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Roll no: 441

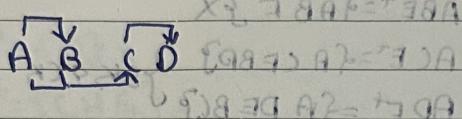
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UGN: OIFE23BCS259

A \rightarrow a a \leftarrow c \rightarrow b b \leftarrow a

✓ ✓ ✓ ✓

✓ ✓

DBMS Assignment + 28 AS-AP-7 (T078A)8 (s)
Q) Find the highest normal form.1) R(ABCD), F = {AB \rightarrow C, C \rightarrow D, A \rightarrow B}x {AB} \rightarrow Cx {C, D} \rightarrow Dx {A, B} \rightarrow B

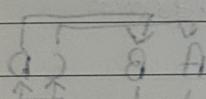
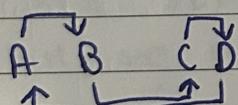
$A^* = \{AB\} \rightarrow SK \& CK$

{AB} is PA

{BCD} is NPA

	AB \rightarrow C	C \rightarrow D	A \rightarrow B
BCNF	✓	x	✓
3NF	x	x	✓
2NF	✓	✓	✓

Hence it is in 2NF

2) R(ABCD), F = {A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow A}

$$\begin{aligned} A^* &= \{ABC\} \\ B^* &= \{ABCD\} \\ C^* &= \{ABCD\} \\ D^* &= \{ABCD\} \end{aligned}$$

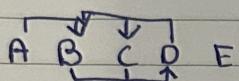
{ABC} is PA
No NPA

x {AB} \rightarrow Cx {BC} \rightarrow Dx {CD} \rightarrow Ax {DA} \rightarrow Bx {AD} \rightarrow Cx {DC} \rightarrow Bx {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow Cx {AC} \rightarrow Dx {CD} \rightarrow Ax {BA} \rightarrow Cx {CB} \rightarrow Dx {DB} \rightarrow Ax {DA} \rightarrow C

$B \rightarrow CNF$ $A \rightarrow B$ $B \rightarrow C$ $C \rightarrow D$ $D \rightarrow A$

\therefore It is in BCNF

3) $R(ABCD)$, $F = \{A \rightarrow B, BC \rightarrow D, D \rightarrow BC, DE \rightarrow \emptyset\}$



$$AE^+ = \{A, E\} \times$$

By default it is in 1NF

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

$$BC^+ = \{B, C, D\} \times$$

$$D^+ = \{D, BC\} \times$$

$$ABE^+ = \{A, B, E\} \times$$

$$ACE^+ = \{A, C, E, B, D\} \quad \text{SK & CK}$$

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

$\therefore \{ACE\}$ are PA $\{B\}$ is NPA

4) $R(ABCD)$, $F = \{A \rightarrow E, B \rightarrow E, A \rightarrow E\}$

\Rightarrow

It cannot be determined

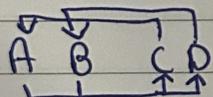
$$A \leftarrow A \quad A \leftarrow B \quad A \leftarrow C \quad A \leftarrow D$$

$$B \leftarrow A \quad B \leftarrow C \quad B \leftarrow D$$

$$C \leftarrow A \quad C \leftarrow B \quad C \leftarrow D$$

$$D \leftarrow A \quad D \leftarrow B \quad D \leftarrow C$$

5) $R(ABCD)$, $F = \{AB \rightarrow CD, C \rightarrow A, D \rightarrow B\}$



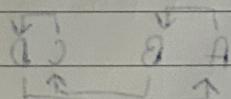
$$A^+ = \{A\} \times$$

$$B^+ = \{B\} \times$$

$$C^+ = \{C\} \times$$

$$D^+ = \{D\} \times$$

$$\{A \leftarrow A, A \leftarrow B, A \leftarrow C, A \leftarrow D\} = \emptyset \quad (\text{NAA})$$



$$AB^+ = \{AB, CD\}$$

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

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

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

$$AC^+ = \{A, C\} \times$$

$$BD^+ = \{B, D\} \times$$

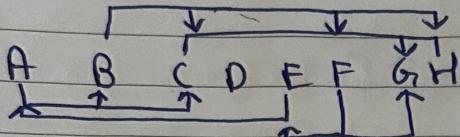
$\{A, B, C, D\}$ are PA

No NPA

$$\begin{cases} \{A \leftarrow A, A \leftarrow B, A \leftarrow C, A \leftarrow D\} = \emptyset \\ \{B \leftarrow A, B \leftarrow C, B \leftarrow D\} = \emptyset \\ \{C \leftarrow A, C \leftarrow B, C \leftarrow D\} = \emptyset \\ \{D \leftarrow A, D \leftarrow B, D \leftarrow C\} = \emptyset \end{cases}$$

BCNF $A \rightarrow CD$ ✓ $C \rightarrow A$ ✗ $D \rightarrow B$ ✗ $(A \rightarrow D) \rightarrow (B \rightarrow C)$ ✗
 3NF $C \rightarrow A$ ✓ $B \rightarrow C$ ✓ $E \rightarrow A$ ✓ $F \rightarrow EG$ ✓
 It is in 3NF form.

