



Database Management System (303105203)

Unit – 3: Database Models

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- Basic concepts
- Integrity constraints
- Database models
- E-R diagrams
- Mapping cardinality
- Participation Constraints
- Weak entity set
- Specialization
- Generalization
- Aggregation
- E-R Diagram Example

Basic Concepts

- Database design involves understanding operational and business needs of an organization, modeling the specified requirements, and realizing the requirements using a database.
- The overall database design process has to follow a series of steps. The systematic process of designing a database is known as design methodology.
- The goal of designing a database is to produce efficient, high quality, and minimum cost database.
- In large organizations, database administrator (DBA) is responsible for designing an efficient database system

Integrity Constraint

- Integrity constraints are the set of rules imposed on database to maintain quality of data.
- Integrity constraints ensures that any manipulation on data does not affect the data integrity.
- It secures the data management.
- Various Integrity Constraints are:
 1. Check
 2. Not null
 3. Unique Key
 4. Primary key
 5. Foreign key

Integrity Constraint

1. Check

- ✓ This constraint is defined on a column of the table.
- ✓ Limits the data values of variables to a specific set of values based on condition.
- ✓ The constraint can be applied for a single column or a group of columns.
- ✓ E.g. amount must be greater than 500.

2. Not null

- ✓ This constraint ensures that each column of all the rows in the table has some value (data).
- ✓ Any column value cannot be NULL (empty).

Integrity Constraint

3. Unique Key

- ✓ Ensures that the data in each row for a single or group of columns is unique (distinct).
- ✓ A column can have NULL values, but cannot be duplicated.
- ✓ E.g. Roll Number of a student is Unique.

4. Primary Key

- ✓ Ensures that a column or a group of columns identify uniquely each row in the table.
- ✓ A column cannot have NULL values and cannot be duplicated.
- ✓ E.g. Roll Number of a student is Unique.

Integrity Constraint

5. Foreign Key

- ✓ Also known as Referential Integrity Constraint
- ✓ Allows a table to refer a column of another table with Primary Key
- ✓ For e.g.
Student (sroll, sname, std)
Result (sroll, m1, m2, m3, result)

Primary Key

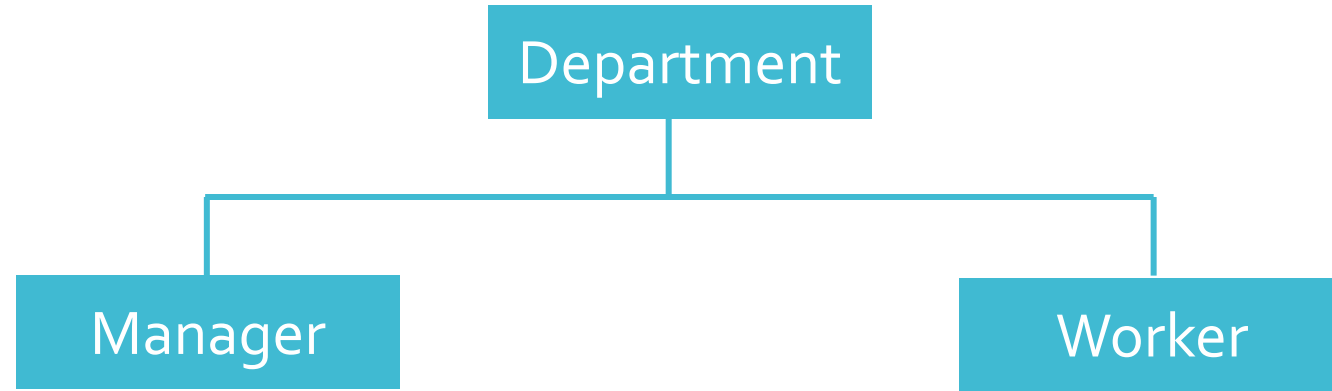
Foreign Key referring to sroll
column of Student table

Database Models

- A database model describes the logical structure of a database.
- It describes whether how a data can be stored, accessed and updated.
- The most popular example of a database model is Relational Model
- Types of Database Model are:
 1. Hierarchical Model
 2. Network Model
 3. Relational Model
 4. Object Oriented Model
 5. Entity Relationship Model

Database Models (Hierarchical Model)

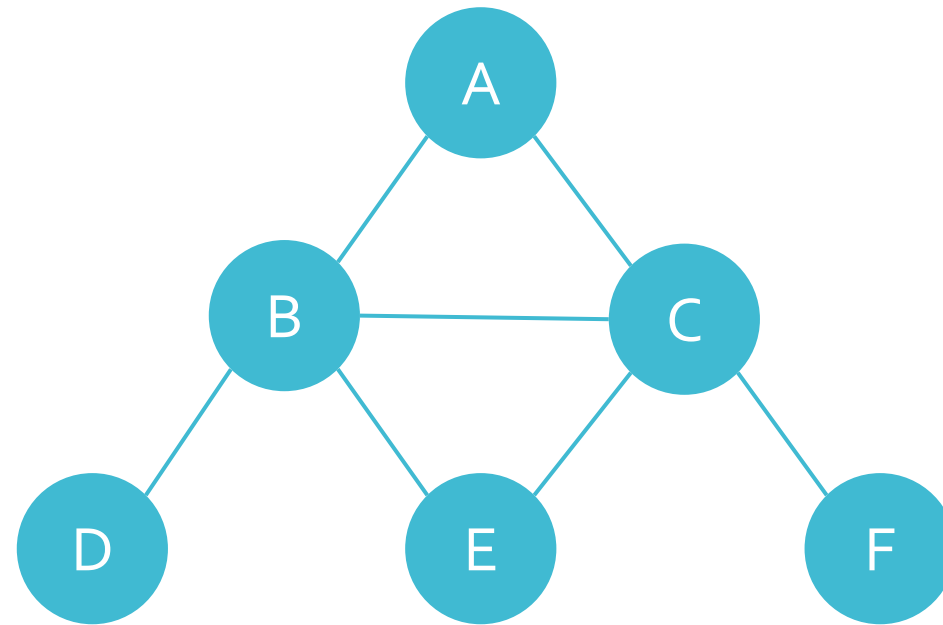
In this, the data is organized into a tree-like structure, where each record has a single parent or root.



- ✓ The data is organised into tree-like structure with one data component connected to many other data components.
- ✓ For example, one department can have many managers and many workers.

In this, the data is organized into a tree-like structure, where each record can have multiple parents or roots.

