# DBI Mock Exam

## Part I: SQL and Relational Algebra

Consider the following relations:

Book

| BID | Title | Year | Rating |
|---|---|---|---|
| **1** | Book1 | 1861 | 4 |
| **2** | Book2 | 1977 | 2 |
| **3** | Book3 | 1944 | 1 |
| **4** | Book4 | 2006 | 5 |

Loans

| SID | BID | StartDate |
|---|---|---|
| **5123** | 3 | 1-May-2019 |
| **4127** | 2 | 22-Feb-2019 |
| **8357** | 4 | 12-Dec-2018 |

Student

| SID | StudentName | Email |
|---|---|---|
| **4127** | Yuri | Yuri@nott.cn |
| **5123** | Kent | Kent@nott.cn |
| **5177** | Juan | Juan@nott.cn |
| **8357** | Fiona | Fiona@nott.cn |

1. What are the results of the following three relational algebra expressions? Provide the answer in a form of table. If the expression is not valid, explain the reason.
    a. $\sigma_{SID>5000}\,(\pi_{Loans.SID,StartDate}(Loans \bowtie_{Loans.SID=Student.SID} Student))$

    b. $\pi_{BID,Title}(Book) \cap \pi_{StudentID,BookID}(Loans)$

    c. $\pi_{SID}(\sigma_{Rating>3}(Student \bowtie_{Student.SID=Loans.SID} Loans \bowtie_{Loans.BID=Book.BID} Book))$

2. The library wants to send warning emails to students who have kept the book for more than four months. These emails also include student names, book titles. Write down **the SQL statement** and **the relational algebra expression** that allow the library to obtain the information from the tables.

3. Write a SQL statement to get the number of books borrowed by each student.

4. Write a SQL statement to get the total number of books with ratings higher than 3.

## Part II: Normalisation

1. The relation below stores information about students, accommodation and personal tutor. Assume that each room in the dormitory building can host more than one student. Attribute "EmailType" can either be staff or student.
    a. Identify the Primary Key for the relation.
    b. Determine all functional dependencies.
    c. From these dependencies, identify which are partial (if any) and which transitive (if any).
    d. Normalise it to 3NF (*)

| ElectricityBill | StudentName | RoomNo | Email | StudentID | TutorName | EmailType |
|---|---|---|---|---|---|---|

2. Normalise the following table "T" into **the 3rd Normal Form**, by clearly describing the normalisation process, i.e. the dependencies removed and how the table is split into sub-tables. For each of the produced sub-tables also describe the functional dependencies.

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|

Attributes (A, B) Forms the primary key. The relation has the following functional dependencies:

A, B -> C, D, E, F, G, H

B -> C

D -> E

E -> A

F -> G, H

## Part III: E/R Diagram

1. Do all E/R Diagram exercises on the slides and lab sheets.
2. The E/R Diagram of your coursework report is a much more realistic exercise where some of the requirements need to be discovered by yourself. You are more likely to encounter this kind of problems in your future.

3. You have been hired by the government of Lukewarm Kingdom to design database for managing data from municipal wastewater treatment stations (WTS). You are asked to develop a database system capable of storing the information about wastewater treatment stations, staffs that inspect the running of these stations as well as station managers.
    - A WTS can either be run by the government or a company.
    - Each WTS is associated with a district of the city and has an address.
    - A company can run multiple WTSs.
    - Each company has its own address.
    - WTSs that are owned by the government are run at the city level. Thus, they are managed by the corresponding city government.
    - Each city government is associated with a contact address.
    - A WTS Inspector has a list of WTSs that he will visit each month.
    - Each inspector has his ID card and is registered with a unique phone number.
    - Some information is not specified directly, you may add them if necessary.

    i. Draw the E/R diagram for this database.
    ii. Write down the SQL script necessary to create the database. Minor syntax errors are tolerated.