

# DBMS SQL

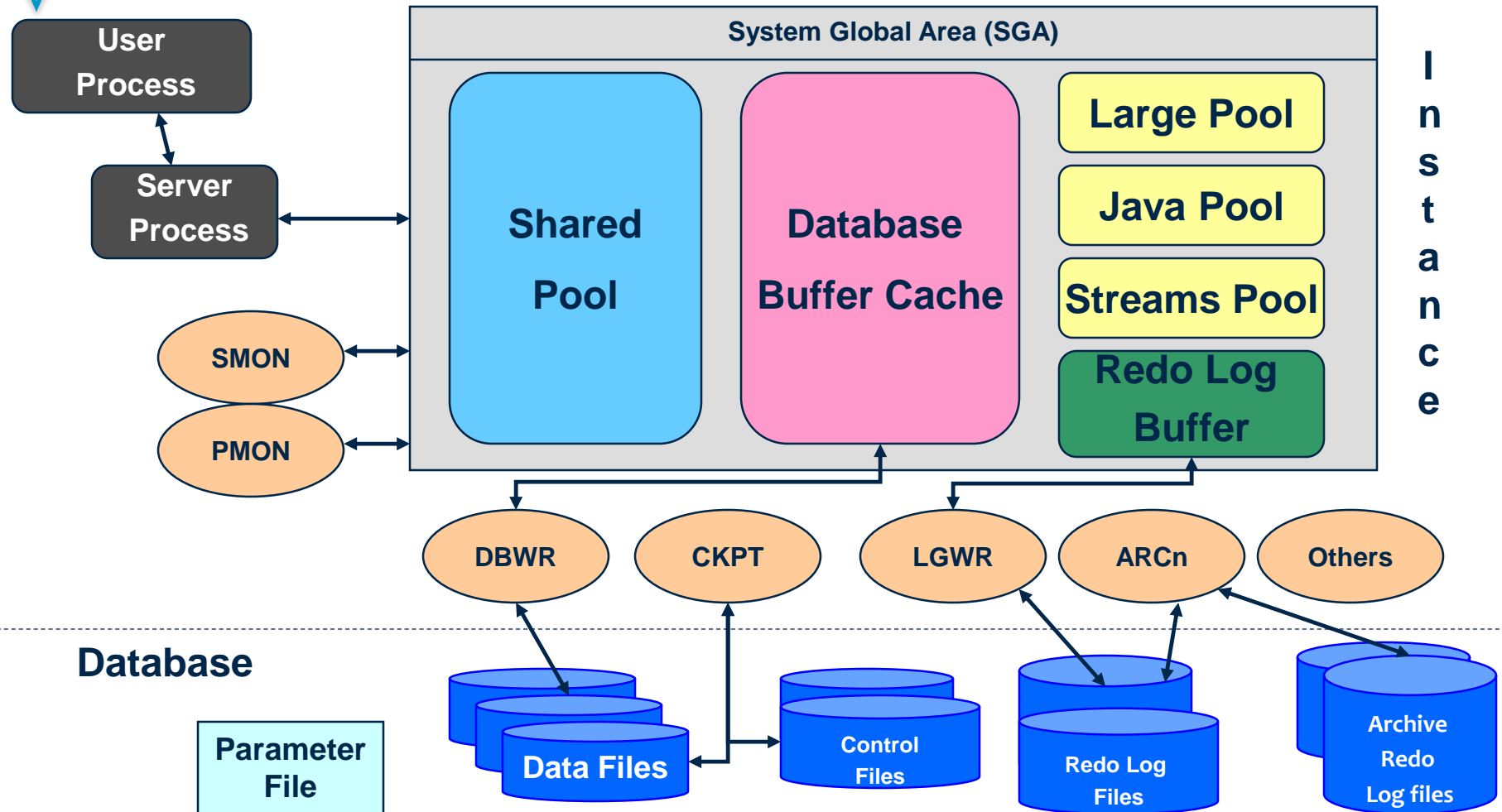
Lesson 13: Introduction to Oracle  
Architecture

# Lesson Objectives

- To understand the following topics:
  - Outline of Oracle architecture and its main components
  - List of structures involved in connecting a user to an Oracle instance



# Oracle SGA and Database

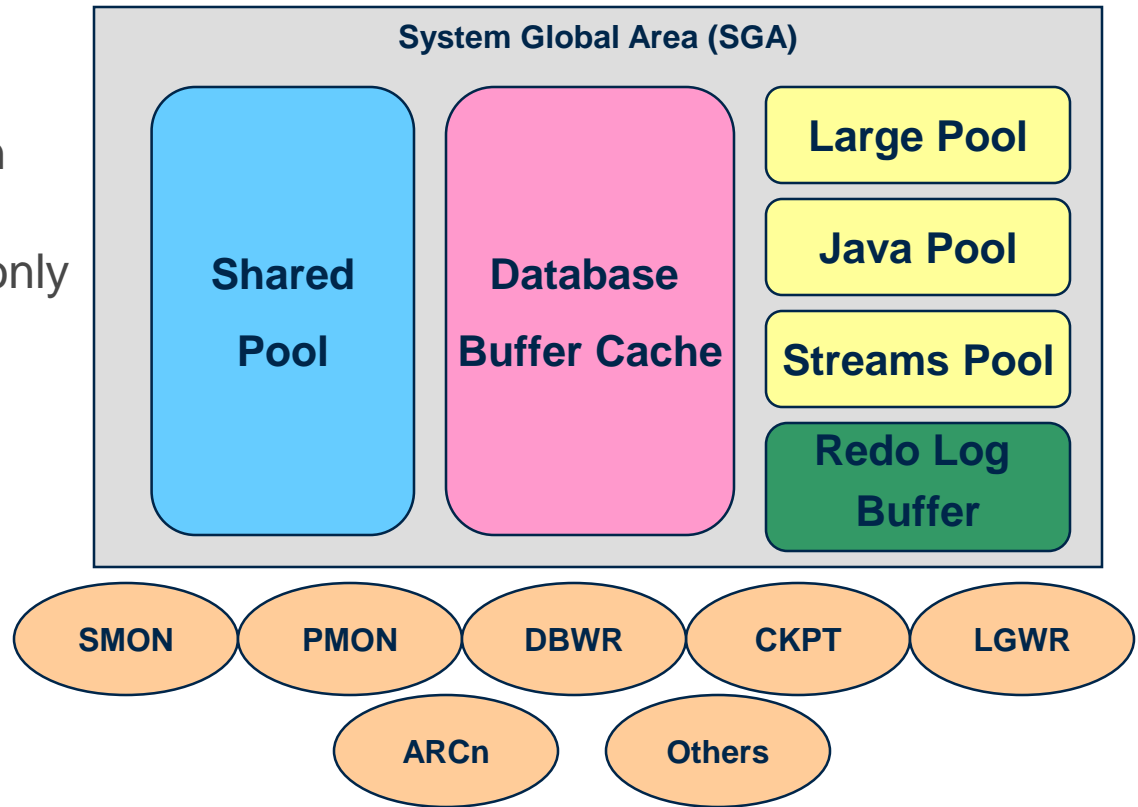


# Oracle Server Defined

- An Oracle server:
  - is a “database management system (DBMS)” that provides an open, comprehensive, integrated approach to information management.
  - consists of an “Oracle instance” and an “Oracle database”.

