

# CS & IT ENGINEERING

**Database Management System**

**FD's & Normalization**

**DPP – 06**

**Discussion Notes**



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# TOPICS TO BE COVERED

01 Question

02 Discussion



Q.1



Assume a relation  $R(P, Q, R, S, T)$  with the following functional dependencies

$\{PQ \rightarrow RST, P \rightarrow R, Q \rightarrow S\}$ . which of the following decomposition of  $R$  satisfies BCNF?

2nd method

[MCQ]

~~A.~~

$R_1(P, R), R_2(Q, S), R_3(\underline{P}, Q, R, S, T)$  (A)  $R_3(P, Q, R, S, T)$   $\underline{P} \rightarrow R, \underline{Q} \rightarrow S$   <sup>$P \neq Q$</sup>  Not Super key  
Not in BCNF

B.

$R_1(P, R), R_2(Q, S), R_3(\underline{P}, Q, R, T)$  (b)  $P \rightarrow R$ ;  $P$  is Not Super key  $\therefore$  Not in BCNF

C.

$R_1(P, R), R_2(Q, S), R_3(\underline{P}, Q, S, T)$  (c)  $Q \rightarrow S$ ;  $Q$  is Not Super key  $\therefore$  Not in BCNF

☒ D.

$R_1(\underline{P}, R), R_2(Q, S), R_3(\underline{P}, \underline{Q}, T)$

Ans (D)



## I<sup>st</sup> Method

### BCNF

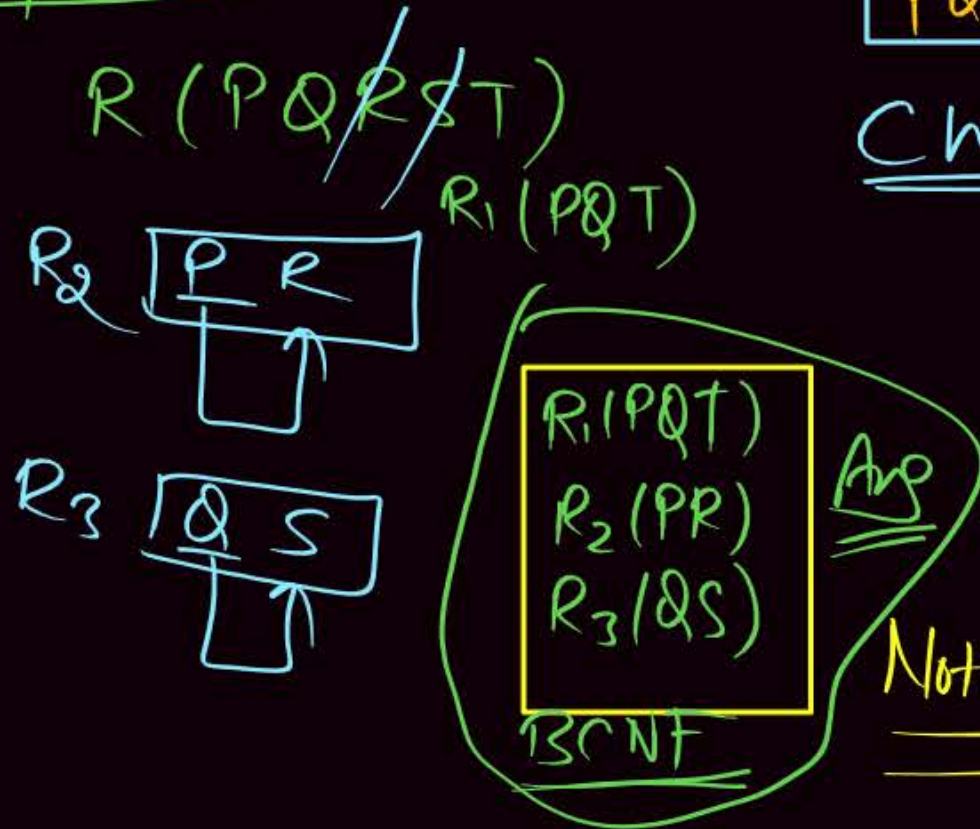
$X \rightarrow Y$  is in BCNF

iff  $X$ : super key.

