

## Lecture Handout

### *Database Management System*

#### Lecture No. 02

#### Reading Material

“Database Systems Principles, Design and Implementation” written by Catherine Ricardo, Maxwell Macmillan.	
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#### **Overview of Lecture**

- Some Additional Advantages of Database Systems
- Costs involved in Database systems
- Levels of data
- Database users

#### **Difference between Data and Information**

Data is the collection of raw facts collected from any specific environment for a specific purpose. Data in itself does not show anything about its environment, so to get desired types of results from the data we transform it into information by applying certain processing on it. Once we have processed data using different methods data is converted into meaningful form and that form of the Data is called information

Example:

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Data & Information			
Company: Super Soft		Dept: Sales	
Emp Name	Age	Salary	
Malik Sharif	23	55	
Sh. M. Akmal	24	55	
M. A. Butt	20	40	
Malik Junaid	19	20	

Fig. 1: Data and Information

If we consider the data in the above figure without the titles or the labels associated with the data (EmpName, age, salary) then it is not much useful. However, after attaching these labels it brings some meanings to us, this meaningfulness is further increased when we associate some other labels, like the company name and the department name etc. So this is a very simple example of processing that we can do on the data to make it information.

Once we have clear idea of what data and information is we proceed with another term known as “schema” Schema is a repository or structure to express the format and other different information about data and database, as we can see from the database definition “Database is a self describing collection of interrelated records.” The word self describing means that the data storage and retrieval mechanism and its format is described in the database, Actual place where these definitions and descriptions are performed is database schema.

#### ○ **Database Application:**

Database Application is a program or group of programs which is used for performing certain operations on the data stored in the database. These operations may contain insertion of data into a database or extracting some data from the database based on a certain condition, updating data in the database, producing the data as output on any device such as Screen, disk or printer.

#### ○ **Database Management Systems:**

Database management system is software of collection of small programs to perform certain operation on data and manage the data.

Two basic operations performed by the DBMS are:

- Management of Data in the Database
- Management of Users associated with the database.

Management of the data means to specify that how data will be stored, structured and accessed in the database.

Management of database users means to manage the users in such a way that they can perform any desired operations on the database. DBMS also ensures that a user can not perform any operation for which he is not allowed. And also an authorized user is not allowed to perform any action which is restricted to that user.

In General DBMS is a collection of Programs performing all necessary actions associated to a database.

### **Further Advantages of Database Systems:**

Database systems are very much beneficent to enterprises and businesses, some of the advantages are listed below:

- Data consistency
- Better data security
- Faster development of new applications
- Economy of scale
- Better concurrency control
- Better backup and recovery procedures

- **Data Consistency:**

Data consistency means that the changes made to different occurrence of data should be controlled and managed in such a way that all the occurrences have same value for any specific data item. Data inconsistency leads to a number of problems, including loss of information and incorrect results. In database approach it is controlled because data is shared and consistency is controlled and maintained.

- **Better Data Security:**

All application programs access data through DBMS, So DBMS can very efficiently check that which user is performing which action and accessing which part of data , So A DBMS is the most effectively control and maintain security of Data stored in a database.

○ **Faster Application Development:**

The database environment allows us faster application development because of its many reasons. As we know that database is designed with the factor of future development in mind

So whenever we have to build a new application to meet the growing needs of the computerized environment, it may be easy due to the following reason:

- The data needed for the new application already resides in the database.
- The data might not already reside in the database but it could be derived from the data present in the database

Thus we can say that, to develop a new application for an existing database system less effort is required in terms of the system and database design.

○ **Economy of Scale:**

Databases and database systems are designed to share data stored in one location for many different purposes, So it needs not be stored as many number of times in different forms as it is used, for example the data used by Admission Department of any education institution can be used to maintain the attendance record of the students as well as the examination records of the students. So it saves us lots of efforts and finances providing economy of scale.

