SNS COLLEGE OF TECHNOLOGY

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Department of MCA

DBMS Architecture

Course Name : 23CAT603 - DATA BASE MANAGEMENT SYSTEM

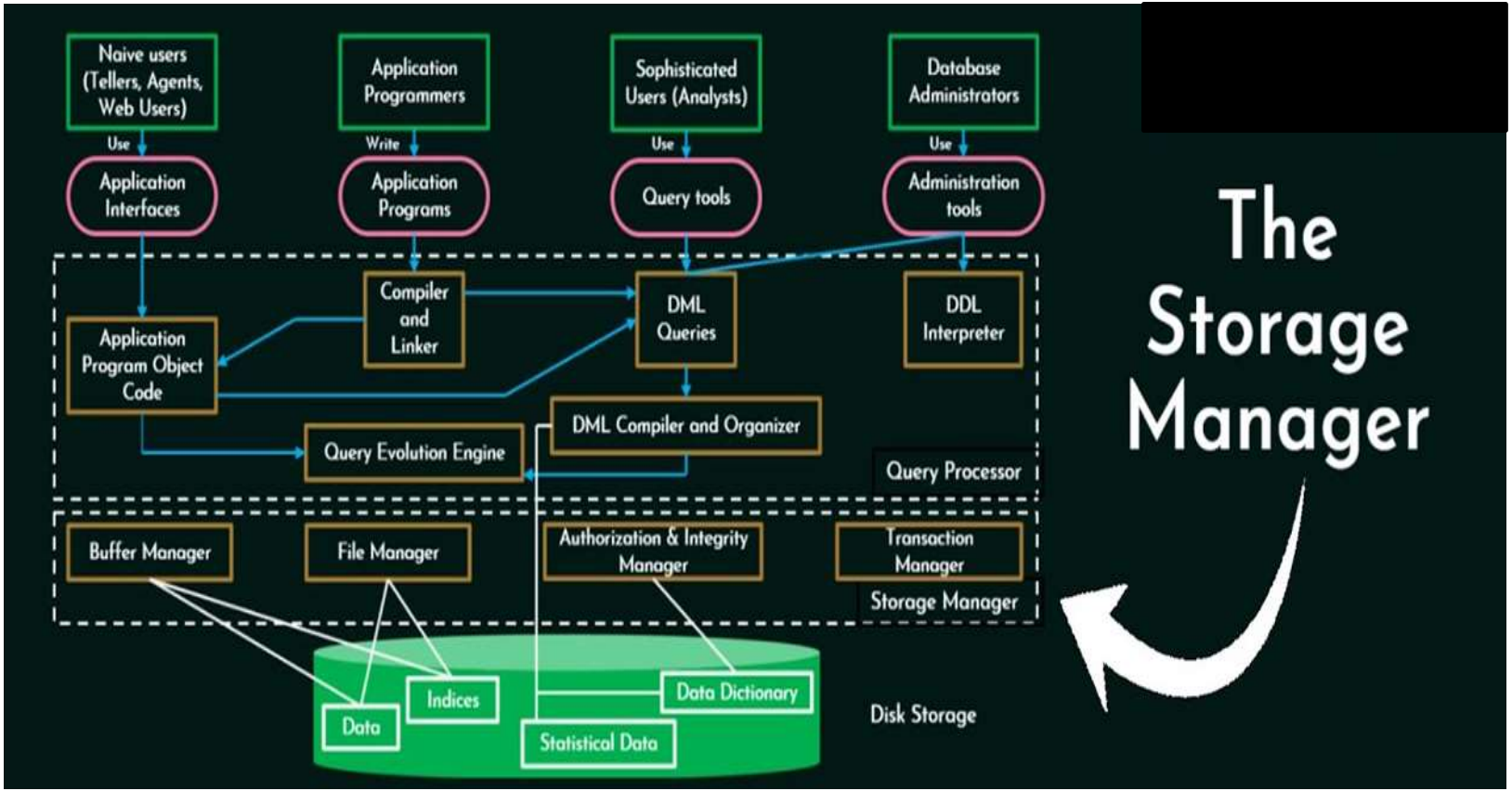
Class : I Year / II Semester

Unit I – DBMS Architecture

