

Chapter 1

Introduction to Database

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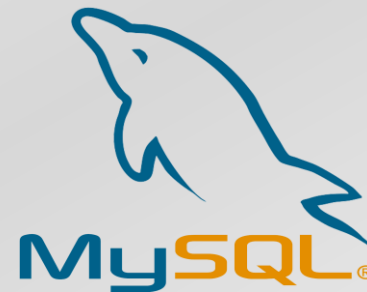
Learning Outcome

- Develop a general understanding of databases, and specific understanding of the relational database model.



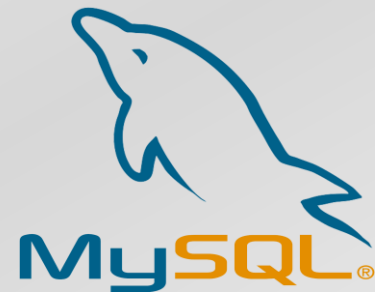
Outline

- Terminology (Data, Database, DBMS)
- The purpose of the DB
- File-Based Systems
- File-Based Systems vs Databases
- Relational DB (RDB)
- Advantages of RDB
- DBMS



What is data?

- Data can be facts related to any object in consideration or just descriptions of things.
 - For example: your name, age, weight, ETC. are some data related to you.
- A picture, numbers, words, measurements, can also be considered data.



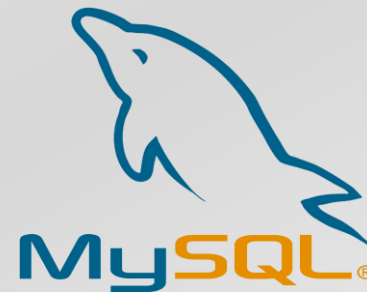
File-Based System

- File-based systems were an early attempt to computerize the manual filing system.
- A File-Based system usually has own files and own application program.
- Collection of application programs that perform services for the end users (e.g. reports)
 - Each program defines and manages its own data.



Limitations of File-Based System

- **Separation and isolation of data**
 - Each program maintains its own set of data
 - It is more difficult to access data that should be available
 - Difficult to collect data from different files
 - Users of one program may be unaware of potentially useful data held by other programs



Limitations of File-Based System

- **Duplication of data (Redundancy)**
 - Same data is held by different programs
 - Duplication is wasteful.
 - It costs time and money to enter the data more than once
 - Wasted space, takes up additional storage space.
 - Potentially different values and/or different formats for the same item be generated



Limitations of File-Based System

- **Poor Data Integrity / Quality**
 - This builds on the previous point in that when data is extensively duplicated, there will be **inaccuracies** in the data.
 - **For example**, if student A's address is stored in two separate files (corresponding to two separate apps.), what happens when it is **altered** on only one of these files?



Limitations of File-Based System

- **Data dependence**
 - File structure is defined in the program code.
- **Incompatible file formats**
 - Programs are written in different languages, and so cannot easily access each other's files.
- **High Development Costs**



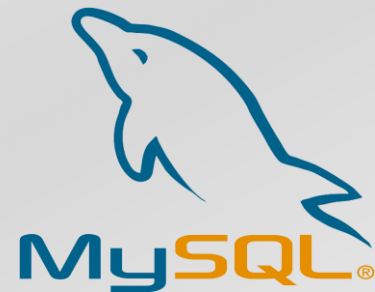
Database Approach

- A shared collection of logically related data and its description, designed to meet the information needs of an organization.
- A database represents some aspect of the real world and typically stored electronically in a computer system.
 - It is a systematic collection of data.



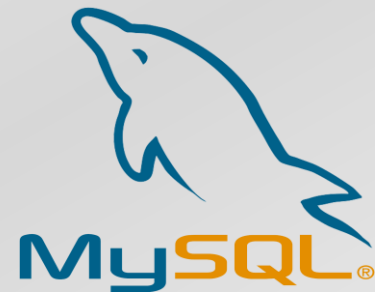
Database Management System

- Database Management System (**DBMS**) is a collection of programs which enables its users to access database, handle and manipulate data.
 - interacts with the users' application programs and the database.



