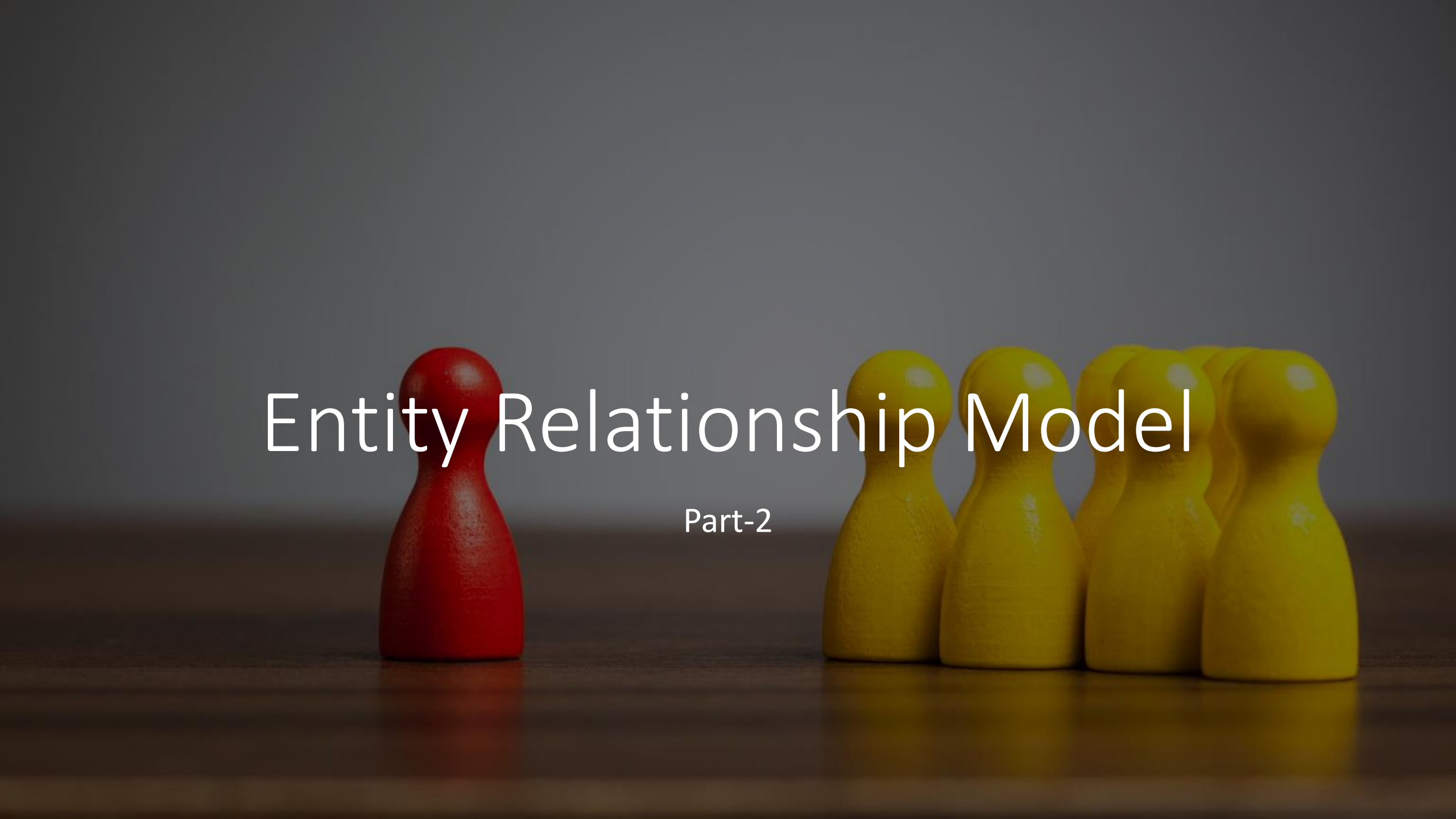

Entity Relationship Model

Part-2

How to design ER diagram??

Steps to design ER model?

Steps to design ER model?

- To identify the entities
- To find the relationships among these entities
- To identify key attributes
- To identify other relevant attributes
- To draw the complete ER diagram

Case study of Bennett university management system?

- Bennett university contains many departments. Each department can offer any number of courses. Many teachers can work in a department. A teacher can work only in one department. For each department there is a Head. A teacher can be head of only one department. Each teacher can take any number of courses. A course can be taken by only one instructor. A student can enroll for any number of courses. Each course can have any number of students

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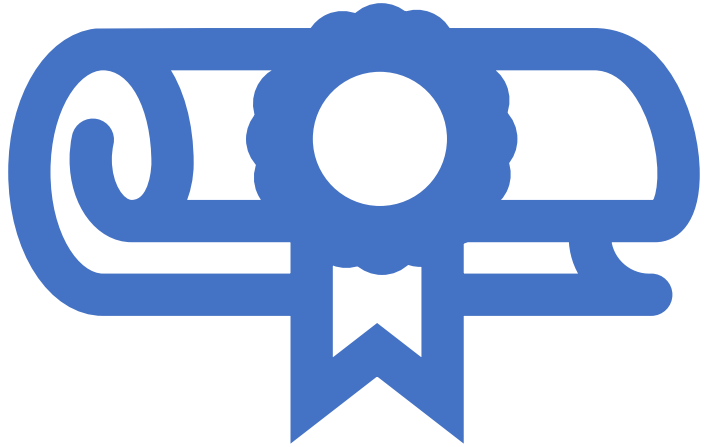
- A student can enroll for any number of courses. Each course can have any number of students

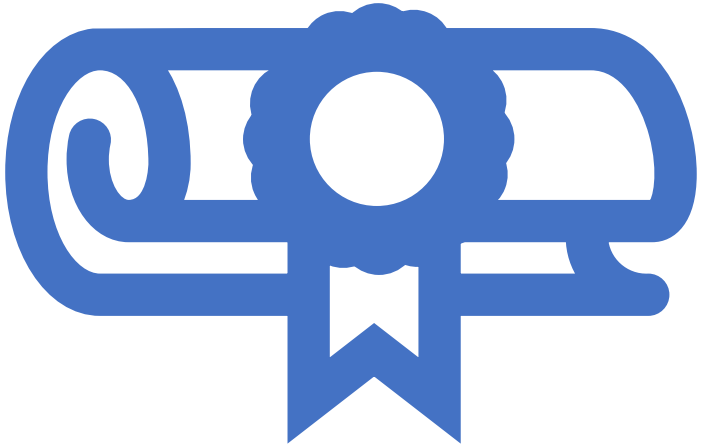
To identify the entities?

- University, Department, Courses, Teacher, Student



To identify the entities?

- University, Department, Courses, Teacher, Student
- Here database is of only one university . If an entity has a single instance, then that entity is ignored. Thus, the final entities are:
  - Department, Courses, Teacher, Student



