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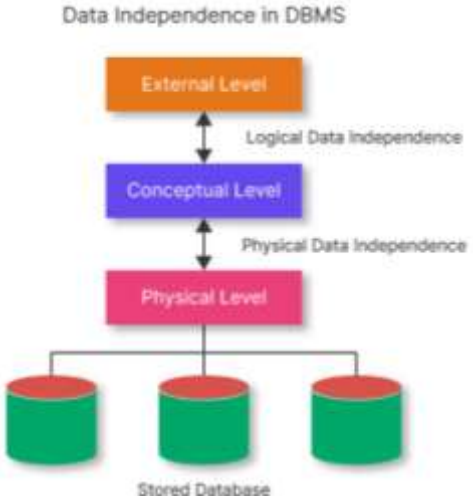
Department of MCA

DBMS ER Model

Course Name : 23CAT603 - DATA BASE MANAGEMENT SYSTEM

Class : I Year / II Semester

Unit I – ER Model



ER Model

- ER model stands for an Entity-Relationship model.
- It is a high-level data model.
- The Entity Relationship model was proposed by Peter Chen in 1976.
- ER model is a logical representation of an enterprise data.
- ER model is a diagrammatic representation of logical structure of database.
- E-R model describes relationship among entities and attributes.

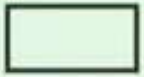
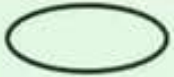
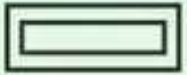
ER Model

- Entity Relationship Diagrams are the best tools to communicate within the entire system.
- These diagrams are the graphical representation of the flow of data and information.
- These diagrams are most commonly used in business organizations to make data travel easy.
- This conceptual database model is an effective way of communicating with the individuals at all the levels.
- The most common use of this diagram is to present the relation of the various tables present in a database.

Symbols Used in ER Model

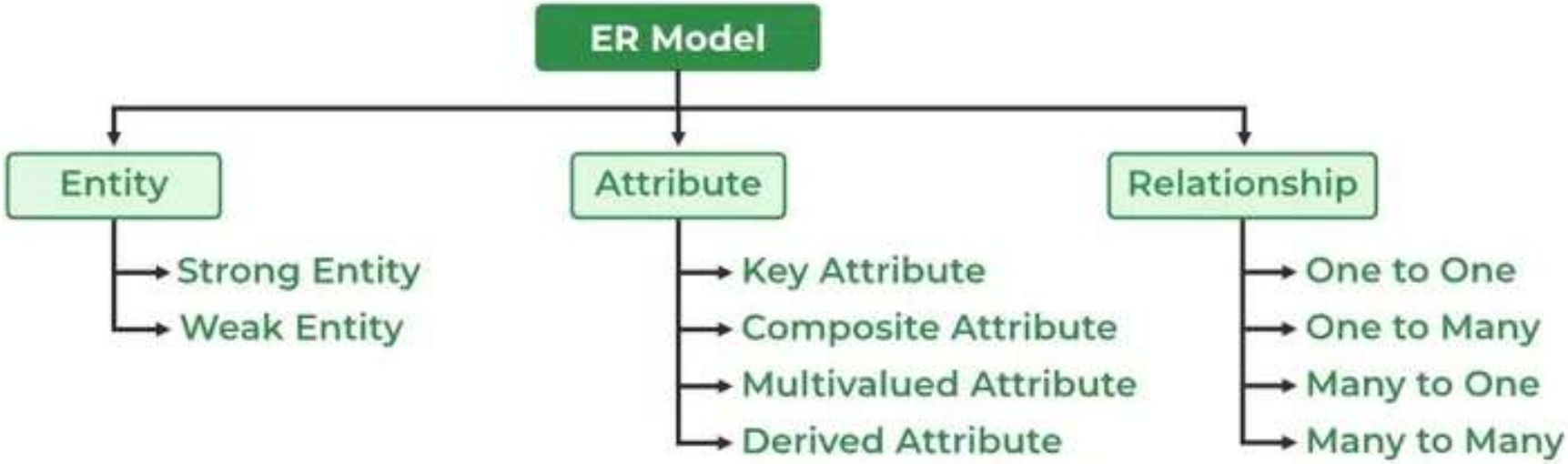
- ER Model is used to model the logical view of the system from a data perspective which consists of these symbols:
- **Rectangles:** Rectangles represent Entities in the ER Model.
- **Ellipses:** Ellipses represent Attributes in the ER Model.
- **Diamond:** Diamonds represent Relationships among Entities.
- **Lines:** Lines represent attributes to entities and entity sets with other relationship types.
- **Double Ellipse:** Double Ellipses represent Multi-Valued Attributes.
- **Double Rectangle:** Double Rectangle represents a Weak Entity.

Symbols Used in ER Model

Figures	Symbols	Represents
Rectangle		Entities in ER Model
Ellipse		Attributes in ER Model
Diamond		Relationships among Entities
Line		Attributes to Entities and Entity Sets with Other Relationship Types
Double Ellipse		Multi-Valued Attributes
Double Rectangle		Weak Entity

Components of ER Diagram

ER Model consists of Entities, Attributes, and Relationships among Entities in a Database System.



