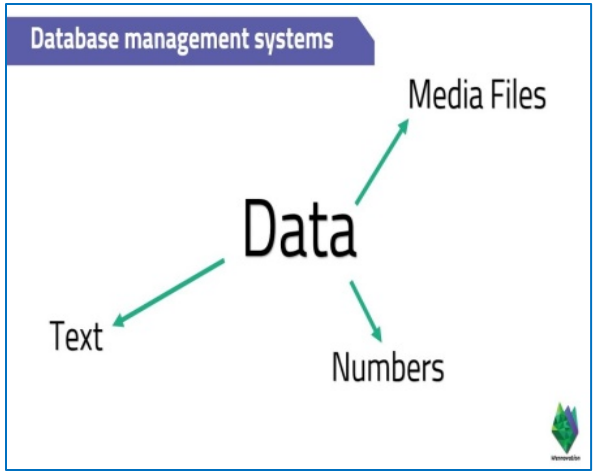
Unit 1: Introduction

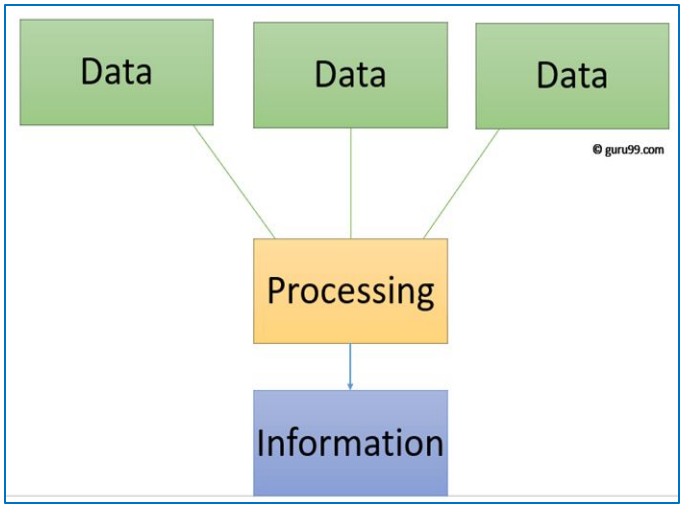
- DBA Roles and Responsibilities;
- Database Architecture; ORACLE logical and physical database structure; Memory and Process Structure,
- SQLPLUS Overview, creating a database;

Data , Information

- In simple words, **data** can be facts related to any object in consideration. For example, your name, age, height, weight, etc. are some data related to you. A picture, image, file, pdf, etc. can also be considered data
  - Example : student ,Ram, CSIT, seventh, Semester



- **Information** is a processed, organized data which gives logical meaning
  - **Ram** is a **student** of **CSIT seventh semester**.



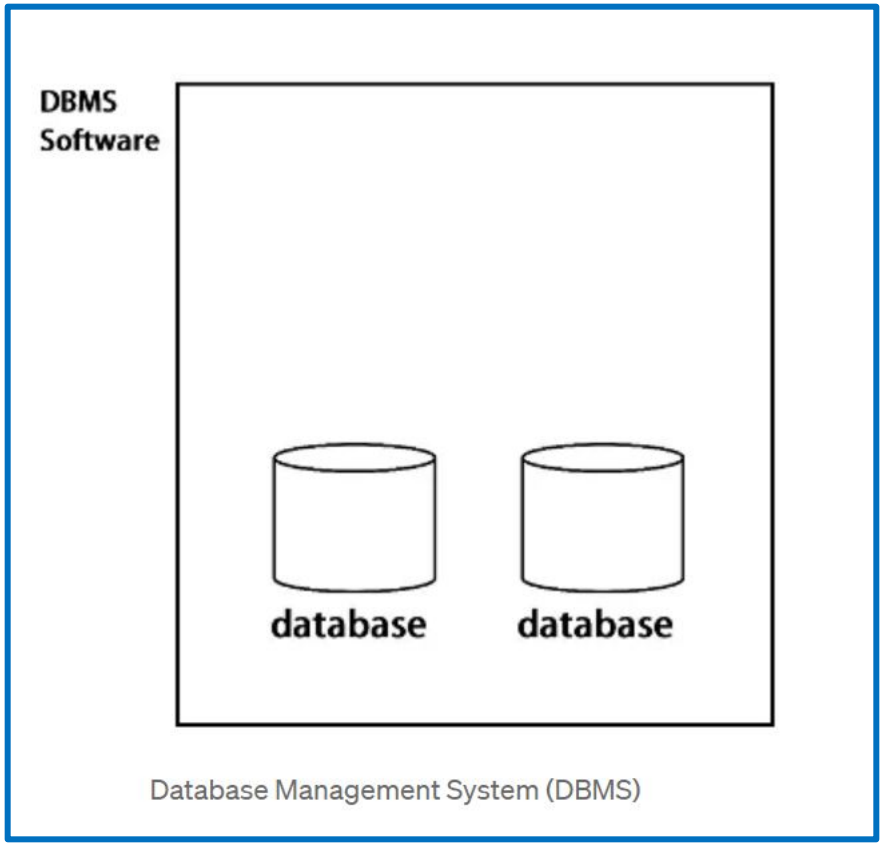
Database

- A database is an organized collection of data, stored and accessed electronically.
- Databases are used to store and manage large amounts of structured and unstructured data, and they can be used to support a wide range of activities, including data storage, data analysis, and data management.
- There are many different types of databases, including relational databases, object-oriented databases, and NoSQL databases, and they can be used in a variety of settings, including business, scientific, and government organizations.
- Examples of databases could be: Database for Educational Institute , a Bank, Library, Ticket Reservation system etc.

Database Management System

- We often mistakenly say our database is *Oracle, MySQL, SQL Server, MongoDB*. But, they aren't databases, they are database management systems (DBMS).
- The DBMS is the software that would be installed on your personal computer or on a server, then you would use it to manage one or more databases.
- The database has your actual data and the rules about that data, while the DBMS is the program that surrounds and manages your actual data, and it enforces the rules you specified on your data. The rules for example could be the type of the data, like integer or string, or the relationship between them.