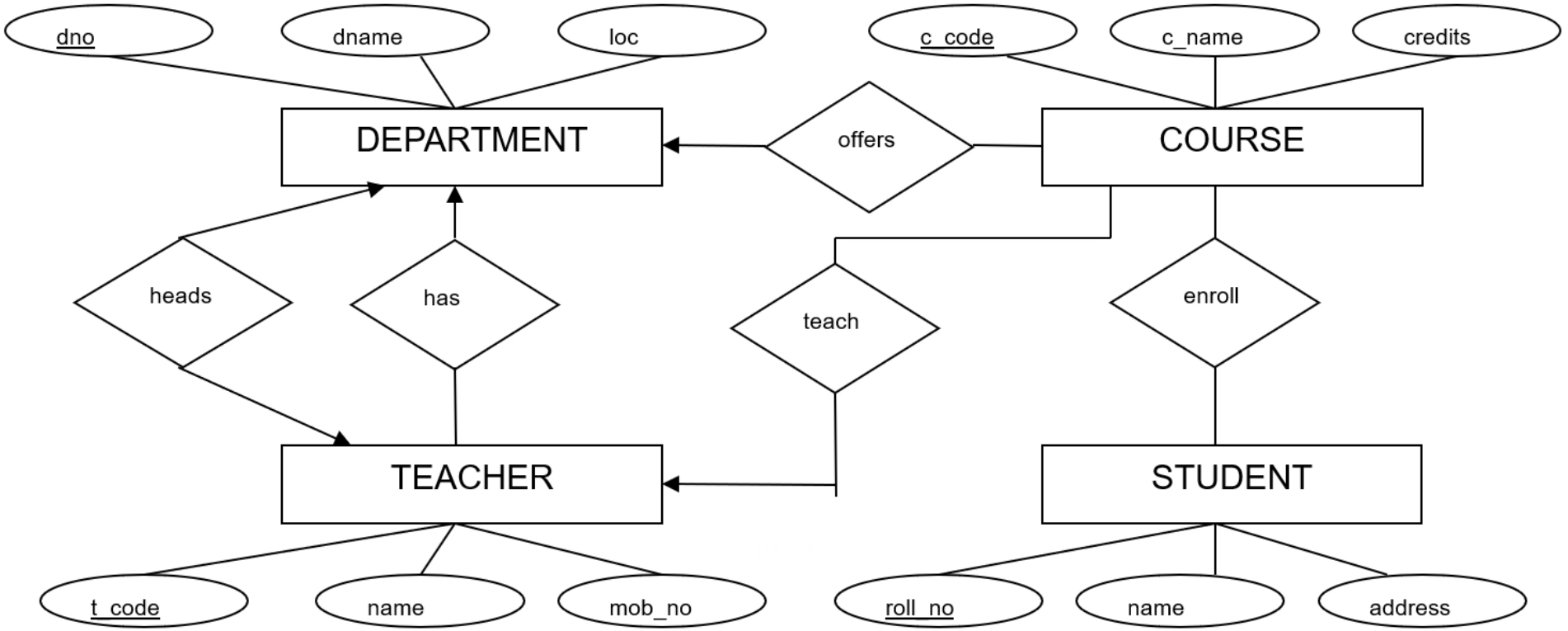
To find the relationships among these entities?

- Bennett university contains many departments.
- Each department can offer any number of courses.
- Many teachers can work in a department. A teacher can work only in one department.
- For each department there is a Head. A teacher can be head of only one department.
- Each teacher can take any number of courses. A course can be taken by only one instructor.
- A student can enroll for any number of courses. Each course can have any number of students

To identify key attributes
To identify other relevant attributes

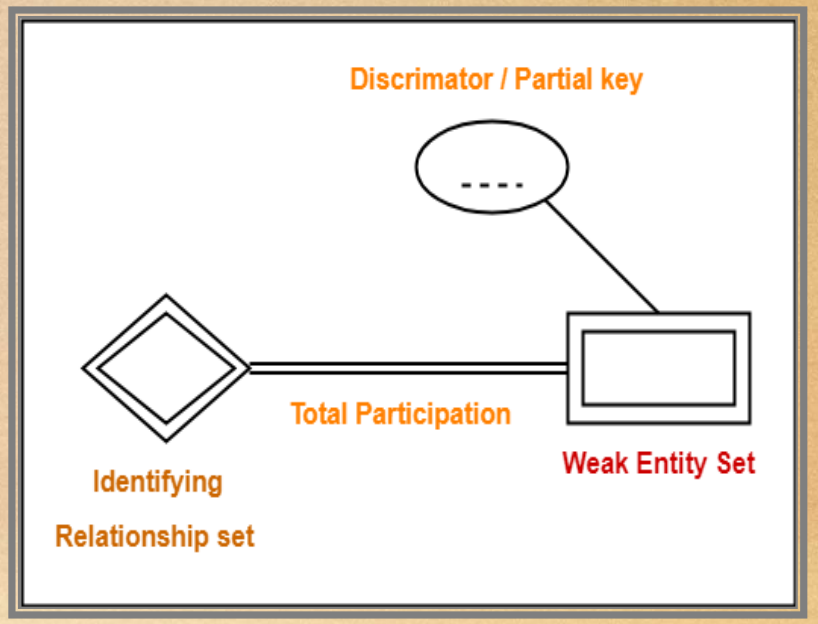
- Department (dno, dname, loc)
- Teacher (t_code, name, mob_no)
- Course (c_code, c_name, credits)
- Student (roll_no, name, address)

ER diagram


dno
dname
loc
c_code
c_name
credits
DEPARTMENT
offers
COURSE
heads
has
teach
enroll
TEACHER
STUDENT
t_code
name
mob_no
roll_no
name
address

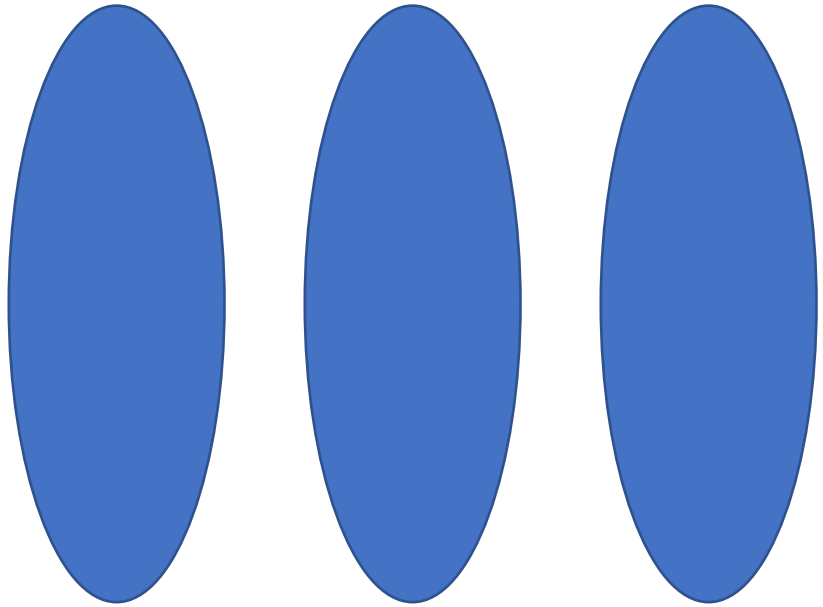
Weak Entity Set

- Weak entity set: An entity set that does not have a primary key.
- Its existence depends on the existence of a strong entity set.
- The discriminator of a weak entity set is the set of attributes that distinguishes between all the entities of a weak entity set.
- Its primary key is created by combining the primary key of the strong entity set on which the weak entity set is existence dependent and the weak entity set's discriminator.
- We underline the discriminator attribute with a dashed line.

