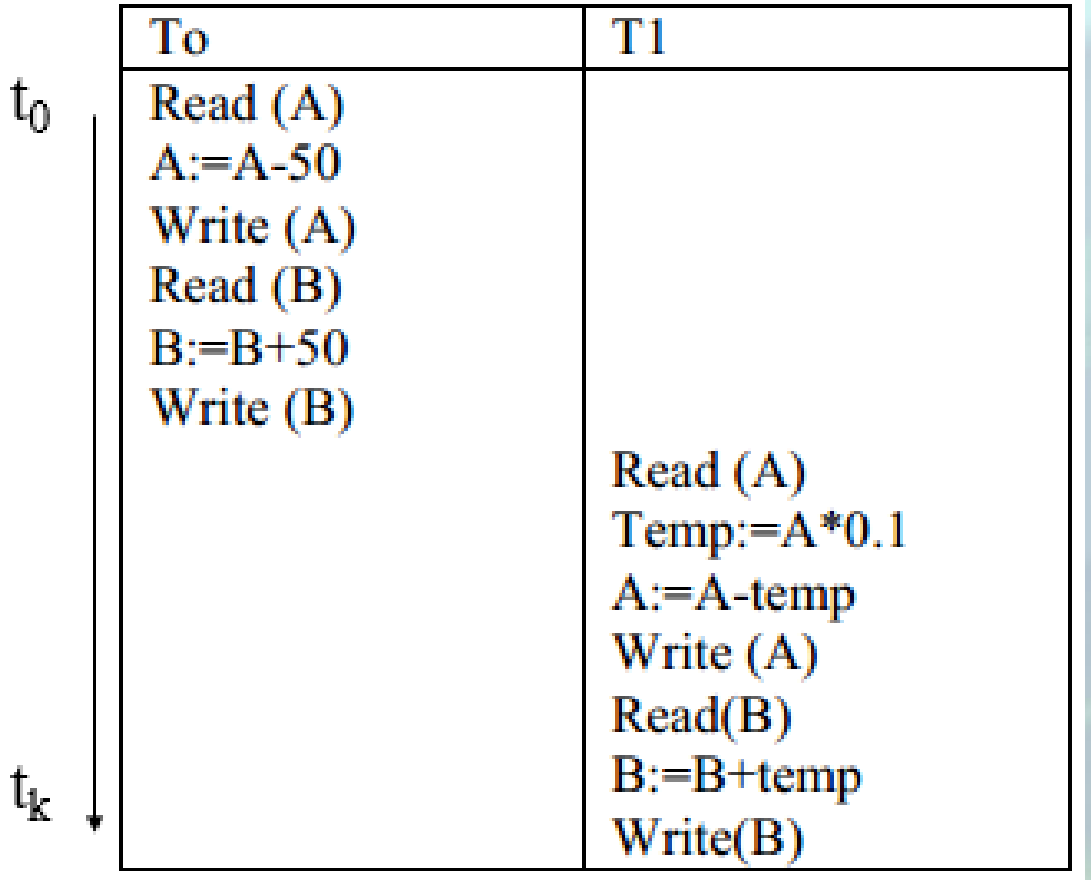
Transactions Write Item

Write-item (X)

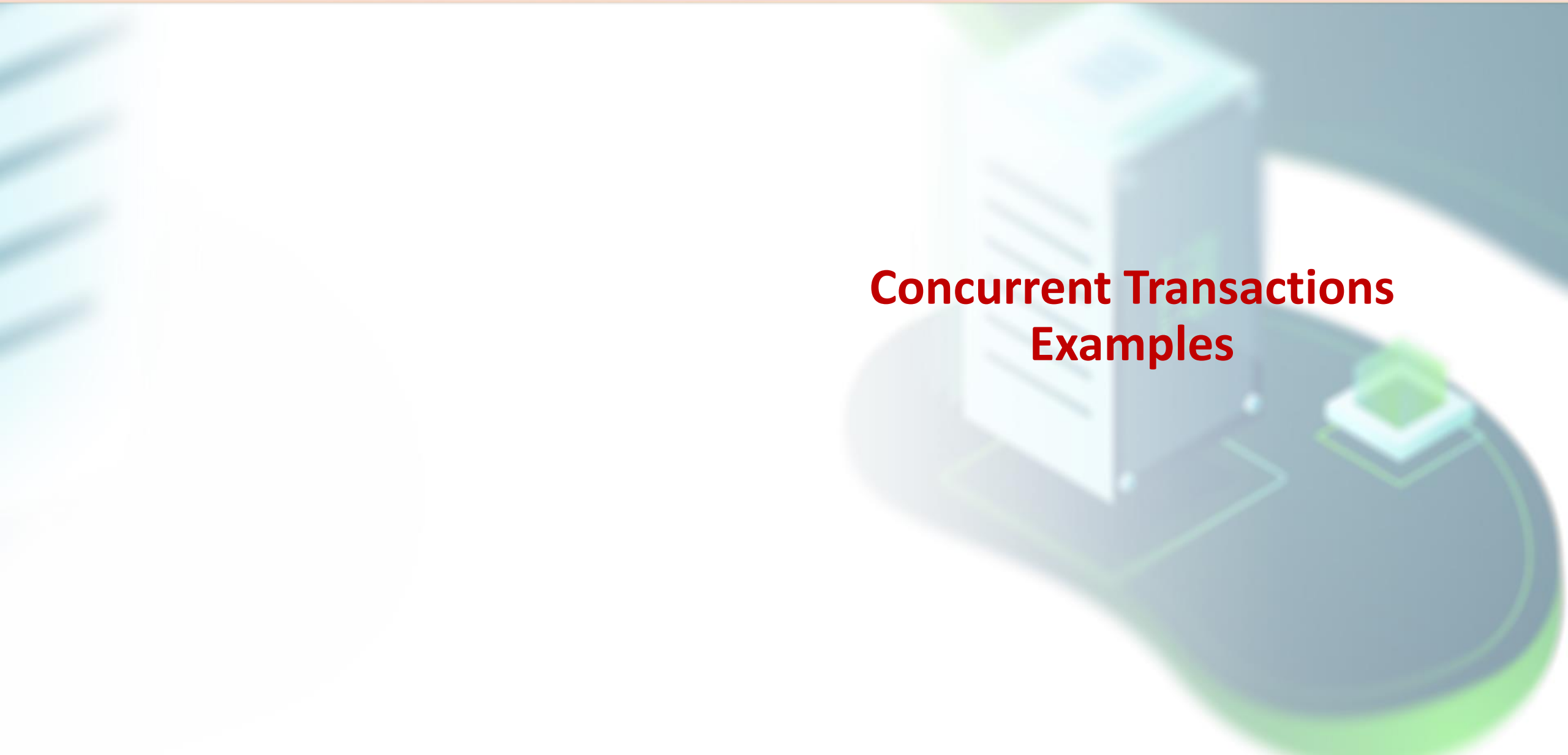
- Find the address of the disk block that contains item X.
- Copy that disk block into a buffer in main memory
- Copy item X from the program variable named X into its correct location in the buffer.
- Store the updated block from the buffer back to disk (either immediately or at some later point in time).

Transactions Read & Write

Two Transactions



	To	T1
t_0	Read (A) A:=A-50 Write (A) Read (B) B:=B+50 Write (B)	
		Read (A) Temp:=A*0.1 A:=A-temp Write (A) Read(B) B:=B+temp Write(B)
t_k		



Concurrent Transactions Examples

Concurrent Transactions Examples

Example of Transactions

- Concurrent Transaction
- Interleaved & Parallel Processing
- Concurrent Processing - An Example

Concurrent Transactions Examples

Concurrent Transaction

In the transaction process, a system usually allows executing more than one transaction simultaneously. This process is called a concurrent execution.

The reasons for wanting to run transactions concurrently are slow input/output devices (usually disks) and the presence of multiple processors on which different transactions can run at the same time.

Concurrent Transactions Examples

Concurrent Transaction

Informally, if there are two transactions in progress concurrently (that is, the Begin of one happens between the Begin and the Commit of the other), we want all the observable effects to be as though all the actions of one transaction happen either before or after all the actions of the other.

Concurrent Transactions Examples

Interleaved & Parallel Processing

Concurrent transactions refer to two or more transactions that appear to users as they are being processed against a database at the same time

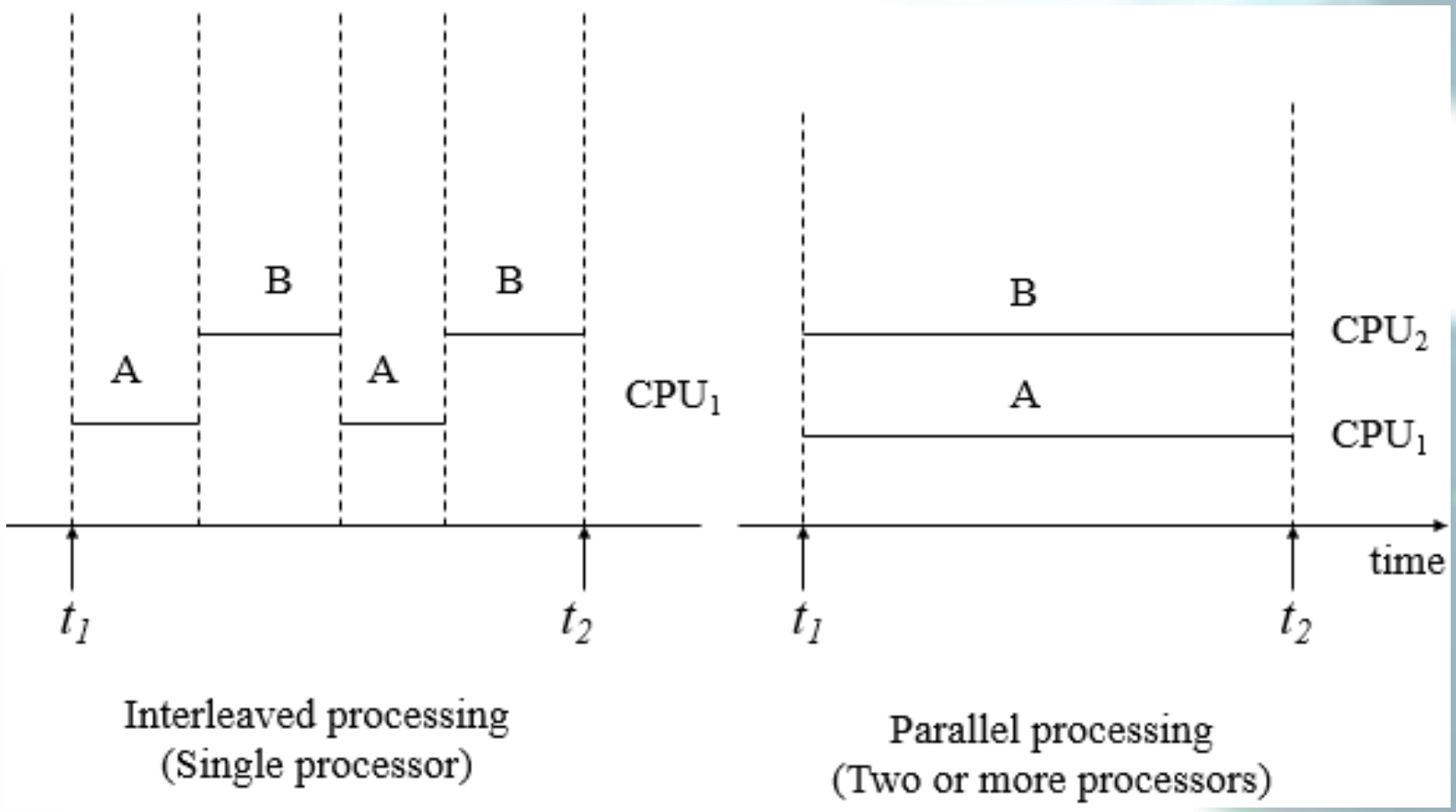
In reality, CPU can execute only one instruction at a time

- **Transactions are interleaved** meaning that the operating system quickly switches CPU services among tasks so that some portion of each of them is carried out in a given interval