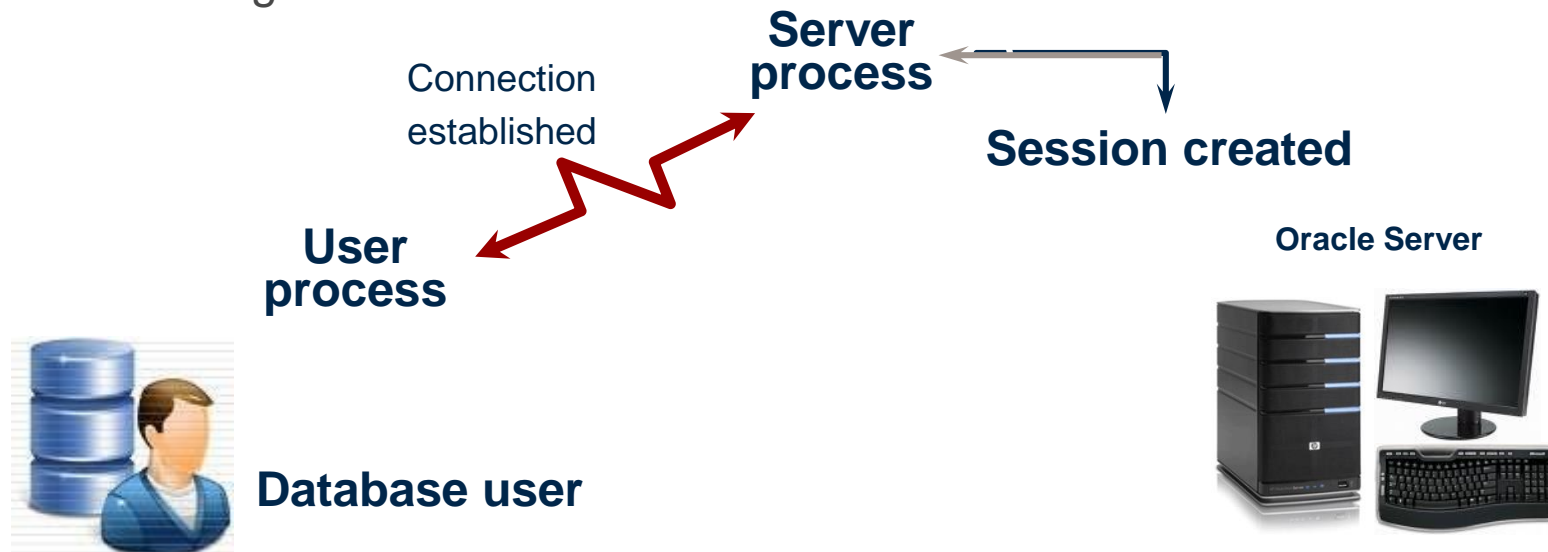
# Oracle Instance

- An Oracle instance:
  - is a means to access an Oracle database.
  - always opens one and only one database.
  - consists of memory and process structures.



# Connection and Creating a Session

- Connecting to an Oracle instance consists of:
  - establishing a User Connection, and
  - creating a Session



# Memory Structure

- Memory Structure:
  - The Memory Structure of Oracle consists of two memory areas known as:
    - **System Global Area (SGA):** Allocated at instance startup, and is a fundamental component of an Oracle Instance.
    - **Program Global Area (PGA):** Allocated when the server process is started.

# System Global Area (SGA)

- The SGA consists of following memory structures:
  - Mandatory
    - Shared pool
    - Database buffer cache
    - Redo log buffer
    - Streams Pool
  - Optional
    - Large pool
    - Java Pool
- SGA can be sized by the SGA\_MAX\_SIZE parameter

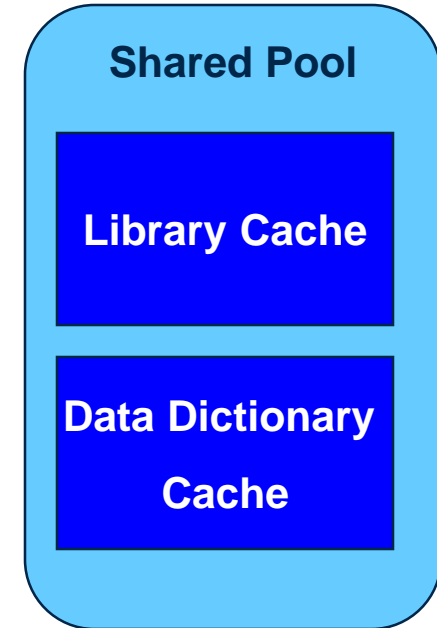


# Shared Pool

- **Shared Pool:**

The shared pool is used to store the most recently executed SQL statements, and the most recently used Data Definitions.

- It consists of two key memory structures:
  - Library cache
  - Data dictionary cache
- It is sized by the parameter SHARED\_POOL\_SIZE.



# Library Cache

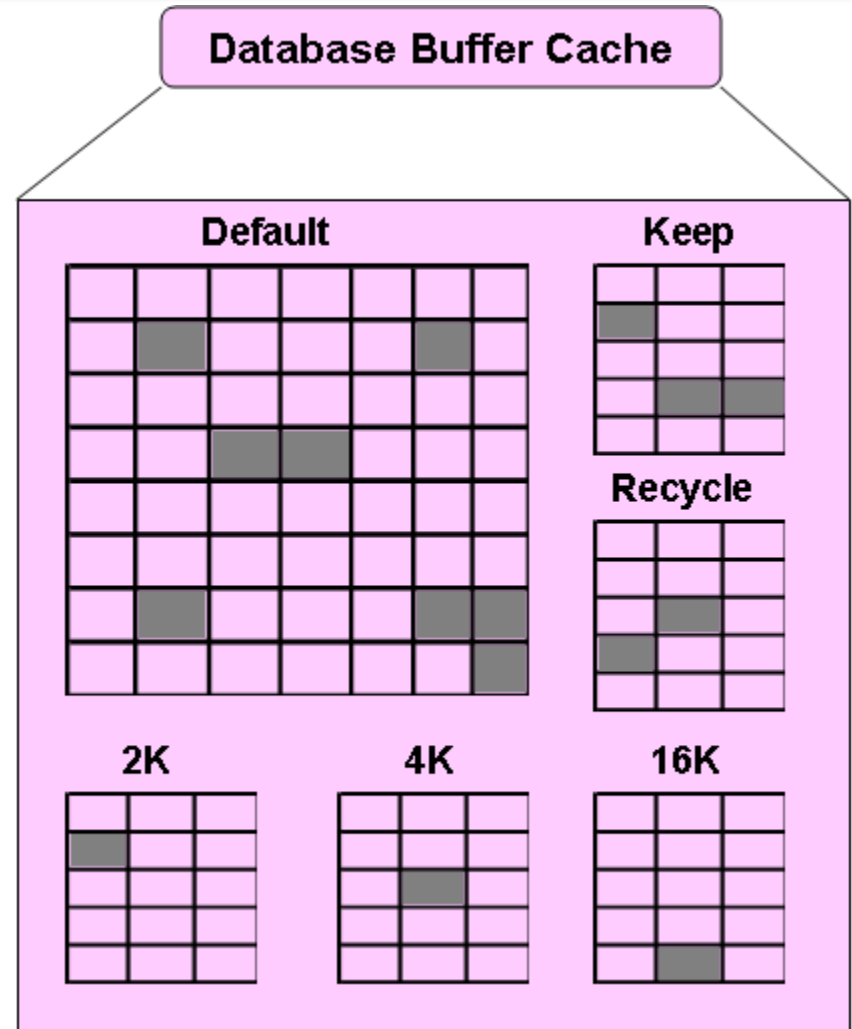
- Library Cache can be described as follows:
  - The Library Cache stores information about the most recently used SQL and PL/SQL statements. The Library Cache enables sharing of commonly used statements.
  - It is managed by a least recently used (LRU) algorithm.
  - It consists of two structures:
    - Shared SQL area
    - Shared PL/SQL area
  - It has its size determined by the Shared Pool Sizing.

