Database Management Systems

(COP 5725)

Fall 2021

Instructor: Dr. Markus Schneider

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Homework 4

Name:	
UFID:	
Email Address:	

Pledge (Must be signed according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

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Signature

For scoring use only:

	Maximum	Received
Exercise 1	30	
Exercise 2	25	
Exercise 3	35	
Exercise 4	10	
Total	100	

Exercise 1 [30 points]

1. [5 points] Use the Armstrong axioms to prove the soundness of the Union rule. If $A \rightarrow B$ and $A \rightarrow C$ holds, then $A \rightarrow BC$ holds.
2. [4 points, 2 points each] Given the set F = {A→B, AB→C, AC→BD} of functional dependencies, prove the following dependencies by using the Armstrong axioms.

   (1) A→ABC
   (2) AD→BCD
3. [6 points] Consider a relation schema R(X, Y, Z) with the functional dependencies XY→Z and Z→X. Can we conclude that Y→XZ holds? If yes, please argue why. If no, please argue why not by giving a counterexample.
4. [5 points] Consider the relation schema R(A, B, C, D, E, F) and the set of functional dependencies F = {A→B, A→C, CD→E, CD→F, B→E}. Infer at least five new FDs by using five different Armstrong's axioms and derived inference rules. (Please do not include the trivial ones such as A→A in your answer.) Show each step.
5. [10 points] Assume we have a set F = {A→B, C→D} of functional dependencies for a relation schema R(A, B, C, D). Write down all the functional dependencies of the closure F^+ of F and count them.

Exercise 2 [25 points]

1. [5 points] Consider the relation schema R = (A, B, C, D, E, F, G, H) with the set of functional dependencies K = {A→B, B→G, AC→D, DF→E, FG→BH}. Show for each of the following FDs whether they can be inferred from K.
   - ABD→ACE
   - BFG→BEFG
   - ABF→ABDG
   - CEG→BCEF
2. [5 points] Consider the relation schema R(A, B, C, D, E, F, G, H) with functional dependencies F = {A→C, AC→E, D→EH, F→G} and G = {A→BCE, AD→CFG, D→A, DE→GH, F→D}. Are the two sets F and G equivalent? Show each step.
3. [5 points] Consider the relation schema R(A, B, C, D, E, F) with the functional dependencies K = {A→B, BD→E, AC→F, DE→C}. Which of the following attribute sets is a key? Show each step.
   - ABCE
   - ABDF
   - BEF
   - ACDE
4. [10 points] Consider the relation schema R(A, B, C, D, E, F) with the set of functional dependencies F = {A→BC, CD→E, B→D, E→A}. By using the algorithm for calculating the attribute closure provided in the lecture slides, calculate the closure of the following attributes.
   - AD
   - ACE

Exercise 3 [35 points]

1. [15 points] Find a minimal cover for the relation R(A, B, C, D, E, F, G) with the set K = {A→B, C→A, BD→E, ADE→B, E→F} of functional dependencies. Show each step.
2. [10 points] Find a standard form of minimal cover for the relation R(A, B, C, D, E, F, G, H) with the set K = {A→BC, B→CE, A→E, AC→H, D→B} of functional dependencies. Show each step.
3. [10 points] Find a minimal cover for the relation R(A, B, C, D, E, F) with the set K = {A→D, AC→DE, B→F, D→CE} of functional dependencies. Show each step.

Exercise 4 [10 points]

1. [5 points] Consider the relation schema R(A, B, C, D, E, F, G, H, I) with the set of functional dependencies K = {B→G, A→D, DE→F, G→BD}. List all candidate keys of R in a systematic manner (do not use Armstrong's Axioms) and explain how you determine them. Show each step.
2. [5 points] Consider the relation schema R(A, B, C, D, E, F, G, H) with the set of functional dependencies K = {A→B, B→DE, F→H, G→CE}. Determine all candidate keys of R in a systematic manner (do not use the Armstrong's Axioms) and explain how you determine them. Show each step.