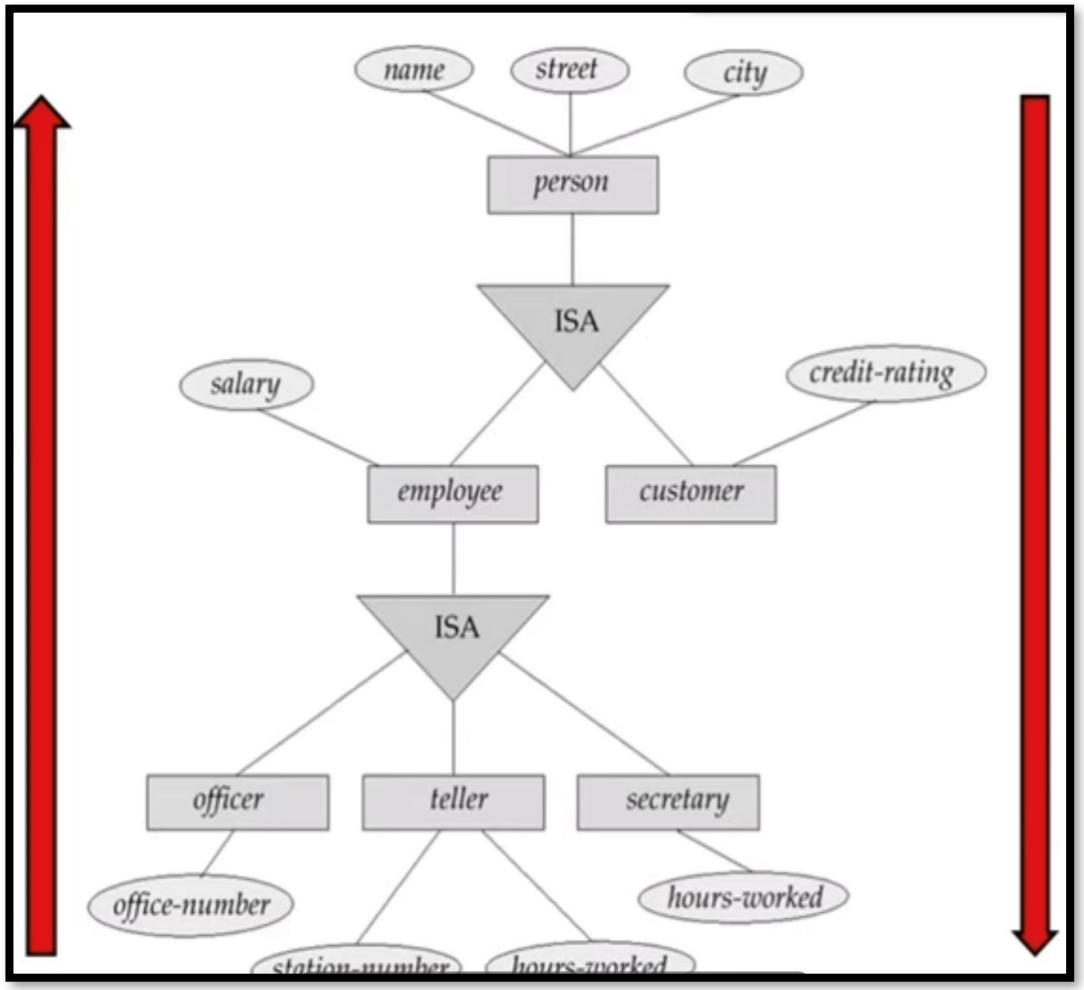
Entity Relationship Model(ER), Relational Model and Extended ER Model

Presented by:-Mr.Loukik Salvi

Specialization and Generalization

- ER diagrams consider entity types to be primitive objects
- EER diagrams allow refinements within the structures of entity types
- **Specialization**: top-down refinement into **(super)classes** and **subclasses**
- **Generalization** groups entity types; bottom up synthesis
- Subclasses **inherit** the attributes and relationships of their super classes



