COMP3010E Database Systems Homework 1 (100 pts)

Due: September 30 (Tuesday), 11:59PM

- Please submit **a single PDF file** with your answers and email it to zhouxun2023@hit.edu.cn
- Put "**[COMP3010E] HW1 <name>**" in your email subject, replace <name> with your name.

You can use software to draw the ERD and Relational Schema, or hand-draw and scan/take pictures, but make sure everything is clear and readable. For all the ERD /EERDs please use Crow's Foot notations.

1. **(20 points)** For the description below, develop an E-R diagram. Clearly show all the entity types, attributes, relationships, min and max cardinalities.

   A book is identified by its ISBN number, and it has a title, a price, and a date of publication. It is published by a publisher, each of which has its own ID number, a name, and an address. The address can be further divided into two components: City and Country. Each book has exactly one publisher, but one publisher typically publishes multiple books over time. A book is written by one or multiple authors. Each author is identified by an author number and has a name and date of birth. Each author has either one or multiple books; in addition, occasionally data are needed also regarding prospective authors who have not yet published any books. A book can be part of a series, which is also identified as a book and has its own ISBN number. One book can belong to only one set and a set consists of at least one but potentially many books.

2. **(20 points)** A bank has three types of accounts: checking, savings, and credit. Following are the attributes for each type of account:

   **CHECKING**: Account No., Date Opened, Balance, Service Charge
   SAVINGS: Account No., Date Opened, Balance, Interest Rate
   CREDIT: Account No., Date Opened, Balance, Payment

   Assume that each bank account must be exactly one of these three types. A credit account may be linked with one checking account to get automatic payment (optional). But a checking account may be used to pay many credit accounts. A customer is identified by Customer_ID, with Name, DOB and Annual_Income as other attributes. A customer may own at most one checking account and one saving account, but may own many credit accounts. But each account, no matter what type, must belong to one customer.

   Using generalization, develop an EER model to represent this situation. You need to specify both completeness and disjointness constraints and include a subtype discriminator.

3. **(20 points)** Convert the following E-R diagram into a relational schema. Make sure to mark all the relation names, primary keys, foreign keys, referential integrity constraints, not null constraints.
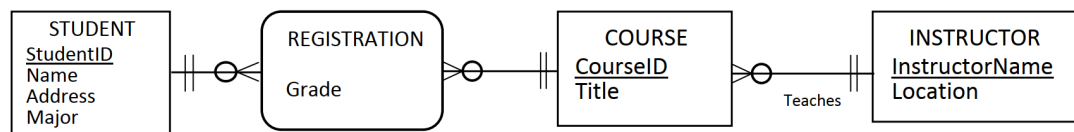
4. **(20 points)** Given the following business rules, first design an E-R diagram, and then convert it into relational schema. For the ERD, clearly show all the entity types, attributes, relationships, min and max cardinalities. For the relational schema, make sure to mark all the relation names, primary keys, foreign keys, referential integrity constraints, and not null constraints.

A company has employees, where each employee is uniquely identified by an EmpID. Other information includes Name, Gender, DOB and Salary. An employee may be appointed as a manager and therefore supervises many other employees. However, an employee may only have one manager. Each employee may work on many projects, but could also have no project to work on at some point. A project is identified by ProjectID, with other attributes including Name, Budget, StartTime and EndTime. A project may have many but at least one employee to work on it. The company also has a number of Accounts, where each account has an AccountNo as the unique identifier, along with Balance, Time_opened and Type as other attributes. Each Project is funded by at least one account, but could also be funded by multiple accounts. Each account can be used to fund any number of projects. An account has a managing employee

5. **(20 points)** Normal Forms. The following table describes user ratings on different video clips for a streaming website. Note each video clip may have different numbers of tags. A user subscribes to one of the many plans with different amount of free data usage in GB. Use the sample data below, complete the following tasks:

(1). Resolve the multi-value attribute "Tag" and convert the table into **two** relations. Work on the new relations for the following questions.
(2). Identify all the non-trivial functional dependencies by listing them in text. Among them, identify all the partial and transitive dependencies.
(3). Identify the candidate key(s) of the relations.
(4). Identify which normal form each relation is in.
(5). Convert all the relations to 3NF, and draw the new schema using graphical representation (no need to populate the data). Clearly mark the PKs, FKs, referential integrity constraints using arrows.

VideoRating

VideoID	VideoTitle	Length	Tag	UserID	UserName	Sex	PlanNo	FreeGB	Rating
1	Lion Tribe	100	Nature Animal Kid	A001	Alex Smith	M	1	100	5
2	Warzone	50	War Military	A001	Alex Smith	M	1	100	3
3	Rio	100	Cartoon Kid	A002	Ben White	F	2	50	5
2	Warzone	50	Outdoor Military	A002	Ben White	F	2	50	1.5
4	Lion Tribe	80	Action Outdoor	A003	Alex Smith	M	3	100	4