### BCNF Decomposition

$P \rightarrow R$

$Q \rightarrow S$



$R(PQRST) [PQ \rightarrow RST, P \rightarrow R, Q \rightarrow S]$

$(PQ)^+ = [PQRST]$

$(P)^+ = [PR]$

$(Q)^+ = [QS]$

$PQ$  is Candidate key - (1)

Check BCNF?  $PQ \rightarrow RST$  ✓ BCNF

$P$  Not Super key  $P \rightarrow R$  : Not in BCNF  
 $Q$  Not Super key  $Q \rightarrow S$  : Not in BCNF

every  $X \rightarrow Y$   
Not in BCNF

$X$ : Not super key

BCNF

$X \rightarrow y$

$X$ : Super key



Q.2



Assume a relation  $R = (P, Q, R, S)$  and a set  $F$  of functional dependencies:

$$F = \{P \rightarrow R, R \rightarrow S\}$$

$F = \{P \rightarrow R, R \rightarrow S, S \rightarrow P, S \rightarrow Q, S \rightarrow R\}$ , Highest normal form satisfied by the relation  $R$  is?

[MCQ]

$R(P, Q, R, S)$

$$F: \{P \rightarrow R, S \rightarrow P, S \rightarrow Q, S \rightarrow R\}$$

$$(PR)^+ = \{PRSQ\}$$

$$(P)^+ = \{P\}$$

$$(R)^+ = \{R\}$$

$PR$  is candidate key — (1)

$$(SR)^+ = \{SPQRS\} \begin{cases} S \rightarrow P \\ R \rightarrow P \end{cases} \rightarrow (R)$$

$$(S)^+ = \{SPQR\}$$

$S$  is candidate key — (2)

A.

2NF

B.

3NF

☒ C.

BCNF

D.

1NF

Ans [C].

Q.C.K

(1)  $PR$

(2)  $S$



Q.3



Assume the relation  $R(P, Q, R, S, T)$  with candidate key  $PQ$  is in at least 3NF. which of the following functional dependencies given in option are invalid?

[MCQ]

$R(PQ RST)$  Candidate key =  $PQ$

Prime/Key Attribute =  $\{P, Q\}$

Non Prime/Non Key Attribute =  $\{R, S, T\}$

3NF: every  $X \rightarrow Y$  Non Trivial FD Satisfy.

$X$ : Super key  
(or)

$Y$ : Key/Prime Attribute

Ans (D)

~~A.~~

$PQ \rightarrow R$ ;  $PQ$  Super key  
(Valid)

B.

$ST \rightarrow Q$ ;  $Q$  is Prime/Key Attribute  
(Valid)

C.

$PQ \rightarrow S$ ;  $PQ$  is Super key  
(Valid)

D.

$RS \rightarrow T$

$RS \rightarrow T$

neither

$RS$ : Super key  $RS$ : Not Super key

(nor)

$T$ : Prime/Key Attribute  $T$ : Not Prime/Not Key Attribute.



Q.4

State which of the following statements is/are true?

[MSQ]



A.

Normal forms are used to eliminate or reduce redundancy in database tables.

B.

A relation is in first normal form if every attribute in that relation is singled valued attribute or No Multivalued Attribute.

C.

A relation is in 2NF if every candidate key is simple candidate key.

D.

A relation R is in BCNF, if R is in 3<sup>rd</sup> normal form and for every functional dependency, LHS is super key. A relation is in BCNF iff in every non-trivial functional dependency  $P \rightarrow Q$ , where P is a super key.

Proper Subset of CK  $\rightarrow$  Non Key Attribute violation of 2NF

$X \rightarrow Y$  is in BCNF  
X: Super Key.

Ans (A) (B) (C) & (D)



Q.5

Consider the following relation  $R(P, Q, R, S)$  and functional dependencies  $F$  that hold over the relation

$F = \{P \rightarrow QS, RS \rightarrow Q, R \rightarrow S, Q \rightarrow PS\}$ . The relation  $R$  is in which of the following normal form?

1NF

2NF

3NF

BCNF

$F: (P \rightarrow QS, RS \rightarrow Q, R \rightarrow S, Q \rightarrow PS)$

$(P)^+ = [PQS]$

$(R)^+ = [RSQP]$

$R$  is Candidate Key

If  $X \text{ Attribute} \rightarrow [\text{Prime Attribute}]$

No multiple CK

② CHECK 3NF ?

Not in 3NF

$P \rightarrow QS$

$Q \rightarrow PS$

$Q$  is Not  $RPS$  Non Key Attribute  
Superkey

$X \rightarrow Y$

$X$ : Super key

$Y$ : Key/Prime Attribute

Prime Attribute =  $[R]$  [MSQ]

Non Key Attributes =  $[P, Q, S]$

① CHECK 2NF ?

Proper subset of CK

Non Key Attribute

Violation of 2NF

Candidate key is a Simple CK then

No violation of 2NF

$R$  is in 2NF

Ans (A) & (B)



Q.6



Consider a relation which contains two different true multivalued dependencies then which of the following normal form is violated automatically.

[MCQ]

A.

2NF

B.

