Database Management System: Assignment 4

Total Marks : 20

February 7, 2024

Question 1

Marks: 2 **MCQ**

Consider the relation `R(X,Y,Z,V,W)` which satisfies the following functional dependencies:
`XY` $\rightarrow$ `Z`
`YZ` $\rightarrow$ `V`
`ZV` $\rightarrow$ `W`
`VW` $\rightarrow$ `X`
`XW` $\rightarrow$ `Y`

Which of the following functional dependencies are also guaranteed to be satisfied by relation R?

a) `XZ` $\rightarrow$ `V`

b) `YZV` $\rightarrow$ `X`

c) `Z` $\rightarrow$ `W`

d) `X` $\rightarrow$ `Z`

Answer: b)
Explanation: In option (a) closure of XZ = `XZ`, does not contain `V`.
In option (c) closure of `Z = Z` does not contain `W`.
In option (d) closure of `X = X` does not contain `Z`.
In option (b) closure of YZV = `XYZVW` contains X, therefore the option is correct.

Refer Module 17 slide 21

Question 2

Marks: 2 **MSQ**

Consider the relation `Student(Reg_No, Name, Address, Phone, Class_ID)` and the set of following functional dependencies:

- FD1: `Reg_No` → `Name`
- FD2: `Address, Phone` → `Class_ID`
- FD3: `Name` → `Phone`
- FD4: `Class_ID` → `Reg_No, Address`

Which of the following are possible sets of candidate key(s) of `Student`?

a) Reg_No

b) Address, Phone

c) Name

d) Class_ID

Answer: b), d)
Explanation: From the given set of functional dependencies, we can see that $(\texttt{Reg\_No})^+ = \{\texttt{Reg\_No, Name, Phone}\}$. Thus, `Reg_No` is not a candidate key. According to FD2 and FD4, {`Address, Phone`} and Class_ID, are the candidate keys.
Hence, options b) and d) are correct.

Question 3

Marks: 2 **MSQ**

Consider the following relational table R:

R				
A	**B**	**C**	**D**	**E**
$\alpha 1$	$\beta 1$	$\gamma 1$	$\delta 1$	$\eta 1$
$\alpha 2$	$\beta 2$	$\gamma 1$	$\delta 2$	$\eta 2$

If, relation R is decomposed into $R_1 = (A, B, C)$ and $R_2 = (C, D, E)$. Choose the correct statement/s based on the above relations.

a) The decomposition does not preserve dependencies

b) $\Pi_{R_1}(R) \bowtie \Pi_{R_2}(R)$ will be:

A	**B**	**C**	**D**	**E**
$\alpha 1$	$\beta 1$	$\gamma 1$	$\delta 1$	$\eta 1$
$\alpha 2$	$\beta 2$	$\gamma 1$	$\delta 2$	$\eta 2$

c) $\Pi_{R_1}(R) \bowtie \Pi_{R_2}(R) \neq R$

d) AB $\rightarrow$ E holds in the table $\Pi_{R_1}(R) \bowtie \Pi_{R_2}(R)$

Answer: a), c)
Explanation: Let us start with computing the join:

$\Pi_{R_1}(R) \bowtie \Pi_{R_2}(R) =$

A	**B**	**C**	**D**	**E**
$\alpha 1$	$\beta 1$	$\gamma 1$	$\delta 1$	$\eta 1$
$\alpha 1$	$\beta 1$	$\gamma 1$	$\delta 2$	$\eta 2$
$\alpha 2$	$\beta 2$	$\gamma 1$	$\delta 1$	$\eta 1$
$\alpha 2$	$\beta 2$	$\gamma 1$	$\delta 2$	$\eta 2$

Clearly, (b) is incorrect.

Also, $\Pi_{R_1}(R) \bowtie \Pi_{R_2}(R) \neq R$ (the decomposition is lossy). So, (c) is correct.

From the above table, we can see that `AB` does not uniquely identify `E` (first two records). So, (d) is incorrect.

However, AB $\rightarrow$ E trivially holds in R. Hence, (a) is correct.

Question 4

Marks: 2 **MCQ**

The following relation guarantees which highest normal form?

sid	sname	course	teacher
S1	RAM	JAVA	AR
S2	MADHAB	DBMS	PPD
S1	RAM	DBMS	PB
S2	MADHAB	JAVA	SM

a) 1NF

b) 2NF

c) BCNF

d) 3NF

Answer: a)
Explanation: The relation contains atomic values so it is in 1NF. The primary key of the relation is `(sid, course)`. But `sid` can uniquely determine `sname`. So, partial dependency exists. Hence, the relation is not in 2NF and not also in other higher normalization forms.

Question 5

Marks: 2 **MSQ**

In a relation `MountainTreking(Altitude, MName, Location, MType, TrekkerAge, Climate, TrekkerExp)`, `Altitude` identifies `MName` and `Location`. Also, `MName, MType, TrekkerAge` and `Climate` combined determines the `TrekkerExp, MType`. `TrekkerAge` of the `MountainTreking` are dependent on `Altitude` and `Climate` together. Which of the following are the non-prime attributes of Mountain?

a) Altitude

b) TrekkerAge

c) Climate

d) TrekkerExp

Answer: b), d)
Explanation: As per the given set of Functional Dependencies,
`Altitude` → `MName`, `Location`
`MName, MType, TrekkerAge, Climate` → `TrekkerExp, MType`
`Altitude, Climate` → `TrekkerAge`
Primary key is { `Altitude,MType,Climate`}
Hence, options (b) and (d) are correct.

