Database Management Systems (DBMS)

Lec 12: The Enhanced ER Model (Cont.)

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Recap

- Enhanced Entity-Relationship (EER) Model
- The concepts of EER model
  - **Subclass and Superclass, Inheritance**

  - **Specialization** (*Top-down conceptual refinement*)
    - Process of defining a set of subclasses of an entity type
  - **Generalization** (*Bottom-down conceptual refinement*)
    - Process of defining a generalized entity type from the given entity types

  - Constraints: Predicate-defined, disjointness, and completeness constraints

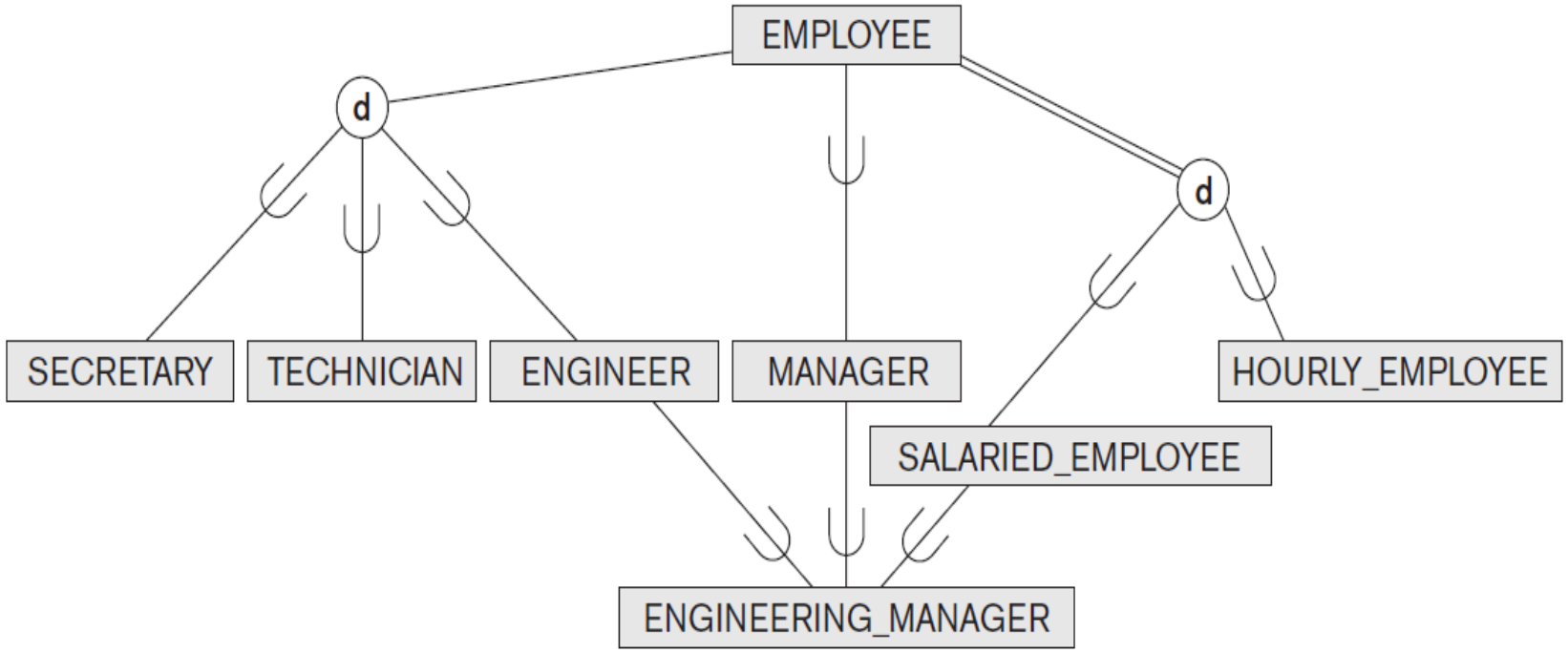
Today's plan

- Specialization/Generalization hierarchies and lattices
- The concepts of EER model
  - Subclass and Superclass, Inheritance
  - Specialization and Generalization
  - **Union or Category**
  - **Aggregation**

Hierarchies and lattices

- A subclass may itself have further subclasses specified on it
  - Forms a ***hierarchy*** or a ***lattice***
- Hierarchy has a constraint that every subclass has only one superclass (called single inheritance)
  - this is basically a tree structure
- In a lattice, a subclass can be subclass of more than one superclass (called multiple inheritance)

Example-1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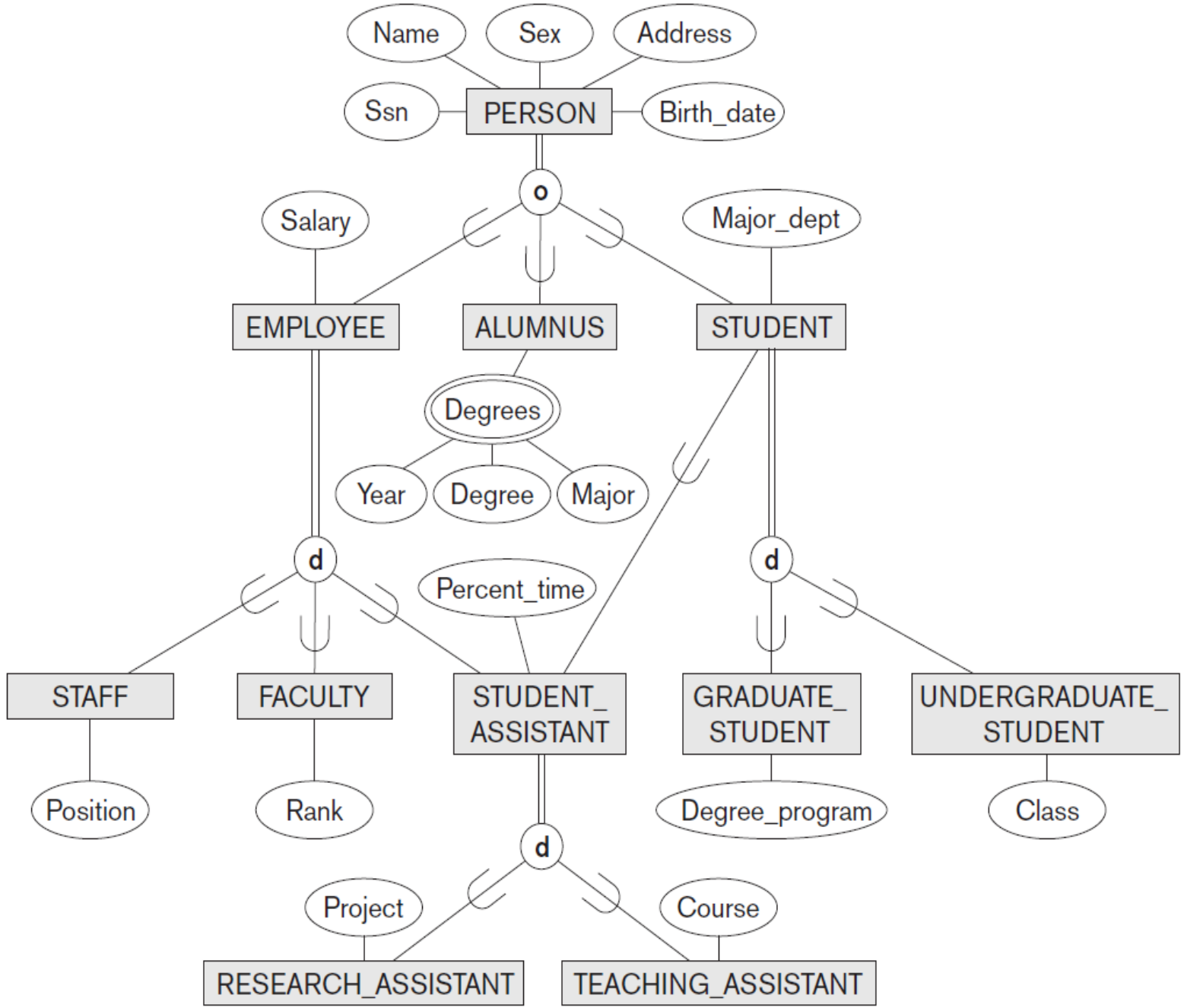
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Properties

