Unit 1

Data Model

What is Data Modelling?

Data modeling is the process of creating a data model for the data to be stored in a Database. This data model is a conceptual representation of

- Data objects
- The associations between different data objects
- The rules.

Data model emphasizes on what data is needed and how it should be organized instead of what operations need to be performed on the data. Data Model is like architect's building plan which helps to build a conceptual model and set the relationship between data items.

There are mainly three different types of data models:

Conceptual: This Data Model defines **WHAT** the system contains. This model is typically created by Business stakeholders and Data Architects. The purpose is to organize, scope and define business concepts and rules.

Logical: Defines **HOW** the system should be implemented regardless of the DBMS. This model is typically created by Data Architects and Business Analysts. The purpose is to developed technical map of rules and data structures.

Physical: This Data Model describes **HOW** the system will be implemented using a specific DBMS system. This model is typically created by DBA and developers. The purpose is actual implementation of the database.

Conceptual Model

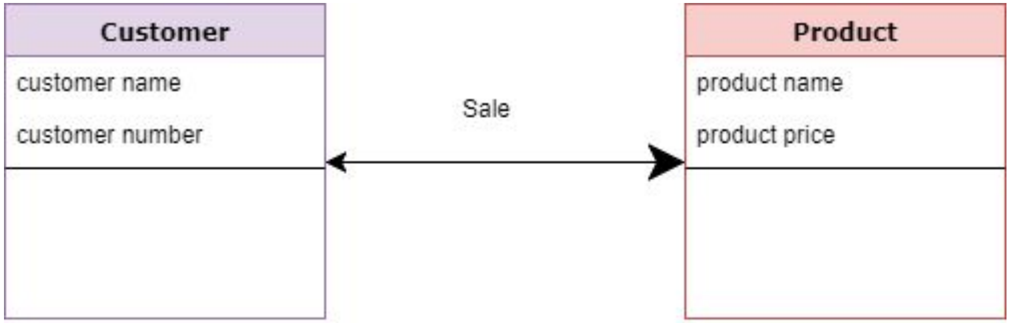
The main aim of this model is to establish the entities, their attributes, and their relationships. In this Data modeling level, there is hardly any detail available of the actual Database structure.

The 3 basic tenants of Data Model are

Entity: A real-world thing

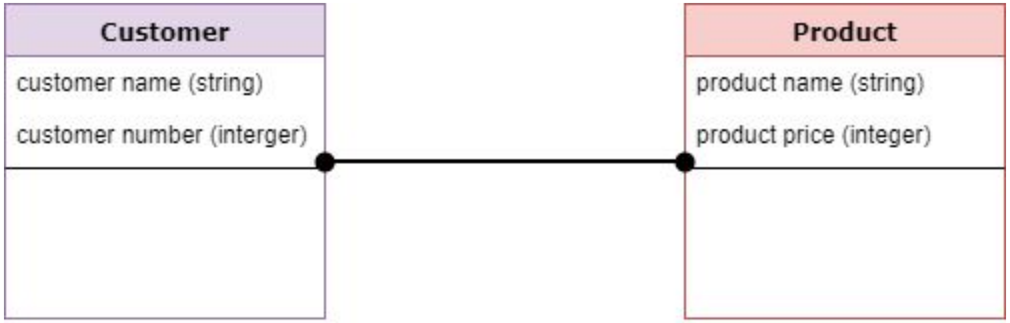
Attribute: Characteristics or properties of an entity

Relationship: Dependency or association between two entities



Logical Data Model

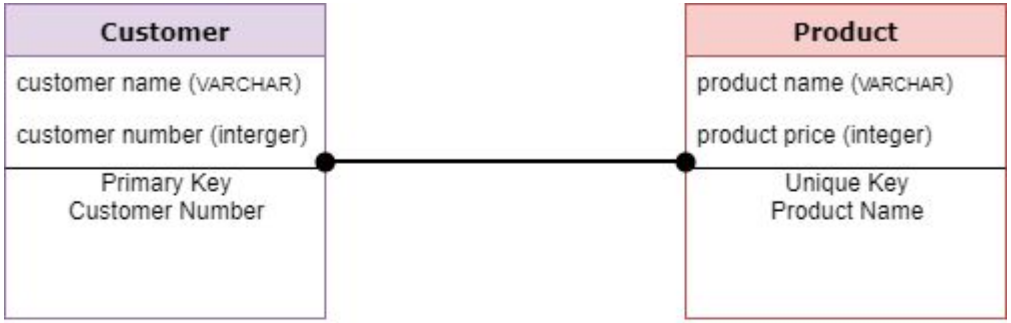
Logical data models add further information to the conceptual model elements. It defines the structure of the data elements and set the relationships between them.