○ **Better Concurrency Control:**

Concurrency means the access of database form as number of points simultaneously. Concurrency control means to access the database in such a way that all the data accesses are completed correctly and transparently. One example of controlled concurrency is the use of ATM Machine for withdrawal of money (cash). All ATM machines of a bank are interconnected to a central database system worldwide, so that a user can access its account from anywhere in the world and can get cash from any ATM terminal. As there are thousands of ATM terminal across the world for a specific bank so as a result thousands of user process and access the bank's database. All this process is managed

concurrently using the database systems and is done in such an efficient manner that no two user face any delay in the processing of their requests.

○ **Better Backup and Recovery Facility:**

Data is a very important resource and is very much valuable for any organization, loss of such a valuable resource can result in a huge strategic disasters. As Data is stored on today's storage devices like hard disks etc., It is necessary to take periodic backups of data so that in case a storage device loses the data due to any damage we should be able to restore the data at a nearest point, Database systems offer excellent facilities for taking backup of data and good mechanism of restoring those backups to get back the backed-up data.

At some time happens that a database which was in use and very important transactions were made after the last backup was made, all of a sudden due to any disastrous situation the database crashes (improper shutdown, invalid disk access, etc.) Now in such a situation the database management system should be able to recover the database to a consistent state so that the transactions made after the last backup are not lost.

**Cost Involved:**

Enjoying all these benefits of the database systems do have some additional costs on any organization which is going to adopt a database environment. These charges may also be known as the disadvantages of the database system. Different types of costs (Financial and Personnel) which an organization faces in adopting a database system are listed below:

○ **High Cost:**

Database Systems have a number of inherent charges which are to be borne by any organization that is going to adopt it. High Cost is one of these inherent charges, it includes the need for specialized software which is used to run database systems, Additional and specialized hardware and technically qualified staff are the requirements for adopting to the database system, all these requirements need an organization to invest a handsome amount of money to have all the requirements of the database systems.

- **Conversion Cost:**

Once an organization has decided to adopt database system for its operations, it is not only the finance and technical man-power which is required for switching on to database system, it further has some conversion charges needed for adopting the database system, this is also a very important stage for making decision about the way the system will be converted to database system.

- **Difficult Recovery Procedures:**

Although the database systems and database management systems provide very efficient ways of data recovery in case of any disaster, still the process of recovering a crashed database is very much technical and needs good professional skills to perform a perfect recovery of the database.

## **Importance of Data**

- **Data as a Resource:**

A resource is anything which is valuable for an organization. There can be a number of resources in any organization, for example, Buildings, Furniture, Vehicle, Technical Staff, Managers, supporting staff and Machinery etc. As all these are resources for organizations and are consumed very much carefully to get full benefit out of them, Data in the same way is a very important resources and needs to be considered equally important as other resources are considered.

*Why we call data as a resource?*

Data is truly considered a resource because for an organization to make proper decisions at proper time it is only the data which can provide correct information and in-turn cause good utilization of other organizational resources. Organizations can not make good and effective decisions if the required data is not available in time or in the correct and desired format, such bad and miscalculated decisions ultimately lead to the failure of organizations or business.

## **Levels of Data**

- **Real World Data**

The real world level of data means that level of data at which entities or objects exist in reality, it means that any object existing in reality have a name and other identifiable attributes through which we can identify that specific object or entity.

Example:

Any Student

○ **Meta Data:**

For storage of the data related to any entity or object existing at real world level we define the way the data will be stored in the database. This is called Meta data. Meta data is also known as schema for the real world data. It tells that what type of data will be stored in the database what will be size of a certain attribute of the real world data, how many and what attributes will be used to store the data about the entity in the database.

Example:     Name ,Character Type, 25 character size field,  
                 Age,                      Date type,        8 bytes size  
                 Class,                   Alpha Numeric,        8 byte size field