Database Management System



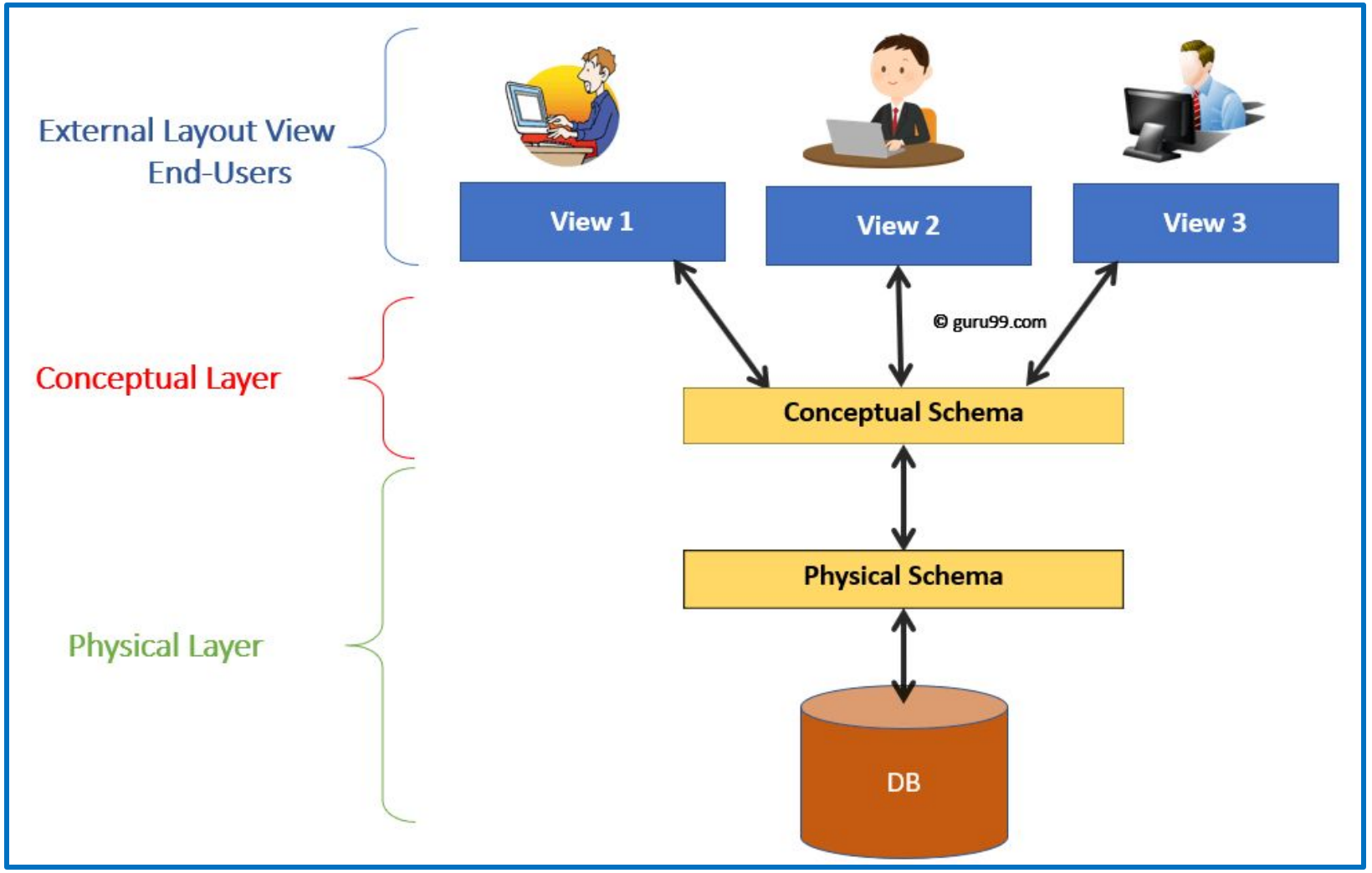
Database Management System

- **DBMS allows users the following tasks:**
  - **Data Definition:** It is used for creation, modification, and removal of definition that defines the organization of data in the database.
  - **Data Modification:** It is used for the insertion, modification, and deletion of the actual data in the database.
  - **Data Retrieval:** It is used to retrieve the data from the database which can be used by applications for various purposes.
  - **User Administration:** It is used for registering and monitoring users, maintain data integrity, enforcing data security, dealing with concurrency control, monitoring performance and recovering information corrupted by unexpected failure.

DBMS Architecture

- A **DBMS Architecture** is a representation of DBMS design.
- It helps to design, develop, implement, and maintain the database management system.
- A DBMS architecture allows dividing the database system into individual components that can be independently modified, changed, replaced, and altered.
- It also helps to understand the components of a database.
- There are following three levels or layers of DBMS architecture:
  - External Level/View Level
  - Conceptual Level
  - Internal Level/Physical

DBMS Architecture



DBMS Architecture

- **External Level / View Level**
  - The user's view of the database.
  - Consists of a number of different external views of the DB.
  - Describes part of the DB for particular group of users.
  - Provides a powerful and flexible security mechanism by hiding parts of the DB from certain users.
  - The user is not aware of the existence of any attributes that are missing from the view.
  - It permits users to access data in a way that is customized to their needs, so that the same data can be seen by different users in different ways, at the same time.

DBMS Architecture

- **Conceptual Level**
- The logical structure of the entire database as seen by DBA.
  - What data is stored in the database.
  - The relationships among the data.
- Complete view of the data requirements of the organization, independent of any storage consideration.
- It Represents:
  - entities, attributes, relations
  - constraints on data
  - semantic information on data
  - security, integrity information
- Supports each external view: any data available to a user must be contained in, or derivable from the conceptual level

