



INTRODUCTION & OVERVIEW ABOUT ORACLE

LESSON 1

UP UNIVERSITY | INSTRUCTOR: UY TRY | BACHELOR DEGREE

BASIC INFORMATION

- What is data?
- What is database?
- What is dbms/rdbms
- What is table?
- What is sql & pl/sql?
- Type of sql statement
- What is relational database?
- What is normalization?
- Problem without normalization
- Type of hosting oracle database 12c or 18c?

BASIC INFORMATION

WHAT IS DATA?

- Facts or figures, pieces of information (Unprocessed, unorganized)

WHAT IS DBMS ?

- Database management system to store and retrieve and modify data in the database.

WHAT IS DATABASE?

- It is organized collection of information. •It is organized collection of information.

And because Oracle is relational database, then we have RDBMS which is: Relational database management system.

BASIC INFORMATION

The purpose of oracle database is to store, organize, and retrieve data for your applications (application is interface between users and DB)

WHAT IS TABLE?

- It is the basic storage unit of an RDBMS (it is logical unit , not physical)
- The table consists of rows and columns

EXAMPLE : DEPARTMENTS TABLE

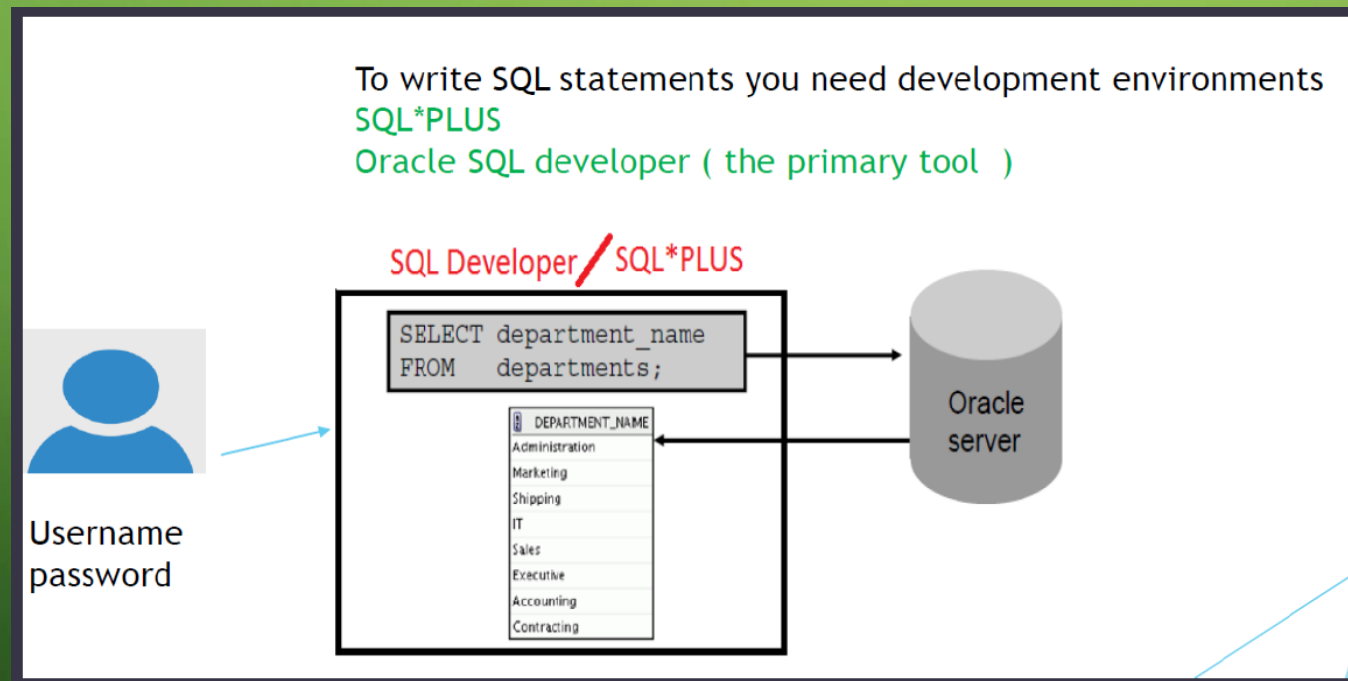
| Column 1 | Column 2 |
|---------------|-----------------|
| DEPARTMENT_ID | DEPARTMENT_NAME |
| 10 | Administration |
| 20 | Marketing |
| 30 | Purchasing |
| 40 | Human Resources |
| 50 | Shipping |
| 60 | IT |

BASIC INFORMATION

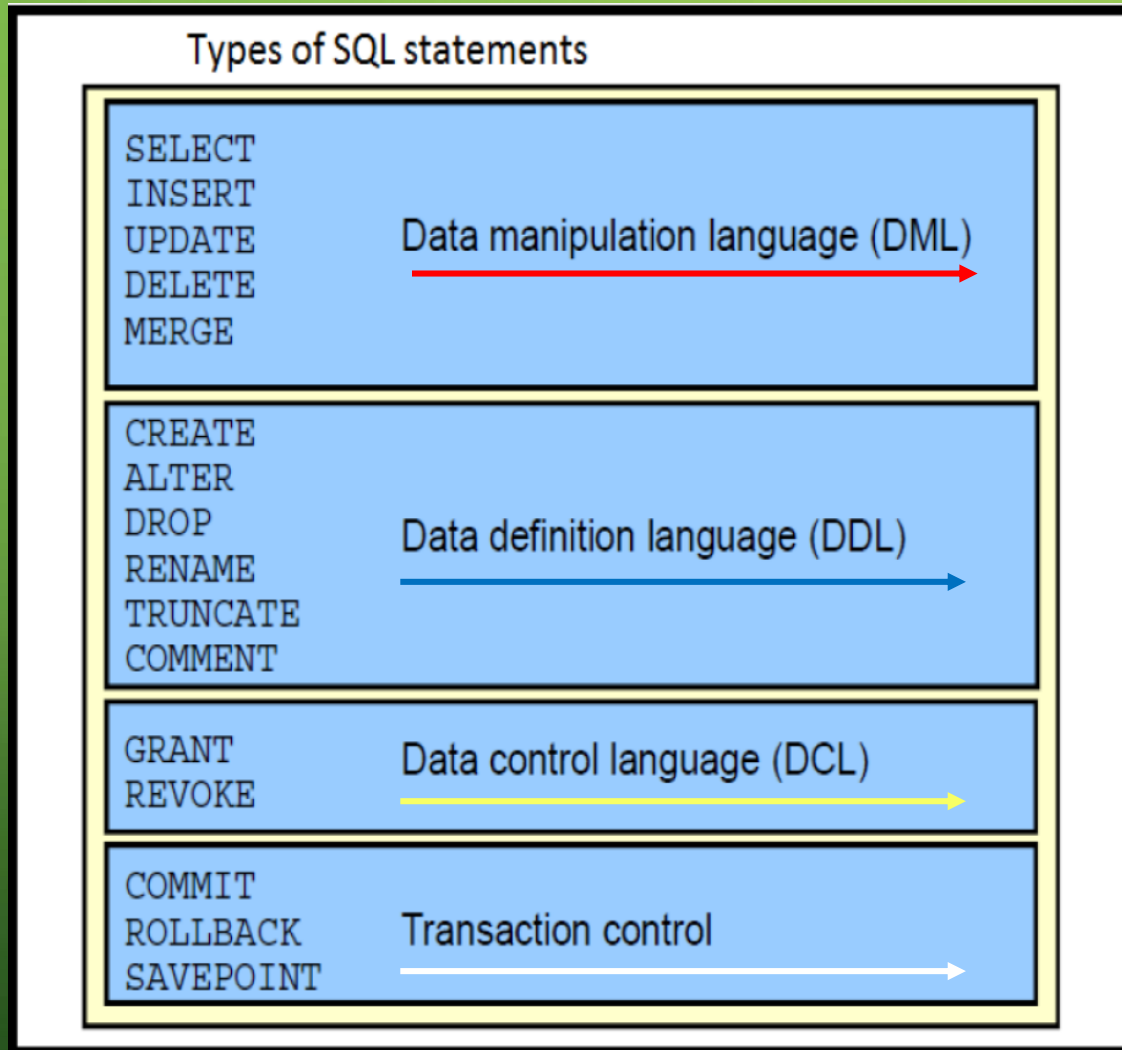
- To access Oracle database you need SQL

WHAT IS SQL?

- SQL is Structure Query Language (SQL)



BASIC INFORMATION



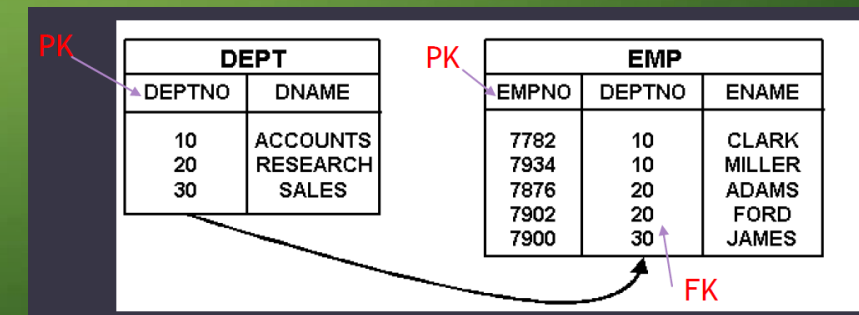
About PL/SQL

Belong to oracle

- PL/SQL is the procedural extension to SQL with design features of programming languages.
- Data manipulation and query statements of SQL are included within procedural units of code.

Oracle Is A Relationship Database?

A relational database stores data in a set of **simple relations**



BASIC INFORMATION

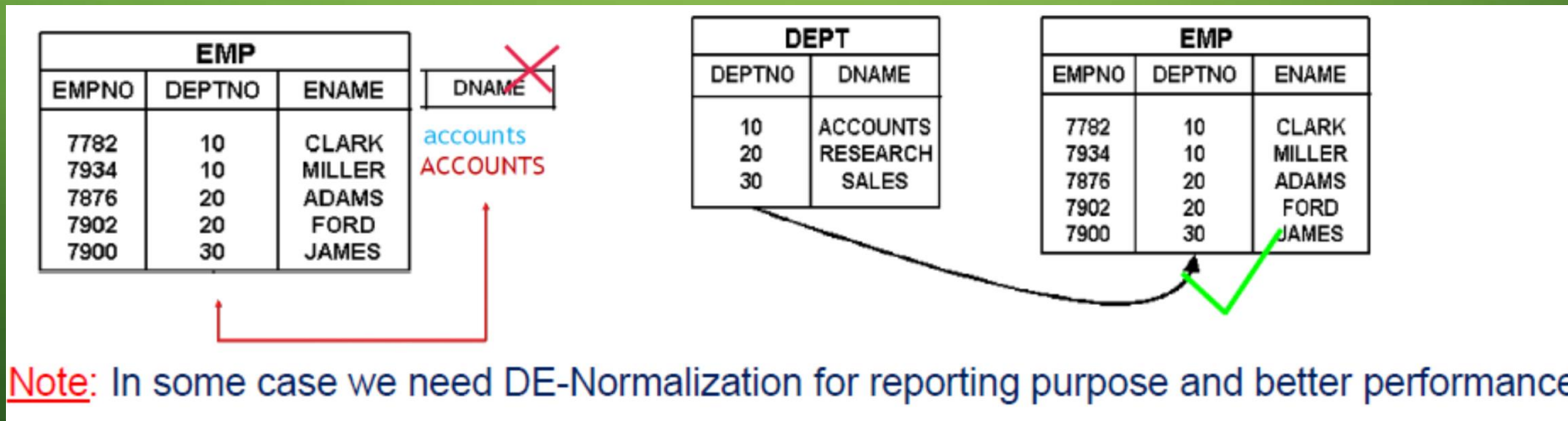
What is Normalization?

1. Normalization is a database design technique which **organizes tables** in a manner that **reduces redundancy** and **dependency of data**.
2. It **divides larger tables to smaller tables** and **links them using relationships**.

