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Introduction

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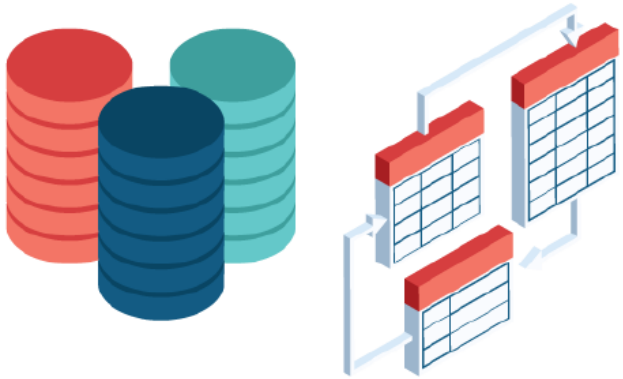
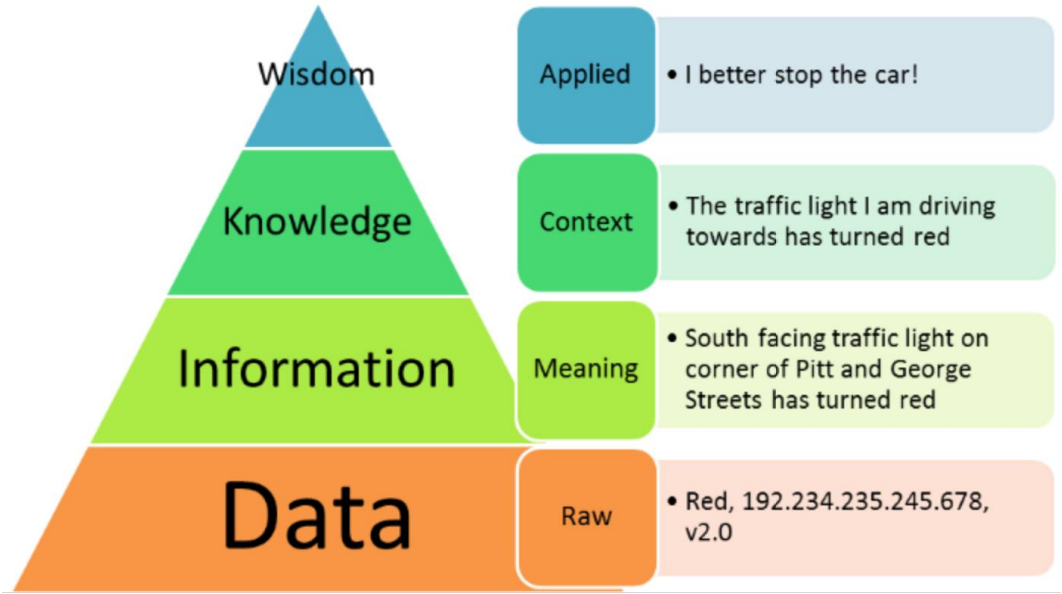


DATA & INFORMATION

- Data is the raw input (numbers, characters, images…) which when processed or arranged makes meaningful output (Information).
- Data is the lowest level of knowledge and information is the second level.
- Data by itself alone is not significant. Information is significant by itself.
- Observations and recordings are done to obtain data, while analysis and processing are done to obtain information.



DATA STORAGE SYSTEMS

- Manual filing system
- File-Based System
- DB system

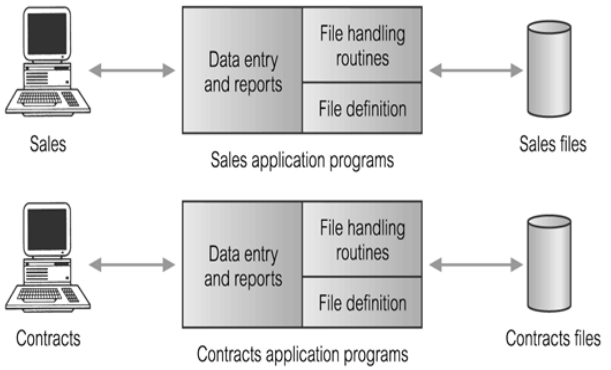
MANUAL FILE SYSTEMS

- Files are labelled and stored in one or more cabinets. For security, the cabinets may have locks or may be located in secure areas of the building.

