DATABASE FUNDAMENTALS

CHAPTER 7

UNIT INTRODUCTION

A database is a collection of related files that are usually integrated, linked or cross-referenced to one another. This unit is dedicated to database and database management systems. It introduces the types of database models and provides the basic knowledge about data modeling and E-R diagram for planning and development of a database system. It presents the advantages of using a database management system over the old file management system. It describes the responsibilities of database administrator for the performance, integrity, aim and security of a database.

7.1 INTRODUCTION TO DATABASE

Q.1 Give a brief introduction to database and database systems.

Answer

Databases and Database Systems

Databases and database systems have become an essential part of everyday life modern society. Most of us encounter several activities that involve some interaction with database.

Explanation

If we go to the bank to deposit or withdraw money; if we make a hotel or airline reservation or if we access a computerized library catalogue to search for a book chances are that our activities will involve someone accessing a database. Even purchasing items from a supermarket nowadays in many cases involves an automatic update of the database that keeps the inventory of supermarket items.

7.1.1 DATA AND INFORMATION

Q.2 Differentiate between data and information with the help of examples.

Answer

Data

Data refers to the facts and figures in raw form i.e. not in organized form. Data is the raw material given as input to the computer for processing.

Example

The item code, description, quantity and price of items purchased in a store are data. When this data is entered into the computer and processed, it prints the bill, which is the output of the computer.

Information

Information is the processed or organized form of data. When the computer processes data and it is properly arranged and organized, it is converted to information. It is also called the output of computer

and is the meaningful form of data.

Example

The names of students and their marks in all the subjects is data. When the computer processes it, the result sheets and report cards produced is information.

7.1.2 FILE MANAGEMENT SYSTEM

Q.3 What is file management system? Explain the problem in this system with the help of an example.

Answer

File Management System / File Based Management System

A file (or file based) management system is a collection of programs used for managing data stored in various files. Each program within a file management system is developed independently and it defines and manages its own data.

Problem in File Management System

In file management system, records in one file are not related to the records in any other file. This approach leads to many problems, which include data duplication in different files, data inconsistency, sharing of data and lack of flexibility in organizing and querying the data.

Example

A company may store a salesman's name, address telephone number and commission rate in a file in Accounts Department and the same information may be stored in another file in Sales Department. The Accounts Department, for example, may change the commission rate of salesman but the Sales Department may fail to update its file. This will produce reports calculated with out-of-data figures. The inconsistency in files occurred due to duplication of same data in files. This is the main problem faced in file management systems.

7.1.3 DATABASE

Q.4 What is the solution of the problems in traditional file management system?

Answer

Solution of the problems in traditional file management system

In order to solve the problems of traditional file management system for managing data, the concept of a database was introduced.

Q.5 Explain 'database' its size, creation and manipulation in detail.

Answer

Database

A database is a collection of related data.

Explanation

Consider the names, telephone numbers and addresses of the people you know. You may have recorded this data in an indexed address book or you stored it on your computer's hard disk using software such as Microsoft Access or Excel. This is a collection of data having implicit meaning and hence is a database.

Size of Database

A database can be of any size and complexity.

Explanation

A database containing names and telephone numbers of your friends may have only a few records. On the other hand, a database containing information about all the citizens of a country for National Identity Card (NIC) may contain millions of records.

Creation and Manipulation of Database

A database may be created and maintained manually or it may be computerized. The library card catalogue is an example of a manually created and maintained database. A computerized database is

created and maintained by a database management system.

Examples

- Library Management System
- Stock Control System
- Examination Control System

7.1.4 DATABASE MANAGEMENT SYSTEM (DBMS)

Q.6 What is meant by DBMS? Explain it in detail.

Answer

DBMS

A database management system (DBMS) is a set of programs that allow users to create, maintain and manipulate database, and store or retrieve data from those database files. It provides user-friendly access and controls between user and database. Its main purpose is to improve data sharing, data access, decision making and increase end user productivity.

Operations in manipulation of data

Manipulation of data includes the following operations:

1. **Adding new data**
   Adding details of new students.
2. **Deleting unwanted data**
   Deleting the details of students who have completed course.
3. **Changing existing data**
   Modifying the fee paid by the students.

Function/Purpose of DBMS

The DBMS helps to create an environment in which users have better access to data. DBMS helps to give an integrated view of the organization's operations. The DBMS makes it possible to share the data in the database among multiple applications and users.

Examples

Some examples of the database systems managed by DBMS are:

- Customer information system
- Inventory information
- Library management
- Accounting and bookkeeping

Examples of DBMS Applications

Examples of DBMS applications are as follows:

- Microsoft Access
- Microsoft SQL Server
- Sybase
- Oracle
- MySQL

7.1.5 ADVANTAGES OF DBMS OVER FILE MANAGEMENT SYSTEM

Q.7 Describe the advantages of DBMS over file management system.

Answer

DBMS has many advantages over the file management system because it provides solutions to all the problems faced in file management system.

Problems in file management system

The following problems were faced in file management system:

- Reduced Data Redundancy
- Data consistency
- Program-Data Dependency
- Lack of Flexibility
- Data not Sharable
- Backup and Recovery
- Data Security

1. Reduced Data Redundancy

Data redundancy is the duplication of data in many different filed in file management system.

Example

A salesman's data may be held on a file in the Sales Department and also Personnel Department.

When data is to be updated, it must be changed in both files. This results in wastage of storage space and may lead to data inconsistency.

DBMS not faced with the problem

This problem is not faced in DBMS because all the data belonging to the entire organization is centralized in a common pool of data, accessible by all the programs.

2. Data consistency

In file management system, same data may be held in several different files, it has to be updated in each separate file when it changes. If data is not updated in any file, it causes data inconsistency.

Solution in DBMS

This problem is solved in DBMS because all the data is centralized for use by all the programs.

Example

In a school, students' information such as name, address, phone number and class are held in a file in Admission Office. The same data with tuition fee and some other data are also kept in another file in Accounts Office. If a student's address changes it must be updated on both files. In case, it is updated in only one file, the other file will have out-of-date data. This will cause data inconsistency.

3. Program-Data Dependency

In file management system, every computer program in each Department has to specify exactly what data fields constitute a record. Any change to the format to the data field of a record, such as adding a new field or changing the length of a field means that every program, which uses that file has to be changed.

Example

If a new field, place of birth of students is to be added in student data files in Admission Office and Accounts Office, run both the programs need to be changed.

4. Lack of Flexibility

In file management system, when information of a non-routine nature is needed, it can take weeks to assemble the data from the various files and write new programs produce the required reports.

Example

A report about students is required in a school that has to merge information stored in various files. This will require lot of time and effort by the programmer to write a program to print such a report in file management system, whereas, it can be feeling very easily produced in database management system.

5. Data not Sharable

When a copy of a data file is made for sharing data with other people in a file management system, it will soon lead to data inconsistency if data in one of the files is not updated. Therefore, it is difficult to share data with others in a file management system.

6. Backup and Recovery

DBMS provides facilities for backup and recovery from failures including disk crash, power failure, software errors, which may bring the database from the consistent state to a state prior to the failure.

7. Data Security

In Conventional filing systems, there is no centralized security system, which restricts users according to their role in the organization. DBMS makes it easier to enforce security restrictions since database is centralized. Users are provided permissions to access data according to their rights.

7.1.6 ROLE OF DATABASE ADMINISTRATOR (DBA)

Q.8 Who is database administrator? What are his responsibilities?

Answer

Database Administrator

Database Administrator (DBA) is the person responsible for supervising the database and the use of DBMS in an organization.

Responsibilities of DBA

DBA has the following responsibilities:

1. Designing the database and enforcing the operational policies and procedures for its usage.
2. Planning security measures and backup of database.
3. Controlling privileges and permissions of database users.
4. Allocating passwords to users.
5. Planning recovery procedures if hardware or software failure occurs and ensuring that no data is lost.
6. Providing training to new employees about using the database.

7.1.7 DATABASE MODELS

Q.9 Define database model. Explain its types.

Answer

Database Model

A database model is the theoretical foundation of a database and determines in which manner data can be stored, organized and manipulated. It defines a way of structuring data.

Types of Database Models

There are five types of database models, which are as follows:

- Hierarchical Database Model
- Network Database Model
- Relational Database Model
- Object-Oriented Database Model
- Object Relational Database Model

1. Hierarchical Database Model

In a hierarchical model, data is organized into a tree-like structure as shown in Fig.7.1.

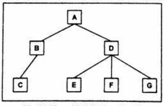

Fig. 7.1 Hierarchical Database Model

It is a logical construct with owner and subordinate relationship.

Members and Owners

Data elements in a subordinate relationship are called members and those having subordinates are

called owners. In a hierarchical structure, subordinates can have only a single owner and there is only one data element that has no owner. This structure is very suitable in describing many relationships in the real world.

Examples of hierarchical model

Some examples of hierarchical model are table of contents, departments of an organization and types of memories.

2. Network Database Model

A network model is a logical structure in which some of the data elements can have more than one owner data element as shown in Fig.7.2.

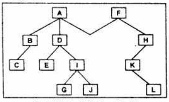

Fig. 7.2 Network Database Model

A network is a more complex structure than a hierarchical model. A hierarchical model can be thought of as a network with some discipline imposed on it. An application with which crew members, aircraft, routes and schedules are related is by its nature a network model.

3. Relational Database Model

In a relational database model, data is held in tables as shown in Fig.7.3 and the tables are linked by means of common fields.

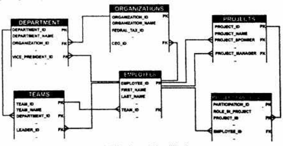

Fig.7.3 Table in a relational database

Relation

The "relation" in a relational database refers to the various tables in the database, which are linked with each other.

Table

A table in database consists of rows and columns. One row of table holds one record. Each column in the table holds one field or attribute.