# Data Dictionary Cache

- Data Dictionary Cache can be described as follows:
  - The Data Dictionary Cache is a collection of the most recently used data dictionary information from the database.
    - It includes database files, tables and their descriptions, Indexes, columns, users, privileges, and other database objects.
    - During the “parse phase”, the “server process” looks at the Data Dictionary for information to resolve “object names”, and validate the access.
    - The query response time is improved by caching the data dictionary information
    - The size is determined by the Shared Pool Sizing.

# Database Buffer Cache

- The Database Buffer Cache stores copies of data blocks that have been retrieved from the data files.
- Enables performance improvement when you obtain and update data.
- Managed through a LRU algorithm.
- DB\_BLOCK\_SIZE determines the primary block size.



# Database Buffer Cache (Contd...)

- Database Buffer Cache consists of sub caches
  - Default
  - Keep
  - Recycle
  - Non-standard block sizes
  
- The size of sub caches can be controlled by parameters:
  - DB\_CACHE\_SIZE
  - DB\_KEEP\_CACHE\_SIZE
  - DB\_RECYCLE\_CACHE\_SIZE
  - DB\_nK\_CACHE\_SIZE

# Redo Log Buffer

- The Redo Log Buffer Cache records all changes made to the data blocks.
  - It's main purpose is recovery.
  - Recorded changes are called redo entries
  - Redo entries contain information to reconstruct or redo changes.  
**It is sized by the parameter LOG\_BUFFER.**

# Large Pool

- The Large Pool is an optional memory area in the SGA and is configured only in shared server environment.
  - The burden on Shared Pool is reduced.
  - This memory area is typically used for Session Memory (UGA), I/O slaves, and backup and restore operations.
  - The Large Pool does not use an LRU list.
  - It is sized by the parameter `LARGE_POOL_SIZE`.

# Java Pool

- The Java Pool services the parsing requirements for Java commands.
  - Required in case of installation and use of Java.
  - Stored in the same way as PL/SQL in database tables.
  - Sized by the JAVA\_POOL\_SIZE parameter.

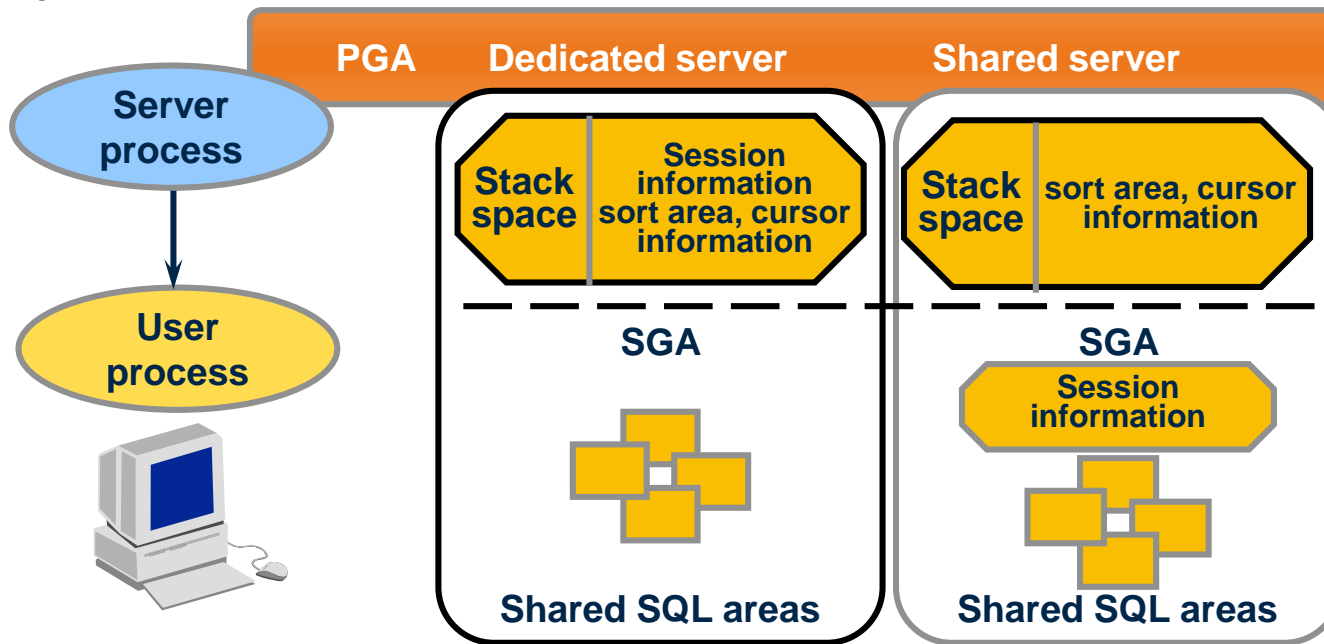


# Streams Pool

- The Streams Pool stores data and control structures to support the Oracle streams feature of Oracle Enterprise Edition.
  - It is new cache introduced in Oracle 10g
  - Sized with parameter STREAMS\_POOL\_SIZE

# Program Global Area

- Program Global Area (PGA) is the memory reserved for each user process that connects to an Oracle database.



# Program Global Area (Contd...)

- It is allocated when a process is created and deallocated when the process is terminated
- Can be sized with parameter PGA\_AGGREGATE\_TARGET

# Process Structure

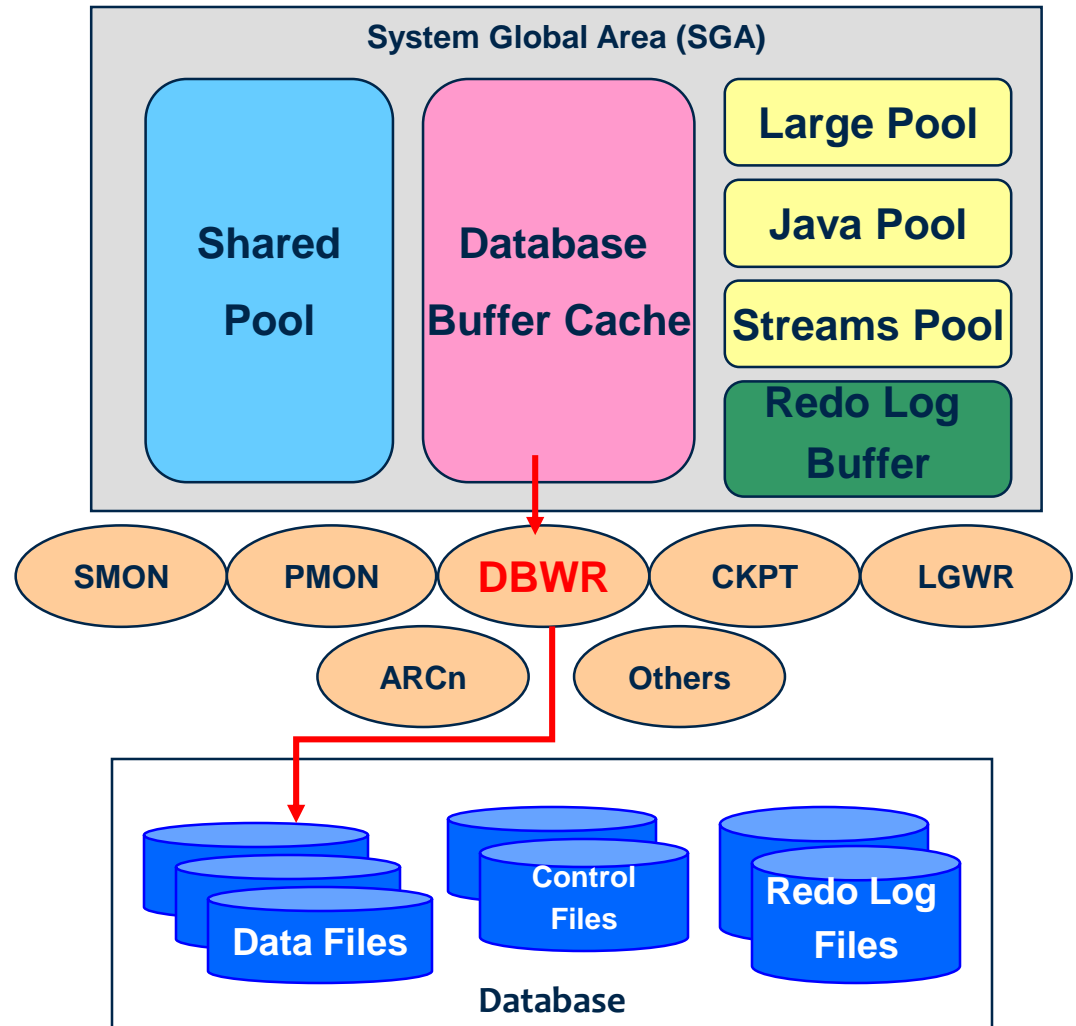
- An Oracle process is a program, which can request information, execute a series of steps, or perform a specific task, depending on its type.
- Oracle has the following types of processes:
  - **User process:** Starts at the time a database user requests connection to the Oracle server.
  - **Server process:** Connects to the Oracle Instance and starts when a user establishes a session.
  - **Background process:** Available when an Oracle instance is started.

