

# Chapter 3

# Introduction to Oracle

Part I



ORACLE



By A.Jakkarin Weekaew

Adapted from A. Nichnan Kittipattanabawon

# Outline

01. Oracle DBMS

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02. Oracle DBA Tasks

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03. Oracle Database Administration Tools

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04. Oracle Architecture

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05. Connecting to a Database

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# Objectives



After completing this lesson, students will be able to:

- Know common tasks of Oracle DBA
- Familiar with necessary tools for Oracle DBA
- Understand primary component of Oracle Server



# Oracle DBMS

## Oracle Server

An **object relational database management system** that provides an open, comprehensive, integrated approach to **information management**.

Store, update, and retrieve data with a high degree of...

- Performance
  - Reliability
  - Scalability
- 

## Relational DB: all data is stored in 2D tables

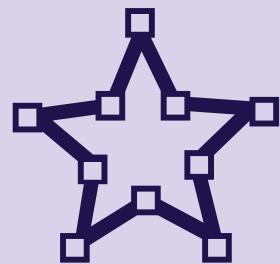
- Rows
  - Columns
-



# Oracle DBA Tasks

## Common Oracle DBA Tasks

- Installing Oracle software
- Creating Oracle databases



## Common Oracle DBA Tasks

Performing upgrades of the database and software to new release levels

## Common Oracle DBA Tasks

- Starting and shutting down the database instance
- Managing the storage structures of the database
- Managing users and security

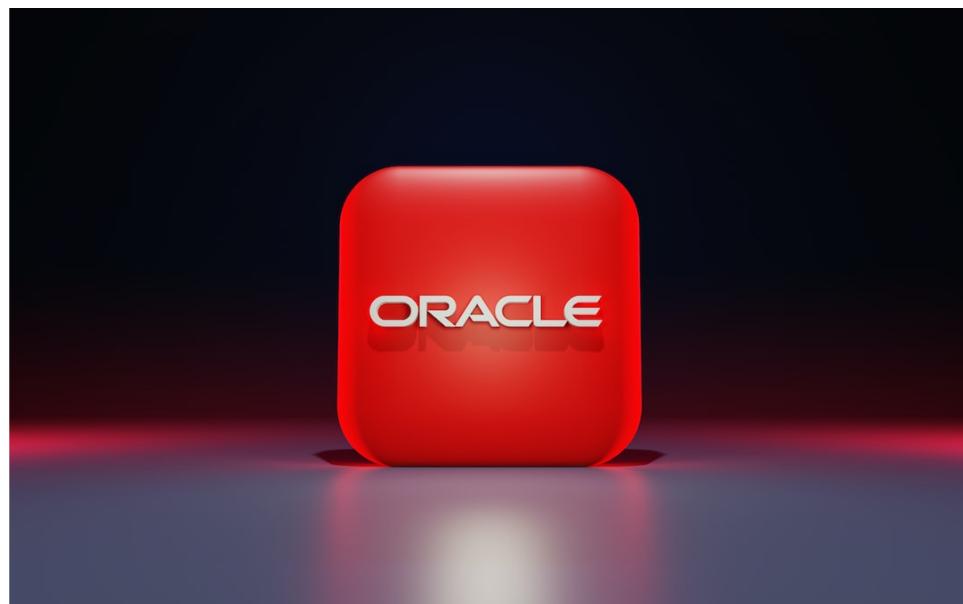




## Oracle Database Administration Tools

Tools enable DBA to manage database

- To quickly and efficiently create Oracle DB
  - To provide guidance in basic database administration
- 





# Common database administration tools

## Oracle Universal Installer (OUI)

To install/deinstall Oracle software and options  
Oracle Database Configuration Assistant (DBCA) is a tool for creating and configuring an Oracle database. DBCA can be launched by the Oracle Universal Installer (OUI), depending upon the type of install that you select.

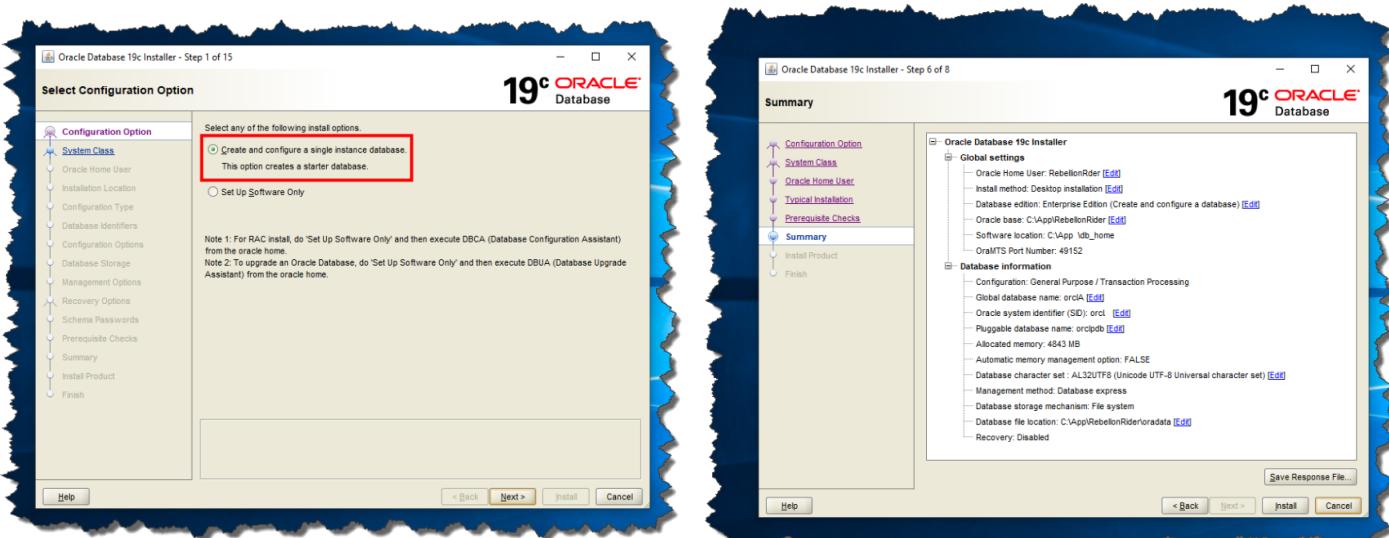


Fig.3.1 Oracle Universal Installer (OUI) (<http://www.rebellionrider.com/how-to-install-oracle-database-19c-on-windows-10/>)



