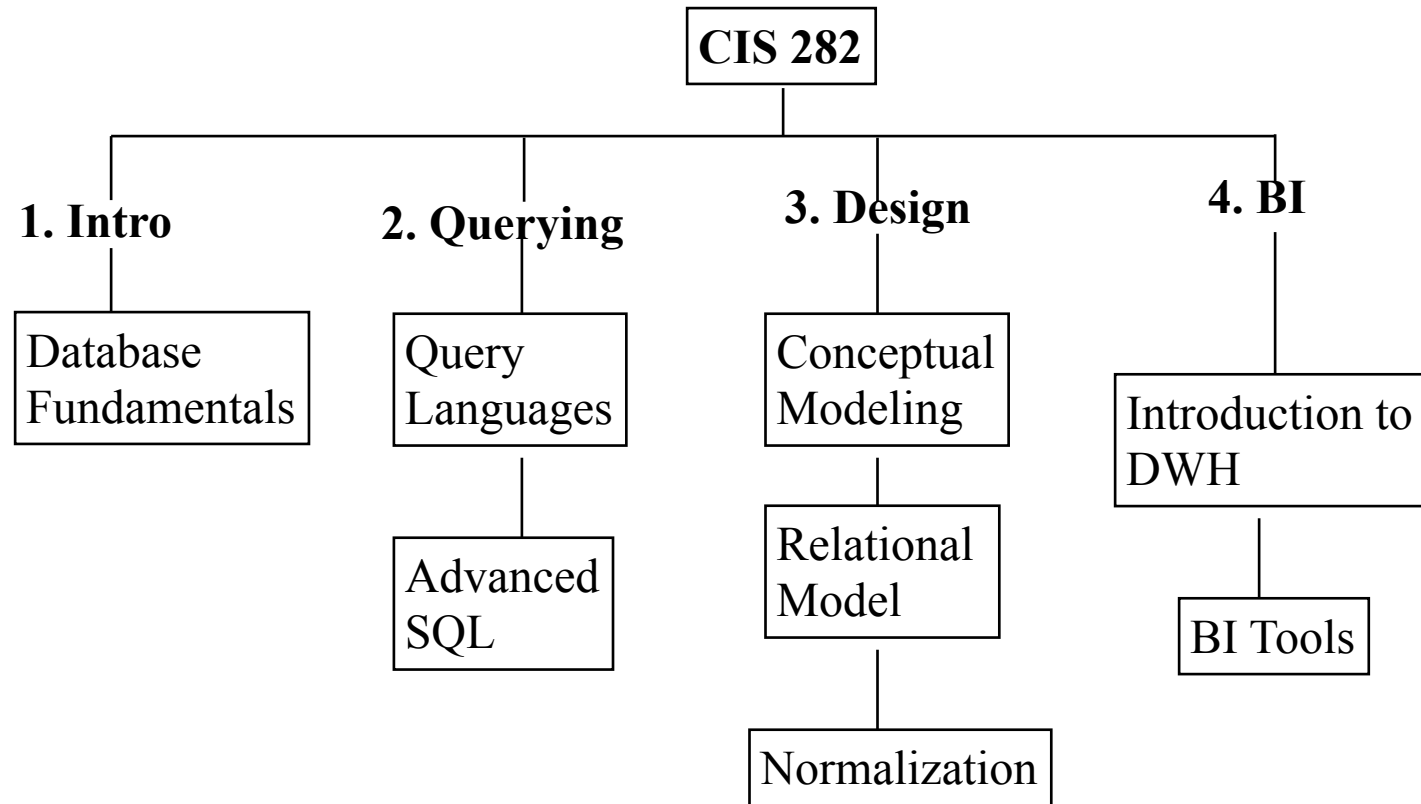


Introduction to Database

Structure of this semester



Newbie Users Designers Developers Professionals

What is.....

► Data?

- What does this string of digits means? 1713445232?
- Could be meaningless digits
- Could be the total of 32
- Could be some1 phone number
- Could be if the first digit is used to represent a person's gender (1 male, 2 female)
- Could be..... etc.

