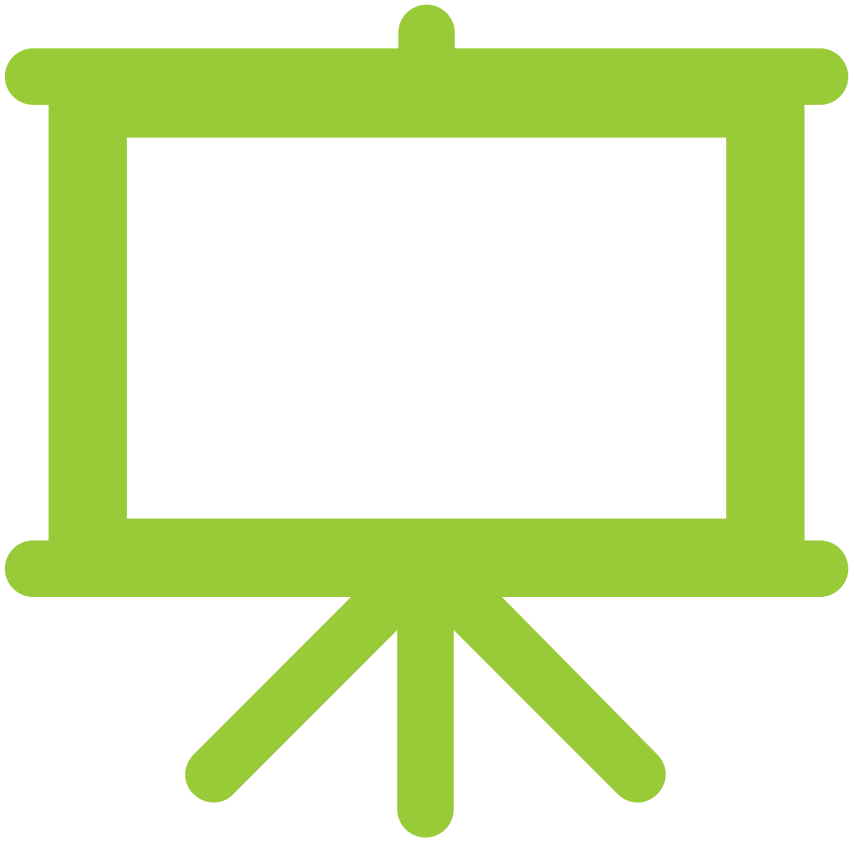


Database Systems

Faculty of AI & MMG

In this Lecture you will Learn about:

- Entity Relationship diagram basic concept
- Why to use ER model/ ER diagram
- Symbols used in ER diagram
- Components of ER diagram
- ER diagram examples & tasks

ER Diagram

Entity

- Thing in the real world

Entity

Person,place,object,event or concept about which data is to be maintained

Example: Car, Student

ER Diagram

Attribute

- Property of an entity
- Most of what we store in the database

Attribute

Property or characteristic of an entity

Example: Color of car Entity

Name of Student Entity

ER Diagram

Relationship

- Association between sets of entities
- Possibly with attribute(s)

Relation

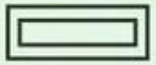
Association between the instances of one or more entity types

Example: Blue Car Belongs to Student Jack

Why Use ER Diagrams in DBMS?

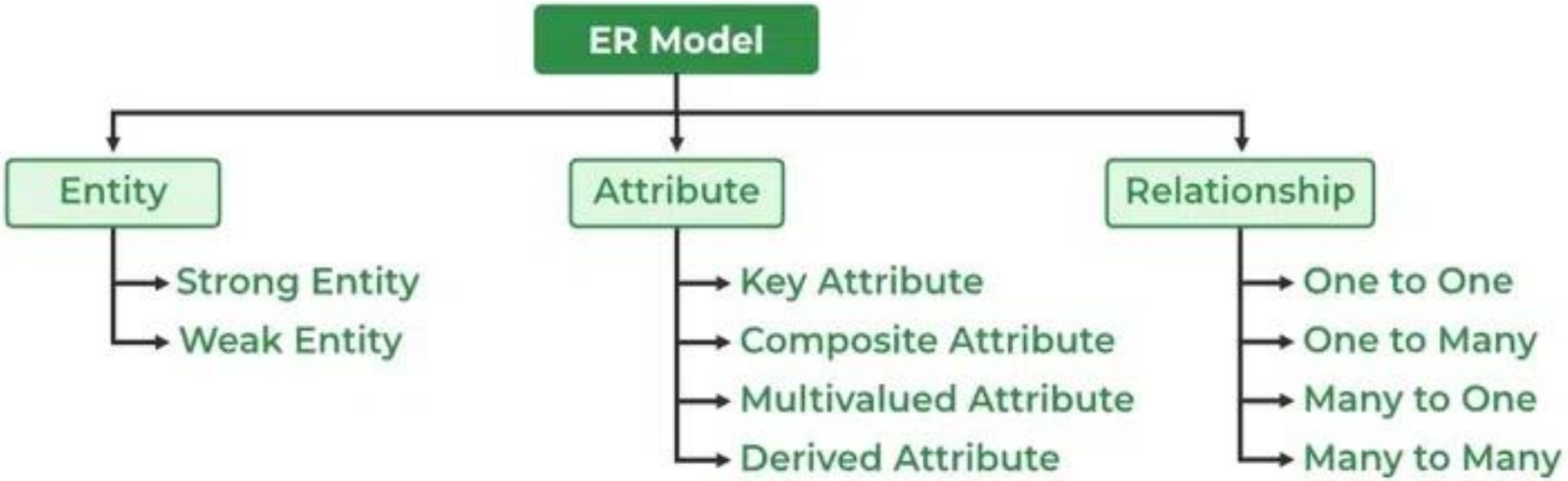
- ER Diagram helps you conceptualize the database and lets you know which fields need to be embedded for a particular entity
- ER Diagram gives a better understanding of the information to be stored in a database
- It reduces complexity and allows database designers to build databases quickly
- It helps to describe elements using Entity-Relationship models
- It allows users to get a preview of the logical structure of the database

Symbols Used in ER Diagrams

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

- Rectangles: This symbol represents entity types
- Ellipses: This symbol represents attributes
- Diamonds: This symbol represents relationship types
- Lines: It links attributes to entity types and entity types with other relationship types
- Double Ellipses: Represents multi-valued attributes

Components of ER Diagram



Components of ER Diagram

Entity

An entity is a real-world thing which can be distinctly identified like a person, place or a concept.

