Week 3 – Lab #2 – Exploring Enhanced Entity-Relationship Models

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Exploring the Enhanced Entity Relationship (EERD) Models

Welcome to your second lab in IS380! In this lab we will expand our experience working with Entity Relationship Diagrams by exploring a new set of relationships that we can create with them: Supertype/Subtype relationships.

We can think of supertype and subtype relationships as general and specific categories respectively for a particular database entity (i.e. "*thing, person, place, unit, object or any item about which the data should be captured*").

By practicing EERD models you will gain the capability of creating more complex models that represent general categories and subcategories within an entity. You will also be able to denote details about how these entities relate to each other including whether one entity instance of the supertype must belong to a subtype or not, and if it does belong to a subtype, can it belong to more than one at a time.

The lab will first introduce the main concepts to concern for the development of effective Enhanced Entity Relationship Diagrams (EERDs) and will then provide 2 problems to solve. The first problem will give a brief discussion of the development of a model for a non-profit organization, while the 2nd one will give you the opportunity to examine a technology company's offerings (think of a company like DELL).

Lab Goals

- SLO1- To infer and Interpret supertype and subtype relationships from business rules.
- SLO2- To Design effective data models with supertype and subtype notations including the proper design of its properties.
- SLO3- To read and understand the key design considerations behind the completeness and disjoint constraints.
- SLO4- To recognize how to use subtype discriminators and when to use entity clusters to summarize models.

What You Will Need to Begin

- Visit draw.io (https://www.draw.io) to gain access to a modeling tool either through its web version or by downloading a copy into your own computer.
- Please complete the modeling exercises in draw.io and copy your models (with your name visible) into this document. Screenshots are an acceptable choice for copying the models.
- Once completed, submit the exercise (this document) into a corresponding DropBox folder within BeachBoard.

Part 1 – Introduction, & summary of Key Concepts for Exploring EERD Models

NOTE: This lab builds on lab #1 by assuming you can develop basic Entity Relationship Diagrams (specifically conceptual models as developed in class). If you have doubts, please do not hesitate to check Lab #1 for instructions on how to carry out the model or ask your instructor for assistant.

Between this section and the following, we will go through each component of the Enhanced Entity Relationship Diagram. We will first review each concept of interest in preparation for carrying out exercises on our own. These are:

1. Main Concepts:

    1. **Enhanced Entity Relationship Diagrams (EERD):**

    1. Supertypes
    2. Subtypes
    3. Generalization
    4. Specialization

b. Completeness Constraint:

- Total Specialization Rule (An instance of the supertype must also belong to either of the subtypes; Use double line)
- Partial Specialization Rule (An instance of an entity could belong to either of the subtypes of none of them; Use single line)

c. Disjointness Constraints:

- Disjoint Rule (Instance of Supertype could be **only ONE** of the subtypes; write a "d" within circle)
- Overlap Rule (Instance of Supertype could be more than one subtype; write an "o" within circle)

d. **Subtype Discriminator** (attribute of the supertype that describes to which subtype an instance of the entity belongs)

- If Disjoint: a simple attribute is created with different categories for each subtype
- If Overlapping: a composite attribute is created with subparts indicating whether or not an instance of the entity belongs to each separate subtype)

e. **Entity Clusters** (If model gets too complex, we can group it into "clusters" by replacing them with an abstract entity type)

f. **Packaged Models** (the search for best practices means that rather than build our models entirely from the ground up, we can acquire data models from vendors)

- Universal data model (generic model template that can be reused with ease in multiple scenarios)
- Industry-specific data model (predefined models for specific scenarios)

Part 2 – Creating your own EERD.

Exercise 1:

To strengthen our modeling skills, we will now explore step by step a single problem:

A non-profit organization depends on several different types of persons to function effectively. The organization is interested in the following attributes for all these persons: SSN, Name, Address, City/Zip Code, and Cellphone.

There are 3 main types of persons of interest: Employees, Volunteers, and Donors. Employees have only a Date Hired attribute, and volunteers have a Skill attribute. On the other hand, Donors have a unique relationship ("Donates") with the entity type "Item".

