Database Management System

Database and DBMS

- Database is a persistent collection of logically related data of an organization.

- DBMS stands for "Database Management System".

- DBMS manages the database of an enterprise.

- DBMS controls access to the data and provides features for database creation, data manipulation like data modification, data retrieval, data deletion, data insertion, data integrity and security.

- It serves as an interface between the database and the end user.

DBMS Architecture- Three Level Architecture

▪ Also known " ANSI/SPARC model".

▪ It describes how the data is stored and presented to the user.

▪ It divides the system into three levels of abstraction:

i. Physical or internal level

ii. Conceptual level

iii. External or view level
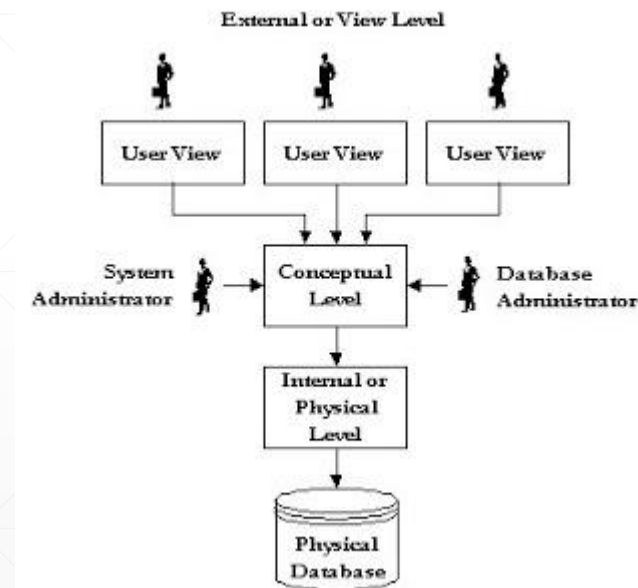
- **External or View Level**:

- It's the highest level of abstraction of database.

- It's closest to the end users.

- It provides a view to the conceptual level, this allows the user to view only the required data.

- It has many views and external schema.

- It consists of the definition of logical records and relationships in the external view.

- It contains the methods for deriving objects like entities, attributes and relationships in the external view from the conceptual view.

- **Conceptual Level or Logical level**:

- It's the middle level in the architecture.

- It provides a logical view of the entire database.

- It brings all the data in the database together and see it in a consistent manner. Therefor, there is only one conceptual schema per database.

- It describes all the data stored and relationships in the database.

- It does not give details of physical storage.

- **Internal or Physical Level**:

- Describes details of how data is stored: files, indices, etc. on the secondary storage.

- This level is very close to physical storage of data.

- At lowest level, it is stored in the form of bits with the physical addresses on the secondary storage device.

- At highest level, it can be viewed in the form of files.

- The internal schema defines the various stored data types. It uses a physical data model.

Data Independence

- It's the ability to change the schema at one level without affecting the schema at next higher level.

- Two types of data independence:

i. Logical data independence

ii. Physical data independence

- Logical data independence:

- It's provided by external/conceptual mapping.

- It defines correspondence between a particular external view and the conceptual view.

- If the structure of the database at the conceptual level is changed, then the external/conceptual mapping must change accordingly so that the view from external level remains the same.

- Physical data independence:

- It's provided by conceptual/internal mapping.

- It defines the correspondence between the records and the files of the conceptual view and the files and data structures of the interval view.

- If the structure of the database is changed, then the conceptual/ internal mapping has to be changed accordingly so that view from conceptual level remains the same.

Components of DBMS

- **Query Processor** : Its responsible for getting the query language and converting them from English-like syntax of query language to a form that DBMS understands. It contains two parts: parser and query optimizer.

  Parser receives the query language statements from application programs or command-line utilities and examines the syntax of the statements to make sure they are correct.

  Query optimizer examines the query language statement and tries to choose the most efficient way of executing them.

- **DDL Complier**: It converts the DDL statements into set of tables containing data dictionary. It coverts DDL statement into object form from source form.

- **DML Complier**: It converts DML statements into low level instructions that are more easy to understand by query evaluation engine.

- **Query Evaluation Engine**: Queries generated by DML compiler are executed in Quesry evaluation Engine.