It is an object which is distinguishable from others.

If we cannot distinguish it from others then it is an object but not an entity. An entity can be of two types:

Tangible Entity: Tangible Entities are those entities which exist in the real world physically. ***Example:*** Person, car, etc.

Intangible Entity: Intangible Entities are those entities which exist only logically and have no physical existence. ***Example:*** Bank Account, etc.

Components of ER Diagram

Entity

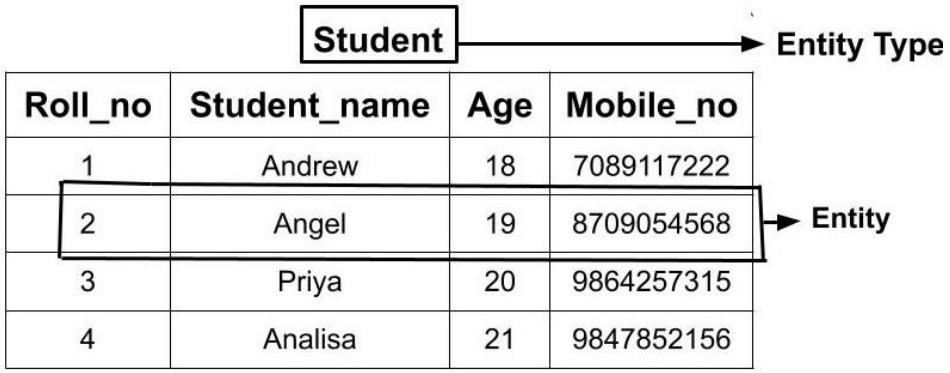
Example: *If we have a table of a Student (Roll_no, Student_name, Age, Mobile_no) then each student in that table is an entity and can be uniquely identified by their Roll Number i.e Roll_no.*

Student

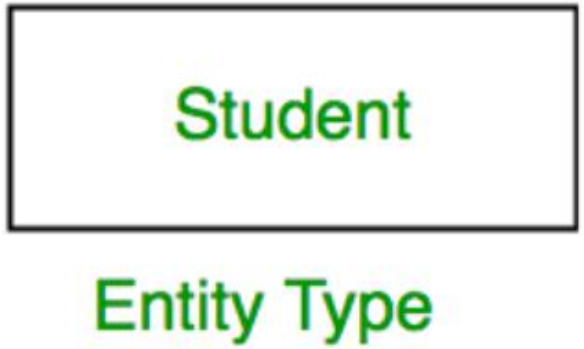
Roll_no	Student_name	Age	Mobile_no
1	Andrew	18	7089117222
2	Angel	19	8709054568
3	Priya	20	9864257315
4	Analisa	21	9847852156

Entity

Components of ER Diagram



Roll_no	Student_name	Age	Mobile_no
1	Andrew	18	7089117222
2	Angel	19	8709054568
3	Priya	20	9864257315
4	Analisa	21	9847852156



Entity Type

An entity type is a category or a blueprint that defines the structure (attributes) of a group of similar entities.

In the Student table example, we have each row as an entity and they are having common attributes i.e each row has its own value for attributes Roll_no, Age, Student_name and Mobile_no.

So, we can define the above STUDENT table as an entity type because it is a collection of entities having the same attributes.

So, an entity type in an ER diagram is defined by a name(here, STUDENT) and a set of attributes(here, Roll_no, Student_name, Age, Mobile_no). The table shows how the data of different entities(different students) are stored.

Components of ER Diagram

Types of Entity type

Strong Entity Type

Weak Entity Type

Components of ER Diagram

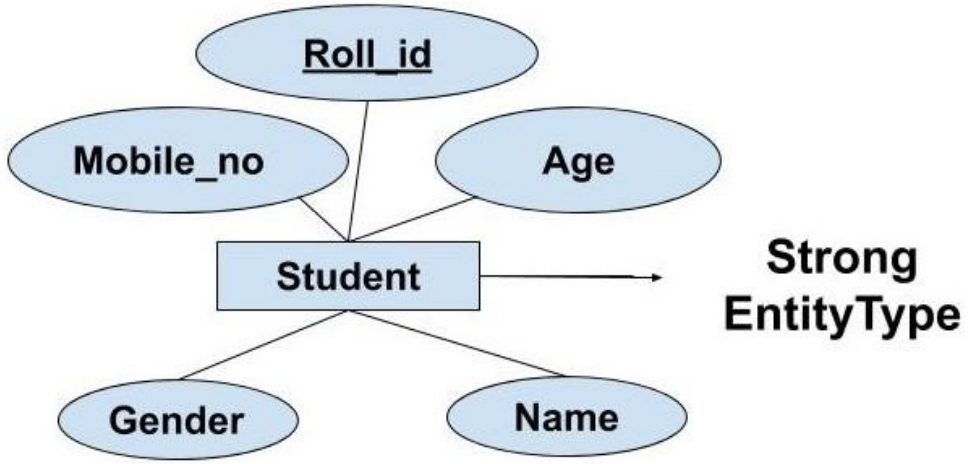
Strong Entity Type:

Strong entity are those entity types which has a key attribute.

The primary key helps in identifying each entity uniquely.

It is represented by a rectangle.

In the above example, Roll_no identifies each element of the table uniquely and hence, we can say that STUDENT is a strong entity type



Components of ER Diagram

Weak Entity Type:

Weak entity type doesn't have a key attribute. Weak entity type can't be identified on its own. It depends upon some other strong entity for its distinct identity.

