Data Models

Entity-Relationship Model

An ER Model is a high level description of the data and the relationships among the data, rather how data is stored. Some features of E-R Model are:

1. The E-R diagram used for representing E-R Model can be easily converted into relations(tables) in relational model.
2. The E-R Model is used for the purpose of good database design by the database developer so as o use that data model in various DBMA.
3. It is a top-down approach to database design.
4. It gives the precise understanding of the nature of data and how it is used by an enterprise.
5. It is very simple, non technical, free of ambiguities and easy to understand by various types of users, programmers and designers because a specific standards are used for their representation.

E-R Diagram

- Entity relationship model defines the conceptual view of database.
- It works around real world entity and association among them.

E-R Model Terminology

ENTITY

- A real-world thing either animate or inanimate that can be easily identifiable and distinguishable.
- Objects about which information can be stored.
    - For example, in a school database, student, teachers, class and course offered can be considered as entities.
- **Properties of Entity :**

1. Entity is represented by set of properties called attributes.
2. Entity is atomic and cannot be broken down into smaller pieces.
3. Entity is an instance of entity type so it is represented in E-R diagrams a rectangular box enclosing its name.

ENTITY TYPE

- An entity type is a collection of entities that have the same attributes but different values.
- **Properties of Entity Type:**

1. An entity is an instance of entity type.
2. An entity type is identified by its name and properties.
3. An entity type is represented by ER diagram as a rectangular box enclosing the entity type.

ENTITY SET

An entity set is a collection of all instances of a particular entity type at any point of time in the database. Each entity set is referred by its name and attribute values.Its name is same as that of entity type.

ATTRIBUTES

Entities are represented by means of their properties, called attributes.

- For example, a student entity may have name, class, age as attributes.

Properties of Attributes

1. The attributes of an entity should be unique.
2. The attributes should uniquely identify the entity.
3. The set of permitted values for each attribute is known as its domain from where its values are chosen.
4. An attribute of an entity is represented in ER diagram as an ellipse attached to a relevant entity by a line and labelled with entity name.

Types of attributes:

- **Simple attribute:**

Simple attributes are atomic values, which cannot be divided further.

  - For example, student's phone-number is an atomic value of 10 digits.

- **Composite attribute:**

Composite attributes are made of more than one simple attribute.

  - For example, a student's complete name may have first_name and last_name.

- **Derived attribute:**

Derived attributes are attributes, which do not exist physical in the database, but there values are derived from other attributes presented in the database.

  - For example, average_salary in a department should be saved in database instead it can be derived.
  - For another example, age can be derived from data_of_birth.

- **Single-valued attribute:**

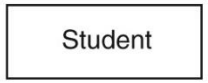
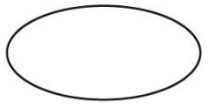
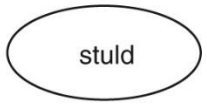
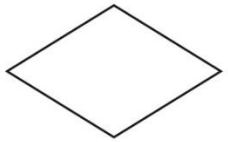
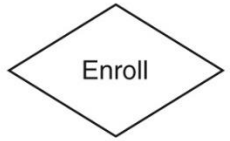
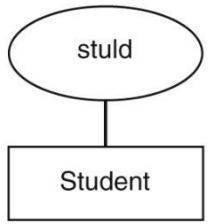
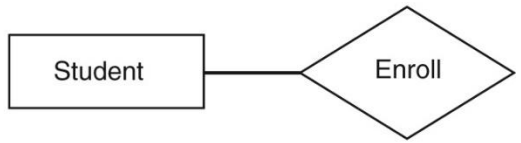
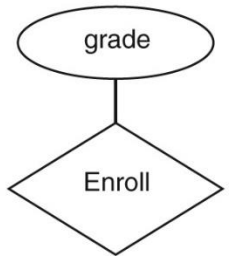
Single valued attributes is the one that has only a single value for a particular entity.

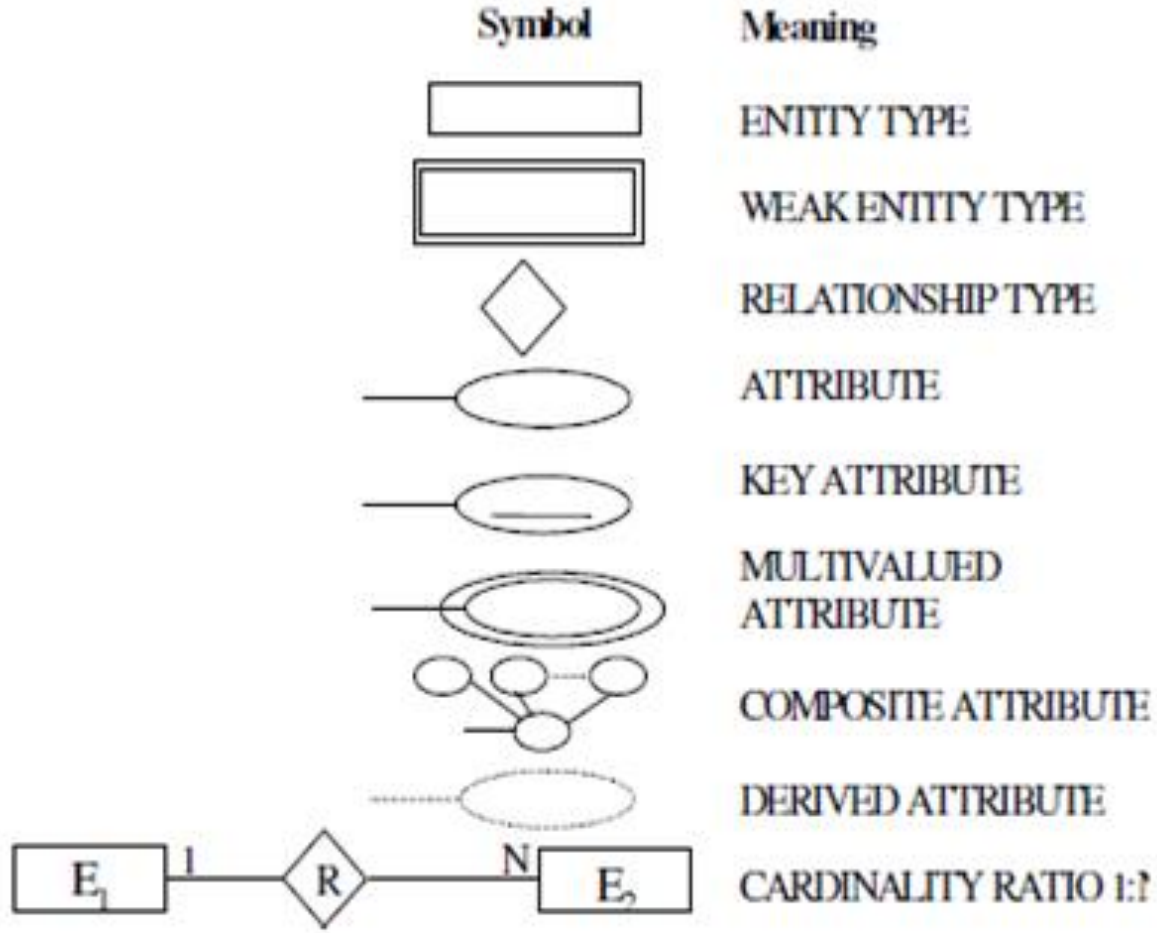
  - For example: RollNo.