# Background Process

- The physical structure and memory structures are related to each other by Oracle background processes
  - Mandatory background processes:
    - SMON
    - PMON
    - DBWR
    - LGWR
    - CKPT
  - Optional background process:
    - Arcn

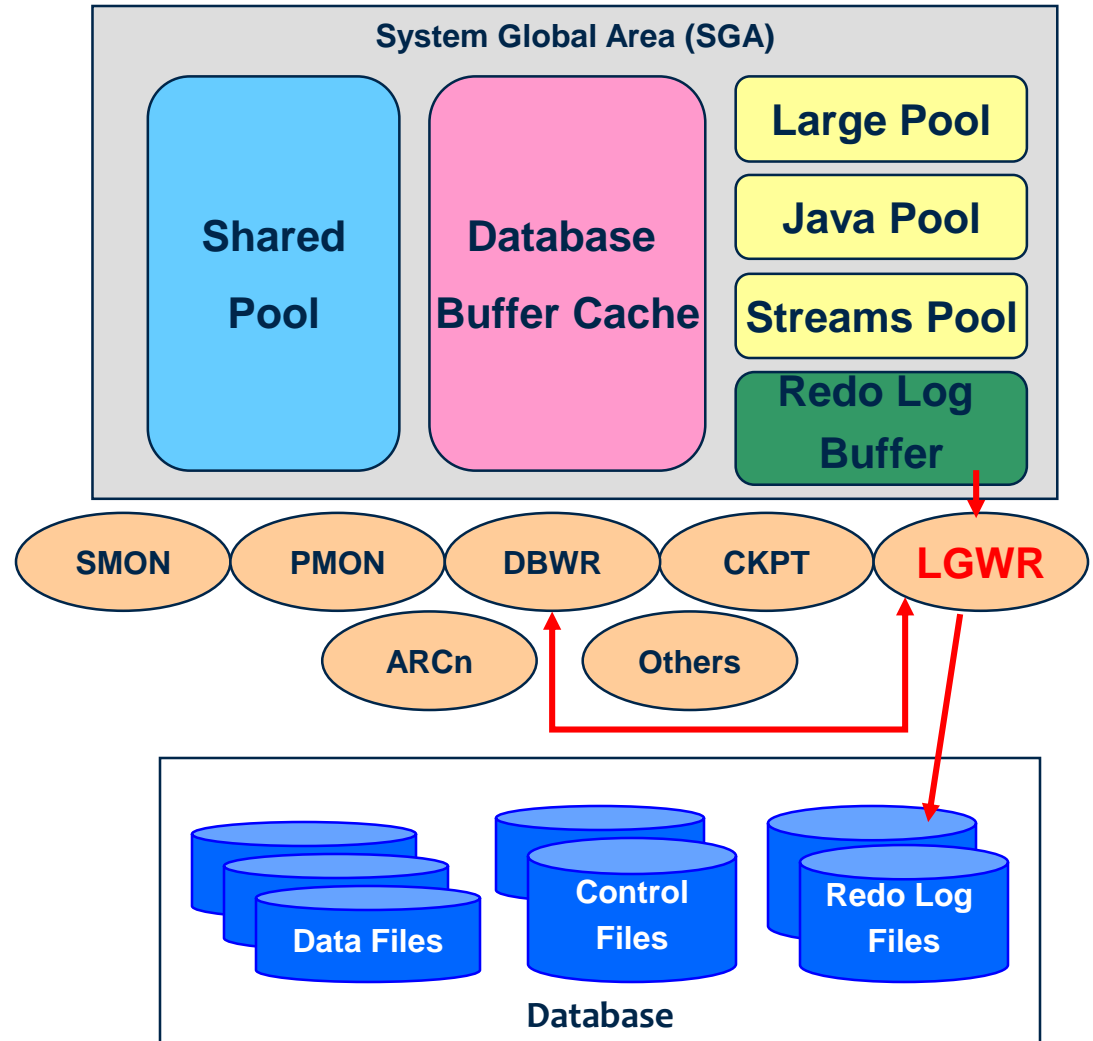
# Database Writer (DBWn)

- Database Writer (DBWn) writes when:
  - Checkpoint occurs
  - on reaching Dirty buffers threshold
  - No Buffers are free
  - Timeout occurs
  - when Tablespace is offline or read only
  - when DROP Table or TRUNCATE Table is used



