

Using Databases I

Application Software



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Allan Chafukira

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Introduction

In this chapter we are going to discuss the following:

- Definition of the term database.
- Definition of other terms related to database.
- Two main types of database.
- Benefits of database. (Computerized)
- Database models.
- Features of a database.



Note!: to the instructor/teacher:

- Make sure the lessons are carried out in a computer lab and demonstration to the students is a **must**.
- MS Access package is a **minimum** requirement for this course.

Note!: to the student:

- Study, Practice, Repeat.

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Definitions

- In computer studies, the term database refers to the ***collection of related data and information that is organized for easy access, management, and update for specific purpose.***
- Think of a database as a filing system where data and information can be stored in cabinets or tables.
- Database are used to **store** and organize data and information so that it can be **retrieved, modified, and managed** efficiently.

Definition of other terms related to database:

- **Store:** the process of saving data in a structured and organized.
- **Retrieve:** the process of accessing and getting data or information from the database.
- **Modify:** the process of changing or updating the already existing data in the database. It includes processes such as;
 - Adding
 - Deleting
 - Editing

Types of database

- The abbreviation of the term database is **DB**.
- In computer system the symbol or the icon for database is shown in Figure 1 below:

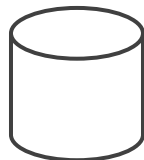


Figure 1: icon for database

We have **two** main types of database, namely:

- Manual database**
- Computerized database**

Manual Database

- This is a traditional method of storing and organizing data and information **by hand**.
- In this type of database, the data or information is written and organized **by hand on paper** and store in and retrieved from a **physical** location **manually**.

Types of database

- Examples of manual database include the use of:
 - Filing cabinets
 - Card catalogs



Figure 2: show an example of manual database

Computerized Database

- This is a modern method that makes use of computer systems and software to store, organize, and manage data and information **electronically**.
- This type database uses a Database Management System (DBMS), which is a software designed to store, manage, and facilitates access to a database.
- Computerized databases are faster and requires minimal physical space as compared to the manual database.

Benefits of using databases

Computer database system were developed to overcome the limitation of the ordinary file processing system.

Below are some of the benefits of using computerized databases:

Save time

- Computerized database are faster through the use of simple queries and search fields than searching through endless piles of paperwork.

More secure

- Computerized databases offers a level of security to valuable data and information by using password, backup, and encryption than using file cabinets which can be compromised, stolen and destroyed.

Ease data sharing

- Due to centralized nature of computerized database, data and information is shared over the network to multiple users and applications.

Benefits of using databases

Controlled data redundancy

- Computerized databases eliminates replication of data in different files ensuring data consistency and saving storage space.

Data integrity

- Computerized database ensure that data in a database is accurate, consistent, and reliable.

Aid communication

- In large organization and companies central computerized databases are used by employees to retrieve and modify records which can also be accessed by other employees immediately.

Backup and recovery

- Computerized databases protect your important data by making copies (backups) and allowing you to restore it if something goes wrong.

Disadvantages of using databases

Apart from the benefits discussed earlier, we also have limitations of computerized database:

Some of these limitations are highlighted below:

- Computerized databases are **expensive** to build, install, and run as compared to manual databases.
- Requires **trained personnel** to use the database.

- Computerized database **require knowledge of programming** as such making it difficult for users who do not know computer programming.

- Computerized database **required constant updating** for the information to be very useful.

- Database **software are complex** for first time users.

- **Privacy concerns** due to improper use of data stored in databases can lead to violation of privacy.

Database Models

- A **database model** is the logical way in which data is organized and structured in a database.
- A database model will show how data in a database is stored, related, and managed.
- In computerized databases we have a lot of database models, some of these database models are listed on the right side:

Database Models

- Hierarchical database model
- Network database model
- Relational database model
- Object – oriented model

Database Models

HIERARCHICAL DATABASE MODEL

- This is database model data is organized into a **tree-like** structure.
- The information or data in this database is represented using the **parent-child** relationship.
- In this database model each parent can have **many** children, but each child has only **one** parent.
- It is also known as a **1:N** (1 to many relationship)

- **Figure 3** below shows the structure of a hierarchical database model.

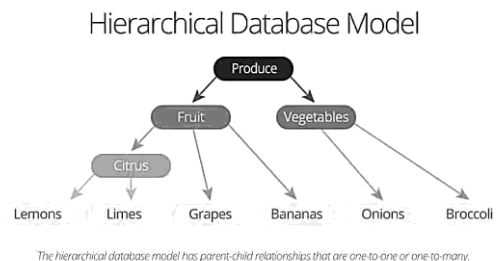


Figure 3: Hierarchical Database model

Database Models

Advantages of hierarchical database model

- it is easy to design.
- It is easy to maintain.
- Speed of accessing data is faster because of the predefined data path.