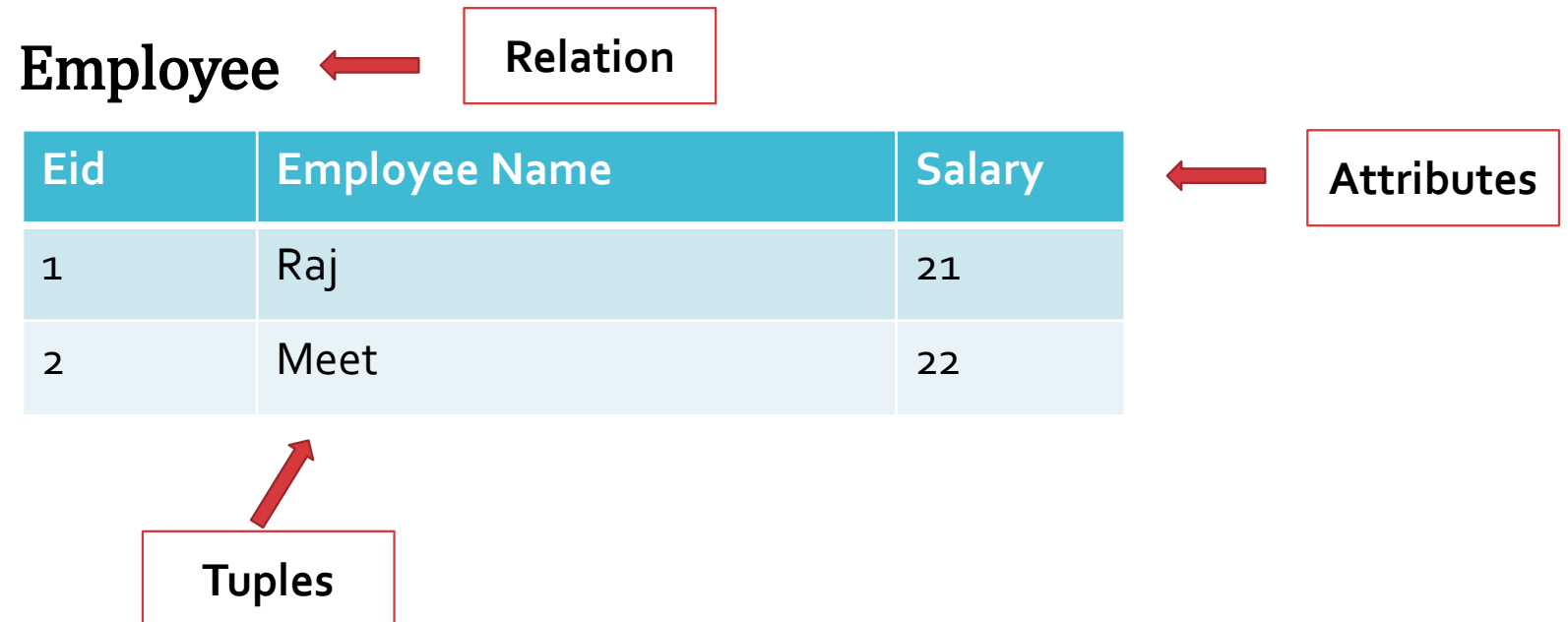
Database Models (Network Model)



- ✓ The data is organised into tree-like structure more than one data components connected to more than one other data components.

Database Models (Relational Model)

- In this, the data is stored in the table known as Relation.
- A Relation contain Rows known as Tuples and column known as Attributes



Object oriented data model is based upon real world situations.

Objects: The real world components and situations are represented as objects

Attributes and Method:

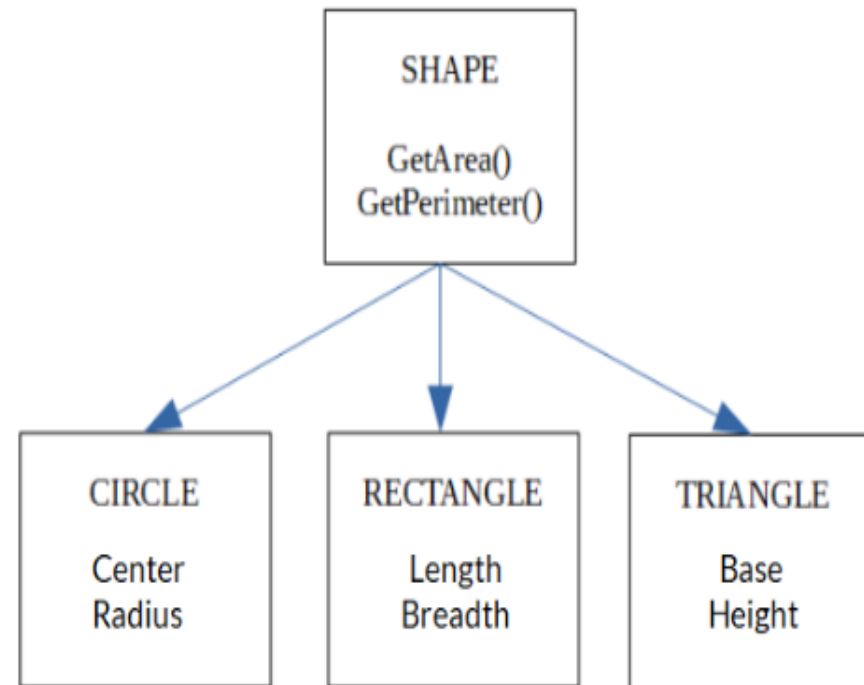
Every object has certain characteristics. These are represented using Attributes. The behavior of the objects is represented using Methods.

Class: Similar attributes and methods are grouped together using a class. An object can be called as an instance of the class.

Database Models (Object Oriented Model)

Inheritance: A new class can be derived from the original class. The derived class contains attributes and methods of the original class as well as its own.

For E.g.



- ✓ Shape, Circle, Rectangle and Triangle are all classes in this model.
- ✓ Shape has methods as `GetArea()` and `GetPerimeter()`
- ✓ Circle has the attributes `Center` and `Radius`.
- ✓ Rectangle has the attributes `Length` and `Breadth`
- ✓ Triangle has the attributes `Base` and `Height`.
- ✓ The Circle, Rectangle and Triangle classes inherit from the class Shape.

Database Models (Object Oriented Model)

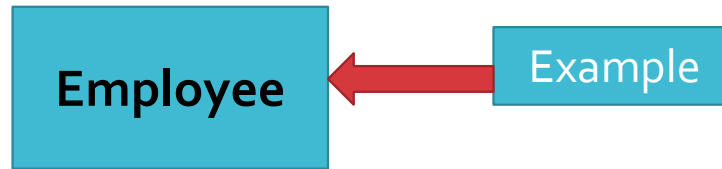
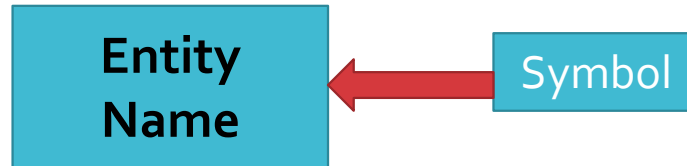
E-R Diagram

- Stands for Entity-Relationship diagram.
- It is a graphical or a pictorial representation of a database.
- It uses different types of symbols to represent various instances of database

E-R Diagram (Entity)

- An entity is a “thing” or “object” in the real world that is distinguishable from all other objects.
- For example, each Employee in a firm is an entity.
- An entity has a set of properties, and the values for some set of properties may uniquely identify an entity.

An entity is represented by a **rectangle** which contains the name of an entity.



E-R Diagram (Entity)

1. Write down the different **entities** of college database.
2. Write down the different **entities** of hotel database.

E-R Diagram (Entity Set)

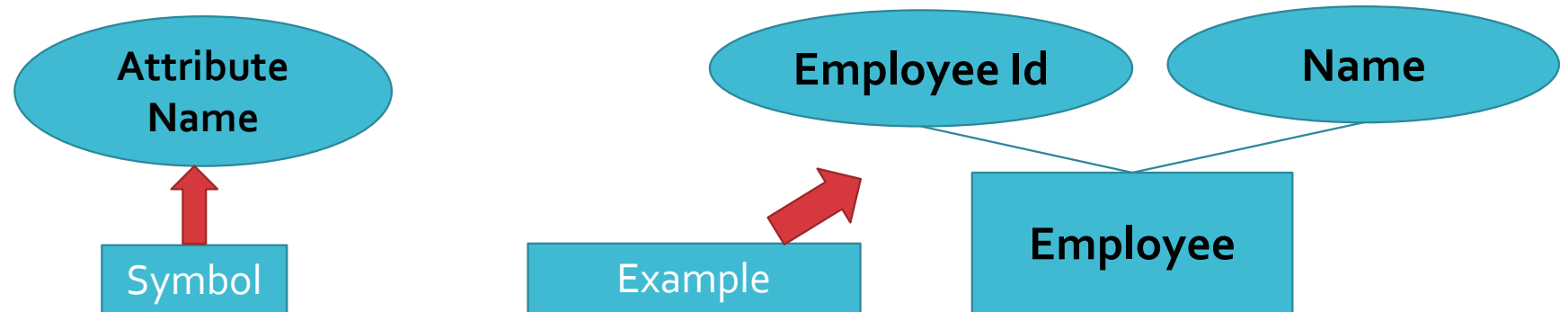
➤ It is a collection of different entities of same type.