## Common database administration tools (cont.)

### Oracle Database Configuration Assistant (DBCA)

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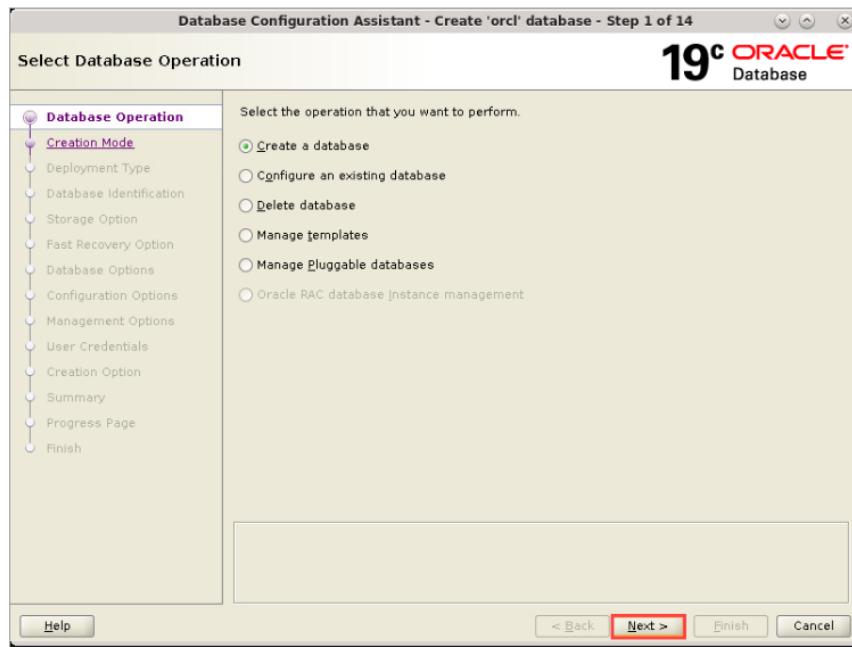


Fig.3.2 Oracle Database Configuration Assistant (DBCA) (<https://docs.oracle.com/en/database/oracle/oracle-database/tutorial-create-advanced-container-db/index.html?opt-release-19c>)



## Common database administration tools (cont.)

### Database Upgrade Assistant (DBUA)

- You can use Database Upgrade Assistant (DBUA) to migrate Oracle Database databases from an existing Oracle home to another Oracle home
- DBUA indicates the type of operation that you can perform for each database (upgrade, move, in place), depending on the database release and location.

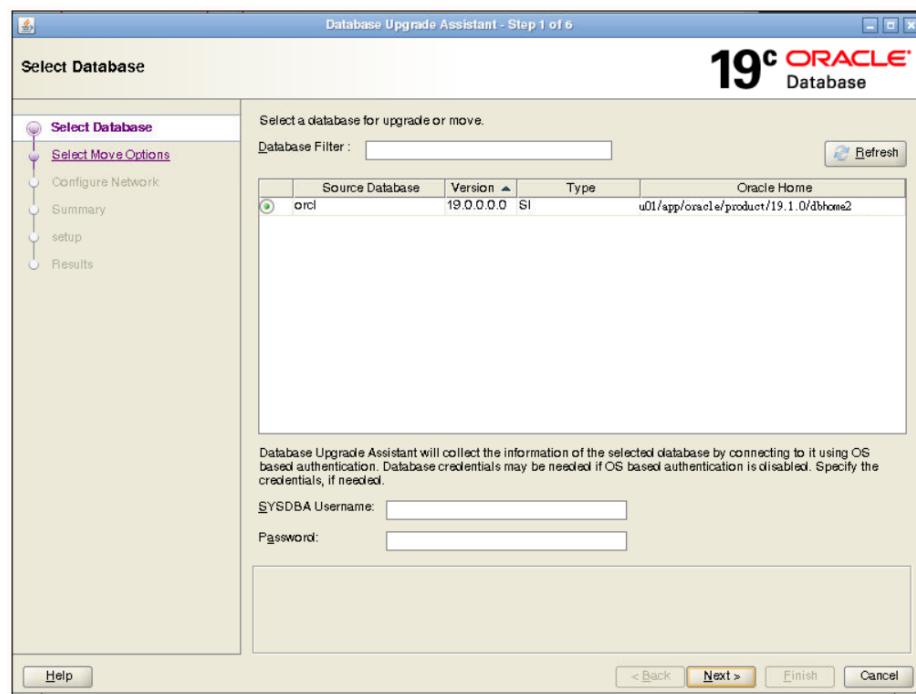


Fig.3.3 Database Upgrade Assistant (DBUA) (<https://docs.oracle.com/en/database/oracle/oracle-database/19/upgrd/upgrading-oracle-database-upgrade-assistant-dbua.html#GUID-F929338D-48EE-434F-A5F9-A9E7CD61B17F>)



## Common database administration tools (cont.)

### Net Configuration Assistant (NETCA)

- You can create a listener in Oracle Database 19c with Network Configuration Assistant



Fig.3.4 Net Configuration Assistant (NETCA) (<https://alekciss.com/create-a-listener-in-oracle-database-19c/>)