Data vs. Information

- ▶ Data are raw facts
- ▶ Raw data must be formatted for storage, processing, and presentation
- ▶ Data are the foundation of information
- ▶ Data have little meaning unless they are grouped in a logical manner.
- ▶ Information is the result of processing raw data to reveal meaning
- ▶ Information produced by processing data

So where does this data get stored?

- ▶ Data get stored in something called Relational database tables that have the following characteristics:
 - A table is made up of columns and rows
 - A column is a set of values of the same data type
 - Each column has a distinct name
 - Each row is typically identified by a unique value - **Primary key**
 - A table is a single store of related data
 - Order of columns or rows is immaterial
 - Each entity is stored in its own table, Ex: sales reps, customers, orders, and parts

Data Processing	Informal Relational DB	Formal Relational DB
File	Table	Relation
Record	Row	Tuple
Field	Column	Attribute

Database


A ***database (db)*** is an organized collection of data, typically stored in electronic format

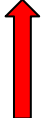
- ▶ Traditional databases are organized by records (rows), fields (columns) stored in tables
- ▶ This structure allows you to input, manage, organize, and retrieve data quickly

Table

- ▶ Consider the table as an excel sheet, it has rows and columns
- ▶ A table usually represent an entity; ex: sales reps, customers, orders, contacts
- ▶ Each row in the Customer table represent an instance of that Customer
- ▶ Each column represents some attribute of the entity that the business interested in
- ▶ We include an ID column into each table or entity so that each record be uniquely identified and they are sequentially incremented

Table OR Entity: Customers

Row(Tuple)	Cust.ID	First Name	Last Name	Phone	Address
	1	John	Doe	734-123-4567	Ann Arbor
	2	Samantha	Wilson	248-123-9587	F. Hills
	3	Jerry	Smith	734-987-9999	Ypsilanti

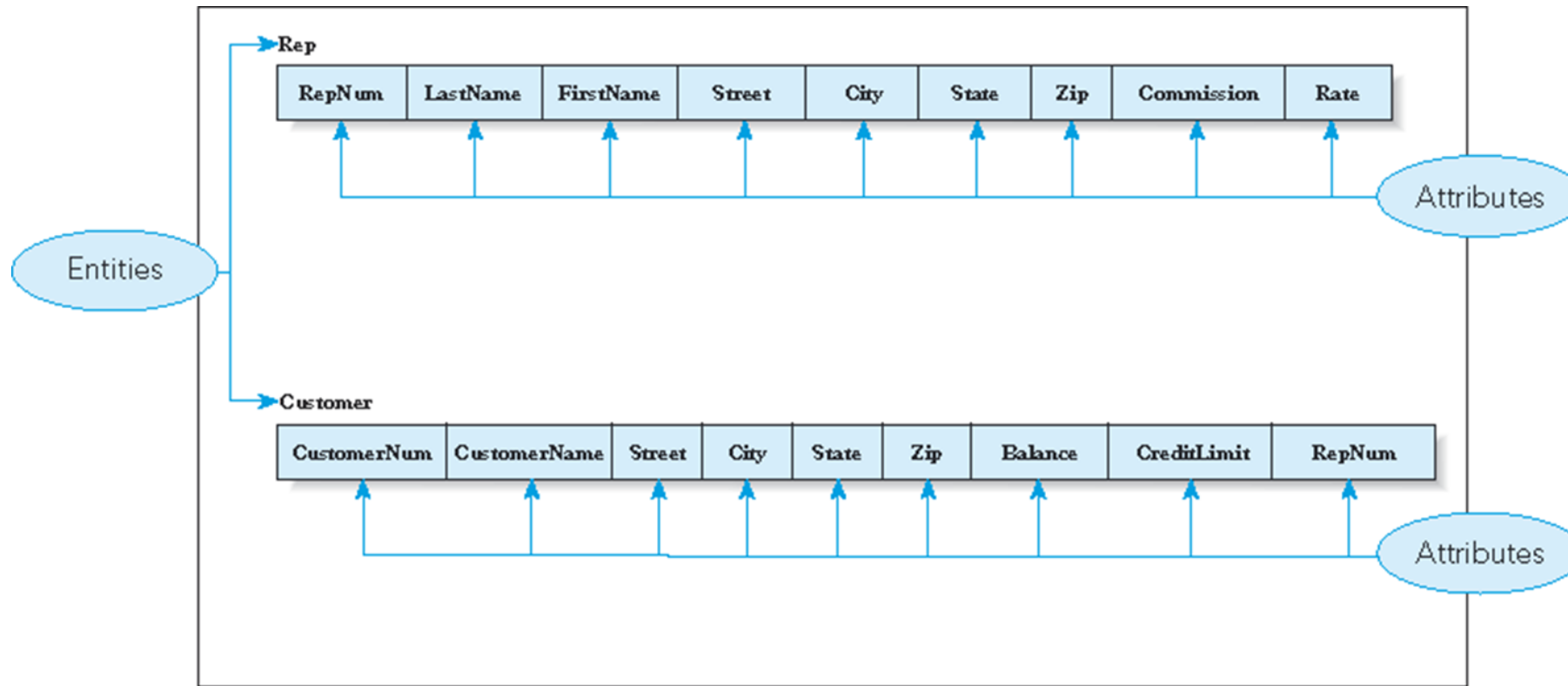
 Column(Attribute)

