Transactions. Transactions.

Chapter - 2

7) Data Model ->

-> Data Model defines how data is connected to each other and how they are processed and stored inside the system. DM,

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Data Model defines how the logical structure of database is modeled.

→ Data Models are fundamental entity to introduce abstraction in a DBMS.

→ The very first data model could be flat data models where all the data used are to be kept in the same place.

→ Data Models define the logical design and structure of the data base and defines how data will be stored, accessed and updated in a DBMS.

→ Relational Data Model is the most widely used data model.

→ There are various data models. They are

(i) Hierarchical Model
(ii) Network data Model
(iii) Entity Relational (ER) model
(iv) Relational data Model
(v) object oriented Data Model.

(i) Hierarchical Model → In this model, there is a parent child relationship. Each entity has only one parent and many abstract children. There's only one entity in HM model that we call root. In this model, data is organized in a tree like structure which has only one root. The data is stored as records that are connected to each other. It was proposed in 1970.

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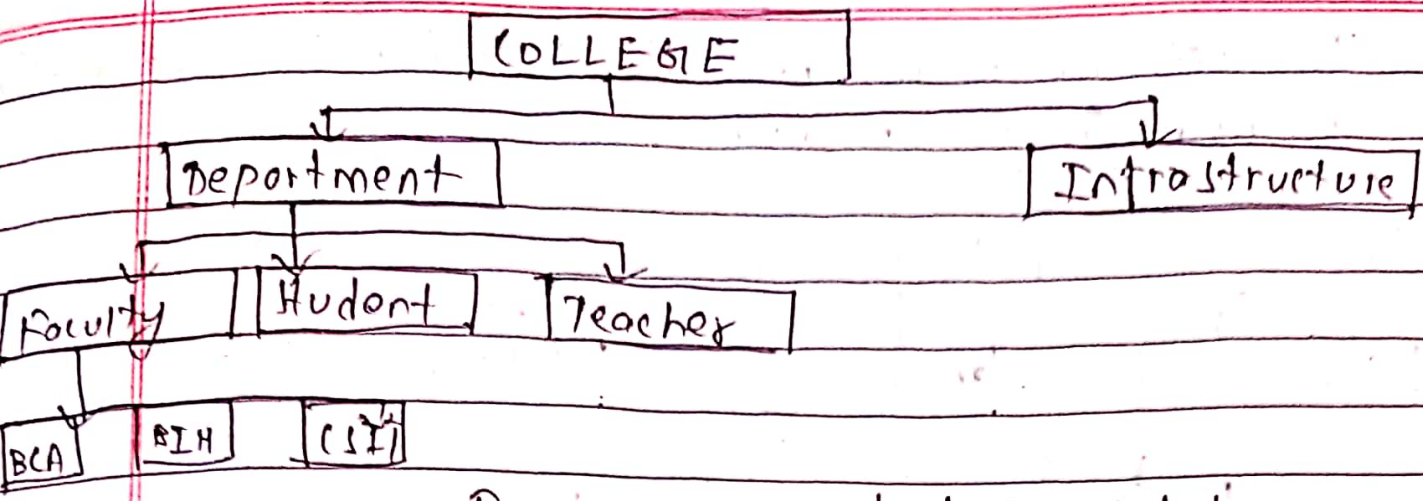

Fig: Hierarchical data Model.

→ It promotes data sharing.
→ There is a parent child relationship, due to which its concept are simple.
→ It takes one-many relationship.
→ It provides data security.

Advantages →

→ It is not flexible
→ It doesn't have data definition and data manipulation
→ It requires knowledge of physical data storage for complex implementation.

② Network Data Model ⇒ This model is an extension of the hierarchical model.
→ In a network model, data is organized into graphs & it can have more than one parent node.
→ There is more parent-child relationship in it
→ Some entity accessed from multiple paths. So we can say that in this model we store & access the data as a network

→ The network model was first used until the relational model was proposed.