- **Multi-value attribute:**

Multi-value attribute is an attribute that holds multiple values for a particular single entity.

  - For example, a person can have more than one phone numbers, email_addresses etc.

SYMBOL	NAME	MEANING	EXAMPLE
	Rectangle	Entity Set	
	Oval	Attribute	
	Diamond	Relationship	
	Line	Links: Attribute to Entity	
		Entity Set to Relationship	
		Attribute to Relationship	



Relationship

- The association between two or more entities is called relationship.
  - For example, employee entity has relation works_at with department
- **Relationship Set:**
- Relationship of similar type is called relationship set.

- **DEGREE OF RELATIONSHIP**
- The number of participating entities in an relationship defines the degree of the relationship **or** Total number of attributes or columns of a relation is known as the degree of the relation.
- **Unary** – When association exists within a single entity type. The degree of unary relationship is 1. It is sometimes called as Recursive Relationship.
- **Binary** - When association exists between two entity types. The degree of binary relationship is 2.
- **Ternary** – When association exists among three entity types. The degree of ternary relationship is 3. It is rarely used in real world. If it exists, is should be decomposed into one or more binary relationships.
- **Quaternary** - When association exists among four entity types. The degree of Quaternary relationship is 4.

Connectivity of Relationship

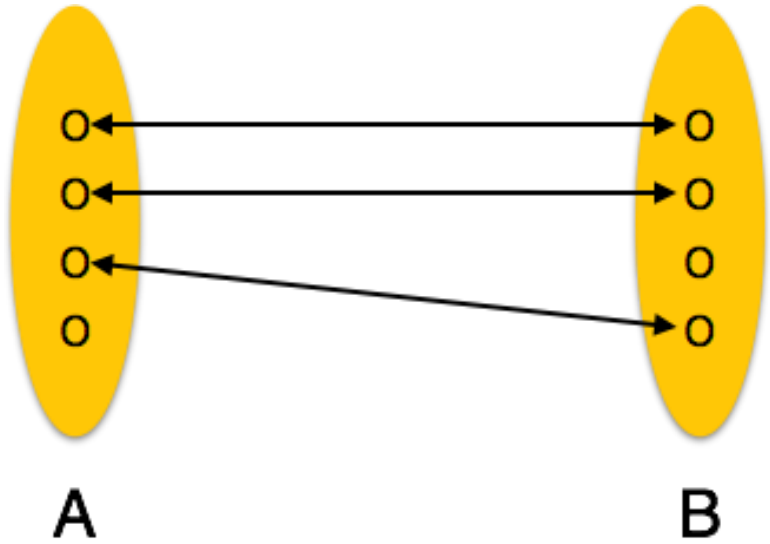
- Connectivity of relationship means how many instances of one entity are associated with how many instances of other entity in a relationship. It describes the mapping of associated entity instances in the relationship.

Mapping Cardinalities:

- **Cardinality** defines the number of entities in one entity set which can be associated to the number of entities of other set via relationship set.

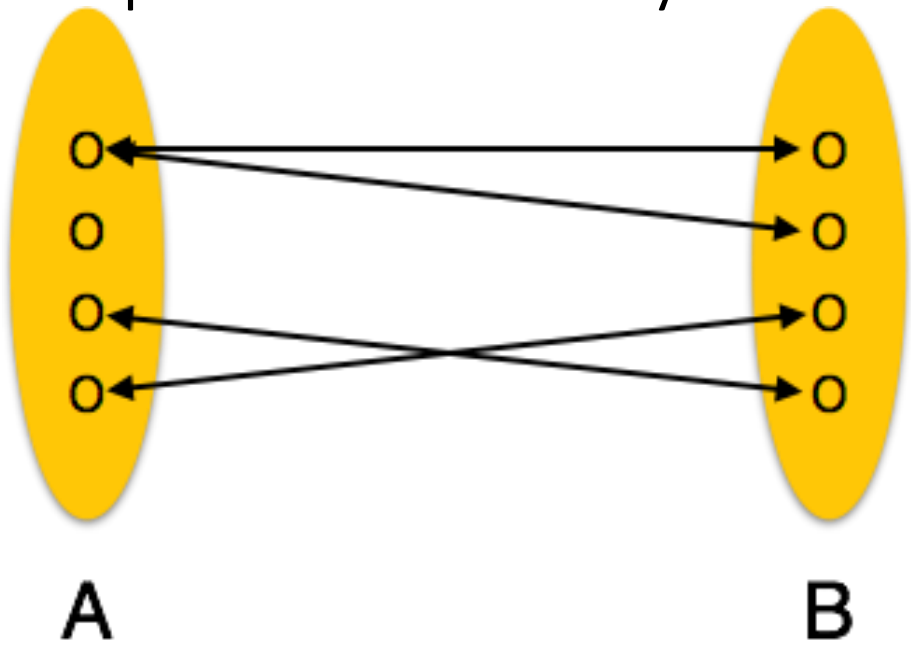
- **One-to-one(1:1):** one entity from entity set A can be associated with at most one entity of entity set B and vice versa. 1:1 relationship occurs when an instance of entity type A is associated with exactly one instance of entity type B.

