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CS315 Midsem Quiz

$A1 \rightarrow$ $A \rightarrow B$ $B \rightarrow C$. $C \rightarrow D$ and $D \rightarrow A$

D $\{A\}^+ = \{A, B, C, D\}$
$\{B\}^+ = \{A, B, C, D\}$
$\{C\}^+ = \{A, B, C, D\}$
$\{D\}^+ = \{A, B, C, D\}$.

$R_1(A, B)$

$L(R_1) = \{A, B\}$.

All non trivial FDs from subset of $L(R_1)$ under S (since these include all attributes there is no point in taking AB)

$\cancel{\{R\}^+}$ $A \rightarrow B$
$B \rightarrow A$.

This is also the minimal basis of set S_1 of FDs of R_1 of $R_1(A, B)$

$R_2(B, C)$

$L(R_2) = \{B, C\}$

All non trivial FDs from subset of $L(R_2)$ under S

$B \rightarrow C$
$C \rightarrow B$.

This is also the minimal basis of set S_2 of FDs of $R_2(B, C$

$R_3(C, D)$

$L(R_3) = \{C, D\}$

All non trivial FDs from subset of $L(R_3)$ under S

$C \rightarrow D$
$D \rightarrow C$

This is also the minimal basis of set S_3 of FDs of $R_3(C, D)$

2) We take the union of FDs of $S_1; S_2, S_3$

$S_1 \cup S_2 \cup S_3 = \{A \to B, B \to A, B \to C, C \to B, C \to D, D \to C\}$ A, E)

We need to check if $S_1 \cup S_2 \cup S_3$ imply S.

~~$~~ we can see from $S_1 \cup S_2 \cup S_3$

$\cancel{\{A\}^+ = \{A, B, C}, \{A\}^+ = \{B\}^+ = \{C\}^+ = \{D\}^+ = \{A, B, C, D\}$ in the closure.

Thus all $\{A, B, C, D\}$ are contained

Therefore $S_1 \cup S_2 \cup S_3$ implies S.

Therefore the decomposition is dependency preserving

$3 = C_1 =$

$= d$

A2 → $R(A, B, C, D, E)$

S = set of FDs

$A \to C$ $B \to C$ $C \to D$ $DE \to C$ $CE \to A$

$R_1(A, D)$ $R_2(A, B)$ $R_3(B, E)$ $R_4(C, D, E)$ $R_5(A, E)$

We use chain test

let $t = (a, b, c, d, e)$ be a tuple in the schema $R(A, B, C, D, E)$

Tableau Obtained →

	A	B	C	D	E
t_1 →	a	b_1	c_1	d	e_1
t_2 →	a	b	c_2	d_1	e_2
t_3 →	a_1	b	c_3	d_2	e
t_4 →	a_2	b_2	c	d	e
t_5 →	a	b_3	c_4	d_3	e

Using $A \to C$ $c_1 = c_2 = c_4$ $B \to C$ $c_2 = c_3 = c_1 = c_4$

	A	B	C	D	E
t_1	a	b_1	c_1	d	e_1
t_2	a	b	c_1	d_1	e_2
t_3	a_1	b	c_1	d_2	e
t_4	a_2	b_2	c	d	e
t_5	a_2	b_3	c_1	d_3	e

Using ~~[illegible]~~ ~~[illegible]~~ $C \to D$ $d_1 = d_2 = d_3 = d$

	A	B	C	D	E
t_1	a	b_1	c_1	d	e_1
t_2	a	b	c_1	d	e_2
t_3	a_1	b	c_1	d	e
t_4	a_2	b_2	c	d	e
t_5	a	b_3	c_1	d	e

Using $DE \to C$ $\boxed{c_1 = c}$ and $CE \to A$ $a_1 = a_2$

	A	B	C	D	E
t_1	a	b_1	c	d	e_1
t_2	a	b	c	d	e_2
t_3	a	b	c	d	e
t_4	a	b_2	c	d	e
t_5	a	b_3	c	d	e

The tuple $t_3 = (a, b, c, d, e)$ is the 3rd row of the tableau.

This proves losless decomposition.