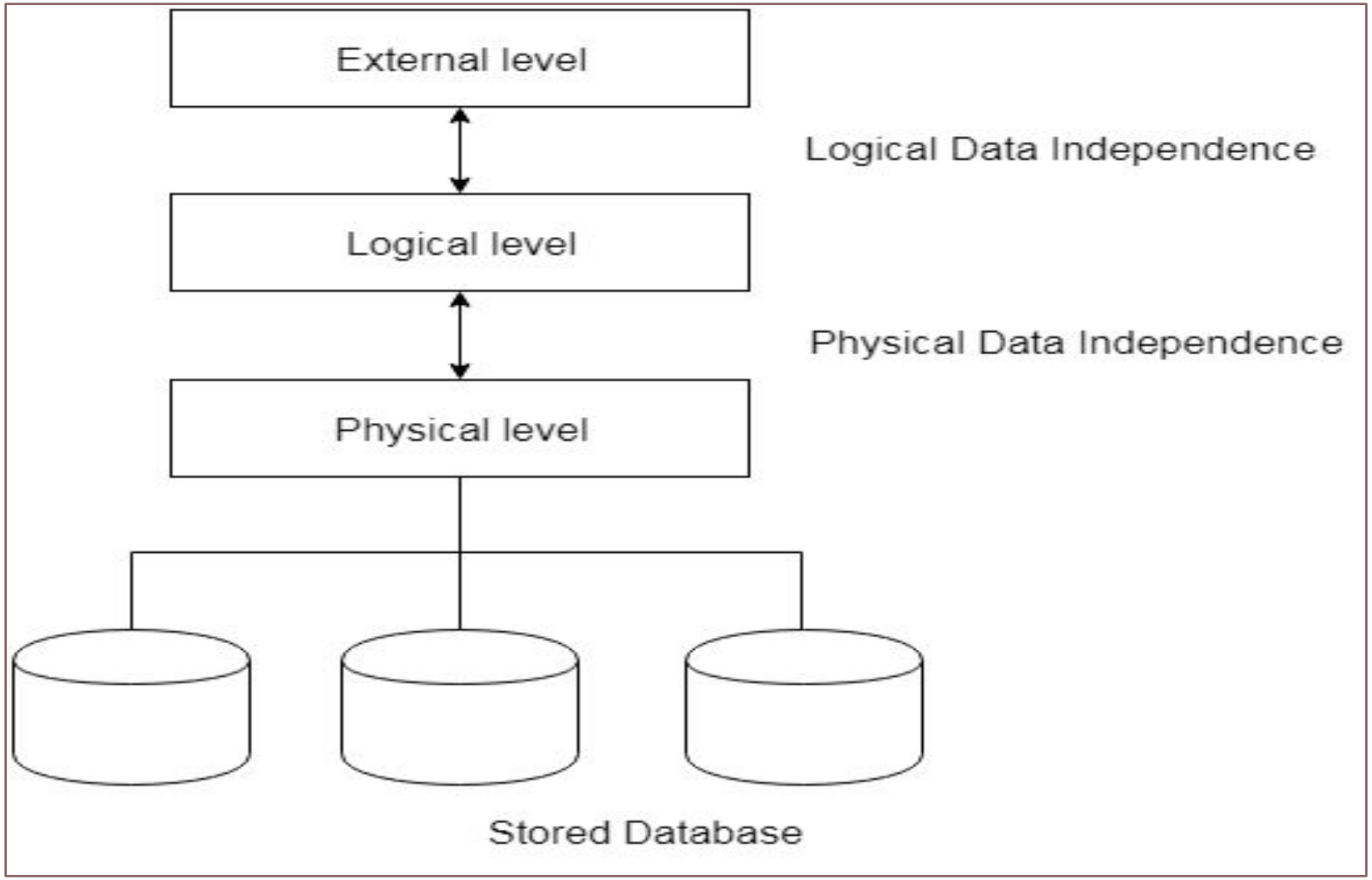
DBMS Architecture

- **Internal Level/ Physical Level**
- Physical representation of the DB on the computer.
- How the data is stored in the database?
- Physical implementation of the DB to achieve optimal runtime performance and storage space utilization.
  - Storage space allocation for data and indexes
  - Record description for storage
  - Record placement
  - Data compression, encryption
  - Managed by the OS under the direction of the DBMS

Data Independence

- The ability to modify a scheme definition in one level without affecting a scheme definition in a next higher level is called data independence.
- There are two kinds of data independence:
  - Logical data independence
  - Physical data independence

Data Independence



Data Independence

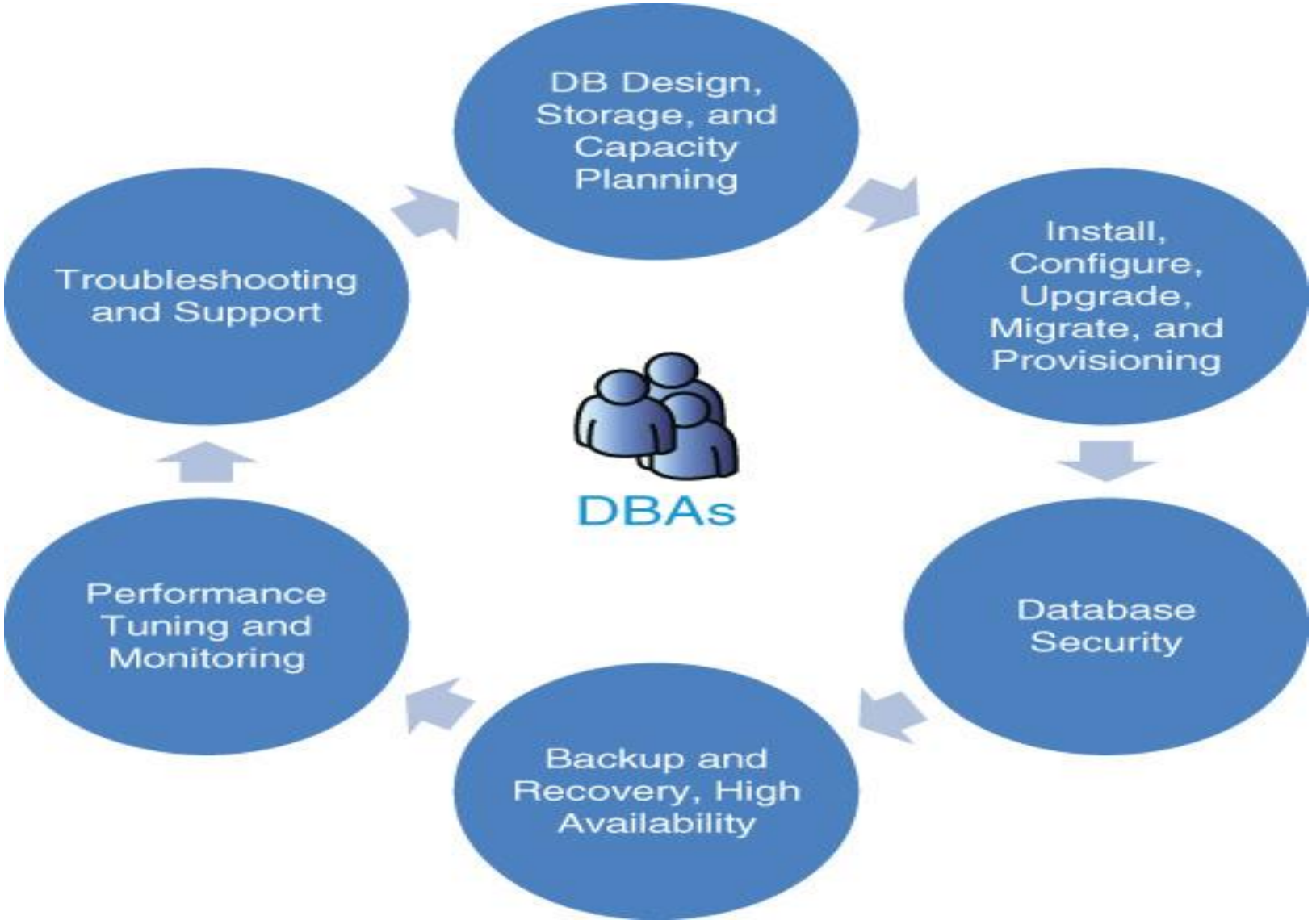
- **Logical data independence**
  - The ability to modify the conceptual schema without causing application programs to be rewritten.
  - The change would be absorbed by the mapping between the external and conceptual levels.
  - Usually done when logical structure of database is altered.
- **Physical data independence**
  - The ability to modify the internal scheme without having to change the conceptual or external schemas.
  - Modifications at this level are usually to improve performance.

WHAT IS DATABASE ADMINISTRATOR ?

A database administrator is a person responsible for the

- installation
- configuration
- upgradation
- administration
- monitoring and maintenance of databases.