Concurrency problems: lost update and inconsistent reads

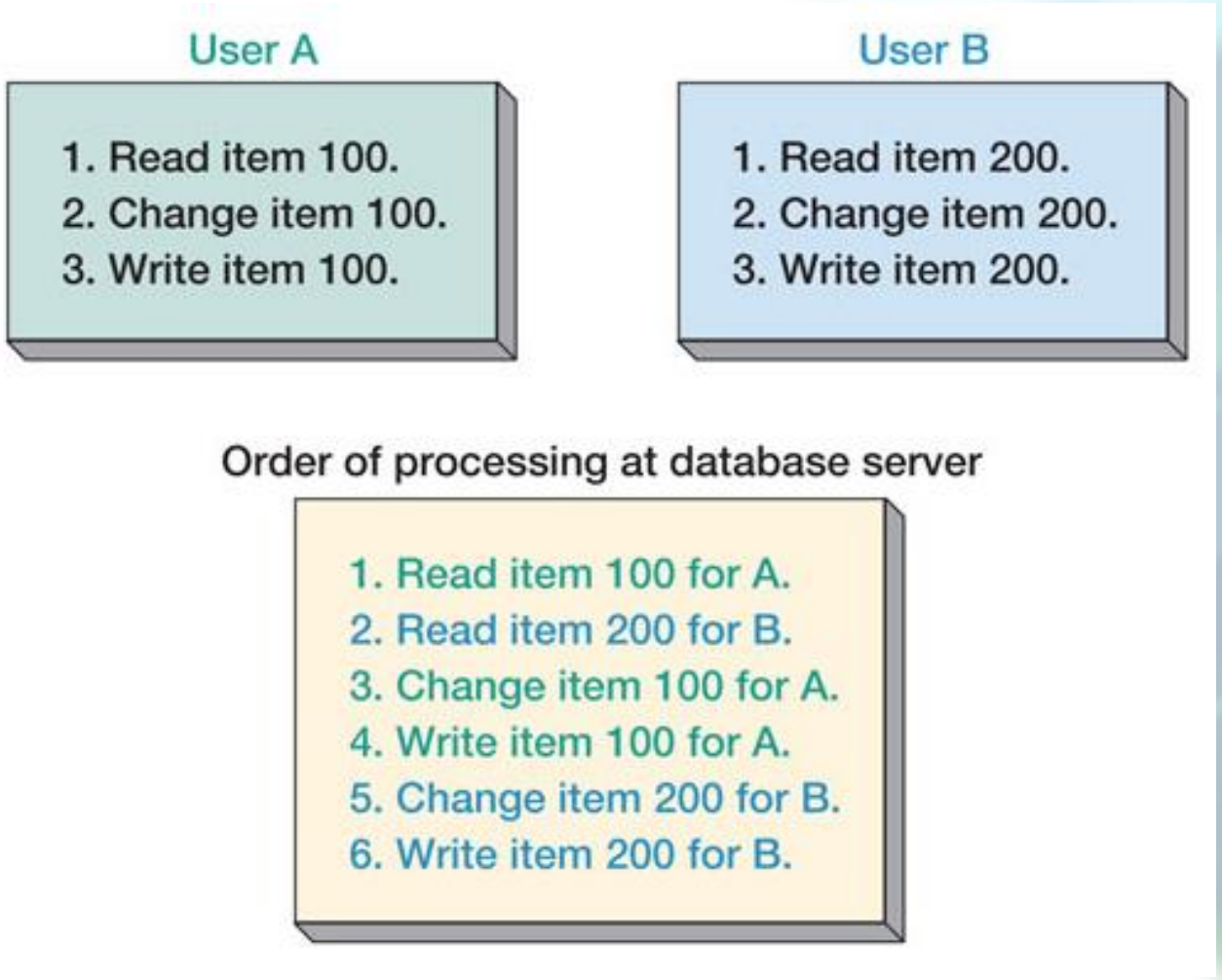
Concurrent Transactions Examples

Interleaved & Parallel Processing



Concurrent Transactions Examples

Concurrent Processing – An Example



Lost Update Example-1

Lost Update Example-1

Example of Transactions

- Concurrency Problems
- Lost Update Problems
- Lost Update Example-1

Lost Update Example-1

Concurrency Problems

Several problems can occur when concurrent transactions are run in an uncontrolled manner, such type of problems is known as concurrency problems.

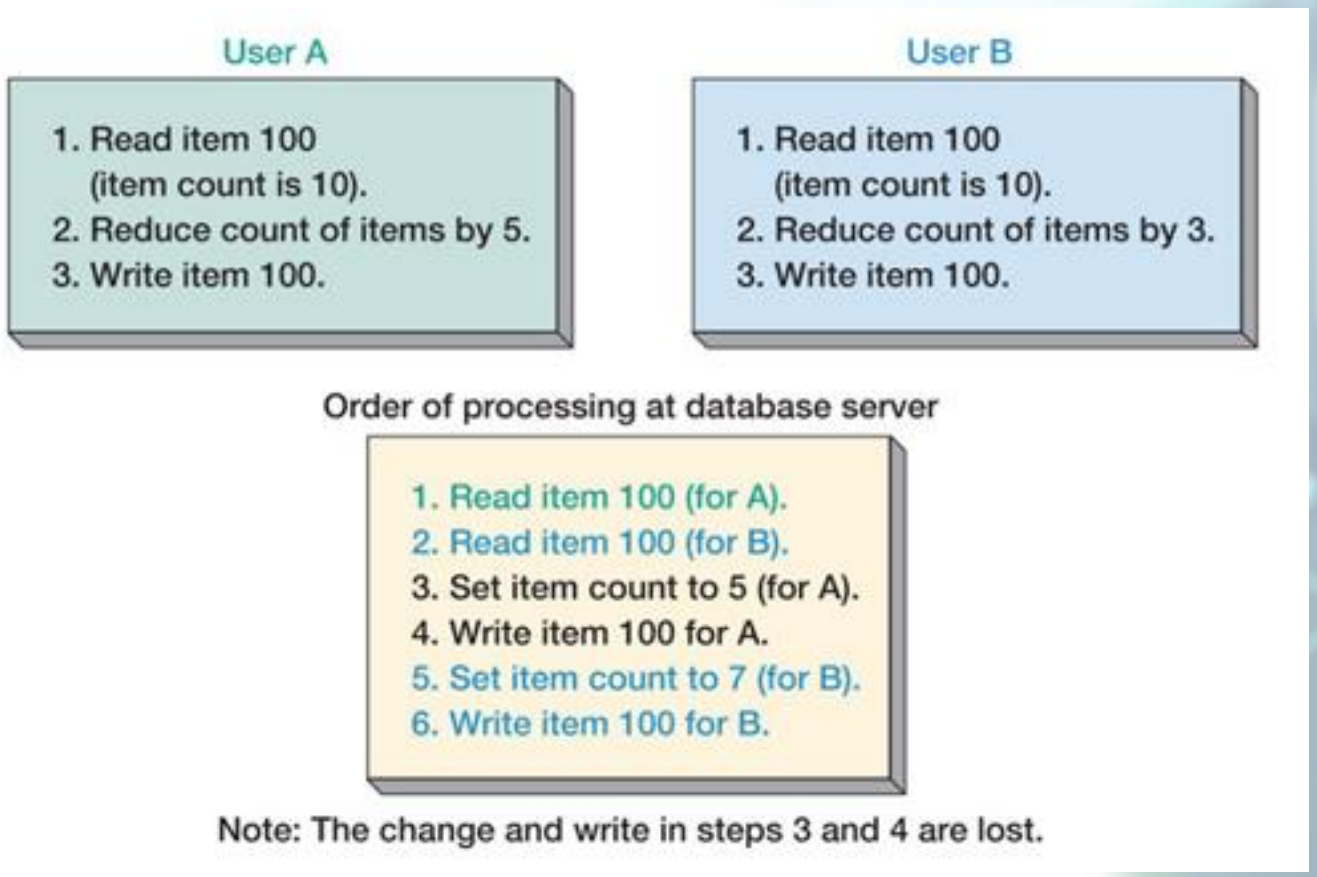
Lost Update Example-1

Lost Update Problems

This type of problem occurs when two transactions in database access the same data item and have their operations in an interleaved manner that makes the value of some database item incorrect.

Lost Update Example-1

Lost Update Example-1



Lost Update Example-2

Lost Update Example-2

Example of Transactions

- Concurrency Problems
- Lost Update Problems
- Lost Update Example-2

Lost Update Example-2

Concurrency Problems

Several problems can occur when concurrent transactions are run in an uncontrolled manner, such type of problems is known as concurrency problems.

Lost Update Example-2

Lost Update Problems

This type of problem occurs when two transactions in database access the same data item and have their operations in an interleaved manner that makes the value of some database item incorrect.

Lost Update Example-2

Lost Update Example-2

Time	T1	T2	balx
t1		BEGIN	100
t2	BEGIN	read(balx)	100
t3	read(balx)	balx=balx+100	100
t4	balx=balx-10	write(balx)	200
t5	write(balx)	commit	90
t6	commit	END	90
t7	END		

Lost Update Example-2

Lost Update Example-2

Two users are reading a same Item#45667, reading current quantity 120 simultaneously

Transaction-1

Transaction-2

Introduction to Database Administration

Dirty Read Example

Dirty Read Example

Dirty Read Transactions

- Dirty Read Problem
- Dirty Read Example

Dirty Read Example

Dirty Read Problem

This type of problem occurs when one transaction T1 updates a data item of the database, and then that transaction fails due to some reason, but its updates are accessed by some other transaction.

Dirty Read Example

Dirty Read Example

Time	T3	T4	balx
t1		BEGIN	100
t2		read(balx)	100
t3		balx=balx+100	100
t4	BEGIN	write(balx)	200
t5	read(balx)	...	200
t6	balx=balx-10	rollback	100
t7	write(balx)	END	190
t8	commit		190
t9	END		

Dirty Read Example

Dirty Read Example

Time	Transaction T1	Transaction T2
t1	Read(A)	
t2	A=A+20	
t3	Write(A)	
t4		Read(A)
t5		A=A+30
t6		Write(A)
t7	Write(B)	

Incorrect Summary Problem

Incorrect Summary Problem

Incorrect Summary Problem

- Incorrect Summary Problem
- Incorrect Summary Problem - An Example

Incorrect Summary Problem

Incorrect Summary Problem

It is also known as an inconsistent retrieval problem. If a transaction T_1 reads a value of data item twice and the data item is changed by another transaction T_2 in between the two read operation. Hence T_1 access two different values for its two read operation of the same data item.

Incorrect Summary Problem

Incorrect Summary Problem – An Example

Time	Transaction T1	Transaction T2
t1	Read(A)	
t2		Read(A)
t3		A=A+30
t4		Write(A)
t5	Read(A)	

Incorrect Summary Problem

Incorrect Summary Problem – An Example

Time	T3	T4	balx	baly	balz	sum
t1		BEGIN	100	50	25	
t2	BEGIN	sum=0				
t3	read(balx)	read(balx)				
t4	balx=balx-10	sum=sum+balx				
t5	write(balx)	read(baly)				
t6	read(balz)	sum=sum+baly				
t7	balz=balz+10					
t8	write(balz)					
t9	commit	read(balz)				
t10	END	sum=sum+balz				
t11		commit				
t12		END				

Introduction to Database Administration

Data Inconsistency in Two Invoices

Data Inconsistency in Two Invoices

Data Inconsistency with Multiple Users

- Single User in a Retail Store
- Retail Store - An Example
- Transactions and their Issues

Data Inconsistency in Two Invoices

Single User in a Retail Store

Single user issue an Invoice one at a time when only one POS terminal is active

When two or more users are issuing invoices, there is a chance of data inconsistency

Data Inconsistency in Two Invoices

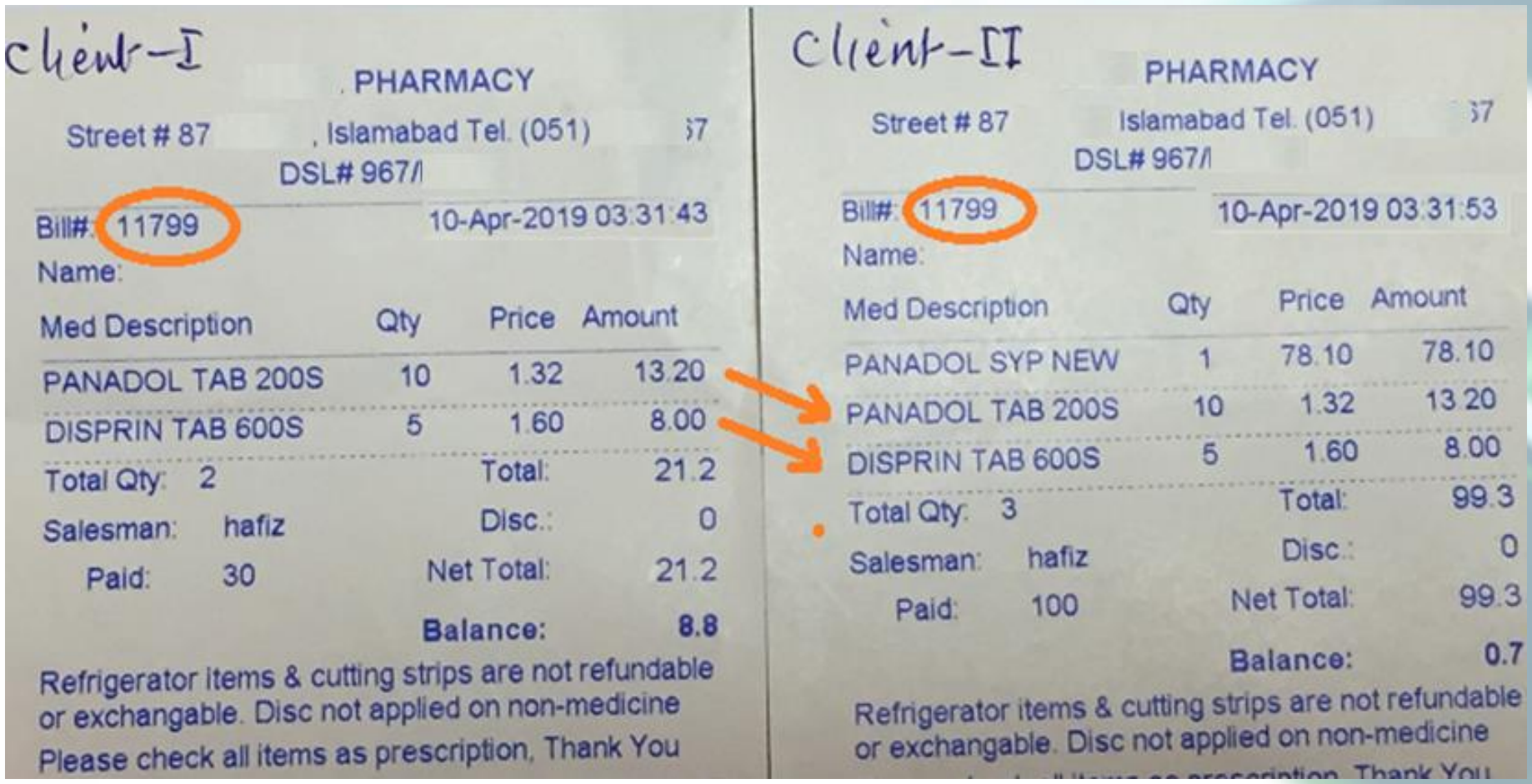
Retail Store – An Example

For example, two invoices are issued at the same time from two POS terminals

What happened multiple invoices are issued in Multi-user environment

Data Inconsistency in Two Invoices

Transactions and their Issues



client-I

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Name:

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Refrigerator items & cutting strips are not refundable or exchangable. Disc not applied on non-medicine

Please check all items as prescription, Thank You

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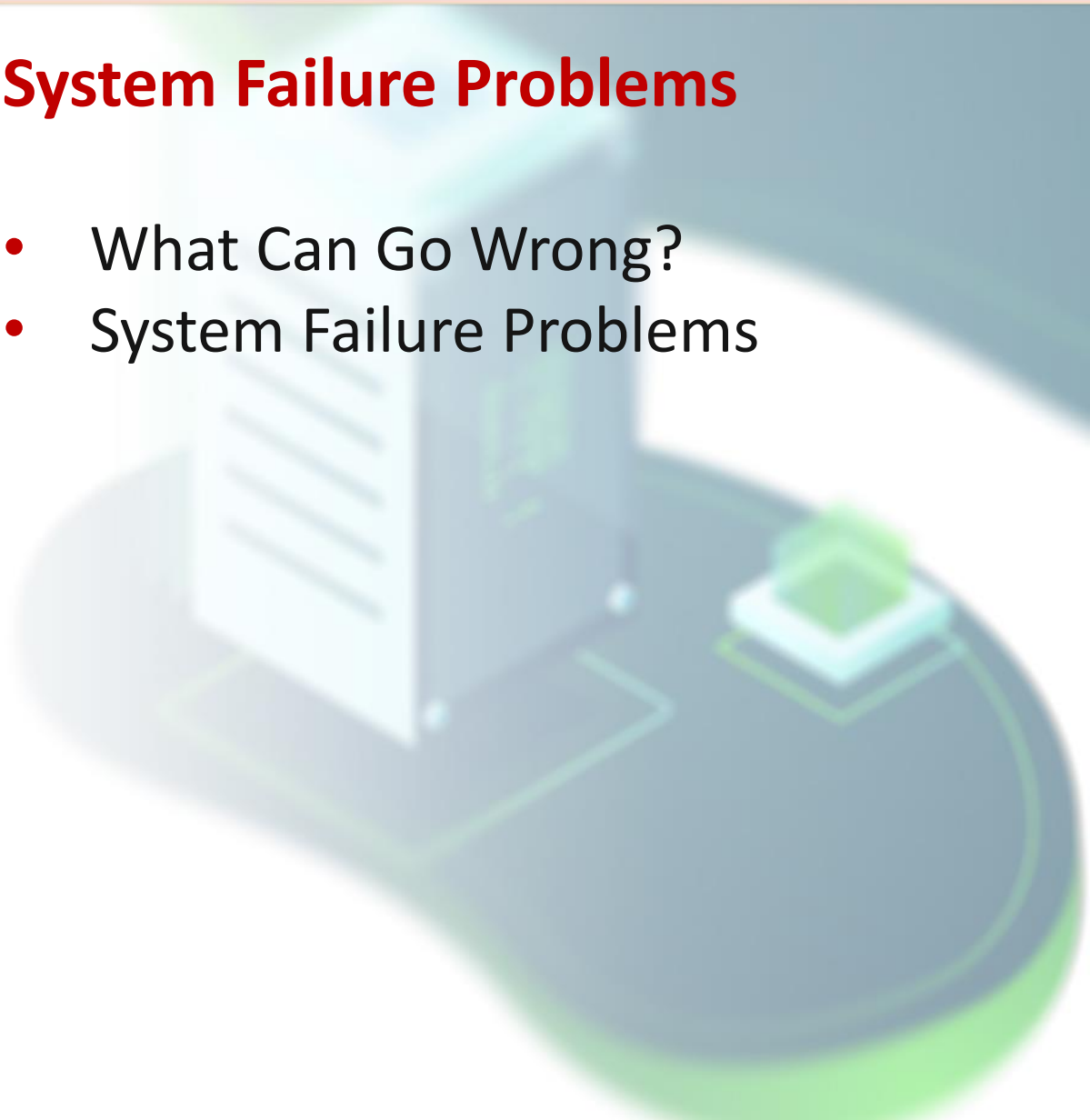
Introduction to Database Administration

System Failure Problems

System Failure Problems

- What Can Go Wrong?
- System Failure Problems



System Failure Problems

What Can Go Wrong?

- System may crash before data is written back to disk
  - Problem of *atomicity*
- Some transaction is modifying shared data while another transaction is ongoing (or vice versa)
  - Problem of *serialization* and *isolation*

System Failure Problems

What Can Go Wrong?

- System may not be able to obtain one or more of the data items
- System may not be able to write one or more of the data items (Problems of *atomicity)*
- DBMS has a *Concurrency Control* subsytem to assure database remains in consistent state despite concurrent execution of transactions

System Failure Problems

System Failure Problems

System failures may occur

- Types of failures:
  - System crash
  - Transaction or system error
  - Local errors
  - Concurrency control enforcement
  - Disk failure
  - Physical failures

DBMS has a *Recovery* Subsystem to protect database against system failures

End

Introduction to Database Administration

System Log

System Log

System Log

- Introduction
- System Log
- How the Log File is used?
- Transaction Log Example

System Log

Introduction

- **Log or Journal** : The log keeps track of all transaction operations that affect the values of database items. This information may be needed to permit recovery from transaction failures. The log is kept on disk, so it is not affected by any type of failure except for disk or catastrophic failure. In addition, the log is periodically backed up to archival storage (tape) to guard against such catastrophic failures.

System Log

Introduction

- T refers to a unique **transaction-id** that is generated automatically by the system and is used to identify each transaction

System Log

System Log

- Transaction –id
- System log
  - Multiple record-type file
  - Log is kept on disk
  - Periodically backed up

System Log

System Log

- Log records
  - [start_transaction, T]
  - [write_item, T,X,old_value,new_value]:
  - [read_item, T,X]
  - [commit,T]
  - [abort,T]
  - [checkpoint]
- Commit point of a transaction

System Log

How the Log File is used?

- All permanent changes to data are recorded
  - Possible to undo changes to data
- After crash, search log backwards until find last checkpoint
  - Know that beyond this point, effects of transaction are permanently recorded

System Log

How the Log File is used?

- Need to either *redo* or *undo* everything that happened since last checkpoint
  - Undo: When transaction only partially completed (before crash)
  - Redo: Transaction completed but we are unsure whether data was written to disk

System Log

Transaction Log Example

TransID	Table	RowID	column	Before	After
100	**start**				
100	EMPLOYEE	1005472	Salary	8000	8250
100	PROJECT	1423PRJ	PrjRate	253	256
100	**end committed**				

Introduction to Database Administration

Schedules & Recoverability

Schedules & Recoverability

- Transaction and Schedule
- Schedule
- Example of Schedule

Schedules & Recoverability

Transaction and Schedule

We have discussed that

- Multiple transactions can be executed concurrently by interleaving their operations

Schedule

- Ordering of execution of operations from various transactions T_1, T_2, … , T_n is called a schedule *S*

Schedules & Recoverability

Schedule

Schedule S of n transactions T_1, T_2, … , T_n is an ordering of the operations of the transactions subject to the constraint that, for each transaction T_i that participates in S, the operations of T_i in S must appear in the same order in which they occur in T_i.

Schedules & Recoverability

Example of Schedule

Transaction T_1: $r_1(X)$; $w_1(X)$; $r_1(Y)$; $w_1(Y)$; c_1

Transaction T_2: $r_2(X)$; $w_2(X)$; c_2

A schedule, S:

$r_1(X)$; $r_2(X)$; $w_1(X)$; $r_1(Y)$; $w_2(X)$; $w_1(Y)$; c_1; c_2

Introduction to Database Administration

Conflicts

Conflicts

Schedule with Conflicts

- Conflicts
- Conditions for Conflicts
- Example of Conflicts

Conflicts

Conflicts

Conflict operations can creates inconsistency

Two operations *conflict* if they satisfy ALL three conditions:

1. they belong to different transactions **AND**
2. they access the same item **AND**
3. at least one is a **write_item()**operation

Conflicts

Conditions for Conflicts

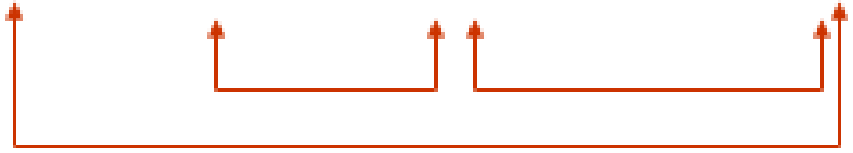
Two operations *conflict* if they satisfy ALL three conditions:

1. they belong to different transactions **AND**
2. they access the same item **AND**
3. at least one is a **write_item()**operation

Conflicts

Example of Conflicts

S: $r_1(X)$; $r_2(X)$; $w_1(X)$; $r_1(Y)$; $w_2(X)$; $w_1(Y)$;



conflicts

Serializability

Serializability

Schedule with Serializability

- Serializability
- Serial Schedule
- Characteristics of Serial Schedule

Serializability

Serializability

- Serial Schedule
- Non-serial schedule
- Serializable schedule
  - Conflict-serializable schedule
  - View-serializable schedule

Serializability

Serializability

- **Serial and Non-serial schedule**
  A schedule *S* is **serial** if, for every transaction *T* participating in the schedule, all the operations of *T* are executed consecutively in the schedule; otherwise, the schedule is called **non-serial**
- **Serializable schedule**
  A schedule *S* of *n* transactions is **serializable** if it is *equivalent to some serial schedule* of the same *n* transactions

Serializability

Serial Schedule

- Serial schedule is guaranteed correct, should we adopt it?
- No, that will be inefficient, under the utilization of resources
- Dislike by the users

Serializability

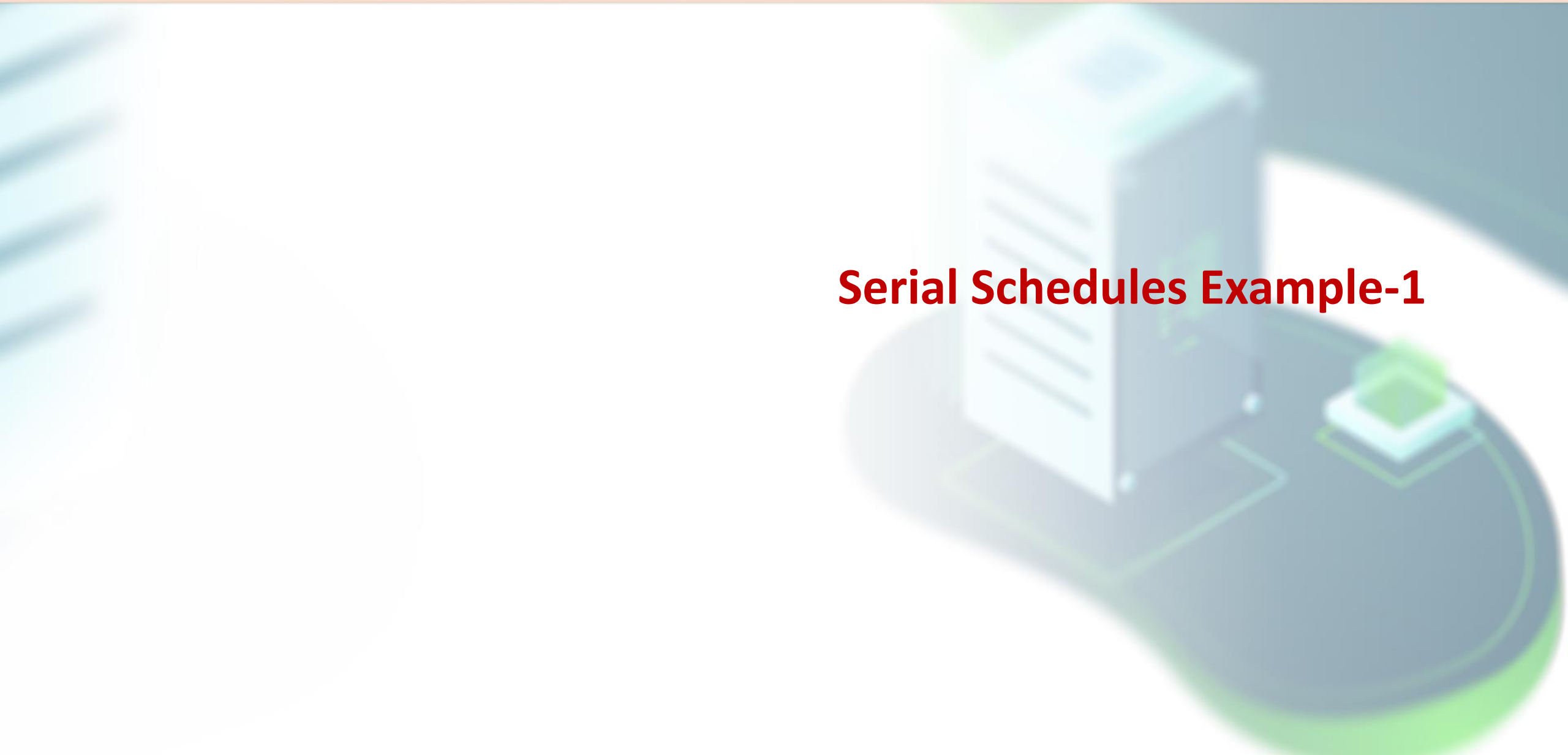
Characteristics of Serial Schedule

Result equivalent: Two schedules are called result equivalent if they produce the same final state of the database.

Conflict equivalent: Two schedules are said to be conflict equivalent if the order of any two conflicting operations is the same in both schedules.

