

Abdullah Tahir

21L-5419

4J

DBMS

Assignment # 2

Question #1

Functional Dependencies

* $D \rightarrow A$

* $B(CD) \rightarrow A$

* $D \rightarrow B$

* $AB(D) \rightarrow C$

* $D \rightarrow C$

* $AC(D) \rightarrow B$

* $AB \rightarrow C$

* $CD \rightarrow A$

* $CD \rightarrow B$

* $AD \rightarrow B$

* $AD \rightarrow C$

* $BD \rightarrow A$

* $BD \rightarrow C$

Question #2 (a)

a) $AB \rightarrow C$ (Holds)

Combination of each value of A and B is different for every value of C.

b) $CD \rightarrow E$ (Holds)

Although determinants do not have unique values but there is no duplication in the values of dependent attribute, each pair of CD determines a unique value.

c) $E \rightarrow A$ (Not holds)

E determines multiple different values of A for each of its values.

d) $F \rightarrow G_r$ (Holds)

For a given value of F, there is only one corresponding value of G_r .

e) $G_r H \rightarrow F$ (Holds)

For every combination of G_r and H there is single corresponding value of F.

(b)

a) $A \rightarrow B$ (Holds)

Every value of A is unique

b) $BC \rightarrow A$ (Not holds)

Combination of B and C determines multiple values of A against a single combination.

c) $B \rightarrow C$ (Holds)

Values of determinants are not unique but they determine unique value of dependent

d) $DE \rightarrow F$ (Holds)

Determinants have unique values

e) $FG \rightarrow H$ (Holds)

it holds as values of determinant are unique

Question #3

(a)

$\{A \rightarrow B\}$ and C subset of B = $\{A \rightarrow C\}$

If $X \rightarrow Y$ and $Y \rightarrow Z$ then $X \rightarrow Z$

Thus $A \rightarrow C$ is true by transitive property

(b)

$A \subset D, C \rightarrow B$

If $X \rightarrow Y$ and $Y \rightarrow W$ then $XW \rightarrow Z$

Thus $AB \rightarrow D$ is true by pseudo transitive property

Question #4

$$A^+ = \{A, B, C, D\}$$

$$B^+ = \{B, D\}$$

$$C^+ = \{C, D\}$$

$$D^+ = \{D\}$$

$$CD = \{C, D\}$$

Question # 5

A = order_id

B = cust_id

C = order_date

D = ship_date

E = item_id

F = item_qty

G_r = item_price

F = {A, E} → F(G_r, B → A ∨ D) \exists

Essential Attributes : B, E

[BE]⁺ = {A, B, C, D, E, F, G_r} = {R} \exists

So BE is the key

Question # 6

R(A, B, C, D, E, F, G_r, H, I)

F = { }

A → BC,

CD → H,

C_rG → AE,

H → G_r,

B → D,

F → G_r

3.

A⁺ = {A, B, C, D, H, G_r, E} \exists

[BC]⁺ = {B, C, D, H, G_r, A, E} \exists

Essential keys = F, I

[IF]⁺ = {I, F, G_r} \exists

$$(ABCDEF\bar{GHI})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(BCDEF\bar{GHI})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(\bar{C}DEF\bar{GHI})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(DEF\bar{GHI})^+ = \{D, E, F, G, H, I\}$$

$$(EF\bar{GHI})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(F\bar{GHI})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(F\bar{H}\bar{I})^+ = \{A, B, C, D, E, F, G, H\}$$

$$(F\bar{I})^+ = \{A, B, C, D, E, F, G, H, I\}$$

$$(\bar{A}FI)^+ = \{A, B, C, D, E, F, G, H, I\}$$

$C_{KS} = CFI, AFI$

Question # 7

1) R (A, B, C, D, E, G, H.)

$$F = \{AB \rightarrow C, DEG \rightarrow H, A \rightarrow C, DE \rightarrow G\}$$

Step is not required in this case

Step 2 :-

$$(AB)^+ = \{A, B, C\}$$

$$(DEG)^+ = \{D, E, G\}$$

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

$$(DE)^+ = \{D, E\}$$

So

$$DEG \rightarrow H$$

$$A \rightarrow C$$

$$DE \rightarrow G$$

Step 3 :-

$$\begin{aligned}(DEG_r)^+ &= \{D, E, G_r, H\} \\ D^+ &= \{D\} \\ E^+ &= \{E\} \\ G_r^+ &= \{G_r\} \\ (DE)^+ &= \{D, E, G_r, H\} \\ D^+ &= \{D\} \\ E^+ &= \{E\}\end{aligned}$$

Step 4 :-

$$DEG_r \rightarrow H$$

$$A \rightarrow C$$

$$DE \rightarrow G_r$$

2) $F = \{A \rightarrow BC, B \rightarrow CE, A \rightarrow E, AC \rightarrow H, D \rightarrow B\}$

Step 1:- $A \rightarrow B \checkmark$ $A \rightarrow E \times$
 $A \rightarrow C \times$ $AC \rightarrow H \checkmark$
 $B \rightarrow C \checkmark$ $D \rightarrow B \checkmark$
 $B \rightarrow E \checkmark$