BASIC INFORMATION

Problem without Normalization

- ❑ Extra memory space
- ❑ Difficult to handle and update the database
- ❑ Data inconsistency



BASIC INFORMATION

Hosting Oracle 12c/ 18c

Hosting Oracle 12c/ 18c

```
graph TD; A[Hosting Oracle 12c/ 18c] --> B[On-Premise]; A --> C[Cloud];
```

The Software installed in your Own environment (in your server room or data center)

Host the database and all its components in Cloud (Oracle Cloud, AWS or Ms. Azure etc)

BRIEF HISTORY OF ORACLE VERSION

- **Brief History of Oracle Database**
- **In 1977, Larry Ellison, Bob Miner, And Ed Oates** Started The Consultancy Software Development Laboratories, Which Became **Relational Software Inc(RSI)**.
- **In 1983, RSI Became Oracle Systems Corporation** And Then Later Oracle Corporation until today.
- **In 1979, Oracle v2** :The First Commercially Available SQL-based RDBMS
- **In 1983, Oracle v3**: The **First Relational Database** To Run On Mainframes, Minicomputers, And Pcs. The Database Was Written In C, Enabling The Database To Be Ported To Multiple Platforms.
- **In 1984, Oracle v4**: Multi-version read consistency
- **In 1985, Oracle v5**: supported client/server computing and distributed database systems
- **In 1988, Oracle v6**: brought enhancements to disk I/O, row locking, scalability, and backup and recovery, introduced the **first version of the PL/SQL language**.

BRIEF HISTORY OF ORACLE VERSION

- In **1992, Oracle 7** :Introduce PL/SQL store procedure and triggers
- In **1997, Oracle 8**: Was released the object-relational database, supporting many new data types. Additionally, Oracle v8 support partitioning of larges tables.
- In **1999, Oracle 8i**: Provided native support for internet protocols and server-side support for Java
- In **2001, Oracle 9i**: Introduced Oracle RAC (Real Application Cluster), enabling multi-instances to access a single database additionally, introduce Oracle XML database.
- In **2003, Oracle 10g**: Introduced **Grid-Computing**, A Computer Architecture that coordinates **larges number of servers and storages** to act as a **SINGLE LARGE COMPUTER**.
- In **2007, Oracle 11g**: **Active Data Guard, Secure Files, Exadata** and many new features,
- In **2013, Oracle 12c**: Designed for **cloud, Multi-Tenant Architecture**.
- In **2018,Oracle 18c**: **Cloud, Multi-Tenant Architecture, and many new features**.

https://en.wikipedia.org/wiki/Oracle_Database

ORACLE ENTERPRISE EDITION

What you will learn in this lecture?

- What are the available database editions in 12c?
- What are the available database editions in 18c?
- What is the purpose of each editions?

Oracle database software can be **very expensive** or **very cheap** (even free), depend on what you **buy** and **use**.

ORACLE ENTERPRISE EDITION

Oracle DB 12c editions

- Oracle Database Personal Edition (PE)

supports **single-user** development, includes all of the components that are included with Enterprise Edition, no Oracle RAC, no Oracle Management Packs.

- Oracle Database Standard Edition 2 (SE2)** starting from Release 1 (12.1.0.2).

Included all the features necessary to develop workgroup and Web applications, support RAC, no parallel execution, no data guard, no management pack, no cloud control, ONLY pluggable database allowed. Noted: before SE2: we have SE & SE1 and both no RAC option.

- Oracle Database Enterprise Edition (EE)**

Oracle Database Enterprise Edition provides performance, availability, scalability, and security for developing applications such as high-volume online transaction processing (OLTP) applications, query-intensive data warehouses, and demanding Internet applications. Oracle Database Enterprise Edition.

- Oracle Database Express Edition (XE)**

Free but limited , use 1 CPU, 1 GB memory

ORACLE ENTERPRISE EDITION

To know more about Oracle Editions

12C

<https://docs.oracle.com/database/121/DBLIC/editions.htm#DBLIC-GUID-B6113390-9586-46D7-9008-DCC9EDA45AB4>

18C

<https://docs.oracle.com/en/database/oracle/oracle-database/18/dblic/Licensing-Information.html#GUID-B6113390-9586-46D7-9008-DCC9EDA45AB4>

DATABASE VS DATABASE INSTANCE

Oracle DB consists of 2 major components

1. The Database Storage: Is an organized collection of information. It contains collection of database files stored in disk storage (**physical files**).

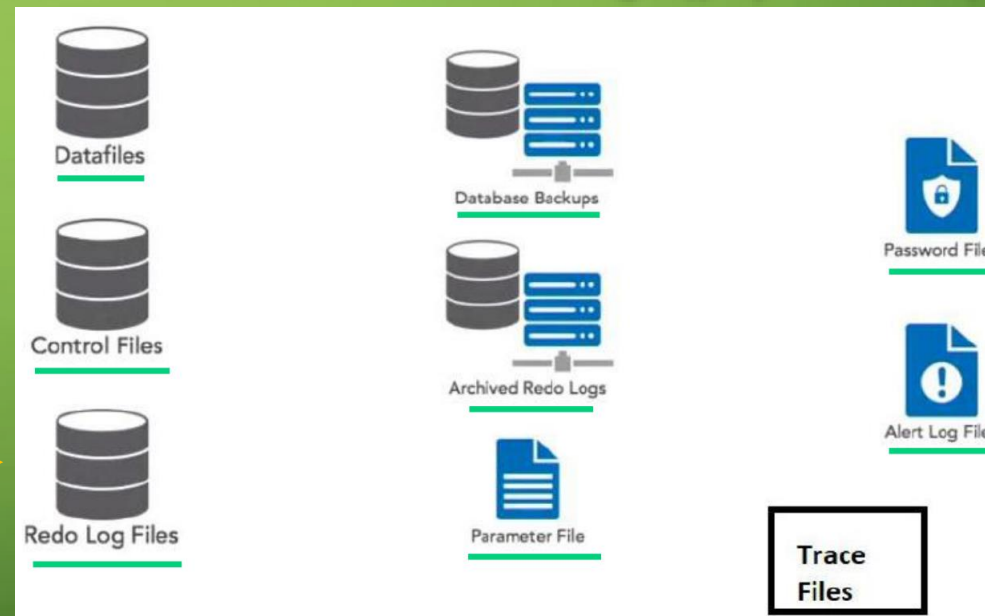
2. The Oracle Instance:

A Oracle or **Database Instance** is a set of

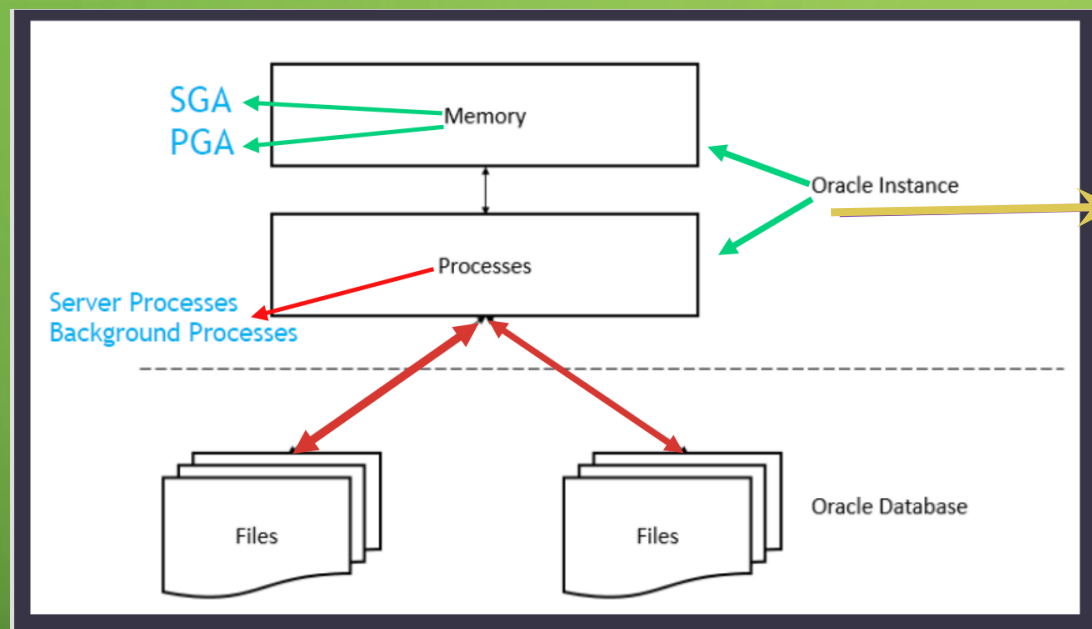
- a) Memory Structure
- b) Process Structure

That Oracle Instance **manages database files** →

Note: A database instance exists only in memory (memory is OS memory allocated to database instance during DB creation)



DATABASE VS DATABASE INSTANCE



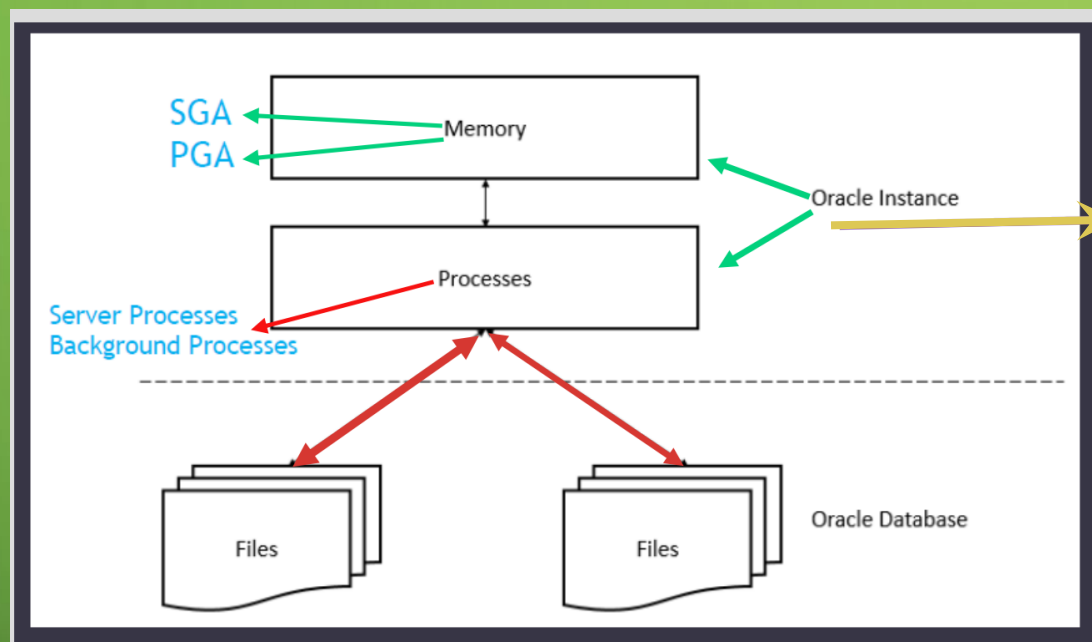
1. The Oracle program, or binary, loaded into the Server / OS RAM

2. Created by Oracle every time when you start up your database

3. Reading from memory is a lot faster compared to reading from disk

- 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.

