STSCI 5060 Homework 2

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1 Problem: Adding Subtype Discriminators

From the diagram representation, we know from the EER that we can add in subtype discriminators by listing the attributes of each supertype, and after identifying the subtypes for a supertype, we assign a subtype discriminator by listing the attributes of each subtype. For the person, employee and student, we know that the attributes of each supertype are reflected in the diagram, in which for all supertypes, instances of the supertype are directly listed below, which will be analyzed.

1.1 Part A: Person

From the given discriminator names and values, we can add a subtype discriminator by first observing that for the person entity, we know that this entity is the supertype. Furthermore, because the person type is an attribute that consists of **both** the attributes of the person entity that are assigned to the subtype discriminator, that adding a subtype discriminator in this case is achieved by requiring information about the person type, namely whether the person is an employee (in which the person could answer "Y" for yes), or an alumnus (in which a person could also answer "Y" for yes), and finally, if they are a student (again with "Y" for yes if they are).

Also, we know that the person supertype contains 3 subtypes Employee, Alumnus, and Student. From these subtypes, the overlap rule tells us that it is possible for the person supertype to simultaneously have the subtype entities of Student, Alumnus, and Employee. From the subtypes, the subtype discriminator that we want for the person entity, from th esupertype to the subtype which includes an employee, alumnus and student has a specialization in that the person we are talking about must be either an employee, alumnus, or student. As a result, the given subtype discriminator, for the person, given the possibilities of employee, alumnus or student, is sufficient.

1.2 Part B: Employee

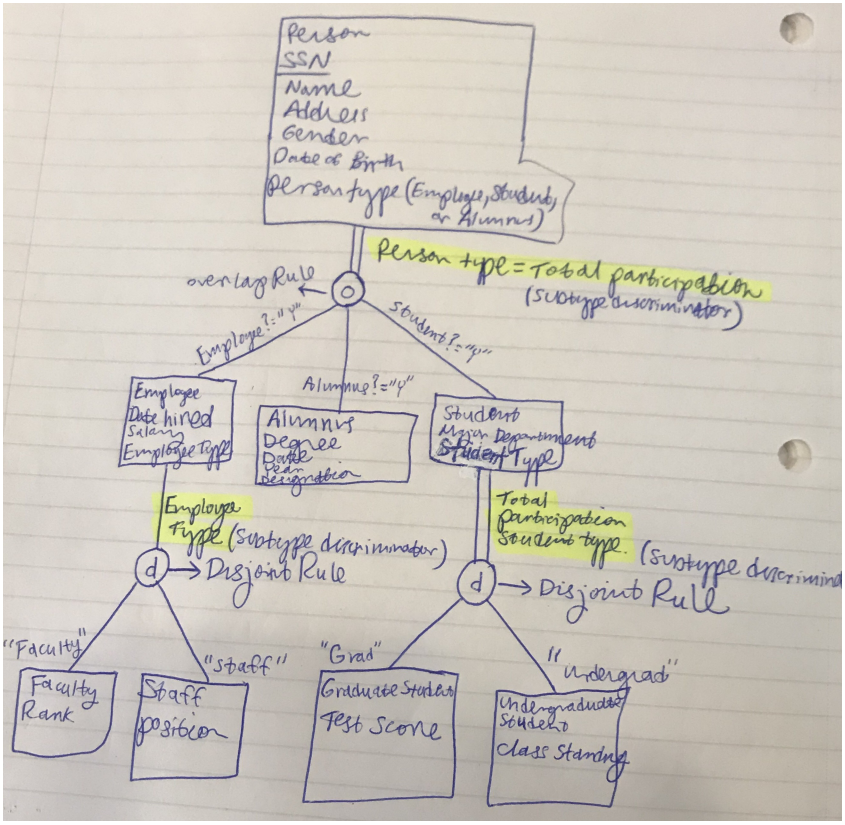
To add a subtype discriminator from the given supertypes, we know that for the employee type in the figure, that the employee serves as a supertype that has subtype entities named faculty and staff. From these subtypes of the employee supertype, we observe that the employee type is an attribute of an employee, and therefore, that the employee type is a subtype discriminator because in this case, an employee can either be faculty or staff. Again, we can apply the disjoint rule to study this relationship, because from the employee supertype, the subtypes employee, and faculty or staff, imply that an instance of the employee supertype cannot simultaneously be an employee and faculty or staff. As a result, the given subtype discriminator, given the possibilities of an employee and the type of employee, sufficiently captures the described supertypes and subtypes.

