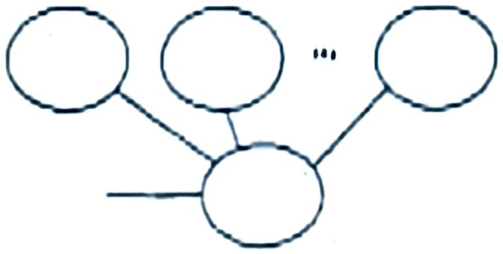
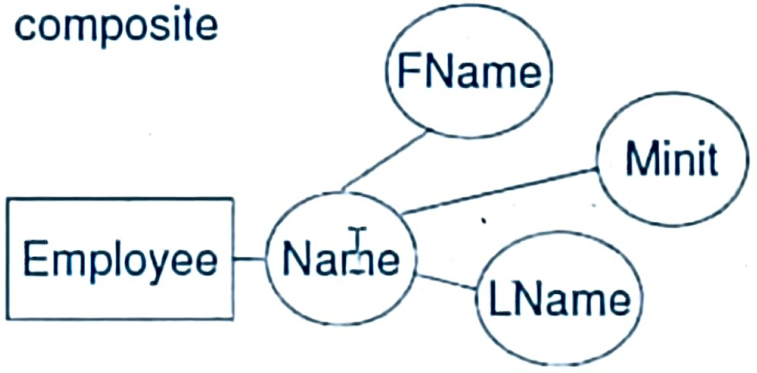
Attribute Types

- Composite Attribute
  - Can be divided into smaller subparts.
  - Example: Address can be derived into “city”, ”street”, ”building number”, and “apartment number”.
  - It’s ER-Diagram notation:



COMPOSITE ATTRIBUTE

Example: Employee Name can be composite



Attribute Types

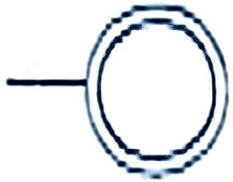
- Single-Valued Attribute:
  - A **single** entity has a **single** value of that attribute.
  - Example: employee ID. A **single** employee has only one **single** ID.
  - Its ER Diagram notation is the same as a general attribute .

ATTRIBUTE

A **single** project has a **single** name

Attribute Types

- Multi-Valued Attribute:
  - A **single** entity has a **multiple** values of that attribute.
  - Example: Employee earned degree. A **single** employee can have **multiple** degrees (B.SC + MS + PhD degrees).
  - Its ER Diagram Notation is **two nested circles**.



MULTIVALUED ATTRIBUTE

Example: A **single** department can have **multiple** locations

Attribute Types

- Stored Attribute
  - Cannot be derived from any other attribute.
  - Example: Birth Date.
  - Its ER-Diagram Notation is the same as the general attribute notation.

ATTRIBUTE

Example: Name is a stored attribute of project entity

Attribute Types

- Derived Attribute
  - Can be derived from a "Stored Attribute".
  - Example: employee age can be derived from his birth date and today's date.
  - Its ER Diagram Notation is **dashed** circle.

DERIVED ATTRIBUTE

Example: NumberOfEmployees
Is a derived attribute of entity Department.
It is derived from count of records.

