Database Management System: Assignment 4

Total Marks : 20

June 20, 2022

Question 1

Consider a relational schema `OnlineClass(classID, classLink, Subject, Mentor, Duration)`. Which of the following set of functional dependencies should be chosen so that `OnlineClass` can be in 2NF but not in 3NF? *Marks: 2* **MCQ**

a) `classID` → {`classLink`,`Subject`}
   `classLink` → `Duration`
   `Mentor` → `Subject`

b) {`classID`,`classLink`} → {`Subject`,`Mentor`,`Duration`}
   {`Mentor`,`Subject`} → {`classLink`,`Duration`,`classID`}

c) {`classID`,`Mentor`} → {`classLink`,`Subject`}
   `classLink` → `Duration`

d) {`classID`,`classLink`} → {`Subject`,`Mentor`,`Duration`}
   `Mentor` → `classLink`

Answer: c)
Explanation: For option (b), the candidates keys are {`classID, classLink`}, {`Mentor, Subject`} which are present on the L.H.S of both the functional dependencies. Thus, it makes `OnlineClass` to stay in BCNF.
For option (a), the candidate key is {`classID, Mentor`}. Since partial dependency is present in the FD set, it allows `OnlineClass` to be in 1NF.
For option (d), the candidate keys are {`classID, classLink`}, {`classID, Mentor`}. Hence, there is neither any partial dependency nor any transitive dependency as the R.H.S of the second FD contains a key attribute. Hence, it is in 3NF.
In option (c), the candidate key is {`classID, Mentor`} There is no partial dependency and there is a transitive dependency. Thus, option (c) is correct.

Question 2

The following dependencies hold in a relation `Placement (JobID ,Company, Position, Salary)`:
`JobID` $\rightarrow$ `Company`
{`Position, Company`} $\rightarrow$ `Salary`
According to which of the following rules, {`JobID, Position`} $\rightarrow$ `Salary` holds?

Marks: 2 **MCQ**

a) Decomposition

b) Augmentation

c) Pseudo-transitivity

d) Transitivity

Answer: c)
Explanation: According to Pseudo-transitivity rule, if `X` determines `Y` and `YZ` determines `W`, then `XZ` determines `W`. Hence, option (c) is correct.

Question 3

Consider the following instance of `Market` relation:

Market		
MarketName	**Product**	**Stock**
SpendWise	Shampoo	12
SpendWise	Spicemix	6
SpendWise	Cookies	6
ShopLuck	Shampoo	20
MarkIt	Cakemix	60
MarkIt	Chocolate	12

Which of the following functional dependencies hold on `Market`? *Marks: 2* **MCQ**

a) `MarketName` $\rightarrow$ {`Product, Stock`}

b) {`Stock, MarketName`} $\rightarrow$ `Product`

c) {`Product`} $\rightarrow$ `MarketName`

d) {`MarketName, Product`} $\rightarrow$ `Stock`

Answer: d)
Explanation: Only for option (d), the attributes on the L.H.S can uniquely identify the attributes on the R.H.S. Hence, option (d) is correct.

Question 4

Consider the following relation:
`Measurement (sensor, device, dataform, uprange, lowrange, delay, status)`
with the following functional dependency set (`F`):
`FD1:` {`sensor, device, status`} $\rightarrow$ {`dataform, uprange, lowrange`}
`FD2:` `sensor` $\rightarrow$ {`delay, status`}
`FD3:` {`status, delay, dataform`} $\rightarrow$ {`sensor, device`}

`Measurement` has 3 candidate keys. Keys K1, K2, and K3 have 2, 2, and 3 attributes respectively. The database admin issues the following order:
`X` needs to be appended to the R.H.S of FDi so that only K3 and $(K1 \cap K2)$ *become the candidate keys of* `Measurement`. Find `X` and `i`. *Marks: 2* **MCQ**

a) `X=device, i=1`

b) `X=delay, i=1`

c) `X=dataform, i=2`

d) `X=status, i=2`

Answer: c)
Explanation: The 3 candfidate keys of `Measurement` are
`K1=`{`device, sensor`}
`K2=`{`dataform, sensor`}
`K3=`{`dataform, delay, status`}
$K1 \cap K2$ `=sensor`

For `sensor` to be the candidate key, either `device` or `dataform` needs to be appended to the R.H.S of `FD2`. Hence, option (c) is correct.

Question 5

Consider the following relation:
`Measurement(sensor, device, dataform, uprange, lowrange, delay, status)`
with the following functional dependency set (`F`):
{`sensor, device, status`} → {`dataform, uprange, lowrange`}
`sensor` → {`delay, status`}
{`status, delay, dataform`} → {`sensor, device`}
Which of the following functional dependencies will not be present in the Canonical Cover of `F` after the application of Union Rule on the final functional dependencies?

Marks: 2 **MCQ**

a) {`sensor, device, status`} → {`dataform, uprange, lowrange`}

b) `sensor` → {`delay,status`}

c) {`status, delay, dataform`} → {`sensor, device`}

d) {`sensor, device`} → {`dataform, uprange, lowrange`}

Answer: a)
Explanation: We can see that the closure of {`sensor, device`} still includes `status`. Thus, `status` is extraneous in the first FD (L.H.S). No other attribute can be removed from any other FD after removing `status`. Thus, {`sensor, device, status`} → {`dataform, uprange, lowrange`} will not be present in the Canonical cover of `F`. Hence, option (a) is correct.