So we can define Tables as

- ▶ A database ***table*** is a collection of rows and columns that is used to organize data about a single topic. Each row within a table corresponds to a single record and contains several attributes that describe the row.
- ▶ These tables are stored in databases

EmployeeID	LastName	FirstName	Department
100	Smith	Bob	IT
101	Jones	Susan	Marketing
102	Adams	John	Finance

Example of an Entities and it's Attributes



Past VS Present

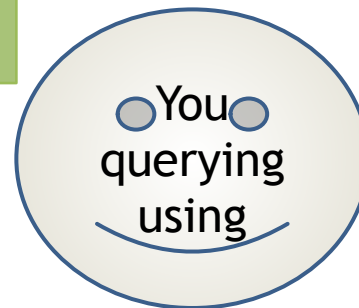
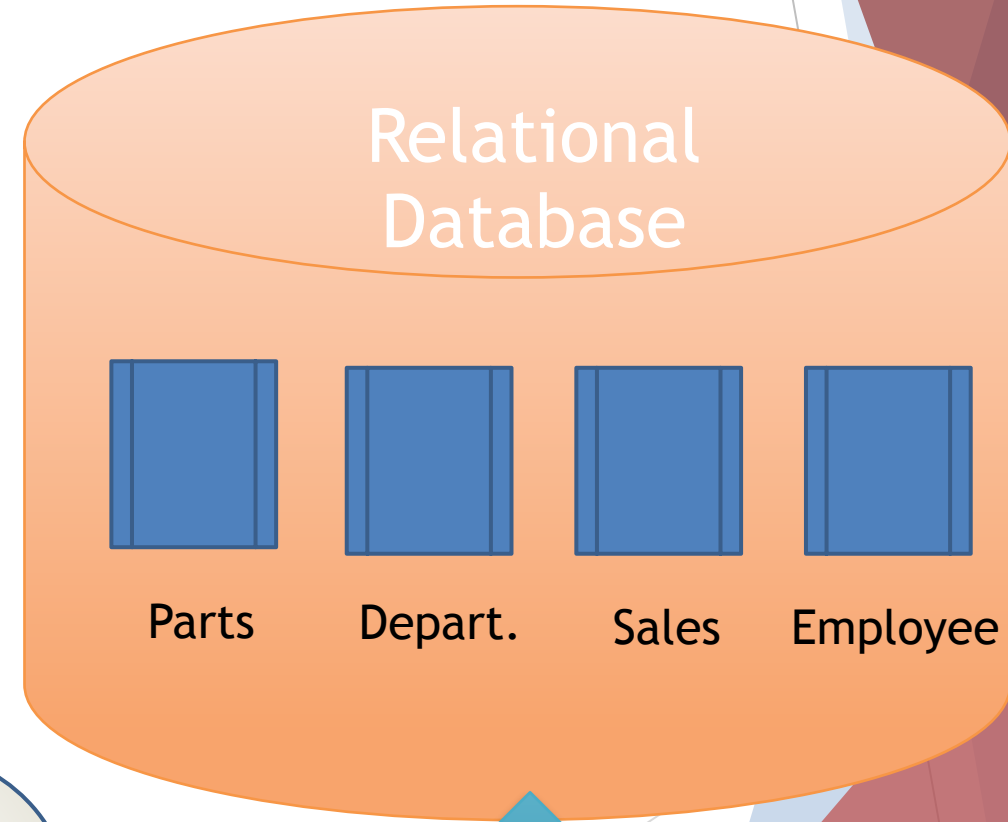
► Flat File Systems