# Common database administration tools (cont.)

## Enterprise Manager (EM)

To manage DB for performance advisors

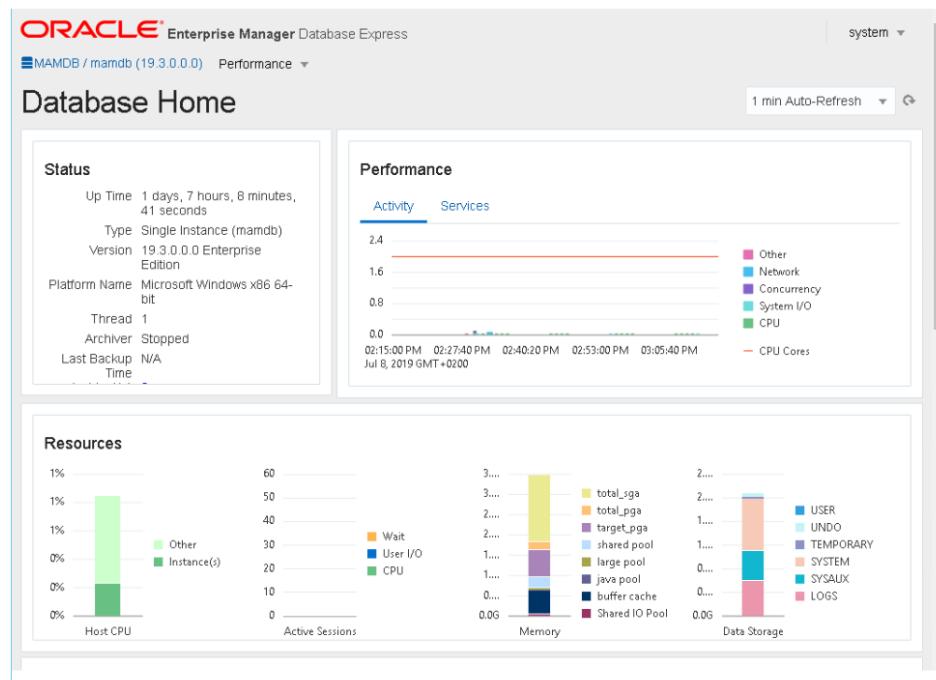


Fig.3.5 Enterprise Manager (EM) (<https://community.oracle.com/tech/apps-infra/discussion/4279368/oracle-19c-the-server-tab-is-missing-in-enterprise-manager>)

# Oracle Architecture

“

Primary components

Oracle database

Collection of data (physical data)

Nondatabase files

Be used to configure and recover the  
database

Oracle instance

Combination of memory structure and  
background process

”

# Oracle Architecture

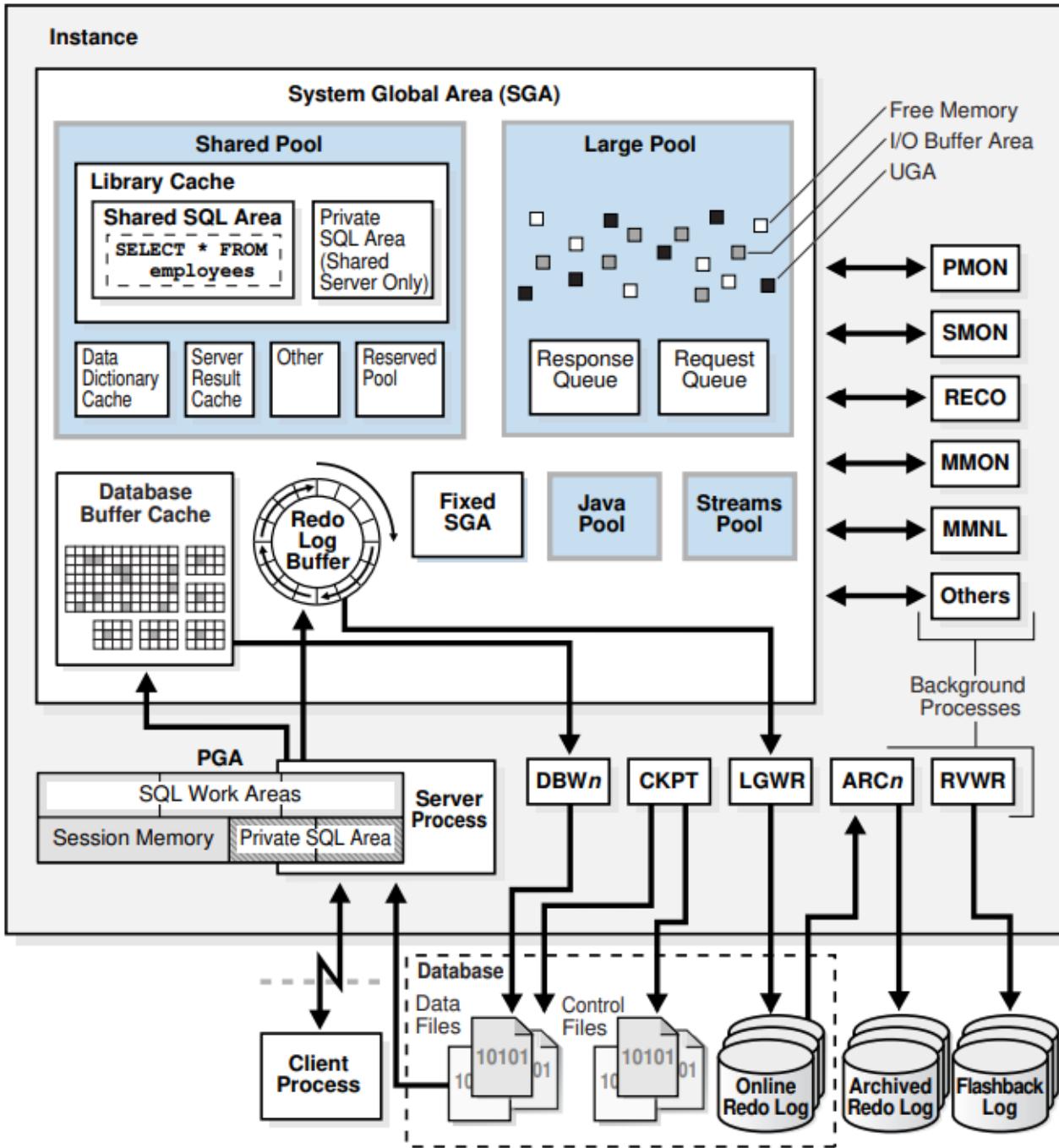


Fig.3.6 Oracle Architecture (<https://docs.oracle.com/en/database/oracle/oracle-database/19/cncpt/database-concepts.pdf>)