DATABASE VS DATABASE INSTANCE



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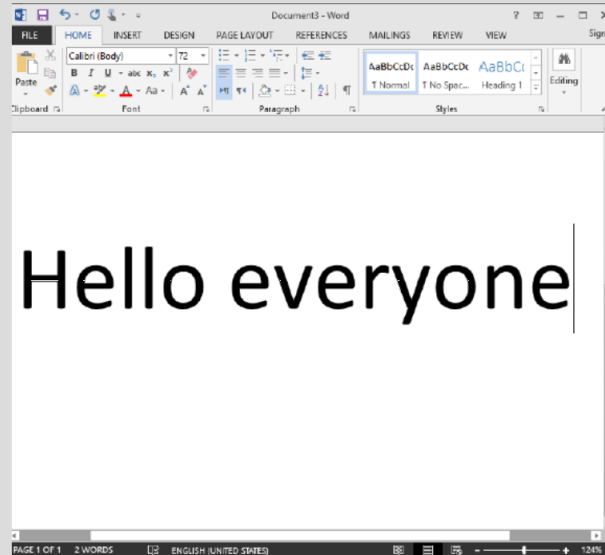
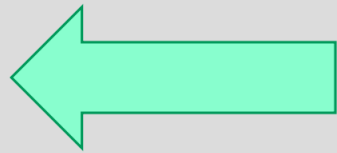
DATABASE VS DATABASE INSTANCE

□ Another Simple Way to Understand Database (DB) and Instance Example:
Microsoft Office Word and Word Document

Example: Microsoft Office Word and Word Document



Microsoft Office Word
(Imagine it the Instance)

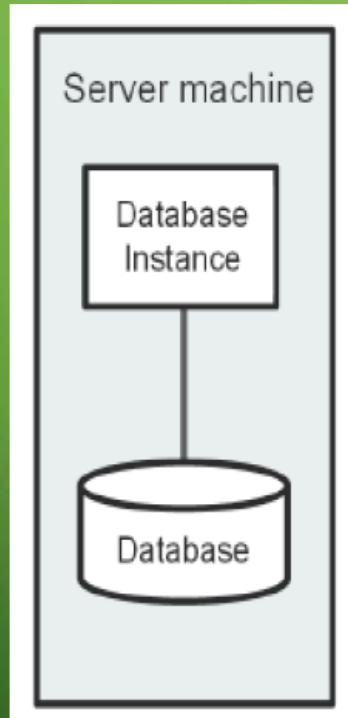


Document1.docx (Imagine it
the Database)

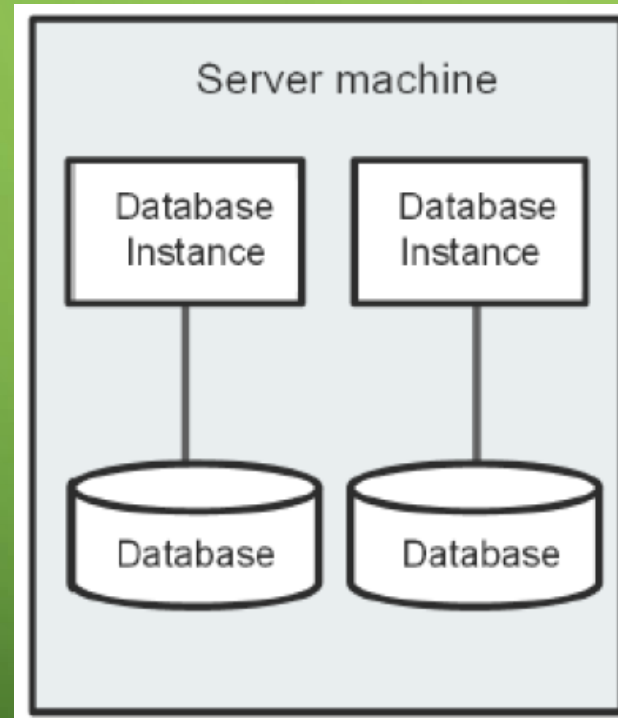
DATABASE VS DATABASE INSTANCE

Oracle Database Server Architecture

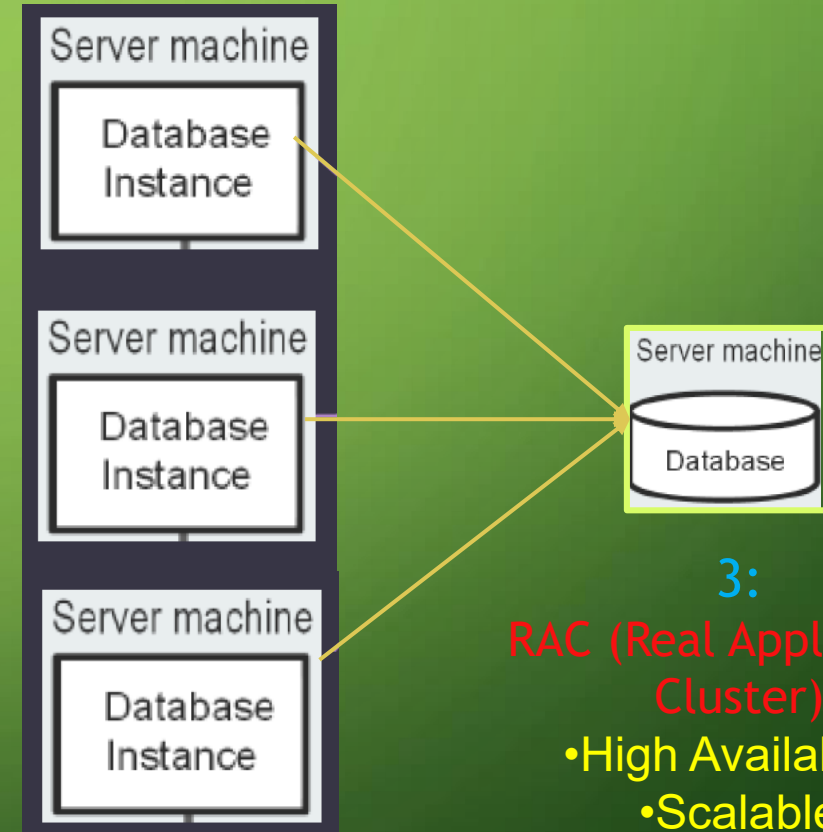
- Configuration Optional



1:
Single Database Instance



2:
Multi Single Instance DBs on Same Server



3:
RAC (Real Application Cluster)
•High Availability
•Scalable
•High Performance

ORACLE INSTANCE

(Server Process + PGA)

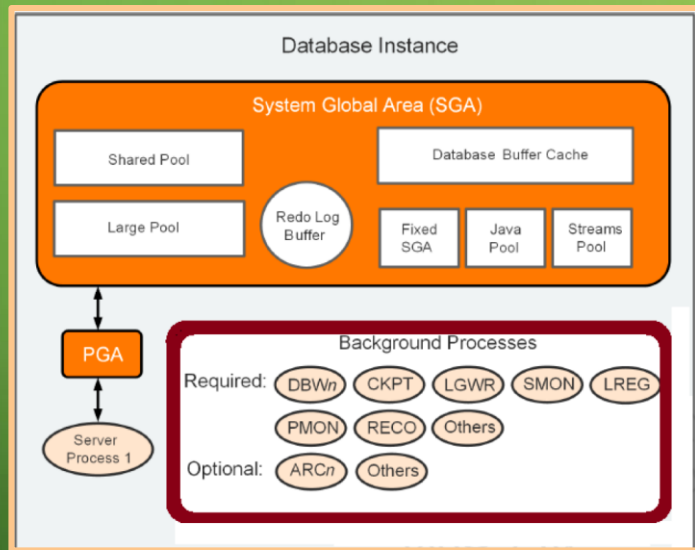
What will you learn in this lecture ?

- What is the server processes ?
- Task of server process ?
- What is the PGA?
- Oracle dedicated server process
- Oracle Shared server Process

ORACLE INSTANCE

Database Instance in-depth

A database **instance** is a set of memory structures and processes that manage database files



Memory:

- System Global Area (SGA)
- Program Global Area (PGA)

Process:

- Background Process
- Server Process

ORACLE INSTANCE

(Server Process + PGA)

What will you learn in this lecture ?

- What is the server processes ?
- Task of server process ?
- What is the PGA?
- Oracle dedicated server process
- Oracle Shared server Process

ORACLE INSTANCE

Server processes + PGA

- Oracle starts up server processes to handle the requests of client process (User sessions)
- Perform the work for the client program. Example: Parsing and running SQL statements, retrieving results to the client program and this mean reading database data from the database storage and loading that data into the Oracle instance buffer cache.
- Act on behalf of client sessions
- Each server process has it own cache dedicated for each connecting client .

This caches is known as PGA

ORACLE INSTANCE

(Server Process + PGA)

What will you learn in this lecture ?

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ORACLE INSTANCE

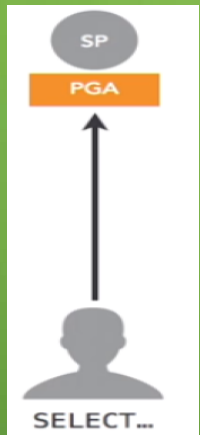
(Server Process + PGA)

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ORACLE INSTANCE

(Server Process + PGA)

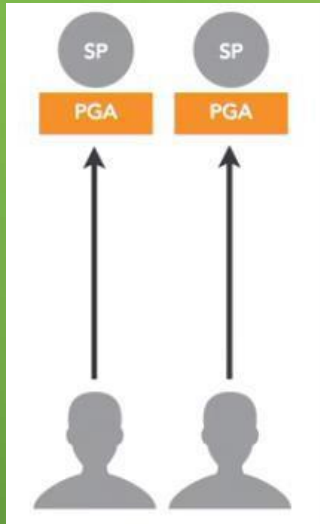


So here in this example, I have one **User Session** doing select statement ,so mean Oracle will create SP (**Server Process**) and this SP has its own PGA
More users = more dedicated server processes
PGA: **non-shared memory** region reserved only for the specific user session connected to that specific server process.

Note: it contains data and control information used by the server processes when sorting data, joining large tables together as part of a SQL statement, and so on

ORACLE INSTANCE

Server Process



Oracle shared server processes

client user processes connect to a dispatcher.

The dispatcher can support multiple client connections concurrently

Note: Shared server architecture eliminates the need for a dedicated server process for each connection.

Oracle dedicated server process (Mostly used)

One to one relation

Between connecting user sessions and server process

SYSTEM GLOBAL AREA (SGA) PART 1

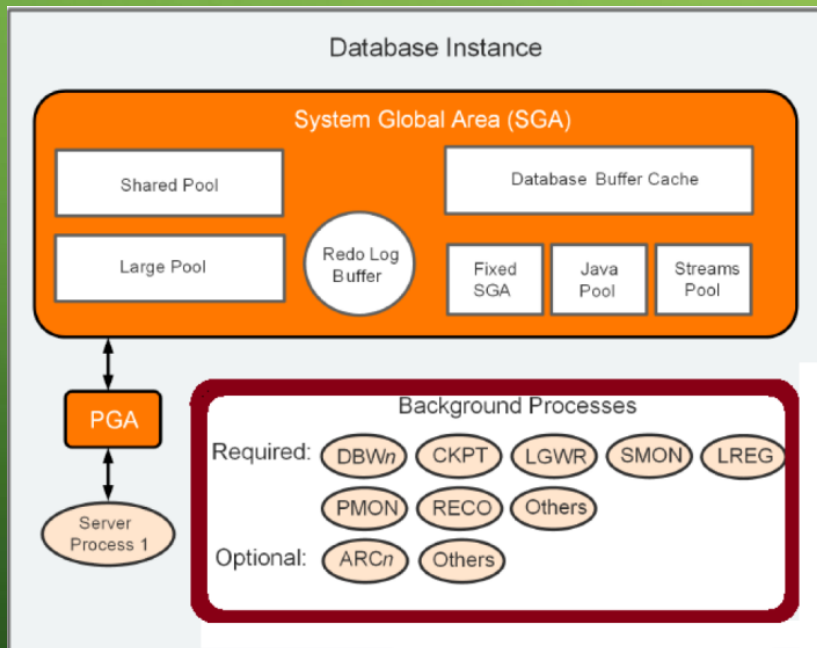
What will you learn in this lecture ?

- What is System Global Area (SGA) ?
- Main tasks of SGA
- Shared Pool
- Database Buffer Cache
- Redo Log Buffer

SYSTEM GLOBAL AREA (SGA) PART 1

Database Instance

A database **instance** is a set of memory structures and processes that manage database files



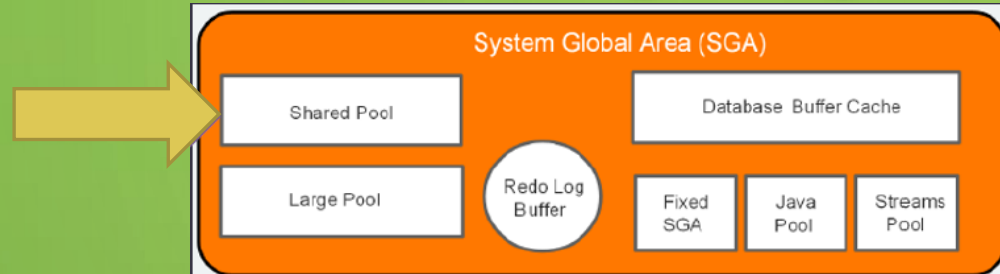
What is System Global Area (SGA)

The SGA is a group of shared memory structures That contain data and control information for one database instance.

