CSE-221

Database Management Systems

ER Diagrams

Reference:

Book Chapter 6

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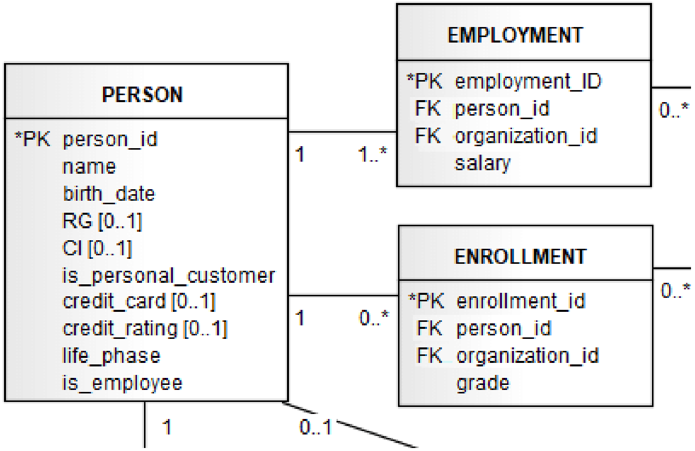
Concepts learnt so far

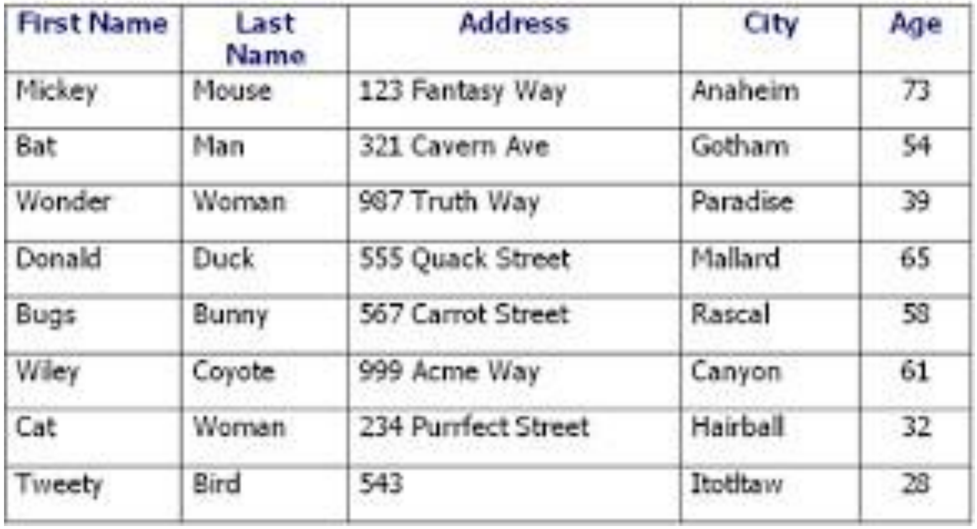
1. SQL
2. DML
3. DDL

4. Schema
5. Relations

Schema vs. Relations



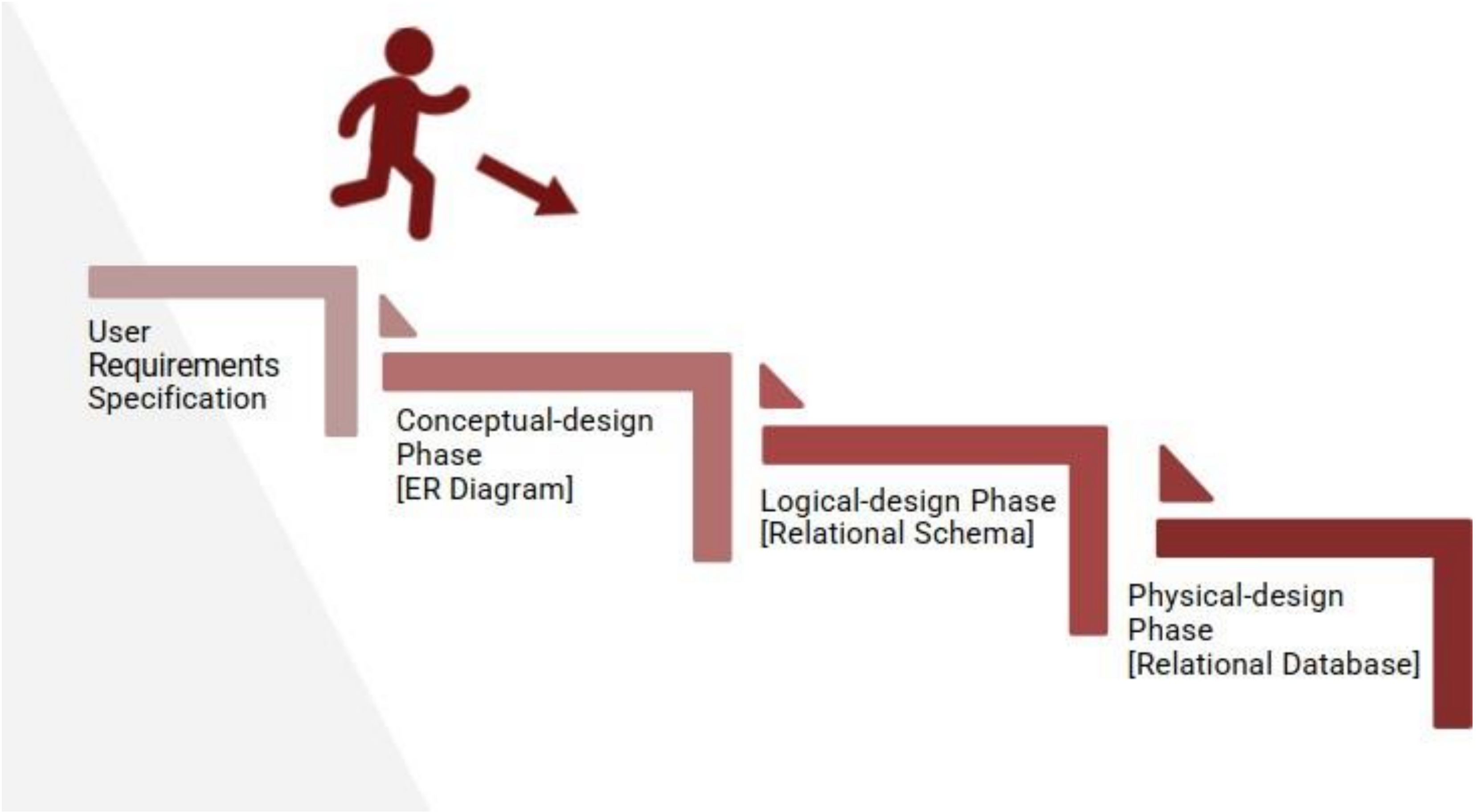
Schema contains design of table/schema



First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
Wiley	Coyote	999 Acme Way	Canyon	61
Cat	Woman	234 Purrfect Street	Hairball	32
Tweety	Bird	543	Itotltaw	28

Relations contain actual data

DB Design Steps



User Requirements Specification

Conceptual-design Phase [ER Diagram]

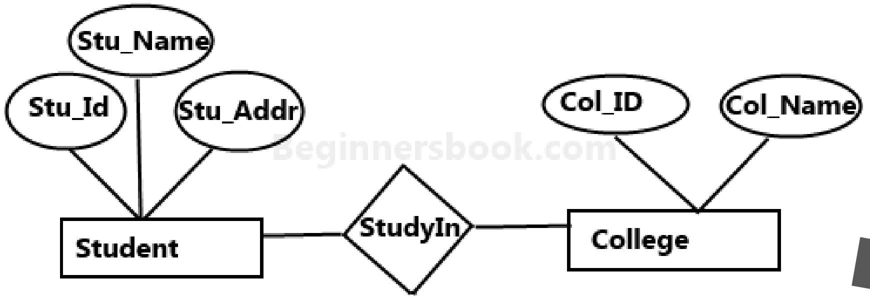
Logical-design Phase [Relational Schema]

Physical-design Phase [Relational Database]

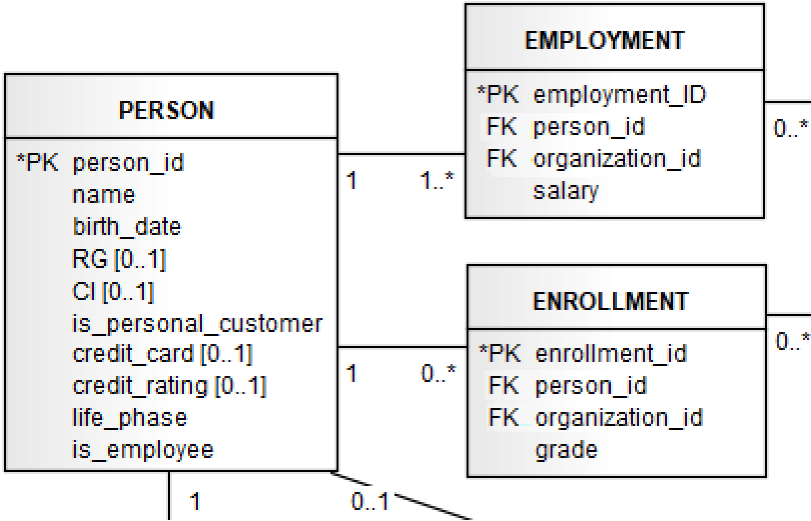
DB Design Steps

1. User Requirement Specification (Planning)

2. ER Diagram (Conceptual Design)



3. Relational Schema (Logical Design)



ER Diagram

- Stands for Entity Relationship Model
- High-level conceptual data model diagram
- Helps to systematically analyze data requirements to produce a well-designed database.
- Represents real-world entities and the relationships between them