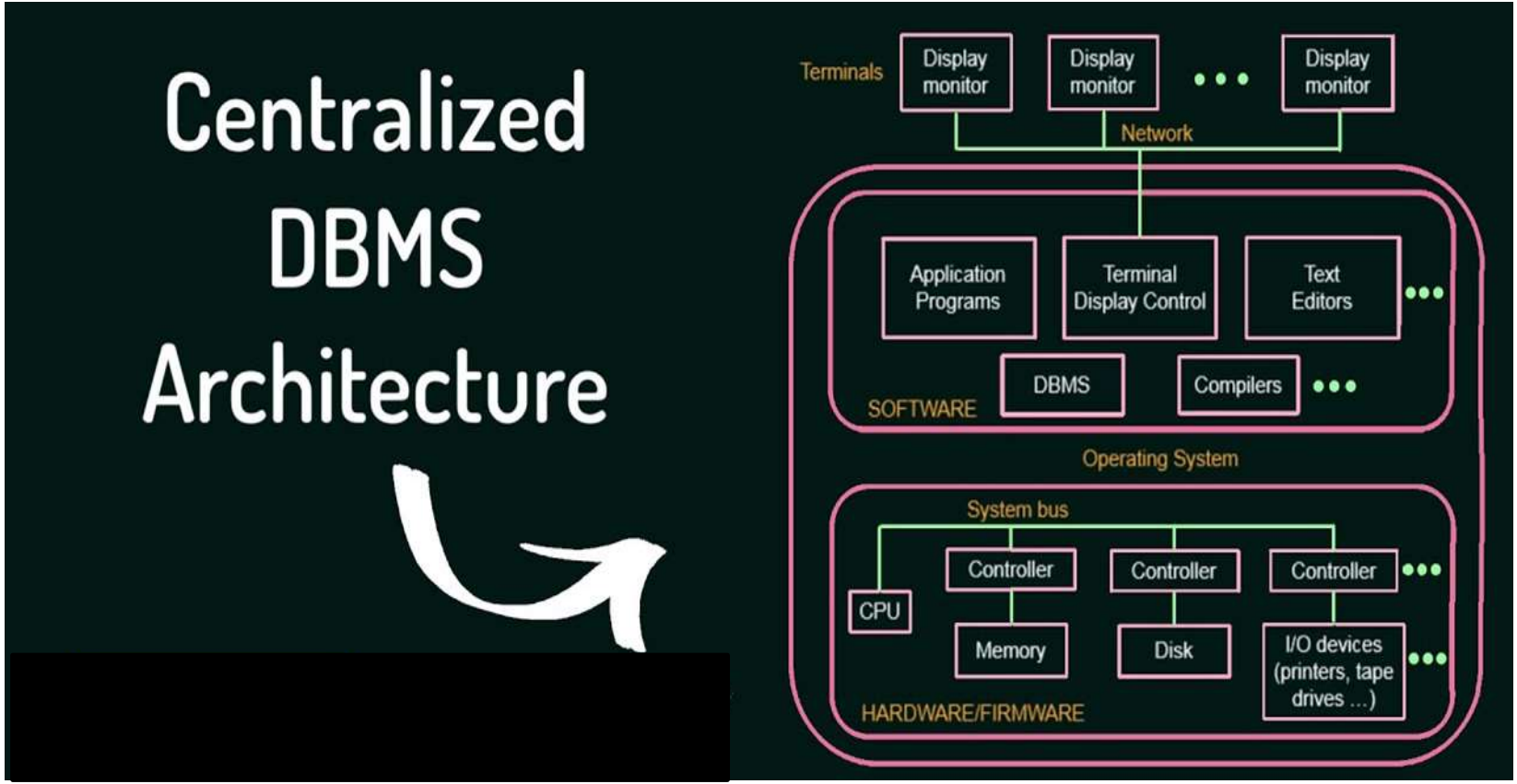
Agenda

- **DBMS Architectures**
- **Classification of Database Management Systems**
- **Three-Schema Architecture and Data Independence**
- **The Database System Environment**
- Data Models
- Database Languages and Interfaces

