Solution to Homework 1

1. (70 points) Design an ER diagram for the Student Registration System based on the provided Requirements Document (see blackboard). Remember to indicate the key for each entity set and the connectivity of each relationship. Use (min, max) format to indicate connectivity. (Note 1: Hand-drawing diagram is acceptable but it must be neat and easy to read. Note 2: For unary relationship, adding role information is often helpful in attaching the correct connectivity information with the right relationship link/edge. Note 3: Some constraints cannot be represented in the ER diagram naturally, no need to design un-natural structures in the ER diagram just to represent such constraints. You can get additional clues on such constraints from Question 2. These constraints will be represented at later stages of the database design. Question 2 of this homework asks you to list these constraints.)

Answer: See the ER Diagram for SRS provided by the instructor in MyCourses.

2. (14 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 status (freshman, sophomore, junior, senior, MS, PhD).
Valid values for gpa (decimal number between 0 and 4).
Students have unique email addresses.

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).

Classes

Valid values for days {Monday, Tuesday, Wednesday, Thursday, Friday}.
Valid values for semester {Spring, Fall, Summer 1, Summer 2}.
start_time < end_time
size <= limit
size >= 5 for graduate classes and size >+ 10 for undergraduate classes

Departments

Departments have unique phone numbers.
Departments have unique phone offices

Faculty

Valid values for faculty {adjunct, lecturer, assistant professor, associate professor, professor}.

Faculty members have unique email addresses.

TAs

Valid values for days {Monday, Tuesday, Wednesday, Thursday, Friday}
start_time < end_time
The pay rate of a TA depends on their level.
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, null}.
- The values for ngrade are limited to {0, 1, 1.7, 2, 2.3, 2.7, 3, 3.3, 3.7, 4, null}.
- The values of lgrade and ngrade for each enrollment must satisfy the following correspondences: A ←→ 4, A- ←→ 3.7, B+ ←→3.3, B ←→ 3, B- ←→ 2.7, C+ ←→ 2.3, C ←→ 2, C- ←→ 1.7, D ←→ 1, F ←→ 0 and I ←→ null.
- Courses and their prerequisite courses do not form cycles.
- No classes of overlapping times can be assigned to the same classroom.
- 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 same class 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.

3. (8 points) Discuss whether or not it is a good idea to create a super entity set for Students and Faculty in the ER diagram for the Student Registration System.

Answer: There is no sufficient justification to create a super entity set for Students and Faculty even though they share some attributes. First, they also have many unique attributes. Most importantly, although they both have relationships with Classes and Departments, they have different relationships and they don't share any relationship. In other words, their behaviors are totally different.

4. (8 points) Discuss whether or not it is a good idea to make TAs a sub entity set of Students in the ER diagram for the Student Registration System.

Answer: It is a good idea to make TAs a sub entity set of Students. With creating such a sub entity set, students who are not TAs (they are majority of the students) would have empty (null) values for many irrelevant attributes. The "assist" relationship would also be less specific. Both situations could cause confusion at the modelling level, i.e., someone viewing such an ER Diagram (the one without the sub entity set TAs) would think every student (at least most) has those irrelevant attributes (e.g., office and pay_rate) and will assist a class. Such potential confusions are avoided with the creation of the TAs sub entity set.