- It is a GUI representation of the logical structure of a Database

Components

This model is based on three basic concepts:

1. Entities
2. Attributes
3. Relationships

We also have

- Entity Set
- Relationship Set

Example

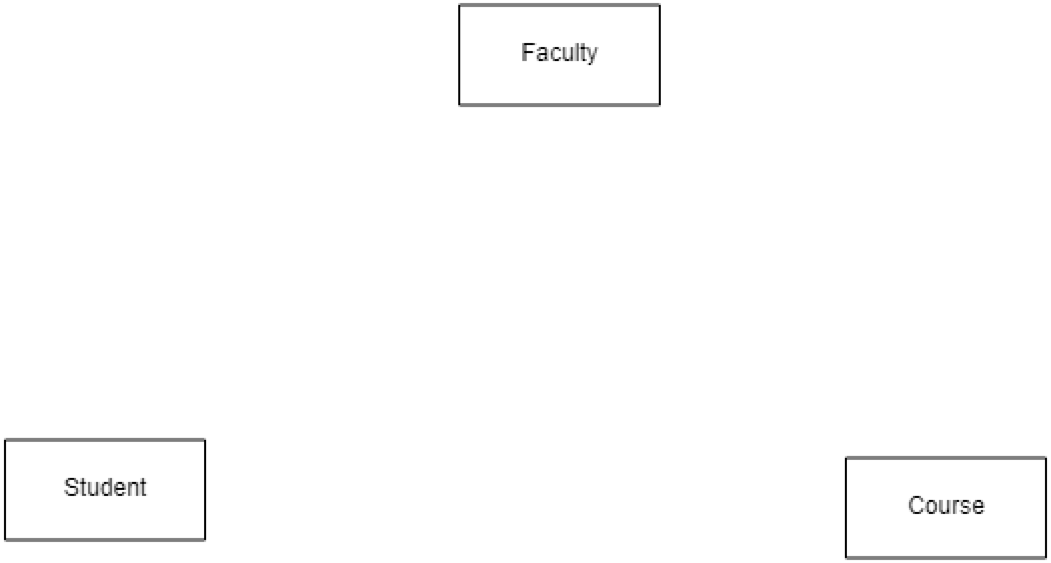
Consider the following scenario:

"Faculty conducts a course. Students enroll in a course"

- Identify the entities, relationships, and attributes
- Give examples of entity set and relationship set

Solution

"Faculty conducts a course. Students enroll in a course"



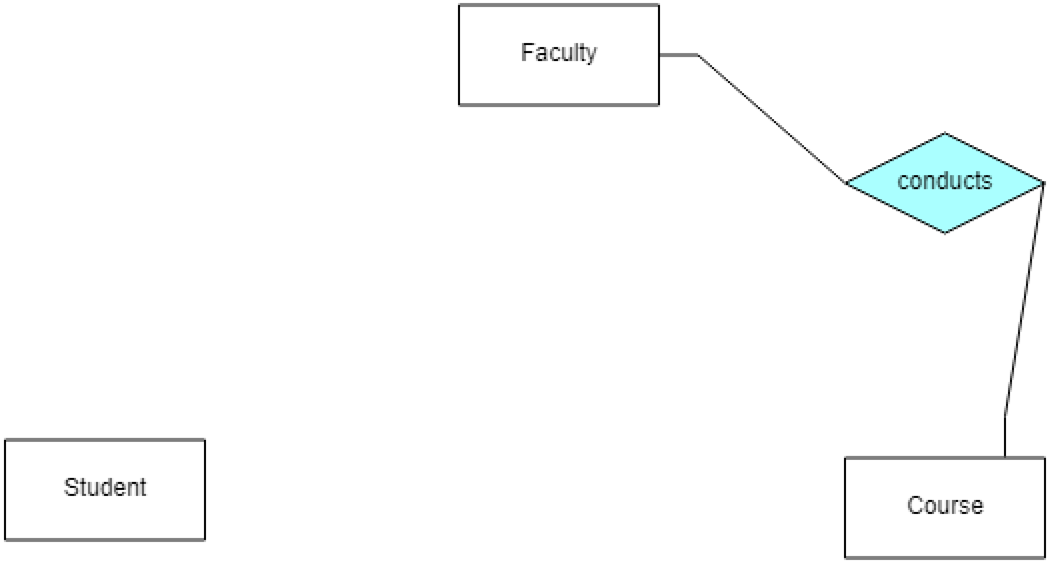
Faculty

Student

Course

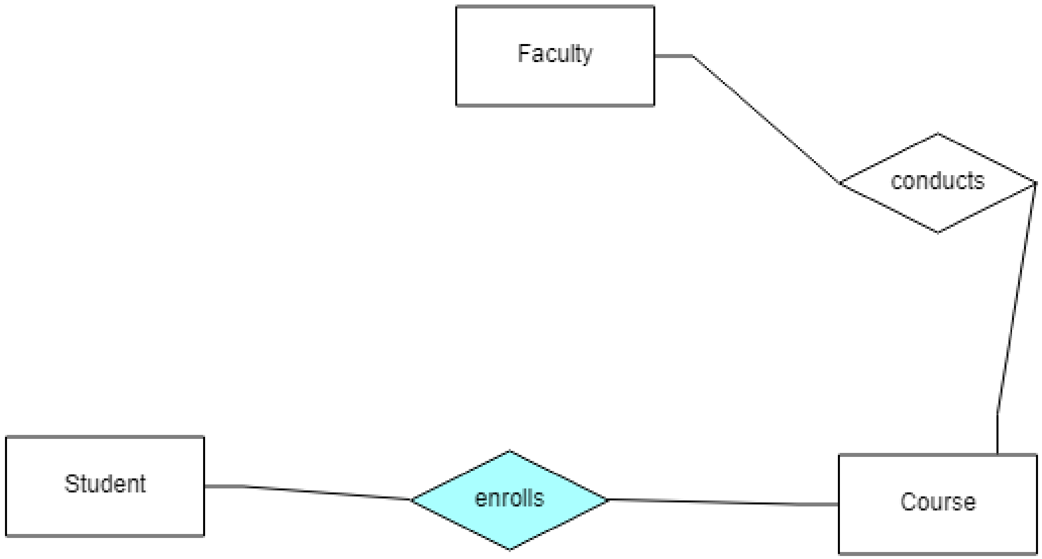
Solution

"Faculty conducts a course. Students enroll in a course"



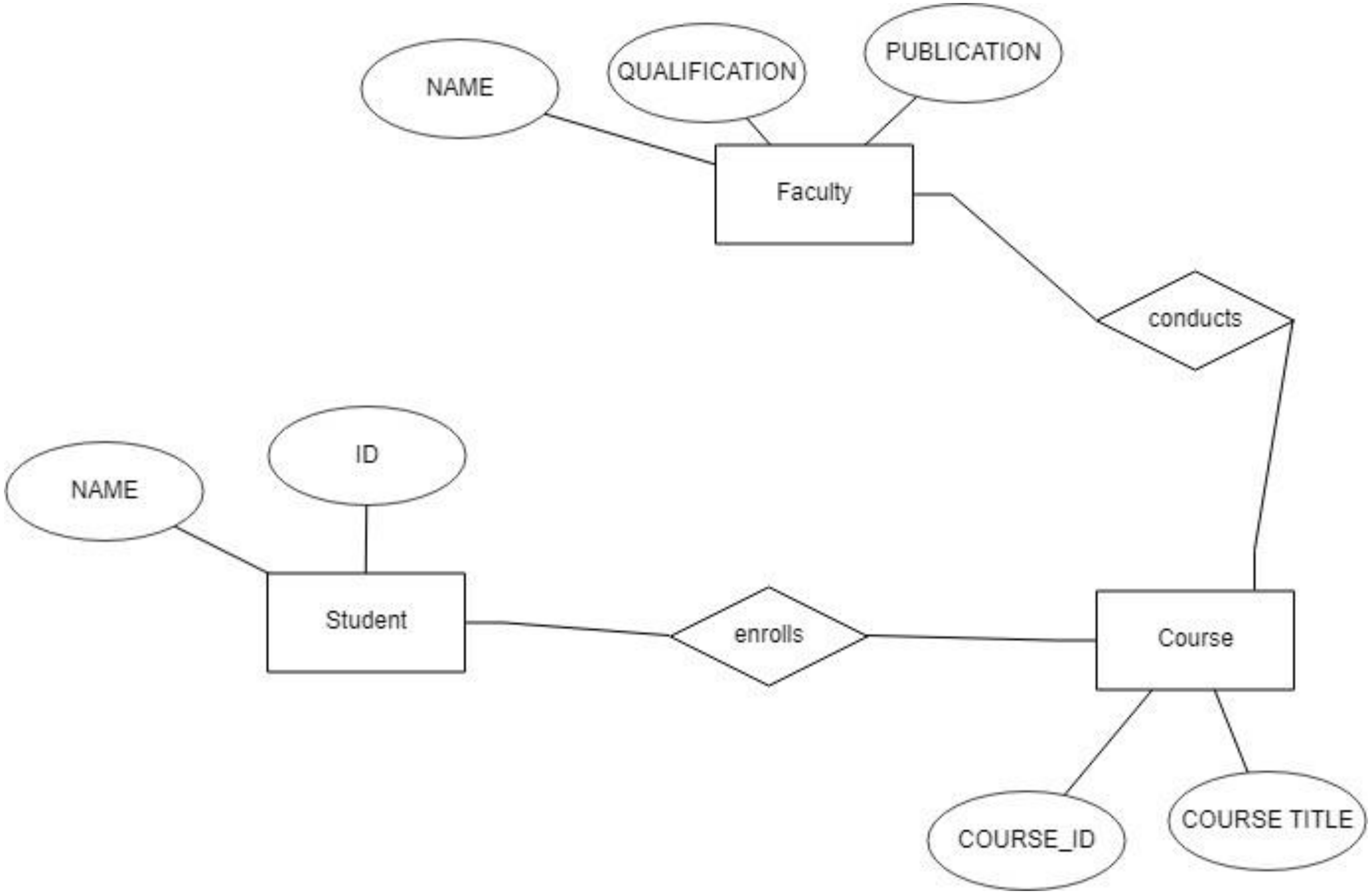
Solution

"Faculty conducts a course. Students enroll in a course"



Solution

"Faculty conducts a course. Students enroll in a course"



Definitions

- Entity: It is a real-world object about which we collect data. In other words, it is a definable thing that can have data stored about it.