DATABASE SYSTEM ARCHITECTURE



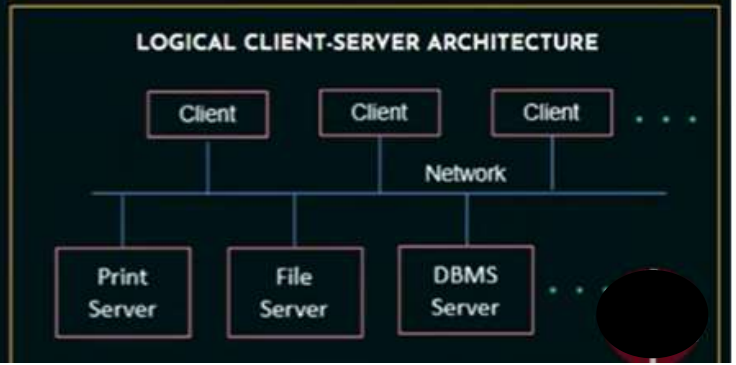
DBMS ARCHITECTURE



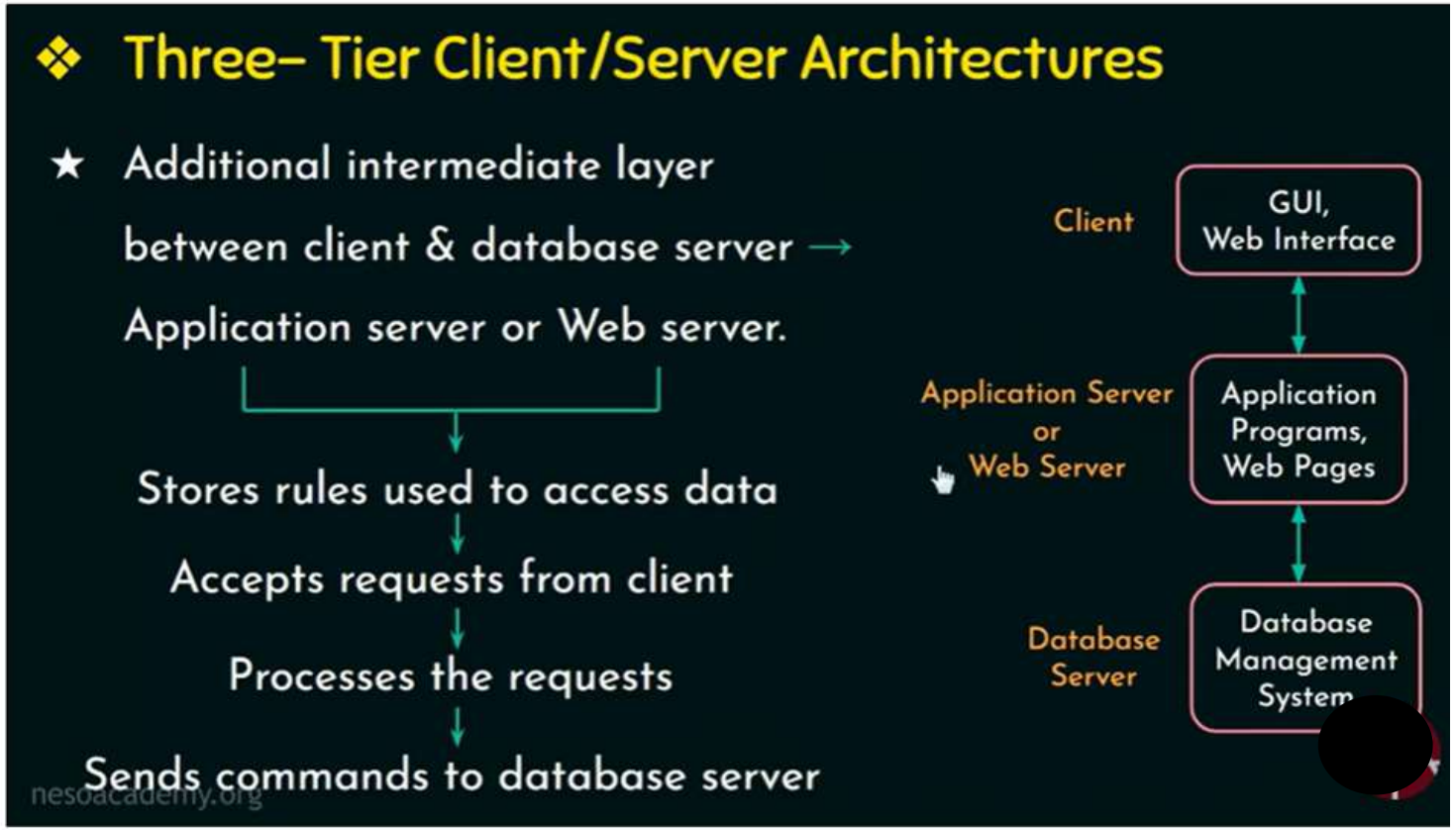
DBMS ARCHITECTURE

Basic Client/Server Architectures

- ★ Goal → define specialized servers with specific functionalities.
- ★ Client → user machine that provides user interface capabilities & local processing.
- ★ Server → provides services to client machines.



DBMS ARCHITECTURE



Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

- **What is Database Architecture?**

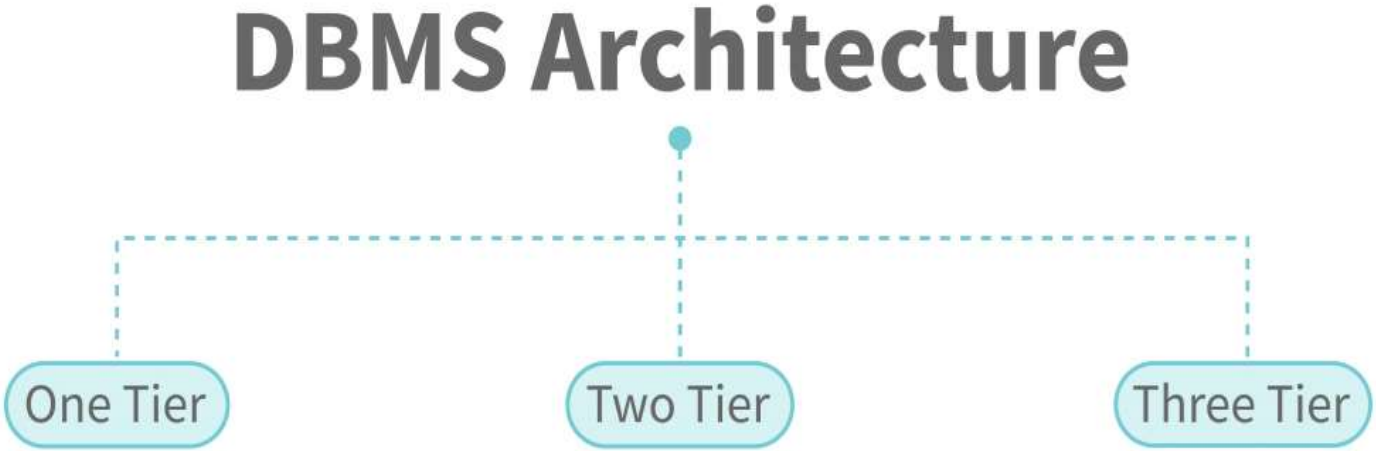
A **Database Architecture** is a representation of DBMS design.
It helps to design, develop, implement, and maintain the database management system.
A Database stores critical information and helps access data quickly and securely