DBA Roles and Responsibilities



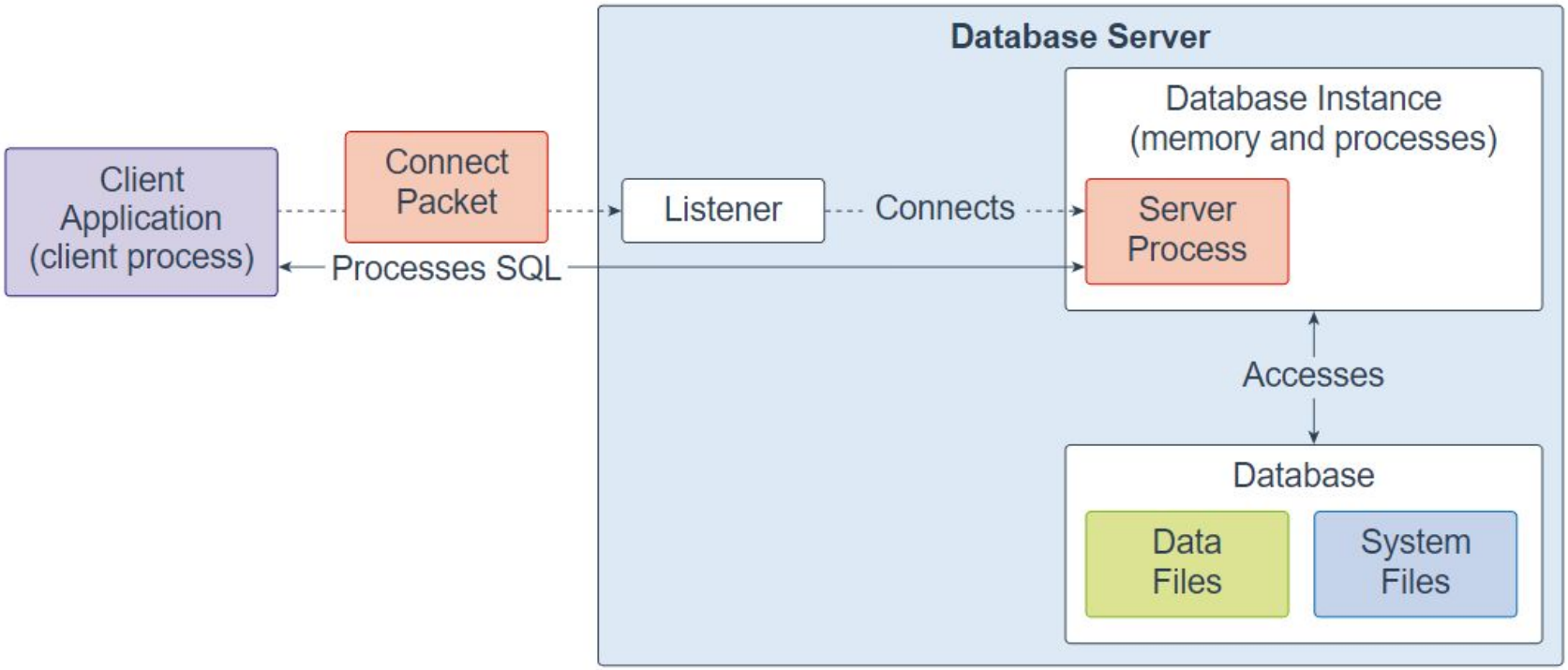
DBA Roles and Responsibilities

- Database installation, upgrade and patching
- Install and configure relevant network components
- Ensure database access, consistency and integrity
- Resolving issues related to performance bottlenecks
- Provide reporting on various metrics including availability, usage and performance
- Performance testing and benchmark activities
- Work with development staff on architectures, coding standards, and quality assurance policies
- Create models for new database development or changes to existing ones
- Respond to and resolve database access and performance issues
- Monitor database system details

DBA Roles and Responsibilities

- Design and implement redundant systems, policies, and procedures for disaster recovery
- Monitor, optimize and allocate physical data storage for database systems
- Plan and coordinate data migrations
- Develop, implement, and maintain change control and testing processes
- Perform database transaction and security audits
- Establish end-user database access control levels
- Implement database encryption and data encryption
- Plan and ensure compliance with established best practices, related policies and legislation
- Participate as a member of a team to move the team toward the completion of its goals

Oracle Database server architecture



Oracle Database Architecture

- There are three major structures in Oracle Database server architecture: memory structures, process structures, and storage structures. A basic Oracle database system consists of an Oracle database and a database instance.
- The database consists of both physical structures and logical structures. Because the physical and logical structures are separate, the physical storage of data can be managed without affecting access to logical storage structures.

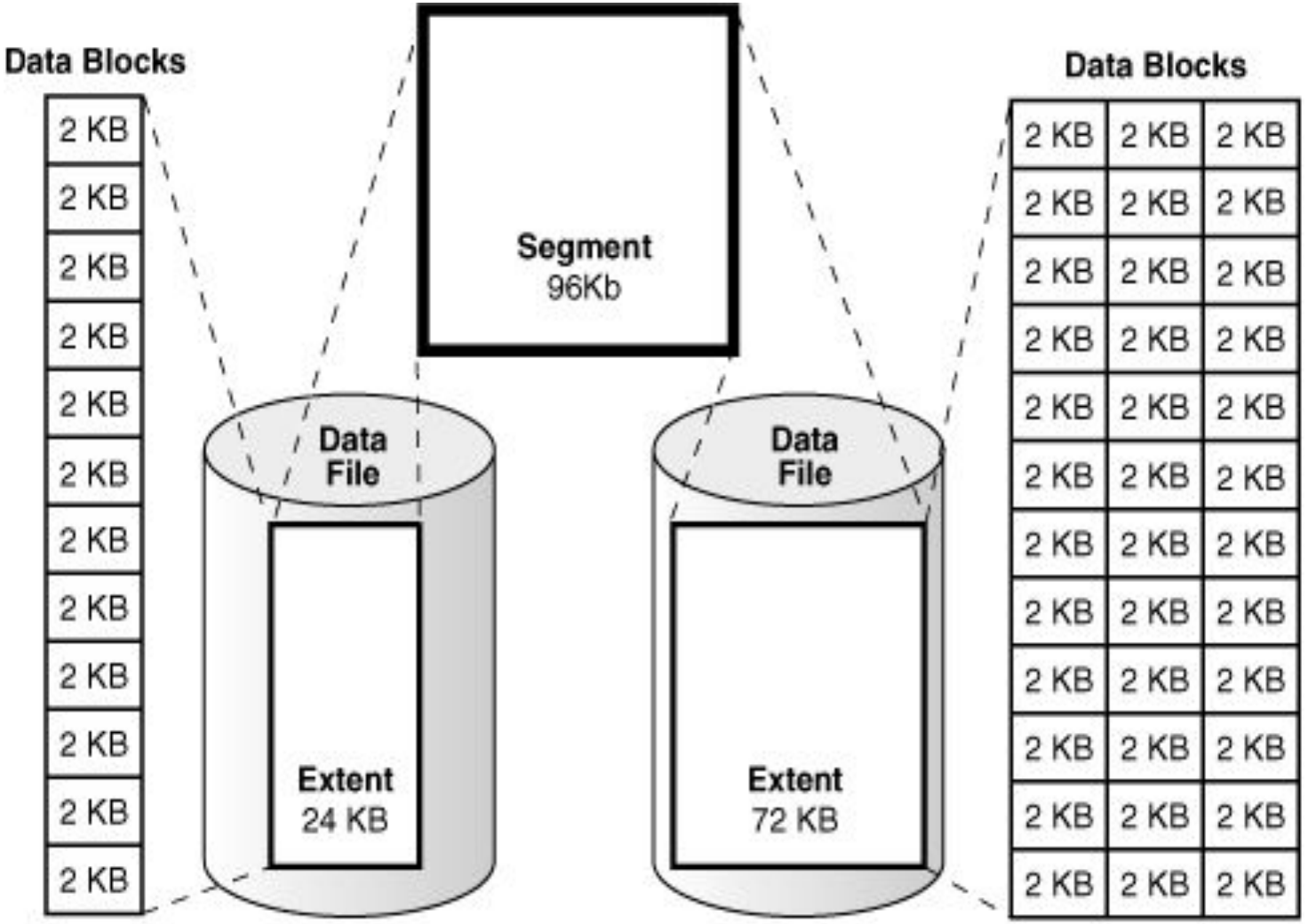
Physical storage structures

- The physical storage structures are simply files that store data. When you execute a CREATE DATABASE statement to create a new database, Oracle creates the following files:
- **Data files**: data files contain real data, e.g., sales order and customer data. The data of logical database structures such as tables and indexes are physically stored in the data files.
- **Control files**: every database has a control file that contains metadata. The metadata describes the physical structure of the database including the database name and the locations of data files.
- **Online redo log files:** every database has an online redo log that consists of two or more online redo log files. An online redo log is made up of redo entries that record all changes made to the data.
- Besides these files, an Oracle database includes other important files such as **parameter files, network files, backup files, and archived redo log files for backup and recovery.**

