Name Quevedo

In Class Assignment

1. Consider the relation R(A,B,C,D,E,F) with F={A->B,B->C,C->D,F->E,F->A} and the following decomposition D={R1(A,B,C),R2(C,D,E,F)}
   a. *(7 points)* Is the decomposition D lossless? Show your work

$R1 \cap R2 = C$ $\quad C \to AB$ no $\quad C^+ = CD$

$R1 - R2 = AB$ $\quad$ or

or $R2 - R1 = DEF$ $\quad C \to DEF$ no

D is not loss less join (lossy)

   b. *(6 points)* Are the relations in D BCNF? Show your work

R1(A,B,C) $\{A \to B, B \to C\}$ candidate key = A $\quad A^+ = ABC$

R1 is not in BCNF

R2(C,D,E,F) $\{C \to D, F \to E\}$ candidate key = CF

R2 is not in BCNF because C is not a super key

   c. *(8 points)* Are the functional dependencies preserved in D? show your work

$A \to B$ is preserved in R1

$B \to C$ is preserved in R1

$C \to D$ is preserved in R2 $\quad$ D is not

$F \to E$ is preserved in R2 $\quad$ a dependency

$F \to A$? (see next page) no $\quad$ preserving decomp.

2. Consider the relation R(A,B,C,D,E,F) with F={C->B,B->AD,C->D,F->E,F->A} and the following decomposition D={R1(A,B,C),R2(C,D), R3(A,E,F)}
   a. *(7 points)* Is the decomposition D lossless? Show your work

$R4 = R1 \bowtie R2$ $\quad R4(A,B,C,D)$

$R1 \cap R2 = C$ $\quad C^+ = CBDA$

$C \to R1 - R2 = AB$? yes

$C \to R2 - R1$ (not needed) $\quad \{R1, R2\}$ is loss less

$R(A,B,C,D,E,F) = R4 \bowtie R3$

$R4 \cap R3 = A$ $\quad A^+ = A$

$A \to R4 - R3 = BCD$

$A \to R3 - R4 = EF$ $\quad$ D is a lossy decomposition

lossy

   b. *(6 points)* Are the relations in D BCNF? Show your work

R1(A,B,C) $\{C \to B, B \to A\}$ candidate key = C

R2(C,D) $\{C \to D\}$ cand. key = C

R3(A,E,F) $\{F \to E, F \to A\}$ cand. key = F

$B \to AD$

$B \to A$

$B \to D$?

R1 is not in BCNF

R2 is in BCNF

R3 is in BCNF

   c. *(8 points)* Are the functional dependencies preserved in D? show your work

$C \to B$ and $B \to A$ are preserved in R1

$C \to D$ is preserved in R2

$F \to E$ and $F \to A$ are preserved in R3

$B \to D$? no $\quad$ D is not dependency preserving

(see next page)

$F \to A$
$X \to Y$

$F \to A$?

$$w := F$$

$$w := w \cup ((w \cap R_i)^+ \cap R_i)$$

$$w := F \cup ((F \cap ABC)^+ \cap ABC) = F$$

$$w := F \cup ((F \cap CDEF)^+ \cap CDEF) = CDEF$$

$$F^+ = FAEBCD$$

$$w := CDEF \cup ((CDEF \cap ABC)^+ \cap ABC) = CDEF$$

$$C^+ = CD$$

$$w := CDEF \cup ((CDEF \cap CDEF)^+ \cap CDEF) = CDEF$$

$A \notin w \quad A \not\subseteq CDEF$

then, $F \to A$ is not preserved

$B \to D$?

$w := B$

$w := w \cup ((w \cap Ri)^+ \cap Ri)$

$w := B \cup ((B \cap ABC)^+ \cap ABC) = AB$

$B^+ = BAD$

$w := AB \cup ((AB \cap CD)^+ \cap CD) = AB$

$w := AB \cup ((AB \cap AEF)^+ \cap AEF) = AB$

$A^+ = A$

$w := AB \cup ((AB \cap ABC)^+ \cap ABC) = AB$

$w := AD$

$w := AB$

$B \to D$ is not preserved because D is not in AB

$R(B, A, H, L, C, At)$

$F = \{B \to AH, L \to BAt\}$

candidate Key = LC

R is currently a 1NF relation

$R(B, A, H, L, C, At)$

$R1(B, L, C, At)$

$F1 = \{L \to BAt\}$

candidate key = LC

$R2(B, A, H)$

$F2 = \{B \to AH\}$

Candidate Key = B

R2 is in BCNF because B is a super key

$R3(L, C)$

$F3 = \{\}$

candidate Key = LC

R3 is BCNF

$R4(L, B, At)$

$F4 = \{L \to BAt\}$

candidate key = L

R4 is in BCNF

$D = \{R2(B, A, H), R3(L, C), R4(L, B, At)\}$

$F4 = \{L \to BAt\}$

$F2 = \{D \to AH\}$

$F3 = \{\}$

Example

$F = \{B \to CD,\ AD \to E,\ B \to A\}$

$G = \{B \to CDE,\ B \to ABC,\ AD \to E\}$

Show that F is a cover of G.