Advantages of hierarchical database model

- **Rigid structure:** this database model it is difficult to make changes, such as adding new relationships since it has predefined path.
- **Redundancy:** Data may need to be duplicated if it doesn't fit neatly into the hierarchy.
- **Limited flexibility:** Complex queries or relationships are harder to manage.

Database Models

Examples of systems that use the hierarchical database model

- Computer file system.
- School management system.
- Organization chart.
- Windows operating system registry.

Figure 4 on the right is an illustration of a real-world hierarchical database model as an organization chart.



Figure 4: Organization structure

Database Models

NETWORK DATABASE MODEL

- This is a database model in which data is organized in the form of a graph, where records are nodes and connected using links.
- This database model allows a **many** to **many** relationship, where a record can have multiple parents and child records.
- **Figure 3** on the right is a network database model structure.

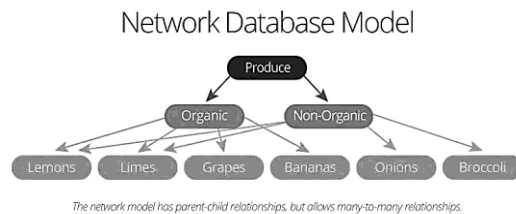


Figure 3: Network database model

Database Models

Advantages of Network database model

- Eliminates the unnecessary duplication of data.
- Very fast in data retrieval due to the predefined paths in the model.
- Enforces data sharing and security because all data is stored in a common place.
- Can handles more types of relationships, i.e: 1:N and M:N

Disadvantages of the Network database model

- It is not user friendly since it requires the know how of the internal structure of the database.
- It requires a lot of programming activities as such it is difficult to maintain and implement.
- It is difficult to make changes in the database – lack structural independence.

Database Models

Examples of system that use network database model

- **Library systems:** used to link books, authors, and borrowers.
- **Bank systems:** used to connect customers, accounts, and transactions.
- **School system:** used to connect teachers, classes, subject, and grades.

Figure 5 on the right shows an illustration of a network database model that can be used in a real world.

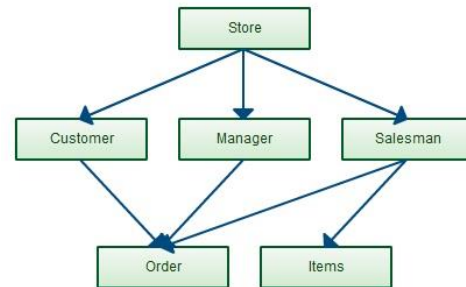


Figure 4: Organization structure

Database Models

RELATIONAL DATABASE MODEL

- In this database model data is organized into tables, where each table contains row and columns.
- The tables are also called relations.
- In this database model, the row represent a record, and column represent an attribute or a field.
- On the right **Figure 5** shows and illustration of a relational database model.

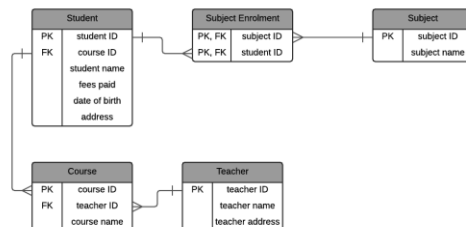


Figure 3: Relational database model

Database Models

- The tables in a relational database model are connected to each using **Keys**.
- We have two types of keys in relational database, namely:
 - **Primary Key (PK)**: this is a unique identifier for each record in a table of a relational database.
 - **Foreign Key (FK)**: this is a field in one table that relates (links) to a primary key in another table.
 - Foreign key is also called **Secondary key**.

Advantages of relational database model.

- Easier database design, implementation, management and use.
- Data integrity: this database prevent data duplication and null values due to the use of primary and secondary keys.
- Flexibility and Scalability: this database model easily allow changes to be made in the data structure and also support scaling to handle larger data volumes.
- Cost effective; most relational database systems are open source and free to use.

Database Models

Disadvantages of relational database model.

- Relational database model requires high storage space due indexing, keys ,and relationships, as such increasing the storage costs.
- May not fit for all business models: relational database model is not ideal for unstructured or semi structured data.
- This database model may require high processing power due to complex joins and queries, as such increasing

the operational costs.

- May promote 'island of information' problem: if relational databases are not properly integrated, we may have data that is isolated and can not be accessed or shared.
- Relational database models can sometimes facilitate poor design and implementation.

Database Models

Examples of systems that use relational database model.

- **Banking and Financial systems.** eg: payment processing systems.
- **Enterprise Resource Planning (ERP)** systems. e.g. inventory and supply chain systems.
- **Human Resource Management systems (HRMS).** e.g. workday
- **Retail point of sale (POS) systems:** use in retail shop like Chipiku and Sana.
- **Content Management systems. (CMS):** use to store website content, user data, and website settings.
- **Social Media Platforms.** e.g. Facebook, and it is used to manage user profiles, connections, and posts.
- **Online learning platforms.** e.g: Moodle, used to manage course progress, student progress, assessments, and user accounts.