Question 6

Marks: 2 **MCQ**

Consider the following instance of the relation `MonthlyExpense(Budget, Month, Expense, Salary)`

MonthlyExpense			
Budget	Month	Expense	Salary
10000	Jan	15000	50000
10000	Feb	15000	50000
10000	Jul	15000	50000
20000	Feb	15000	50000
30000	Feb	10000	100000
10000	Feb	10000	100000

Which of the following Functional Dependencies hold for `MonthlyExpense`?

a) {Budget, Month}→ Expense

b) {Expense, Month}→ Budget

c) Budget→ Salary

d) Expense→ Salary

Answer: d)
Explanation: Among the given options, only `Expense` (determinant) has unique values corresponding to each unique value of `Salary` (dependent). Hence, option (d) is correct.

Question 7

Marks: 2 **MCQ**

Consider the relational schema `Flight(FNo, SeatNo, Window, Pilot, Duration)` with the following functional dependencies:
`FNo`→{`Pilot, SeatNo`}
`Duration`→{`FNo, Window`}

Which of the following decomposition of `Flight` is lossless?

a) `F1(FNo, Duration), F2(SeatNo, Window, Pilot, Duration)`

b) `F1(FNo, SeatNo), F2(Window, Pilot, Duration)`

c) `F1(FNo, Window), F2(SeatNo, Pilot, Duration)`

d) `F1(FNo, Pilot), F2(SeatNo, Window, Pilot, Duration)`

Answer: a)
Explanation: The primary key of `Flight` is `Duration`. For option (a),
`Attribute(F1)` $\cup$ `Attribute(F2) = Attribute(Flight)`
`Attribute(F1)` $\cap$ `Attribute(F2)` $\neq \phi$
`Attribute(F1)` $\cap$ `Attribute(F2)` $=$ `Duration`
`And Duration` $\rightarrow$ `FNo`
Hence, option (a) is correct.

Question 8

Marks: 2 **MCQ**

Consider the relation `HousePlan(Room, Area, Location, Floor)` with the following Functional Dependency set

```
F={
FD1:  Room→{Area, Location}
FD2:  Location→Floor
FD3:  {Area, Floor}→{Room, Location}
}
```

What is the canonical cover of `F`?

a)
```
FD1:  Room→{Area, Location}
FD2:  Location→Floor
FD3:  {Area, Floor}→Room
```

b)
```
FD1:  Room→Area
FD2:  Location→Floor
FD3:  {Area, Floor}→{Room, Location}
```

c)
```
FD1:  Room→Location
FD2:  Location→Floor
FD3:  {Area, Floor}→{Room, Location}
```

d)
```
FD1:  Room→{Area, Location}
FD2:  Location→Floor
FD3:  Floor→{Room, Location}
```

Answer: a)

Explanation:

1. Checking for extraneous attributes in L.H.S of FD3: {`Area, Floor`}→{`Room, Location`}

`Area` is not extraneous because `Floor`$^+$`=Floor` and does not contain `Area`.

`Floor` is not extraneous because `Area`$^+$`=Area` and does not contain `Floor`.

2. Checking for extraneous attributes in R.H.S of FD3: {`Area, Floor`}→{`Room, Location`}

`Location` is extraneous because, `(Area, Floor)`$^+$`=Area, Floor, Room, Location`, using the set

```
F'={
FD1:  Room→{Area, Location}
FD2:  Location→Floor
FD3:  {Area, Floor}→{Room}
}
```

No attribute is extraneous in FD1. Hence, option (a) is correct.

Question 9

Marks: 2 **MCQ**

Consider the relational schema `Book(Author,ISBN,Title,Category,Pages,Publisher)` which satisfies the following functional dependencies:

- FD1: `Author,ISBN` $\rightarrow$ `Title`
- FD2: `Author` $\rightarrow$ `Category`
- FD3: `ISBN` $\rightarrow$ `Pages,Publisher`

The given relation guarantees which highest normal form?

a) 1 NF

b) 2 NF

c) 3 NF

d) BCNF

Answer: a)
Explanation: $\{\texttt{Author,ISBN}\}^+ = \{\texttt{Author,ISBN,Title,Category,Pages,Publisher}\}$. Therefore, $\{\texttt{Author,ISBN}\}$ is the key. So, the relation is in 1 NF form because of atomic valued attributes. However, partial dependency exists in FD2 and FD3, preventing the relation to be in 2NF.

Question 10

Marks: 2 **MCQ**

Determine the highest Normal Form of the relation `Restaurant(Dish, Chef, Table, Price)` having the following complete set of functional dependencies.
`Dish` → `Chef`, `Table`
`Table` → `Price`

a) 1 NF

b) 2 NF

c) 3 NF

d) BCNF

Answer: b)
Explanation: `Dish` → `Price` is a transitive dependency. which prevents the relation from being in 3NF.
So, the relation `Restaurant` is in 2NF.