A3 → R(A, B, C, D)

Set S of FDs.

A → C BC → A CD → B.

Phase I

1) → Closure of $\{A\}^+$ under $S' = S - \{A \to C\}$

$\{A\}^+ = \{A\}$

So A → C is not implied, hence not redudanct.

2) Check FD BC → A Using only A → C, CD → B

$\{B, C\}^+ = \{B, C\}$

BC → A is not implied, hence not redundant

3) Check FD CD → B, Using only A → C, BC → A

$\{C, D\}^+ = \{C, D\}$

CD → B is not implied, not redundant

Phase II check

Given FD set S, is the LHS of every FD minimal.

To check for FDs BC → A and CD → B.

check for BC → A

1) if B can be removed from BC → A

$\{C\}^+ = \{C\}$ under S ⇒ does not imply C → A.

2) if C can be removed from BC → A

$\{B\}^+ = \{B\}$ under S ⇒ does not imply B → A.

check for CD → B

(i) if C can be removed from CD → B.

$\{D\}^+ = \{D\}$ under S ⇒ does not imply C → B

D(A, B, C, D)

(1) if D can be removed from $CD \to B$

$\{C\}^+ = \{C\}$ under S $\Rightarrow$ does not imply $D \to B$.

Hence S is a minimal basis.

$\boxed{A \to C \quad , \quad BC \to A \quad , \quad CD \to B}$

2) R(A, B, C, D)

$\{A\}^+ = \{A, C\}$ $\quad$ $\{A, B\}^+ = \{A, B, C\}$ $\quad$ $\{A, C\}^+ = \{A, C\}$

$\{B\}^+ = \{B\}$ $\quad$ $\{B, C\}^+ = \{A, B, C\}$ $\quad$ $\{B, D\}^+ = \{B, D\}$

$\{C\}^+ = \{C\}$ $\quad$ $\{C, D\}^+ = \{B, C, D\}$

$\{D\} = \{D\}$ $\quad$ $\{D, A\}^+ = \{A, B, C, D\}$

$\{A, B, C\}^+ = \{A, B, C\}$

$\{B, C, D\}^+ = \{A, B, C, D\}$

Therefore we observe the keys for R(A, B, C, D) under the set of FDs S are $\{A, D\}$, $\{B, C, D\}$.

3) 3NF decomposition

Since S is a minimal basis, decomposing S into

$R_1(A, C)$ $\quad$ $R_2(A, B, C)$ $\quad$ $R_3(B, C, D)$.

Also $R_3(B, C, D)$ contains $\{B, C, D\}$ whose schema is a key for R.

$\Rightarrow$ Final 3NF decomposition.

$R_1(A, C)$ $\quad$ $R_2(A, B, C)$ $\quad$ $R_3(B, C, D)$

A 3)

4) $R(A, B, C, D)$

$BC \to A$.

we ~~can~~ break $R(A, B, C, D)$

into $R_3(B, C, D)$ and $R_x(A, B, D)$ (using BCNF decomposition)

Consider $R_x(A, C, D)$

$A \to C$

(using BCNF decomposition)

we decompose $R_x(A, C, D)$

into $R_1(A, C)$ $R_2(C, D)$.

Therefore obtained relations using BCNF are

$R_1(A, C)$ $R_2(A, B, C)$ $R_3(B, C, D)$

This is the same as that obtained using BCNF decomposition.

BCNF decomposition.

Therefore (B) is BCNF decomposition .

A4 →

CIATRSG

CI → A　　AC → I　　ATI → R　　ATS → R

ATR → C　　ATC → R　　CS → G

1) $\{C, I, T\}^+ = \{C, I, T, A, R\}$

$\{A, T, I\}^+ = \{A, T, I, R, C\}$

$\{A, T, S\}^+ = \{A, T, S, R, C, G, I\}$

2) We can see from 1) that $\{A, T, S\}^+ = \{C, I, A, T, R, S, G\}$

Therefore it is a key for the schema

Also $\{I, C, S, T\}^+ = \{C, I, A, T, R, S, G\}$

Therefore 2 keys exist for the given schema