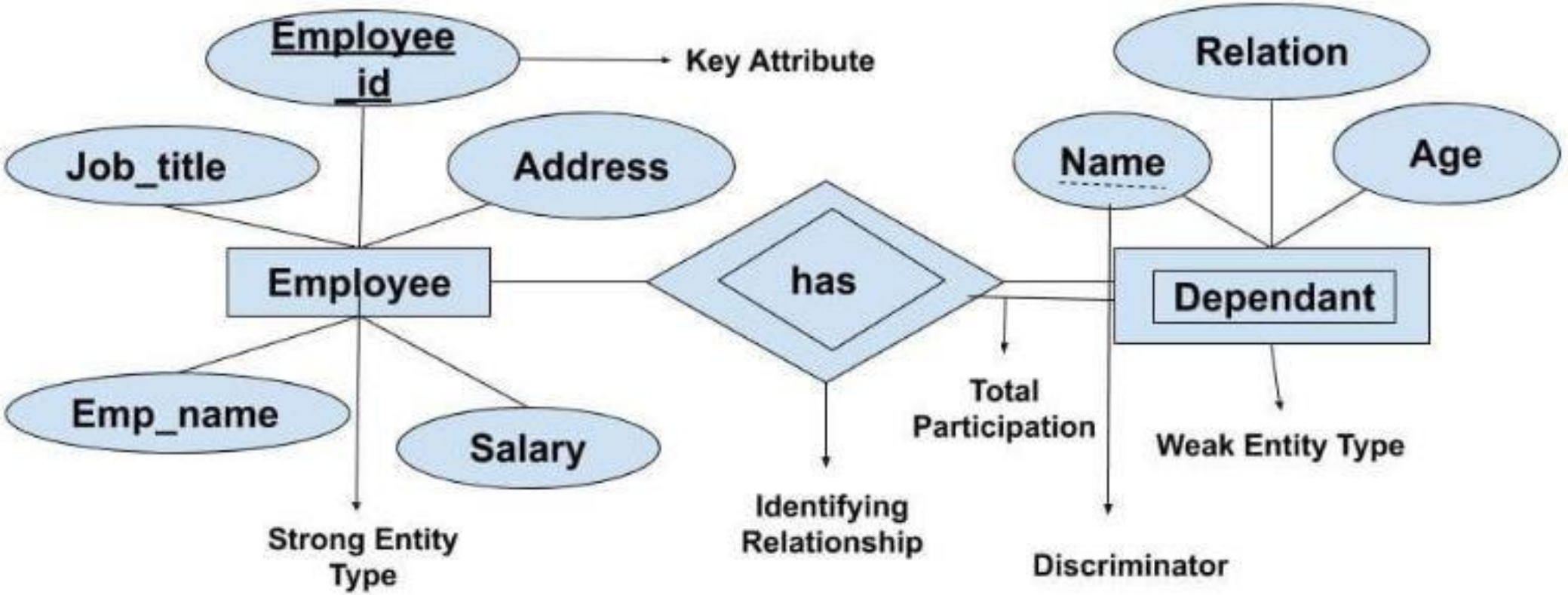


Example

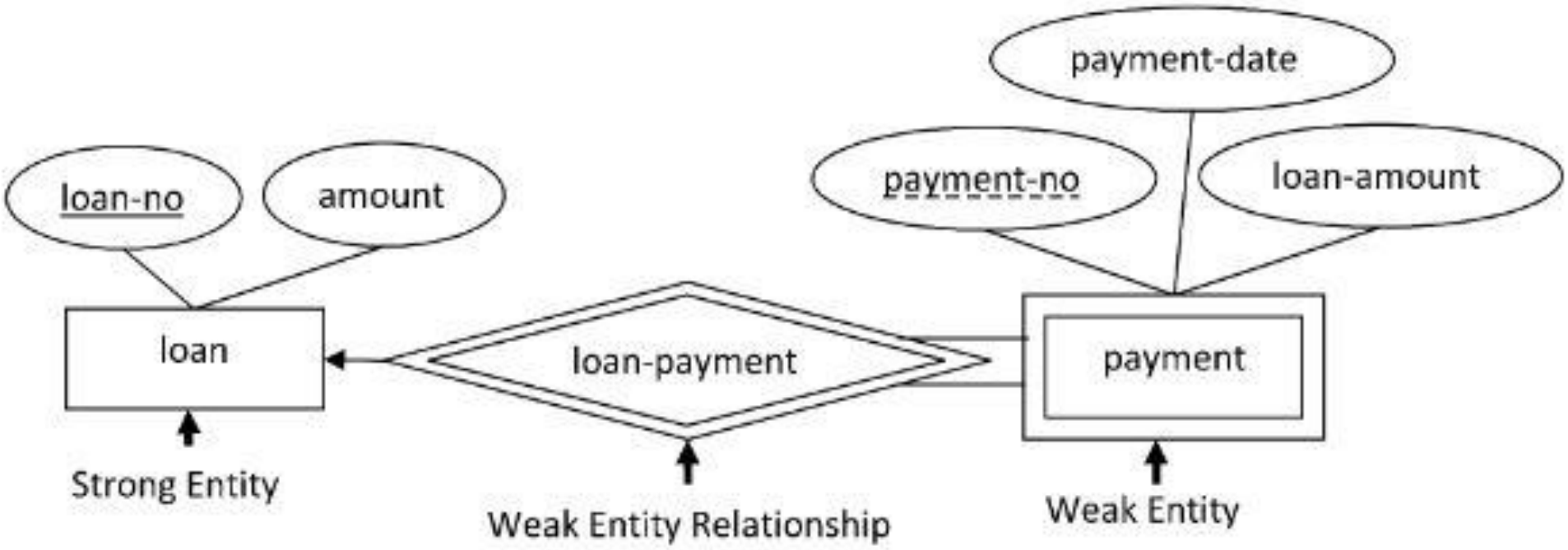
- Employee={eid,name, age,department}
- Dependent={name,age,relation}



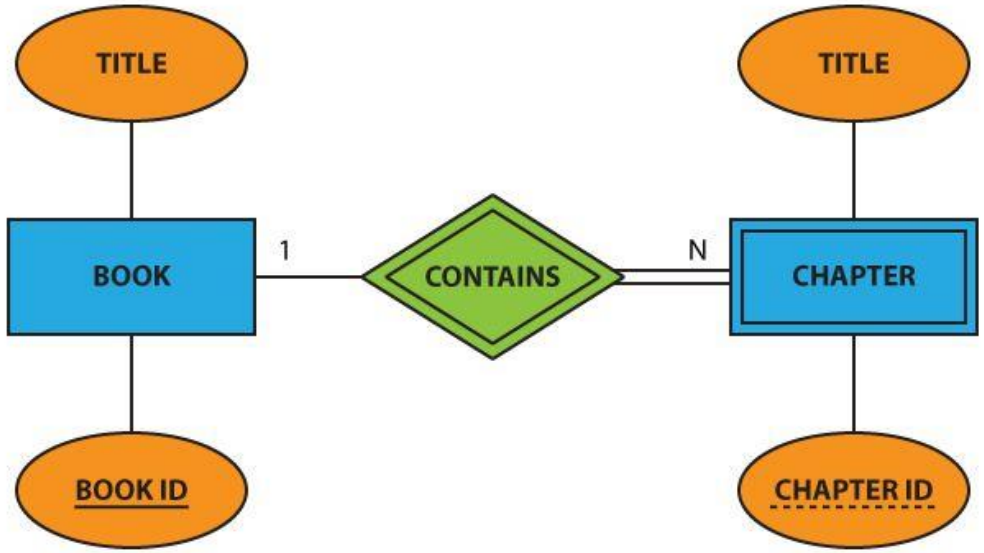
Weak Entity set examples contd.



Weak Entity set examples

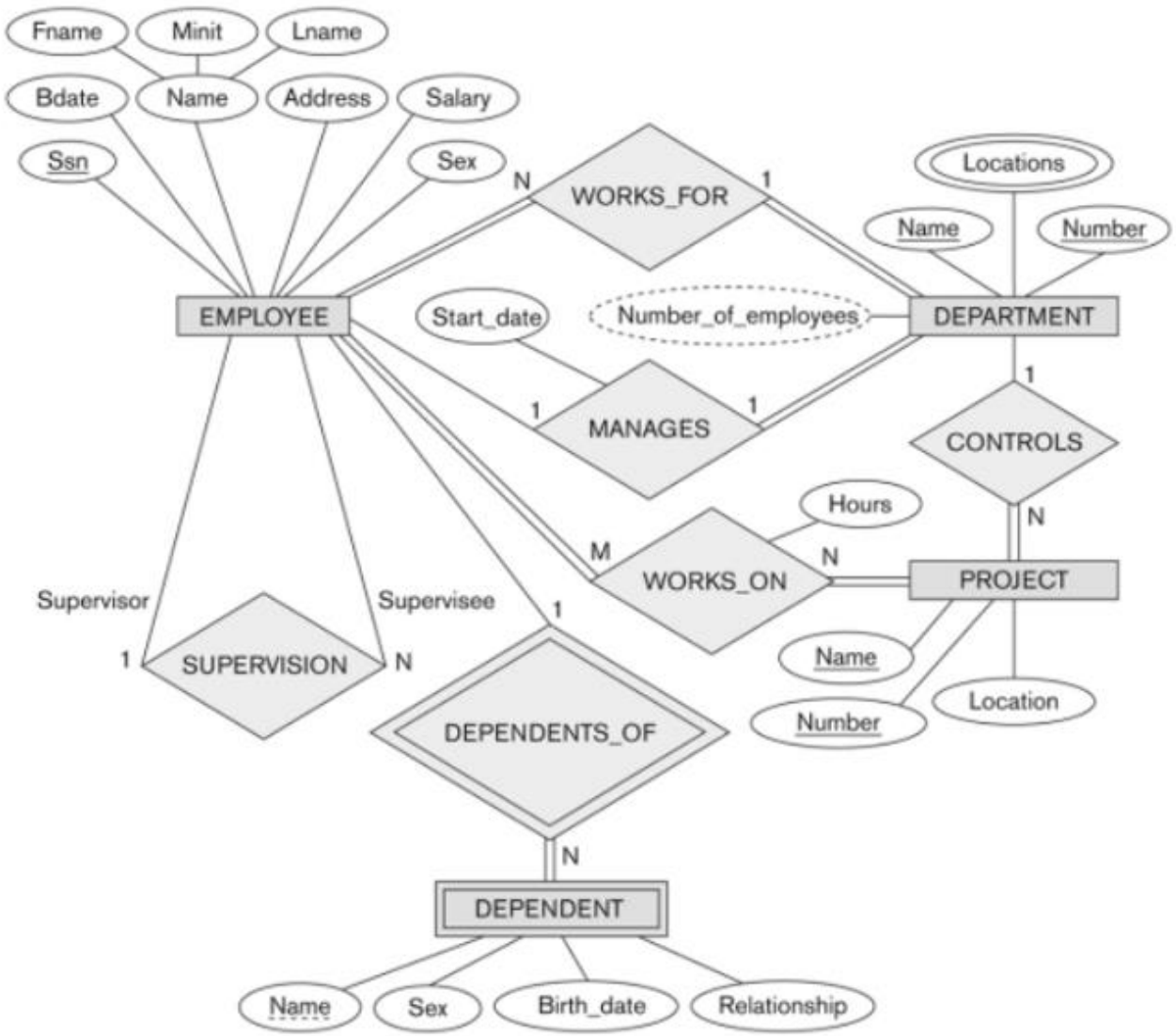


Weak Entity set examples contd.