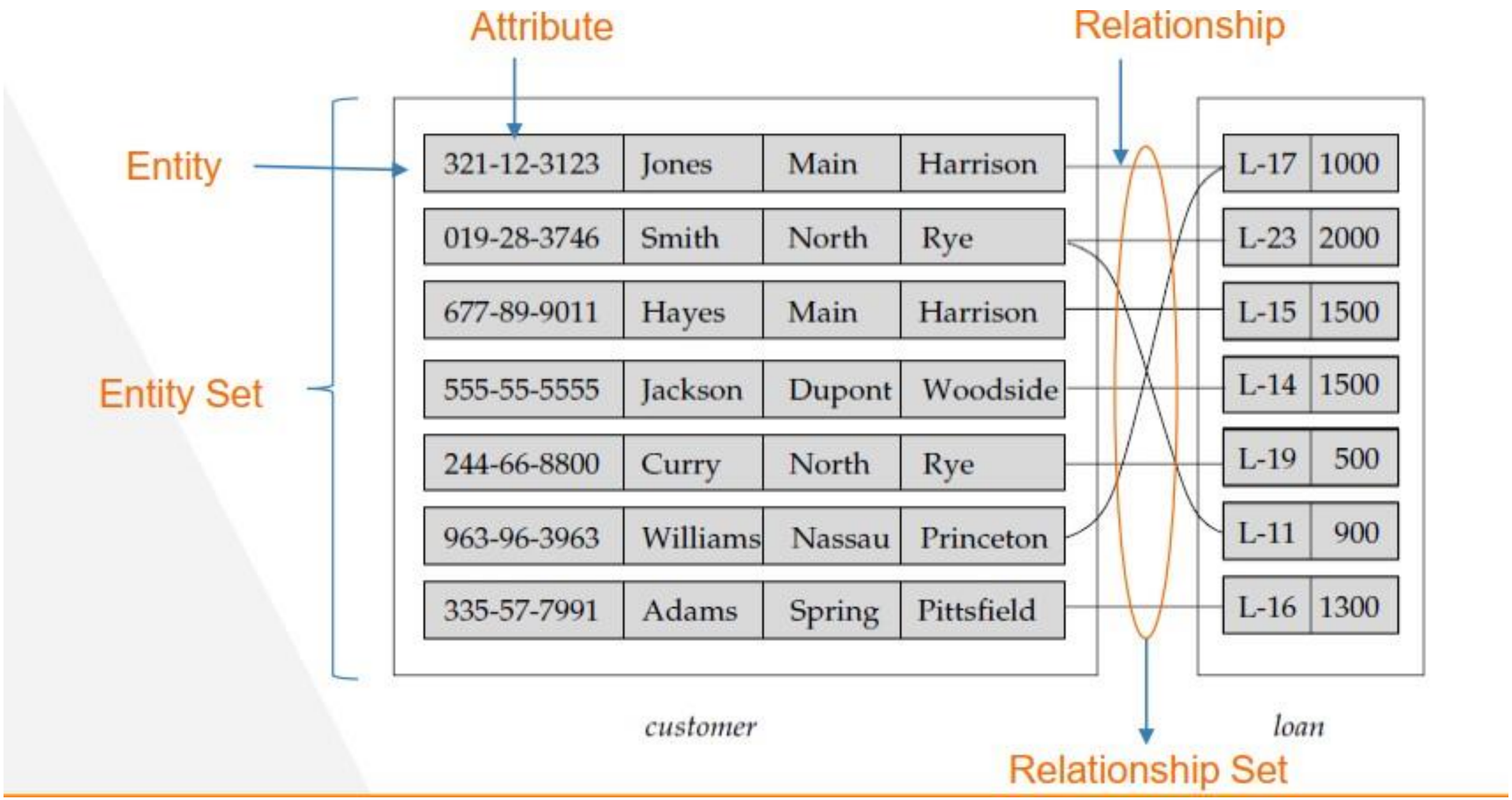
- Entity Set: An entity set is a set of entities of the same type that share the same properties or attributes.

- Attributes: Attributes are descriptive properties of the entities in the entity set. Each entity has its own value for each attribute.

- Relationship: It is an association among several entities.

- Relationship Set: It is a set of relationships of the same type

Example ER Diagram Components in a ?



Attribute

Relationship

Entity

Entity Set

321-12-3123	Jones	Main	Harrison
019-28-3746	Smith	North	Rye
677-89-9011	Hayes	Main	Harrison
555-55-5555	Jackson	Dupont	Woodside
244-66-8800	Curry	North	Rye
963-96-3963	Williams	Nassau	Princeton
335-57-7991	Adams	Spring	Pittsfield

