ST. LAWRENCE HIGH SCHOOL

A Jesuit Christian Minority Institution

STUDY MATERIAL - 12

Subject: COMPUTER SCIENCE **Class - 12**

Chapter: DBMS **Date: 01/08/2020**

INTRODUCTION TO DATABASE

What is Database?

The database is a collection of inter-related data which is used to retrieve, insert and delete the data efficiently. It is also used to organize the data in the form of a table, schema, views, and reports, etc.

For example: The college Database organizes the data about the admin, staff, students and faculty etc.

Using the database, you can easily retrieve, insert, and delete the information.

Database Management System

- Database management system is a software which is used to manage the database. For example: MySQL, Oracle, etc. are a very popular commercial database which is used in different applications.
- DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database and a lot more.
- It provides protection and security to the database. In the case of multiple users, it also maintains data consistency.

DBMS allows users the following tasks:

- **Data Definition:** It is used for creation, modification, and removal of definition that defines the organization of data in the database.
- **Data Updation:** It is used for the insertion, modification, and deletion of the actual data in the database.
- **Data Retrieval:** It is used to retrieve the data from the database which can be used by applications for various purposes.
- **User Administration:** It is used for registering and monitoring users, maintain data integrity, enforcing data security, dealing with concurrency control, monitoring performance and recovering information corrupted by unexpected failure.

Characteristics of DBMS

- It uses a digital repository established on a server to store and manage the information.
- It can provide a clear and logical view of the process that manipulates data.
- DBMS contains automatic backup and recovery procedures.
- It contains ACID properties which maintain data in a healthy state in case of failure.
- It can reduce the complex relationship between data.
- It is used to support manipulation and processing of data.
- It is used to provide security of data.
- It can view the database from different viewpoints according to the requirements of the user.

Advantages of DBMS

- **Controls database redundancy:** It can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database.
- **Data sharing:** In DBMS, the authorized users of an organization can share the data among multiple users.
- **Easily Maintenance:** It can be easily maintainable due to the centralized nature of the database system.
- **Reduce time:** It reduces development time and maintenance need.
- **Backup:** It provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required.
- **multiple user interface:** It provides different types of user interfaces like graphical user interfaces, application program interfaces

Disadvantages of DBMS

- **Cost of Hardware and Software:** It requires a high speed of data processor and large memory size to run DBMS software.
- **Size:** It occupies a large space of disks and large memory to run them efficiently.
- **Complexity:** Database system creates additional complexity and requirements.
- **Higher impact of failure:** Failure is highly impacted the database because in most of the organization, all the data stored in a single database and if the database is damaged due to electric failure or database corruption then the data may be lost forever.

Components of DBMS

DBMS have several components, each performing very significant tasks in the database management system environment. Below is a list of components within the database and its environment.

Software: This is the set of programs used to control and manage the overall database. This includes the DBMS software itself, the Operating System, the network software being used to share the data among users, and the application programs used to access data in the DBMS.

Hardware consists of a set of physical electronic devices such as computers, I/O devices, storage devices, etc., this provides the interface between computers and the real world systems.

Data: DBMS exists to collect, store, process and access data, the most important component. The database contains both the actual or operational data and the metadata.

Procedures: These are the instructions and rules that assist on how to use the DBMS, and in designing and running the database, using documented procedures, to guide the users that operate and manage it.

Database Access Language: This is used to access the data to and from the database, to enter new data, update existing data, or retrieve required data from databases. The user writes a set of appropriate commands in a database access language, submits these to the DBMS, which then processes the data and generates and displays a set of results into a user readable form.

Query Processor: This transforms the user queries into a series of low level instructions. This reads the online user's query and translates it into an efficient series of operations in a form capable of being sent to the run time data manager for execution.

Run Time Database Manager: Sometimes referred to as the database control system, this is the central software component of the DBMS that interfaces with user-submitted application programs and queries, and handles database access at run time. Its function is to convert operations in user's queries. It provides control to maintain the consistency, integrity and security of the data.

Data Manager Also called the cache manager; this is responsible for handling of data in the database, providing a recovery to the system that allows it to recover the data after a failure.