Types of DBMS Architecture

1-Tier Architecture
2-Tier Architecture
3-Tier Architecture

Types of DBMS Architecture

- There are mainly three types of DBMS architecture:
  - One Tier Architecture (Single Tier Architecture)
  - Two Tier Architecture
  - Three Tier Architecture

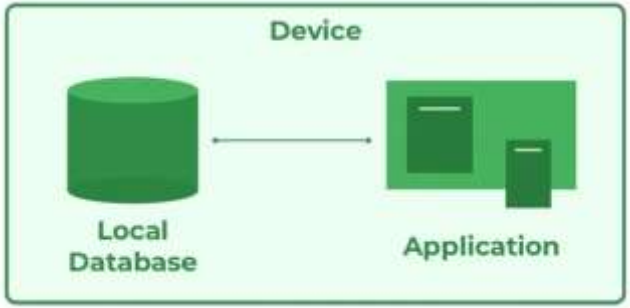


Types of DBMS Architecture

- In 1-Tier Architecture the database is directly available to the user, the user can directly sit on the DBMS and use it that is, the **client, server, and Database are all present on the same machine.**
- For Example: **to learn SQL we set up an SQL server and the database on the local system.** This enables us to directly interact with the relational database and execute operations. The industry won't use this architecture they logically go for 2-tier and 3-tier Architecture.

1-Tier Architecture

1 Tier Architecture in DBMS is the simplest architecture of Database in which the client, server, and Database all reside on the same machine.



Advantages of 1-Tier Architecture

Below mentioned are the advantages of 1-Tier Architecture.

Simple Architecture: 1-Tier Architecture is the most simple architecture to set up, as only a single machine is required to maintain it.

Cost-Effective: No additional hardware is required for implementing 1-Tier Architecture, which makes it cost-effective.

Easy to Implement: 1-Tier Architecture can be easily deployed, and hence it is mostly used in small projects.

2 Tier Architecture Diagram

The 2-tier architecture is similar to a basic client-server model . The application at the client end directly communicates with the database on the server side. **APIs** like **ODBC and JDBC** are used for this interaction. The **server side is responsible** for providing **query processing** and **transaction management** functionalities. On the client side, the user interfaces and application programs are run.

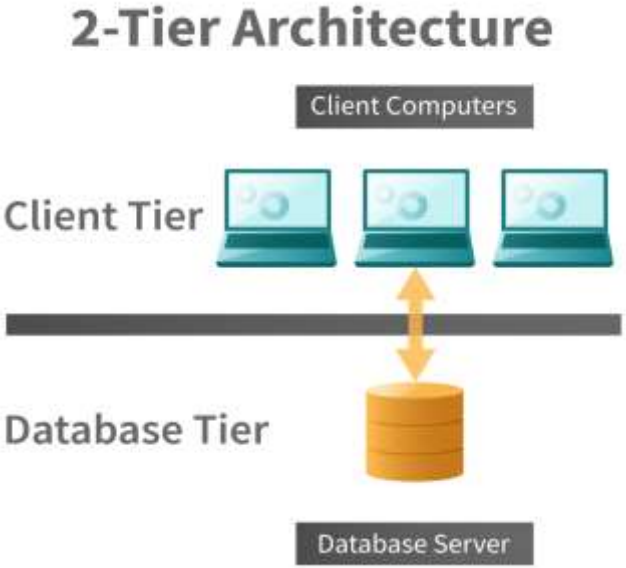
The application on the client side establishes a connection with the server side to communicate with the DBMS.

