Homework 3

Due date: Thursday, May 7, 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. $D, E \rightarrow B, C$
   $A, C \rightarrow E$
   $A \rightarrow F, B$
   $B \rightarrow A$

2. $B \rightarrow C$
   $B, F \rightarrow D, E$
   $A, B, E \rightarrow B, D, F$

3. $B, F \rightarrow C, A$
   $B, C \rightarrow D$
   $C, A \rightarrow F$

4. $F \rightarrow B, E$
   $A, B \rightarrow D$
   $A, C \rightarrow B$
   $A, B \rightarrow E$

5. $B, C \rightarrow D$
   $B, D, E \rightarrow F$
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:

\begin{align*}
S & \rightarrow D \\
I & \rightarrow B \\
I, S & \rightarrow Q \\
B & \rightarrow O
\end{align*}

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:

\begin{align*}
(a) & \ \{B\} \\
(b) & \ \{A, D\} \\
(c) & \ \{C, E\} \\
(d) & \ \{A, B, F\}
\end{align*}

\begin{align*}
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
\end{align*}