At this Data Modeling level, no primary or secondary key is defined. At this Data modeling level, you need to verify and adjust the connector details that were set earlier for relationships.

Physical Data Model

A Physical Data Model describes the database specific implementation of the data model. It offers an abstraction of the database and helps generate schema. This is because of the richness of meta-data offered by a Physical Data Model.



Customer

customer name (VARCHAR)

customer number (interger)

Primary Key
Customer Number

Product

product name (VARCHAR)

product price (integer)

Unique Key
Product Name

This type of Data model also helps to visualize database structure. It helps to model database columns keys, constraints, indexes, triggers, and other RDBMS features.

Data Models

Logical Data Model are two types

1. Object based logical models

1. Entity Relationship model
2. Object Oriented model

2. Record based logical models

1.Relational model
2. Network model
3. Hierarchical model

1.Object Based Logical Model

These models are used in describing data at the logical and view level. It provides flexible structuring capabilities. The data constraints are specified explicitly.

1. Entity Relationship Model

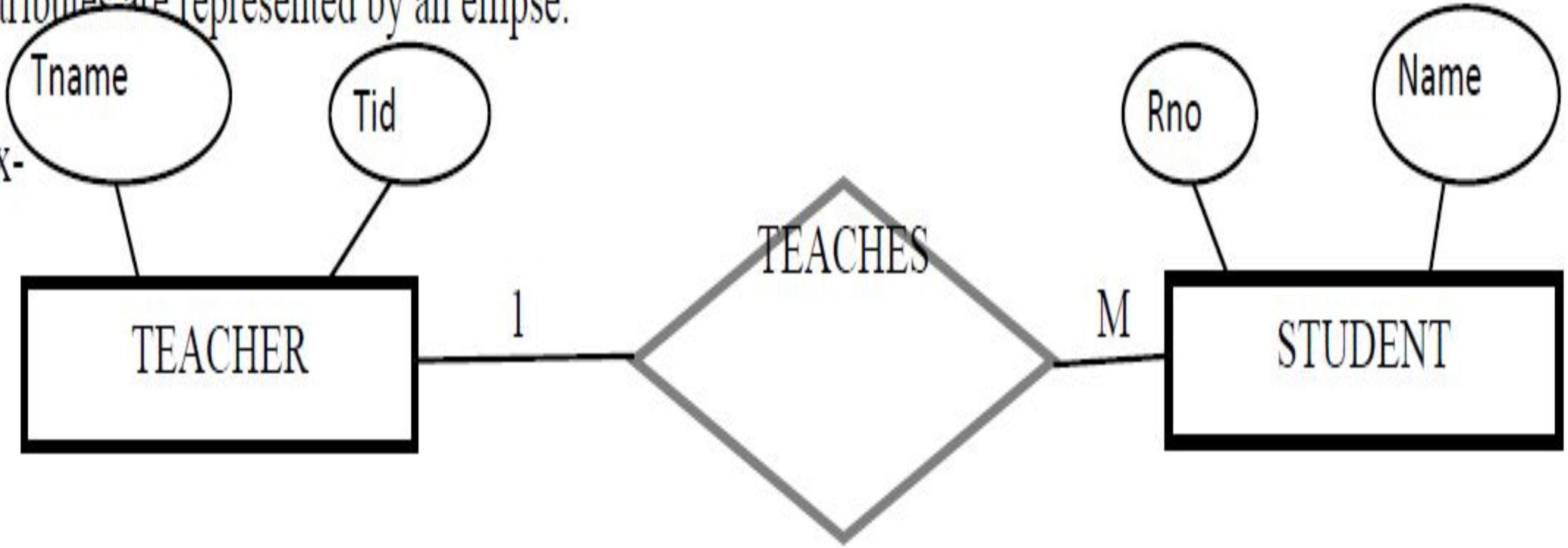
It is the pictorial representation of data where data is treated as object and it is represented in the form of entity whereas association between these objects is represented in the form of relationships. The characteristics of object are represented in the form of attributes.

