DBMS I — Homework 6

December 7, 2007

The purpose of this homework is for you to review the different notions introduced in Chapter 7. They are

- When is an instance r of a relation schema R satisfy a FD?
- When is an instance r of a relation schema R legal?
- What is a closure of a set of an attributes (given a set of FDs Σ)?
- What could be a key (superkey) of a relation schema R given a set of FDs of R?

Let $R(A, B, C, D)$ be a relation schema with the following set of FDs

$$\{AB \to C,\ CB \to D\}$$

Answer the following questions:

1. Let r be the instance (or table)

A	B	C	D
1	2	3	1
1	3	4	1
1	2	4	1
2	2	3	1

   Show that r is not a legal instance of R? Justify your answer.
   Consider these rows (1, 2, 3, 1) and (1, 2, 4, 1), the values in A and B are equal but the values in C is not so r is not a legal instance.

2. Supposed that we know that the instance r was a manual copy of a legal instance of R. Question 1 suggests that the copying was at fault. Suppose also that we know that the original table consists of four rows. Find *a minimal number of changes* that you need to make to the instance r in order to restore its legitimacy (i.e., the changes made to r create a new instance r' which is a legal instance of R). Your answer should be given in the following form:

   ```
   Row Z, change value of the attribute K from X to Y
   ...
   ```

   or

   ```
   Delete row
   ```

Each of the above changes will be counted as **one** change. Provide justifications for your proposed changes.

Note: Be careful in answering the question as it asks for *a minimal number of changes*. Also, because of the original instance has four rows, you cannot delete any row.
There are many solutions:
1. Row 1, change value of the attribute B from 2 to 1
or
2. Row 3, change value of the attribute B from 2 to 1
After the change, the FD $BC \rightarrow D$ will still be satisfied because D only has one value, 1. The FD $AB \rightarrow C$ will be satisfied because there is no rows in the table that has the same value for A and B. These solutions has minimal number of changes(only one).

3. Compute the closure of AB and CD. (or what are AB^+ and CD^+)

   We have AB $\rightarrow$ C so C $\in AB^+$, BC $\rightarrow$ D so D $\in AB^+$.
   Hence $AB^+ = \{A, B, C, D\}$
   $CD^+ = \{C, D\}$

4. Find two superkeys of R. We have $AB^+ = \{A, B, C, D\} = R$ so AB is a superkey.
   $ABCD \rightarrow ABCD$ so ABCD is also a superkey.

5. Find one key of R. We have AB is a superkey.
   $A^+ = \{A\} \neq R, B^+ = \{B\} \neq R$ so AB is a minimum superkey.
   Hence AB is a key of R.