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CS442B

11 December 2016

*I pledge my honor that I have abided by the Stevens Honor System.*

Assignment 4

1. Consider a relation R(A, B, C, D, E) with

FD = {AB -> C, CD -> E, C-> A, C -> D, D -> B}

Scratch work:

AB -> {ABCDE}

AC -> {ABCDE} (redundant because of C)

CD -> {ABCDE} (redundant because of C)

AD -> {ABCDE}

C -> {ABCDE}

D -> {BD}

E -> {E}

**Keys:**

AB -> {ABCDE}

AD -> {ABCDE}

C -> {ABDCE}

1. Consider a relation schema R(A, B, C, D, E, F) with

FD = {AB -> C, AD -> B, C -> B, F -> AD, F-> E}

* 1. Use Armstrong’s Axioms to prove F is a superkey of R.

F+ -> {F} (Reflexivity)

F+ -> {ADF} (F-> AD) (given)

F+ -> {ADEF} (F -> E) (given)

F+ -> {ABDEF} (AD -> B) (Transitive)

F+ -> {ABCDEF} (F -> A & F -> B because of Decomposition) (AB -> C) (Transitive)

**F is a superkey of R.**

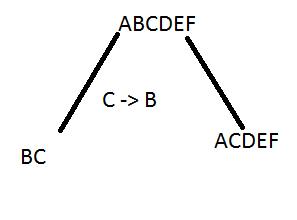
* 1. Construct a BCNF decomposition of R.
     1. Find candidate keys.

|  |  |  |
| --- | --- | --- |
| Left | Middle | Right |
| F | A, B, C, D | E |

**F is a superkey alone.**

* + 1. Decompose the ones that are not a superkey.

AB -> C, AD -> B, and C -> B are all violations. We try to pull them out from ABCDEF.



This leaves us with BC and ACDEF.

* + 1. Is this lossless?

BC intersect ACDEF yields us C, which by the given FD (C -> B) can give us BC back, proves that this BCNF decomposition is lossless, as all BCNF decompositions are by definition.

* + 1. Is this dependency preserving?

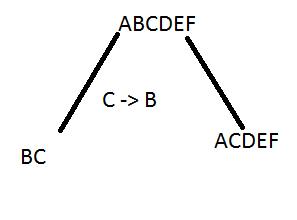
If there exists a given FD that cannot be performed in the decomposed tables without joining them, the decomposition is not dependency preserving. One given FD is (AB -> C). BC cannot do this, as A is not one of its members. ACDEF cannot do this, as B is not one of its members. Without joining these tables, we are unable to preserve this dependency. As such, this BCNF decomposition is lossless, but not dependency preserving.

* 1. Produce a lossless, dependency preserving 3NF decomposition for R.
     1. Find the minimal cover for R.

Minimize the right side: F’ = {F -> A, F -> D, F -> E, AB -> C, C -> B, AD -> B}

The left side cannot be further minimized. None of these FDs are redundant, as such F’ is our minimal cover for R.

* + 1. BCNF Decomposition



We decompose into BC and ACDEF. D = {BC, ACDEF}

* + 1. Identify dependencies N in F’ not preserved

N = {AB -> C, AD -> B}

* + 1. For each X -> A in N, create a relation schema XA and add it to D

D = {BC, ACDEF, ABC, ADB}

With step iv complete, D is now a lossless, dependency preserving 3NF decomposition of scheme R.