Examples:

- All the employees working in a firm
- All persons having an account in a bank
- All the students studying in a school


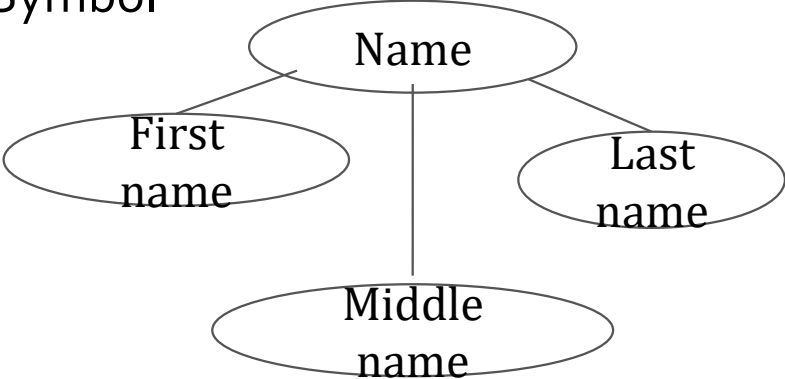
E-R Diagram (Attributes)

- Each entity is described by a set of attributes/properties. In short, Attributes define details of Entity
- An attribute is represented by an **oval** containing name of an attribute.
- For e.g., Employee ID and Name are the attributes of Employee.


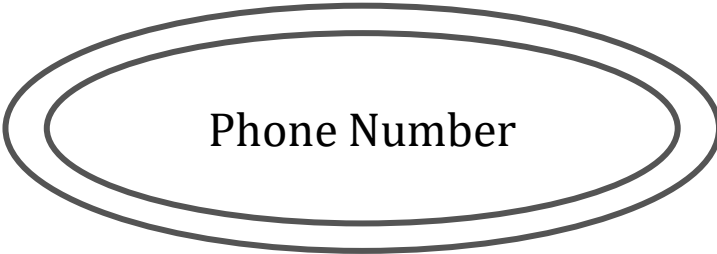


1. Write down the different **attributes** of college database.
2. Write down the different **attributes** of hotel database.

E-R Diagram (Types of Attributes)

Simple Attribute	Composite Attribute
Cannot be divided into sub attributes	Can be divided into sub attributes
E.g. Employee ID	E.g. Name (first name, middle name, last name)
Symbol 	Symbol 

E-R Diagram (Types of Attributes)

Single-Valued Attribute	Multi-Valued Attribute
Can have only 1 value	Can have multiple values
E.g. Employee ID	E.g. Phone Number (Can have more than 1 phone numbers)
Symbol 	Symbol 

E-R Diagram (Types of Attributes)

Derived Attributes

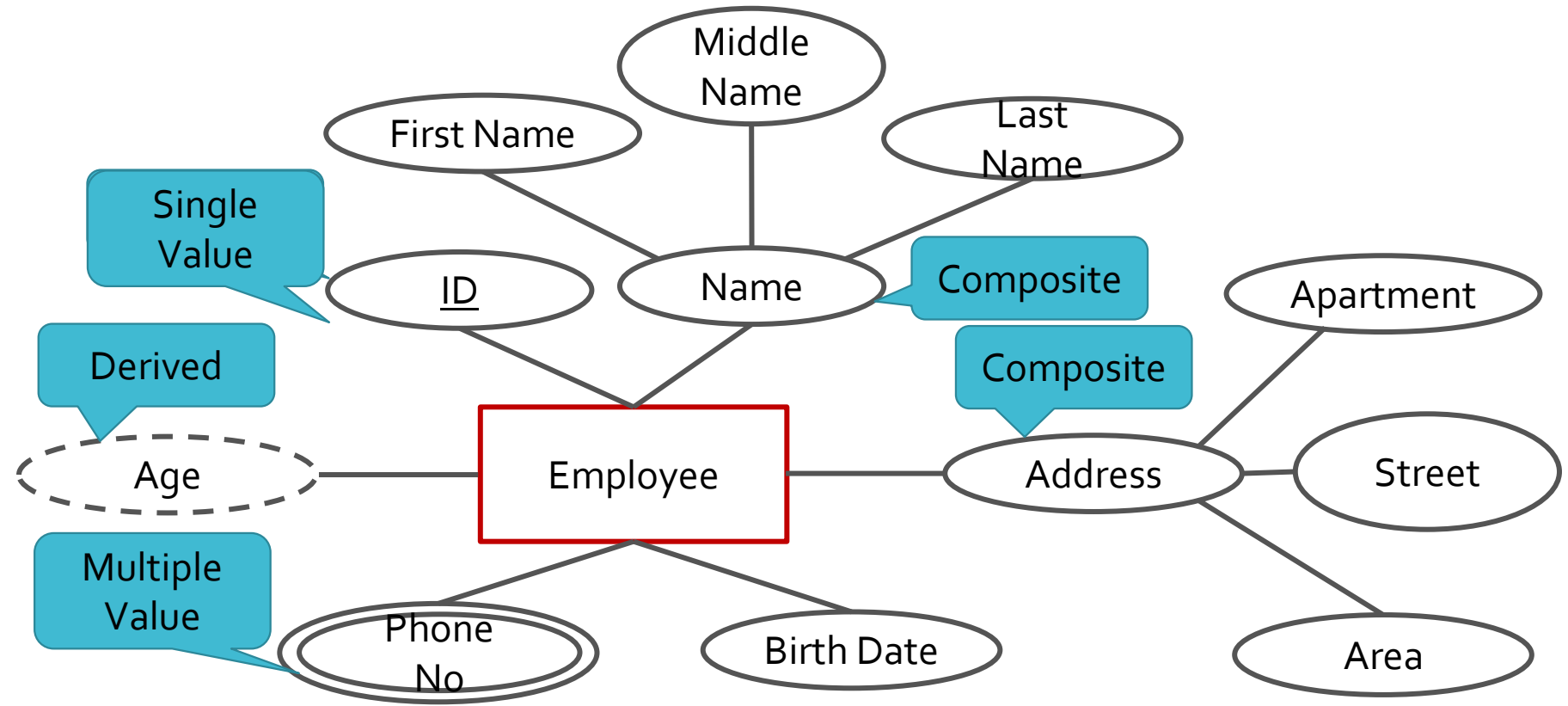
It's value is derived or calculated from other attributes.

For e.g. Age of a person can be easily known from his/her birthdate

Symbol:



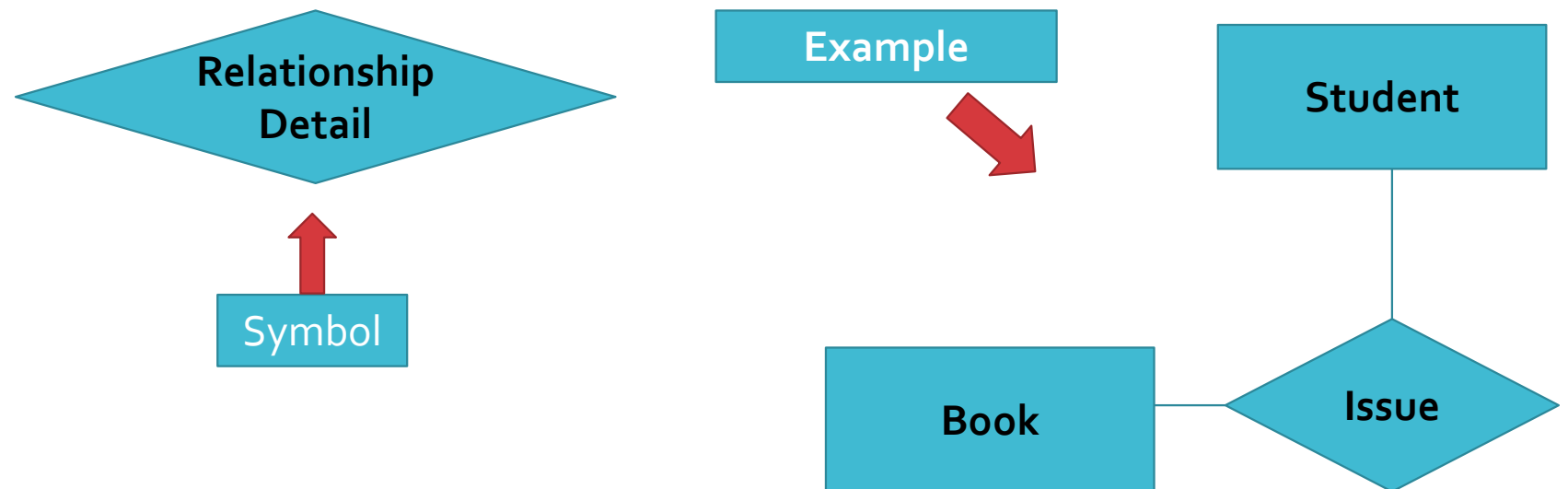
E-R Diagram (Attributes Example)