Generalization Vs Specialization

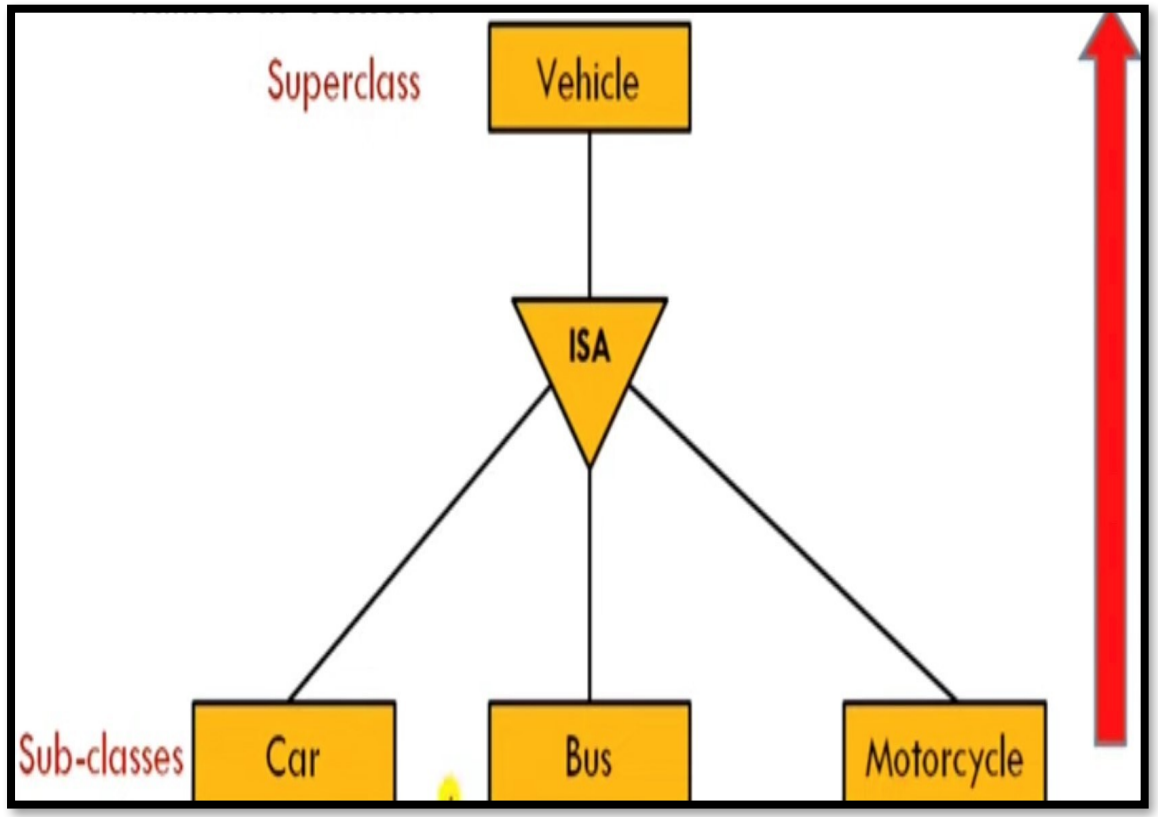