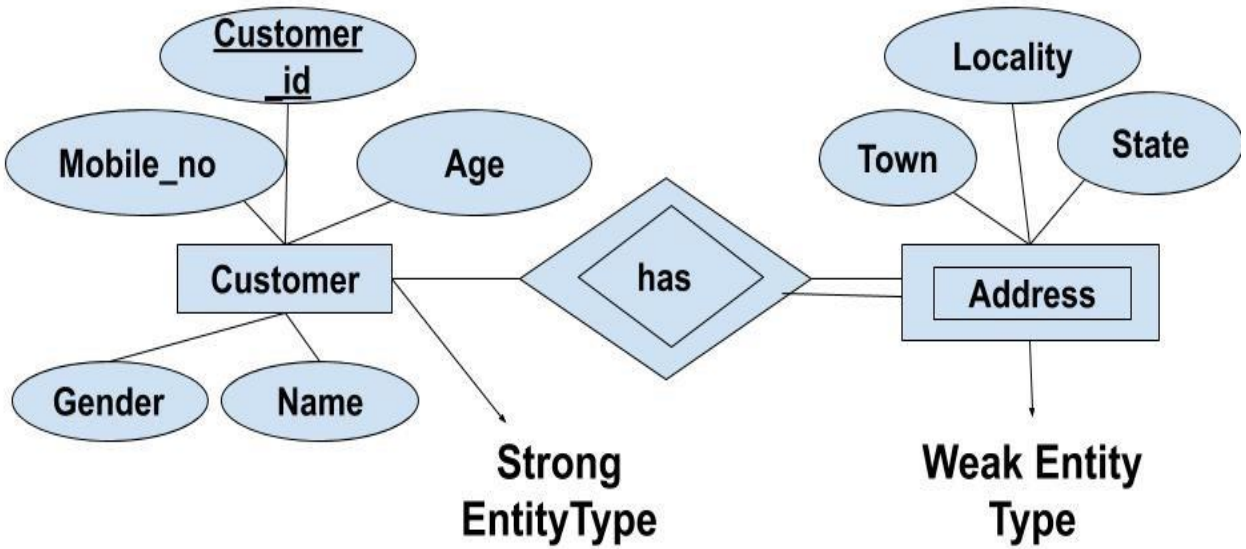
This can be understood with a real-life example.

- There can be children only if the parent exits. There can be no independent existence of children.
- There can be a room only if building exits. There can be no independent existence of a room.

A weak entity is represented by a double outlined rectangle.

The relationship between a weak entity type and strong entity type is called an identifying relationship and shown with a double outlined diamond instead of a single outlined diamond.

Components of ER Diagram

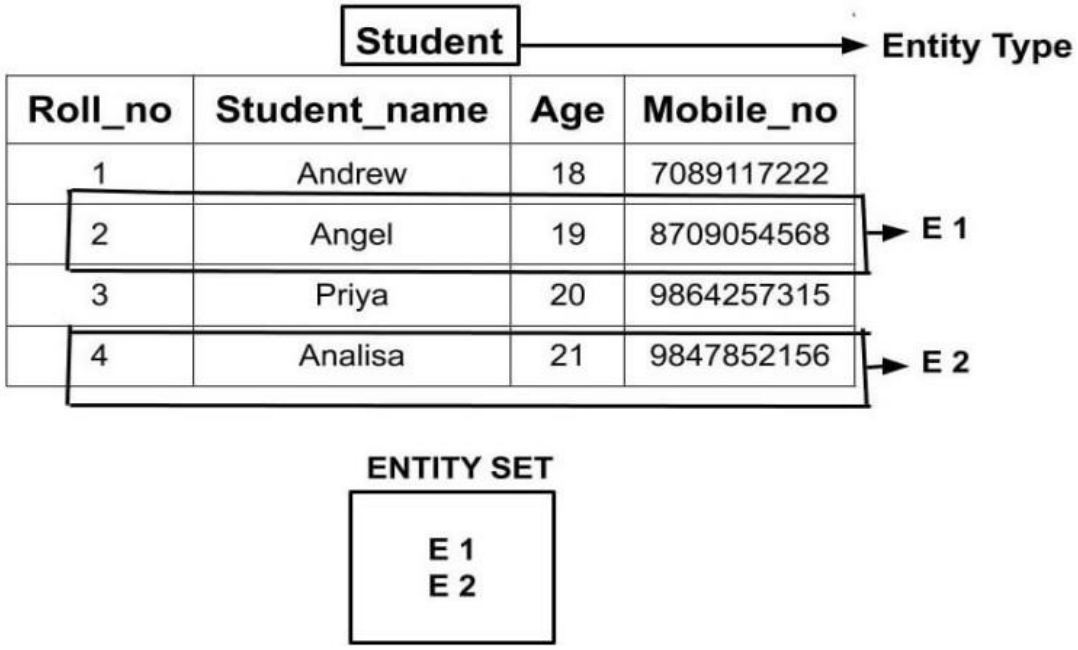


Weak Entity Type:

This representation can be seen in the diagram below.

Example : *If we have two tables of Customer(Customer_id, Name, Mobile_no, Age, Gender) and Address(Locality, Town, State, Customer_id). Here we cannot identify the address uniquely as there can be many customers from the same locality. So, for this, we need an attribute of Strong Entity Type i.e 'Customer' here to uniquely identify entities of 'Address' Entity Type.*

Components of ER Diagram



Entity Set

Entity Set is a collection of entities of the same entity type.

In the example of STUDENT entity type, a collection of entities from the Student entity type would form an entity set.

Example 1: *In the below example, two entities E1 (2, Angel, 19, 8709054568) and E2(4, Analisa, 21, 9847852156) form an entity set.*

Entity	Entity Type	Entity Set
A thing in the real world with independent existence	A category of a particular entity	Set of all entities of a particular entity type.
Any particular row (a record) in a relation(table) is known as an entity.	The name of a relation (table) in RDBMS is an entity type	All rows of a relation (table) in RDBMS is entity set

Components of ER Diagram

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.

Attribute

Components of ER Diagram

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.

Key Attribute

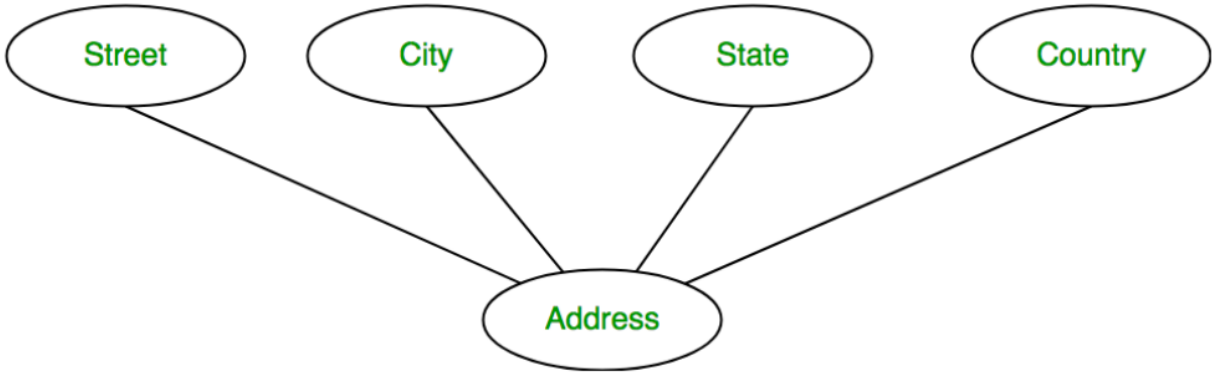
Components of ER Diagram

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.



