❖ Contents:

Data: data can be anything for Example person data, company data, student data (name, id, age).

OR

"Data is unprocessed information".

Data must be processed in proper way to generate useful and meaningful information.

Information: "Processed data is known as information."

1. Overview of DBMS and RDBMS.

DBMS:

- Database Management System. A database management system (DBMS) is system software for creating and managing data database. A DBMS makes it possible for end users to create, protect, read, update and delete data in database.
- These programs enable users to access and modify database.
- It basically controls the storage management and fetching of data from database.
- A DBMS includes four main components, which are:
  1) Modeling Language.
  2) Data Structures.
  3) DB Query Language and Report Writer.
  4) Transaction Mechanism.

RDBMS:

- RDBMS is relational database management system. Basically, we can say that RDBMS is an extension of DBMS systems.
- Database Management System (DBMS) is a software that is used to define, create and maintain a database and provides controlled access to the data.
- Relational Database Management System (RDBMS) is an advanced version of DBMS.

DBMS	RDBMS
DBMS stores data as file.	RDBMS stores data in tabular form.
Data elements need to access individually.	Multiple data elements can be accessed at the same time.
No relationship between data.	Data is stored in the form of tables which are related to each other
Normalization is not present.	Normalization is present.
It deals with small quantity of data.	It deals with large amount of data.
It supports single user.	It supports multiple users.
The data in a DBMS is subject to low security levels with regards to data Manipulation.	There exists multiple levels of data security in a RDBMS.
Examples: XML, Microsoft Access, etc.	Examples: MySQL, PostgreSQL, SQL Server, Oracle, etc.

- Three schema Architecture:

The three schema architecture is also called ANSI/SPARC architecture or three-level Architecture.

The three schema (diagrammatical presentation) architecture is also called ANSI/SPARC architecture or three-level architecture.

This framework is used to describe the structure of a specific database system.

The three schema architecture is also used to separate the user applications and physical database.

The three schema architecture contains three-levels. It breaks the database down into three different categories.

1) Internal Level.
2) Conceptual Level.
3) External Level.

