

chapter-2 (Entity Relationship Model)

- ① Entity, Entity set
- ② Relationship, set of relationship
- ③ Entity relationship model
- ④ Degree of a relationship model
- ⑤ Attribute, Types of attribute
- ⑥ Entity relationship diagram
- ⑦ Mapping cardinality
- ⑧ Total and partial participation
- ⑨ Key
- ⑩ Weak entity set
- ⑪ E-R diagram of weak entity set
- ⑫ Redundancy of schema
- ⑬ Specialization, Generalization
- ⑭ Aggregation
- ⑮ Entities vs relationship set

Attribute	Relationship
name	name
age	age

Entity: An entity is an object that exists and is distinguishable from other objects.

Ex: Each person in a university is an entity.

⇒ An entity has a set of properties and the values for some set of properties may uniquely identify an entity.

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

An entity set student might represent the set of all students in the university.

Ex: instructor = (ID, name, salary)

course = (course_id, title, credits)

Entity set can be represented graphically as follows:

⇒ Rectangles represent entity sets

⇒ Attributes listed inside entity rectangle

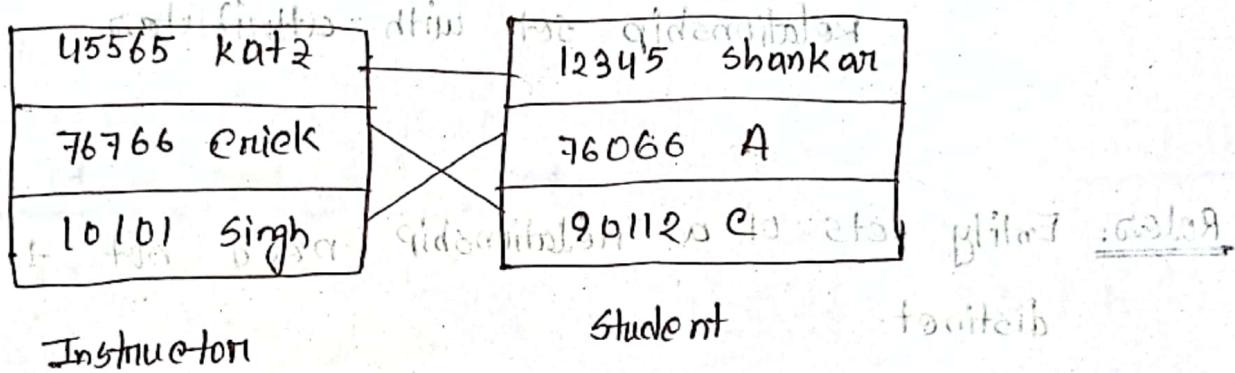
⇒ Underline indicates primary key attributes

instructor	student
76766 Crick	76066 A
98945 Katz	72011 B
10101 Singh	90112 C

Fig: Entity sets
instructor and
student

Relationship sets: A relationship is an association among several entities. A relational database consists of a collection of tables.

Example: we can define a relationship advises that associates instructor Katz or with student Shankar.

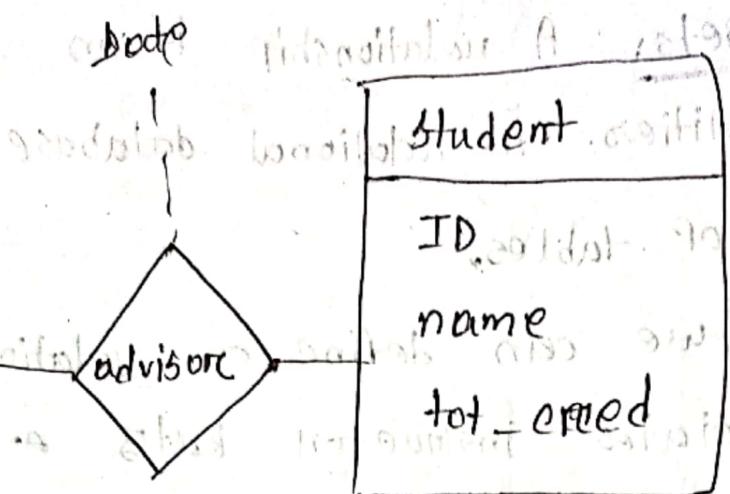
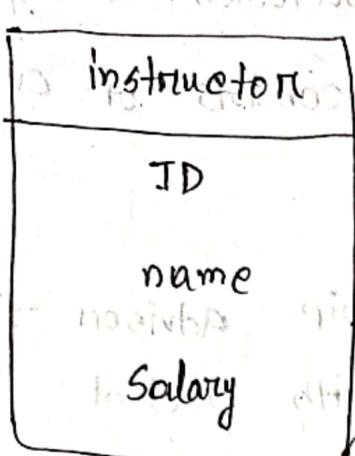


Relationship set

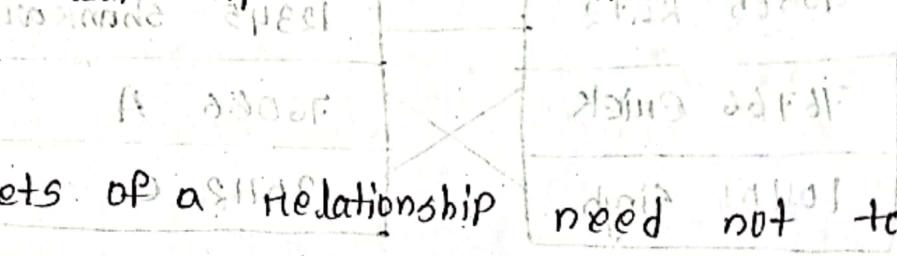
A relationship set is a set of relationships of the same type. It is mathematically relation on $n \geq 2$, entity set. If E_1, E_2, \dots, E_n are entity sets then a relationship set R is a subset of,

$$\{ (e_1, e_2, \dots, e_n) \mid e_1 \in E_1, e_2 \in E_2, \dots, e_n \in E_n \}$$

where (e_1, e_2, \dots, e_n) is a relationship.