# Chapter 3

# Introduction to Oracle

Part II



ORACLE



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# Oracle Architecture

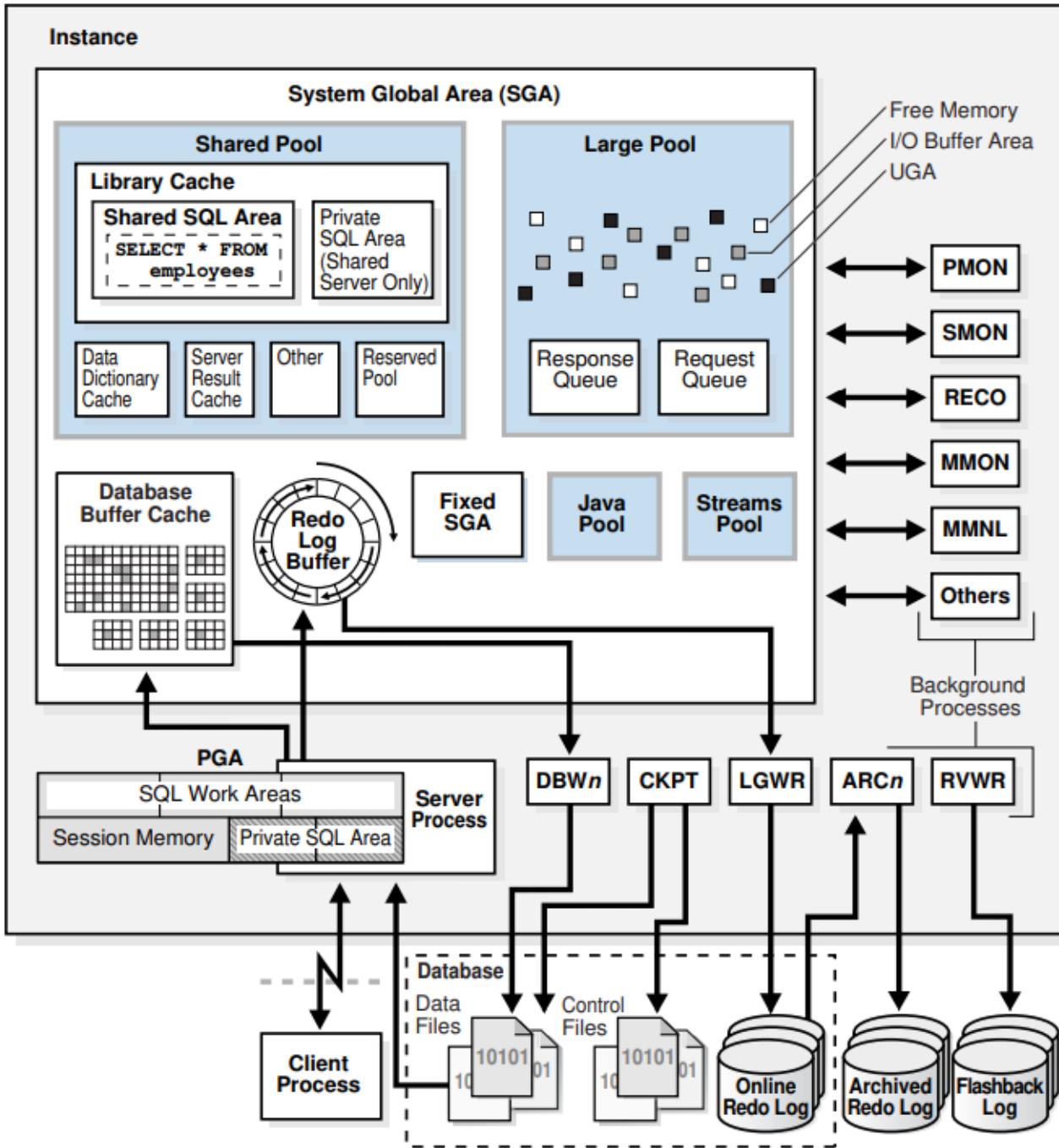


Fig.3.6 Oracle Architecture (<https://docs.oracle.com/en/database/oracle/oracle-database/19/cncpt/database-concepts.pdf>)



# Oracle Database Architecture

## Oracle Server

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.

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## Database and Instance

- An Oracle database server consists of a database and at least one database instance, commonly referred to as simply an instance.
  - Because an instance and a database are so closely connected, the term Oracle database is sometimes used to refer to both instance and database.
-



# Oracle Database Architecture

## Database

A database is a set of files, located on disk, that store data. These files can exist independently of a database instance.

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## 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.
  - For each user connection to the instance, a client process runs the application.
  - 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)**.
  - Although in the strict sense an Oracle database is a set of physical structures (files and memory structures), applications can interact with multiple logical databases inside a single physical database, or a single logical database distributed across multiple physical databases.
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# Oracle Database Architecture

## Database

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What are Multitenant Architecture  
and Sharding Architecture??

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# Oracle Database Architecture

## Multitenant Architecture

- The multitenant architecture enables an Oracle database to be a multitenant container database (CDB).
  - A non-CDB is a traditional Oracle database that cannot contain PDBs.
  - A CDB is a single physical database that contains zero, one, or many user-created pluggable databases.
  - A pluggable database (PDB) is a portable collection of schemas, schema objects, and nonschema objects that appears to an Oracle Net client as a non-CDB
- 

**Note:** CDBs and non-CDBs have architectural differences. This manual assumes the architecture of a non-CDB unless otherwise indicated.