What is DBMS?

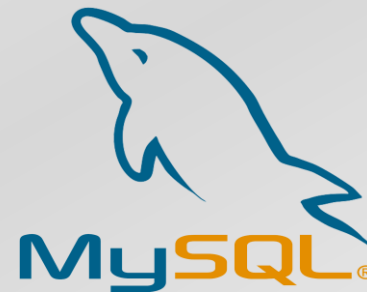
- **DBMS** is a collection of programs which enables its users to access database, handle and manipulate data.
- A software system that enables users to define, create, maintain, and control access to the database.
 - Interacts with the users' application programs and the database.



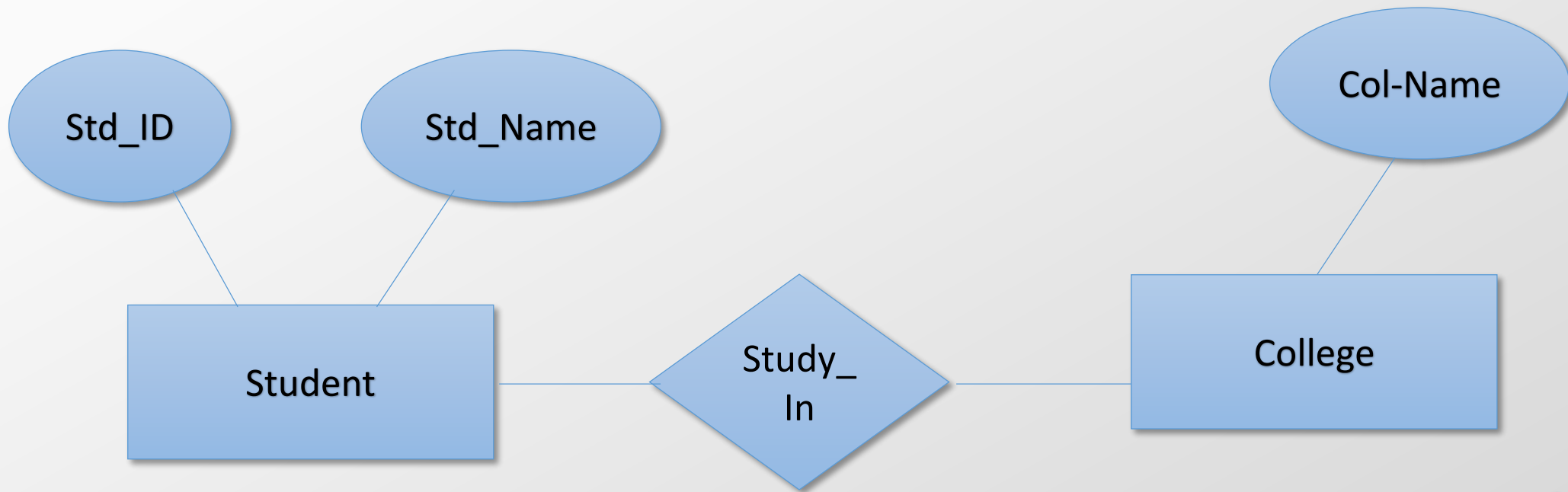
Database Properties

Shared collection of logically related data

- Represents the entities, the attributes, and the logical relationships between the entities of an organization's information.
 - An **entity** is a distinct object (a person, place, thing, concept, or event) in the organization that is to be represented in the database.
 - An **attribute** is a property that describes some aspect of the object that we wish to record,
 - A **relationship** is an association between entities.
- Designed to meet the information needs of an organization.



Entities, attributes, and relationships



Database Properties

Metadata—also known as System catalog or data dictionary

- It is the self-describing nature of a database that provides program–data independence.
 - “data about data”
- provides description of data to enable program



Database Properties

Data abstraction.