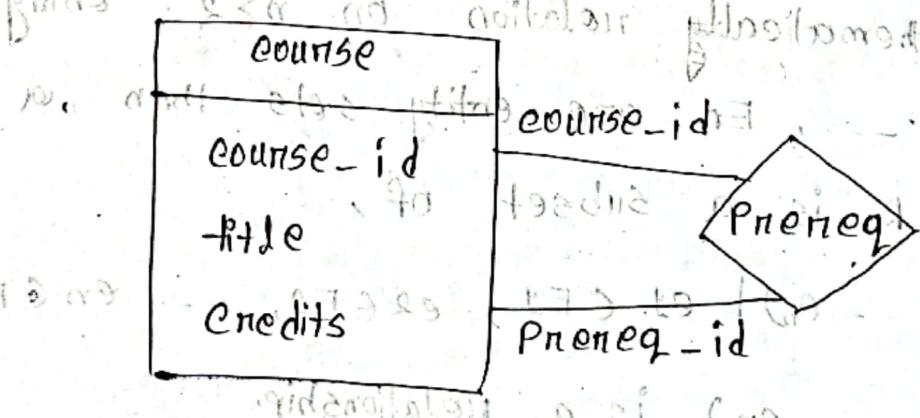
Relationship set with attributes



Role: Entity sets of a relationship need not to be distinct.

→ Each occurrence of an entity set plays a

'role' in the relationship



→ The labels 'course_id' and 'prereq_id' are called roles.

Entity

n Relationship model: The entity relationship (E-R) data model was developed to facilitate database design by allowing specification of an enterprise schema, that represents the overall logical structure of a database.

The E-R model is very useful in mapping the meanings and interactions of real-world enterprise onto a conceptual schema.

Degree of a relationship set:

① Binary relationship

② Non-binary relationship

Binary relationship: ④ Involve two entity sets

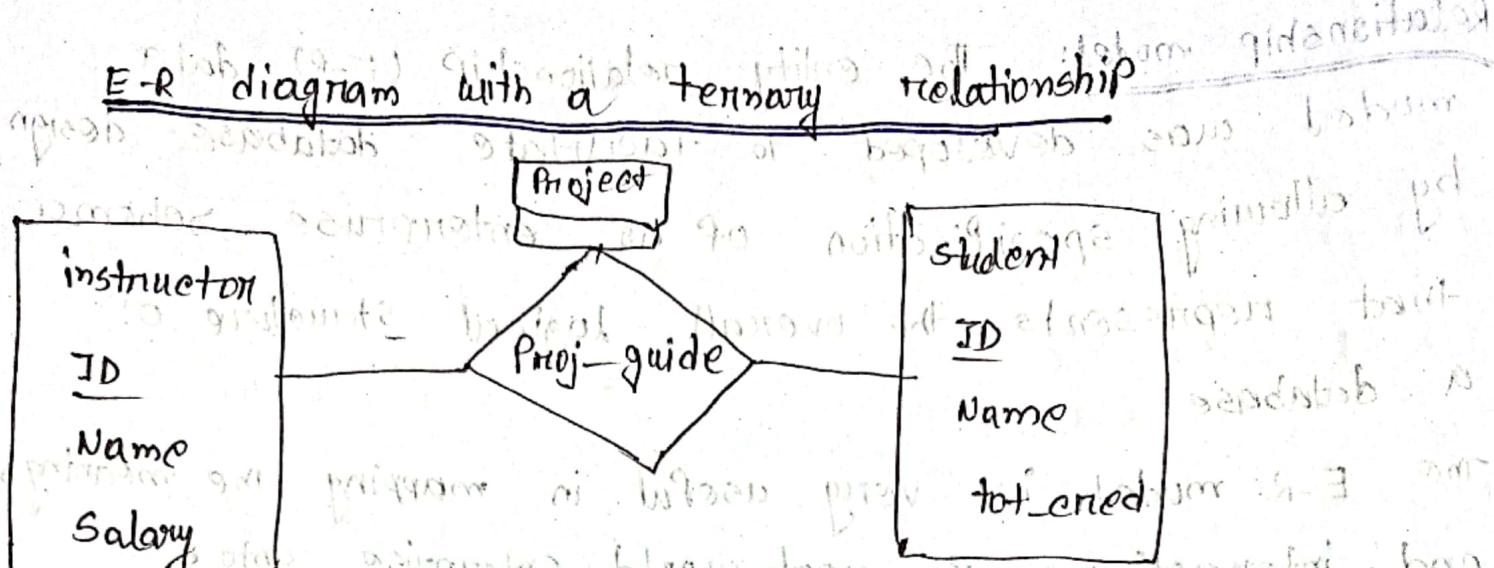
④ Most relationship sets in a database system are binary.

④ Relationship between more than two entity sets are rare. Most relationships are binary.

→ Relationship proj-guide is a ternary relationship between instruction, student and project.

Non-binary relationship: ④ Most relationship sets are binary.

④ There are occasions when it is more convenient to represent relationships as non-binary.



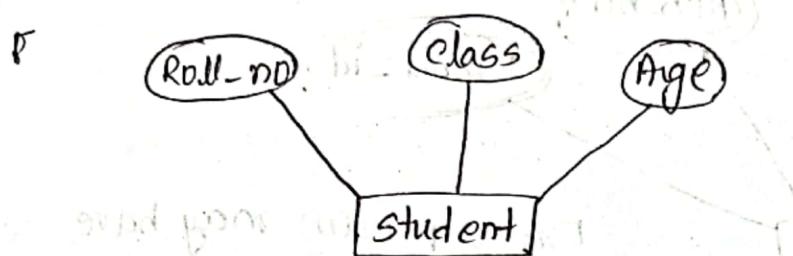
Attribute: There is a set of permitted values, called the domain or value set of that attribute. An attribute of an entity set is a function that maps from the entity set into a domain.

⇒ An attribute is a piece of data that describes an entity.

- In a customer database, the attributes might be name, address and phone number.
- In a product database, the attributes might be name, price and date of manufacture.

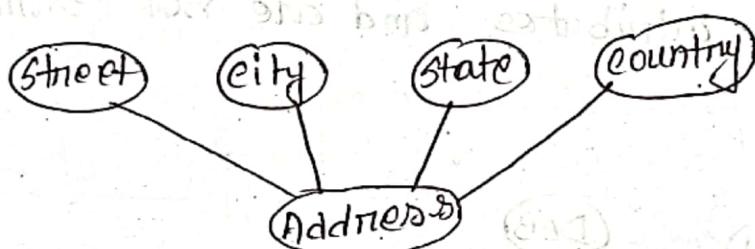
Types of attributes: (complex Attributes)

- ① Simple attributes: simple attributes are those that cannot be further divided into sub-attributes.



