Database Design & Applications (SS ZG 518)

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Content

❑ *Enhanced ER modeling*

❑ *Super-class and sub-class representation*

❑ *Constrains*

Introduction to EER

Why EER

Some applications like –GIS, CAD/CAM, Telecommunication Have more complex requirements than normal database applications.
To meet the requirements additional modeling concepts were incorporated into Conceptual data modeling such as ER modeling.
The result is EER, stands for
  Extended ER modeling or *Enhanced ER modeling*

The additional EER concepts are used to model applications more

completely and more accurately.

EER includes some object-oriented concepts, such as inheritance

EER Basics

Additional concepts:

- Subclasses/super classes

- Specialization/generalization

- Attribute and relationship   Inheritance

These are fundamental to conceptual modeling.

Subclasses in EER

Subclass of an Entity type

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
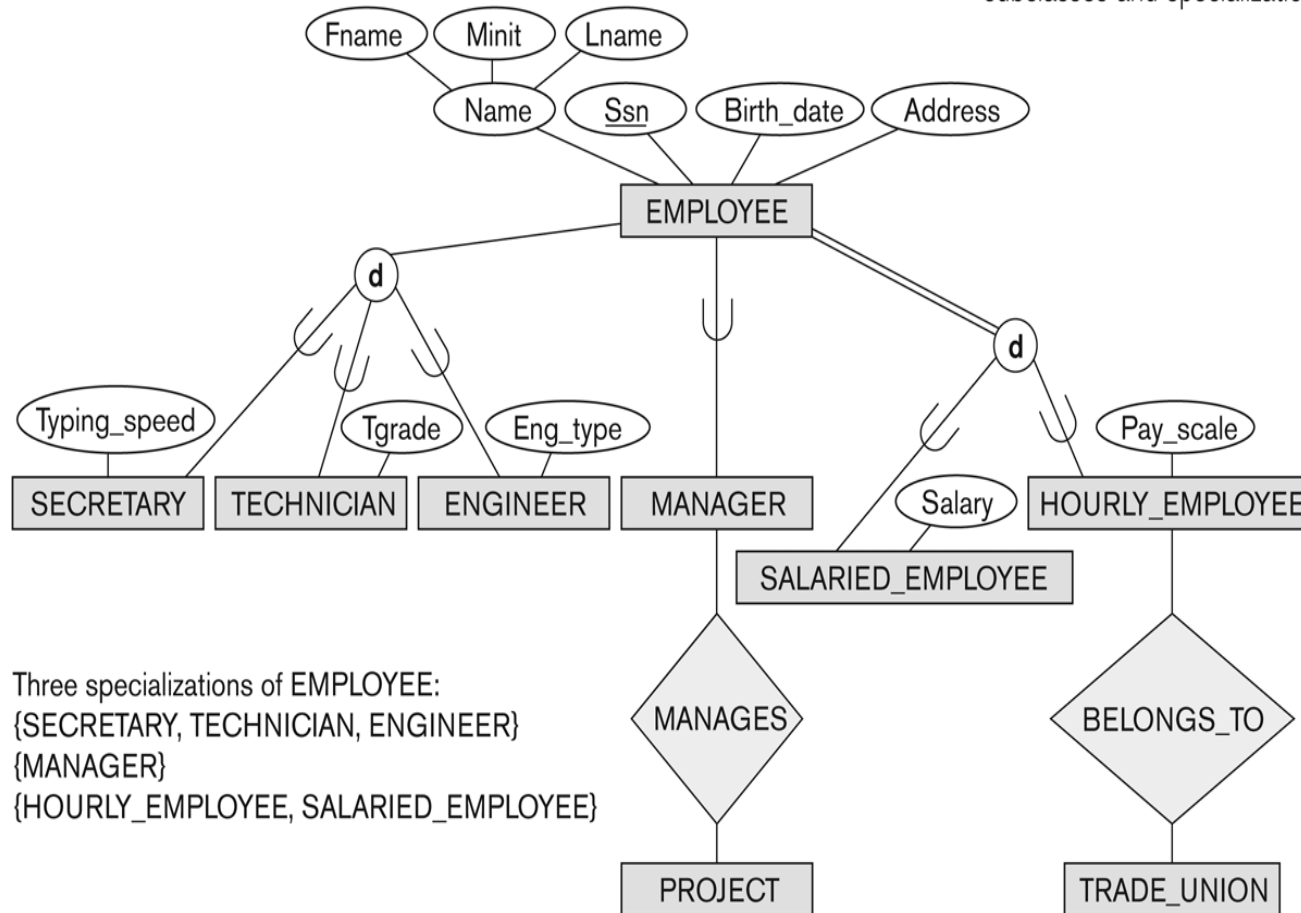>   - Based on the EMPLOYEE's method of pay