## Benefits of the Multitenant Architecture

- Cost reduction for hardware
  - Easier and more rapid movement of data and code
  - Easier management and monitoring of the physical database
  - Separation of data and code
- 

**Note:** Oracle Multitenant Administrator's Guide to learn more about the benefits of the multitenant architecture (<https://docs.oracle.com/pls/topic/lookup?ctx=en/database/oracle/oracle-database/19/cncpt&id=MULTI-GUID-31CE5970-4A53-44E0-AEA0-D2F7AE09D7E7#MULTI-GUID-31CE5970-4A53-44E0-AEA0-D2F7AE09D7E7>)



# Oracle Database Architecture

## Sharding Architecture

- Oracle Sharding is a database scaling technique based on horizontal partitioning of data across multiple Oracle databases.
- Applications perceive the pool of databases as a single logical database.
- Key benefits of sharding for OLTP applications include linear scalability, fault containment, and geographical data distribution.
- Sharding is well suited to deployment in the Oracle Cloud.
- Unlike NoSQL data stores that implement sharding, Oracle Sharding provides the benefits of sharding without sacrificing the capabilities of an enterprise RDBMS.

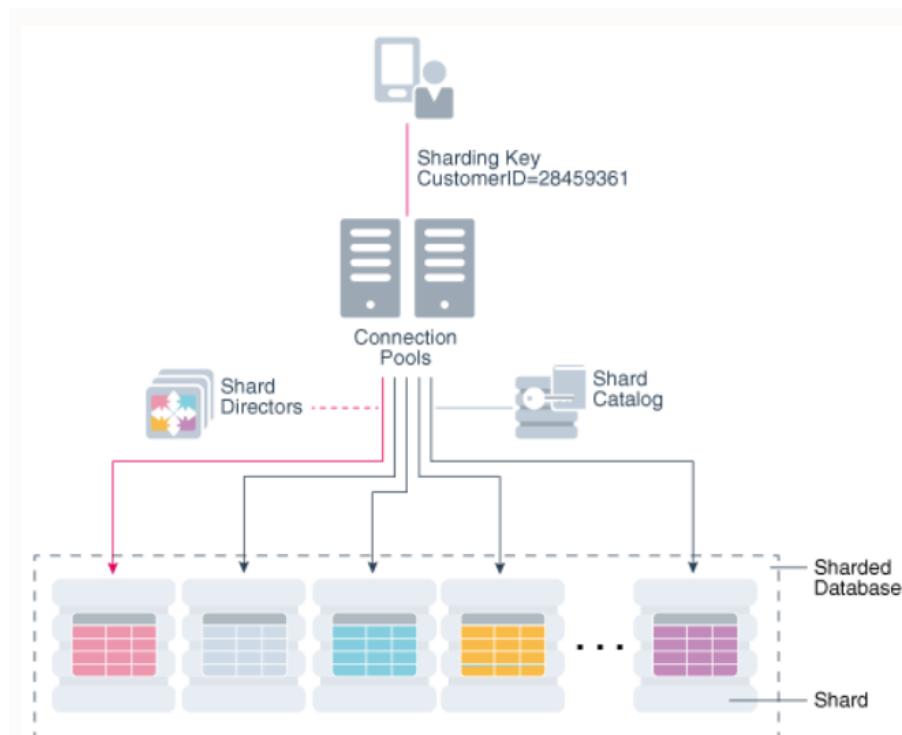


Fig.3.7 Oracle Sharding Architecture (<https://docs.oracle.com/en/database/oracle/oracle-database/19/cncpt/introduction-to-oracle-database.html#GUID-8F1E6C26-A65A-4D62-B236-BFE3DA6CD43F>)



# Database Storage Structures

## Physical and logical perspective

A database can be considered from both a physical and logical perspective.

- Physical data is data viewable at the operating system level. For example, operating system utilities such as the Linux ls and ps can list database files and processes.
  - Logical data such as a table is meaningful only for the database. A SQL statement can list the tables in an Oracle database, but an operating system utility cannot.
- 

**The database has physical structures and logical structures.**

Because the physical and logical structures are separate, you can manage the physical storage of data without affecting access to logical storage structures. For example, renaming a physical database file does not rename the tables whose data is stored in this file.

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# Database Storage Structures

## Physical Storage Structures

When you execute a `CREATE DATABASE` statement, the following files are created:

- Data files

Every Oracle database has one or more physical data files, which contain all the database data. The data of logical database structures, such as tables and indexes, is physically stored in the data files.

Contain actual data, including

- User data: tables, indexes, and other types
- System data: data dictionary, temporary, etc.



# Oracle Database Architecture

## Physical Storage Structures

### Control files

- Every Oracle database has a control file.
- A control file contains metadata specifying the physical structure of the database, including the database name and the names and locations of the database files.
  - e.g., Location of data files

### Online redo log files

- Every Oracle Database has an online redo log, which is a set of two or more online redo log files.
- An online redo log is made up of redo entries (also called redo log records), which record all changes made to data.

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## Nondatabase Files (Other key files)

Parameter files

Password files

Archived log files



# Database Storage Structures

## Nondatabase Files

- Parameter files

Contain all configuration parameters for Oracle instance  
e.g., init.ora

- Password files

Authenticates which users are permitted to start up  
and shutdown an Oracle instance

- Archived redo log files

Offline copies of the redo log files that may be  
necessary to recover from media failures

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## Oracle Architecture

### Oracle instance

- Allocated when Oracle database is started
  - Must be started to access data in database
  - Opened and used only one database at a time
  - Combination of two elements
    - 1 Memory structure (System Global Area: SGA)
    - 2 Background Process
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# Oracle Architecture