- **Database Manager**: Database manager acts as an interface between low level data, application program and queries. It is responsible for the backup and recovery operations of database. Also it controls the consistency and integrity of data. Security is also enforced by the database manager.

- **Integrity manager**: Integrity manager check the integrity constrains like various keys Primary.

- **Buffer Manager**: It is responsible for the transfer of data between main memory and secondary storage.

- *Data Dictionary*: This is a reserved space within a database used to store information about the database itself.

- **File Manager:** File manager manages the file space and it takes care of the structure of the file. It manages the allocation space on disk storage and the data structures used to represent information stored on other media.

- **Data Dictionary**: The data dictionary contains the data about the data. The information about attributes, entity, mapping & cross reference information is contained in the data dictionary.

Overall Structure of DBMS.

System structure
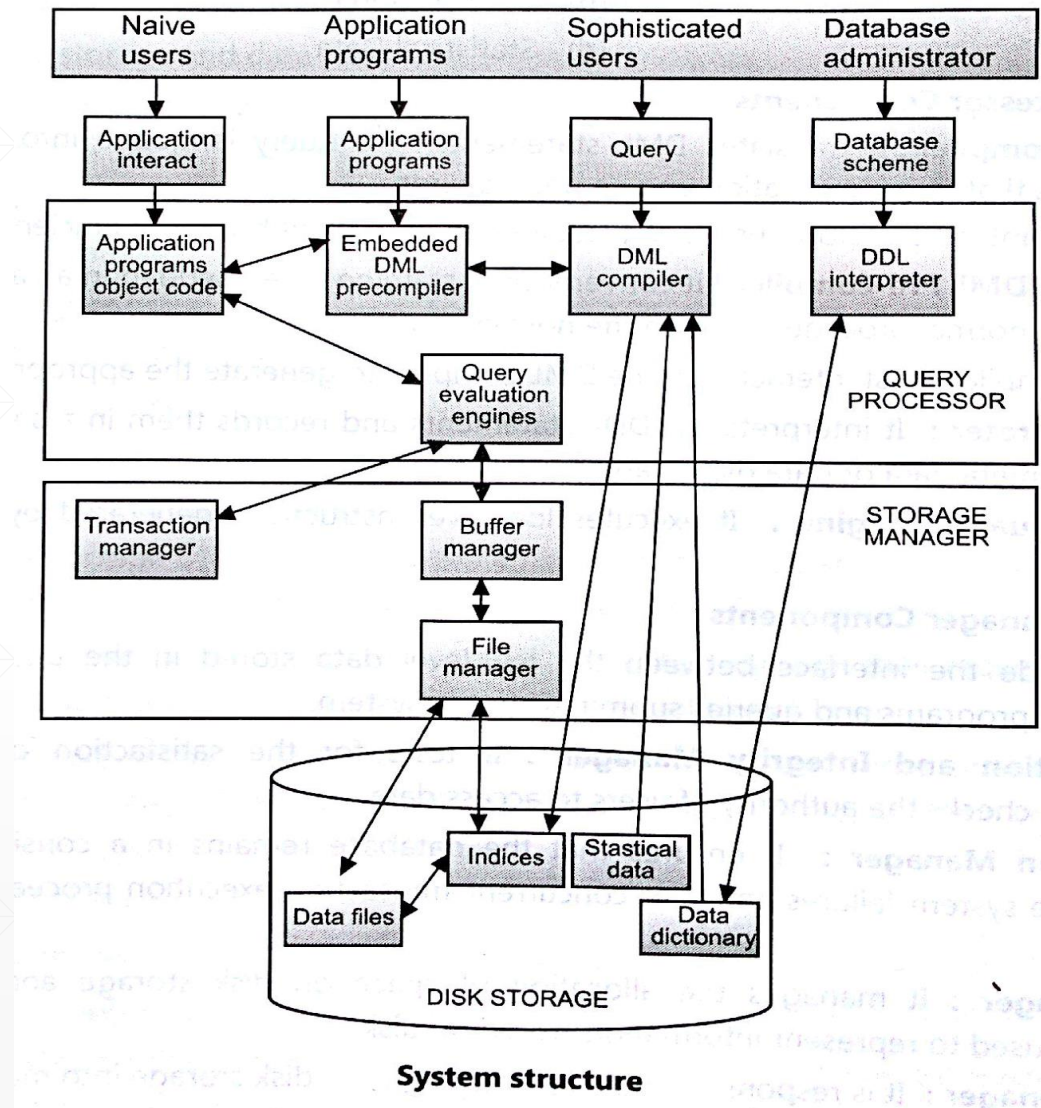
Types of DBMS

- 4 types of DBMS:

1. Hierarchical

2. Network

3. Relational

4. Object-oriented database

Users of DBMS

▪ People who manage the databases and perform different operations on the databases in the database system are called users.

▪ Three users of DBMS:

1.   Application Programmers

2.   Database Administrators

3.   End-Users

▪ **Application Programmers**: The people who write application programs in programming languages (such as Visual Basic, Java, or C++) to interact with databases are called Application Programmer.

▪ **Database Administrators** : A person who is responsible for managing the overall database management system is called database administrator or DBA.

▪ **End-Users**: The people who interact with database management system to perform different operations on database such as retrieving, updating, inserting, deleting data etc. are called end-users.

Advantages of DBMS

- **Improved Backup and Recovery**: Backup and Recovery system provides features for recovering database from hardware and software failures. When a program fails, it restores the database to a state in which it was before execution of the program.

- **Multiuser and Concurrent Access**: DBMS allows multiple transactions to occur at the same time . Though there are restrictions on transactions when users attempt to handle the same data item, but users are always unaware of them.

- **Sharing of Data**: Data can be shared by authorized users of the organization. The database administrator is responsible for this.

- **Data consistency**: In DBMS, data is stored in a single place so this does not permit data inconsistency.

- **Data Independence**: The separation of data structure of database from the application program that uses the data is called data independence. In DBMS, you can easily change the structure of database without modifying the application program.

- **Report Writers:** DBMS provides tools to create reports quickly and easily. The created reports are also saved.

- **Improved Integrity**: Data Integrity refers to validity and consistency of data. Data integrity means data should be accurate and consistent. This is done by providing some checks or constraints. Constraints are consistency rules that database should not violate.

- **Maintaining Cost** : DBMS systems are costly but after purchasing them their maintenance cost is very less. It can be maintained by few programmers that is not costly for an enterprise.

- **Powerful User Language**: A DBMS permits end users to use database without having special training or expertise. Any untrained user can easily query, search and updates data in database. He can easily generate report or documents with less knowledge.

- **Creating Forms:** Forms can be created quickly and easily. The created reports are also saved.

- **Efficient Data Access**: It provides techniques to retrieve and store data efficiently for unforeseen queries. It provides the data immediately to the end users.

- **Reduction of Redundancies:** In database approach data is stored at a single place or with controlled redundancy under DBMS, this saves space and does not permit inconsistency.

- **Improved Security**: Data of an organization is vital and confidential. In a shared system where multiple users share the data, all information should not be shared by all users. Database should be protected from unauthorized users. This is done by the DBA(Database Administrator) by providing username and password for the authorized users only.

Disadvantages of DBMS

- It is bit complex. Since it supports multiple functionality to give the user the best, the underlying software has become complex. The designers and developers should have thorough knowledge about the software to get the most out of it.

- Because of its complexity and functionality, it uses large amount of memory. It also needs large memory to run efficiently.

- DBMS system works on the centralized system, i.e.; all the users from all over the world access this database. Hence any failure of the DBMS, will impact all the users.

- DBMS is generalized software, i.e.; it is written work on the entire systems rather specific one. Hence some of the application will run slow.

- A team of technical staff is required who understand DBMS and company have to pay handsome salary to them too.

Applications of DBMS

- **Banking**: used for storing customer information, account, payments, loan, deposits and transactions.

- **Universities**: used for storing course details, student details, colleges and grades.

- **Airlines**: used for storing reservation details and schedules.

- **Telecommunication**: used for keeping track of calls made, generating monthly bills, storing information about communication network.

- **Sales**: used for storing customer, product and sales information.

- **Credit Card Transactions**: used for storing information about purchases on credit cards and generation of monthly statements.