Conflict serializable: A schedule S is said to be conflict serializable if it is conflict equivalent to some serial schedule S'.

End



Serial Schedules Example-1

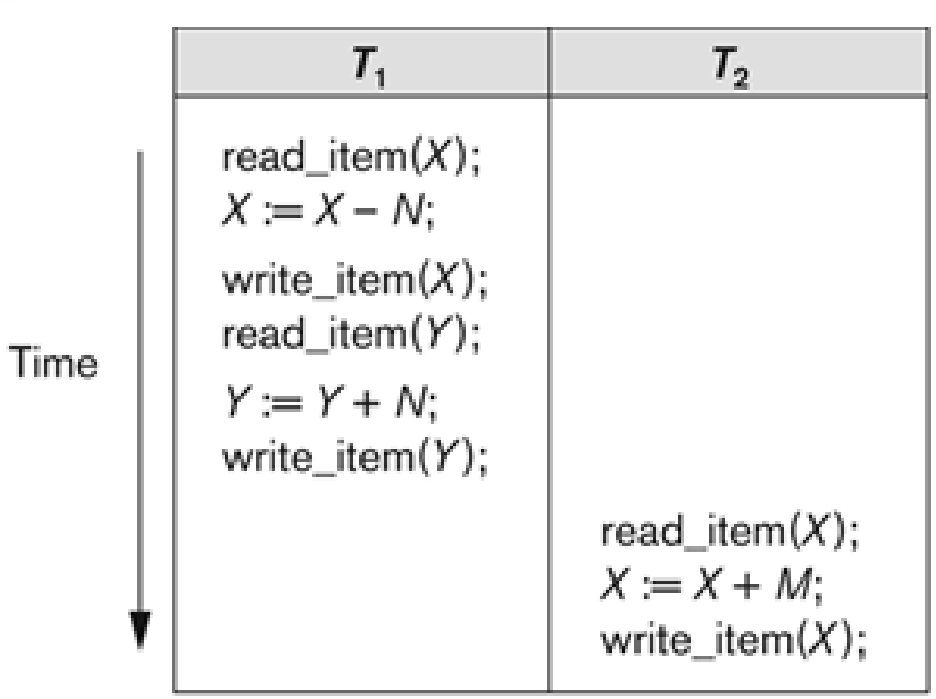
Serial Schedules Example-1

Schedule with Serial Schedules Example-1

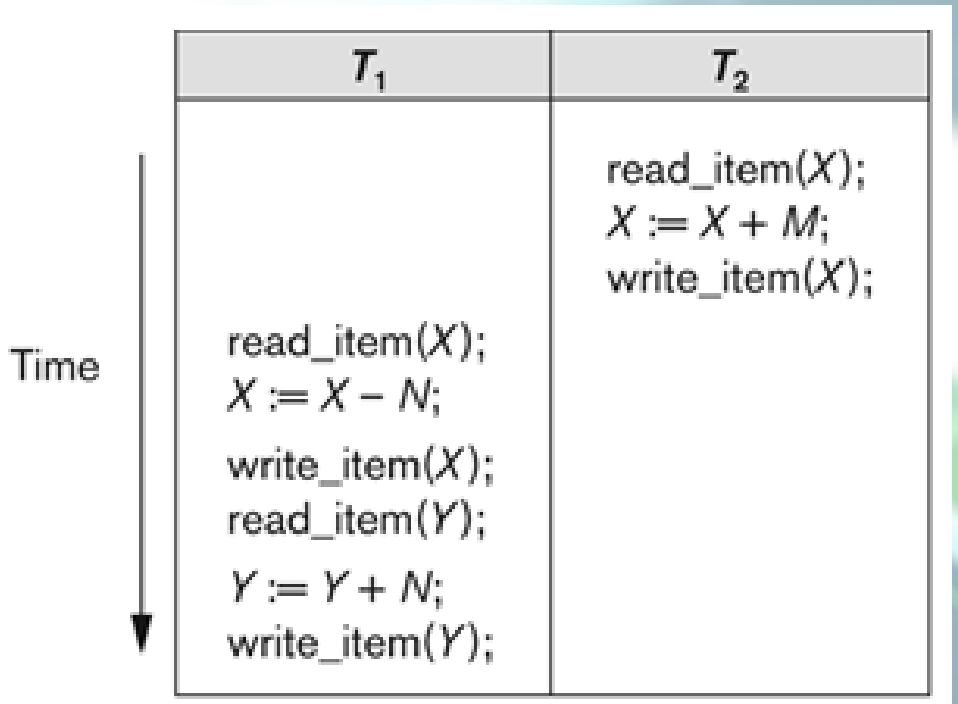
- Example-1

Serial Schedules Example-1

Example-1

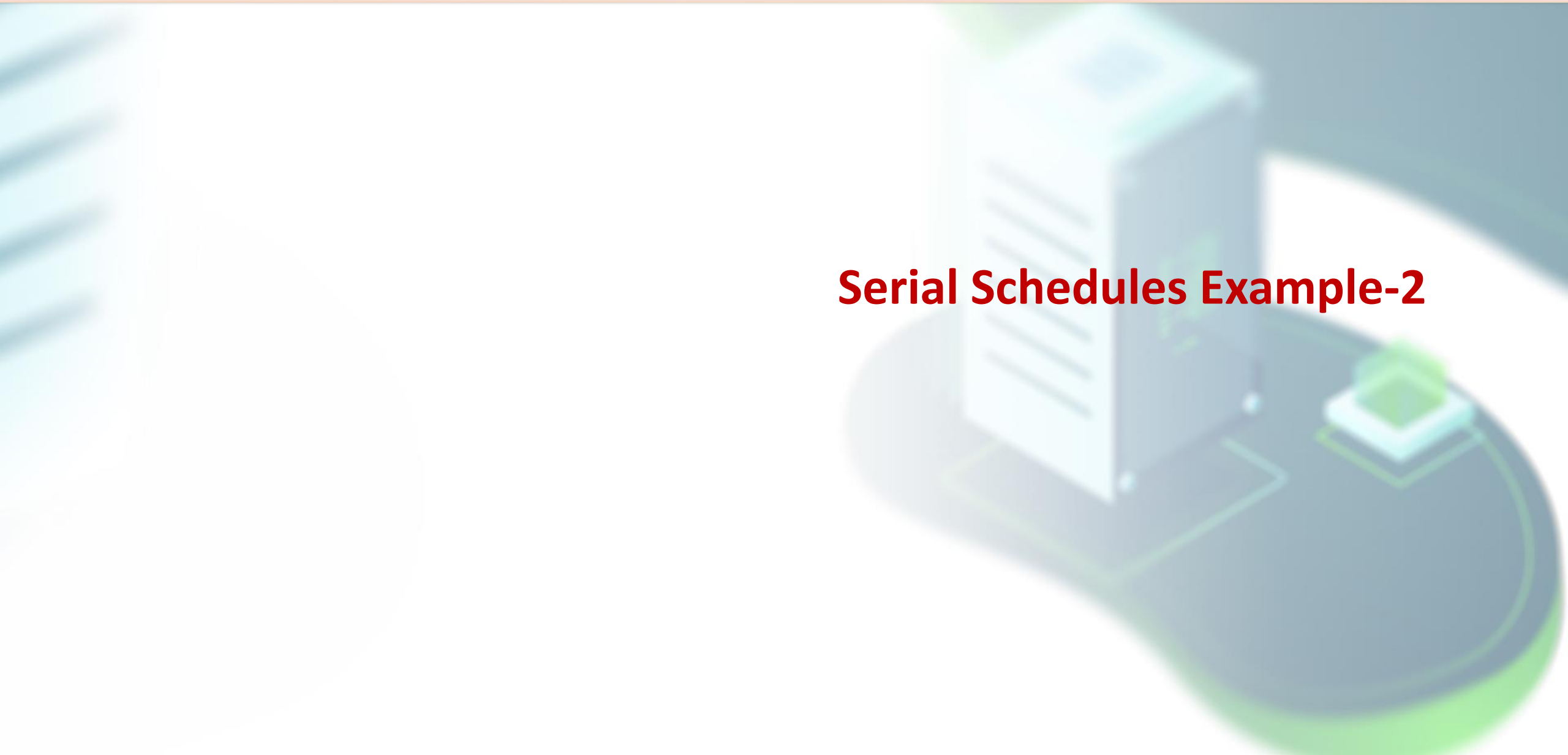


Schedule A



Schedule B

Assume X=90, Y=90, N=3, M=2



Serial Schedules Example-2

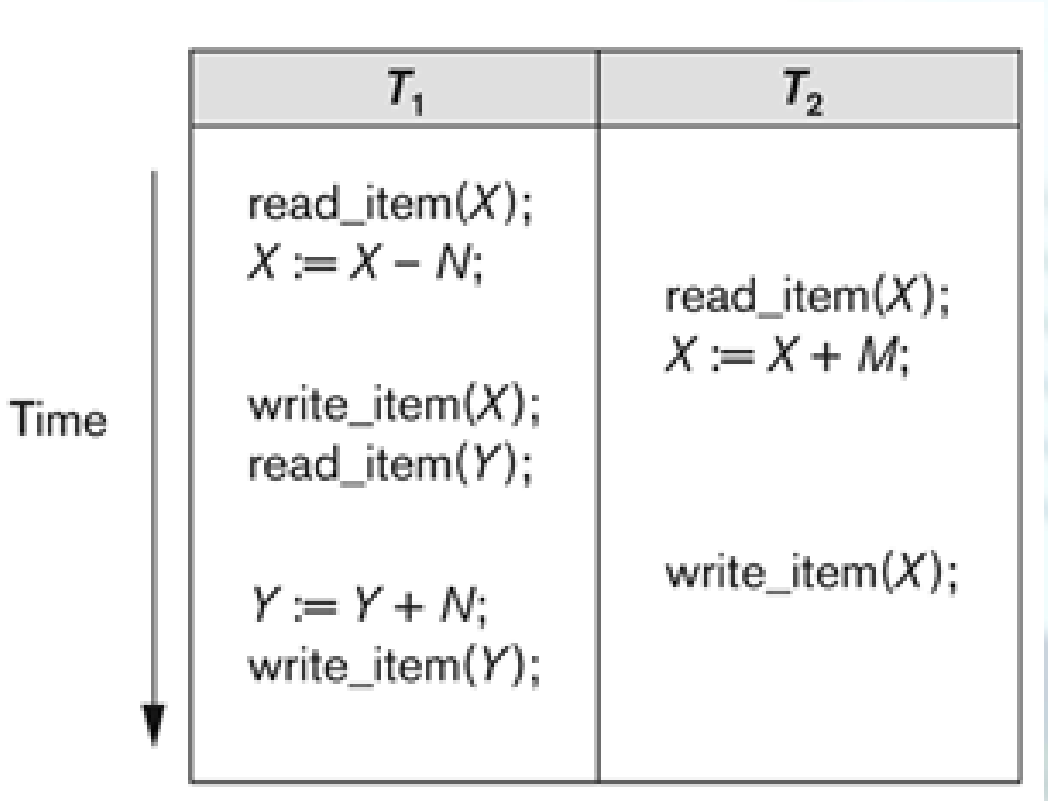
Serial Schedules Example-2

Schedule with Serial Schedules Example-2

- Example-2

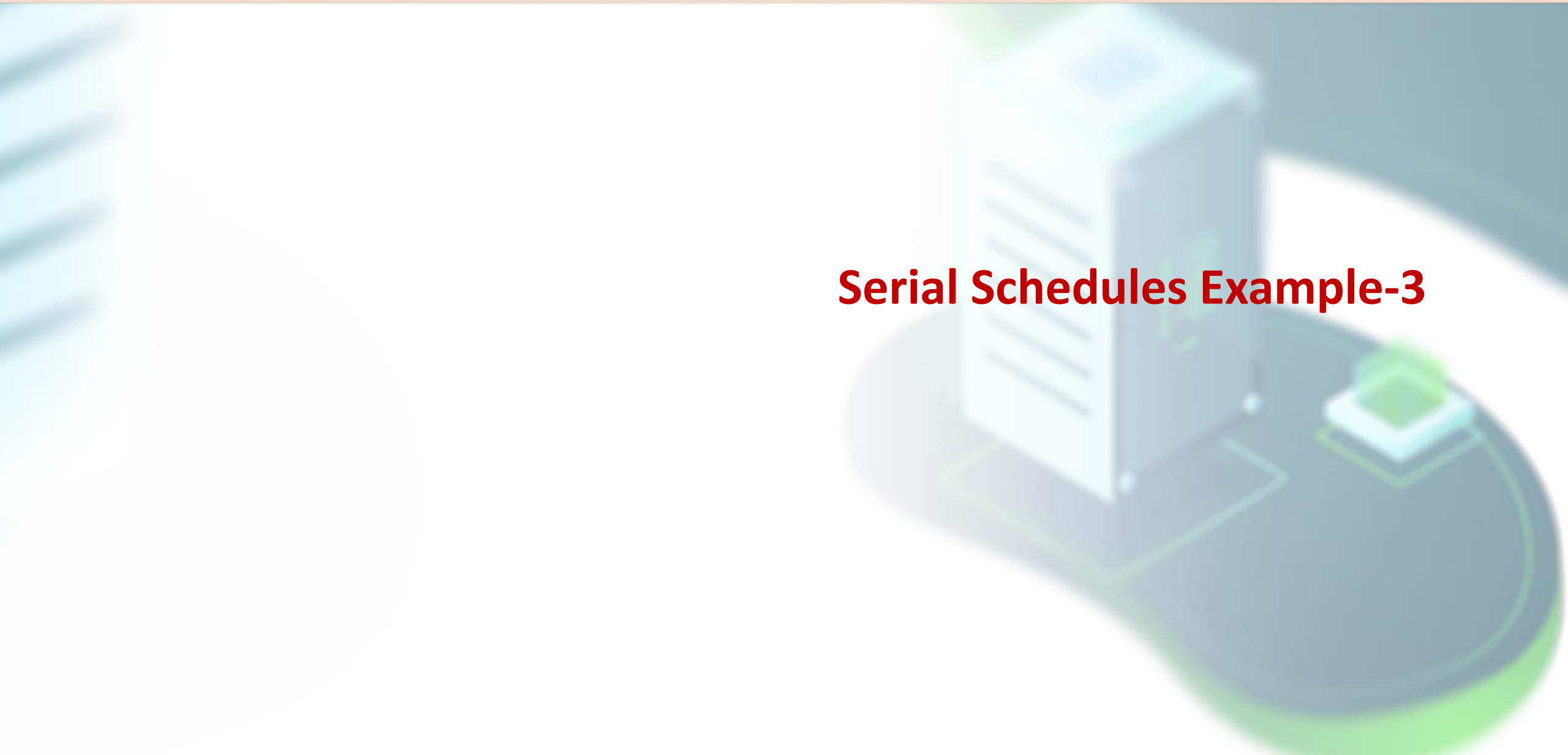
Serial Schedules Example-2

Example-2 (Schedule S')