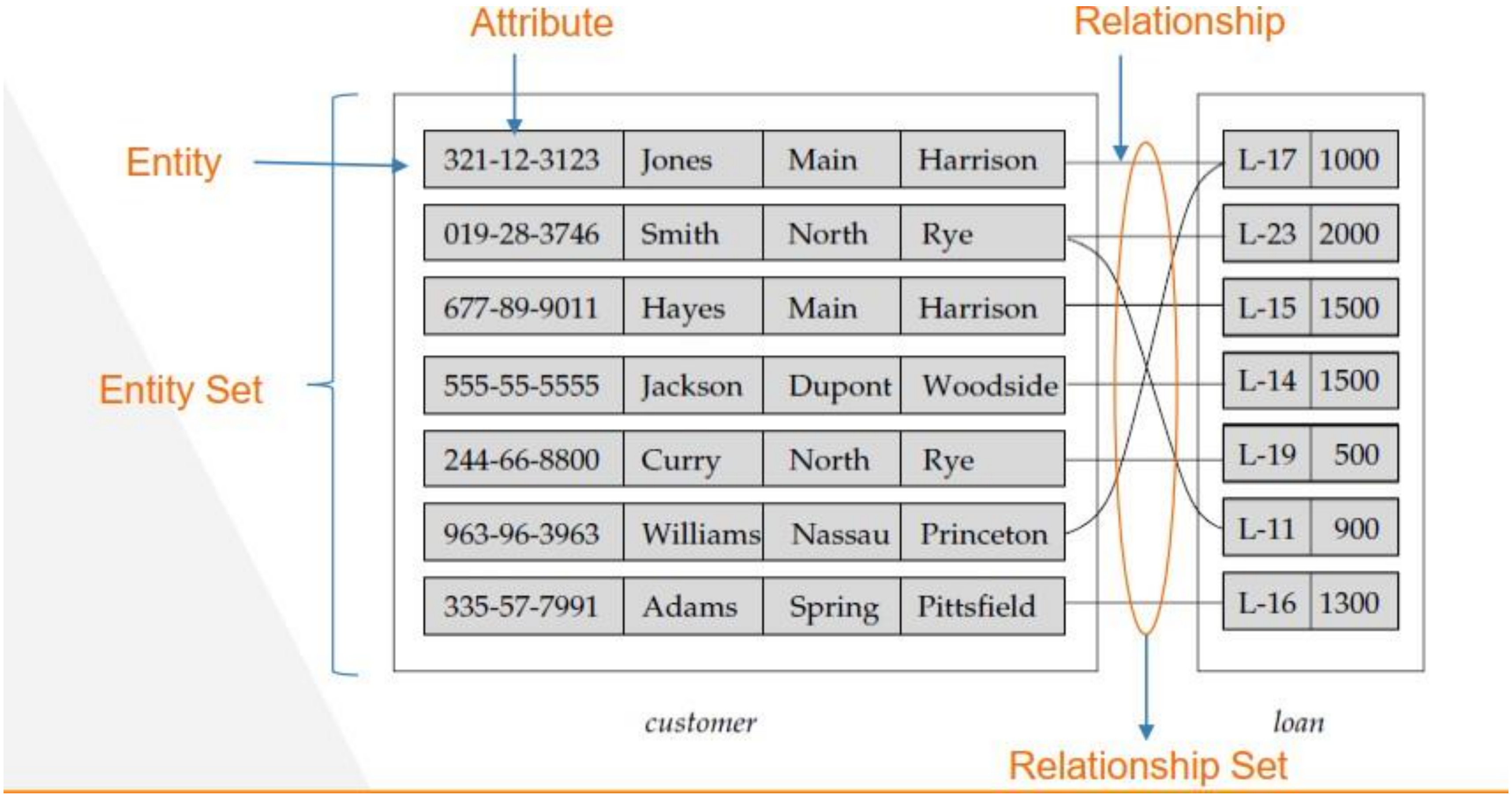
customer

L-17	1000
L-23	2000
L-15	1500
L-14	1500
L-19	500
L-11	900
L-16	1300

loan

Relationship Set

Example ER Diagram Components in a relation



321-12-3123	Jones	Main	Harrison
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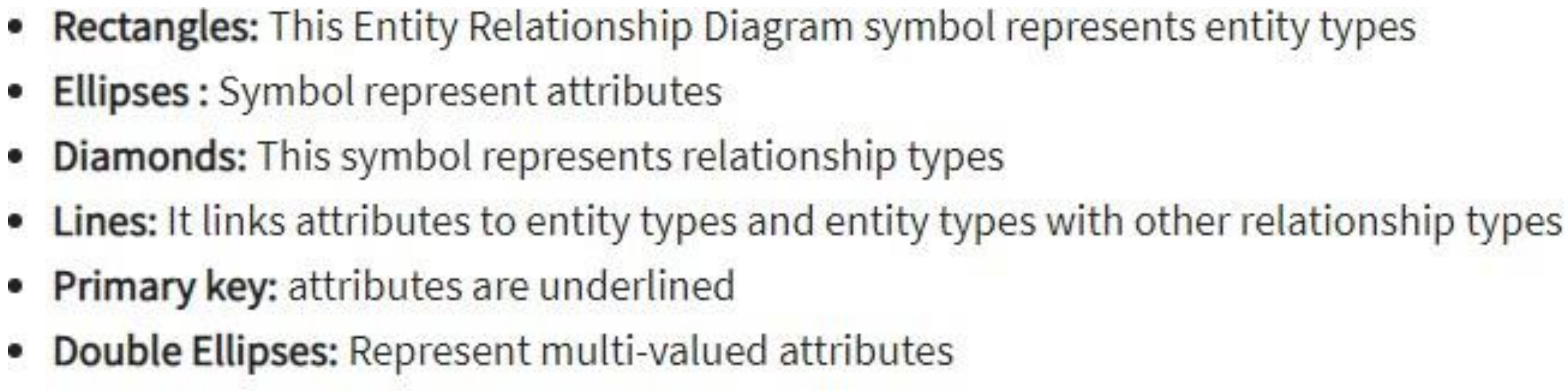
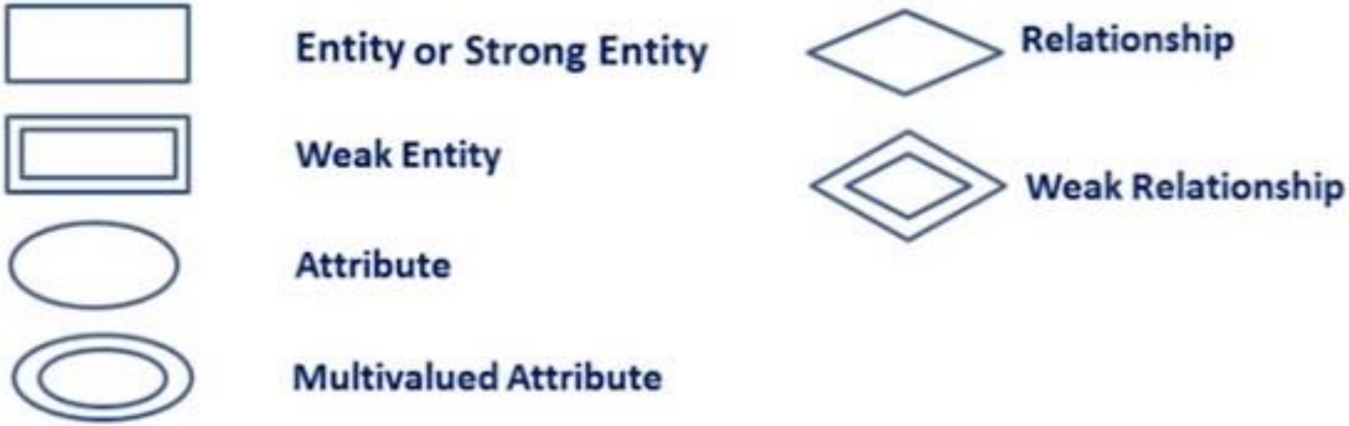
loan

Symbols



- **Rectangles:** This Entity Relationship Diagram symbol represents entity types
- **Ellipses :** Symbol represent attributes
- **Diamonds:** This symbol represents relationship types
- **Lines:** It links attributes to entity types and entity types with other relationship types
- **Primary key:** attributes are underlined
- **Double Ellipses:** Represent multi-valued attributes



Attributes

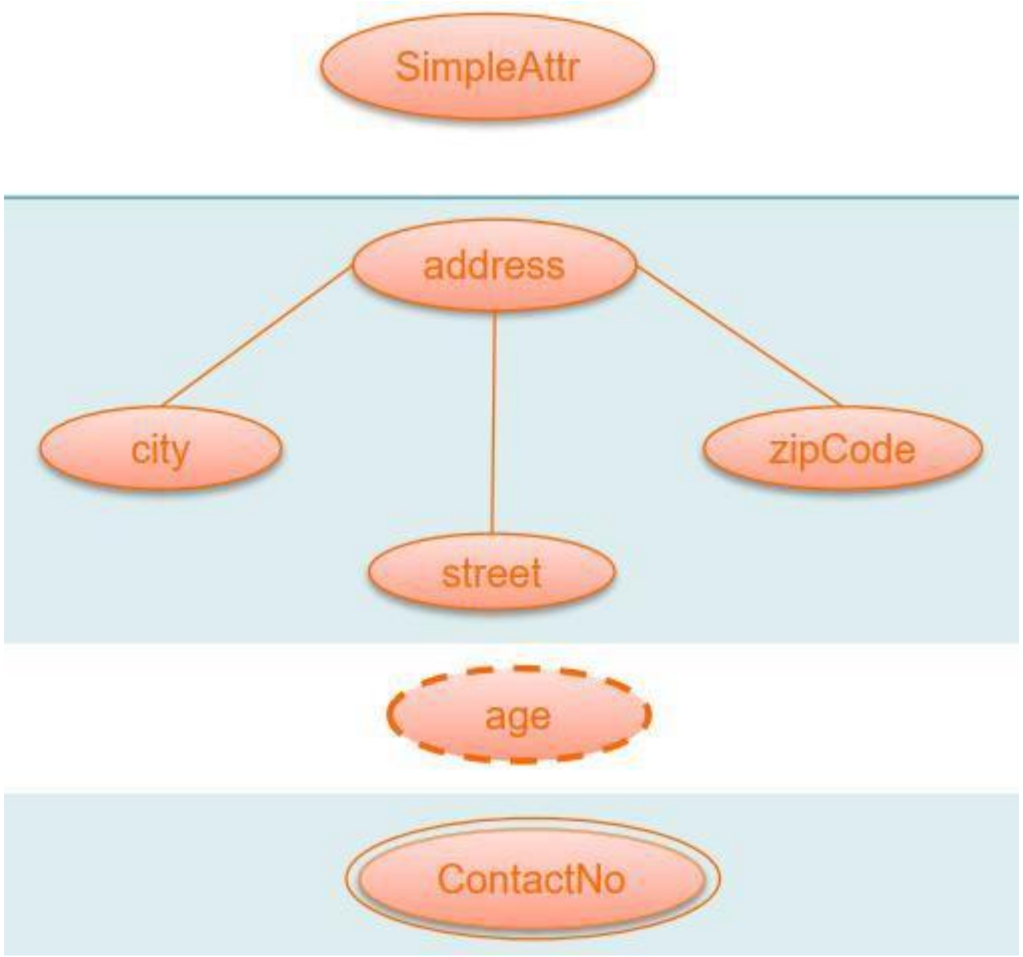
Attributes of Entity

Simple – Attribute value is atomic and can’t be divided into subparts.

Composite – Attributes that can be divided into subparts i.e. other attributes.

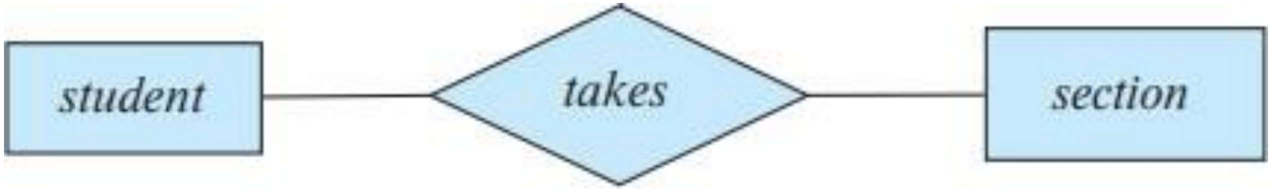
Derived – Attributes that can be calculated from other related attributes.

Multivalued – Attributes having more than one values (a set of values) for a specific entity.