Eg- No student can do the same project and no student can do more than 1 project.



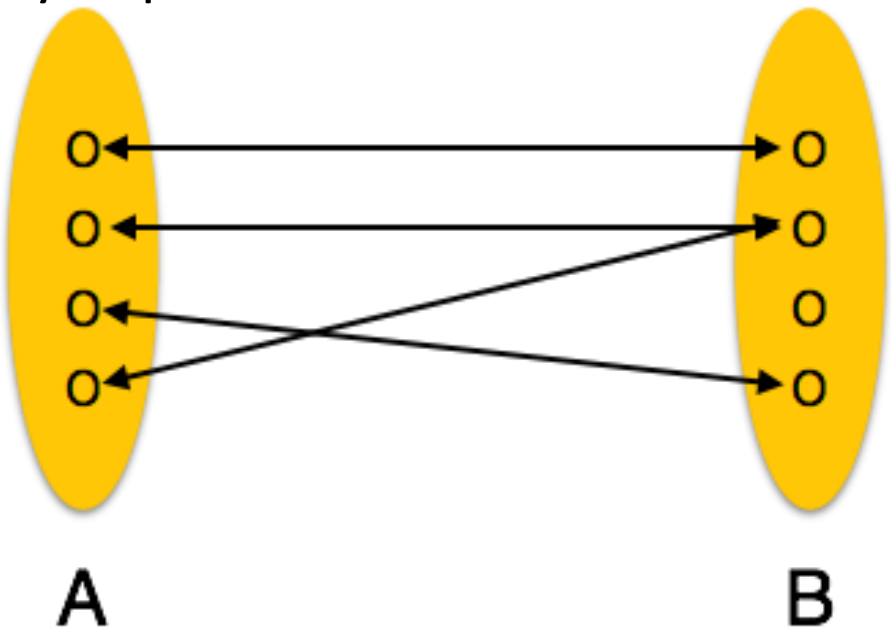
- **One-to-many(1:N):** One entity from entity set A can be associated with more than one entities of entity set B but from entity set B one entity can be associated with at most one entity. 1:N relationship occurs when any one instance of entity type A is associated with N number of instance of another entity type B.

Eg- Relationship between Department and Faculty.



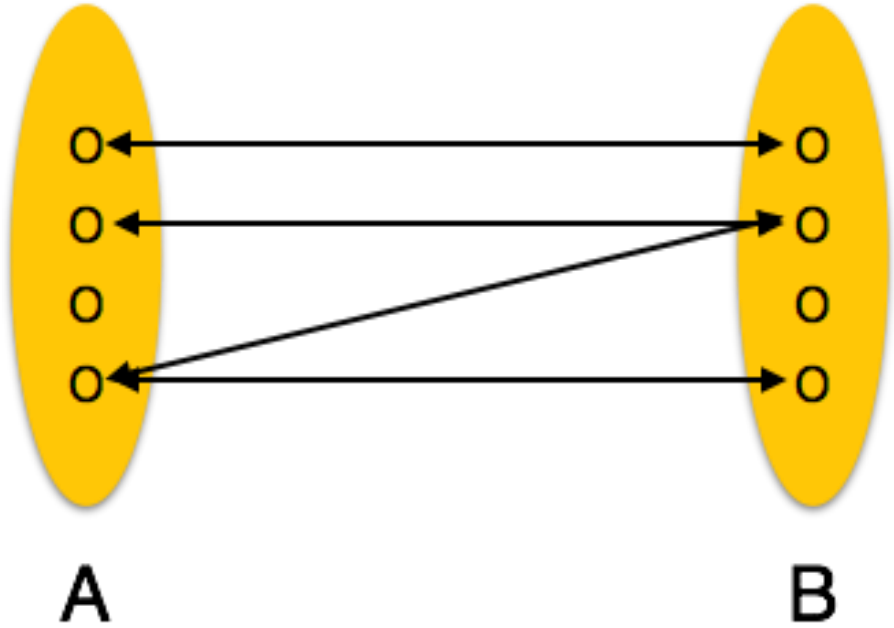
- **Many-to-one:** More than one entities from entity set A can be associated with at most one entity of entity set B but one entity from entity set B can be associated with more than one entity from entity set A. N:1 relationship occurs when any N number of instances of entity type A is associated with atmost one instance of entity type B.

Eg- faculty are employed by department.



- **Many-to-many:** one entity from A can be associated with more than one entity from B and vice versa. M:N relationship occurs when an instance of entity type A is associated with any number of instances of entity type B and instance of entity type B is associated with any number of instances of entity type A.

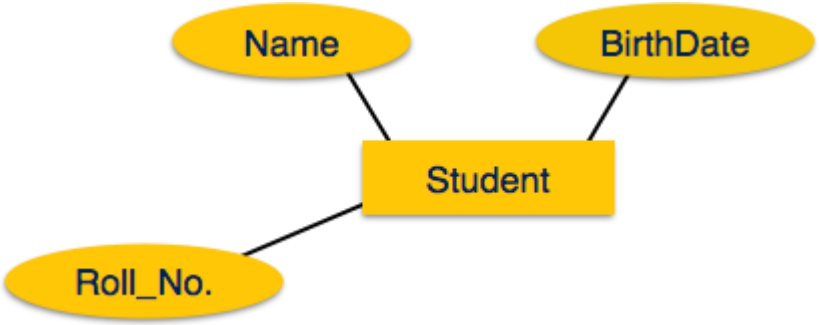
Eg- Author writes books.

