NOC24-CS75
Data Base Management System

Tutorial by: Adwait P. Parsodkar
Week - 4

Question - 1

Consider the relational schema

CourseAssignments (AssignmentNo, QNo, Topic, Marks, QType)

with the following Functional Dependencies:

$$\text{AssignmentNo} \rightarrow \text{Topic}$$

$$\text{Topic} \rightarrow \{\text{Marks}, \text{AssignmentNo}\}$$

$$\{\text{Topic}, \text{QNo}\} \rightarrow \text{QType}$$

Which of the following is not a prime attribute of CourseAssignments?

a) QNo

b) Topic

c) QType

d) AssignmentNo

Solution - 1

Solution: (c)

The candidate keys of CourseAssignments are {QNo, AssignmentNo} and {QNo, Topic}.
Prime attribute is an attribute that is part of any candidate key.

Question - 2

Consider the relational schemaFileRepo(RepoName, FileNo, IndexNo, AdminID, FileCount) with the following functional dependencies:

$$\text{RepoName} \rightarrow \{\text{AdminID, FileNo}\}$$

$$\text{FileCount} \rightarrow \{\text{RepoName, IndexNo}\}$$

Which of the following decomposition of FileRepo is lossless?

a) FileRepo1(RepoName, FileNo), FileRepo2(IndexNo, AdminID, FileCount)

b) FileRepo1(RepoName, FileNo), FileRepo2(FileNo, AdminID, FileCount)

c) FileRepo1(RepoName, FileCount), FileRepo2(FileNo, IndexNo, AdminID, FileCount)

d) FileRepo1(RepoName, AdminID), FileRepo2(FileNo, IndexNo, AdminID, FileCount)

Solution - 2

Solution: (c)

Explanation: From the functional dependencies, the primary key of the schema can be identified as FileCount. In option (c),

FileRepo1 ∩ FileRepo2={FileCount} and,

FileRepo1 ∪ FileRepo2={RepoName, FileNo, IndexNo, AdminID, FileCount}.

Hence, the decomposition given in option (c) is lossless.

Question - 3

Consider the relational schema CourseAssignments (AssignmentNo, QNo, Topic, Marks, QType) with the following Functional Dependency set:

$$
\begin{aligned}
F = \{ & \\
& QNo \rightarrow \{Topic, AssignmentNo\} \\
& Topic \rightarrow \{Marks, AssignmentNo\} \\
& \{Topic, QNo\} \rightarrow QType \\
\} &
\end{aligned}
$$

What is the canonical cover of F?

Question - 3

a) QNo → Topic

Topic → Marks

Topic → AssignmentNo

QNo → QType

b) QNo → Topic

QNo → AssignmentNo

Topic → Marks

Topic → AssignmentNo

QNo → QType

c) QNo → Topic

QNo → AssignmentNo

Topic → AssignmentNo

QNo → QType

d) QNo → Topic

QNo → AssignmentNo

Topic → Marks

Topic → AssignmentNo

{Topic, QNo} → QType

Solution - 3

Solution: (a)

QNo → {Topic, AssignmentNo}

Topic → {Marks, AssignmentNo}

{Topic, QNo} → QType

QNo → Topic

Topic → Marks

Topic → AssignmentNo

QNo → QType

Solution - 3

Solution: (a)

In the FD {Topic, QNo} → QType, Topic is extraneous in L.H.S as QNo+ contains Topic from QNo → {Topic, AssignmentNo}. Similarly, in QNo → {Topic, AssignmentNo}, AssignmentNo is extraneous as QNo+ contains AssignmentNo from F'={

QNo → {Topic}

Topic → {Marks, AssignmentNo}

{ QNo} → QType

}

Question - 4

Consider the relational schema GameRepo (GameName,GameType,Developer,PlayedBy) with the following Functional Dependency

GameName,GameType → Developer

GameType → PlayedBy

Developer → GameName

Identify the possible number of superkeys of GameRepo.

a) 4 b) 6 c) 8 d) 10`

Solution - 4

Solution: (b)

Explanation: The candidate keys of GameRepo are {GameType, GameName}, {GameType, Developer}.

Superkeys: {GT, GN}, {GT, GN, P}, {GT, GN, D}, {GT, GN, D, P}

{GT, D}, ~~{GT, D, GN}~~, {GT, D, P}, ~~{GT, D, GN, P}~~

Question - 5

Consider the relation Fig(FNo,Page,Colored,Dimensions) with the following Functional Dependencies:

FD1: FNo,Page → Colored

FD2: Colored → Dimensions

FD3: Dimensions → FNo

If Fig is decomposed into Fig1(FNo,Page,Colored) and Fig2(Colored,Dimensions), which of the following options is (are) true?

Question - 5

a) The decomposition is both lossless and dependency preserving.

b) The decomposition is lossless but not dependency preserving.

c) The decomposition neither lossless nor dependency preserving.

d) The decomposition is not lossless but is dependency preserving.

Solution - 5

Solution: (b)

The decomposition is lossless because the common attribute is Colored, which is a key in Fig2. The decomposition is not dependency preserving as Dimensions → FNo cannot be preserved from the decomposition.

Question - 6

Consider the relational schema GameRepo (GameName,GameType,Developer,PlayedBy) with the following Functional Dependency

GameName,GameType → Developer

GameType → PlayedBy

Developer → GameName

What is the highest Normal form of GameRepo?

a) 1NF b) 2NF c) 3NF d) BCNF

Solution - 6

Solution: (a)

Candidate keys: {GameType, GameName}, {GameType, Developer}

Prime Attributes: {GameType, GameName, Developer}

1NF: Yes

2NF: Proper subset of candidate key should not determine a non-prime attribute.