- In specialization lattice or hierarchy, a subclass inherits the attributes not only of its direct superclass, but also of all its predecessor superclasses all the way to the root of the hierarchy or lattice

- An entity may exist in several ***leaf nodes*** of the hierarchy

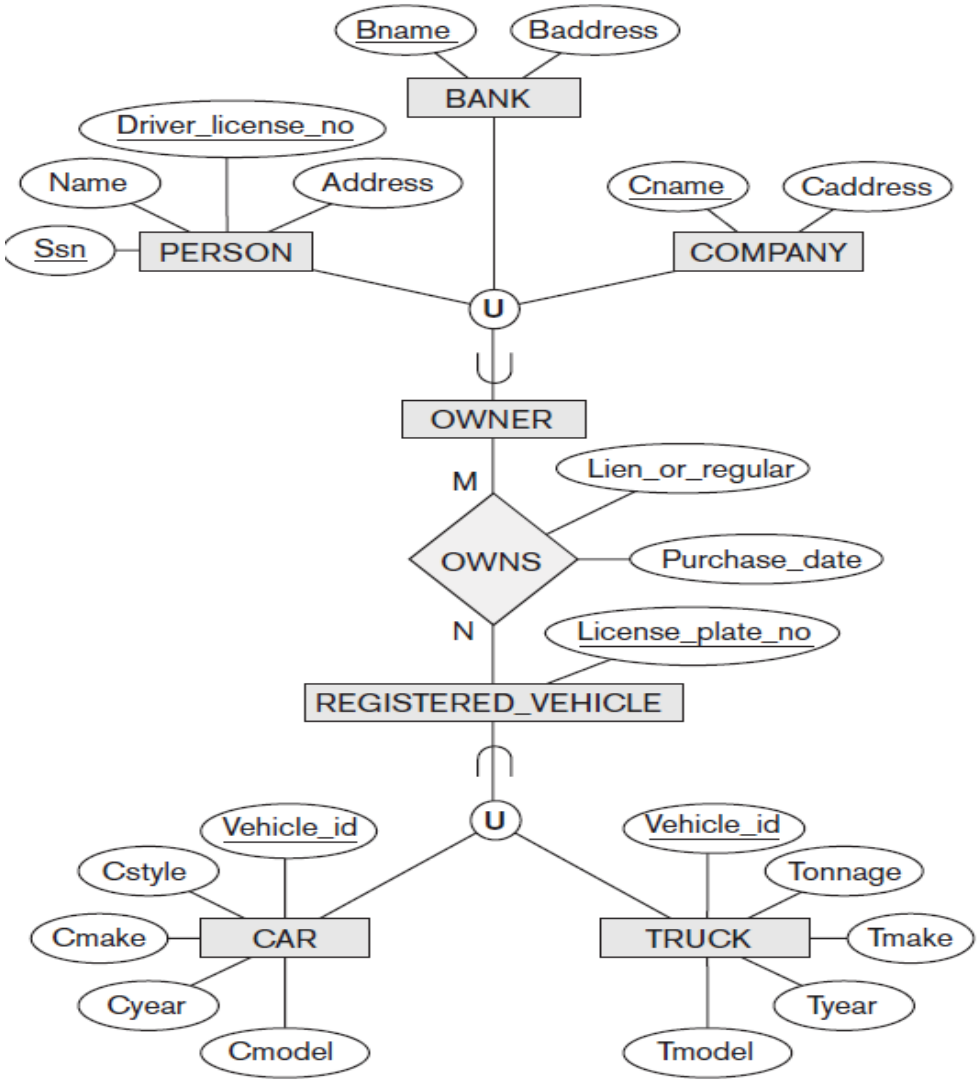
Properties (Cont.)

- A subclass with *more than one* superclass is called a ***shared subclass***
  - the existence of at least one shared subclass leads to a lattice

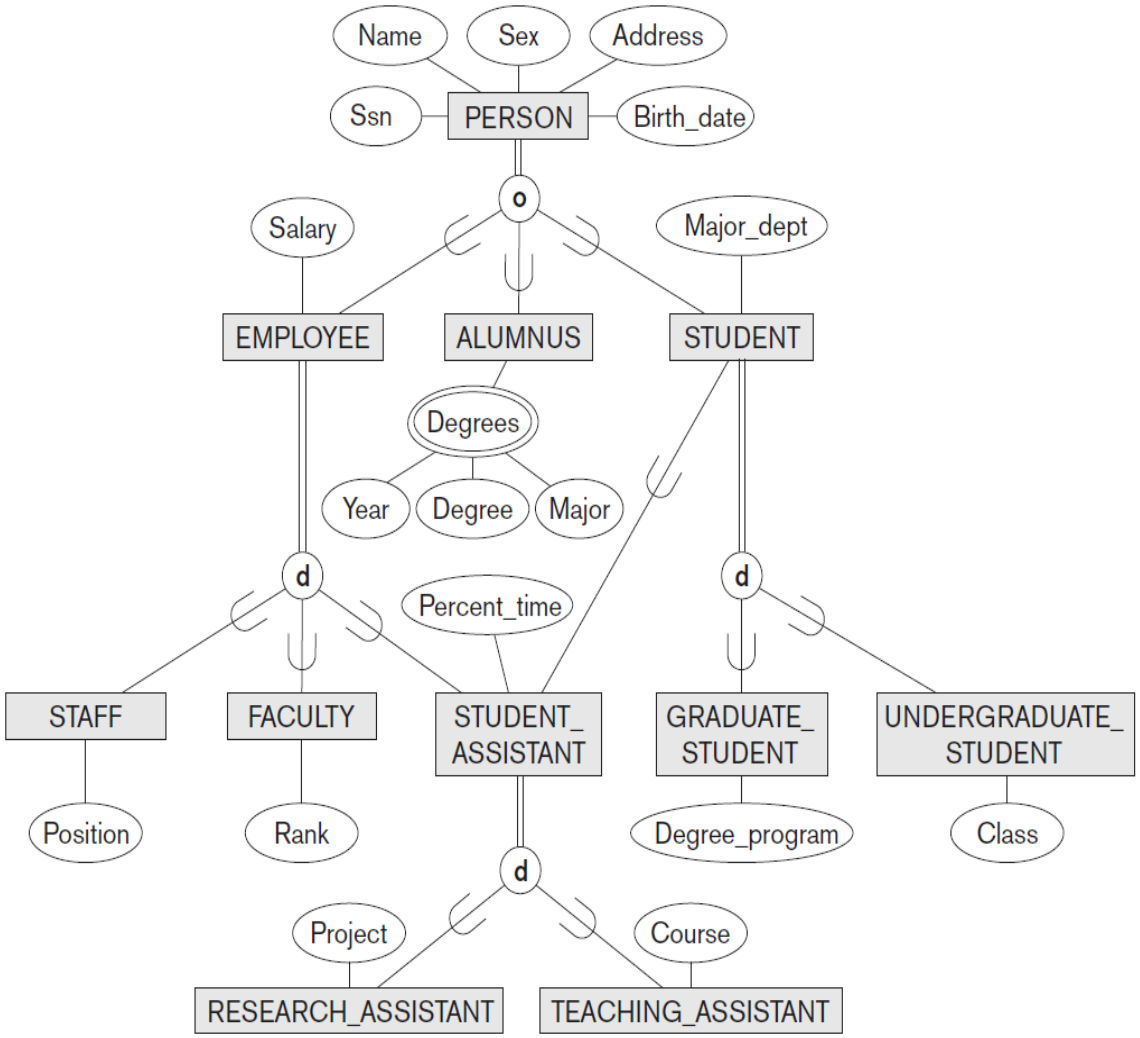
- In multiple inheritance, if an attribute (or relationship) originating in the ***same superclass*** is inherited more than once via different paths in the lattice, then it should be included only once in the shared subclass*

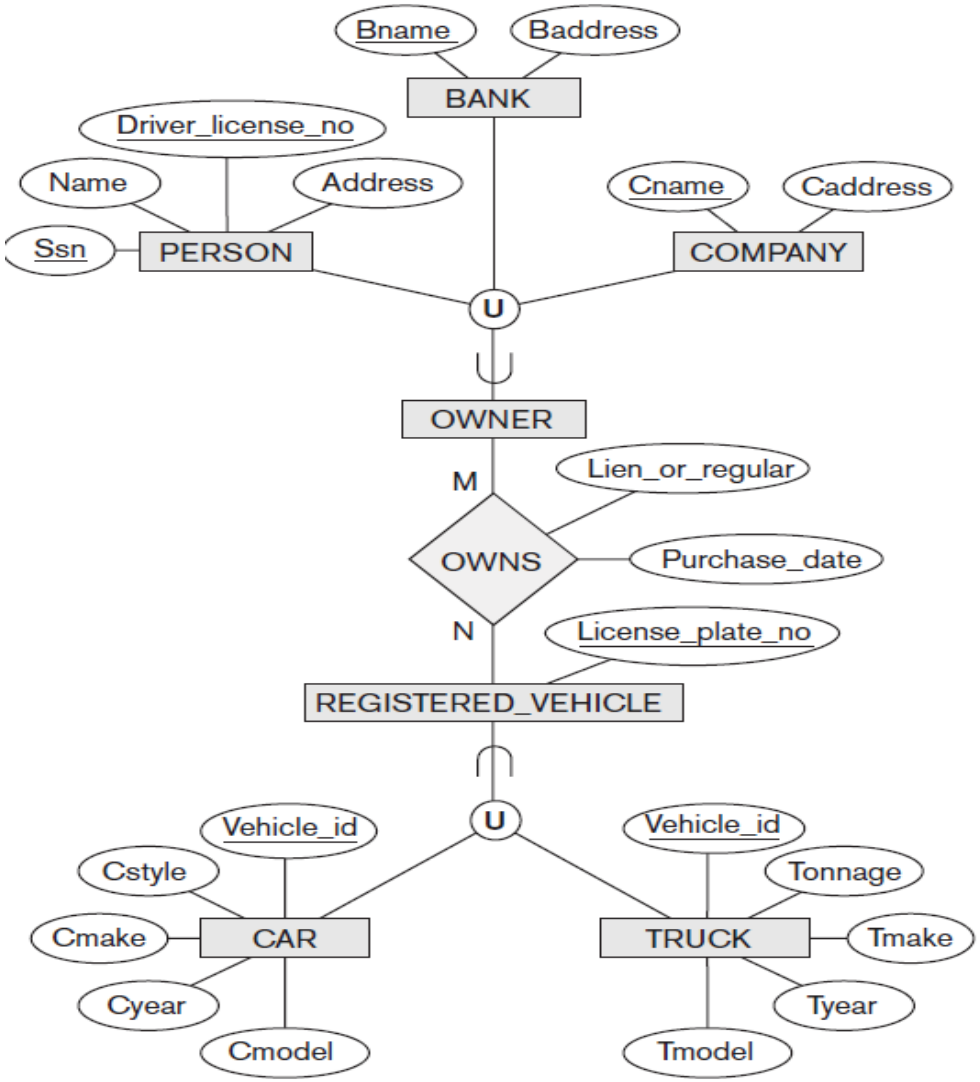
Modeling of Union types using Categories

- Sometimes it is necessary to represent a collection of entities from different entity types
- A subclass is said to be ***Union type*** or a ***category*** if it represents a collection of entities that is a subset of the ***union*** of entities from distinct entity types
  - Represents a single superclass/subclass relationship with more than one superclass



Shared subclass vs category



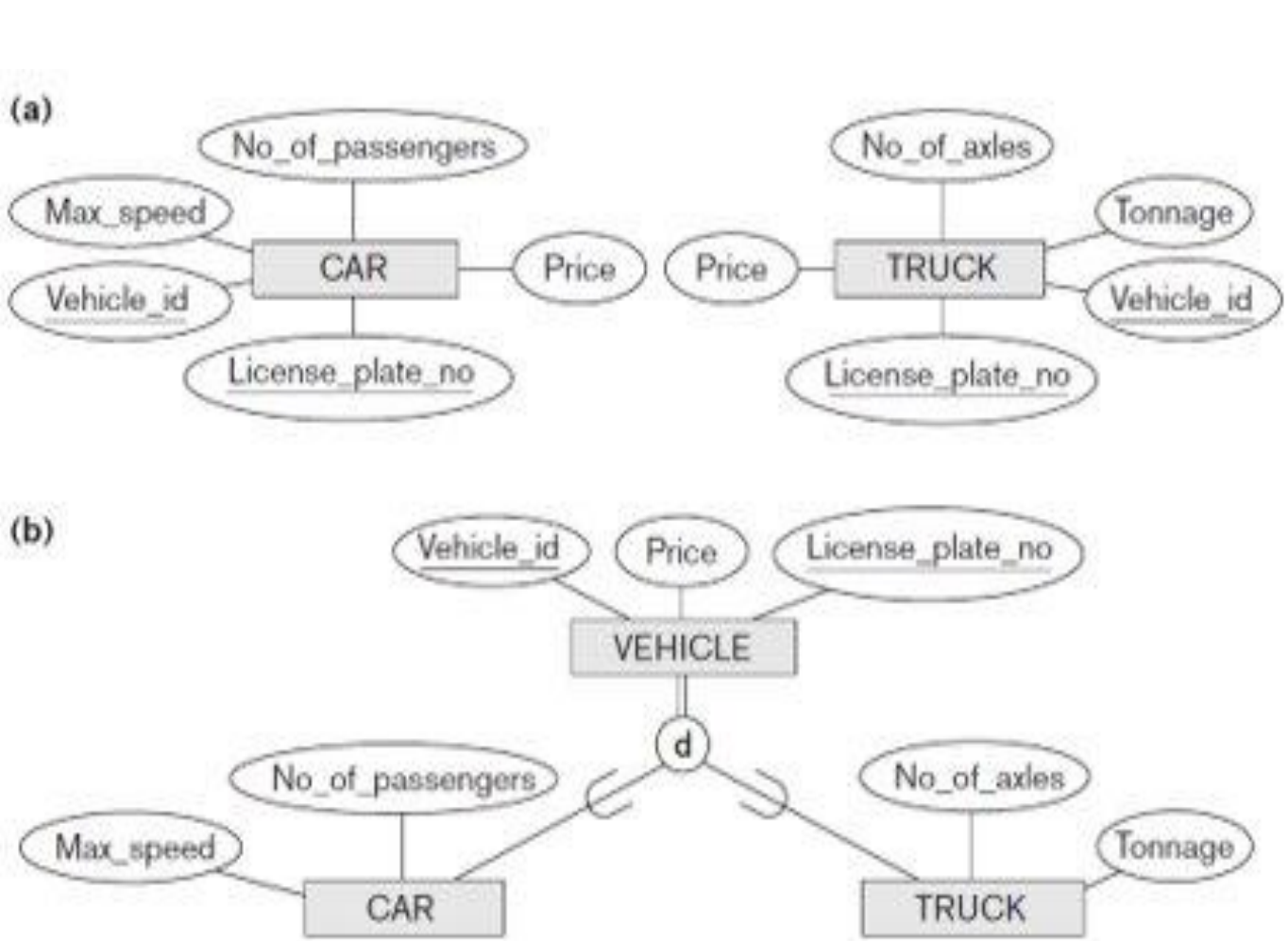


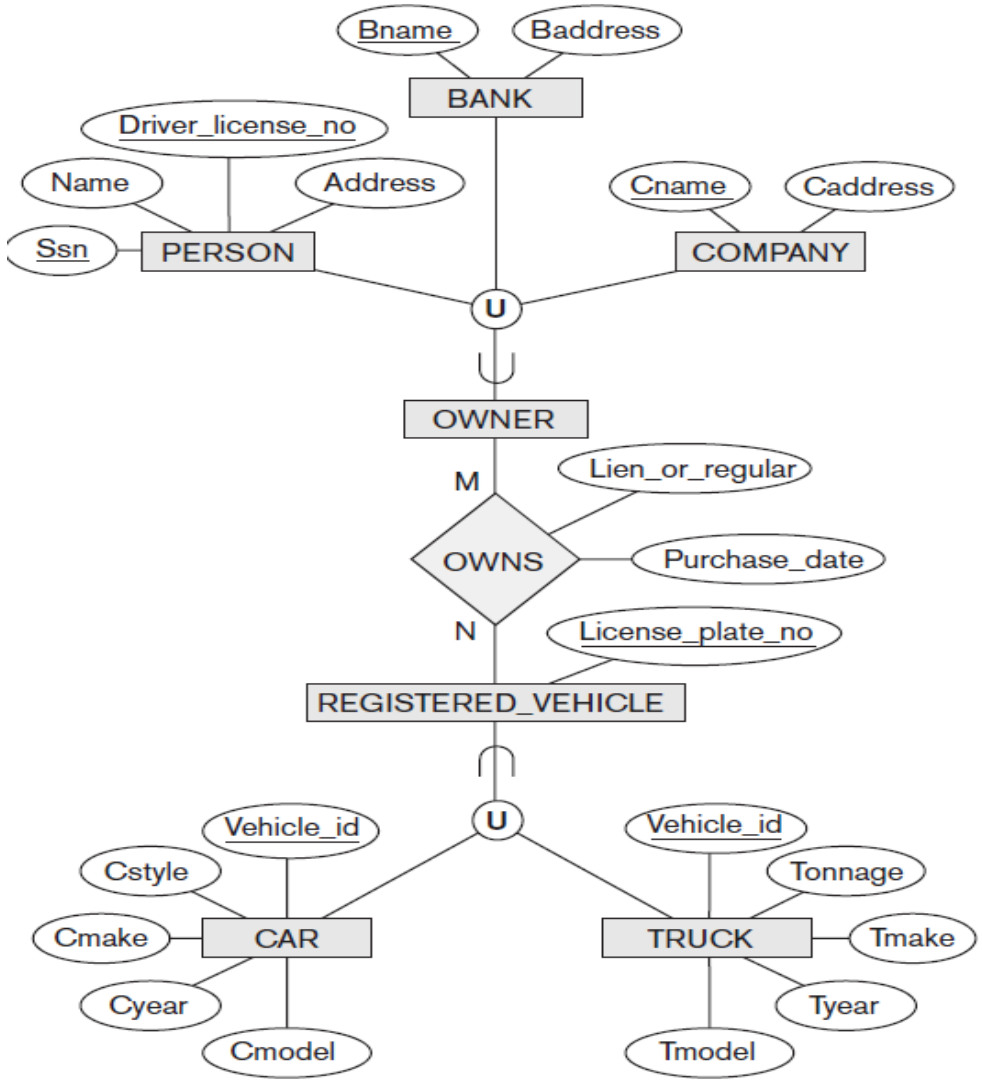
Shared subclass vs category

- The collection of entities in a shared subclass is a subset of the ***intersection*** of its superclasses
  - I.e., an entity must exist in ***all*** the superclasses
- Inherits all the attributes of its superclasses
- The superclasses of a shared subclass always have the same key attribute(s)

- The collection of entities in a category is the ***union*** of its superclasses
  - I.e., an entity must exist in ***only one*** of the superclasses
- Inherits the attributes depending on the superclass to which the entity belongs
- The superclasses of a category may have different key attributes or they may have the same key attribute

Generalization vs category





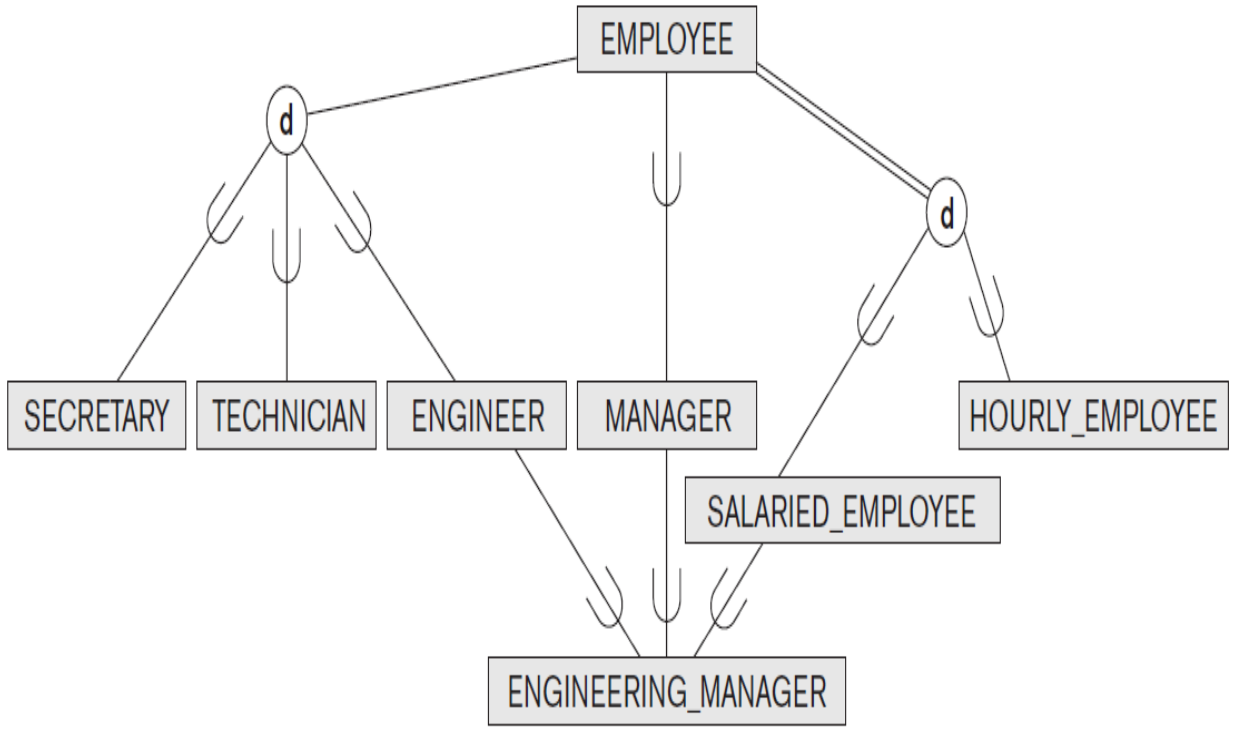
Design Choices for Specialization/Generalization

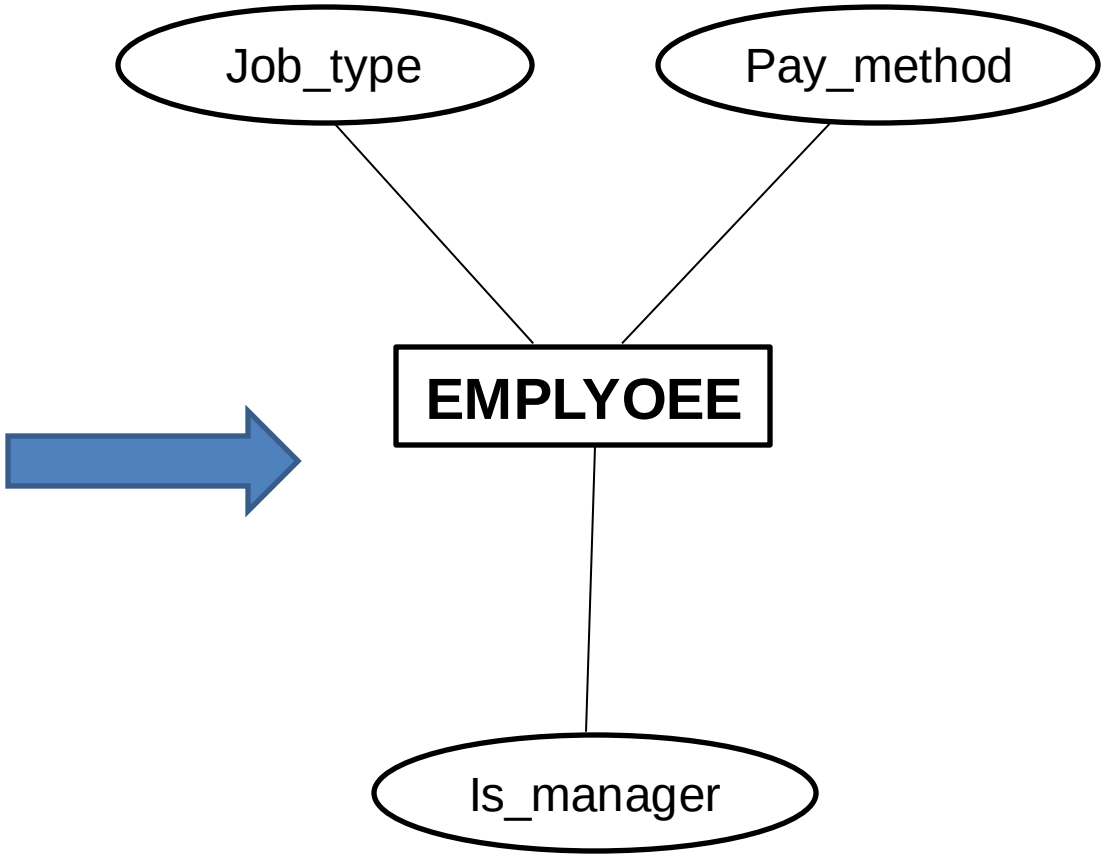
- Many specializations/generalizations and subclasses can be defined to make the conceptual model accurate
  - the drawback is that the design becomes quite cluttered
- If a subclass has few specific (local) attributes and no specific relationships, it can be merged into the superclass
  - The specific attributes would hold NULL values for entities that are not members of the subclass
  - We can add a ***type*** attribute which specifies whether an entity is a member of the subclass