1. Create E-R Diagram for **college database**. Use all types of Attributes
2. Create E-R Diagram for **hotel database**. Use all types of Attributes

E-R Diagram (Relationship Set)

- Relationship is link between several entities.
- It must be placed between two entities and a line linking it to an entity.
- A relationship is represented by a **diamond** containing relationship details.
- A Relationship between 2 Entities is called **Binary Relationship** and A Relationship between 3 Entities is called **Ternary Relationship**.

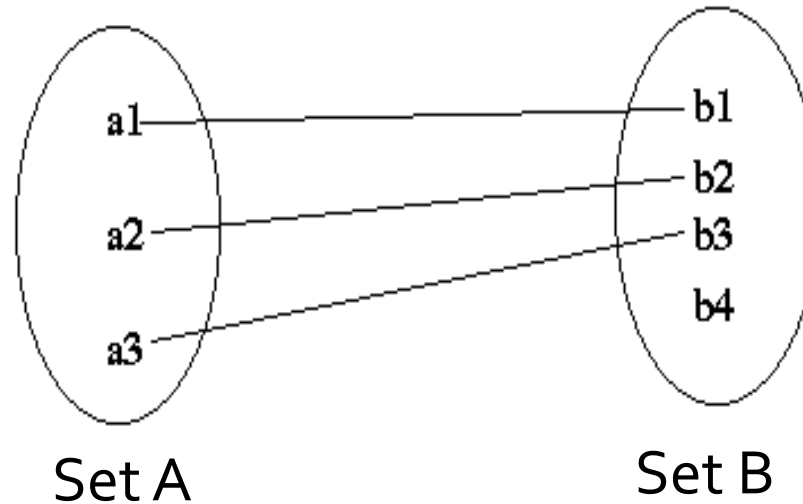


Mapping Cardinality

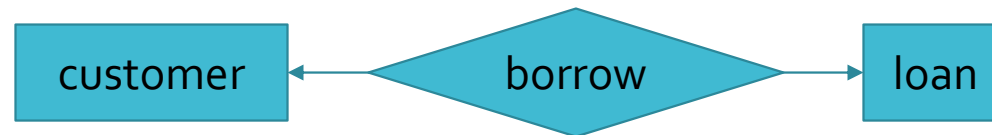
- It defined number of entities of one entity set connected to number of entities of another entity set using a relationship set.
- Mapping cardinalities are most useful in describing binary relationship sets.
- The mapping cardinality are of following types:
 1. One to One
 2. One to Many
 3. Many to One
 4. Many to Many

Mapping Cardinality (One to One)

An entity in entity set **A** is associated with at most one entity in entity set **B**, and an entity in entity set **B** is associated with at most one entity in entity set **A**.



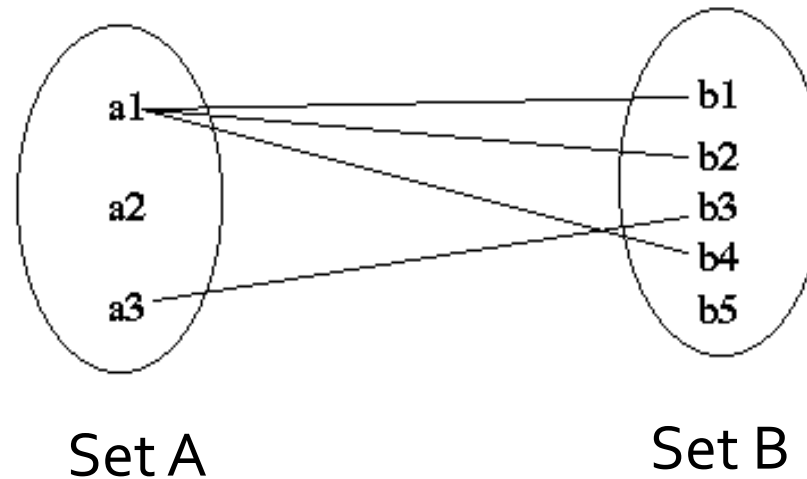
For e.g.



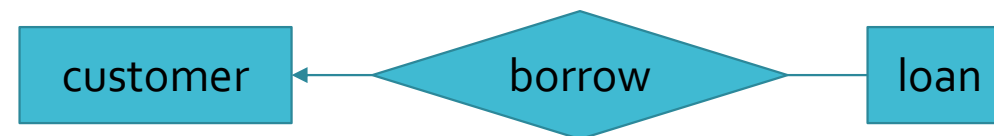
One Customer is connected with only one Loan and One Loan is connected to only One Customer using Borrow Relationship Set.

An entity in entity set A is associated with any number (more than 1) of entities in entity set B. An entity in entity set B is associated with at only one entity in entity set A.

Mapping Cardinality (One to Many)

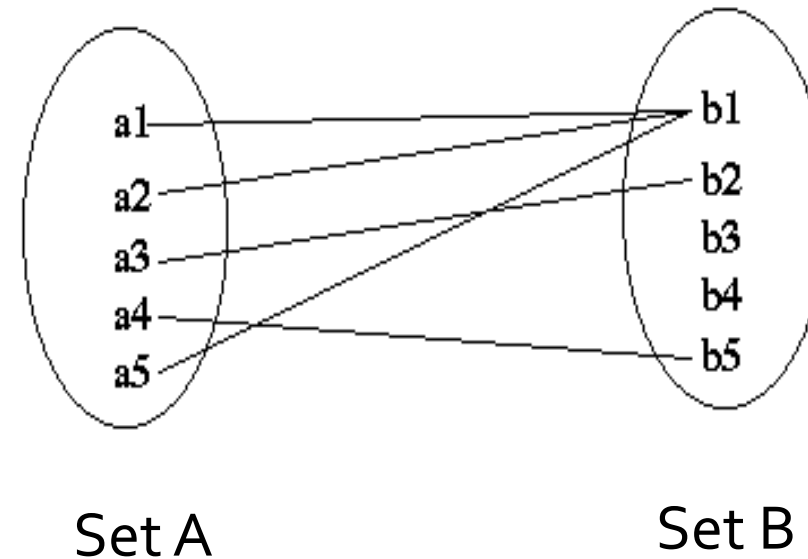


For e.g.

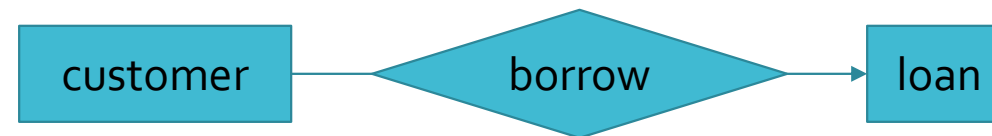


One Customer is connected with more than one Loan; but, One Loan is connected to only One Customer using Borrow Relationship Set.