Entity is represented by a rectangle symbol and relationships are represented by diamond and

attributes are represented by an ellipse.

attributes are represented by an ellipse.

Ex-



2. Object Oriented Model

In this model data members and member’s functions embedded in a class. One can create n

number of objects of a class these objects are useful for accessing the data members and member functions of a class. Object is also called as instance of a class

```
Ex- Class student
{
  Public:
  int roll_no;
  char name[20];
  getdata();
  putdata();
}
Class student s;
s.getdata();
s.putdata();
```

2. Record Based Logical Models

These models are used in describing data at logical and view levels. The database

structured in fixed format records of several types. Each record type defines a fixed number of fields or attributes and each field is usually of a fixed length

1. Relational model
2. Network model
3. Hierarchical model
4. Entity Relationship model

1.Relational Model

Relational model stores data in the form of a table. This type of model is powerful because it is based on few assumptions about how data is related or how it will be extracted from the database. Same database can be viewed in different ways.

A single database can be spread across several tables. It uses tables to organize data elements. Each table corresponds to an application entity and each row represents an instance of that entity.

- **S UDENT TABLE**

Roll number	Name	Address
1	Ajay	Pune
2	Anita	Chinchwad
3	Amay	Nigdi

Student entity in an application corresponds to a student table in the database. Each row represents different student.

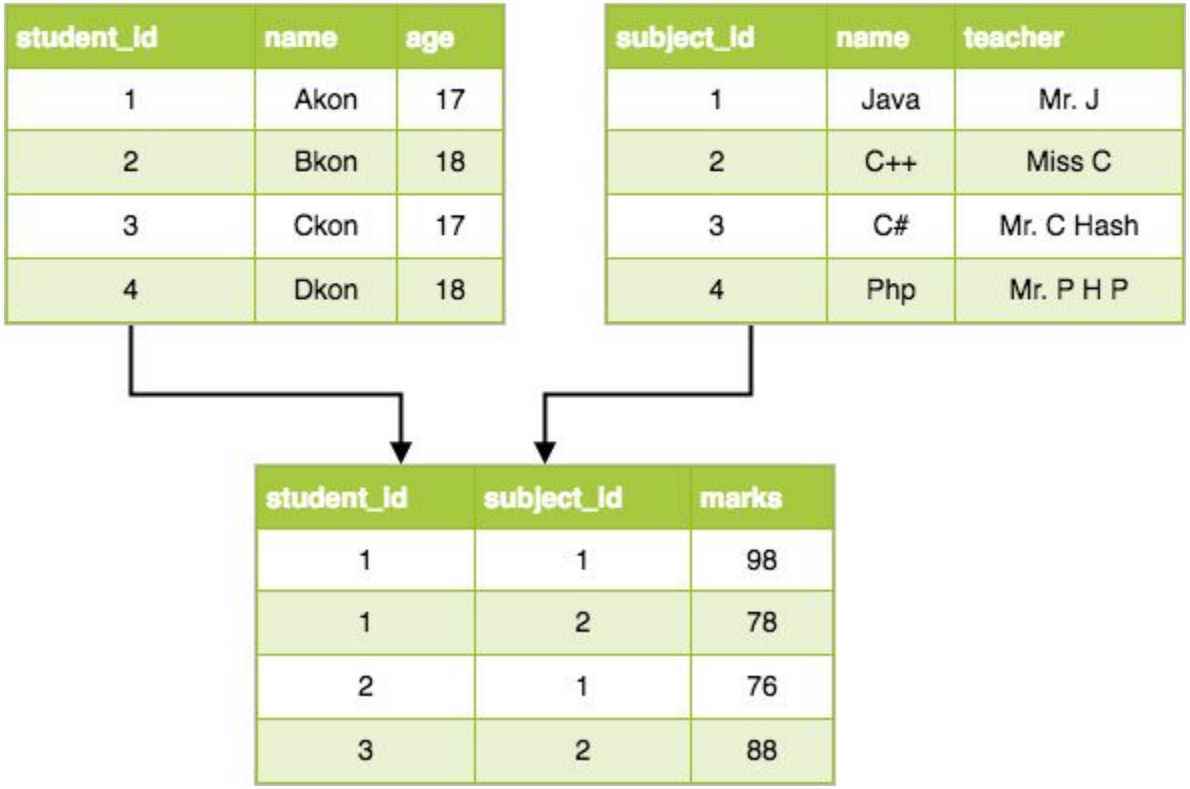
Relational Model

In this model, data is organised in two-dimensional **tables** and the relationship is maintained by storing a common field.