Java, Cobol, C

VS

Relational Database



SQL

Flat File VS Relational Database

- ▶ Multiple file and each file stores different data
- ▶ No specific format and No defined structure
- ▶ To retrieve any data you need to understand the logic
- ▶ The logic is different from each company to another
- ▶ IF the programmer left the organization the next programmer need to know how the data get stored and understand the logic
- ▶ There is no standardized method
- ▶ The programmer need to write complex code
- ▶ The data get stored in proper structured
- ▶ There is standard methods
- ▶ Ease to retrieve data using SQL
- ▶ SQL uses English syntax

▶ Attribute

- ▶ Characteristic or property of an entity
- ▶ Example: Customer has name, street, city, etc.
- ▶ May also be called a **field** or **column**
- ▶ Each column has a distinct name

▶ Relationship

- ▶ Association between entities

▶ Types of relationship

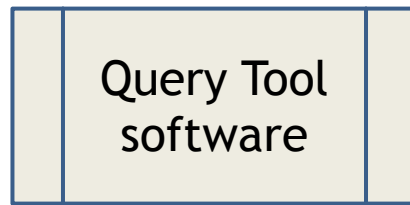
- ▶ One - to - One OR 1:1
- ▶ One - to - Many OR 1:M
- ▶ Many - to - Many OR M:N

Relational databases

- ▶ A **relational database** a collection of tables of data all of which are formally described and organized according to the relational model. Each table must identify a column or group of columns, called the **PRIMARY KEY**, to uniquely identify each row

So the Relational Database or Model consists of:

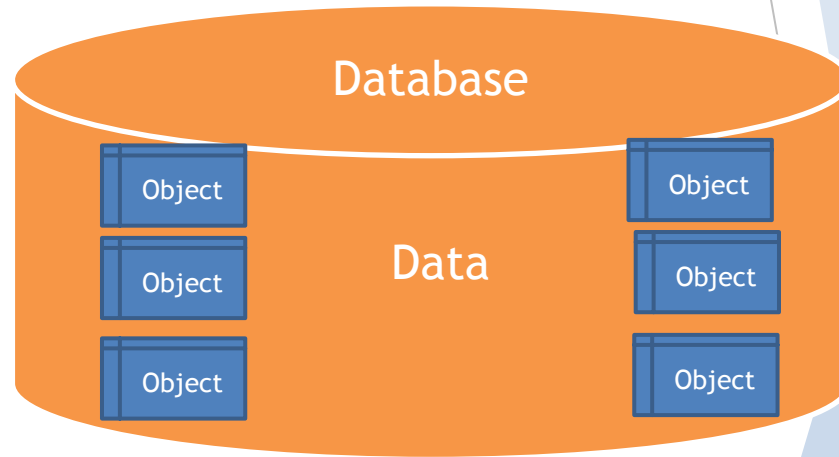
- ▶ **DB** = Set of named **relations** or **Tables**
- ▶ Each **relation** has a set of named **Attributes** or **column**
- ▶ Each **Tuple** or **Row** has a value for each **attribute**
- ▶ Each **attribute** has a **data type** or **domain**
- ▶ **Schema**: the structural description of relations in DB and the attributes for that relations
- ▶ **NULL**: Special Value for “Unknown” OR “Undefined”
- ▶ **Key**: Attribute of a relation where every value for that attribute is unique in each tuple or row or Set of attributes whose combined values are unique
- ▶ The Structured Query Language (SQL) is used to manipulate relational databases



SQL



- ☐ Retrieve Data
- ☐ Insert Data
- ☐ Modify Data
- ☐ Delete Data



Relational DB rules

- ▶ Every row must have exactly the same number of columns (fields or attributes)
- ▶ Each row can have only one value stored in each column (fields or attributes)
- ▶ A column must contain the same kind of value in every row of that column
- ▶ No two rows can be exactly the same
- ▶ The order of the rows or of the columns can't be used to provide information

So what is the Database 1 more time?

