Exercises *Databases*
Session 3: normal forms

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Exercise 15

Prove that every relation scheme consisting of only two attributes is in BCNF.

Exercise 16

Give an argument for the claim that the BCNF-decomposition algorithm (slide FD 33) always returns lossless decompositions.

Exercise 17

We have the relational scheme $S(ABCDEFG)$ and an FD-set
$F_S = \{A \rightarrow BCD, ADE \rightarrow CF, E \rightarrow G, G \rightarrow AB\}$
Determine a minimal cover for F_S.

Exercise 18

Look again at exercise 17. Give a lossless 3NF/DP decomposition of S.

Exercise 19

Give an argument for the claim that the 3NF-algorithm returns DP decompositions.

Exercise 20

Suppose we have a relation
ANIMAL (lname, species, food, continent).
Lname stands for the latin name to identify each species.
Food contains the type of food the species eats, like seeds, nuts, insects, fish, meat, leaves and so on. Finally, we keep track on which continents the species occur.
Identify FDs and MVDs. Which assumption do you make identifying the MVD? Bring Animal into 4NF.

Exercise 21

A variation on ER-modeling deals with the notion of *multivalued attributes* related to entities. As an example: an attribute *email-adress* or *phone-number* related to an entity *person* could very well be regarded multivalued instead of single valued. Explain how this concept relates to the notions of MVD and 4NF.

Exercise 22

It has been claimed that MVD's occur very rarely in practice. Do you agree?

Exercise 23(!)

When we reduce left sides, strictly spoken we want to check whether
$F \equiv F - \{\alpha \to \beta\} \cup \{\alpha' \to \beta\}$, for some $\alpha' \subset \alpha$.
In words: F^+ remains the same when we replace $\alpha \to \beta$ with $\alpha' \to \beta$.
However, the test we really do is checking whether $\alpha' \to \beta$ can be derived from F. Explain why this is sufficient.

Exercise 24(!)

Prove the following *theorem:*
Suppose we have a scheme $R(XYZ)$.
$X \twoheadrightarrow Y \Leftrightarrow$ the decomposition $R_1(XY), R_2(XZ)$ is lossless