Database Engine: The core service for storing, processing, and securing data, this provides controlled access and rapid transaction processing to address the requirements of the most demanding data consuming applications. It is often used to create relational databases for online transaction processing or online analytical processing data.

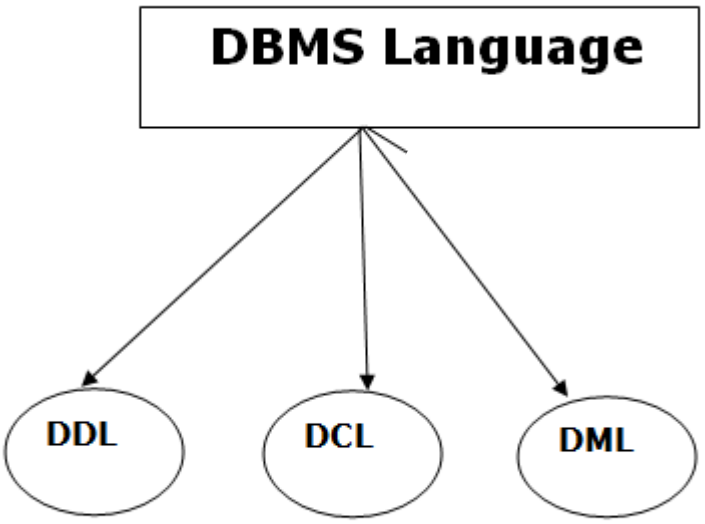
Data Dictionary: This is a reserved space within a database used to store information about the database itself. A data dictionary is a set of read-only table and views, containing the different information about the data used in the enterprise to ensure that database representation of the data follow one standard as defined in the dictionary.

Report Writer
Also referred to as the report generator, it is a program that extracts information from one or more files and presents the information in a specified format. Most report writers allow the user to select records that meet certain conditions and to display selected fields in rows and columns, or also format the data into different charts.

Database Language

- A DBMS has appropriate languages and interfaces to express database queries and updates.
- Database languages can be used to read, store and update the data in the database.

Types of Database Language



1. Data Definition Language

- **DDL** stands for **D**ata **D**efinition **L**anguage. It is used to define database structure or pattern.
- It is used to create schema, tables, indexes, constraints, etc. in the database.
- Using the DDL statements, you can create the skeleton of the database.
- Data definition language is used to store the information of metadata like the number of tables and schemas, their names, indexes, columns in each table, constraints, etc.

Here are some tasks that come under DDL:

- **Create:** It is used to create objects in the database.
- **Alter:** It is used to alter the structure of the database.
- **Drop:** It is used to delete objects from the database.
- **Truncate:** It is used to remove all records from a table.
- **Rename:** It is used to rename an object.
- **Comment:** It is used to comment on the data dictionary.

These commands are used to update the database schema that's why they come under Data definition language.

2. Data Manipulation Language

DML stands for **D**ata **M**anipulation **L**anguage. It is used for accessing and manipulating data in a database. It handles user requests.

Here are some tasks that come under DML:

- **Select:** It is used to retrieve data from a database.
- **Insert:** It is used to insert data into a table.
- **Update:** It is used to update existing data within a table.
- **Delete:** It is used to delete all records from a table.
- **Merge:** It performs UPSERT operation, i.e., insert or update operations.
- **Call:** It is used to call a structured query language or a Java subprogram.
- **Explain Plan:** It has the parameter of explaining data.
- **Lock Table:** It controls concurrency.

3. Data Control Language

- **DCL** stands for **D**ata **C**ontrol **L**anguage. It is used to retrieve the stored or saved data.
- The DCL execution is transactional. It also has rollback parameters.

  (But in Oracle database, the execution of data control language does not have the feature of rolling back.)

Here are some tasks that come under DCL:

- **Grant:** It is used to give user access privileges to a database.
- **Revoke:** It is used to take back permissions from the user.

There are the following operations which have the authorization of Revoke:

CONNECT, INSERT, USAGE, EXECUTE, DELETE, UPDATE and SELECT.