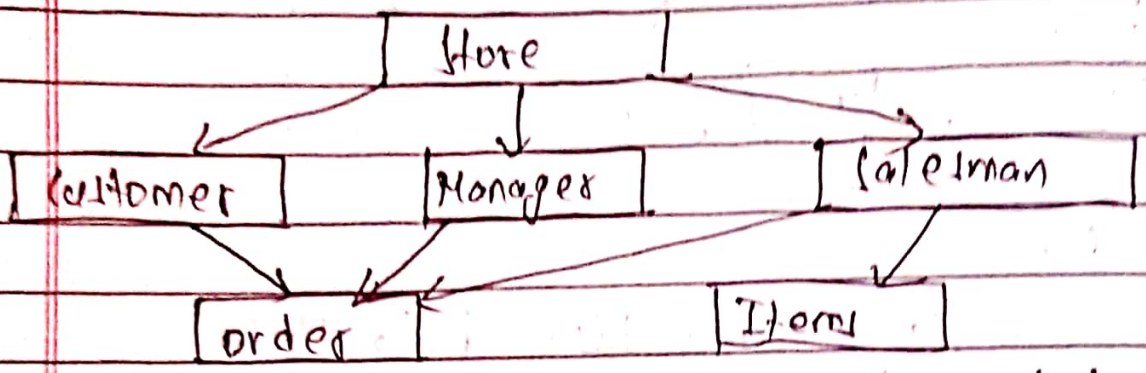

Fig: Network Data Model:

Advantages

(i) It's concept is as simple as Hierarchical model.
(ii) Data can be easily accessed.
(iii) There is more than one parent child relationship.
(iv) It provides data integrity.
(v) It takes many-many relationship.
(vi) It contains data definition language and data manipulation language

Disadvantages

→ Its data structure is very complex because all the records in it are maintained using pointer
→ Changes in its structure require changes in all programs.

(3) Entity Relational Model → ER model stands for Entity Relational Model. It is a high level conceptual data model diagram.
→ ER model has to systematically analyse data requirements to produce a well designed database.

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→ The ER model represents real world entity and the relationship between them.
→ Creating an ER model in data base Management System before implementing the database
→ ER modeling helps you to analyse data requirement systematically.
→ It is considered the best practice to complete ER-modeling before implementing your database.
→ Peter Chen proposed ER model in 1971 to create a uniform convention that can be used for relational database.

Advantages of ER Model:
(i) It is very simple to design
(ii) It is an effective communication tool for database designer.
~~Feature of ER:~~
~~• ER contains of some important features~~ :
~~(i) Data Definition~~
(iii) By seeing ER diagram we can easily understand relationship among entity.
(iv) It is highly integrated with relational model.
(v) ER model can be easily converted into another data model.

Disadvantages:
(i) It has limited constraint. (rules and regulations)

(ii) Some information might be lost or hidden in the model.
(iii) It is difficult to show data manipulation.
(iv) ER model represents limited relationship as compared to another data model like relational model.
(v) No industry standard for notation.

