CS1555 Recitation 10 Solution

Objective: to practice normalization, finding canonical forms, checking for lossless decompositions.

**Part 1:** For each of the following relations R and sets of functional dependencies F, find the canonical cover (minimal cover) of F.

**1.** Consider the following set of functional dependencies F on a relation R (A, B, C, D, E):

A → BC

A → D

B → C

C → D

DE → C

BC → D

Finding the canonical form:

* Transform all FDs to canonical form (i.e., one attributes on the right):

A → B

A → C

A → D

B → C

C → D

DE → C

BC → D

* Drop extraneous attributes:

B in BC → D is extraneous, since we already have C → D. The set of FDs becomes:

A → B

A → C

A → D

B → C

C → D

DE → C

* Drop redundant FDs:

A → B and B → C implies A → C, so we drop A → C.

A → B, B → C and C → D implies A → D, so we drop A → D.

The set of FDs becomes:

A → B

B → C

C → D

DE → C

which is the canonical cover of F.

**2.** Consider the following set of functional dependencies F on relation R (A, B, C, D, E, H):

A → C

AC → D

E → AD

E → H

A → CD

E → AH

Finding the canonical form:

* Transform all FDs to canonical form (i.e., one attribute on the right):

A → C

AC →D

E → AD becomes E →A and E→D

E → H

A→ CD becomes A→C and A→D

E → AH becomes E→A and E→H

* Remove redundant dependencies:

A → C

AC → D

E → A

E → D

E → H

A → D

* Drop extraneous attributes:

AC→D can be removed because we have A→D so C is redundant:

A → C

E → A

E → D

E → H

A → D

* Drop redundant FDs:

Try removing some dependencies in F and still have a set of dependencies equivalent to F.

E→D can be deduced from E→A and A→D so we can remove E→D.

The set of FDs becomes:

A→C

E→A

E→H

A→D

which is the canonical cover of F.

**Part 2:** Assume that R is decomposed into:

R1 (A, B), F1 = {A → B}

R2 (B, C), F2 = {B → C}

R3 (C, D, E), F3 = {C → D, DE → C)

Is this decomposition a lossless-join decomposition? Use the table method.

Checking for lossless-join:

Initially the Table looks like this:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E |
| R1(A,B) | a1 | a2 | U13 | U14 | U15 |
| R2(B,C) | U21 | a2 | a3 | U24 | U25 |
| R3(C,D,E) | U31 | U32 | a3 | a4 | a5 |

Using B → C: we can replace U13 by a3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E |
| R1(A,B) | a1 | a2 | **a3** | U14 | U15 |
| R2(B,C) | U21 | a2 | a3 | U24 | U25 |
| R3(C,D,E) | U31 | U32 | a3 | a4 | a5 |

Using C → D: we can replace U14 and U24 by a4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E |
| R1(A,B) | a1 | a2 | **a3** | **a4** | U15 |
| R2(B,C) | U21 | a2 | a3 | **a4** | U25 |
| R3(C,D,E) | U31 | U32 | a3 | a4 | a5 |

We cannot proceed and there is no row of all known values 🡪 the decomposition is lossy.