**1. Generalization**

**Definition:**

Generalization is the process of **combining two or more lower-level entities** into a **higher-level entity** by extracting their common attributes. It is an **abstraction** process where similar entities are grouped under a common entity.

**Example in Your ER Model:**

In your ER diagram, you could apply **generalization** to **Doctor** and **Patient**, as both can be considered as **Persons** with common attributes like **Name, Address, Phone No**.

🔹 **Generalized Entity: Person**

* **Attributes:** Name, Address, Phone No
* **Specialized Entities:** Patient, Doctor
* **Additional Attributes:**
  + Patient → SSN, DOB, Age
  + Doctor → SSN, Speciality, Cost

**2. Specialization**

**Definition:**

Specialization is the **reverse of generalization**, where a higher-level entity is **divided into two or more specialized lower-level entities** based on some distinguishing characteristics.

**Example in Your ER Model:**

* **Entity: Person**
  + **Specialized into:**
    - **Doctor** (has attributes: SSN, Speciality, Cost)
    - **Patient** (has attributes: SSN, DOB, Age)

🔹 **Specialization helps in defining more specific relationships**. For example, only a **doctor** can prescribe a **prescription**, but not a patient.

**3. Weak Entity**

**Definition:**

A weak entity is an entity that **does not have a sufficient attribute (primary key) to uniquely identify it** and relies on a **strong entity for identification**. It has a **partial key** and a **strong entity** provides its **foreign key**.

**Example in Your ER Model:**

* **Entity: Prescription**
  + It depends on **Patient** and **Doctor** for identification.
  + **Prescription does not have a unique key** on its own.
  + **Primary Key:** Prescription ID (which is associated with the patient and doctor).
  + **Supporting Foreign Keys:** Patient SSN, Doctor SSN.

🔹 **Weak entities always have a relationship with a strong entity, called an Identifying Relationship.**  
For instance:

Patient (SSN) → Prescription (Prescription ID, Patient SSN, Doctor SSN)

**4. One-to-One (1:1) Relationship**

**Definition:**

A one-to-one (1:1) relationship exists when **one entity is associated with only one instance of another entity**.

**Example in Your ER Model:**

* **Doctor and Prescription**
  + A prescription is **written by only one doctor**.
  + A doctor may have **multiple prescriptions**, but a **specific prescription** is associated with only **one doctor**.

**Example Table:**

| Prescription\_ID | Doctor\_SSN |

|----------------|------------|

| 1 | 5678 |

| 2 | 5678 |

**5. One-to-Many (1:M) Relationship**

**Definition:**

A one-to-many (1:M) relationship exists when **one entity is associated with multiple instances of another entity**.

**Example in Your ER Model:**

* **Patient and Prescription**
  + A **patient** can have **multiple prescriptions**, but a **prescription belongs to only one patient**.

**Example Table:**

| Patient\_SSN | Prescription\_ID |

|------------|----------------|

| 1234 | 1 |

| 1234 | 2 |

**6. Many-to-Many (M:N) Relationship**

**Definition:**

A many-to-many (M:N) relationship exists when **multiple entities of one type can be related to multiple entities of another type**.

**Example in Your ER Model:**

* **Prescription and Drugs**
  + A **prescription** can contain **multiple drugs**.
  + A **drug** can be part of **multiple prescriptions**.

🔹 **To implement M:N relationships in relational databases, we use a bridge (junction) table.**

**Bridge Table: Prescription\_Drugs**

| Prescription\_ID | Drug\_ID |

|----------------|--------|

| 1 | 101 |

| 1 | 102 |

| 2 | 101 |

**7. Discriminator (Attribute in Specialization)**

**Definition:**

A **discriminator** is an **attribute in a generalized entity** that **distinguishes between different specialized entities**.

**Example in Your ER Model:**

* **Entity: Person**
  + **Discriminator Attribute: Role**
  + **Values:** "Doctor" or "Patient"

🔹 This helps classify whether a **Person** is a **Doctor or a Patient**.

| SSN | Name | Phone No. | Role |

|------|--------|------------|--------|

| 1234 | John | 1234567890 | Patient |

| 5678 | Smith | 9876543210 | Doctor |

**8. Relationship Types in Your ER Model**

| **Type** | **Entities Involved** | **Example** |
| --- | --- | --- |
| **One-to-One** (1:1) | Doctor - Prescription | A prescription is written by one doctor |
| **One-to-Many** (1:M) | Patient - Prescription | A patient can have many prescriptions |
| **Many-to-Many** (M:N) | Prescription - Drugs | A prescription contains multiple drugs, and a drug can belong to multiple prescriptions |

**Conclusion**

Your ER diagram includes various **concepts** like **generalization, specialization, weak entities, one-to-one, one-to-many, many-to-many relationships, and discriminators**.  
Here's a **quick summary**:

✅ **Generalization:** Person (generalized entity) → Doctor & Patient (specialized entities)  
✅ **Specialization:** Person → Doctor (Speciality, Cost), Patient (DOB, Age)  
✅ **Weak Entity:** Prescription (depends on Patient & Doctor)  
✅ **1:1 Relationship:** Doctor writes Prescription  
✅ **1:M Relationship:** Patient has multiple Prescriptions  
✅ **M:N Relationship:** Prescription contains multiple Drugs, and Drugs belong to multiple Prescriptions  
✅ **Discriminator Attribute:** Role (for distinguishing between Doctor and Patient)