**Database Technology**

Assignment – 3

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**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} b) {A, E} → {F}

Answer 1: a.) {C} → {B}

FD4: C → A Decomposition rule of FD2

FD5: C → B, C Transitivity Rule on FD4 & FD1

FD6: C → B Decomposition Rule of FD5

Answer 1: b.) {A, E} → {F}

FD4: C → D Decomposition rule of FD2

FD5: C, E → D, E Augmentation rule of FD4 and E

FD6: C, E → F Transitivity rule of FD5 and FD3

FD7: A, E → B, C, E Augmentation rule of FD1 and E

FD8: A, E → C, E Decomposition rule of FD7

FD9: A, E → F Transitivity rule of FD8 and FD6

**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} b) X = {C, E}

Answer 2: a.)

X+ = {A}

X+ = {A, B, C} from FD1

X+ = {A, B, C, D} from FD2

Answer 2: b.)

X+ = {C, E}

X+ = {C, A, D, E} from FD2

X+ = {C, A, D, E, F} from FD3

X+ = {A, B, C, D, E, F} from FD1

**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.

b) Note that R is not in BCNF. Which FD(s) violate the BCNF condition?

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 the relation schemas along the way).

Answer 3: a.) A is not on the right-hand side, so A must be a part of the candidate key.

{A, B} + = {A, B, C, D, E, F}

{A, D} + = {A, D, B}

= {A, D, B, C, E, F}

{A, E} + = {A, E, F}

Here by, I conclude that {A, B} and {A, D} is the candidate key for this relation.

Answer 3: b.)

Both FD2 and FD3 are violating the BCNF condition

E → F and D → B do not contain all the attributes in R, and which do not have any mentioned candidate key on the left-hand side.

Answer 3: c.)

\*\*\*Decompose R using FD2

R1(E, F) with FD2 candidate Key is E

R2(A, B, C, D, E, F) with FD3 and new FD4: A, B → C, D, E derived from decomposition of the FD1

So, candidate key is A, B.

R1 is BCNF but R2 is not in BCNF because of FD3

\*\*\* Decompose R2 using FD3

R3(D, B) with FD3 with a Candidate key D

R4 (A, C, D, E) with new function dependency FD5: A, D → C, E where the Candidate key is A, D.

FD5 is derived from Augmentation rule of FD3 with A

A, D → A, B

Then Transitivity rule of FD3 and FD4.

A, D → C, D, E

Finally, it is followed by the decomposition rule

A, D → C, E

Now, Both R3 and R4 are in BCNF.

Hence, the result of normalizing R consists of R1, R3, and R4 – {E, F}, {D,B} and {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.

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

by step)

Answer 4: a.)

In this relation B, C does not occur on the right-hand side of the any FD’s. where E does not occur on the left-hand side of the FD’s. This proves that {B, C} is a candidate key for this relation.

{B, C} + = {B, C, D, A, E}

Answer 4: b.)

R1{C, D} with FD3 Candidate key is {C}

R2{A, B, C, E} with a new FD’s are mentioned below

FD4: {A, B, C} → {E} from decomposition of FD1

FD5: {B, C} → {A, E} from augmentation of FD3 with BC and

transitivity of the resulting FD with FD2

Candidate key is {B, C}

Both R1 and R2 are in BCNF.

Hence, the result of normalizing R consists of R1, R2 – {C, D} and {A, B, C, E}