What is Data?

Data means Know facts that can be recor
& that have implicit meaning

In simple words Data is information.

Daily activities uses data

Banking system
Library System
Ledger
Enquiry System
Hotel Management

Why Software?

Any Software is made to manage data

benefits

Less time
Less human resource
Accuracy
Free for manual errors

Manage data means storing, processing & extracting data.

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What is Data Persistence ?

Data Persistence means existence of data.

In any program we want to manage data

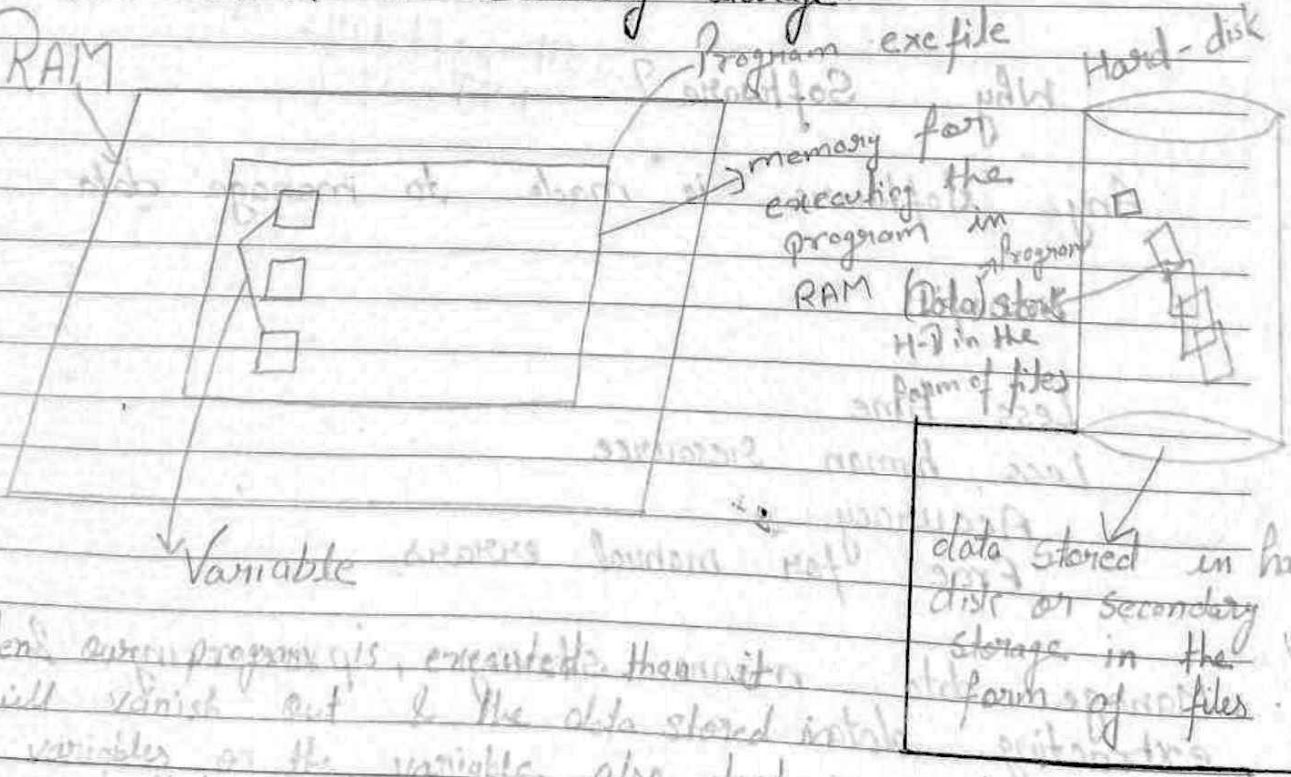
Data that is required to manage needs to be stored somewhere until job is not over.

life of data

Constants in the expressions

Data stored in variables

Data stored in Secondary storage.



when any program is executed then it will vanish out & the data stored in variables or the variable also destroy so in case if we need that particular data we have to store data in secondary storage in the form of file.

Life of variable <= Life of Program

We need to analyse that for how long we want data to persist in the memory.

Data persistence is life of data.

Sometimes we need data even beyond the life of the program.

What is Database?

Files

When data is stored in the secondary memory it is bound to reside in a file.

File is an operating system concept, which makes separation among bundles of heterogeneous data stored in the storage.

What is database.

A Software application most of the times required to store relevant information in the secondary storag (in the form of files)

A database is a place where all your applicatio related data is stored.

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One application data can be stored in a bunch of files.

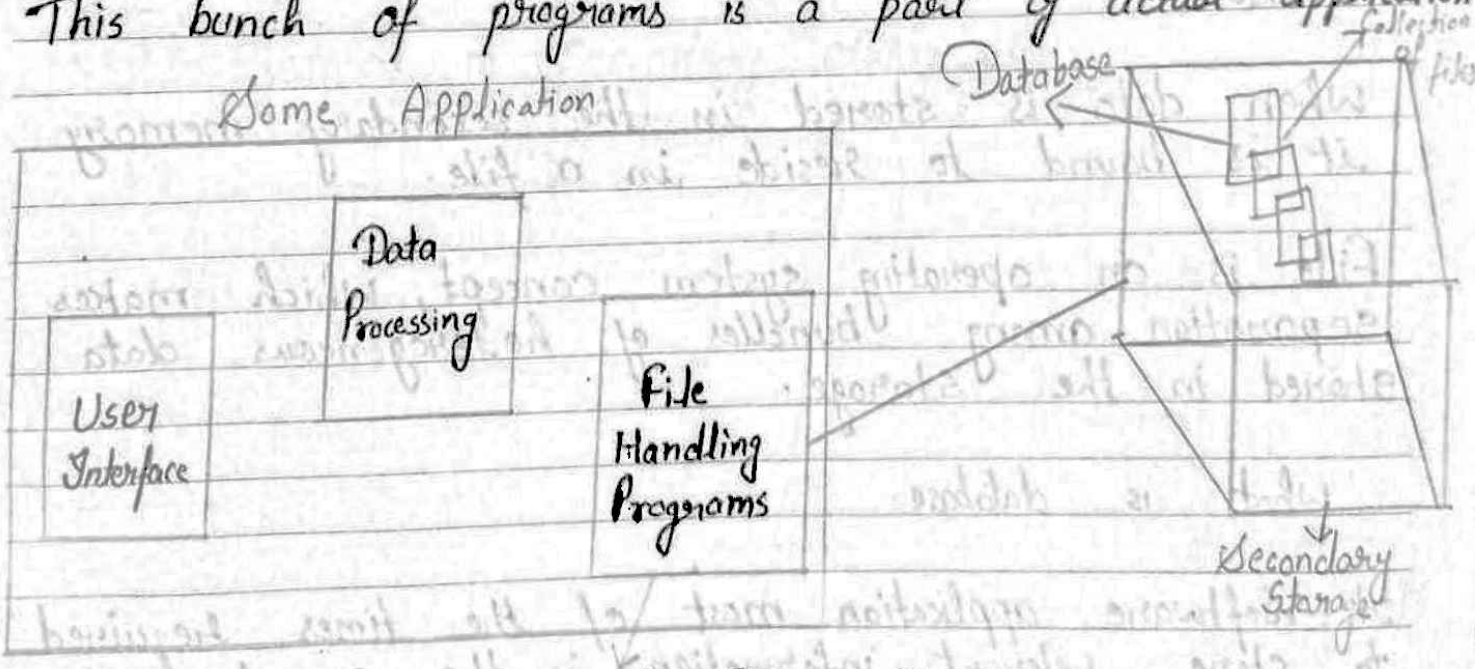
We can say, database is a collection of files.

