Homework 3

Due date: Wednesday, February 17, 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. $D, E \rightarrow B, C$
2. $A, C \rightarrow E$
   $A \rightarrow F, B$
   $B \rightarrow A$
3. $B \rightarrow C$
   $B, F \rightarrow D, E$
   $A, B, E \rightarrow B, D, F$
4. $A, B \rightarrow E$
   $A, C \rightarrow B$
5. $B, C \rightarrow D$
   $B, D, E \rightarrow F$
\[ A, B, E \rightarrow D, E \]
\[ A, B, D \rightarrow D, C \]
\[ A, B, C \rightarrow C, F \]
\[ A, B, F \rightarrow E, F \]

Problem 2

Consider the relation \textbf{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 \textbf{Stocks}. List all prime and non-prime attributes.

2. Describe all violations of 3NF.

3. Decompose \textbf{Stocks} into a 3NF-compliant database schema.

Problem 3

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

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

\[ A \rightarrow D, E \]

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. \[ B, D \rightarrow E \]
\[ E, F \rightarrow A \]
\[ E, B \rightarrow F \]