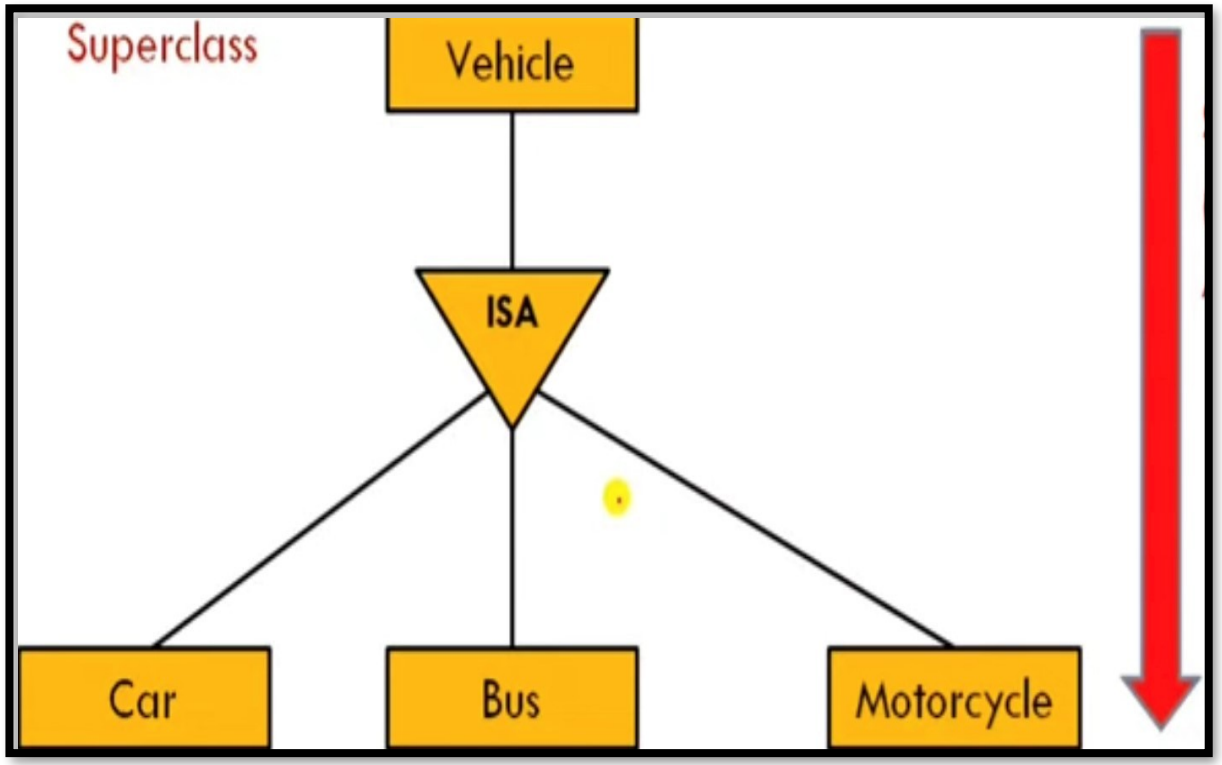
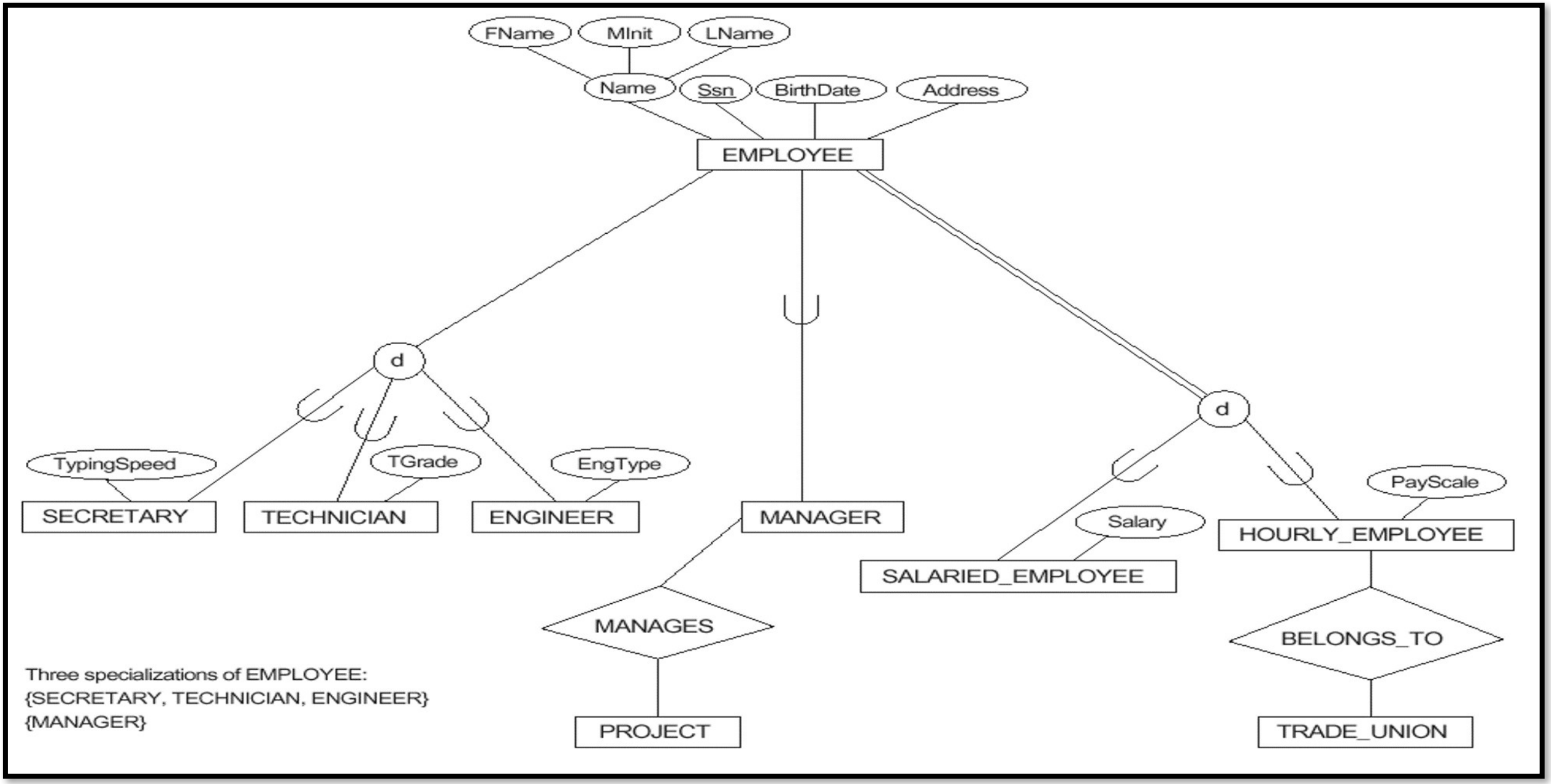