- The applications that access the **data do not have to know how the data is stored**, they simply use the mechanisms available to them, via the DBMS (Database Management System).
 - The database approach **separates** the structure of the data from the application programs and stores it in the database.
 - From the application programs, is similar to the approach taken in modern software development.
- The underlying data structures can be altered without having to alter the applications that use it. (Except where deletions have taken place).



Purpose of Database

- To **store** data
- To provide an **organizational structure** for data
- To provide a mechanism for querying, creating, modifying and deleting data (**CRUD**)



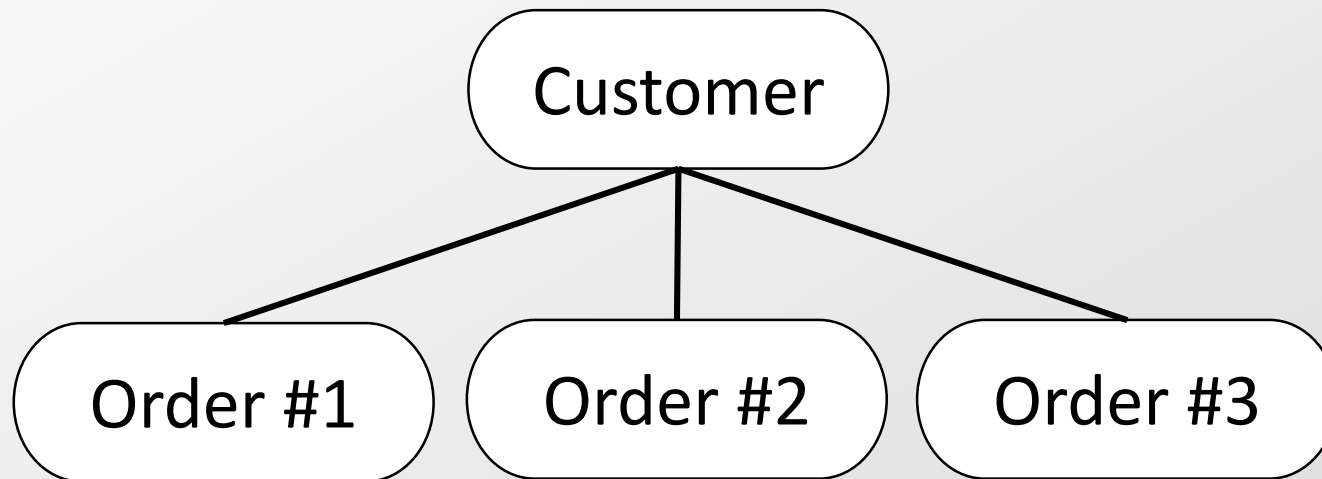
Relational Database

- **A relational database (RDB)** is a collective set of multiple data sets organized by tables, records and columns.
- RDBs establish a **well-defined relationship** between database tables.
- Tables communicate and share information, which facilitates data search, organization and reporting.



Relational Database

- For example customer can place many different orders



Relational Database

Table

- RDB stores data in a table
- A table is simply a two dimensional grid of data.

Relational Database - Example

Employee table

Employee ID	Employee Name	Phone Number
1	Mohammed	0795423566
2	Sami	0778855445
3	Ayah	0785463127
4	Ala	0798654123



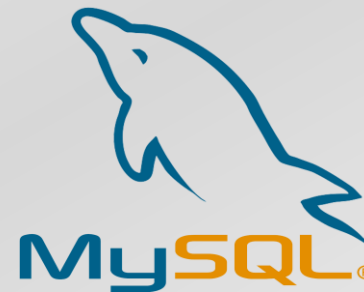
Relational Database - Example

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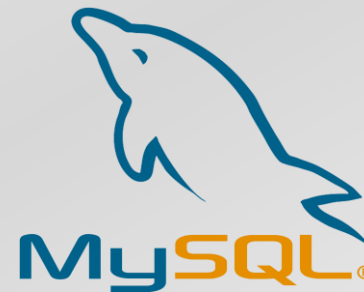
Department