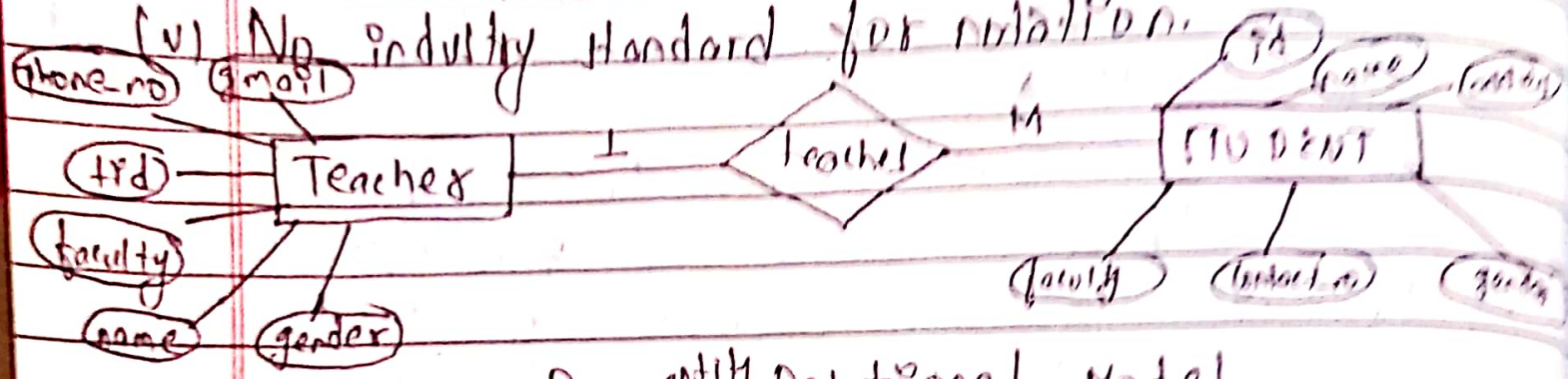

Fig: ER Relational Model

(iv) Relational data Model → In this model data is stored in relational i.e. table and each relation has rows and columns.
→ A relational model is a group of table in which data and relationships are specified.
→ In this the ~~table~~ model, data is stored in 2D table. The tables are also called relational and row of each table is called tuple (data).
→ The ~~table~~ tuple represents the entity and the column of table represents the attribute.

STUDENT → column = attribute = schema = field

Sid	Name	Address	Faculty	gender
1	Shreya	Ktm	BSc. CSIT	Female
2	Hari	Ktm	BCA	Male

Row = { Tuple = { Data = Instance

→ The relational model was proposed by E F codd in 1969 and then since this model has been used the most.

Advantages:

→ It is very flexible.

→ This model data is kept in table. So its concept is very simple.

→ It provides data integrity.

Disadvantages

(i) It requires powerful hardware computer.

(ii) It requires large storage device and expensive software.

(iii) It is very easy to use but when a ~~user~~ user stores data in it correctly then it becomes very bad DBMS.

(iv) It has data inconsistency and data duplication problem when some user create their database.

(v) Object oriented data Model → In an object oriented model information or data is displayed as an objects. and these object stores the value in the instance variable. In this model, OOP concept is used. This model works with OOP language like python, Java, C#, VB.net, etc. It was constructed in 1980's.

Advantage:

(i) Semantic content can be put in it.

(ii) It supports inheritance which increases data integrity.

(iii) It improves performance.

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Disadvantages:
(i) It is a very complex data Model.
(ii) To use it, first we have to learn it.
(iii) It requires powerful system

(X) Components of DBMS:
→ There are five components of DBMS. They are:
(i) Software (iv) Data
(ii) Hardware (v) User.
(iii) Procedures

- Software → The main component of DBMS is software. DBMS software provides and easy to use interface. Store, retrieve and update data in the database. The DBMS software are: Oracle, MySQL, MS Access, IBM lemer, MongoDB, etc.

- Hardware → The component of DBMS consist of a set of physical electronic devices such as computer input/output devices, storage devices, etc.

- Procedure → It refers to general rules & instruction that help to design the database and to use a DBMS.

- Data → It is the most important component of a DBMS. The main task of DBMS is to process the data.

- User → The users are the people who control and manage the database and perform different types of operation.

the database in the DBMS. There are following types of user who play different role in DBMS.

(1) Database Administrator (DBA) → A DBA is specialized computer system administrator who maintains successful database environment by directing or performing all related activity to keep the data secure. The top responsibility of DBA is to maintain data integrity. This means the DBA will ensure that data is unauthorized access but ~~each~~ is available to other users. Some major function of DBA in database system are:-

- Installing and configuration of database.
- Deciding the hardware devices.
- Managing data integrity.
- Decides data recovery and backup method.
- Performance tuning.
- Database design.
- physical organization modification.
- Decides validation checks on data.
- Aligning various security level.
- Give all the database related advice.

(2) Database Designer (DB Designer).

→ DB designer are responsible for identifying data to be stored in the database. Designing is undertaken before the database is actually implemented.

(3) Application programmer or System Analyst → The user

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who write the application program in programming language such as Java, C#, P.net, etc Interact with database are called application programmer

System Analyst determines the requirement of end user and develop specification that these requirements.