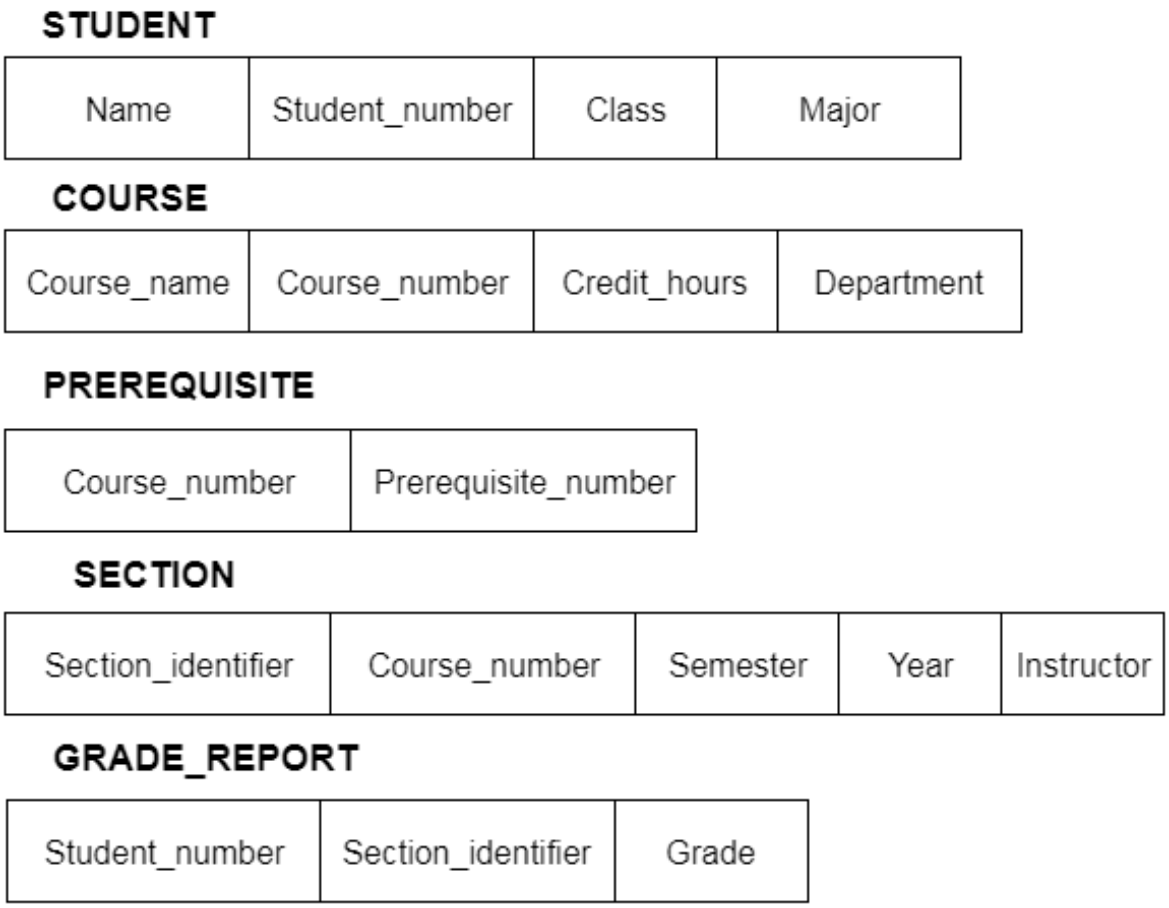
Data model Schema and Instance

- The data which is stored in the database at a particular moment of time is called an instance of the database.
- The overall design of a database is called schema.
- A database schema is the skeleton structure of the database. It represents the logical view of the entire database.
- A schema contains schema objects like table, foreign key, primary key, views, columns, data types, stored procedure, etc.
- A database schema can be represented by using the visual diagram. That diagram shows the database objects and relationship with each other.

- A database schema is designed by the database designers to help programmers whose software will interact with the database. The process of database creation is called data modelling.

A schema diagram can display only some aspects of a schema like the name of record type, data type, and constraints. Other aspects can't be specified through the schema diagram. For example, the given figure neither shows the data type of each data item nor the relationship among various files.

In the database, actual data changes quite frequently. For example, in the given figure, the database changes whenever we add a new grade or add a student. The data at a particular moment of time is called the instance of the database.



Types of database models

There are many kinds of data models. Some of the most common ones include:

- Hierarchical database model
- Relational model
- Network model
- Entity-relationship model

You may choose to describe a database with any one of these depending on several factors. The biggest factor is whether the database management system you are using supports a particular model. Most database management systems are built with a particular data model in mind and require their users to adopt that model, although some do support multiple models.

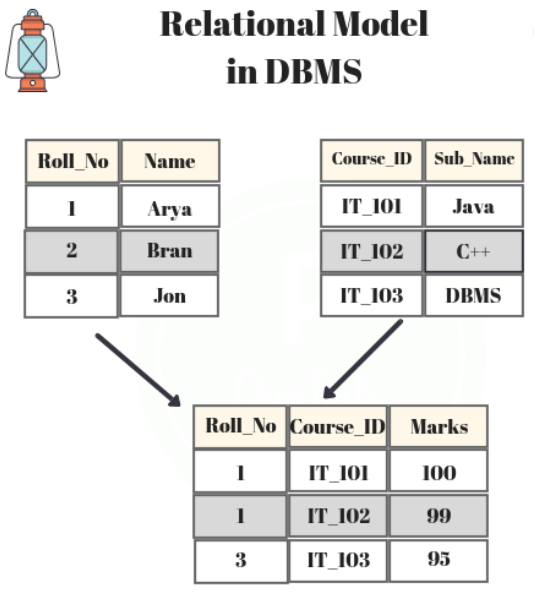
In addition, different models apply to different stages of the database design process. High-level conceptual data models are best for mapping out relationships between data in ways that people perceive that data. Record-based logical models, on the other hand, more closely reflect ways that the data is stored on the server.

Selecting a data model is also a matter of aligning your priorities for the database with the strengths of a particular model, whether those priorities include speed, cost reduction, usability, or something else.

Let's take a closer look at some of the most common database models.

Relational model

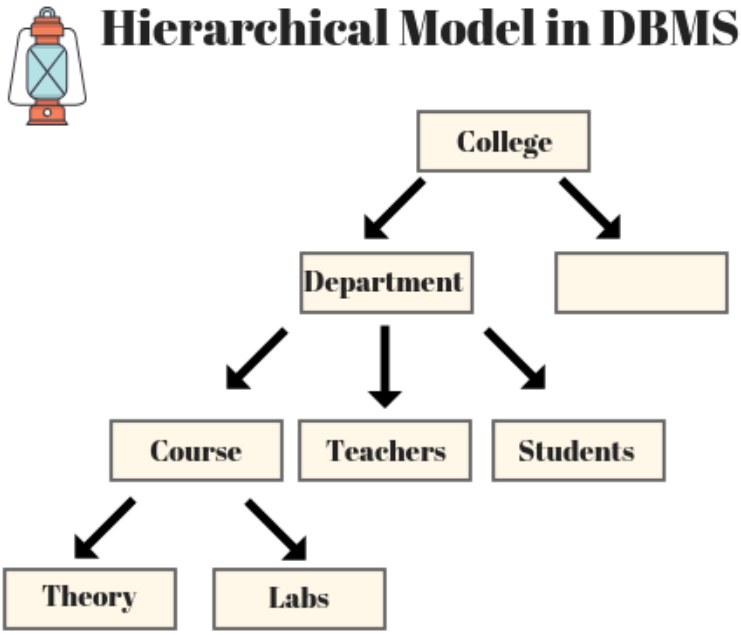
- The most common model, the relational model sorts data into tables, also known as relations, each of which consists of columns and rows. Each column lists an attribute of the entity in question, such as price, zip code, or birth date. Together, the attributes in a relation are called a domain. A particular attribute or combination of attributes is chosen as a primary key that can be referred to in other tables, when it's called a foreign key.
- Each row, also called a tuple, includes data about a specific instance of the entity in question, such as a particular employee.
- The model also accounts for the types of relationships between those tables, including one-to-one, one-to-many, and many-to-many relationships. Here's an example:



- Within the database, tables can be normalized, or brought to comply with normalization rules that make the database flexible, adaptable, and scalable. When normalized, each piece of data is atomic, or broken into the smallest useful pieces.
- Relational databases are typically written in Structured Query Language (SQL). The model was introduced by E.F. Codd in 1970.

Hierarchical model

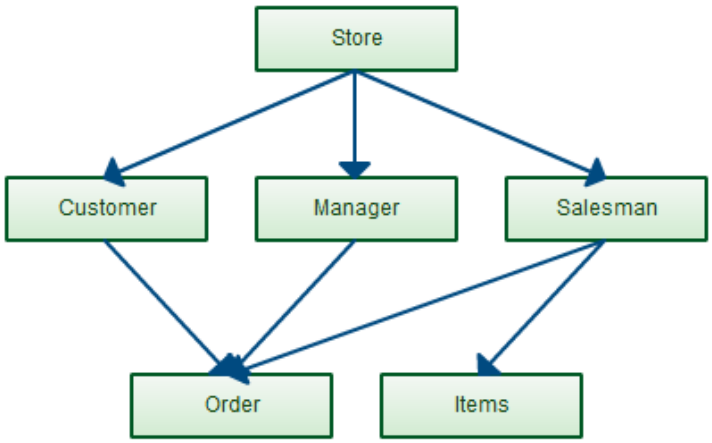
- The hierarchical model organizes data into a tree-like structure, where each record has a single parent or root. Sibling records are sorted in a particular order. That order is used as the physical order for storing the database. This model is good for describing many real-world relationships.



- This model was primarily used by IBM's Information Management Systems in the 60s and 70s, but they are rarely seen today due to certain operational inefficiencies.

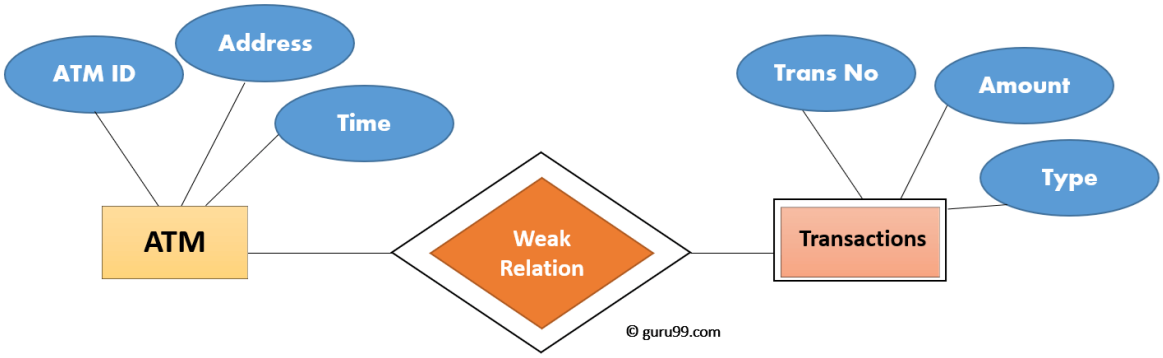
Network model

- The network model builds on the hierarchical model by allowing many-to-many relationships between linked records, implying multiple parent records. Based on mathematical set theory, the model is constructed with sets of related records. Each set consists of one owner or parent record and one or more member or child records. A record can be a member or child in multiple sets, allowing this model to convey complex relationships.
- It was most popular in the 70s after it was formally defined by the Conference on Data Systems Languages (CODASYL).



Entity-relationship model

- This model captures the relationships between real-world entities much like the network model, but it isn't as directly tied to the physical structure of the database. Instead, it's often used for designing a database conceptually.
- Here, the people, places, and things about which data points are stored are referred to as entities, each of which has certain attributes that together make up their domain. The cardinality, or relationships between entities, are mapped as well.



A common form of the ER diagram is the star schema, in which a central fact table connects to multiple dimensional tables.