What is DBMS ?

What is file handling ?

Files need to be handled by set of programs

This bunch of programs is a part of actual application



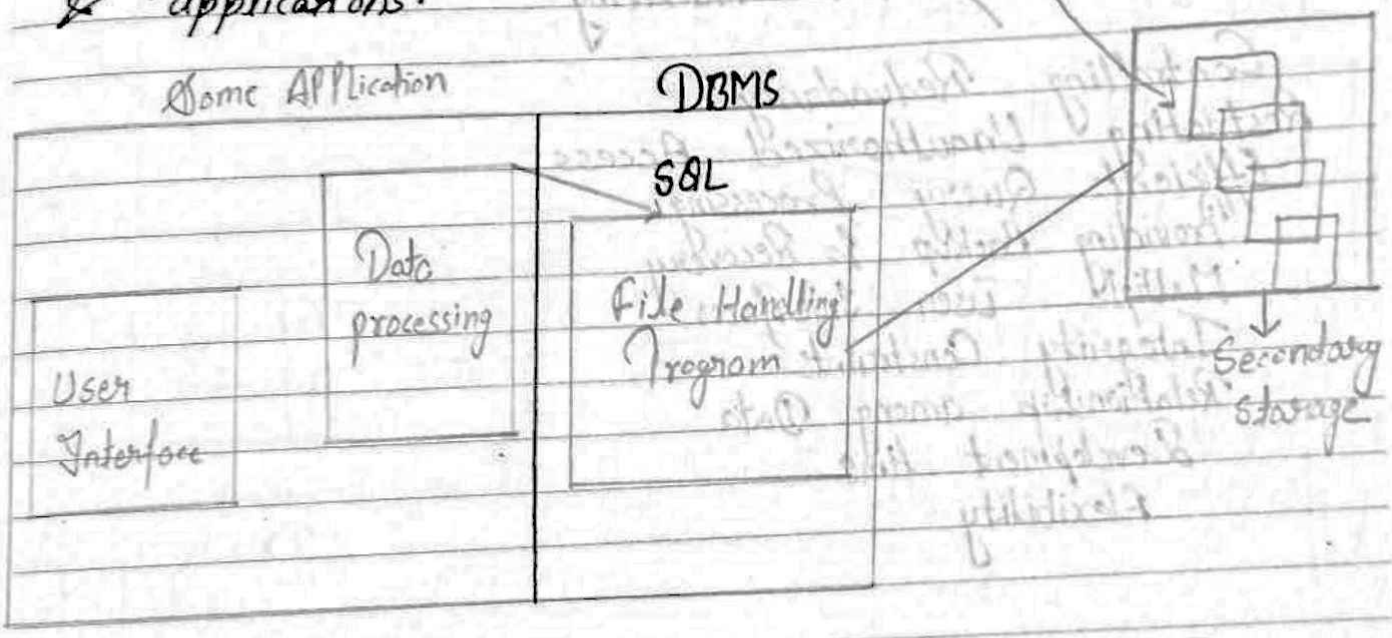
Oracle, DB2, My SQL

What is DBMS ?

DBMS is database management system.

It is collection of programs that enables user to create & maintain a database.

The DBMS is a general purpose software system that facilitates the process of defining, constructing, manipulating, & sharing databases among various users & applications.



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DBMS vs Traditional File Handling

Exhaustive analysis, huge coding & rigorous testing of file handling code is expensive, time consuming & risky

DBMS is general purpose software which can be used in place of file handling code to perform the same task in the most efficient way possible.

DBMS vs File Handling

Controlling Redundancy
Restricting Unauthorized Access
Efficient Query Processing
Providing Backup & Recovery
Multiple user Interfaces
Integrity Constraints
Relationship among Data
Development time
Flexibility

Database Architecture in DBMS

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Database architecture in DBMS is logically divided into two types

Two tier Client Server architecture
Three tier Client Server architecture

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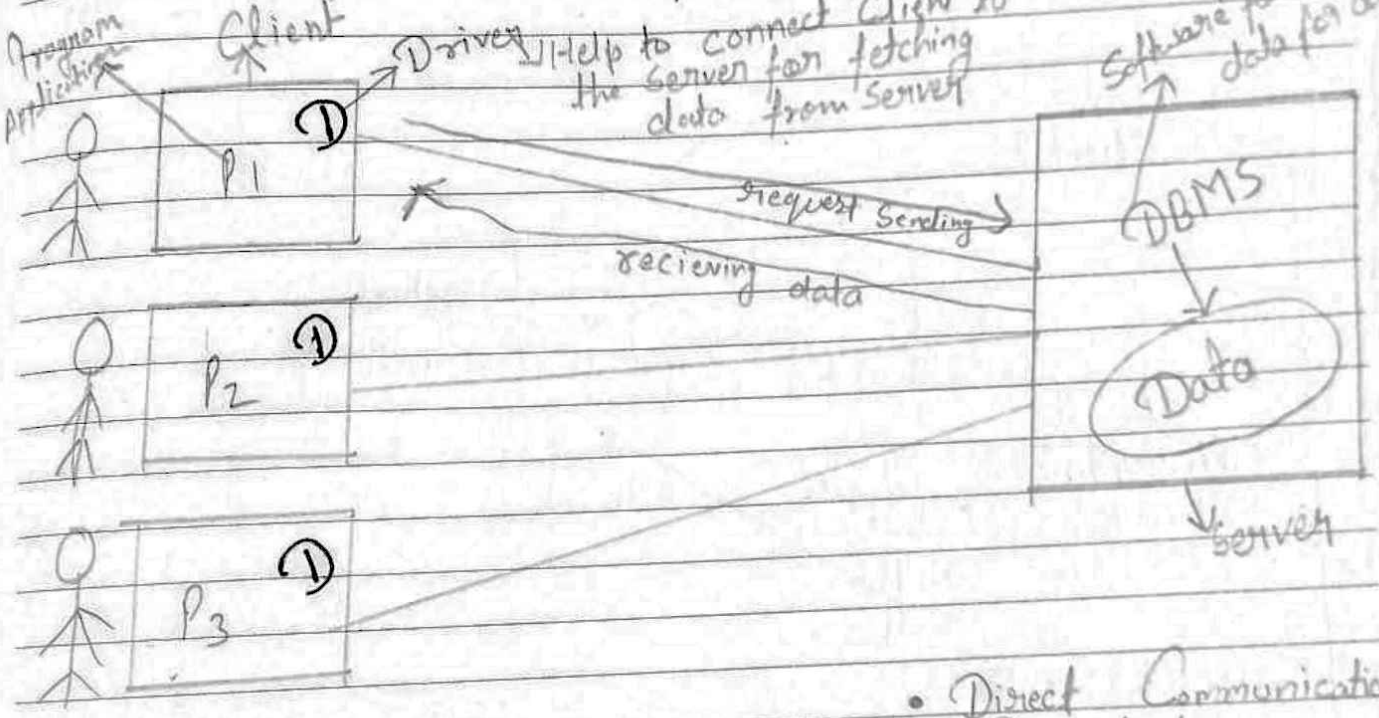
Two tier