This model was introduced by E.F Codd in 1970, and since then it has been the most widely used database model, infact, we can say the only database model used around the world.

The basic structure of data in the relational model is tables. All the information related to a particular type is stored in rows of that table. Hence, tables are also known as **relations** in relational model.

Relational Model



student_id	name	age
1	Akon	17
2	Bkon	18
3	Ckon	17
4	Dkon	18

subject_id	name	teacher
1	Java	Mr. J
2	C++	Miss C
3	C#	Mr. C Hash
4	Php	Mr. P H P

student_id	subject_id	marks
1	1	98
1	2	78
2	1	76
3	2	88

Advantages

1. Structural Independence

Programmer need not have to worry about the learning details of data storage.

2. Conceptual Simplicity

Instead of storage details programmer can concentrate on logic

3. Design, Implementation maintenance and usage is easy.

4. Ad hoc query capability

Disadvantages

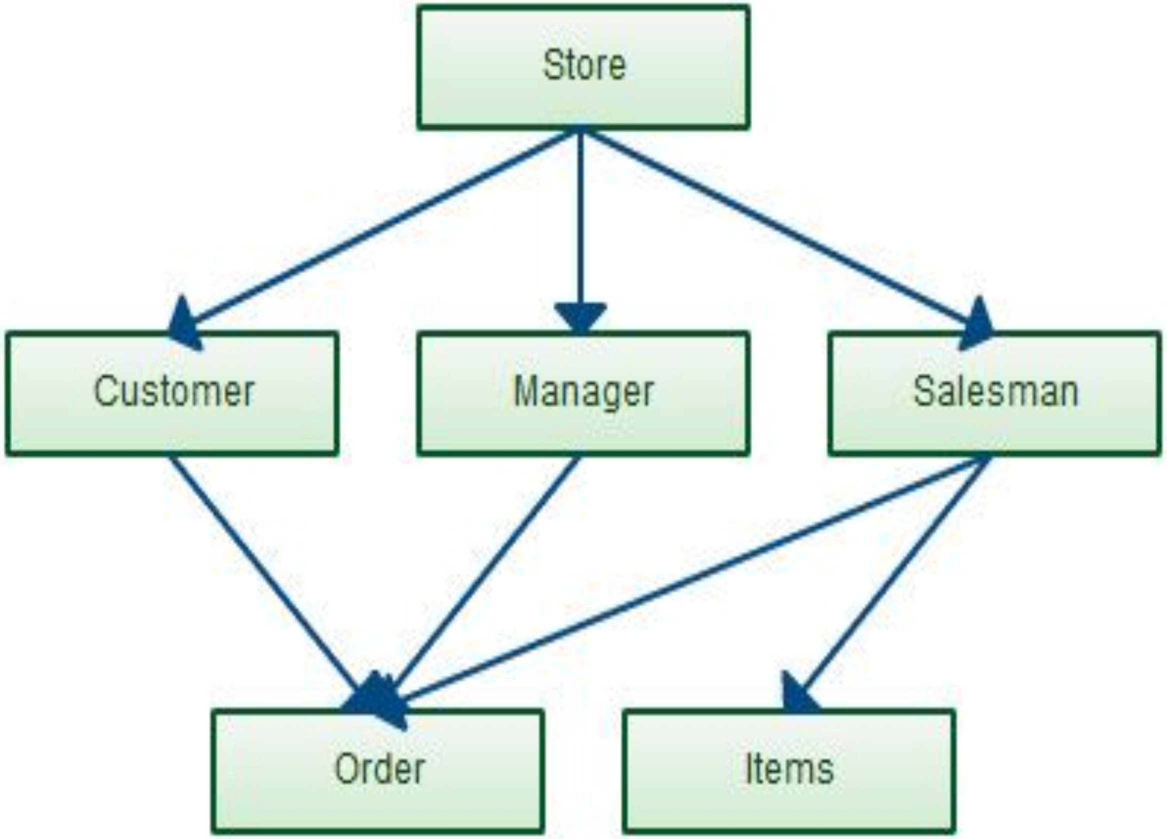
1. Hardware overheads

There can be hardware overheads because storage details are unknown to the programmer.