- ***Problems***
  - Searching
  - Retrieving data from multiple files
  - Production of detailed monthly, quarterly, and annual reports
  - Physical problems

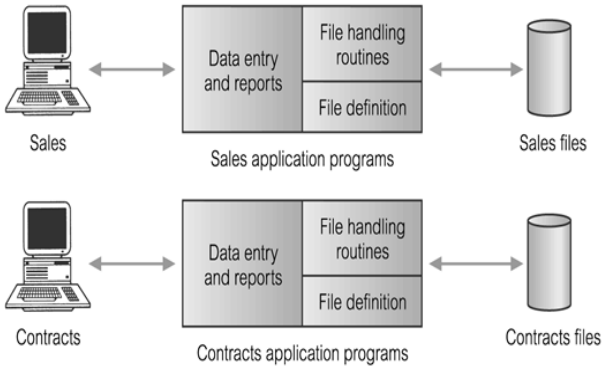
FILE BASED SYSTEM

- One way to keep information on a computer is to store it in permanent files.
- A company system has a number of application programs; each of them is designed to manipulate data files.
- Early attempt to computerize the manual filling system , each Program defines and manages its own data.
- Collection of application programs that perform services for the end users.
- *Each program defines and manages its own data.*



FILE BASED SYSTEM

- *Each program defines and manages its own data.*



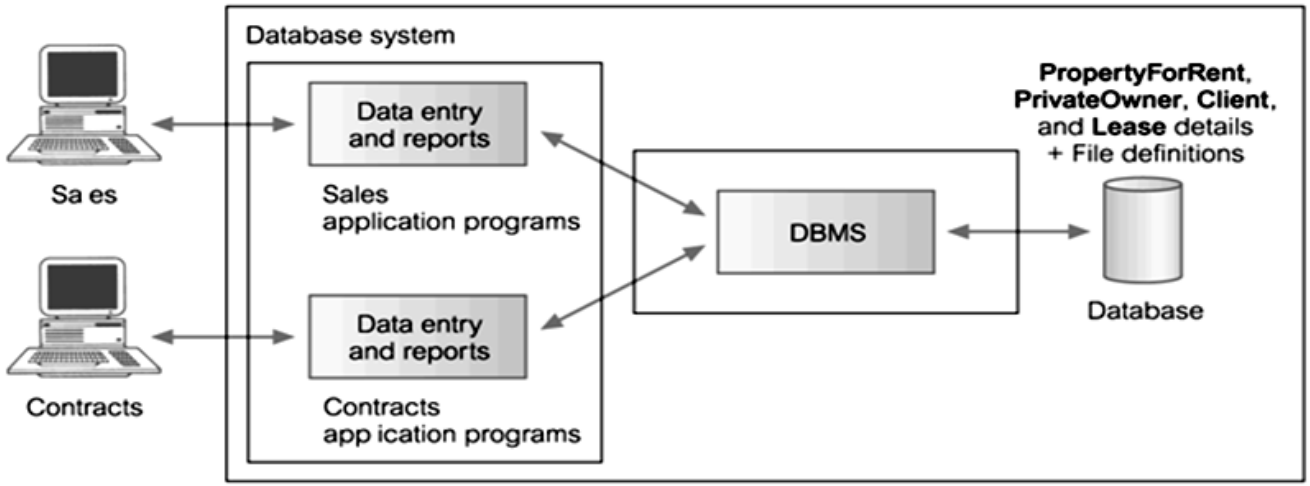
- **A file** is simply a collection of records, which contains logically related data.
- Each **record** contains a logically connected set of one or more fields,
- Where each **field** represents some characteristic of the real-world object that is being modelled.

FILE-BASED SYSTEMS DISADVANTAGES

- Separation & Isolation Of data (each user has a copy) (no sharing)
- Data Redundancy (Duplication of data)
  - Inconsistency in data format
- Integrity problems
- Difficulty in accessing data
    - Need to write a new program to carry out each new task
- Atomicity of updates
- Security problems (no constraints)
- Concurrency control (no concurrency)

WHAT IS A DATABASE ?

