DATA BASE MANAGEMENT SYSTEM

ER Diagrams:

- ER diagram or Entity Relationship diagram is a conceptual model that gives the graphical representation of the logical structure of the database.
- It shows all the constraints and relationships that exist among the different components.

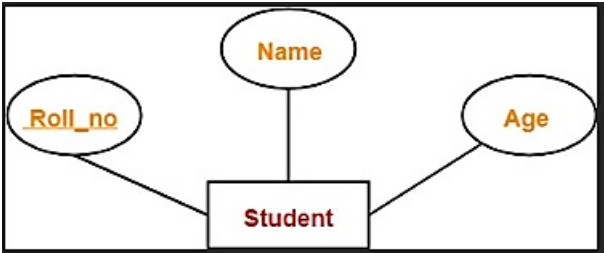**Components of ER diagram:** An ER diagram is mainly composed of following three components-

1. Entity Sets
2. Attributes
3. Relationship Set

Example: Consider the following Student table-

Roll_no	Name	Age
1	Akshay	20
2	Rahul	19
3	Pooja	20
4	Aarti	19

This complete table is referred to as "Student Entity Set" and each row represents an "entity".

Representation as ER Diagram: The above table may be represented as ER diagram as-

Here,

- Roll_no is a primary key that can identify each entity uniquely.
- Thus, by using student's roll number, a student can be identified uniquely.

ER Diagram Symbols: An ER diagram is composed of several components and each component in ER diagram is represented using a specific symbol.

ER diagram symbols are discussed below-

1. For Entity Sets-

An entity set is a set of same type of entities.

An entity refers to any object having-

- Either a physical existence such as a particular person, office, house or car.
- Or a conceptual existence such as a school or a company.

In ER diagram,

- Attributes are associated with an entity set.
- Attributes describe the properties of entities in the entity set.
- Based on the values of certain attributes, an entity can be identified uniquely.

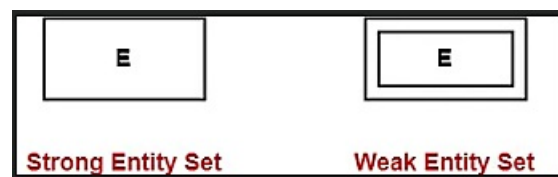An entity set may be of the following two types-
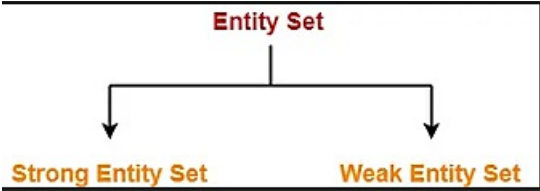
1. Strong entity set
2. Weak entity set

1. Strong Entity Set-

- A strong entity set possess its own primary key.
- It is represented using a single rectangle.
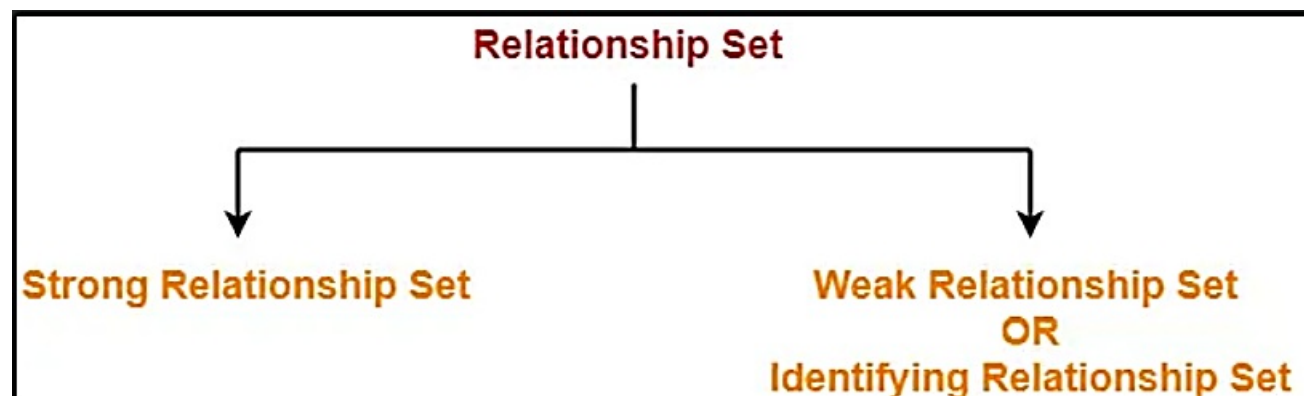
2. Weak Entity Set-

- A weak entity set do not possess its own primary key.
- It is represented using a double rectangle.

2. For Relationship Sets-

- Relationship defines an association among several entities.
- A relationship set is a set of same type of relationships.

A relationship set may be of the following two types-

1. Strong relationship set
2. Weak relationship set

1. Strong Relationship Set-

- A strong relationship exists between two strong entity sets.
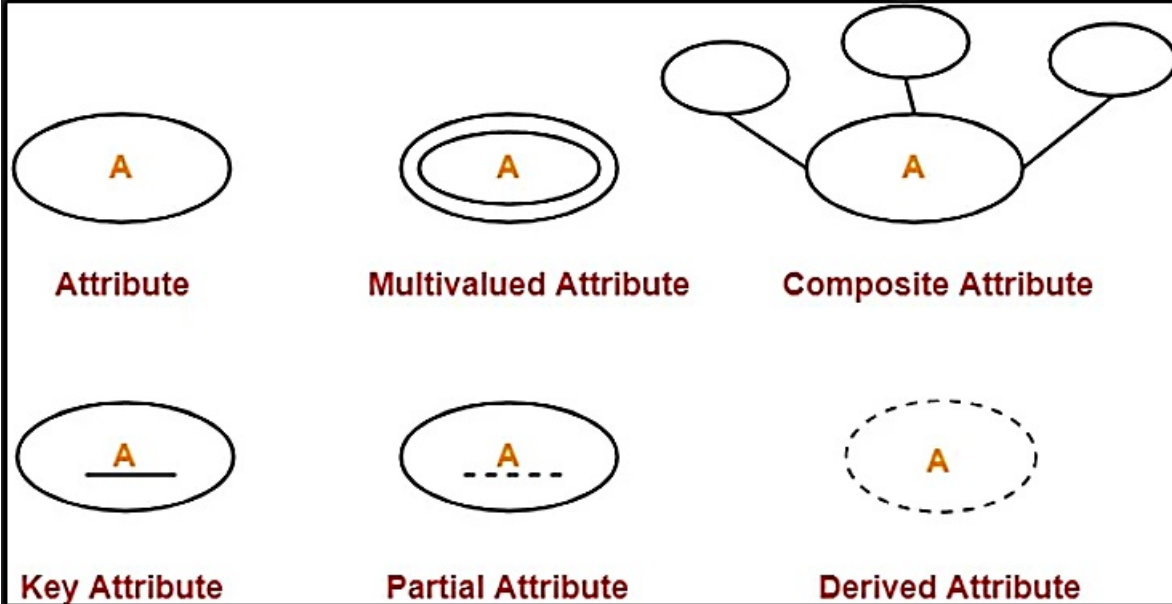- It is represented using a diamond symbol.