Dept_Id	Dept_Name
1	IT
2	HR



Putting the pieces back together

- In our relational DB example we broke apart the list into several table. Somehow the table must be joined back together.
- In Relational DB, tables are joined together using matched pairs of data values.
 - For example in employee department RDB, we can add column (**dept ID**) to the employee table to determine the dept and to be used for the joining purpose.



Putting the pieces back together

Employee

Employee ID	Employee Name	Phone Number	Dept ID
1	Moh	0795423566	1
2	Sami	0778855445	1
3	Aya	0785463127	2
4	Ala	0798654123	1

Dept

Dept Id	Dept Name
1	IS
2	HR



Advantages of RDB

- RDB minimizes data redundancy
- RDB preserve relationships



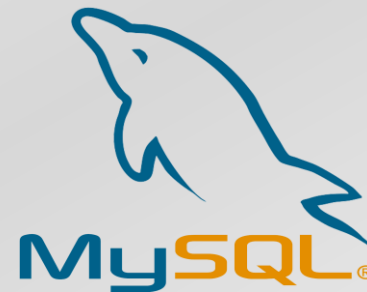
What is DBMS?

- **DBMS: A software system** that enables users to define, create, maintain, and control access to the database.
- **Database application program:** a computer program that interacts with database by issuing an appropriate request (SQL statement) to the DBMS.



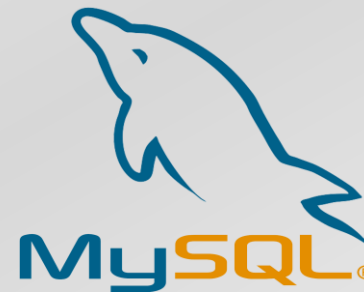
DBMS Facilities

- It allows users to define the database, usually through a **Data Definition Language (DDL)**. The DDL allows users to specify the data types and structures and the constraints on the data to be stored in the database.
- It allows users to insert, update, delete, and retrieve data from the database, usually through a **Data Manipulation Language (DML)**.
- The most common query language is the **Structured Query Language (SQL)**, pronounced “S-Q-L”, or sometimes “See-Quel”),



DBMS Facilities

- It provides controlled access to the database. For example, it may provide:
 - A **security** system, which prevents unauthorized users accessing the database;
 - An **integrity** system, which maintains the consistency of stored data;
 - A **concurrency** control system, which allows shared access of the database;
 - A **recovery** control system, which restores the database to a previous consistent
 - State **following** a hardware or **software failure**.
 - A **user-accessible** catalog, which contains descriptions of the data in the database.