Composite Attribute

Components of ER Diagram

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.

Multivalued Attribute

Components of ER Diagram

4. Derived Attribute

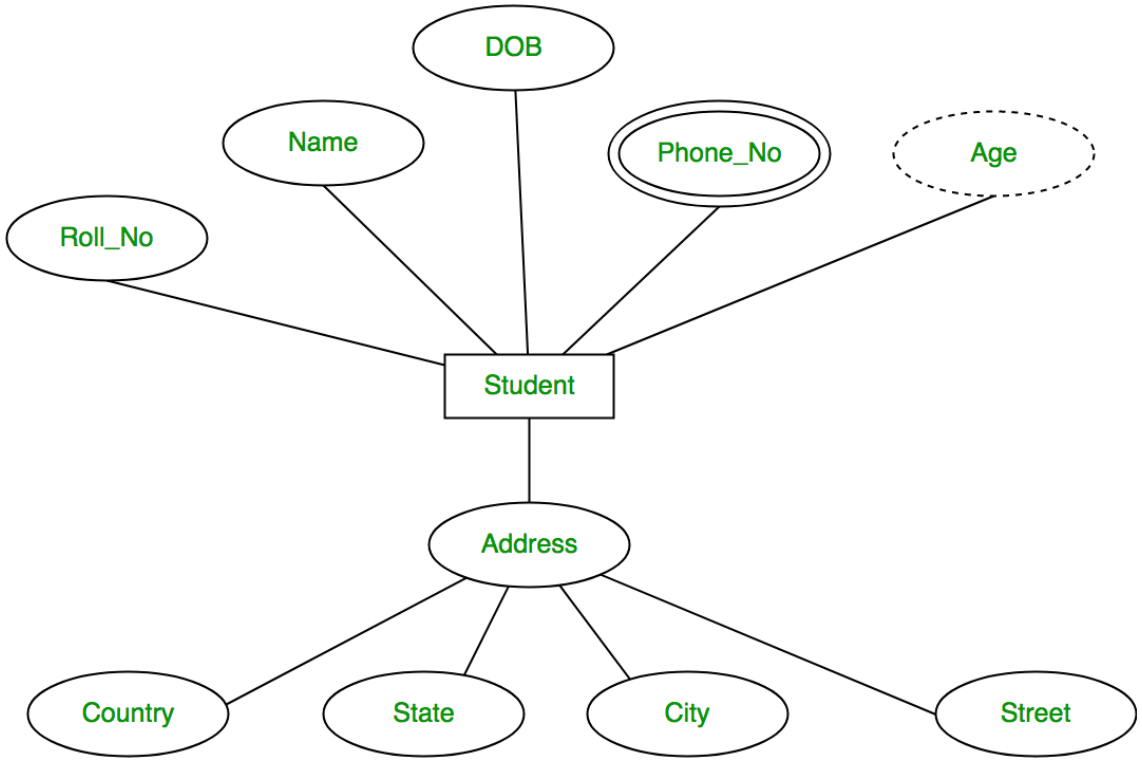
An attribute that can be derived from other attributes of the entity type is known as a derived attribute.

e.g.; Age (can be derived from DOB). In ER diagram, the derived attribute is represented by a dashed oval.

Derived Attribute

Components of ER Diagram

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



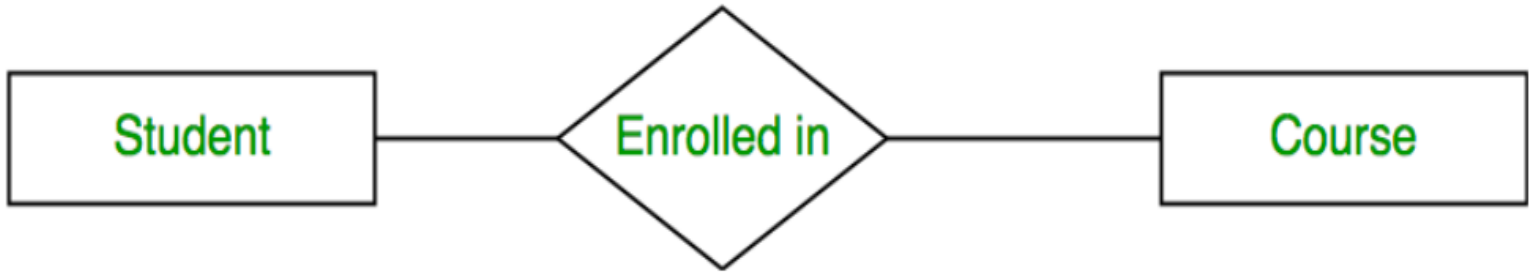
Components of ER Diagram

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.

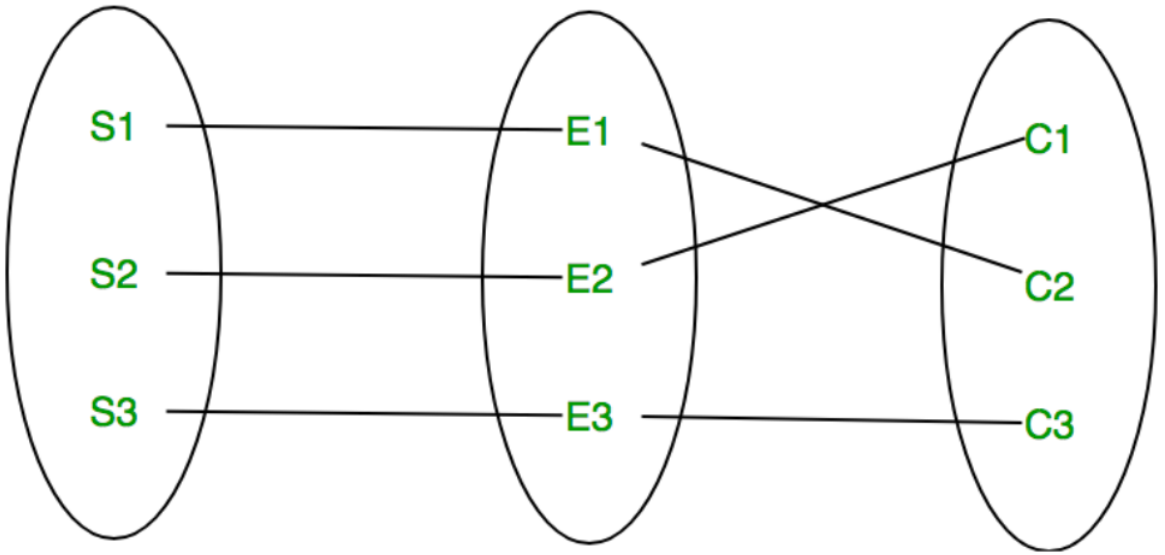


Entity-Relationship Set

Components of ER Diagram

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.