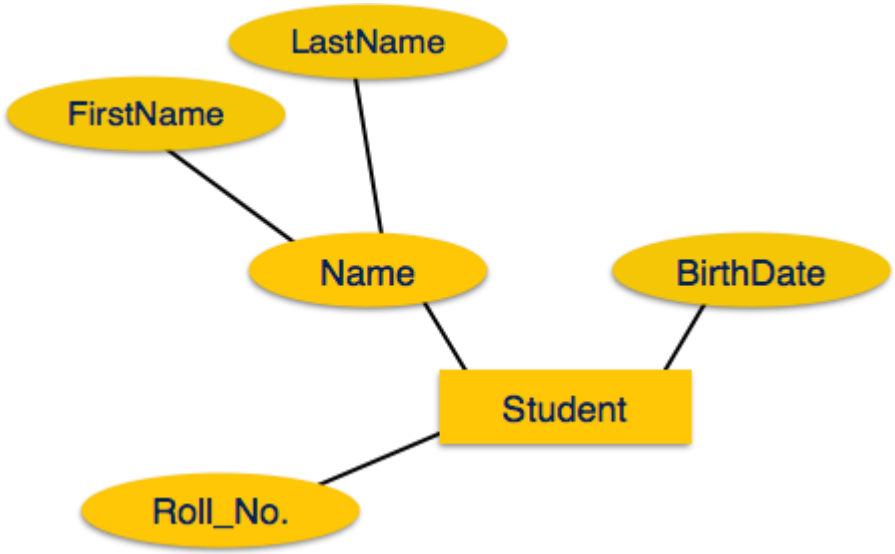


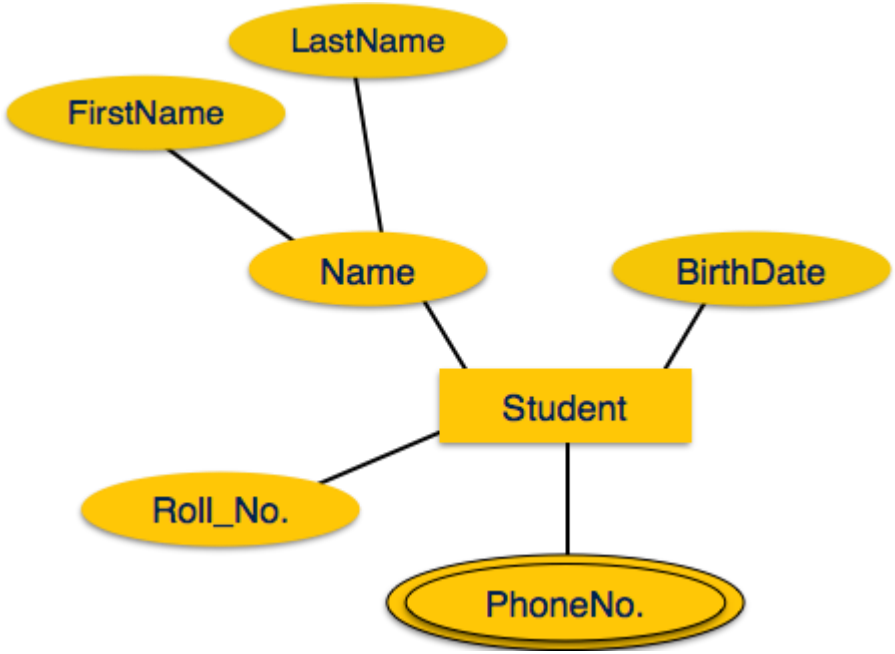
ER Diagram Representation

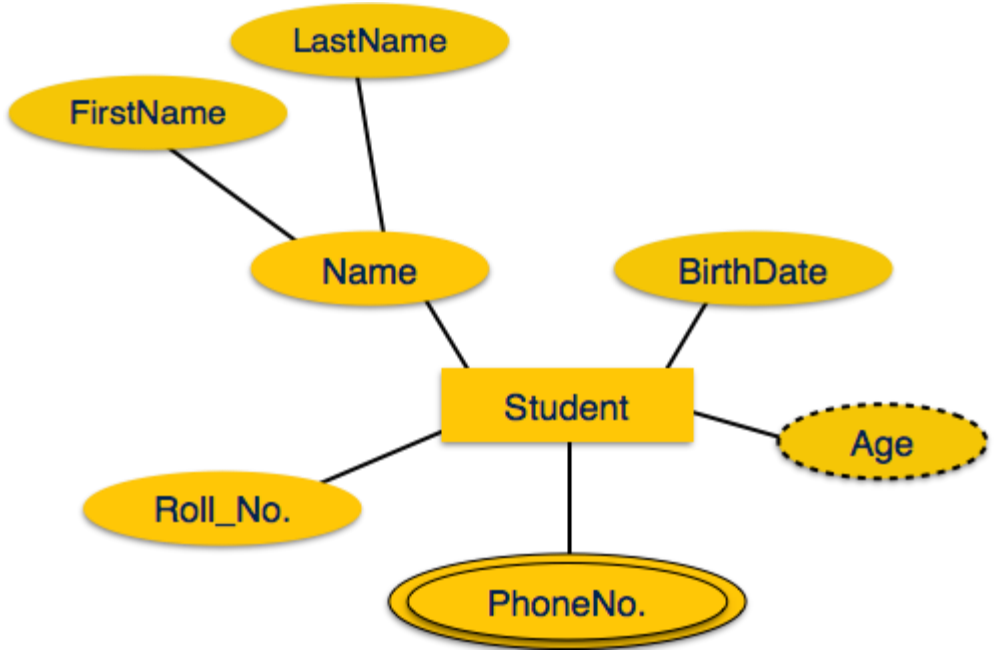
- **Entity**
- Entities are represented by means of rectangles. Rectangles are named with the entity set they represent.

- **Attributes**


Name
BirthDate
Student
Roll_No.


LastName
FirstName
Name
BirthDate
Student
Roll_No.


LastName
FirstName
Name
BirthDate
Student
Roll_No.
PhoneNo.


LastName
FirstName
Name
BirthDate
Student
Age
Roll_No.
PhoneNo.