An entity in entity set A is associated with only one entity in entity set B. An entity in entity set B is associated with more than one entities in entity set A.



For e.g.

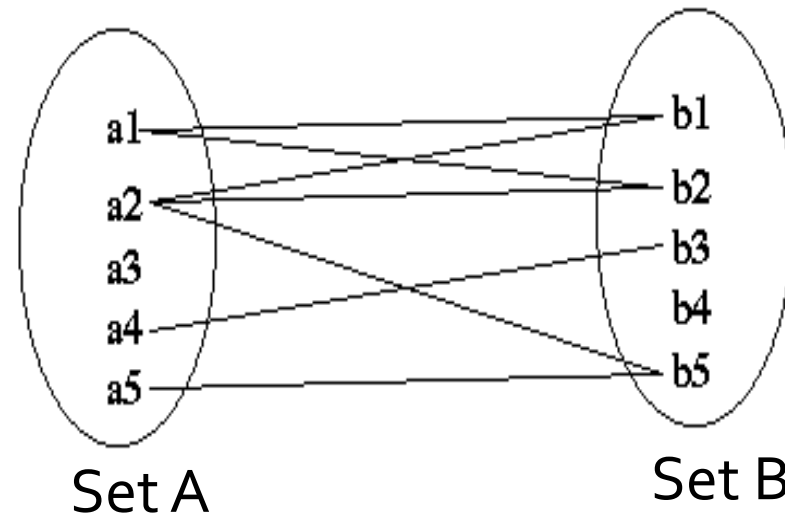


One Loan is connected to more than one Customers; but, One Customer is connected with only one Loan using Borrow Relationship Set.

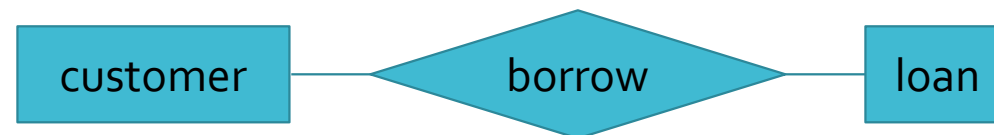
Mapping Cardinality (Many to One)

Mapping Cardinality (Many to Many)

More than one entities in entity set A is associated with more than one entities in entity set B. More than one entities in entity set B is associated with more than one entities in entity set A.



For e.g.



One Loan is connected to more than one Customers and One Customer is connected with more than one Loan using Borrow Relationship Set.

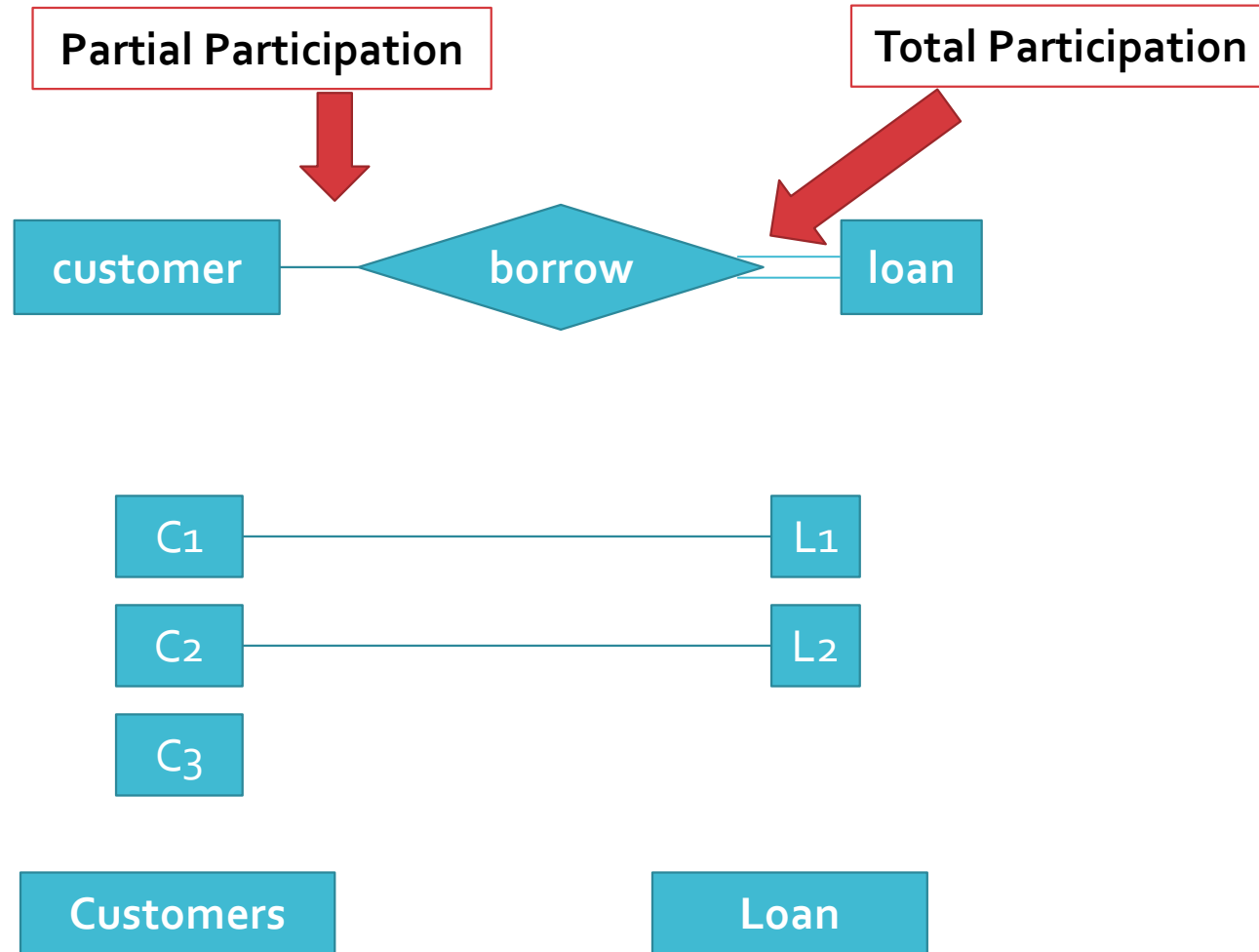
Participation Constraints

It specifies the participation of an entity set in a relationship set.

There are two types participation constraints:

- **Total participation:**
every entity in the entity set participates in at least one relationship in the relationship set. It is denoted by **Double Line**
- **Partial participation**
some entities in the entity set may not participate in any relationship in the relationship set. It is denoted by **Single Line**