EER diagrams extend ER diagrams to represent these additional subgroupings, called *subclasses* or *subtypes*

EER Notations

Figure 4.1
EER diagram notation to represent subclasses and specialization.

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

Subclasses in EER (cntd..)

- Each of these subgroupings is a subset of EMPLOYEE entities

- Each is called a subclass of EMPLOYEE

- EMPLOYEE is the superclass for each of these subclasses

- These are called superclass/subclass relationships:

  - EMPLOYEE/SECRETARY
  - EMPLOYEE/TECHNICIAN
  - EMPLOYEE/MANAGER

Subclasses in EER (cntd..)

- 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
  - ❖ A member of the superclass can be optionally included as a member of any number of its subclasses

Subclasses in EER (cntd..)

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:
  - o MANAGER,
  - o ENGINEER, and
  - o SALARIED_EMPLOYEE

It is not necessary that every entity in a superclass be a member of some subclass

Subclasses in EER (cntd..)

Attribute Inheritance in Superclass / Subclass Relationships

An entity that is member of a subclass *inherits*

❑ All attributes of the entity as a member of the superclass

❑ All relationships of the entity as a member of the superclass

Example:

➢ In the previous slide, SECRETARY (as well as TECHNICIAN and ENGINEER) inherit the attributes Name, SSN, ..., from EMPLOYEE

➢ Every SECRETARY entity will have values for the inherited attributes

Specialization in EER

Specialization is the process of defining a set of subclasses of a superclass

The set of subclasses is based upon some distinguishing characteristics of the entities in the superclass

Example: {SECRETARY, ENGINEER, TECHNICIAN} is a specialization of EMPLOYEE based upon *job type.*

- May have several specializations of the same superclass

Specialization

Example: Another specialization of EMPLOYEE based on *method of pay* is {SALARIED_EMPLOYEE, HOURLY_EMPLOYEE}.

❖ Superclass/subclass relationships and specialization can be diagrammatically represented in EER diagrams

❖ Attributes of a subclass are called *specific* or *local* attributes.
  For example, the attribute TypingSpeed of SECRETARY

❖ The subclass can also participate in specific relationship types.
  For example, a relationship BELONGS_TO of HOURLY_EMPLOYEE

Figure 4.1
EER diagram notation to represent subclasses and specialization.