Main Tasks of SGA

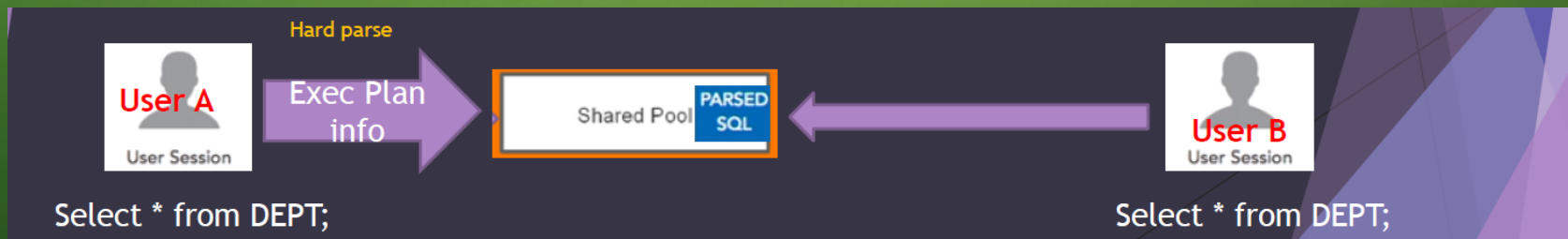
- Maintaining internal data structure that many processes access concurrently
- Caching data blocks read from disk
- Buffering redo data before writing it to the online redo log files
- Storing SQL execution plan

SYSTEM GLOBAL AREA (SGA) PART 1



Shared Pool

- The most important component of SGA
- Cache non user Data like Data dictionary
- (metadata: data about data ex: DBA_tables)
- Shared Pool contains sub components like Data dictionary cache, library cache ,server result cache and many others
- Store the cached information about each SQL statement that is executed, like execution plan



SYSTEM GLOBAL AREA (SGA) PART 1



Database buffer cache

- Responsible for caching database user data
- The buffer cache caches frequently accessed database data into memory
- Note: The buffer cache caches blocks of data instead of individual rows (1 block=8 kb by default)
- All users who are concurrently connected to the database shared and access a single database buffer cache
- The buffer cache including the keep pool, recycle pool, and others

SYSTEM GLOBAL AREA (SGA) PART 1



- Circular buffer that hold information about changes made to the database
- Designed to store redo entries (small records that reflect any changes made to the database as part of transactions or database structure changes).

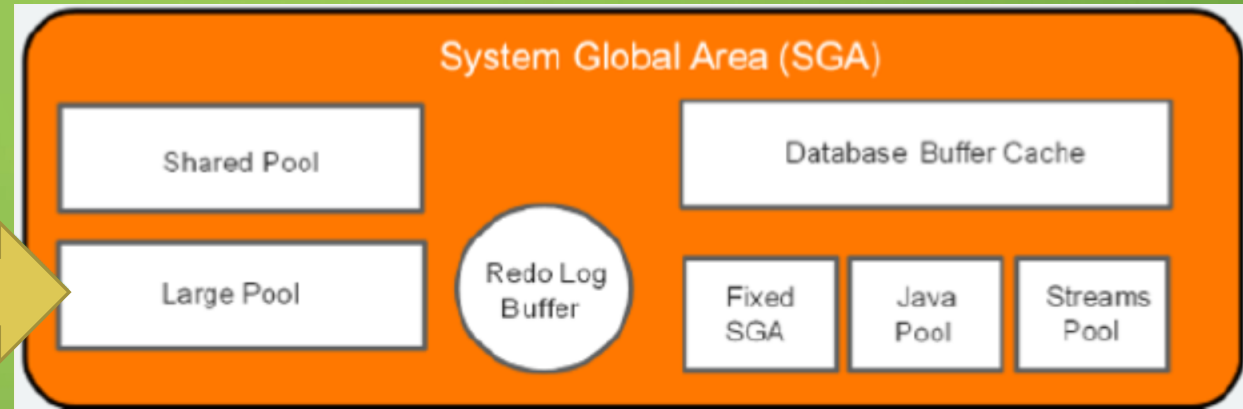
Note: Redo entries are used for database recovery when and if needed.

- The Redo Log entries in the Redo Log buffer are also written on a periodic basis to a set of files in our Oracle database storage known as Redo logs files

SYSTEM GLOBAL AREA (SGA) PART 1

- Large Pool
- Java Pool
- Fixed SGA
- Stream Pool
- Sizing SGA and PGA

SYSTEM GLOBAL AREA (SGA) PART 2



Large Pool

Contain memory used by special Oracle feature like:

- Shared Server Processes
- Parallels Queries

```
SELECT /*+ PARALLEL(emp,4) */ FROM EMP.
```

- Database Backup and Recovery Operation
- I/O Server Processes

SYSTEM GLOBAL AREA (SGA) PART 2

Java Pool

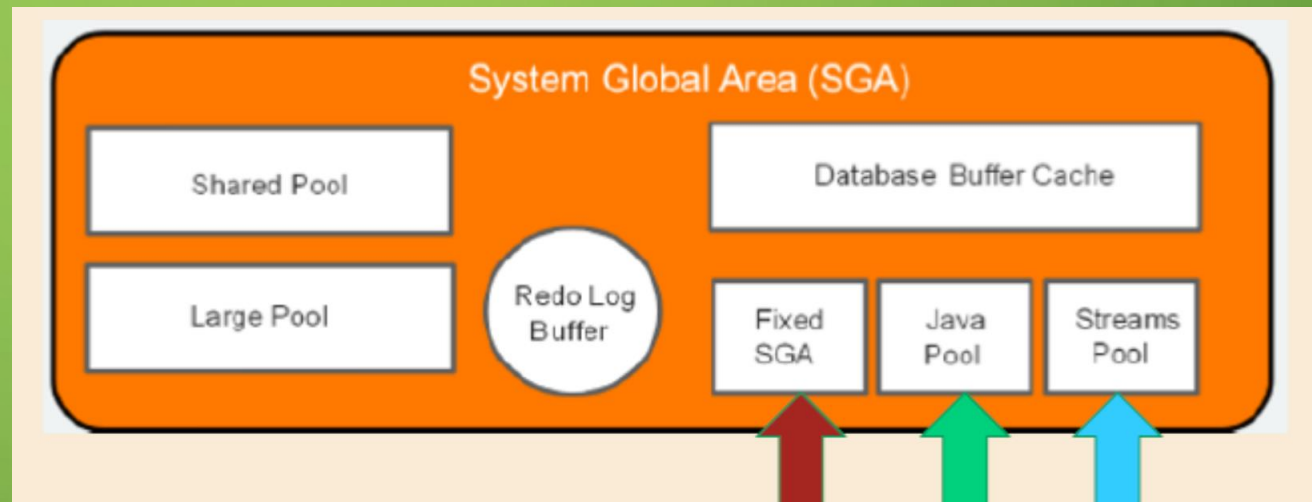
- Parsing of Java Code and Scripts.

Fixed SGA

- Contains general information about the state of the database and the instance

Streams Pool

- Provide memory for Oracle Streams Process.



SYSTEM GLOBAL AREA (SGA) PART 1

1

Sizing SGA & PGA

2

1. Using Automatic Shared memory Management

ASMM SGA_Target: actual memory is used by the **current SGA**

SGA_Max_Size: the largest amount of memory that **will be available** for the SGA in the instance

Oracle Database **automatically distributes this memory amount the various of SGA** components to ensure the most effective memory utilization

2. Using Manual Shared Memory Management

You must manually configure several SGA component size

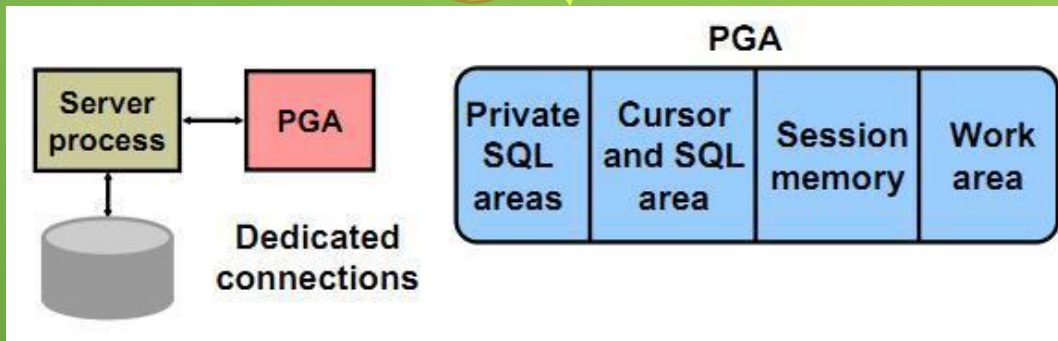
- Set the **Memory_Target** initialization Parameter to 0.
- Set the **SGA_Target** initialization Parameter to 0.
- Manual configure SGA component

SYSTEM GLOBAL AREA (SGA) PART 2

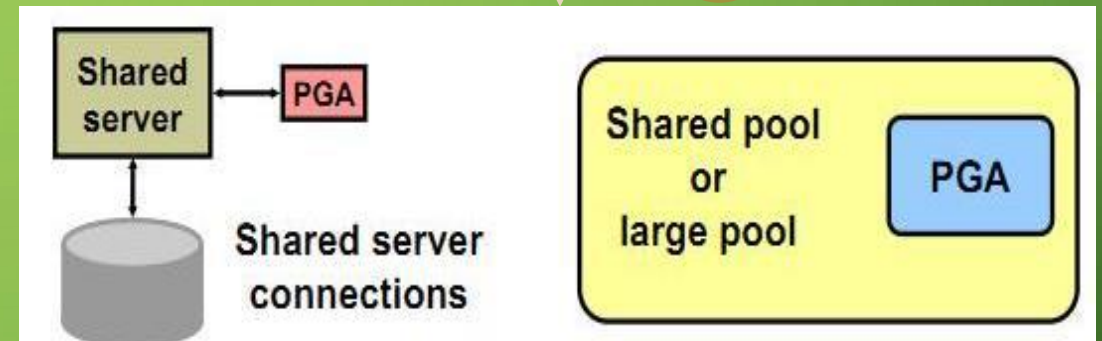
1

Sizing PGA

2



1. Using Automatic PGA Memory Management
`PGA_Aggregate_Target`: total amount of PGA memory allocated across all database server processes and background processes
Oracle strongly recommends that you leave automatic PGA memory management enabled.



2. Using Manual PGA Memory Management
You must manually configure several PGA component size. **Not Recommended !**

DATABASE INSTANCE - BACKGROUND PROCESS

What will you learn in this lecture ?

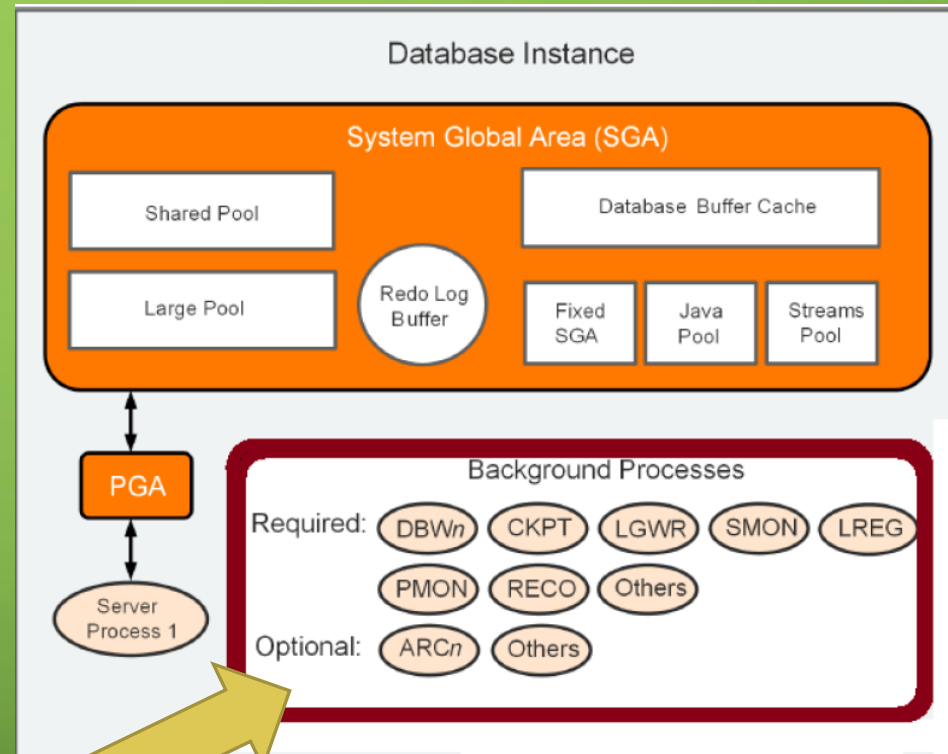
- What are the Background Processes?
- The Main Purpose of Each Background Process

DATABASE INSTANCE - BACKGROUND PROCESS

Background Processes:

Bunch of dedicated server-side processes running in the background
TASKS:

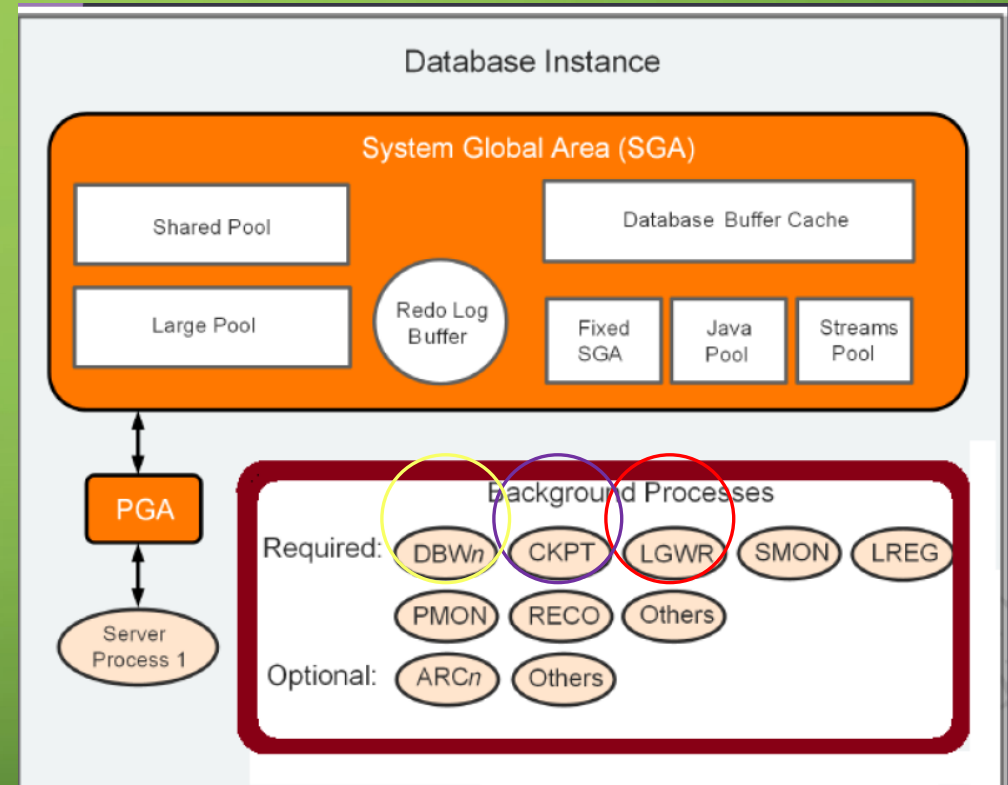
- Writing database blocks to disk
- Writing redo entries to disk
- Making sure all of the database files on disk are synchronized.



DATABASE INSTANCE - BACKGROUND PROCESS

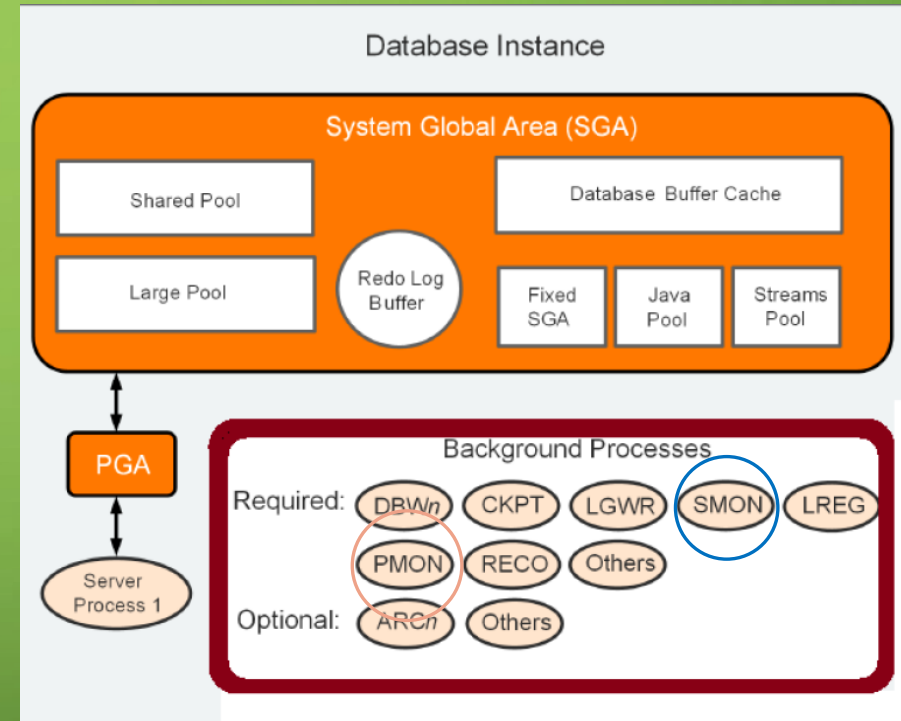
- Database Writer Process (DBWn): responsible for writing contents of the database **buffers to data files** on disk
- Checkpoint process (CKPT): This process handle database checkpoints
- Log Writer (LGWR): responsible for writing redo records from the redo log buffering **memory to disk (log files)**

An **Oracle Checkpoint** is a database event which synchronizes **modified data blocks in memory from buffer caches with data files on disk.**



DATABASE INSTANCE - BACKGROUND PROCESS

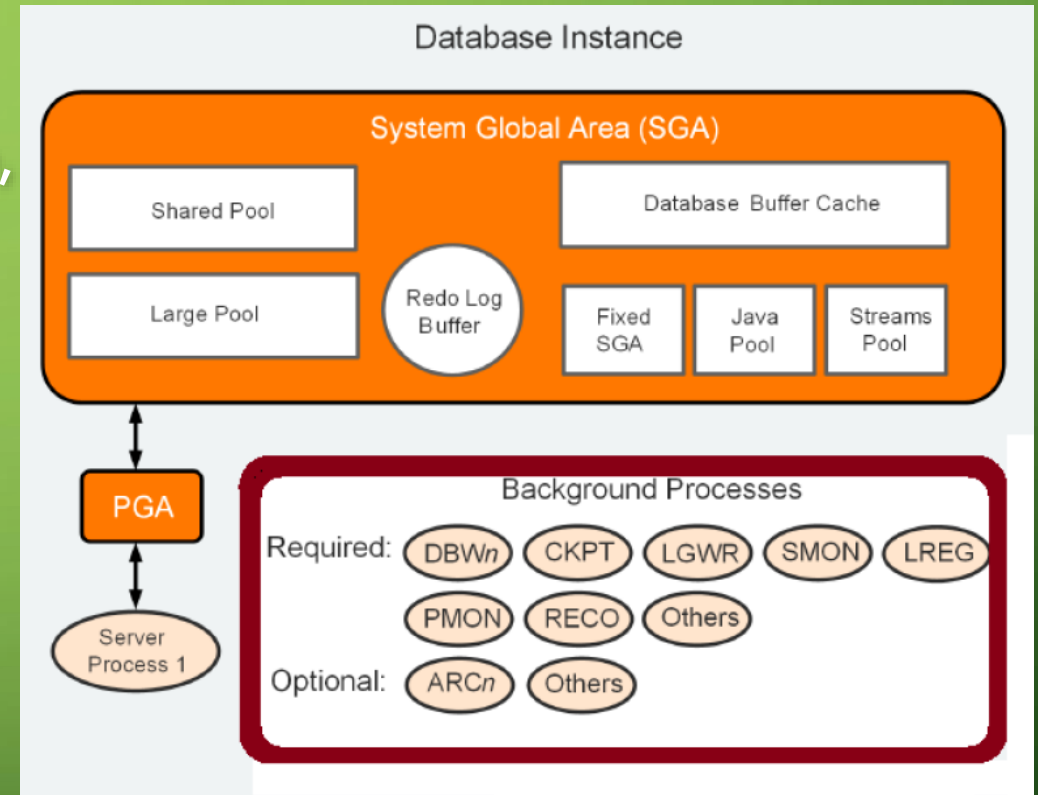
- **System Monitoring Process (SMON):** Perform **recovery** during the startup sequence of the **Oracle Instance** if required. Responsible for **cleaning up any unused temporary segments**
- **Process Monitoring (PMON):** Perform process recovery when a user process or session fails. Responsible for **cleaning up** any changes made to blocks in the database buffer cache, and releasing resource that were previously used by a **failed user session**.



DATABASE INSTANCE - BACKGROUND PROCESS

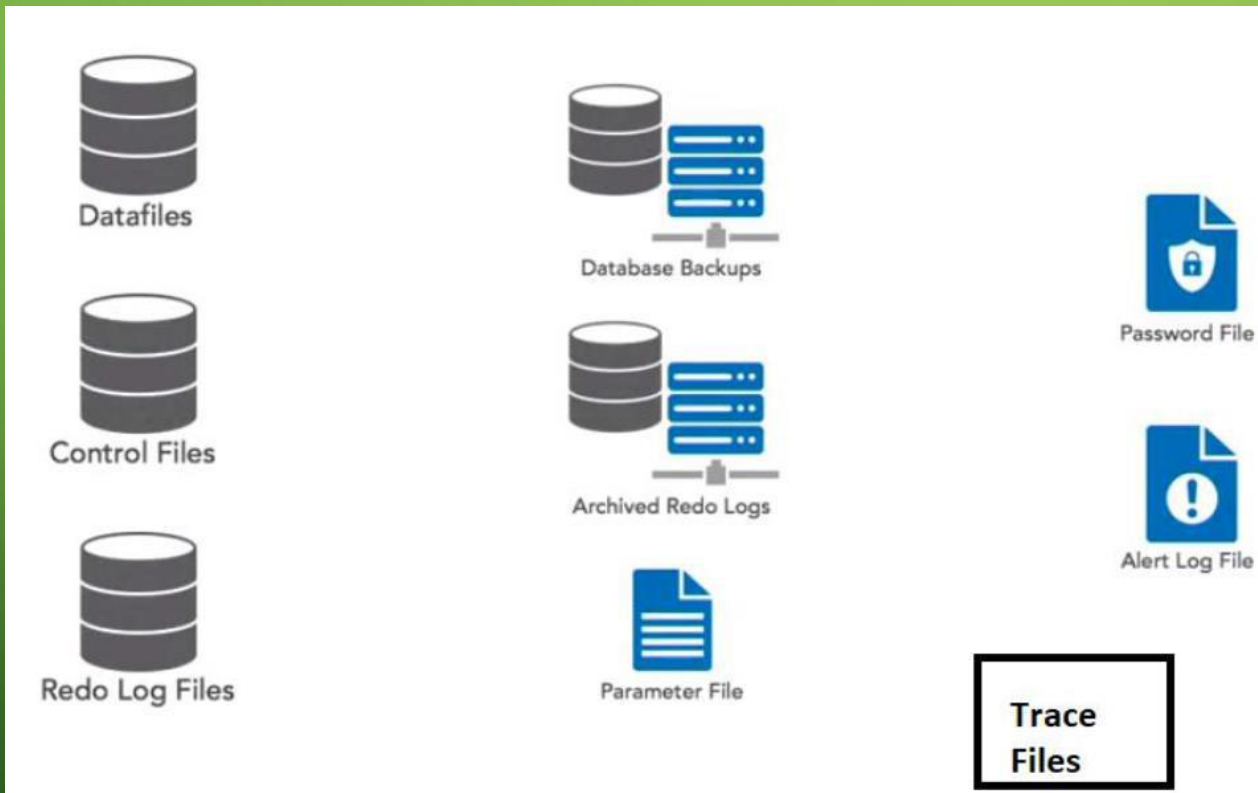
- **Recover Process:** Used as part of distributed database transaction. Distributed transactions are transactions that involve **multiple database**, and should either commit a rollback on both database at once.
- **Listener registration process (LREP):** Register Oracle Instance with Oracle network listener. The Listener accepting remote incoming user connections.
- **Achiever Process (ARCn):** copy the redo log files to a remote storage device/location after redo log switch occurs

Note: Copying the database redo logs to another storage system is very important from a backup and recovery perspective



ORACLE DATABASE FILES

Database Files Database: Organized collection of information It contains collection of database files store in disk storage (Physical Files).



ORACLE DATABASE FILES

Datafiles:

Contains the actual users data, applications data, metadata.

(Tables, Rows, indexes, procedures, views...)

Note: If you lose **Datafiles**, you lose your **database**. The extension for datafiles is **.dbf**

Control files: Stores metadata about the **datafiles** and **online redo log files** (like names, locations and statuses) and this info is required by the database instance to open the database.

Note: If you lose **control files**, you lose your **database**. The extension for Control files is **.ctl**

Redo log files:

Stores changes to the database as they occur and are used for data recovery.