Use of relational database model

The relational database model is used to make database management systems more independent of any particular application. It is the most popular database model used in business applications.

4. Object-Oriented Database Model

Object-oriented databases is also called Object Database Management Systems (ODBMS). Object

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databases store objects rather than data such as integers, real numbers and strings. Objects are used in object oriented programming languages such as C++ and Java.

Characteristics of Real world

Real world objects have two characteristics, that is, state and behaviour.

Example

The object radio has four states and five behaviours as shown in Fig.7.4.

Object :	**Radio**
States	**Behaviours**
On	turn on
Off	turn off
Current channel	tune channel
Volume	increase/decrease volume

Fig.7.4 States and Behaviour of object Radio

Object

An object stores its states in variables and exposes its behaviour through functions in programming languages.

5. Object Relational Database Model

An Object Relational Database (ORD) is a database management system similar to relational database, but with an object-oriented database. In object relational database, the approach is essentially that of relational database. The data resides in the database and is manipulated collectively with queries in a query language.

7.1.8 DATABASE LANGUAGES

Q.10 What is meant by SQL? Explain SQL languages in detail.

Answer

SQL

SQL (Structured Query Language) is a standard language for accessing and manipulating databases.

Types of SQL languages

There are three types of SQL languages for relational databases. These are:

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Data Control Language (DCL)

1. Data Definition Language

Data Definition Language (DDL) is a computer language for defining different data structures. DDL statements create, modify and remove data objects such as tables.

Tasks of DDL

Some important tasks of DDL are:

- To create objects in a database model
- To alter the structure of the database
- To delete objects from the database

2. Data Manipulation Language

Data Manipulation Language (DML) statements are used to manage or manipulate data.

Tasks of DML

Some examples of DML tasks are:

- To retrieve data from a database
- To insert data into a table

- To update existing data within a table
- To delete records from a table

3. Data Control Language

Data Control Language (DCL) is used for controlling the data. A user can access the data based on the privileges given to him

Tasks of DCL

Some important tasks of DCL are:

- To allow specified users to perform specific tasks
- To disallow specified users from performing specified tasks
- To cancel previously granted or denied permissions

7.2 BASIC DATABASE TERMINOLOGIES

Q.11 What is the purpose of DBMS?

Answer

Effective DBMS

An effective DBMS provides users with timely, accurate and relevant information. This information is stored in computer files, which needs to be suitably organized and properly maintained so that users can easily access the information they need.

Q.12 Briefly explain the database term 'table'.

Answer

Table/Relation

A database table is a file that contains data about a single entity. An entity can be a person, place or event, etc..

Example

'Student', Teacher', 'Stock', etc. are entities.

Composition of table

A database table is composed of rows and columns. Rows hold the records and columns hold the fields. Data item is inserted at each row and column intersection. Tables are also called relations in RDBMS.

Each table in a database holds data about a different but related subject.

Fig. 7.5 shows a database table containing data about the entity 'Student'.

Columns

Rows

Roll No.	Name	Class	Section	Date of Birth	Address
1	Muhammad Ali	XI	A	20-6-1999	Islamabad
2	Zahid Saleem	XI	A	15-4-2000	Rawalpindi
3	Mustafa	XI	A	6-6-2001	Rawalpindi
4	Ahmed	XI	A	12-8-1999	Islamabad
5	Umar Gul	XI	A	23-7-2000	Islamabad

Fig. 7.5 A Table/Relation

Q.13 Explain record/tuple/row and field/attribute/column.

Answer

Record/Tuple/Row

A collection of related fields treated as a single unit is called a record. All the information about one

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person or item is held in a record. When records are stored in a table, rows represent records and columns represent fields. In relational database, rows are also known as tuples. Database table in Fig. 7.5 has five records, represented row wise, about the entity 'Student'.

Fields/Attribute/Column

A field or attribute is part of a record and contains a single piece of data for the subject of the record. In the database table illustrated in Fig.7.5, each record contains six fields:

Roll No.	Used to assign a unique roll number to a student.
Name	Used to give name of the student.
Class	Used to give class of the student.
Section	Used to store the section of the student.
Date of Birth	Used to give date of birth of the student.
Address	Used to give the address of the student.

Fields appear as columns in a database table.

Q.14 Define file and tables/relations with respect to database.

Answer

File

A file is a collection of records.

Example

A stock file contains records for items of stock; a payroll file contains records for employees and so on.

Tables/Relations

In a relational database, records are stored in files called tables/relations.

Fig. 7.5 shows a table/relation of 'Student' file.

Q.15 Define view and data types with respect to database.

Answer

View

View is made up of rows and columns. It may display information that is restricted to a part of table. It may also present selected data from several tables simultaneously. View cannot exist independently of tables.

Data Types

Every field in a table is assigned a data type. Data types available in a relational database are character data, integers/real numbers, Boolean data, date/time, etc..

1. Character

Character is used to store text and combinations of text and numbers

2. Integer

Integer is used to store whole numbers such as 34 and 2073.

3. Real numbers

Real numbers are used to store numbers that have fractional part such as 23.75.

4. Boolean data

Boolean data is used for True or False values. Null values are not allowed.

5. Date and time

Date and time is used for storing date and time.

Q.16 Define key with respect to database and explain its types.

Answer

Key

Key is an attribute (or field) that is used to identify records in a table. The purpose of key is to link data together between tables without repeating all of the data in every table.

Types of keys

The following are the types of keys used in databases:

- Primary Key
- Candidate or Alternate Key
- Secondary Key
- Foreign Key

1. Primary Key

Each entity in a database must have a unique key field known as primary key to identify a record.

Example

Roll Number of a student can be used as primary key in a student database

(Fig. 7.5) since it is unique key field.

2. Candidate or Alternate Key

A key field that can act as a primary key field in a table to unique identifies each record but it is not chosen, as primary key is known as candidate or alternate key.

Example

Roll Number of a student is chosen as primary key field in a student database N.I.C. Number of a student is unique and it can also act as primary key. Therefore, N.I.C Number is a candidate or alternate key.

3. Secondary Key

Sometimes a record in a table need to be searched on field other than primary key such a field is known as secondary key.

Example

A student table needs to be search by name. Then name becomes secondary key.

4. Foreign Key

A key field used in a relationship between tables whose value matches a primary key in the other table is known as foreign key.

Example

Suppose a student database has two tables. Student table that contains students' particulars and another Result table that contains the results. Student table is the primary table in which Roll Number is primary key. To link the student table and the Result table, the field Roll Number can also be used as foreign key in the Result table.

7.3 PLANNING A DATABASE

Q.17 What is database planning? Explain the steps for planning a database.

Answer

Database planning

Database planning is a systematic approach to the development of database that moves from concept to design and development to implementation. A well-designed database promotes consistent data entry and retrieval. Database should be planned in a systematic way to save time, efforts and make it perform the expected tasks. The time and work required to plan a database depends on its complexity.

Steps for planning a database

The following steps are involved in planning a database:

- Problem Identification/Definition
- Feasibility Study
- Requirement Analysis
- Identify Entities and Attributes
- Assigning Names to Tables and Columns

1. Problem Identification/Definition

In this step, the nature and scope of the problem, to be solved, is identified and the problem is clearly defined. The database developers must know what type of information is given and what are the unknowns. They have to analyze the problem to gather as much information as possible for finding a solution.

Example

The Examination Section Head of a College has been getting complaints of poor Examination services from the Examination department. This may lead an initial investigation to find whether a new system can solve the problem. If the report suggests a new system, this leads to the next phase, which is the feasibility study of the new system.

2. Feasibility Study

The purpose of feasibility study is to find one or more solutions of the problem and to suggest the most desirable and economical solution. For this purpose, the database developer needs to generate several solutions of the problem to accomplish the desired task and propose one solution.

Steps of Feasibility study

Feasibility study includes the following steps:

- Investigate the problem
- Find out all the possible solutions available
- Study all the solutions to determine their feasibility
- List the issues with each solution
- Select the preferred solution for implementation
- Document the results in a feasibility report

3. Requirement Analysis

The purpose of requirement analysis is to obtain thorough and detailed understanding of the problem. It is important to create a complete and accurate presentation of all the requirements. Only then, it is possible to develop a database that fully satisfies the requirements.

Example

To develop 'College Examination System' a detailed study is needed to analyze the requirements. This will include the following:

(i) Entities required i.e. the number of tables (database files) required (like Student, Exam, Exam Type, Result, Courses, etc.)
(ii) Fields required for each entity in each table (like Roll No., Name, Class, Section, etc. for Student entity)
(iii) Key field in each table Data types to fields
(iv) Relationship between entities
(v) Queries
(vi) Forms design
(vii) Reports

4. Identify Entities and Attributes

After requirements identification, the next step is to identify the entities and its attributes. An entity is the main data object that is of significant interest to the organization. It is usually a person, place, thing, or event to be recorded in the database.

An Attribute is a property that describes an entity.

Example 1

If employee is an entity then the employee's name, age, address, salary and job etc. are the attributes.

Example 2

To develop 'College Examination System' the following entities and attributes will be required as shown in Fig. 7.6.

Entities	Attributes
Student	Roll_number, Name, Class, Section, Date of birth, Address
Course	Course_Id, Course_name, Description
Exam	Exam_Id, Exam_name, Start_date
Exam_result	Marks

Fig. 7.6 Entities and Attributes of Examination System

5. Assigning Names to Tables and Columns

Once entities and attributes are identified, entities are converted to tables and attributes to columns of the tables. There are no standard conventions for naming tables and columns but all names should be meaningful and consistent throughout the database.

Example 1

"Student" for Student's table. In case of attributes, meaningful names should be used wherever possible.

Example 2

The College Exam System may have the table name 'Student' and the columns (attributes) may be assigned the names, Roll number, Name, Class, Section, Date of birth, Address. The table Student is shown in Fig.7.7 with three records.

Roll_number	Name	Class	Section	Date of birth	Address
1	Fahad	XI	B	15/05/1986	Sialkot
2	Meerab	XI	B	26/02/1987	Lahore
3	Rameen	XI	B	23/08/1988	Lahore

Fig.7.7 Table Student with three records

7.4 DATA MODELING AND ENTITY-RELATIONSHIP DIAGRAM

7.4.1 DATA MODELING

Q.18 Briefly explain data modeling.

Answer

Data Modeling / Entity-Relationship diagram (ERD)

Data modeling is the process of designing logical structure of a database with a diagram using text and symbols to represent the way data needs to flow. This diagram is called Entity-Relationship diagram (ERD).

Data models define how data is connected to each other and how they are processed and stored inside the system. Data models are built during the analysis and design phases of a project to ensure that the requirements for a new application are fully understood. A data model can be thought of as a diagram or flowchart that illustrates the relationships between data. Well-documented conceptual, logical and physical data models allow stake-holders to identify errors and make changes before any programming code has been written.

Data model designers often use multiple models to view the same data and ensure that all processes, entities, relationships and data flows have been identified.

Q.19 Write down the different approaches to data modeling.

Answer

Approaches to data modeling

There are several different approaches to data modeling including:

1. Conceptual Data Modeling

Conceptual Data Modeling identifies the highest-level relationships between different entities.

2. Enterprise Data Modeling

Enterprise Data Modeling is similar to conceptual data modeling, but addresses the unique

requirements of a specific business.

3. Logical Data Modeling

Logical Data Modeling illustrates the specific entities, attributes and relationships involved in a business function serves as the basis for the creation of the physical data model.

4. Physical Data Modeling

Physical Data Modeling represents an application and database-specific implementation of a logical data model.

Identify and state the data needs

When a system developer designs a new database system, one crucial task is to identify and state the data needs of the organization. This describes how the data elements in the system are to be grouped.

Q.20 Define the terms which are used in building picture of the data requirements.

Answer

Terms used in data requirements

The following terms are used in building a picture of the data requirements.

- Entity
- Attribute
- Relationship
- Keys

1. Entity

An entity is a thing of interest to an organization about which data is to be held.

Examples

Examples of entities include Student, Customer, Employee, Stock Item, Supplier, etc.

2. Attribute

An attribute is a property or characteristic of an entity.

Examples

Examples of attributes associated with a Customer include Customer ID, Surname, Initials, Title, Address, etc..

3. Relationship

A relationship is a link or association between entities.

Example

An example is the link between Dentist and Patient; one dentist has many patients, but each patient has only one dentist.

5. Keys

Key is an attribute used to identify a record in a database. Keys are used to create links between tables to avoid duplication of data in various tables.

7.4.2 Entity-Relationship (ER) Diagram

Q.21 What is E-R diagram? Explain in detail.

Answer

Entity-Relationship (ER) diagram or model

The Entity-Relationship (ER) diagram or model defines the conceptual view of a database. It is made up of entities and the associations among them. At view level, the ER model is considered a good option for designing databases. Any object, for example, entities, attributes of an entity, relationship sets, and attributes of relationship sets, can be represented with the help of an ER diagram. ER Model is best used for the conceptual design of a database.

ER Model is based on:

- Entities and their attributes

- Relationships among entities

These concepts are explained in Fig. 7.8.

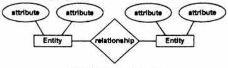


Fig.7.8 ER diagram concept

1. Entity

An entity in an ER Model is a real-world entity having properties called ***attributes***. Every ***attribute*** is defined by its set of values called ***domain.***

Example

In a school database, a 'Student' is considered as an entity. Student has various attributes like roll number, name, age, class, etc..

Representation of entities

Entities are represented by means of rectangles. Rectangles are named with the entity set they represent. Fig. 7.9 shows some entities.

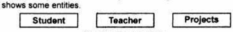


Fig.7.9 Entities Attributes

2. Attributes

Attributes are the properties of entities. Attributes are represented by means of ellipses. Every ellipse represents one attribute and is directly connected to its entity (rectangle).

Example

Fig 7.10 shows three attributes 'Roll No.', 'Name and 'BirthDate' of entity 'Student'. The primary key attribute is underlined, for example, Roll_No. attribute.

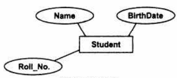


Fig.7.10 Attributes

3. Relationship

The logical association among entities is called relationship. Relationships are represented by a diamond symbol connected to the related entities. Fig 7.11 shows some relationships between entities.

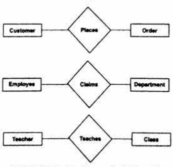


Fig.7.11 Relationships Degree of a Relationship

Q.22 Describe the degree of the relationship.

Answer

Degree of the relationship

The number of participating entities in a relationship is known as the degree of the relationship.

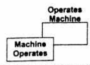


Fig.7.12 Unary Relationship

Types of relationship

Relationship has two types:

1. Unary relationship

It exists when an association is maintained within a single entity. It is also known as a recursive relationship. Fig. 7.12 shows a unary relationship, in which only one entity i.e. 'Machine Operator' is maintaining the recursive relationship.

2. Binary relationship

It exists when two entities are associated with each other through a relationship or if there are two entity types involved.

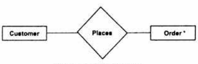


Fig.7.13 Binary Relationship

Q.23 Explain the association between two entity types.

Answer

Association between entity types

In binary relationship, the associations between two entity types may be described as:

- One-to-one
- One-to-many
- Many-to-many

1. One-to-one

When only one instance of an entity is associated with the relationship, it is marked as '1:1'. Fig. 7.13 reflects that only one instance of each entity should be associated with the relationship. It depicts one-to-one relationship.

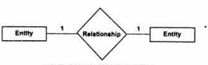


Fig.7.14 One-to-one Relationship

2. One-to-many

When more than one instance of an entity is associated with a relationship, it is marked as '1:N'. Fig. 7.14 reflects that only one instance of entity on the left and more than one instance of an entity on the right can be associated with the relationship.

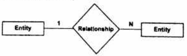


Fig.7.15 One-to-many Relationship

3. Many-to-many

When more than one instance of an entity on the left and more than one instance of an entity on the right can be associated with the relationship.

Fig. 7.15 shows many-to-many relationship.

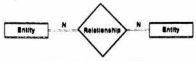


Fig.7.16 Many-to-many Relationship

7.4.3 CARDINALITY AND MODALITY

Q.24 Explain cardinality and modality with the help of examples.

Answer

Cardinality and modality specify the business rules in a relationship.

Cardinality

Cardinality refers to the maximum number of times an instance in one entity can be associated with instances in the related entity. An instance in a database is the actual content of the database at a particular point in time.

Modality

Modality refers to the minimum number of times an instance in one entity can be associated with an instance in the related entity.

Explanation of Cardinality and Modality

Cardinality can be 1 or many and the symbol is placed on the outside ends of the relationship line, closest to the entity.

Modality can be 1 or 0 and the symbol is place on the inside, next to the cardinality symbol. When cardinality and modality are specified together in a relationship between entities, for a cardinality of 1, a straight line is drawn.

For a cardinality of many, a foot with three toes is drawn. For a modality of 1 a straight line is drawn and for 0 a circle in drawn. Cardinality and modality are shown at both ends of the relationship line.

Example 1

Let us draw E-R diagram of entity 'Student' and 'Seat' that specifies the cardinality modality. A student fills a seat. This is a one-to-one relationship. This relationship can be as shown in Fig.7.16.

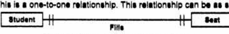


Fig.7.17 Relationship between Student and Seat

Cardinality

One student can fill a maximum of one seat. One seat can be filled by a maximum of one student. Each side of the relationship has a cardinality of one.

Modality

The modality on each side is also one. A student must fill at least one seat, and one seat must be filled by at least one student.

Example 2

Let us see the relationship between the entities 'Teacher' and 'Course'. A teacher teaches one or more courses. This is a one-to-many relationship. This relationship is shown in ' Fig.7.17.

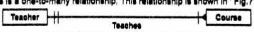


Fig.7.18 Relationship between Teacher and Course

Cardinality

One teacher can teach many courses. One course is taught by only one teacher. The cardinality is one-to-many.

Modality

The modality is one on both ends of the relationship. One teacher must teach at least one course and one teacher must teach a course.

Example 3

A 'Branch' of a company has many 'Departments' and a 'Manager' manages each department. The E-R diagram that shows the cardinality and modality for this is shown in Fig.7.18.

There are three entities in this example, which are Branch, Department and Manager. Following are the cardinalities and modalities between these entities:

1. **Cardinality between Branch and Department**
   - i. Each Branch has one or more departments.
   - ii. One Department can only be in one branch.

   Therefore, cardinality between Branch and Department is one-to-many as shown in the E-R diagram (Fig. 7.18).

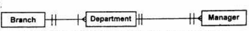


Fig.7.19 Relationship between Branch, Department and Manager

2. **Cardinality between Department and Manager**
   - i. Each Department is managed by a Manager.
   - ii. Each Manager belongs to only one Department.

   Therefore, cardinality between Department and Manager is one-to-one.
3. **Modality between Branch and Department**

   Modality between Branch and Department is one on both ends of the relationship because each Branch must have at least one Department and each Department belongs to only one Branch.
4. **·Modality between Department and Manager**

   Modality between Department and Manager is also one on both ends of the relationship because a Department must have at least one Manager and a Manager must manage one department.

7.4.4 ENTITY- RELATIONSHIP (ER) DIAGRAM -- EXAMPLES

The following are few examples of E-R Diagrams for some systems like Library Management System, Student Management System and Ticket Booking System

Q.25 Draw E-R diagram for library management system.

Answer

Library Management System

Library Management Systems consists of three entities. The entities are Books, Readers and Staff. E-R diagram for Library Management System is shown in Fig.7.19.