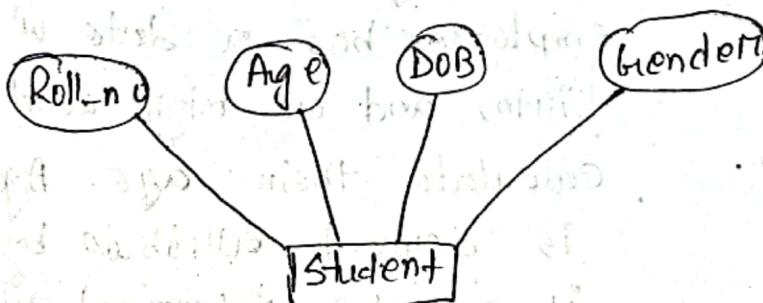
Ex: A student's roll number or the employee identification number.

- ② Composite attributes: composite attributes are made up of two or more simple attributes.



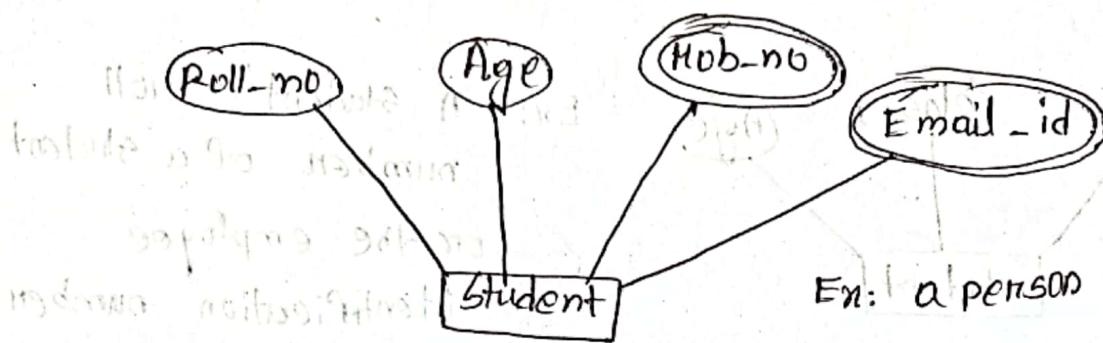
Ex: a person's address may be a composite attribute that is made up of the person's street address, city, state, and zip code.

- ③ Single-valued attributes: single valued attributes can only have one value.



Ex: a person's NID number or DOB is a single-valued attribute.

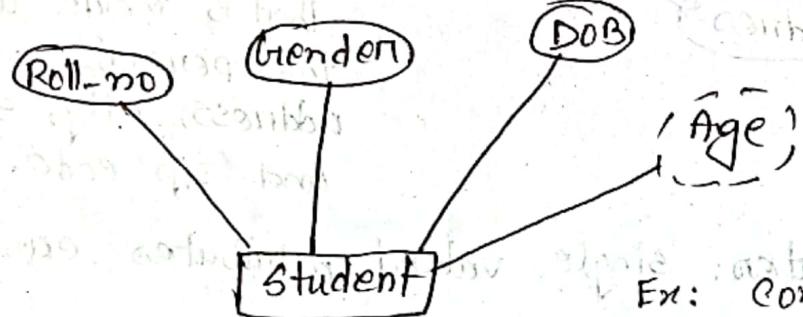
④ Multivalued attributes: It can have more than one value.



Ex: a person may have multiple email addresses or phone numbers.

⑤ Derived attributes: Derived attributes are

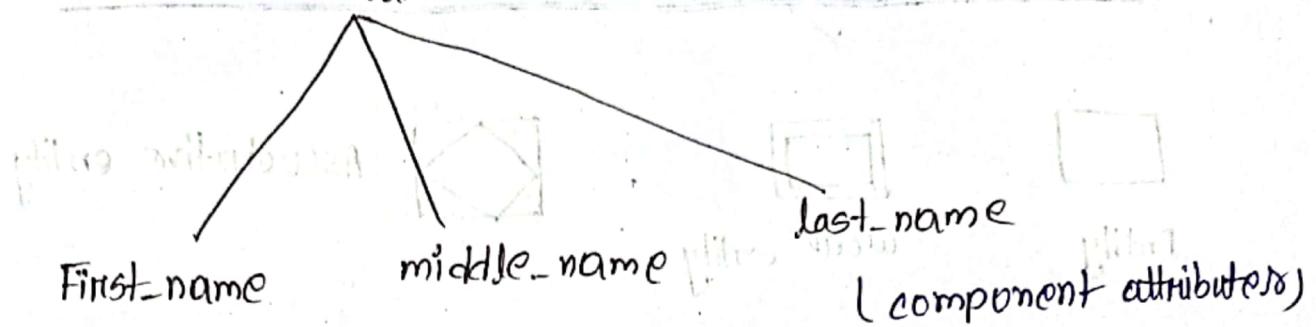
based on other attributes and are not stored directly.



Ex: Consider a database

of employees. Each employee has a date of birth, and we might want to calculate their age. Age is a derived attribute because it can be determined from the date of birth.

Example: Name — composite attribute



Representing complex attributes in ER diagram

instructor

ID

name

first-name

middle-initial

last-name

address

street

street-number

street-name

apt-number

city

state

zip

2 phone-number

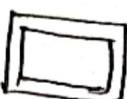
date-of-birth

age!!