Cardinality of Relationship

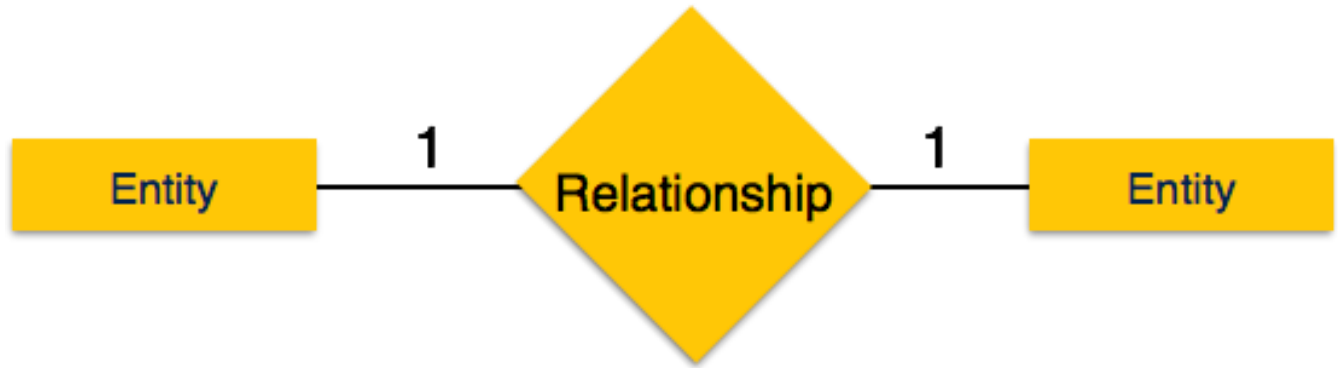
- The total number of rows or tuples in a table is referred as Cardinality of a relation.
- Cardinality of a relationship quantifies the relationship between entities by measuring how many instances of one entity type are related to a single instance of another.
- The actual count of elements associated with the connectivity is called Cardinality.

Direction of Relationship

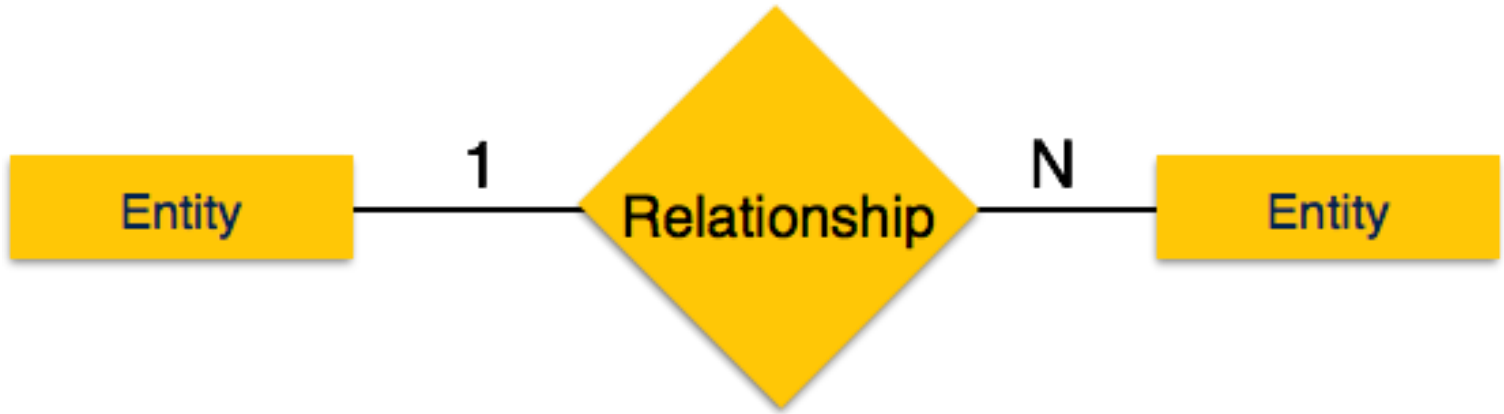
- The direction of the relationship is the line connecting the two entities related to each other by a relationship.
- The entity from where the relationship starts is the parent entity and the entity where the relationship ends is called the child entity.
- The type of relation is determined by the line connecting the entities and the relationship components.

relationship and cardinality

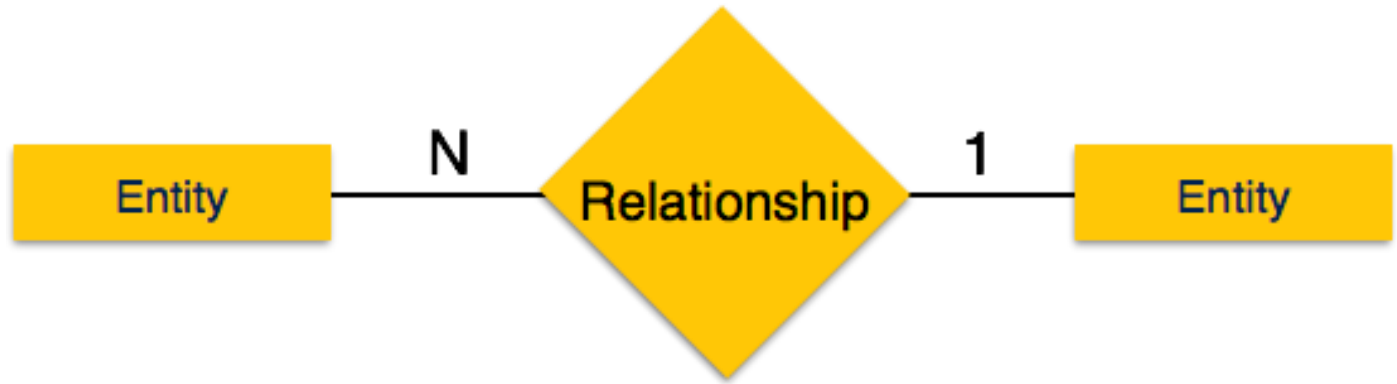
- **One-to-one**
- When only one instance of entity is associated with the relationship, it is marked as '1'. This image below reflects that only 1 instance of each entity should be associated with the relationship. It depicts one-to-one relationship.