Assume X=90, Y=90, N=3, M=2
Not Correct Values

Serial Schedules Example-3



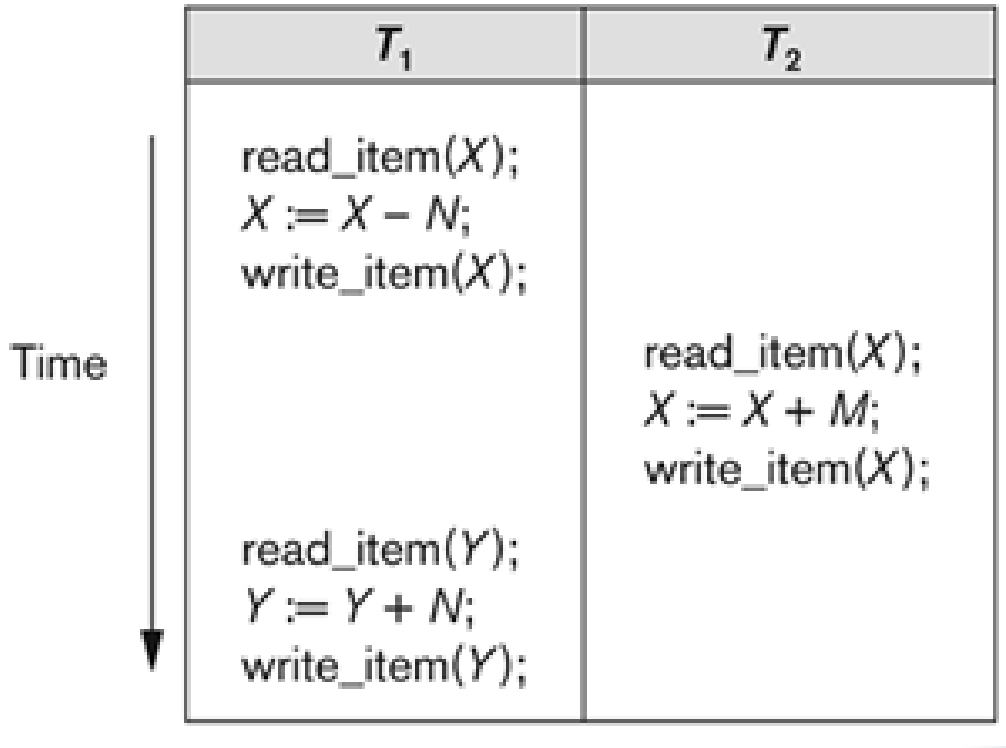
Serial Schedules Example-3

Schedule with Serial Schedules Example-3

- Example-3

Serial Schedules Example-3

Example-3 (Schedule S'')



Assume X=90, Y=90, N=3, M=2

Produces same result as serial schedule

Conflict Serializability Example-1

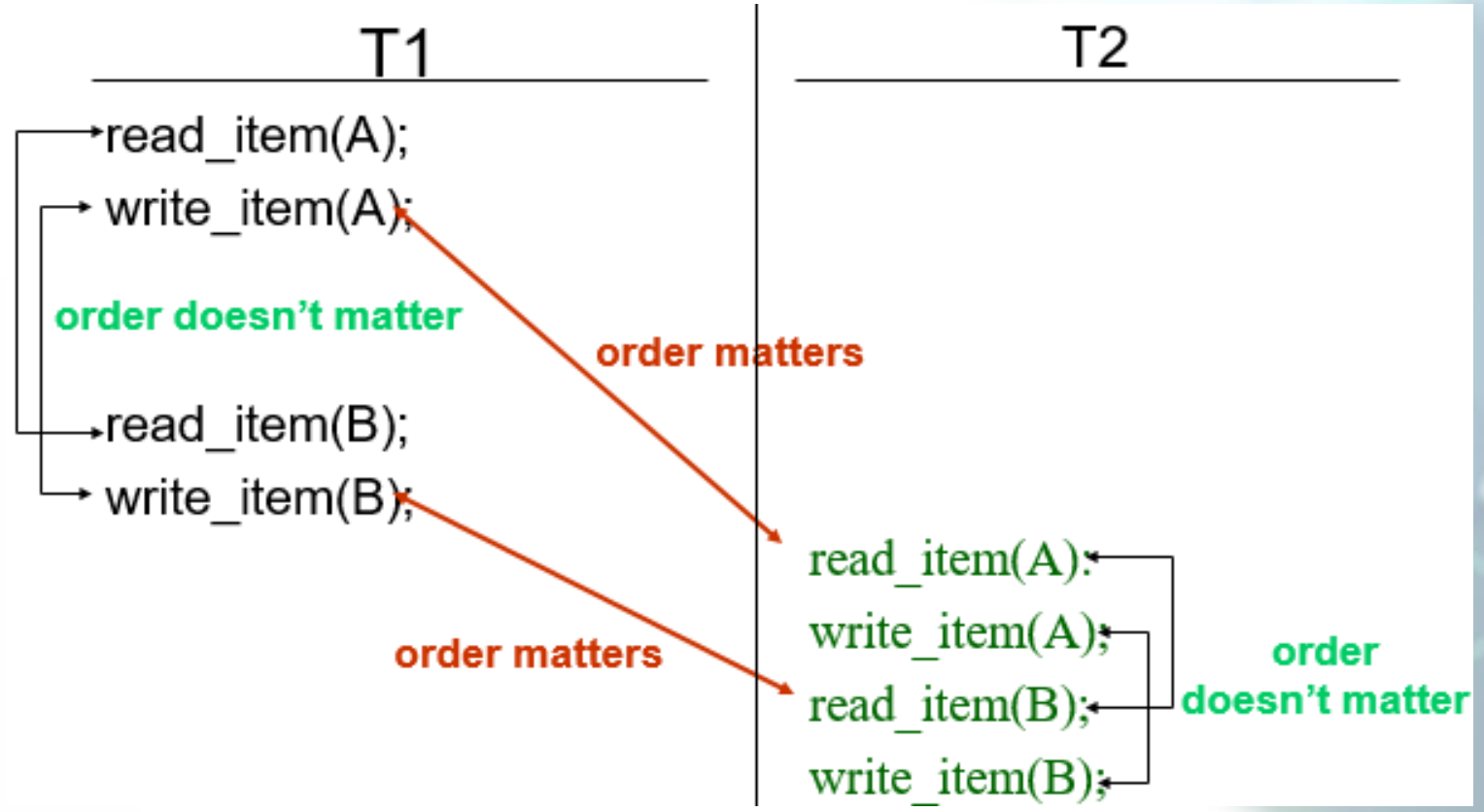
Conflict Serializability Example-1

Schedule with Conflict Serializability Example-1

- Example-1 (S1)
- Example-1 (S1’)
- Example-1 (Schedules A, B)

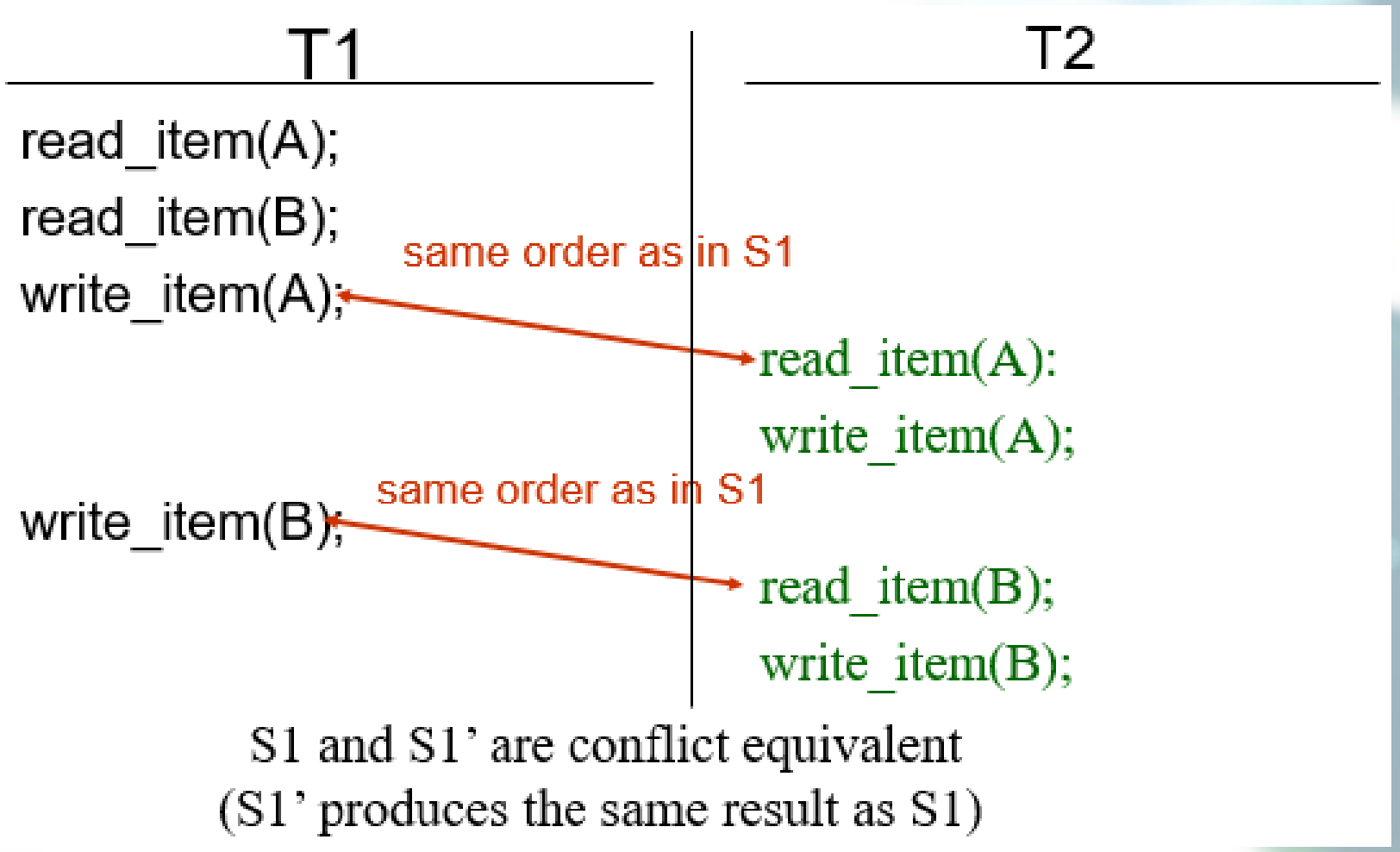
Conflict Serializability Example-1

Example-1 (Schedule S)



Conflict Serializability Example-1

Example-1 (Schedule S1')



S1 and S1' are conflict equivalent
(S1' produces the same result as S1)

Conflict Serializability Example-1

Example-1 (Schedules A, B)

Schedule A

T1	T2
read_item(X);	
X:=X-N;	
write_item(X);	
read_item(Y);	
Y:=Y+N;	
write_item(Y);	
	read_item(X);
	X:=X+M;
	write_item(X);

Schedule B

T1	T2
read_item(X);	
X:=X-N;	
write_item(X);	
	read_item(X);
	X:=X+M;
	write_item(X);
read_item(Y);	
Y:=Y+N;	
write_item(Y);	

B is conflict equivalent to A ⇒ B is serializable

Conflict Serializability Example-2 (Graph Test)

Conflict Serializability Example-2 (Graph Test)

Conflict Serializability Example-2 (Graph Test)

- Test for Serializability
- Example-2 (Graph Test)

Conflict Serializability Example-2 (Graph Test)

Test for Serializability

Construct a directed graph, *precedence graph,* G = (V, E)

V: set of all transactions participating in schedule

E: set of edges $T_i \rightarrow T_j$ for which one of the following holds:

T_i executes a write_item(X) before T_j executes read_item(X)

T_i executes a read_item(X) before T_j executes write_item(X)

T_i executes a write_item(X) before T_j executes write_item(X)

Conflict Serializability Example-2 (Graph Test)

Test for Serializability

An edge $T_i \rightarrow T_j$ means that in any serial schedule equivalent to S, T_i must come before T_j

If G has a cycle, then S is not conflict serializable

If not, use topological sort to obtain serializable schedule (linear order consistent with precedence order of graph)

To check consistency if graph is acyclic otherwise schedule has deadlock means inconsistent

Conflict Serializability Example-2 (Graph Test)

Example-2 (Graph Test)

T1	T2	T3
		read_item(Y);
		read_item(Z);
read_item(X);		
write_item(X);		
		write_item(Y);
		write_item(Z);
	read_item(Z);	
read_item(Y);		
write_item(Y);		
	read_item(Y);	
	write_item(Y);	
	read_item(X);	
	write_item(X);	

Apply Locking

Apply Locking

Apply Locking

- Database Locks
- Locks in Oracle SQL
- Locks Update

Apply Locking

Database Locks

- When two sessions or users of database try to update or delete the same data in a table, then there will be a concurrent update problem. In order to avoid this problem, database locks the data for the first user and allows him to update/delete the data.
- Once he is done with his update/delete, he COMMITs or ROLLBACK the transaction, which will release the lock on the data. When lock on the data is released, another user can lock it for his changes.