Note: If you lose **Redo log files**, you lose your **database**. The extension for redo log file is **.log**

ORACLE DATABASE FILES

Database Backups Files

include any backups of your database that you have taken and placed somewhere safe

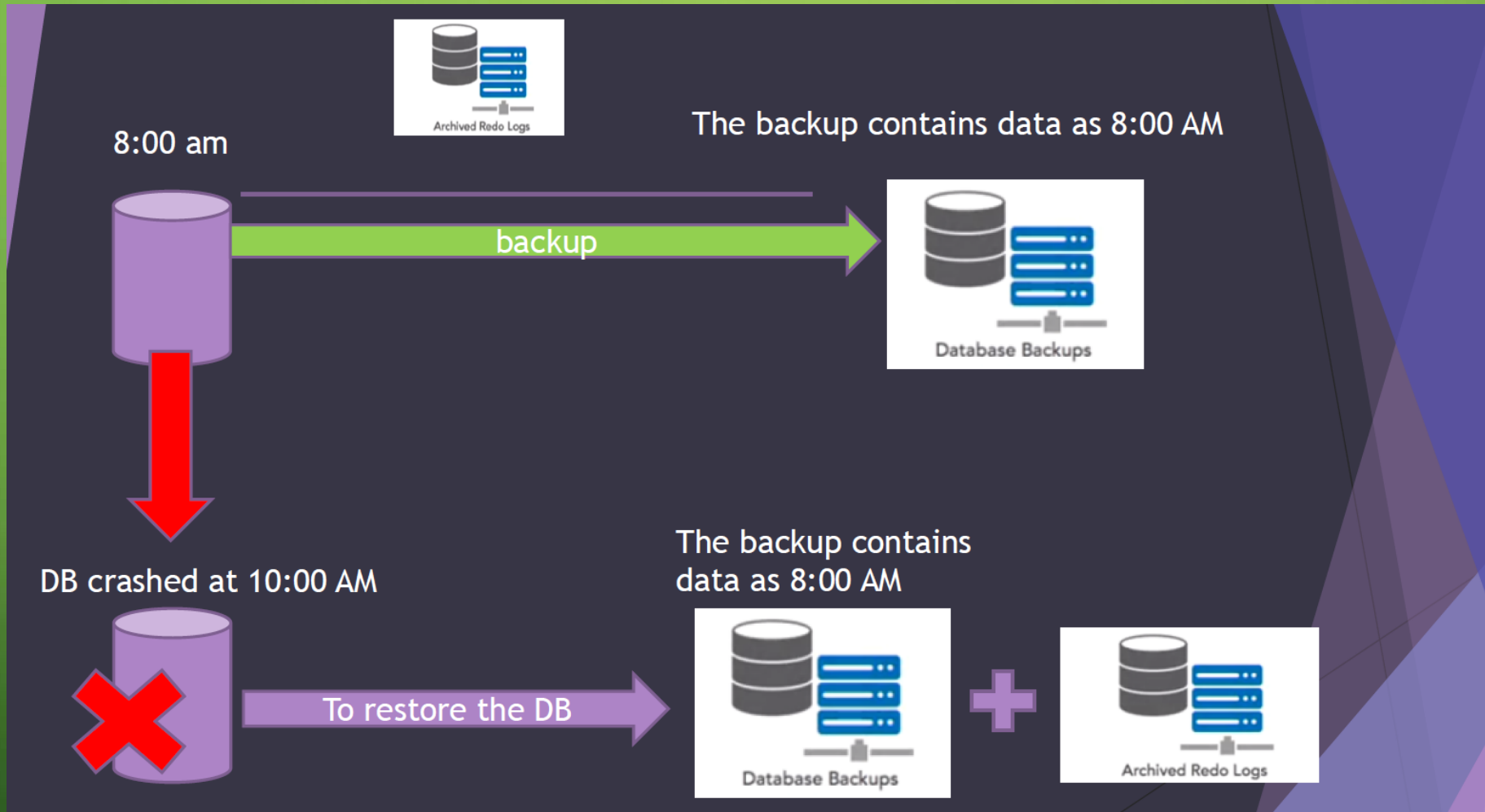
Note: it should include the datafiles, control files, redo log files. The extension for redo log file is .log

Archived Redo Log Files (groups of redo log files after backup)

Contains ongoing history of the data changes .

Using these files + backups files you can recover your database

ORACLE DATABASE FILES



ORACLE DATABASE FILES

Parameter file (spfile, pfile)

This file defines how the database *instance* is configured **when it starts up**.

Example: the PGA size `PGA_AGGREGATE_TARGET`

*Note: spfile is binary file, you can **not edit directly**, it should be by oracle commands.*

Password File

Stores **passwords** for users with administrative privileges (sys user) in order to connect remotely.

Note: DBA password cannot be stored in the database, because **Oracle cannot access the database before the instance is started**, Therefore, the authentication of the DBA must happen outside of the database

Alert Log File

is a chronological log of messages and errors written out by an Oracle Database. So this is your go-to file in case you're trying to **troubleshoot a problem with your database**.

Example: You can see when the database was started and stopped.

Trace File: **Each server and background process** writes to a trace file.

When a process detects an internal error, it writes information about the error to its trace file.

LOGICAL STORAGE STRUCTURE

Tablespaces are logical storage groups that can be used to store logical database constructs, such as tables and indexes
Logically it stores the database files

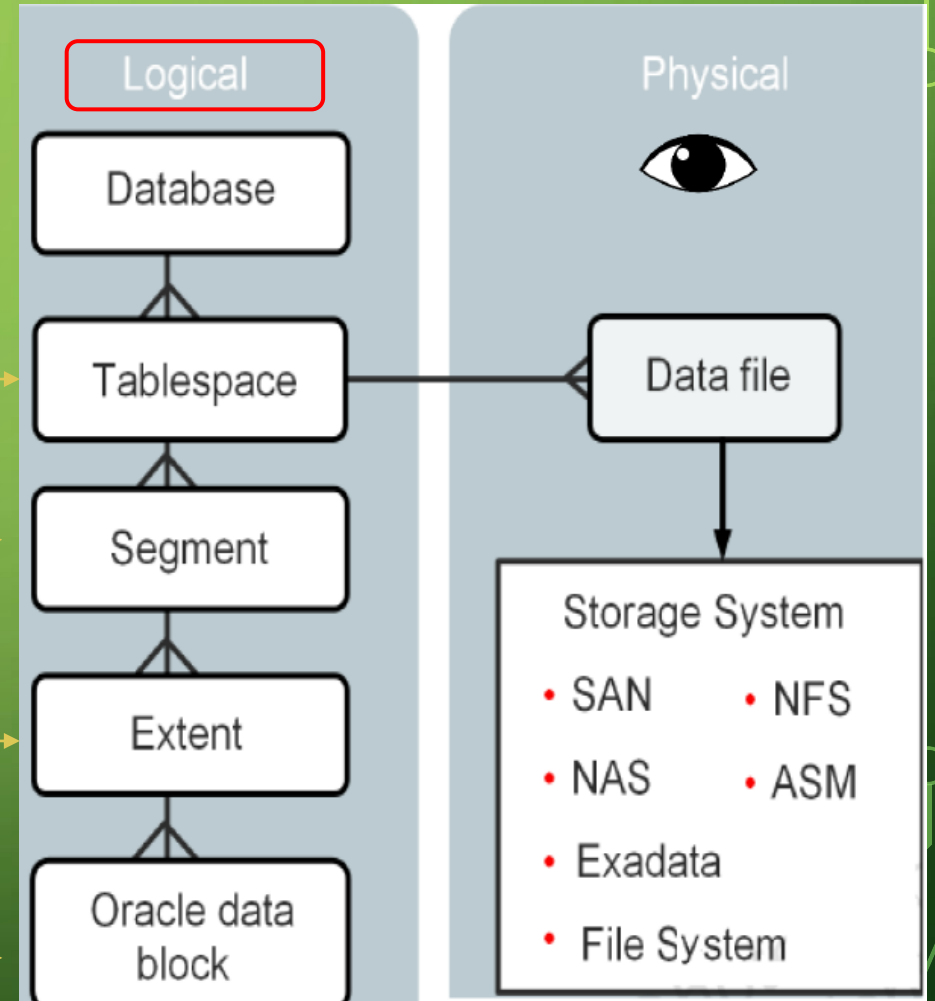
A Segment is a set of Extents, one or more Extents, allocated for certain logical structures inside the database (ex: table, index)

An Extent is a set of contiguous Oracle Data Blocks it is much more efficient, when allocating space