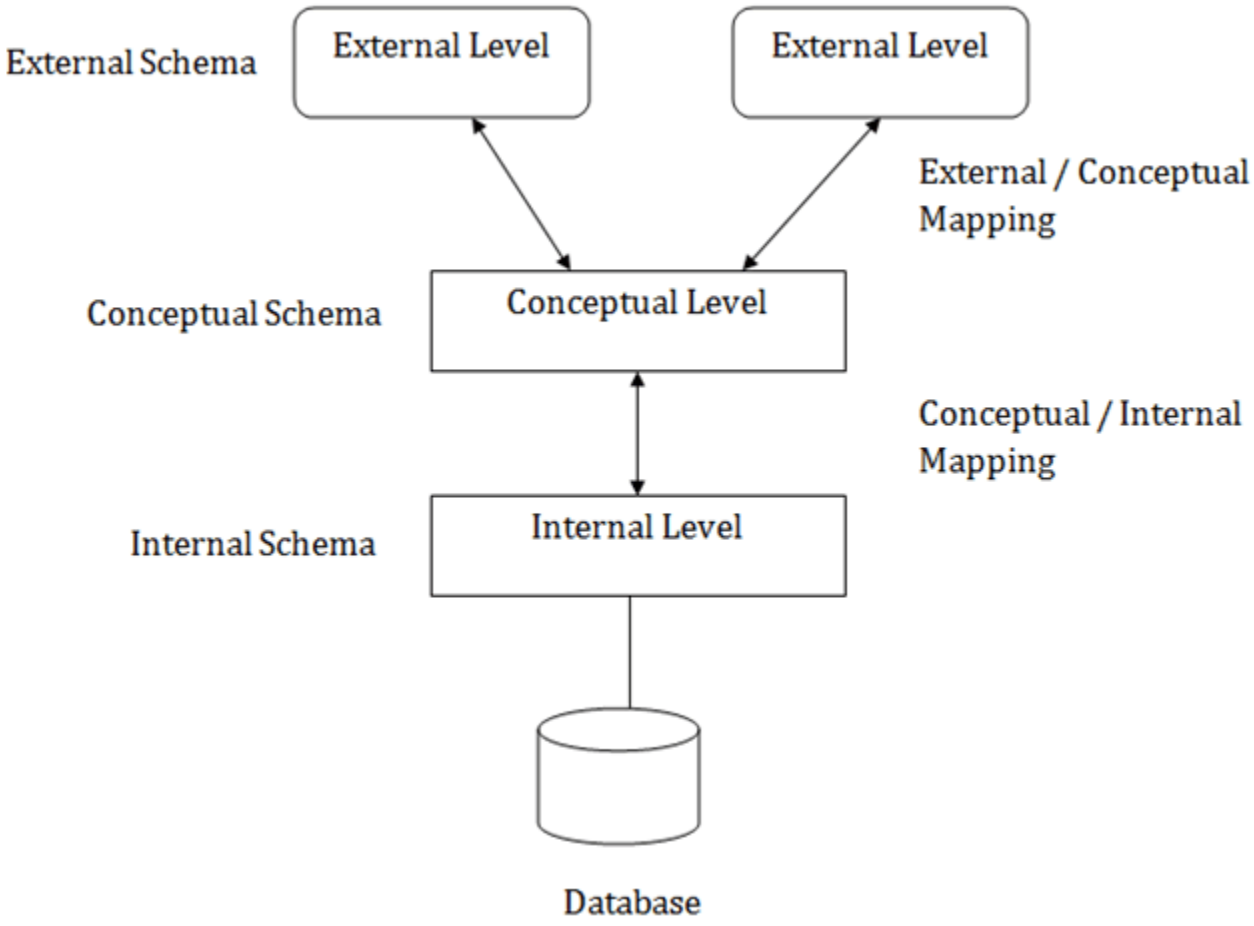
1. Internal Level

The internal level has an internal schema which describes the physical storage structure of the database.

The internal schema is also known as a physical schema.

It uses the physical data model. It is used to define that how the data will be stored in a block.

The physical level is used to describe complex low-level data structures in detail.



2) Conceptual Level:

The conceptual schema describes the design of a database at the conceptual level. Conceptual level is also known as logical level.

The conceptual schema describes the structure of the whole database.

The conceptual level describes what data are to be stored in the database and also describes what relationship exists among those data.

In the conceptual level, internal details such as an implementation of the data structure are hidden.

Programmers and database administrators work at this level.

3) External Level

At the external level, a database contains several schemas that sometimes called as subschema. The subschema is used to describe the different view of the database.

An external schema is also known as view schema.

Each view schema describes the database part that a particular user group is interested and hides the remaining database from that user group.

The view schema describes the end user interaction with database systems.

❖ Advantages Database Schema

1) You can manage data independent of the physical storage.
2) Faster Migration to new graphical environments.
3) DBMS Architecture allows you to make changes on the presentation level without affecting the other two layers.
4) As each tier is separate, it is possible to use different sets of developers.
5) It is more secure as the client doesn't have direct access to the database business logic.
6) In case of the failure of the one-tier no data loss as you are always secure by accessing the other tier.