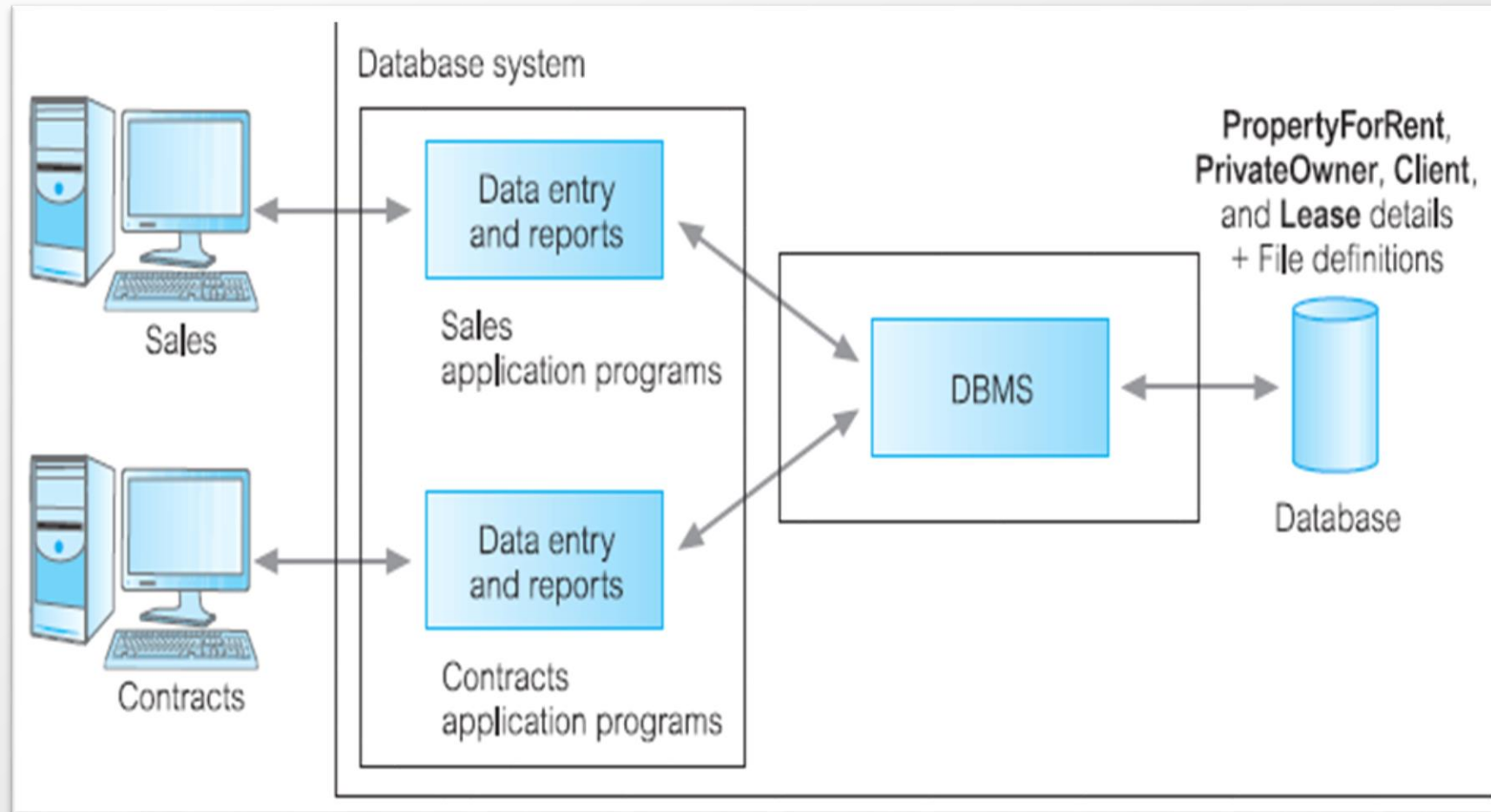


Working with Databases

- **Defining the database** involves specifying the Data types, structures and constraints for the data to be stored in the database.
- **Constructing the database** is the process of storing the data on a storage medium controlled by the DBMS
- **Manipulating the database** includes:
 - Querying the database to retrieve specific data
 - Updating the database to reflect changes in the mini-world
 - Generating reports from the data



Database Processing



Database Languages

- Data definition language (DDL).
 - Permits specification of data types, structures and any data constraints.
 - All specifications are stored in the database.
- Data manipulation language (DML).
 - General enquiry facility (query language) of the data.
 - Read and update data



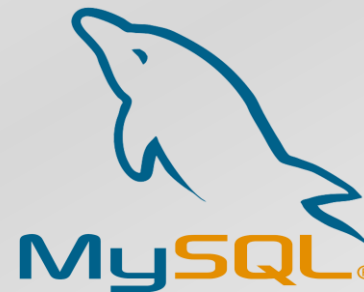
Database Languages - DML

- A language that provides a set of operations to support the basic data manipulation operations on the data held in the database.
 - **Insertion** of new data into the database.
 - **Modification** of data stored in the database.
 - **Retrieval** of data contained in the database.
 - **Deletion** of data from the database.