Attributes of Relationship

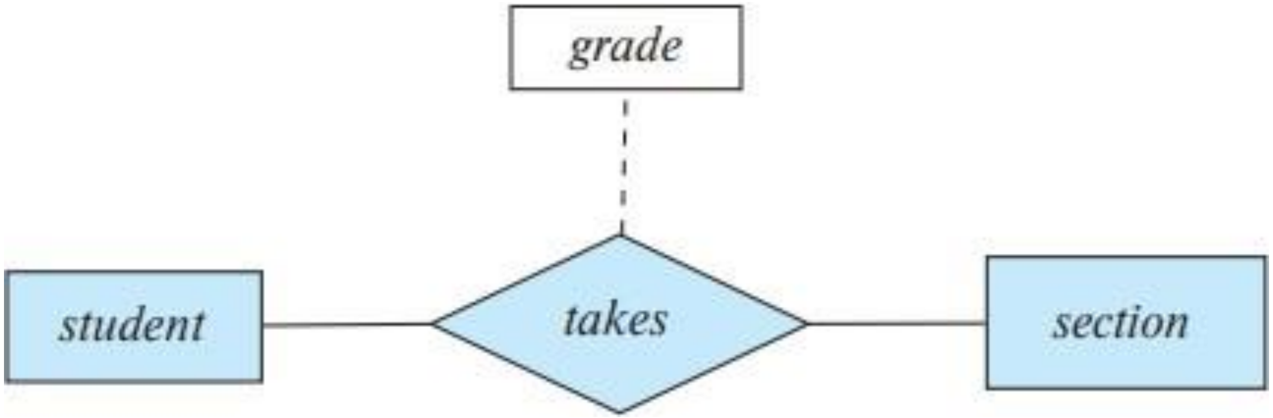
If an attribute is a bi-product of a relation, and can’t be associated with any entity that the relationship links, then it is called **Descriptive Attribute**



Example: Consider the relationship set *takes* which relates entity sets *student* and *section*. We may wish to store a **descriptive** attribute *grade* with the relationship to record the grade that a student received in a course offering.

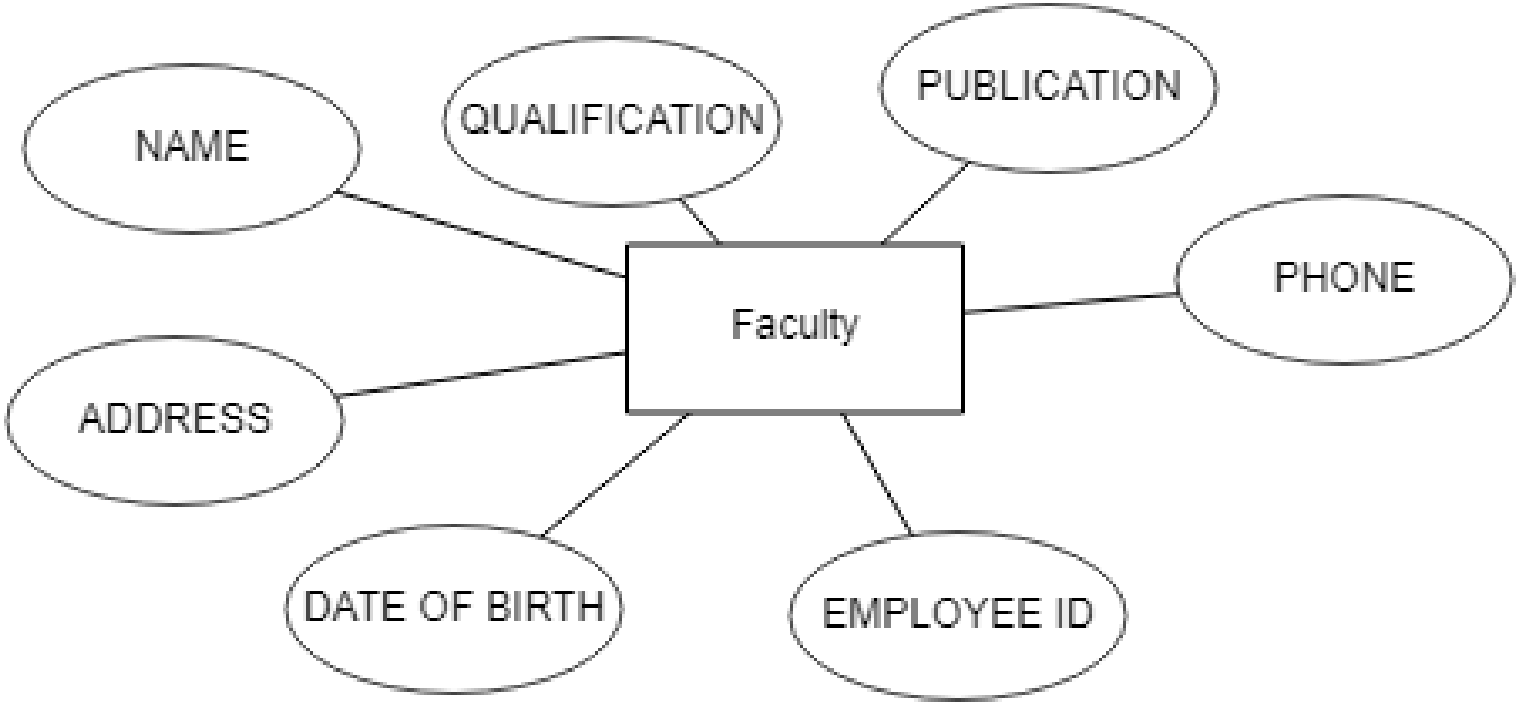
Attributes of Relationship

If an attribute is a bi-product of a relation, and can’t be associated with any entity that the relationship links, then it is called **Descriptive Attribute**



Example: Consider the relationship set *takes* which relates entity sets *student* and *section*. We may wish to store a **descriptive** attribute *grade* with the relationship to record the grade that a student received in a course offering.

Special Attributes : Keys



How can we uniquely identify a faculty from these information?

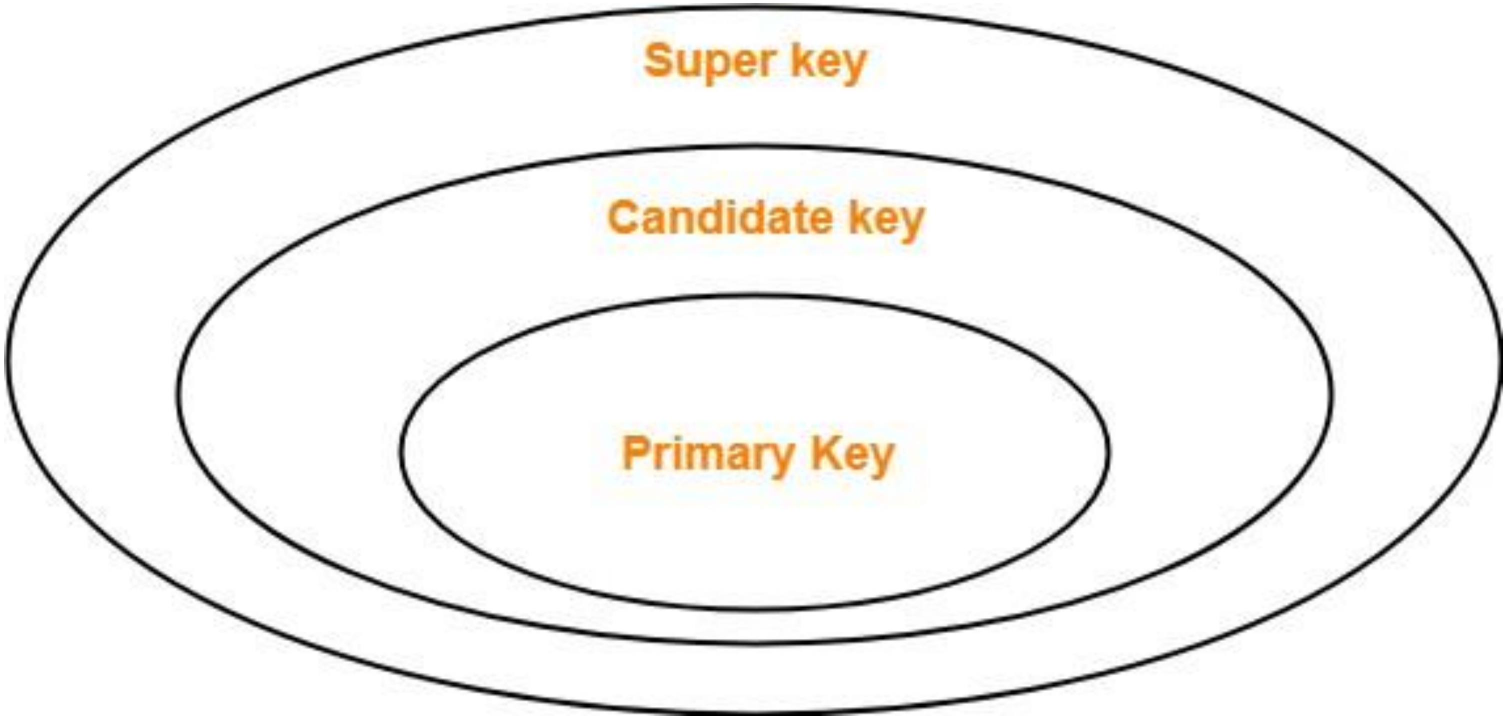
Special Attributes : Keys

Superkey – A set of one or more attributes that, taken collectively, allow us to identify uniquely an entity in the entity set.

Candidate key – A minimal (irreducible) superkey such that no proper subset of its attributes is also a superkey.

Primary key – The candidate key chosen to be used for identifying entities and accessing records.

Special Attributes : Keys



Special Attributes : Keys

Key attribute – An attribute that is part of a (primary) key.

