

IT 231

Foundation of Information
Technology

Unit 8

Database and Database Management System

Data category

Structure Data: Data that has a structure and is well organized either in the form of tables or other way and can be easily operated. Fast processing of the data.

Relational database, spreadsheet are the example of structured data.

Semi-Structured Data: Structured data but not organized. Difficult to retrieve, analyze due to un-organized.

XML files, .csv, tab delimited files are the example of semi-structured data.

Unstructured Data: data that is unstructured or unorganized which is difficult to access, search and requires advance software to access them.

Image, word file, pdf documents are the example of Unstructured data.

Introduction

- Collection of interrelated data and a set of programs to access those data.
- a software package designed to define, manipulate, retrieve and manage data in a database.
- DB are designed to manage large and vague information properly
- Collection of data is database related to any particular enterprise.

File System

- The file system is software that manages and organizes the files in a storage medium within a computer.
- Redundant data can be present in a file system.
- There is no efficient query processing in the file system
- There is less data consistency in the file system.
- Only manage the physical access of the data and there might be inconsistency in Data.

Purpose of DB System

- Provide a convenient and effective method of defining, storing or constructing, and retrieving or manipulating database for various applications.
- To reduce data redundancy and inconsistency
- Easily access the data
- To provide data security.
- To preserve consistency of database (integrity constraint)

Data Models

Data model is a collection of conceptual tools for describing data, data relationships, data semantics, and consistency constraints. Data model provides a way to describe the design of a database at the physical, logical, and view levels. Data model is either physical or conceptual model.

Object Based Logical Model

- Entity-Relationship Model
- Object Oriented Model

Record Based Data Model

- Hierarchical Model
- Network Model
- Relational Model

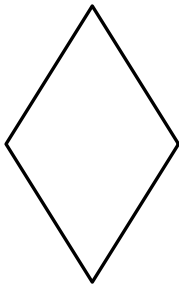
Entity- Relationship Model

- The entity-relationship (E-R) data model uses a collection of basic objects, called *entities*, and *relationships* among these objects.
- ER Model is used to develop the design of the database.
- Display database design in pictorial form.
- Shows entities and relationship between entities and among other attributes.
- Different symbol are used to design ER-Model eg: Oval, rectangle, line, connector etc.

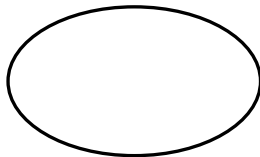
Basic Symbol use in ER Diagram



Rectangle Represent Entity.



Diamond Represent Relationship.



Oval Represent Attributes.



Line Represent Connections.

Object Oriented Model

- It is based on collection of objects, like ER Model. Object Contains values and bodies of codes, which are called methods.
- An object can contain another object to an arbitrarily deep level of nesting
- Object is instance of class. one object is communicate with other object by sending message.

Relational Model

- Data and relationship are represent by table.
- Each table has multiple columns and each column contain a unique name.

Relational Model

Activity Code	Activity Name
23	Patching
24	Overlay
25	Crack Sealing

Key = 24

Activity Code	Date	Route No.
24	01/12/01	I-95
24	02/08/01	I-66

Date	Activity Code	Route No.
01/12/01	24	I-95
01/15/01	23	I-495
02/08/01	24	I-66

Network Model

- database model that is designed as a flexible approach to representing objects and their relationships
- unique feature of the network model is its schema, which is viewed as a graph where relationship types are arcs and object types are nodes.
- The network model has the ability to manage one-to-one (1:1) as well as many-to-many (N: N) relationships.
- System Complexity: Each and every record has to be maintained with the help of pointers, which makes the database structure more complex

Hierarchical Model

- Similar network model, but organization of record is a collection of trees, rather than arbitrary graph.
- One parent record with many children.
- Major drawback is that ,it can have only one to many relationships between nodes.
- Hierarchical databases were popular in early database design, in the era of mainframe computers.

Database Management System

- A DBMS is a software package designed to organize and manage data in database.
- DBMS helps to retrieve, update, manipulate and manage data in database.
- Helps to efficient insertion, selection, updating and deletion of data as well as creation and recreation of structure in database using different command.
- Mostly use command are Data Definition Language (DDL) and Data Manipulation Language (DML) command.