2. Weak Relationship Set-

- A weak or identifying relationship exists between the strong and weak entity set.
- It is represented using a double diamond symbol.
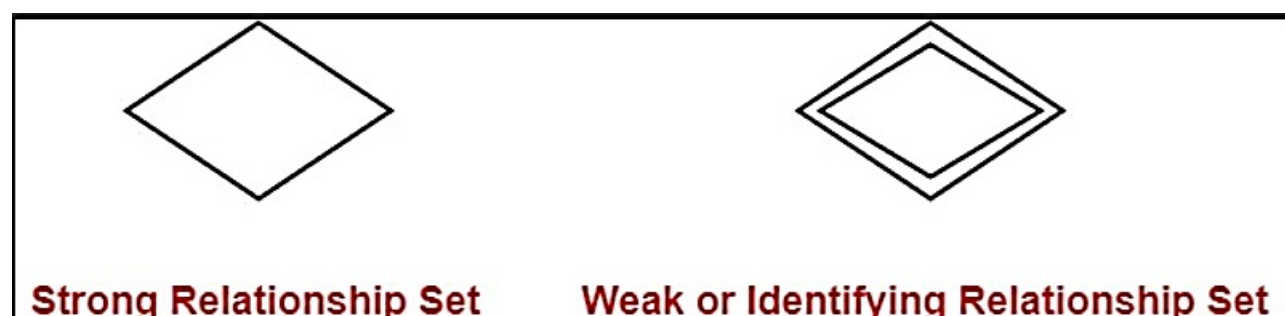
3. For Attributes-

- Attributes are the properties which describes the entities of an entity set.
- There are several types of attributes.

4. For Participation Constraints- Participation constraint defines the least number of relationship instances in which an entity has to necessarily participate.

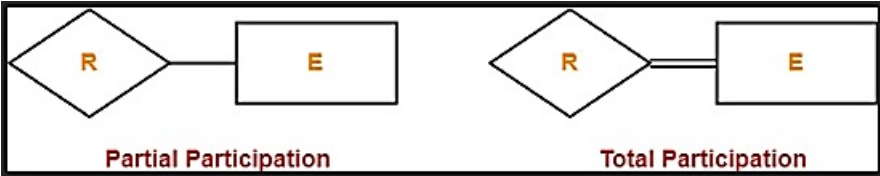There are two types of participation constraints-

1. Partial participation
2. Total participation

1. Partial Participation-

Partial participation is represented using a single line between the entity set and relationship set.

2. Total Participation-

Total participation is represented using a double line between the entity set and relationship set.


5. For Specialization and Generalization-

- Generalization is a process of forming a generalized super class by extracting the common characteristics from two or more classes.
- Specialization is a reverse process of generalization where a super class is divided into sub classes by assigning the specific characteristics of sub classes to them.
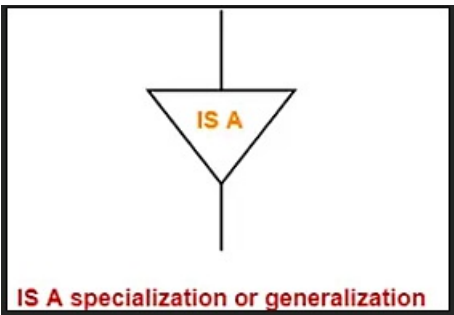
6. For Cardinality Constraints / Ratios- Cardinality constraint defines the maximum number of relationship instances in which an entity can participate.

There are 4 types of cardinality ratios-

1. Many-to-many cardinality (m:n)
2. Many-to-one cardinality (m:1)
3. One-to-many cardinality (1:n)
4. One-to-one cardinality (1:1)
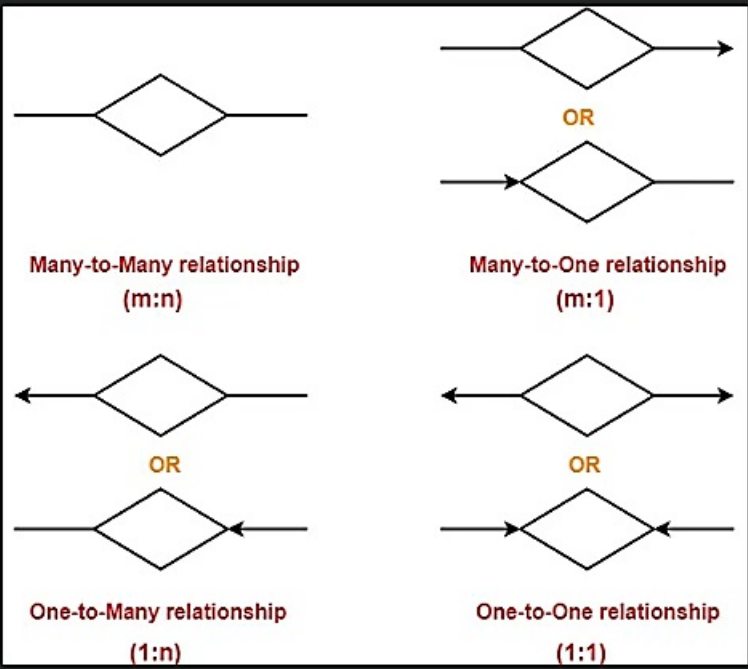
Entity Sets in DBMS | Strong and Weak entity set

An entity set is a set of same type of entities.

An entity refers to any object having-

- Either a physical existence such as a particular person, office, house or car.
- Or a conceptual existence such as a school or a company.

In ER diagram,

- Attributes are associated with an entity set.
- Attributes describe the properties of entities in the entity set.
- Based on the values of certain attributes, an entity can be identified uniquely.