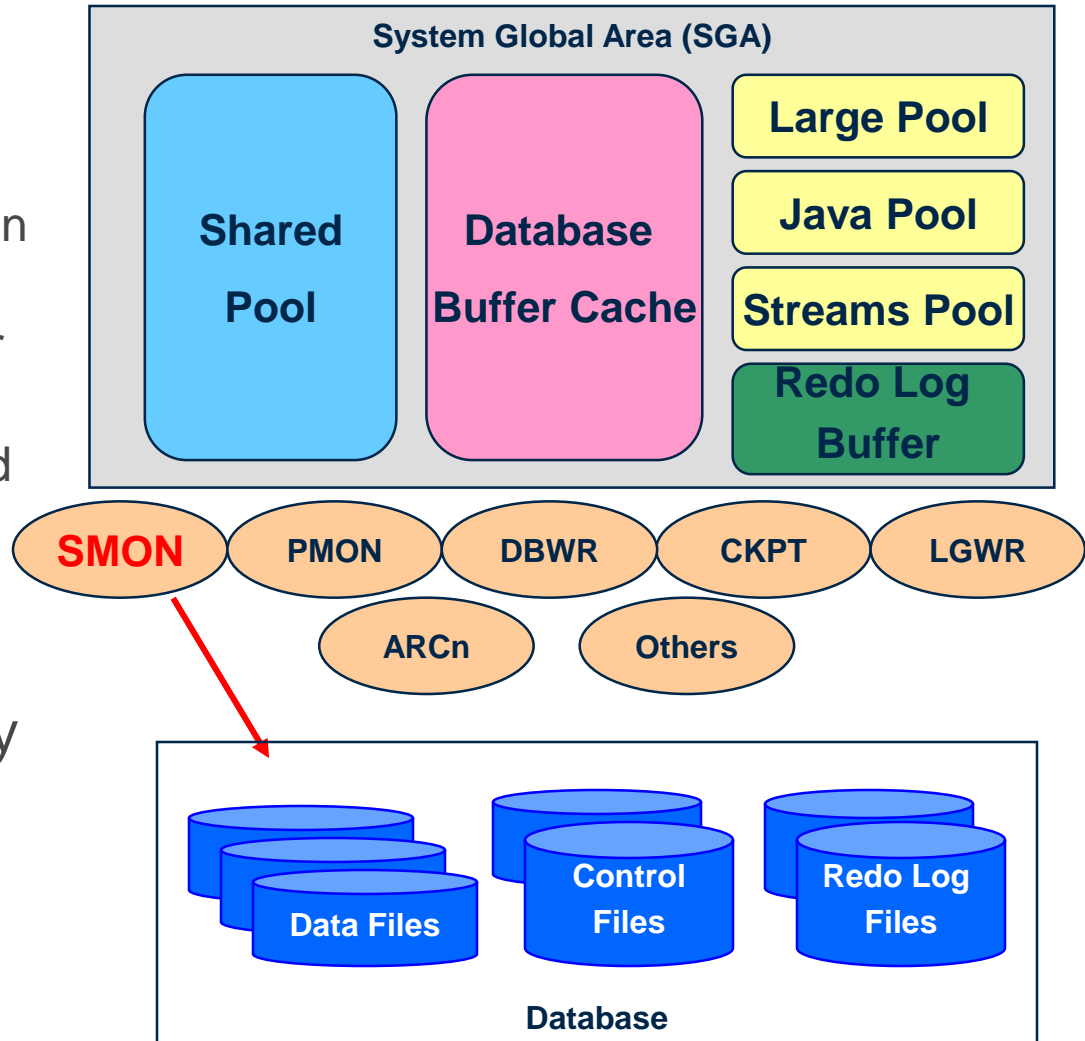
# Log Writer (LGWR)

- Log Writer (LGWR) writes:
  - on Commit
  - when one-third is full
  - when there is 1 MB of redo
  - every 3 seconds
  - before DBWn writes



# System Monitor (SMON)

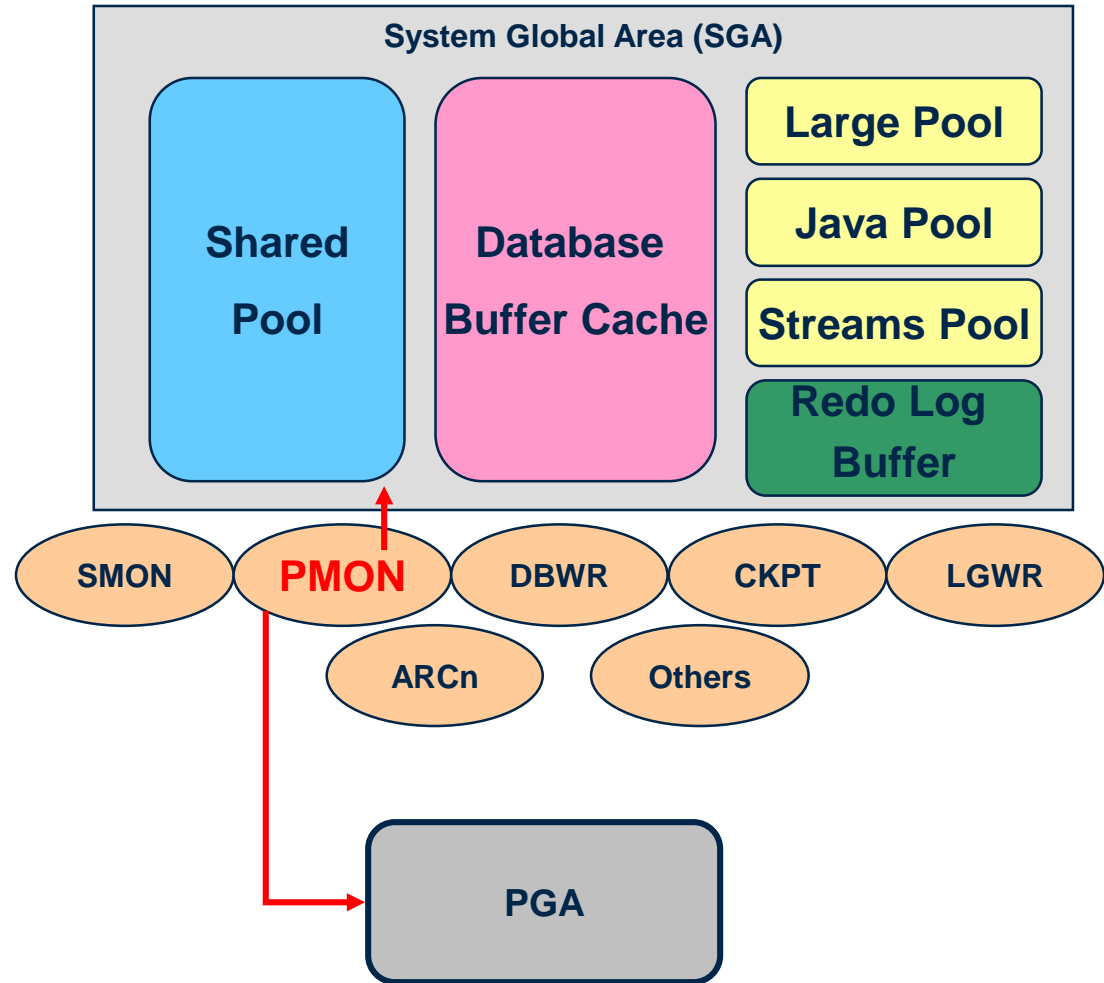
- SMON does instance recovery
  - Rolls forward changes in redo logs
  - Opens the database for user access
  - Rolls back uncommitted transactions
- Every 3 secs coalesces free space
- Deallocates temporary segments