- Databases and database systems are an essential component of life in modern society
- A database is an organized shared collection of related data used to support the activities of a particular organization



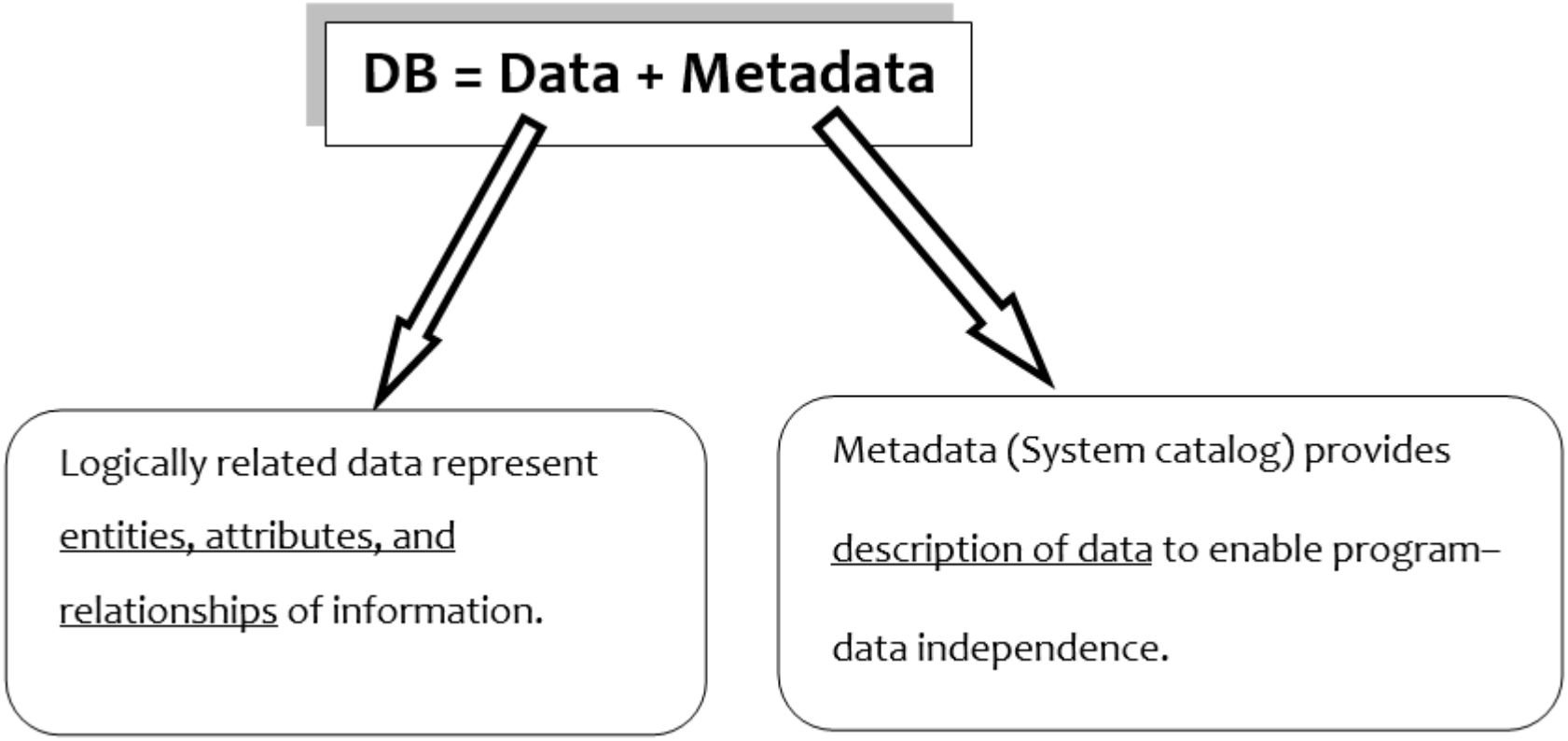
DATABASE PROPERTIES

- Represents the real world.
- Logically coherent collection of data.
- Designed, built, and populated for a specific purpose.
- Any size and of varying complexity.
- Generated and maintained manually or by machine.

