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Theory I, Sheet 12

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- The solutions should be submitted in English.
- JUST FOR FUN exercises are not mandatory.
- Your solutions should be delivered to the lockbox in building 051 floor 00, or right before the start of the tutorial (23rd July 2012, 4:00 p.m.).
- You are allowed to discuss your solutions with each other. Nevertheless, you are required to write down the answers in your own words.

**Exercise 12.1 - Domain-independency and safety of formulas in relational calculus**

Which of the following formulas are safe? Which are domain-independent? If they are not domain-independent, give domains, which result in different query-answers. Translate the safe formulas to relational algebra.

- (a)  $\{X, Y | \exists Z. (S(X, Z) \wedge \exists W. T(W, X, Y)) \wedge X = Y\}$   
 (b)  $\{X, Y | (X = a \vee \exists Z. R(Y, Z)) \wedge S(Y)\}$   
 (c)  $\{X, Y | (X = a \vee \exists Z. R(Y, Z)) \wedge S(Y) \wedge T(X)\}$   
 (d)  $\{X | \forall Y. R(Y) \Rightarrow S(X, Y)\}$

**Exercise 12.2 - Armstrong Axioms**

By using Armstrong axioms  $\{A1, A2, A3\}$  derive the following axioms:

- (A6) **Decomposition**  $X \rightarrow Y, Z \subseteq Y \Rightarrow X \rightarrow Z$   
 (A7) **Reflexivity**  $X \rightarrow X$   
 (A8) **Accumulation**  $X \rightarrow YZ, Z \rightarrow AW \Rightarrow X \rightarrow YZA$

**Exercise 12.3 - BCNF 3NF**

JUST FOR FUN. For the given relation schemata and FDs

- (a)  $R(A, B, C, D)$  with  $\mathcal{F} = \{AB \rightarrow C, C \rightarrow D, D \rightarrow A\}$   
 (b)  $R(A, B, C, D)$  with  $\mathcal{F} = \{B \rightarrow C, B \rightarrow D\}$   
 (c)  $R(A, B, C, D)$  with  $\mathcal{F} = \{AB \rightarrow C, C \rightarrow D, BC \rightarrow D\}$

complete the following tasks:

- Give the violation FDs for BCNF
- Decompose  $R$  to sub-relations, so that each of them is in BCNF
- Give the violation FDs for 3NF
- Decompose  $R$  to sub-relations, so that each of them is in 3NF