Apply Locking

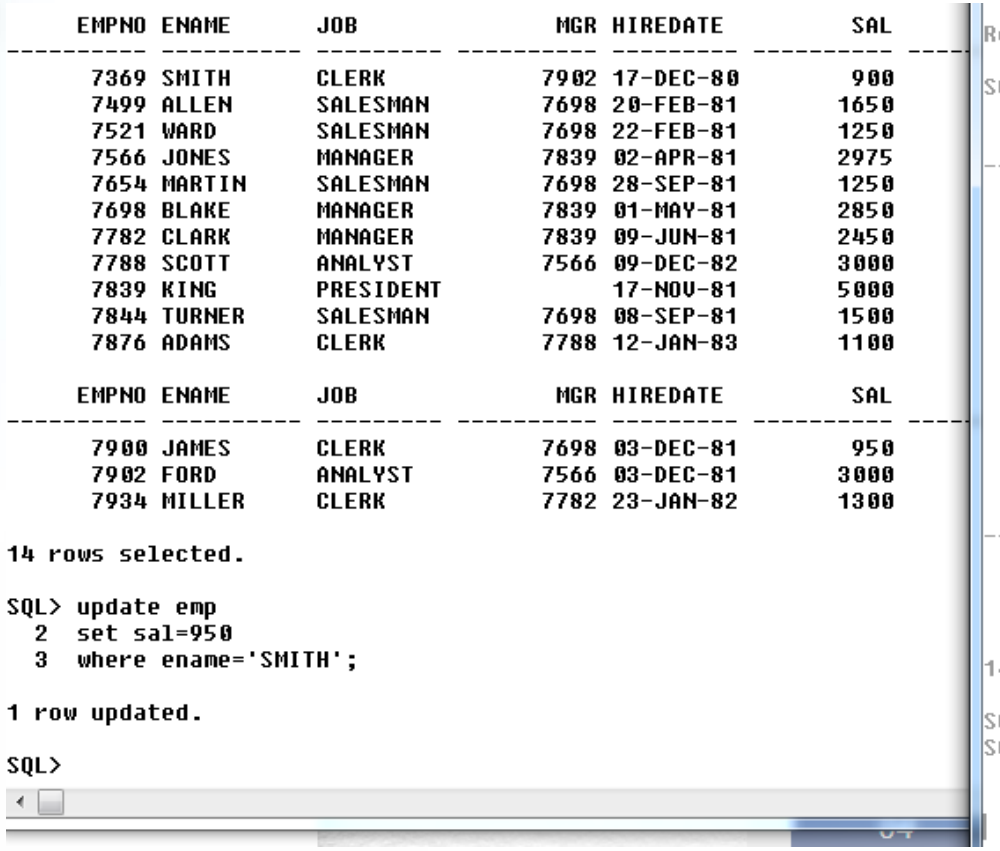
Database Locks

- An Object is locked before it performs any operation
- Two types of operations, two types of locks

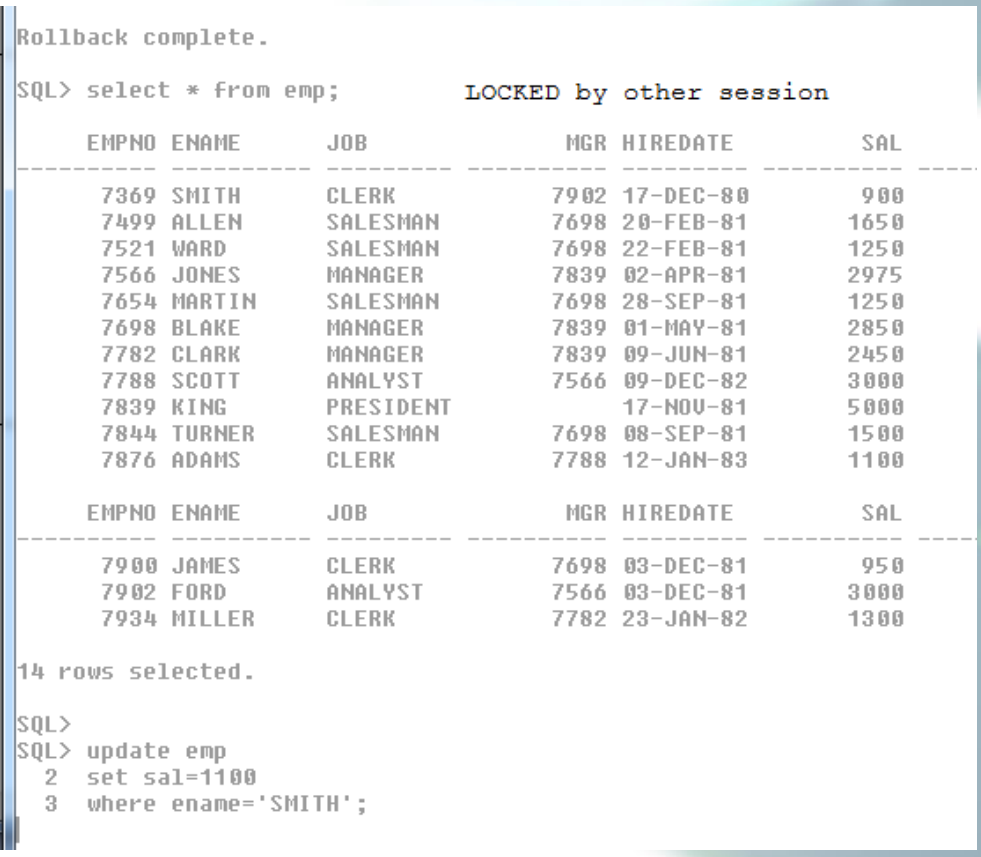
  Shared & Exclusive Locks

Apply Locking

Locks in Oracle SQL



```
     EMPNO ENAME      JOB              MGR HIREDATE         SAL
---------- ---------- --------- ---------- --------- ----------
      7369 SMITH      CLERK           7902 17-DEC-80        900
      7499 ALLEN      SALESMAN        7698 20-FEB-81       1650
      7521 WARD       SALESMAN        7698 22-FEB-81       1250
      7566 JONES      MANAGER         7839 02-APR-81       2975
      7654 MARTIN     SALESMAN        7698 28-SEP-81       1250
      7698 BLAKE      MANAGER         7839 01-MAY-81       2850
      7782 CLARK      MANAGER         7839 09-JUN-81       2450
      7788 SCOTT      ANALYST         7566 09-DEC-82       3000
      7839 KING       PRESIDENT            17-NOV-81       5000
      7844 TURNER     SALESMAN        7698 08-SEP-81       1500
      7876 ADAMS      CLERK           7788 12-JAN-83       1100

     EMPNO ENAME      JOB              MGR HIREDATE         SAL
---------- ---------- --------- ---------- --------- ----------
      7900 JAMES      CLERK           7698 03-DEC-81        950
      7902 FORD       ANALYST         7566 03-DEC-81       3000
      7934 MILLER     CLERK           7782 23-JAN-82       1300

14 rows selected.

SQL> update emp
  2  set sal=950
  3  where ename='SMITH';

1 row updated.

SQL>
```

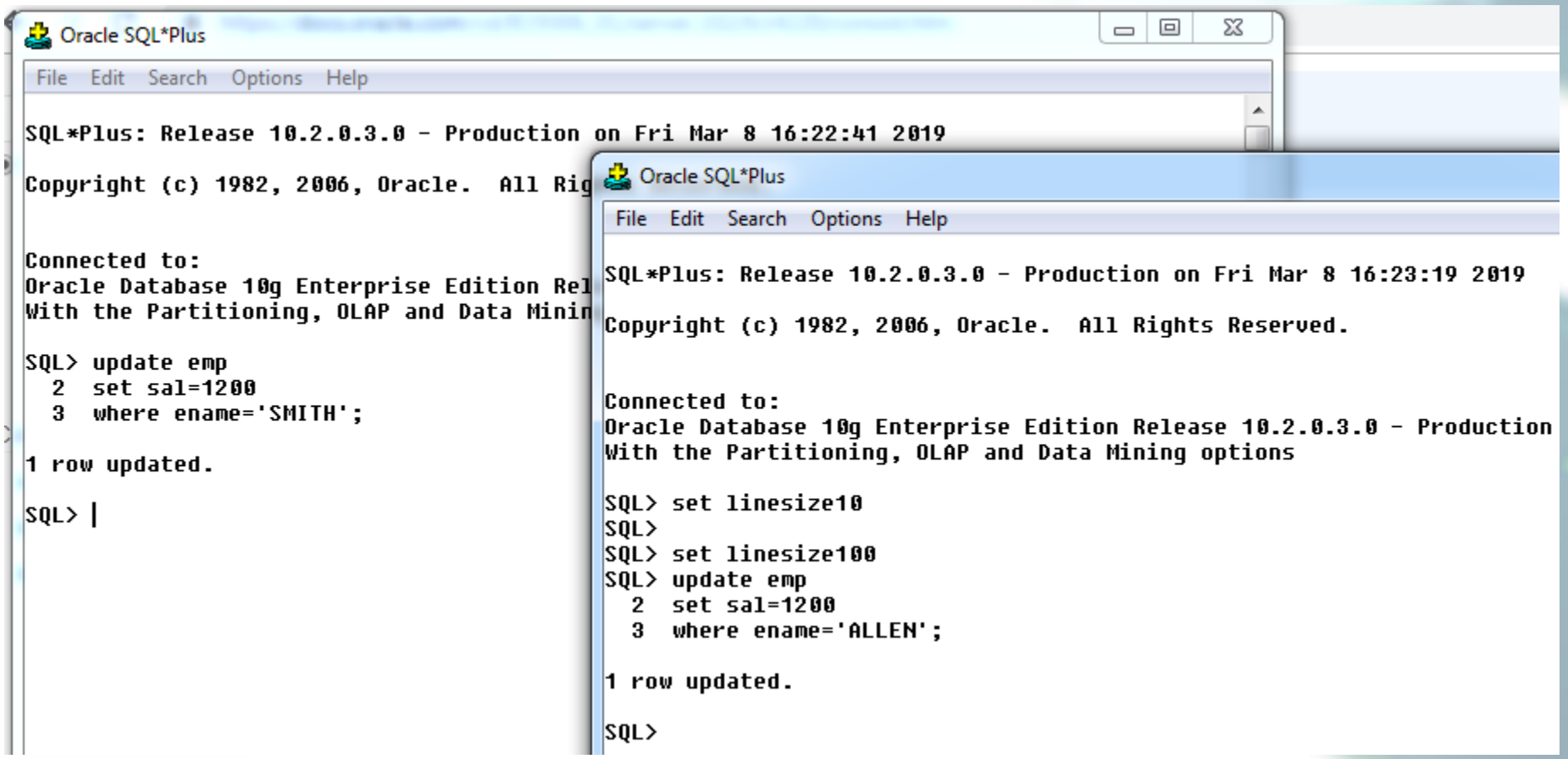


```
Rollback complete.

SQL> select * from emp;          LOCKED by other session

     EMPNO ENAME      JOB              MGR HIREDATE         SAL
---------- ---------- --------- ---------- --------- ----------
      7369 SMITH      CLERK           7902 17-DEC-80        900
      7499 ALLEN      SALESMAN        7698 20-FEB-81       1650
      7521 WARD       SALESMAN        7698 22-FEB-81       1250
      7566 JONES      MANAGER         7839 02-APR-81       2975
      7654 MARTIN     SALESMAN        7698 28-SEP-81       1250
      7698 BLAKE      MANAGER         7839 01-MAY-81       2850
      7782 CLARK      MANAGER         7839 09-JUN-81       2450
      7788 SCOTT      ANALYST         7566 09-DEC-82       3000
      7839 KING       PRESIDENT            17-NOV-81       5000
      7844 TURNER     SALESMAN        7698 08-SEP-81       1500
      7876 ADAMS      CLERK           7788 12-JAN-83       1100

     EMPNO ENAME      JOB              MGR HIREDATE         SAL
---------- ---------- --------- ---------- --------- ----------
      7900 JAMES      CLERK           7698 03-DEC-81        950
      7902 FORD       ANALYST         7566 03-DEC-81       3000
      7934 MILLER     CLERK           7782 23-JAN-82       1300

14 rows selected.

SQL>
SQL> update emp
  2  set sal=1100
  3  where ename='SMITH';
```

Record level lock/ Row Lock – same record

Apply Locking

Locks Update



Introduction to Database Administration

Deadlocks

Deadlocks

Deadlocks

- Database Deadlocks
- Deadlocks - Two Transactions
- Applying Locks at Table Level
- Deadlock - Example