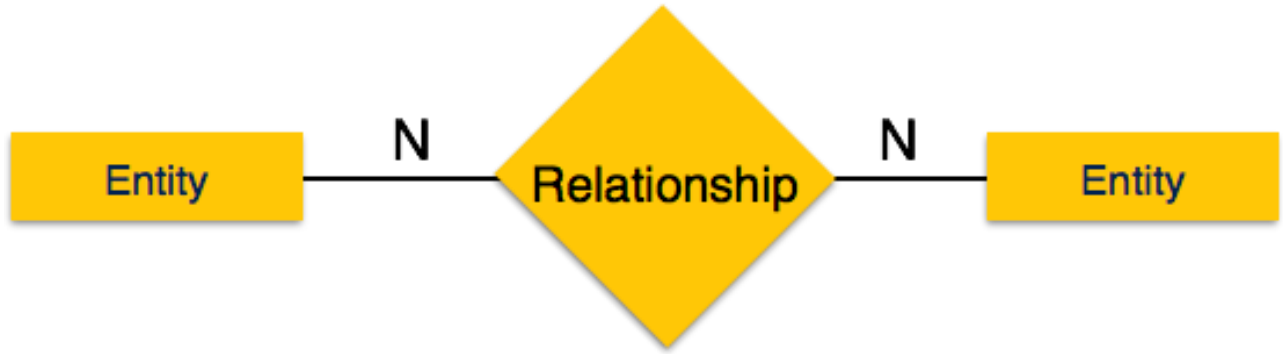
- **One-to-many**
- When more than one instance of entity is associated with the relationship, it is marked as 'N'. This image below reflects that only 1 instance of entity on the left and more than one instance of entity on the right can be associated with the relationship. It depicts one-to-many relationship.



- **Many-to-one**
- When more than one instance of entity is associated with the relationship, it is marked as 'N'. This image below reflects that more than one instance of entity on the left and only one instance of entity on the right can be associated with the relationship. It depicts many-to-one relationship

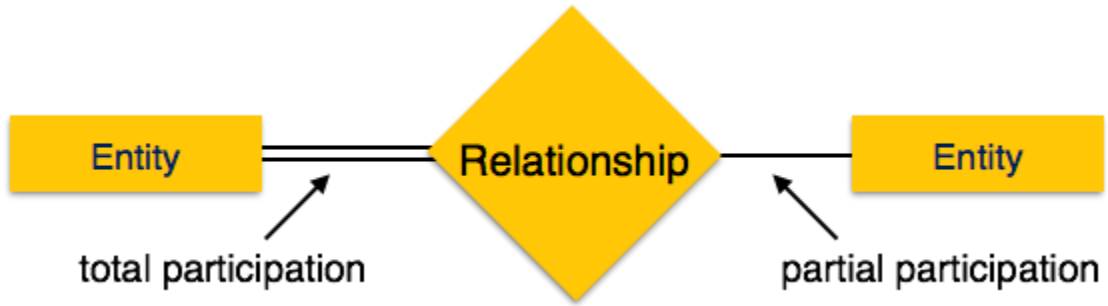


- **Many-to-many**
- This image below reflects that more than one instance of entity on the left and more than one instance of entity on the right can be associated with the relationship. It depicts many-to-many relationship.



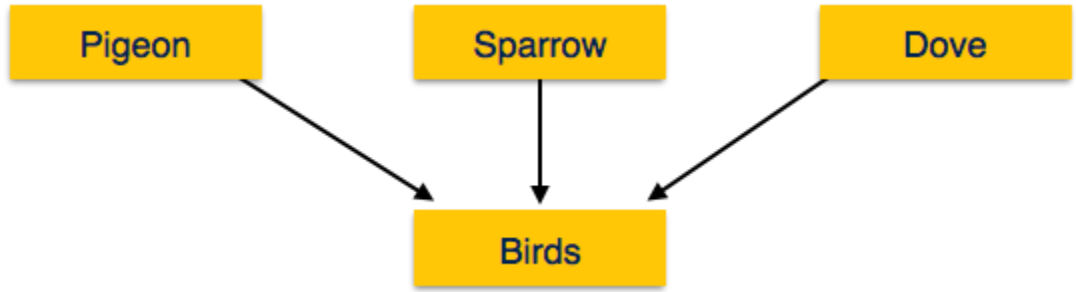
Participation Constraints

- **Total Participation:** Each entity in the entity is involved in the relationship. Total participation is represented by double lines.
- **Partial participation:** Not all entities are involved in the relation ship. Partial participation is represented by single line.



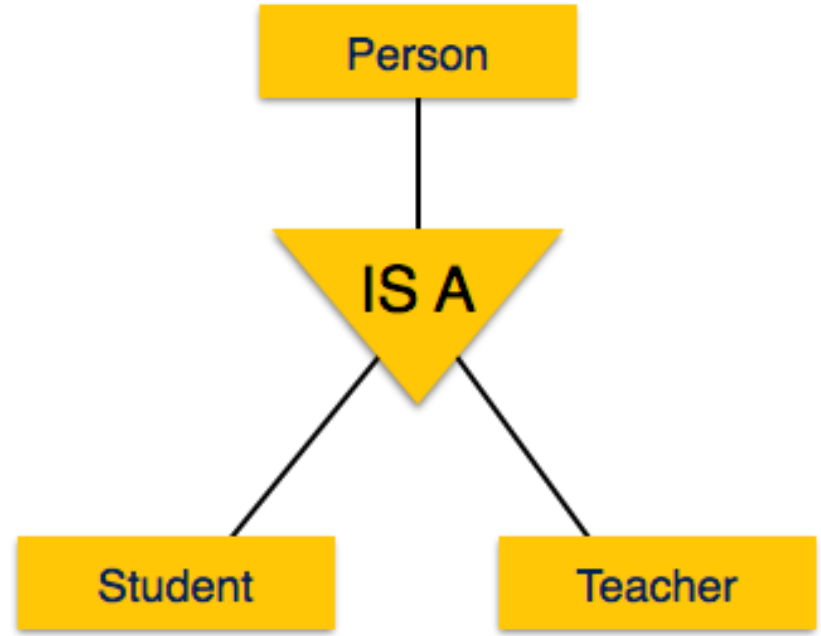
Generalization Aggregation

- In generalization, a number of entities are brought together into one generalized entity based on their similar characteristics. For an example, pigeon, house sparrow, crow and dove all can be generalized as Birds



