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Lab 7

1. (6 points) A given relation R={A, B, C, D, E} is decomposed into three relations: R1={A, B, C}, R2={B, C, D}, and R3={A, C, E}
   1. Based on the given set of FDs F={B->E, CE->A}, is the above decomposition a lossless-join decomposition?

R1 interset R2 = {BC}

Closure of {BC} = {ABCE}

R1 is contained in {ABCE}. R1 U R2 is Lossless.

R1 U R2 {ABCD} intersect R3 = {AC}

Closure of {AC} = {AC}

Neither R1 U R2 nor R3 is contained within {AC} - (R1 U R2) U R3 is Lossy.

R2 interset R3 = {C}

Closure of {C} = {C}

Neither R2 nor R3 is contained within {C}. R2 U R3 is Lossy.

R1 intersect R3 = {AC}

Closure of {AC} = {AC}

Neither R1 nor R3 is contained within {AC}. R1 U R3 is Lossy.

**None of the Unions can reach the original relation without losing something. Therefore this is a LOSSY decompisition.**

* 1. Based on the given set of FDs F={AC->E, BC->D }, is the above decomposition a lossless-join decomposition?

R1 interset R2 = {BC}

Closure of {CB} = {BCD}

R2 is contained within {BCD}. R1 U R2 is Lossless.

R1 U R2 {ABCD} intersect R3 = {AC}

Closure of {AC} = {ACE}

R3 is contained within {ACE}. (R1 U R2) U R3 is Lossless.

**We were able to join R1 U R2 and then (R1 U R2) U R3 without losing anything. Therefore this decomposition is LOSSLESS.**

(10 points) A given relation R={A, B, C, D, E}, and a given set of FDs F={AB->C, DE->C, B->D}.

* 1. Is R in BCNF? If not, do the decomposition accordingly.

Closure of {AB} is {ABCD} - AB is not a superkey of R - Therefore **Relation R is Not in BCNF**

Decomposing to achieve BCNF

In terms of A and B - where A is left half of FD and B is right half of same FD

R1 = A U B ----- R2 = R - (A - B)

Using FD, {AB > C}

R1 = {ABC}, R2 = = {ABDE} (ABCDE - C)

**R1 is in BCNF**, as the only FD that apply to it are AB->C and AB is a superkey of R1 since AB+ is ABC.

**R2 is not in BCNF**, since B->D applies to R2 and B is not a superkey of R2 since B+ is BD and not ABDE.

Using FD, {B->D}

R2A = {BD}, R2B = {ABE}

**R2A is in BCNF,** since the only FD that applies to it is B->D, and B is a superkey of R2A.

**R2B is in BNCF,** since none of the FD listed above apply to R2.

For relation R = {ABCDE} and F={AB->C, DE->C, B->D}. Decomposition is below

FINAL ANSWER - **R1 = {ABC}, R2A = {BD}, R2B = {ABE},** This decomposition is in BCNF and Lossless.

* 1. Is your decomposition a lossless-join decomposition? Why?

R1 intersect R2A = {B}

Closure of {B} = {BD}

R2A is contained within {BD}. R1 U R2A {ABCD} is Lossless.

R2B intersect (R1 U R2A) = {AB}

Closure of {AB} = {ABCD}

(R1 U R2A) is contained within {ABCD}. R2B U (R1 U R2A) {ABCDE} is Lossless.

**We were able to join R1 U R2A and then (R1 U R2A) U R2B without losing anything. Therefore this decomposition is LOSSLESS.**

* 1. Is your decomposition a dependency-preserving decomposition? Why?

**This Decomposition is not dependency-preserving.** This is because although the FDs AB->C and B->D are preserved in relations R1 and R2A respectively, the dependency DE->C cannot be represented by any of the relations R1, R2A, R2B, since none of them contain each of C, D, and E.

* 1. List all the candidate keys of relation R.

None of the attributes in R are absent from either sides of any of the functional dependency. In other words there is no Attribute X in R such that X is not contained within one of the FDs of R.

Now we check the right side of the FDs of R where the attribute in the right side does not appear in any of the FDs on the left side..

AB->C, B->D, DE->C.

Since D is on the left side of DE->C, the only option here is C.

The Closure of C = C

C cannot uniquely identify R and is not a candidate key, now we move to the left side of the FDs of R.

We only take from the Left side of FDs of R attributes that are unique to the left side of R.

A, B, and E are our options here, since D is on the right side of B->D.

Closure of A = A. Doesn’t work

Closure of B = BD. Doesn’t Work

Closure of E = E. Doesn’t Work

Now we add these together since no candidate keys have been found.

Closure of AB = ABCD. Doesn’t Work

Closure of AE = AE. Doesn’t Work

Closure of BE = BCDE. Doesn’t Work

Closure of ABE = ABCDE. This Works. This is our Candidate Key.

**The Candidate Key(s) of R are: {ABE}**

* 1. Is R in the 3rdNF? Why?

**R is not in 3rdNF**. 3NF requires that for each FD within the Relation. Either:

* Alpha (left side) of the FD is a super-key of R

Or

* Beta (right side) of the FD is a prime-attribute of R.

A super-key is a set of attributes that uniquely identifies the tuple, A prime-attribute is an attribute that is contained within the candidate key.

For FD = {AB->C, B->D, DE->C}, none of the Alphas are superkeys. AB, B, nor DE uniquely identifies R since none of the Closures of AB, B, or DE contains all the Attributes in R.

For FD = {AB->C, B->D, DE->C}, none of the Betas are prime Attributes, since ABE is the candidate key of R and the only attributes represented by the beta’s are C and D.

**As seen above, R does not satisfy the (Alpha == superkey || Beta == prime Attribute) requirements of 3rdNF. R is not in 3NF.**