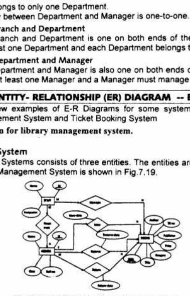


Fig.7.20 E-R Diagram for Library Management System

Entities

1. **STAFF:** The entity STAFF is the all staff of the library and its attributes are Id (primary key), Name and Designation.
2. **BOOKS:** The entity BOOKS is the all-available books in the library. Its attributes are ISBN (primary key), Title, Category, Price, Publisher, Sr no and Author.
3. **READERS:** The entity READERS is all the members of the library. Its attributes are Id (primary key), Name, Class and Roll no.

Relationships

1. The relationship between Staff and Books is many-to-many because many staff members are maintaining the books.
2. The relationship between Staff and Readers is many-to-many because many staff members keep track of many readers.
3. The relationship between Readers and Books is one-to-many because a reader can borrow one or more books.
4. The relationship between Readers and Books is many to many as many readers can reserve and also return many books.

Q.26 Draw E-R diagram for student management system.

Answer

Student Management System

Student Management System registers students for various courses and stores and prints their results. It consists of three entities, which are Student, Course and Result.

E-R diagram for student management system is shown in Fig.7.10.

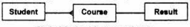


Fig.7.10 Student Management System

Entities

1. **Student:** The entity Student is set of all the students and its attributes are Admission_No, Student_Name, Address, DOB (Date of Birth) and Tel_No.
2. **Course:** The entity Course is a set of all the courses offered and its attributes are Course_Code, Course_Name, Credits, Semester and Year.
3. **Result:** The entity Result is a set of all the results of students and its attributes are Marks_Obtained, Max_Marks and Grade.

Relationships

1. The relationship between Student and Course is one-to-many because a student can register for one or more courses.
2. The relationship between Course and/Result is one-to-one because there is only one result for each course.

Q.27 Draw E-R diagram for ticket booking system.

Answer

Ticket Booking System

Ticket Booking System has three entities. The entities are Airlines, Flights and Tickets. The E-R diagram for this is shown in Fig.7.11.

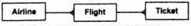


Fig.7.11 E-R Diagram of Ticket Booking System

Entities

1. **Airline:** The entity Airline is set of all the airlines and its attributes are Airline_Code and

---

Airline_Name.

2. **Flight:** Attributes for Flight are Flight_Code, Departure_Location, Arrival_Location, Departure_Time, Arrival_Time, Departure_Date, Price and Seats_Available.
3. **Ticket:** Attributes for Ticket are Ticket_No, Passenger_Name, Address, Tel_No and Email_Address.

Relationships

1. The type of relationship between Airline and Flight is one-to-many because one airline has many flights.
2. The relationship between Flight and Ticket is also one-to-many since many tickets are booked for a single flight.

7.5 RELATIONAL SCHEMA

Q.28 What is meant by schema? Briefly explain database schema.

Answer

Schema

The word schema is a Greek word, which means shape or plan.

Database Schema

A database schema represents the structure of a database system in a formal language. It refers to the organization of data to construct a database

7.5.1 TRANSFORM E-R DIAGRAM TO RELATIONAL SCHEMA

The E-R diagram represents the conceptual level of database design. It describes real-world entities. Although, E-R diagram is constructed in such a way to allow easy transition to relational model, it is not a simple process. A relational schema is at the logical level of database design. In a relational database, the schema defines the objects in the database.

Q.29 Write down the steps to transform E-R diagram to relational schema.

Answer

Steps to transform E-R diagram to relational schema

The following steps transform E-R diagram to relational schema:

1. **Transforming Entity to Relational Schema**

   An entity turns into a table.

Example

Suppose you have an entity named Student that has attributes, StudentID, Name, Class and Address. The entity Student will turn into a Student table.

2. **Transforming Attribute to Relational Schema**

   Each attribute turns into a column (field) in the table.

Example

The attributes of entity named Student will become columns in the Student table.

3. **Transforming Relationships to Relational Schema**

   To transform a relationship in the E-R diagram to relational schema, you have to turn the primary key of the entity to the primary key in the table and make sure that foreign keys are in place in the schema to allow join between the tables.
4. **Transforming One-to-Many Relationship**

   To represent the one-to-many relationship, take the primary key of the table on the "one" side and insert it as a foreign key into the table on the "many" side. This is the most common use of a foreign key. It may make sense to rename the foreign key to reflect its relationship to the table you are inserting into.
5. **Transforming One-to-One Relationship**

   To represent a one-to-one relationship, you have to decide whether it makes more sense to keep it as two separate tables or to join them together to make on big table. If you have to chose two tables for a one-to-one relationship, you must decide which table will have the primary key and which table will have the primary key of the other as foreign key.

Q.30 Give an example which explain the transformation of E-R diagram to relational schema.

Answer

Example

Suppose we want to develop a student database management system to store student particulars and their results of various examinations throughout the year. The E-R diagram of this database has two entities, that is, Student and Examination. The relationship between these entities will be one-to-many as shown Fig.7.13 since students have many examinations throughout the year.

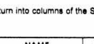


Fig.7.13 E-R diagram of Student and Examination

Entity Student

It has the attributes, STUDENTID, NAME, CLASS and ADDRESS.

Entity Examination

It has the attributes, EXAM NAME, ENG, URDU, ISL, MATHS, PHY and COMP.

E-R diagram into relational schema

Now, let us transform this E-R diagram into relational schema.

The entities, Student and Examination, will turn into Student table and Examination table respectively.

The attributes of both entities will turn into columns of the Student and Examination tables as shown in Fig.7.14.

Student Table

STUDENTID	NAME	CLASS	ADDRESS

Examination Table

RESULTID	EXAM NAME	ENG	URDU	ISL	MATH	PHY	COMP

Fig.7.14 Student and Examination tables

Create relational schema between the entities

To create relational schema between the entities, STUDENTID will be primary key in that Student table since it has unique values and it will become foreign key in the Examination table. It makes sense to rename the foreign key as RESULTID in the Examination table to reflect its relationship to the Student table. The Student and Examination tables will have one-to-many relationship. For a single record in Student table, there may be multiple corresponding records in Examination table representing results of many examinations throughout the years, such as 1st Term, 2nd Term, Final, etc..

7.5.2 NORMALIZATION OF RELATIONAL DATABASE

Q.31 Why database should be normalize? How many forms of normalization are there?

Answer

Databases are normalized to avoid data redundancy and inconsistency.

Forms of normalization

There are five normal forms for normalization of a database. The first three normal forms will be

discussed here to understand the concept of normalization.

Q.32 Explain first normal form.

Answer

First Normal Form

To get to first normal form, we break up our data into its related data groups.

Explanation

To understand how to obtain the first normal form, consider the table shown in Fig. 7.15.

It stores information about members of library and the books borrowed by them.

MemberID	Name	TeLNo	BookID	Title	Author	Pub_Date
481	Raja Imran	4815568	20056	Introduction to Java	Ali Ahmed	2006
481	Raja Imran	4815568	36211	Using Internet	Rizwan Khan	2009
532	Nasir Ali	2309116	20568	Computer Networks	Amjad Ali	1998
532	Nasir Ali	2309116	44195	Learning MS Word	Imran Khan	2010
532	Nasir Ali	2309116	31128	Web Designing	Waqas Arif	2011
669	Arif Khan	4212957	62617	Mastering MS Excel	Syed Fawad	2005

Fig. 7.15 Table in Un-normal Form

In this example, the primary key is the MemberID and we have two fields, Name and Tel_No repeating themselves across the tuples for each of the different BookID entries. The redundant data will take lot of space to store the data and more time will be required to search through.

The rules of first normal form break this table into two and relate them to each. The repeated information in the table is removed. This will create the two tables shown in Fig.7.16.

MemberID	Name	Tel_No
481	Raja Imran	4815568
532	Nasir Ali	2309116
669	Arif Khan	4212957

MemberID	BookID	Title	Author	Pub_Date
481	20056	Introduction to Java	Ali Ahmed	2006
481	36211	Using Internet	Rizwan Khan	2009
532	20568	Computer Networks	Amjad Ali	1998
532	44195	Learning MS Word	Imran Khan	2010
532	31128	Web Designing	Waqas Arif	2011
669	62617	Mastering MS Excel	Syed Fawad	2005

Fig. 7.16 Tables in First Normal Form

The other normal forms are also obtained in a similar way by further breaking up the table and removing repeating information if it exists.

Q.33 Explain second normal form.

Answer

Second Normal Form (Removes Partial Functional Dependencies)

To move into second normal form, all partial functional dependencies must be removed. Partial

functional dependencies occur when there is a composite key and only one part of the key is needed to determine one or more other attributes. To remove partial functional dependencies, we have to project out the partial functional dependencies into its own table, creating two tables from one.

Explanation

In our example, we have to further check if we are keeping more data than we need to in our relation. If we look at Fig. 7.16, we can see that for every UnitCode, we are also storing the UnitName. It will make more sense, if we look up UnitCode 443 in another table and find the UnitName. This is how we can avoid the duplicate information entered in the UnitName field. UnitName is only dependent on UnitCode and has no dependency on StudentID. To be in second normal form, all partial dependencies must be removed. When we apply the rules of second normal form and remove the partial functional dependency in our database, we get the following tables shown in Fig. 7.17, which are in second normal form.

StudentID	UnitCode
481	UC443
481	UC471
481	UC422
532	UC443
669	UC471
669	UC468

UnitCode	UnitName
UC443	Database Design
UC471	Operating System
UC422	Digital Electronics
UC468	Accounting

Fig. 7.17 Table in Second Normal Form

Q.34 Explain third normal form.

Answer

Third Normal Form (Removes Transitive Functional Dependencies)

The next step is to move into third normal form. In order to reach third normal form, all transitive functional dependencies must be removed. Similar to partial functional dependencies, transitive functional dependencies occur when a non-key attribute can determine another non-key attribute. Transitive functional dependencies are removed by projecting out the transitively dependent attributes to another table while leaving the determinate as a foreign key in the original table.