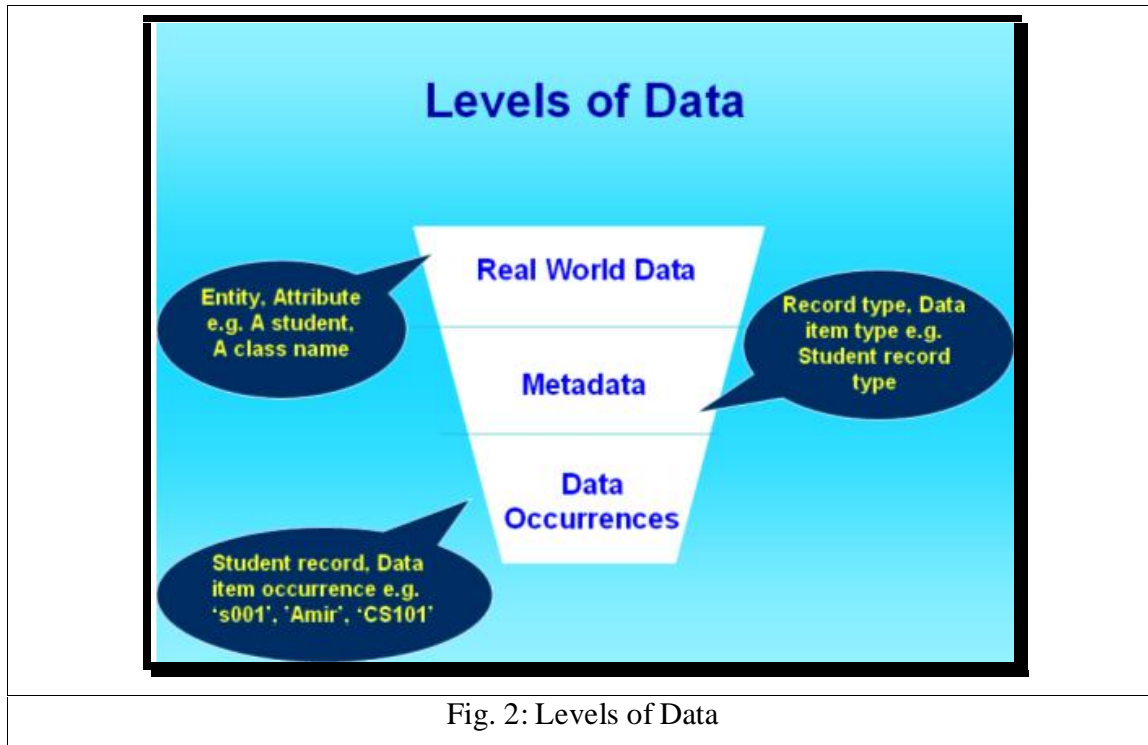
○ **Existence of Data:**

Existence of the data level shows the actual data regarding the entities as real world level according to the rules define at the Meta Data level.

Example:

According to the definition given in the Meta data level the Actual data or Data occurrence for the entity at real world level is shown below:

Name	Age	Class	
Ali	20/8/1979	MCS-I	
Amir	22/3/1978	MCS-II	etc...



### Users of Database Systems:

- Application Programmers
- End Users
  - Naïve
  - Sophisticated

#### ○ **Application programmers:**

This category of database users contains those people who create different types of database application programs that we have seen earlier. Application programmers design the application according to the needs of the other users of the database in a certain environment. Application programmers are skilled people who have clear idea of the structure of the database and know clearly about the needs of the organizations.

#### ○ **End Users:**



Second category of the Database users are the end users, this group of users contains the people who use the database application programs developed by the Application programmers. This category further contains two types of users

- Naïve Users
- Sophisticated Users

- Naïve Users

This category of users is that category who simply use the application database programs created by the programmers. This groups has no interaction with other parts of there database and only use the programs meant for them. They have not to worry about the further working of the database.

- Sophisticated Users:

This type of users has some additional rights over the Naïve users, which means that they can access the data stored in the database any of their desired way. They can access data using the application programs as well as other ways of accessing data. Although this type of users has more rights to access data, but these users have to take more responsibility and they need to be aware of the database structure. Moreover such users should be skilled enough to be able to get data from database with making and damage or loss to the data in database.

- **Database Administrators (DBA):**

This class of database users is the most technical class of db users. They need to have the knowledge of how to design and manage the database use as well as to manage the data in the database. DBA is a very responsible position in an organization. He is responsible for proper working of the database and DBMS, has the responsibility of making proper database backups and make necessary actions for recovering the database in case of a database crash. To fulfill the requirements of a DBA position a DBA needs vast experience and very elegant technical skills.