Fig1:- Generalization

Fig2:- Specialization




FName
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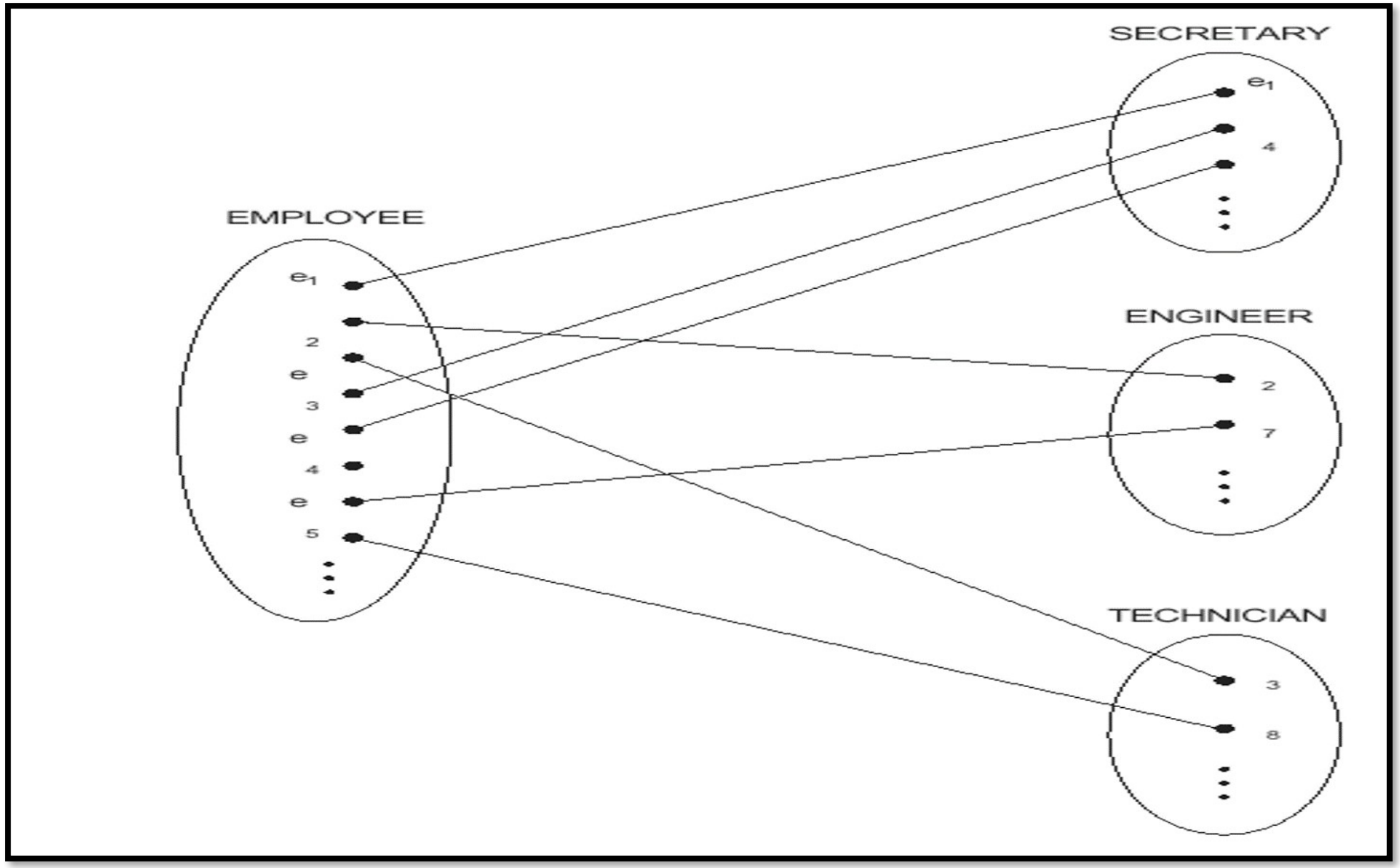
ENGINEER
MANAGER
Salary
PayScale
SALARIED_EMPLOYEE
HOURLY_EMPLOYEE
MANAGES
BELONGS_TO
PROJECT
TRADE_UNION
Three specializations of EMPLOYEE:
{SECRETARY, TECHNICIAN, ENGINEER}
{MANAGER}