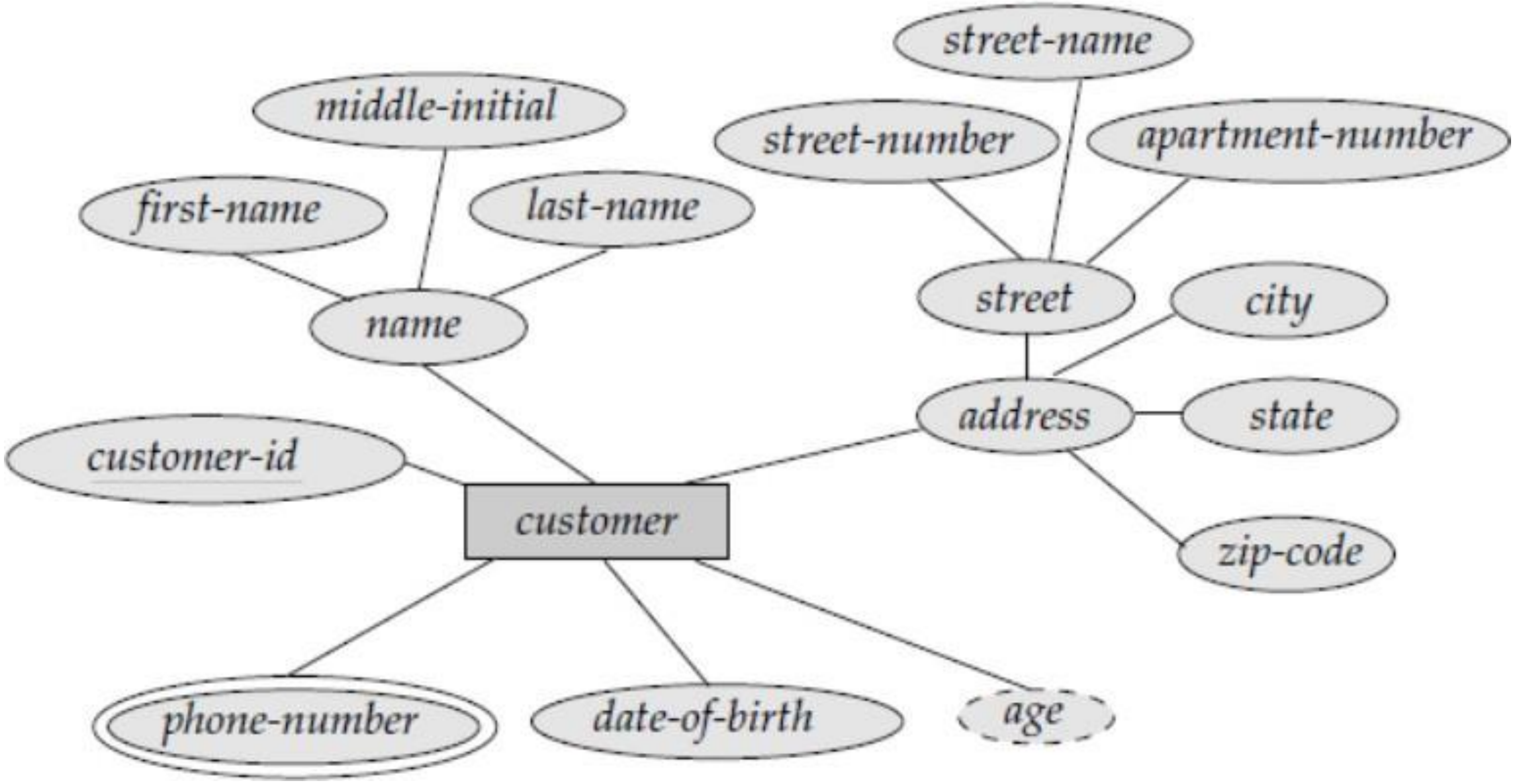
Partial key/Discriminator – an attribute that when combined with the key attribute of the owner entity, provides identification for the weak entity.

Composite key – A key that is composed of more than one attribute

Foreign key – An attribute or combination of attributes in one table whose values must either match the primary key in another table or be null.

Foreign keys are used to ensure referential integrity, the condition in which every foreign key entry must either be null or a valid value in the primary key of the related table.

Example

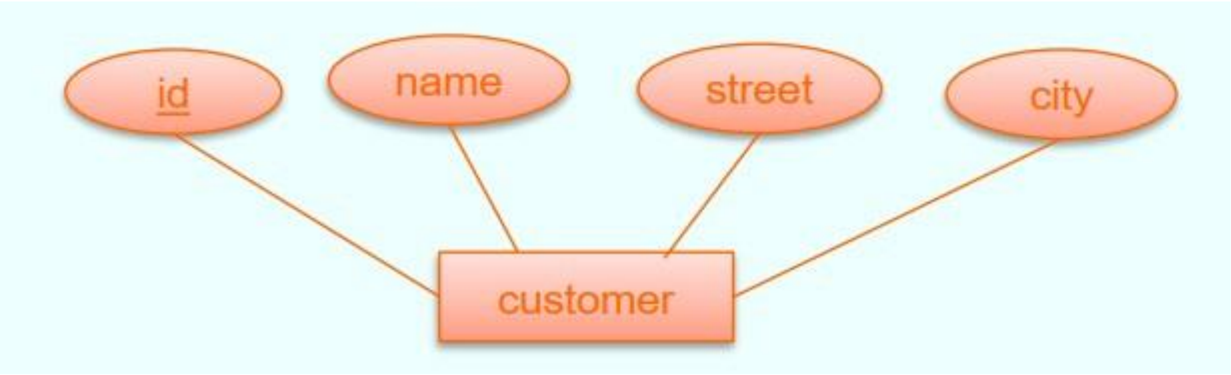

street-name
middle-initial
street-number
apartment-number
first-name
last-name
street
city
name
address
state
customer-id
customer
zip-code
phone-number
date-of-birth
age

Entity

Special Attributes : Entity Types

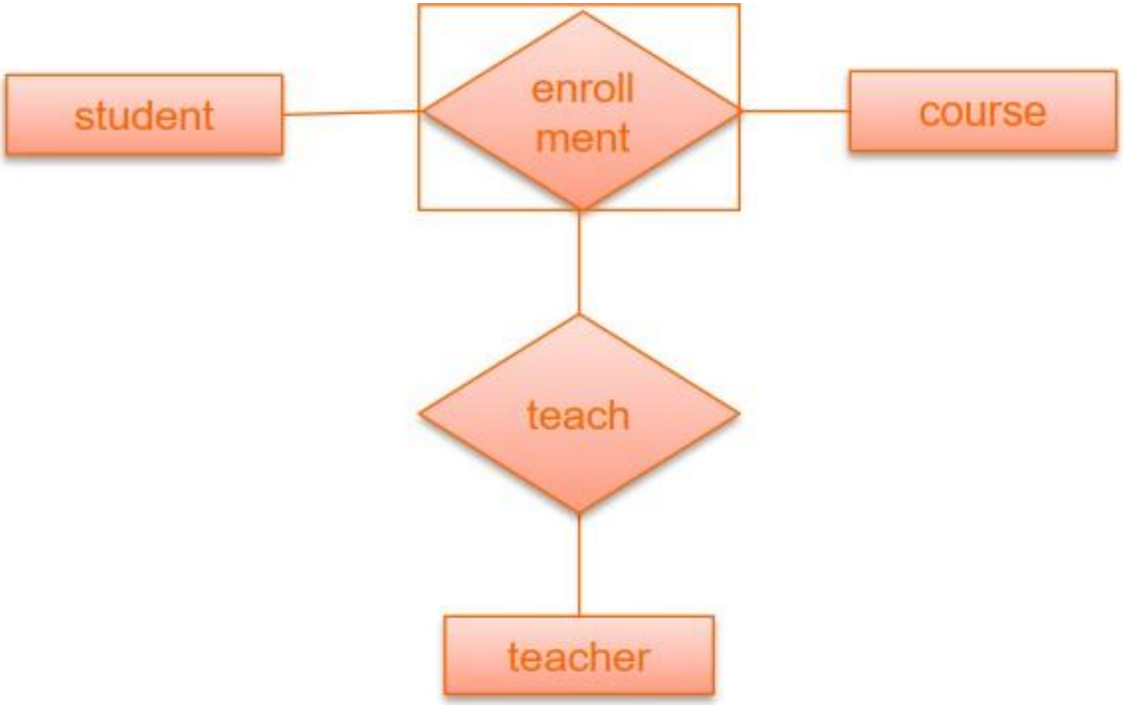
Strong Entity – has enough attributes to uniquely identify each entity. (Has a primary key)

Weak Entity – Does not have a primary key. it is one whose existence is dependent on another (identifying) entity set. The primary key attributes of the identifying entity set, along with the discriminator (partial key) attributes of its own are used to uniquely identify each weak entity. Example: Order and Order Item, Employee and Dependent, Class and Section, Host and Logins.



Special Attributes : Entity Types

Associative Entity– This type of entity set is used in a many-to-many relationship.
When you need a relationship to be involved in a relationship then the former relationship is converted to an associative entity.



Relationship

Special Attributes : Relationship Types

Identifying Relationship– A relationship where child entity is existence-independent of parent entity, and primary key of child doesn’t contain primary key component of parent entity. In terms of relationship strength, it is also known as **weak relationship**.

