

A3 (a)

7

R(IJ K L M N O P)

FDs = $\{M \rightarrow IJL, J \rightarrow LI, JN \rightarrow KM, M \rightarrow J, KLN \rightarrow M, K \rightarrow IJL, IJ \rightarrow K\}$

①

~~$M \rightarrow I$~~

$M \rightarrow J$

~~$M \rightarrow L$~~

~~$J \rightarrow L$~~

~~$J \rightarrow I$~~

~~$JN \rightarrow K$~~

~~$JN \rightarrow M$~~

~~$M \rightarrow J$~~

~~$KLN \rightarrow M$~~

$K \rightarrow I$

$K \rightarrow J$

$K \rightarrow L$

~~$IJ \rightarrow K$~~

②

$J^+ = JLIK$

$N^+ = N$

$K^+ = KIJL$

$L^+ = L$

$I^+ = I$

③

M^+ w/o $M \rightarrow I = MJLI$ has I

M^+ w/o $M \rightarrow J = ML$ has no J

M^+ w/o $M \rightarrow L = MJL$ has L

J^+ w/o $J \rightarrow L = JIKL$ has L

J^+ w/o $J \rightarrow I = JKI$ has I

J^+ w/o $J \rightarrow K = J$ has no K

JN^+ w/o $JN \rightarrow M = JNKM$ has M

KN^+ w/o $KN \rightarrow M = KNIL$ has no M

K^+ w/o $K \rightarrow I = KJL$ has no I

K^+ w/o $K \rightarrow J = KIL$ has no J

K^+ w/o $K \rightarrow L = KIJ$ has no L

a) attr's in each LHS in alphabetical order:

attr's in each RHS in alphabetical order:

entire set of FDs in alphabetical order:

$\{J \rightarrow K, K \rightarrow I, K \rightarrow J, K \rightarrow L, KN \rightarrow M, M \rightarrow J\}$

$R(IJKLMNOP)$

A3 1b)

FDs = $\{J \rightarrow K, K \rightarrow IJL, KN \rightarrow M, M \rightarrow J\}$

N/A and/ L	M	R
N	J	I
O	K	L
P	M	

$NOP^+ = NOP$: not key

$NOPJ^+ = NOPJKILM$: key

$NOPK^+ = NOPKIJLM$: key

$NOPM^+ = NOPMJKIL$: key

b) keys: $NOPJ, NOPK, NOPM$

minimal basis FDs = $\{J \rightarrow K, K \rightarrow IJL, KN \rightarrow M, M \rightarrow J\}$

A3 1c)

~~$R_1(JK)$~~

$R_2(KIJL)$

$R_3(KNM)$

$R_4(MJ)$

$R_1(KIJL)$

$R_2(KNM)$

$R_3(MJ)$

+ $R_4(NOPJ)$ (to include a key)

c) 3NF synthesized decomposition of R :

$R_1(KIJL)$

$R_2(KNM)$

$R_3(MJ)$

$R_4(NOPJ)$

8

 $R_1(KIJL)$ Ans 1dFDs that project onto $R_1: \{J \rightarrow K, K \rightarrow IJL\}$ $J^+ = JKIL$ $K^+ = KIJL$ $R_2(KNM)$ FDs that project onto $R_2: \{KN \rightarrow M\}$ $KN^+ = KNM$ $R_3(MJ)$ FDs that project onto $R_3: \{M \rightarrow J\}$ $M^+ = MJ$ $R_4(NOPJ)$ FDs that project onto $R_4: \{\}$

d) the schema (3NF synthesized decomposition of R) does not allow redundancy, because for each of the FDs that project onto each of the relations in the schema, none of them violate BCNF.

$R(DEF GHIJ)$

A3 2a

FDs: $\{C \rightarrow EH, DEI \rightarrow F, F \rightarrow D, EH \rightarrow CJ, J \rightarrow FGI\}$

$C^+ = CEHJFGID$

$DEI^+ = DEIF$: not key $\therefore DEI \rightarrow F$ violates BCNF

$F^+ = FD$: not key $\therefore F \rightarrow D$ violates BCNF

$EH^+ = EHCJFGID$

$J^+ = JFGID$: not key $\therefore J \rightarrow FGI$ violates BCNF

a) $\{DEI \rightarrow F, F \rightarrow D, J \rightarrow FGI\}$ violate BCNF

A3 2b

decomposing R using $DEI \rightarrow F$:

$R_1 = DEI^+ = DEIF = DEFI$

$R_2 = R - (R_1 \text{ except for } DEI) = CDEGHJ$

FDs that project onto R_1 : $\{DEI \rightarrow F, F \rightarrow D\}$

$DEI^+ = DEIF$

$F^+ = FD$: not key $\therefore F \rightarrow D$ violates BCNF

decomposing R_1 using $F \rightarrow D$:

$R_3 = F^+ = FD = DF$

$R_4 = R_1 - (R_3 \text{ except for } F) = EFI$

FDs that project onto R_3 : $\{F \rightarrow D\}$

$F^+ = FD$

FDs that project onto R_4 : $\{\}$

9
FDs that project onto $R_2: \{C \rightarrow EH, EH \rightarrow CJ\}$

$C^+ = CEHJ$: not key $\therefore C \rightarrow EH$ violates BCNF

decomposing R_2 using $C \rightarrow EH$

$$R_5 = C^+ = CEHJ$$

$$R_6 = R_2 - (R_5 \text{ except for } C) = CDGI$$

FDs that project onto $R_5: \{C \rightarrow EH, EH \rightarrow CJ\}$

$$C^+ = CEHJ$$

$$EH^+ = EHCJ$$

FDs that project onto $R_6: \{\}$

\therefore final decomposition =

$R_3(DE)$ with FD: $\{E \rightarrow D\}$

$R_4(EFI)$ with no FDs

$R_5(CEHJ)$ with FDs: $\{C \rightarrow EH, EH \rightarrow CJ\}$

$R_6(CDGI)$ with no FDs