## Oracle instance

When an instance is started

- SGA is allocated

- Background process are started

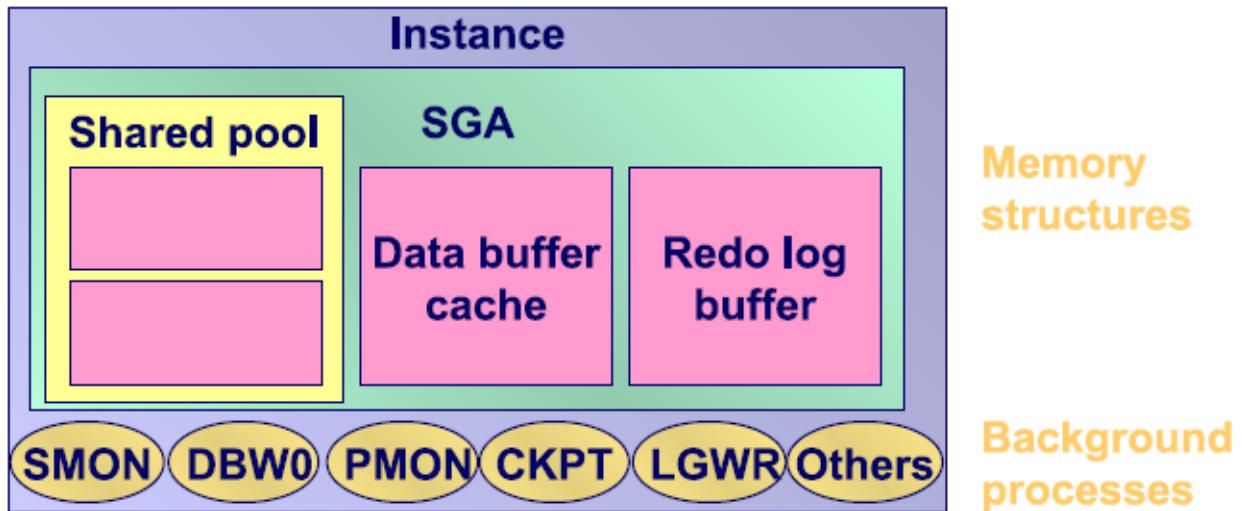


Fig.3.8 Oracle Instance



## Oracle Architecture

### System Global Area (SGA)

Shared memory area used to store database information

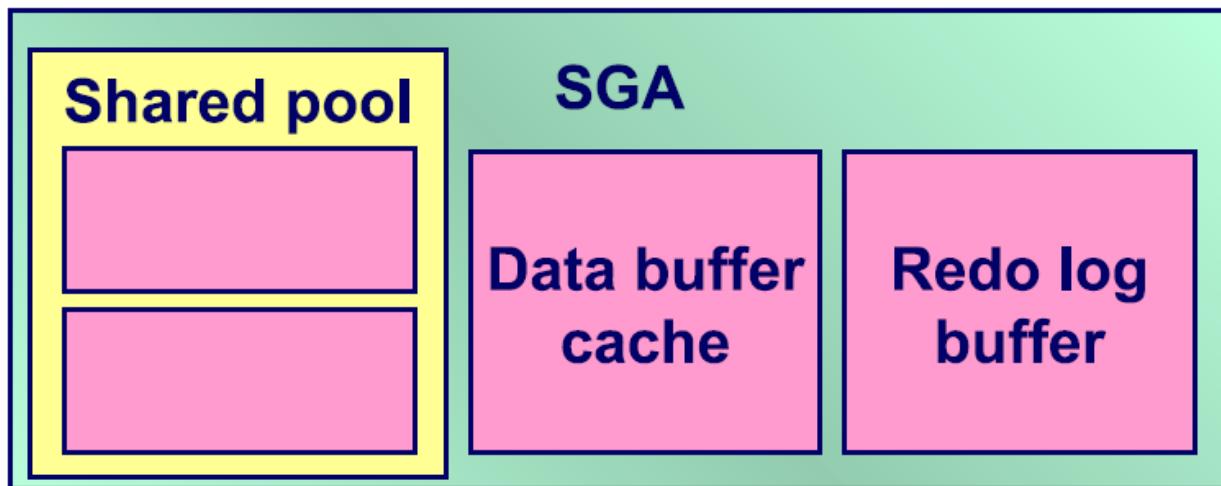


Fig.3.9 Oracle System Global Area (SGA)



# Oracle Architecture

## SGA memory structure

- Data buffer cache

Store the most recently used data

- Redo log buffer

Store track changes made to DB

- Shared pool

Library cache

Store the most recently executed SQL statements

Data dictionary cache

Store the most recently used data from data dictionary

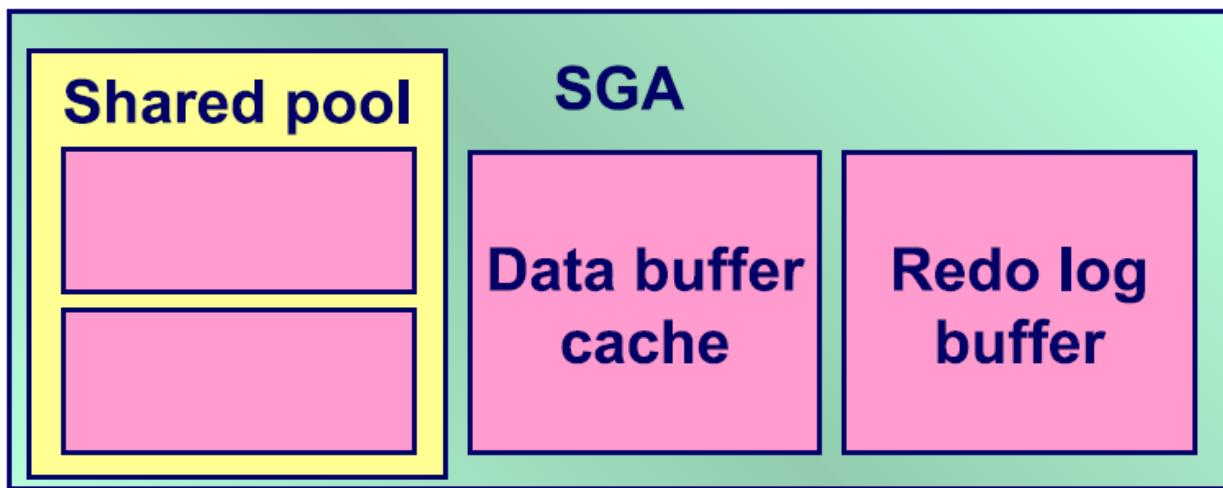


Fig.3.9 Oracle System Global Area (SGA)