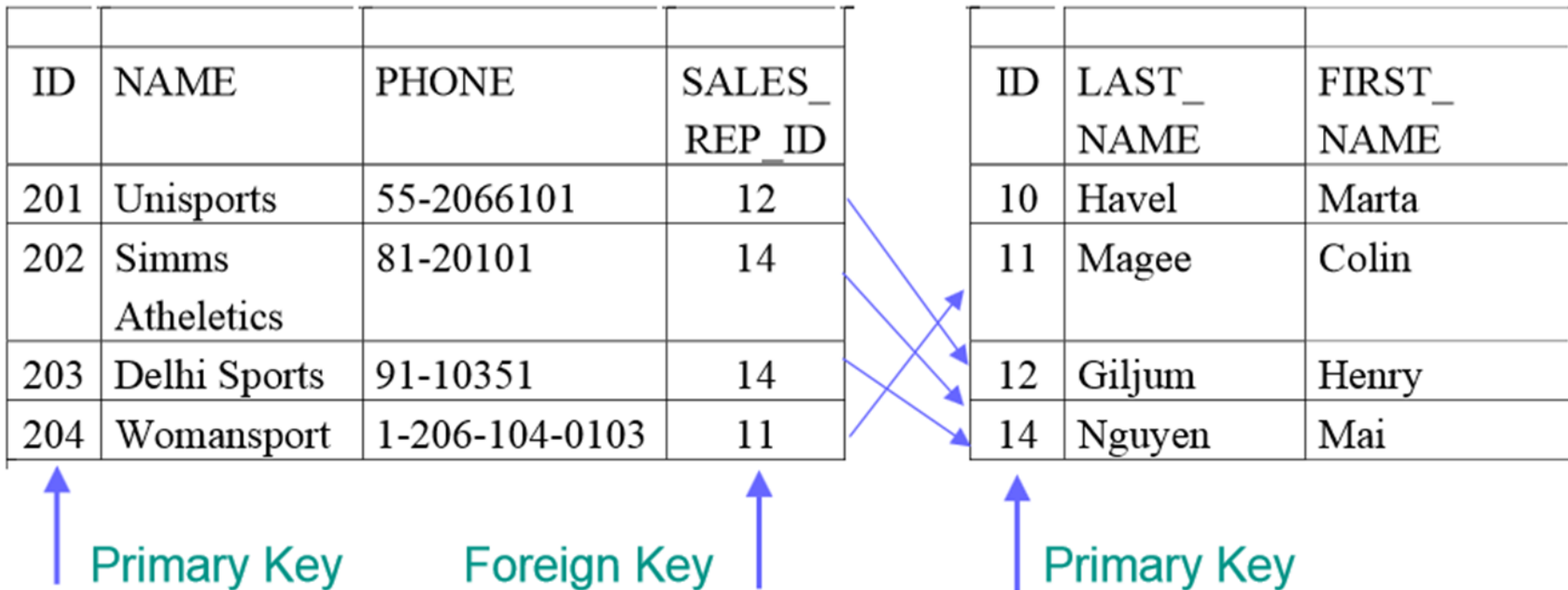
- ▶ a place to store data OR
- ▶ Collection of tables and other objects, such as views, sequences..... table is used to store data OR
- ▶ The structure that can store information about multiple types of entities, attributes of entities, and relationships among entities OR
- ▶ It means of handling large amount of data. Provide efficient, reliable, convenient and safe multi user storage and access to massive amount of persistent data

Overview of Database and DBMS

- ▶ A **Database** is a collection of related data organized in a way that data can be easily accessed, managed and updated. Database is actually a place where related piece of Data is stored and various operations can be performed on it.
- ▶ A **DBMS** is a software that allows creation, definition and manipulation of database. Dbms is actually a tool used to perform any kind of operation on data in database. Dbms also provides protection and security to database. It maintains data consistency in case of multiple users. Here are some examples of popular dbms; SSMS, MySQL, Oracle, Sybase, Microsoft Access and IBM DB2 etc.