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Database Models

Below is an example of a real relational database model:

CLASS ID	CLASS TEACHER	CLASS LOCATION
4E	Mphahle Makame	Eastern Block
4N	Cyrus Tafadewa	Western Block
4S	Jack Chisomo	Administration Block
4W	Sally Vinumbike	Western Block

ADMISSION NUMBER	CLASS ID	FIRST NAME	LAST NAME	GENDER
8001	4E	Sabina	Alte	Female
8002	4N	Laurande	Bomani	Male
8003	4S	Ruth	Buseje	Female
8004	4W	Emmanuel	Chaburea	Male
8005	4E	Ephrem	Chisome	Male

EXAM ID	ADMISSION NUMBER	MATHS	ENGLISH	COMPUTER STUDIES
TIC12014	8001	78	71	88
TIC12014	8002	90	65	88
TIC12014	8003	78	44	87
TIC22014	8004	65	69	61

Figure 2.4: Relational model

OBJECT ORIENTED DATABASE MODEL

- In this database model, data is stored and organized as **objects**.
- These objects will combine the attributes of the data and the operations that can be performed on the data.
- These objects are similar to the objects we use in real life or programming.

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Database Models

- The object in this type of database model is like a container that will hold two items:
 - Data: this can be the information about the object. Also called attributes.
 - Behavior: this is the action that the object can perform. Also called methods.
- These object can belong to **classes** have common attributes and methods.
- The table on the right highlights some of the advantages and disadvantages of the object-oriented database model.

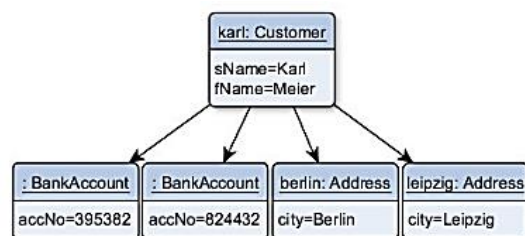
	Advantages	Disadvantages
a.	Represent real world objects easily.	Difficult to learn for beginners.
b.	Objects and classes can be reused.	Not widely used and supported.
c.	Handle complex data with ease.	Slower for simple tasks and queries.

- Below are examples of systems that make use of the object-oriented database model:

Database Models

- Multimedia applications
- Computer Aided Design (CAD) systems
- Scientific database
- Object – oriented programming applications.
- Geographic Information systems (GIS).

On the right is an example of object – oriented database model:



Features of database

- These are functionalities or characteristics that make databases efficient tools for storing, managing, and retrieving data.
- These features include, but not limited to:
 - a. **Data organization:** Databases store data in a structured format such as tables and objects making it easy to retrieve and manipulate data.
 - b. **Editing features:** these are features that allow users to delete, replace, re-arrange, and move data from one Place to another.
 - c. **Data security:** databases allow users to set authorization measures and to encrypt data so that it can only be accessed by the authorized users only.
 - d. **Formatting features:** allow users to make changes to the appearance of the data in a database and also set the required number formatting for different fields.
 - e. **Formula and function features:** allow users to perform calculation on the data item stored in the database.

Database Management Software

- In simple terms, this is a computer program that help users store, organize, and manage data in a database.
 - The function of a database management software is to provide a user interface for users to interact with a database.
- Note:** Below is the difference between DBMS and database management software.
- A DBMS (Database Management System) includes software, hardware, and processes for managing databases.
- while, a database management Software is only a computer program that is used to manage databases.
- In simple terms we can say that:
- **Database Management Software** is a tool you use to **interact with a database** (like an app to access data).
 - **Database Management System (DBMS)** is the entire system that **stores, organizes, and manages the data** (like the engine running the database).

Database Management Software

Some common examples of database management software are,

- MySQL workbench
- Microsoft Access
- phpMyAdmin

Some common examples of Database Management System (DBMS) are,

- Microsoft SQL Server
- Oracle Database
- MySQL
- MariaDB
- PostgreSQL
- Microsoft Access

• Some computer programmes can combine both the function of a DBMS and a database management software.

• Examples of such computer programs include:

- Microsoft Access
- SQLite
- File Maker Pro
- FoxPro

Quiz 1

1. Define the following terms as used in databases:
 - i. Retrieve (1 mark)
 - ii. Modify (1 mark)
2. Describe the **two** types of databases. (4 marks)
3. With the aid of a well labelled diagram, describe the Network database model. (5 marks)
4. Give any **two** examples of database management software. (2 marks)
5. Discuss any **five** places where databases are used in our everyday life. (10 marks)

Next: Using database II
Hands-on classes

References

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