

Assignment: 1

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Semester: III

Q1) Define DBMS and list its main functions:

→ DBMS is a collection of programs that enables users to create and maintain a database. DBMS is a general purpose software system that facilitates the process of defining, constructing and manipulating database for various applications.

Some of its main functions

- i) Data access: allows users to easily access and manage data
- ii) Provides fast replies to data queries.
- iii) Minimizes duplicate data using normalization.
- iv) Handles large amounts of data efficiently.
- v) Enables many users to access data at the same time
- vi) Protect the data from unauthorized access or damage
- vii) Maintains accuracy and consistency of data
- viii) Supports growth of database over time.

2) Explain the three levels of data abstraction in DBMS.

→ In DBMS, data is hidden and organized at three different levels to simplify things for users and developers.
 The three levels are:

i) Physical level (low-level)

- It describes how data is actually stored like on hard drives, indexes, file structure etc.
- Mostly cared by database admins and system programmers.
- Eg: Data stored in binary format in files or blocks.

ii) Logical level (middle-level)

- Shows what data is stored and the relationships between data.
- Used or cared by database designers.
- Eg: "A student" table with fields like Name, PRN, Branch.

iii) View level (high-level)

- The way users see the data - different users can have different views.
- Used by End-users and application developers.

Eg: A student portal shows only your marks, not the whole database.

③ Differentiate between logical and physical data independence.

→ The difference between is as follows:

Logical Data independence	Physical data independence
I) Ability to change the logical structure without changing the program.	Ability to change the physical storage without affecting the logical structure.
II) Deals with: Tables, relationships.	Deals with: storagelies, indexing.
III) eg: Adding a new column to a table without updating user apps.	eg: Moving data from SSD to HDD without changing database design.
IV) Harder to achieve	Easier to handle.

④ What are the advantages of DBMS over file systems?

→ The advantages of DBMS over file systems are as follows:

i) Better Data security

- DBMS controls access and protects data from unauthorized access

ii) Reduced Data Redundancy

- Avoids storing the same data in multiple places.

- iii) Data Integrity & Accuracy
 - Ensures data is valid and consistent across the system.
- iv) Easy Data Access
 - Powerful query language (MySQL) make data retrieval quick and flexible.
- v) Backup & Recovery
 - DBMS supports automatic backup and recovery in case of system failure.
- vi) Better Data Management
 - organizes data more efficiently with relationships and constraints.

⑤ Describe the components of a database system architecture.

→ A database system isn't just the data. It's a full architecture of parts working together to store, manage and retrieve data efficiently. Components are as follows:

- i) Database : Actual collection of data . organized in tables, rows, columns etc.
- ii) DBMS : The software that manages the database . Handles storage , updates, retrieval and security.
- iii) Database Engine: core service that handles data storage, retrieval and update. All behind processing.

- iv) DDL: Data Definition Language compiler
 - processes DDL commands like CREATE, ALTER, DROP.
 - updates metadata (data about data)
- v) Data Manipulation Language (DML) compiler
 - interprets DML queries like SELECT, INSERT, UPDATE, DELETE
- vi) Transaction manager
 - Ensures all database transactions are completed fully or not at all (ACID properties).
- vii) Query processor
- viii) Storage manager
- ix) User Interface

⑥ Explain the concept of data models with examples.

→ Data model depicts the way in which data in the database are structured (represented). They are classified into two types.

i) Entity Relationship (ER) model.

→ ER model represents real world situation using concepts commonly used by people. ER model shows graphical representation of entities and their relationships in a database structure. Its elements are as:

A) Entity: It is a thing of interest to an organization about which data is to be held. Eg: customer, employee, supplier

B) Attribute:

- It is a property of an entity. Eg, customer id, name, title etc.

C) Relationship:

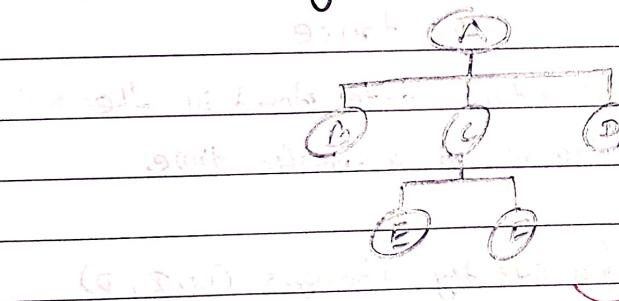
- It is a link of association between entities. Eg : A link between dentist and patients

ii) Implementation Model

- This model focuses on how the data are represented in the database.

