Branch : CSE & IT Batch : Hinglish

WEEKLY TEST – 03

Subject : Database Management System

Topic : Normal Form and Serializability

Maximum Marks 12

Q.1 to 4 Carry ONE Mark Each

[MCQ]

1. Consider the relation R(ABCDE) with the following set of functional dependencies (FD's)
F: {AB→C, C→D, D→E, E→A, D→B}
The which of the following Highest Normal form satisfied by the above relation R?
(a) BCNF (b) 3NF
(c) 2NF (d) 1NF

[MSQ]

2. Consider the following relation with given functional dependencies.
A (R, S, T, U, V)
FD's: {RS→T, RS→U, U→R, ST→U, ST→ V}
Then Relation is in which Normal Form?
(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

3. **[NAT]**
Consider 3 transactions T_1, T_2 and T_3 having 2, 3 and 4 operations respectively.
The total number of non-serial schedule is_____.

[MSQ]

4. Consider the following schedule:
S1: $r_1(x)$ $w_2(x)$ $w_1(x)$ $w_3(x)$ $r_3(x)$
S2: $r_1(x)$ $w_2(x)$ $w_3(x)$ $w_1(x)$ $r_3(x)$
Which of the following is correct about the Schedule S?
(a) S_1 is conflict serializable.
(b) S_1 is not conflict serializable.
(c) S_2 is conflict serializable.
(d) S_2 is not conflict serializable.

Q.5 to 8 Carry TWO Mark Each

5. **[NAT]**
Consider the following Relation:
R(ABCDEFGH) with FD set of Relation R {A→B, C→D, E→FGH} what is the minimum number of relations required to decompose into BCNF which satisfy lossless join and Dependency preserving decomposition _____.

6. **[MSQ]**
Consider the following two schedules S_1 and S_2 involving three transactions T_1, T_2 and T_3 as:
S_1: $R_2(x)W_1(y)W_1(z)$ $R_1(w)$ $R_3(y)$ $R_2(y)$ $R_1(x)$ $R_3(w)$ $R_2(z)$ $W_3(x)$ $R_2(w)$ $W_1(x)$
S_2: $R_1(x)$ $R_3(w)$ $W_1(y)$ $W_1(z)$ $R_1(w)$ $W_3(y)$ $R_3(y)$ $R_2(y)$ $R_2(x)$ $R_2(z)$ $R_2(w)$
Which of the following options is/are correct regarding the above two schedules S_1 and S_2?
(a) S_1 is conflict serializable.
(b) S_1 is not conflict serializable.
(c) S_2 is conflict serializable.
(d) S_2 is not conflict serializable.

7. **[NAT]**
Consider the following relational schema with given FD's
Schema I: R(ABCD) and FD's are [AB → C, C→ D, D → A]

Schema II: R(ABCDE) and FD's are [AB $\rightarrow$ C, C $\rightarrow$ D, D $\rightarrow$ B, D $\rightarrow$ E]

Schema III: R(ABCDE) and FD's are [A $\rightarrow$ B, B $\rightarrow$ C, C $\rightarrow$ D, D $\rightarrow$ E, D $\rightarrow$ A]

Schema IV: R(ABCDE) and FD's are [B $\rightarrow$ C, B $\rightarrow$ D, D $\rightarrow$ E]

How many above schema satisfy the third normal form (3NF) is_____?

8. [MSQ]

Consider the relation R(ABCDE) with the following set of functional dependencies

F: [A $\rightarrow$ D, AB $\rightarrow$ C, AD $\rightarrow$ CE, B $\rightarrow$ C, D $\rightarrow$ A, D $\rightarrow$ B]

Then which of the following is/are True for R?

(a) R is in 1NF
(b) R is in 2NF
(c) R is in 3NF
(d) R is Not is 3NF & Not in BCNF

Answer Key

1. **(b)**
2. **(a, b, c)**
3. **(1254)**
4. **(b, d)**
5. **(4)**
6. **(b, c)**
7. **(2)**
8. **(a, b, d)**

Hints and Solutions

1. (b)

F:{AB→C, C→D, D→E, E→A, D→B}
Candidate keys = [AB, EB, C, D]
Prime / key Attribute = [A, B, C, D, E]
Here all attribute of relation R is key/prime attribute.
So R is in 3NF
Here R is not in BCNF because in FD
E→A: E is not super key.
So R is in 1NF, 2NF and 3NF.
So highest normal form satisfy is 3NF.

2. (a, b, c)

FD's: {RS→T, RS→U, U→R, ST→U, ST→V}
In this question candidate keys = [RS, SU, ST]
In the FD U→R, U is not a super key.
So Relation is Not in BCNF but in 3NF.
So, this relation is in 1NF, 2NF & 3NF also.