Two tier architecture is used for Application Programs that runs on Client Side

An interface called ODBC (open Database Connectivity) provides an API that allow client side programs to call the dbms.

Most DBMS vendors provide ODBC drivers.



- Direct Communication
- Run faster

और DATA को एक Server पर इसलिए रखते हैं क्योंकि एक Machince को Secure & Maintain करना ज्यादा आसान है बजाए और Machines के।

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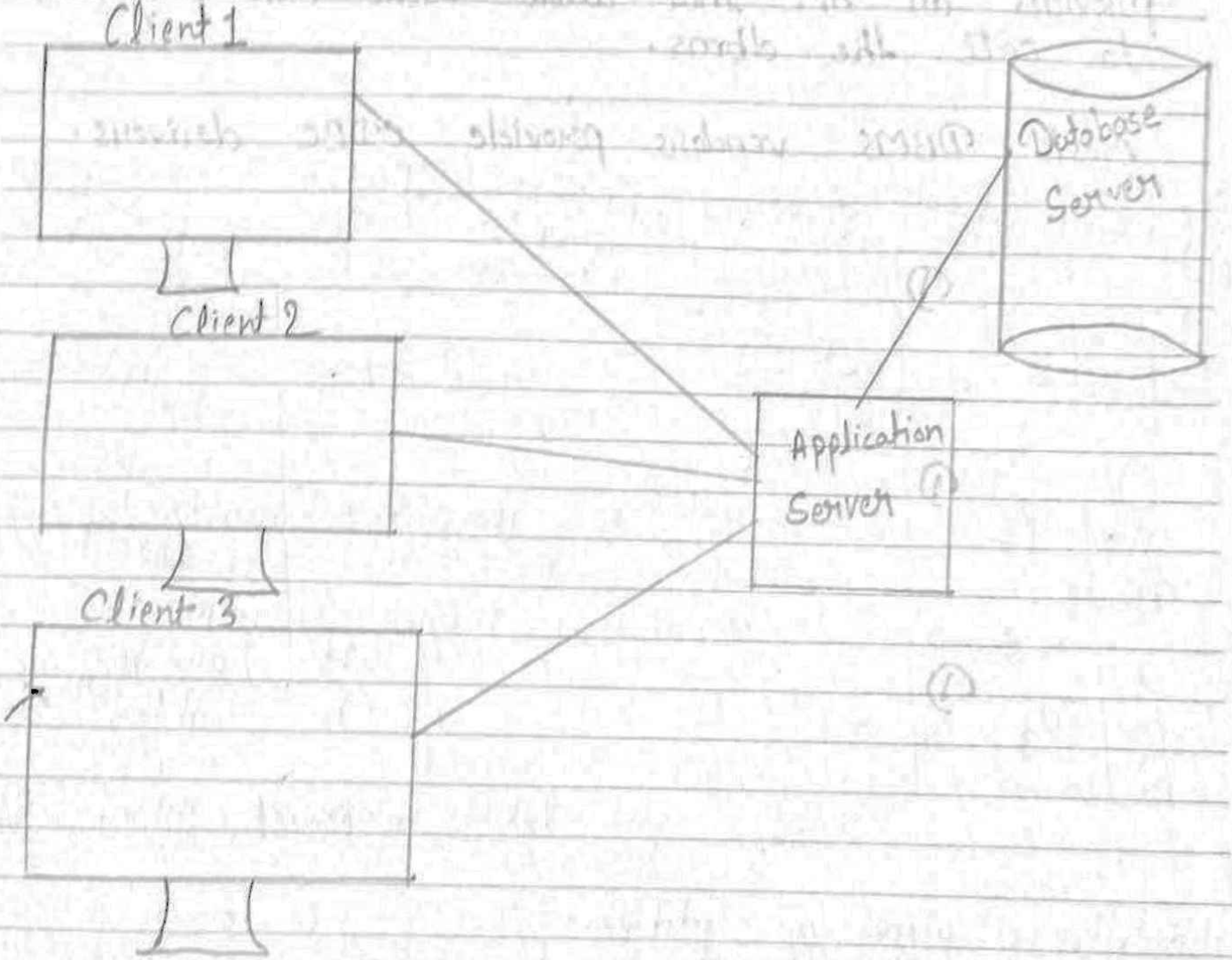
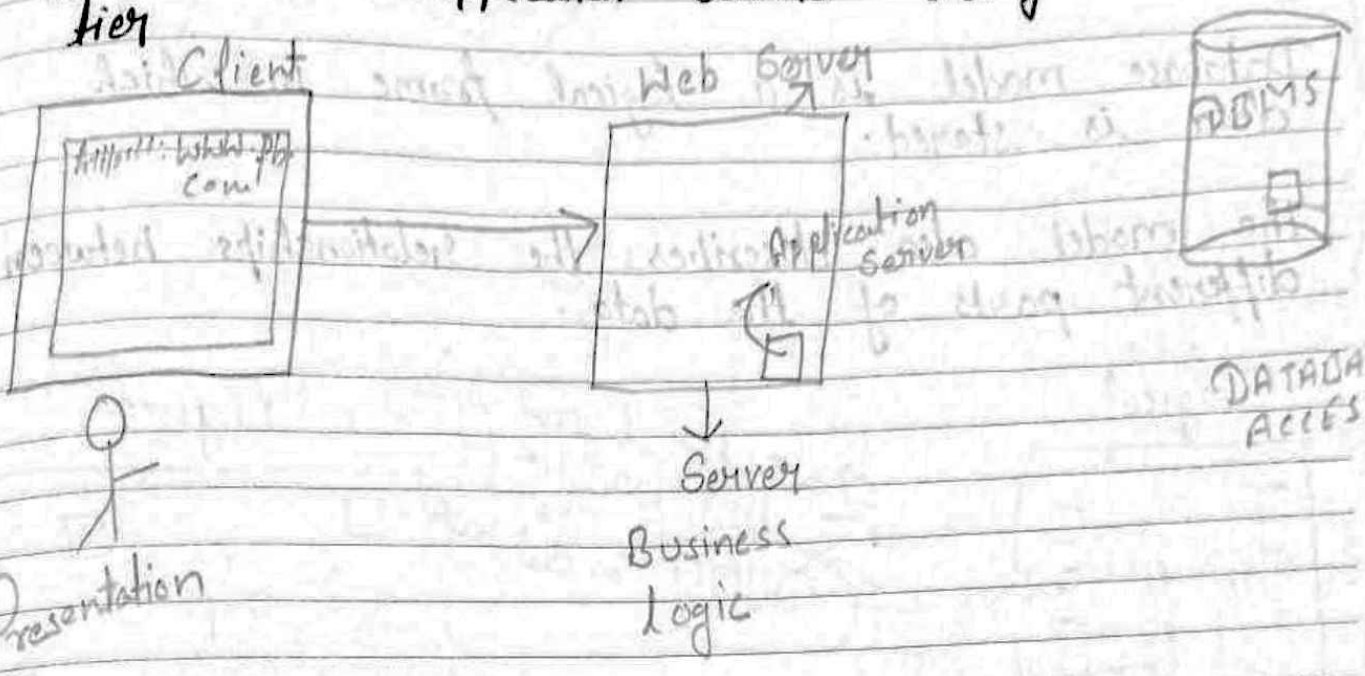
Three tier