- **Duties of the DBA**

A Database administrator has some very precisely defined duties which need be performed by the DBA very religiously. A short account of these jobs is listed below:

- Schema definition
- Granting data access
- Routine Maintenance
  - Backups
  - Monitoring disk space
  - Monitoring jobs running

○ **Schema Design**

DBA in some organization is responsible for designing the database schema, which means that DBA is the person who create all the meta Data information for the organization on which the database is based. However in some very large scale organizations this job is performed by the Database designer, which is hired for the purpose of database Design and once the database system, is installed and working it is handed over to the DBA for further operation.

○ **Granting Access to Users:**

DBA is also responsible for grant of access rights to the database users. Along with granting and revoking (taking back) the rights the DBA continuously monitors and ensure the legal use of these rights.

○ **Monitoring Disk Space :**

When a new database is created it takes a limited space but as a result of daily activity the database acquires more data and grows in size very rapidly. The DBA has to monitor the disk space usage and statistics to ensure that no data over flow occurs at any stage.

○ **Monitoring Running Jobs:**

To ensure the secure and proper functioning of the database system a DBA continuously monitors some associated activities also and ensure that all users are using their authorities legally and different devices attached to the database system are functioning properly.

Typical Components of a Database Environment:

Different typical components of a database environment are shown in the figures below; they describe graphically the role of different types of users.

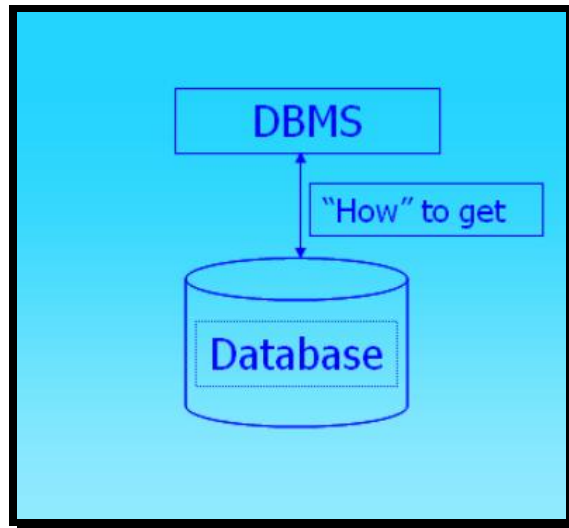


Fig. 3: DBMS and Database

Database is used to store data and DBMS uses mechanisms to get data from the database