DATABASE TYPES

- **Traditional database applications**
  - Store textual or numeric information
- **Multimedia databases**
  - Store images, audio clips, and video streams digitally
- **Geographic information systems (GIS)**
  - Store and analyze maps, weather data, and satellite images
- **Data warehouses systems**
  - Extract and analyze useful business information from very large databases
  - Support decision making

DATA && METADATA



DATA && METADATA

Structured Object

Data

- Actual Stored Data

Metadata

- Data about Data.
- Describes the structure "tables. definitions".

Area	Corresponding Data Needed
• University	• Students, Staff, Facilities, Building.....
• Companies	• Product, Employee, Customers, Accounts
• Hospital	• Patient, Employee, Doctors, Pharmacy.....
• Library	• Book, Publisher.....
• Lab	• Machine, Maintains Co.
• Bank	• Customers, Employee
.....	.....

Attribute Name	Type	Comment
Patient_Id #	Number	*Primary Key*
Name	Character	
Age	Number	
City	Character	
Phone_number	Number	
diagnosis	Character	between(Ca, Ked,Heart)
.....	.....	.....

MAIN CHARACTERISTICS OF DATA IN DATABASE APPROACH

- Self-describing nature of a database system
- Insulation between programs and data, and data abstraction
- Support of multiple views of the data
- Sharing of data and multiuser transaction processing

SELF-DESCRIBING NATURE OF A DATABASE SYSTEM

- A fundamental characteristic of the database approach is that the database system contains not only the database itself but also a complete definition or description of the database structure and constraints.
- This definition is stored in the DBMS catalog, which contains information such as the structure of each file, the type and storage format of each data item, and various constraints on the data.
- The information stored in the catalog is called meta-data, and it describes the structure of the primary database.
- It is important to note that some newer types of database systems, *known as NOSQL systems, do not require meta-data*. Rather the data is stored as self-describing data that includes the data item names and data values together in one structure.

INSULATION BETWEEN PROGRAMS AND DATA, AND DATA ABSTRACTION

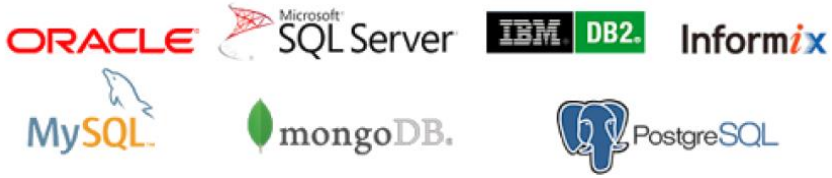
- **In the file-based system,** the structure of the data files is defined in the application programs so if a user wants to change the structure of a file, all the programs that access that file might need to be changed as well.
- On the other hand, **in the database approach**, the data structure is stored in the system catalogue and not in the programs.
- Therefore, one change is all that is needed to change the structure of a file. This insulation between the programs and data is also called program-data independence

SUPPORT OF MULTIPLE VIEWS OF THE DATA

- A database typically has many types of users, each of whom may require a different perspective or **view** of the database.
- A view may be a subset of the database or it may contain **virtual data** that is derived from the database files but is not explicitly stored.
- Some users may not need to be aware of whether the data they refer to is stored or derived.

DATABASE MANAGEMENT SYSTEM(DBMS)

- **It is the intermediate layer between the database and the programs that access the data.**
- **It is collection of programs that enables users to create and maintain a database and control access to them.**
- The DBMS is a *general-purpose software system* that facilitates the processes of *defining*, *constructing*, *manipulating*, and *sharing* databases among various users and applications.
- **Defining** a database involves specifying the data types, structures, and constraints of the data to be stored in the database. The database definition or descriptive information is also stored by the DBMS in the form of a database catalog or dictionary; it is called **meta-data**.
- **Constructing** the database is the process of storing the data on some storage medium that is controlled by the DBMS.