Entity relationship diagram (ER diagram):



Entity



weak entity



associative entity



Relationship



Identifying
Relationship

Mandatory relationship

partial relationship

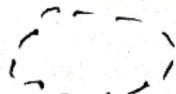
Optional
relationship

Total participation

Attribute
key attribute



Multivalued
attribute



Derived
attribute

Composite
attribute

Example: E-R diagram for the University Enterprise

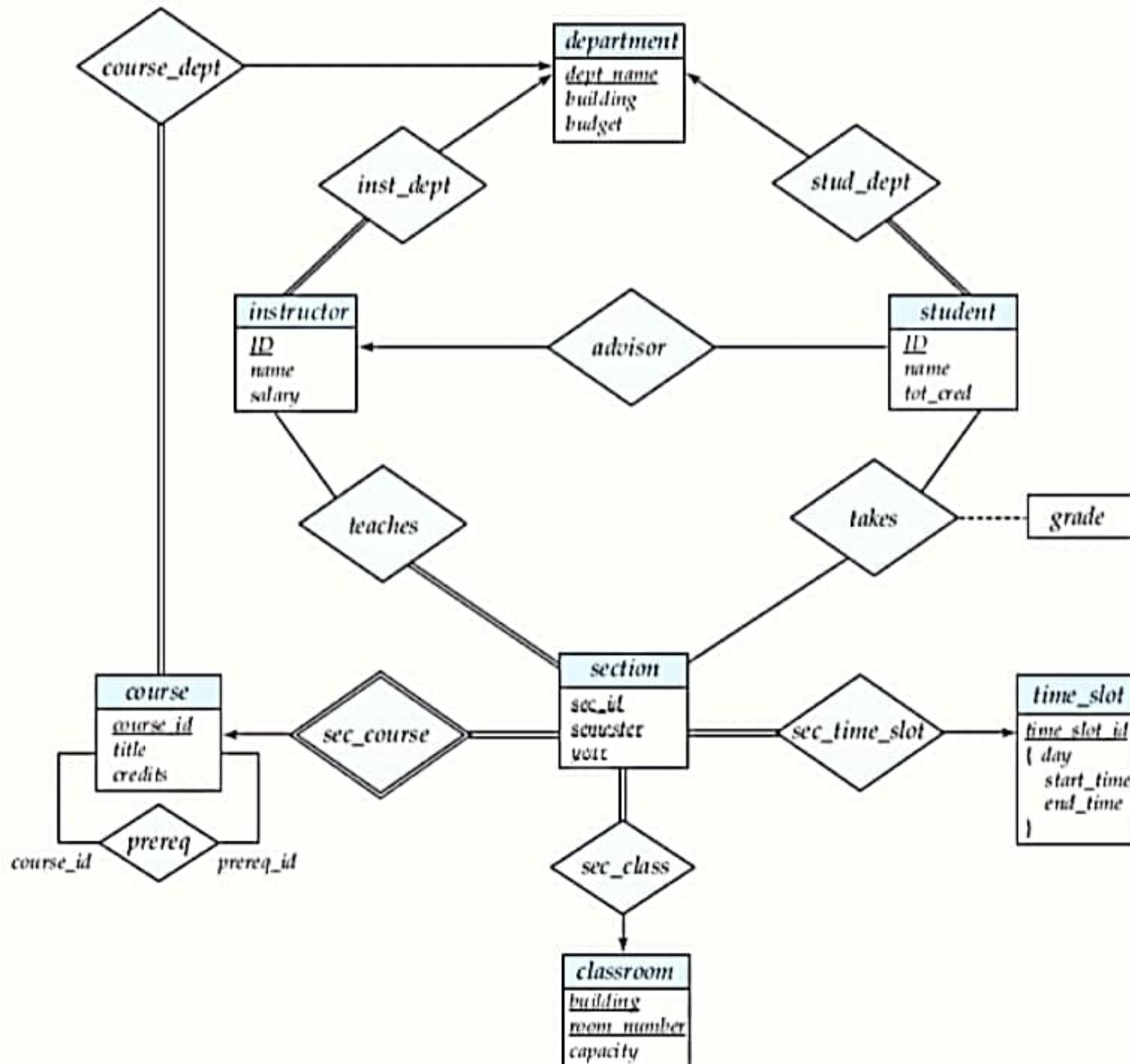


Figure 7.15 E-R diagram for a university enterprise.

Mapping cardinality: It expresses the numbers of entities to which another entity can be associated via a relationship set.

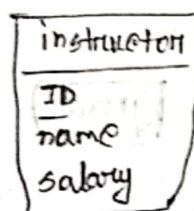
→ One to one

⇒ One to many

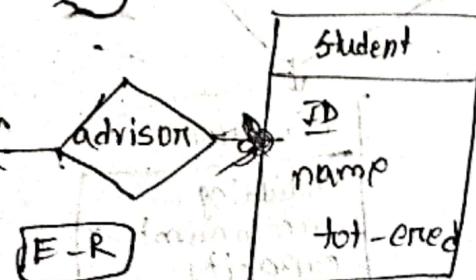
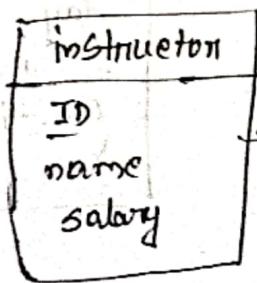
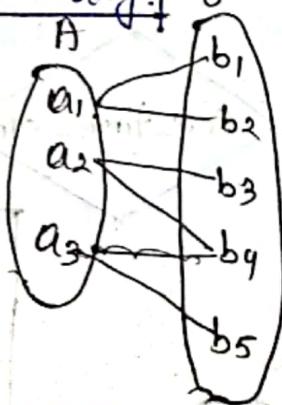
⇒ Many to one

⇒ many to many

One to one.



one to many: 3



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.

- ④ Student associated with at most one instructor via the relationship advisor.
 - ⑤ A student is associated with at most one department

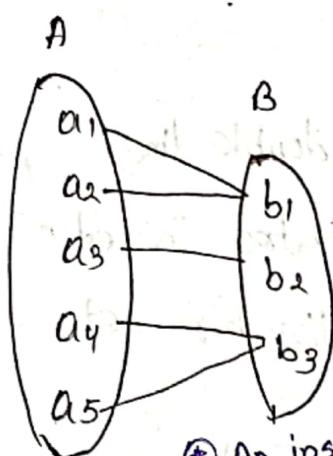
■ An entity in A is associated

with any number(zero or more)

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

- ④ An instructor is associated with several students via advisor
 - ⑤ a student is associated with at most one instructor via advisor.