An entity set may be of the following two types-
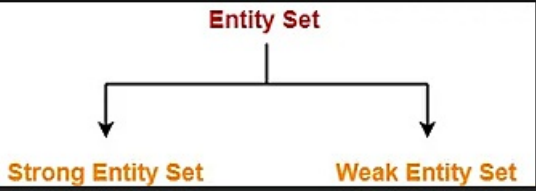
1. Strong entity set
2. Weak entity set
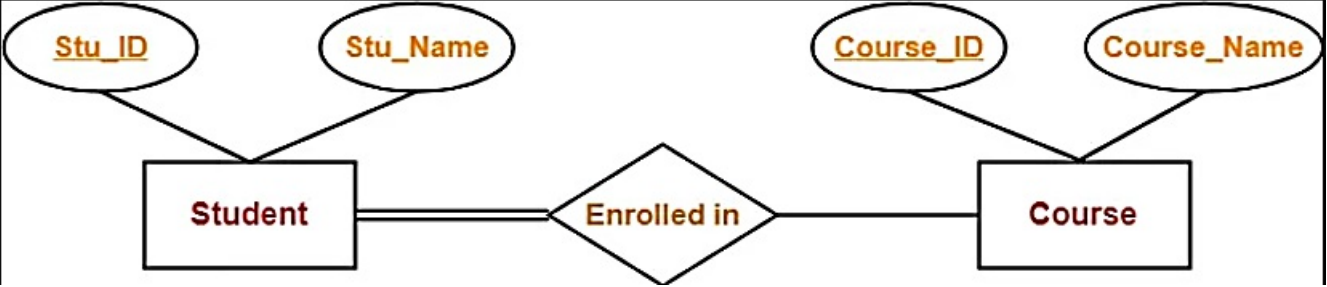
1. Strong Entity Set-

- A strong entity set is an entity set that contains sufficient attributes to uniquely identify all its entities.
- In other words, a primary key exists for a strong entity set.
- Primary key of a strong entity set is represented by underlining it.

Symbols Used-

- A single rectangle is used for representing a strong entity set.
- A diamond symbol is used for representing the relationship that exists between two strong entity sets.
- A single line is used for representing the connection of the strong entity set with the relationship set.
- A double line is used for representing the total participation of an entity set with the relationship set.
- Total participation may or may not exist in the relationship.

Example-

Consider the following ER diagram-

In this ER diagram,

- Two strong entity sets "Student" and "Course" are related to each other.
- Student ID and Student name are the attributes of entity set "Student".
- Student ID is the primary key using which any student can be identified uniquely.
- Course ID and Course name are the attributes of entity set "Course".
- Course ID is the primary key using which any course can be identified uniquely.
- Double line between Student and relationship set signifies total participation.
- It suggests that each student must be enrolled in at least one course.
- Single line between Course and relationship set signifies partial participation.
- It suggests that there might exist some courses for which no enrollments are made.

2. Weak Entity Set-

- A weak entity set is an entity set that does not contain sufficient attributes to uniquely identify its entities.
- In other words, a primary key does not exist for a weak entity set.
- However, it contains a partial key called as a discriminator.
- Discriminator can identify a group of entities from the entity set.
- Discriminator is represented by underlining with a dashed line.

NOTE-

- The combination of discriminator and primary key of the strong entity set makes it possible to uniquely identify all entities of the weak entity set.
- Thus, this combination serves as a primary key for the weak entity set.
- Clearly, this primary key is not formed by the weak entity set completely.

Symbols Used:

- A double rectangle is used for representing a weak entity set.
- A double diamond symbol is used for representing the relationship that exists between the strong and weak entity sets and this relationship is known as identifying relationship.
- A double line is used for representing the connection of the weak entity set with the relationship set.
- Total participation always exists in the identifying relationship.

Example-

Consider the following ER diagram-
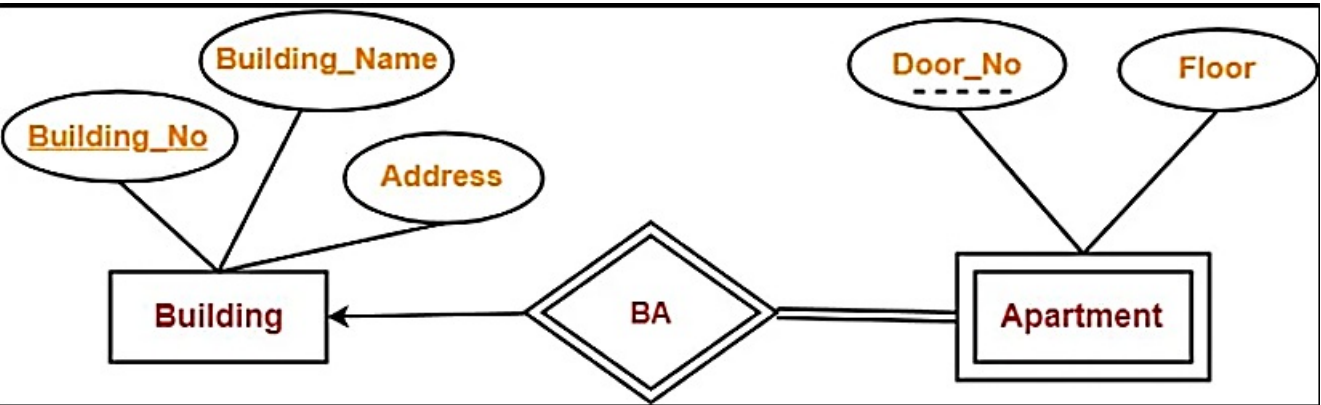
In this ER diagram,

- One strong entity set "Building" and one weak entity set "Apartment" are related to each other.
- Strong entity set "Building" has building number as its primary key.

- Door number is the discriminator of the weak entity set "Apartment".
- This is because door number alone can not identify an apartment uniquely as there may be several other buildings having the same door number.
- Double line between Apartment and relationship set signifies total participation.
- It suggests that each apartment must be present in at least one building.
- Single line between Building and relationship set signifies partial participation.
- It suggests that there might exist some buildings which has no apartment.

To uniquely identify any apartment,

- First, building number is required to identify the particular building.
- Secondly, door number of the apartment is required to uniquely identify the apartment.

Thus,

Primary key of Apartment

= Primary key of Building + Its own discriminator

= Building number + Door number

Differences between Strong entity set and Weak entity set-

| Strong entity set	Weak entity set
A single rectangle is used for the representation of a strong entity set.	A double rectangle is used for the representation of a weak entity set.
It contains sufficient attributes to form its primary key.	It does not contain sufficient attributes to form its primary key.
A diamond symbol is used for the representation of the relationship that exists between the two strong entity sets.	A double diamond symbol is used for the representation of the identifying relationship that exists between the strong and weak entity set.
A single line is used for the representation of the connection between the strong entity set and the relationship.	A double line is used for the representation of the connection between the weak entity set and the relationship set.
Total participation may or may not exist in the relationship.	Total participation always exists in the identifying relationship.

Important Note-

In ER diagram, weak entity set is always present in total participation with the identifying relationship set.

So, we always have the picture like shown here-
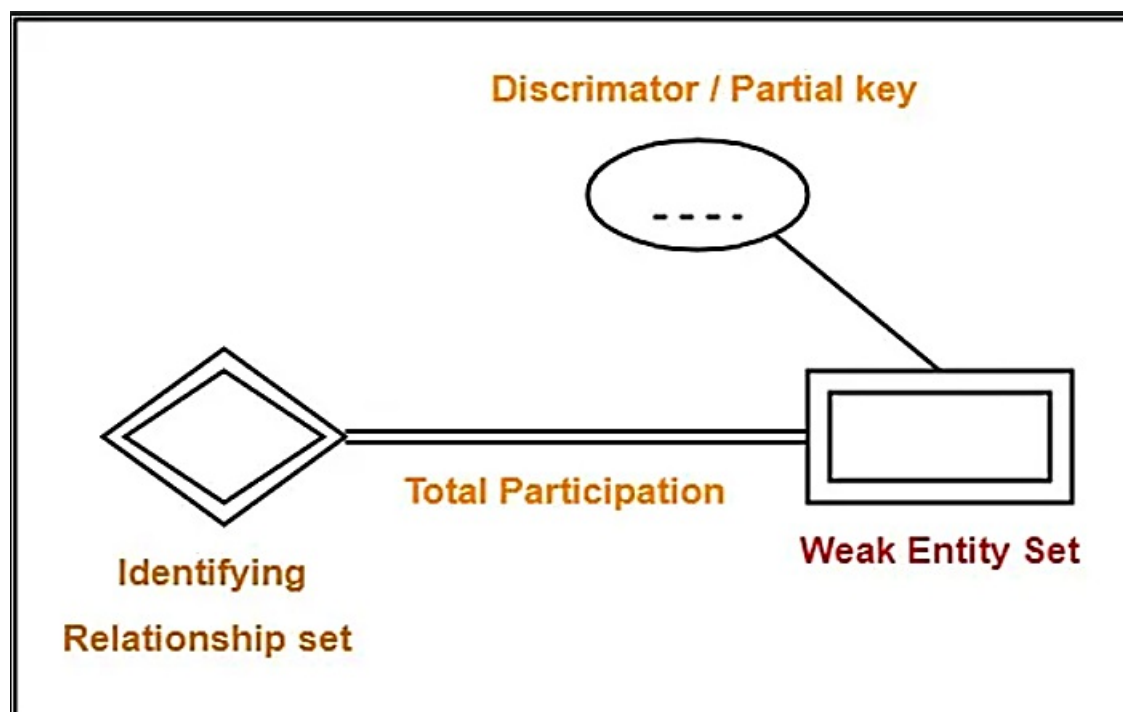
Relationship in DBMS

A relationship is defined as an association among several entities.

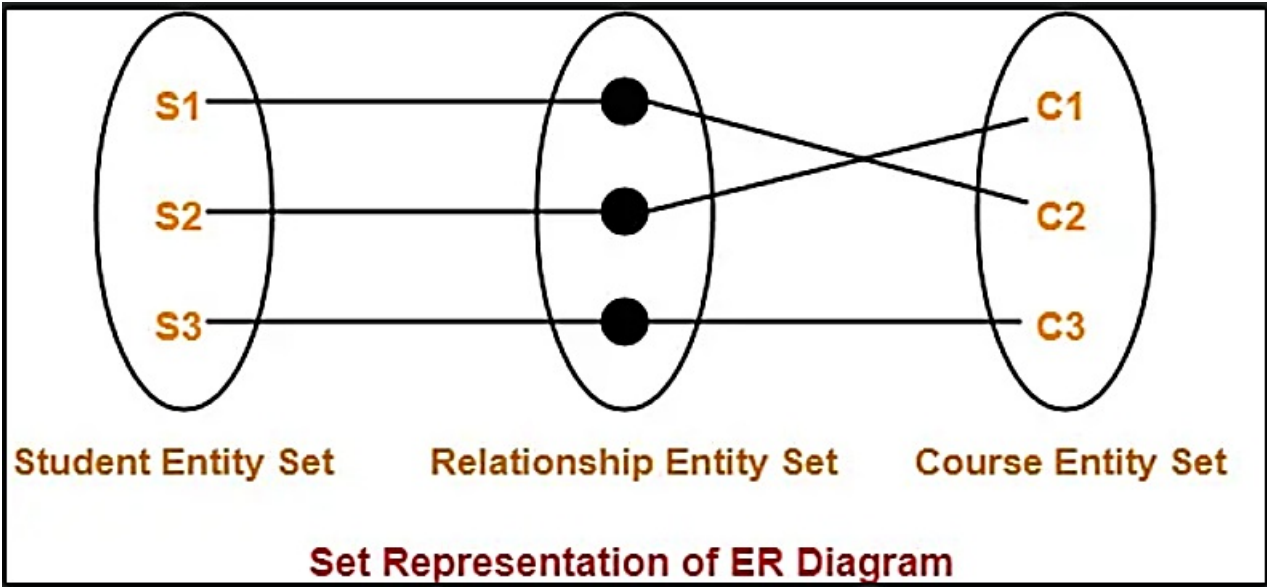Example: 'Enrolled in' is a relationship that exists between entities Student and Course.

Relationship Set-

A relationship set is a set of relationships of same type.

Example-

Set representation of above ER diagram is-

Set Representation of ER Diagram

Degree of a Relationship Set-

The number of entity sets that participate in a relationship set is termed as the degree of that relationship set. Thus,

Degree of a relationship set = Number of entity sets participating in a relationship set

Types of Relationship Sets-

On the basis of degree of a relationship set, a relationship set can be classified into the following types-
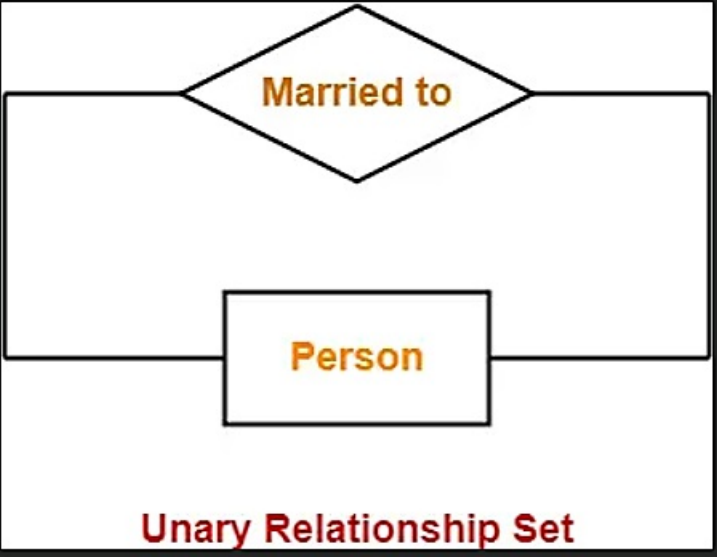
1. Unary relationship set
2. Binary relationship set
3. Ternary relationship set
4. N-ary relationship set

1. Unary Relationship Set

Unary relationship set is a relationship set where only one entity set participates in a relationship set.