A Donor must have donated one or more items, and an item may have no donors or one or more donors.

There are persons other than employees, volunteers, and donors who are of interest to the organization so that a person need not belong to any of these three groups. On the other hand, at a given time a person may belong to two or more of these groups (e.g., employee and donor).

Let us start by repeating the process with carried out during our first lab and:

Q1. Please identify the entities, their attributes, and their relationships as suggested in the problem above:

Entity	Attributes	Relationship to (add name to it)
Persons	SSN, Name, Address	Employees, Volunteers, Donors
Employees	Date Hired	Persons
Donors		Persons
Volunteers	Skills	Skills

Q2. Are there any supertype/subtype relationships present? If so, what entities would be involved? Which would be the supertype, and which would be the subtype?

Yes. Persons is the Entity supertype. The subtypes are Employees, Donors, and Volunteers.

Q3. Now consider the completeness constraint. In the supertype/subtype relationship identified above a total specialization rule or a partial specialization rule? **What does this mean for this relationship**? (Refer to part 1 or the class lecture for a refresher on this)

This is a partial specialization rule because the text states that the non-profit has 3 "main types" but does not state that this is exclusive. This means that there are potentially other categories that can be included under the "Persons" supertype.

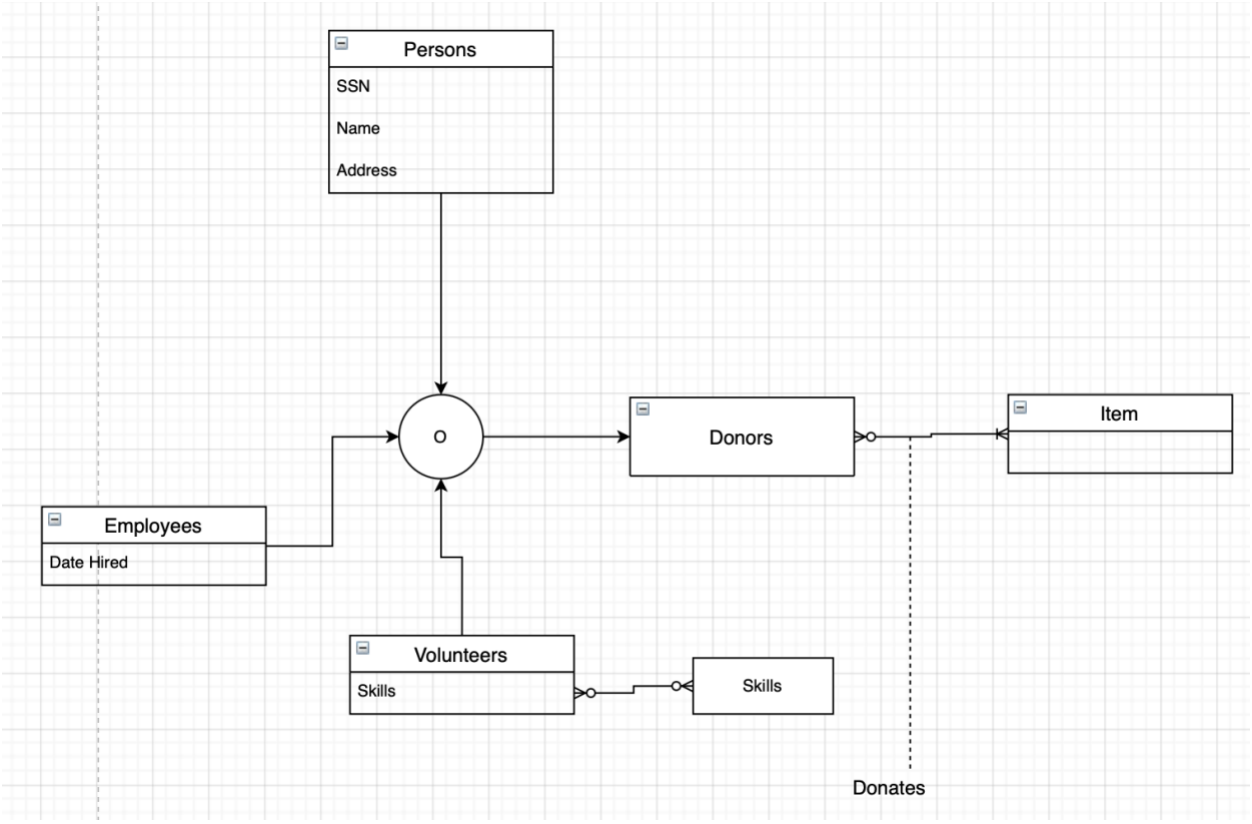
Q4. Now consider the disjointness Constraints. Is this a disjoint rule or an overlapping rule? **What does this mean for this relationship?** (Refer to part 1 or the class lecture for a refresher on this)