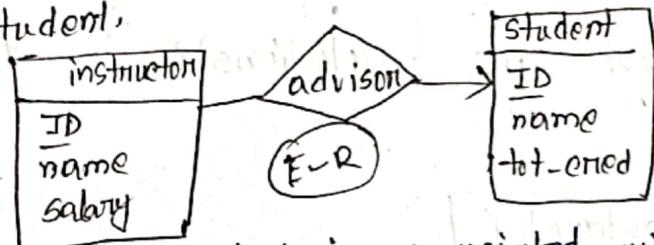
Many to one:



- ① An instructor is associated with at most one student via advisor

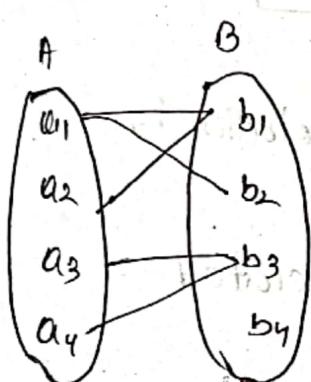
② An entity in A is associated with at most one entity in B. An entity in B can be associated with any number (zero or more) of entities in A.

⇒ Relationship between an instructor and a student.

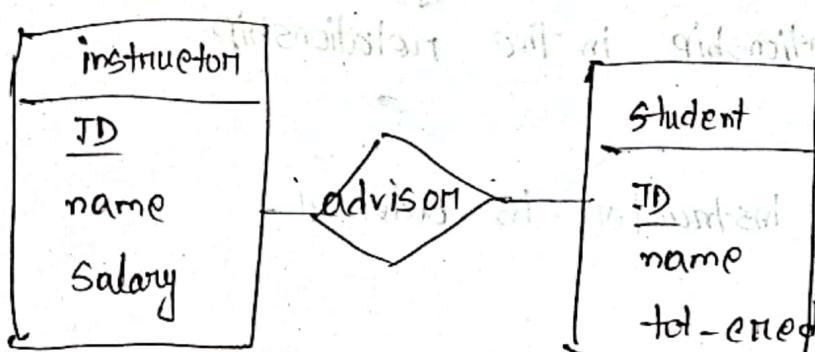


- ③ And a student is associated with several instructors via advisor

Many to many:



④ An entity in A is associated with any number (zero or more) of entities in B, and an entity in B is associated with any number (zero or more) of entities in A



(E-R diagram)

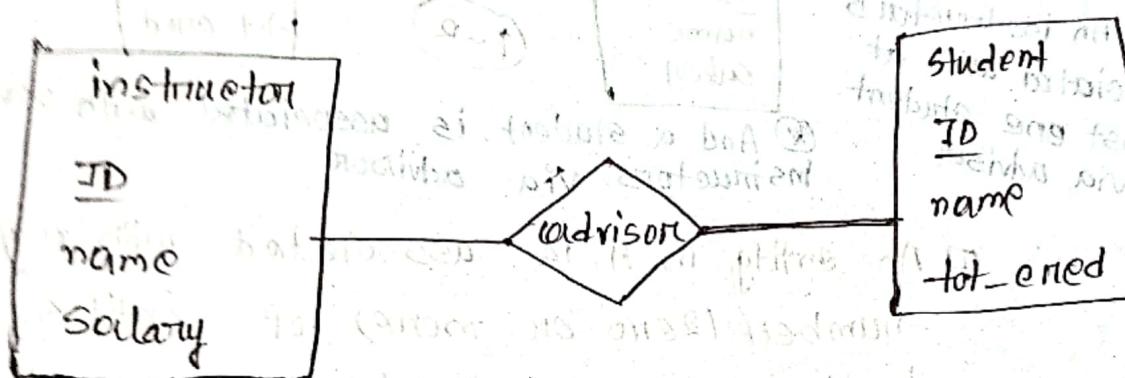
- ⑤ An instructor is associated with several students via advisor.

- ⑥ A student is associated with several instructors via advisor.

Total and partial participation:

(ii) Total participation: (Indicated by double line)

Every entity in the entity set participates in at least one relationship in the relationship set.



→ Participation of student in advisor relation is total.

→ every student must have an associated instructor.

(iii) Partial participation: Some entities may not participate in any relationship in the relationship set.

ExP: participation of

instructor in advisor

is partial.

(examples 4-7)

Primary key: It is the attribute or group of attributes which uniquely identifies a tuple.

- key:
 - (1) Super key
 - (2) Candidate key
 - (3) Primary key
 - (4) Composite key
 - (5) Foreign key

Super key: A superkey is a set of one or more attributes that taken collectively, allow us to identify uniquely a tuple in the relation. Super key attributes can also contain NULL values.

(class, section, roll) \Rightarrow superkey

(class, section, roll, gender) \Rightarrow superkey

Candidate key: Such minimal superkeys are called candidate keys. i.e. this attribute can also contain NULL values.

(class, section, roll) \Rightarrow candidate key

Composite key: The type of primary key consists of two or more attributes, such as multiple columns.

(class, section, roll) \Rightarrow composite key

Foreign key: A foreign key is a field in some table that refers to the primary key in another table.

Primary key: This provide a way to specify how entities and relations are distinguished.

- Entity sets to be a part of a single unique
- Relationship sets as there is no sufficient constraint
- weak entity sets

Primary key for entity sets:

- Individual entities are distinct
- The values of the attribute values of an entity must be such that they can uniquely identify the entity
- No two entities in an entity set are allowed to have exactly the same values for all attributes

Primary key for relationship set:

- To distinguish among the various relationships of a relationship set we use the individual primary keys of the entities in the relationship set.
- Let R be a relationship set involving entity sets E_1, E_2, \dots, E_n .
 - Relationship set 'advisor'
The primary key consists of instruction ID and Student ID.
 - The choice of primary key for a relationship set depends on the mapping cardinality of the relationship set,

choice of primary key for Binary Relationship:

- ① Many to many \Rightarrow Primary key is a minimal superkey
- ② One to many \Rightarrow Many side is a minimal superkey
- ③ Many to one \Rightarrow Many side is a minimal superkey
- ④ One to one \Rightarrow minimal superkey

Weak Entity sets: A weak entity set is one whose existence is dependent on another entity, called its identifying entity.