Example-

One person is married to only one person
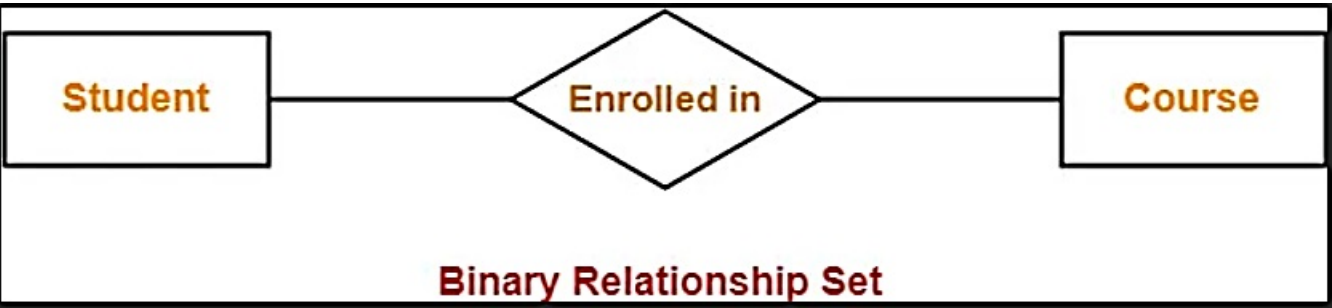
Unary Relationship Set

2. Binary Relationship Set-

Binary relationship set is a relationship set where two entity sets participate in a relationship set.
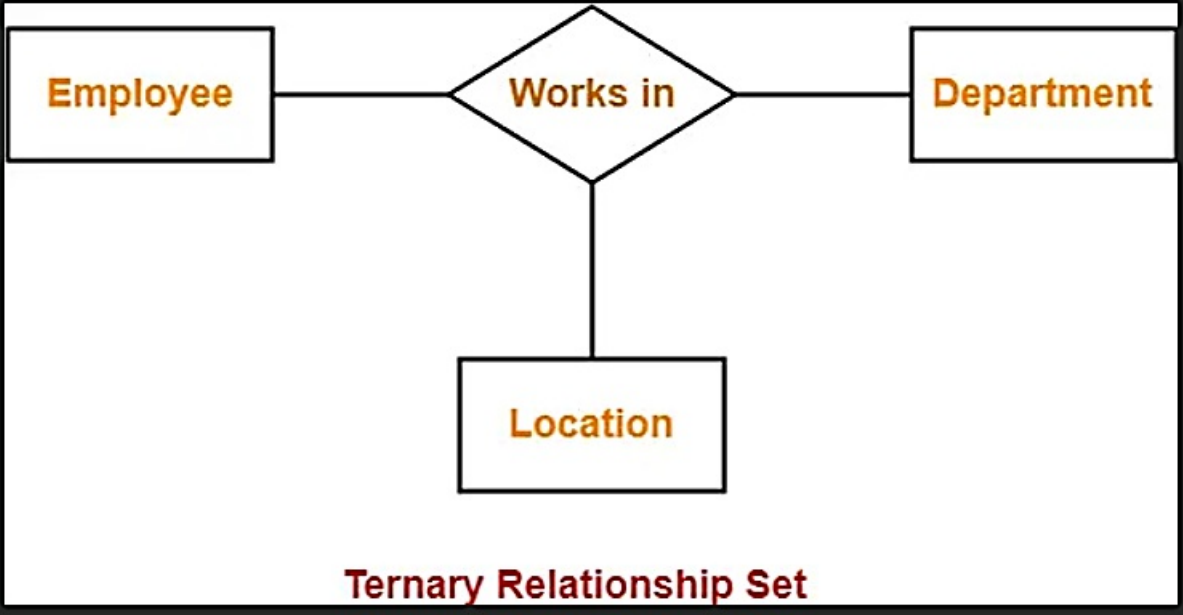
Example-

Student is enrolled in a Course

Binary Relationship Set

3. Ternary Relationship Set-

Ternary relationship set is a relationship set where three entity sets participate in a relationship set.

Example-

Ternary Relationship Set

4. N-ary Relationship Set-

N-ary relationship set is a relationship set where 'n' entity sets participate in a relationship set.

Cardinality in ER Diagram | DBMS

Cardinality Constraint- Cardinality constraint defines the maximum number of relationship instances in which an entity can participate.

Types of Cardinality Ratios-

There are 4 types of cardinality ratios-

1. Many-to-Many cardinality (m:n)
2. Many-to-One cardinality (m:1)
3. One-to-Many cardinality (1:n)
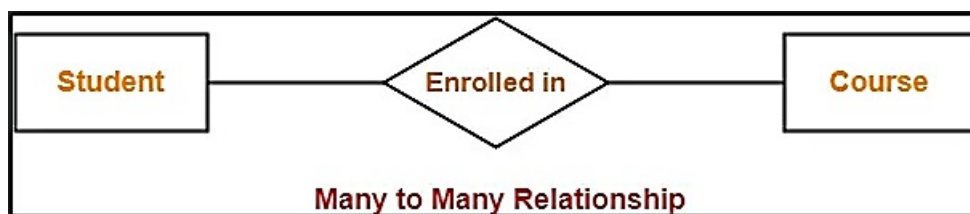4. One-to-One cardinality (1:1)

1. Many-to-Many Cardinality-

By this cardinality constraint,

- An entity in set A can be associated with any number (zero or more) of entities in set B.
- An entity in set B can be associated with any number (zero or more) of entities in set A.