Three-tier client/server database architecture is commonly used architecture for web applications.

Intermediate layer called Application Server.



How a web application works through three tier



Suppose a user client server wants to open a fb site so he open the browser installed on a client server. After that he writes www.facebook.com then the login page open. The user provides the username & password then it sends to the web server which is a software installed on a server when the web server get data. Then it searches the data in hard drive where another Application server is installed which accepts the data & verify it from another server that is Database server with help of DBMS Software which was already installed in Database Server when the verification is completed it sends to the web server & it sends to the client server this is called a three tier architecture.

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How we see the data is located in Database

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logical — Physical (how data is actually located)

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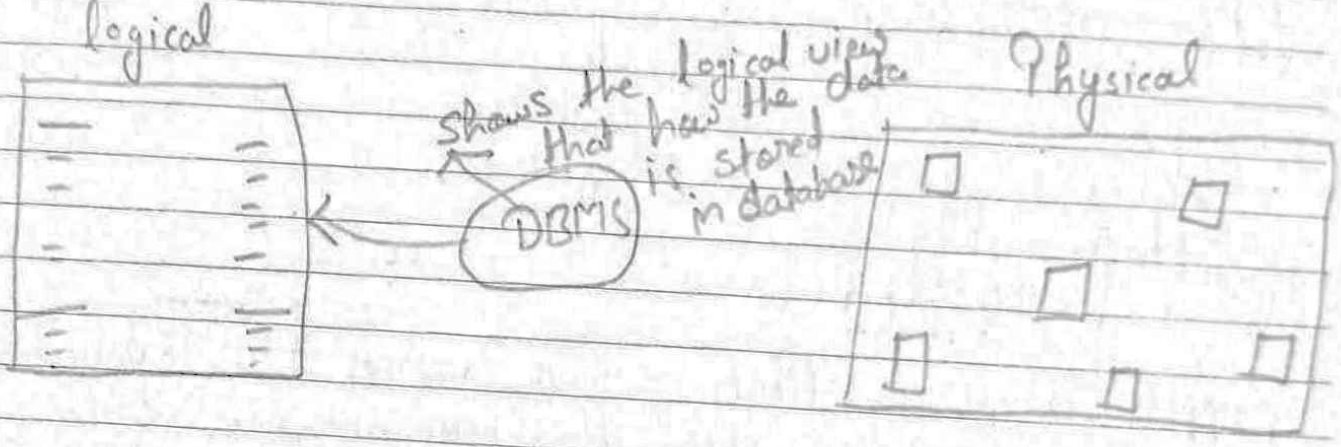
Database Model

Database model is a logical frame in which data is stored.

The model also describes the relationships between different parts of the data.