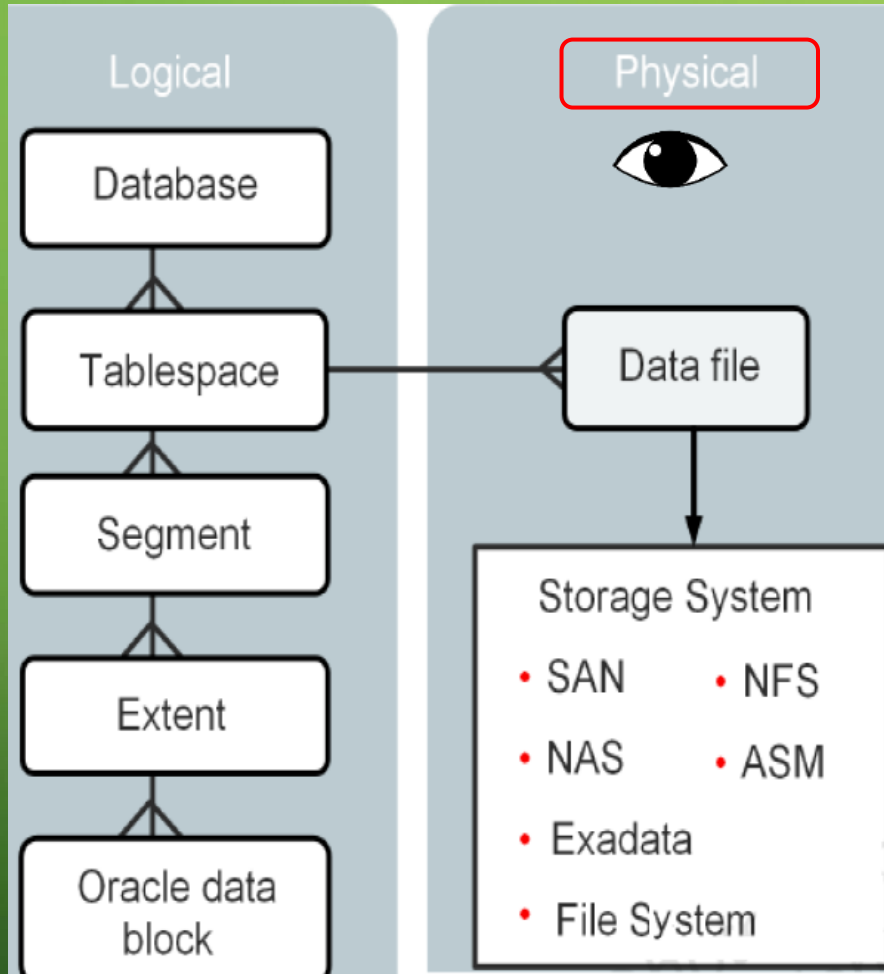
Oracle data stored in data blocks

1 Block= 8 K by default

A single Oracle Data Block contains one or more rows



LOGICAL STORAGE STRUCTURE



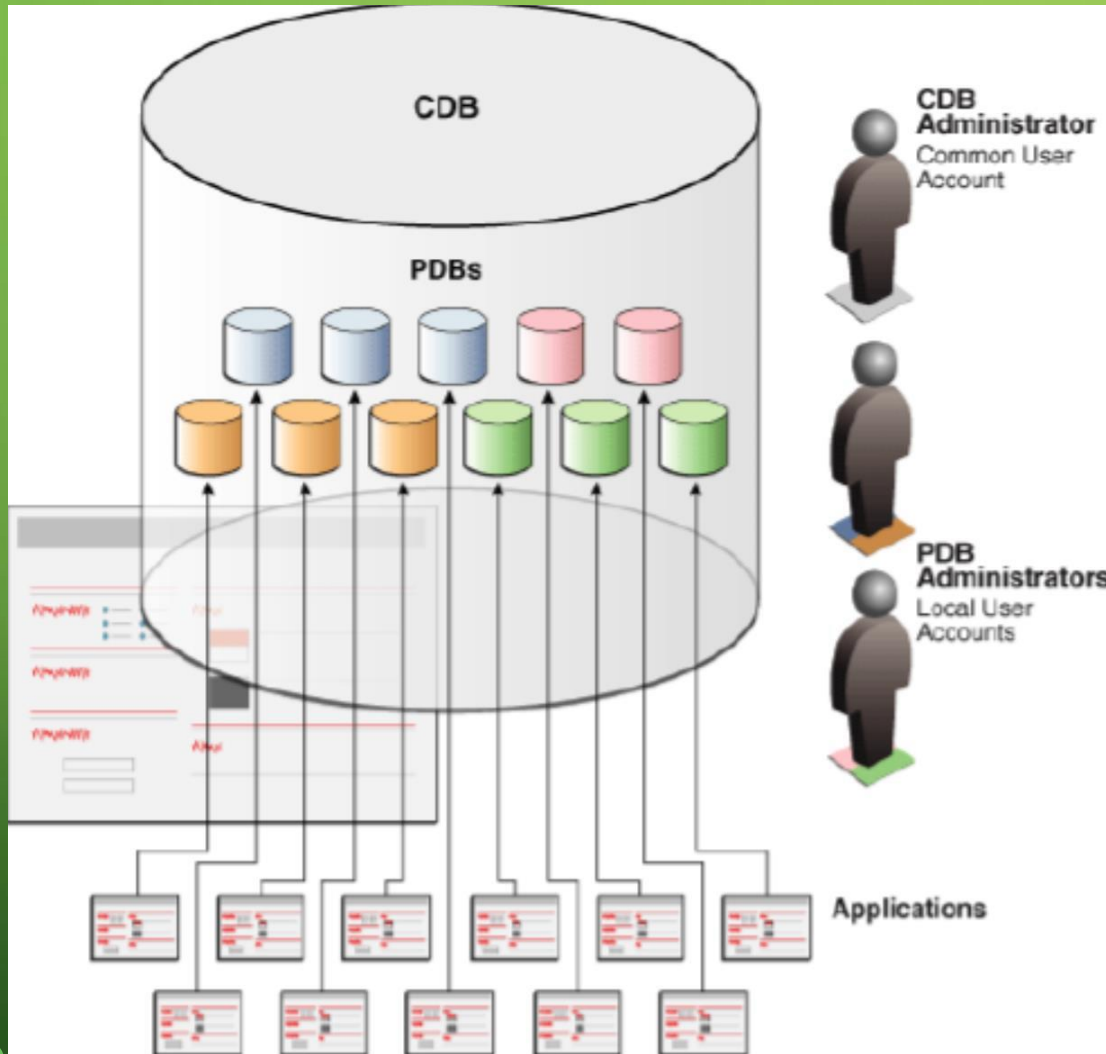
SAN: Storage area network

NAS: network attached storage

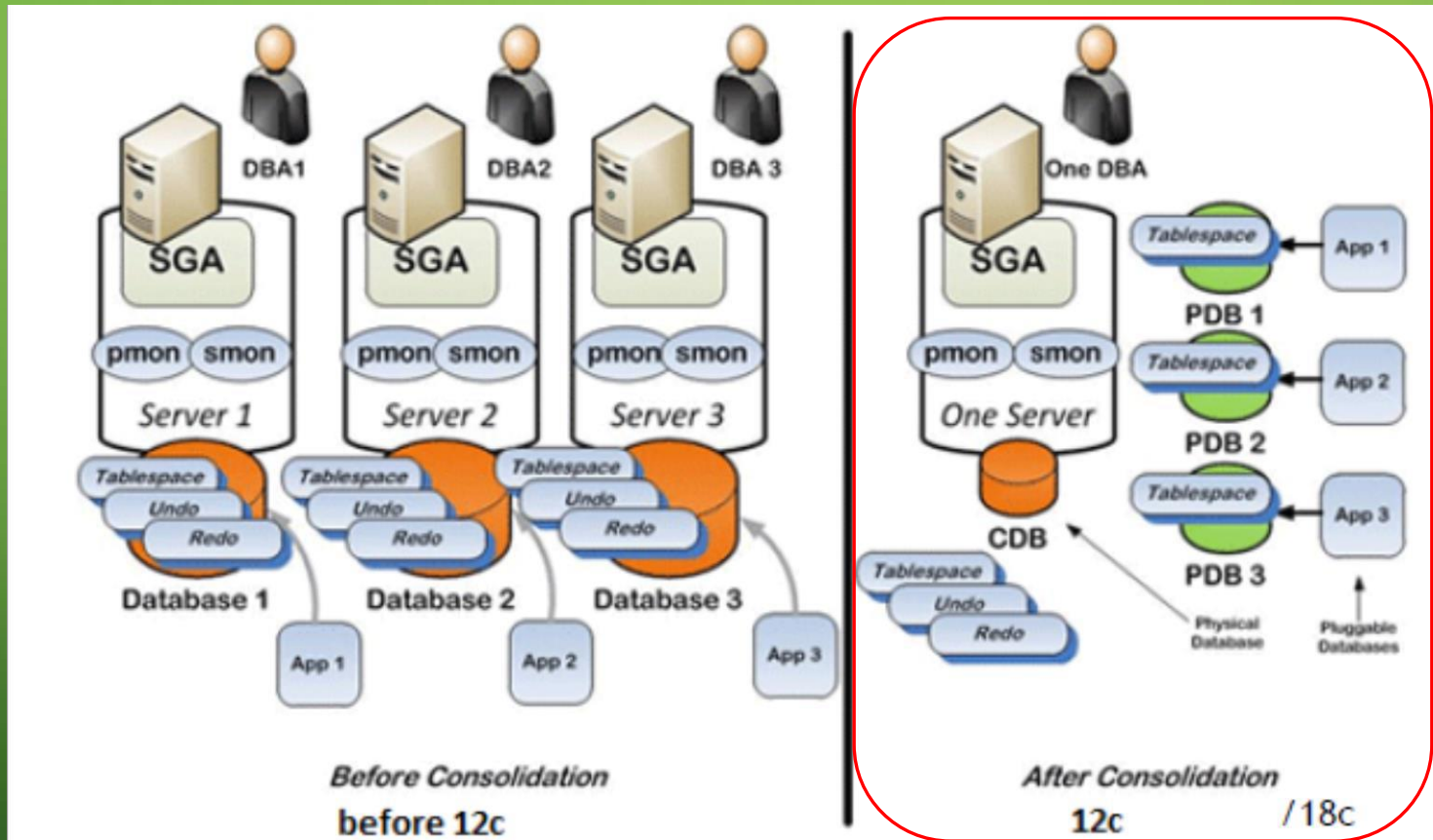
NFS: network file system

ASM: automatic storage management

MULTITENANT DATABASE 12C /18C

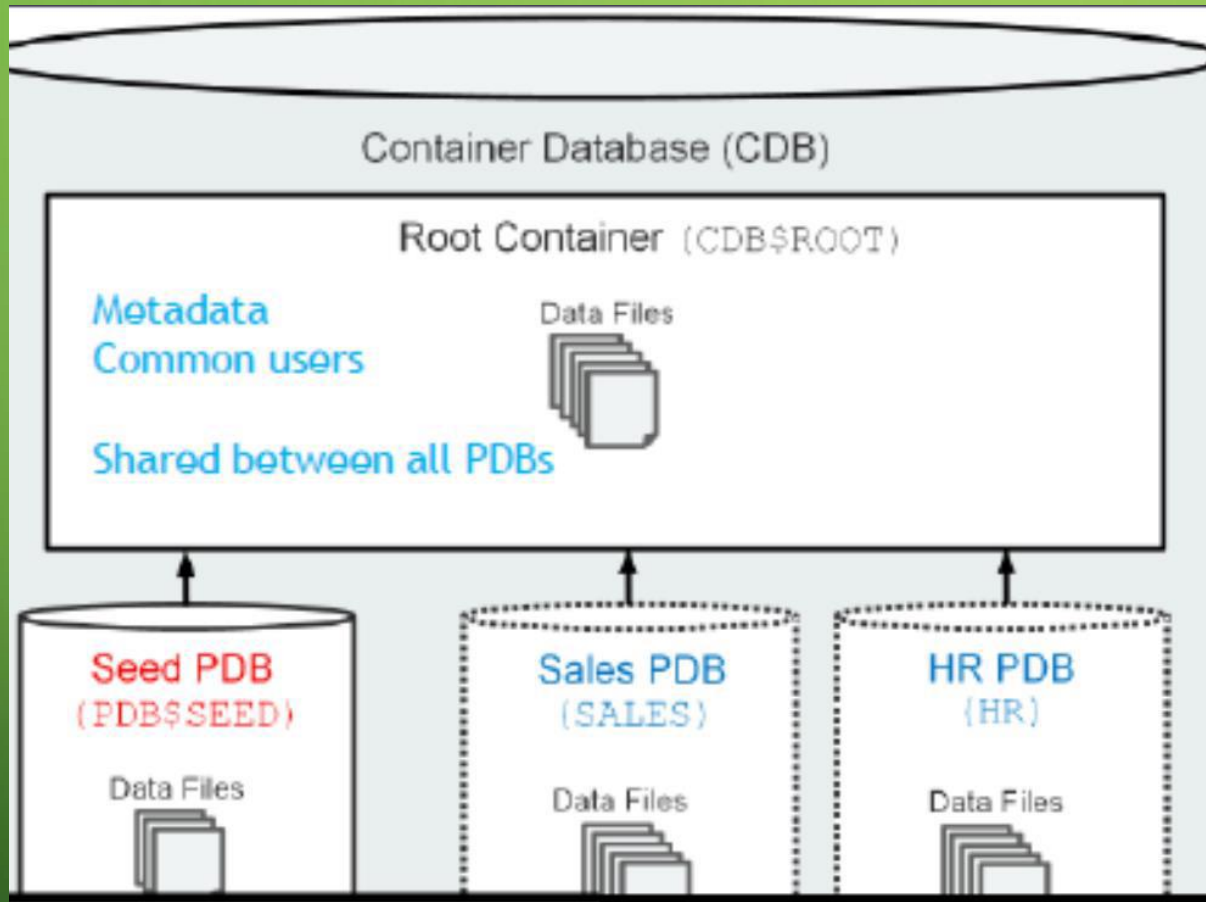


MULTITENANT DATABASE 12C /18C



- Reduce cost
- Saving resources
- Easy maintenance
- Easy backup
- Easy cloning
- Separation of rules (PDB Admin vs CDB Admin)

MULTITENANT DATABASE 12C /18C



Every CDB has the following containers:

1. Exactly one CDB root container called CDB\$ROOT
2. Seed PDB called PDB\$SEED (it is a template)
3. Zero or more user-created PDBs

Note: starting from 12c R2 , we have something called application container, but it is out of scope of this course. Application Container is optional. Application container seems to be a mini CDB, within CDB root.