## Oracle Architecture

### Background processes

-Perform common function that are needed to service request from concurrent users



Fig.3.10 Oracle background processes

- Perform I/O and monitor other Oracle processes  
To provide increased parallelism for better performance and reliability



## Oracle Architecture

### Basic processes of background process

- **Database Writer (DBW0)** -Write data from data cache contained in memory out to the data files (physical disk)
- **Log Writer (LGWR)** -Write changes registered in redo log buffer to redo log files
- **System Monitor (SMON)**
  - Check consistency of database
  - Initiate recovery of the database when the database is started (If DB crashes)
- **Process Monitor (PMON)** -Clean up resources if one of processes fails
- **Checkpoint Process (CKPT)** -Update DB status information in the control files and data files whenever changes in the buffer cache are permanently recorded in DB



# Oracle Architecture

## Connecting to a Database

- A connection is a communication pathway between a user/client process and a server process (Oracle server)
- A process is a mechanism in an operating system that can run a series of steps. Some operating systems use the terms job, task, or thread.

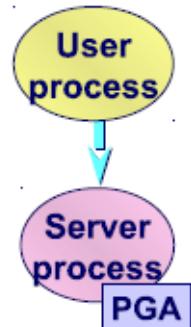


Fig.3.11 Oracle user and server processes

- User/client process
- Server process
- Background processes



## Oracle Architecture

### Connecting to a Database

- User/client process

- These processes are created and maintained to run the software code of an application program or an Oracle tool.

- Most environments have separate computers for client processes.

- Process that user originates SQL statements submitted by

- SQL\*Plus or any application, e.g., Oracle Forms

- Server process

- These processes communicate with client processes and interact with Oracle Database to fulfill requests.

- Process that is created on the computer running the Oracle server which

- Execute SQL statements sent from the user process



## Oracle Architecture

### Connecting to a Database

- Background processes

- These processes consolidate functions that would otherwise be handled by multiple Oracle Database programs running for each client process.

- Background processes asynchronously perform I/O and monitor other Oracle Database processes to provide increased parallelism for better performance and reliability.

**Note:** Oracle processes include server processes and background processes. In most environments, Oracle processes and client processes run on separate computers.



## Oracle Architecture

### Instance Memory Structures

Oracle Database creates and uses memory structures for program code, data shared among users, and private data areas for each connected user.

The following memory structures are associated with a database instance:

#### System Global Area (SGA)

- The SGA is a group of shared memory structures that contain data and control information for one database instance.
- Examples of SGA components include the database buffer cache and shared SQL areas.

**Note:** Starting in Oracle Database 12c Release 1 (12.1.0.2), the SGA can contain an optional In-Memory Column Store (IM column store), which enables data to be populated in memory in a columnar format.