Steps in Designing an Entity-Relationship Schema

1. Identify entity types (entity type vs. attribute)
2. Identify relationship types
3. Identify and associate attributes with entity and relationship types
4. Determine attribute domains.
5. Determine primary key attributes for entity types
6. Associate (refined) cardinality ratio(s) with relationship types
7. **Design generalization/specialization hierarchies including constraints (includes natural language statements as well)**


Fname
Minit
Lname
Bdate
Name
Address
Salary
Ssn
Sex
N
WORKS_FOR
1
Locations
Name
Number
EMPLOYEE
Start_date
Number_of_employees
DEPARTMENT
1
1
MANAGES
1
CONTROLS
Hours
N
M
WORKS_ON
N
PROJECT
Supervisor
Supervisee
1
1
SUPERVISION
N
Name
Location
Number
DEPENDENTS_OF
N
DEPENDENT
Name
Sex
Birth_date
Relationship

EER Model

EER stands for Extended/Enhance ER model

Enhanced entity-relationship diagrams are advanced database diagrams very similar to regular ER diagrams which represents requirements and complexities of complex databases.

Why to go for EER model?

The additional EER concepts are used to model applications more accurately and more completely.

EER includes some object oriented concepts such as inheritance.

Extended Features of ER Model

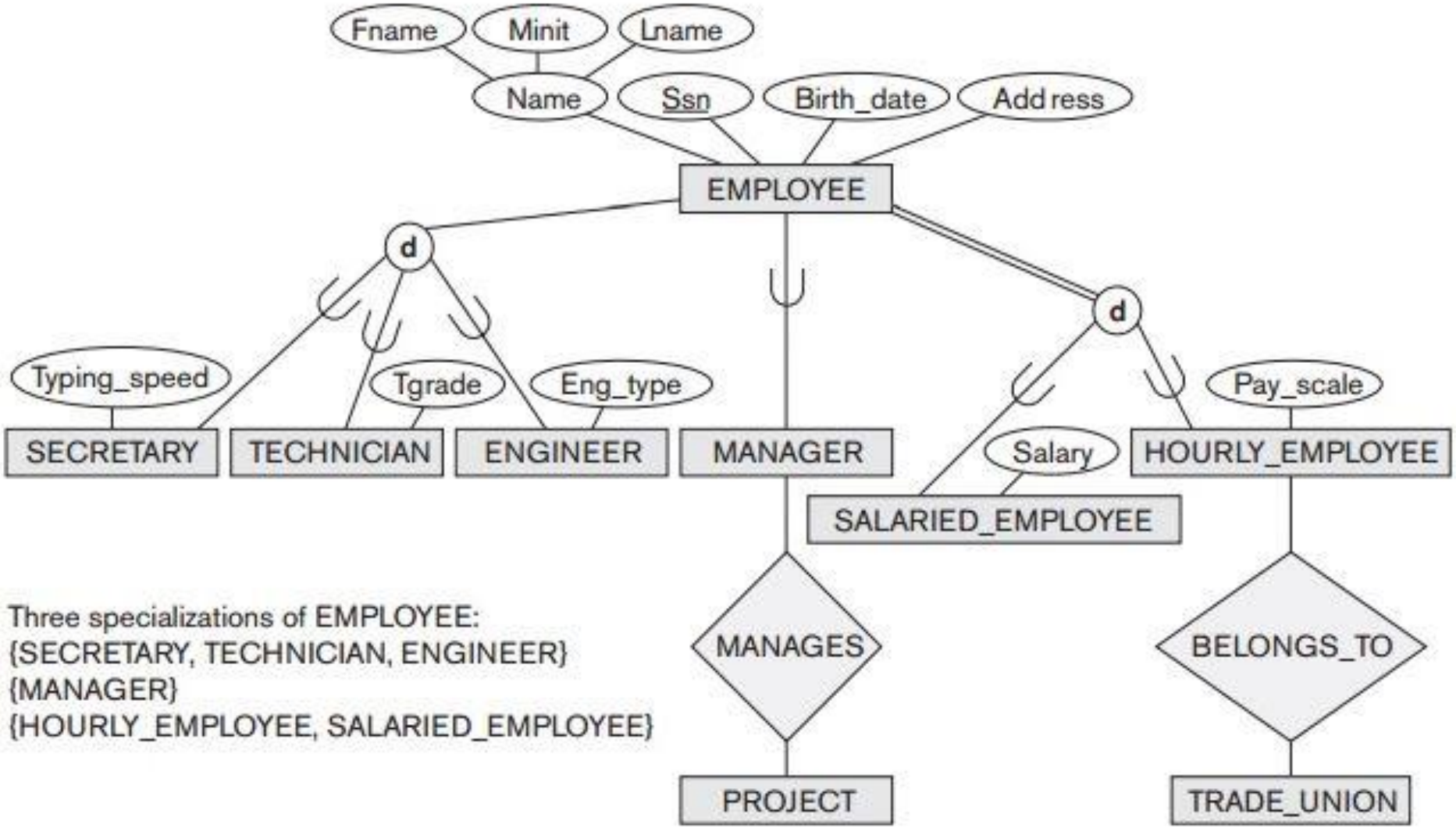
Specialization

Generalization

Inheritance

Subclasses and Superclasses (1)

- An entity type may have additional meaningful subgroupings of its entities
  - Example: EMPLOYEE may be further grouped into:
  - SECRETARY, ENGINEER, TECHNICIAN, …
    - Based on the EMPLOYEE's Job
  - MANAGER
    - EMPLOYEEs who are managers
  - SALARIED_EMPLOYEE, HOURLY_EMPLOYEE
    - Based on the EMPLOYEE's method of pay
- EER diagrams extend ER diagrams to represent these additional subgroupings, called subclasses or subtypes



Three specializations of EMPLOYEE:
{SECRETARY, TECHNICIAN, ENGINEER}
{MANAGER}
{HOURLY_EMPLOYEE, SALARIED_EMPLOYEE}

How Can you categorize employees of BU

- Professors, Data Entry operators, clerks, gardeners, drivers (job type)
- Deans(only deans manages schools)
- Permanent and contract employees (job agreement)

Subclasses and Superclasses (2)

- These are also called **IS-A** relationships
  - SECRETARY **IS-A** EMPLOYEE, TECHNICIAN **IS-A** EMPLOYEE, ….
- **Note:** An entity that is member of a subclass represents the same real-world entity as some member of the superclass:
  - The subclass member is the same entity in a distinct specific role
  - An entity cannot exist in the database merely by being a member of a subclass; it must also be a member of the superclass

Subclasses and Superclasses (2)

- A member of the superclass can be optionally included as a member of any number of its subclasses
- Examples:
  - A salaried employee who is also an engineer belongs to the two subclasses:
    - ENGINEER, and
    - SALARIED_EMPLOYEE
  - A salaried employee who is also an engineering manager belongs to the three subclasses:
    - MANAGER,
    - ENGINEER, and
    - SALARIED_EMPLOYEE
- It is not necessary that every entity in a superclass be a member of some subclass

Specialization

Top-down design process: We designate sub grouping within an entity set that are distinctive from other entities in the set.

