

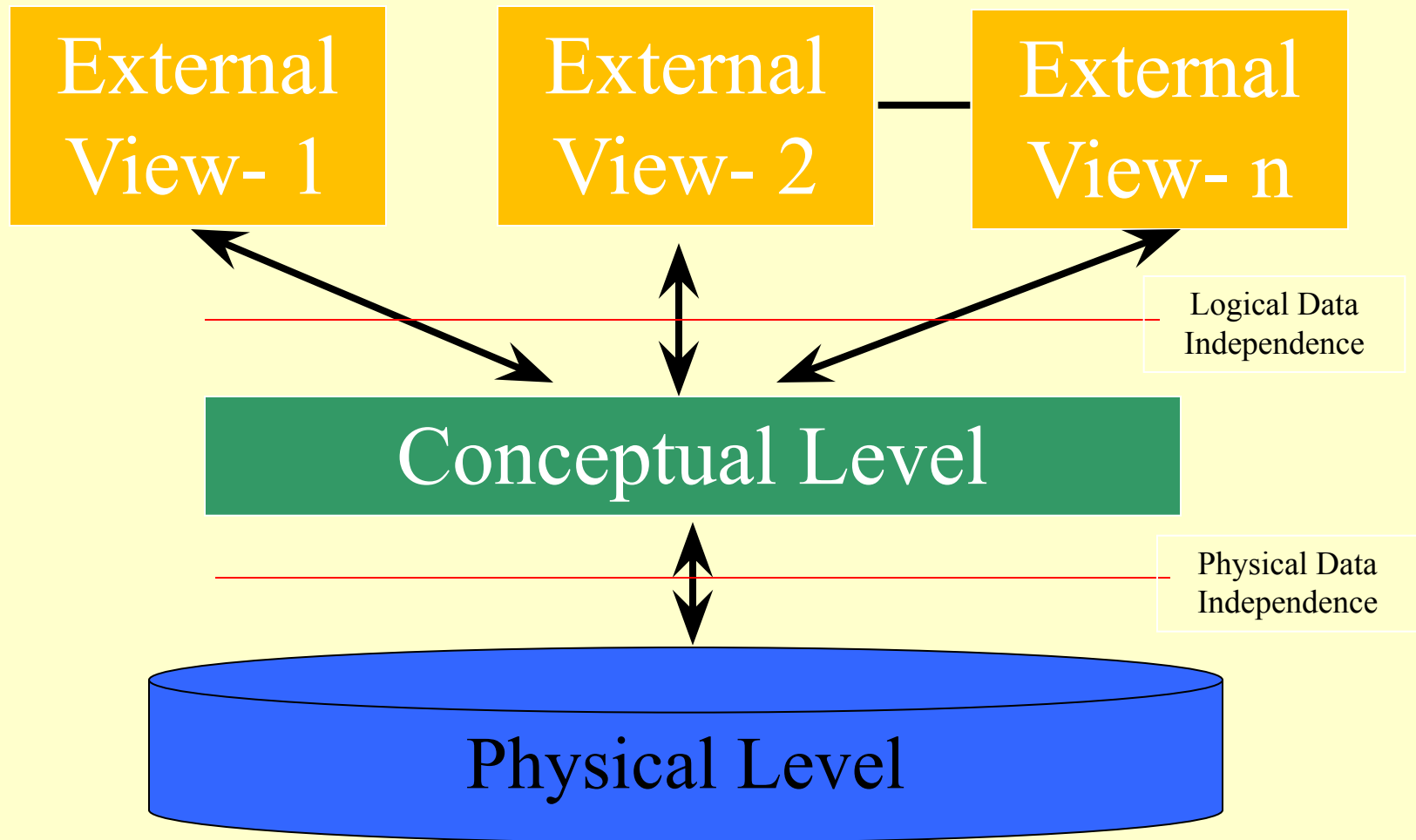
Database Systems

Database Architecture and Components

Database Architecture

- To support data independence, DBMS employs three level architecture. These levels / layers are:
 1. External Level / Layer
 2. Conceptual Level / Layer
 3. Internal Level / Layer
- This architecture is also called ANSI-SPARC architecture proposed by Standards Planning and Requirements Committee (SPARC) of ANSI.
- The objective of the three-level architecture is to separate each user's view from the way database is physically represented.