Question 6

In a relation `Weather(Country, City, DayNo, TimeHr, ProbRain, ProbWind, ProbTemp)` {`Country, City, DayNo`} uniquely identifies the {`ProbRain, ProbWind, ProbTemp`}. `TimeHr` is identified by `DayNo`. `Country` is determined by {`ProbRain, ProbTemp`}. What are the non-prime attributes of `Weather`? *Marks: 2* **MCQ**

a) Both `City & DayNo`

b) Both `Country & ProbTemp`

c) Both `ProbWind & TimeHr`

d) Both `ProbRain & ProbWind`

Answer: c)
Explanation: According to the problem, the following FDs hold
{`Country, City, DayNo`} $\rightarrow$ {`ProbRain, ProbWind, ProbTemp`}
`DayNo` $\rightarrow$ `TimeHr`
{`ProbRain, ProbTemp`} $\rightarrow$ `Country`

The candidate keys are {`City, DayNo, Country`} and {`City, DayNo, ProbRain, ProbTemp`}. Hence, option (c) is correct.

Question 7

In a relation `Weather(Country, City, DayNo, TimeHr, ProbRain, ProbWind, ProbTemp)` {`Country, City, DayNo`} uniquely identifies the {`ProbRain, ProbWind, ProbTemp`}. `TimeHr` is identified by `DayNo`. `Country` is determined by {`ProbRain, ProbTemp`}. If `Weather` has to be normalized to 2NF, which of the attributes will be present in both the decompositions of `Weather`? *Marks: 2* **MCQ**

a) `Country`

b) `TimeHr`

c) `ProbRain`

d) `DayNo`

Answer: d)
Explanation: The FD that causes the violation of 2NF is `DayNo` $\rightarrow$ `TimeHr`. Hence, one of the decompositions should be `Weather1(DayNo, TimeHr)`. For the decompositions to be lossless, the common attribute should be a superkey in atleast one of the decompositions. In `Weather1(DayNo, TimeHr)`, the FD `DayNo` $\rightarrow$ `TimeHr` holds and `DayNo` is the candidate key. Hence, the other decomposed relation should be `Weather2(Country, City, DayNo, ProbRain, ProbWind, ProbTemp)`. Thus, option (d) is correct.

Question 8

Consider the following relation `VehService(Vehicle, Color, Capacity, Wheels, Owner)` with the following functional dependency sets:

`S1={`
`FD1:` {`Vehicle, Color`} → `Capacity`
`FD2:` `Wheels` → {`Vehicle, Capacity, Owner`}
}
`S2={`
`FD1:` `Vehicle` → {`Color, Capacity`}
`FD2:` `Wheels` → {`Vehicle, Owner`}
}

Which of the following statements is true? *Marks: 2* **MCQ**

a) Neither `S1` covers `S2` nor `S2` covers `S1`

b) `S2` covers `S1` but `S1` does not cover `S2`

c) `S1` covers `S2` but `S2` does not cover `S1`

d) Both `S1` covers `S2` and `S2` covers `S1`

Answer: b)
Explanation: The FD `Vehicle` → {`Color, Capacity`} of `S2` cannot be derived from `S1` as `(Vehicle)`$^+$ does not contain {`Color, Capacity`} in `S1`. All FDs of `S1` can be derived from `S2`. Hence, option (b) is correct.

Question 9

Consider the relation `PollutionControl (PolType, Cause, Severity, Effect, Measure, TargetZone)` with the following functional dependencies:
`FD1:` `PolType` $\rightarrow$ `Cause`
`FD2:` `Severity` $\rightarrow$ `Effect`
`FD3:` {`PolType, Measure`} $\rightarrow$ `TargetZone`
`FD4:` {`Cause, Effect`} $\rightarrow$ {`Measure, Severity`}
Which of the following options is true? *Marks: 2* **MCQ**

a) `PollutionControl` has 1 candidate key and is in 1NF.

b) `PollutionControl` has 2 candidate keys and is in 1NF.

c) `PollutionControl` has 1 candidate key and is in 2NF.

d) `PollutionControl` has 2 candidate keys and is in 2NF.

Answer: b)
Explanation: The candidate keys of `PollutionControl` are {`PolType, Severity`} `&` {`PolType, Effect`}. Since partial dependency occurs in `FD1`, it is in 1NF.
Hence, option (b) is correct.

Question 10

`PollutionControl (PolType, Cause, Severity, Effect, Measure, TargetZone)` with the following functional dependencies:
`FD1: PolType` $\rightarrow$ `Cause`
`FD2: Severity` $\rightarrow$ `Effect`
`FD3:` {`PolType, Measure`} $\rightarrow$ `TargetZone`
`FD4:` {`Cause, Effect`} $\rightarrow$ {`Measure, Severity`}
The relation is decomposed into the following:
`PollutionControl1 (PolType, Cause, Severity, Effect)`
`PollutionControl2 (PolType, Severity, Measure, TargetZone)`
Which of the following is true about the decomposition? *Marks: 2* **MCQ**

a) Both lossless and dependency preserving.

b) Neither lossless nor dependency preserving.

c) Lossless but not dependency preserving.

d) Lossy but dependency preserving.

Answer: c)
Explanation: The union of attributes of `PollutionControl1` and `PollutionControl2` encompass all the attributes of `PollutionControl`. The common attribute between the two decomposed relations are `PolType, Severity` which is the key in `PollutionControl1`. Hence, the decomposition is lossless.
From `PollutionControl1`, FD1 and FD2 can be derived. FD3 can be derived from `PollutionControl2`. However, FD4 cannot be derived from these decompositions, thus making them violate the dependency preserving criteria. Hence, option (c) is correct.