Key Terms in Database

Instances: Databases change over time as information is inserted and deleted. The collection of information stored in a database at a particular moment is called **instances of a database**.

Schema: The overall design of the database is called **schema**.

Three types of schema: **physical schema, logical schema, view schema**.

- **Physical:** how the data stored in blocks of storage
- **Logical:** Programmers and DBA works at this level
- **View:** Describes end user interaction with database.

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Data Manipulation Language (DML): language that enables users to access or manipulate data.

Data Definition Language (DDL): defines the different structure in database

Primary Key: Unique value within column that uniquely identified other value in each row. Primary key may be single column or composed of multiple column which contain not null unique value.

Foreign Key: A key which is reference from another table's primary key for linking two table relationship.

Unique Key: A column in a table which contain unique value in each row. May contain null value also.

Database User

The person who use the database systems are called database user. There are four different types of user.

1. Naive User

Interact with the system by using previously written program. End user who interact with DB using certain application software.

2. Application Programmer

Computer professional who writes application programs.

3. Sophisticated Users

They are database developers, who write SQL queries to select/insert/delete/update data. These users will be scientists, engineers, analysts who thoroughly study SQL and DBMS to apply the concepts in their requirement.

4. Specialized Users

These are also sophisticated users, but they write special database application programs. They are the developers who develop the complex programs to the requirement.

Database Administrator

- **The person who have central control of the both data and the programs, that access those data, over the system is called DBA.**
- DB Designing, implementing, maintaining, security management and policy management are key responsibility of DBA

Functions of DBA

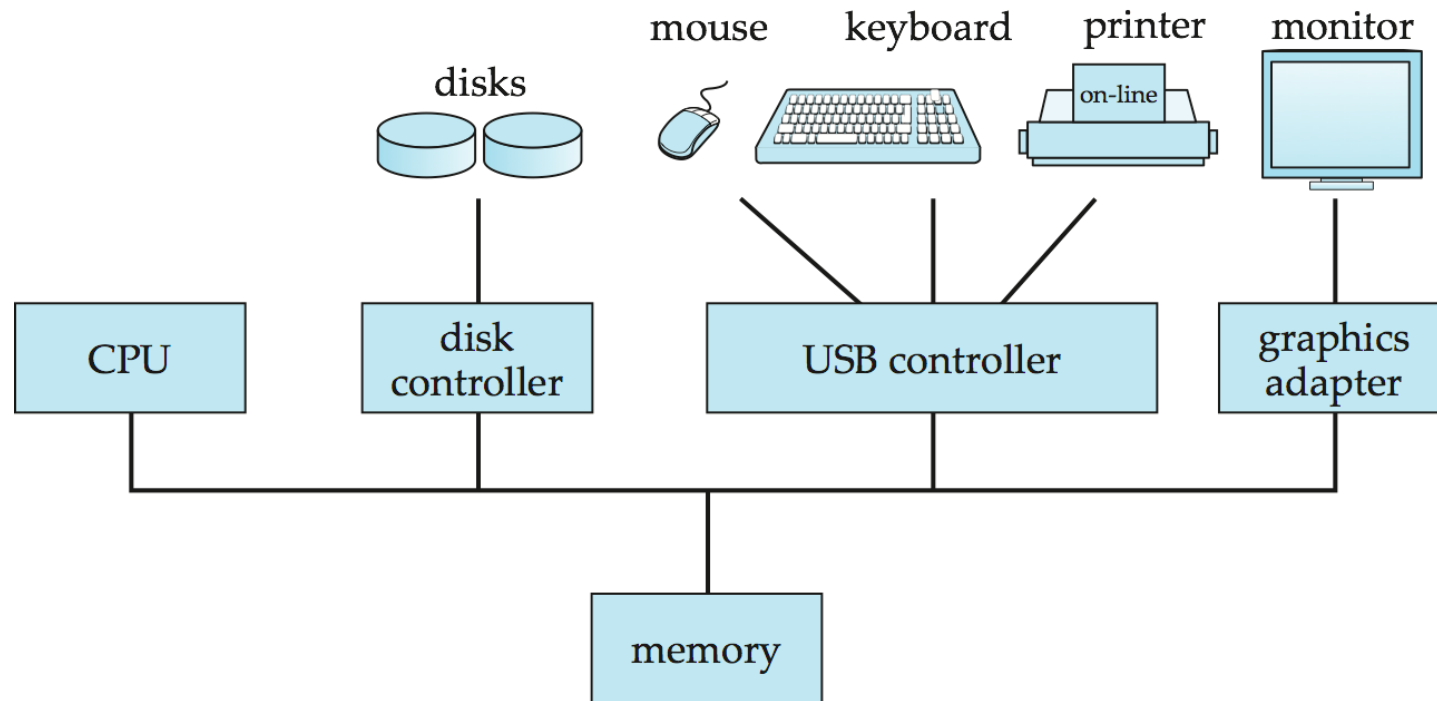
- Schema Definition
- Granting the authorization of DB access
- Integrity-constraint specifications.
- Routine maintenance
- Disaster/ security recovery plans
- Backup and restore process etc...

