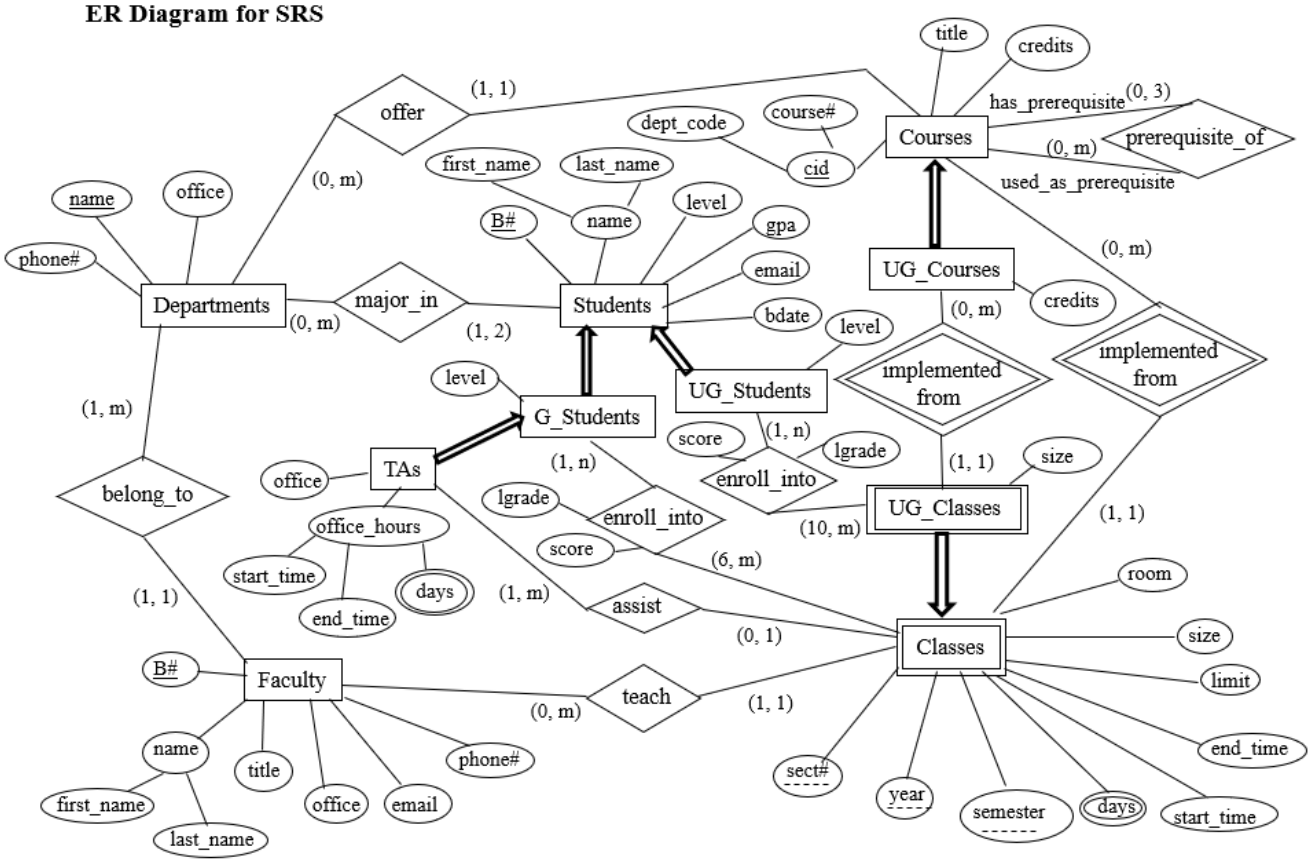
Solution to Homework 1

1. (10 points) Discuss whether or not it is a good idea to create entity sets Undergraduate Students and Graduate Students and make them sub entity sets of Students in the ER diagram for the Student Registration System.

Answer: It is a good idea. The reasons are as follows. Without creating sub entity set Undergraduate Students (UG_Students), we won't be able to represent the requirement that "undergraduate students can only enroll in undergraduate classes". Without creating sub entity set Graduate Students (G_Students), we won't be able to represent the requirement that "graduate students can take any classes". Furthermore, without G_Students, we won't be able to precisely represent that TAs are graduate students.

2. (70 points) Design an ER diagram for the Student Registration System based on the provided Requirements Document (see Brightspace). Remember to indicate the key for each entity set and the connectivity of each relationship. Use (min, max) format to indicate connectivity. No need to specify connectivity for ternary relationships. (Note 1: Use only information in Section 2 of the Requirements Document to design the ER Diagram. Note 2: Some constraints cannot be represented in the ER diagram naturally, no need to design un-natural structures in the ER diagram just to try to represent such constraints. These constraints will be represented at later stages of the database design process. Question 2 of this homework asks you to list these constraints. Note 3: If you use ERDPlus to draw the ER Diagram, some notations may be different from those introduced in class. Notations from ERDPlus are acceptable.)

Answer: See a note about the ER Diagram.



Note: The reason that attribute "level" is repeated for G_Students and UG_Students (i.e., not inherited from Students) is that the valid value constraints for the three entity sets are all different. Similarly, attribute "credits" is repeated for UG_Courses and attribute "size" is repeated for UG_Classes.

3. (20 points) Identify constraints in the Requirements Document for the Student Registration System that cannot be naturally expressed using the ER model discussed in class. First list the constraints not represented in your ER diagram for each entity set separately. Then list the unrepresented constraints involving multiple entity sets or some relationship.

Answer: Constraints that cannot be naturally represented in the ER diagram:

Students:

Valid values for level (freshman, sophomore, junior, senior, master, PhD).
Valid values for gpa (decimal number between 0 and 4).
B# must start with "B" followed by 8 digits.
Students have unique email addresses (additional keys).

G_Students

Valid values for level {master, PhD}.

UG_Students

Valid values for level {freshman, sophomore, junior, senior}.

Courses

Special value requirement for courses# (value ranges for graduate and undergraduate course numbers).
Special values for credits (3 for graduate courses and 4 for undergraduate courses).

UG_Courses

Valid value for credit: 4

Classes

Valid values for days {Monday, Tuesday, Wednesday, Thursday, Friday}.
Valid values for semester {Spring, Fall, Summer 1, Summer 2, Winter}.
start_time < end_time
size <= limit
size >= 6

UG_Classes

size >= 10

Departments

Departments have unique phone numbers.
Departments have unique phone offices

Faculty

Valid values for faculty {adjunct, lecturer, assistant professor, associate professor, professor}.
B# must start with "B" followed by 8 digits.
Faculty members have unique email addresses.

TAs

Valid values for days {Monday, Tuesday, Wednesday, Thursday, Friday}
office_hour_start_time < office_hour_end_time
TAs have unique email addresses

Additional constraints (they either involve multiple entities or a relationship) include:

- The values for lgrade are limited to {A, A-, B+, B, B-, C+, C, C-, D, F, I}.
- The values for score are limited to numbers between 0 and 100.
- Letter grades are determined by scores.
- Courses and their prerequisite courses do not form cycles.
- No faculty member can teach classes with overlapping times.
- Each faculty can teach up to three classes in a semester.
- Each TA can assist exactly one class in a semester.
- No student can take more than 5 classes in a semester.
- A student cannot enroll into the different sections (i.e., classes) of the same course more than once.
- A student must have completed all prerequisite courses with a grade of at least C in order to enroll successfully into a class.
- A student cannot be registered in classes with overlapping times.