DBMS Advantages

- Control of data redundancy
 - The database approach attempts to eliminate the redundancy by integrating the files so that multiple copies of the same data are not stored.
 - Sometimes it is necessary to duplicate key data items to model relationships
- Data consistency
 - If a data item is stored only once in the database, any update to its value has to be performed only once and the new value is available immediately to all users.
- Improved data integrity
 - Database integrity refers to the validity and consistency of stored data.
 - Integrity is usually expressed in terms of **constraints** (integrity constraint).



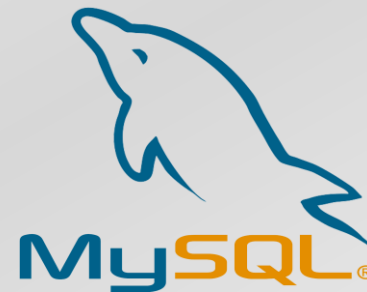
DBMS Advantages

- Improved security
 - No unauthorised access
 - User access levels (views)
- Increased concurrency
 - More than one user allowed to access the same data at the same time - but not simultaneous updating.
- Improved backup and recovery services
 - This may involve performing **a nightly backup** of the data.
 - In the event of a failure during the next day, the backup is **restored** and the work that has taken place since this backup is lost and has to be re-entered.



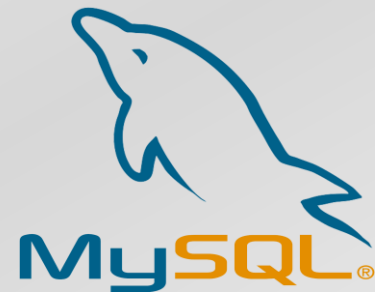
DBMS Disadvantages

- Complexity
 - The provision of the **functionality** expected of a good DBMS makes it an extremely complex piece of software.
 - Database designers and developers, database administrators, and end-users must **understand** this functionality to take full advantage of it and make good decisions.
- Size
 - The complexity and breadth of functionality makes the DBMS an extremely large piece of software.
- Cost of DBMS
 - Depending on the environment and functionality provided.
 - The recurrent annual maintenance cost.
 - Additional hardware costs



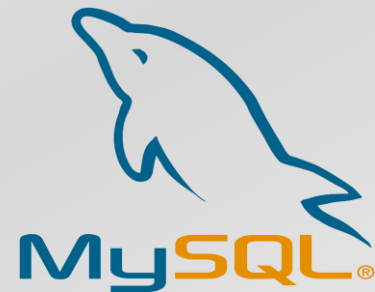
DBMS Disadvantages

- Performance
 - DBMS is written to be more general compared with the file-based system, to cater for many applications.
- High impact of a failure
 - all users and applications rely on the availability of the DBMS, the failure of certain components can bring operations to a halt.