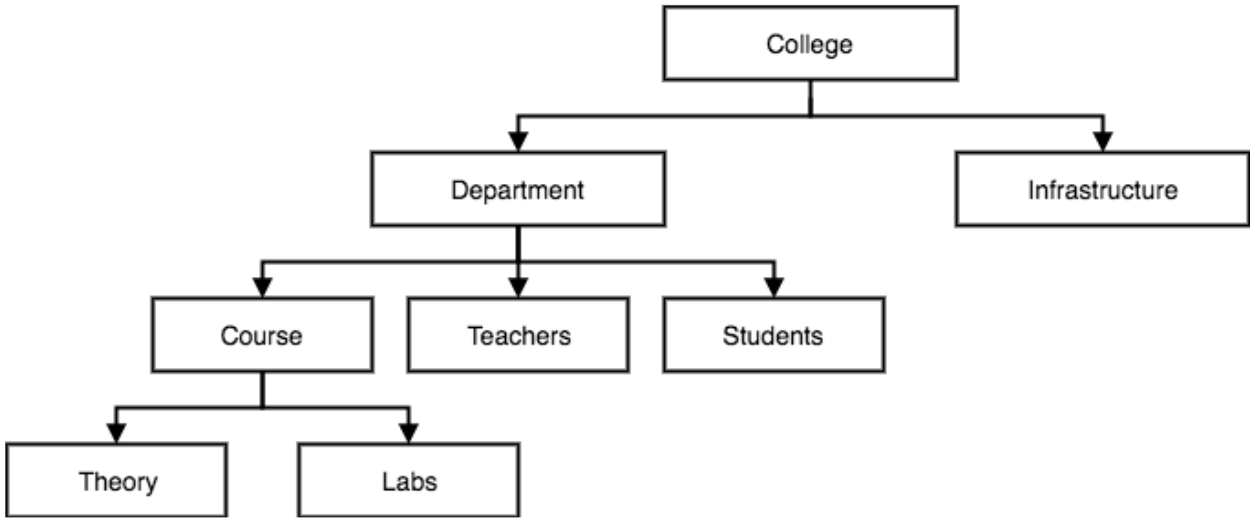
❖ Disadvantages Database Schema

1) Complete DB Schema is a complex structure which is difficult to understand for everyone.
2) Difficult to set up and maintain.
3) The physical separation of the tiers can affect the performance of the Database.

❖ Data Model:

1) Hierarchical Data Model.
2) Network Model.
3) Relational Data Model.

1). Hierarchical Data Model:



Hierarchical data model is the oldest type of the data model.

It was developed by IBM in 1968. It organizes data in the tree-like structure.

His database model organizes data into a tree-like-structure, with a single root, to which all the other data is linked.

The hierarchy starts from the **Root** data, and expands like a tree, adding child nodes to the parent nodes.

In this model, a child node will only have a single parent node.

Advantages of Hierarchical data model:

(1) Easy to understand:

- Information is represented in form of tree structure.
- It is easy to view, understand and retrieve the data.
- We can easily know the relationship among data.

(2) Database security:

- Security is provided by DBMS.
- Data is very important and may be confidential.
- Unauthorized person must not access such confident data.
- DBA is responsible for providing security to our database.

(3) Data independence:

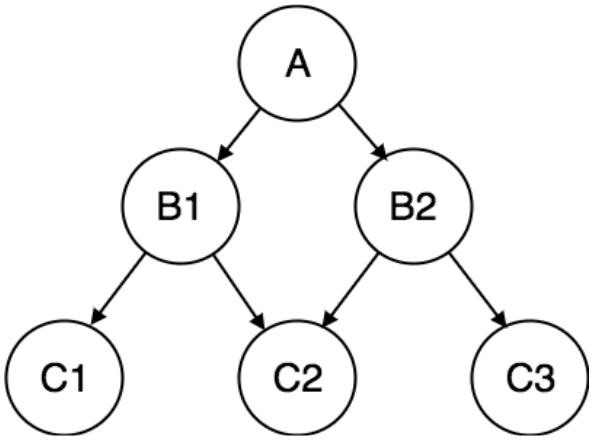
- If changes are made in design of database. There is no need to make change in system.
- Changes are done without affecting the other level data.

Disadvantages of Hierarchical data model:

(1) Anomalies:

- Insertion, deleting and updating the database using this model is difficult.
- You cannot insert a new record without depending on other records.
- Deleting one record will delete all the records which are depend on that record.
- Updation of one record requires to make changes in many places.

2) Network Model.



This is an extension of the Hierarchical model. In this model data is organized more like a graph, and are allowed to have more than one parent node.

In this database model data is more related as more relationships are established in this database model. Also, as the data is more related, hence accessing the data is also easier and fast. This database model was used to map many-to-many data relationships.

This was the most widely used database model, before Relational Model was introduced.