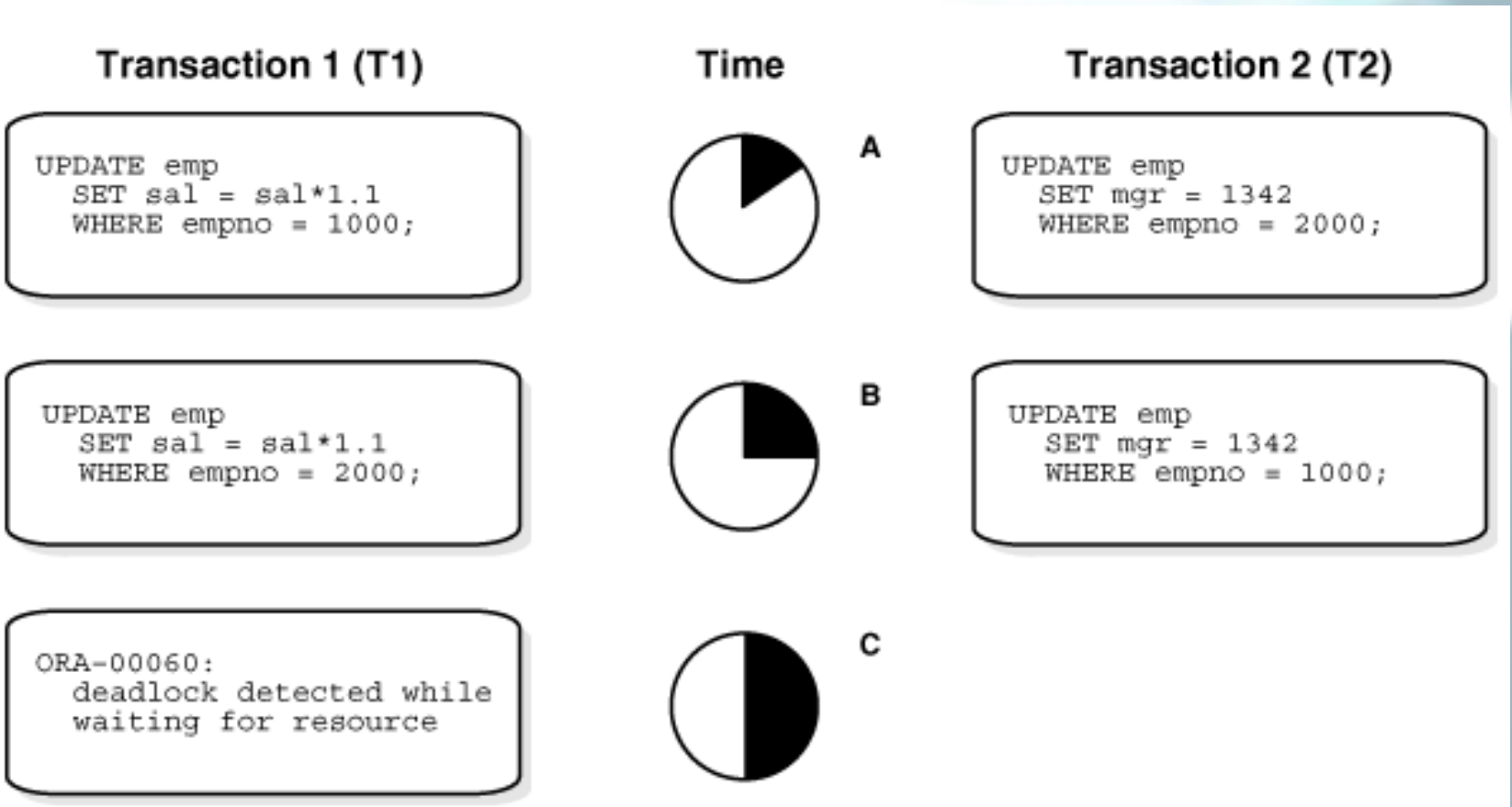
Deadlocks

Database Deadlocks

In a **database**, a **deadlock** is a situation in which two or more transactions are waiting for one another to give up locks. For example, Transaction A might hold a lock on some rows in the Accounts table and needs to update some rows in the Orders table to finish.

Deadlocks

Deadlocks – Two Transactions



Deadlocks

Applying Locks at Table Level

```
--user scott
Lock table dept IN EXCLUSIVE MODE;

--user can use rollback to unlock this table

--user sys
 select object_id, session_id, oracle_username, locked_mode
 from V$Locked_Object;

 OBJECT_ID SESSION_ID ORACLE_USERNAME                 LOCKED_MODE
---------- ---------- ------------------------------ -----------
     53768        140 SCOTT                                    6  (Locked applied)
     53768        148 SCOTT                                    0  (Locked in other session)

--in session 148
SQL> update dept
  2  set loc='BOSTON1'
  3  where deptno=40;

----LOCKED-------

How to put in share mode?
Lock table dept in share mode;
```

Deadlocks

Deadlock - Example

Time	T1	T2
t1	XLock(x)	…
t2	…	XLock(y)
t3	Request y	…
t4	wait	Request x
t5	wait	wait
t6	wait	wait

DDL Schema Script for Project

DDL Schema Script for Project

DDL Schema Script for Project

- Plan the Script for Schema
- Sample Script

DDL Schema Script for Project

Plan the Script for Schema

ANSI standard script of SQL consists of

Create and Alter Statements

Standard & Additional Constraints

Tables with Tablespace Storage

Database Security

Shared Logical Objects such as Views, Synonyms

Logical & Physical Storage

DML - SQL

DDL Schema Script for Project

Sample Script

```
Drop table employee;
Drop table orders;
Drop table customer;
Drop table Item;

create table Customer
(custID          CHAR(10),
CustName         VARCHAR2(25) NOT NULL,
Address          VARCHAR2(50),
City             VARCHAR2(50),
TelNo            VARCHAR2(15),
Email            VARCHAR2(50) UNIQUE)
tablespace TS_Sales;

Alter table Customer
add constraint PK_Custid primary key (CustID);

Create table Orders
(InvoiceNo       CHAR(12),
InvType          CHAR(1),
InvDate          Date NOT NULL,
TotalPrice       Number(6,2),
SalesEmpID       CHAR(5),
CustID           CHAR(8))
tablespace TS_Sales;

Alter table Orders
add constraint PK_InvNo primary key (InvoiceNO)
USING INDEX TABLESPACE Sale_indx;

Alter table Orders
add constraint FK_Cust_CustID foreign key (custID)
references Customer(CustID);
```

DDL Schema Script for Project

Alter Table with Move on Storage

```
ALTER TABLE hr.admin_emp MOVE
      STORAGE ( INITIAL 20K
                NEXT 40K
                MINEXTENTS 2
                MAXEXTENTS 20
                PCTINCREASE 0 )
  TABLESPACE hr_tbs;

ALTER TABLE hr.admin_emp
      ADD (bonus NUMBER (7,2));
```

Introduction to Database Administration

DDL Schema Script including Tables, Columns and Data Types

DDL Schema Script including Tables, Columns and Data Types

DDL Schema Script including Tables, Columns and Data Types

- DDL Script for Schema
- Sample Create Table - SQL
- Sample Create/ Alter Table with Constraints
- Sample Create Table with Additional Constraints

DDL Schema Script including Tables, Columns and Data Types

DDL Script for Schema

Scripts are used to create objects (structures) such as tables, sequences, views and PL/SQL programs etc in a schema. Many script contains DDL SQL.

Script can contain DML for populating data for development and testing.

Similarly, structure of schema objects can be populated using exported DMP file.

DDL Schema Script including Tables, Columns and Data Types

Sample Create Table - SQL

```
CREATE TABLE hr.admin_emp (
         empno       NUMBER(5) PRIMARY KEY,
         ename       VARCHAR2(15) NOT NULL,
         ssn         NUMBER(9) ENCRYPT USING 'AES256',
         job         VARCHAR2(10),
         mgr         NUMBER(5),
         hiredate    DATE DEFAULT (sysdate),
         photo       BLOB,
         sal         NUMBER(7,2),
         hrly_rate   NUMBER(7,2) GENERATED ALWAYS AS (sal/2080),
         comm        NUMBER(7,2),
         deptno      NUMBER(3) NOT NULL
                      CONSTRAINT admin_dept_fkey REFERENCES hr.departments
                      (department_id))
   TABLESPACE admin_tbs
   STORAGE ( INITIAL 50K);

COMMENT ON TABLE hr.admin_emp IS 'Enhanced employee table';
```

DDL Schema Script including Tables, Columns and Data Types

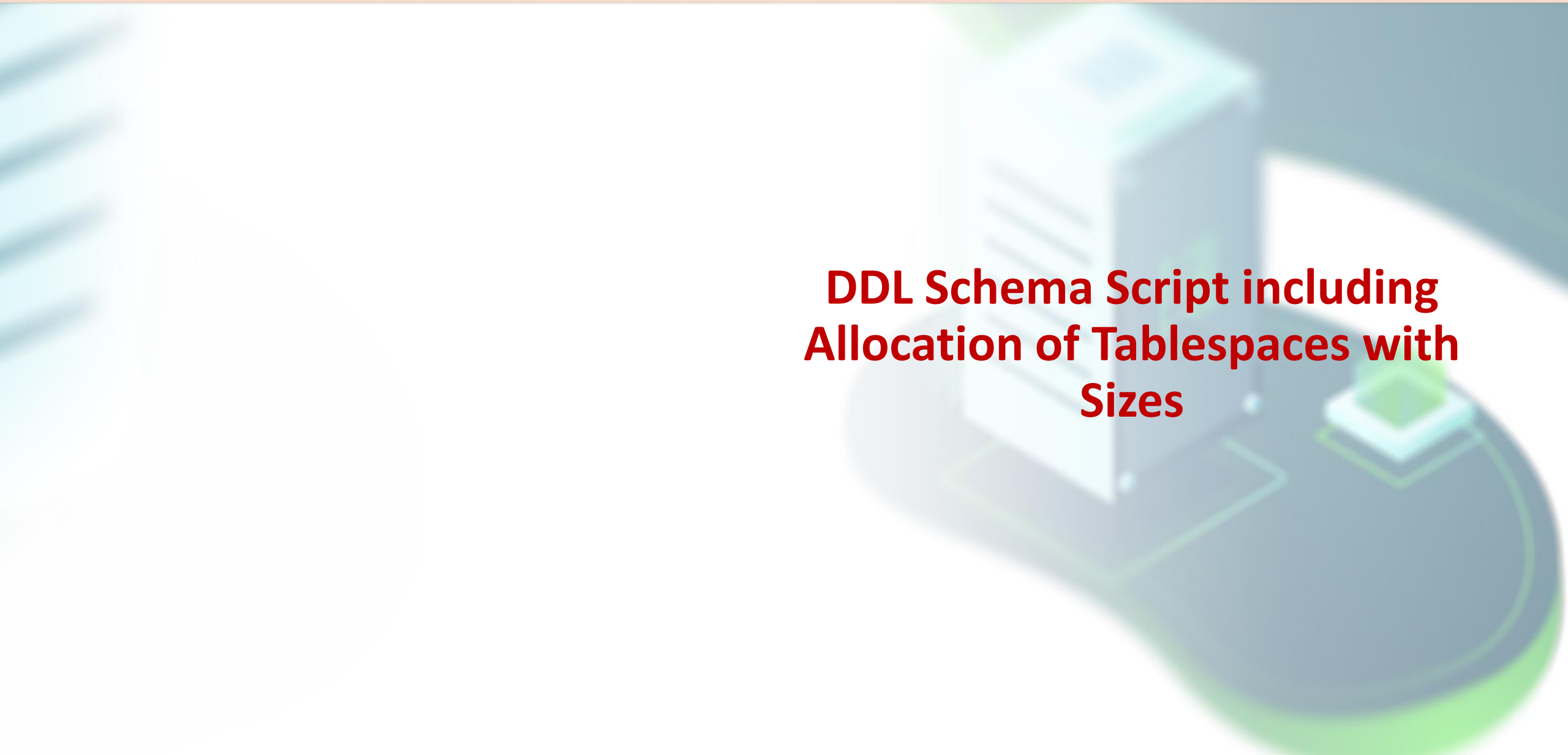
Sample Create/ Alter Table with Constraints

```
Drop table employee;
Drop table orders;
Drop table customer;
Drop table Item;

create table Customer
(custID          CHAR(10),
CustName         VARCHAR2(25) NOT NULL,
Address          VARCHAR2(50),
City             VARCHAR2(50),
TelNo            VARCHAR2(15),
Email            VARCHAR2(50) UNIQUE)
tablespace TS_Sales;

Alter table Customer
add constraint PK_Custid primary key (CustID);

Create table Orders
(InvoiceNo       CHAR(12),
InvType          CHAR(1),
InvDate          Date NOT NULL,
TotalPrice       Number(6,2),
SalesEmpID       CHAR(5),
CustID           CHAR(8))
tablespace TS_Sales;

Alter table Orders
add constraint PK_InvNo primary key (InvoiceNO)
USING INDEX TABLESPACE Sale_indx;

Alter table Orders
add constraint FK_Cust_CustID foreign key (custID)
references Customer(CustID);
```

DDL Schema Script including Tables, Columns and Data Types

Sample Create Table with Additional Constraints

```
create table Employee
(EmpID              CHAR(3),
EmpName             VARCHAR2(25) NOT NULL,
Address             VARCHAR2(50),
City                VARCHAR2(50),
TelNo               VARCHAR2(15),
Email               VARCHAR2(50) UNIQUE,
Status              CHAR(1))
tablespace TS_Sales;

Alter table Employee
add constraint ck_status
check (Status in ('Y', 'N'));

Alter table Employee
add constraint PK_EmpID primary key (EmpID)
USING INDEX TABLESPACE Sale_indx;
```



DDL Schema Script including Allocation of Tablespaces with Sizes

DDL Schema Script including Allocation of Tablespaces with Sizes

DDL Schema Script for Tablespaces

- Logical & Physical Storage
- Data Tablespaces for Tables
- Tablespace for Indexes
- Temporary Tablespace for Project

DDL Schema Script including Allocation of Tablespaces with Sizes

Logical & Physical Storage

- Creating tablespaces for data, indexes
- Tablespaces for table or tables
- Tablespace with OS level storage