The subgrouping become lower level entity sets that have attributes or participate in relationships that do not apply to the higher level entity set

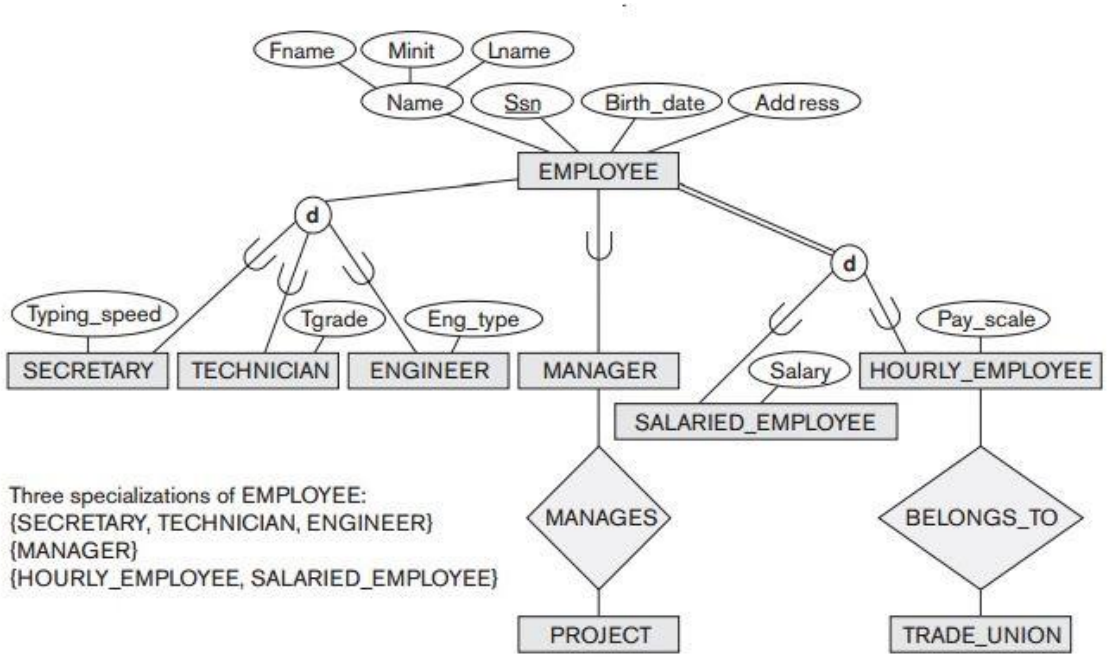
Depicted by a **triangle component labelled ISA.**

Attribute inheritance: A lower level entity set inherits all the attributes and relationship participation of the linked higher entity set.

Specialization Example

The distinguished feature for specialization are:

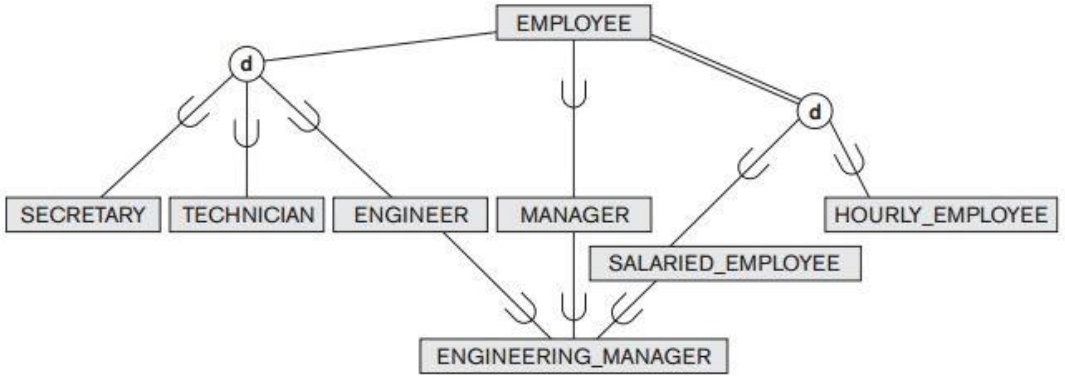
- The job the employee performs.
- the person is a temporary (limited-term) employee or a permanent employee



Specialization Lattice

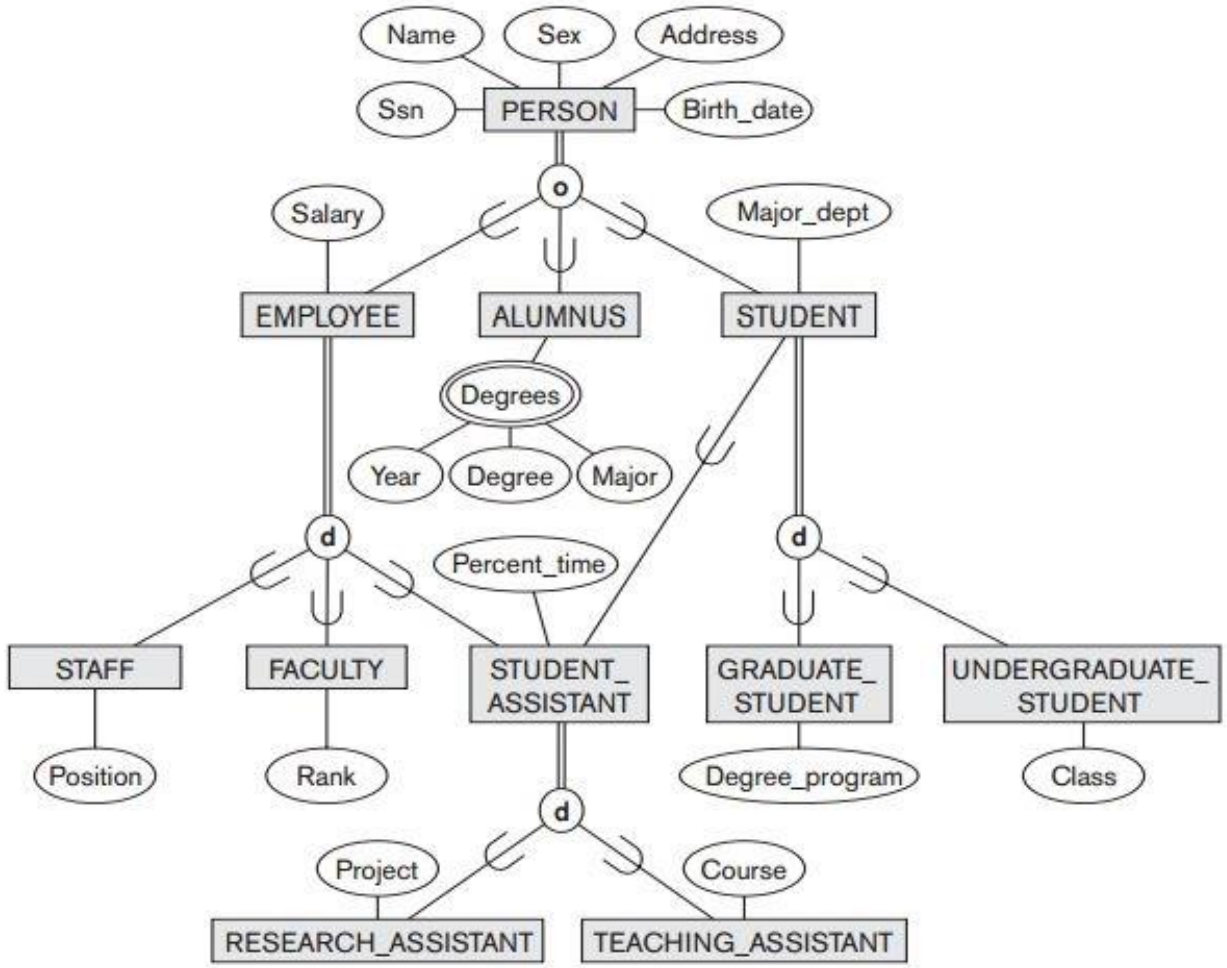
A **specialization hierarchy** has the constraint that every subclass participates *as a subclass* in *only one* class/subclass relationship

For a **specialization lattice**, a subclass can be a subclass in *more than one* class/subclass relationship.