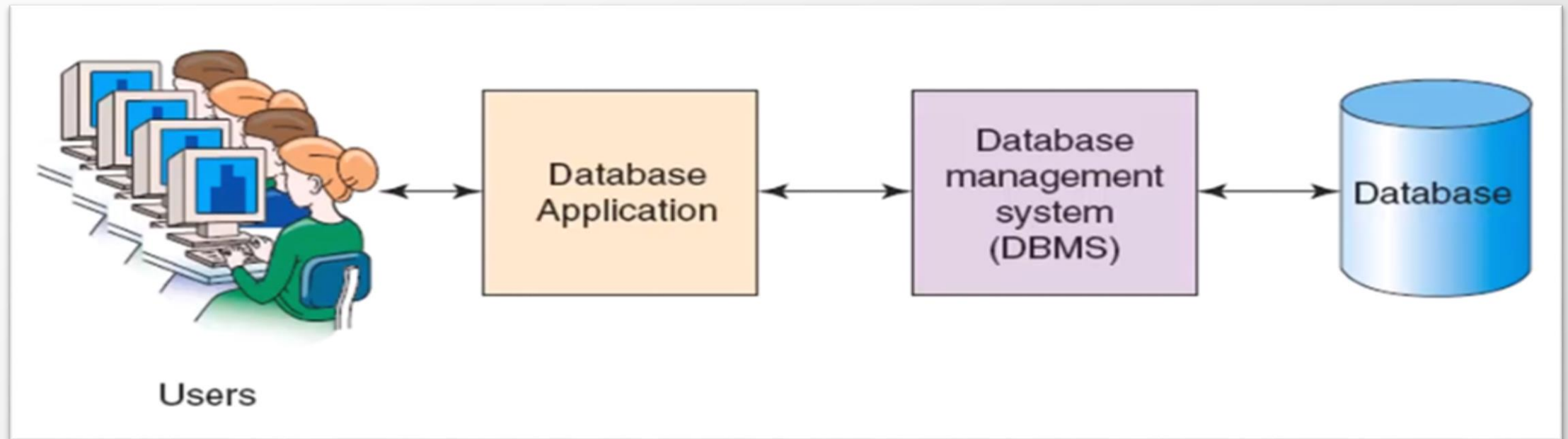


Components of DB system

- The four components of DB system:
 - Users
 - DB applications
 - Database management system
 - database



Components of DB system



Components of DB system - User

- Use database application to keep track of info.
- Use user interface forms to enter, update, delete and query data.
- Produce reports.



Database Content

- User data
- Metadata



Database Application

- A **database application** is simply a program that interacts with the database at some point in its execution



Database Example Applications

- Purchases from the supermarket
- Purchases using your credit card
- Booking a holiday at the travel agents
- Using the local library
- Taking out insurance
- Using the Internet
- Studying at university



Database Example Applications

Purchases from the supermarket

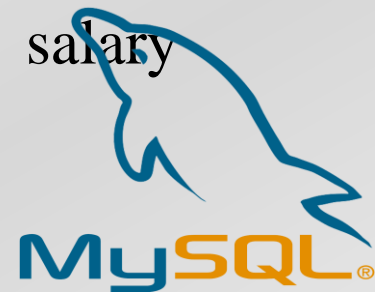
When you purchase goods from your local supermarket, it is likely that a database is accessed. The checkout assistant uses a bar code reader to scan each of your purchases. This reader is linked to a database application that uses the bar code to find out the price of the item from a product database. The application then reduces the number of such items in stock and displays the price on the cash register.



Database Example Applications

Studying at College

If you are at college, there will be a database system containing information about yourself, your major and minor fields, the courses you are enrolled in, details about your financial aid, the classes you have taken in previous years or are taking this year, and details of all your examination results. There may also be a database containing details relating to the next year's admissions and a database containing details of the staff working at the university, giving personal details and salary related details for the payroll office.



Database Example Applications

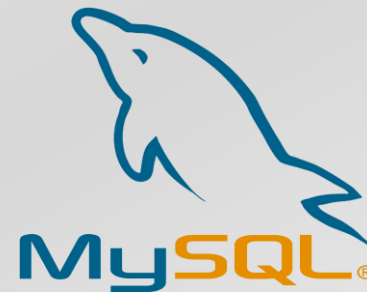
Booking a vacation with a travel agent

When you make inquiries about a vacation, your travel agent may access several databases containing vacation and flight details. When you book your vacation, the database system has to make all the necessary booking arrangements. In this case, the system has to ensure that two different agents do not book the same vacation or overbook the seats on the flight.



DBMS Functions (Recap)

- Create databases
- Create tables
- Establish relationships.
- Read database data
- Modify database data (insert, delete, update)
- Enforce rules
- Provide security
- And many others.



End of Chapter 1