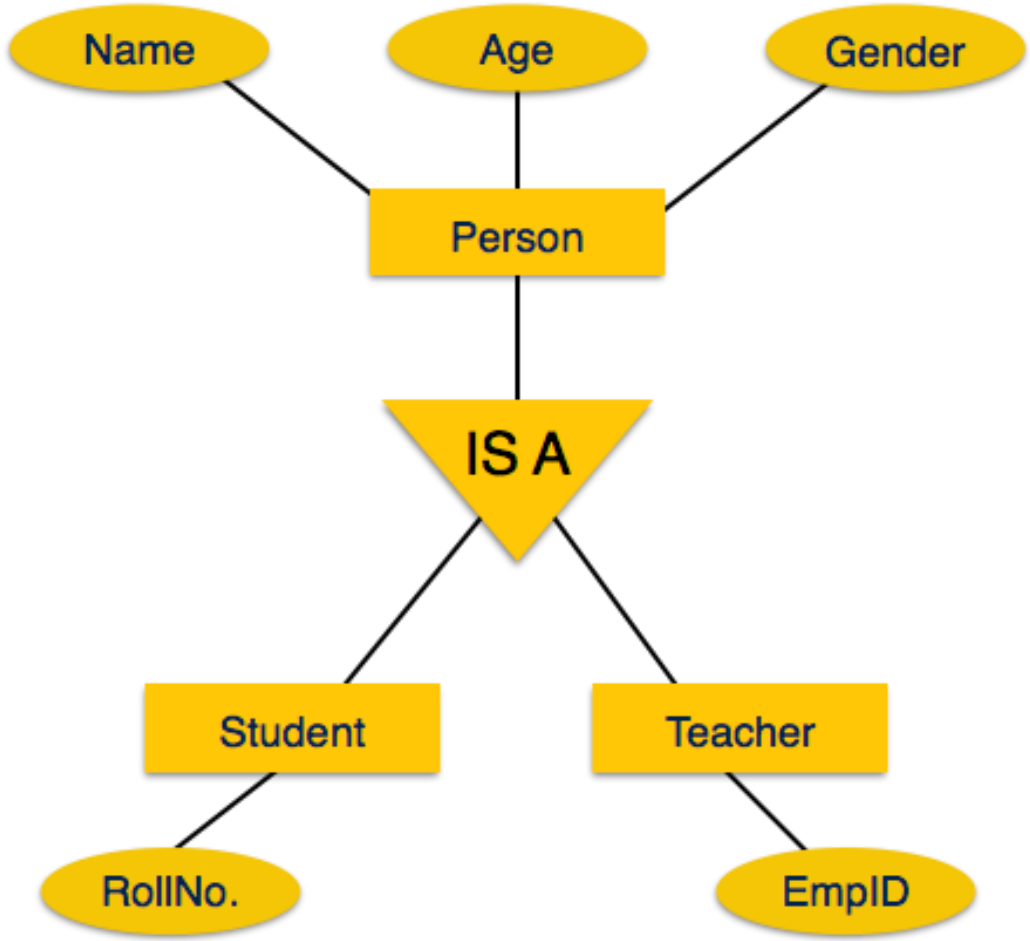
Specialization

- Specialization is a process, which is opposite to generalization, as mentioned above. In specialization, a group of entities is divided into sub-groups based on their characteristics.
- In a company, a person can be identified as employee, employer, customer or vendor based on what role do they play in company.



Inheritance

- The important features of Generalization and Specialization, is inheritance, that is, the attributes of higher-level entities are inherited by the lower level entities.