Advantages of Network data model:

(1) Easy to understand:

- It is very easy to design.
- It is easy to view, understand and retrieve the data.

(2) Handle complex relationship:

- Many too many relationships can be implemented without any repetition.

(3) Anomalies:

- Anomalies of hierarchical model are removed in this model.
- You can insert a new record without depending on other records.
- Deleting one record will not delete all the records which are depend on that record.

Disadvantages of Network data model:

(1) Complexity:

In network data model data are stored using pointer.
In network model to design a graph many pointer are required.
Thus the entire database becomes very complex.

3) Relational Model.

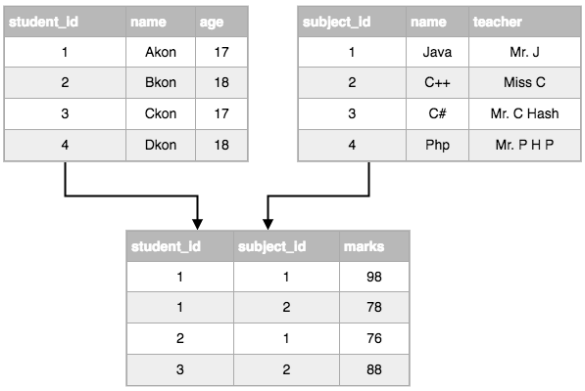
This model, data is organized in two-dimensional **tables** and the relationship is maintained by storing a common field.

This model was introduced by E.F Coded in 1970, and since then it has been the most widely used database model, infect, we can say the only database model used around the world.

The basic structure of data in the relational model is tables. All the information related to a particular type is stored in rows of that table.

Hence, tables are also known as **relations** in relational model.

In the coming tutorials we will learn how to design tables, normalize them to reduce data redundancy and how to use Structured Query language to access data from tables.



student_id	name	age
1	Akon	17
2	Bkon	18
3	Ckon	17
4	Dkon	18

subject_id	name	teacher
1	Java	Mr. J
2	C++	Miss C
3	C#	Mr. C Hash
4	Php	Mr. P H P

student_id	subject_id	marks
1	1	98
1	2	78
2	1	76
3	2	88

Advantages of Relational data model:

(1) Easy to design:

- It is very easy to design.
- To implement relational model programmer need not be aware how tables are stored internally.

(2) Efficient:

- Database design, maintenance, administration and usage are much easier than other model.

(3) Query capabilities:

- We can write query easily to find out the data.
- All the remaining work is performed by database itself and it is hidden from user.

Differents:

Hierarchical Data Model	Network Data Model	Relational Data Model
In this model, to store data hierarchy method is used. It is the oldest method and not in use today.	It organizes records to one another through links or pointers.	It organizes records in the form of table and relationship between tables are set using common fields
To organize records, it uses tree structure.	It organizes records in the form of directed graphs.	It organizes records in the form of tables.
It implements 1:1 and 1: n relations.	In addition to 1:1 and 1: n it also implements many to many relationships.	In addition to 1:1 and 1: n it also implements many to many relationships.
&XML and XAML use this model.	VAX-DBMS, DMS-1100 of UNIVAC and SUPRADBMS's	It is mostly used in real world applications. Oracle,

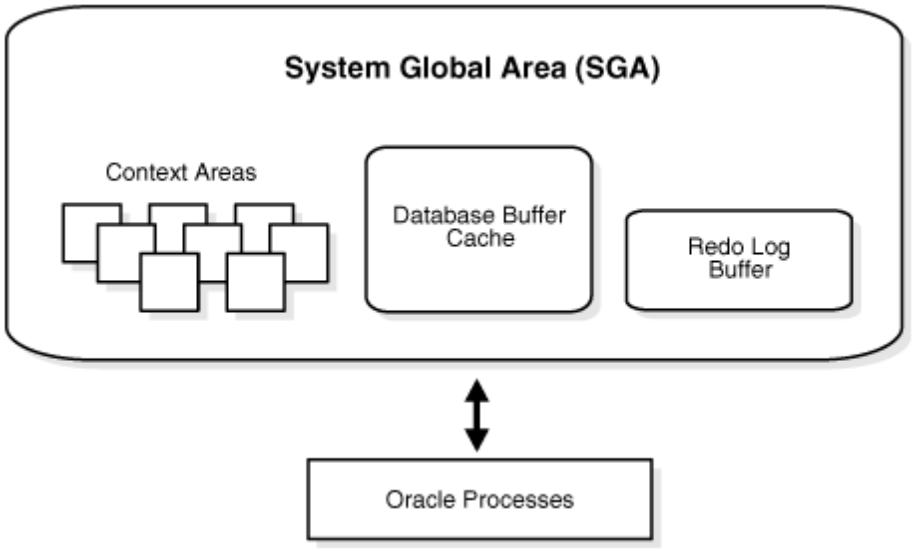
	use this model.	SQL.