1.3 Part C: Student

From the student type, undergraduate or graduate, a subtype discriminator can be added here as well, by observing that the student entity acts a supertype. From usual properties of supertypes, we know that the student supertype has subtype entities of graduate student and undergraduate student, and furthermore, that the student has attributes that are assigned to the subtype discriminator. Because the student supertype has attributes specifying the major department of the student, the subtype entities of graduate and undergraduate students have different attributes, the test score and class standing, respectively. From the student supertype,

we know that if we have an instance of this supertype, that a student has to either be a graduate or undergraduate. As a result, the given subtype discriminator captures, given the options of student as graduate or undergraduate, attributes of each instance of the student type.

1.4 Diagram with Subtype Discriminators



Comments about Diagram with Subtype Discriminators

- The subtype discriminators are highlighted in yellow.
- From the subtype discriminators, we are able to easily identify the attributes of different instances of the supertype. That is, if we are given one of the 3 possible supertypes from the figure above, we know that we can classify the attributes of each subtype, given a supertype, by first, examining whether the rule that allows us to relate the subtypes to the supertypes is joint, and second, the specific attributes of the subtype that it shares with the supertype, and whether attributes of this particular subtype are shared by other subtypes of the supertype.
- From the single overlap and 2 disjoint rules, we know that the subtypes for the supertype that is directly above them in the diagram can either be disjoint, implying that the individual subtypes of a given supertype can simultaneously share all attributes that have been listed for each subtype, or that the subtypes can be disjoint, implying that they cannot simultaneously share attributes that are common to both of them, which they have inherited from the supertype.

2 Problem: EER Model

2.1 Description of Business Rules and how they are reflected in the EER Model

To develop such an EER Model, the database management system would have to include the following. First of all, we observe that, from the description of the instructors that will be teaching the classes at the international school, that the ROOM in which the instructors will be teaching the classes is a supertype. From this supertype, we know that the attributes of the Building ID, the room number of individual parts of the building, the

capacities of each room, and even the type of the room, are attributes of the building supertype that are the same between its subtypes and entity types.

Next, we also observe that the subtypes of the Room supertype include the lab and classroom. These subtypes clearly share attributes that are common to this supertype, because each one of the subtypes, for instance, lab, has the same attributes as the room supertype. On the other hand, the other subtype classroom has an attribute board type, which in this case is again an attribute that it shares with the room supertype. Furthermore, each instance of the supertype room has the characteristics which include the type of the room, which is an attribute of the room that is designated for the subtype discriminator which details characteristics of the subtype. From each room in the building, we know that the subtype discriminator specifies which type of room there is in a particular building at the school, from which the database management system can adhere to specific business rules that will be discussed at length.

In addition to the observation that the room type is an attribute of all room across buildings on campus, we also know that a room supertype cannot be, at the same time, a subtype of the lab and classroom. Because a room in some building is either a lab or a classroom, the subtypes for the room supertype must be separate, therefore allowing us to make use of the disjoint rule, which claims that the lab and room subtypes of the room supertype are totally specialized, and that these instances of the distinct supertypes are completely separate. Besides the room supertype, we also know that there are Media, Computer, Instructor, and Timeslot entity types.

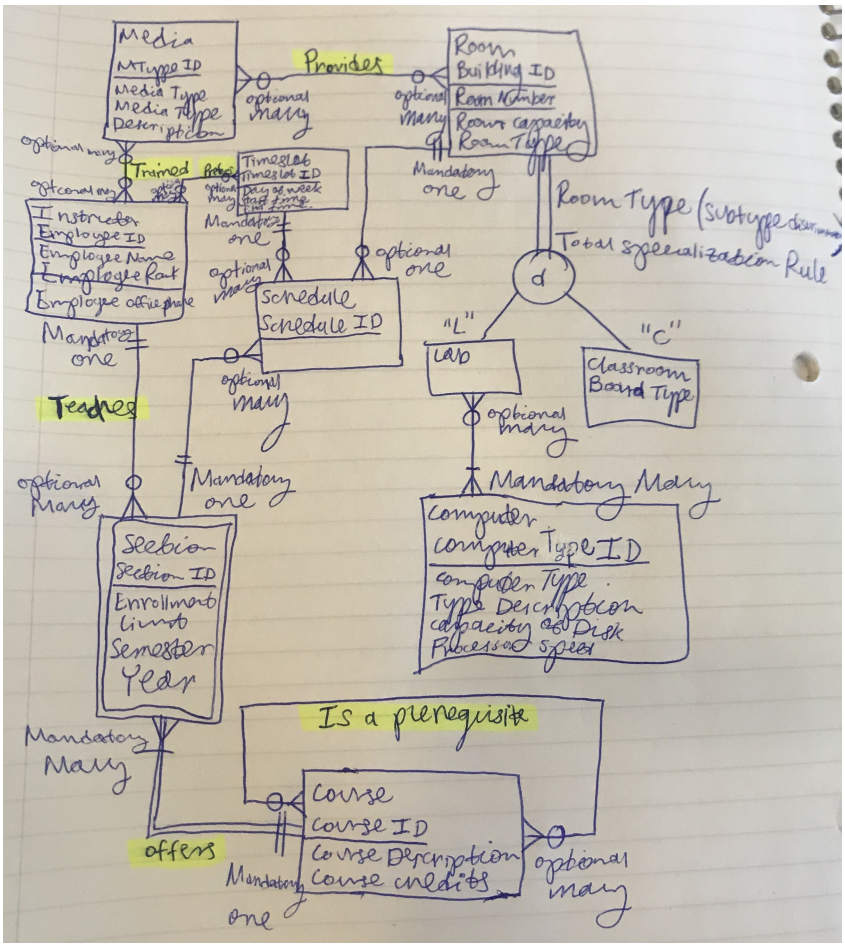
For each of these entity types, first, the Media entity type contains the required attributes including the MType ID, Media Type, and Media Type Description; second, the Computer entity type is an entity type that contains the Ctype ID (ie the ID of the computer and its type), the Computer type, the type description, the disk capacity and speed of the processor; third, the instructor entity type has the attributes employee ID, name of the employee, rank of the employee, and office phone of the employee; finally, the timeslot entity type contains the attributes Timeslot ID, day of the week, and starting and ending time.

