University of Toronto
CSC343

In-class Exercises: Functional Dependencies

Suppose we have a relation R with attributes $ABCD$

1. **What an FD means.** Suppose the functional dependency $BC \rightarrow D$ holds in R. Create an instance of R that violates this FD.

2. **Equivalent sets of FDs.**

   (a) Are the sets $A \rightarrow BC$ and $A \rightarrow B, A \rightarrow C$ equivalent? If yes, explain why. If no, construct an instance of R that satisfies one set of FDs but not the other.

   (b) Are the sets $PQ \rightarrow R$ and $P \rightarrow R, Q \rightarrow R$ equivalent? If yes, explain why. If no, construct an instance of R that satisfies one set of FDs but not the other.

   (c) Are the sets $PQ \rightarrow R$ and $P \rightarrow Q, P \rightarrow R$ equivalent? If yes, explain why. If no, construct an instance of R that satisfies one set of FDs but not the other.

3. **Keys and FDs.**

   (a) We claimed that if a set of attributes K functionally determines all attributes, K must be a superkey (*i.e.*, no two tuples can agree on all attributes in K). Do you believe this? Suppose these FDs hold in R: $A \rightarrow BC$, $C \rightarrow D$. Does A functionally determine all attributes of R? Can two tuples agree on A?

(b) We also said that if K is a superkey (*i.e.*, no two tuples can agree on all attributes in K) K must functionally determine all attributes. Do you believe this? Suppose A is a superkey of R Does A functionally determine all attributes of R?

4. **Does an FD follow from a set of FDs?** Suppose we have a relation on attributes $ABCDEF$ with these FDs:

$$AC \to F, CEF \to B, C \to D, DC \to A$$

(a) Does it follow that $C \to F$?

(b) Does it follow that $ACD \to B$?

5. **Projecting a set of FDs onto a subset of the attributes.** Suppose we have a relation on attributes $ABCDE$ with these FDs:

$$A \to C, \quad C \to E, \quad E \to BD$$

(a) Project the FDs onto attributes ABC.

(b) Project the FDs onto attributes ADE.