Ref:-

Relationship Mapping for E-E-R



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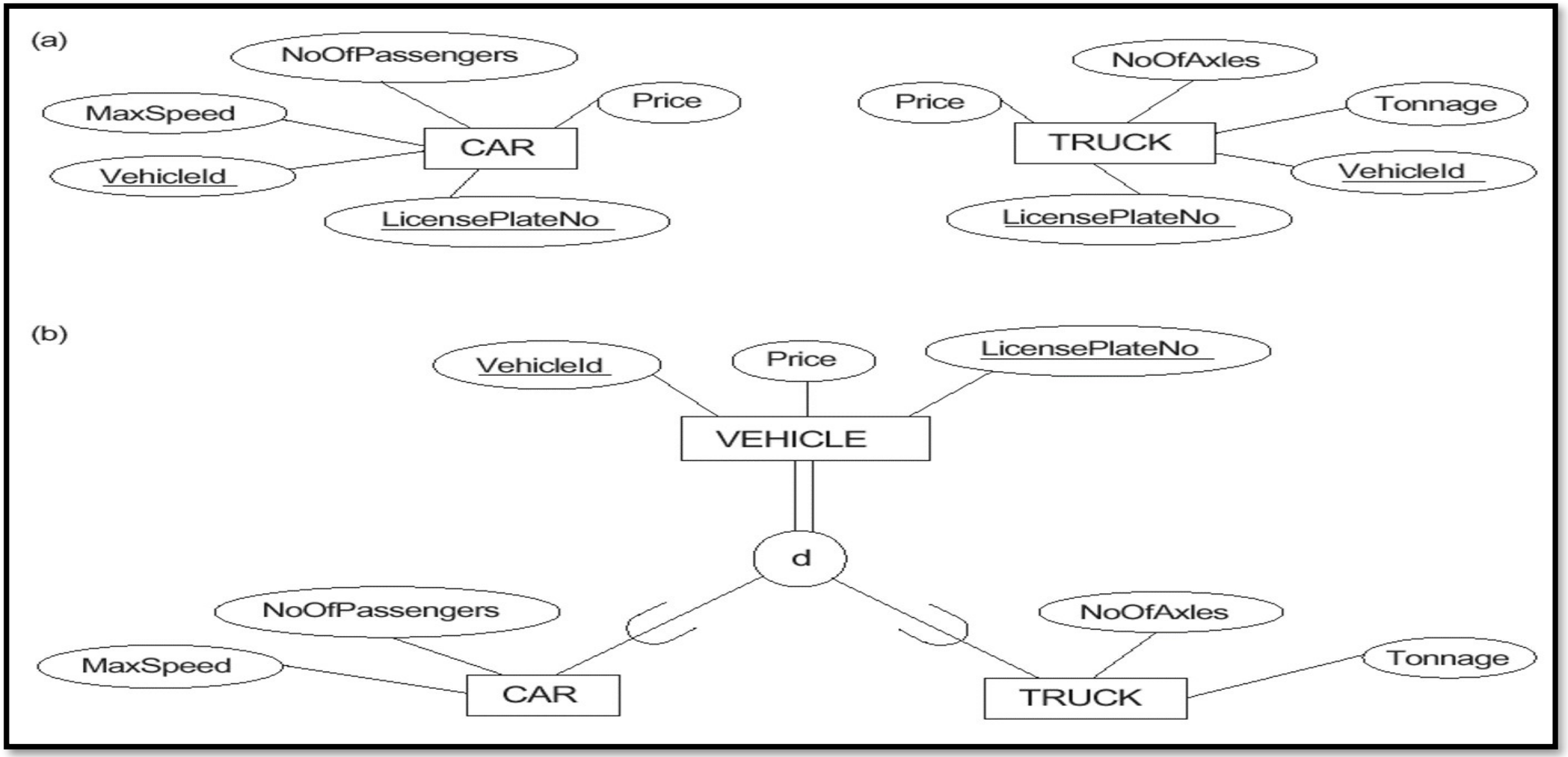