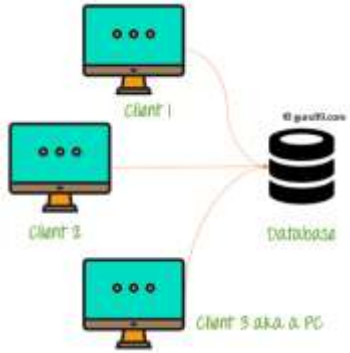
An advantage of this type is that maintenance and understanding are easier, and compatible with existing systems. However, this model gives poor performance when there are a large number of users.

2 Tier Architecture Diagram

2-Tier Architecture

2-Tier Architecture in DBMS is a Database architecture where the presentation layer runs on a client (PC, Mobile, Tablet, etc.), and data is stored on a server called the second tier.





In the above 2 Tier client-server architecture of database management system, we can see that one server is connected with clients 1, 2, and 3.

Advantages of 2-Tier Architecture

Easy to Access: 2-Tier Architecture makes easy access to the database, which makes fast retrieval.

Scalable: We can scale the database easily, by adding clients or upgrading hardware.

Low Cost: 2-Tier Architecture is cheaper than 3-Tier Architecture and Multi-Tier Architecture .

Easy Deployment: 2-Tier Architecture is easier to deploy than 3-Tier Architecture.

Simple: 2-Tier Architecture is easily understandable as well as simple because of only two components.

3 Tier Architecture Diagram

In 3-Tier Architecture , there is another layer between the client and the server. The **client does not directly communicate** with the **server**.

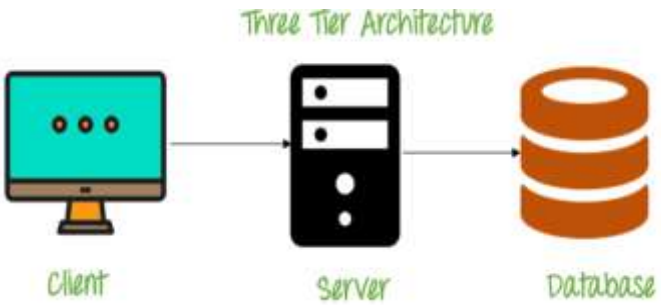
Instead, **it interacts with an application server** which further **communicates with the database system** and then the query processing and transaction management takes place.

This intermediate layer acts as a medium for the exchange of partially processed data between the server and the client. This type of architecture is used in the case of large web applications.

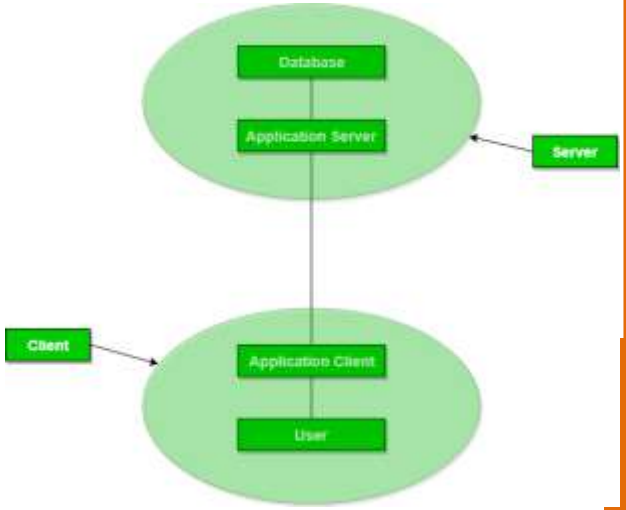
3 Tier Architecture Diagram

A 3-tier architecture has the following layers:

- Presentation layer (your PC, Tablet, Mobile, etc.)
- Application layer (server)
- Database Server



3 Tier Architecture Diagram



Advantages of 3-Tier Architecture

Enhanced scalability: Scalability is enhanced due to the distributed deployment of application servers. Now, individual connections need not be made between the client and server.

Data Integrity: 3-Tier Architecture maintains Data Integrity. Since there is a middle layer between the client and the server, data corruption can be avoided/removed.

Security: 3-Tier Architecture Improves Security. This type of model prevents direct interaction of the client with the server thereby reducing access to unauthorized data.