3NF

C.

BCNF

☒ D.

4NF

$$\underline{X \twoheadrightarrow Y}$$

x	y	z
x <sub>1</sub>	A/B	C/D

$$\underline{X \twoheadrightarrow Y}$$

$$t_1.x = t_2.x = t_3.x = t_4.x$$

and

$$t_1.y = t_2.y \text{ \& } t_3.y = t_4.y$$

and

$$t_1.z = t_3.z \text{ \& } t_2.z = t_4.z$$

x	y	z
x <sub>1</sub>	A	C
x <sub>1</sub>	A	D
x <sub>1</sub>	B	C
x <sub>1</sub>	B	D

Ans (D)

$X \twoheadrightarrow Y$  exist

If  $t_1.x = t_2.x$  then  $t_1.y = t_2.y$  must be same



Q.7



Assume a relation  $R(P, Q, R, S, T, U)$  with the following dependencies

$$(PQ)^+ = [PQRSTU]$$

PQ is Candidate key

$$(P)^+ = [P] \\ (Q)^+ = [QTR]$$

1.  $PQ \rightarrow RS$

2.  $T \rightarrow R$

3.  $Q \rightarrow TU$

Given the functional dependencies as shown above which among the options shows the decomposition of relation R is normalized to 3NF?

[MCQ]

~~A.~~

$R_1(P, Q, R, S, T, U) R_2(T, R) R_3(Q, T, U)$

~~B.~~

$R_1(P, Q, R, S) R_2(R, T) R_3(T, U, Q)$

~~C.~~

$R_1(P, Q, R, S) R_2(R, T) R_3(Q, T, U)$

D.

$R_1(P, Q, S), R_2(T, R) R_3(Q, T, U)$

Ans(D)

$$\begin{aligned} &\cancel{PQ \rightarrow R} \\ &\checkmark PQ \rightarrow S \\ &\checkmark T \rightarrow R \\ &\checkmark Q \rightarrow T \\ &\checkmark Q \rightarrow U \end{aligned}$$

$$\begin{aligned} (PQ)^+ &= [PQRSTU] \\ (PQ)^+ &= [PQSTUR] \\ (T)^+ &= [T] \\ (Q)^+ &= [QU] \\ (Q)^+ &= [QTR] \end{aligned}$$



$PQ \rightarrow S, T \rightarrow R, Q \rightarrow T, Q \rightarrow U$

$PQ \rightarrow S, T \rightarrow R, Q \rightarrow TU$

$PQ$  is Candidate key

Check 3NF?

$PQ \rightarrow S$  ✓ 3NF

$T \rightarrow R$  X  
 $Q \rightarrow TU$  X }  $\underline{X \rightarrow Y}$

X: Not Super key  
(X)

Y: Not Prime Attribute

3NF Decomposition

$T \rightarrow R$

$Q \rightarrow TU$

$R(PQ \neq S \neq Y)$

$\boxed{TR}$

$\uparrow$

$\boxed{QTU}$

$\uparrow \uparrow$

$R_1(PQS) \rightarrow PQ \rightarrow S$   
 $R_2(TR) \rightarrow T \rightarrow R$   
 $R_3(QU) \rightarrow Q \rightarrow TU$

3NF  
+ Def. preserved  
+ Lossless

$R_1(PQS) R_2(TR) R_3(QU)$

$(T)^+ = (QU)^+$

super key of  $R_3$

$R_1(PQS) \wedge R_{23}(QTUR)$

$(Q)^+ = (QTUR)^+ \text{ since } R_3$

$R_{123}(PQRSTU)$   
Lossless



Q.8



Given the relation 'R' with attributes PQRST with set of functional dependencies  $\{P \rightarrow PQRST, Q \rightarrow R\}$  which of the following is / are true?

$$(P)^+ = \{PQRST\}$$

P is Candidate key

[MCQ]

A.

$R_1(\text{PRST})$   $R_2(\text{QR})$  are both in BCNF and preserves lossless join.

B.

$R_1(\text{PQST})$ ,  $R_2(\text{QR})$  are both in BCNF and preserves lossless join

C.

$R_1(\text{PST})$ ,  $R_2(\text{QR})$  are both in BCNF and preserves lossless join.

D.

None of the above.

check BCNF?

$Q \rightarrow R$  fails BCNF : Q is Not Super key.

BCNF Decomposition

Ans (B)

$Q \rightarrow R$

$R(\text{PQST})$

QR

$R_1(\text{PQST})$

$R_2(\text{QR})$

BCNF

$R_1(\text{PQST}) \cap R_2(\text{QR})$

$(Q)^+ = \{QR\}$

super key of  $R_2$

Lossless