(4) End user → End users are the people who require access to the database for querying, updating and generating reports. There are 2 different types of end users.

(i) Casual → Casual end users occasionally access the and they may need different info each time

(ii) Parametric or Native → The main job of native include querying and updating the database. They perform a constant function and require same kind of information each time.

(*) Data Abstraction → [view level].

⇒ View of data in DBMS means how the data is visualize at each level of data abstraction.

- It allows developers to keep complex data structure away from the users.
- The Developers achieve this by hiding the complex data structure through levels of abstraction.

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- Database system are made up of complex data structure.
- To ease the user interaction with the database, developers hide the internal irrelevant details from user.
- This process of hiding irrelevant details from user is called data abstraction.

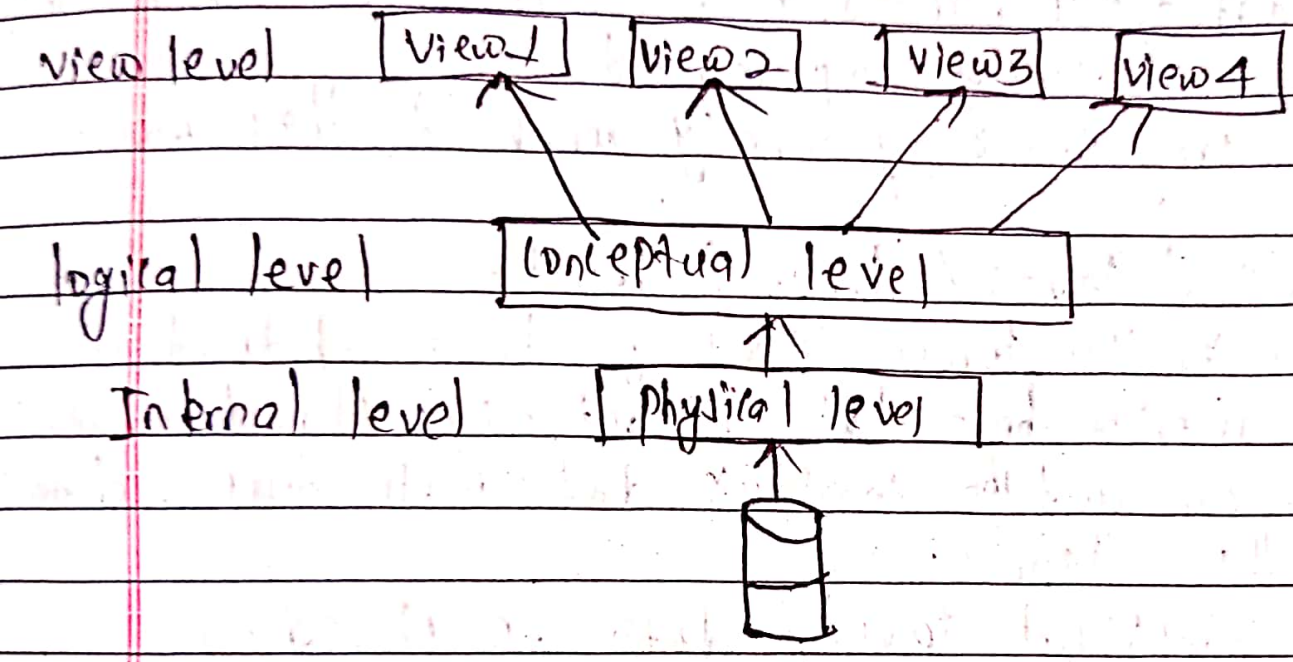


fig: Data abstraction or view of data

View level

- Highest level of data abstraction.
- This level describes the user interaction with database system.
- At view level, user just interacts with system with the help of GUI and enter the details of the screen, they are not aware of how data is stored and what data are stored
- Such details are hidden from them.