Symbol Used-

Cardinality Ratio = m : n

Example-

Many to Many Relationship
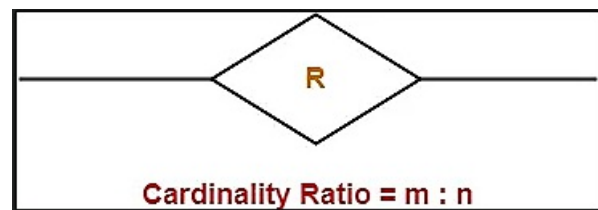
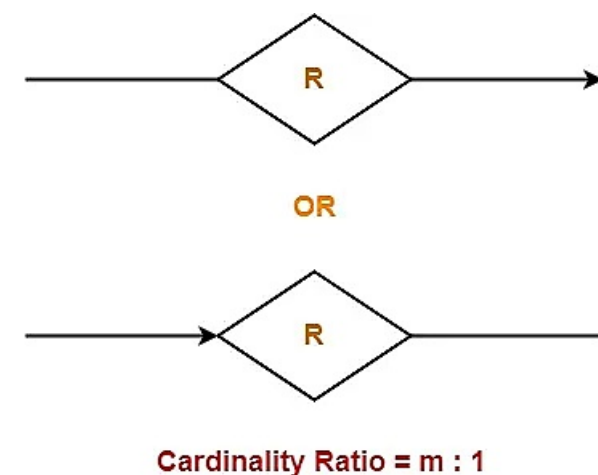Consider the following ER diagram-

Here,

- One student can enroll in any number (zero or more) of courses.
- One course can be enrolled by any number (zero or more) of students.

2. Many-to-One Cardinality-

By this cardinality constraint,

- An entity in set A can be associated with at most one entity in set B.
- An entity in set B can be associated with any number (zero or more) of entities in set A.

Symbol Used-

OR

Cardinality Ratio = m : 1

Example-

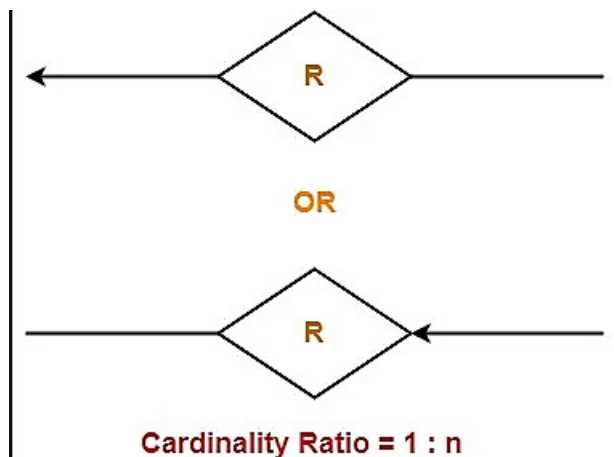Consider the following ER diagram-

Many to One Relationship

Here,

- One student can enroll in at most one course.
- One course can be enrolled by any number (zero or more) of students.

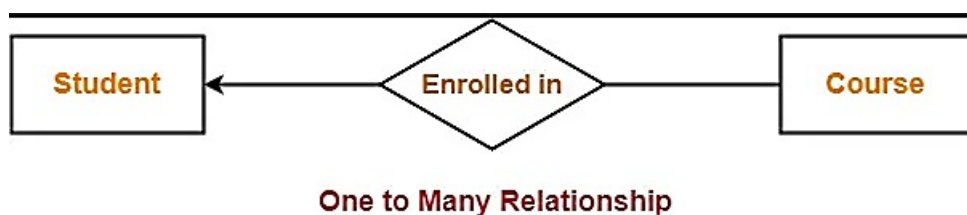## 3. One-to-Many Cardinality-

By this cardinality constraint,

- An entity in set A can be associated with any number (zero or more) of entities in set B.
- An entity in set B can be associated with at most one entity in set A.

Symbol Used-

Cardinality Ratio = 1 : n

Example-

Consider the following ER diagram-
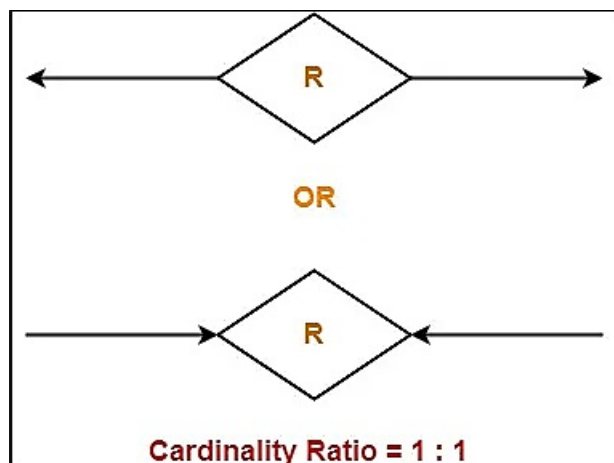

One to Many Relationship

Here,

- One student can enroll in any number (zero or more) of courses.
- One course can be enrolled by at most one student.

4. One-to-One Cardinality-

By this cardinality constraint,

- An entity in set A can be associated with at most one entity in set B.
- An entity in set B can be associated with at most one entity in set A.

Symbol Used-

Cardinality Ratio = 1 : 1

Example-

Consider the following ER diagram-

One to One Relationship

Here,

- One student can enroll in at most one course.
- One course can be enrolled by at most one student.

Participation Constraints

Participation constraints define the least number of relationship instances in which an entity must compulsorily participate.
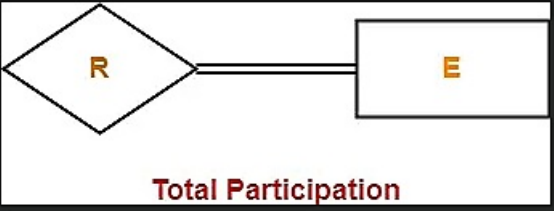
Types of Participation Constraints-

There are two types of participation constraints-

1. Total participation
2. Partial participation

1. Total Participation-

- It specifies that each entity in the entity set must compulsorily participate in at least one relationship instance in that relationship set.
- That is why, it is also called as mandatory participation.
- Total participation is represented using a double line between the entity set and relationship set.
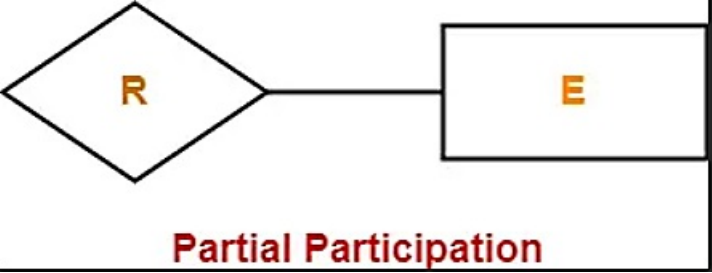

Total Participation

Example-

Here,

- Double line between the entity set "Student" and relationship set "Enrolled in" signifies total participation.
- It specifies that each student must be enrolled in at least one course.

2. Partial Participation-

- It specifies that each entity in the entity set may or may not participate in the relationship instance in that relationship set.
- That is why, it is also called as optional participation.
- Partial participation is represented using a single line between the entity set and relationship set.

Partial Participation

Example-

Here,

- Single line between the entity set "Course" and relationship set "Enrolled in" signifies partial participation.
- It specifies that there might exist some courses for which no enrollments are made.

Relationship between Cardinality and Participation Constraints-

Minimum cardinality tells whether the participation is partial or total.

- If minimum cardinality = 0, then it signifies partial participation.
- If minimum cardinality = 1, then it signifies total participation.

Maximum cardinality tells the maximum number of entities that participates in a relationship set.

Attributes in ER Diagram

- Attributes are the descriptive properties which are owned by each entity of an Entity Set.
- There exist a specific domain or set of values for each attribute from where the attribute can take its values.
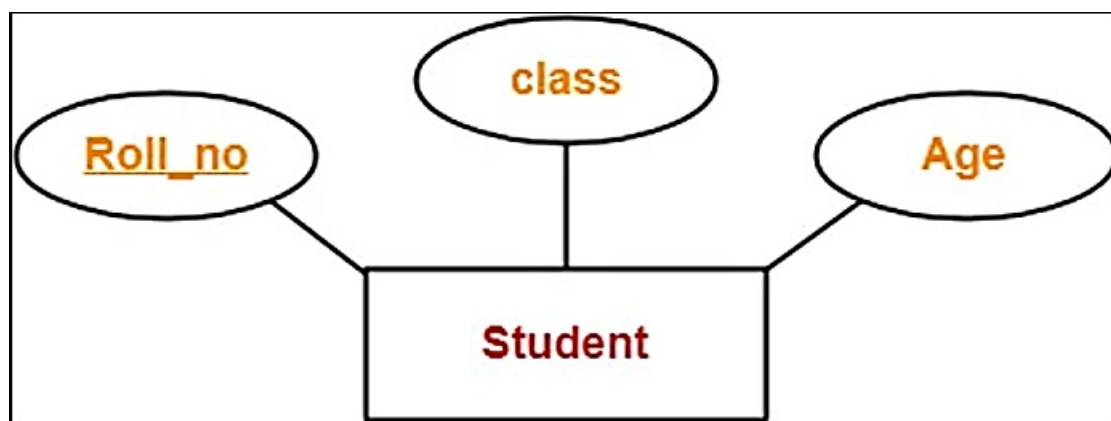
Types of Attributes-

In ER diagram, attributes associated with an entity set may be of the following types-

1. Simple attributes
2. Composite attributes
3. Single valued attributes
4. Multi valued attributes
5. Derived attributes
6. Key attributes

1. Simple Attributes-

Simple attributes are those attributes which can not be divided further.
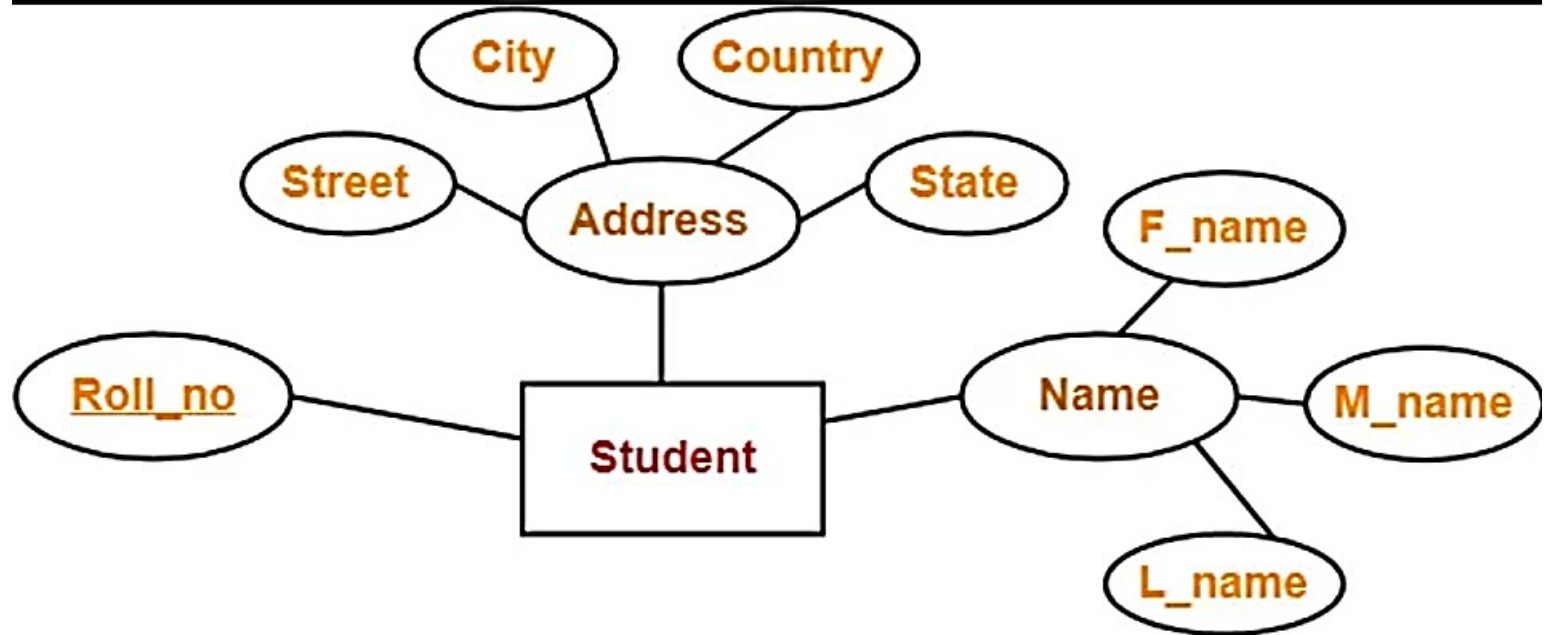
Example-

Here, all the attributes are simple attributes as they can not be divided further.