3. (1254)

3 Transaction T_1: 2 operation (n_1)
T_2: 3 operation (n_2)
T_3: 4 operation (n_3)

Total number of Concurrent Schedule

$$= \frac{(n_1+n_2+n_3)!}{(n_1!)(n_2!)(n_3!)}$$

$$= \frac{(2+3+4)!}{(2!)(3!)(4!)} = \frac{9!}{2\times 6\times 4!}$$

$$= \frac{9\times 8\times 7\times 6\times 5\times 4!}{2\times 6\times 4!}$$

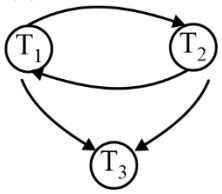
Total No. of Concurrent Schedule = 1260

Total No. of serial schedule = 3! = 6 Serial Schedule.
Total Number of = 1260 – 6
Non-Serial Schedule = 1254

4. (b, d)

Schedule: S1

T_1	T_2	T_3
r(x)		
	w(x)	
w(x)		
		w(x)
		r(x)



Cycle exists, therefore S1 not conflict serializable.
Schedule S2: S2 is also not conflict serializable as precedence graph contains cycle.

5. (4)

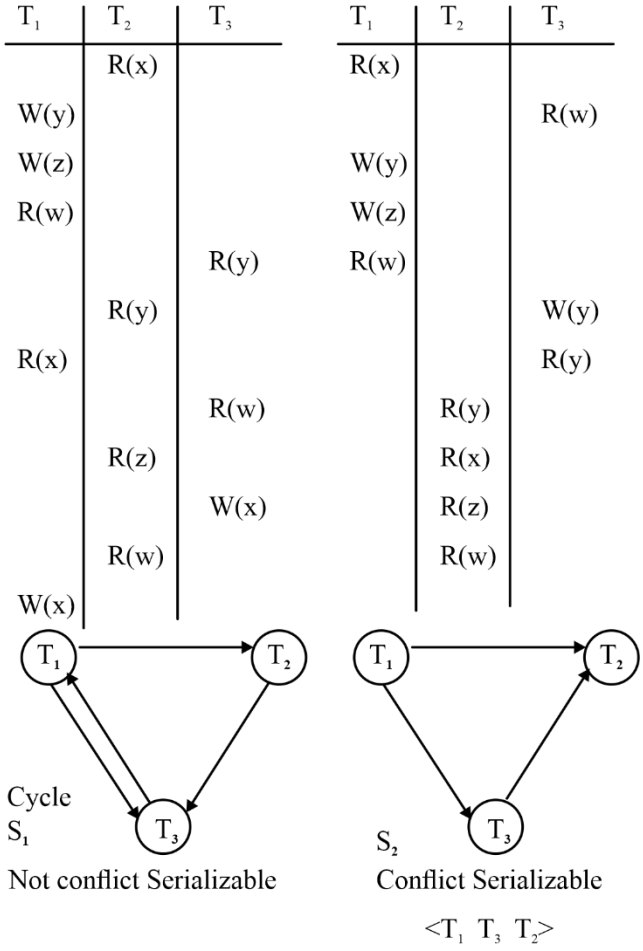
R (ABCDEFG) {A→B, C→D, E→FGH]
Candidate key = [ACE]
Check BCNF = ?
A→B, C→D, E→FGH} violates BCNF
Because $\underline{x}$→y : x is Not super key
So, R Not in BCNF.
BCNF Deconposition
R_1(AB) R_2 (CD) R_3 (EFGH) R_4 (ACE)
Now its in BCNF + losseless join + Dependency Preserving.

6. (b, c)

Sol.

S_1: $R_2(x)W_1(y)W_1(z)$ $R_1(w)$ $R_3(y)$ $R_2(y)$ $R_1(x)$ $R_3(w)$ $R_2(z)$ $W_3(x)$ $R_2(w)$ $W_1(x)$

S_2: $R_1(x)$ $R_3(w)$ $W_1(y)$ $W_1(z)$ $R_1(w)$ $W_3(y)$ $R_3(y)$ $R_2(y)$ $R_2(x)$ $R_2(z)$ $R_2(w)$



Not conflict Serializable

Conflict Serializable

$<T_1\ T_3\ T_2>$

7. (2)

Schema I: R(ABCD) and FD's are [AB → C, C→ D, D → A]

Candidate keys = [AB, DB, CB]

Relation R is in INF, 2NF & 3NF But Not in BCNF because C → D, D → A violate BCNF definition.

Schema II: R(ABCDE) and FD's are [AB → C, C→ D, D → B, D → E]

Candidate keys = [AB, AD, AC]

Here D → E is a Partial Dependency so R Not in 2NF.

Schema III: R(ABCDE) and FD's are [A → B, B→ C, C → D, D → E, D → A]

Candidate key = [A, B, C, B]

Here in every Non Trivial FD x→ y, x [determinant] is a supper key so R is in BCNF & 3NF.

Schema IV: R(ABCDE) and FD's are [B → C, B→ D, D → E]

Candidate key = [AB]

Here B → C & B → D is a Partial Dependency. So R Not in 2NF.

So, Schema I & Schema III Satisfy 3NF.

8. (a, b, d)

R(ABCDE) {A → D, AB → C, AD → CE, B → C, D → A, D → B}

$(A)^+ = (ADBCE)$

A is Candidate key ……(1)

D → A

$(D)^+ = (ABCDE)$

D is candidate key ……(2)

Candidate keys = [A, D]

Check 2NF? No Partial Dependency, ∴R is in 2NF

Check 3NF? B→C; Non key/Non Prime Attribute ⟶ Non key Attribute } Voilate 3NF

OR

B→C B is Not super key or C is Non key Attribute

So, R is in 2NF But Not in 3NF & Not in BCNF

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