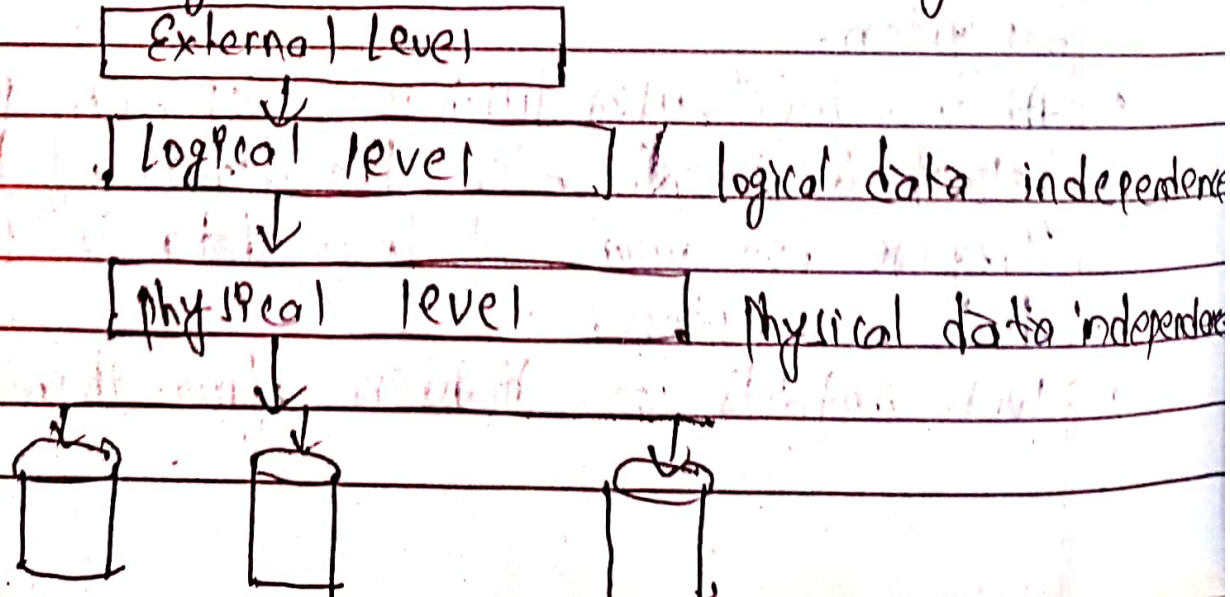
Logical level :-

- This is the middle level of the three level of data abstraction architecture.
- It describes what data is stored in database.
- At the logical level, these records (data) can be described as fields and attributes along with their data types, their relationship among each other can be logically implemented.
- The programmer generally work at this level.

(#) Physical level / Internal level :-

→ This is the lowest level of data abstraction.
→ It describe how data is actually stored in it.
→ You can get the complex data structure details of this level.
→ At physical level, data are stored.

(#) Data independence refers to characteristics of being able to modify the schema at one level of the database system without altering the schema at the next higher level



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There are two types of data independence: logical and physical independence.

(i) Logical → It refers to the characteristics of being able to change the conceptual schema without having to change the external schema.

(ii) physical data independence → It can be defined as the capacity to change the external schema without having to change the conceptual schema.

(#) Logical	physical
→ It is mainly concerned with structure or changing the data definition	It is mainly concerned with storage of data
→ It is difficult as the retrieving the data is mainly depended on the logical structure.	It is easy to retrieve
→ Compare to ~~logical~~ physical independence, it is difficult to achieve logical data independence.	Compare to logical data independence, it is easier to achieve physical data independence.
→ Concerned with conceptual schema	Concerned with internal schema.
→ Eg: ~~Age~~, Add, modify, delete, select or retrieve	Changing storage devices etc.

(#) Importance of data independence.
(1) Helps you to improve the quality of data
(2) Database system maintenance becomes affordable
(3) Enforcement of standards & improvement in database security.
(4) You don't need to alter data structure in application program
(5) Easy modification in physical level.