Key Attribute Examples

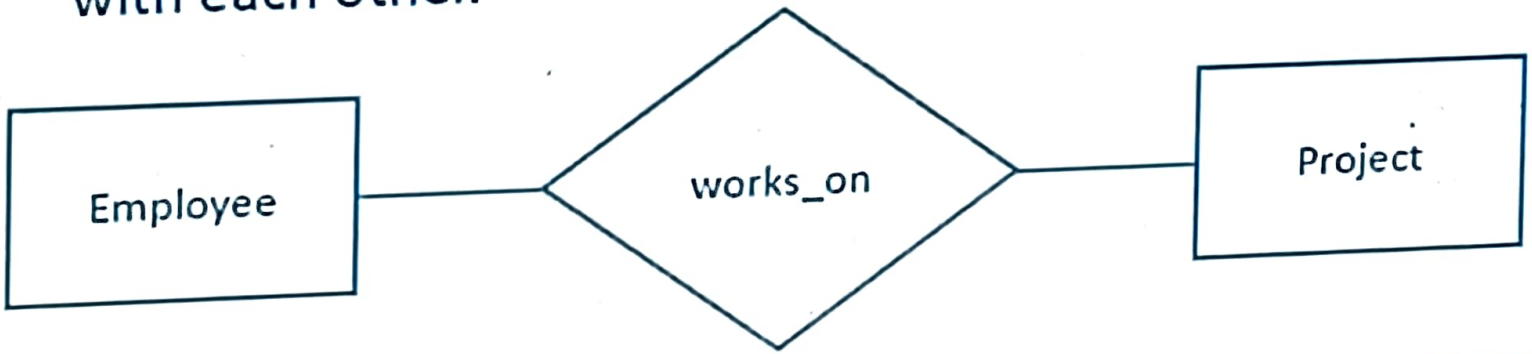
- What is the key of the following entities?

Entity	Key
Student	Student_id
Employee	Employee_id
Course	Course_number
Section	section_id, course_number, semester,year
Bank branch	bank_id, branch_id
Employee Project	employee_id, project_id

Relationship

- A Relationship is an association between two or more entities.
- It is represented in ER diagram by using the following shape which is connected to participating entities.

- Usually, a "verb" is written inside the relationship shape because verbs can express why the entities are connected with each other.