Database System Architecture

Centralized Systems

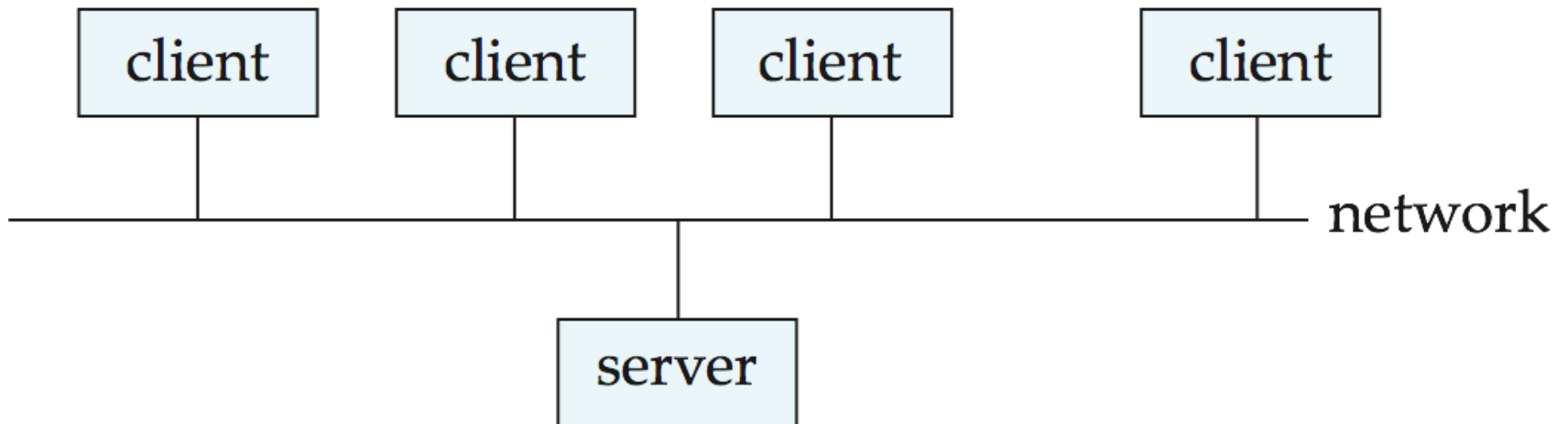
- Run on a single computer system and do not interact with other computer systems.
- General-purpose computer system: one to a few CPUs and a number of device controllers that are connected through a common bus that provides access to shared memory.
- Single-user system (e.g., personal computer or workstation): desk-top unit, single user, usually has only one CPU and one or two hard disks; the OS may support only one user.
- Multi-user system: more disks, more memory, multiple CPUs, and a multi-user OS. Serve a large number of users who are connected to the system via terminals. Often called *server* systems.

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Client-Server System

Server systems satisfy requests generated at m client systems, whose general structure is shown below:

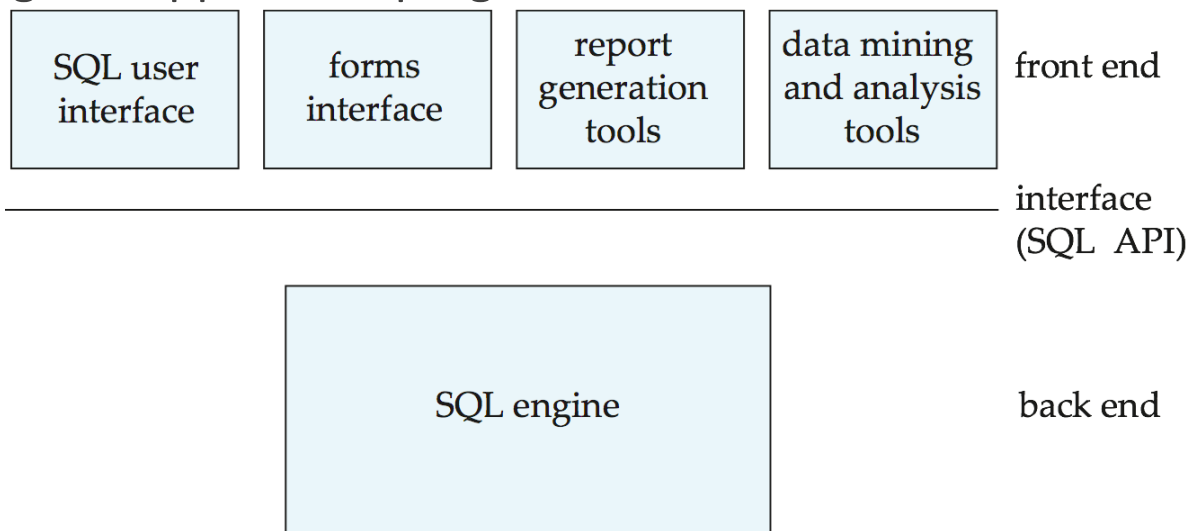


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Database functionality can be divided into:

- **Back-end**: manages access structures, query evaluation and optimization, concurrency control and recovery.
- **Front-end**: consists of tools such as *forms*, *report-writers*, and graphical user interface facilities.

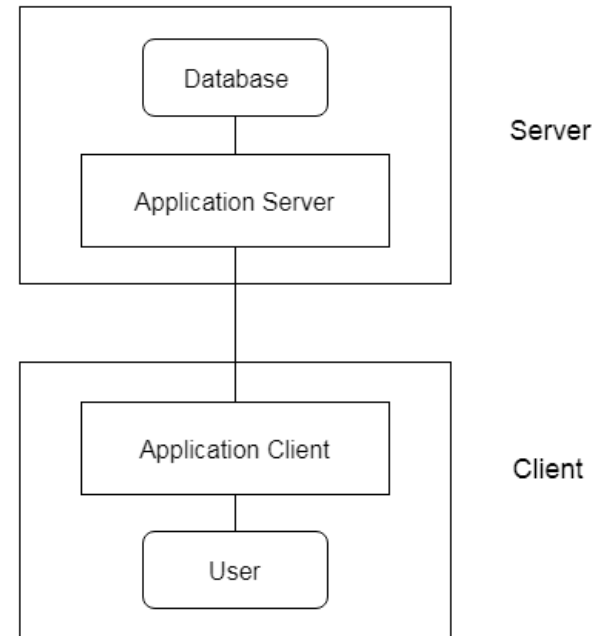
The interface between the front-end and the back-end is through SQL or through an application program interface.



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Advantages of replacing mainframes with networks of workstations or personal computers connected to back-end server machines:

- better functionality for the cost
- flexibility in locating resources and expanding facilities
- better user interfaces
- easier maintenance