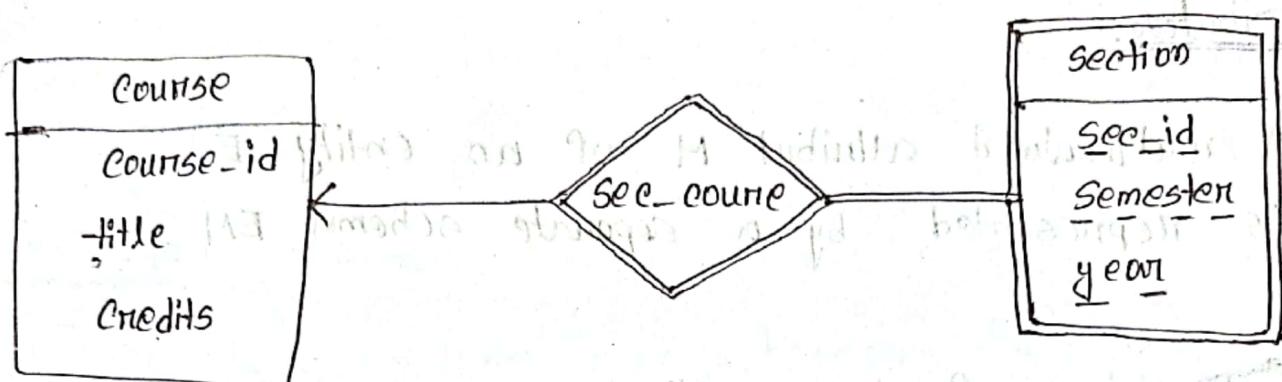
→ Instead of associating it with primary key with a weak entity, we use the identifying entity along with extra attributes called discriminators to uniquely identify a weak entity.

→ An entity set that is not a weak entity is termed a strong entity set.

→ The identifying entity set is said to own the weak entity sets that is identified.

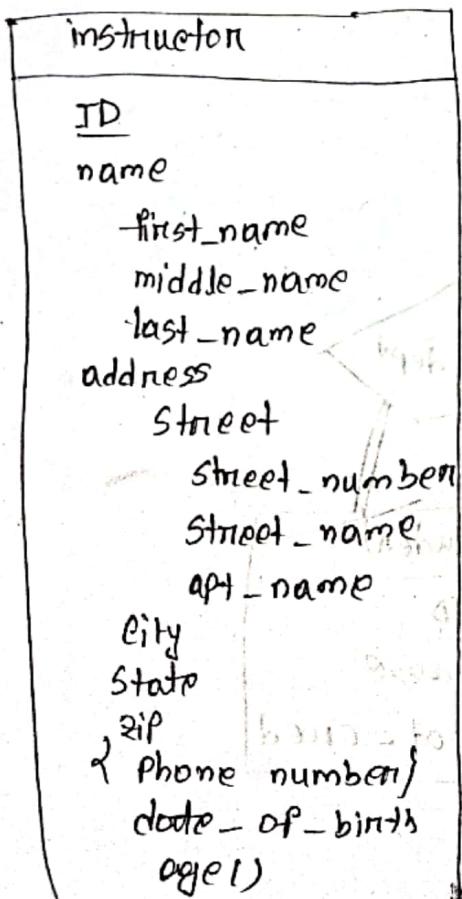
→ Every weak entity must be associated with an identifying entity; the weak entity set is said to be existence dependent on the identifying entity set.

E-R diagram of weak entity set:

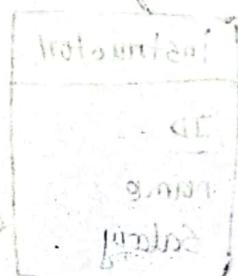


- In E-R diagram, a weak entity set is depicted via a double rectangle
- Primary key for section - (course-id, sec-id, semester, year)

Representing of entity sets with composite attributes:



- Composite attributes are flattened out by creating a separate attribute for each component attribute.
- Ignoring multi-valued attributes, extended instructor schema is \Rightarrow instructor (ID - - - date-of-birth)



Representation of entity sets with multivalued attributes:

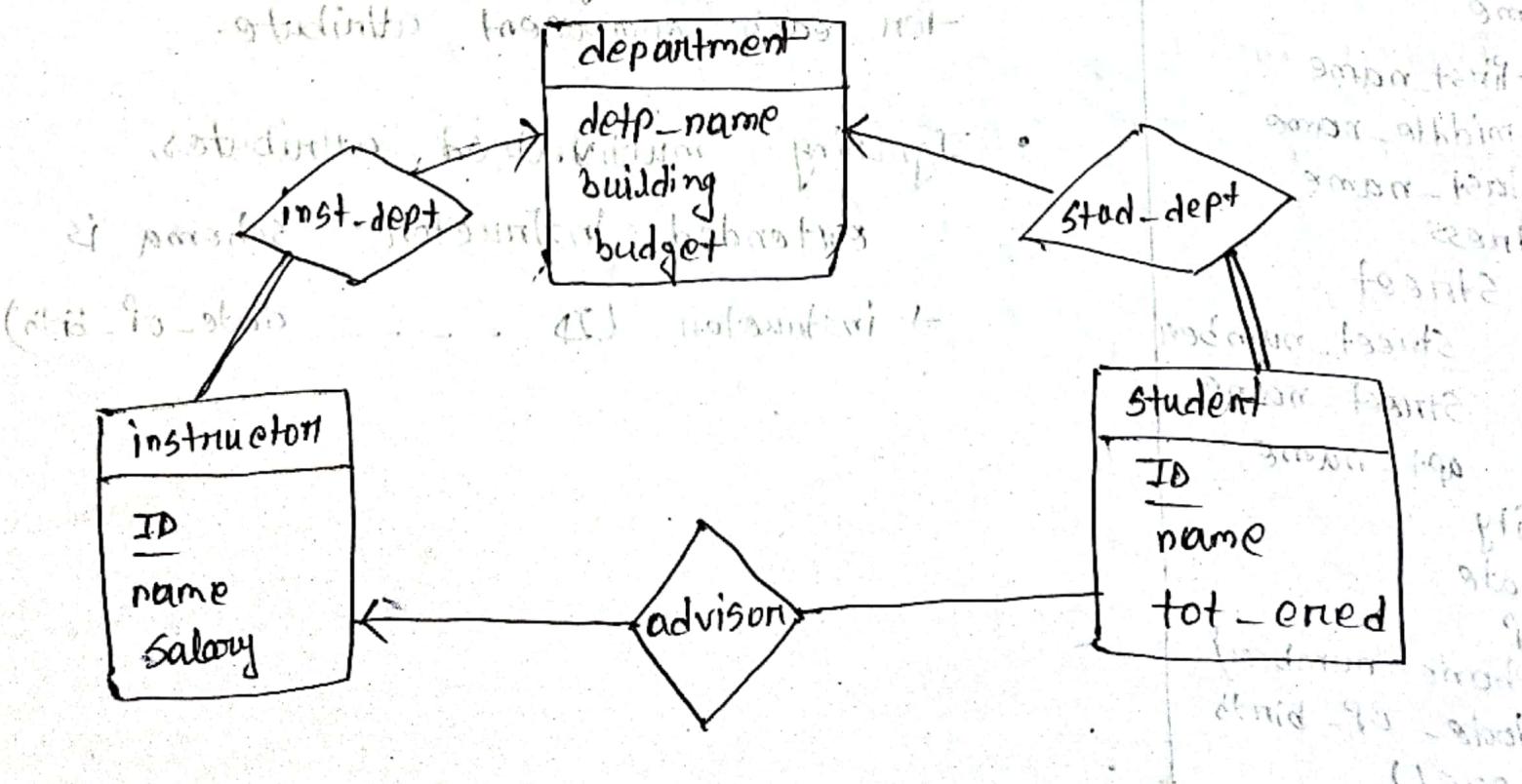
- A multivalued attribute M of an entity is represented by a separate schema EM.
- Each value of the multivalued attribute maps to a separate tuple of the relation on Schema EM.