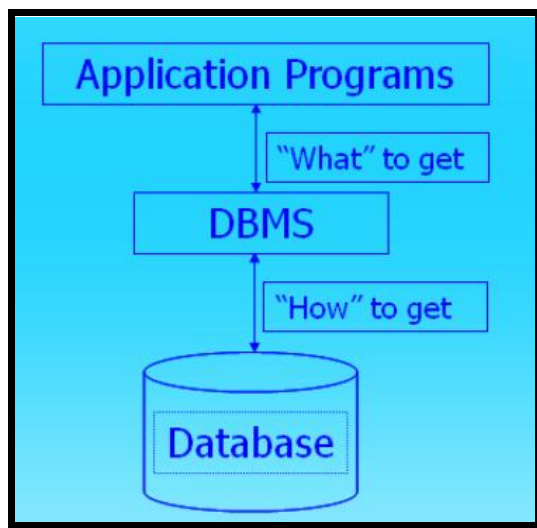


Fig. 4: Application Programs

Application programs talk to DBMS and ask for the data required

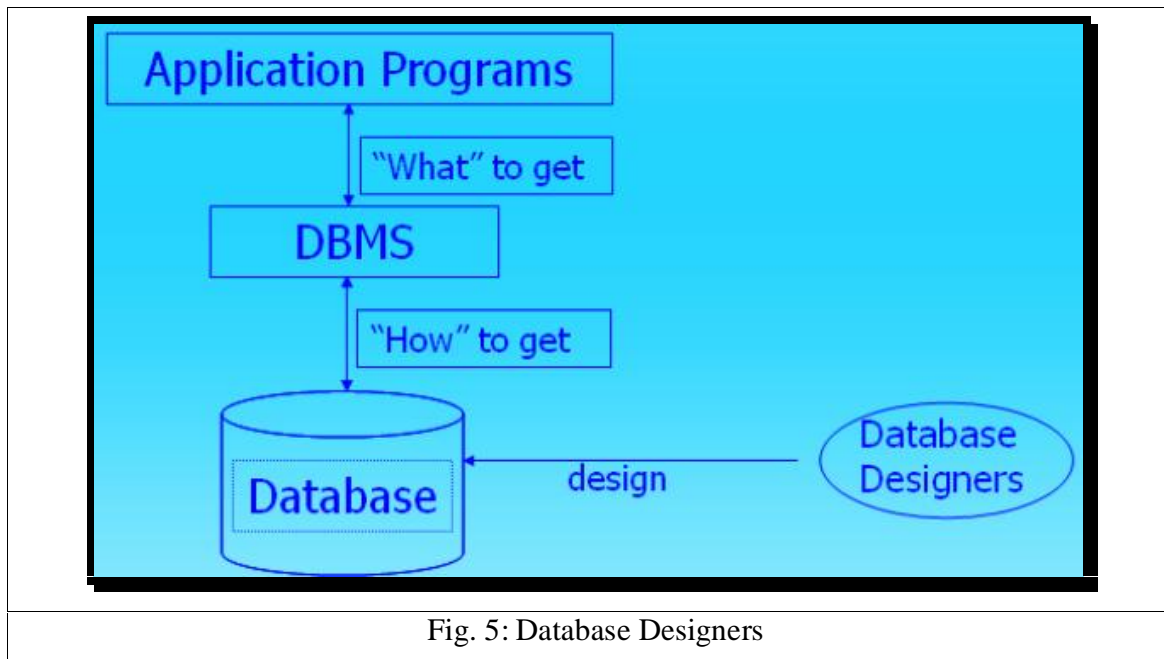


Fig. 5: Database Designers

Database designers design (for large organizations) the database and install the DBMS for use by the users of the database in any specific organization.