Non-Identifying Relationship – A relationship where child entity is existence-dependent on parent (identifying) entity, and primary key of child entity contains primary key component of parent entity.
The identifying relationship set should not have any descriptive attributes, since any such attributes can instead be associated with the weak entity set.
In terms of relationship strength, it is also known as **strong relationship**

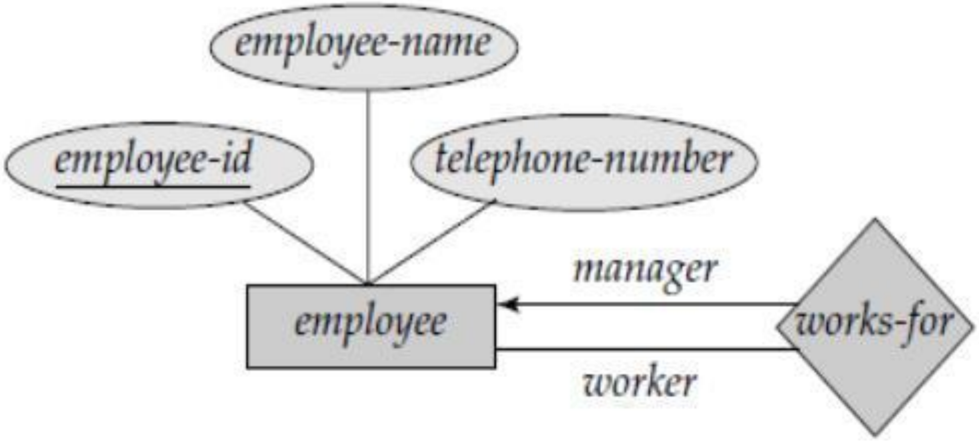
Special Attributes : Relationship Types

Recursive Relationship – The same entity participates more than once in the relationship.

▪ The function that an entity plays in a relationship is called that entity's role.

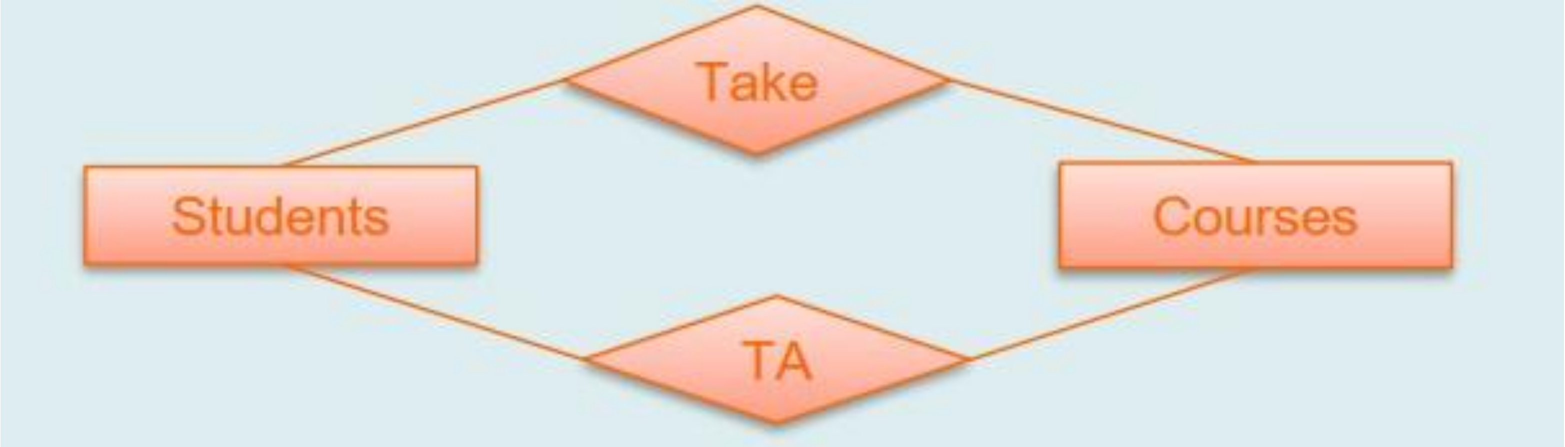
▪ Since entity sets participating in a relationship set are generally distinct, roles are implicit and are not usually specified.

▪ However, they are useful when the meaning of a relationship needs clarification.



Special Attributes : Relationship Types

Parallel Relationship – more than one relationships between the same entities.



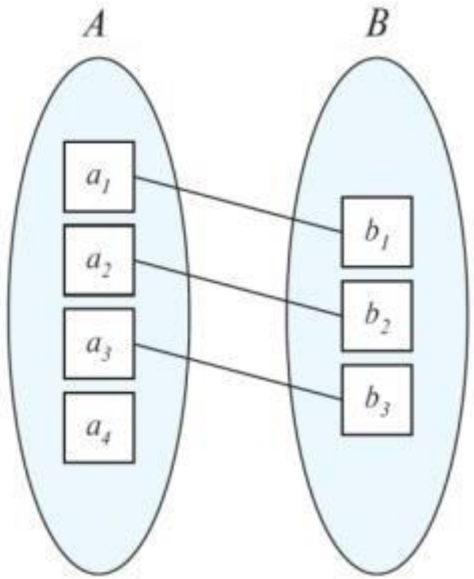
Cardinalities

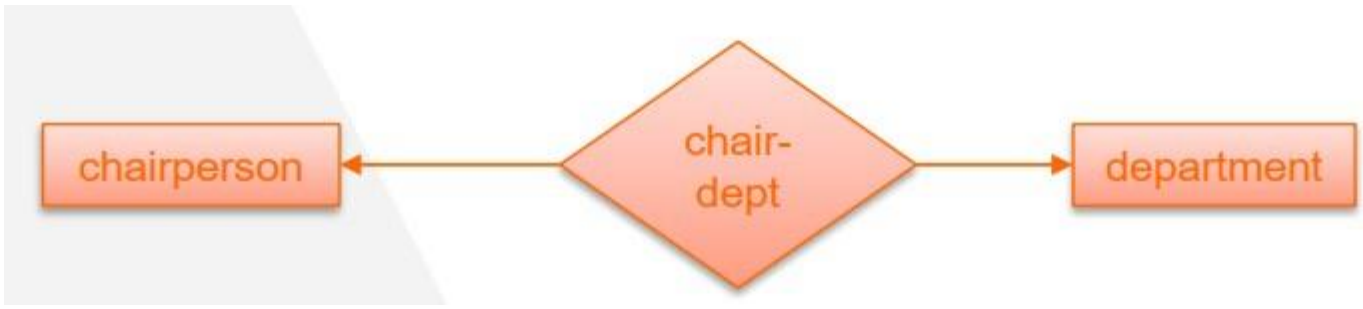
Cardinalities

Mapping cardinalities, or Cardinality ratios, express the number of entities to which another entity can be associated via a relationship set.

One-to-one (1:1)

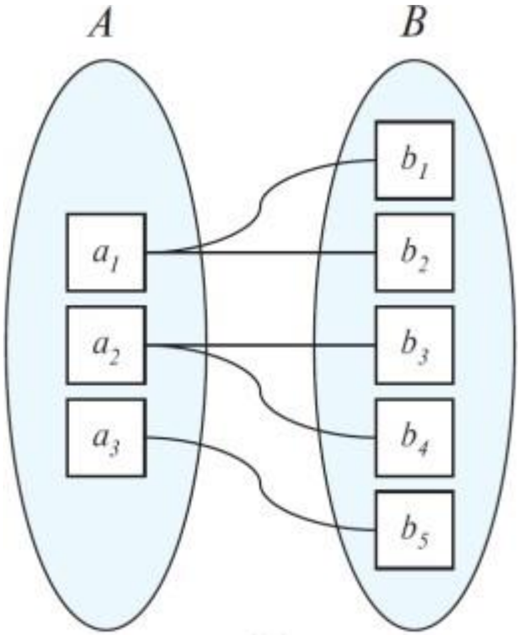
An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A.

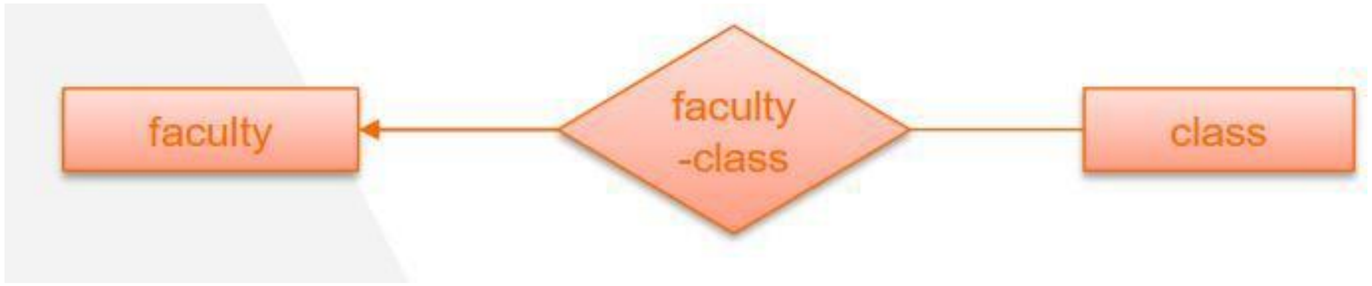




One-to-many (1:n)

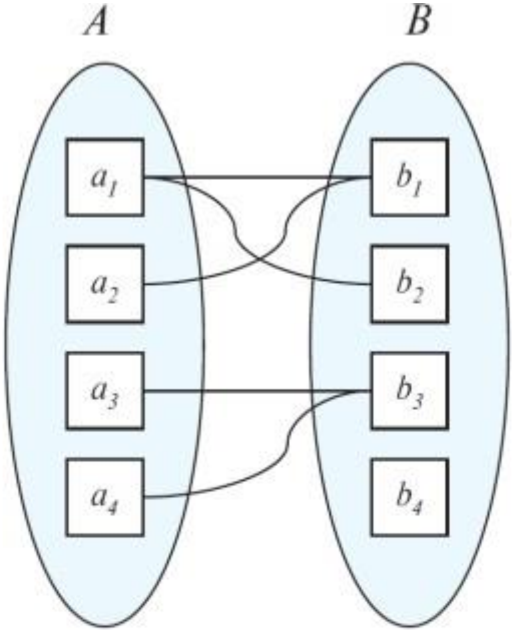
An entity in A is associated with any number of entities in B. An entity in B, however, can be associated with at most one entity in A.

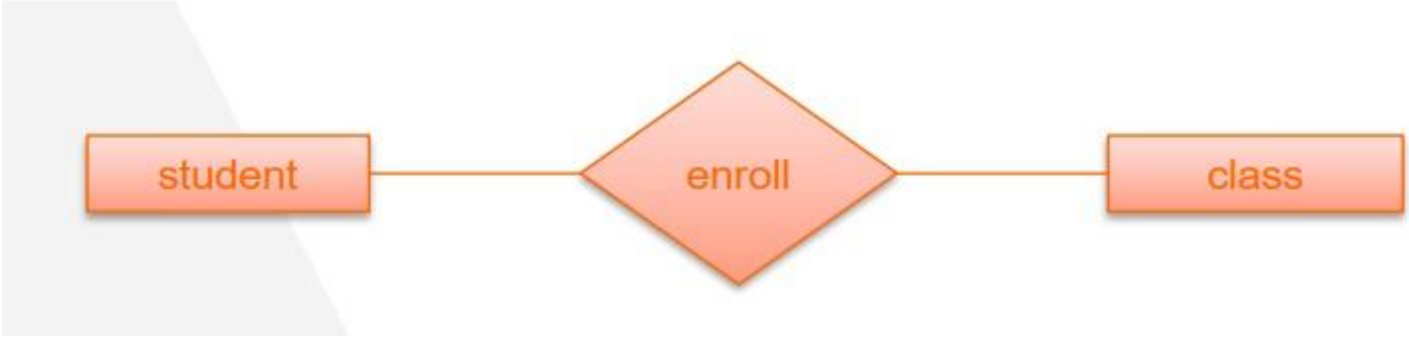




Many-to-many (n:n)

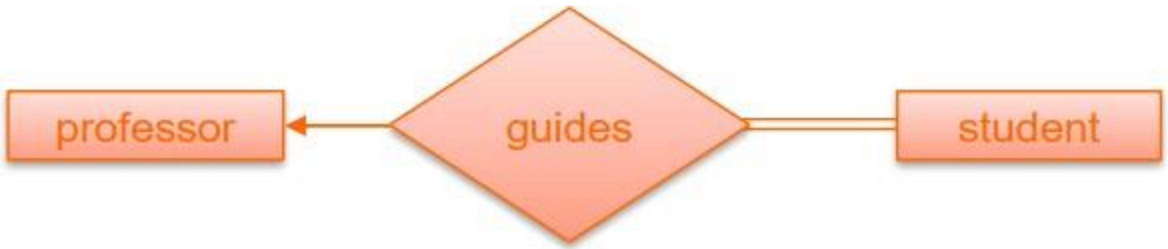
An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A.





Participations

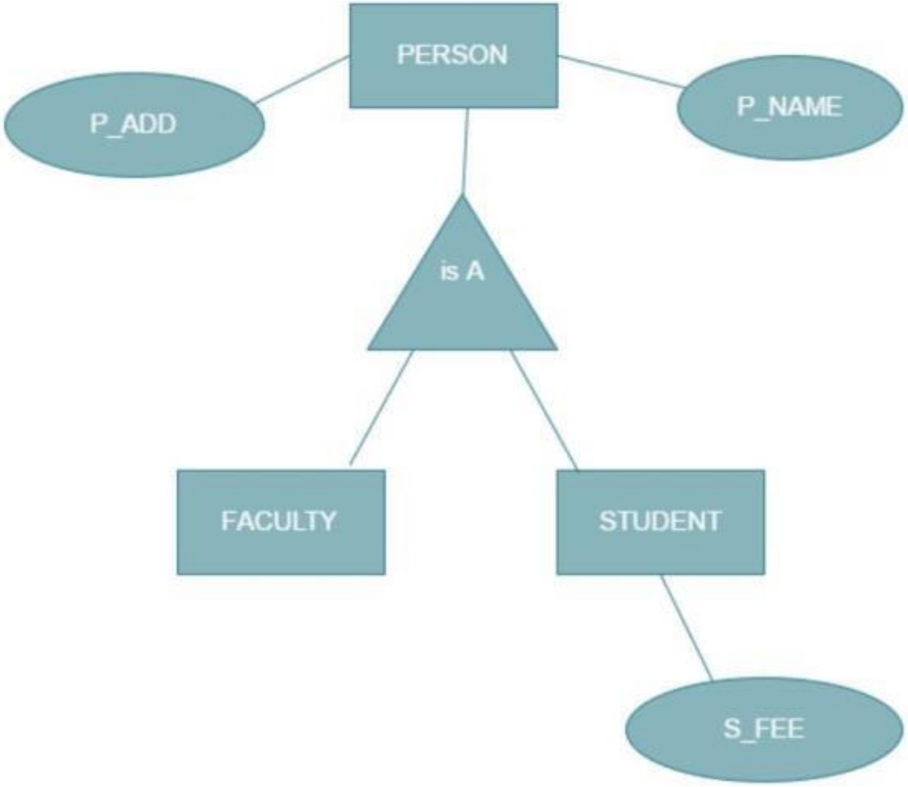
Total participation – Every member of the entity set must participate in the relationship



Partial participation – Not all entities in the set are involved in the relationship. In the previous example not every professor guides student.

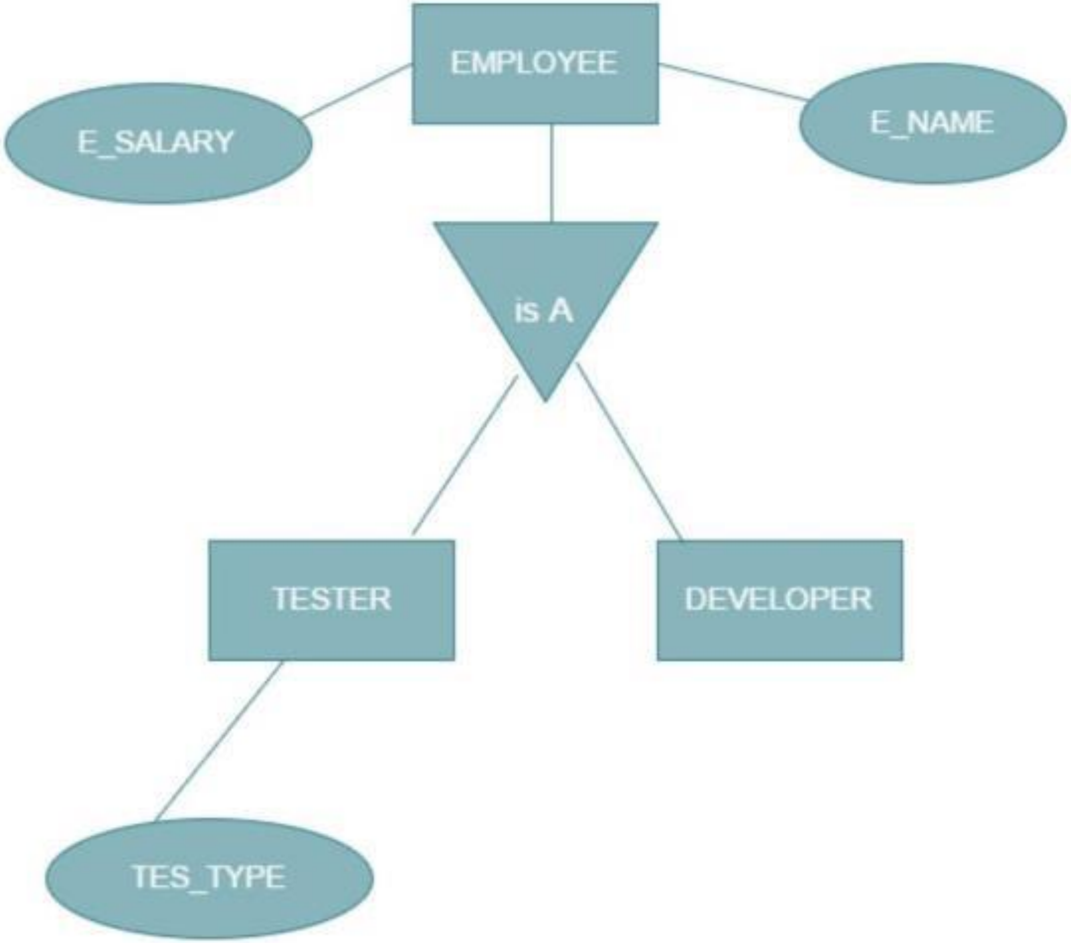
Inheritance

Generalization – It is the process of extracting common properties from a set of entities and create a generalized entity from it.
It is a bottom-up approach in which tow or more entities can be generalized to a higher level entity if they have some attributes in common.



Inheritance

Specialization – an entity is divided into sub entities based on their characteristics. It is a top-down approach where higher level entity s specialized into two or more lower level entities.



Reference

1. https://www.slideshare.net/imamhossain75054/dbms-1-introduction-to-dbms-250584928
2. https://www.guru99.com/er-diagram-tutorial-dbms.html