6) $R(ABCDEFGH)$ F = { $CH \rightarrow G$, $A \rightarrow BC$, $B \rightarrow CFH$, $E \rightarrow A$, $F \rightarrow EG$ }



$$D^+ = \{D\} \times$$

$$CH^+ = \{CHG\} \times$$

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

$$B^+ = \{BCF\} \times$$

$$E^+ = \{EFG\} \times$$

$$F^+ = \{FGA\} \times$$

$$AD^+ = \{ABCDEFGH\}$$

$$DB^+ = \{ABCDEF\}$$

$$DE^+ = \{ABCD\}$$

$$PF^+ = \{AB\}$$

SK & CK

$\{AD\}$ $\{DB\}$ $\{DE\}$ $\{DF\}$ are P.A

$\{C\}$ $\{G\}$ $\{H\}$ are N.P.A

X ✓ X ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

$CH \rightarrow G$ $A \rightarrow BC$ $B \rightarrow CFH$ $E \rightarrow A$ $F \rightarrow EG$

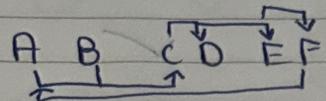
BCNF ✗ ✗ ✗ ✗ ✗ ✗ ✓ ✓ ✓ ✓ ✓

3NF ✗ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

2NF ✓ ✗ ✗ ✗ ✗ ✗ ✗ ✗ ✗ ✗ ✗

\therefore It is 1NF form.

7) R(ABCD, DEF), F = {AB → C, C → DE, E → F, F → A}



$$AB^+ = \{ABCDEF\} \times$$

$$C^+ = \{CDEF\} \times$$

$$E^+ = \{EF\} \times$$

$$F^+ = \{F\} \times$$

$$B^+ = \{B\} \times$$

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

$$D^+ = \{D\} \times$$

$$AC^+ = \{ACDEF\} \times$$

$$AD^+ = \{AD\} \times$$

$$AE^+ = \{AEF\} \times$$

$$AF^+ = \{AF\} \times$$

$$BC^+ = \{BCDEF\} \times$$

$$BD^+ = \{BD\} \times$$

$$BE^+ = \{BEF\} \times$$

$$BF^+ = \{BF\} \times$$

$$\{A, B, C, D, E, F\} = \{A, B, C, D, E, F\}$$

$$CD^+ = \{CDEF\} \times$$

$$CE^+ = \{CEF\} \times$$

$$CF^+ = \{CF\} \times$$

$$EF^+ = \{EF\} \times$$

$$\{A, B, C\} \text{ are PNF}$$

$$\{D, E, F\} \text{ are NNF}$$

$$DE^+ = \{DE\} \times$$

$$DF^+ = \{DF\} \times$$

	$AB \rightarrow C$	$C \rightarrow DE$	$E \rightarrow F$	$F \rightarrow A$	
B(NF)	✓	✗	✗	✗	

	$AB \rightarrow C$	$C \rightarrow DE$	$E \rightarrow F$	$F \rightarrow A$	
3NF	✓	✓	✗	✓	✗

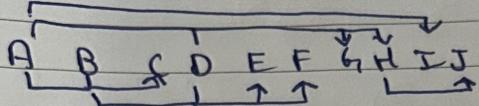
	$AB \rightarrow C$	$C \rightarrow DE$	$E \rightarrow F$	$F \rightarrow A$	
2NF	✓	✗	✗	✗	✗

Hence it is in 2NF form

8) R(ABCDEF GHIJ)

 $F = \{AB \rightarrow C, AD \rightarrow GH, BD \rightarrow EF, A \rightarrow I, H \rightarrow J\}$

Decompose into 3NF

 \Rightarrow  $ABD^t = \{AB, BG, H\} \rightarrow SK \neq CK$ $A^t = \{AI\} \times$ $B^t = \{B\} \times$ $D^t = \{DH\} \times$

{A, B, D} is P.A.

{C, E, F, G, H, I, J} are N.P.A

 $H \rightarrow J \Rightarrow N.P.A \rightarrow N.P.A$, so it is not in 3NF form

2 min