2. Ease of design can lead to bad design.

2.Network Model

A network database consists of collection of records connected to one another through links. A record similar to entity in ER. Each record is a collection of fields each of which contains only one data value. A link is an association between two records. Network data model has ability to handle M:M relationship.



Store

Customer

Manager

Salesman

Order

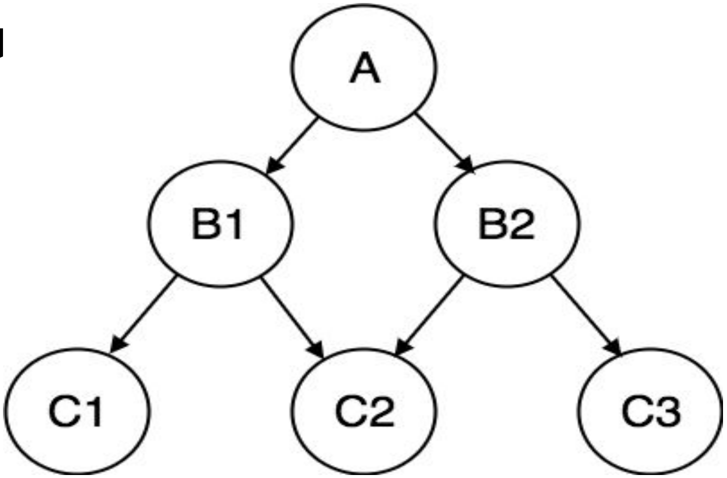
Items

Network Model

This is an extension of the Hierarchical model. In this model data is organised more like a graph, and are allowed to have more than one parent node.

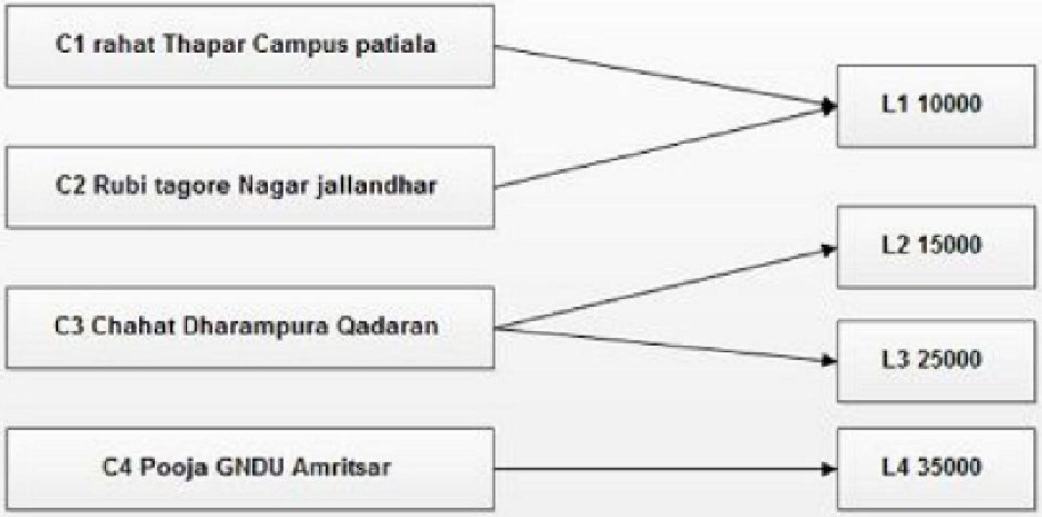
In this database model data is more related as more relationships are established in this database model. Also, as the data is more related, hence accessing the data is also easier and fast. This database model was used to map many-to-many data relationships.

This was the most widely used database model, before Relational Model was introdu



Network Model

Ex-


C1 rahat Thapar Campus patiala
C2 Rubi tagore Nagar jallandhar
C3 Chahat Dharampura Qadaran
C4 Pooja GNDU Amritsar
L1 10000
L2 15000
L3 25000
L4 35000