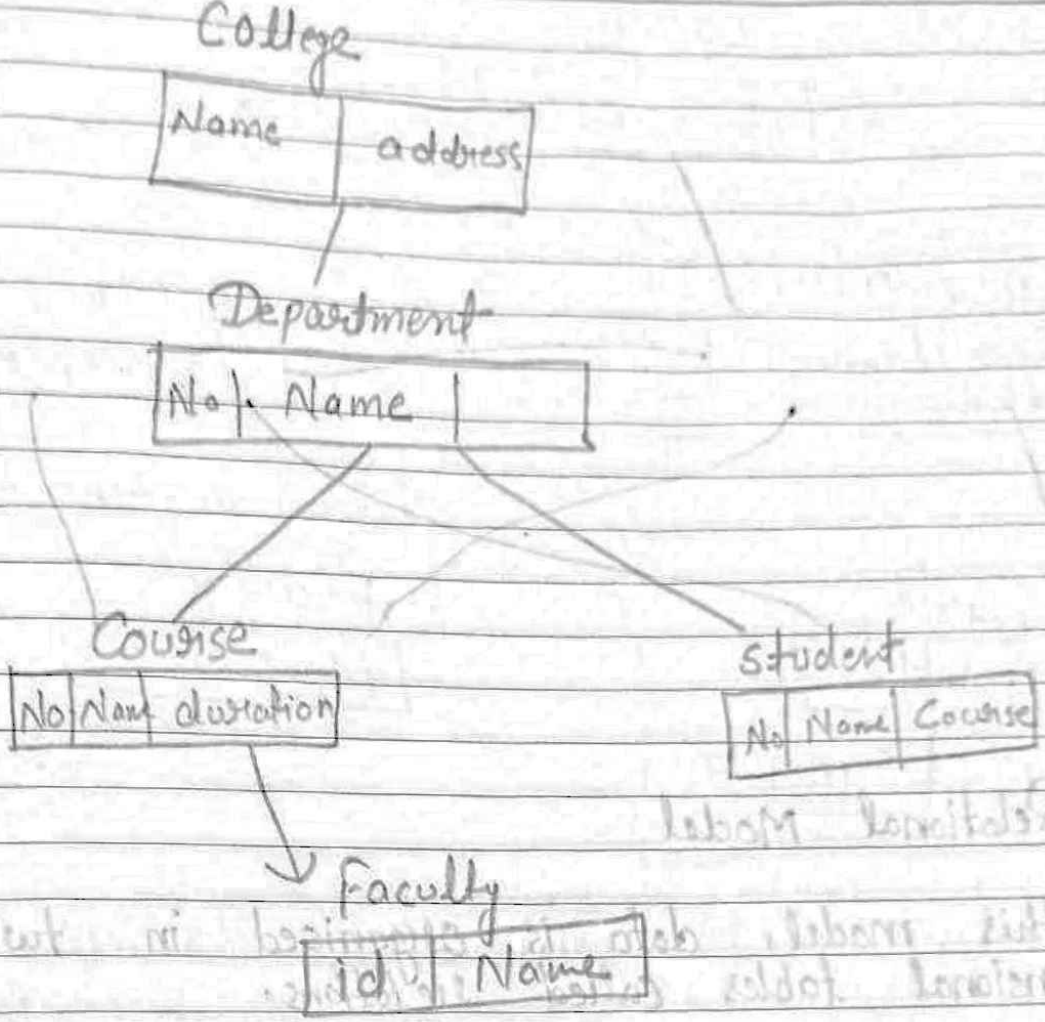
Traditional Models

Hierarchical Model
Network Model
Relational Model

Hierarchical Model

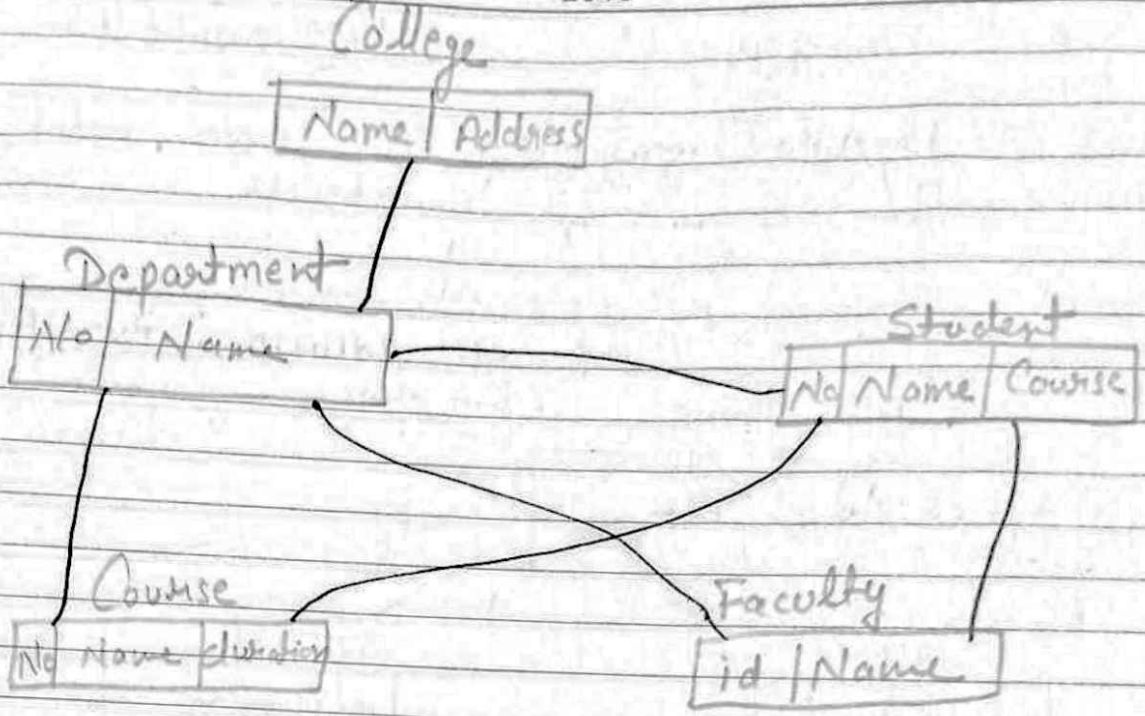
In this model each entity has only one parent but can have several children.

At the top of hierarchy there is only one entity which is called Root.



