Homework 3

Due date: Thursday, Feb 14, in class.

Problem 1

Consider relation $R(A, B, C, D, E, F)$. For each set of FDs shown below, perform the following actions:

(a) Determine all keys and identify all prime and non-prime attributes.

(b) Determine if $R$ is in 2NF, 3NF, BCNF. Explain all violations of these normal forms.

(c) If $R$ is NOT in 3NF, decompose $R$ into 3NF-compliant relations.

1. $B, C \rightarrow D, E$
   1. $A, E \rightarrow C$
      $F, B \rightarrow A$
      $A \rightarrow B$
   2. $A \rightarrow C$
      $A, D \rightarrow F, E$
      $A, B, C \rightarrow D, E, F$
   3. $D, F \rightarrow C, A$
      $D, C \rightarrow B$
      $F, A \rightarrow C$
   4. $C \rightarrow B, D$
      $A, B \rightarrow E$
      $A, B \rightarrow C$
      $A, C \rightarrow D$
   5. $B, C \rightarrow E$
      $C, D, E \rightarrow F$
Problem 2

Consider the relation Stocks(B,O,I,S,Q,D) with attributes describing Broker, Office of the broker, Investor, Stock, Quantity owned by investor and Dividend of the stock. The following FDs are asserted:

\[ S \rightarrow D \]
\[ I \rightarrow B \]
\[ I, S \rightarrow Q \]
\[ B \rightarrow O \]

1. Find all the keys for Stocks. List all prime and non-prime attributes.
2. Describe all violations of 3NF.
3. Decompose Stocks into a 3NF-compliant database schema.

Problem 3

Consider a relational table \(R(A, B, C, D, E, F)\). For each collection of FDs, find the closure of the following sets of attributes:

(a) \(\{A\}\)  (b) \(\{D\}\)  (c) \(\{B, C\}\)  (d) \(\{A, D, F\}\)

1. \(A, E \rightarrow C\)
   \(B, C, D, E \rightarrow A\)
   \(F, D, C \rightarrow B, A\)

2. \(A, D, C \rightarrow C, E\)
   \(B, D, F \rightarrow A, E\)
   \(A, B, C \rightarrow D, E, F\)

3. \(D, F \rightarrow C, A\)
   \(D, C \rightarrow B\)
   \(A \rightarrow C\)
   \(C \rightarrow B, D\)

4. \(B, D \rightarrow E\)
   \(E, F \rightarrow A\)
   \(E, B \rightarrow F\)

Problem 4 [Extra Credit] Exercise 3.2.4, page 84 (textbook, 3d Ed.; Ex. 3.5.4, p. 101 in 2nd Ed.).