Logical Storage Structures

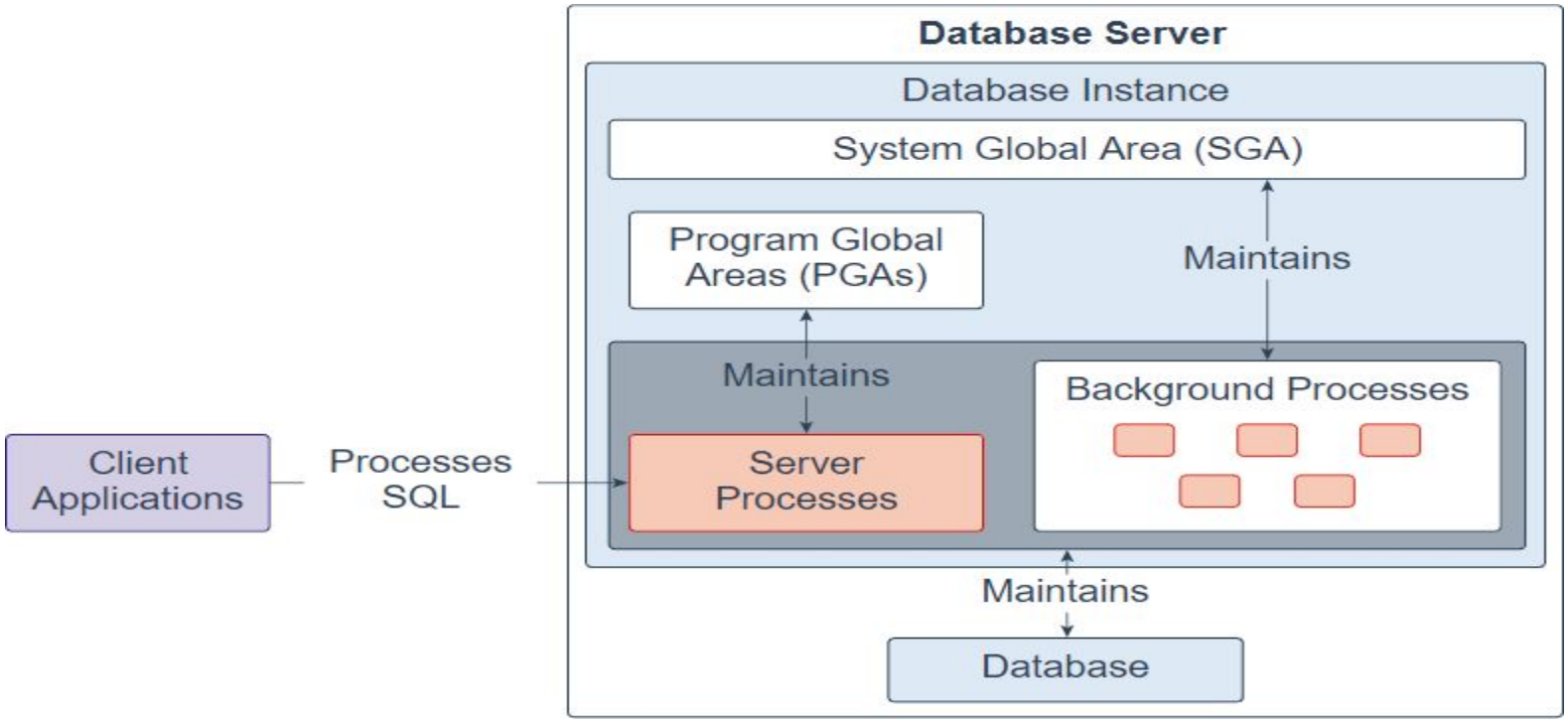
- Oracle Database uses a logical storage structure for fine-grained control of disk space usage. The following are logical storage structures in an Oracle Database:
- **Data blocks**: a data block corresponds to a number of bytes on the disk. Oracle stores data in data blocks. Data blocks are also referred to as logical blocks, Oracle blocks or pages.
- **Extents**: An extent is a specific number of logically contiguous data blocks used to store the particular type of information.
- **Segments**: a segment is a set of extents allocated for storing database objects, e.g., a table or an index.
- **Tablespaces**: a database is divided into logical storage units called tablespaces. A tablespace is a logical container for a segment. Each tablespace consists of at least one data file.

The following picture illustrates segments, extents and data blocks within a tablespace:



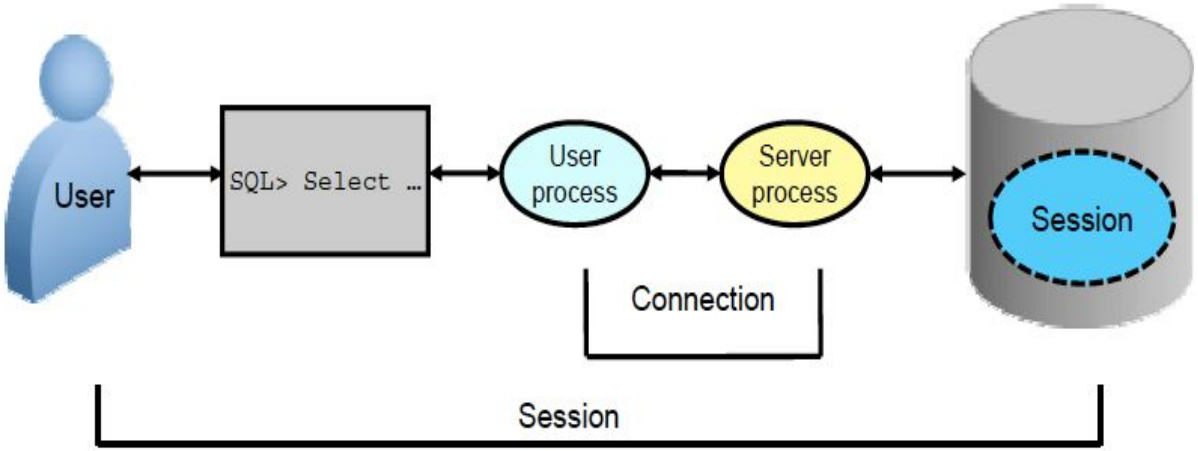
Database Instance

- A Database Instance is an interface between client applications (users) and the database. An Oracle instance consists of three main parts: System Global Area (SGA), Program Global Area (PGA), and background processes.