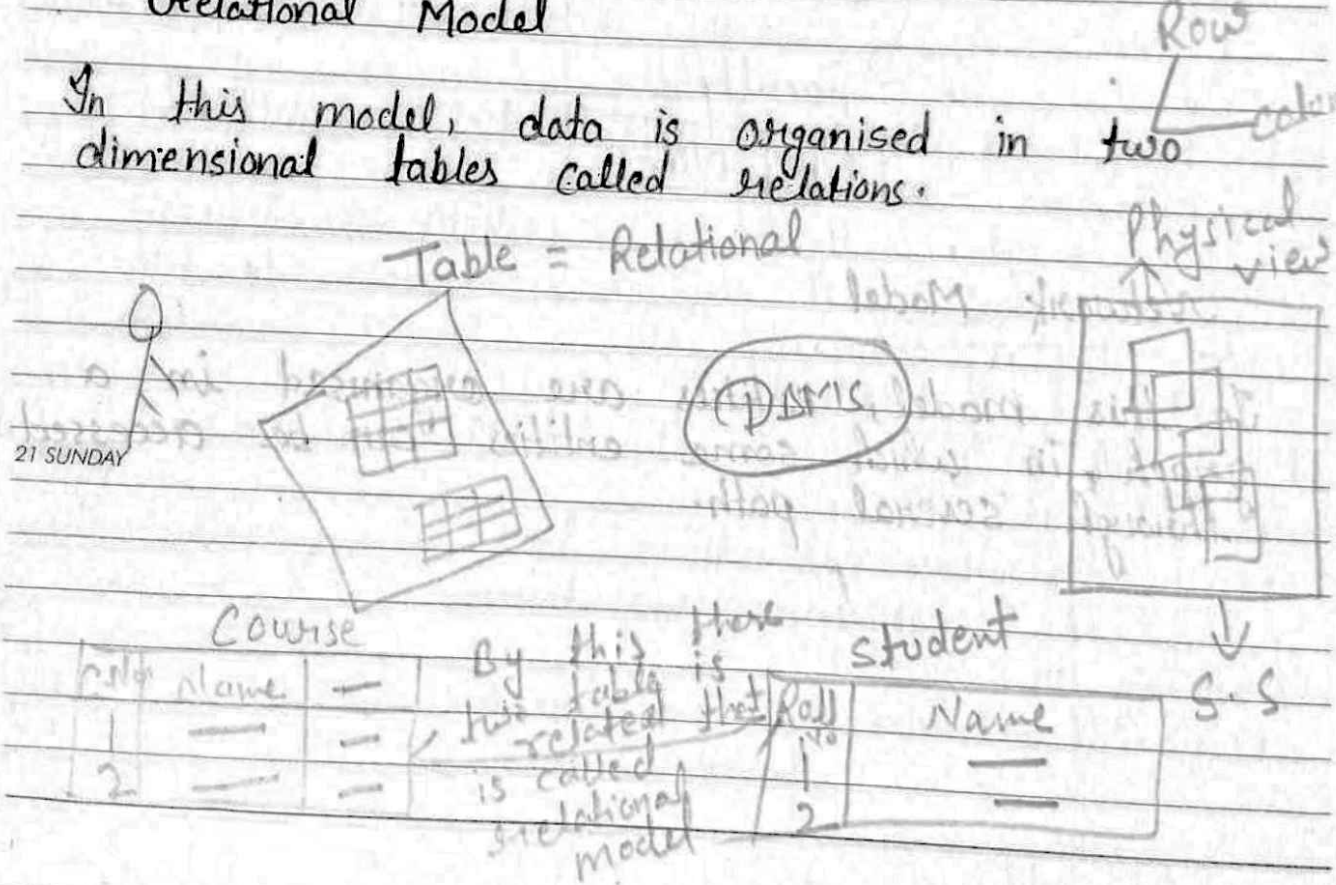
Network Model

In this model, entities are organised in a graph, in which some entities can be accessed through several path.



Relational Model

In this model, data is organised in two dimensional tables called relations.



College

No	Name	Address

Department

No	Name	College no

Faculty

Id	N	Ph	Ad.

No	Name	Dept no

No	Name	Course no

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RDBMS Concepts

A Relational Database management System (RDBMS) is a database management system based on relation model introduced by E.F Codd

In ket relational model, data is represented in terms of tuples (rows).

RDBMS is used to manage Relational database.

Tables

Relational database is a collection of organized set of tables from which data can be accessed easily

Database is a collection of tables (conceptually)

Table

A table is a collection of data elements organised in terms of rows & columns.

Each row in a table represent one single data

one record or row can be a collection of fields.

Student

S.NO	St. Name	Age	—	—
1	AMIT	16		
2	ADARSH	15		
3	MAX	17		
4	JACK	14		

one row in a table is also known as one Record

(Record in a table represent a set of related data)

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Record

A Single entry in a table is called a Record or Row.

A Record in a table represent set of related data

Field

A table consists of several records (row), each record can be broken into several smaller entities known as Fields.

Column

A Column is a set of value of a particular type. Sometimes also known as attribute.

Codd's 12 Rules

Edgar Frank "Ted" Codd (19 August 1923 - 18 April 2003) was an English computer scientist who, while working for IBM, invented the relational model for database management, the theoretical basis for relational databases.

13 not 12

Codd proposed thirteen rules, numbered 0 to 12.

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According to him if a database meets these rules, it can be called relational database management system.

Rule 0

The system must qualify as relational as a database & as a management system.

For a system to qualify as a relational database management system, that system must use its relational facilities to manage database

The other 12 rules derive from this rule.

Rule 1 : Information Rule

All information (including metadata) is to be represented as stored data in cells of tables.

The row & columns have to be strictly unordered

Student table

NAME	AGE	PH	ADD
Alvin	-	-	-
-	-	-	-
-	-	-	-

These are metadata means information about data related to structure of data

Data recorded in a cells of table

Rule 2: Guaranteed Access

Each unique piece of data (atomic value) should be accessible by: Table Name + primary key (Row) + Attribute (column)

Rule 3: Systematic Treatment of NULL

Null has several meanings, it can mean missing data, not applicable or no value. it should be handled consistently.

Primary key must not be null.

Expression on NULL must give null.

Rule 4: Active online catalogue

Database dictionary must have description of Database.

Catalogue to be governed by same rule as rest of the database. The same query language to be used on Catalogue as on application database.

Rule 5: Powerful Language

One well defined language must be there to provide all manners of access to data.

S.Q.L.

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Rule 6: View updation

All view that are theoretically updatable should be updatable by the system.

View is a virtual table.

Rule 7: R Relational Level operation

There must be Insert, Delete, Update operations at each level of relations.

Set operation like Union, Intersection & minus should also be supported.

Rule 8: Physical Data Independence

The physical storage of data should not matter to the system

if say, some file supporting table were renamed or moved from one disk to another, it should not effect the application.

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Rule 9: Logical Data Independence

if there is change in the logical structure (table structures) of the database the user view of data should not change.

Say, if a table is split into two tables, a new view should give result as the join of the two tables. This rule is most difficult to satisfy.

Rule 10: Integrity Independence

The database should be able to conforce its own integrity rathey than using athey progroams. Key & check constraints, trigger etc should be stored in Data Dictionary.

This also make RDBMS independent of front end.

Rule 11: Distribution Independence

A database should work properly regardless of its distribution across a network. This lays foundation of distributed database.

Rule 12: Non - subversion rule

if low level access is allowed to a system it should not be able to subvert or bypass integrity rule to change data.

This can be achieved by some sort of looking or encryption.

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Database Keys

Keys are a key part of a relational database. They ensure each record within a table can be uniquely identified by one or a combination of fields within the table.

They help in identifying the relationship between tables.

Types of Keys

There are three main types of keys, Candidate Keys, primary keys & foreign keys.

Super Key

Super	NAME	Phone	Email	Semester	Branch
1	Anshaj	8127677487	a@gmail.com	3	CSE
2	Abhishek	8249770131	b@gmail.com	5	EC

A Super Key is any combination of fields within a table that uniquely identifies each record within that table.

Candidate Key

A Candidate key is a subset of a Super key.

A Candidate Key is a single field or the least combination of fields that uniquely identifies each record in the table.

In order to be eligible for a candidate key it must pass certain criteria.

It must contain unique values.
It must not contain null values.
It contains the minimum number of fields to ensure uniqueness.

It must uniquely identify each record in the table.

Primary Key

Once your candidate keys have been identified you can now select one to be your primary key.

A primary key is a candidate key that is most appropriate to be the main reference key for the table.

The primary key must contain unique values.

It must never be null.

It uniquely identify each record in the table.