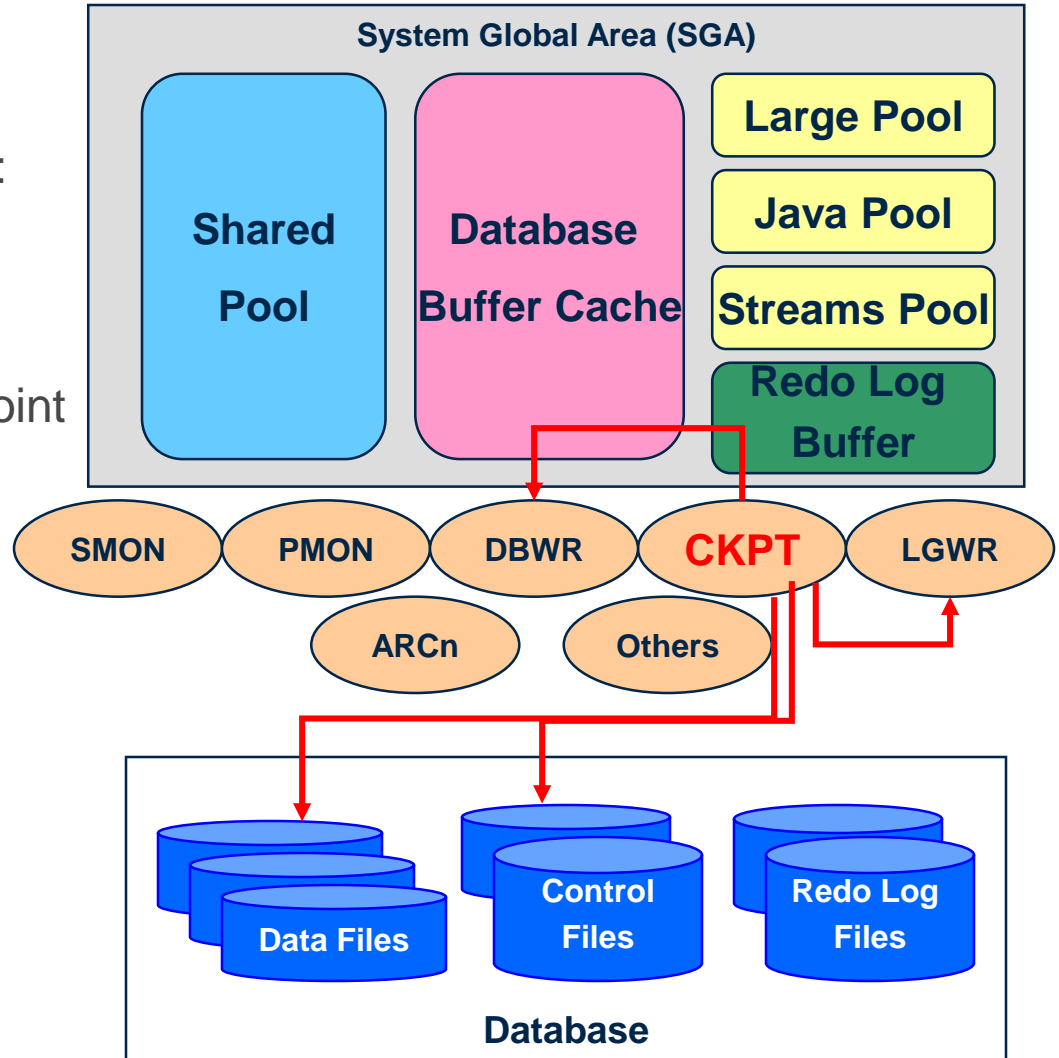
# Process Monitor (PMON)

- Process Monitor (PMON)
  - PMON cleans up after failed processes, by:
    - rolling back the transaction
    - releasing locks
    - releasing other resources



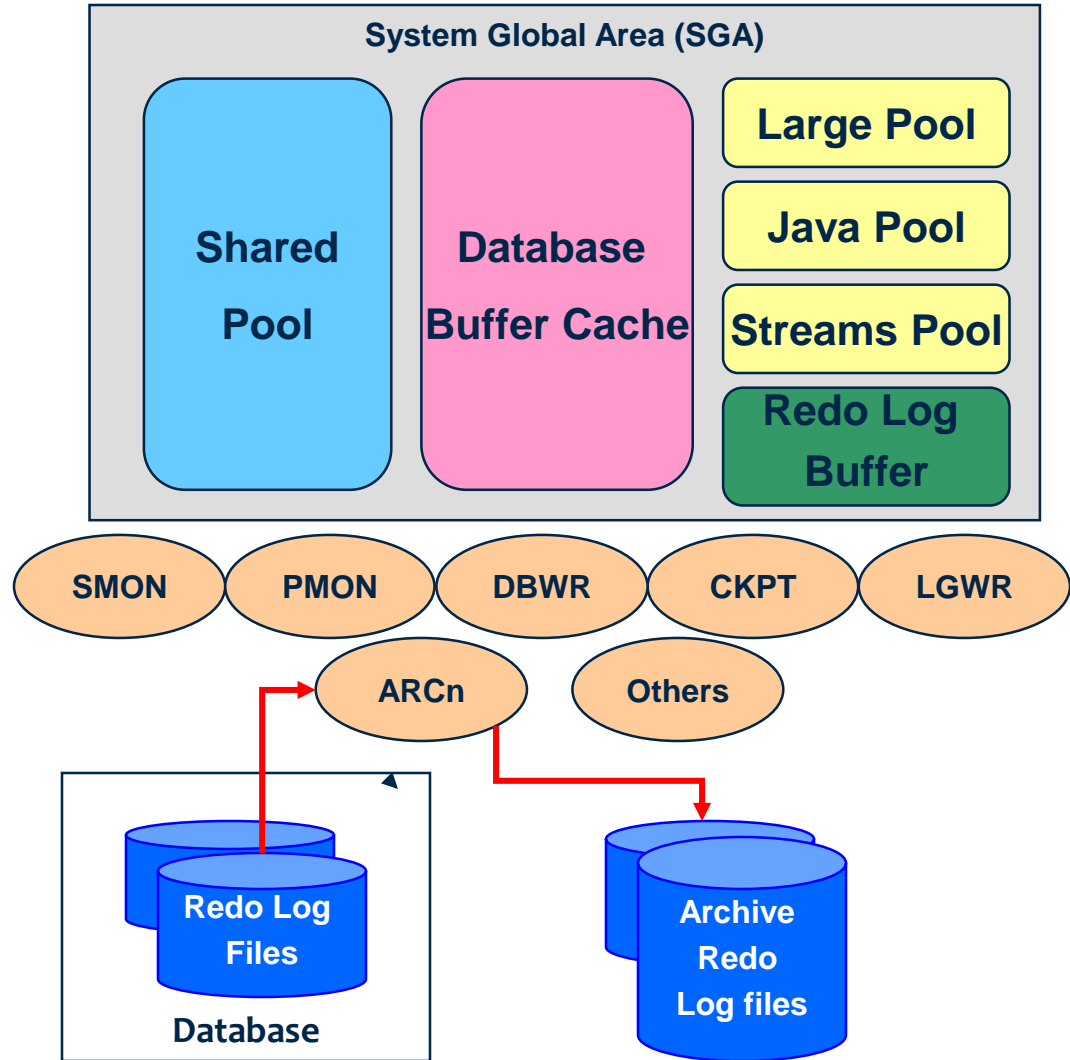
# Checkpoint (CKPT)

- Checkpoint (CKPT):
  - CKPT is responsible for:
    - signaling DBWn at checkpoints
    - updating data-file headers with checkpoint information
    - updating control files with checkpoint information



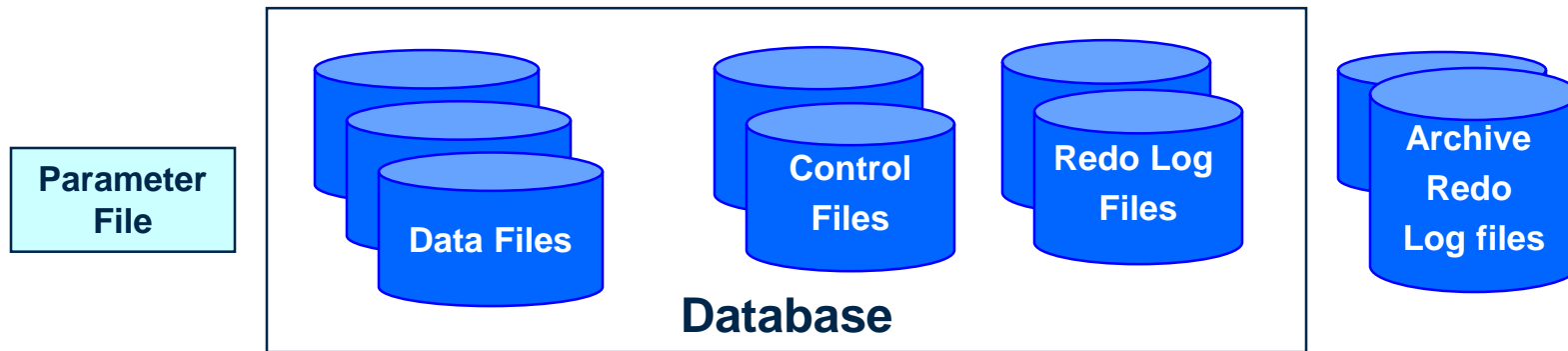
# Archiver (ARCn)

- Archiver (ARCn):
  - It is an optional background process, responsible for:
    - Automatically archiving online redo logs when ARCHIVELOG mode is set
    - Preserving the record of all changes made to the database



# Physical Structure

- An Oracle database:
  - is a collection of data that is treated as a unit.
  - consists of mainly three file types.