Functions and responsibilities of DBAs

DBA: person in the organization who controls the design and the use of the database refers as DBA.

1. Schema Definition:

- The DBA definition the logical Schema of the database. A Schema refers to the overall logical structure of the database.
- According to this schema, database will be developed to store required data for an organization.

2. Storage Structure and Access Method Definition:

- The DBA decides how the data is to be represented in the stored database.

3. Assisting Application Programmers:

- The DBA provides assistance to application programmers to develop application programs.

4. Physical Organization Modification:

- The DBA modifies the physical organization of the database to reflect the changing needs of the organization or to improve performance.

5. Approving Data Access:

- The DBA determines which user needs access to which part of the database.
- According to this, various types of authorizations are granted to different users.

6. Monitoring Performance:

- The DBA monitors performance of the system. The DBA ensures that better performance is maintained by making changes in physical or logical schema if required.

7. Backup and Recovery:

- Database should not be lost or damaged.
- The DBA ensures this periodically backing up the database on magnetic tapes or remote servers.
- In case of failure, such as virus attack database is recovered from this backup.

Answer the following questions:

1. List few advantages of DBMS.

Ans: Some advantages are listed below:

- Controls database redundancy: It can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database.
- Data sharing: In DBMS, the authorized users of an organization can share the data among multiple users.
- Easily Maintenance: It can be easily maintainable due to the centralized nature of the database system.
- Reduce time: It reduces development time and maintenance need.
- Backup: It provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required.

2. Write a short note on DML.

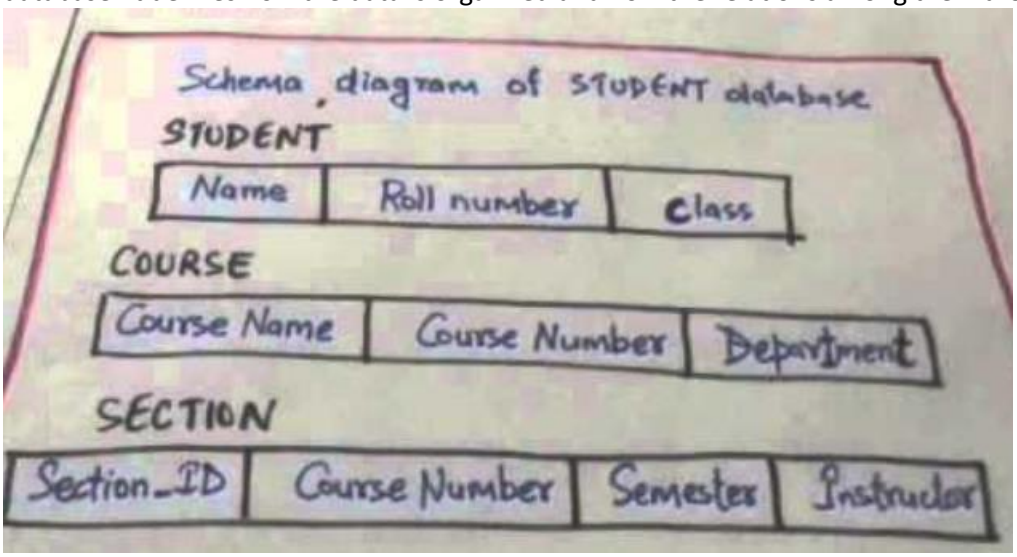
Ans: The SQL commands that deals with the manipulation of data present in the database belong to DML or Data Manipulation Language and this includes most of the SQL statements.

Examples of DML:

- **INSERT** – is used to insert data into a table.
- **UPDATE** – is used to update existing data within a table.
- **DELETE** – is used to delete records from a database table.

3. Define database schema. Provide suitable example.

Ans: A database *schema* is the skeleton structure that represents the logical view of the entire database. It defines how the data is organized and how the relations among them are associated.