Network Model Of Customer Loan Databse

Advantages

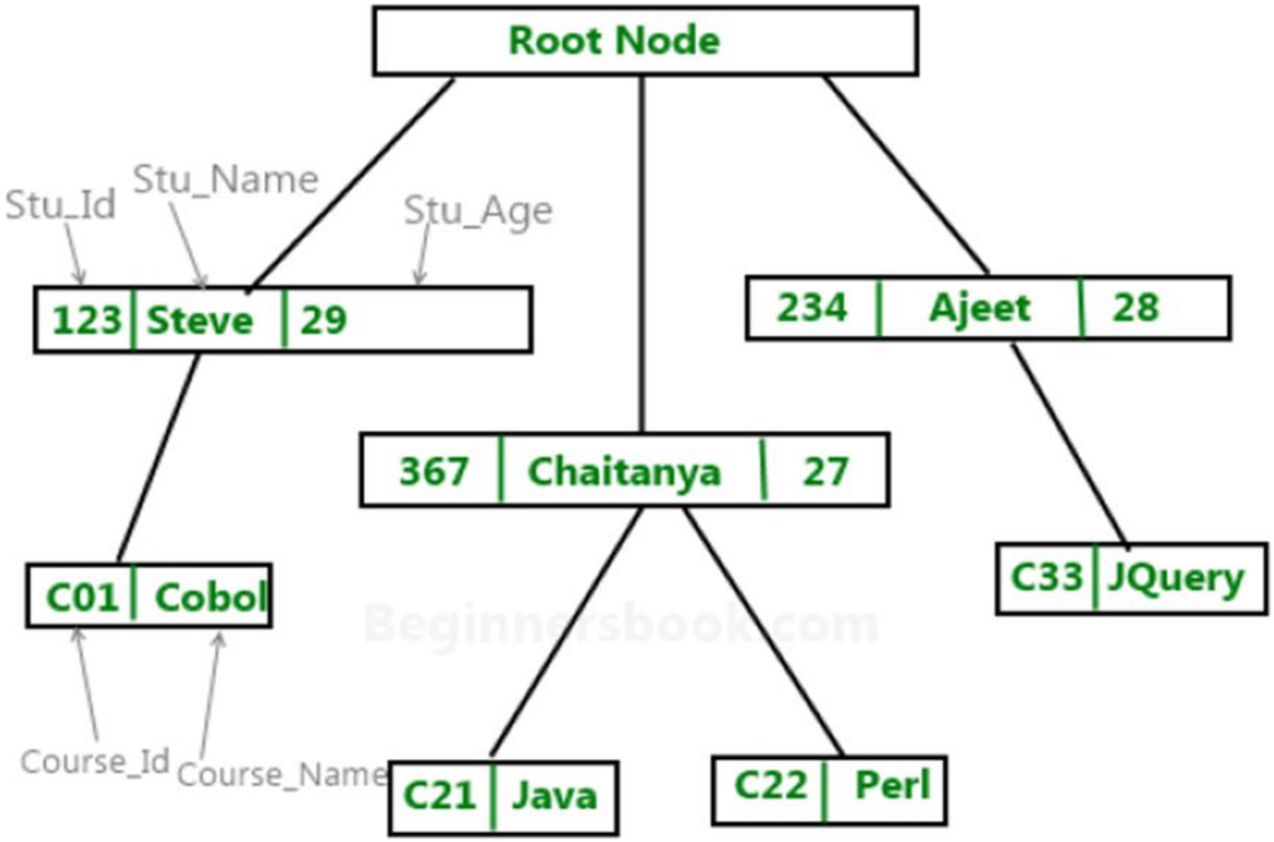
- Network models represent complex data relationships better than the hierarchical models.
- It handles so many relationship types.
- Data access is more flexible than hierarchical models.
- Improved database performance.
- It includes Data Definition Language (DDL) and Data Manipulation Language (DML) commands.

Disadvantages

- Database contains a complex array of pointers.
- System complexity limits efficiency.
- Structural changes require changes in all application programs.
- Navigation systems yield complex implementation and management.
- Keep heavy pressure on programmers due to the complex structure.
- Any change like updating, deletion, insertion is very complex.

3. Hierarchical Model (1:M)

A hierarchical model represents the data in a tree-like structure in which there is a single parent for each record. To maintain order there is a sort field which keeps sibling nodes into a recorded manner. These types of models are designed basically for the early mainframe database management systems, like the Information Management System (IMS) by IBM.


Root Node
Stu_Id
Stu_Name
Stu_Age
123
Steve
29
234
Ajeet
28
367
Chaitanya
27
C01
Cobol
Course_Id
Course_Name
C21
Java
C22
Perl
C33
JQuery
Beginnersbook.com

Hierarchical Model

This database model organises data into a tree-like-structure, with a single root, to which all the other data is linked. The heirarchy starts from the **Root** data, and expands like a tree, adding child nodes to the parent nodes.