Database Keys

- ▶ Keys are very important part of Relation Database. They are used to establish and identify relationship between the tables.
- ▶ Each row of data in a table is uniquely identified by a primary key (PK).
- ▶ You can logically relate information from multiple tables using foreign keys (FK).



Primary Key

- ▶ A primary key (PK) column or set of columns that uniquely identifies each row in a table
- ▶ Each table must have a primary key and a primary key must be unique
- ▶ A PK consisting of multiple columns is called a composite Primary Key
- ▶ No part of the PK can be null
 - ▶ A NULL is the absence of a value

Foreign Key

- ▶ A foreign key (FK) is a column or combination of columns in one table that refers to a primary key in the same or another table
- ▶ A FK must match an existing primary key value (or else be null)

Database management system (DBMS)

- It's a program through which users interact with a database; lets you perform administrative tasks on the databases and objects contained within the database like creating forms and reports quickly and easily and obtain answers to questions about the data
- DBMS is a collection of programs that:
 - ▶ Manages structure and controls access to data
 - ▶ to help you create, deploy, and manage reports for your organization.
- ▶ Popular DBMSs: Access, Oracle, DB2, MySQL, and SQL Server
- ▶ DBMS is the intermediary between the user and the database
- ▶ DBMS enables data to be shared
- ▶ DBMS integrates many users' views of the data

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Database servers

- ▶ Databases are stored on *database servers* which are dedicated physical or virtual servers that host the database files and provide high-level performance for users who are accessing the data.
- ▶ Database servers contain the DBMS used to manage the data and administer the SQL Server environment.
- ▶ A database server can have one default instance and several named instances of SQL Server. A SQL Server instance is a copy of the sqlservr.exe program that runs as a Windows operating system service.
- ▶ Often multiple database servers are deployed to provide high availability and improve performance

Functions of DBMS

- ▶ Provides data Independence
- ▶ Concurrency Control
- ▶ Provides Recovery services
- ▶ Provides Utility services
- ▶ Provides a clear and logical view of the process that manipulates data.

Advantages of a DBMS:

- ▶ Improved data sharing
- ▶ Improved data security
- ▶ Better data integration
- ▶ Minimized data inconsistency
- ▶ Improved data access
- ▶ Improved decision making
- ▶ Increased end-user productivity
- ▶ Controlling redundancy
- ▶ Facilitating consistency
- ▶ DBMS provides backup and data recovery to ensure data safety and integrity
- ▶ Providing data independence: can change structure of a database without changing the programs that access the database

Disadvantages of a DBMS:

- ▶ Larger file size
- ▶ Increased complexity
- ▶ Greater impact of failure
- ▶ More difficult recovery
- ▶ Increased costs

The Database System Environment

- ▶ Five major parts of a database system:
 - ▶ Hardware
 - ▶ Software
 - ▶ People
 - ▶ Procedures
 - ▶ Data

The Database System Environment (cont'd.)

- ▶ Hardware: all the system's physical devices
- ▶ Software: three types of software required
 - ▶ Operating system software
 - ▶ DBMS software
 - ▶ Application programs
- ▶ People: all users of the database system
 - ▶ System and database administrators
 - ▶ Database designers
 - ▶ Systems analysts and programmers

The Database System Environment (cont'd.)

- ▶ Procedures: instructions and rules that govern the design and use of the database system
- ▶ Data: the collection of facts stored in the database
- ▶ Database solutions must be cost-effective as well as tactically and strategically effective

Summary

- ▶ A database (db) is an organized collection of data, typically stored in electronic format.
- ▶ Microsoft SQL Server and MySQL are examples of relational databases
- ▶ DBMS is application used to perform administrative tasks on databases and used to interact with data stored in databases.
- ▶ Database server hosts DBMS system and one or more instances of SQL Server