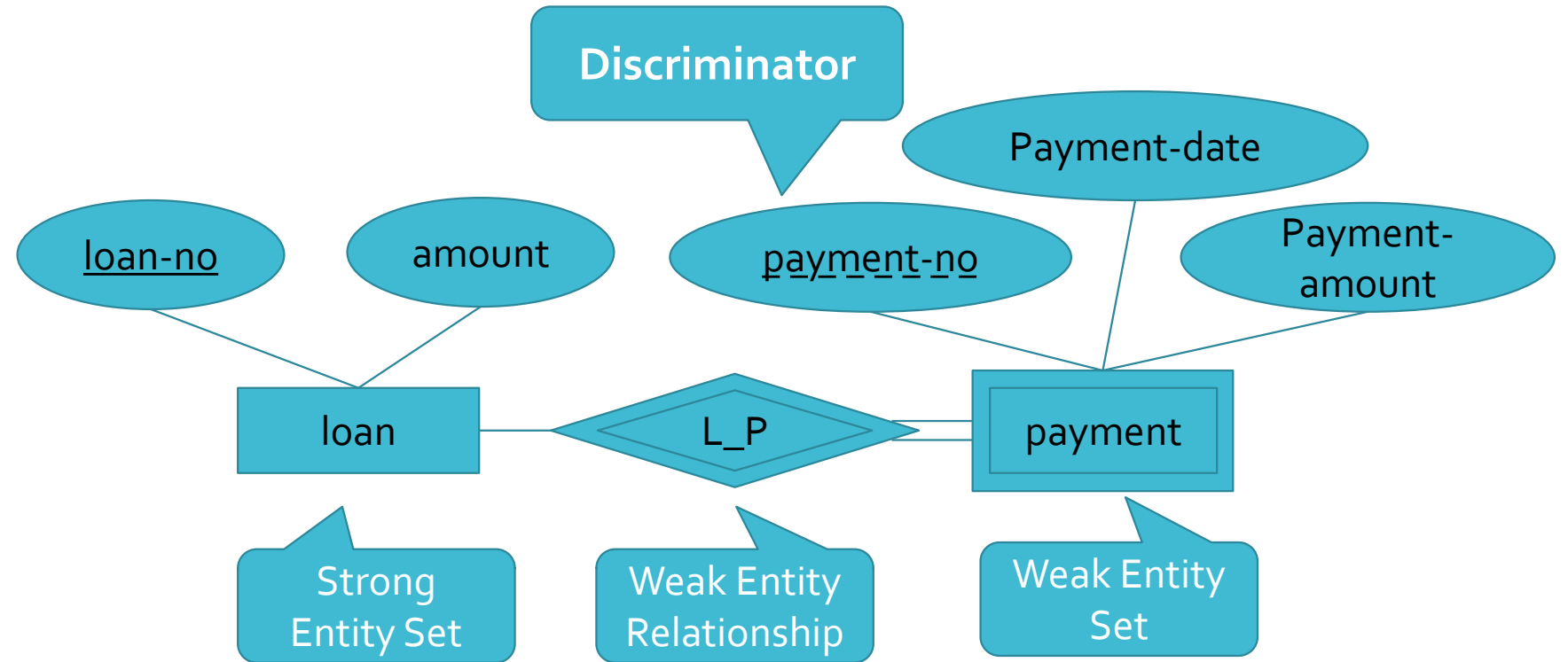
Participation Constraints (Example)



Weak Entity Set

- An entity set that does not have a primary key is called weak entity set.
- It is denoted by double rectangle symbol.
- When a weak entity set is connected with strong entity set by some relation, then the relation is known as Weak Relationship Set.
- It is denoted by Double Diamond.
- A **Discriminator** in Weak Entity Set distinguishes all other entities.
- It is denoted by Dashed Line
- To make Relationship stronger, the Primary Key is created by combining Discriminator of Weak Entity Set and Primary Key of Strong Entity Set.

Weak Entity Set (Example)

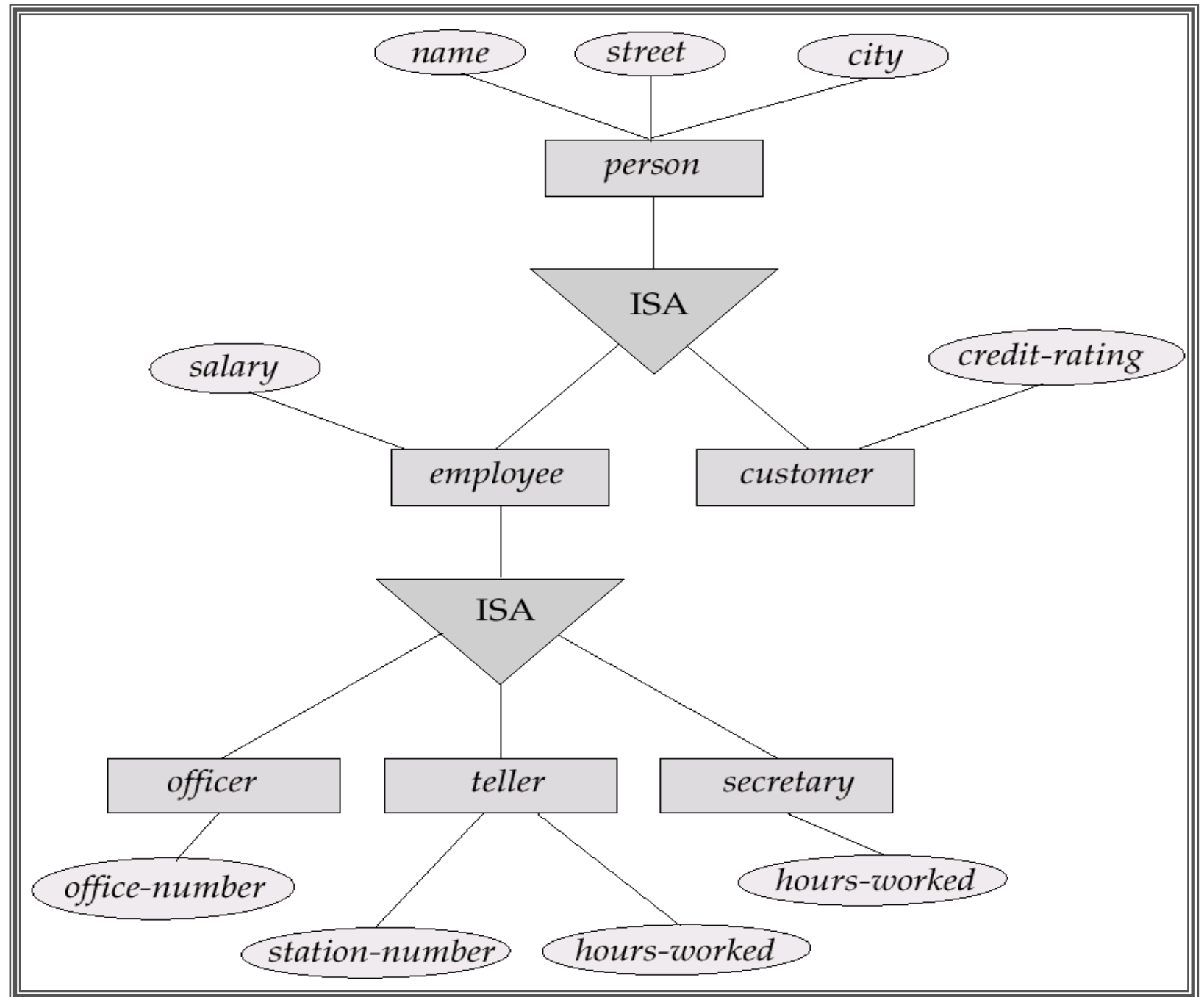


- In the above example, the relationship can be made stronger by creating Primary Key by combining Discriminator of Weak Entity Set and Primary Key of Strong Entity Set.
- In above e.g. **payment-no** (Discriminator) & **loan-no** (Primary Key) combines to generate **Composite Primary Key** as (loan-no, payment-no)

Extended E-R Diagram : Specialization

- The process of creating sub-groups within an entity is called specialization.
- Top-Down design process; designate subgroupings within an entity set that are distinctive from other entities in the set.
- The process of taking a subset of higher level entity set to form a lower level entity set.
- Uses a triangle component labeled as “ISA”