ORACLE DBA TOOL

DBA Tasks and tools

- ❖ Installing Oracle software
- ❖ Creating Oracle databases
- ❖ Performing upgrades of the database and software to new release levels
- ❖ Starting and shutting down the database instance

- ❖ Managing the storage structures of the database
- ❖ Managing users and security
- ❖ Managing database objects, such as tables, indexes, and views
- ❖ Backing up the database and performing recovery operations when necessary
- ❖ Monitoring the state of the database
- ❖ Monitoring and tuning database performance
- ❖ Reporting critical errors to Oracle Support Services

Common Oracle DBA Tasks

ORACLE DBA TOOL

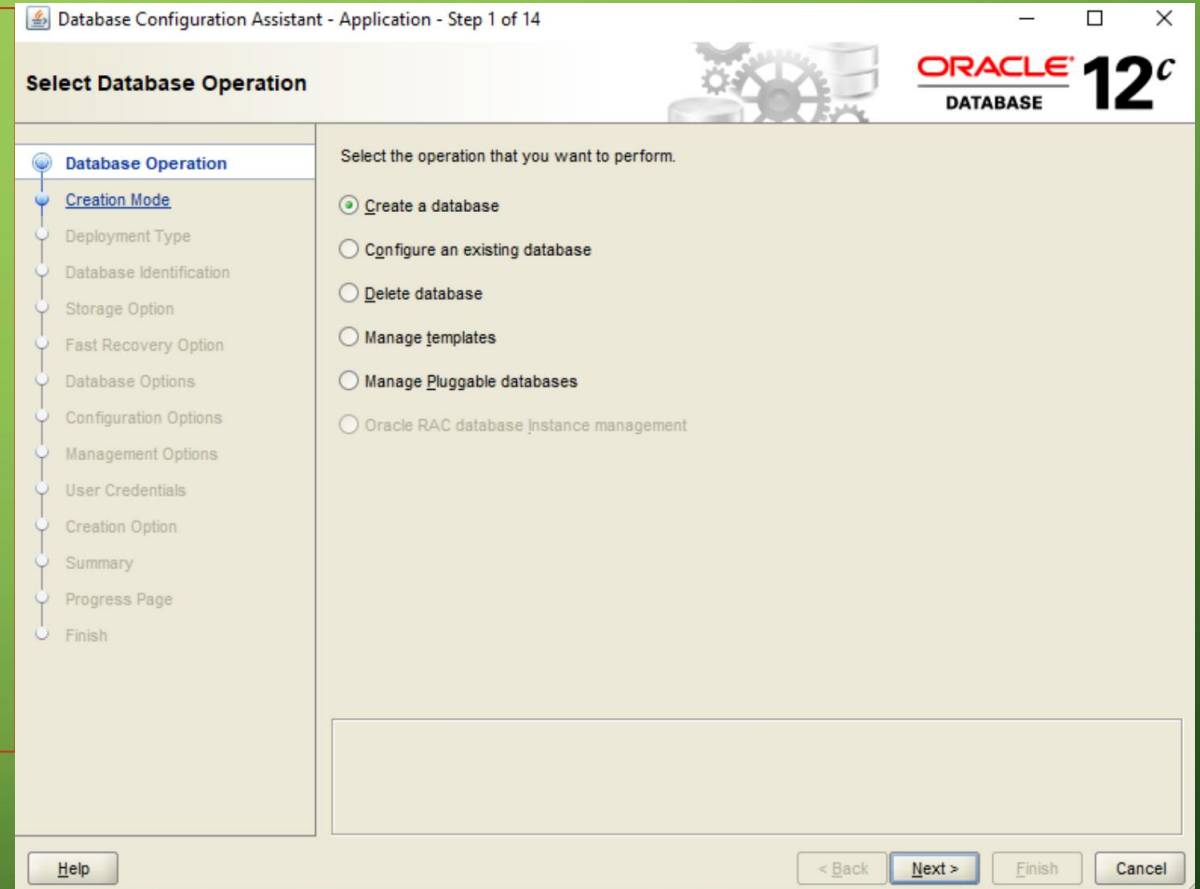
DBA Tasks and tools

- ❖ Installing Oracle software
- ❖ Oracle Universal Installer is a utility that installs your Oracle software and options. It can automatically start Oracle Database Configuration Assistant to install a database.



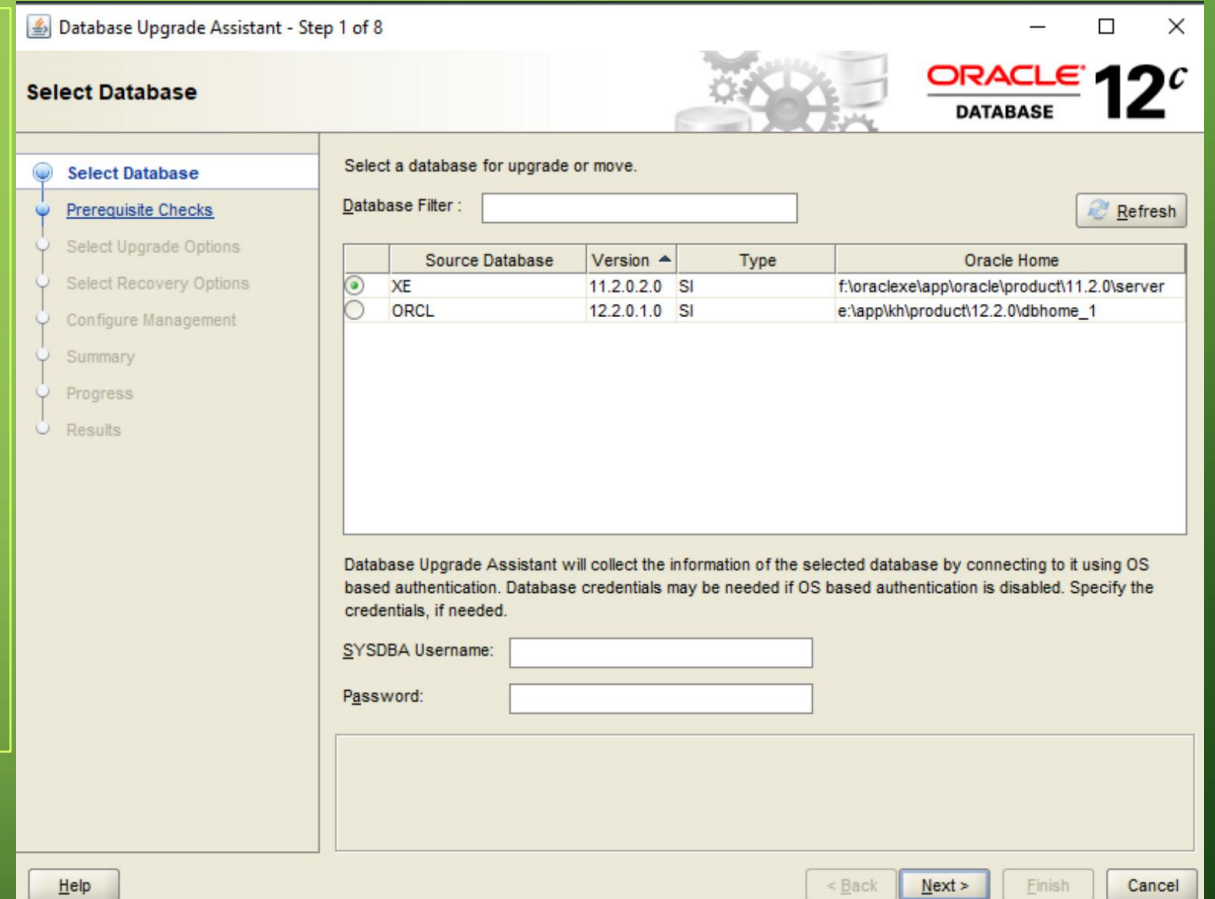
ORACLE DBA TOOL

❖ Creating Oracle databases
Oracle Database Configuration Assistant (DBCA) is a utility that creates a database from templates that are supplied by Oracle



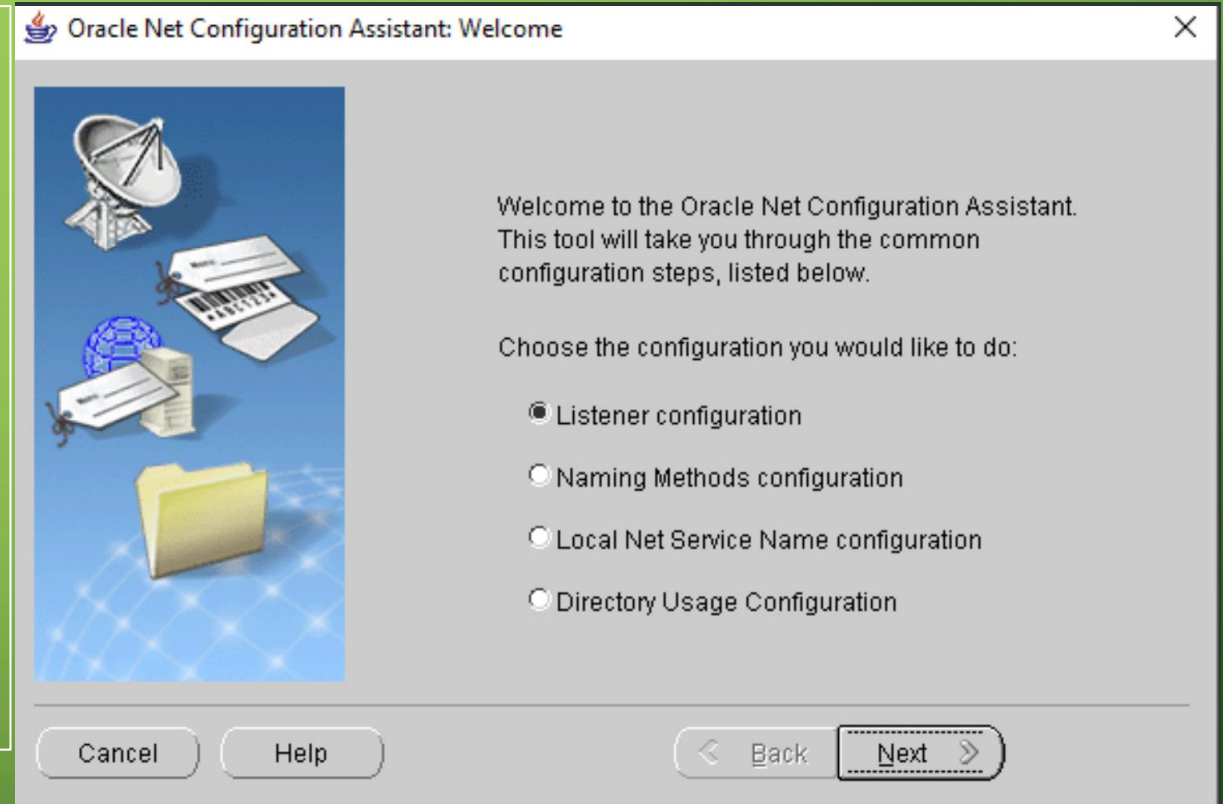
ORACLE DBA TOOL

❖ Database Upgrade Assistant (DBUA) is a tool that guides you through the upgrade of your existing database to a new Oracle Database release



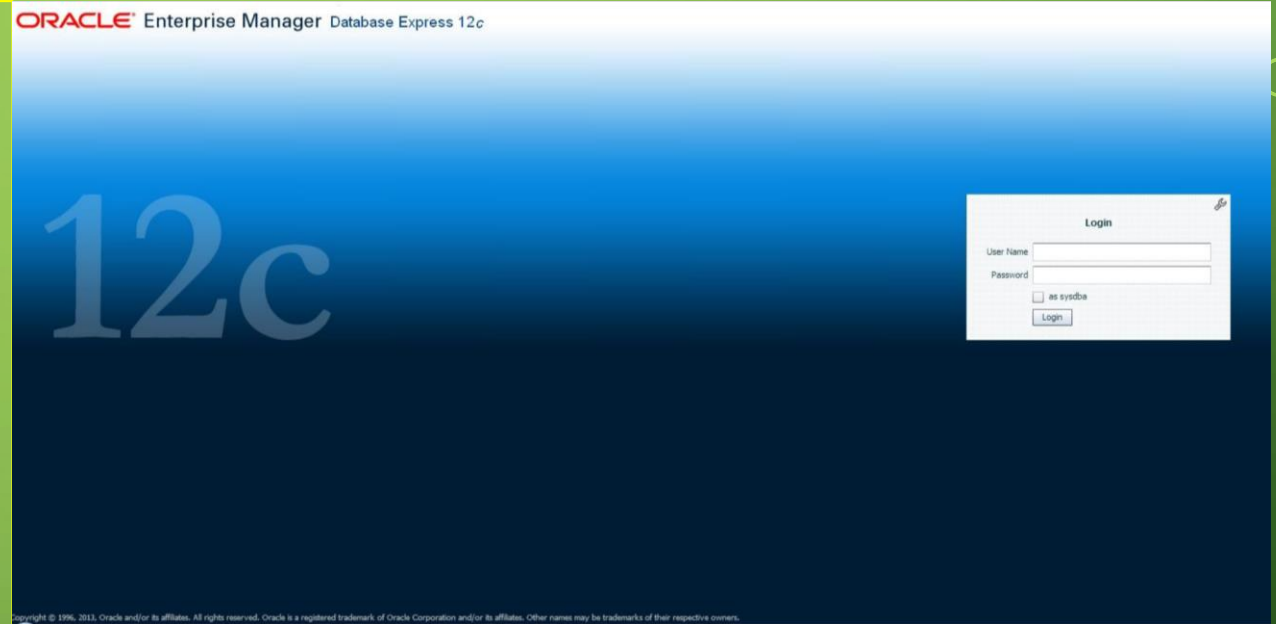
ORACLE DBA TOOL

❖ Net Configuration Assistant is a utility that enables you to configure listeners and naming methods, which are critical components of the Oracle Database network.



ORACLE DBA TOOL

❖ Oracle Enterprise Manager Database Express The primary product for managing your database, a Web-based interface EM Express used to manage your database in very simple ways like simple wizard



ORACLE DBA TOOL

❖ Oracle SQL Developer SQL Developer provides another GUI for accessing your Oracle database. SQL Developer