❖ Oracle Server and Instance:

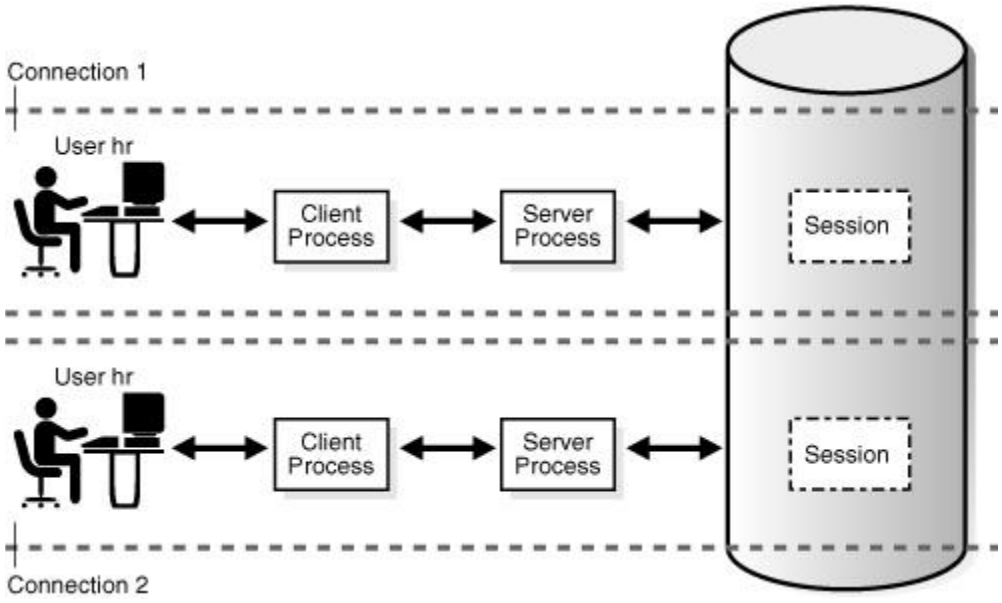
Every running Oracle database is associated with an Oracle instance. When a database is started on a database server (regardless of the type of computer), Oracle allocates a memory area called the System Global Area (SGA) and starts one or more Oracle processes.

This combination of the SGA and the Oracle processes is called an Oracle **instance**.

The memory and processes of an instance manage the associated database's data efficiently and serve the one or multiple users of the database.



➢ How Oracle Actually Works:



Oracle processes are server processes that perform, communicate with and work for the user processes.

These server processes handle requests from connected user processes. They communicate with the user process and call other processes to carry out requests.

Say, if the user wants to access data not already in the SGA it calls a process to read it in from disk.

Background processes are those processes that perform maintenance work for the Oracle server.

Database Structure & Space Management.

- An oracle database is a collection of data that is treated as a unit.
- An oracle database is a collection of data that is treated as a unit.
- A database server is the key to solving the problems of information management.
- An oracle database has both a physical and a logical structure.
- Physical and logical server structures are separate.

1. Logical Database Structures:

The logical structure of an oracle database includes:

(1) Table space. (2) Schemas and schema objects.

(3) Data blocks. (4) Extents. (5) Segments.