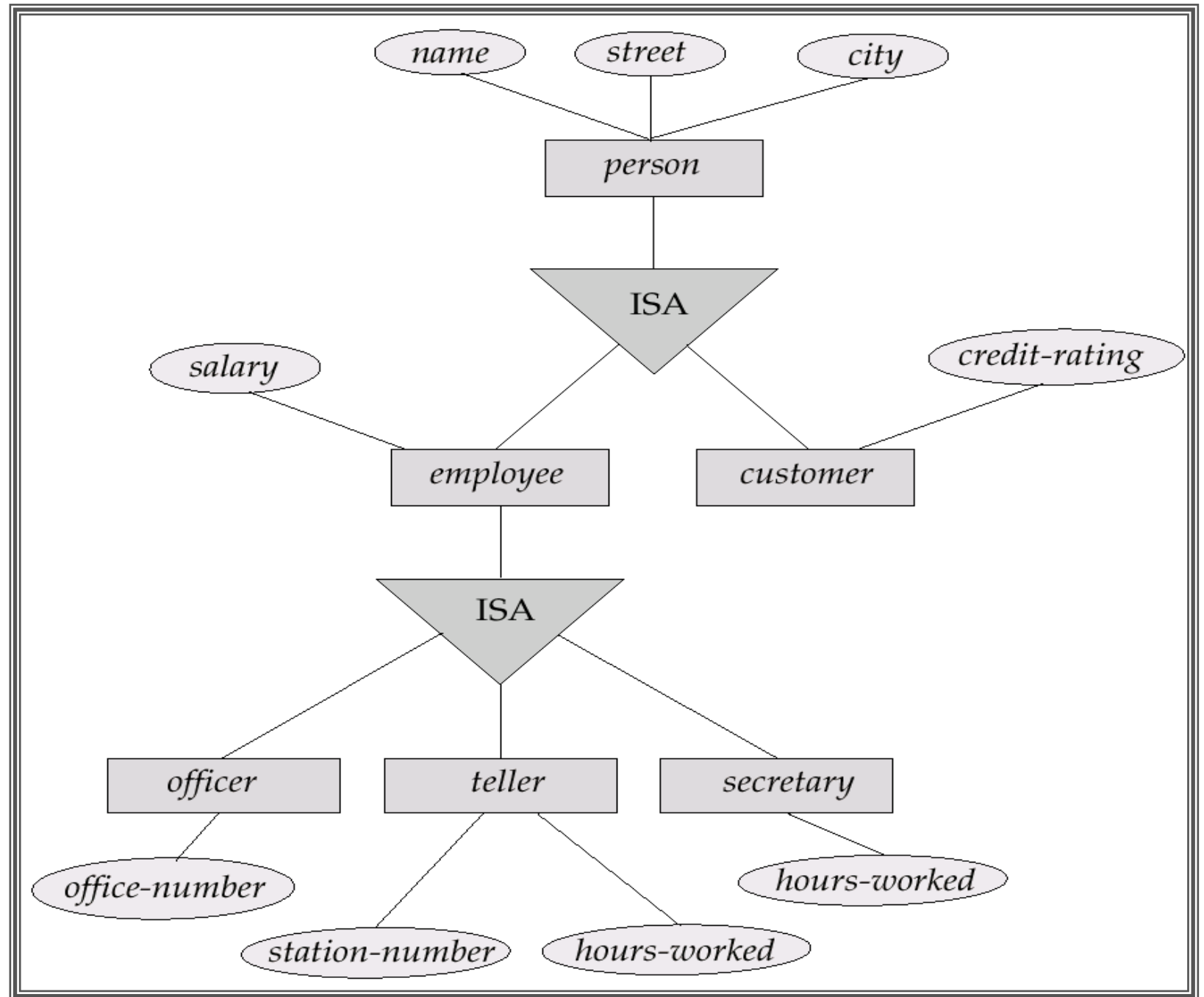
Specialization (Example)



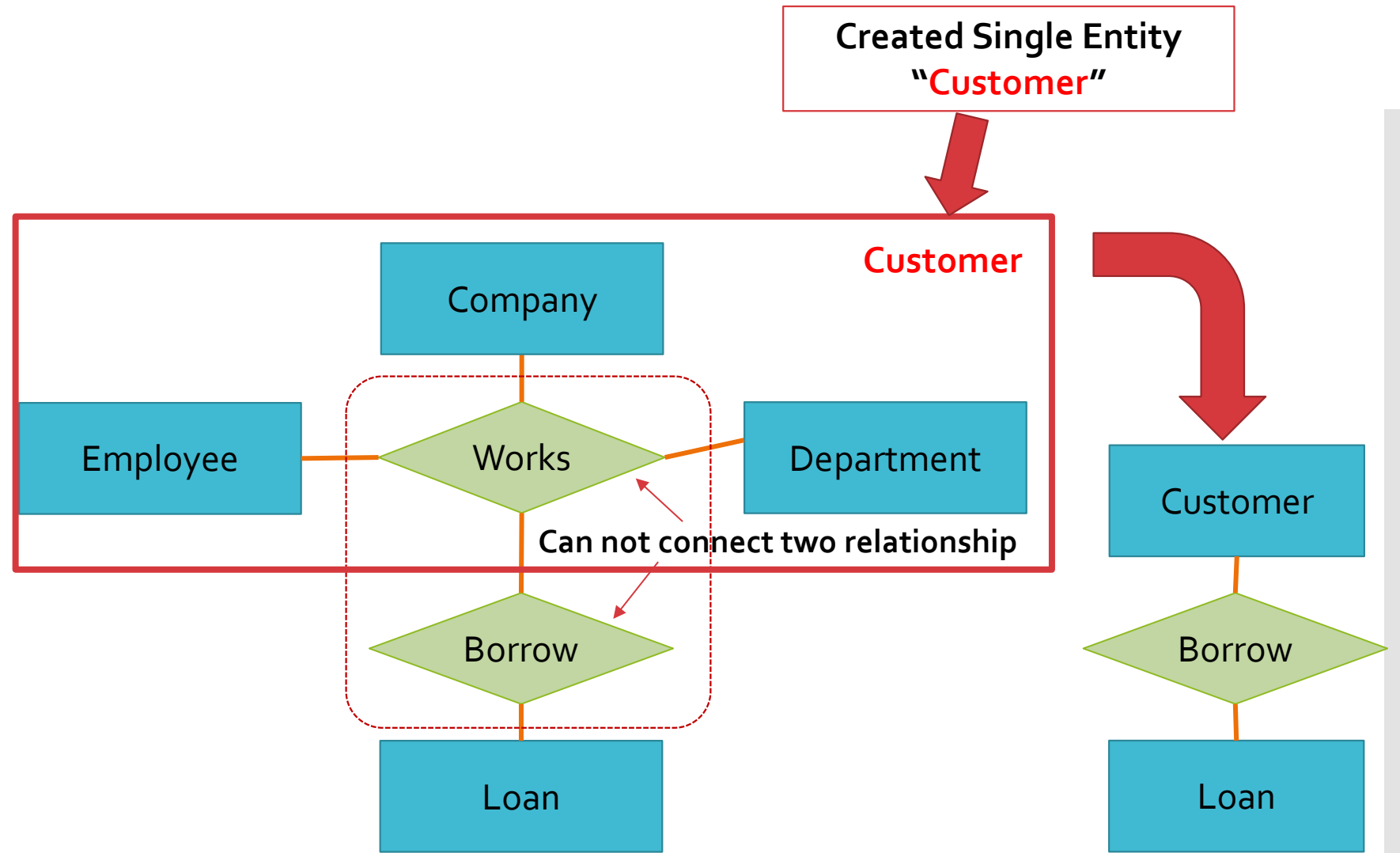
Extended E-R Diagram : Generalization

- The process of creating a main group from different entities is called generalization.
- Bottom-Up design process; combine a number of entity sets that share the same features into a higher-level entity set.
- The process of combining two or more low level entity sets to generate high level entity set.
- Uses a triangle component labeled as “ISA”

Generalization (Example)