Relationship Set

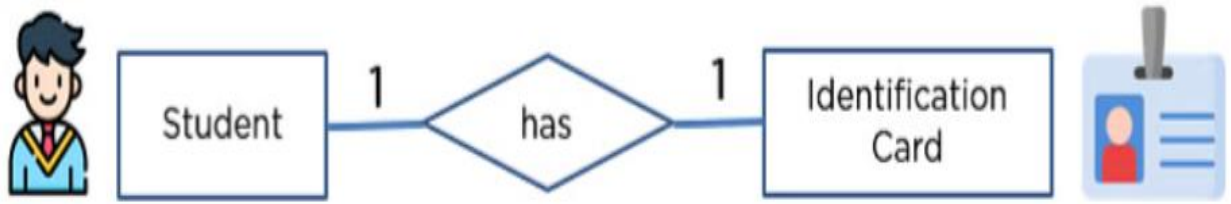
Components of ER Diagram

Relationships

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.



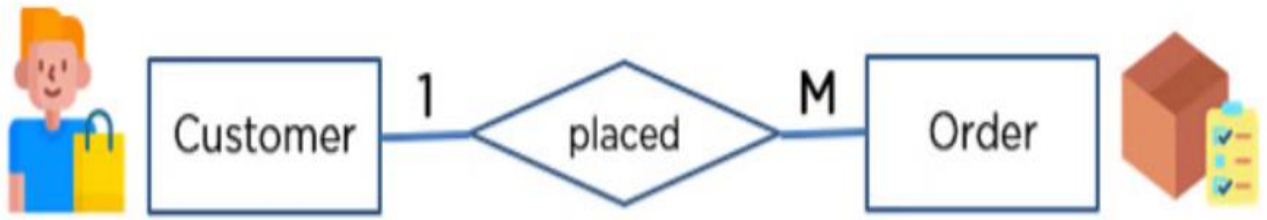
Components of ER Diagram

Relationships

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.