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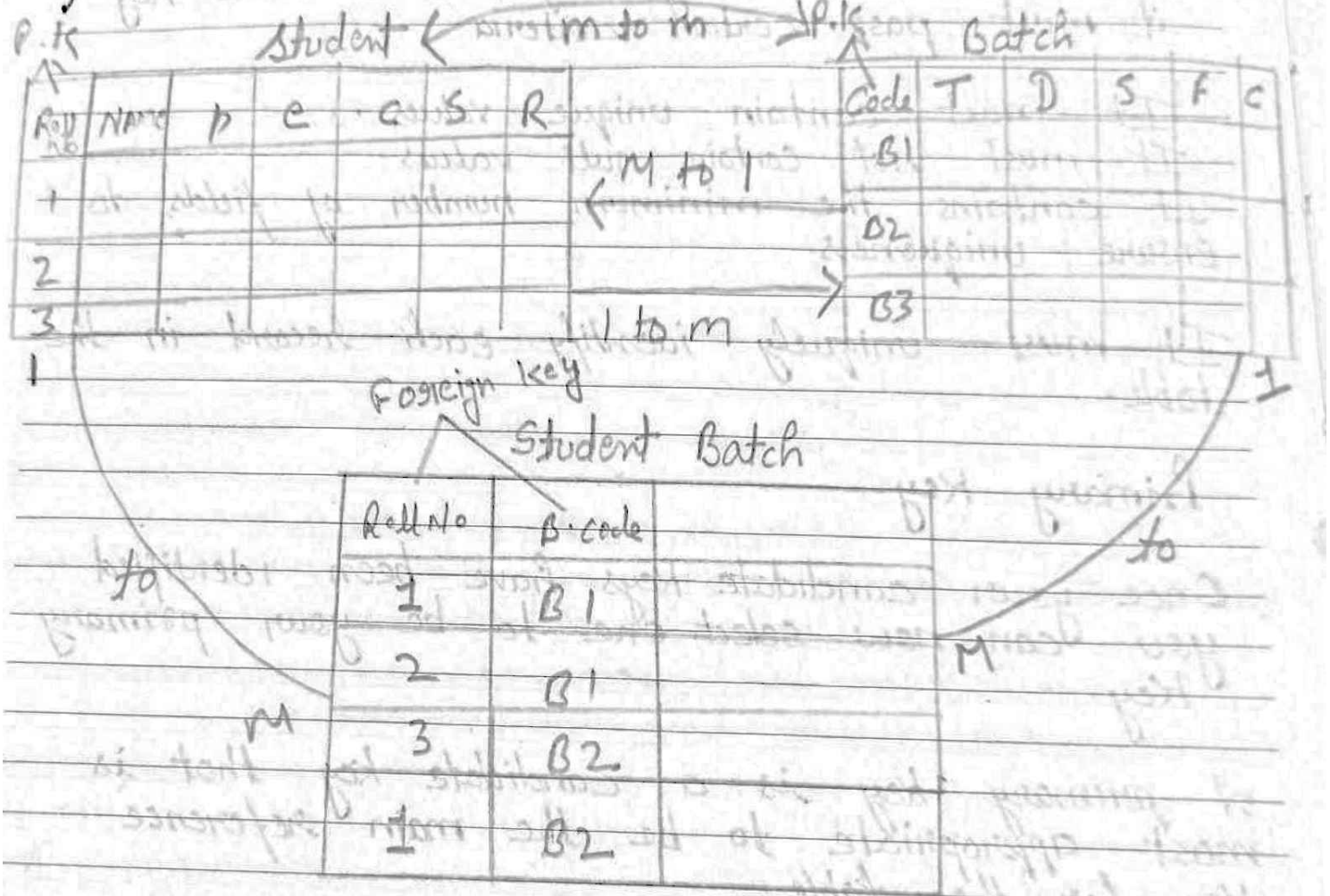
Foreign key

A foreign key is a primary key from one table that appears as a field in another where the first table has a relationship to the second.



ER Diagram

Database

Application data need to be stored in set of files (physically) & conceptualize as set of tables (logically)

Set of such tables is known as database, where you keep all application data.

ER – Diagram

E.R. - Diagram is a diagrammatic representation of logical structure of database

ER diagram describes relationship between tables.

Peter chen developed ERDs in 1976

Since then charles Bachman & James Martine have added some slight refinements to the basic ERD principles.

Entities & Attributes

The basic object that the ER model represents is an entity, which is a thing in real world with an independent existence.

Each entity has attributes. They are the properties whose values are the data that stored in the database.

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Types of Attributes

Holds one value.

Holds multiple values to make it

Atomic V/S Composite

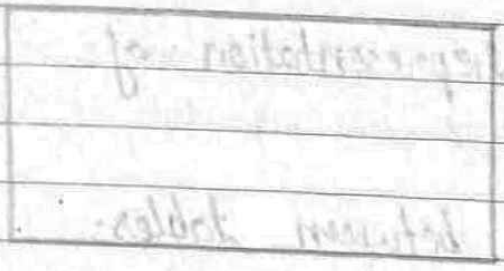
Single valued V/S Multivalued

Stored V/S derived - By Default we didn't store this but find out the value on the basis of other values by making formula

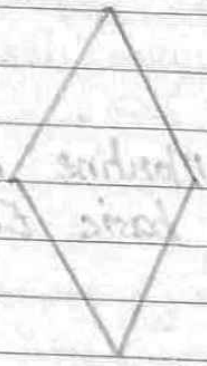
Null valued

Key Attributes

Symbols used in ER-Diagram



Entity (table)



Relationship

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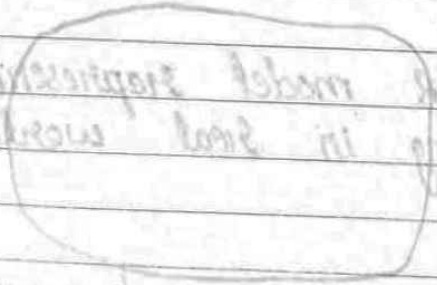
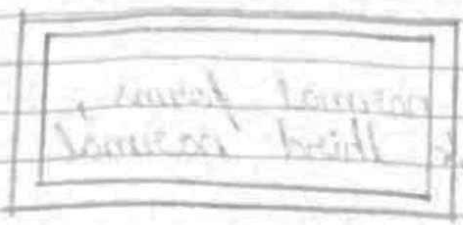
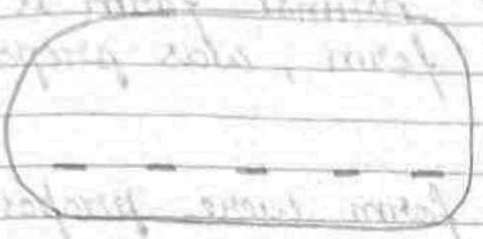


Attributes



Which does not Contain primary key

Weak Entity



Foreign key Attribute

Primary Key Attribute

First Normal Form

Normalization

The normalization process was first proposed by Codd in 1972

This process takes a relation schema through a series of tests to certify whether it satisfies a certain normal form.

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How many normal forms?

Initially, Codd proposed three normal forms, which he called first, second & third normal form.

A Stronger definition of third normal form is called Boyce - Codd normal form, was proposed later by Boyce & codd.

