# <u>UNIT 3</u>

# Data Modeling using E.R. Model (Entity Relationship <u>Model)</u>

**Data models:** A Database model defines the logical design and structure of a database and defines how data will be stored, accessed and updated in a database management system. While the **Relational Model** is the most widely used database model, there are other models too:

- Hierarchical Model
- Network Model
- Entity-relationship Model
- Relational Model

#### 1. 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-tomany relationship between two different types of data, for example, one department can have many courses, many professors and of-course many students.



#### 2. 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 introduced.



- 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).

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.Relationships can also be of different types.



# 4. 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.



# **ER Model in DBMS**

Entity-relationship model is a model used for design and representation of relationships between data. The main data objects are termed as Entities, with their details defined as attributes, some of these attributes are important and are used to identity the entity, and different entities are related using relationships.

### Here are the geometric shapes and their meaning in an E-R Diagram

- **Rectangle**: Represents Entity sets.
- Ellipses: Attributes
- Diamonds: Relationship Set
- Lines: They link attributes to Entity Sets and Entity sets to Relationship Set
- **Double Ellipses:** Multivalued Attributes
- Dashed Ellipses: Derived Attributes
- **Double Rectangles**: Weak Entity Sets
- **Double Lines**: Total participation of an entity in a relationship set

In short, to understand about the ER Model, we must understand about:

- Entity and Entity Set
- What are Attributes? And Types of Attributes.
- Keys
- Relationships

Let's take an example, For a **School Management Software**, we will have to store **Student** information, **Teacher** information, **Classes**, **Subjects** taught in each class etc.

### **1. Entity and Entity Set:**

- An **Entity** is generally a real-world object which has characteristics and holds relationships in a DBMS.
- An entity set is a set of entities of the same type



• Considering the above example, **Student** is an entity, **Teacher** is an entity, similarly, **Class**, **Subject** etc are also entities.

If a Student is an Entity, then the complete dataset of all the students will be the **Entity Set** 

• Weak Entity: Weak entity is an entity that depends on another entity. Weak entity doesn't have any key attribute of its own. Double rectangle is used to represent a weak entity. For example – a bank account cannot be uniquely identified without knowing the bank to which the account belongs, so bank account is a weak entity.



2. Attributes: The attribute is used to describe the property of an entity. Eclipse is used to represent an attribute. If a Student is an Entity, then student's roll no., student's name, student's age, student's gender etc will be its attributes.



An attribute can be of many types, here are different types of attributes defined in ER database model:

- a. **Simple attribute:** The attributes with values that are atomic and cannot be broken down further are simple attributes. For example, student's **age**.
- b. **Composite attribute:** A composite attribute is made up of more than one simple attribute. For example, student's **address** will contain, **house no.**, **street name**, **pincode** etc. The composite attribute is represented by an ellipse, and those ellipses are connected with an ellipse.



c. **Derived attribute:** These are the attributes which are not present in the whole database management system, but are derived using other attributes. For example, *average age of students in a class*.



d. **Multivalued Attribute**: An attribute can have more than one value. These attributes are known as a multivalued attribute. The double oval is used to represent multivalued attribute. **For example,** a student can have more than one phone number.



**3. Keys:** The key attribute is used to represent the main characteristics of an entity. It represents a primary key. The key attribute is represented by an ellipse with the text underlined.

If the attribute **roll no.** can uniquely identify a student entity, amongst all the students, then the attribute **roll no.** will be said to be a key.



Following are the types of Keys:

- a. Super Key
- b. Candidate Key
- c. Primary Key:
- **4. Relationships:** A relationship is used to describe the relation between entities. Diamond or rhombus is used to represent the relationship.



- When an Entity is related to another Entity, they are said to have a relationship. For example, A **Class** Entity is related to **Student** entity, because students study in classes, hence this is a relationship.
- Depending upon the number of entities involved, a **degree** is assigned to relationships.
- For example, if 2 entities are involved, it is said to be **Binary relationship**, if 3 entities are involved, it is said to be **Ternary** relationship, and so on.

# **Types of relationship are as follows:**

a. One-to-One Relationship: When only one instance of an entity is associated with the relationship, then it is known as one to one relationship.
For example, A student can enroll to one course.



**b. One-to-many relationship:**When only one instance of the entity on the left, and more than one instance of an entity on the right associates with the relationship then this is known as a one-to-many relationship.

For example, Scientist can invent many inventions, but the invention is done by the only specific scientist.



**c.** Many-to-one relationship: When more than one instance of the entity on the left, and only one instance of an entity on the right associates with the relationship then it is known as a many-to-one relationship.

For example, a course can have many students.



**d.** Many-to-many relationship: When more than one instance of the entity on the left, and more than one instance of an entity on the right associates with the relationship then it is known as a many-to-many relationship.

**For example,** Employee can assign by many projects and project can have many employees.



**Total Participation of an Entity set:** A Total participation of an entity set represents that each entity in entity set must have at least one relationship in a relationship set.

For example: In the below diagram each college must have at-least one associated Student.



E-R Digram with total participation of College entity set in StudyIn relationship Set - This indicates that each college must have atleast one associated Student.