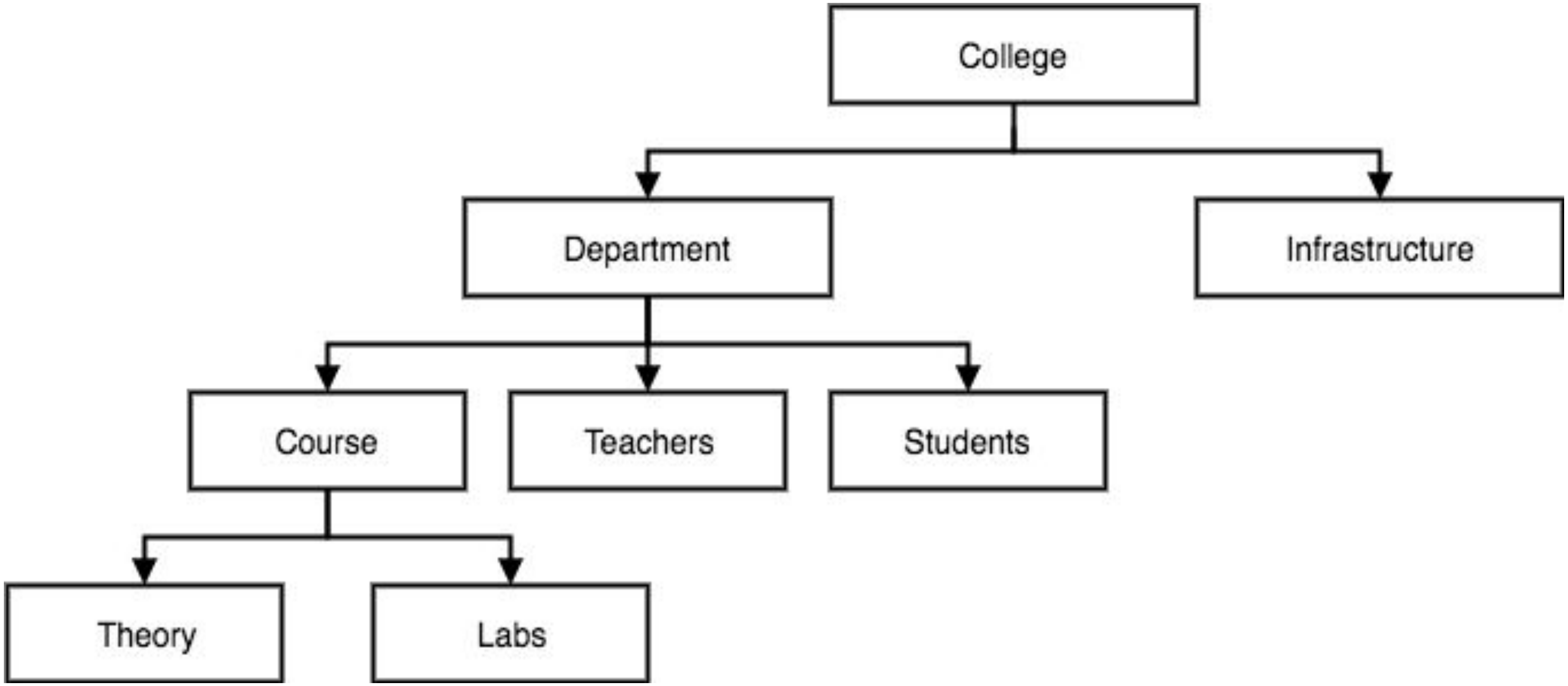
In this model, a child node will only have a single parent node.

This model efficiently describes many real-world relationships like index of a book, recipes etc.

In hierarchical model, data is organised into tree-like structure with one one-to-many relationship between two different types of data

Hierarchical Model

for example, one department can have many courses, many professors and of-course many students.