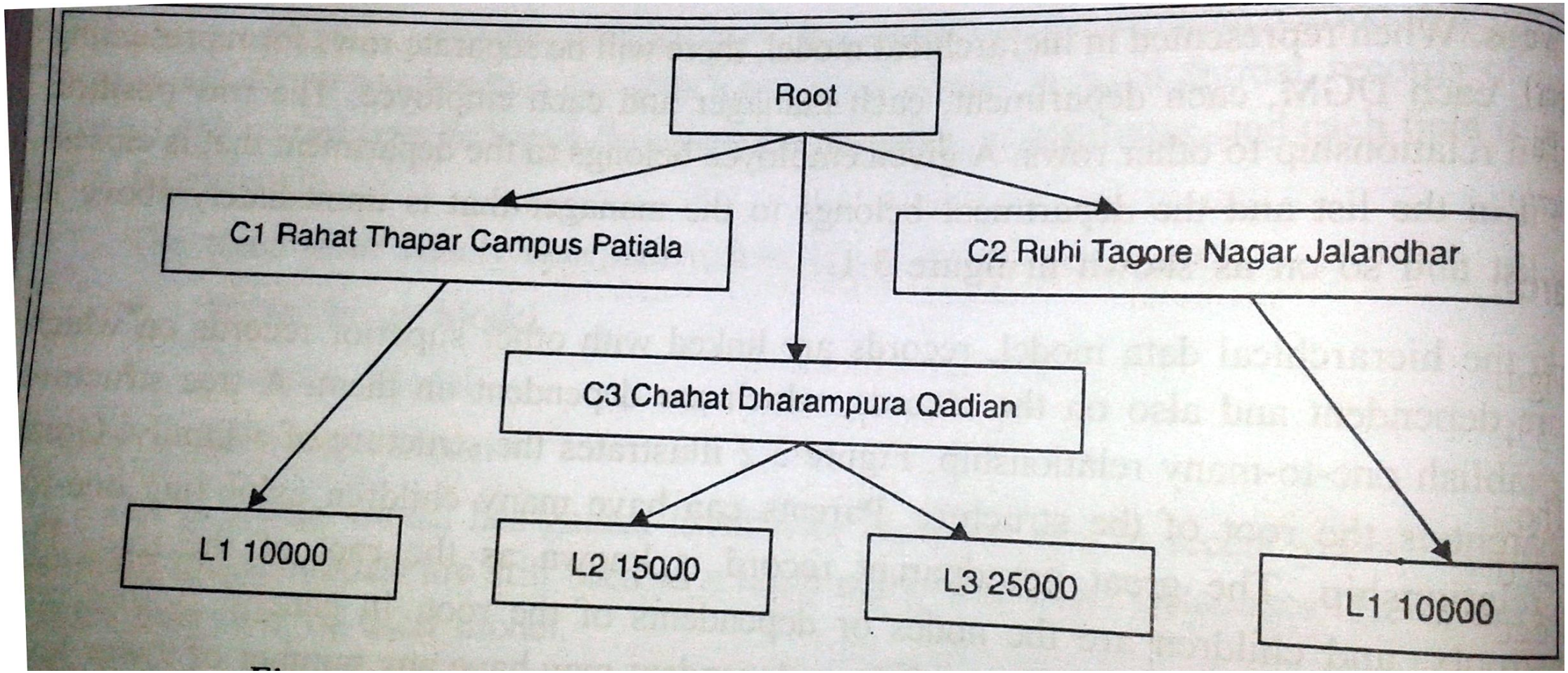


Hierarchical Model

- First hierarchical data model was designed by IBM and North American Rockwell in 1950.
- Records are arranged in tree like structure, and are linked with their superior records on which they are dependent and to them which are dependent on them.
- One to many relationship.

Operations on Hierarchical Model

- Insert
- Update
- Delete
- Retrieval of information

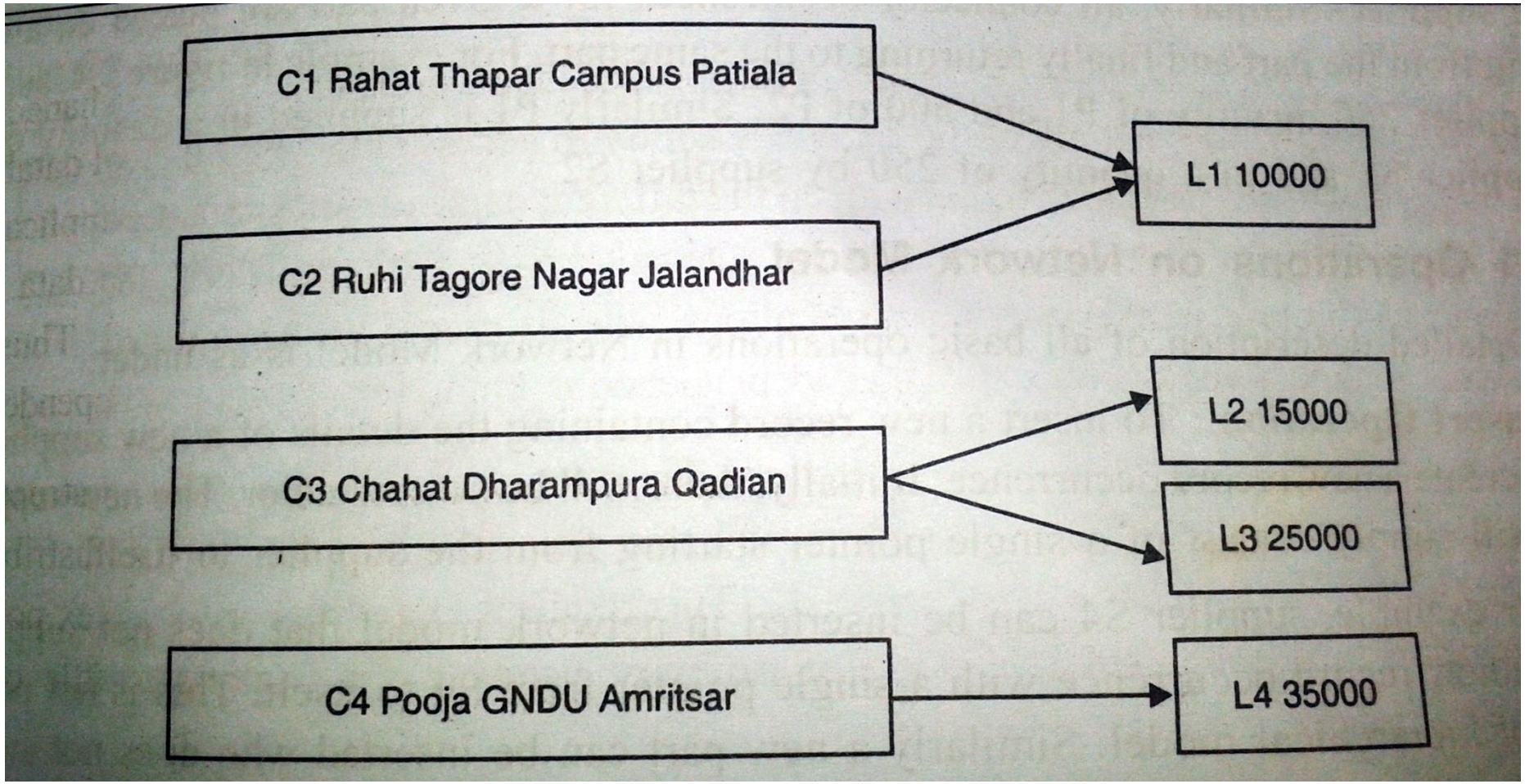

Root
C1 Rahat Thapar Campus Patiala
C2 Ruhi Tagore Nagar Jalandhar
C3 Chahat Dharampura Qadian
L1 10000
L2 15000
L3 25000
L1 10000

Advantages/ Disadvantages

- Advantages:
- Simplicity
- Data security
- Data integrity
- Efficiency
- Disadvantages
- Implementation complexity
- Database management problem
- Lack of structural independence

Network Model

- Network model replace the tree structure with graph.
- Advantages:
  - Conceptual simplicity
  - Capable to handle more relationship typed: 1:N,N:N
  - Data integrity
  - Data independence
- Database standards:
  - ANSI in 1970
- Disadvantages :
  - System complexity
  - Operational anomalies
  - Absence of structural independence


C1 Rahat Thapar Campus Patiala
C2 Ruhi Tagore Nagar Jalandhar
C3 Chahat Dharampura Qadian
C4 Pooja GNDU Amritsar
L1 10000
L2 15000
L3 25000
L4 35000