DATABASE MANAGEMENT SYSTEM(DBMS)

- **Manipulating** a database includes functions such as querying the database to retrieve specific data, updating the database to reflect changes in the miniworld, and generating reports from the data.
- **Sharing** a database allows multiple users and programs to access the database simultaneously
- Other important functions provided by the DBMS include *protecting* the database and *maintaining* it over a long period of time.
- **Protection** includes *system protection* against hardware or software malfunction (or crashes) and *security protection* against unauthorized or malicious access. A typical large database may have a life cycle of many years, so the DBMS must be able to **maintain** the database system by allowing the system to evolve as requirements change over time.

DBMS FUNCTIONS

- **Constructing Database.**
- Manipulating Database.
- **Data Security**
- **Data Integrity.**
- Concurrency.
- Backup & Recovery.
- Data Dictionary (Meta Data).
- Performance.

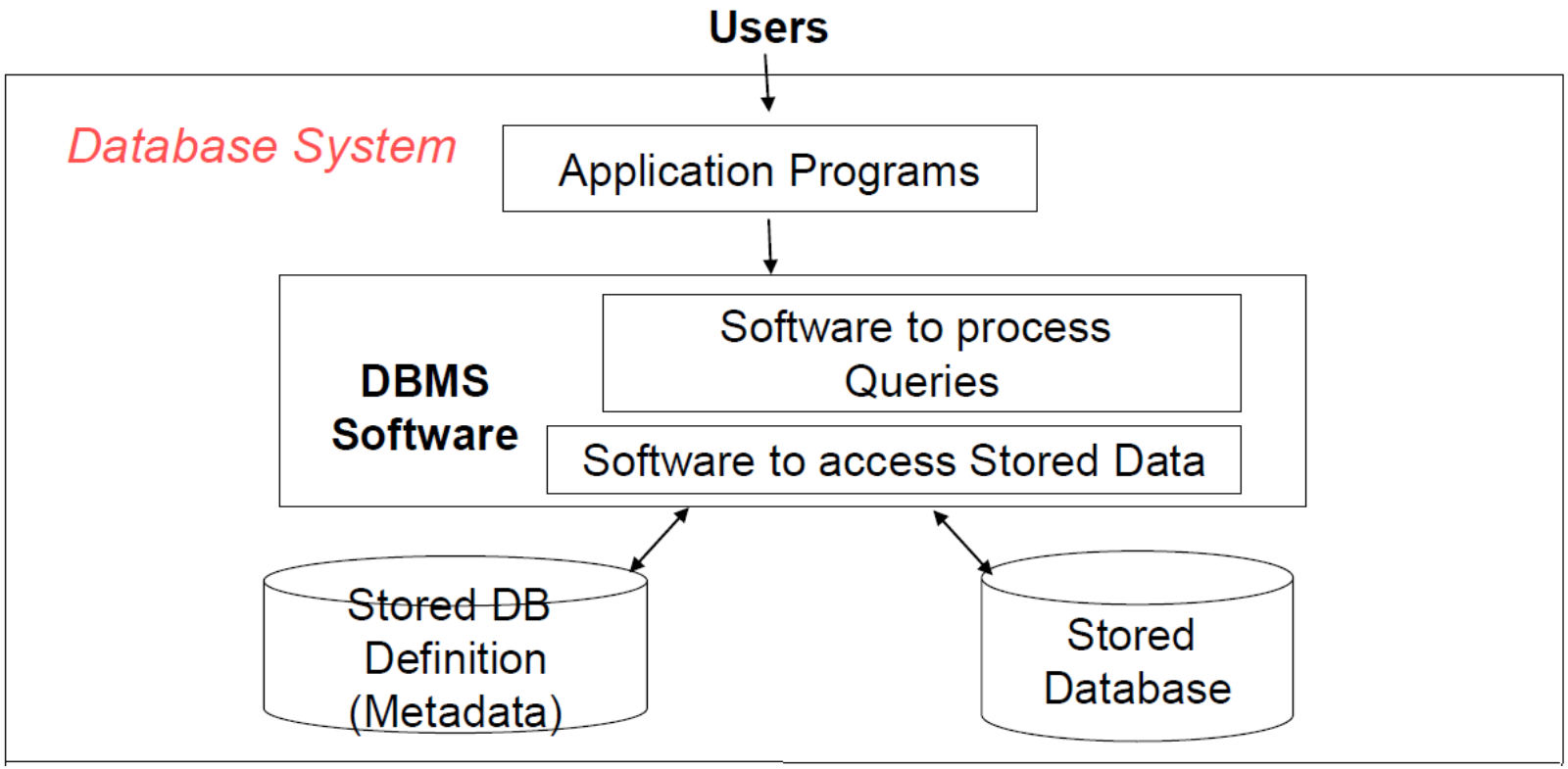
ADVANTAGES OF DATABASE

- Redundancy can be reduced.
- Inconsistency can be avoided.
- Data can be shared.
- Security restrictions can be applied.
- Enforcing Integrity Constraints.
- Providing Backup and Recovery

