1DV013 – Database Theory

Theoretical Assignment 2 (40 p)

Deadline: October 5, 2014

1 Relations

Consider the relation $(PersonID, Language, ComputerLanguage)$ with the multivalued dependency $PersonID \twoheadrightarrow Language$ and the following set of tuples:

PersonID	Language	ComputerLanguage
5006	Greek	C
5007	Latin	Visual Basic
5007	Greek	Pascal

Is this an instance of the relation given above? If not, what tuples need to be added in order to make this an instance of the relation? Explain why!

2 Functional and multivalued dependencies

1. Consider the following relation: *(PersonID, Language, ComputerLanguage)* with the multivalued dependency $PersonID \twoheadrightarrow Language$. Which MVD(s) can be derived?

2. Give examples of trivial functional dependencies and trivial multivalued functional dependencies. Show the main difference between them.

3. Why every functional dependency is a multivalued function dependency? Show an example.

4. Consider the following functional dependencies: $A \rightarrow D, BD \rightarrow E, AC \rightarrow E, DE \rightarrow B$. Compute the closure of the left side of each functional dependency.

3 Normal forms

1. What are anomalies in database schema design? Give examples.

2. Consider the relation R: (A, B, C, D) with its functional dependencies $A \rightarrow C$, $A \rightarrow D$, and $CD \rightarrow B$ and those that can be derived. Is the relation in BCNF?

3. Consider the following relation R: (<u>A</u>, <u>B</u>, C, D) and its functional dependencies $B \rightarrow C$, $B \rightarrow D$. Is this relation in BCNF? If not, decompose it into BCNF.

4. Consider the relation R: (<u>A</u>, B, C, D) with its MVDs $A \twoheadrightarrow CD$, $B \twoheadrightarrow CD$. Is this relation in 4NF? If not, decompose it into 4NF.

5. Consider the following relation R: ($\underline{A}$, $\underline{B}$, $\underline{C}$, $\underline{D}$) and its MVDs $A \twoheadrightarrow B$, $A \twoheadrightarrow C$. Is this relation in 4NF? If not, decompose it into 4NF.

6. Consider the relation R: ($\underline{A}$, B, C, D) with its multivalued dependencies $A \twoheadrightarrow BC$ and $D \twoheadrightarrow ABC$ and those that can be derived. Is the relation in NF4?

All answers should be explained sufficiently! Note: primary keys, if any, are denoted by underlining.

4 Schemata comparison

Consider the following two schemata:

Schema 1: R(A,B,C,D)

Schema 2: R1(A,B,C), R2(B,D)

1. Consider Schema 1 and assume that the only functional dependencies are $A \rightarrow B$, $C \rightarrow D$, and those possibly derived from these ones. Is Schema 1 in BCNF?

2. Consider Schema 2 and assume that the only functional dependencies are $A \rightarrow B$, $A \rightarrow C$, $B \rightarrow A$, $A \rightarrow D$, and those derived from these ones. Is Schema 2 in BCNF?

3. Consider Schema 1 and assume that the only functional dependencies and multivalued dependencies are $A \rightarrow BD$, $D \rightarrow C$, $C \twoheadrightarrow AB$, and $B \twoheadrightarrow D$, and those derived from these ones. Is Schema 1 in NF4 ?

All answers should be explained sufficiently!

5 E/R to relational schema translation

Solve the following exercise (Exercise 4.6.1, page 171, in the DBCB book (2nd edition) as well as in the FCDB book (3rd edition)): convert the E/R diagram of Fig. 1 to a relational database schema, using each of the following approaches:

1. The straight-E/R method.
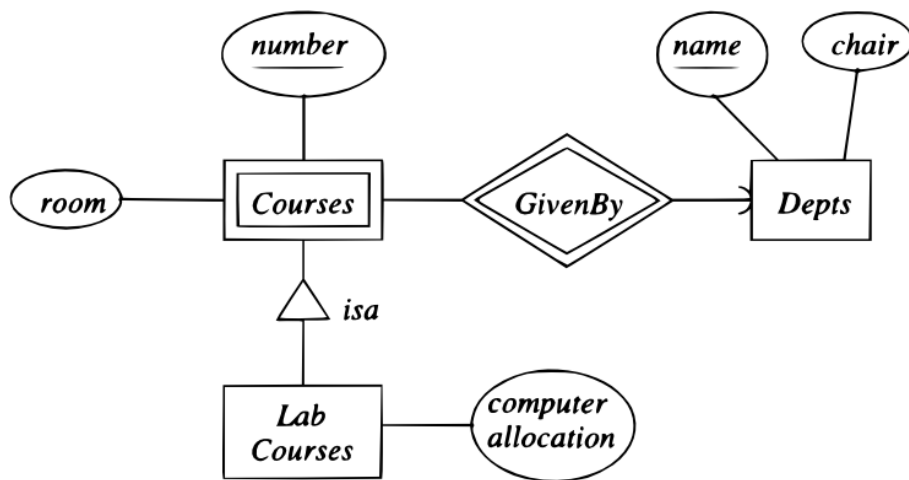
2. The object-oriented method.

3. The nulls method.

Figure 1: E/R diagram for Exercise 5

Hand in a single PDF document with the answers. Assignment must be submitted via the Moodle submission system. Email submission attempts will be ignored.