Design Choices for Specialization/Generalization (Cont.)

- Union types and categories should generally be avoided
  - If possible, we try to model using specialization/generalization
- The choice of disjoint/overlapping and total/partial constraints on specialization/generalization is driven by the application
  - If the requirements do not indicate any particular constraints, the default would generally be overlapping and partial

An example of applying the guidelines

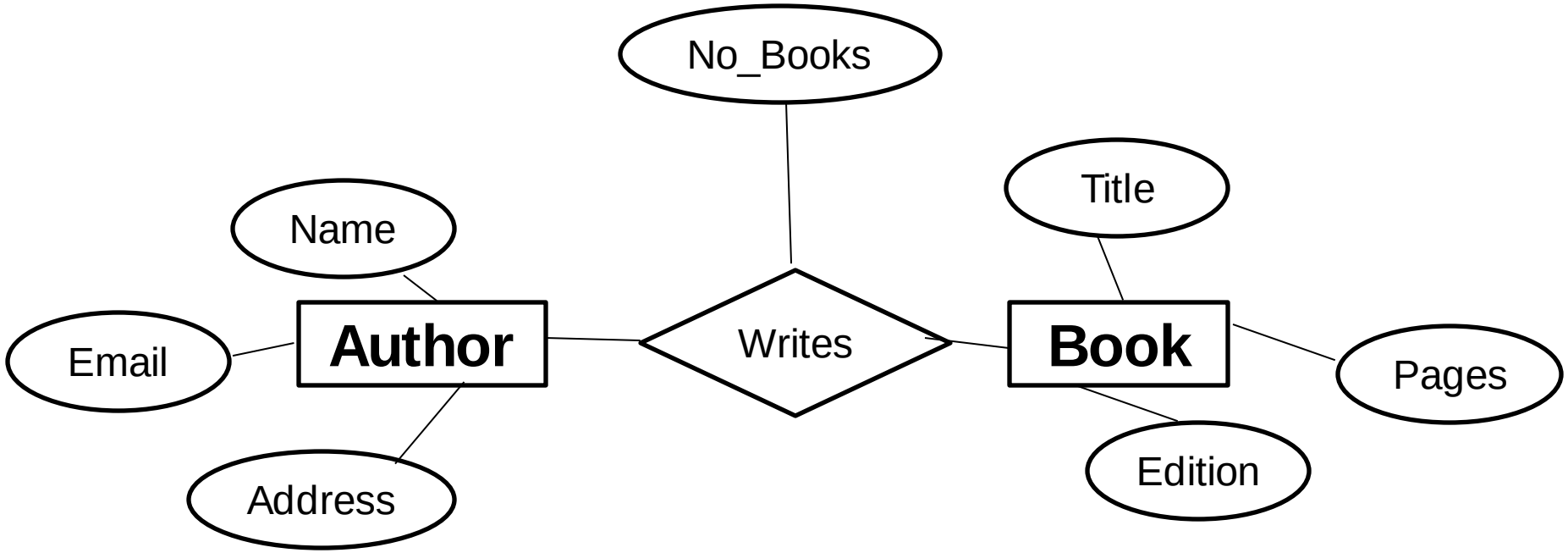




Aggregation

- One limitation of the ER model is that it cannot express relationships among relationships
- Aggregation is an abstraction through which relationships are treated as higher level entities
  - It refers to the process by which entities are combined to form a single entity

Example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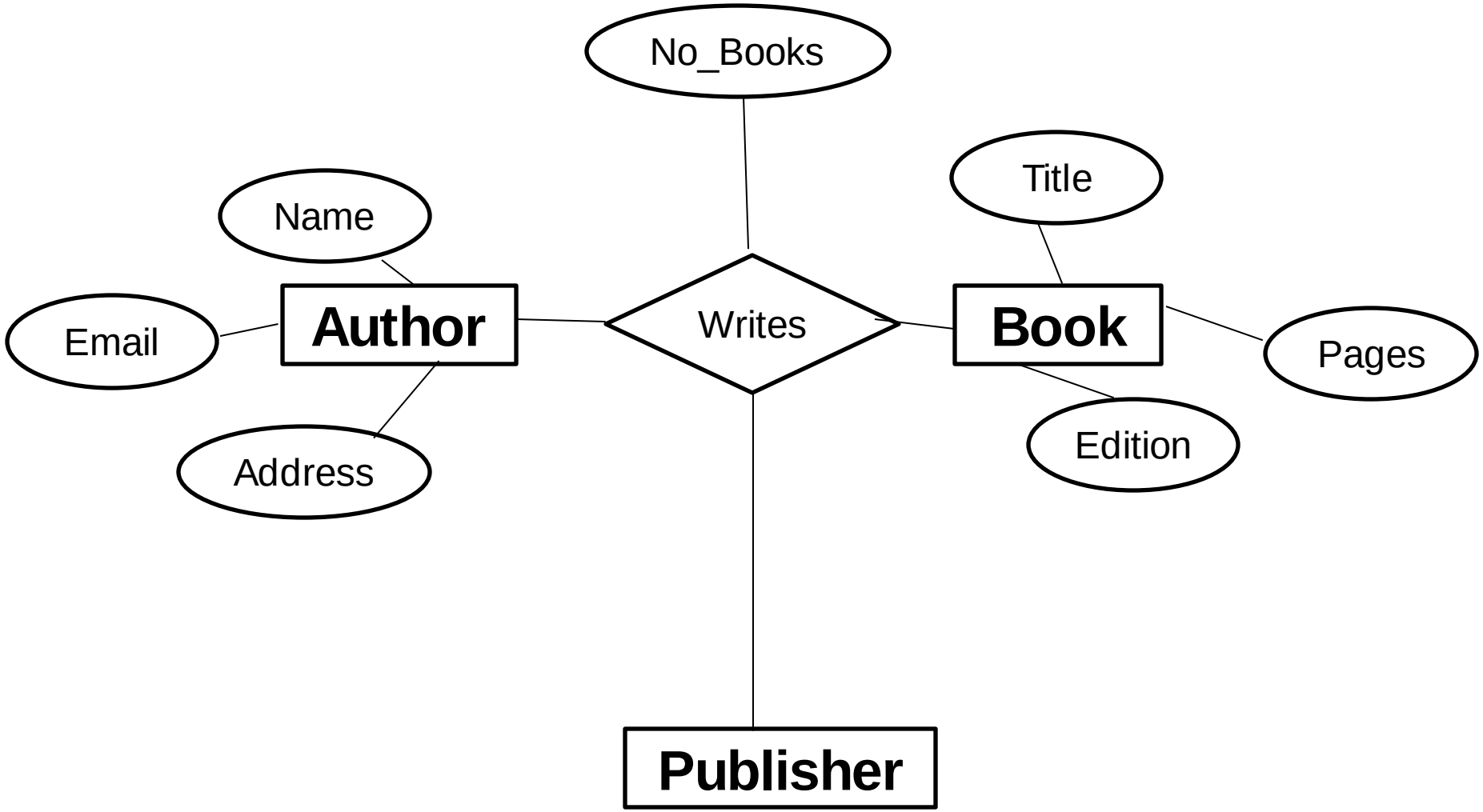
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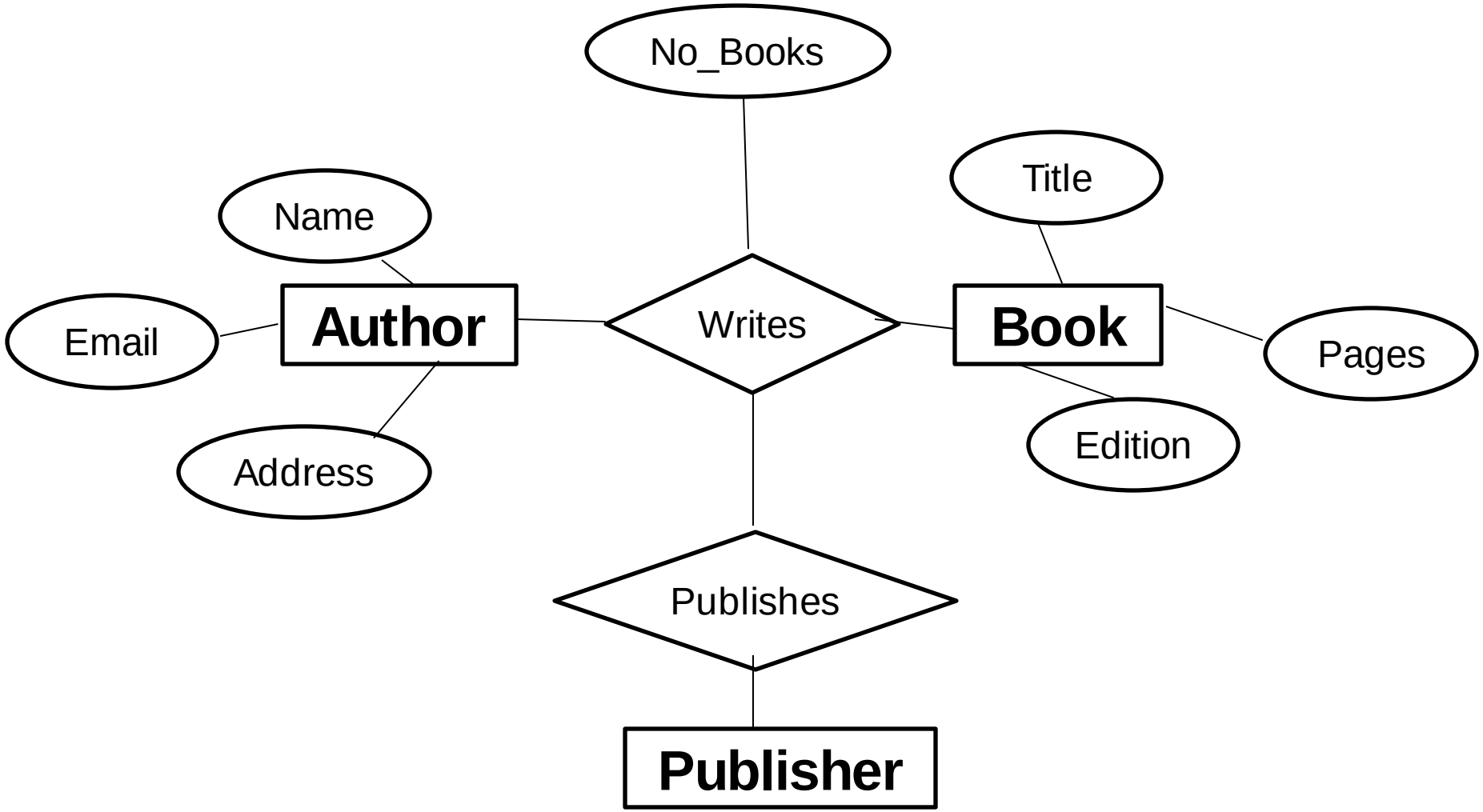
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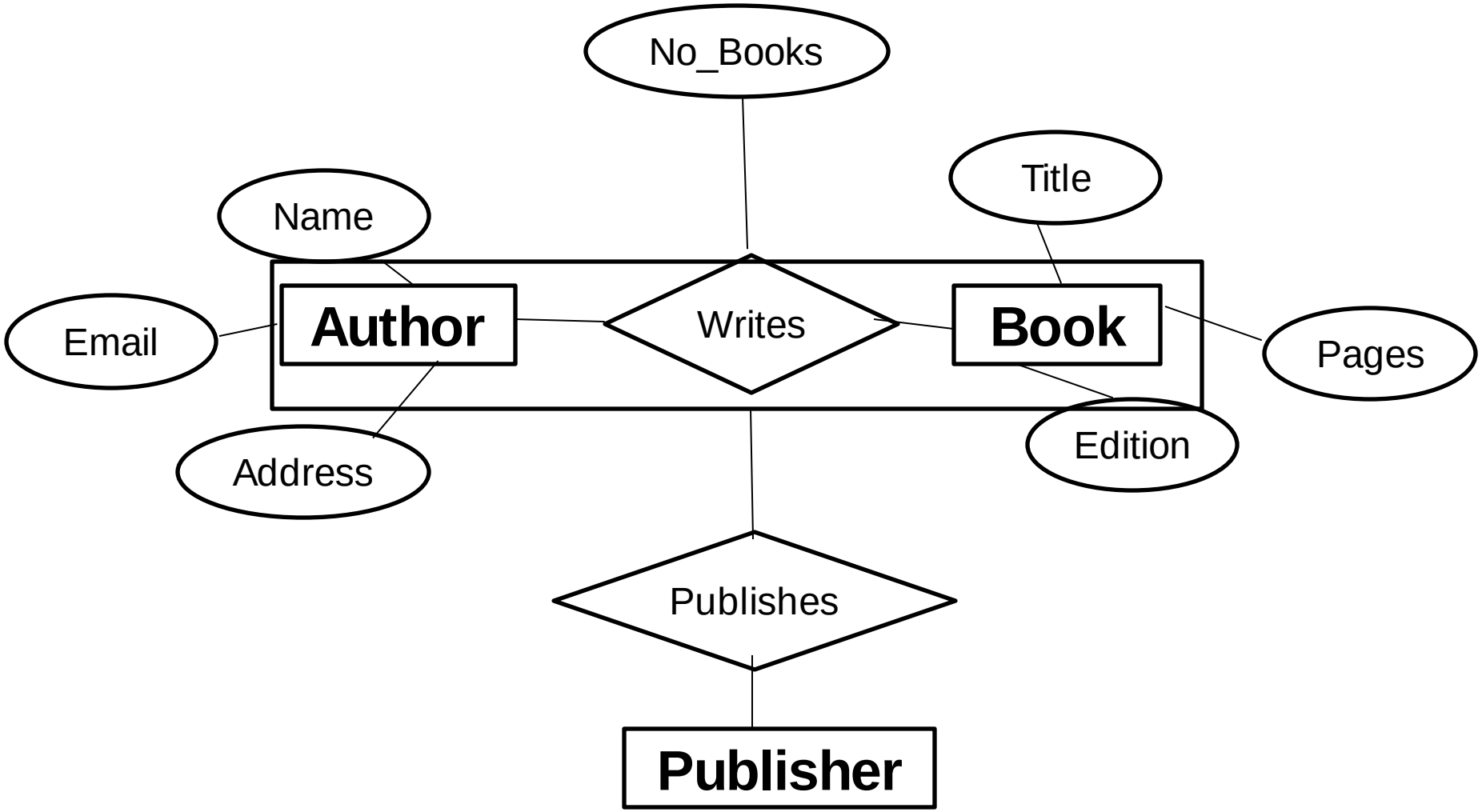
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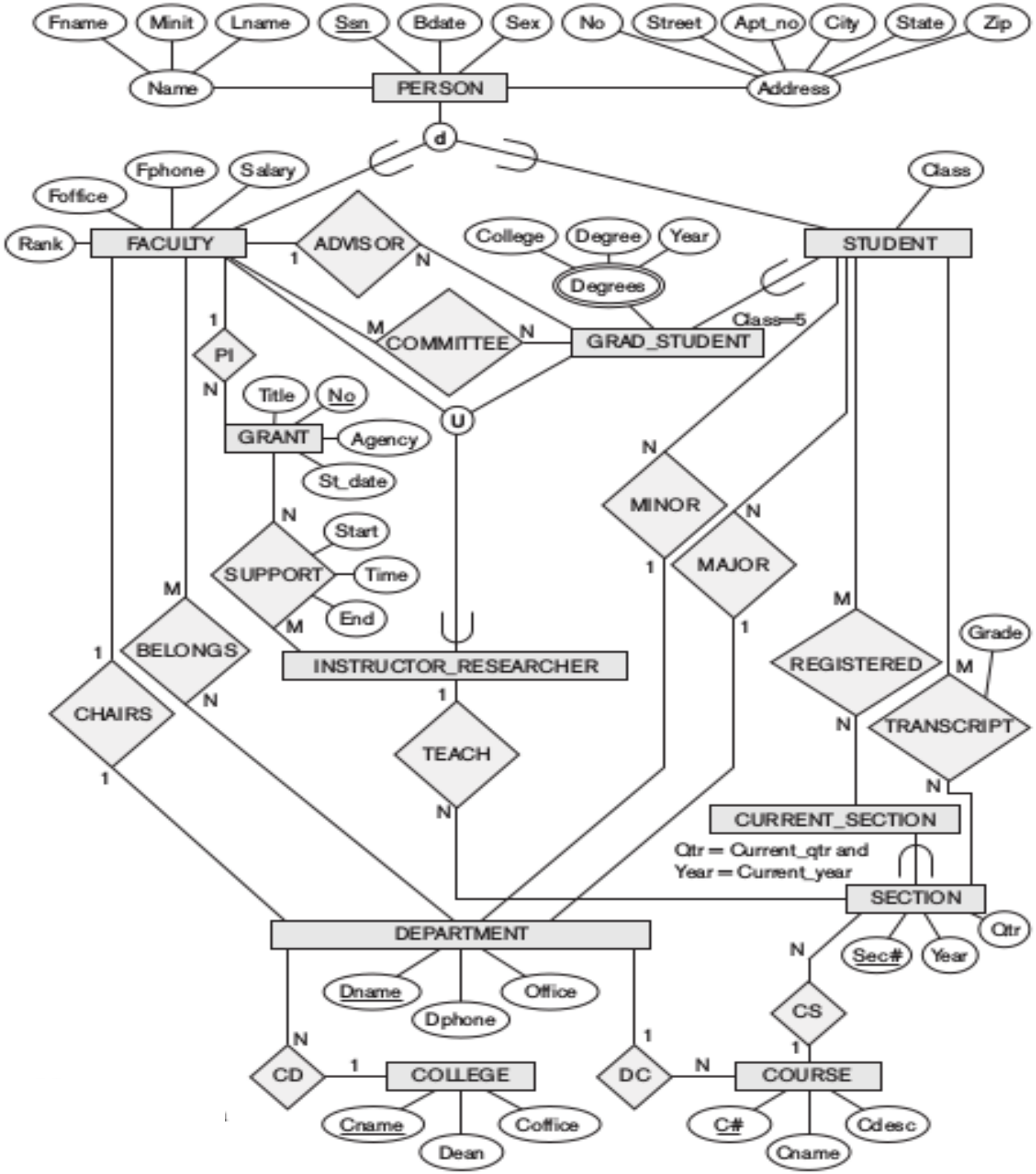
An example UNIVERSITY EER Schema

A University database

- Students and their majors
- Transcripts and registration
- university's course offerings
- the sponsored research projects of faculty and graduate students



Summary of EER model

- Extensions to ER model that improve its representational capabilities
  - Subclass and its superclass
  - Specialization and generalization
  - Category or union type
  - Aggregation

Thank you!