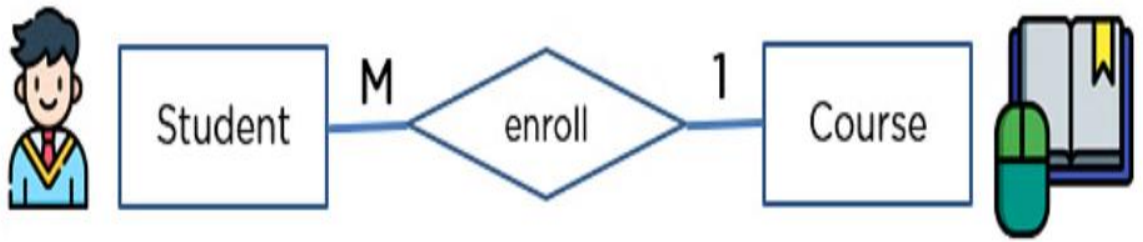
Components of ER Diagram

Relationships

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

Relationships

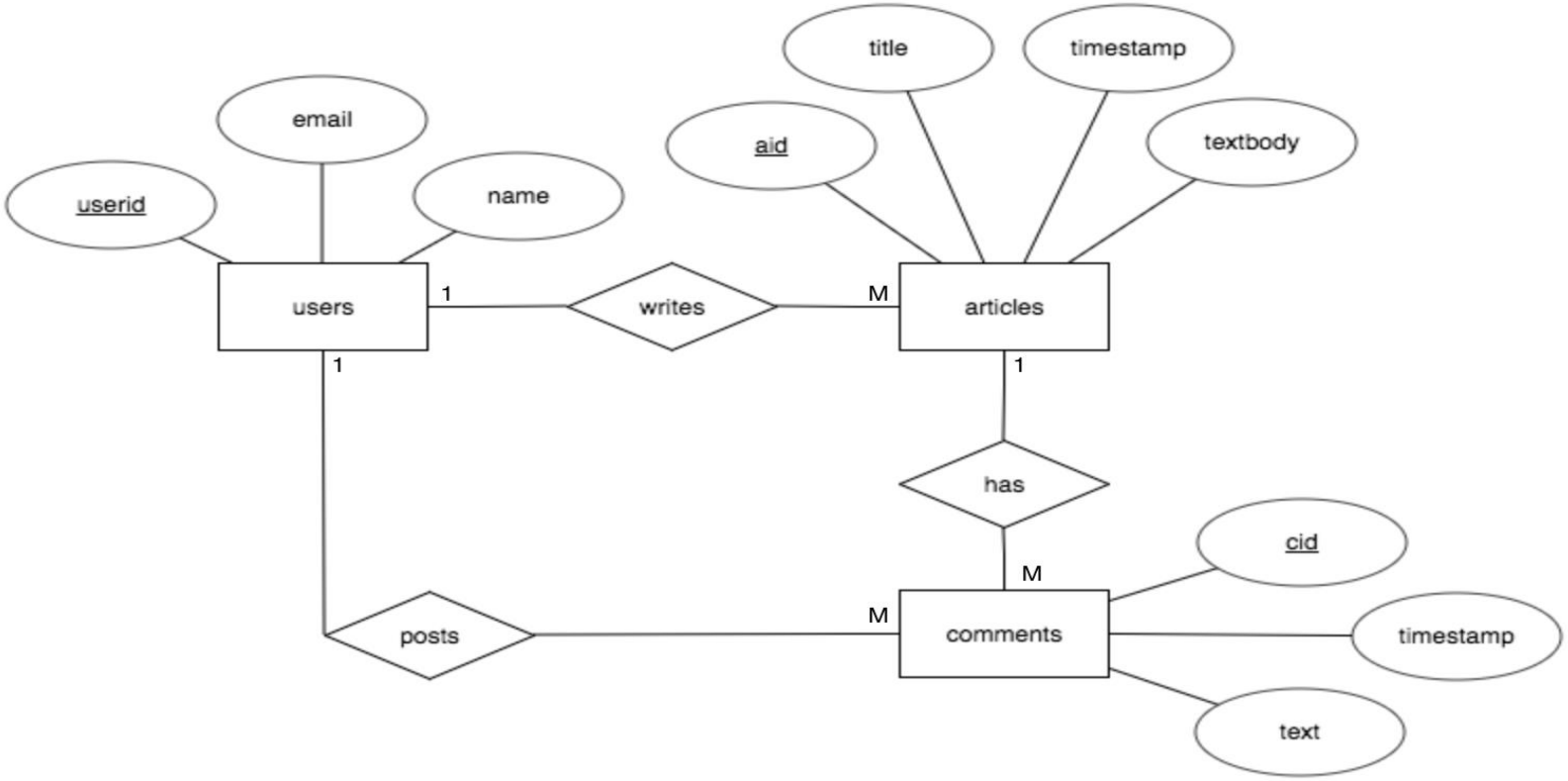
Many-to-Many Relationship

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.

Components of ER Diagram

Relationships



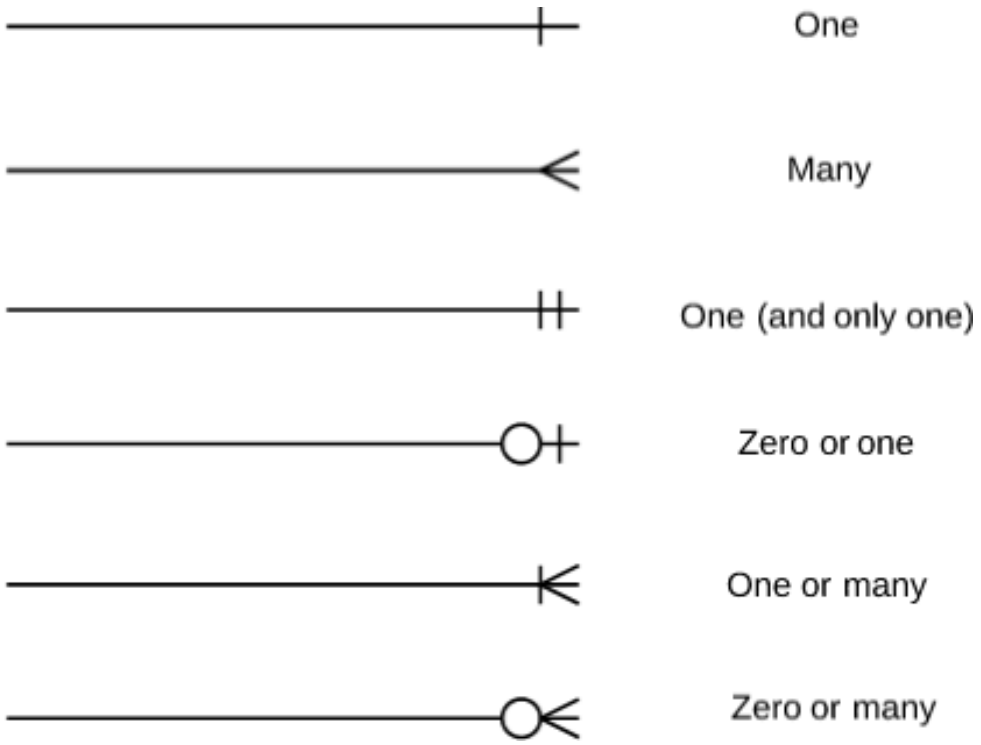
Components of ER Diagram

Cardinality

- Defines the numerical attributes of the relationship between two entities or entity sets.
- Cardinality refers to the maximum number of times an instance in one entity can relate to instances of another entity.
- Ordinality, on the other hand, is the minimum number of times an instance in one entity can be associated with an instance in the related entity.
- Cardinality and ordinality are shown by the styling of a line and its endpoint, according to the chosen notation style.

Components of ER Diagram

Cardinality



Components of ER Diagram

Cardinality

Zero or One (0..1):

Example: Consider entities Person and Driver's License. Each person may or may not have a driver's license, and if they have one, they can have at most one.

One (1):

Example: Consider entities Country and Capital. Each country must have exactly one capital.

Zero to Many (0..N):

Example: Consider entities Customer and Product. A customer may make zero or more product purchases.

One to Many (1..N):

Example: Consider entities Department and Employee. Each department must have at least one employee, but it can have more than one

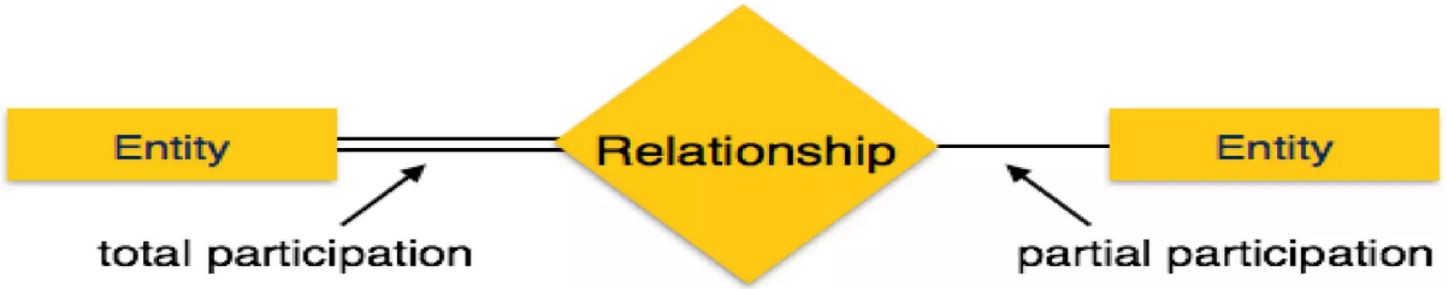
Components of ER Diagram

Types of Participation Constraints-

There are two types of participation constraints-

Components of ER Diagram

- Participation Constraints
- **Total Participation** – Each entity is involved in the relationship. Total participation is represented by double lines.
- **Partial participation** – Not all entities are involved in the relationship. Partial participation is represented by single lines.