Components of ER Diagram

What is Entity?

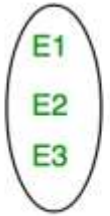
An Entity may be an object with a physical existence – a particular person, car, house, or employee – or it may be an object with a conceptual existence – a company, a job, or a university course.

What is Entity Set?

An Entity is an object of Entity Type and a set of all entities is called an entity set. For Example, E1 is an entity having Entity Type Student and the set of all students is called Entity Set. In ER diagram, Entity Type is represented as:

Entity Type

We can represent the entity set in ER Diagram but can't represent entity in ER Diagram because entity is row and column in the relation and ER Diagram is graphical representation of data.



Entity Set

Components of ER Diagram

Types of Entity

There are two types of entity:

1. Strong Entity

A Strong Entity is a type of entity that has a key Attribute. Strong Entity does not depend on other Entity in the Schema. It has a primary key, that helps in identifying it uniquely, and it is represented by a rectangle. These are called Strong Entity Types.

Components of ER Diagram

2. Weak Entity

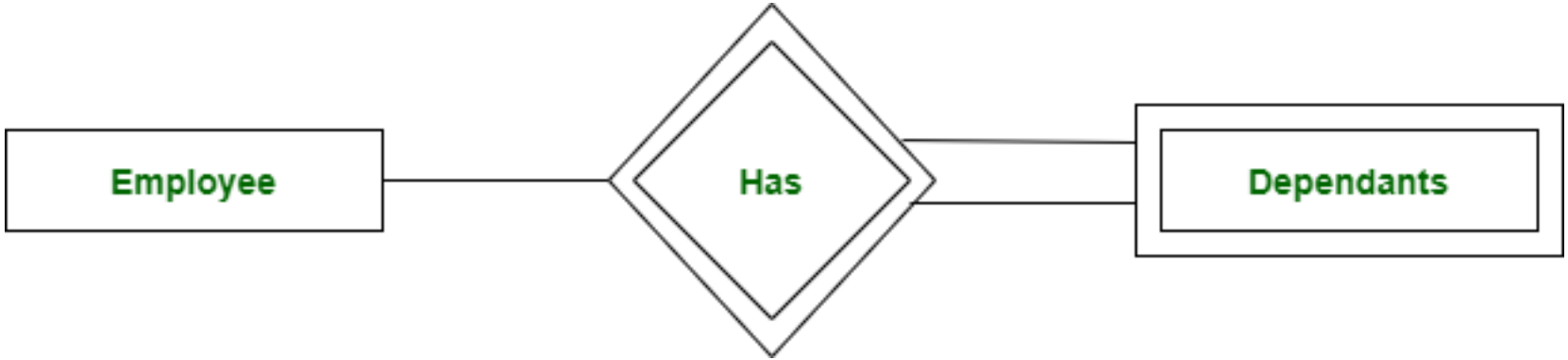
An Entity type has a key attribute that uniquely identifies each entity in the entity set. But some entity type exists for which key attributes can't be defined. These are called Weak Entity types .

For Example, A company may store the information of dependents (Parents, Children, Spouse) of an Employee. But the dependents can't exist without the employee. So Dependent will be a **Weak Entity Type** and Employee will be Identifying Entity type for Dependent, which means it is **Strong Entity Type** .

A weak entity type is represented by a Double Rectangle. The participation of weak entity types is always total. The relationship between the weak entity type and its identifying strong entity type is called identifying relationship and it is represented by a double diamond.

Components of ER Diagram

2. Weak Entity



Components of ER Diagram

What is Attributes?

Attributes are the properties that define the entity type. For example, Roll_No, Name, DOB, Age, Address, and Mobile_No are the attributes that define entity type Student. In ER diagram, the attribute is represented by an oval.

Types of Attributes

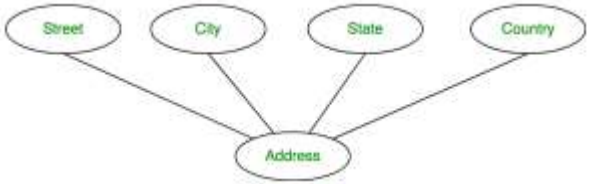
1. Key Attribute

The attribute which **uniquely identifies each entity** in the entity set is called the key attribute. For example, Roll_No will be unique for each student. In ER diagram, the key attribute is represented by an oval with underlying lines.

Components of ER Diagram

2. Composite Attribute

An attribute **composed of many other attributes** is called a composite attribute. For example, the Address attribute of the student Entity type consists of Street, City, State, and Country. In ER diagram, the composite attribute is represented by an oval comprising of ovals.



3. Multivalued Attribute

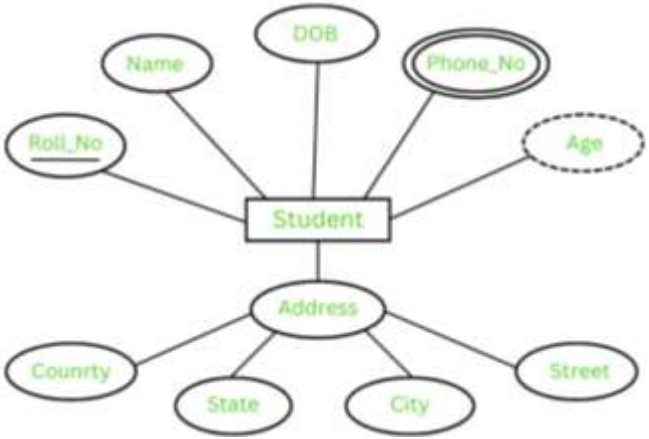
An attribute consisting of more than one value for a given entity. For example, Phone_No (can be more than one for a given student). In ER diagram, a multivalued attribute is represented by a double oval.

Components of ER Diagram

4. Derived Attribute

An attribute that can be derived from other attributes of the entity type is known as a derived attribute. e.g.; Age (can be derived from DOB). In ER diagram, the derived attribute is represented by a dashed oval.

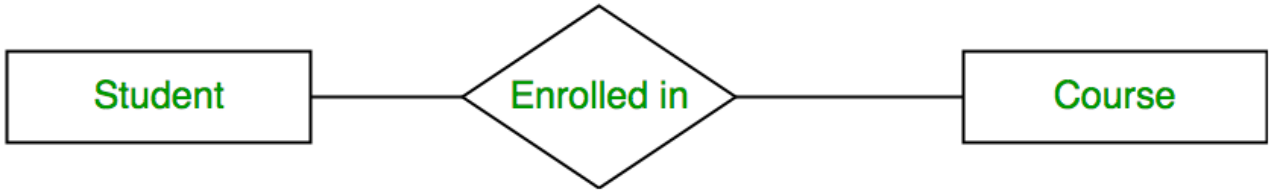
The Complete Entity Type Student with its Attributes can be represented as:



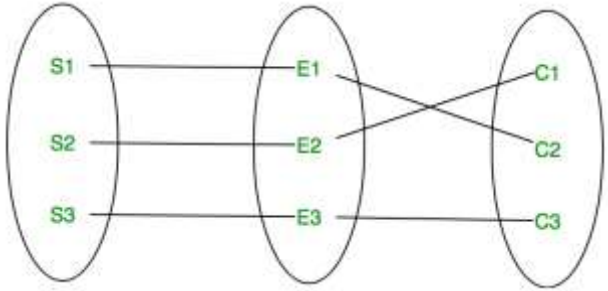
Components of ER Diagram

Relationship Type and Relationship Set

A Relationship Type represents the association between entity types. For example, 'Enrolled in' is a relationship type that exists between entity type Student and Course. In ER diagram, the relationship type is represented by a diamond and connecting the entities with lines.



A set of relationships of the same type is known as a relationship set. The following relationship set depicts S1 as enrolled in C2, S2 as enrolled in C1, and S3 as registered in C3.

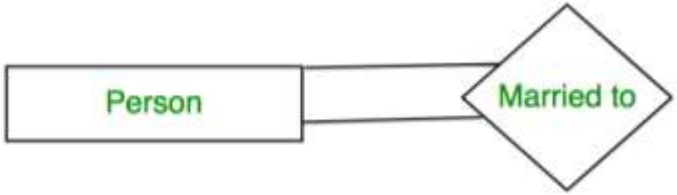


Components of ER Diagram

Degree of a Relationship Set

The number of different entity sets participating in a relationship set is called the degree of a relationship set.

1. **Unary Relationship:** When there is only ONE entity set participating in a relation, the relationship is called a unary relationship. For example, one person is married to only one person.



2. Binary Relationship: When there are TWO entities set participating in a relationship, the relationship is called a binary relationship. For example, a Student is enrolled in a Course.

Components of ER Diagram

3. Ternary Relationship: When there are three entity sets participating in a relationship, the relationship is called a ternary relationship.

4. N-ary Relationship: When there are n entities set participating in a relationship, the relationship is called an n-ary relationship.

What is Cardinality?

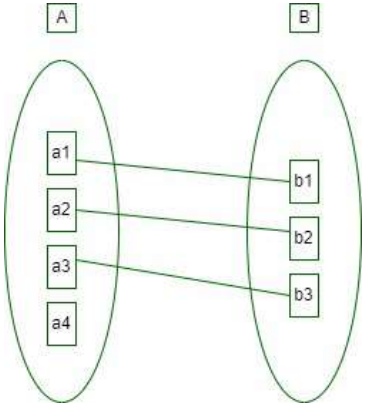
The number of times an entity of an entity set participates in a relationship set is known as cardinality . Cardinality can be of different types:

1. One-to-One: When each entity in each entity set can take part only once in the relationship, the cardinality is one-to-one. Let us assume that a male can marry one female and a female can marry one male. So the relationship will be one-to-one.

the total number of tables that can be used in this is 2.

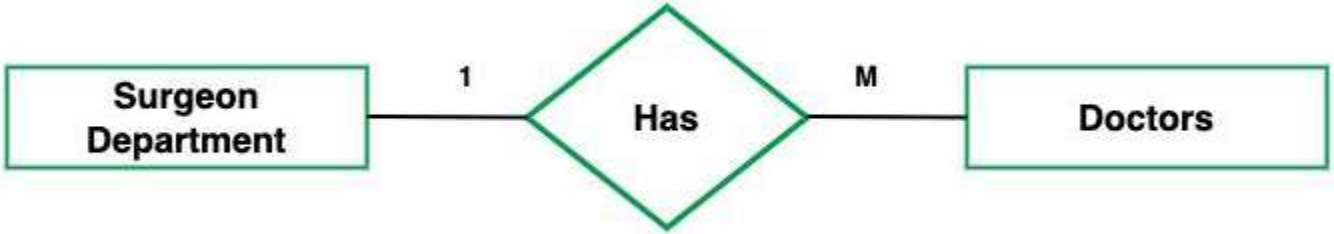
Components of ER Diagram

Using Sets, it can be represented as:

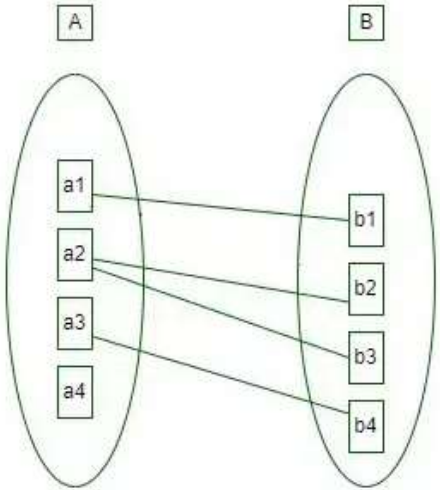


2. One-to-Many: In one-to-many mapping as well where each entity can be related to more than one entity and the total number of tables that can be used in this is 2. Let us assume that one surgeon department can accommodate many doctors. So the Cardinality will be 1 to M. It means one department has many Doctors.
total number of tables that can used is 3.

Components of ER Diagram



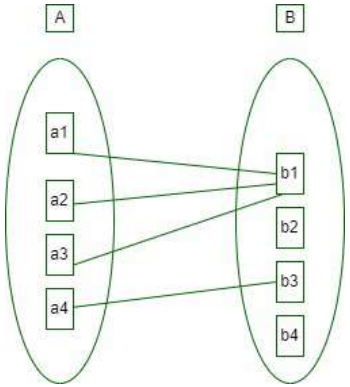
Using sets, one-to-many cardinality can be represented as:



Components of ER Diagram

3. Many-to-One: When entities in one entity set can take part only once in the relationship set and entities in other entity sets can take part more than once in the relationship set, cardinality is many to one. Let us assume that a student can take only one course but one course can be taken by many students. So the cardinality will be n to 1. It means that for one course there can be n students but for one student, there will be only one course.
The total number of tables that can be used in this is 3.

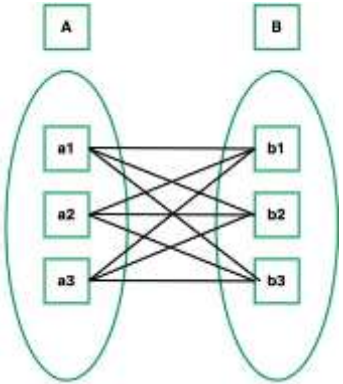
Using Sets, it can be represented as:
In this case, each student is taking only 1 course but 1 course has been taken by many students.



Components of ER Diagram

4. Many-to-Many: When entities in all entity sets can take part more than once in the relationship cardinality is many to many. Let us assume that a student can take more than one course and one course can be taken by many students. So the relationship will be many to many.
the total number of tables that can be used in this is 3.

Using Sets, it can be represented as:
In this example, student S1 is enrolled in C1 and C3 and Course C3 is enrolled by S1, S3, and S4. So it is many-to-many relationships.



Participation Constraint

Participation Constraint is applied to the entity participating in the relationship set.

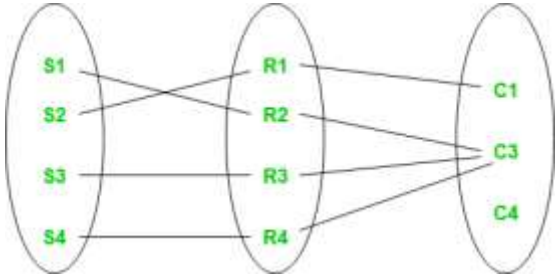
1. Total Participation – Each entity in the entity set must participate in the relationship. If each student must enroll in a course, the participation of students will be total. Total participation is shown by a double line in the ER diagram.

2. Partial Participation – The entity in the entity set may or may NOT participate in the relationship. If some courses are not enrolled by any of the students, the participation in the course will be partial.

The diagram depicts the 'Enrolled in' relationship set with Student Entity set having total participation and Course Entity set having partial participation.

Using Set, it can be represented as,

Every student in the Student Entity set participates in a relationship but there exists a course C4 that is not taking part in the relationship.



Components of ER Diagram

ER Diagram on three basic concepts:

- Entities
  - Weak Entity
- Attributes
  - Key Attribute
  - Composite Attribute
  - Multivalued Attribute
  - Derived Attribute
- Relationships
  - One-to-One Relationships
  - One-to-Many Relationships
  - Many-to-One Relationships
  - Many-to-Many Relationships

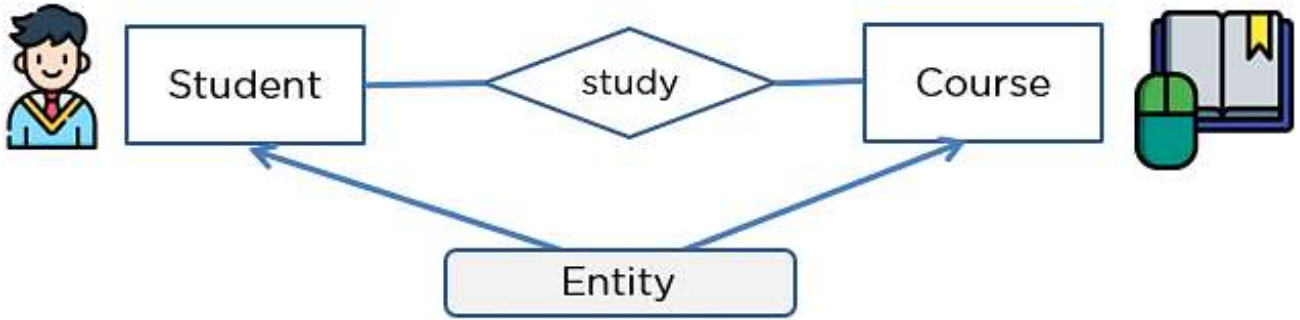
Components of ER Diagram

Entities

An entity can be either a living or non-living component.

It showcases an entity as a rectangle in an ER diagram.

For example, in a student study course, both the student and the course are entities.



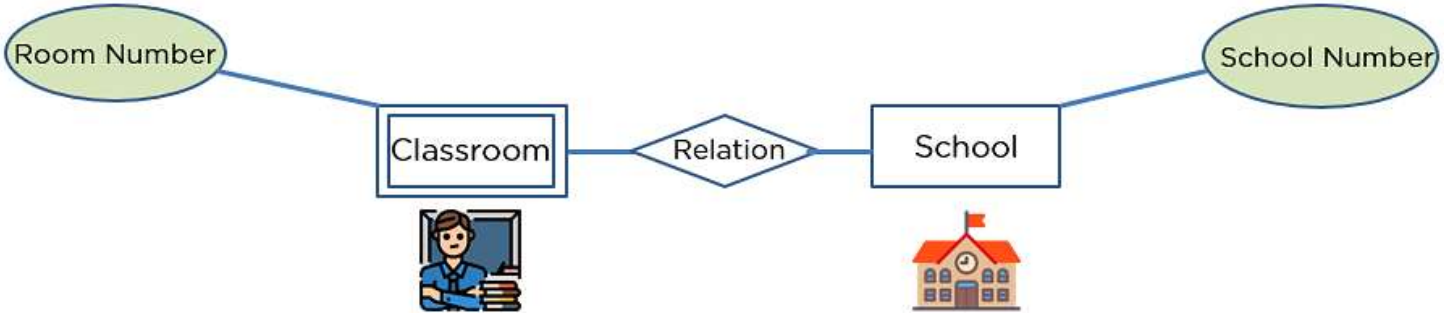
Components of ER Diagram

Weak Entity

An entity that makes reliance over another entity is called a weak entity

You showcase the weak entity as a double rectangle in ER Diagram.

In the example below, school is a strong entity because it has a primary key attribute - school number. Unlike school, the classroom is a weak entity because it does not have any primary key and the room number here acts only as a discriminator.

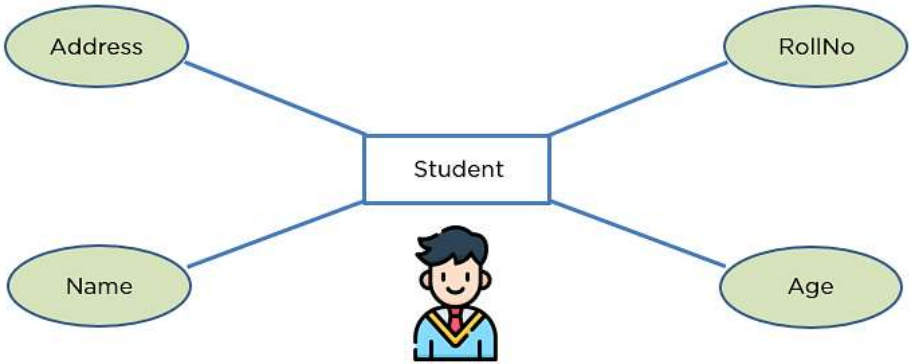


Components of ER Diagram

Attribute

An attribute exhibits the properties of an entity.

You can illustrate an attribute with an oval shape in an ER diagram.



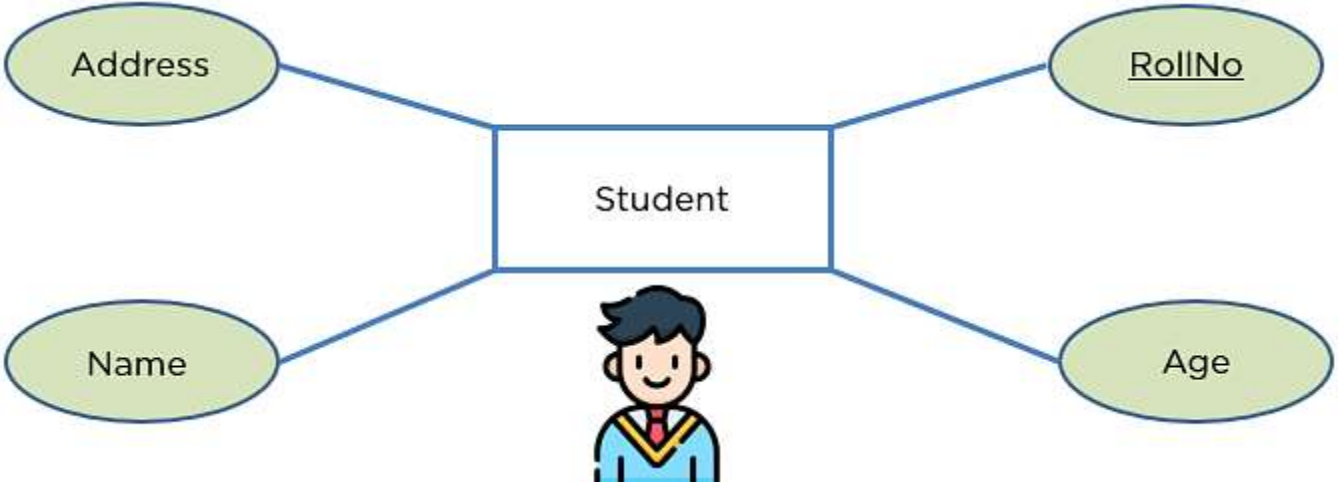
Components of ER Diagram

Key Attribute

Key attribute uniquely identifies an entity from an entity set.

It underlines the text of a key attribute.

For example: For a student entity, the roll number can uniquely identify a student from a set of students.

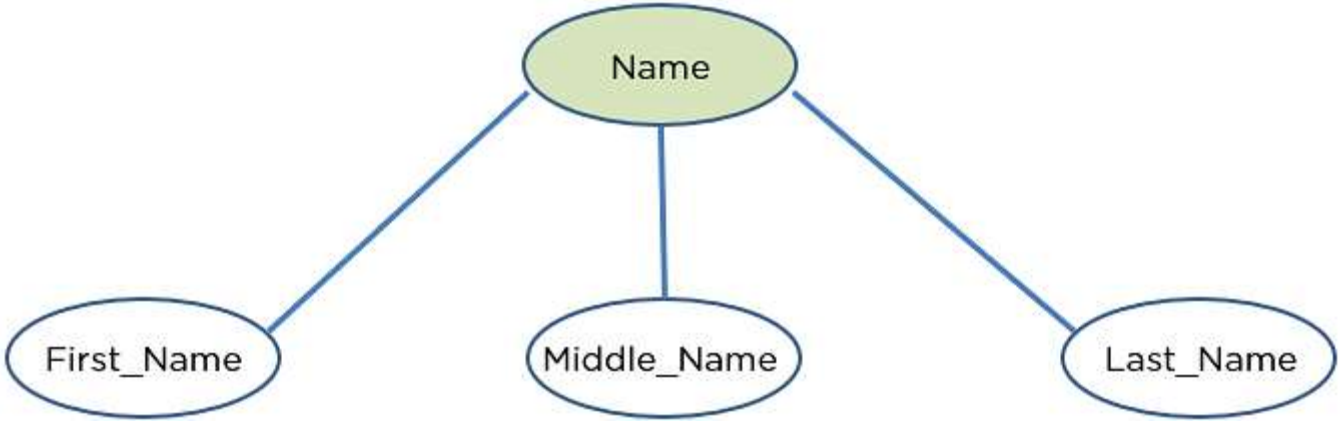


Components of ER Diagram

Composite Attribute

An attribute that is composed of several other attributes is known as a composite attribute.

An oval showcases the composite attribute, and the composite attribute oval is further connected with other ovals.



Components of ER Diagram

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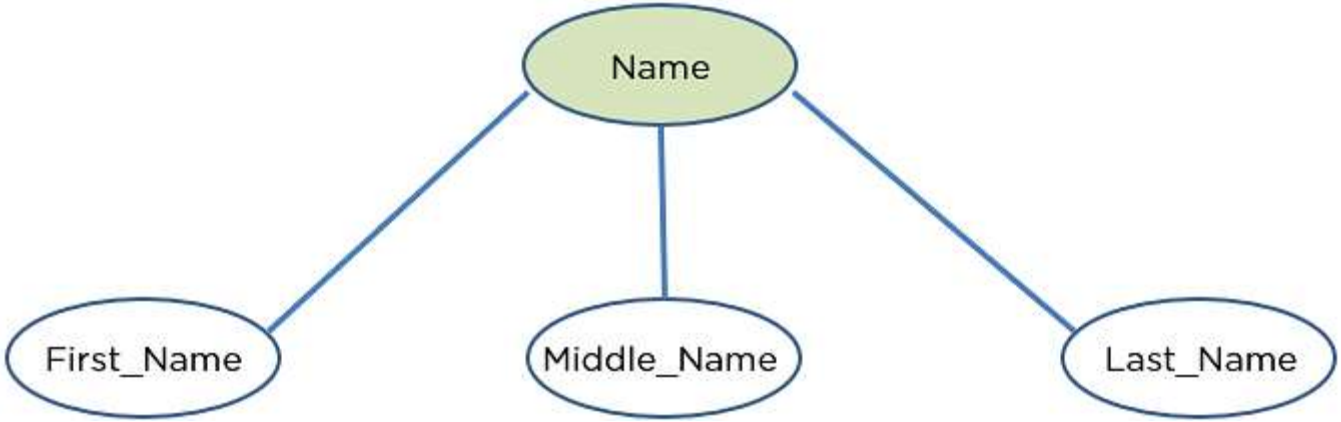
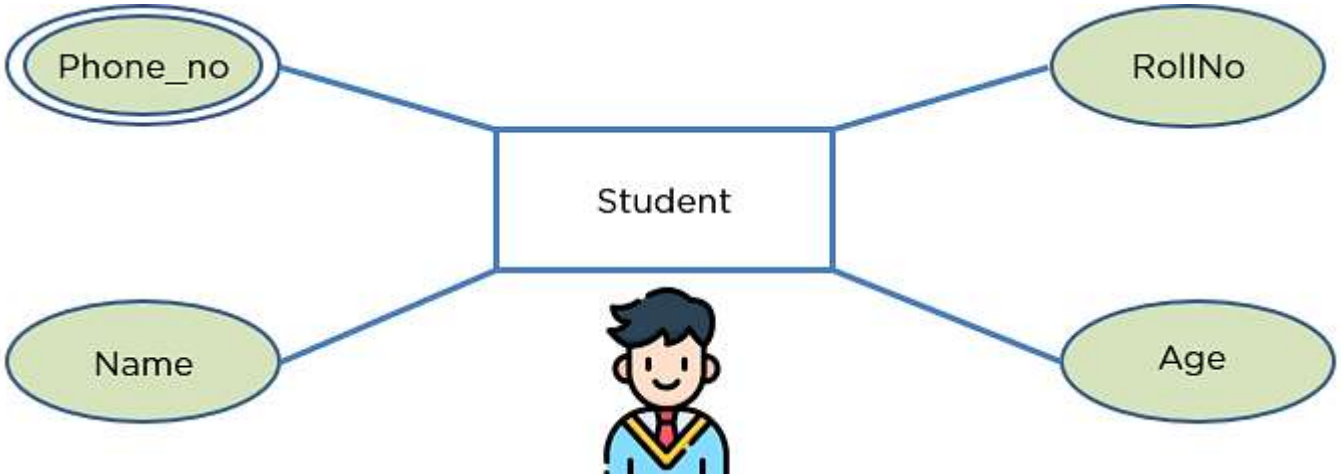


Components of ER Diagram

Multivalued Attribute

Some attributes can possess over one value, those attributes are called multivalued attributes.

The double oval shape is used to represent a multivalued attribute.

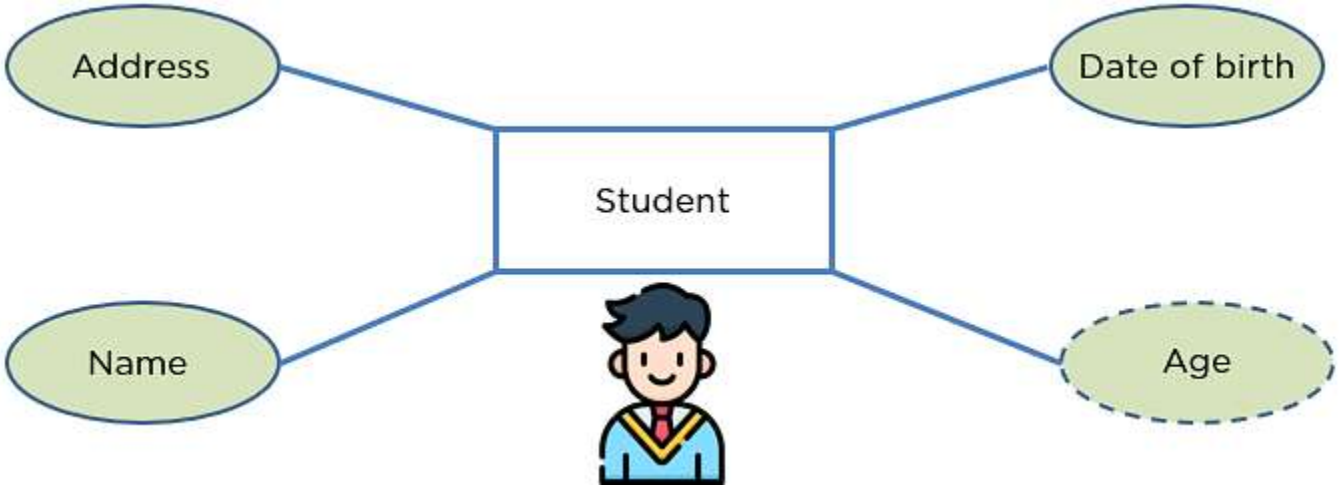


Components of ER Diagram

Derived Attribute

An attribute that can be derived from other attributes of the entity is known as a derived attribute.