Database Architecture



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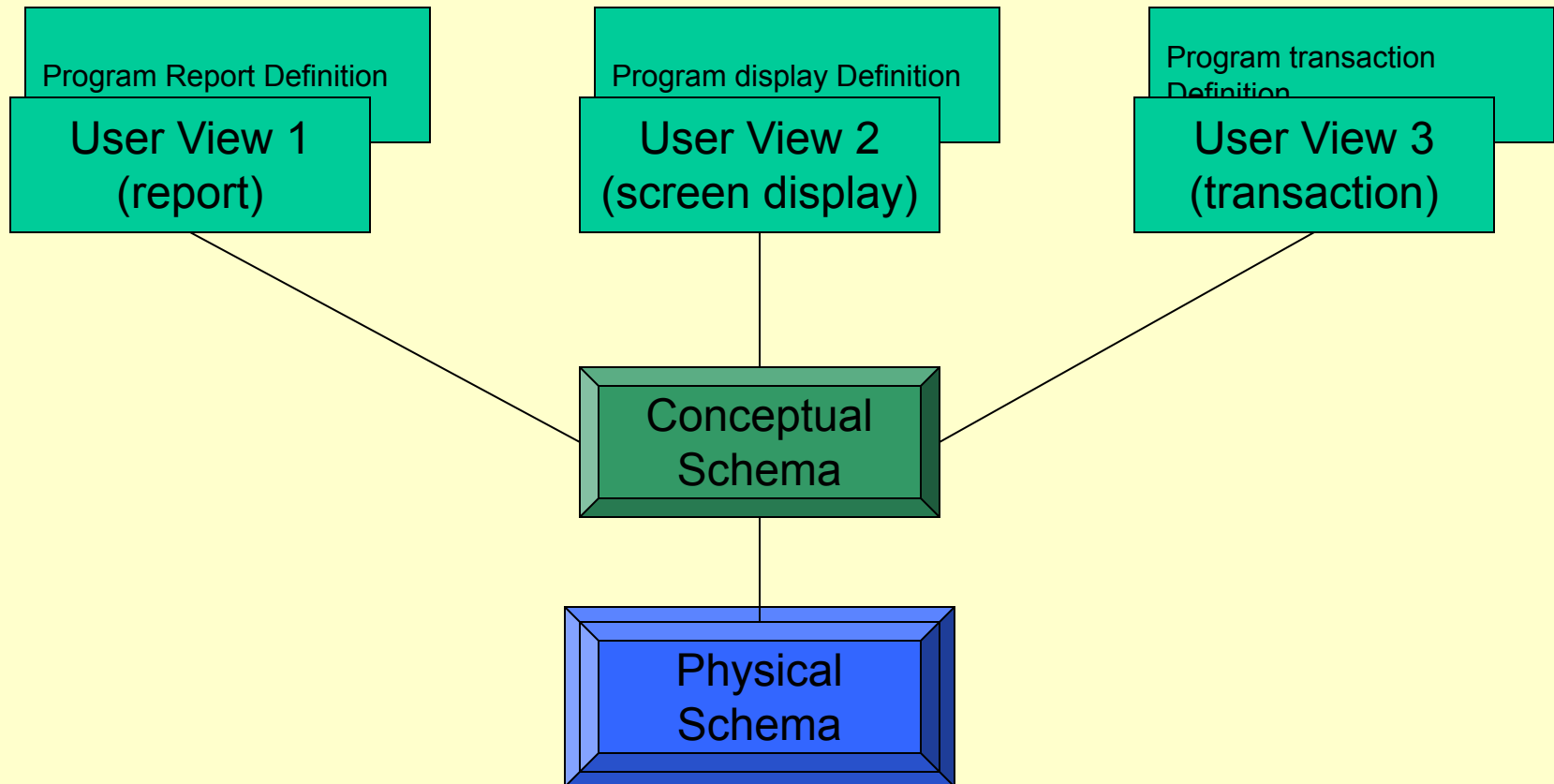
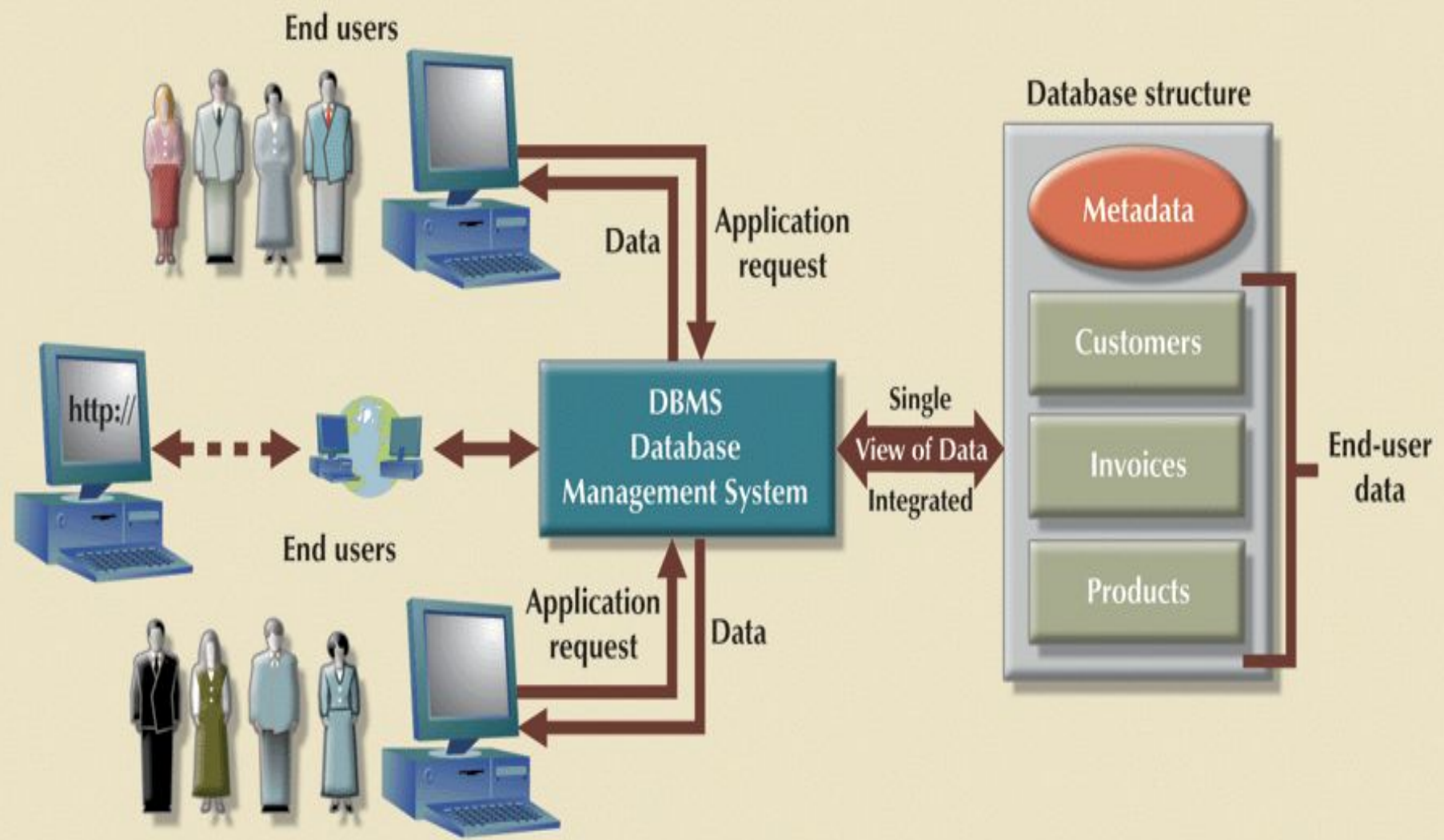