Step 2:-

$$\begin{aligned}(A)^+ &= \{A, C, E, H\} \\ (A)^+ &= \{A, B, C, E, G, H\} \\ (B)^+ &= \{B, E\} \\ (B)^+ &= \{B, C\} \\ (A)^+ &= \{A, B, C, \textcircled{E}, H\}\end{aligned}$$

$$(AC)^+ = \{A, B, C, E\}$$

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

Step 3:-

$$(AC)^+ = \{A, G, H, B, E\}$$

$$(A)^+ = \{A, B, C, E, H\}$$

$$C^+ = \{C\}$$

$$\text{So } AC \rightarrow H$$

$$A \rightarrow H$$

Step 4:-

$$A \rightarrow H$$

$$B \rightarrow CE$$

$$D \rightarrow B$$

Question # 8

1. $F = (A \rightarrow C, AC \rightarrow DE \rightarrow AD)$

$$G = (A \rightarrow CD, E \rightarrow AH)$$

$$F \subseteq G$$

$$G \subseteq F$$

$$A^+ = \{A, C, D\}$$

$$A^+ = \{A, C, D, E\}$$

$$E^+ = \{E\}$$

$$(AC)^+ = \{A, C, D\}$$

$$(DE)^+ = \{D, E, A, H, C\}$$

$$(DE)^+ = \{D, E, A, H, C\}$$

F and G are not equivalent

$$2 \quad F = \{ A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H \}$$

$$Gr = \{ A \rightarrow CD, E \rightarrow AH \}$$

$$F \subseteq Gr$$

$$Gr \subseteq F$$

$$A^+ = \{ A, C, D \}$$

$$(AC)^+ = \{ A, C, D \}$$

$$E^+ = \{ A, E, H, C, D \}$$

$$A^+ = \{ A, C, D \}$$

$$E^+ = \{ A, D, C, H, E \}$$

$$(E)^+ = \{ A \} \text{ Equivalent.}$$

Question #9

$$F = \{ BC \rightarrow A, AD \rightarrow B, CD \rightarrow B, AC \rightarrow D \}$$

Essential Key = C

$$(AC)^+ = \{ A, B, C, D \}$$

$$(BC)^+ = \{ A, B, C, D \}$$

$$(DC)^+ = \{ A, B, C, D \}$$

$$P = A, B, C, D$$

$$N.P =$$

$$\text{Candidate Keys} = \{ AC, BC, DC \}$$

NF1, NF2, NF3 exist, so we assume all are atomic attributes. No partial and transitive dependencies exist. It is not BCNF. One of the FDs does not have Super Key as Best i.e $A \rightarrow B$

$R(A B C D)$

$R_1(\underline{A D B})$

$R_2(\underline{A C D})$

$F_1 = \{A D \rightarrow B\}$

$F_2 = \{AC \rightarrow D, CD \rightarrow A\}$

$CK = A C, C D$

$R_1(\underline{A D B}) \quad R_2(\underline{A C D})$

lossless but not dependency preserving ($B \rightarrow A$)

Question #10

$R(A B C D E)$, $F = \{AB \rightarrow C, DE \rightarrow C, B \rightarrow D\}$

Essential Key = E, $(ABE)^+ = \{A, B, C, D, E\}$

Candidate Key = ABE

\Rightarrow NF1 exists

\Rightarrow Removing partial dependency

$$AB \rightarrow C$$

$$(AB)^+ = \{A, B, C\}$$

$$B \rightarrow D$$

$$(B)^+ = \{B, D\}$$

$$R_1(\underline{AB}C) \quad R_2(\underline{B}D) \quad R_3(\underline{AB}E)$$

$$AB \rightarrow C$$

$$B \rightarrow D$$

$$AB \rightarrow E$$

\Rightarrow No transitive dependency $(ABE)^+ = \{A, B, C, D, E\}$

\Rightarrow BCNF

$$R_1(\underline{AB}C) \quad R_2(\underline{B}D) \quad R_3(\underline{AB}E)$$

lossless but not dependency preserving ie $D \rightarrow C$

Question #11

$$R(\underline{AB}(D), F = \{AB \rightarrow C, C \rightarrow D, D \rightarrow A\})$$

$$CK_s = AB, BC, CD$$

a) $R_1(\underline{AB}), R_2(\underline{CD}), R_3(\underline{DA})$

$$R_1, R_3(ABD), R_2(CD)$$

common attribute = D

$$D^+ = \{D, A\} \quad D^+ = \{D\}$$

Not CK

Not CK

As common attribute is not CK so it is not a lossless decomposition

b- $R_1(BC)$, $R_2(CD)$, $R_3(DA)$

$R_1, R_2(BCD)$ $R_3(DA)$
common attribute = D

$$D^+ = \{D\}$$

Not CK

$$D^+ = \{D, A\}$$

Not CK

$R_2, R_3(CDA)$

$R_1(BC)$

common attribute = C

$$C^+ = \{D, A\}$$

~~Not~~ CK

$$C^+ = \{C\}$$

Not CK

lossless decomposition because common attribute is CK in one relation.

Question# 12

$R(ABCD E)$

$$F = \{AC \rightarrow B, DE \rightarrow B, C \rightarrow E\}$$

$$CK = ACD$$

a- $R_1(ACB)$, $R_2(ACD)$, $R_3(CE)$

$R_1, R_2(ABCD)$ $R_3(CE)$

common attribute = C

$$C^+ = \{C, E\}$$

Not CK

$$C^+ = \{C, E\}$$

CK

$R_1, R_3(ABC E)$ $R_2(ACD)$

common attribute = AC

$$(AC)^+ = \{A, B, C, E\}$$

CK

$$(AC)^+ = \{A, C\}$$

Not CK

lossless decomposition

b- $R_1(ACB)$, $R_2(BDE)$, $R_3(CE)$

$R_1, R_2(ACBDE)$

$R_3(CE)$

common attribute = CE

$$(CE)^+ = \{C, E\}$$

Not CK

$$(CE)^+ = \{C, E\}$$

CK

$R_1, R_3(ACBE)$

$R_2(BDE)$

common attribute = BE

$$(BE)^+ = \{B, E\}$$

Not CK

$$(BE)^+ = \{B, E\}$$

Not CK

Not lossless decomposition.