In the ER diagram, the dashed oval represents the derived attribute.



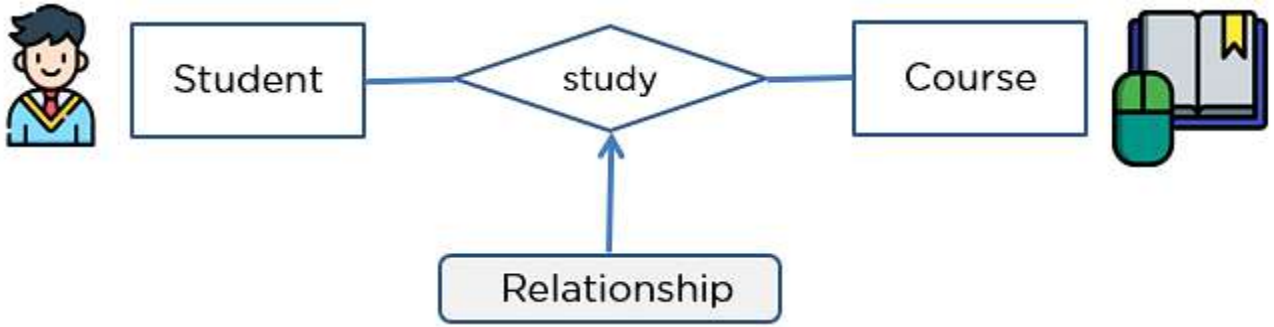
Components of ER Diagram

Relationship

The diamond shape showcases a relationship in the ER diagram.

It depicts the relationship between two entities.

In the example below, both the student and the course are entities, and study is the relationship between them.

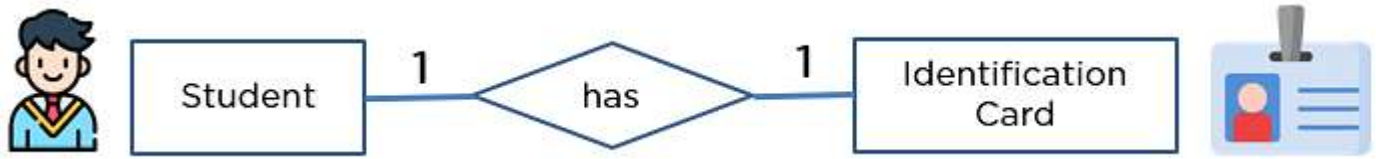


Components of ER Diagram

One-to-One Relationship

When a single element of an entity is associated with a single element of another entity, it is called a one-to-one relationship.

For example, a student has only one identification card and an identification card is given to one person.

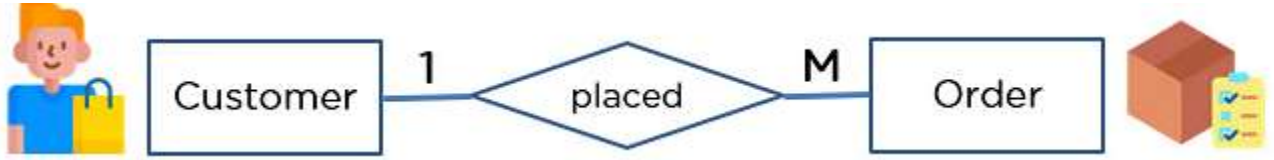


Components of ER Diagram

One-to-Many Relationship

When a single element of an entity is associated with more than one element of another entity, it is called a one-to-many relationship

For example, a customer can place many orders, but an order cannot be placed by many customers.

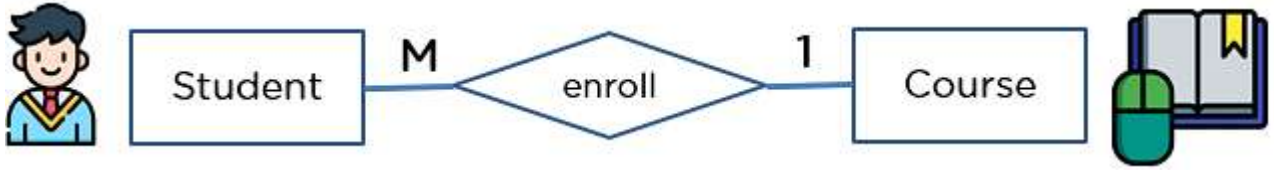


Components of ER Diagram

Many-to-One Relationship

When more than one element of an entity is related to a single element of another entity, then it is called a many-to-one relationship.

For example, students have to opt for a single course, but a course can have many students.



Components of ER Diagram

Many-to-Many Relationship

When more than one element of an entity is associated with more than one element of another entity, this is called a many-to-many relationship.

For example, you can assign an employee to many projects and a project can have many employees.

How to Draw ER Diagram?

The very first step is Identifying all the Entities, and place them in a Rectangle, and labeling them accordingly.
The next step is to identify the relationship between them and place them accordingly using the Diamond, and make sure that, Relationships are not connected to each other.
Attach attributes to the entities properly.
Remove redundant entities and relationships.
Add proper colors to highlight the data present in the database.

References

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