FIGURE 1.2 The DBMS manages the interaction between the end user and the database



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External Level

Sales Officer

View 1
Item_Name
Price

Inventory Controller

View 2
Item_Name
Stock

Conceptual Level

Conceptual
Item_Number Character (6)
Item_Name Character(30)
Price Numeric(5,2)
Stock Numeric(4)

Physical Level

Physical
Stored_Item Length=50
Item # Type = Byte(6), offset = 0, Index = 1x
Name Type = Byte(30), offset = 6
Price Type = Byte(8), offset = 36
Stock Type = Byte(4), offset = 44

Database Architecture

1. External Level / Layer

- It is the individual user level.
- External Schema is used to generate different external views and external records.
- An External Record is a Record as seen by a particular user.
- DBMS uses External Schema to create a User Interface, which is both facility and barrier.
- An External Record may be a virtual one created by combining different Physical Records, hiding certain data items and performing operations on them.
- The external schema evolves as the user needs are changed over time.

Database Architecture

2. Conceptual Level / Layer

- This level describes what data is stored in the database and the relationships among the data.
- It includes the logical structure of the database as seen by the DBA.
- It also includes the constraints on data, security and integrity information.
- Conceptual Schema is used to generate the conceptual view or conceptual record.
- The conceptual view is a view of the data “as it really is” rather than as seen by the users.

Database Architecture

3. Internal Level / Layer

- The physical representation of the database on the computer.
- It describes where and how the data is stored on the storage devices.
- It includes all the internal/physical details such as pointers, indexes, hashing, file organization etc.
- This level deals with low-level access methods and how bytes are transferred to and from storage devices.
- Internal Schema is used to describe the Internal Record.
- An Internal Record is a single stored record.
- Physical Level is managed by OS under the direction of DBMS.

Database Architecture

Schemas and Mappings

- The overall description of the database is called the database schema.
 - We have three schemas i.e. external schema, conceptual schema and internal schema.
 - The DBMS is responsible for mapping between these three types of schemas.
1. **The External – Conceptual Mapping** defines the correspondence between a particular External view and Conceptual view.
 2. **The Conceptual – Internal Mapping** defines the correspondence between the Conceptual view and Internal view.

Types of Data Independence

- The major objective for the three-level architecture is to provide **data independence**, which means that the upper levels are unaffected by changes to lower level.
- There are two types of data independence:
 1. Logical Data Independence
 2. Physical Data Independence.

Types of Data Independence

1. Logical Data Independence

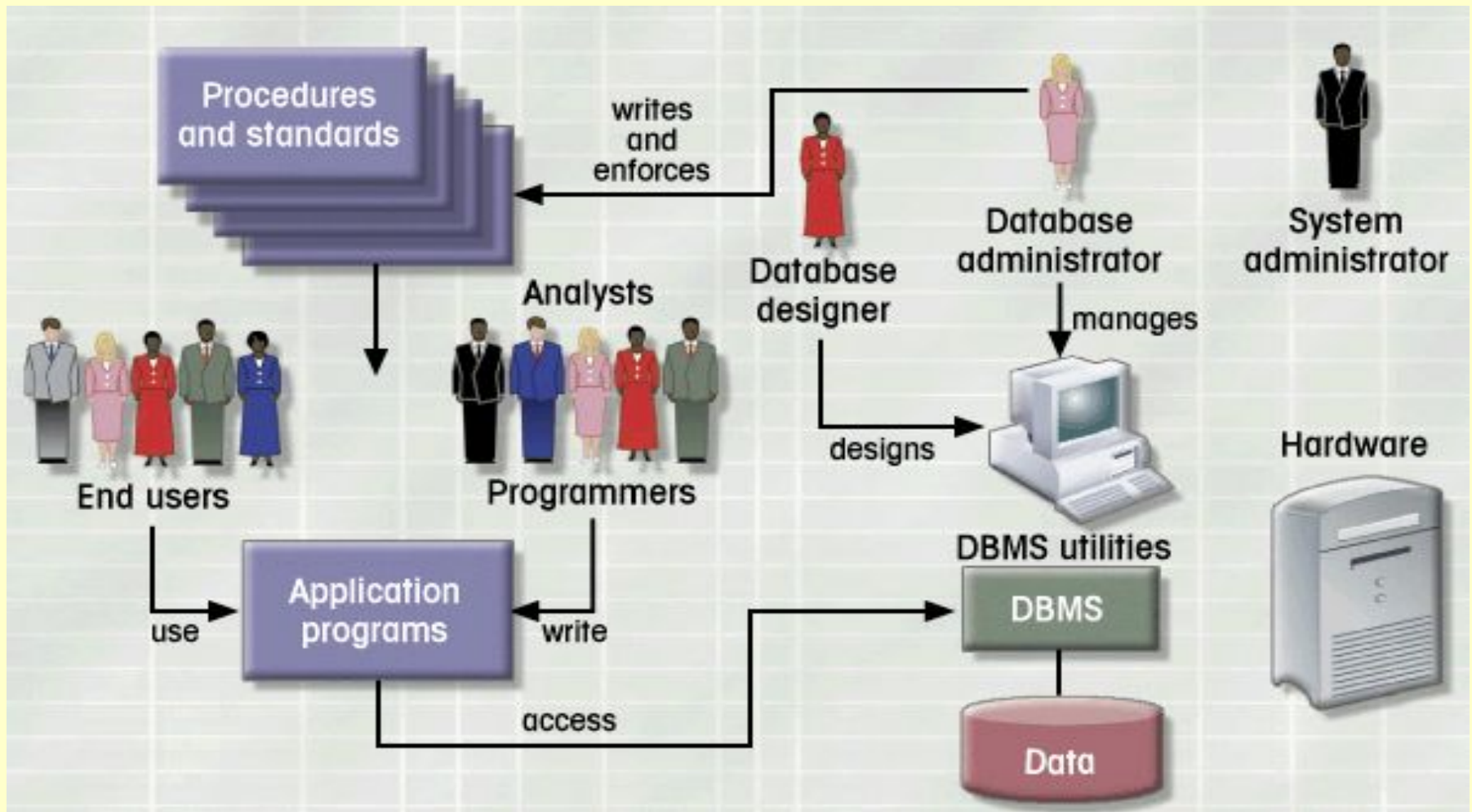
- It refers to the immunity of the external levels to the changes in the conceptual level i.e. conceptual level changes are possible without affecting the existing external levels.
- The user for whom the changes are made shouldn't affect the other users and other application programs.