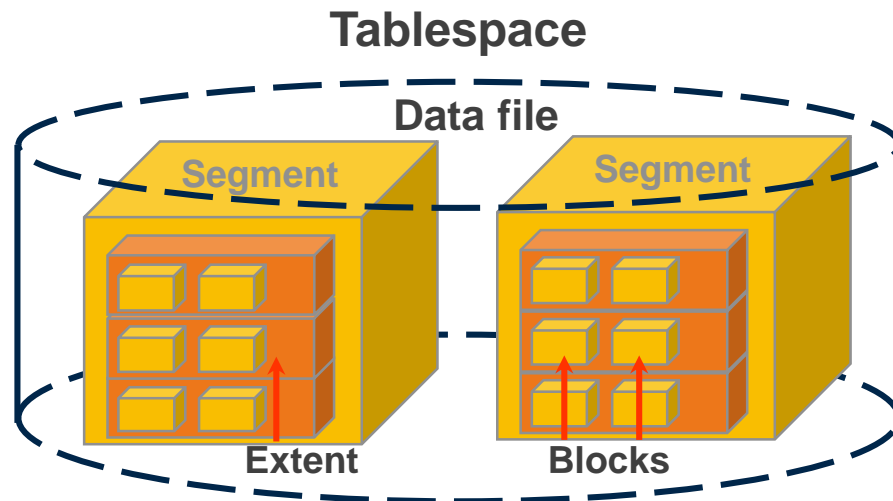


# Physical Structure (Contd...)

- Physical structure:
  - The physical structure of an Oracle database is determined by the Operating System files that provide the actual physical storage for database information, namely:
    - Control files
    - Data files
    - Redo log files

# Logical Structure

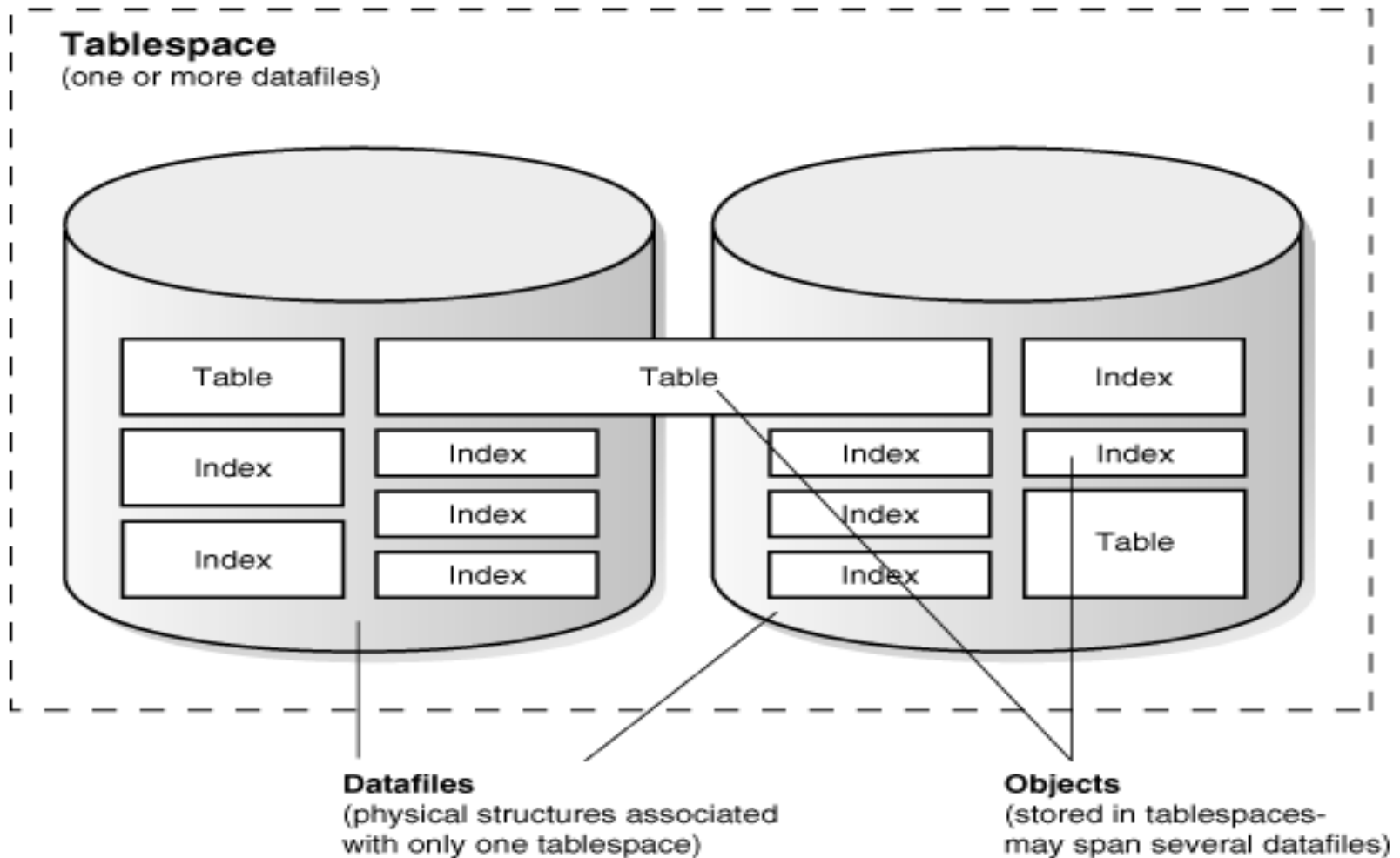
- The “logical structure” of the Oracle architecture dictates how the “physical space” of a database should be used.
  - A hierarchy exists in this structure that consists of tablespaces, segments, extents, and blocks.



# Logical Structure (Contd...)

- Oracle stores data - logically in “tablespaces”, and physically in “datafiles” associated with the corresponding tablespace.
  - An Oracle database consists of one or more logical storage units called tablespaces, which collectively store all the data in the database.
  - Tablespaces are further divided into logical units of storage called “Segments”.
  - “Segments” are further divided into “Extents”.
  - “Extents” are a collection of “contiguous blocks”.

