Introduction to Database Systems

Individual Homework 3: ER Model & Normalization

1. Introduction

In this homework, you need to complete two tasks. The first task is to plot an ER Model for a given architecture and some constraint. The second is to answer some questions about ER Model, functional dependency and normalization. Please read the following description for detail.

2. Tasks

☆ Part 1 - Design the ER model for CS department system

"Sports week" is an annual event at NYCU. Students sign up as a team to compete. To simplify the registration process, we need to create a sign-up system. Now you are assigned to design an Entity-Relationship diagram(ER diagram) to complete this task.

In this part, you need to use any kind of online application like ERDPlus to plot your ER Model. You can also use other applications to plot your ER Diagram, but **directly plotting on the paper and taking photos is not allowed (using iPad or any other forms of diagram drawn by hands are also not permitted)**, **you will get a huge penalty if you do so**.

The following description is the entity you need to plot and the relations you need to consider. **Please point out how you can achieve the relation constraint by your ER Model design respectively in your report**! (For example, the relation X can be achieved by one-to-many relationship between Entity Y and Entity Z, etc.)

Entities:

A. User
   user id, name, email, department id, gender, phone number

B. Department
   department id, name, class, grade
   e.g. (1, computer science, class B, 2)

C. Event
   event id, name, team limit, max team members, min team members, datetime

D. Team
   team id, name, user id

E. Registration
   registration id, event id, team id, datetime

F. Match

match id, event id, team id, order, score, datetime

Relations:

A. Each student can only represent one department, but one department has multiple students.
B. Each student can participate in multiple teams. Each team needs to have at least one student or more.
C. It is not mandatory for students to participate in sports week. In other words, some students might not sign up for any event.
D. Each team can participate in multiple events, but they need to turn in a separate sign up sheet for every event. One sign up sheet can only register for one event.
E. There will be multiple matches in each event. Each match belongs to one specific event.
F. Each team can have many matches.

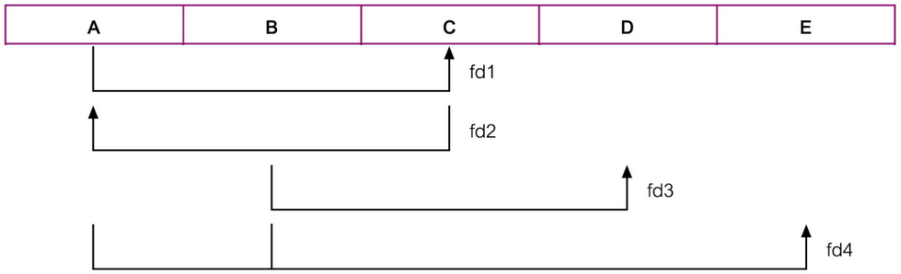
There could be multiple feasible designs, you will get the points if your design is reasonable. But, again, you need to **plot your design by online software** instead of drawing by your hand directly, and **you need to point out how you can achieve the above relations by your design respectively** (means that you need to write down six points to talk about which design can fulfill the above relations one by one). **You will get no points if you do not do that!** Besides, you can use Chinese or English to do this homework, feel free to use the language you are familiar with.

☆ Part 2 - Paper Exercise

In this part, there are four questions you need to answer. You are required to **type your answer into your report directly** due to the concern that the handwriting is too hard to recognize, except your functional dependency diagram. You can plot your diagram on a blank paper, take a photo, and paste the photo to your report.

A. (10%) What is a function dependency (FD)? Why can we not infer a FD automatically from a particular relation state? Give out some **examples** to explain your answer to the above **two questions**.
B. (10%) What is 3NF (Third Normal Form)? What is BCNF (Boyce-Codd Normal Form)? What's the difference between 3NF and BCNF? Please give the **definition**, **explanation** and some **examples** to answer the above **three questions**.
C. (15%) Consider the universal relation R = {A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies F = {{A, B}→{C}, {A}→{D, E}, {B}→{F}, {F}→{G, H}, {D}→{I, J}}. What is the **key for R**? **Decompose R into 2NF**.
   You need to give the **reason**, **explanation** and plot the functional dependency diagram like the following example **before and after normalization** (which means

that you will plot more than one diagram in this question). In this question, you can plot the diagram by online software, or you can draw on white paper, take a photo and paste it on your report.



D. (15%) Consider the following relation for published books:
BOOK (Book_title, Author_name, Book_type, List_price, Author_affil, Publisher)
Author_affil refers to the affiliation of the author.

Suppose the following dependencies exist:
Book_title → *Publisher, Book_type*
Book_type → *List_price*
Author_name → *Author_affil*
What normal form is the relation in? Please explain your answer with your **reason** and **plot** the functional dependency diagram.

3. Grading

Plagiarism is not allowed! You will get a **huge penalty** if we find that.

Description	Score(%)
Part 1 - All entities and attributes are appeared in you design	8
Part 1 - Achieve six relations	42
Part 2 - four questions	50

4. Discussion

TAs had opened a channel **HW3** 討論區 on New E3 forum of the course, you can post questions about the homework on the forum. TAs will answer questions as soon as possible.

Discussion rules:

1. Do not ask for the answer to the homework.
2. Check if someone has asked the same question before asking.

3. We encourage you to answer other students' questions, but again, do not give the answer of the homework. Reply the messages to answer questions.
4. Since we have this discussion forum, do not send email to ask questions about the homework unless the questions are personal and you do not want to ask publicly.

5. Submission

1. The deadline of this homework is **6/17 (Thu.) 23:55:00**, **no late submission accepted this time**.
2. You only need to submit one `pdf` file named as "**HW3_XXXXXXX.pdf**" where XXXXXXX is your student ID. Wrong file or naming format causes **-10** points to your score.
3. If there is anything you are not sure about submission, ask in the discussion forum.