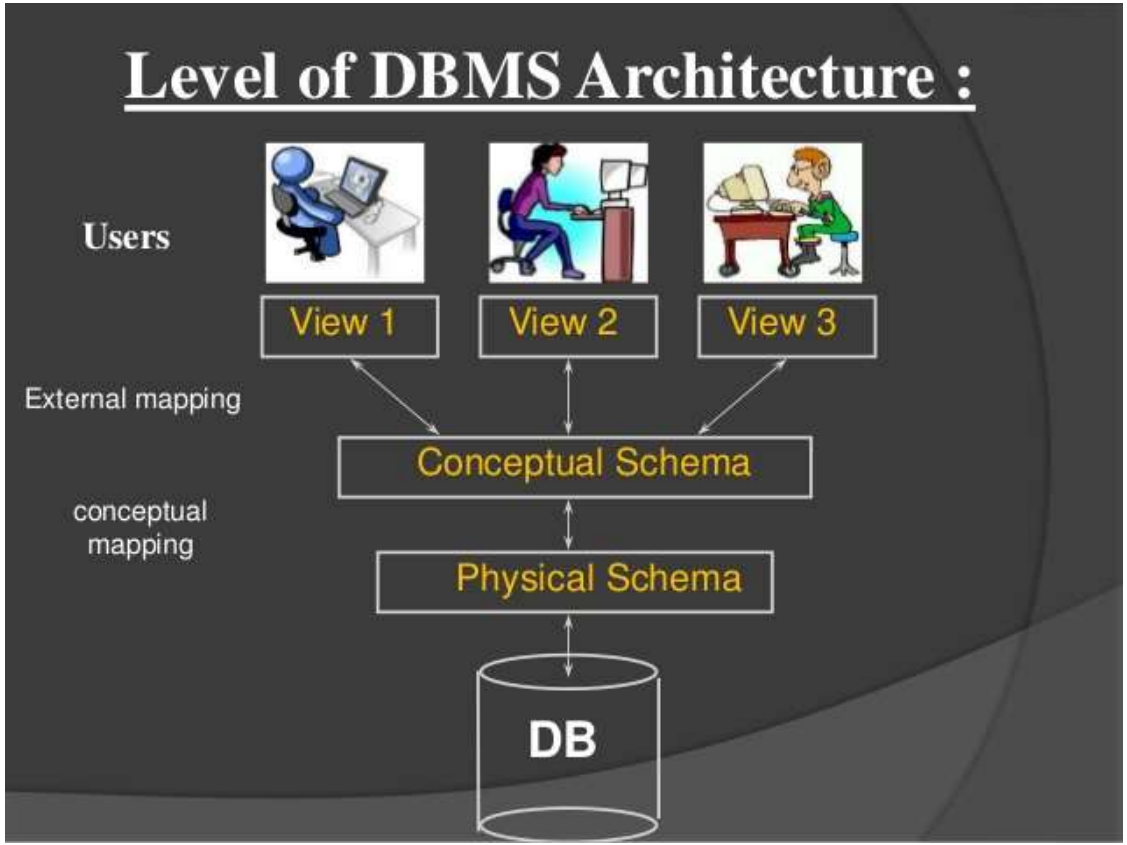
Disadvantages of 3-Tier Architecture

More Complex: 3-Tier Architecture is more complex in comparison to 2-Tier Architecture. Communication Points are also doubled in 3-Tier Architecture.

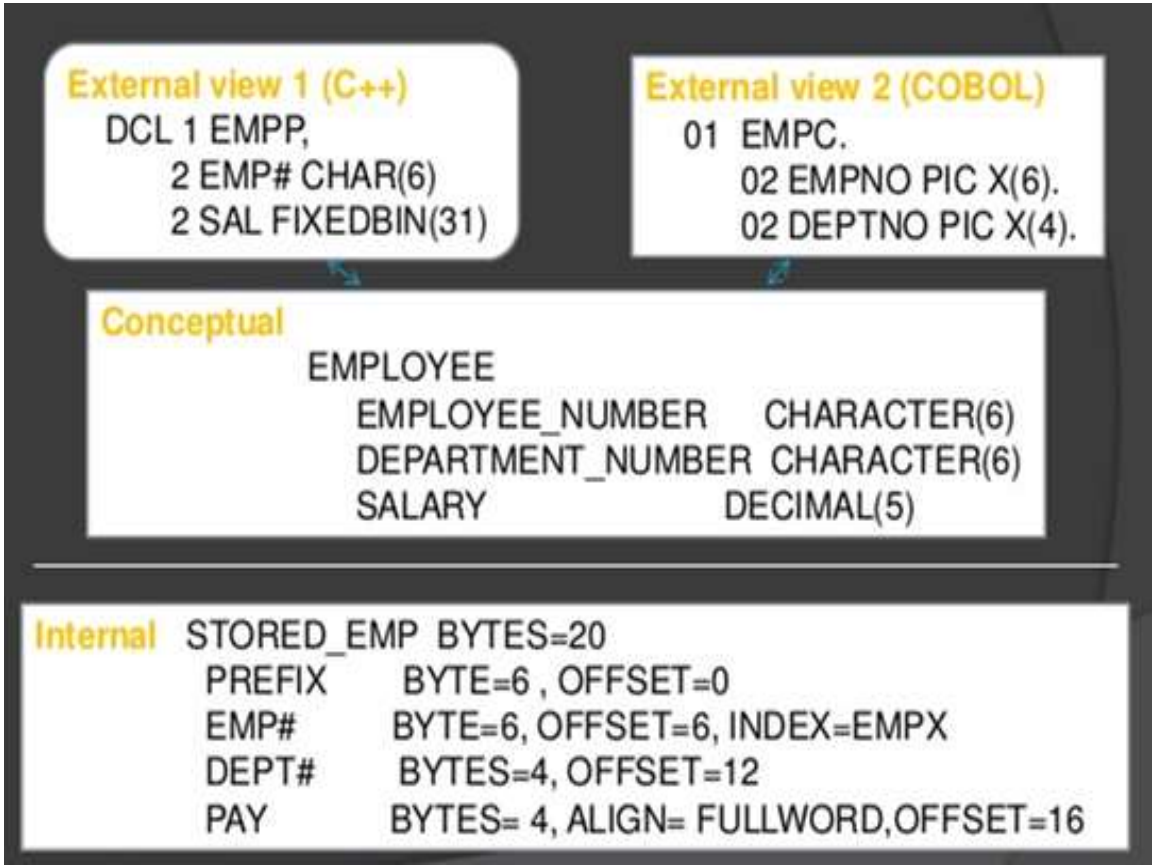
Difficult to Interact: It becomes difficult for this sort of interaction to take place due to the presence of middle layers.