UnitCode	UnitName	CourseCode	CourseName
UC443	Database Design	COMP2010	Computing
UC471	Operating System	COMP2010	Computing
UC422	Digital Electronics	COMP2010	Computing
UC468	Accounting	BUS2010	E-Commerce

Fig 7.18 Table with CourseCode and CourseName attributes

Explanation

In our example above, we have CourseName that is dependent on CourseCode and

CourseCode is dependent on UnitCode. Therefore, CourseName is transitively dependent UnitCode. To remove the transitional dependency, break the table into two tables, leaving the determinant as foreign key in the original table. This is shown in the tables of Fig. 7.19, Here, CourseCode is foreign key in the first table and CourseCode is primary key in the second table.

UnitCode	UnitName	CourseCode
UC443	Database Design	COMP2010
UC471	Operating System	COMP2010
UC422	Digital Electronics	COMP2010
UC468	Accounting	BUS2010

CourseCode	CourseName
COMP2010	Computing
BUS2010	E-Commerce

Fig 7.19 Table in Third Normal Form

KEY POINTS

- Data refers to facts and figures. It is raw material that is input in the computer for processing.
- Information is organized form of data that is meaningful and easily understandable by computer users. It is the output produced by computer after processing the data.
- A database is a collection of related data. A database consists of one or more data files and data files contain fields.
- A Database Management System (DBMS) is a collection of programs that enables users to create and maintain a database.
- Database administrator (DBA) is the person in charge for supervising the database and that use of DBMS in an organization.
- In a Relational Database Model, data is stored in tables and the tables are linked by mean of common fields. Each column of table holds one field and each row one record. It is the most commonly used database model.
- All the information about one person or item is held is a record. When records are stored in tables, rows represent records and columns represent fields.
- Key is an attribute (or field) that is used to identify records in tables.
- Entity is a thing of interest to an organization about which data is to be held. For example employees in an organization or books in a library.
- Attribute is a property or characteristics of an entity.
- Relationship is a link between entities. In a relational database, it is the link between tables.
- Data modeling is the process of creating a conceptual data model that identifies the data needed by an organization to achieve its objectives.
- An instance in a database is the actual content of the database at a particular point in time.
- Cardinality refers to the maximum number of times an instance in one entity can be associated with instances in the related entity.
- Modality refers to the minimum number of times an instance in one entity can be associated with an instance in the related entity.
- Entity-Relationship (E-R) diagram is a diagrammatic way of representing the relationship between the entities of a database.
- Normalization is a series of steps to create normal forms used to ensure that data anomalies are not created when information is inserted, updated or deleted.

EXERCISE

Q1. Select the best answer for the following MCQs.

i. Duplication of data in different files is called ____________
A. Data inconsistency B. Data redundancy C. Data overflow D. Invalid data

ii. If data is not updated in a file in file based data management systems, what type of problem will it cause?
A. Data inconsistency B. Data redundancy
C. Data overflow D. Invalid data

iii. A record is also called:
A. Attribute B. Entity C. Property D. Tuple

iv. An attribute is also called:
A. Record B. Entity C. Field D. Relation

v. What is a thing of interest to an organization called about which data is to be held?
A. Field B. Relation C. Entity D. Attribute

vi. In which type of database, data is held in tables and tables are linked by common field?
A. Hierarchical Database B. Network Database
C. Relational Database D. Object-Oriented Database

vii. In which database model, data is organized in tree-like structure?
A. Hierarchical Database B. Network Database
C. Relational Database D. Object-Oriented Database

viii. What refers to the maximum number of times an instance in one entity can be associated with instances in the related entity?
A. Relation B. Cardinality C. Modality D. E-R diagram

ix. What refers to the minimum number of times an instance in one entity can be associated with an instance in the related entity?
A. Relation B. Cardinality C. Modality D. E-R diagram

x. What is a key field called that is used in relationship between tables whose value matches a primary key in the other table?
A. Candidate key B. Secondary key C. Alternate key D. Foreign key

Answers

i.	B	ii.	A	iii.	D	iv.	C	v.	C
vi.	C	vii.	A	viii.	B	ix.	C	x.	D

Q2. Give short answers of the following questions.

i. Differentiate between data and information.

Answer

Difference between data and information:

Data	Information
Data refers to facts and figures. It is raw material that is input in the computer for processing.	Information is organized form of data that is meaningful and easily understandable by computer users. It is the output produced by computer after processing the data.

ii. Define a database.

Answer

Database

A database is a collection of related data. A database consists of one or more data files and data

files contain fields.

iii. What is a Database Management System (DBMS)?

Answer

Database Management System (DBMS)

A database management system (DBMS) is a set of programs that allow users to create, maintain and manipulate database, and store or retrieve data from those database files. It provides user-friendly access and controls between user and database. Its main purpose is to improve data sharing, data access, decision making and increase end user productivity.

iv. What is a relational database?

Answer

Relational Database

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

v. Define primary and secondary key.

Answer

Primary Key

Each entity in a database must have a unique key field known as primary key to identify a record.

Secondary Key

Sometimes a record in a table need to be searched on field other than primary key such a field is known as secondary key.

vi. Define attribute and entity.

Answer

Attribute

Attribute is a property or characteristics of an entity.

Entity

Entity is a thing of interest to an organization about which data is to be held.

vii. What is meant by instance?

Answer

Instance

An instance in a database is the actual content of the database at a particular point in time.

viii. Differentiate between cardinality and modality.

Answer

Difference between cardinality and modality

Cardinality	Modality
Cardinality refers to the maximum number of times an instance in one entity can be associated with instances in the related entity.	Modality refers to the minimum number of times an instance in one entity can be associated with an instance in the related entity.

ix. Define schema.

Answer

Schema

The word schema is a Greek word, which means shape or plan.

x. Why is it necessary to normalize a relational database?

Answer

To avoid data redundancy and inconsistency, it is necessary to normalize a relational database.

Q3. Write long answers of the following questions.

i. What are the advantages of using a DBMS over file management system?

Answer

DBMS has many advantages over the file management system because it provides solutions to all the problems faced in file management system.

Problems in file management system

The following problems were faced in file management system:

- Reduced Data Redundancy
- Data consistency
- Program-Data Dependency
- Lack of Flexibility
- Data not Sharable
- Backup and Recovery
- Data Security

1. Reduced Data Redundancy

Data redundancy is the duplication of data in many different filed in file management system.

Example

A salesman's data may be held on a file in the Sales Department and also Personnel Department. When data is to be updated, it must be changed in both files. This results in wastage of storage space and may lead to data inconsistency.

DBMS not faced with the problem

This problem is not faced in DBMS because all the data belonging to the entire organization is centralized in a common pool of data, accessible by all the programs.

2. Data consistency

In file management system, same data may be held in several different files, it has to be updated in each separate file when it changes. If data is not updated in any file, it causes data inconsistency.

Solution in DBMS

This problem is solved in DBMS because all the data is centralized for use by all the programs.

Example

In a school, students' information such as name, address, phone number and class are held in a file in Admission Office. The same data with tuition fee and some other data are also kept in another file in Accounts Office. If a student's address changes it must be updated on both files. In case, it is updated in only one file, the other file will have out-of-date data. This will cause data inconsistency.

3. Program-Data Dependency

In file management system, every computer program in each Department has to specify exactly what data fields constitute a record. Any change to the format to the data field of a record, such as adding a new field or changing the length of a field means that every program, which uses that file has to be changed.

Example

If a new field, place of birth of students is to be added in student data files in Admission Office and Accounts Office, run both the programs need to be changed.

4. Lack of Flexibility

In file management system, when information of a non-routine nature is needed, it can take weeks to assemble the data from the various files and write new programs produce the required reports.

Example

A report about students is required in a school that has to merge information stored in various files. This will require lot of time and effort by the programmer to write a program to print such a report in file management system, whereas, it can be feeling very easily produced in database management system.

5. Data not Sharable

When a copy of a data file is made for sharing data with other people in a file management system, it will soon lead to data inconsistency if data in one of the files is not updated. Therefore, it is difficult to share data with others in a file management system.

6. Backup and Recovery

DBMS provides facilities for backup and recovery from failures including disk crash, power failure, software errors, which may bring the database from the consistent state to a state prior to the failure.

7. Data Security

In Conventional filing systems, there is no centralized security system, which restricts users according to their role in the organization. DBMS makes it easier to enforce security restrictions since database is centralized. Users are provided permissions to access data according to their rights.

ii. Define Database Administrator and describe the tasks performed by him.

Answer

Database Administrator

Database Administrator (DBA) is the person responsible for supervising the database and the use of DBMS in an organization.

Tasks performed by DBA

DBA performed the following tasks:

1. Designing the database and enforcing the operational policies and procedures for its usage.
2. Planning security measures and backup of database.
3. Controlling privileges and permissions of database users.
4. Allocating passwords to users.
5. Planning recovery procedures if hardware or software failure occurs and ensuring that no data is lost.
6. Providing training to new employees about using the database.

iii. Define database model and explain its types.

Answer

Database Model

A database model is the theoretical foundation of a database and determines in which manner data can be stored, organized and manipulated. It defines a way of structuring data.

Types of Database Models

There are five types of database models, which are as follows:

- Hierarchical Database Model
- Network Database Model
- Relational Database Model
- Object-Oriented Database Model
- Object Relational Database Model

1. Hierarchical Database Model

In a hierarchical model, data is organized into a tree-like structure as shown in Fig.7.1.

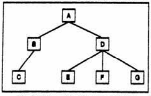


Fig. 7.1 Hierarchical Database Model

It is a logical construct with owner and subordinate relationship.

Members and Owners

Data elements in a subordinate relationship are called members and those having subordinates are called owners. In a hierarchical structure, subordinates can have only a single owner and there is only one data element that has no owner. This structure is very suitable in describing many relationships in the real world.