(*) Three - schema Architecture of Database :⇒
→ The goal of three schema architecture is to separate the user's application and the physical database. In this architecture, schema can be defined by following three levels :-

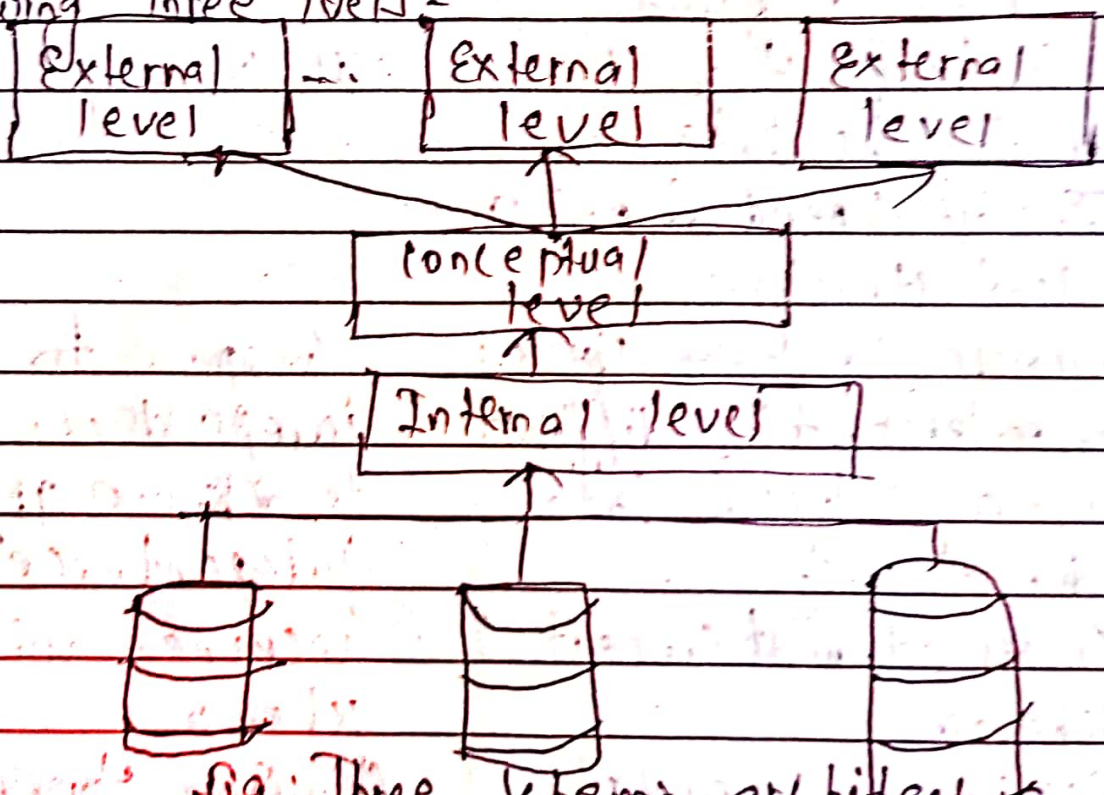

fig: Three schema architecture

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(#) Schema and Instance:

→ The description of database is called database schema which is specified during database design and is not expected to change frequently

→ Most datamodel have some rules for displaying schema as diagram i.e. schema diagram.

Example:

