**CS3431-A22 Wong**

**Assignment 5**

**Due Date:** F 10/7 at 11:59pm. No late submissions because solutions will be posted immediately after the

deadline.

**Teams:** The project is to be done in the same team as your project team. Each team member is

expected to work on at least one BCNF decomposition and one 3NF decomposition.

Decomposition is very tricky! The highest grades in this assignment are usually accomplished by

teams where each member does the entire assignment and solutions are compared.

**Note: students who do not contribute to the assignment will receive a zero grade.**

**Submission:** Upload your typed Word or PDF document to Canvas using the Assignment 5 button. Include

all team members’ names at the top of the document.

For attribute closures and relational schemas, list the attributes in alphabetical order for grading purposes. For example, instead of AE+ = AED, please write AE+ = ADE. And instead of R1(D, B, A), write R1(A, B, D).

**Problem 1 (50 Points)**

For the relational schema given below and its corresponding functional dependencies (FDs):

R(A, B, C, D, E) S = { AB → D,   AB → E, BC → D, C → A, CD → B } answer the following questions:

1. (10 points) Find all candidate keys of the relation through an exhaustive set of attribute closures. Specify when an attribute set closure is trivial, or a super key – just enter “super”.
2. (5 points) Find the FDs in order that they appear in S that violate BCNF.
3. (15 Points) Decompose the relations to satisfy BCNF using the **right-most** FD violation. For example, if C 🡪 A and CD 🡪 B are in BCNF but the other FDs are in violation, you would use BC 🡪 D for the decomposition. Specify which FD is used to make the decomposition. If there is a multi-step decomposition, then indicate each step along with which FD is used for the decomposition.
4. (10 points) Calculate the minimal basis, S’, for R. Sort the FDs in order alphabetically by the left side. As an example, { D 🡪 C, DE 🡪 B, A 🡪 E } would become { A 🡪 E, D 🡪 C, DE 🡪 B }.
5. (5 points) Using S’ instead of S for the rest of this problem, find the FDs in order that they appear in S’ that violate 3NF.
6. (5 points) Decompose R into 3NF.

**Problem 2 (50 Points)**

Given a relation R(A, B, C, D, E) with functional dependencies S = { BE 🡪 A, CD 🡪 E, AD 🡪 C }

1. (10 points) Find all candidate keys of the relation through an exhaustive set of attribute closures. Specify when an attribute set closure is trivial, or a super key – just enter “super”.
2. (5 points) Find the FDs in order that they appear in S that violate BCNF.
3. (15 Points) Decompose the relations to satisfy BCNF using the **left-most** FD violation. For example, if BE 🡪 A is in BCNF but the other FDs are in violation, you would use CD 🡪 E for the decomposition. Specify which FD is used to make the decomposition. If there is a multi-step decomposition, then indicate each step along with which FD is used for the decomposition.
4. (10 points) Calculate the minimal basis, S’, for R. Sort the FDs in order alphabetically by the left side. As an example, { D 🡪 C, DE 🡪 B, A 🡪 E } would become { A 🡪 E, D 🡪 C, DE 🡪 B }.
5. (10 points) If S’ is not in 3NF, decompose the relation R to satisfy 3NF. Otherwise state that S’ is in 3NF and why.