Redundancy of schema:

Many-to-one and one-to-many relationship sets that are total on the many side can be represented by adding an extra attribute to the 'many' side.

student shape in professor and has

instructor shape in student



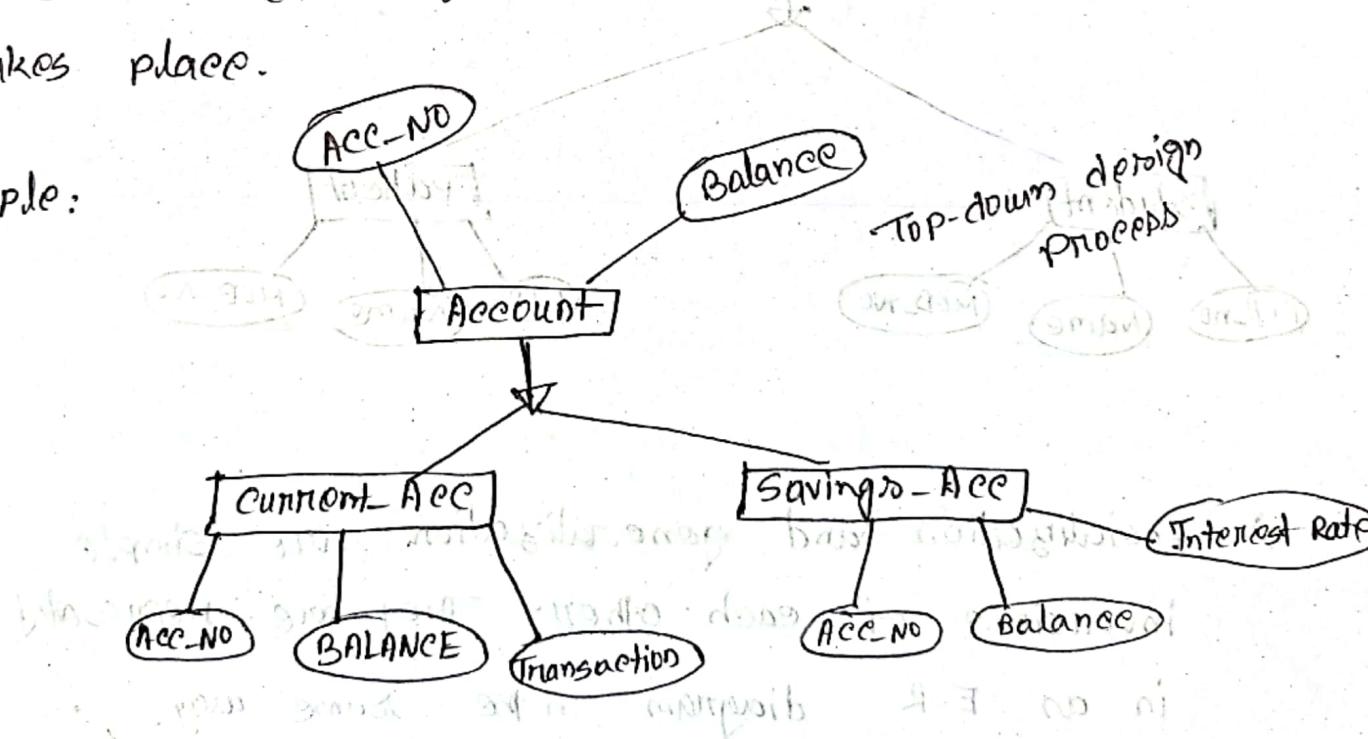
⇒ The schema corresponding to a relationship set linking a weak entity set to its identifying strong entity set is redundant. Most usual field in a database contains local budget until

Specialization: Specialization is opposite of Generalization.

In specialization, things are broken down into smaller things to simplify it further.

⇒ Specialization is a particular entity gets divided into sub entities and it's done on the basis of its characteristics. Also in specialization inheritance takes place.