Figure 4.3 Examples of generalization. (a) Two entity types CAR and TRUCK. (b) Generalizing CAR and TRUCK into VEHICLE ▪

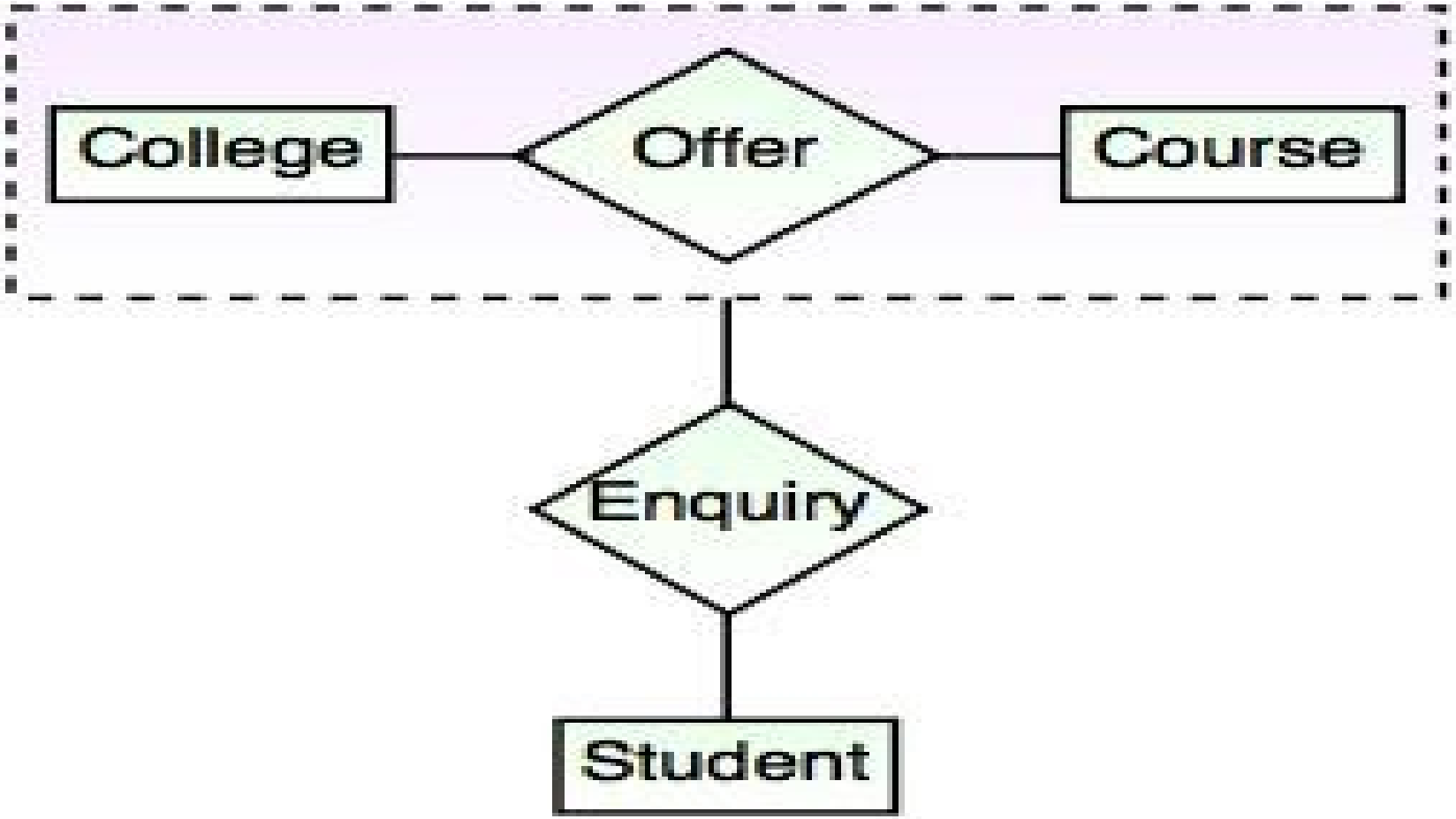

Fig. Aggregation

Need for Specialization &Generalization

1.Modeling Hierarchical Relationships: Specialization and generalization are essential for representing hierarchical relationships within entities. Generalization allows for the identification of common characteristics shared by a set of entities, which can be grouped into a higher-level entity, while specialization allows for the creation of sub-entities that inherit attributes from a parent entity but also possess distinct features.

2. Enhanced Data Abstraction: These concepts enable a more abstract and flexible representation of data, which is crucial for complex systems where entities share common properties but also have unique attributes or behaviors. This abstraction simplifies the design process by reducing redundancy and emphasizing the shared characteristics among related entities.

3. Facilitating Database Evolution: In dynamic database environments, where new types of entities may emerge, specialization and generalization allow for the easy extension of the data model. New sub-entities can be created under existing general entities without altering the overall structure, facilitating the ongoing evolution and scalability of the database system.

University Database System

Scenario: Imagine designing a database for a large university that needs to manage a wide variety of data about its students, staff, courses, departments, and research projects.

Why E-E-R is Better:

1. Specialization and Generalization:

1. **Entities**: The university has different types of people: *Undergraduate Students*, *Graduate Students*, *Faculty Members*, and *Administrative Staff*.