Examples of hierarchical model

Some examples of hierarchical model are table of contents, departments of an organization and types of memories.

2. Network Database Model

A network model is a logical structure in which some of the data elements can have more than one owner data element as shown in Fig.7.2.

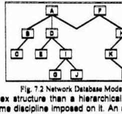


Fig. 7.2 Network Database Model

A network is a more complex structure than a hierarchical model. A hierarchical model can be thought of as a network with some discipline imposed on it. An application with which crew members, aircraft, routes and schedules are related is by its nature a network model.

3. Relational Database Model

In a relational database model, data is held in tables as shown in Fig.7.3 and the tables are linked by means of common fields.

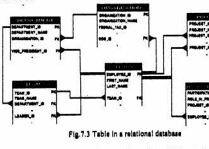


Fig.7.3 Table in a relational database

Relation

The "relation" in a relational database refers to the various tables in the database, which are linked with each other.

Table

A table in database consists of rows and columns. One row of table holds one record. Each column in the table holds one field or attribute.

Use of relational database model

The relational database model is used to make database management systems more independent of any particular application. It is the most popular database model used in business applications.

4. Object-Oriented Database Model

Object-oriented databases also called Object Database Management Systems (ODBMS). Object databases store objects rather than data such as integers, real numbers and strings. Objects are used

in object oriented programming languages such as C++ and Java.

Characteristics of Real world

Real world objects have two characteristics, that is, state and behaviour.

Example

The object radio has four states and five behaviours as shown in Fig.7.4.

Object	Radio
States	Behaviours
On	turn on
Off	turn off
Current channel	tune channel
Volume	increase/decrease volume

Fig.7.4 States and Behaviour of object Radio

Object

An object stores its states in variables and exposes its behaviour through functions in programming languages.

5. Object Relational Database Model

An Object Relational Database (ORD) is a database management system similar to relational database, but with an object-oriented database. In object relational database, the approach is essentially that of relational database. The data resides in the database and is manipulated collectively with queries in a query language.

iv. Describe the steps involved in database design.

Answer

Steps for designing database

Following steps are performed for designing database:

Step 1: Define the Purpose of the Database (Requirement Analysis)

Gather the requirements and define the objective of your database, e.g. drafting out the sample input forms, queries and reports, often helps.

Step 2: Gather Data, Organize in tables and Specify the Primary Keys

Once you have decided on the purpose of the database, gather the data that are needed to be stored in the database. Divide the data into subject-based tables.

Choose one column (or a few columns) as the primary key, which uniquely identify the each of the rows.

Step 3: Create Relationships among Tables

A database consisting of independent and unrelated tables serves little purpose. The power of relational database lies in the relationship that can be defined between tables. The most crucial aspect in designing a relational database is to identify the relationships among tables. The types of relationship include:

- One-to-many
- Many-to-many
- One-to-one

Step 4: Refine & Normalize the Design

Refine and normalize the design by following steps:

- Adding more columns.
- Create a new table for optional data using one-to-one relationship.
- Split a large table into two smaller tables.

v. What is an E-R diagram? Explain with examples.

Answer

E-R Diagram

The Entity-Relationship (ER) diagram or model defines the conceptual view of a database. It is made up of entities and the associations among them. At view level, the ER model is considered a

good option for designing databases. Any object, for example, entities, attributes of an entity, relationship sets, and attributes of relationship sets, can be represented with the help of an ER diagram. ER Model is best used for the conceptual design of a database.

ER Model is based on:

- Entities and their attributes
- Relationships among entities

These concepts are explained in Fig. 7.8.

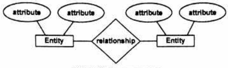


Fig.7.8 ER diagram concept

1. Entity

An entity in an ER Model is a real-world entity having properties called ***attributes***. Every ***attribute*** is defined by its set of values called ***domain.***

Example

In a school database, a 'Student' is considered as an entity. Student has various attributes like roll number, name, age, class, etc.

Representation of entities

Entities are represented by means of rectangles. Rectangles are named with the entity set they represent. Fig. 7.9 shows some entities.

Student
Teacher
Projects

Fig.7.9 Entities Attributes

2. Attributes

Attributes are the properties of entities. Attributes are represented by means of ellipses. Every ellipse represents one attribute and is directly connected to its entity (rectangle).

Example

Fig 7.10 shows three attributes 'Roll No.', 'Name and 'BirthDate' of entity 'Student'. The primary key attribute is underlined, for example, Roll_No. attribute.

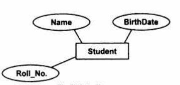


Fig.7.10 Attributes

3. Relationship

The logical association among entities is called relationship. Relationships are represented by a diamond symbol connected to the related entities. Fig 7.11 shows some relationships between entities.

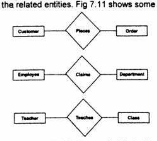


Fig.7.11 Relationships Degree of a Relationship

vi. What is Normalization? Explain the following Normal Forms 1NF, 2NF, 3NF.

Answer

Normalization

Normalization is a series of steps to create normal forms used to ensure that data anomalies are not created when information is inserted, updated or deleted.

First Normal Form

To get to first normal form, we break up our data into its related data groups.

Explanation

To understand how to obtain the first normal form, consider the table shown in Fig. 7.15. It stores information about members of library and the books borrowed by them

MemberID	Name	TeLNo	BookID	Title	Author	Pub_Date
481	Raja Imran	4815568	20056	Introduction to Java	Ali Ahmed	2006
481	Raja Imran	4815568	36211	Using Internet	Rizwan Khan	2009
532	Nasir Ali	2309116	20568	Computer Networks	Amjad Ali	1998
532	Nasir Ali	2309116	44195	Learning MS Word	Imran Khan	2010
532	Nasir Ali	2309116	31128	Web Designing	Waqas Arif	2011
669	Arif Khan	4212957	62617	Mastering MS Excel	Syed Fawad	2005

Fig. 7.15 Table in Un-normal Form

In this example, the primary key is the MemberID and we have two fields, Name and Tel_No repeating themselves across the tuples for each of the different BookID entries. The redundant data will take lot of space to store the data and more time will be required to search through.

The rules of first normal form break this table into two and relate them to each. The repeated information in the table is removed. This will create the two tables shown in Fig.7.16.

MemberID	Name	Tel_No
481	Raja Imran	4815568
532	Nasir Ali	2309116
669	Arif Khan	4212957

MemberID	BookID	Title	Author	Pub_Date
481	20056	Introduction to Java	Ali Ahmed	2006
481	36211	Using Internet	Rizwan Khan	2009
532	20568	Computer Networks	Amjad Ali	1998
532	44195	Learning MS Word	Imran Khan	2010
532	31128	Web Designing	Waqas Arif	2011
669	62617	Mastering MS Excel	Syed Fawad	2005

Fig. 7.16 Tables in First Normal Form

The other normal forms are also obtained in a similar way by further breaking up the table and removing repeating information if it exists.

Second Normal Form (Removes Partial Functional Dependencies)

To move into second normal form, all partial functional dependencies must be removed. Partial functional dependencies occur when there is a composite key and only one part of the key is needed to determine one or more other attributes. To remove partial functional dependencies, we have to project out the partial functional dependencies into its own table, creating two tables from one

Explanation

In our example, we have to further check if we are keeping more data than we need to in our relation. If we look at Fig. 7.16, we can see that for every UnitCode, we are also storing the UnitName. It will make more sense, if we look up UnitCode 443 in another table and find the UnitName. This is how we can avoid the duplicate information entered in the UnitName field. UnitName is only dependent on UnitCode and has no dependency on StudentID. To be in second normal form, all partial dependencies must be removed. When we apply the rules of second normal form and remove the partial functional dependency in our database, we get the following tables shown in Fig. 7.17, which are in second normal form.

StudentID	UnitCode
481	UC443
481	UC471
481	UC422
532	UC443
669	UC471
669	UC468

UnitCode	UnitName
UC443	Database Design
UC471	Operating System
UC422	Digital Electronics
UC468	Accounting
UC443	Database Design
UC471	Operating System

Fig. 7.17 Table in Second Normal Form

Third Normal Form (Removes Transitive Functional Dependencies)

The next step is to move into third normal form. In order to reach third normal form, all transitive functional dependencies must be removed. Similar to partial functional dependencies, transitive functional dependencies occur when a non-key attribute can determine another non-key attribute. Transitive functional dependencies are removed by projecting out the transitively dependent attributes to another table while leaving the determinate as a foreign key in the original table.

UnitCode	UnitName	CourseCode	CourseName
UC443	Database Design	COMP2010	Computing
UC471	Operating System	COMP2010	Computing
UC422	Digital Electronics	COMP2010	Computing
UC468	Accounting	BUS2010	E-Commerce

Fig 7.18 Table with CourseCode and CourseName attributes

Explanation

In our example above, we have CourseName that is dependent on CourseCode and CourseCode is dependent on UnitCode. Therefore, CourseName is transitively dependent UnitCode. To remove the transitional dependency, break the table into two tables, leaving the determinant as foreign key in the original table. This is shown in the tables of Fig. 7.19, Here, CourseCode is foreign key in the first table and CourseCode is primary key in the second table.

UnitCode	UnitName	CourseCode
UC443	Database Design	COMP2010
UC471	Operating System	COMP2010
UC422	Digital Electronics	COMP2010
UC468	Accounting	BUS2010

CourseCode	CourseName
COMP2010	Computing
BUS2010	E-Commerce

Fig 7.19 Table in Third Normal Form

LAB ACTIVITIES

Following lab activities are to be carried out during the practical periods.