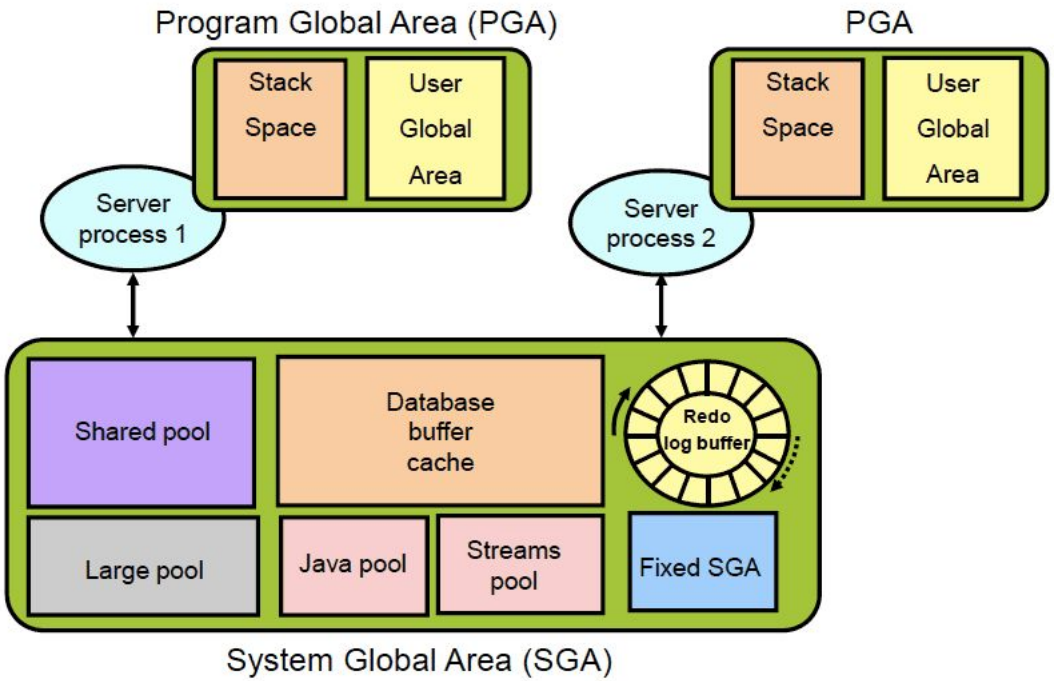
Connecting to the Database Instance

- A **connection** is a communication pathway between a user process and an Oracle Database instance.
- A **session** represents the state of a current user login to the database instance.



Oracle Database Memory Structures

- Oracle Database creates and uses memory structures for various purposes. For example, memory stores program code being run, data that is shared among users, and private data areas for each connected user.



Oracle Database Memory Structures

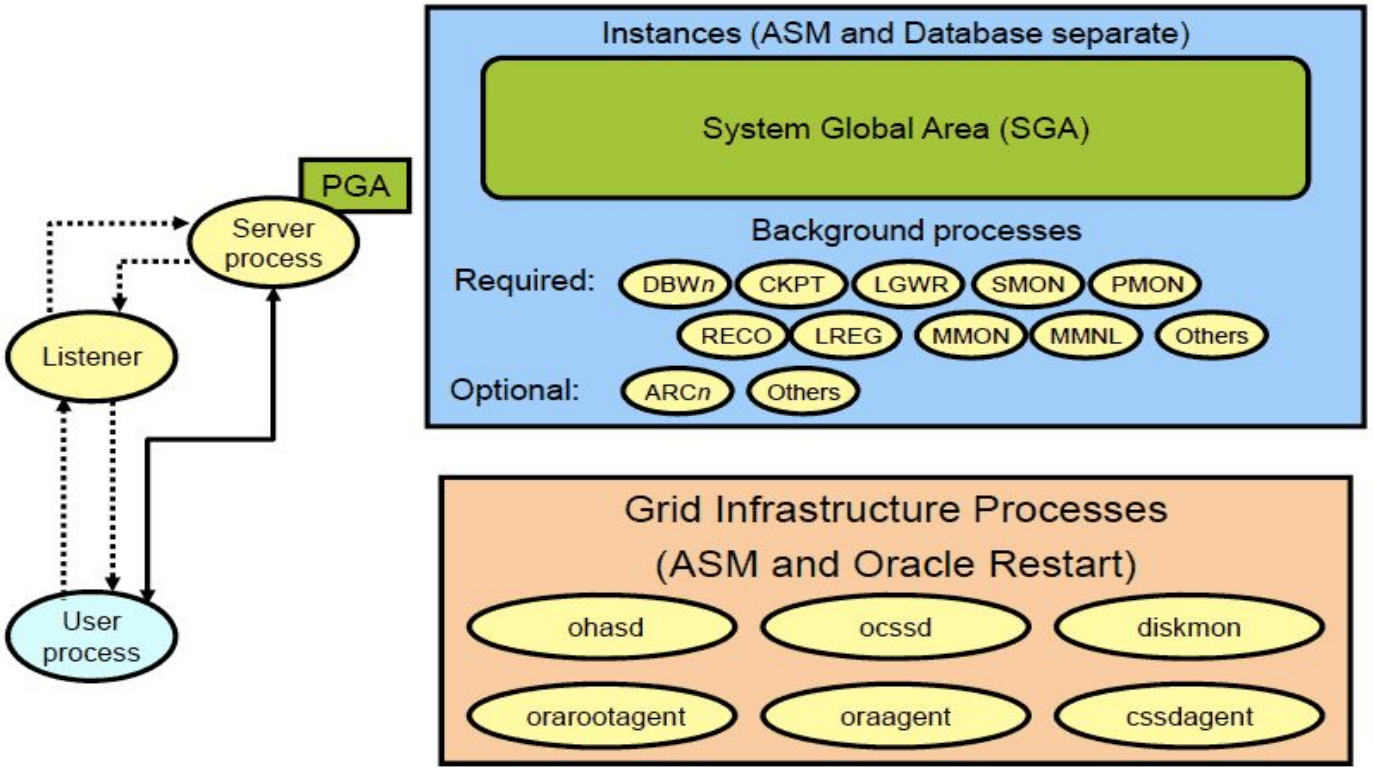
- **System Global Area (SGA)**: Group of shared memory structures, known as SGA components, that contain data and control information for one Oracle Database instance. The SGA is shared by all server and background processes. Examples of data stored in the SGA include cached data blocks and shared SQL areas.
- **Program Global Areas (PGA)**: Memory regions that contain data and control information for a server or background process. A PGA is nonshared memory created by Oracle Database when a server or background process is started. Access to the PGA is exclusive to the server process. Each server process and background process has its own PGA.

- The SGA is the memory area that contains data and control information for the instance. The SGA includes the following data structures:
  - **Shared pool**: Caches various constructs that can be shared among users
  - **Database buffer cache**: Caches blocks of data retrieved from the database
  - **Redo log buffer**: Caches redo information (used for instance recovery) until it can be written to the physical redo log files stored on the disk
  - **Large pool**: Optional area that provides large memory allocations for certain large processes, such as Oracle backup and recovery operations, and I/O server processes
  - **Java pool**: Used for all session-specific Java code and data in the Java Virtual Machine (JVM)
  - **Streams pool**: Used by Oracle Streams to store information required by capture and apply
  - **Fixed SGA**: An internal housekeeping area containing general information about the state of the database and the instance, and information communicated between processes When you start the instance, the amount of memory allocated for the SGA is displayed.

