Example 5

$R(a, b, c, d, E)$

$bEd \to c \quad b \to c \quad ac \to E \quad dE \to a$

Key (bEd) (bda)

$(bda)^+ = \{b, d, a, c, E\}$

I R1: (a, c, E) R2 (b, c) R3 (a, b, d)

II R1 (a, d, E) R2 (b, c) R3 (b, d, E)

Keys : $R(\cancel{a}, b, \cancel{c}, d, \cancel{E})$

$(bd)^+ = \{b, d, c\}$

$(bda)^+ = \{b, d, a, c, E\}$

$(bdE)^+ = \{b, d, E, a, c\}$

$(bdc)^+ = \{b, d, c$

X

Normalize

$R(a, b, c, d, E)$ key (bda) (bdE)

I $ac \to E$

R1$(\underline{a}, \underline{c}, E)$ key (ac) R1 in BCNF

R2(a, c, b, d) key (bda) X

R3 $(\underline{b}, c)$ R3 in 3NF

R4 $(\underline{a}, \underline{b}, \underline{d})$ R4 in 3NF

$R = R1 \bowtie R3 \bowtie R4$

II $\quad b \rightarrow c$

$R1(\underline{b}, c)$ — R1 in BCNF

$R2(a, b, d, E)$ — keys (bda) (bdE)

R2 not in BCNF

$R3(a, \underline{d}, \underline{E})$ — R3 in BCNF

$R4(\underline{b}, \underline{d}, \underline{E})$ — R4 in BCNF

$R = R1 \bowtie R3 \bowtie R4$

III $\quad R1(b, c)$

$R2(a, c, d, E)$ ✗

$R \neq R1 \bowtie R2$

<u>Example</u>: $R(a, b, c, d, E)$

$bE \rightarrow d$, $b \rightarrow E$, $cd \rightarrow a$, $d \rightarrow E$

$(b)^+ = \{b, E, d\}$

$(bc)^+ = \{b, E, d, c, a\}$ — Key (bc)

$bE \rightarrow d \quad b \rightarrow E \quad \Rightarrow \quad b \rightarrow d$

$b \to dE$, $cd \to a$, $d \to E$

I $\quad cd \to a$

R1 (a, $\underline{c}$, $\underline{d}$) ✓

R2 (b, c, d, E) ✗ $\quad$ key (bc)

R3 ($\underline{d}$, E) ✓

R4 (b, c, d) ✗ $\quad$ key (bc)

R5 ($\underline{b}$, d) ✓

R6 ($\underline{b}$, $\underline{c}$) ✓

$R = R1 \bowtie R3 \bowtie R5 \bowtie R6$

II $\quad d \to E$

R1 ($\underline{d}$, E) ✓

R2 (a, $\underline{b}$, $\underline{c}$, d) $\quad$ Key (bc) ✗

R3 ($\underline{b}$, d) ✓

R4 (a, $\underline{b}$, $\underline{c}$) ✓ Key (bc)

$R = R1 \bowtie R3 \bowtie R4$

Question : $R(a, b, c, d)$

$a \rightarrow b$, $c \rightarrow d$ $ad \rightarrow c$ $bc \rightarrow a$

$ad \rightarrow c \rightarrow d$

Does this imply that $a \rightarrow c$?

No