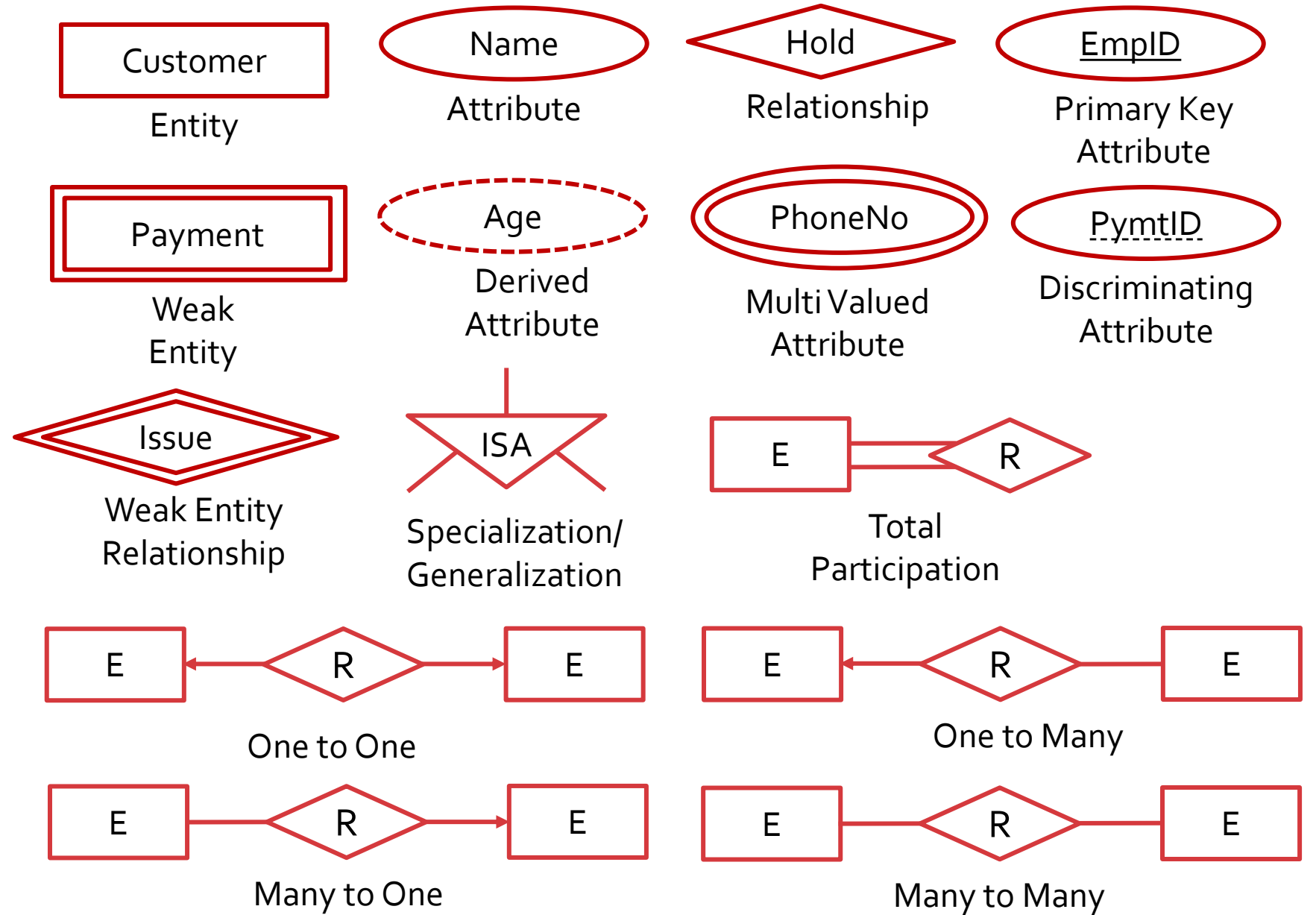


Aggregation

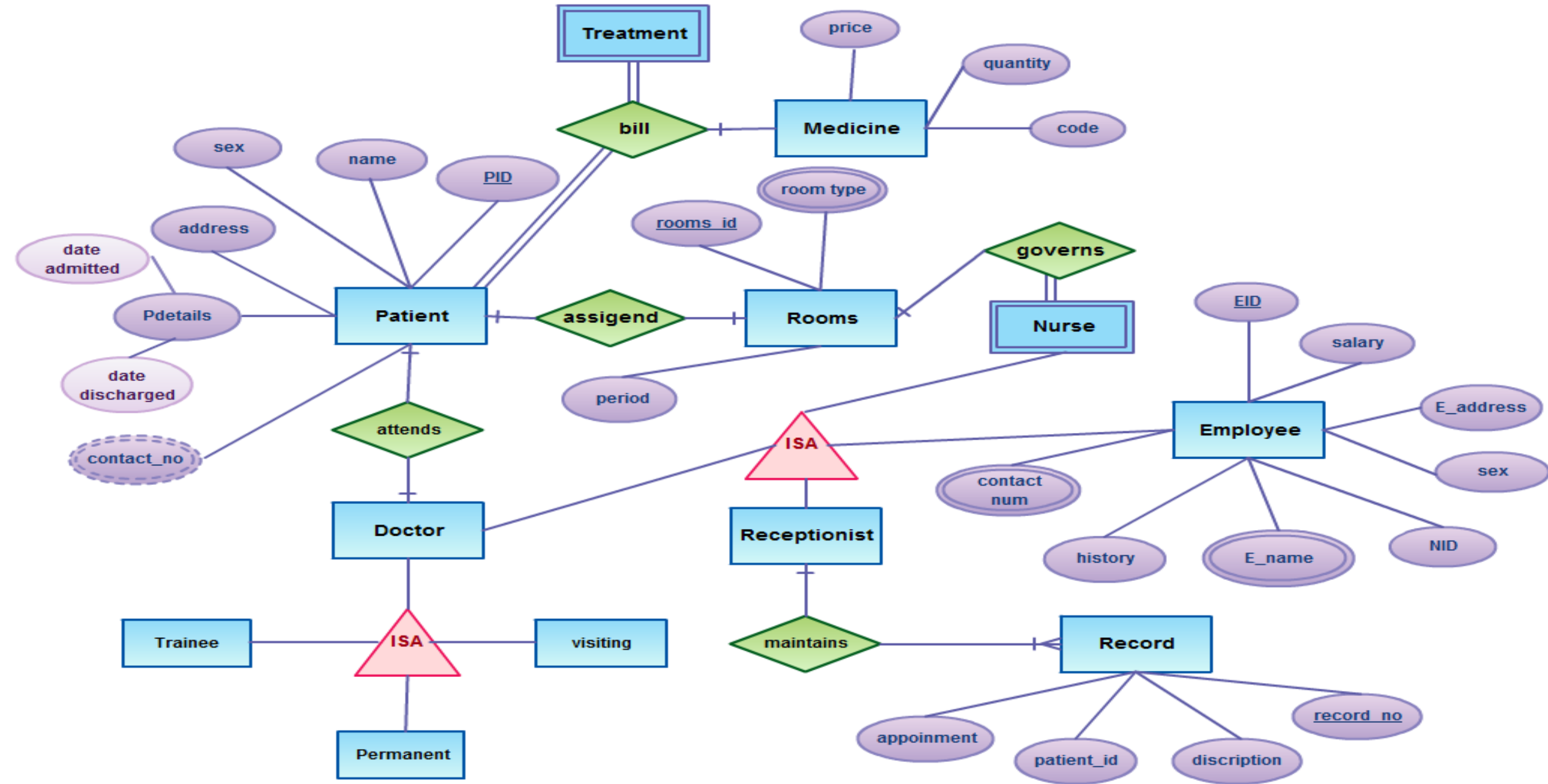


This process of merging various entities into one single entity is called Aggregation.

E-R Diagram (Summary)



E-R Diagram for Hospital Management System



E-R Diagram (Home Work)

Draw E-R Diagram for the following:

- 1) Hospital Management
- 2) School Management
- 3) Library Management
- 4) Hotel Management
- 5) Bus/Airline/Train Reservation

Tips for Examination:

- ✓ Define minimum 4 entities with at least 4 attributes.
- ✓ Provide all types of attributes somewhere in any of the entities
- ✓ Show weak entity set, few mapping cardinalities.

Thanks