Assignment 3

Published: Oct. 7, 2016
Due: Oct. 14, 2016 (11:59pm)

Total: 45 points

Please upload your solutions to classes*v2. To do so, please enter the classes*v2 page of CPSC 437/537, then click the “Assignment” button on your left-hand toolbar, and finally click “Assignment3” to upload your assignment.

If you know you are going to submit your assignment late, please let us know in advance (send an email to cs437ta@cs.yale.edu). Any and all resources may be used as long as you cite them, with the exception of collaborating with other people.

* Do not copypasta your solutions from the Internet. We do not really care if you do this, but you are not really learning anything.

If you have ANY questions, please do not hesitate to let us know (email, office hours, etc.)
Part 1: Concepts (12 points)

For each of the following statements, please first answer “True” or “False”, and then provide a clear explanation:

1. An E-R diagram with \( m \) entities and \( n \) relationships will translate to \( m+n \) tables. (3 points)

False. Many-to-one relationships can often be merged and therefore reduce the overall number of tables needed.

2. A table with two attributes, such as \( R(A, B) \), must be in BCNF. (3 points)

True. The only two non-trivial FDs for this relation will be \( A \rightarrow B \) or \( B \rightarrow A \), and both do not violate BCNF. (Using Google, you can find a more interesting formal proof about every two-column relation is in BCNF)

3. In relational algebra, join is a derived operator. (3 points)

True. In relational algebra, join can be derived from Cartesian product and selection.

4. For relation \( R(A, B, C) \), if \( A \) is a key, then the decomposition into \( R(A, B) \) and \( R(A, C) \) is lossless. (3 points)

True. You can always reconstruct the original table \( (A, B, C) \) by joining \( (A, B) \) with \( (A, C) \), because \( A \) is a key.

Part 2: Database Design (13 points)

You have been asked to design a database for the university administration, which records the following information:

1. All the students necessarily have a unique student ID, a name, and a university email address.
2. Each student has an advisor.
3. Students take courses. A student may take one course, multiple courses or no courses.
4. Each course has a course number, course name, and days of the week the course is scheduled.
5. Each course has exactly one head TA, who is also a student.
6. Every head TA has an office.

a) Draw an E-R diagram for this application. Be sure to mark the multiplicity of each relationship of the diagram. Decide the key attributes and identify them on the diagram. Please state all assumptions you make in your answers, if you add additional assumptions. (9 points)

There are many possible ways to answer this question based on different assumptions. Any reasonable answer is acceptable. Here is just a simplified version for reference. I do not know why my figure cannot show primary key in each entity :(. 
b) Translate your E-R diagram into a relational schema. Specify the key of each relation in your schema. (4 points)

Because we do not have requirements on the normal form, any reasonable schema design is acceptable.

student(student_id, name, email)
instructor(instructor_id, name, email)
course(course_id, course_name, days_scheduled)
advise(student_id, instructor_id)
takes(student_id, course_id)
head_TA(course_id, student_id, office)