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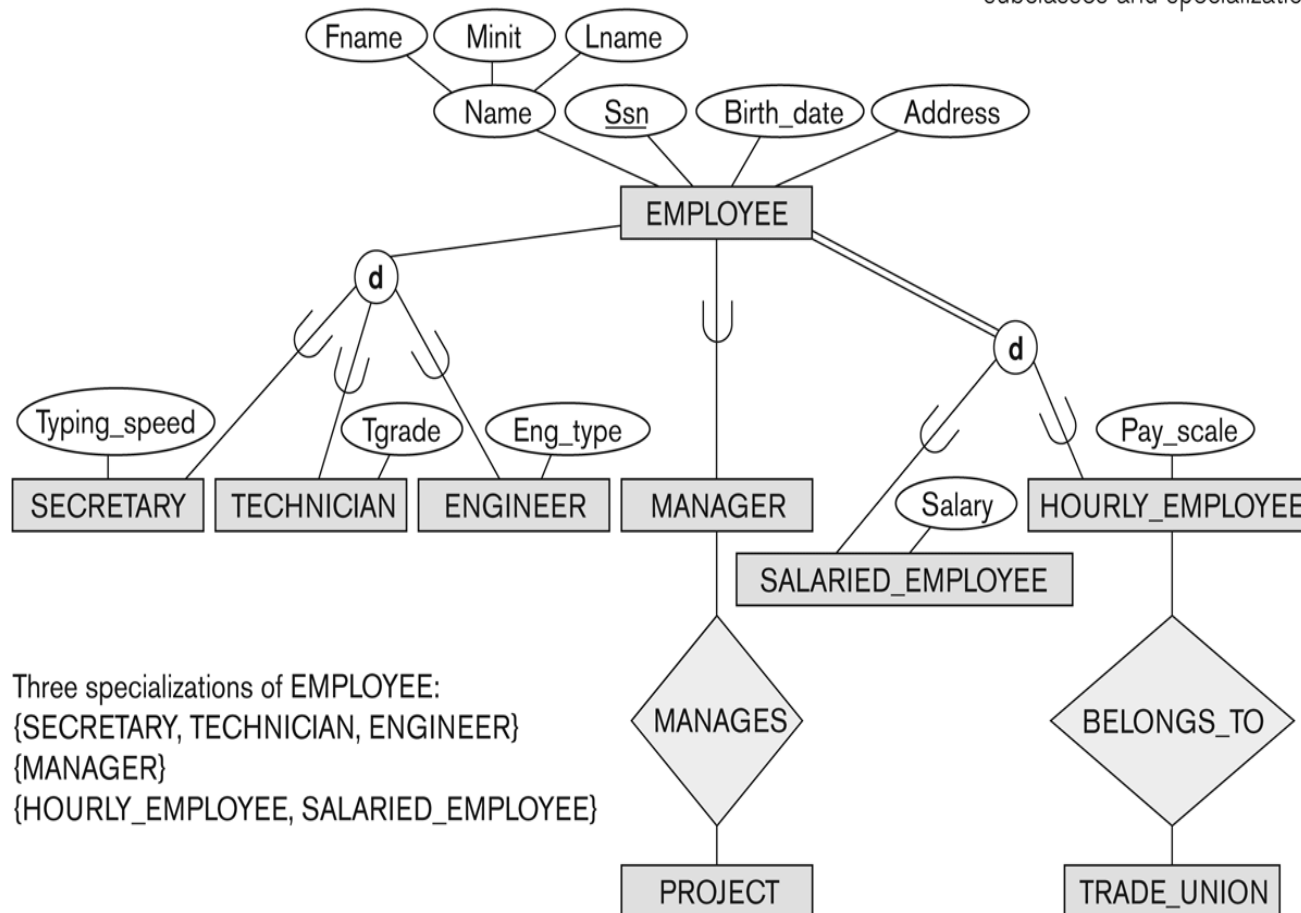
Generalization

Generalization is the reverse of the specialization process

Several classes with common features are generalized into a superclass;

> Original classes become its subclasses

Example: CAR, TRUCK generalized into VEHICLE;