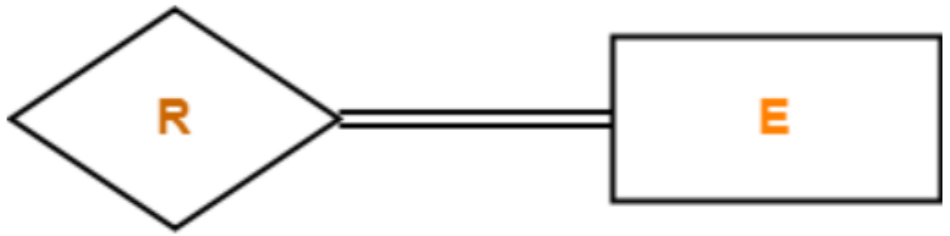


Components of ER Diagram

Types of Participation Constraints-

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

Components of ER Diagram

Types of Participation Constraints-

1. Total Participation-

Here,

Double line between the entity set “Student” and relationship set “Enrolled in” signifies total participation.

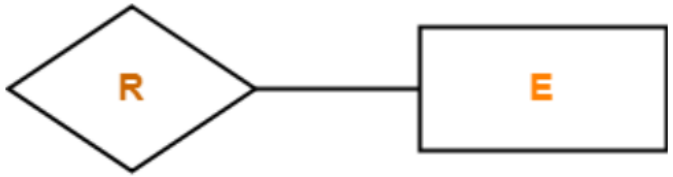
It specifies that each student must be enrolled in at least one course.

Components of ER Diagram

Types of Participation Constraints-

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

Components of ER Diagram

Types of Participation Constraints-

2. Partial Participation-

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.

Tasks

Online Store:

- Entities: Customer, Product, Order, Payment
- Relationships:
  - Each customer can place multiple orders.
  - Each order contains one or more products.
  - Each order requires one payment.

Tasks

Social Media Network:

- Entities: User, Post, Comment, FriendRequest
- Relationships:
  - Each user can make multiple posts.
  - Each post can have multiple comments.
  - Users can send and receive friend requests.

Tasks

Hospital Management System:

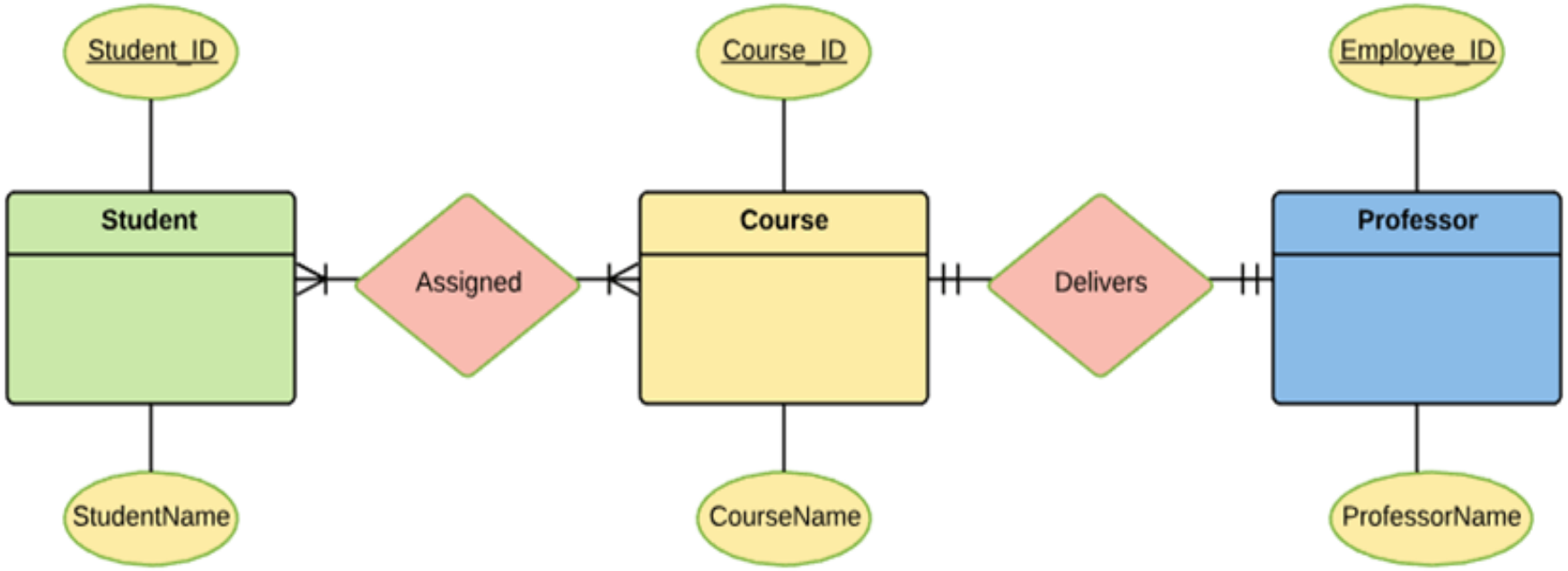
- Entities: Patient, Doctor, Appointment, Department
- Relationships:
  - Each patient can have multiple appointments.
  - Each doctor can have multiple appointments.
  - Each department has multiple doctors.

Tasks

- In a university,
  - a Student enrolls in Courses.
  - A student must be assigned to at least one or more Courses.
  - Each course is taught by a single Professor.
  - To maintain instruction quality, a Professor can deliver only one course

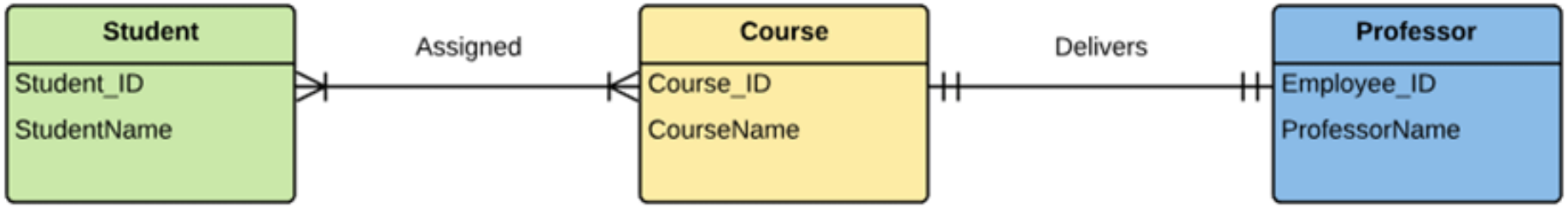
Tasks

1.