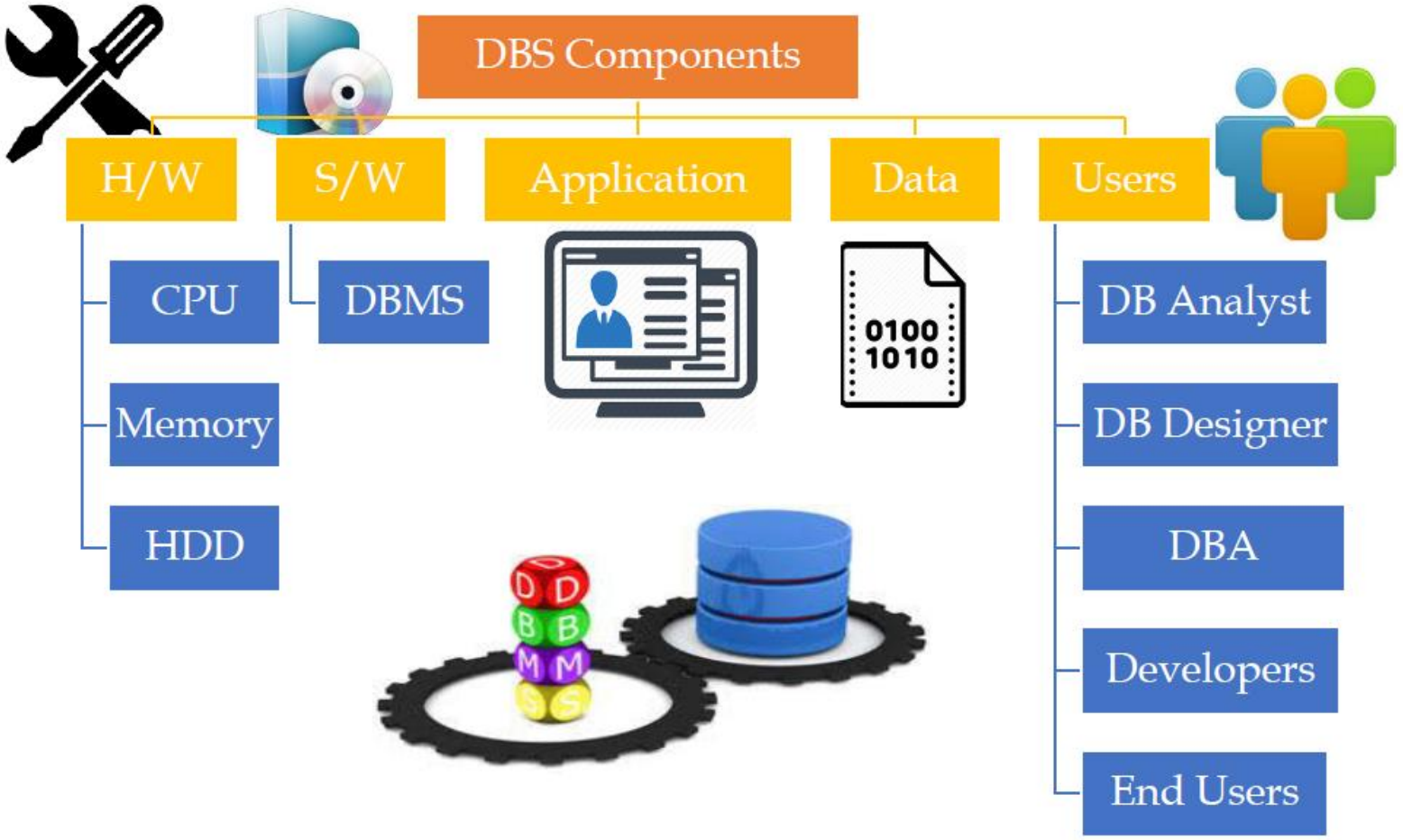
DISADVANTAGES OF DATABASE

- It needs expertise to use.
- DBMS itself is expensive.
- DBMS may be incompatible with any other available DBMS.

DATABASE SYSTEM



DATABASE SYSTEMS COMPONENTS

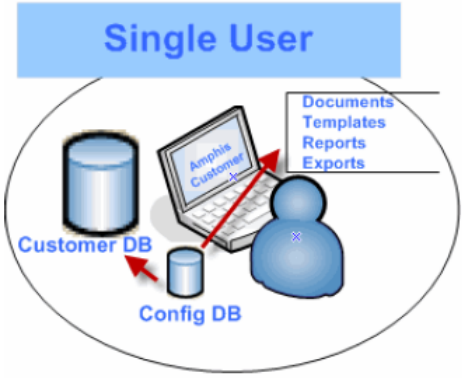


DATABASE SYSTEMS COMPONENTS

- An **application program** accesses the database by sending queries or requests for data to the DBMS.
- A **query** typically causes some data to be retrieved
- a **transaction** may cause some data to be read and some data to be written into the database.

SINGLE USER VS. MULTIUSER DBS

- **A single-user DBS** is a system in which at most one user can access the database at any given time "Data is integrated and shared".