- ➢ both CAR, TRUCK become subclasses of the superclass VEHICLE.
- ➢ We can view {CAR, TRUCK} as a specialization of VEHICLE
- ➢ Alternatively, we can view VEHICLE as a generalization of CAR and TRUCK
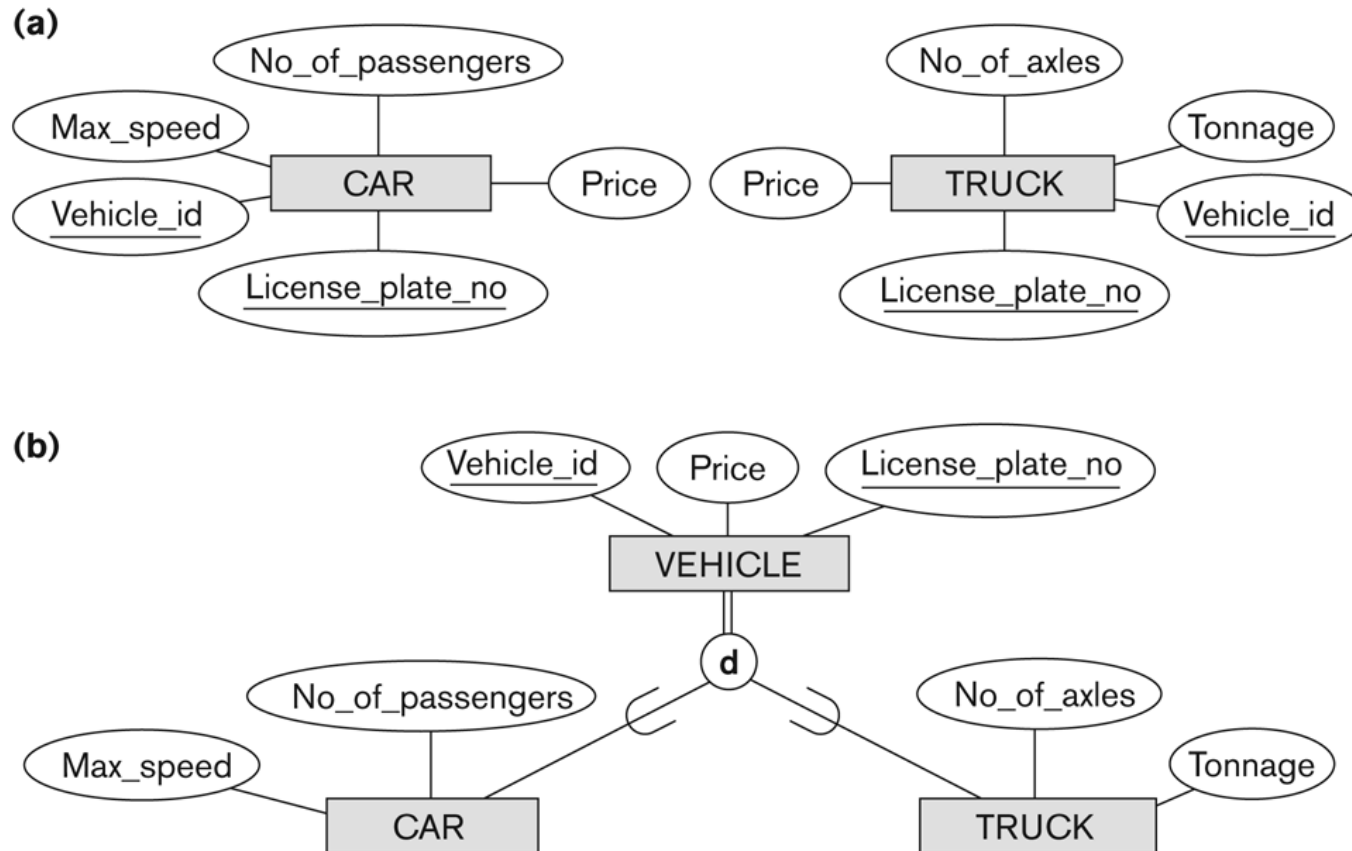
Figure 4.3
Generalization. (a) Two entity types, CAR and TRUCK.
(b) Generalizing CAR and TRUCK into the superclass VEHICLE.