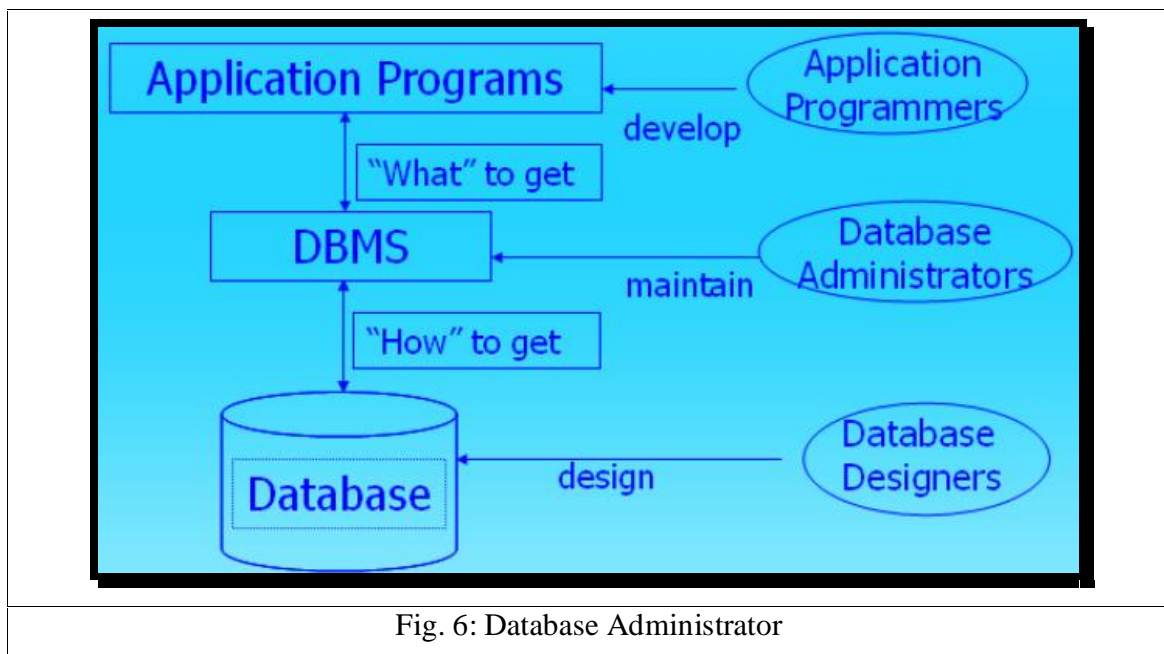


Fig. 6: Database Administrator

Once Database has been installed and is functioning properly in a production environment of an organization the Database Administrator takes over the charge and performs specific DBA related activities including:

- Database maintenance.
- Database Backup.
- Grant of rights to database users.
- Monitoring of Running Jobs
- Managing Print jobs
- Ensuring quality of Service to all users.

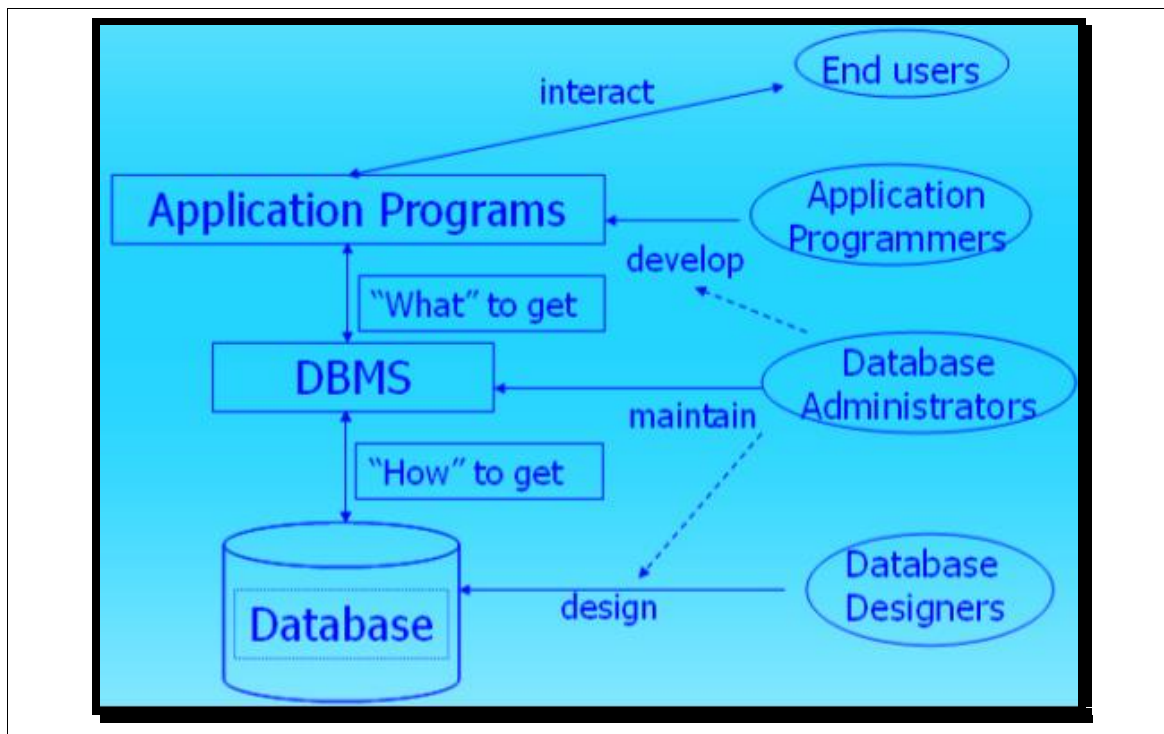


Fig. 7: Database Administration's interaction with other users

- Database administrator can interact with the database designer during database design phase so that he has a clear idea of the database structure for easy reference in future.
- This helps DBA perform different tasks related to the database structure.
- DBA also interacts with the application programmers during the application development process and provides his services for better design of applications.

- End users also interact with the system using application programs and other tools as specified in the description above.

This concludes lecture number 2, in case of any queries, please feel free to contact.