Process Architecture

- The processes in an Oracle Database system can be divided into three major groups:
  - **User processes** that run the application or Oracle tool code
  - **Oracle Database processes** that run the Oracle Database server code (including server processes and background processes)
  - **Oracle daemons and application processes** not specific to a single database

Process Structures



Server Processes

- Oracle Database creates server processes to handle the requests of user processes connected to the instance. The user process represents the application or tool that connects to the Oracle database. It may be on the same machine as the Oracle database, or it may exist on a remote client and use a network to reach the Oracle database. The user process first communicates with a listener process that creates a server process in a dedicated environment.
- Server processes created on behalf of each user's application can perform one or more of the following:
  - Parse and run SQL statements issued through the application.
  - Read necessary data blocks from data files on disk into the shared database buffers of the SGA (if the blocks are not already present in the SGA).
  - Return results in such a way that the application can process the information.

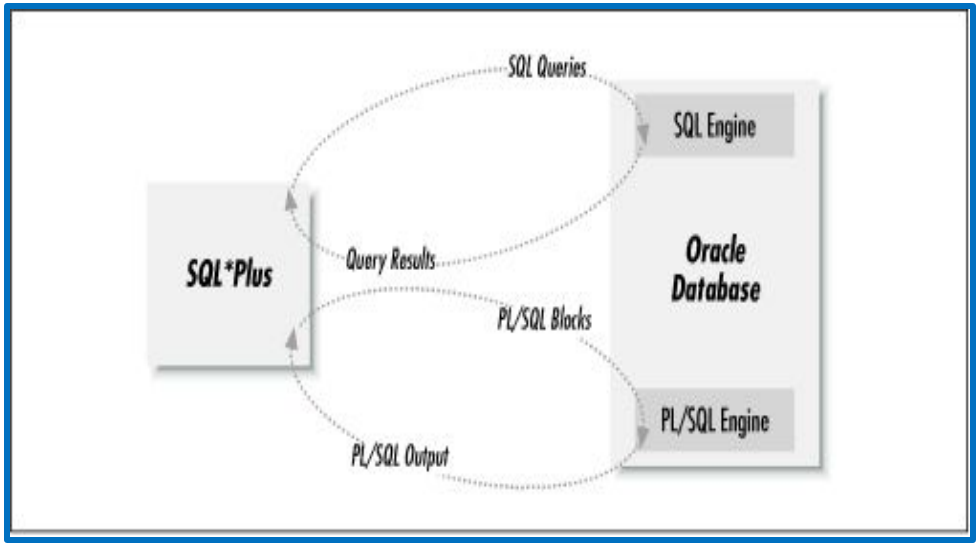
Background Processes

- To maximize performance and accommodate many users, a multiprocess Oracle Database system uses some additional Oracle Database processes called background processes. An Oracle Database instance can have many background processes.
- The background processes commonly seen in non-RAC, non-ASM environments can include the following:
  - Database Writer process (DBWn)
  - Log Writer process (LGWR)
  - Checkpoint process (CKPT)
  - System monitor process (SMON)
  - Process monitor process (PMON)
  - Recoverer process (RECO)
  - Listener registration process (LREG)
  - Manageability monitor process (MMON)
  - Manageability monitor lite process (MMNL)
  - Job queue coordinator (CJQ0)
  - Job slave processes (Jnnn)
  - Archiver processes (ARCn)
  - Queue monitor processes (QMNn)
  - The process spawner process (PSP0)

- Oracle Grid Infrastructure processes on Linux and UNIX systems include the following:
  - **ohasd (Oracle High Availability Service daemon)**: Is responsible for starting Oracle Clusterware processes
  - **ocssd**: Cluster Synchronization Service daemon
  - **diskmon (Disk Monitor daemon)**: Is responsible for input and output fencing for Oracle Exadata Storage
  - **cssdagent**: Starts, stops, and check the status of the CSS daemon, ocssd
  - **oraagent**: Extends clusterware to support Oracle-specific requirements and complex resources
  - **orarootagent**: Is a specialized Oracle agent process that helps manage resources owned by root, such as the network.

SQLPLUS Overview

- SQL*Plus is an Oracle-developed tool that allows you to interactively enter and execute SQL commands and PL/SQL code and send it to the server to be executed.
- SQL*Plus is one of the most common front end used to develop and create stored PL/SQL functions and procedures.
- SQL * Plus is command line tool.



SQLPLUS Overview

- If you are in windows environment and your database server somewhere on the network, so the following things is happen:
  - SQL*plus is transfer the your sql query over the network on the database server.
  - SQL*Plus is wait for the reply from the database server.
  - The database server execute the query and transmit result to the SQL * plus.
  - Then SQL *Plus display the query result on computer screen.
- If you are not running in a networked windows environment, the same thing is happen. only difference might be that the database server and SQL * Plus is running on same physical machine.

SQLPLUS : Techniques to make the output more readable

- In Oracle SQLPlus, you can produce more readable and formatted output for query results by using various SQLPlus commands and settings. Here are some techniques to make the output more readable:
- **Column Formatting:** Use the SQL*Plus COLUMN command to format the display of specific columns.
- For example:
  COLUMN column_name FORMAT A20 -- Set the format of a column to display up to 20 characters.
- COLUMN date_column FORMAT DATE -- Set the format for date columns.

SQLPLUS : Techniques to make the output more readable

- **Page Size and Line Size:** Adjust the page size and line size using the SET PAGESIZE and SET LINESIZE commands to control how many rows and characters are displayed per page.
  - SET PAGESIZE 50 -- Set the number of lines per page.
  - SET LINESIZE 100 -- Set the number of characters per line.
- **Column Headings:** Change column headings to make them more descriptive using the COLUMN command:
  - COLUMN employee_id HEADING 'Employee ID'
- **Truncating Long Values:**To prevent long values from wrapping to the next line, you can use the SET WRAP OFF command:
  - SET WRAP OFF

SQLPLUS : Techniques to make the output more readable

- Column Formatting with SQL Functions:You can use SQL functions like TO_CHAR to format date and numeric columns in a more human-readable way within your SQL query:
  - SELECT employee_id, TO_CHAR(hire_date, 'DD-MON-YYYY') AS hire_date FROM employees;
- Spooling Output: You can use the SPOOL command to save query results to a file for more detailed analysis. This can be useful for larger datasets.
  - SPOOL output.txt
  - SELECT * FROM your_table;
  - SPOOL OFF