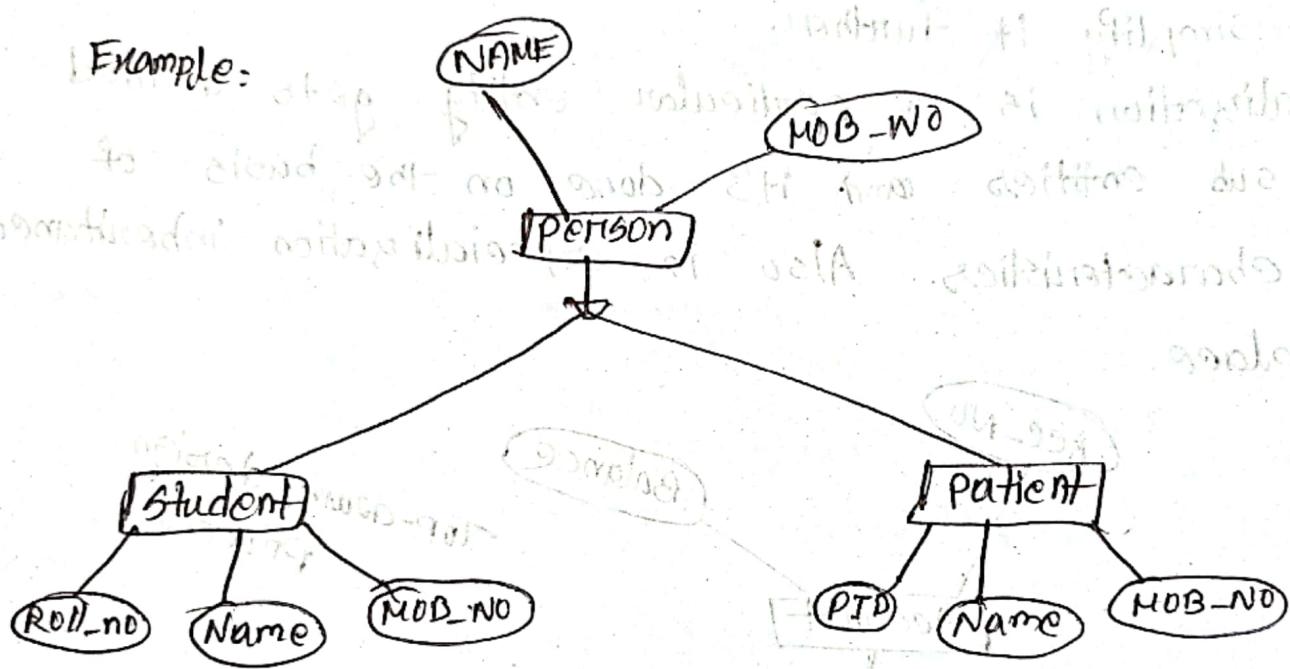
Example:



Generalization: (Bottom up design process)

In this, lower-level functions are combined to form higher-level function which is called entities. This process is repeated further to make advanced level entities.

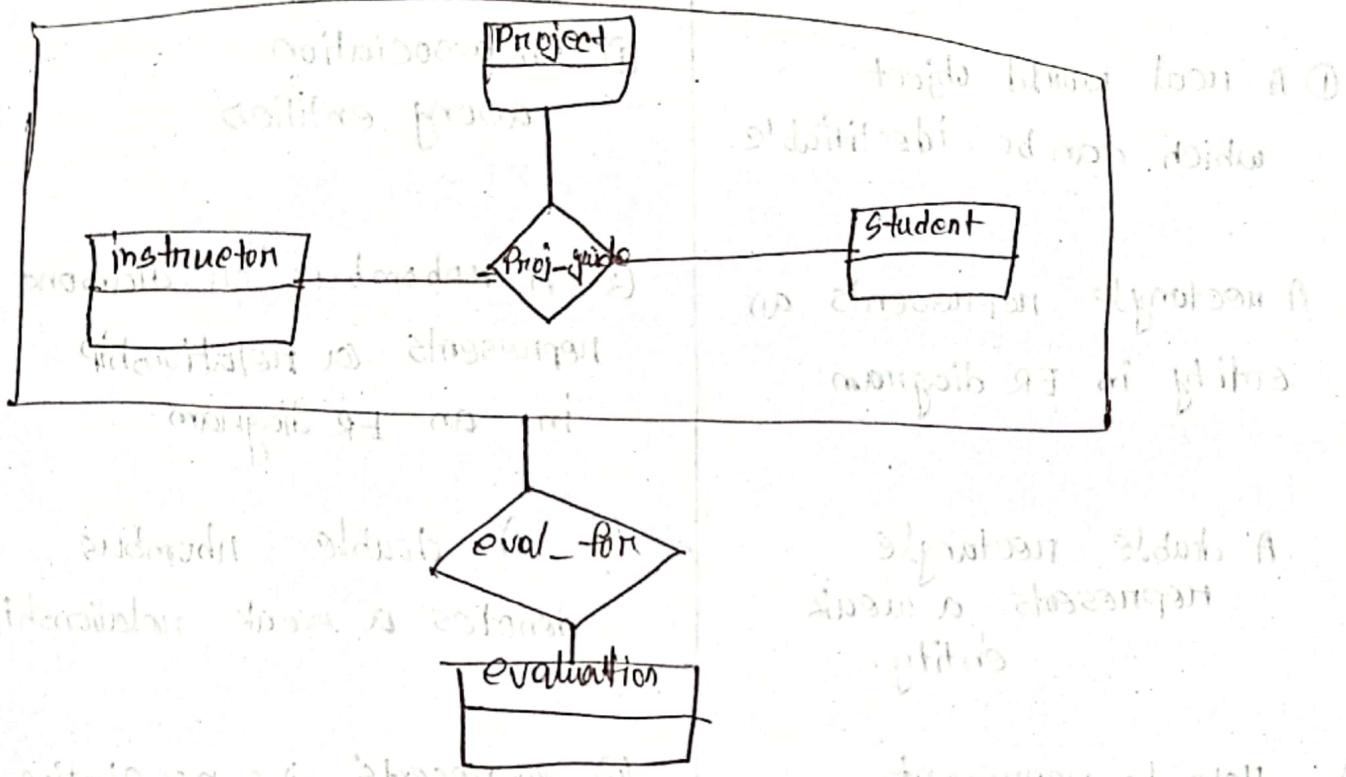
Example:



→ Specialization and generalization are simple inversions of each other. They are represented in an E-R diagram in the same way.

Aggregation:

A student is guided by a particular instructor on a particular project.



To represent aggregation, create a schema containing

- Primary key of the aggregated relationship
- primary key of the associated entity set

Entities vs Relationship sets

Entity	Relationship
① A real world object which can be identifiable	① An association among entities
② A rectangle represents an entity in ER diagram	② A rhombus or diamond represents a relationship in an ER diagram.
③ A double rectangle represents a weak entity.	③ A double rhombus denotes a weak relationship
④ Help to represent world objects	④ Represents the association between two or more entities.