From further discussions, additional entity types that need to be represented include the course entity type, the section weak entity type, and the schedule associative entity type. From these entities, we know that the course entity type has the attributes course ID, description of the course, and credits that are offered for the course; the section weak entity type has the attributes ID of the section, enrollment limit of the section, the semester during which the section is offered, and the year in which the section is offered; the schedule associative entity type has the attribute the schedule ID, which is important for relationships that relate to the associative entity.

Specifically, the schedule associative entity type has a relationship between the entity schedule and the timeslot and section, which is a mandatory one to optional many relationship, and also a relationship between the associative entity of schedule between the room and section, which is also a mandatory one to optional many relationship. Moreover, the associative entity has a 'provides' and 'trained' relationship; the provides relationship exists between the entity media and room, and the relationship is provides because the schedule associative entity provides a room in which one type, several types, or no types, of media can be held. On the other hand, the trained relationship also exists between the entity media and instructor, because an instructor is trained to use one, none, or many types of media, because the instructors who teach different classes are trained to use one, none, or many types of media.

Other important relationships include, the entity instructor and the timeslot have a 'prefers' relationship. The prefers relationship exists between these entities because an instructor may, or may not, prefer one or more timeslots for work that he or she performs. Also, these is a teaching relationship between the instructor entity and the section weak entity because an instructor may or may not teach many sections in some semester. But the weak entity section and the entity course also share an offers relationship because many sections of the class, which are taught by instructors, are offered in addition to a specific course that is offered each semester. From the course entity, we also have a 'is a prerequiste' relationship because for a given course, this entity has a relationship consisting of the fact that for some course, there are prerequistes that the student must take in order to enroll, and therefore take, the course; the cardinality of this relationship is optional many to many. Finally, we also have that, between the subtype entity lab and the entity Computer, there is a contains relationship because for a given lab in some room in a building, the lab contains one or more types of computers; the cardinality of the contains relationship is optional many to mandatory many.

2.2 EER



2.3 Comments about EER

- The relationships discussed above are highlighted in yellow.
- By listing the media entity type first in the leftmost corner of the ER diagram, we have diagramatically represented the different mandatory one and optional many, etc relationships, which account for the business rules demanding that a section that is offered for some course can **only** be offered during one particular time slot, so as to avoid time conflicts with other sections for different courses, in addition to the fact that the rooms, which include labs and classrooms, can hold specific media types that are used in sections for courses to teach students.
- From all of the relationships included in the diagram, from mandatory one to optional many to optional many to mandatory one, realistically capture other business rules relating to how courses can be schedule insofar as to avoid timing conflict between sections of different courses. From the associative entity schedule, it is possible to address these business concerns by 'centering' the ER diagram around the schedule, because the section, timeslot, instructor, and room for a course are determined by the associative entity schedule which has the attribute schedule ID.
- From the associative entity schedule, we know that representing the attributes of this entity, as shown in the diagram above, allows us to easily maintain the scheduling data for each semester and for a given year. From the scheduling data, we can identify not only the semester in which a course was offered, but also the year in which the course was offered, from which all relevant information related to the course, the section, the room type that the section was offered in, and even the description of the course and the credits offered for the course, are listed under entities in the diagram that have relationships with the schedule associative entity, with > 2 entries.