Library Mangement system

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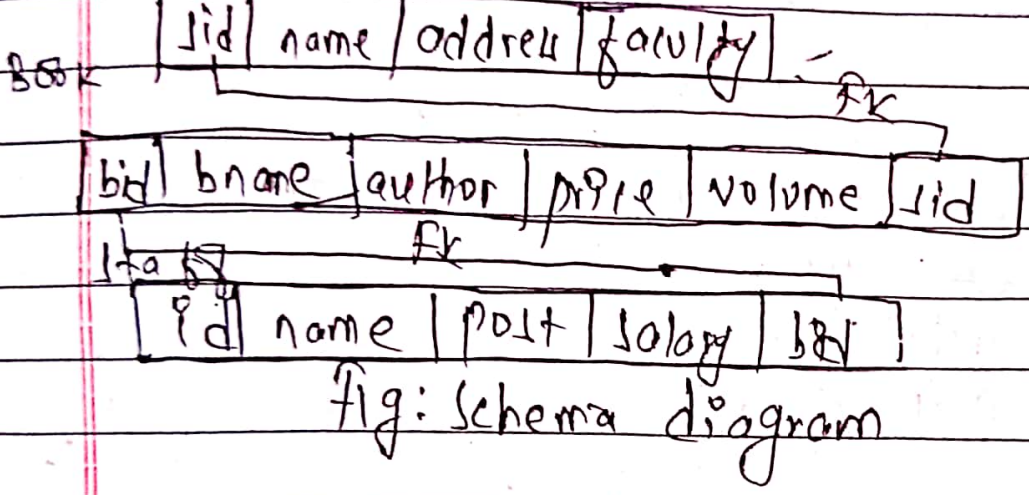

fig: Schema diagram

(#) The actual data in the database may change quite frequently every time when a new data is inserted / updated and deleted. The data in the database at a particular moment of time is called database instance = tuple = record = data = state = snapshot.

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	sid	name	address	Faculty	bid
data	101	Ram	Brt	CSIT	B01
	102	Shoaib	Pkr	BIM	B02
	103	Nisha	Ktm	BIM	B03
	104	Nisha	Ktm	BIM	B04

Normalization
1st NF, 2nd NF...

(#) Database system → It is an environment that deals with the component of an organization that defines and regulate the collection, storage, management and use of data with in a database. Database system is composed of different major parts. They are hardware, software, people, procedure, data, etc.

VVI

(x) Architecture of database system:
→ There are two approaches to implement client server architecture ~~two type~~.
(i) 2-tier Architecture.
(ii) 3-tier Architecture

(9) 2-tier Architecture → In this approach the user interface and application programs are placed on client side and database system on the server side. The architecture is also called two-tier client server architecture. The application program that resides at the client side invoke the DBMS at the server side. The application programme interface standard like open database connectivity. (ODBC) and Java Database connectivity (JDBC) are used for interaction between client and server. There is no intermediate between client and server.

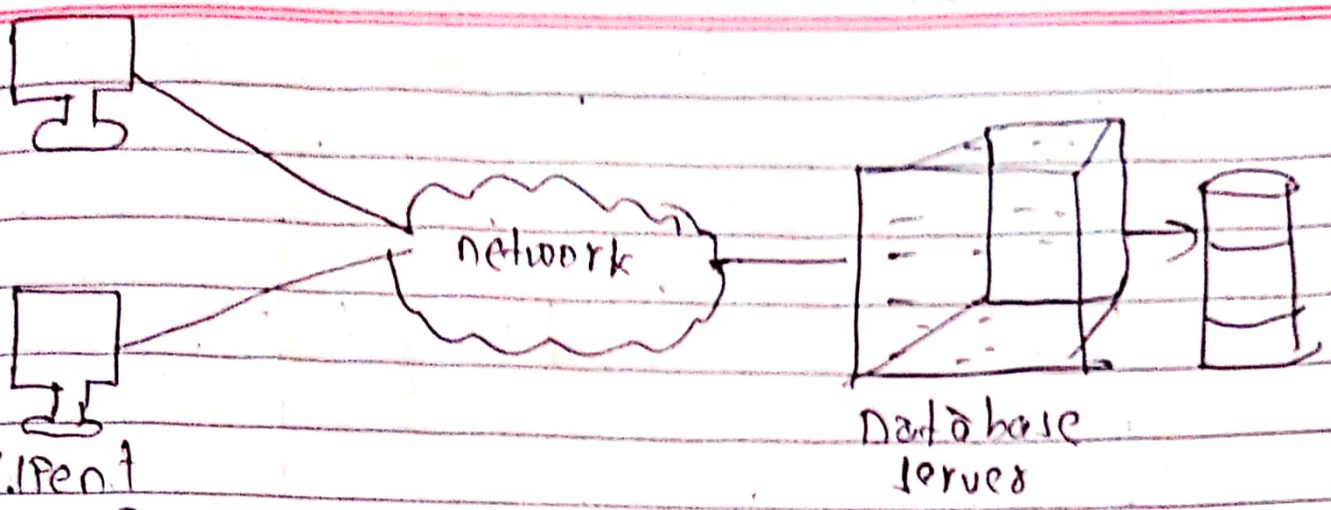


Fig: Two tier client/server architecture.