# Oracle Architecture

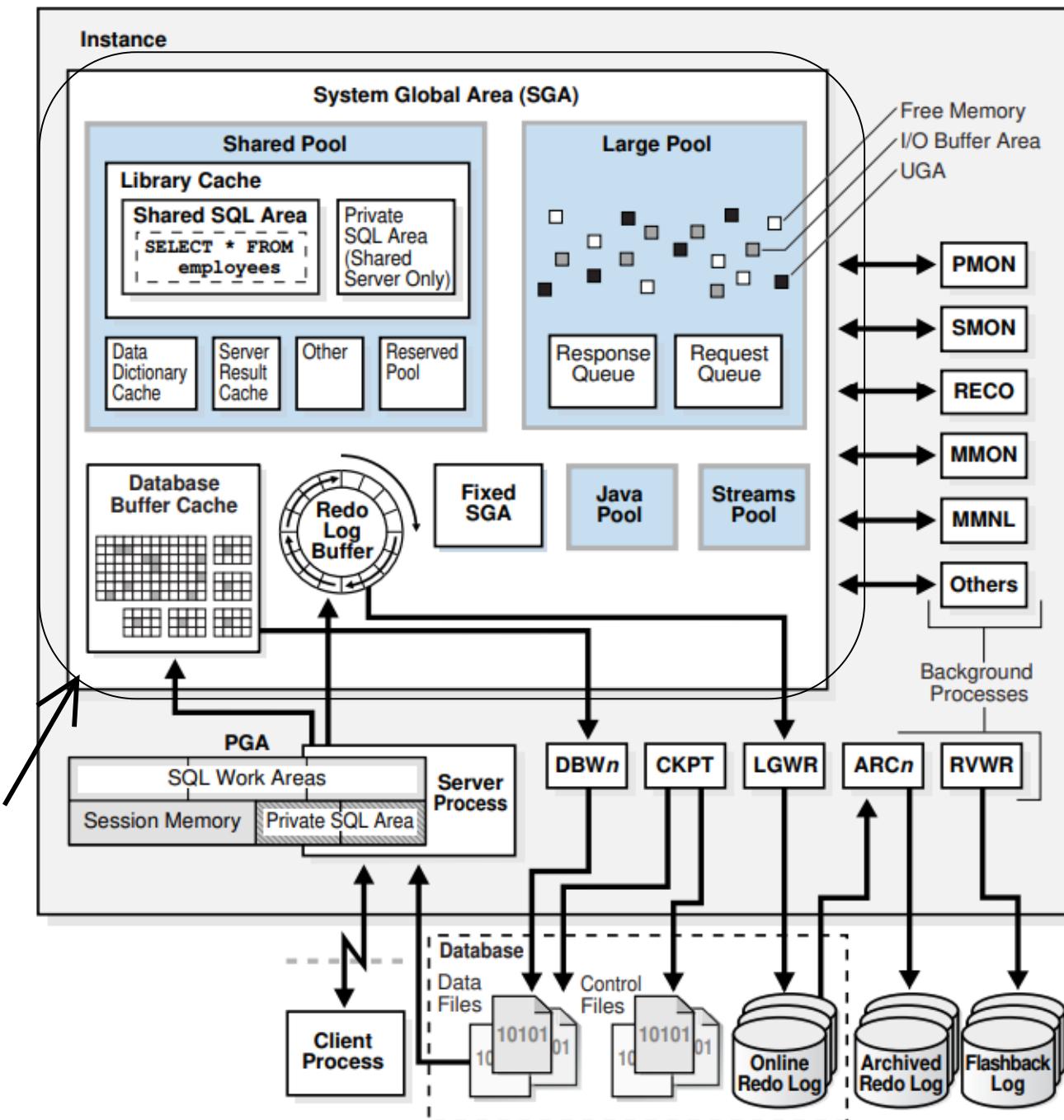


Fig.3.6 Oracle Architecture (<https://docs.oracle.com/en/database/oracle/oracle-database/19/cncpt/database-concepts.pdf>)



# Oracle Database Architecture

## Instance Memory Structures

### Program Global Areas (PGA)

- A PGA is a memory region that contains data and control information for a server or background process.
- Access to the PGA is exclusive to the process.
- Each server process and background process has its own PGA.





# Oracle Database Architecture

## Instance Memory Structures

### Program Global Areas (PGA)

- private SQL area to store bind variable values, query execution state information, and query execution work areas.
- A work area is a private allocation of PGA memory used for memory-intensive operations.

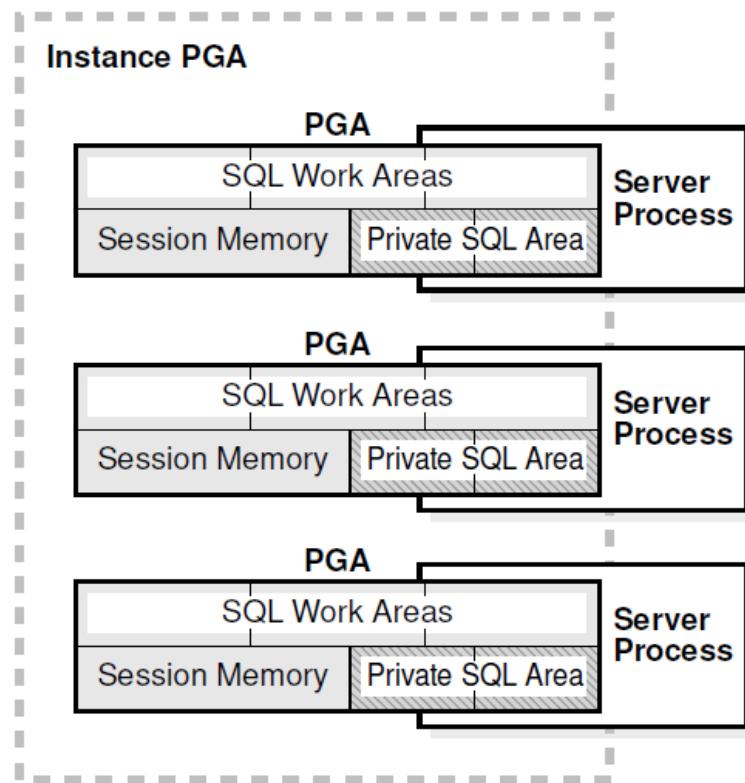


Fig.3.12 Instance PGA



# Oracle Database Architecture

## Instance Memory Structures

### Session

- Specific connection of a user to an Oracle server

#### Connecting to an Oracle Instance:

- Establishing a user connection
- Creating a session

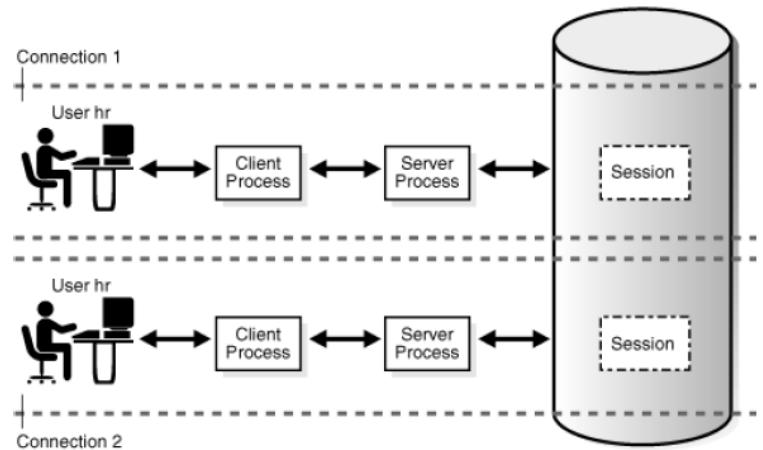
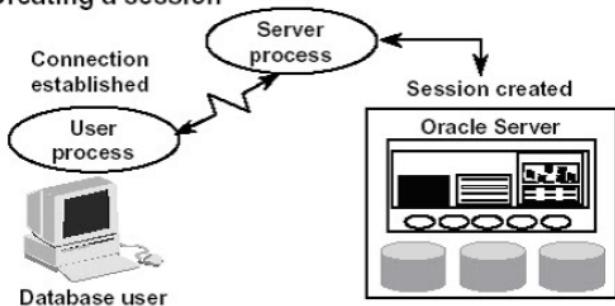


Fig.3.13 Connecting to an instance ([www.jignyasa.net](http://www.jignyasa.net), [docs.oracle.com](http://docs.oracle.com))



# Oracle Database Architecture

## Summary

Before managing database, DBA should know the database software well

- Oracle DBA tasks
- Oracle tools
- Oracle architecture
- Connecting to an Oracle database