2. Composite Attributes-

Composite attributes are those attributes which are composed of many other simple attributes.
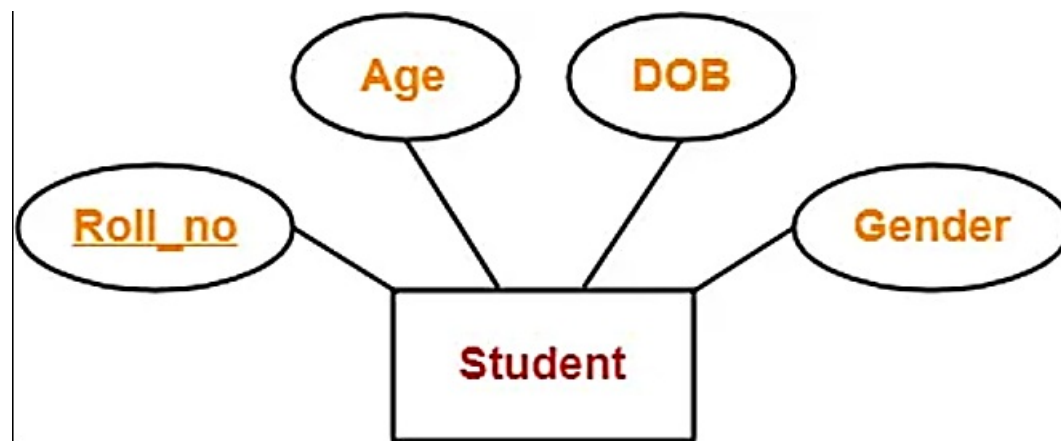
Example-

Here, the attributes "Name" and "Address" are composite attributes as they are composed of many other simple attributes.

3. Single Valued Attributes-

Single valued attributes are those attributes which can take only one value for a given entity from an entity set.
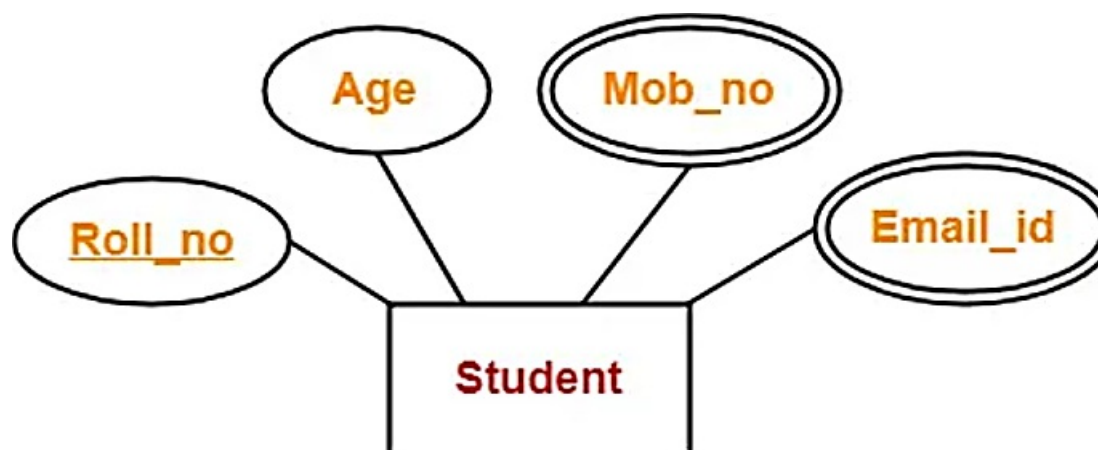
Example-

Here, all the attributes are single valued attributes as they can take only one specific value for each entity.

4. Multi Valued Attributes-

Multi valued attributes are those attributes which can take more than one value for a given entity from an entity set.
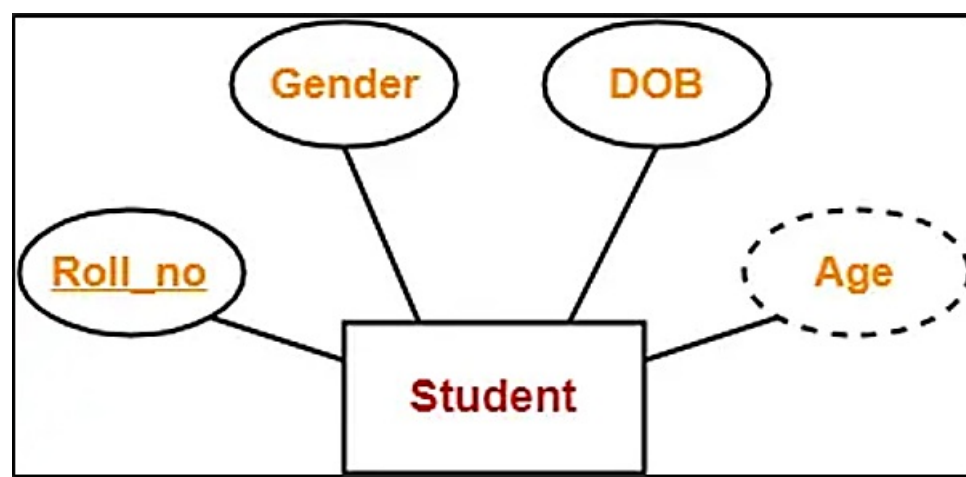
Example-

Here, the attributes "Mob_no" and "Email_id" are multi valued attributes as they can take more than one values for a given entity.

5. Derived Attributes-

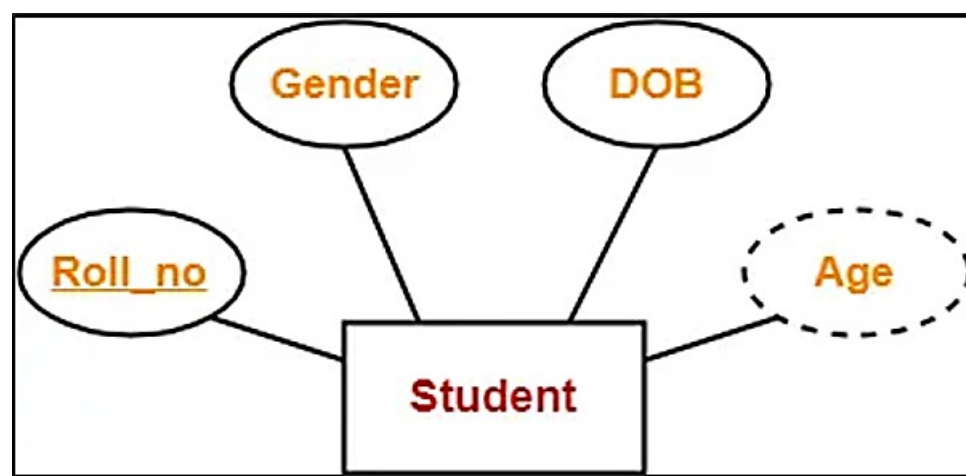Derived attributes are those attributes which can be derived from other attribute(s).

Example-

Here, the attribute "Age" is a derived attribute as it can be derived from the attribute "DOB".

6. Key Attributes-

Key attributes are those attributes which can identify an entity uniquely in an entity set.

Example-

Here, the attribute "Roll_no" is a key attribute as it can identify any student uniquely.