$F \models B \to CDE$? yes $B^+ = BCDAE$

$F \models B \to ABC$? yes

$F \models AD \to E$? yes $AD \to E$ is in F

$\therefore$ F is a cover of G

Is G a cover of F ?

$G \models B \to CD$? yes $B^+ = BCDEA$

$G \models AD \to E$? yes $AD \to E$ in G

$G \models B \to A$? yes

G is a cover of F

therefore G and F are equivalent

$G \equiv F$

Example Given $F = \{A \to BC, B \to C, A \to B, AB \to C\}$ Find F_{min}

$F \equiv \{A \to B, \cancel{A \to C}, B \to C, \cancel{A \to B}, \cancel{AB \to C}\}$

$AB \to AC \to C$

$F_{min} = \{A \to B, B \to C\}$

Example:

$F = \{A \to AC, B \to ABC, D \to ABC\}$

Find F_{min}

$F \equiv \{\cancel{A \to A}, A \to C, B \to A, \cancel{B \to B}, \cancel{B \to C}, \cancel{D \to A}, D \to B, \cancel{D \to C}\}$

$F_{min} = \{A \to C, B \to A, D \to B\}$

Example:

$F = \{AB \to C, A \to B, A \to C, AC \to D\}$

Find F_{min}

$F \equiv \{\cancel{AB \to C}, A \to B, A \to C, AC \to D\}$

$F_{min} = \{A \to B, A \to C, A \to D\}$

Example

Normalize to 3NF

$$I \quad Cno \quad C \quad T$$

$$R(\text{Instructor}, \text{Class\_no}, \text{Classroom}, \text{Text})$$

$$F = \{ \{\text{class\_no}\} \rightarrow \{\text{classroom}, \text{Text}\} \}$$

$$R(I, Cno, C, T)$$

$$F = \{ Cno \rightarrow CT \}$$

steps

(1) Candidate key $Cno\,I$

R is in 1NF

compute Fmin

(2) $F_{min} = \{ Cno \rightarrow C, Cno \rightarrow T \}$

(3) $R1(Cno, C, T)$

(4) $R2(Cno, I)$

$$D = \{ R1(Cno, C, T), R2(Cno, I) \}$$

$$F1 = \{ Cno \rightarrow C, Cno \rightarrow T \} \qquad F2 = \{ \}$$

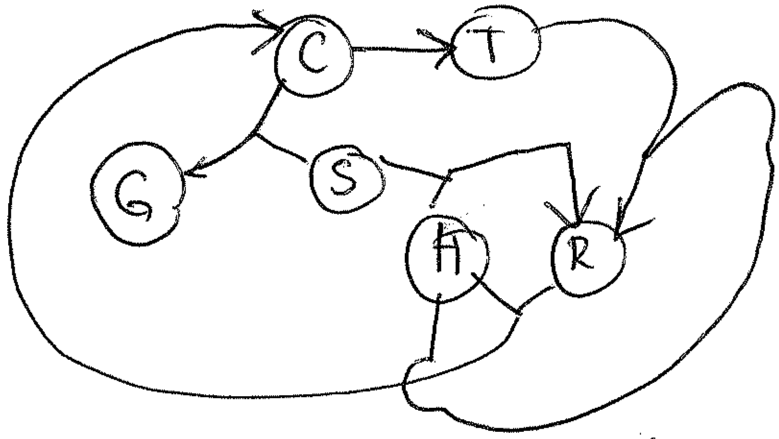
~~Decom~~ Relations in D are in BCNF

Example: Find 3NF decomposition

$$R = CTHRSG$$

$$F = \{ C \rightarrow T, CS \rightarrow G, HR \rightarrow C, HS \rightarrow R, HT \rightarrow R \}$$

(1) Find candidate keys



$V_{0i} = \{G\}$

$V_{ni} = \{H, S\}$

$(HS)^+ = HSRCTG$

HS is the only candidate key

(2) Find $F_{min} = F$

(3) and (4)

D = { R1(C,T), R2(C,S,G), R3(H,R,C), R4(H,S,R), R5(H,T,R) }