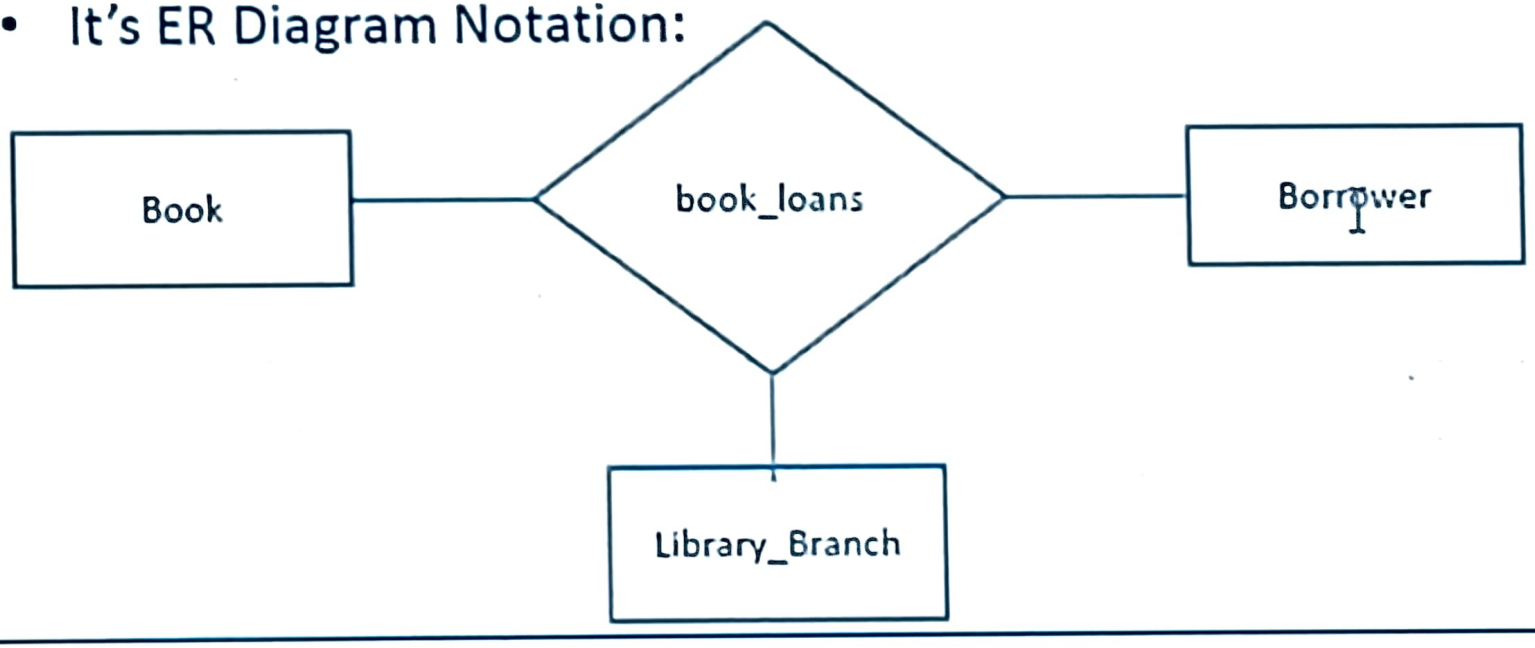
Relationship Degree

- Relationship **degree** is the number of participating entity types.

- Possible relationship degrees are
  - Binary Relationship: includes 2 entity types.
  - Ternary Relationship: includes 3 entity types.
  - N-ary Relationship: includes N entity types.

Relationship Degree

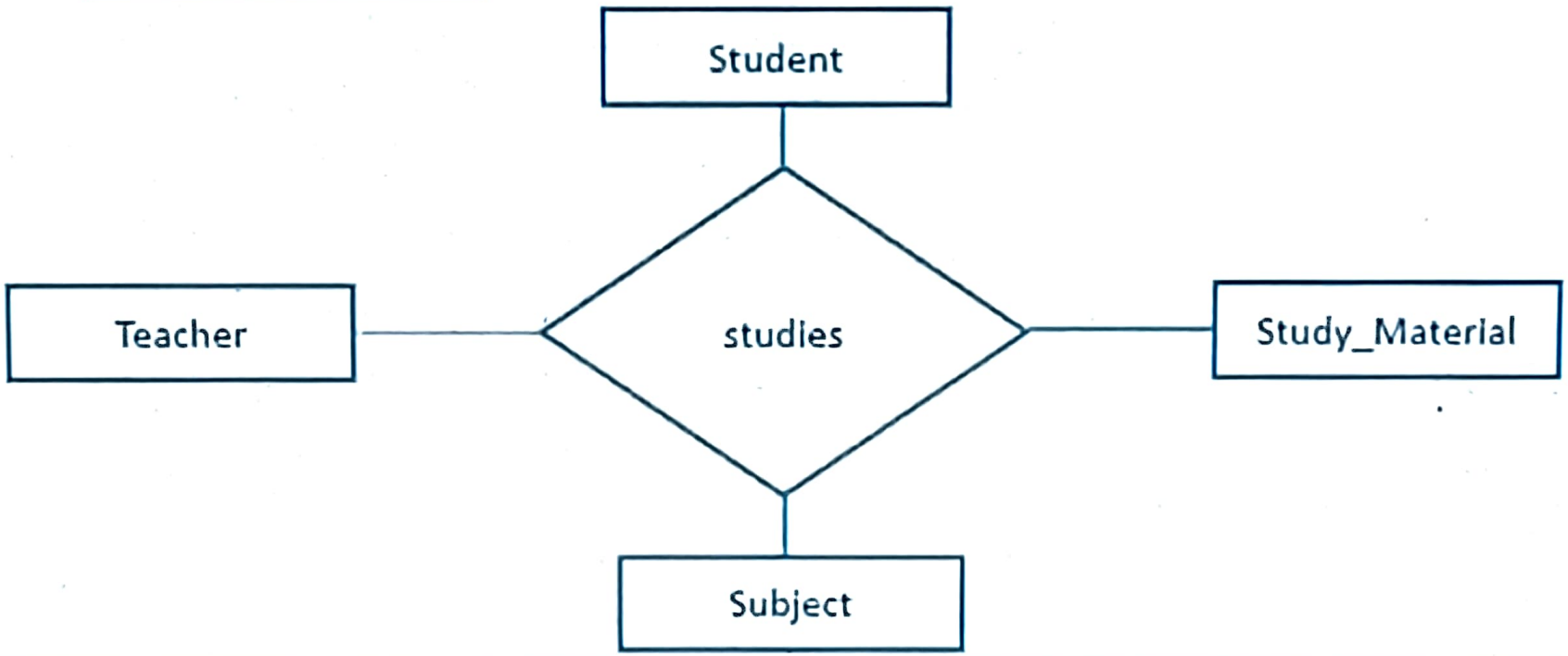
- Ternary relationship: includes 3 entity types
- Example: Book_loans: is a relationship that shows:
  - Each borrowed book (**Book**)
  - Who borrowed it (**Borrower**)
  - Which library branch the book was borrowed from (**Library_Branch**)
- It's ER Diagram Notation:



Relationship Degrees

- N-ary Relationship: includes N entity types.

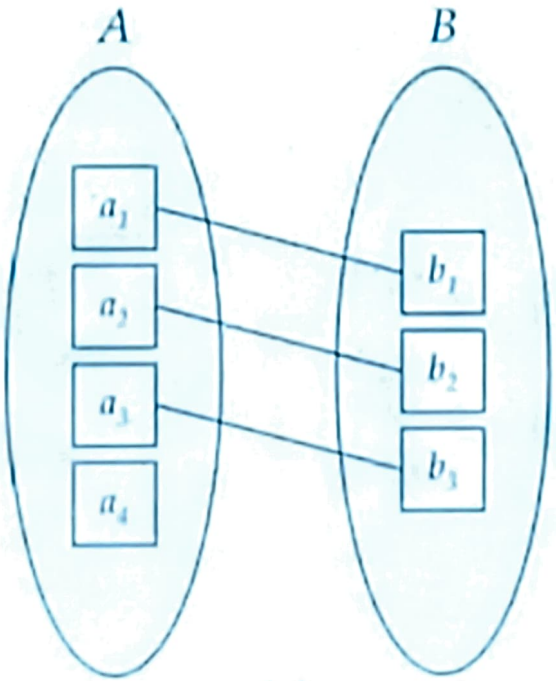
- Example: studies: is a 4-ary relationship that shows that a "**student**" studies a "**subject**" with a "**teacher**" and the help of "**study_material**".



Mapping Cardinality Constraints

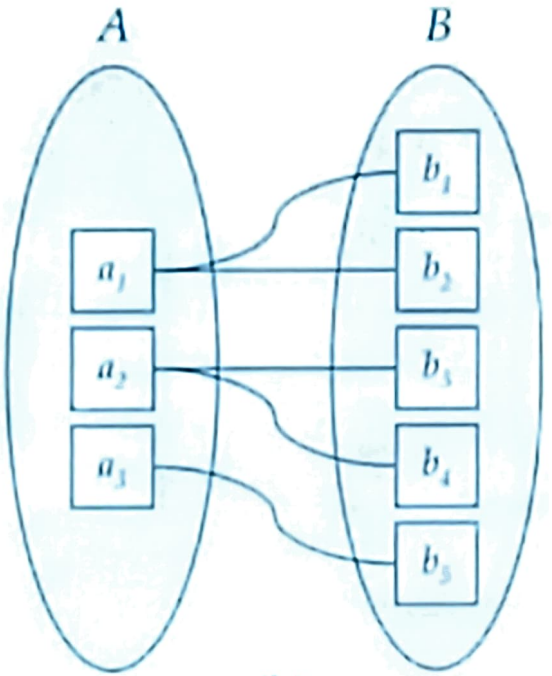
- Express the number of entities to which another entity can be associated via a relationship set.
- Most useful in describing binary relationship sets.
- For a binary relationship set the mapping cardinality must be one of the following types:
  - One to one
  - One to many
  - Many to one
  - Many to many