1) **A city has many universities and each university has many departments. Each department has many teachers. Define the attributes for the entities, university, department and teacher and draw the E-R diagram.**

Answer

Practical Work

2) **A company sells many products to their customers. There are many suppliers who supply various products. Draw the E-R diagram of entities, company, supplier and customer.**

Answer

Practical Work

3) **An institute offers many courses. A student is allowed to register in only one course at a time. An instructor teaches many courses. Draw the E-R diagram of entities, courses, student and instructor.**

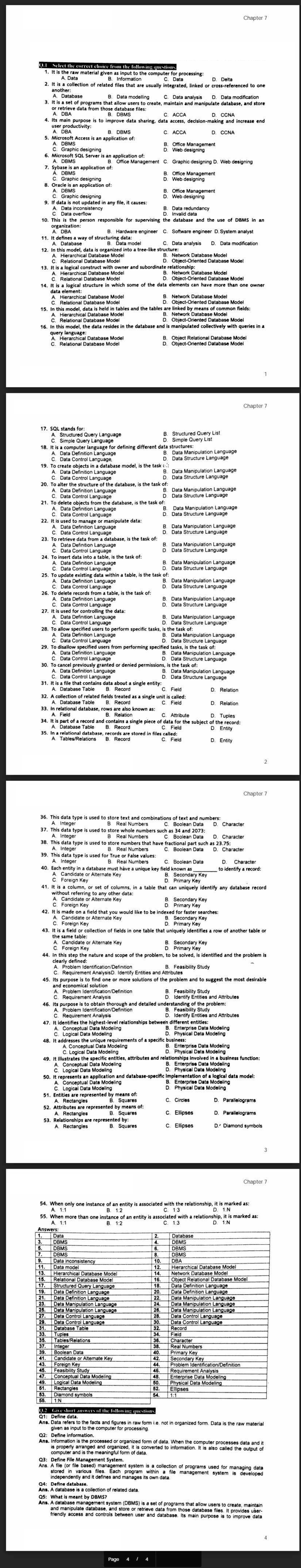
Answer

Practical Work

4) **A city has many Cable TV companies. Each company has many TV channels. A customer subscribes Cable TV from only one company. Draw the E-R diagram of entities, Cable TV Company, channels and customer.**

Answer

Practical Work



Q.1 Select the correct choice from the following questions.

1. **It is the raw material given as input to the computer for processing:**
A. Data B. Information C. Data D. Delta

2. **It is a collection of related files that are usually integrated, linked or cross-referenced to one another:**
A. Database B. Data modelling C. Data analysis D. Data modification

3. **It is a set of programs that allow users to create, maintain and manipulate database, and store or retrieve data from those database files:**
A. DBA B. DBMS C. ACCA D. CCNA

4. **Its main purpose is to improve data sharing, data access, decision-making and increase end user productivity:**
A. DBA B. DBMS C. ACCA D. CCNA

5. **Microsoft Access is an application of:**
A. DBMS B. Office Management
C. Graphic designing D. Web designing

6. **Microsoft SQL Server is an application of:**
A. DBMS B. Office Management C. Graphic designing D. Web designing

7. **Sybase is an application of:**
A. DBMS B. Office Management
C. Graphic designing D. Web designing

8. **Oracle is an application of:**
A. DBMS B. Office Management
C. Graphic designing D. Web designing

9. **If data is not updated in any file, it causes:**
A. Data inconsistency B. Data redundancy
C. Data overflow D. Invalid data

10. **This is the person responsible for supervising the database and the use of DBMS in an organization:**
A. DBA B. Hardware engineer C. Software engineer D. System analyst

11. **It defines a way of structuring data:**
A. Database B. Data model C. Data analysis D. Data modification

12. **In this model, data is organized into a tree-like structure:**
A. Hierarchical Database Model B. Network Database Model
C. Relational Database Model D. Object-Oriented Database Model

13. **It is a logical construct with owner and subordinate relationship:**
A. Hierarchical Database Model B. Network Database Model
C. Relational Database Model D. Object-Oriented Database Model

14. **It is a logical structure in which some of the data elements can have more than one owner data element:**
A. Hierarchical Database Model B. Network Database Model
C. Relational Database Model D. Object-Oriented Database Model

15. **In this model, data is held in tables and the tables are linked by means of common fields:**
A. Hierarchical Database Model B. Network Database Model
C. Relational Database Model D. Object-Oriented Database Model

16. **In this model, the data resides in the database and is manipulated collectively with queries in a query language:**
A. Hierarchical Database Model B. Object Relational Database Model
C. Relational Database Model D. Object-Oriented Database Model

17. **SQL stands for:**
A. Structured Query Language B. Structured Query List
C. Simple Query Language D. Simple Query List

18. **It is a computer language for defining different data structures:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language. D. Data Structure Language

19. **To create objects in a database model, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

20. **To alter the structure of the database, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

21. **To delete objects from the database, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

22. **It is used to manage or manipulate data:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

23. **To retrieve data from a database, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

24. **To insert data into a table, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

25. **To update existing data within a table, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

26. **To delete records from a table, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

27. **It is used for controlling the data:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

28. **To allow specified users to perform specific tasks, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

29. **To disallow specified users from performing specified tasks, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

30. **To cancel previously granted or denied permissions, is the task of:**
A. Data Definition Language B. Data Manipulation Language
C. Data Control Language D. Data Structure Language

31. **It is a file that contains data about a single entity:**
A. Database Table B. Record C. Field D. Relation

32. **A collection of related fields treated as a single unit is called:**
A. Database Table B. Record C. Field D. Relation

33. **In relational database, rows are also known as:**
A. Field B. Relation C. Attribute D. Tuples

34. **It is part of a record and contains a single piece of data for the subject of the record:**
A. Database Table B. Record C. Field D. Entity

35. **In a relational database, records are stored in files called:**
A. Tables/Relations B. Record C. Field D. Entity

36. **This data type is used to store text and combinations of text and numbers:**
A. Integer B. Real Numbers C. Boolean Data D. Character

37. **This data type is used to store whole numbers such as 34 and 2073:**
A. Integer B. Real Numbers C. Boolean Data D. Character

38. **This data type is used to store numbers that have fractional part such as 23.75:**
A. Integer B. Real Numbers C. Boolean Data D. Character

39. **This data type is used for True or False values:**
A. Integer B. Real Numbers C. Boolean Data D. Character

40. **Each entity in a database must hâve a unique key field known as _________ to identify a record:**
A. Candidate or Alternate Key B. Secondary Key
C. Foreign Key D. Primary Key

41. **It is a column, or set of columns, in a table that can uniquely identify any database record without referring to any other data:**
A. Candidate or Alternate Key B. Secondary Key
C. Foreign Key D. Primary Key

42. **It is made on a field that you would like to be indexed for faster searches:**
A. Candidate or Alternate Key B. Secondary Key
C. Foreign Key D. Primary Key

43. **It is a field or collection of fields in one table that uniquely identifies a row of another table or the same table:**
A. Candidate or Alternate Key B. Secondary Key
C. Foreign Key D. Primary Key

44. **In this step the nature and scope of the problem, to be solved, is identified and the problem is clearly defined:**
A. Problem Identification/Definition B. Feasibility Study
C. Requirement AnalysisD. Identify Entities and Attributes

45. **Its purpose is to find one or more solutions of the problem and to suggest the most desirable and economical solution**
A. Problem Identification/Definition B. Feasibility Study
C. Requirement Analysis D. Identify Entities and Attributes

46. **Its purpose is to obtain thorough and detailed understanding of the problem:**
A. Problem Identification/Definition B. Feasibility Study
C. Requirement Analysis D. Identify Entities and Attributes

47. **It identifies the highest-level relationships between different entities:**
A. Conceptual Data Modeling B. Enterprise Data Modeling
C. Logical Data Modeling D. Physical Data Modeling

48. **It addresses the unique requirements of a specific business:**
A. Conceptual Data Modeling B. Enterprise Data Modeling
C. Logical Data Modeling D. Physical Data Modeling

49. **It illustrates the specific entities, attributes and relationships involved in a business function:**
A. Conceptual Data Modeling B. Enterprise Data Modeling
C. Logical Data Modeling D. Physical Data Modeling

50. **It represents an application and database-specific implementation of a logical data model:**
A. Conceptual Data Modeling B. Enterprise Data Modeling
C. Logical Data Modeling D. Physical Data Modeling

51. **Entities are represented by means of:**
A. Rectangles B. Squares C. Circles D. Parallelograms

52. **Attributes are represented by means of:**
A. Rectangles B. Squares C. Ellipses D. Parallelograms

53. **Relationships are represented by:**
A. Rectangles B. Squares C. Ellipses D. Diamond symbols

54. **When only one instance of an entity is associated with the relationship, it is marked as:**
A. 1:1 B. 1:2 C. 1:3 D. 1:N

55. **When more than one instance of an entity is associated with a relationship, it is marked as:**
A. 1:1 B. 1:2 C. 1:3 D. 1:N

Answers:

1.	Data	2.	Database
3.	DBMS	4.	DBMS
5.	DBMS	6.	DBMS
7.	DBMS	8.	DBMS
9.	Data inconsistency	10.	DBA
11.	Data model	12.	Hierarchical Database Model
13.	Hierarchical Database Model	14.	Network Database Model
15.	Relational Database Model	16.	Object Relational Database Model
17.	Structured Query Language	18.	Data Definition Language
19.	Data Definition Language	20.	Data Definition Language
21.	Data Definition Language	22.	Data Manipulation Language
23.	Data Manipulation Language	24.	Data Manipulation Language
25.	Data Manipulation Language	26.	Data Manipulation Language
27.	Data Control Language	28.	Data Control Language
29.	Data Control Language	30.	Data Control Language
31.	Database Table	32.	Record
33.	Tuples	34.	Field
35.	Tables/Relations	36.	Character
37.	Integer	38.	Real Numbers
39.	Boolean Data	40.	Primary Key
41.	Candidate or Alternate Key	42.	Secondary Key
43.	Foreign Key	44.	Problem Identification/Definition
45.	Feasibility Study	46.	Requirement Analysis
47.	Conceptual Data Modeling	48.	Enterprise Data Modeling
49.	Logical Data Modeling	50.	Physical Data Modeling
51.	Rectangles	52.	Ellipses
53.	Diamond symbols	54.	1:1
55.	1:N		

Q.2 Give short answers of the following questions.