Constraints

Two basic constraints can apply to a specialization/generalization:

- o Disjointness Constraint:

- o Completeness Constraint:

Disjointness Constraint:

- ❑ Specifies that the subclasses of the specialization must be *disjoint*:
  - ➢ an entity can be a member of at most one of the subclasses of the specialization
- ❑ Specified by **_d_** in EER diagram
- ❑ If not disjoint, specialization is *overlapping*:
  - ➢ that is the same entity may be a member of more than one subclass of the specialization
- ❑ Specified by **_o_** in EER diagram

Completeness Constraint:

❖ *Total* specifies that every entity in the superclass must be a member of some subclass in the specialization/generalization

❖ Shown in EER diagrams by a ***double line***

❖ *Partial* allows an entity not to belong to any of the subclasses

❖ Shown in EER diagrams by a single line

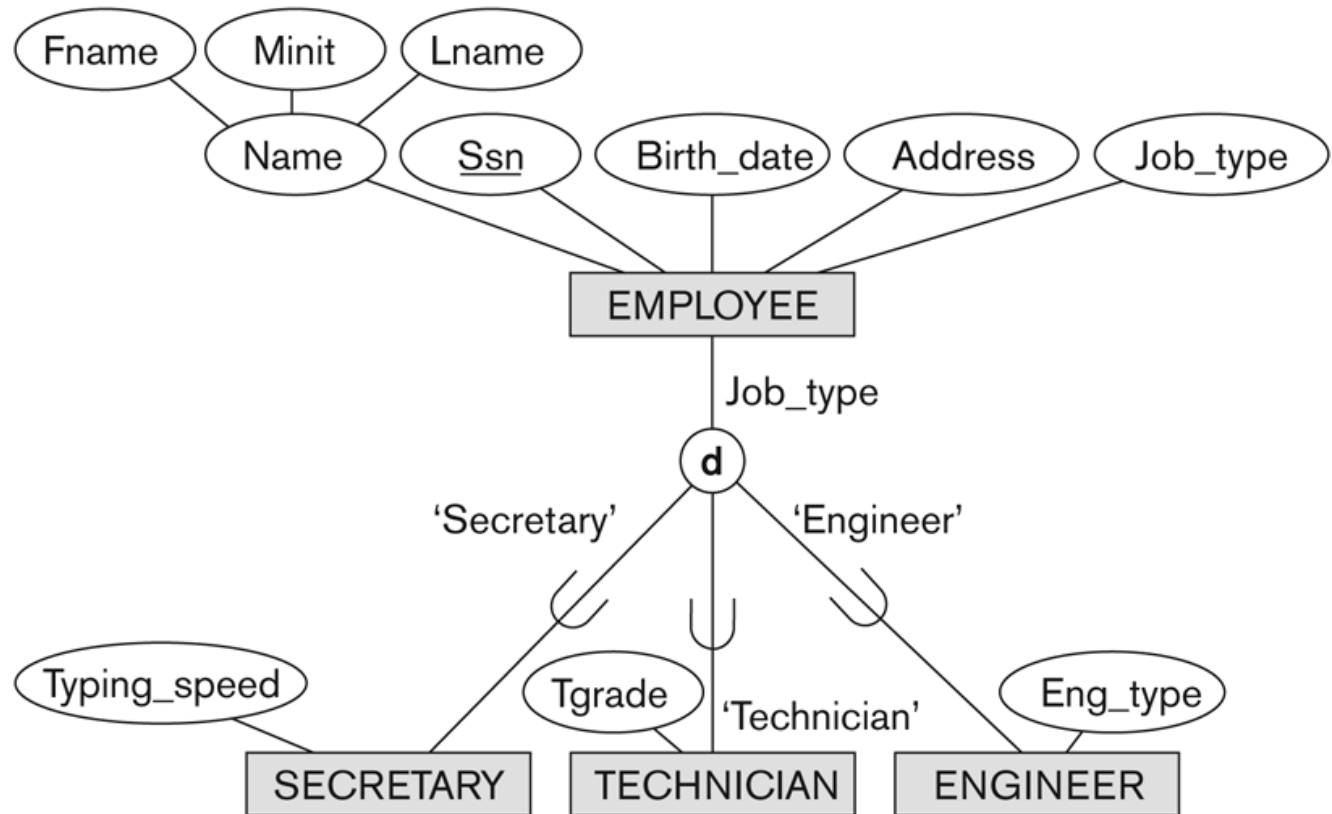Hence, we have four types of specialization/generalization:

- ❑ Disjoint, total
- ❑ Disjoint, partial
- ❑ Overlapping, total
- ❑ Overlapping, partial

Note: Generalization usually is total because the superclass is derived from the subclasses.
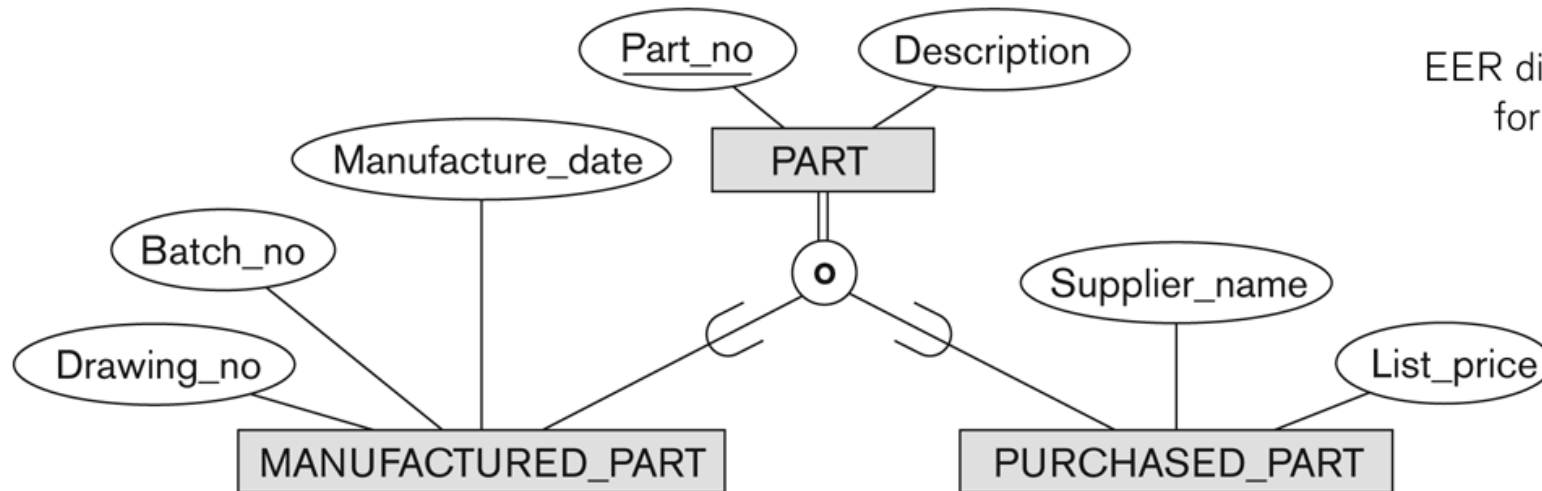
Example of disjoint partial Specialization

Figure 4.4
EER diagram notation for an attribute-defined specialization on Job_type.

Example of overlapping total Specialization

Figure 4.5
EER diagram notation for an overlapping (nondisjoint) specialization.

Exercise

Placements scenario in an Educational Institution:

Students (sid-unique, name, branch, cgpa) get placed by Organizations. each org has a name (unique) , address, min CGPA, package etc.

An org can be private or Govt. If it is Govt. it belongs to Central Govt. and will be attached with some ministry

If private it will have CEO name. An Org can either be Govt. or Private not both. Some Orgs may not belong to any of these categories.

Draw EER.

Summary

✓ *Enhanced ER notations*

✓ *Super-class and sub-classing*

✓ *Constraints in class hierarchies*