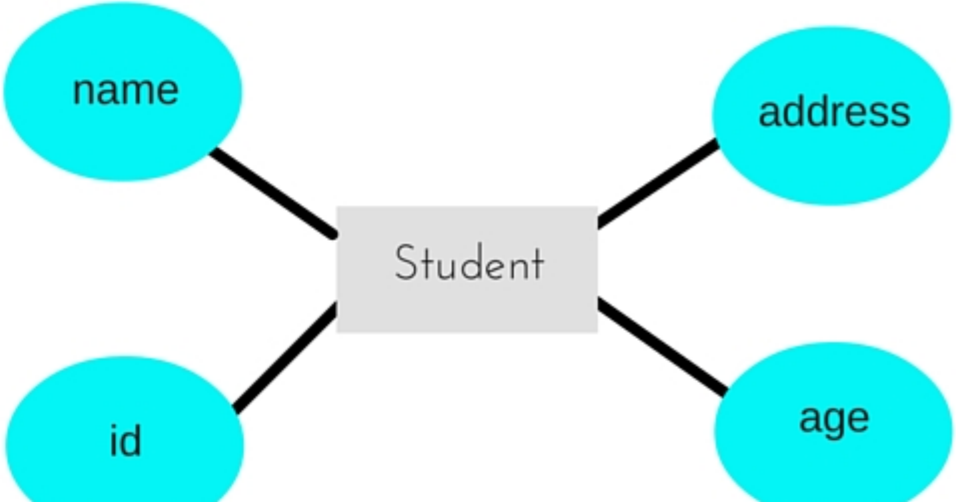
Entity-relationship Model

In this database model, relationships are created by dividing object of interest into entity and its characteristics into attributes.
Different entities are related using relationships.

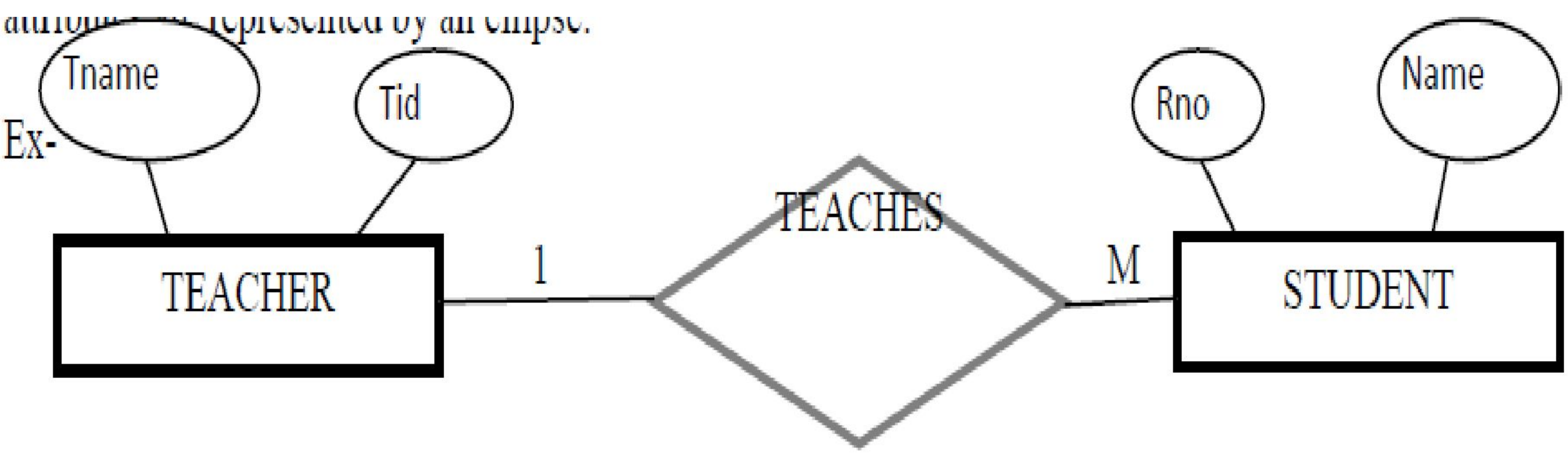
E-R Models are defined to represent the relationships into pictorial form to make it easier for different stakeholders to understand.
This model is good to design a database, which can then be turned into tables in relational model(explained below).

Entity-relationship Model

Let's take an example, If we have to design a School Database, then **Student** will be an **entity** with **attributes** name, age, address etc. As **Address** is generally complex, it can be another **entity** with **attributes** street name, pincode, city etc, and there will be a relationship between them.



Entity-relationship Model


attribute are represented by an ellipse.
Ex-
Tname
Tid
TEACHER
1
TEACHES
M
STUDENT
Rno
Name