4. Write any five functions of DBA.

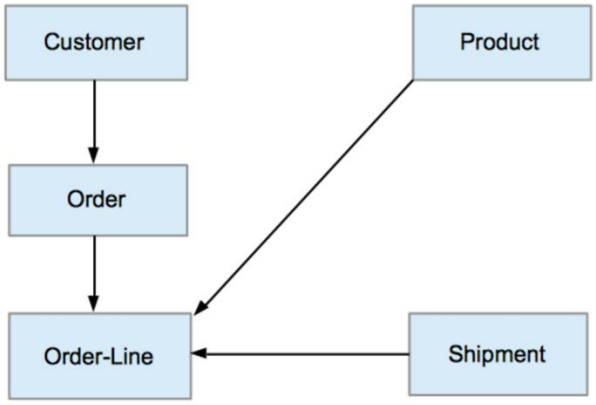
Ans:

Functions of a **DBA** include

- **Schema definition**: The DBA creates the original database schema by executing a set of data definition statements in the DDL.
- **Storage structure and access-method definition.**
- **Schema and physical-organization modification**: The DBA carries out changes to the schema and physical organization to reflect the changing needs of the organization, or to alter the physical organization to improve performance.
- **Granting of authorization for data access.** By granting different types of authorization, the database administrator can regulate which parts of the database various users can access.
- **Routine maintenance**

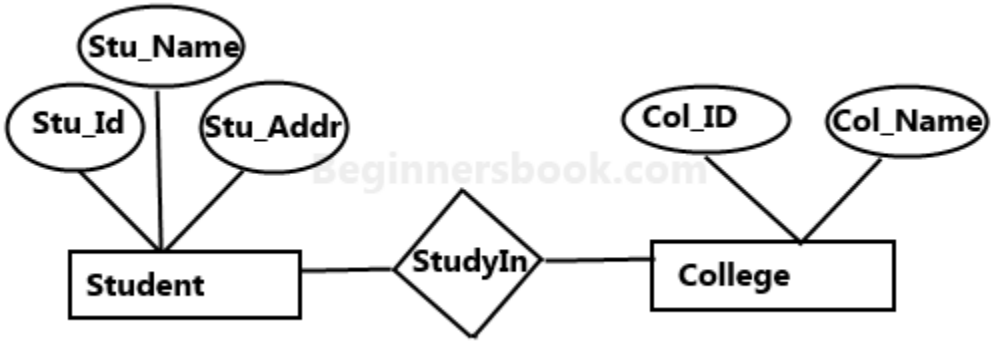
5. Write a short note on Network Model.

Ans: A network model is a database model that is designed as a flexible approach to representing objects and their relationships. A 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. Unlike other database models, the network model's schema is not confined to be a lattice or hierarchy; the hierarchical tree is replaced by a graph, which allows for more basic connections with the nodes.



6. Provide a suitable example of ERD model.

Ans:



7. What is the difference between DBMS and file system?

Ans:

DBMS	File System
DBMS is a collection of data. In DBMS, the user is not required to write the procedures.	File system is a collection of data. In this system, the user has to write the procedures for managing the database.
DBMS gives an abstract view of data that hides the details.	File system provides the detail of the data representation and storage of data.
DBMS provides a crash recovery mechanism, i.e., DBMS protects the user from the system failure.	File system doesn't have a crash mechanism, i.e., if the system crashes while entering some data, then the content of the file will lost.
DBMS provides a good protection mechanism.	It is very difficult to protect a file under the file system.
DBMS contains a wide variety of sophisticated techniques to store and retrieve the data.	File system can't efficiently store and retrieve the data.
DBMS takes care of Concurrent access of data using some form of locking.	In the File system, concurrent access has many problems like redirecting the file while other deleting some information or updating some information.

8. **Explain the following terms briefly: tuples, relation, instance, attributes, and entity.**
   Ans:
   Tuples : Rows in a table is known as tuples.
   Relation : In a relational **database**, the table is a **relation** because it stores the **relation** between data in its column-row format.
   Instance : In the relational database system, the relational instance is represented by a finite set of tuples. Relation instances do not have duplicate tuples.
   Attribute : It contains the name of a column in a particular table.
   Entity: An entity is real-world objects that are represented in database. It can be any object, place, person or class.