CS 353 Spring 2017
Homework 5
Due: 24 April, Monday till 17:00

Q.1 [16 pts, 4 pts each] Given the relation schema R(A, B, C, D, E) with the set of functional dependencies F = {AB → C, BC → D, A → B, D → E}. Check whether each of the following functional dependencies is implied by F or not.

(a) A → D
(b) B → D
(c) AB → ED
(d) AC → DEB

Q.2 [12 pts] Given the relation schema R(A, B, C, D, E), show that the following two functional dependency sets on R are not equivalent:
F1 = {A → B, B → D, C → D, D → E}, F2 = {A → BD, B → A, C → DE}

Q.3 [15 pts, 5 pts each] Given the relation schema R(A, B, C, D, E, F) with the following set of functional dependencies: {A → B, AC → DE, D → F}.

(a) Find the candidate key(s) of R.
(b) Give all the functional dependencies that violate BCNF, and justify your answer.
(c) Give all the functional dependencies that violate 3NF, and justify your answer.

Q.4 [15 pts, 5 pts each] Consider a relation R(A, B, C, D, E, F) and a set of functional dependencies {AC → D, E → F} that hold on R.
Decompose R into two relations R1 and R2, such that the decomposition is:

(a) Dependency-preserving and lossless-join.
(b) Dependency-preserving but not lossless-join.
(c) Neither dependency-preserving nor lossless-join.

Explain each case in detail.

Q.5 [10 pts, 5 pts each] Given two relation schemas: R(A, B) with functional dependency A → B, and S(B, C) with functional dependency B → C.

(a) State whether (R ⋈ S) is in 3NF or not, and why.
(b) State whether (R ⋈ S) is in BCNF or not, and why.

Q.6 [16 pts, 4 pts each] Given a relation R (A, B, C, D, E) with the set of functional dependencies {A → D, B → C, CD → E, A → BC and E → B}.

(a) Show that this relation is not in BCNF.
(b) Decompose R into BCNF relations.
(c) Is your decomposition dependency preserving? Explain your answer.
(d) Is relation R in 3NF? Explain your answer.

Q.7 [16 pts] Given the relation schema R(X, Y, Z, W) with the functional dependency set
F = { X → Y, XY → Z, X → WZ, Y → W, WX → Z }.
Find a canonical cover of Fc of F.