# Relation Between Tablespace & Datafiles



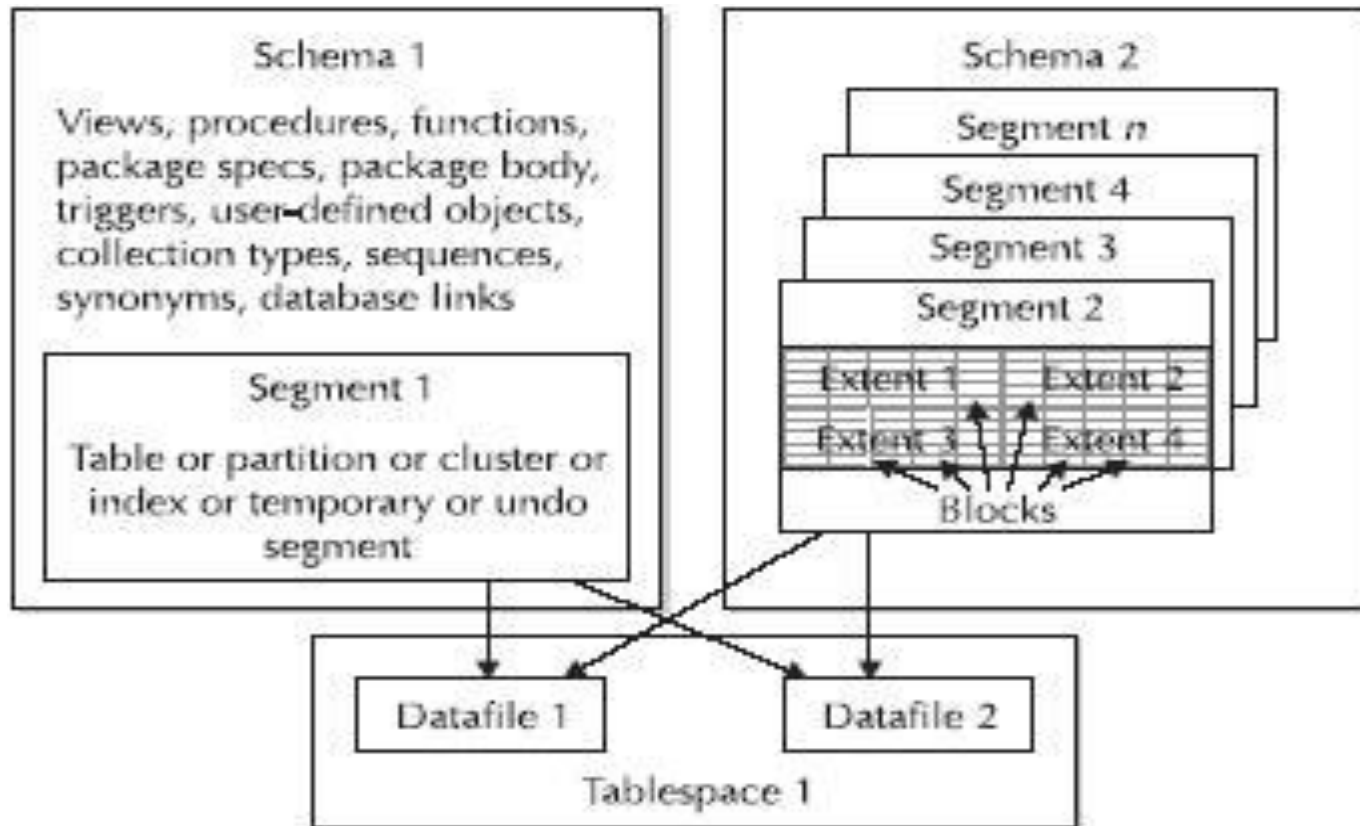


# Schemas

- An Oracle database contains many schemas.
  - A “schema” is a logical structure that contains objects like segments, views, procedures, functions, packages, triggers, user-defined objects, collection types, sequences, synonyms, and database links.
    - A “segment” is a data structure that can be a table, index, or temporary or undo segment.
    - The schema name is the user that controls the schema.
    - **Examples of schemas:** System, Sys, Scott, and SH schemas

# Schemas and Tablespaces

- Relationship between Schemas and Tablespace:



# Schemas and Tablespaces (Contd...)

- However, each partition is itself a “segment”, and each segment can only reside in one “tablespace”.
- “Clustered tables” are another special case where two tables with a close link between them can have their data stored together in a “single block” to improve join operations.
- “Indexes” are optionally built on tables to help improve performance and to help implement “integrity constraints” such as primary keys and uniqueness.

# Schemas and Tablespaces (Contd...)

- “Temporary segments” are used as a temporary storage area by Oracle to run an SQL statement.
  - For example: Temporary segments may be used for sorting data, and then discarded once a query or transaction is complete.
- “Undo Segments” or “Rollback Segments” are used:
  - to manage the before image of changes to allow data to roll back, if required, and
  - to help provide data consistency for users querying data that is being changed.

# RowID

- RowID:

- Oracle has its own way of storing the data.
- To retrieve the data quickly, Oracle assigns each row with a unique ROWID.
  - The ROWID does not change throughout the life of the row.
  - Oracle always retrieves the row using the ROWID.
  - When you create an Index, Oracle stores the key column and the ROWID for that row in the index.
  - ROWID cannot be used for computation and it is HEX value

# Characteristics

- Characteristics of ROWID are:
  - ROWID provides the fastest access to a row.
    - It stores the “disk block address” where the row is stored.
  - The ROWID of a row does not change ever for a row as long as it exists
  - All Oracle applications such as Forms, Reports, PL/SQL use ROWID to access, lock, and update rows.
  - ROWID of a row does not change unless you export and import the table.
  - As a programmer you will always try to use the primary key to access the row. It is not recommended that the programmer explicitly uses the ROWID.

# Types of RowID

- Types of ROWIDs are:
  - Oracle has two different representations of ROWIDS – namely Restricted ROWID and Extended ROWID.
  - **Restricted ROWID:**
    - It uses a binary representation, to store the ROWID (discontinued in Oracle 8i)
    - When ROWID is used in SQLPLUS, it is converted into a varchar2 format and displayed.
    - The format of restricted ROWID is:
      - Block.row.file
      - For example: 00000DD5.00000.0001

# Types of RowID (Contd...)

## ■ Extended ROWID:

- Oracle 8i and above, always uses Extended ROWID for storing rows.
- Extended ROWID uses a 64 bit representation of every row. It has the following format:

– OOOOOOFFFBBBBBBRRR

where:

OOOOOO: Data object number

FFF: Tablespace relative datafile number

BBBBBB: Data block number within that file

RRR: Row in that file

– For example: AAAAaoAATAAABrXAAA



# Types of RowID (Contd...)

- Note:

- The ROWID of a record is the fastest method of record retrieval.
- The performance can be improved by selecting a record before updating or deleting it and including ROWID in the initial selection list.

# Summary

- In this lesson you have learnt about:

- Concept of Database file

- Data files
- Control files
- Online redo logs

- Concept of SGA memory structure:

- Database Buffer cache
- Shared SQL Pool
- Redo Log Buffer



# Review Question

- Question 1: The “Oracle server” consists of an \_\_\_\_ and an \_\_\_\_.
- Question 2: \_\_\_\_ provide the actual physical storage for database information.
- Question 3: A single Oracle9i instance can open multiple databases.
  - True / False



# Review Question

- Question 4: The Background process communicates with the Oracle instance on behalf of the “user process”, which runs on the client.
  - True / False
- Question 5: Redo logs contain a record of changes made to the database.
  - True / False



# Review Question: Match the Following

1. Java Pool

2. Large Pool

3. SGA

4. PGA

a. is allocated when the database instance is started

b. is sized by the  
JAVA\_POOL\_SIZE parameter

c. is allocated when a user process is created

d. is an optional area of memory in the shared global area