A specialization lattice with shared subclass ENGINEERING_MANAGER

A Specialization Lattice with multiple Inheritance for a university database

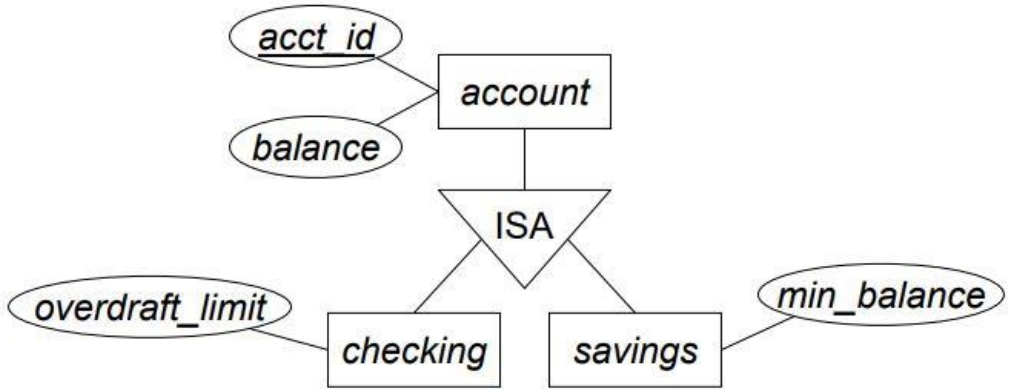


Generalization

A bottom up design process: Combine a number of entity sets that share the same features into a higher level entity set.

The term generalization and specialization are used interchangeably.

The ISA relationship can also referred as “superclass-subclass” relationship.



Inheritance

Attributes of higher-level entity-sets are inherited by lower-level entity-sets

Relationships involving at higher level is also inherited by lower level elements

When entity-sets inherit from one super class

- Entity sets form a hierarchy

When entity-sets inherit from multiple super classes

- Entity-sets form a lattice

Constraints on Specialization/Generalization: Membership Constraints

- **Predicate defined subclasses:** The subclass is defined through a predicate on the attributes of the superclass
- **Attribute defined subclasses**
  - The subclasses in the specialization are all defined by the same attribute of the superclass. E.g.- Based on account type, it can be divided into saving and checking account.
- **User defined subclasses**
  - Membership in the subclasses is determined at the insertion operation level. E.g.- Team formed to create specific task

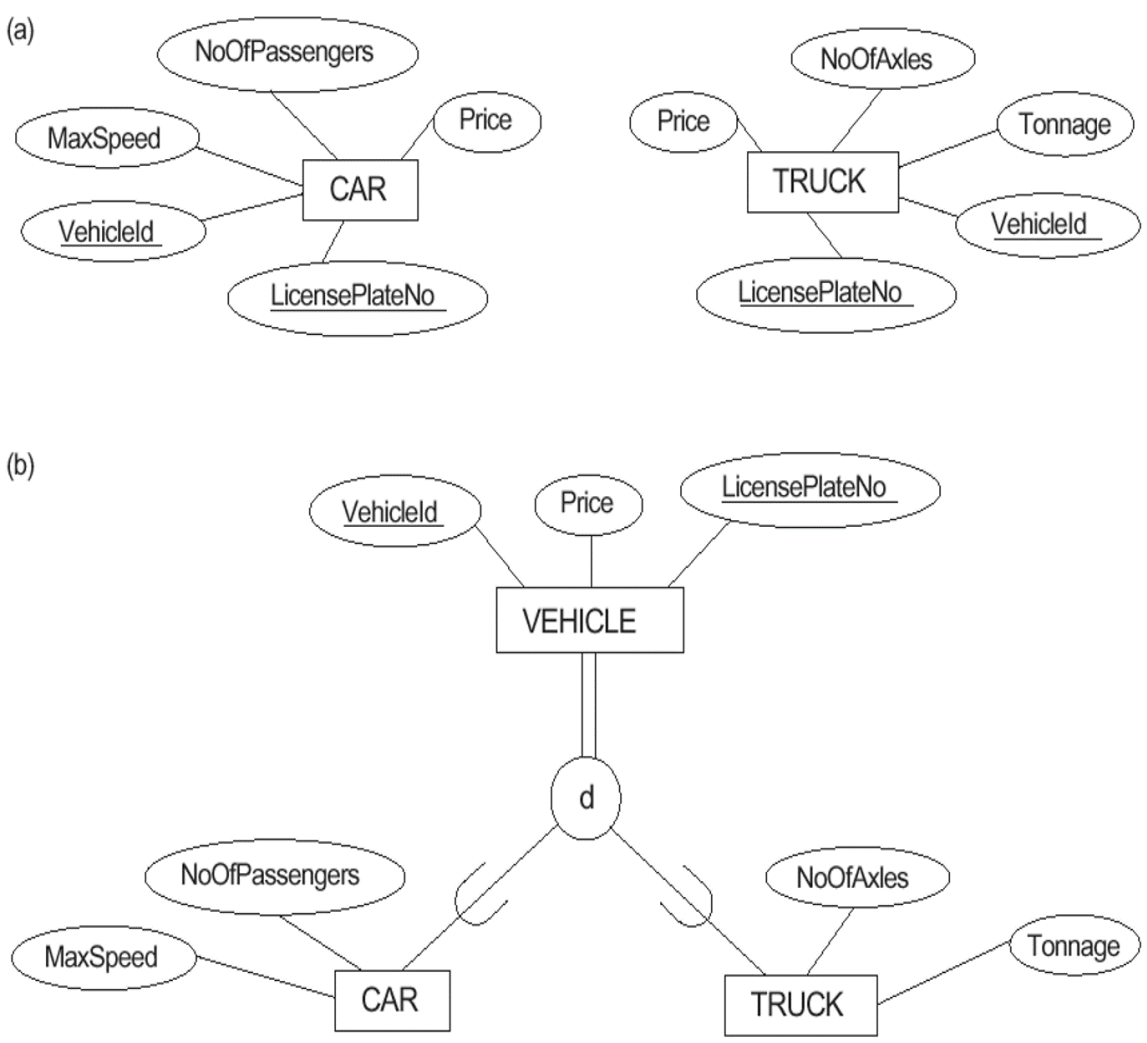
Constraints on Specialization/Generalization: Disjointness Constraints

Disjoint (d)

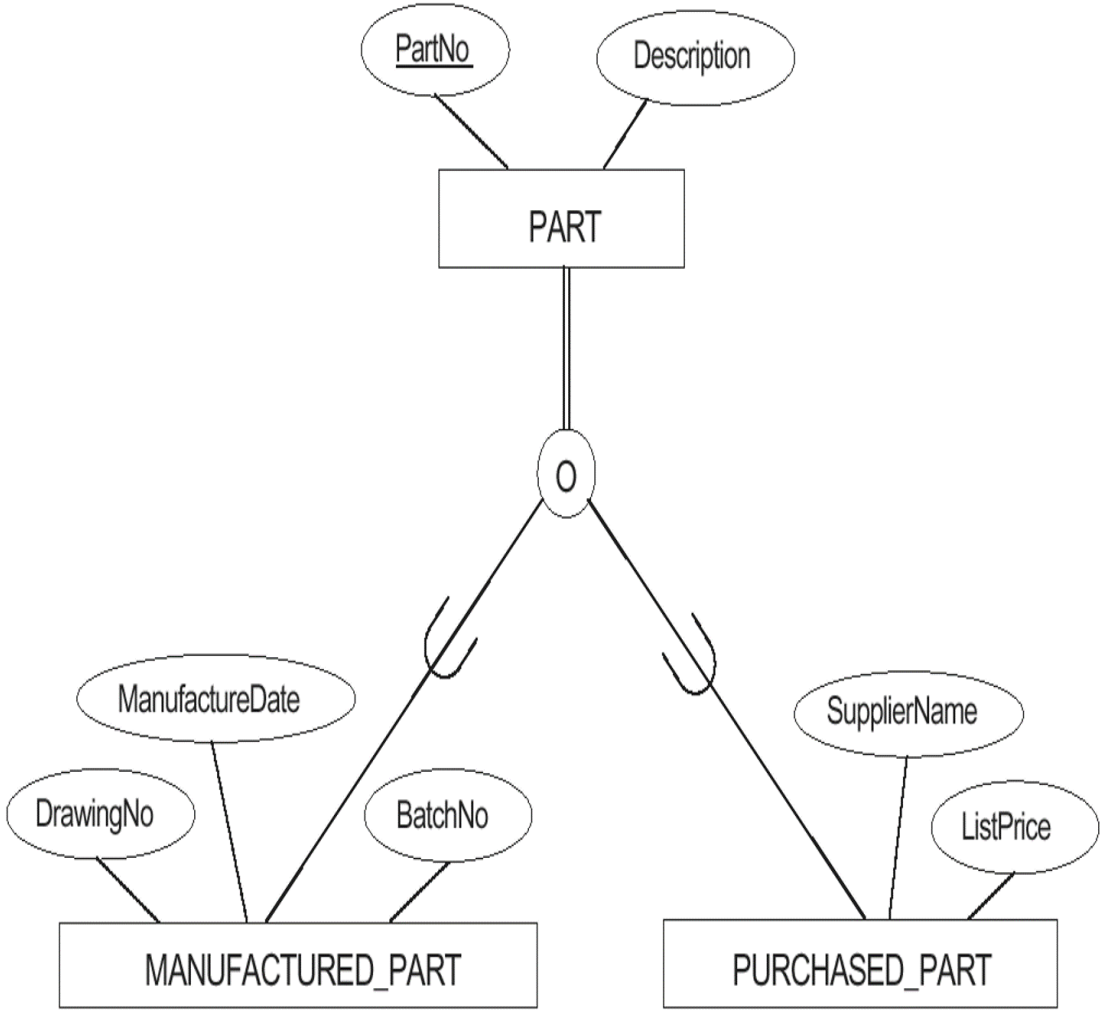
- The subclasses must have disjoint sets of entities