2. **Problem**: In a basic E-R diagram, you might create a single "Person" entity with attributes like name, age, and ID. However, this would not efficiently capture the distinct characteristics and roles of each type of person.
3. **E-E-R Advantage**: Using specialization, the "Person" entity can be generalized into sub-entities like "Undergraduate Student," "Graduate Student," "Faculty Member," etc., each with specific attributes and relationships (e.g., Graduate Students might have attributes related to their thesis, while Faculty Members have attributes related to their research projects).

2.Inheritance

•**Entities**: Faculty Members and Graduate Students both participate in research projects.
•**Problem**: In a standard E-R diagram, the relationships would be duplicated for each entity type, leading to redundancy.
•**E-E-R Advantage**: By using generalization, "Research Participant" can be an entity that is a superclass for both "Faculty Member" and "Graduate Student." This allows them to inherit common relationships and attributes, reducing redundancy and improving clarity.

3.Complex Relationships

•**Entities**: The university's database needs to manage relationships between students, courses, departments, and faculty. Some faculty members may belong to multiple departments or be advisors to multiple students.
•**Problem**: Basic E-R diagrams might struggle with representing such many-to-many relationships without resulting in a convoluted diagram.
•**E-E-R Advantage**: E-E-R diagrams can better handle these complex relationships, making use of aggregation and categorization to clearly depict how these entities interact, ensuring a more accurate representation of real-world scenarios.