Tier Architecture

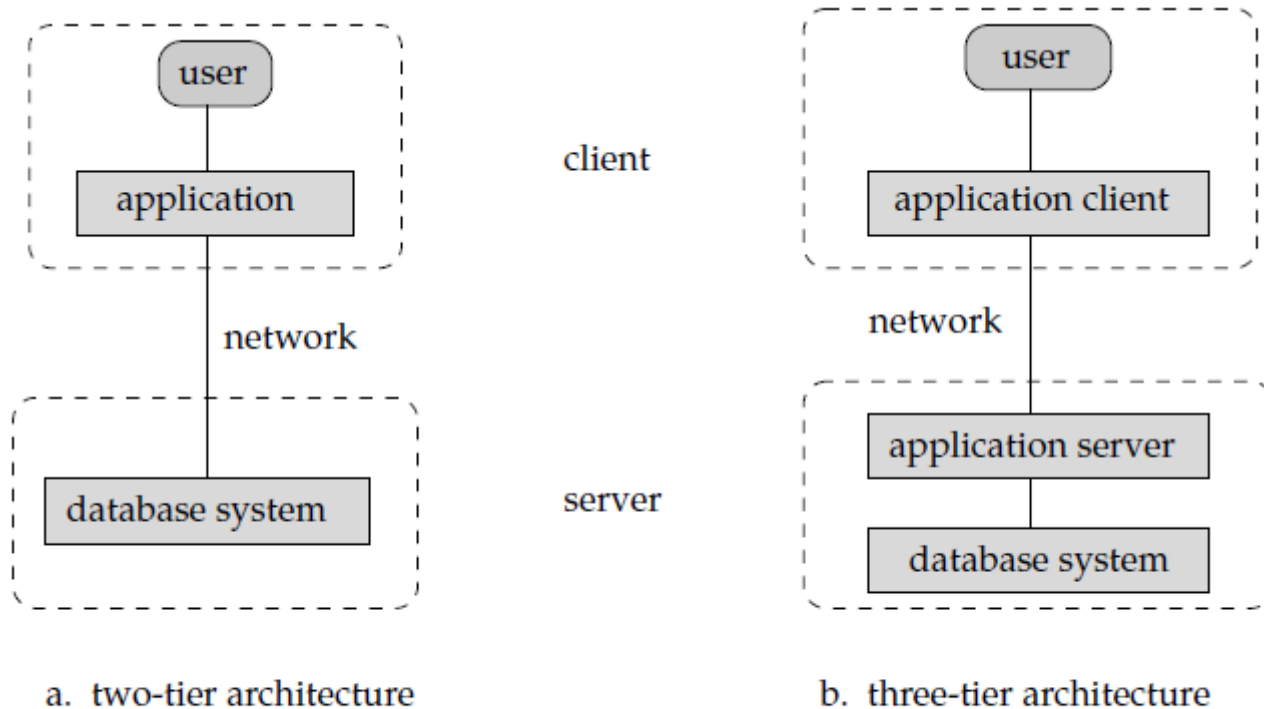
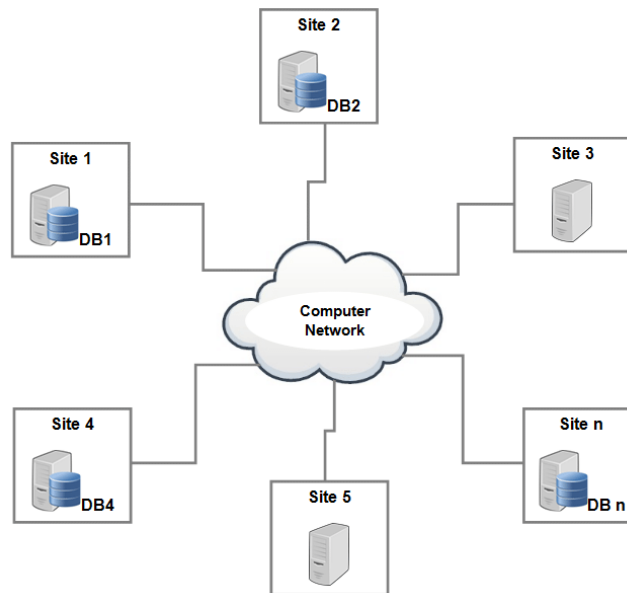


Figure 1.5 Two-tier and three-tier architectures.

Distributed Database

Database system that consists of two or more file located in different database server within the same network or different network.

Database are store in multiple physical location and processed from multiple nodes.



Application Area of Database

- Banking
- Airlines
- Universities
- Telecommunication
- Finance
- Sales
- Credit & Transaction
- Manufacturing
- Human Resources

Cloud Database

A cloud database is a database that is built, deployed, and accessed in a cloud environment, such as a private, public, or hybrid cloud.

Traditional Database: similar to an onsite, in-house managed database—except for infrastructure provisioning. In this case, an organization purchases virtual machine space from a cloud services provider, and the database is deployed to the cloud.

Database as a service (DBaaS): organization contracts with a cloud services provider through a fee-based subscription service. The service provider offers a variety of real-time operational, maintenance, administrative, and database management tasks to the end user. The database runs on the service provider's infrastructure.

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