- **A multi-user DBS** is a system in which many users can access the database at the same time "Data is integrated and shared concurrently".

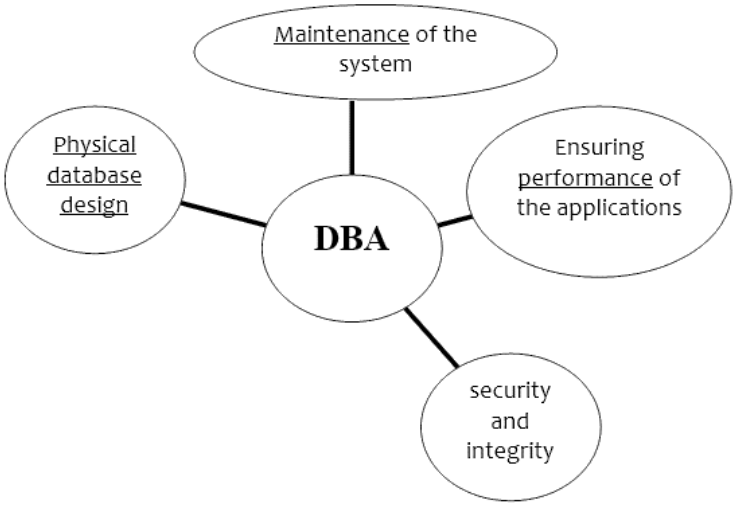


ROLES IN THE DATABASE ENVIRONMENT (PEOPLE)

- **Database designers** are responsible for:
  - Identifying the data to be stored
  - Choosing appropriate structures to represent and store this data
- ***Database Designers***
  - Logical database designer
    - Identifying the data (that is, the entities and attributes),
    - Relationships between the data
    - Constraints on the data that is to be stored in the database.
  - Physical database designer decides how the logical database design is to be physically realized:
    - Mapping the logical database design into a set of tables;
    - selecting access methods for data;
    - Designing security measures required on the data.