- From the enhanced entity relationships that have been described, we know that the subtypes and supertypes can also be represented. For these parts of the diagram, especially from the weak entity section, we know that, because from the room supertype that we discussed at length in the beginning, that the attributes for this supertype include the building ID, the room number, the capacity of the room, and the type of the room. From the 2 types of rooms, we contain them separately because they are 2 individual subtypes. But from the lab subtype, according to the business rules, we know that a lab can have computers, but that the classrooms cannot have computers. But if the room is a lab which is a type of room that **can** have computers, we only track the type of computer that is kept in the room, and not an individual ID for each computer. In the case of the lab having computers, we have included a list of the attributes of the computer, in addition to how the subtypes and supertypes would be arranged together in another EER **below**.

- From the described business scenario, it is possible to move the attributes of the weak section, namely the semester and the year, to the course entity, if one wishes. In terms of the EER, this would still result in a diagram that not only appropriately adheres to the business scenario, but also maintains key information about the year and semester in which a course was offered. Furthermore, although it is possible to include these attributes for the course entity, my decision for listing them as attributes of the section weak entity was determined by the fact that, from the additional business rules that are listed, that the section being taught by an instructor will have the year and semester in which the section is taught, as attributes of the section.

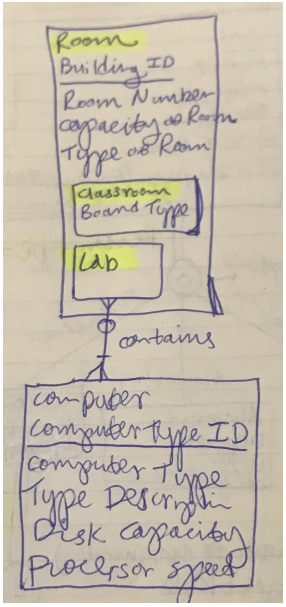
- From the instructor entity, we know that the EERs above and below accurately reflect the business situation and rules because, given the associative entity of schedule, we are able to allow rooms to account for more than one occasion at separate times, which the associative entity is able to process with information from the schedule ID. Because an instructor teaches one, none, or many sections of a class, the business rule is accurately reflected through the cardinality of these relationships in the diagram above. However, it is an interesting business rule that the instructor must be trained in order to use certain types of media, which is again certainly reflected in the relationship that the instructor has with the media entity, through the trained relationship.

- From the course entity that has been described, we also know that the attributes of the course, namely the course ID, description of the course, and credits offered for taking the course, are reflected in the offers relationship that the course has with a section, as the section has the attributes through the Section ID, which contains the enrollment number, year and semester.

- From the room supertype, we have completely adhered to the business rules and scenario by not only including all relevant information for the types of computers that will be stored in the lab, which is an instance of the room supertype, but also have included the necessary information for all rooms other than labs, namely classrooms, which also have attributes of their own that are listed in the diagram above.

- Finally, as described in the hint, the ER Diagrams in each case reflect a weak entity, the section, that has more than **one** relationship with the other entities. Again from previous comments, briefly, we reiterate that these relationships from the weak entity include the teaches relationship between the instructor and the section, as well as the offers relationship between the course and the weak entity section.

2.4 EER with Subtypes and Supertypes Grouped Together (slightly different notation, I just included it anyways)



2.5 Comments about the Subtype and Supertype ER Diagram Above

- Given the same relationships and entities that have bene represented in the previous EER, we can keep all of these elements of the diagram the same, and if we introduce slightly different notation, we can include the Room supertype and its 2 subtypes. The Room supertype and the subtypes below it are highlighted in yellow.
- From the supertypes notation diagram, it is possible to capture the same relationships that are already present in the EER above. Namely, we know that the business rule of a room serving as only a classrom and a lab are fulfilled, and as the 2 subtypes that we have listed are included under the room supertype, it is clear that the associative entity schedule affirms the discussed business rules, as separate rooms can be used on more than one occasion, given the schedule ID from the associative entity schedule so as to avoid time conflict.
- Within the room supertype, the lab subtype reflects an optional many to mandatory many relationship with the computers held in the lab, as each one of the computers in the labs has attributes that have been discussed.
- The subtype lab has a contains relationship with the computers that are in the lab, identifying the type of each computer only.
- With either notation, the room supertype and the subtypes of room are reflected through the business rules, in which different subtypes of the room supertype are disjoint, as a room that is a lab cannot also be a room that is used as a classroom.