Homework 1 Solutions

1. (75 points) Design an ER diagram for the Student Registration System based on the provided Requirements Document. Remember to indicate the key for each entity set and the connectivity of each relationship. Use (min, max) format to indicate connectivity. (Note: Many constraints cannot be represented in the ER diagram and they will be represented at later stages of the design. Question 3 of this homework asks you to list these constraints.).

Answer: The ER diagram is shown in a separate file.

2. (10 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 apparent advantage in creating a super entity set for Students and Faculty. Usually, a super entity set is created on top of multiple existing entity sets only if these entity sets share significant common attributes and relationships. For Students and Faculty in the Student Registration System, this is hardly the case. The only common attributes between Students and Faculty are name and email, and there are no shared relationships.

3. (15 points) Identify constraints in the Requirements Document for the Student Registration System that cannot be expressed using the ER model we discussed in class. First list the constraints not represented in the ER diagram for each entity set separately. Then list the constraints involving multiple entity sets. Based on the constraints you listed, summarize what types of constraints generally cannot be represented in the ER model.

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

Students

- Specific values for status (freshman, sophomore, junior, senior, graduate).
- Specific values for GPA (decimal number between 0 and 4).
- Different students have different email addresses.

Courses

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

Classes

- Classes are uniquely identified by the combination of the following attributes: cid, sect#, year, semester.
- The values of days are limited to {Monday, Tuesday, Wednesday, Thursday, Friday}.
- The values of semester are limited to {Spring, Fall, Summer 1, Summer 2}.
- The actual size of a class must not exceed the limit of the class.
- The limit of a class must not exceed the capacity of the assigned classroom.
- No classes of overlapping times can be assigned to the same classroom.

Departments

Different departments have difference offices.

Faculty

The values for faculty rank are limited to: {lecturer, assistant professor, associate professor, professor}.

Different faculty members have different offices.

Different faculty members have different email addresses.

Additional constraints include:

- The values for lgrade are limited to {A, B, C, D, F, I, null}.
- The values for ngrade are limited to {0, 1, 2, 3, 4, null}.
- The values of lgrade and ngrade for each enrollment must satisfy the following correspondences: A = 4, B = 3, C = 2, D = 1, F = 0 and I = null, and null is null.
- Courses and their prerequisite courses do not form cycles.
- No faculty member can teach classes with overlapping times.
- 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.

In general, several types of constraints cannot be expressed using the ER model discussed in class.

a. Attribute values. Constraints on valid values an attribute can take cannot be expressed because ER model does not consider individual values.
b. Additional keys. Since only one key can be denoted for each entity set, additional keys cannot be expressed.
c. Value relationships/constraints across different attributes.
d. Some complex relationships/constraints. These include (i) courses and their prerequisite courses do not form cycles; (ii) no classes of overlapping times can be assigned to the same classroom; (iii) no faculty member can teach classes with overlapping times; (iv) a student cannot be registered in the same class more than once; (v) a student must have completed all prerequisite courses with a grade of at least C in order to be successfully registered in a course; (vi) a student cannot be registered in classes with overlapping times.

Note that constraints that cannot be modeled by the ER model will be implemented/enforced by other means in later steps of the application development.