Overlapping. The text states: "at any given time a person may belong to one or more of these groups." This means that a person can be both an employee and a donor or a volunteer and a donor simultaneously.

Q5. Now let us consider the subtype discriminator. How would you describe the subtype discriminator for this supertype/subtype relationship? Is it a simple attribute, or a composite attribute?

The subtype discriminator for Volunteers is "Skills", and this is a composite discriminator as it can be composed of multiple attributes itself. Similarly Donors can donate Items that are composed of multiple attributes.

Q6. Finally, please use the information above and create a corresponding EERD model. Take a screenshot, and post it back under this question:



Exercise 2:

To strengthen our modeling skills, we will now explore step by step a single problem:

A technology company provides offerings to its customers. Offerings are of two separate types: products and services. Offerings are identified by an offering ID and an attribute of description. In addition, products are described by product name, standard price, and date of first release; services are described by name of the company's unit responsible for the service and conditions of service.

There are repair, maintenance, and other types of services. A repair service has a cost and is the repair of some product; a maintenance service has an hourly rate. Fortunately, some products never require repair. However, there are many potential repair services for a product.

A customer may purchase an offering, and the company needs to keep track of when the offering was purchased and the contact person for that offering with the customer. Unfortunately, not all offerings are purchased. Customers are identified by customer ID and have descriptive data of name, address, and phone number.

When a service is performed, that service is billed to some customer. Because some customers purchase offerings for their clients, a customer may be billed for services he or she did not purchase, as well as for ones that were purchased. When a customer is billed for a service (although some may never require a service of any type), the company needs to keep track of the date the service was performed, the date the bill is due, and the amount due.

Once more, let us start by repeating the process with carried out during our first lab and:

Q7. Please identify the entities, their attributes, and their relationships as suggested in the problem above:

Entity	Attributes	Relationship to (add name to it)
Offerings	Services, Products	Customer
Products	Name, Price, Date	Repair
Services	Repair	Customer

Q8. Are there any supertype/subtype relationships present? If so, what entities would be involved? Which would be the supertype, and which would be the subtype?

Entity	Attributes	Relationship to (add name to it)	Subtype or Supertype? (N/A if not part of Subtype/supertype relationship)
Offerings	Products, Services	Customer, Products, Services	Supertype
Products	Name, Price, Date		Subtype
Services	Repair, Maintenance	Customer	Supertype

Q9. Now consider the completeness constraint. In the supertype/subtype relationship identified above a total specialization rule or a partial specialization rule? **What does this mean for this/these relationship(s)?** (Refer to part 1 or the class lecture for a refresher on this)

Subtypes that existing under the 'Offerings' supertype are total specialization (meaning that these are the only two available subtypes) and the subtypes under the "Services" supertype is partial specialization.

Q10. Now consider the disjointness Constraints. Is this a disjoint rule or an overlapping rule? **What does that mean for this/these relationship (s)**? (Refer to part 1 or the class lecture for a refresher on this)

Disjointed. The subtypes for either of the Supertypes do not overlap.

Q11. Now let us consider the subtype discriminator. How would you describe the subtype discriminator for this supertype/subtype relationship? Is it a simple attribute, or a composite attribute?

Attributes that fall under the "Services" (Service Date, Billing Date, Amount) and "Customer" (Address) subtype are composite attributes.

Q12. Finally, please use the information above and create a corresponding EERD model. Take a screenshot, and post it back under this question: