Spring 2016, CS122A, UC Irvine, Quiz 8, Prof. Chen Li

Student ID:____________________ **Name:**__________________________ **Score (out of 16):**______________

Let the relation R(A, B, C, D, E) have a functional dependency set F={A->B, B->C, CD->E}.

1. Suppose we decompose R into R1(A, B, C) and R2(C, D, E)
   a. Compute the local dependencies in F_{R1} and F_{R2}.

      F_{R1} = {A->B, B->C}

      F_{R2} = {CD->E}

   b. What's the strongest normal form of R1 and R2 respectively?

      The strongest normal form of R1 is 2NF (R1 violates 3NF due to transitivity, ie, A->B and B->C imply A->C) and R2 is BCNF (since there is only one dependency CD->E)

   c. Is this decomposition lossless join?

      No, since the R1 ∩ R2 = C but C is a key for neither R1 nor R2

   d. Is this decomposition dependency preserving?

      Yes (it is easy to check that $(F_{R1} \cup F_{R2})^+ = F^+$)

2. Suppose we decompose R into R3(A, B, C, D), R2(C, D, E).
   a. Compute the local dependencies in F_{R3} and F_{R2}.

      F_{R3} = {A->B, B->C}

      F_{R2} = {CD->E}

   b. What's the strongest normal form of R3 and R2 respectively?

      The strongest normal form of R3 is potentially 1NF (R3 violates 2NF due to A->B but A is a proper subset of the key {A,D}) and R2 is BCNF (since there is only one dependency CD->E)

   c. Is this decomposition lossless join?

      Yes, since the R3 ∩ R2 = {C, D} and {C, D} is a key for R2

   d. Is this decomposition dependency preserving?

      Yes (it is easy to check that $(F_{R3} \cup F_{R2})^+ = F^+$)

Let relation R(A, B, C, D, E) have a functional dependency set F={A->B, B->C, CD->E} (same as before).

3. Suppose we decompose R into R4(A, B), R5(B, C), R2(C, D, E).
   a. Compute the local dependencies in F_{R4}, F_{R5} and F_{R2}.

      F_{R4} = {A->B}

      F_{R5} = {B->C}

      F_{R2} = {CD->E}

   b. What's the strongest normal form of R4, R5, and R2 respectively?

      The strongest normal form of R4 is BCNF (since there is only one dependency A->B), R5 is BCNF (since there is only one dependency B->C), R2 is BCNF (since there is only one dependency CD->E)

   c. Is this decomposition lossless join?

      No, since the R5 ∩ R2 = C but C is a key for neither R5 nor R2

   d. Is this decomposition dependency preserving?

      Yes (it is easy to check that $(F_{R3} \cup F_{R2})^{+} = F^{+}$)

4. Suppose we decompose R into R6(A, B, D), R7(A, C, D, E).
   a. Compute the local dependencies in F_{R6} and F_{R7}.

      F_{R6} = {A->B}

      F_{R7} = {A->C, CD->E}

   b. What's the strongest normal form of R6 and R7 respectively?

      The strongest normal form of R6 is potentially 1NF (since {A, D} is the set of prime attributes and we have A->B which is a 2NF violation), R7 is potentially 1NF (since {A, D} is the set of prime attributes and we have A->C which is a 2NF violation)

   c. Is this decomposition lossless join?

      Yes, since the R6 ∩ R7 = {A, D} and {A, D} is a key for R6 (and R7)

   d. Is this decomposition dependency preserving?

      No (it is easy to check that $(F_{R6} \cup F_{R7})^{+} \neq F^{+}$ by noting that the dependency B->C is missing in $(F_{R6} \cup F_{R7})^{+}$ whereas B->C is present in F^{+})