Mapping Cardinalities



(a)

One to one

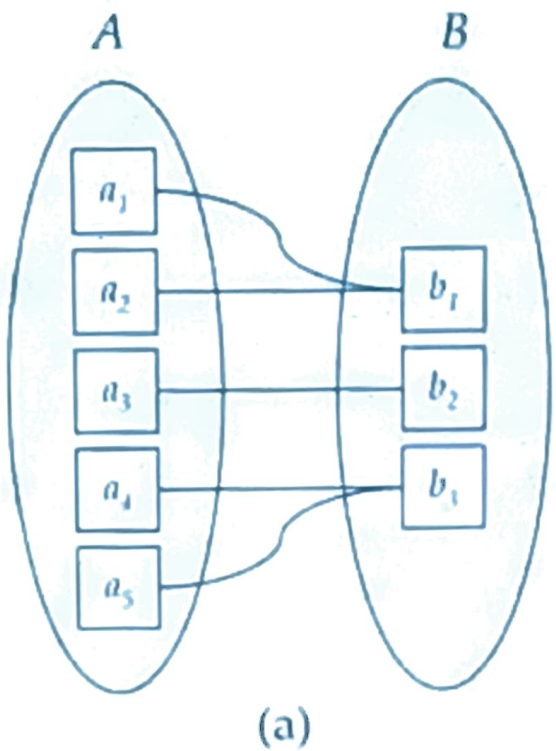


(b)

One to many

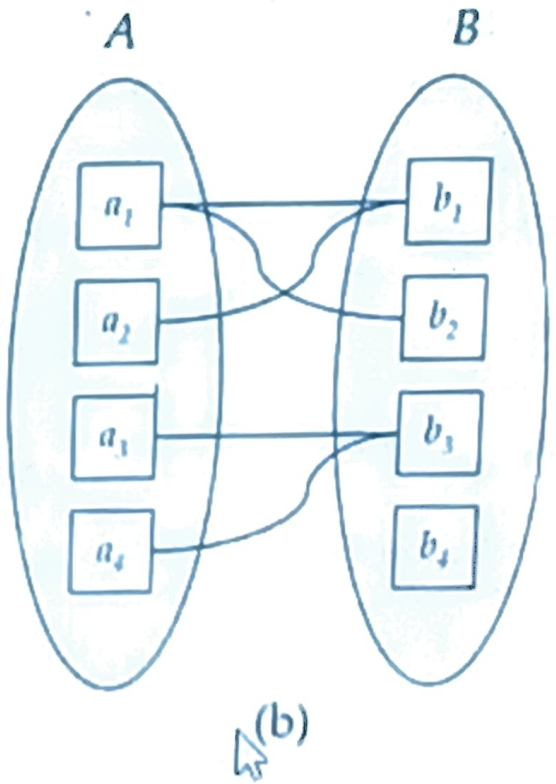
Note: Some elements in A and B may not be mapped to any elements in the other set

Mapping Cardinalities



(a)

Many to one



(b)

Many to many

Note: Some elements in A and B may not be mapped to any elements in the other set

Representing Cardinality Constraints in ER Diagram

We express cardinality constraints by drawing either a directed line (→), signifying "one," or an undirected line (—), signifying "many," between the relationship set and the entity set.

One-to-one relationship between an *instructor* and a *student* :

- A student is associated with at most one *instructor* via the relationship *advisor*
- A *student* is associated with at most one *department* via *stud_dept*

Exercise-1

Construct an E-R diagram for a car insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents. Each insurance policy covers one or more cars and has one or more premium payments associated with it. Each payment is for a particular period of time, and has an associated due date, and the date when the payment was received.