The assignment is to be turned in before Midnight (by 11:59pm) on January 28th. You should turn in the solutions to this assignment as a PDF file through Canvas. The solutions should be produced using editing software programs, such as LaTeX or Word, otherwise they will not be graded. The assignment should be done in groups of two students. Each group must submit only one file that contains the full name, OSU email, and ONID of every member of the group.

1: BCNF and 3NF (2 points)

Consider a relation R with five attributes A, B, C, D, and E. You are given the following functional dependencies: A → B, BC→E, and ED→A.

(a) List all keys for R. (1 point)

(b) Is R in BCNF? If it is not, decompose it into a collection of BCNF relations. (0.5 point)

(c) Is R in 3NF? If it is not, convert it into a collection of 3NF relations. (0.5 point)

2: BCNF and 3NF (1.5 points)

Consider the relation schema R with attributes A, B, C, and D and the following functional dependencies: AB→C, AC→B, B→D, BC→A.

(a) List all keys for R. (0.5 point)

(b) Is R in BCNF? If it is not, decompose it into a collection of BCNF relations. (0.5 point)

(g) Is R in 3NF? If it is not, convert it into a collection of 3NF relations. (0.5 point)

3: FD Implication & Schema Decomposition (1 point)

(a) Given that X, Y, W, Z are attributes in a relation, using the Armstrong's axioms, prove that if we have $X \rightarrow Y$ and $YW \rightarrow Z$, then $XW \rightarrow Z$. (0.25 point)

(b) Given that X, Y, Z are attributes in a relation, using the Armstrong's axioms, prove that if we have $X \rightarrow Y$ and $X \rightarrow Z$, then $X \rightarrow YZ$. (0.25 point)

(c) Prove that, if relation R has only one simple key, it is in BCNF if and only if it is in 3NF. (0.5 point)

3: Information preservation (0.5 point)

(a) Suppose you are given a relation R(A,B,C,D) with functional dependencies B→C and D→A. State whether the decomposition of R to S_1(B,C) and S_2(A,D) is lossless or dependency preserving and briefly explain why or why not. (0.5 point)