ROLES IN THE DATABASE ENVIRONMENT (PEOPLE)

- ***Database Administrator (DBA)*** : Responsible for the physical realization of the database
- **Database administrators (DBA)** are responsible for:
  - Authorizing access to the database
  - Coordinating and monitoring its use
  - Acquiring software and hardware resources



ROLES IN THE DATABASE ENVIRONMENT (PEOPLE)

- ***Application Programmers***
- Implemented the application programs that provide the required functionality for the end-users.
- ***End Users***
  - Naïve users
    - Unaware of the DBMS.
    - Access the database using application programs.
  - Sophisticated end-user
    - Familiar with the structure of DB and DBMS.
    - Use a high-level query language (SQL) to perform the required operations.
    - Some sophisticated end-users write application programs for their own use.

ROLES IN THE DATABASE ENVIRONMENT (PEOPLE)

- **System analysts**
  - Determine requirements of end users

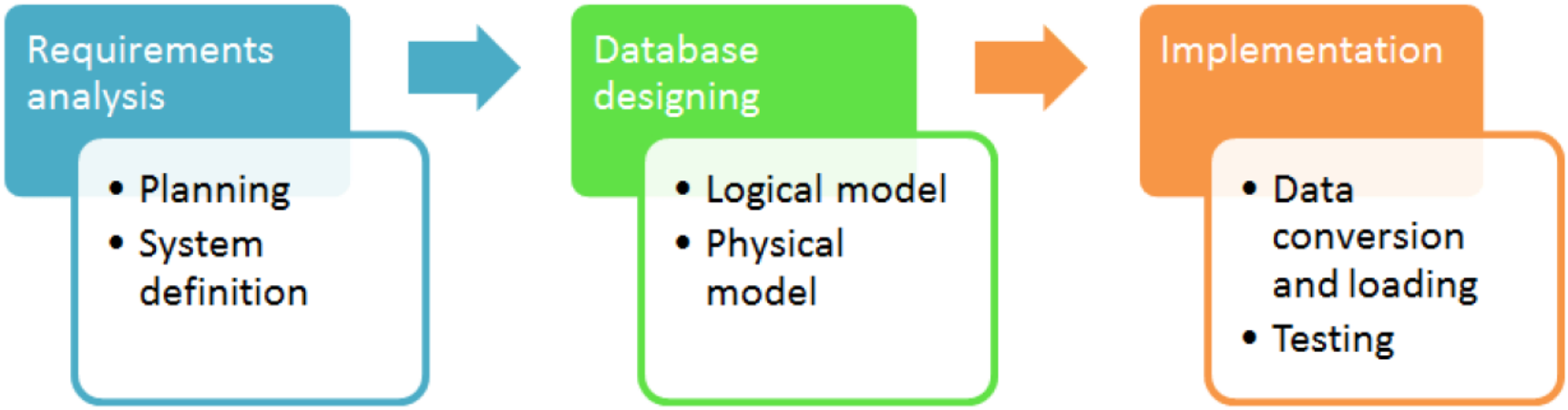
- **Workers behind the scene**
- **DBMS system designers and implementers**
  - Design and implement the DBMS modules and interfaces as a software package
- **Tool developers**
  - Design and implement **tools**
- **Operators and maintenance personnel**
  - Responsible for running and maintenance of hardware and software environment for database system

DATABASE SYSTEM

Database application program:

- A computer program that interacts with database by issuing an appropriate request (SQL statement) to the DBMS.
- is simply a program that interacts with the database at some point in its execution

DATABASE DEVELOPMENT LIFE CYCLE



HISTORY OF DATABASE SYSTEMS

- *1950s and early 1960s:*
  - Data processing using magnetic tapes for storage
  - Tapes provided only sequential access
- *Late 1960s and 1970s*:
  - Hard disks allowed direct access to data
  - Network and hierarchical data models in widespread use
- *1980s:*
  - Parallel and distributed database systems
  - Object-oriented database systems
  - SQL becomes industrial standard

HISTORY OF DATABASE SYSTEMS

- *1990s:*
  - Large decision support and data-mining applications
  - Large multi-terabyte data warehouses
  - Emergence of Web commerce
- *Early 2000s:*
  - XML and XQuery standards
  - Automated database administration
- *Later 2000s:*
  - Giant (عملاقه) data storage systems (Google Big Table, Amazon)

Thanks

Any questions