SQLPLUS : Techniques to make the output more readable

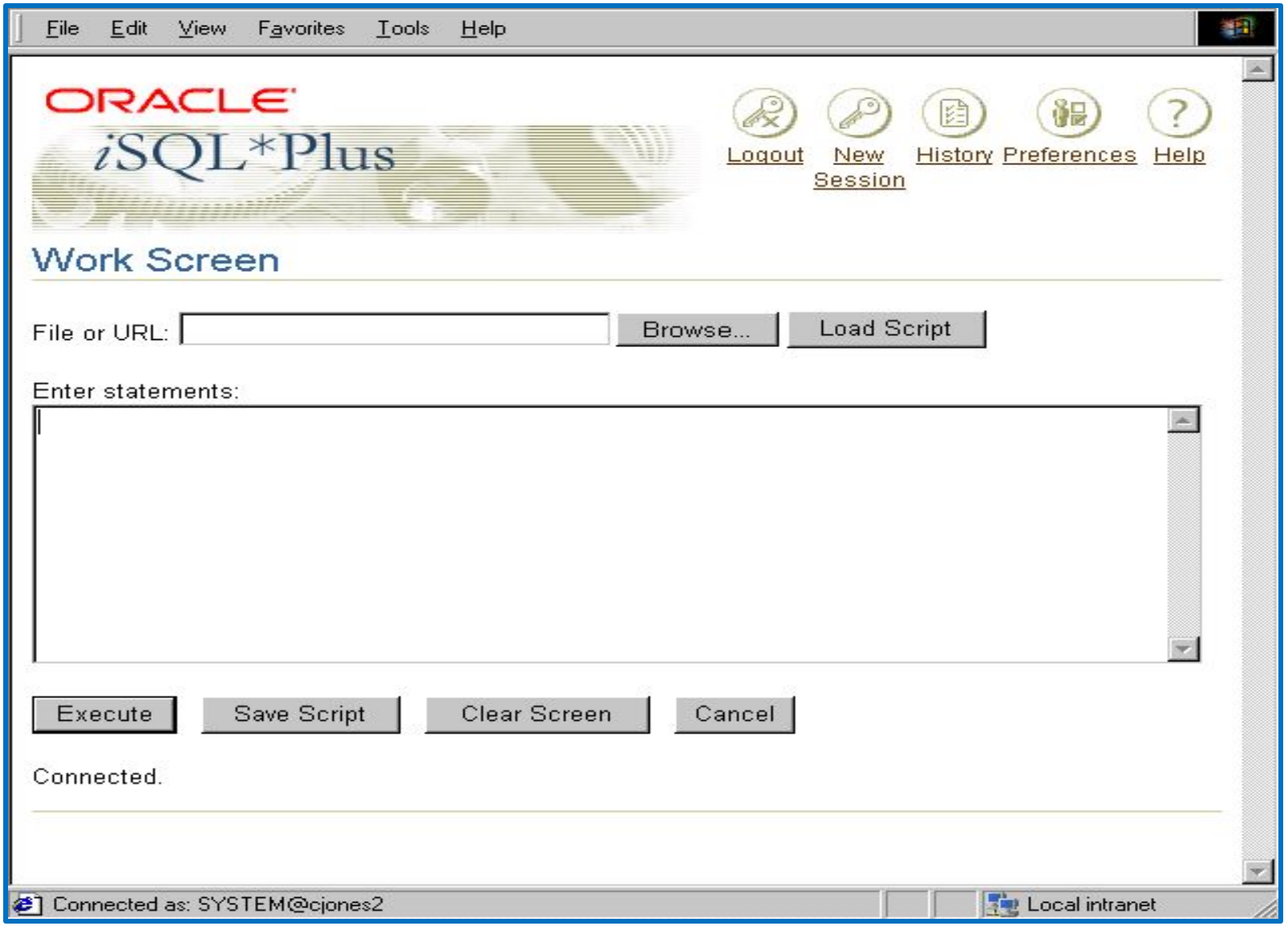
- Set Feedback and Heading: Use the SET FEEDBACK command to control the display of the "n rows selected" message, and use SET HEADING to control the column headings.
  - SET FEEDBACK OFF -- Turn off the "n rows selected" message.
  - SET HEADING ON -- Turn column headings on.
- SQL*Plus Page Titles:You can set a title for your query results using the TTITLE or BTITLE commands. This can provide context for the output.
  - TTITLE 'Employee Report’

SQLPLUS : Techniques to make the output more readable

- SQL*Plus Command-Line Options: When starting SQL*Plus from the command line, you can use options like -s for silent mode, which suppresses column headings and page titles. This can be useful for scripting.
  - sqlplus -s username/password@database
- SQL*Plus Format Commands: SQL*Plus provides various formatting commands like TTITLE, BTITLE, and BREAK that allow you to control the appearance of output.
- By using these SQL*Plus commands and settings, you can format and customize the output of your SQL queries to make it more readable and user-friendly for reporting and analysis purposes.

What is *i*SQL*Plus?

- *i*SQL*Plus is a browser-based interface to SQL*Plus. *i*SQL*Plus is a component of the SQL*Plus product.
- *i*SQL*Plus enables you to use a web browser to connect to Oracle9i and perform the same actions as you would through the command line version of SQL*Plus (known as *SQL*Plus* in this guide). You can use *i*SQL*Plus to write SQL*Plus, SQL and PL/SQL commands to:
  - Enter, edit, run and save SQL commands and PL/SQL blocks.
  - Calculate, and print query results.
  - List column definitions for any table.
  - Access and copy data between databases.
  - Perform database administration.


File Edit View Favorites Tools Help
ORACLE
iSQL*Plus
Logout
New Session
History
Preferences
Help
Work Screen
File or URL:
Browse...
Load Script
Enter statements:
Execute
Save Script
Clear Screen
Cancel
Connected.
Connected as: SYSTEM@cjones2
Local intranet

Creating a Database

- **Creating a Database with DBCA**
  - Database Configuration Assistant (DBCA) is the preferred way to create a database, because it is a more automated approach, and your database is ready to use when DBCA completes.
  - DBCA can be launched by the Oracle Universal Installer (OUI), depending upon the type of install that you select. You can also launch DBCA as a standalone tool at any time after Oracle Database installation.

- The Database Configuration Assistant (DBCA) Creation Mode window enables you to create a database with default configuration or to use Advanced Mode to create a database.
- If you choose **Advanced Mode**, you can customize storage locations, initialization parameters, management options, database options, and different passwords for Administrator user accounts.
- If you choose **Create a database with default configuration**, you make fewer choices in the options for your database, which allows you to create your database sooner.
- When you select **Create a database with default configuration**, you can select the following options:
  - **Global Database Name**: Enter the database name in the form *database_name.domain_name*.

- **Storage Type**: Choose either **File System** or **Automatic Storage Management**.
- When you choose **File System**, your database files are managed by the file system of your operating system.
- When you choose **Automatic Storage Management**, you place your data files in Oracle Automatic Storage Management (Oracle ASM) disk groups.
- **Database Files Location**: The choice you make for the **Storage Type** option determines what you specify for the **Database Files Location** option.
- When you choose **File System** in the **Storage Type** field, you specify the directory path where the database files are to be stored in the **Database Files Location** field. Oracle Database can create and manage the actual files.

- When you choose **Automatic Storage Management** in the **Storage Type** field, you specify the disk group to use in the **Database Files Location** field (the disk group must already exist). With Oracle ASM, Oracle Database automatically manages database file placement and naming.
- **Fast Recovery Area**: Specify a backup and recovery area.
- **Database Character Set**: Choose the character set to use for the database. See "Character Sets" for more information about character sets.
- **Administrative Password**: Enter the password to use for the database administrative passwords (such as the SYS and SYSTEM accounts).

- **User "Oracle Home User" Password** *(on Microsoft Windows operating systems only)*: If during the installation you specified a non-administrator, low privileged Windows User Account (as Oracle Home User) to run the database services under, you are prompted for the password of that user account.
- **Create as Container Database**: Enable this option to create the database as a multitenant container database (CDB) that can support zero, one, or many user-created pluggable databases (PDBs).
- If you want DBCA to create a PDB when it creates the CDB, specify the PDB name in the **Pluggable Database Name** field.