Exercise Sheet 10: Normalization

(until Thursday 10.01.2013)

Please note that you need **50%** of all exercise points to receive the "Studienleistung". Exercises have to be turned in until **Thursday** of each respective week and must be completed in teams of two students each. You may hand in your solutions either on paper **before the lecture** or into the mailbox at the IFIS floor (Informatikzentrum 2nd floor). Please do not forget to write your "Matrikelnummer" and your tutorial group number on your solutions. Your solutions may be in German or English. Please note: To pass the "RDB 1 Modul" you need both the exercise points and the exam!

Exercise 10.1 (3 points)

a. What is a lossless decomposition? Please explain in your own words. (1 point)
b. Given a relation schema with one single relation $R(A, B, C, D)$ and a functional dependency $B \rightarrow CD$. Apply Heath's theorem to decompose R into two relations R_1 and R_2 using the given functional dependency. (2 points)

Exercise 10.2 (5 points)

Given a relation $R(A, B, C, D, E)$ as well as some data:

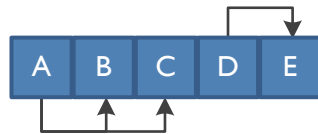| A	B	C	D	E
1	4	4	3	2
4	1	2	1	2
2	5	5	4	3
1	4	2	1	2
2	5	4	3	2
4	1	4	3	2
3	4	3	3	3

a. Find at least 3 independent, non-trivial functional dependencies that do not conflict with the given data (3 points)
b. Can you be sure, if the functional dependencies found in the previous exercise are the "real" functional dependencies, defined on the schema? Explain your answer. (2 point)
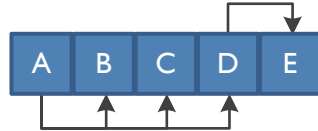
Exercise 10.3 (8 points)

a. What kind of modification anomalies can occur in non-normalized relation schemas? (3 points)
b. Can a violation of the first normal form be detected using functional dependencies? Explain your answer. (1 point)

c. Given following schemata. Which normal form is violated in the according schema? What exactly causes the violation? (4 points)

   i.

   ii.

Exercise 10.3 (8 points)

Given a Schema with one single relation $R(A, B, C, D, E)$ and a set of functional dependencies $F = \{BC \rightarrow DC, B \rightarrow E, D \rightarrow EF, \cancel{FC \rightarrow E}, C \rightarrow A, \cancel{F \rightarrow E}\}$

a. Find a minimal equivalent set of dependencies to F (2 points)
b. Normalize the schema into BCNF. Use Heath's theorem to split up the given relation and note the functional dependency used for each step. Intermediate results should include a normalized schema in 2NF(but not in 3NF) and 3NF~~(but not in BCNF)~~. (6 points)
   Hint: The functional dependency used to decompose the relation may also be part of F^+.

Merry Christmas