Level of DBMS Architecture

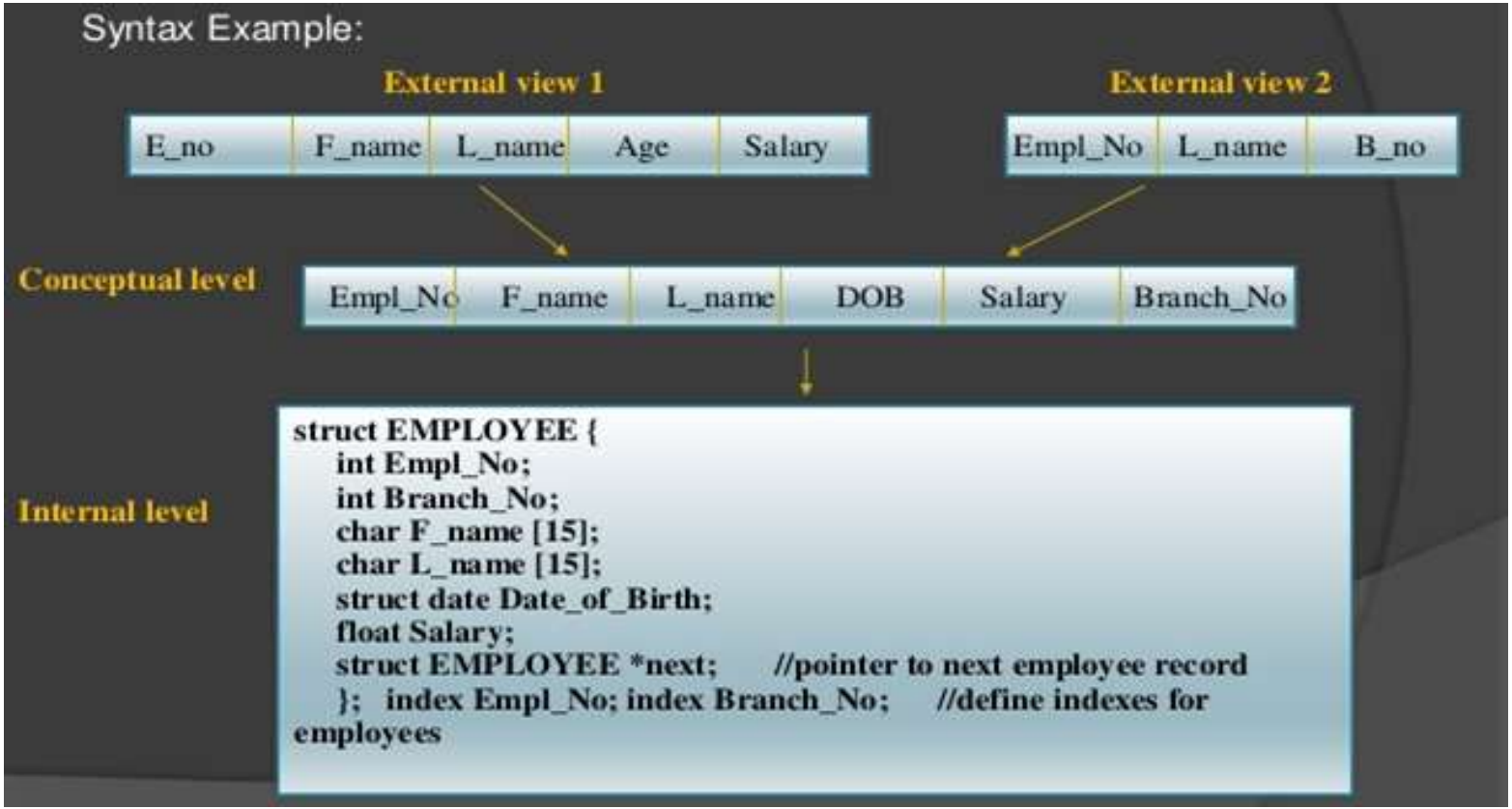
Level of DBMS Architecture



Example: employee Database



Three Levels of Architecture



Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

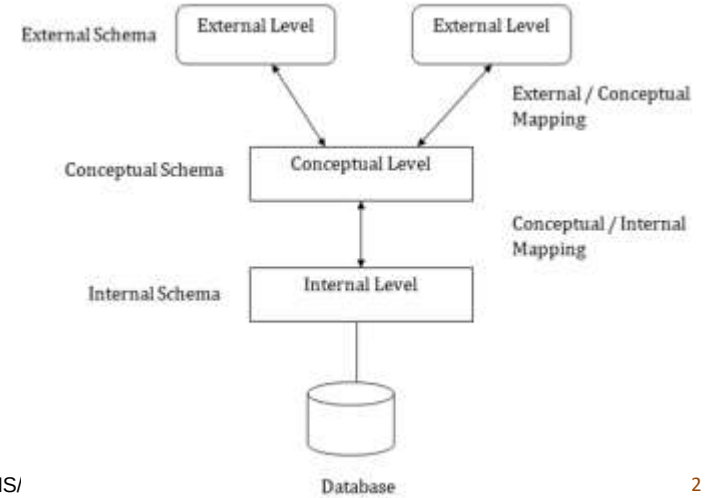
Three schema Architecture

The three schema 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.



Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

In the above diagram:

- It shows the DBMS architecture.
- Mapping is used to transform the request and response between various database levels of architecture.
- Mapping is not good for small DBMS because it takes more time.
- In External / Conceptual mapping, it is necessary to transform the request from external level to conceptual schema.
- In Conceptual / Internal mapping, DBMS transform the request from the conceptual to internal level.

Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

Objectives of Three schema Architecture

The main objective of three level architecture is to enable multiple users to access the same data with a personalized view while storing the underlying data only once. Thus it separates the user's view from the physical structure of the database. This separation is desirable for the following reasons:

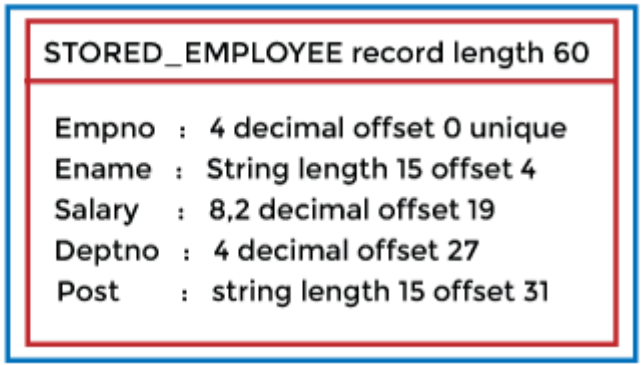
- Different users need different views of the same data.
- The approach in which a particular user needs to see the data may change over time.
- The users of the database should not worry about the physical implementation and internal workings of the database such as data compression and encryption techniques, hashing, optimization of the internal structures etc.
- All users should be able to access the same data according to their requirements.
- DBA should be able to change the conceptual structure of the database without affecting the user's