Types of Data Independence

2. Physical Data Independence

- It refers to the immunity of the conceptual level to the changes in the internal level i.e. internal level changes are possible without affecting the existing conceptual level.
- The internal level changes such as a different physical sequencing of the records, switching from one access method to another, change of data structure, using new storage device etc. should have no effect on the conceptual level.

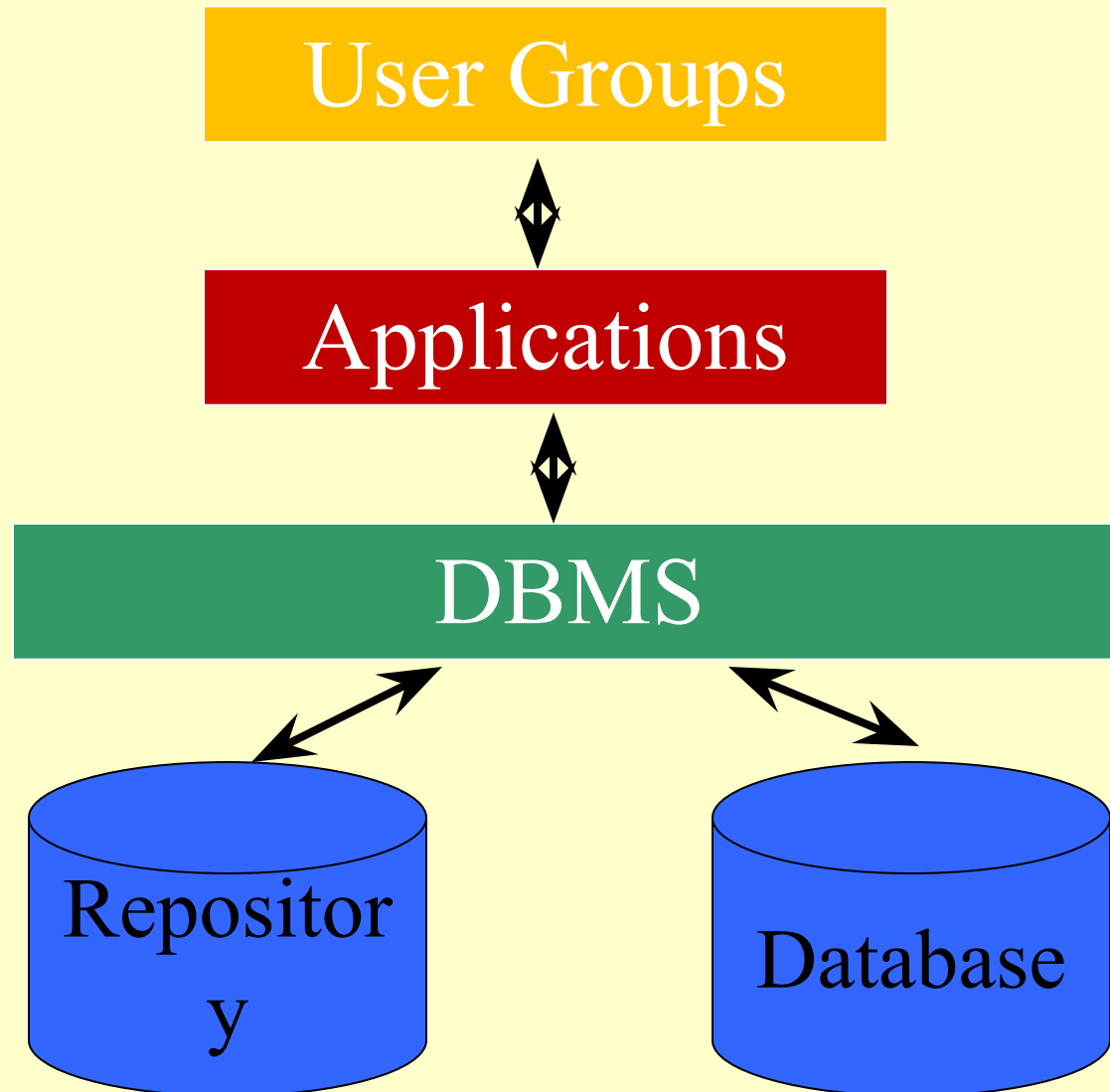
Database Environment



Components of Database Environment

1. Application Programs
2. Repository
3. Database
4. DBMS
5. User Groups

Components of Database Environment



Components of Database Environment

1. Applications

- These are the programs used to interact with DBMS and perform all the necessary operations.
- These form the **Front End** for end users
- The language used for performing different operations on database is **SQL**: Structured Query Language pronounced as Sequel.

2. Database

- An organized collection of logically related data, usually designed to meet the information needs of multiple users in organization.
- It contains all the occurrences of data i.e. Actual Data.

Components of Database Environment

3. Repository – Data Dictionary (D/D)

- It contains all the data definitions and relationships among them.
- The data contained in D/D is called **meta data**.
- The D/D may be regarded as a database in its own right, but a system database rather than a user database.
- D/D is mandatory for DBMS operations.

Components of Database Environment

4. DBMS

- Commercial software system used to define, create, maintain, and provide controlled access to the Database and also to the repository.
- Three basic functions include:
 - **Defining** a database – specifying the metadata (data types, constraints, etc.) for data storage
 - **Constructing** a database – storing data
 - **Manipulating** a database – querying the database for specific data, updating the database and generating reports from the data
- It manages all the tasks like memory management, user rights, recovery etc.
- Examples: **MS Access, Oracle, SQL Server, MySQL etc.**

Components of Database Environment

4. DBMS - Languages

- **DDL (Data Definition Language):** It allows the user to define database structure, data types and the constraints on the data to be stored in the database.
- **DML (Data Manipulation Language):** It allows the user to insert, update, delete and retrieve data from the database.
- **DCL (Data Control Language):** It allows the user to define different users of the database and their privileges.

Components of Database Environment

5. User Groups

- a) System Developers
- b) End Users
 - i) Naïve Users (Entry Level)
 - ii) Sophisticated Users (Experienced)
- c) Database Administrator (DBA)

DBA is a person responsible for overall management and control of the system.

Functions of DBMS

- Data storage, retrieval and update
- Data transformation and presentation
- Integrity services
- Transaction support
- Concurrency control services
- Recovery services
- Authorization services
- Utility services

Components of DBMS

- **DBMS** is highly complex and sophisticated piece of software that aims to provide the services as discussed.
- A DBMS is partitioned into several software components or modules, each of which is assigned a specific operation.
 - Database engine
 - Data dictionary
 - Query processor
 - Report writer
 - Forms generator
 - Communication & integration utilities
 - Security utilities