> GameType → PlayedBy, a non-prime attribute is dependant on a proper subset of a candidate key. Hence not in 2NF.

Question - 7

Consider the relation Fig(FNo,Page,Colored,Dimensions) with the following Functional Dependencies:

FD1: FNo,Page → Colored

FD2: Colored → Dimensions

FD3: Dimensions → FNo

Identify the number of candidate keys and the highest normal form of Fig.

Solution - 7

Solution: Fig has 3 candidate keys and is in 3NF

Candidate keys: {Page, FNo},{Page, Colored}, {Page, Dimensions}

Prime attributes: {Page, FNo, Colored, Dimensions}

1NF: Yes

2NF: Since all attributes are prime, there is no non-prime attribute that is determined by a proper subset of a candidate key.

3NF: Since all attributes are prime, the RHS will always be the part of some key.

BCNF: In FD2 and FD3, the LHS is not a super key.

Question - 8

Consider the instance of the relation Food (DishName, Price, Restaurant). Which of the following Functional Dependencies hold true on Food as can be found in the given instance?

a) {DishName, Price} → Restaurant

b) {Restaurant, Price} → DishName

c) {Restaurant, DishName} → Price

d) Restaurant → {Price, DishName}

DishName	Price	Restaurant
Pasta	500	ItaliYum
Pasta	1000	Parista
MudCake	250	ItaliYum
Samosa	20	Gupta Snacks
Samosa	20	Roy Sweets

Solution - 8

Solution: (b), (c)

Explanation: {DishName, Price} cannot identify Restaurant uniquely as {Samosa, 20} relates to both Gupta Snacks and Roy Sweets. Similarly, Restaurant cannot identify any of the other fields uniquely.

Question - 9

Consider the instance of the relation Food(DishName, Price, Restaurant). If a new tuple {Risotto, 250, ItaliYum} is inserted to the given instance of Food, which of the following can not be a possible candidate key of Food?

a) {DishName, Price}

b) {Restaurant, Price}

c) {Restaurant, DishName}

d) {DishName, Price, Restaurant}

DishName	Price	Restaurant
Pasta	500	ItaliYum
Pasta	1000	Parista
MudCake	250	ItaliYum
Samosa	20	Gupta Snacks

Solution - 9

Solution: (b), (d)

Option (b) cannot be a candidate key as the tuple {250, ItaliYum} corresponds to both MudCake and Risotto. Option (d) is incorrect as it is a superkey.

Question - 10

Consider the following relation: ClothesShop(ClothType, CColor, Designer, ShopID) with the following functional dependencies:

FD1: ClothType → CColor

FD2: {Designer, CColor} → ShopID

According to the rule of pseudo-transitivity, which of the following functional dependencies can be derived?

a) CColor → ShopID

b) {ClothType, CColor} → ShopID

c) {ClothType, Designer} → ShopID

d) ClothType → ShopID

Solution - 10

Solution: (c) {ClothType, Designer} → ShopID

Explanation: According to the rule of pseudo transitivity.

If X → Y

and YZ → W

then, XZ → W

ClothType (X) → CColor (Y)

{Designer (Z), CColor (Y)} → ShopID (W)

Question - 11

Consider the relation R(X,Y,Z,V,W) which satisfies the following functional dependencies:

XY → Z
YZ → V
ZV → W
VW → X
XW → Y

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

a) XZ → V

b) YZV → X

c) Z → W

d) X → Z

Solution - 11

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.

Question - 12

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

Solution - 12

Solution: (b), (d)

Question - 13

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

Solution - 13

Solution: 1NF

Given: Primary Key: {sid, course}

Prime attribute: {sid, course}

1NF: Yes

2NF: We notice that sid → sname

Proper subset of candidate key determines a non-prime attribute. Hence not in 2NF.

Question - 14

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

Solution - 14

Answer: b), d)

Explanation: As per the given set of Functional Dependencies,

`Altitude` $\rightarrow$ `MName, Location`

`MName, MType, TrekkerAge, Climate` $\rightarrow$ `TrekkerExp, MType`

`Altitude, Climate` $\rightarrow$ `TrekkerAge`

Primary key is { `Altitude,MType,Climate`}

Hence, options (b) and (d) are correct.

Question - 15

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

Solution - 15

Solution: (d)

Question - 16

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

`FNo`$\rightarrow$`{Pilot, SeatNo}`

`Duration`$\rightarrow$`{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)`

Solution - 16

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 - 17

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}

Solution - 17

Answer: a)

Explanation:

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

Area is not extraneous because $\texttt{Floor}^{+}$=Floor and does not contain Area.

Floor is not extraneous because $\texttt{Area}^{+}$=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, $\texttt{(Area, Floor)}^{+}$=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 - 18

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

Solution - 18

Solution: 1NF

Candidate Key: {Author, ISBN}
Prime Attributes: {Author, ISBN}

1NF: Yes

2NF: A subset of primary key determines a non-prime attribute in

Author → Category
ISBN → Pages
ISBN → Publisher

Question - 19

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

`Dish` $\rightarrow$ `Chef, Table`

`Table` $\rightarrow$ `Price`

a) 1 NF

b) 2 NF

c) 3 NF

d) BCNF

Solution - 19

Solution: 2NF

Candidate key: {Dish}
Prime attribute: {Dish}

1NF: Yes
2NF: No non-prime attribute is determined by a proper subset of a candidate key.
3NF: Table → Price does not satisfy any of the following conditions

a. RHS should be a subset of LHS
b. LHS is a superkey
c. RHS is part of some key