(1) Table Space:

An oracle database comprises of a no. of physical files called data files. These files are logically grouped together into an oracle (logical) structure called a table space.

A table space can be online (available) or offline (Not available).

Online table space is accessible to user.

Offline table space is unavailable while allowing normal access to the database.

Table spaces are a mechanism or a means by which logical object such as tables, indexes, views are mapped to a specific data file. Table spaces are also used to group different types of (logical) database object together.

(2) Schemas and schema objects:

A Schema is a collection of database objects. It is owned by a database user and has the same name as that user. The schema objects are the logical structures that directly refer to the database's data.

Each user owns as a single schema. Schema objects can be created and manipulated with SQL.

Schema objects include structures like tables, view and indexes.

A) Tables are the basic unit of data storage in database. It holds all user-accessible data. Each Table has columns and rows.

B) Views are customized presentations of data in one or more tables or other views.

C) Indexes are optional structures associated with tables. Indexes can be created to increase the Performance of data retrieval.

(3) Data Blocks:

At the first level of storage, Oracle database data is stored in data blocks.
One data block is assigned specific number of bytes of physical database space on disk.
The standard block size is specified by the DB_BLOCK_SIZE initialization parameter.

(4) Extent:

After data blocks, the next level of logical database space is an extent.
It is specific number of contiguous data blocks.

(5) Segment:

The next level of logical database storage above an extent is called a segment.
A segment is a set of extents allocated for a certain logical structure.
For example: Data segment, Index segment, Rollback segment and temporary segment.

2. Physical Database Structures:

The physical structure of an oracle database includes:
(1) Data files. (2) Redo Log Files. (3) Control Files.

❖ Memory & Process Structure:

This section covers the memory and process structures that are used by an oracle server to manage a database. Memory structure gives ability for several users to access a database at the same time. The high performance required by current database system from different users and applications.
An oracle server uses memory structures & processes to manage and access the database.
All these structures exist in the main memory of computers, and represent the database system.
Processes are jobs or tasks that work in the memory of those computers.

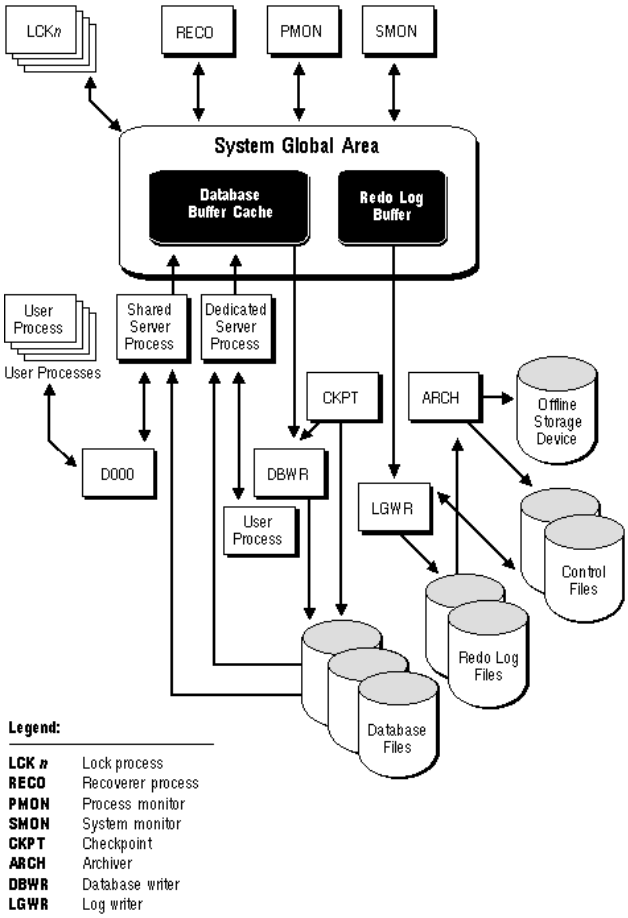
Memory Structures:

An oracle server creates and uses memory structures and processes to manage and access the Database. The memory stores the code of a program that is executed and the data is shared among the users.
The basic memory structures associated with oracle includes:
1) System Global Area (SGA).
2) Program Global Area (PGA).
3) Cursor.