DDL Schema Script including Allocation of Tablespaces with Sizes

Data Tablespaces for Tables

```
Create tablespace MedCare Datafile
     'D:\oracle9i\ora92\oradata\MCare01.dbf' Size 150M online
     MINIMUM EXTENT 64K
     DEFAULT STORAGE (INITIAL 64K NEXT 64K);


Create tablespace MCare_IVF Datafile
      'D:\oracle9i\ora92\oradata\MCIVF01.dbf' Size 50M online
      MINIMUM EXTENT 64K
      DEFAULT STORAGE (INITIAL 64K NEXT 64K);

CREATE TABLESPACE MCare_IVFCHART DATAFILE
     'D:\oracle9i\ora92\oradata\MCare_IVFCHART01.dbf' SIZE 50M
     MINIMUM EXTENT 1024K
     DEFAULT STORAGE (INITIAL 1024K NEXT 1024K);
```

DDL Schema Script including Allocation of Tablespaces with Sizes

Tablespace for Indexes

```
CREATE TABLESPACE MCare_indx
DATAFILE 'D:\oracle9i\ora92\oradata\MCare_indx01.dbf' SIZE 100M
MINIMUM EXTENT 64K
DEFAULT STORAGE (INITIAL 64K NEXT 64K);
```

DDL Schema Script including Allocation of Tablespaces with Sizes

Temporary Tablespace for Project

```
CREATE TEMPORARY TABLESPACE "TEMP_DEFAULT3" TEMPFILE
    'D:\ORACLE9I\ORA92\ORADATA\eahmed\TEMP_DEFAUL3.DBF' SIZE
    1000M EXTENT MANAGEMENT LOCAL UNIFORM SIZE 1M;

ALTER DATABASE DEFAULT TEMPORARY TABLESPACE "TEMP_DEFAULT3";
```

Introduction to Database Administration

Creation of DML Insert Statements for Data

Creation of DML Insert Statements for Data

DML Schema Script

- DDL & DML Script
- Sample DML Insert Statements
- Sample DML Insert & Update Statements

Creation of DML Insert Statements for Data

DDL & DML Script

- One script file can be created to manage DDL & DML commands
- Separate files for DDL & DML
- DML Insert, Delete and Update commands
- All commands are in an order
- Well-defined datasets are selected

Creation of DML Insert Statements for Data

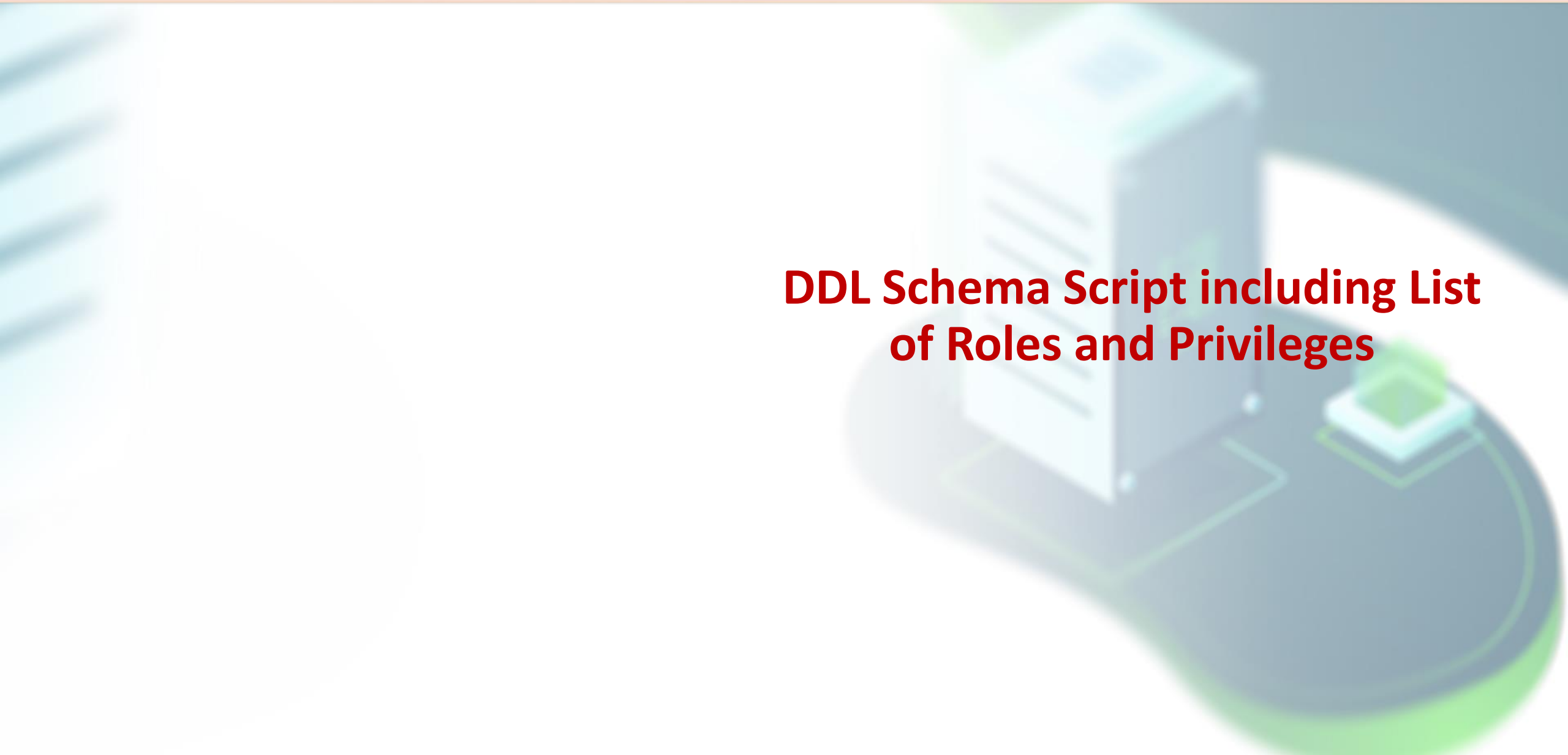
Sample DML Insert Statements

```
insert into customer(
CUSTID,
CUSTNAME,
ADDRESS,
CITY,
TELNO,
EMAIL)
values(
'88700110',
'3M Co',
'41 Main st.',
'Lahore',
'0514568877',
'ejaz@nu.edu.pk'
);

insert into customer(
CUSTID,
CUSTNAME,
ADDRESS,
```

Creation of DML Insert Statements for Data

Sample DML Insert & Update Statements

```
Insert into Customer

...

Update Sold
set qty = (select qty
           from Item
           where ItemID='254011');
```



DDL Schema Script including List of Roles and Privileges

DDL Schema Script including List of Roles and Privileges

Script for Security

- Roles & Privileges
- Creating User with Grants

DDL Schema Script including List of Roles and Privileges

Roles & Privileges

- Create roles
- Assign privileges to roles
- Assign privileges to users

DDL Schema Script including List of Roles and Privileges

Creating User with Grants

```
create tablespace work
datafile 'E:\oracle\product\10.2.0\db_2\oradata\work01.dbf'size 500M online;

create user uwork
identified by xyz
default tablespace work
temporary tablespace temp;

grant connect, resource to uwork;
grant create table to uwork;


create tablespace work_indx
datafile 'E:\oracle\product\10.2.0\db_2\oradata\WIndx01.dbf'size 200M online;

create tablespace work_depend
datafile 'E:\oracle\product\10.2.0\db_2\oradata\WDepend01.dbf'size 300M online;
```

DDL Schema Script including List of Roles and Privileges

Creating User with Grants

```
grant select on MED_STOCK  to public;
grant select on TRANSACTION   to public;
grant select on TRANS_DETAIL  to public;


grant select, insert, update on EMP to public;
grant select, insert, update on DEPT to ejaz;
```

Introduction to Database Administration

DDL Schema Script including Synonyms of Tables & Drop of all Objects

DDL Schema Script including Synonyms of Tables & Drop of all Objects

Synonyms & Drop Objects

- Generate SQL Script using SELECT Clause
- Creating Synonyms
- Drop Synonyms
- Drop Tables

DDL Schema Script including Synonyms of Tables & Drop of all Objects

Generate SQL Script using Select Clause

```
--Table EMP owner (scott) gives grant:
grant select on emp to u1;
--generate the following SQLs from scott schema and run in u1 schema
select 'create synonym '||tname||' for scott.'||tname||';'
from tab;
```

DDL Schema Script including Synonyms of Tables & Drop of all Objects

Creating Synonyms

```
grant create synonym to ul;
grant create public synonym to ul;
grant create synonym to scott;
grant create public synonym to scott;
```

DDL Schema Script including Synonyms of Tables & Drop of all Objects

Drop Synonyms

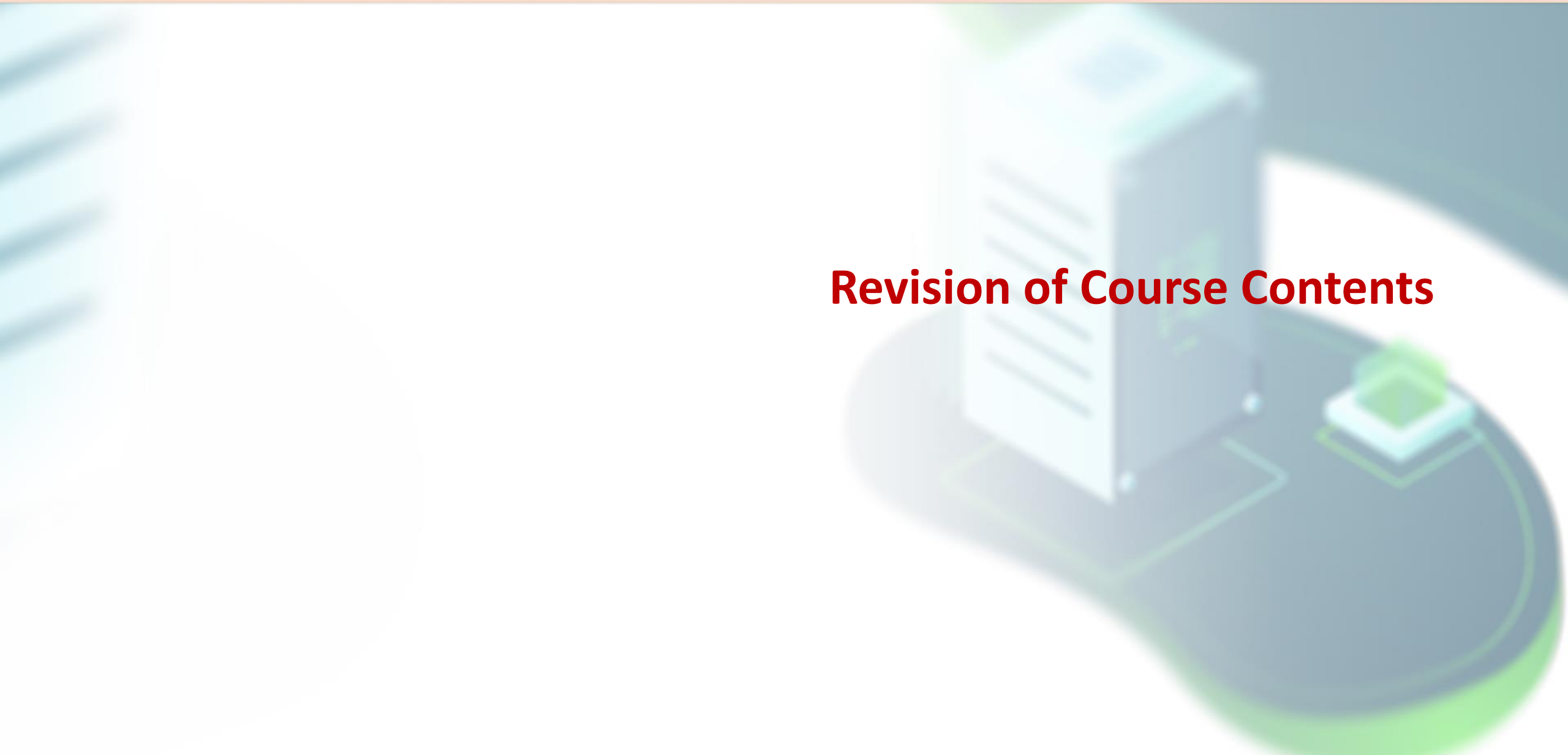
```
--inside same schema of scott:
create public synonym syn_emp for scott.emp;

drop synonym dept;
drop synonym emp;
```

DDL Schema Script including Synonyms of Tables & Drop of all Objects

Drop Tables

```
drop table EMP;
drop table ProjectAssign;
drop table DEPT;
drop project;
```

Introduction to Database Administration



Revision of Course Contents

Revision of Course Contents

Revision of DBA Course

- Introduction to Database & Architecture
- Database Design (Development)
- DBA
- PL/SQL
- Project’s Preparations & Scripts
- Logical & Physical Storage

Revision of Course Contents

Introduction to Database & Architecture

- What is Database?
- What is DBMS?
- ANSI SPARK 3 Level Architecture
- 2 & 3 Tiers Client Server Architecture
- Keys & Constraints

Revision of Course Contents

Database Design (Development)

- What is ER Model?
- ER Model Artifacts
- ER Mapping & Implementation

Revision of Course Contents

DBA

- DBA tasks & responsibilities
- Data Dictionary
- Oracle Installation & Configuration
- Logical & Physical Storage
- Backup & Recovery
- Database Tuning & Performance
- Support & Services
- Transaction Processing

Revision of Course Contents

PLSQL

- Procedure programming using Blocks
- Programming exceptions
- Procedures, functions & packages
- Cursor and loops
- Advance topics using Arrays, Dynamic SQL.

Revision of Course Contents

Project's Preparation and Scripts

- Database Mapping or Implementation
- Scripts for DDL
- Scripts for logical tablespaces
- Scripts for Security
- Data Migration

Revision of Course Contents

Logical & Physical Storage