Q1: Define data.

Ans. Data refers to the facts and figures in raw form i.e. not in organized form. Data is the raw material given as input to the computer for processing.

Q2: Define information.

Ans. Information is the processed or organized form of data. When the computer processes data and it is properly arranged and organized, it is converted to information. It is also called the output of computer and is the meaningful form of data.

Q3: Define File Management System.

Ans. A file (or file based) management system is a collection of programs used for managing data stored in various files. Each program within a file management system is developed independently and it defines and manages its own data.

Q4: Define database.

Ans. A database is a collection of related data.

Q5: What is meant by DBMS?

Ans. A database management system (DBMS) is a set of programs that allow users to create, maintain and manipulate database, and store or retrieve data from those database files. It provides user-friendly access and controls between user and database. Its main purpose is to improve data

54. When only one instance of an entity is associated with the relationship, it is marked as:
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5.	DBMS	**6.**	DBMS
7.	DBMS	**8.**	DBMS
9.	Data inconsistency	**10.**	DBA
11.	Data model	**12.**	Hierarchical Database Model
13.	Hierarchical Database Model	**14.**	Network Database Model
15.	Relational Database Model	**16.**	Object Relational Database Model
17.	Structured Query Language	**18.**	Data Definition Language
19.	Data Definition Language	**20.**	Data Definition Language
21.	Data Definition Language	**22.**	Data Manipulation Language
23.	Data Manipulation Language	**24.**	Data Manipulation Language
25.	Data Manipulation Language	**26.**	Data Manipulation Language
27.	Data Control Language	**28.**	Data Control Language
29.	Data Control Language	**30.**	Data Control Language
31.	Database Table	**32.**	Record
33.	Tuples	**34.**	Field
35.	Tables/Relations	**36.**	Character
37.	Integer	**38.**	Real Numbers
39.	Boolean Data	**40.**	Primary Key
41.	Candidate or Alternate Key	**42.**	Secondary Key
43.	Foreign Key	**44.**	Problem Identification/Definition
45.	Feasibility Study	**46.**	Requirement Analysis
47.	Conceptual Data Modeling	**48.**	Enterprise Data Modeling
49.	Logical Data Modeling	**50.**	Physical Data Modeling
51.	Rectangles	**52.**	Ellipses
53.	Diamond symbols	**54.**	1:1
55.	1:N		

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Q1: Define data.
Ans. Data refers to the facts and figures in raw form i.e. not in organized form. Data is the raw material given as input to the computer for processing.

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Ans. Information is the processed or organized form of data. When the computer processes data and it is properly arranged and organized, it is converted to information. It is also called the output of computer and is the meaningful form of data.

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Ans. A database management system (DBMS) is a set of programs that allow users to create, maintain and manipulate database, and store or retrieve data from those database files. It provides user-friendly access and controls between user and database. Its main purpose is to improve data

sharing, data access, decision making and increase end user productivity.

Q6: Which operations are included in manipulation of data?
Ans. Manipulation of data includes the following operations:
- Adding new data
- Deleting unwanted data,
- Changing existing data
- Select Query
- Update Query
- Delete Query
- Append Query
- Make Table Query

Q7: What are the responsibilities of DBMS?
Ans. The DBMS helps to create an environment in which users have better access to data. DBMS helps to give an integrated view of the organization's operations. The DBMS makes it possible to share the data in the database among multiple applications and users.

Q8: Give some examples of the database systems managed by DBMS.
Ans. Some examples of the database systems managed by DBMS are:
- Customer information system
- Inventory information
- Library management
- Accounting and bookkeeping

Q9: Give some examples of DBMS software.
Ans. Examples of DBMS software include
- Microsoft Access
- Microsoft SQL Server
- Sybase
- Oracle
- MySQL

Q10: Which problems were faced in file management system?
Ans. The following problems were faced in file management system:
- Reduced Data Redundancy
- Data consistency
- Program-Data Dependency
- Lack of Flexibility
- Data not Sharable
- Backup and Recovery
- Data Security

Q11: Who is database administrator?
Ans. Database Administrator (DBA) is the person responsible for supervising the database and the use of DBMS in an organization.

Q12: Write down any four responsibilities of DBA.
Ans. DBA has the following responsibilities.
- Designing the database and enforcing the operational policies and procedures for its usage.
- Planning security measures and backup of database.
- Controlling privileges and permissions of database users.
- Allocating passwords to users.

Q13: What is meant by database model?
Ans. A database model is the theoretical foundation of a database and determines in which manner data can be stored, organized and manipulated. It defines a way of structuring data.

Q14: How many types of database models are there?
Ans. There are five types of database models:
- Hierarchical Database Model
- Network Database Model
- Relational Database Model
- Object-Oriented Database Model
- Object Relational Database Model

Q15: Define members and owners in hierarchical structure.
Ans. Data elements in a subordinate relationship are called members and those having subordinates are called owners. In a hierarchical structure, subordinates can have only a single owner and there is only one data element that has no owner. This structure is very suitable in describing many relationships in the real world.

Q16: Give some examples of the hierarchical database model.
Ans. Some examples of hierarchical model are table of contents, departments of an organization and types of memories.

Q17: Define relation in a relational database model.
Ans. The "relation" in a relational database refers to the various tables in the database, which are linked with each other.

Q18: Write down the use of relational database model.
Ans. The relational database model is used to make database management systems more independent of any particular application. It is the most popular database model used in business applications.

Q19: What is meant by SQL?
Ans. SQL (Structured Query Language) is a standard language for accessing and manipulating databases.

Q20: How many types of SQL languages are for relational databases?
Ans. There are three types of SQL languages for relational databases. These are:
- Data Definition Language
- Data Manipulation Language
- Data Control Language

Q21: What are the important tasks of DDL?
Ans. Some important tasks of DDL are:
- To create objects in a database model
- To alter the structure of the database
- To delete objects from the database

Q22: Give some examples of DML tasks.
Ans. Some examples of DML tasks are:
- To retrieve data from a database
- To insert data into a table
- To update existing data within a table
- To delete records from a table

Q23: What are the important tasks of DCL?
Ans. Some important tasks of DCL are:
- To allow specified users to perform specific tasks
- To disallow specified users from performing specified tasks

- To cancel previously granted or denied permissions

Q24: What is meant by effective DBMS?
Ans. An effective DBMS provides users with timely, accurate and relevant information. This information is stored in computer files, which needs to be suitably organized and properly maintained so that users can easily access the information they need.

Q25: Define database table.
Ans. A database table is a file that contains data about a single entity. An entity can be a person, place or event, etc..

Q26: State the composition of database table.
Ans. A database table is composed of rows and columns. Rows hold the records and columns hold the fields. Data Item is inserted at each row and column intersection. Tables are also called relations in RDBMS.

Q27: How many types of keys are used in database?
Ans. The following are the types of keys used in databases:
- Primary Key
- Candidate or Alternate Key
- Secondary Key
- Foreign Key

Q28: Define candidate key or alternate key.
Ans. A key field that can act as a primary key field in a table to unique identifies each record but it is not chosen, as primary key is known as candidate or alternate key.

Q29: What is meant by foreign key?
Ans. A key field used in a relationship between tables whose value matches a primary key in the other table is known as foreign key.

Q30: Define database planning.
Ans. Database planning is a systematic approach to the development of database that moves from concept to design and development to implementation.

Q31: How a database should be planned?
Ans. Database should be planned in a systematic way to save time, efforts and make it perform the expected tasks. The time and work required to plan a database depends on its complexity.

Q32: Which steps are involved in planning a database?
Ans. The following steps are involved in planning a database:
- Problem Identification/Definition
- Feasibility Study
- Requirement Analysis
- Identify Entities and Attributes
- Assigning Names to Tables and Columns

Q33: Which steps are included in feasibility study?
Ans. Feasibility study includes the following steps:
- Investigate the problem
- Find out all the possible solutions available
- Study all the solutions to determine their feasibility
- List the issues with each solution
- Select the preferred solution for implementation
- Document the results in a feasibility report

Q34: Which diagram is called Entity-Relationship diagram (ERD)?
Ans. Data modeling is the process of designing logical structure of a database with a diagram using text and symbols to represent the way data needs to flow. This diagram is called Entity-Relationship diagram (ERD).

Q35: Write a short note on data models.
Ans. Data models define how data is connected to each other and how they are processed and stored inside the system. Data models are built during the analysis and design phases of a project to ensure that the requirements for a new application are fully understood. A data model can be thought of as a diagram or flowchart that illustrates the relationships between data. Well-documented conceptual, logical and physical data models allow stake-holders to identify errors and make changes before any programming code has been written.

Q36: Define entity.
Ans. An entity is a thing of interest to an organization about which data is to be held.

Q37: Define relationship.
Ans. A relationship is a link or association between entities.

Q38: On which factors, ER model is based on?
Ans. ER Model is based on:
- Entities and their attributes
- Relationships among entities

Q39: Define degree of the relationship.
Ans. The number of participating entities in a relationship is known as the degree of the relationship.

Q40: Define one-to-one relationship.
Ans. When only one instance of an entity is associated with the relationship, it is marked as '1:1' and is called one-to-one relationship.

Q41: Define one-to-many relationship.
Ans. When more than one instance of an entity is associated with a relationship, it is marked as '1:N' and is called one-to-many relationship.

Q42: Define many-to-many relationship.
Ans. When more than one instance of an entity on the left and more than one instance of an entity on the right can be associated with the relationship, it is called many-to-many relationship.

Q43: How to get first normal form?
Ans. To get to first normal form, we break up our data into its related data groups.

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