Lab 3 - TDDD37

by *Martin Gustafsson and Axel Gard*

Task 1:

Consider the relation schema R(A, B, C, D, E, F) and the following three FDs:
FD1: {A} → {B,C}
FD2: {C} → {A,D}
FD3: {D,E} → {F}
Use the Armstrong rules to derive each of the following two FDs. In both cases, describe the derivation process step by step (i.e., which rule did you apply to which FDs).

a) {C} → {B}
{C} → {A, D} [FD2]
{C} → {A} [Decomposition]
{C} → {B, C} [Transitivity with FD1]
{C} → {B} [Decomposition]

b) {A,E} → {F}
{D,E} → {F} [FD3]
{A, E, D} → {A, F} [Augmentation with A]
{C, E} → {A, F} [Pseudo-transitivity with FD2]
{B, C, E} → {A, B, F} [Augmentation with B]
{A, E} → {A, B, F} [Pseudo-transitivity with FD1]
{A, E} → {B, F} [Decomposition]
{A, E} → {F} [Decomposition]

Task 2:

For the aforementioned relation schema with its functional dependencies, compute the attribute closure X+ for each of the following two sets of attributes.
a) X = { A }
X+ = {A, B, C, D}

b) X = { C, E }
X+ = {A, B, C, D, E

Task 3:

Consider the relation schema R(A, B, C, D, E, F) with the following FDs
FD1: {A,B} → {C,D,E,F}
FD2: {E} → {F}
FD3: {D} → {B}
a) Determine the candidate key(s) for R.
X = {A,B} => X+ = {A, B, C, D, E, F} (candidate key)
X = {A} => X+ = {A}
X = {B} => X+ = {B}
X = {A, E} => X+ = {A, E, F}
X = {A, D} => X+ = {A, B, C, D, E, F} (candidate key)
X = {D} => X+ = {D, B}

Candidate keys are:
{A, B} and {A, D}

b) Note that R is not in BCNF. Which FD(s) violate the BCNF condition?
FD2: Because if X = {E} then X+ = {E, F} which is not R therefore X is not a superkey
FD3: Because if X = {D} then X+ = {D, B} which is not R therefore X is not a superkey

c) Decompose R into a set of BCNF relations, and describe the process step by step (don't forget to determine the FDs and the candidate key(s) for all of the relation schemas along the way

Decompose on FD2:
R1(E, F) with FD2

- {E} is a candidate key so R1 is in BCNF

R2(A, B, C, D, E) with FD3, FD4 = {A,B} → {C,D,E}

- X = {D} then X+ = {D, B} which is not R therefore X is not a superkey so R2 is not in BCNF.

Decompose on FD3:
R3(B, D) with FD3

- {D} is a candidate key so R3 is in BCNF

R4(A, C, D, E) with FD5 = {A} → {C,D,E}

- {A} is a candidate key so R4 is in BCNF

So the new relations are:
R1(E, F)
R3(B, D)
R4(A, C, D, E)

Task 4:

Consider the relation schema R(A, B, C, D, E) with the following FDs
FD1: {A,B,C} → {D,E}
FD2: {B,C,D} → {A,E}
FD3: {C} → {D}

a) Show that R is not in BCNF.
X = {C} then X+ = {C, D} which is not R therefore X is not a superkey so R is not in BCNF.

b) Decompose R into a set of BCNF relations (describe the process step by step).

Decompose on FD3:
R1(C, D) with FD3

- {C} is a candidate key so R1 is in BCNF

R2(A, B, C, E) with:

- FD4: {A,B,C} → {E}
- X = {A, B, C} then X+={A, B, C, E} so {A, B, C} is a candidate key as no smaller superkeys exist.