Student_ID
Course_ID
Employee_ID
Student
Assigned
Course
Delivers
Professor
StudentName
CourseName
ProfessorName

Tasks

1.


Student
Student_ID
StudentName
Assigned
Course
Course_ID
CourseName
Delivers
Professor
Employee_ID
ProfessorName

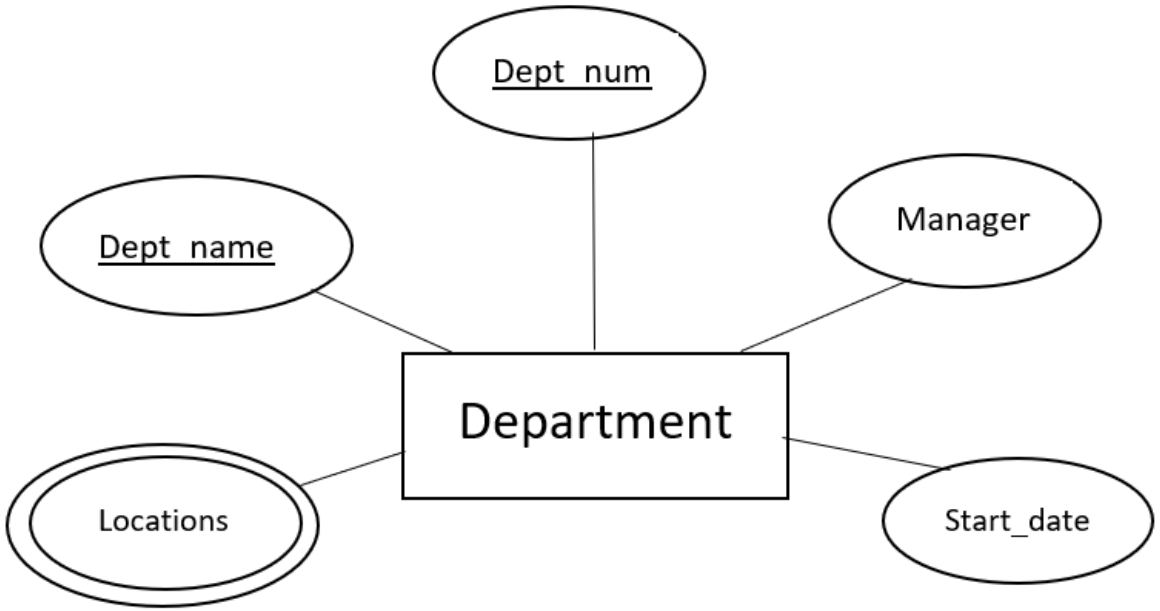
Tasks

2. Draw an ERD for the following description:

- Each department has a unique name, a unique number, and a particular employee who manages the department.
- We keep track of the start date when that employee began managing the department.
- A department may have several locations.

Tasks

2.

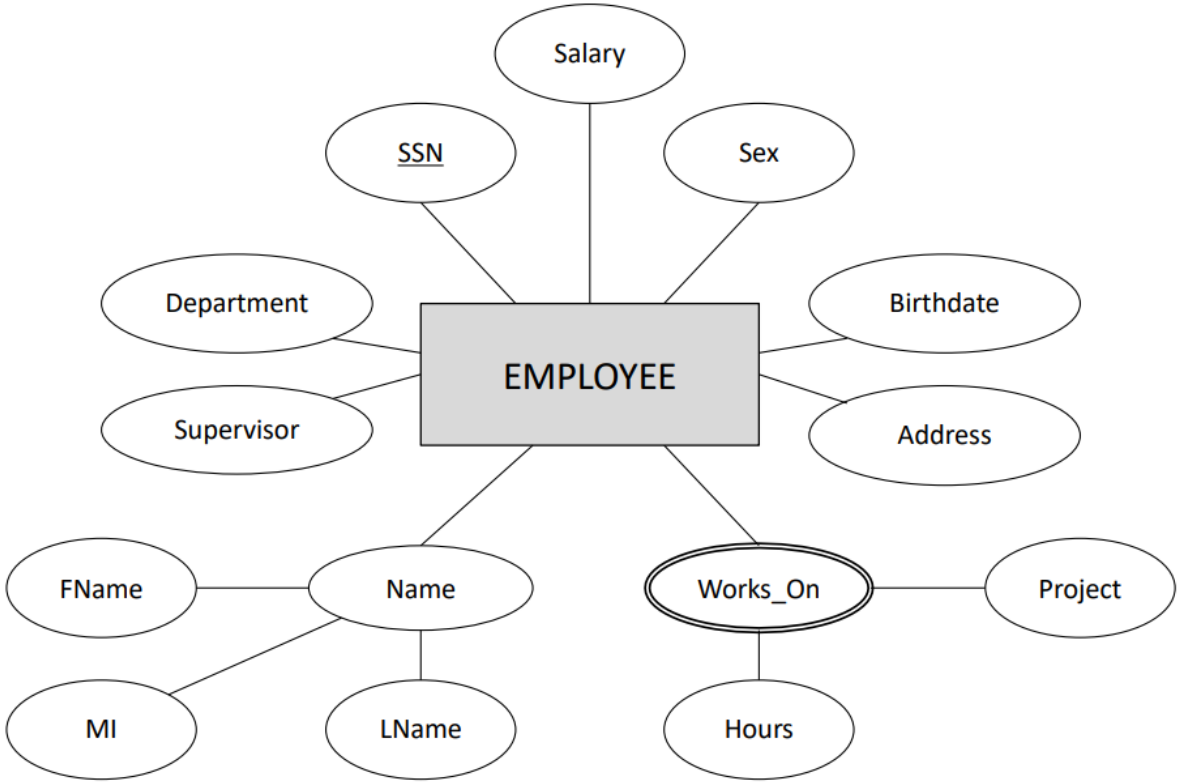

Dept_num
Dept_name
Manager
Department
Locations
Start_date

Tasks

3. Draw an ERD for the following description: We store each employee's name (first, last, MI), Social Security number (SSN), street address, salary, sex (gender), and birth date. An employee is assigned to one department, but may work on several projects, which are not necessarily controlled by the same department. We keep track of the current number of hours per week that an employee works on each project. We also keep track of the direct supervisor of each employee (who is another employee).

Tasks

3.


Salary
SSN
Sex
Department
Birthdate
EMPLOYEE
Supervisor
Address
FName
Name
Works_On
Project
MI
LName
Hours