Overlap (o)

- The subclasses may have overlapping sets of entities



Disjoint Example



Overlapping Example

Constraints on Specialization/Generalization: Completeness Constraints

Partial

- An entity may not belong to any of the subclasses (single-line)

Total

- Every entity in the superclass must be a member of some subclass (double-edge)

Constraints on Specialization/Generalization:

Hence we have four types of Specialization/Generalization:

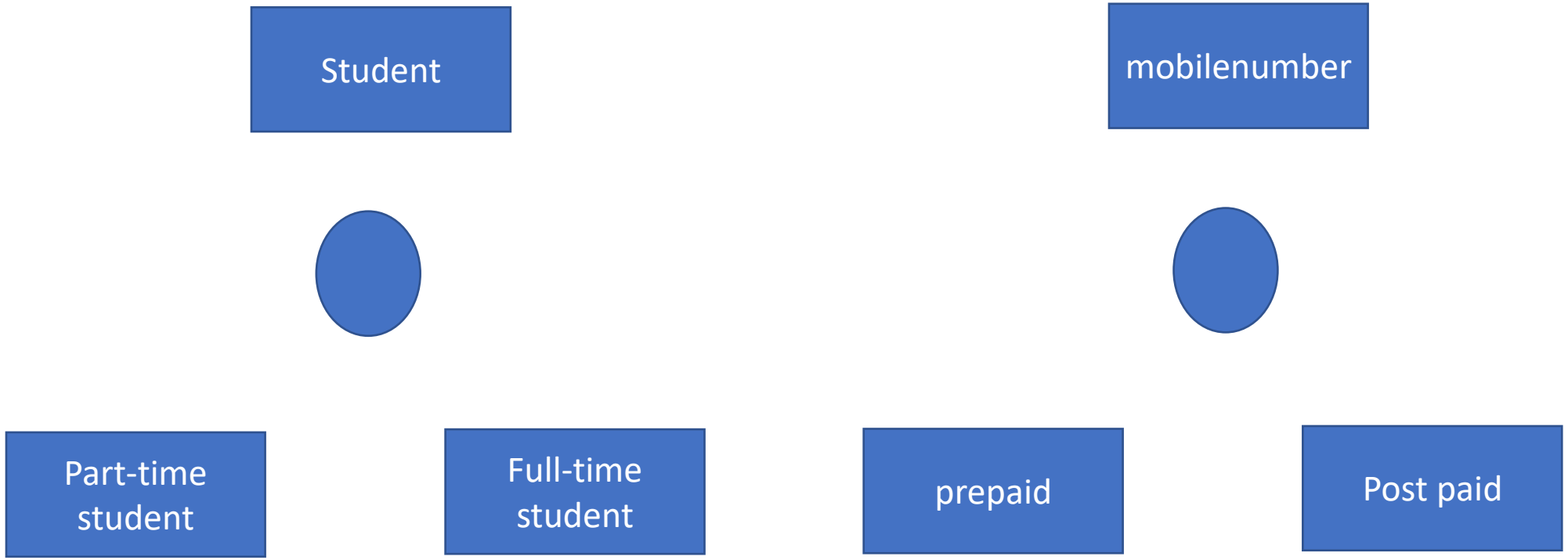
Disjoint, total

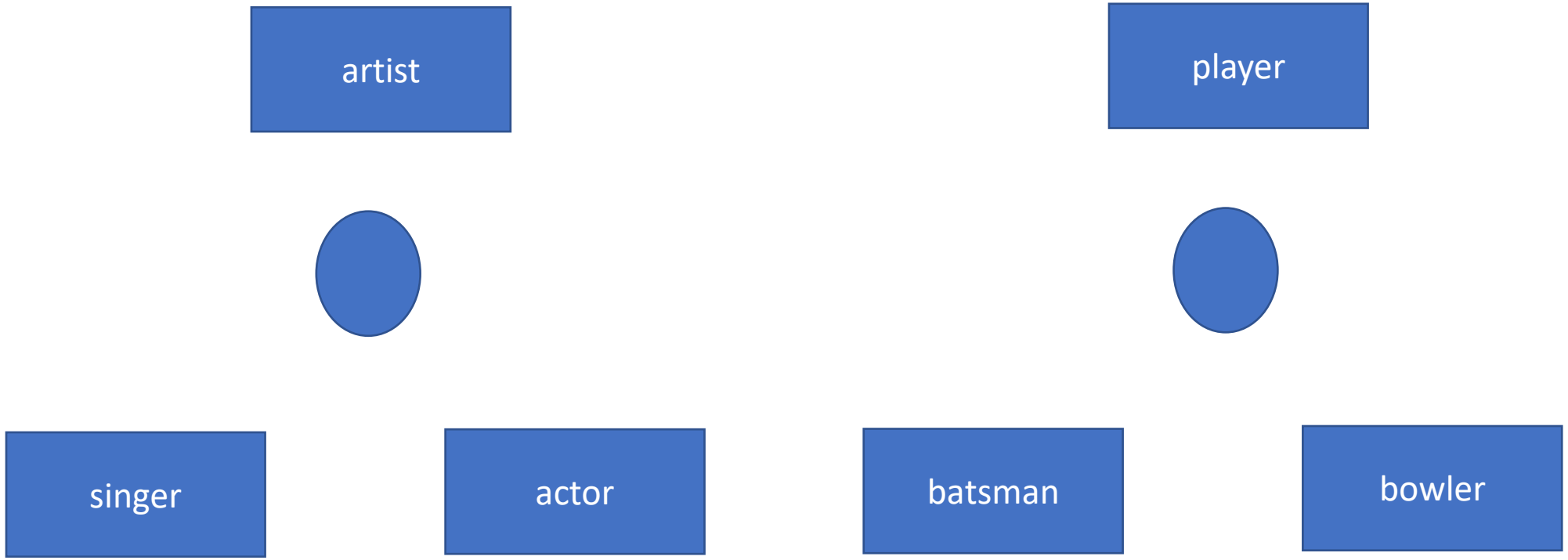
Disjoint partial

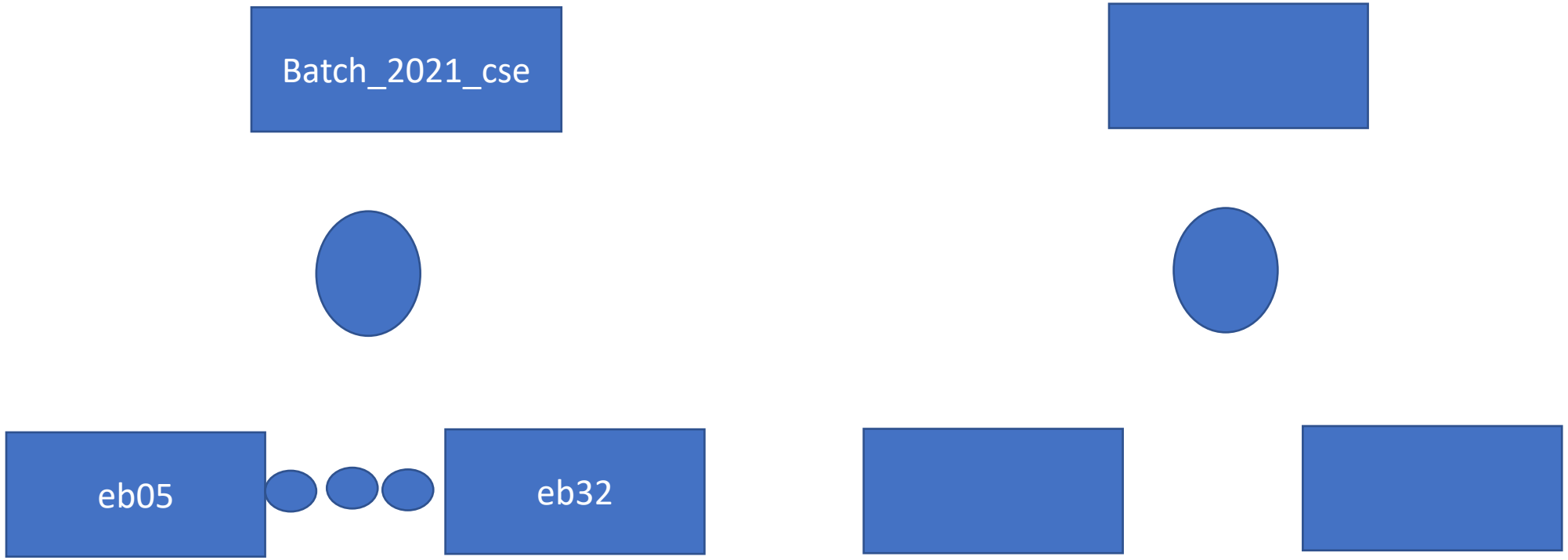
Overlapping , total

Overlapping, partial

Note: Generalization usually is total because the superclass is derived from the subclass.


Student
mobilenumber
Part-time student
Full-time student
prepaid
Post paid


artist
player
singer
actor
batsman
bowler


Batch_2021_cse
eb05
eb32

Aggregation

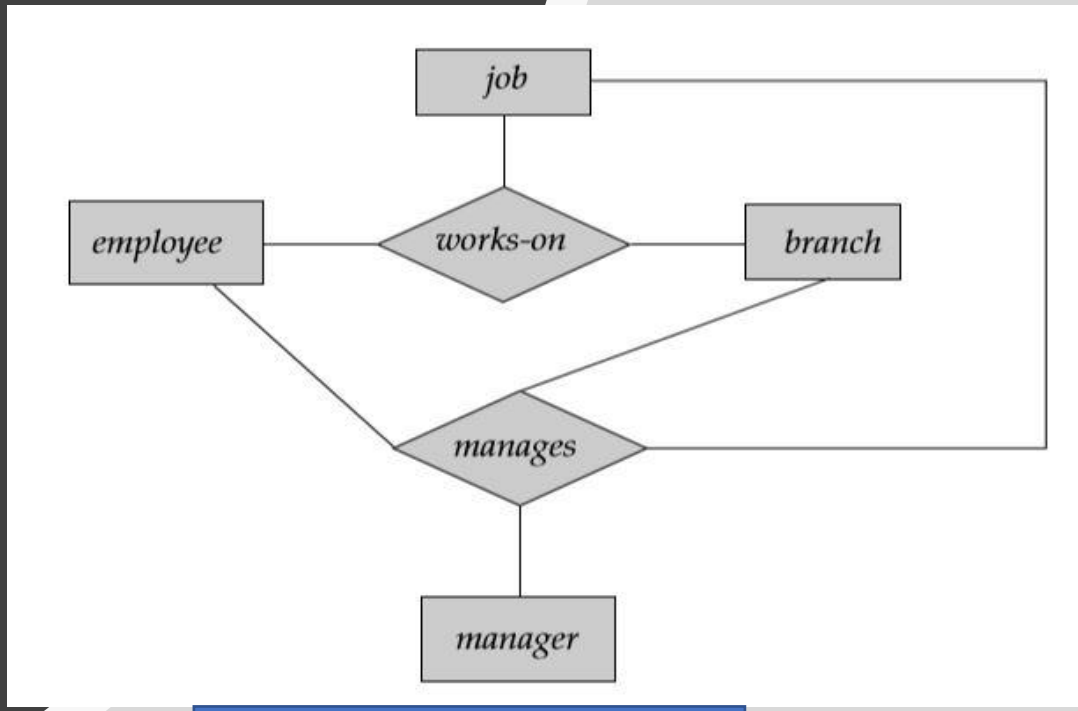
An ER diagram is not capable of representing relationship between an entity and a relationship which may be required in some scenarios.

In those cases, a relationship with its corresponding entities is aggregated into a higher level entity.

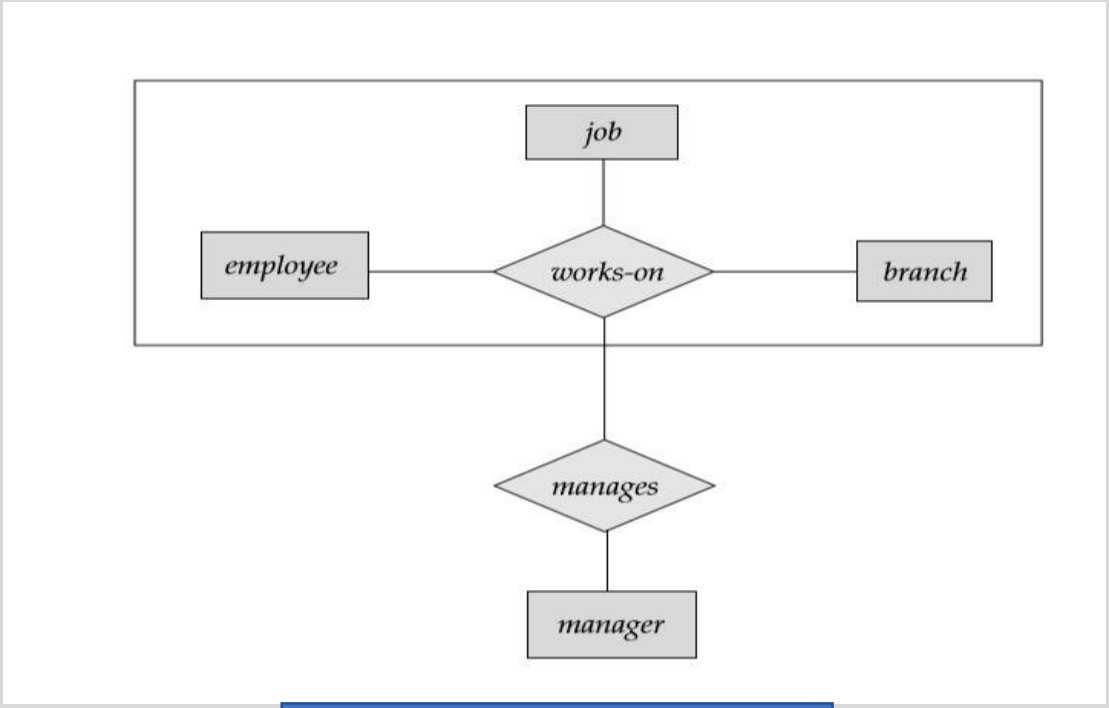
Aggregation is an abstraction through which relationships are treated as higher level entities.

It is used to express relationships among relationships.

Aggregation Contd.



Without Aggregation



With Aggregation

MCQ

- The entity set person is classified as student and employee. This process is called _____
  a) Generalization
  b) Specialization
  c) Inheritance
  d) Constraint generalization

MCQ

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  b) **Specialization**
  c) Inheritance
  d) Constraint generalization

MCQ

- Which relationship is used to represent a specialization entity?
  a) ISA
  b) AIS
  c) ONIS
  d) WHOIS

MCQ

- Which relationship is used to represent a specialization entity?
  a) **ISA**
  b) AIS
  c) ONIS
  d) WHOIS

MCQ

- There are similarities between the instructor entity set and the secretary entity set in the sense that they have several attributes that are conceptually the same across the two entity sets: namely, the identifier, name, and salary attributes. This process is called
  a) Commonality
  b) Specialization
  c) Generalization
  d) Similarity

MCQ

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  b) Specialization
  c) **Generalization**
  d) Similarity

MCQ

- The completeness constraint may be one of the following: Total generalization or specialization, Partial generalization or specialization. Which is the default?
  a) Total
  b) Partial
  c) Should be specified
  d) Cannot be determined

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MCQ

- Consider the employee work-team example, and assume that certain employees participate in more than one work team. A given employee may therefore appear in more than one of the team entity sets that are lower level entity sets of employee. Thus, the generalization is _____
  a) Overlapping
  b) Disjointness
  c) Uniqueness
  d) Relational

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