Later fourth & fifth normal form were proposed.

Why normalization?

It is the process of analyzing the given relation schema based on their functional Dependencies & primary keys to achieve the desirable properties of

Minimizing redundancy

Minimizing the insertion, deletion & update

First Normal Form

First normal form states that, the domain of an attributes must include only atomic values.

Atomic ??

Person

Attributes

Person id	First Name	Last Name	phone	email
1	Amit	Sahu	123, 243, 345	—

phone

phone id	phone no.	Person id
P1	123	1
P2	243	1
P3	345	1
P4	100	2
P5	201	3

So, here if we want to be mapped the phone table to the master data the master we want the primary key of the master database.

So, here every data has a single value & there is no data is multiple valued in attributes. This is called first normal form

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Second Normal Form

Second normal form (2NF) is a normal form used in database normalization.

2NF was originally defined by E.F. Codd

A table that is in first normal form (1NF) must meet additional criteria if it is to qualify for second normal form.

Second normal form states that it should meet all the rules for 1NF & there must be no partial dependences of any of the columns on the primary key.

dependency of primary key

Eg.

Roll No	NAME	Phone No.	Email id	Address
1	AMIT	—	—	—
2	AMIT	—		
3	Rahul			
4	Ravi			
5	Romesh			

So, here we see that in name column data is repeated if we want to known the ph. no. of Amit then could we know that which ph. no is belong to which Amit. here we use the Roll No. which primary key. By the help of this we can find out. As we known that P.K identify each row uniquely. this means dependency of P.K.

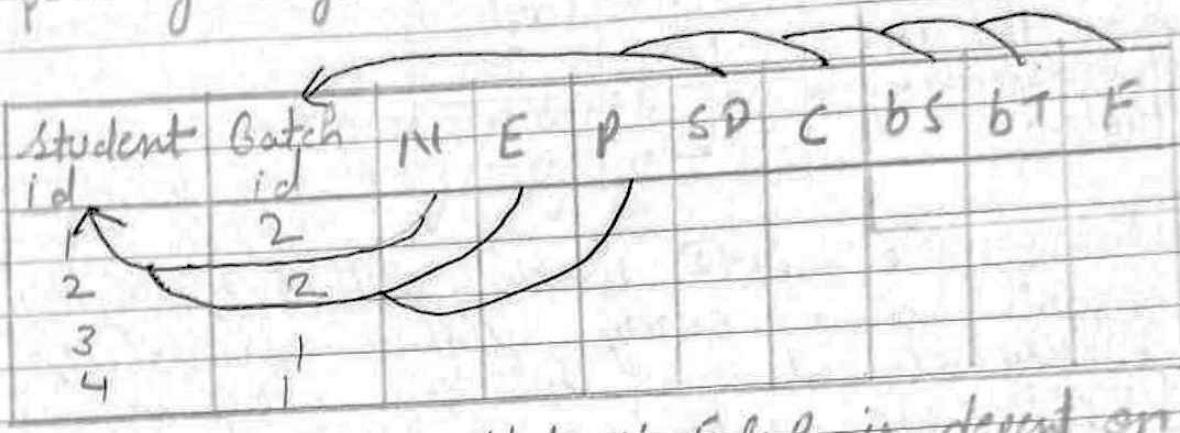
Partial dependency

Ex

Table: Student

Columns: Student id, Name, email, Ph. Phone, Batch id, Start_date, course, batch_size, batch time, faculty

So, here we see that there are so many attributes we are going to draw a table by using two primary keys which is student id & Batch id



Student id	Batch id	N	E	P	SD	C	bS	bT	F
1	2								
2	2								
3	1								
4	1								

So, here we see that N, E & P is depent on one key attribute that is student id as same SD, C, bS, bT & F is depend on another key attribute that is Batch id here we see that some attributes are depend on one key attribute as same as some are depend on another attribute that is called partial dependency where some attributes of a table depend on one key attribute & some depend on another key attribute in the same table.

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So if we want to reduce partial dependency we have to split this table to another next table that is the first one is Student & second one is Batch

Student

Student id			

Batch

Batch id					

if we get the two primary keys in a single table we have to ensure that there is no partial dependency in the table.

Student id	Batch id
1	2
2	2

Here we see after breaking the table into two parts Now every attribute is totally & Completely depend on its key attribute in all this we introduce another table which holds Student id & Batch id. So here partial dependency is totaly reduced & the table is in Second normal Form.

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Third Normal Form in DBMS

Third normal form (3NF) is a normal form used in database normalization

3NF was originally defined by E.F. Codd.

Codd's definition states that a table is in 3NF if & only if both of the following conditions hold

The relation R (table) is in second normal form (2NF).

Every non-prime attribute of R is non-transitively dependent on every key of R.

FacultyID	NAME	Dept	Dept Head
101	S.K. Sharma	Physics	Shri Lal
102	Rajendra Sen	Chemistry	O.P Rai
103	R. Gupta	Mathmatics	R. Gupta

In this table we see that Faculty Id is primary where name & Dept is depend on it which is a non-prime attribute but there is one more attribute which is Dept Hod it is not depend on faculty Id. it is depend on Dept. So we can say that this attribute is indirectly or non-transitively depend on prime attribute

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for Converting this table into Third normal form we have to break this table into two differed table where in 1st table Faculty Id act as a prime attribute & name & Dept act as a non-prime attribute

Now in second table Department Name act as a prime table & Dept head act as a non-prime attribute.

Integrity Constraints

Integrity constraints provide a way of ensuring that changes made to the database by authorized users do not result in a loss of data consistency.

Integrity means something like 'be right' & consistent

Types of integrity

Domain integrity
Entity integrity
Referential integrity
Foreign key integrity

Domain Integrity

Domain integrity means the definition of a valid set of values for an attributes. you define

Data type
Length or Size
Is null value allowed
Is the value unique
Default value
Range of values

Entity Integrity

The entity integrity constraints states that primary keys can't be null.

There must be a proper value in the primary key field.

This is because the primary key valued is used to identify indivival rows in a table.

Referential Integrity

The referential integrity constraint is specified between two tables & it is used to maintain the consistency among rows between the two tables.

Rules

you can't delete a record from a primary table if matching records exist in a related table.

you can't change a primary key value in the primary table if that record has related records.

you can't enter a value in the foreign key field of the related table that doesn't exist in the primary key of the primary table.

However, you can enter a null value in the foreign key, specifying that the records are unrelated.

Foreign Key Integrity

There are two foreign key constraint:

Cascade update related fields
Cascade delete related rows.

Cascade update related fields

Any time you change the primary key of a row in the primary table, the foreign key values are updated in the matching rows in the related table.

Cascade delete related rows

Any time you delete a row in the primary table, the matching rows are automatically deleted in the related tables.