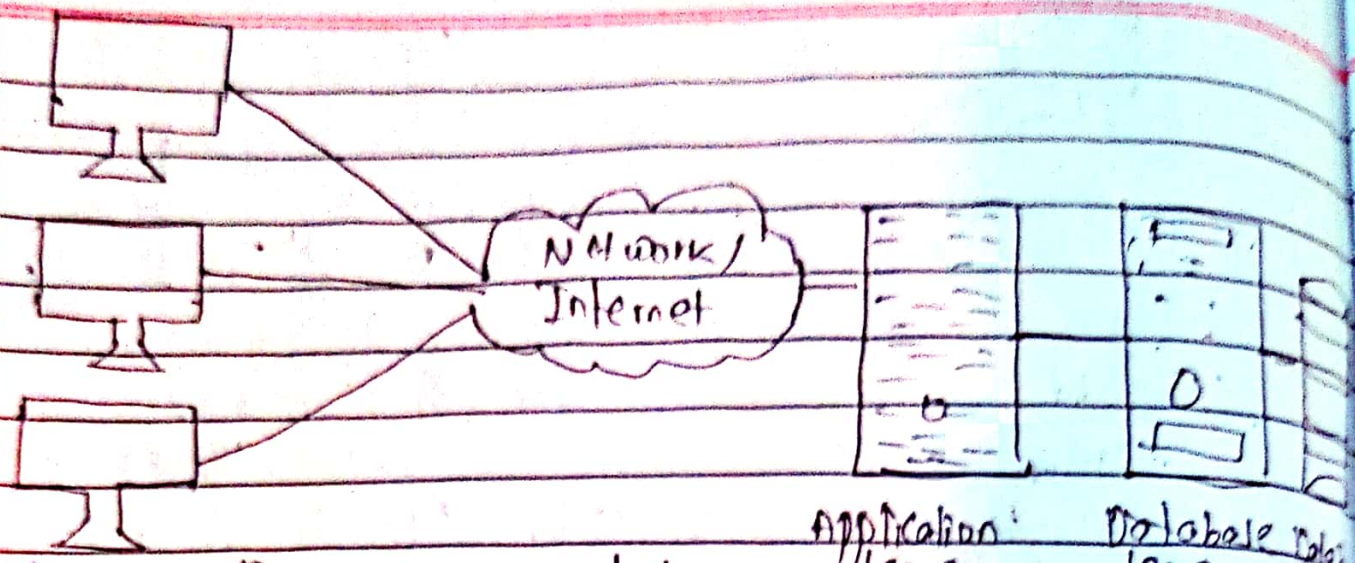
- Advantages:

→ Easy to understand as it directly communicates with the database.
→ Requested data can be retrieve very quickly.
→ Easy to modify. i.e. any changes required directly request can be sent to database.
→ Easy to maintain.

Disadvantages:

→ When there is large number of users it would be time consuming retrieve data.
→ This architecture would little cost defective

(ii) 3-tier client server Architecture → Three tier schema is an extension of two-tier architecture. Three tier architecture has following layers :- (i) Presentation layer (user layer)
(ii) Application server
(iii) Database server



User

Fig: 3-tier client / server Architecture

→ This architecture contains an application layer between the user and database, which is responsible for communicating the user request to the DBMS system and send the response from the DBMS to the user. The application layer also provides functional logic, constraints and rules before passing data to the user. The three tier architecture is the most popular DBMS architecture.

Advantages:

(i) Easy to maintain and modify.
(ii) Improve security.
(iii) Good performance

Disadvantages:

(i) It is a complex architecture.
(ii) Trained manpower required to build three tier architecture.
(iii) It is expensive than two tier architecture.