- Internal structure of the database should be unaffected by changes to physical aspects of the storage.

Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

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.
- The internal level is generally is concerned with the following activities:
- Storage space allocations.
  For Example: B-Trees, Hashing etc.
- Access paths.
  For Example: Specification of primary and secondary keys, indexes, pointers and sequencing.
- Data compression and encryption techniques.
- Optimization of internal structures.
- Representation of stored fields.

Internal view

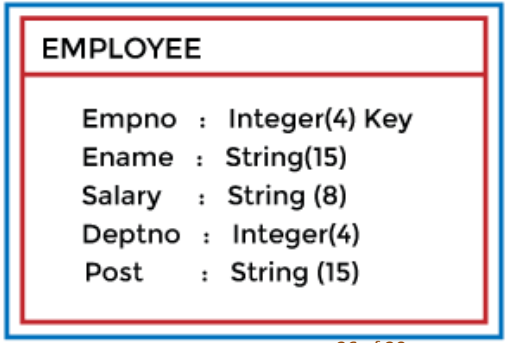


Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

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.

Global view



Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

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.

Database Architecture in DBMS: 1-Tier, 2-Tier and 3-Tier

Mapping between Views

The three levels of DBMS architecture don't exist independently of each other. There must be correspondence between the three levels i.e. how they actually correspond with each other. DBMS is responsible for correspondence between the three types of schema. This correspondence is called Mapping.

There are basically two types of mapping in the database architecture:

Conceptual/ Internal Mapping

External / Conceptual Mapping

Conceptual/ Internal Mapping

The Conceptual/ Internal Mapping lies between the conceptual level and the internal level. Its role is to define the correspondence between the records and fields of the conceptual level and files and data structures of the internal level.

External/ Conceptual Mapping

The external/Conceptual Mapping lies between the external level and the Conceptual level. Its role is to define the correspondence between a particular external and the conceptual view.

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