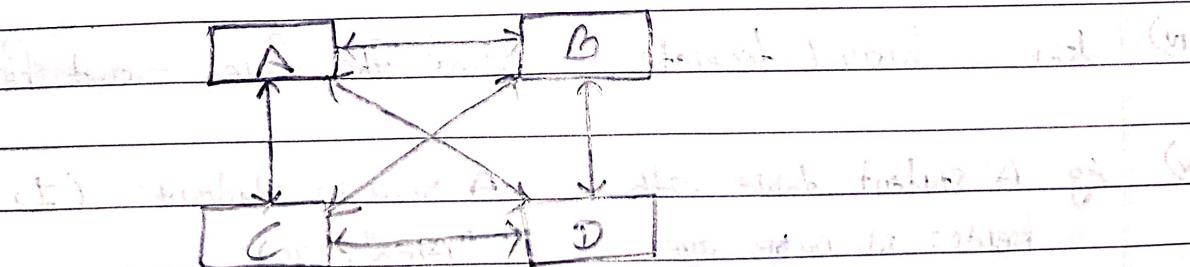
A) Hierarchical database model

- Records are grouped in such a way that their relationships form a branching, tree-like structure.



B) Network based model:

- A model where a single file can be associated to one to more than one no of files.



C) Relational Database model:

- It is the type of database model where data is presented using two dimensional table.

D) object-oriented database model

- It is a flexible database that supports the use of abstract data types, objects and classes and that can store a wide range of data, often including sound, video and graphics, in addition to text and numbers.

⑦ What is the difference between a Schema and an instance?

→ The difference between are as:

Schema	Instance
i) The blueprint or structure of the database.	The actual data stored in the database at a specific time.
ii) Rarely changes	Frequently changes (U, I, D)
iii) Design of tables, columns, types, etc.	Current content of tables (row / records).
iv) like a form / template	like the filled - out form.
v) Eg: A student table with fields: id, name, age.	A row in student: (1, "Alex", 20)

(8) Describe the Entity-relationship model and its components

→ The ER model is a high-level, conceptual data model used to visually represent the structure of a database. It helps database designers understand the system's data requirements and relationships before creating the actual database.

It consists of three main core components:

i) Entities

- An entity is a distinguishable object or concept in the real world that is important to the organization and needs to be represented in the database.

Examples: Healthcare system entities: Patient, Doctor, Appointment

E-commerce system entities: product, customer, order

Entity types & examples

i)

Strong Entities

Customer

Product

Employee

Can exist independently

ii) weak entities

OrderItem

Dependent

Payment/Installment

ii) Attributes

- It describes the properties of entities and relationships in an ER model. They represent the data we want to store.
- Some types: Simple / Atomic attribute, composite attribute, multi-valued attribute, derived attribute, key attributes

Examples: Health care patient Entity: patient (ID) (key), full-name (composite), dob (simple), age (derived)

ER Notation for Attributes:

Simple Attribute: Product Name

Primary key: customer ID

multi-valued: Phone numbers

Derived: age

Composite: full-name

firstname last name

iii) Relationships:

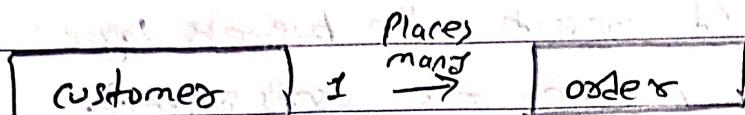
- It is an association between two or more entities that defines how these entities interact with each other in the real world.

Some of its types

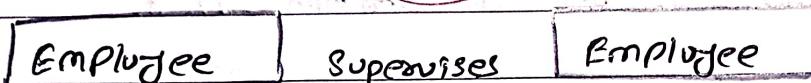
- Binary relationship
- Unary (Recursive relationship)
- Ternary relationship

ER Notation for Relationships

Binary ($1:m$)



Recursive (self-referencing)



- ③ Explain the architecture of DBMS with a net diagram and describe each component.

→ A Database management system is a software system that enables users to define, create, maintain, and control access to a database. Its architecture is designed to provide an efficient and effective way to manage large volume of data.

Three-tier DBMS architecture

- This is a client-server model that consists of the following three tiers:

i) Presentation tier (User tier) View Layer

- This tier is the top-most level of the architecture with which the end-users directly interact. Its primary function is to present data to the user and to collect user input.