(1) System Global Area (SGA):
The SGA is the primary component of the oracle instance.

The SGA is a shared region in the memory that contains data and control information for an oracle instance. SGA contains all the memory structures necessary for data manipulation, statement parsing and redo caching.
SGA is also shared global area because multiple users can access and modify data at the same time. Oracle automatically allocates memory for an SGA when an instance is created.
Each instance has its own SGA. The SGA provides read/write operations.
Information stored inside the SGA is divided into several types of memory structures.

SGA contains the following data structures:
A) Database buffer cache.
B) Redo log buffer.
C) Shared pool.
D) Large pool.
E) Java pool.
F) Stream pool.



(2) Program global area [PGA]:
The PGA is a memory buffer containing data and control information for a server process.
A PGA is created by oracle when a server process is initiated.
The information in a PGA depends on the configuration of oracle.

(3) Cursors:
A cursor is a handle [a name or pointer] of memory associated to a specific SQL declaration.
Most of the time oracle makes automatic cursor management. However the programmatic interfaces [PL-SQL] offer greater control over the cursors to the Application developers.

- **Process Architecture:**

A process is a "control thread" or a mechanism of an operating system that can execute a series of steps. Some of these systems use the term "job" or "task".
Normally a process has its own private memory area in which it is executed.
Each process in an oracle instance performs a specific job.

An oracle server has three general types of processes:
1) User processes.
2) Server Process.
3) Background Process.

(1) User Processes (Client):
User processes starts when a database user requests to connect to an Oracle Server.
User process is created and maintained to execute the software code of an application such as Pro*C/C++ or oracle tool such as SQL*Plus.
User processes also manages communication with the server processes through the program Interface. Connection and session are closely related to user process but are very different in meaning a connection is communication pathway between a user process and an oracle instance. A session is a connection between user and an oracle instance through a user process. For example: when a user starts SQL*Plus, a user must provide a valid user name and password, and then a session is established for that user.

(2) Server Process:
Oracle creates server processes to handle the requests of user processes connected to the instance. 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.
Return results in such a way that the application can process the information.

(3) Background Process:
- Oracle creates a set of background processes for each instance.
- An oracle instance can have many background processes.
- Some background processes are compulsory and some are optional.

❖ **Compulsory Background Processes:**

1) Database Writer (DBWn):

The database writer is responsible for writing modified data blocks from the database cache to data files on disk. One can configure additional processes [DBW1 up to DBW9] to improve the performance of a System with many changes to data.
Oracle uses the write ahead log method to write changes into data files.
In this method oracle does not have to write the blocks when a transaction is made.
Less recent data is written first to the data files.

2) Log Writer (LGWR):

The log writer writes the entries of the redo log buffer to redo record file of disk.
These entries are generated in the redo log buffer of the system global area [SGA].
The LGWR writes the entries to the redo log sequentially in an online redo log file.
When a database has a multiplexed redo log, the LGWR also writes the entries to the redo log in a group of online redo log files.

3) Process Monitor (PMON):

The process monitor performs the recovery of failed user process.
It also cleans the cache and free resources that have been used by the failed user process.
It also checks the dispatcher and server processes and restarts those which are stopped.

4) System Monitor (SMON):

SMON is responsible for recovery during start up.
It is also responsible for cleaning up temporary segments that are no longer used
SMON recovers any terminated transactions which were skipped during instance recovery due to file read or offline error.

5) Archiver (ARCH):

The archiver copies online redo log files, once they become full to a specified storage device or Location. It is present only when the database is started in ARCHVELOG mode.

❖ **Optional Background Processes:**

1) Checkpoint (CKPT):

Checkpoint is updates the headers of all data files to record details of the checkpoint processing. It does not write block to disk which is performed by DBWn.

2) Recover (RECO):

Recovery process is responsible for recovery of fail transaction due to network or system failure in distributed database. It is automatically started when the database is configured.
It is automatically complete the commit and rollback at the different time interval.