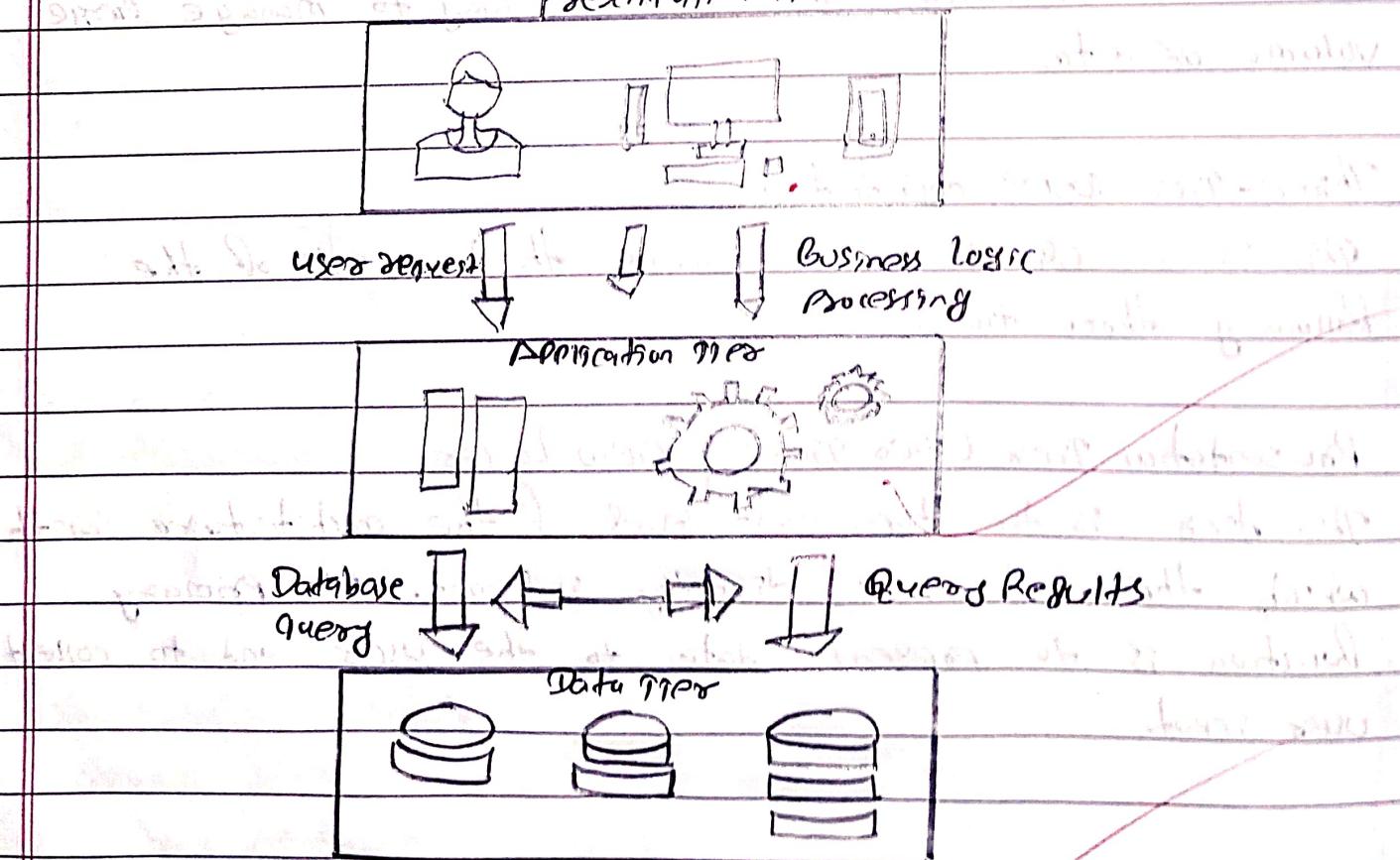
II) Application tier (middle tier): Logical level

- This tier acts as an ~~information~~ ~~between~~ ~~the presentation~~ tier and data tier. It consists of the business logic of the application and processes the user's request.
- It receives request from the presentation tier, processes them by interacting with the data tier, and then sends the result back to the presentation tier.

III) Data tier (Database tier): Physical level

- This tier is responsible for storing and managing the data. It consists of the database and the DBMS. This tier handles all the data-related operations, such as storing, retrieval, updates, and deleting data.

Diagram illustrating the flow of data between the four tiers:



(10) Discuss the advantages and disadvantages of DBMS compared to traditional file systems.

→ Advantages:

- In DBMS data is centralized and normalized so duplicates are minimized.
- DBMS enforces rules to keep data accurate and consistent.
- Access control, uses permissions and encryption features, protect data.
- Query language allows powerful and flexible data retrieval.
- DBMS supports automatic backups and data recovery after crashes.

Disadvantages:

- DBMS is more complex to design, implement and manage than a file system.
- Licensing, hardware, and maintenance can be expensive.
- For simpler tasks or very small datasets, file systems may be faster.
- Users and admins need training to work with a DBMS effectively.
- DBMS comes with added overhead like transaction control, security, etc. which may not be necessary for all applications.

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