3) Dispatcher (Dnnn):

The dispatcher process allows user process to share a limited number of shared server process. Atleast one dispatcher process is created for each communication protocol that is being used [DO0O...Dnnn].

Each of its processes is responsible for the routing requests of the user processes connected to the available processes of the shared server.

4) ALock (LCKn):

The lock [LCKo] process is used to block instances in the oracle parallel server.

Shared Server Process (Snnn):

Shared server process serve multiple client requests in the shared configuration.

The number of shared server processes be created using parameter SHARED _SERVERS.

Job Queue (SNPn):

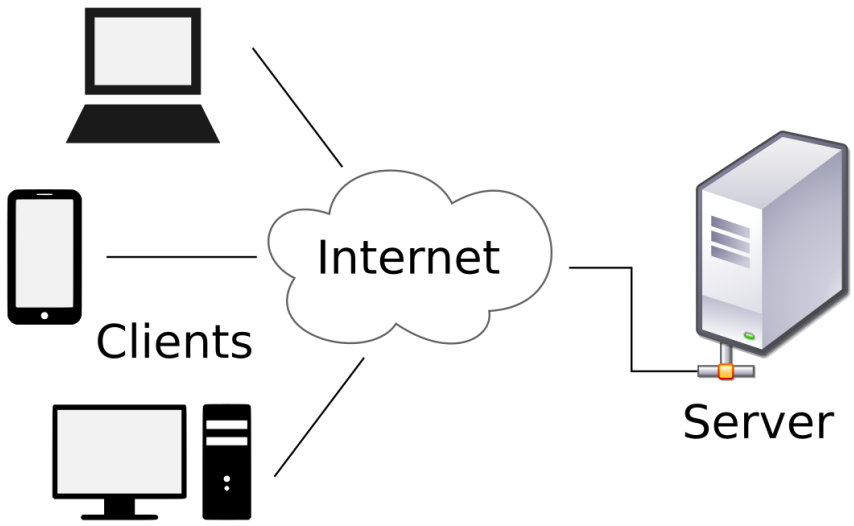
❖ Client-Server Architecture

The Client:

The client is the front end application of a database, accessed by a user.

It interacts with a user through the keyboard, monitor, and mouse. The client has no responsibilities for accessing data. It concentrates on the request, processing, and the presentation of data manages by server.

The client workstation can be specifically set up for its tasks. For example it may not need a great amount of disk space or graphic capabilities.



The server:

The server is responsible to give response of client request.
The server executes oracle software and deals with the functions required for simultaneous and Shared data access. The server receives and processes the SQL and PL\SQL declarations that originate in the client Applications.

❖ How oracle works:

A client Server Oracle configuration where the user and server process are on separate machines (connected via a network).
An instance is currently running on the computer that is executing Oracle (often called the host or Database server).
A computer running an application (client workstation) runs the application in a user process.
The client application attempts to establish a connection to the server using the proper Net8 driver.
The server is running the proper Net8 driver.
The server detects the connection request from the application and creates a (dedicated) server process on behalf of the user process.
The user executes a SQL statement and commits the transaction. For example, the user changes a name in a row of a table.
The server process receives the statement and checks the shared pool for any shared SQL area that contains an identical SQL statement. If a shared SQL area is found, the server process checks the user's access privileges to the requested data and the previously existing shared SQL area is used to process the statement; if not, a new shared SQL area is allocated for the statement so that it can be parsed and processed.
The server process retrieves any necessary data values from the actual data files (table) or those stored in the system global area.
The server process modifies data in the system global area.
The DBWn process writes modified blocks permanently to disk when doing so is efficient. Because the transaction committed, the LGWR process immediately records the transaction in the online redo log file.

❖ Assignment:

Q-1: Write a short note on an oracle server & instance.
Q-2: Explain in detail database structure & space management?
Q-3: Write a short note on memory and process structure?
Q-4: Explain client-server architecture in detail?
Q-5: Explain three schema architecture?
Q-6: Explain in details how oracle works?