Normalization

Q1.

We have a database table with relational schema R(XYZPQ):

X	Y	Z	P	Q
A1	B1	C1	D1	E1
A2	B2	C1	D2	E1
A3	B2	C2	D1	E2
A4	B3	C1	D3	E3
A5	B2	C2	D4	E2

Check the validity of the functional dependencies

- ZP -> Q
- YZ -> P
- Z -> Y
- Y -> X

Solution:

- ZP -> Q --- Valid
- YZ -> P --- Invalid
- Z -> Y --- Invalid
- Y -> X --- Invalid

Q2.

For a given relational schema S = (UVWXYZ), following functional dependencies hold:

U -> V

VW -> X

Y -> W

X -> U

Find Candidate keys

Solution:

YZ cannot be determined from the given functional dependencies (FDs). Hence, it will take part in the formation of candidate keys.

(YZ)+ = {YZW}

(UYZ)+ = {UYZVWX} (**Candidate Key**)

As X is producing U; so, U can be replaced by X

(XYZ)+ = {XYZUWV} (**Candidate Key**)

Now X can be replaced with VW and W can be derived by Y

(VWYZ)+ = (VYZ)+ = {VYZWXU}(**Candidate Key**)

Hence candidate keys are

{UYZ, XYZ, VYZ}

Q3:

If a functional dependency set F is {A -> B, BC -> E, ED -> A, EF -> G, E -> F}, find

The closure of attribute set (AC)

a. {A, B, C, D, E, F, G}
b. {B, C, D, A, E, G}
c. {B, C, D, A, E, F}
d. {B, C, A, E, F, G}

Solution:

(AC)+ = {A,C, B, E, F, G}

Q4:

Consider a relation R(ABCDEFGHIJ) with the following functional dependencies:

F = {AB -> C, A -> DE, B -> F, F -> GH, D -> IJ}

a. Find all the candidate keys of relation R.
   Solution:
   AB can not be determined from the given functional dependencies. Hence it will take part in Candidate key formation.
   (AB)+ = {ABCDEFGHIJ} (candidate key)
   Only one candidate key is possible for the given relation
b. Which dependency/ies is/are violating the condition of 2NF?

   Solution:

   Prime attributes: {A,B}

   Non-prime attributes: {C,D,E,F,G,H, I,J}

   The dependencies A -> DE and B -> F are partial dependencies. Hence, the dependencies are violating the condition of 2NF.

Q5:

A relation R(ABC) is having 5 tuples: (1,2,3), (4,2,3), (5, 3,3), (2,4,4), (4,3,7). Which of the following dependencies hold over relation R?

A -> B

AB -> C

B -> C

C -> B

Solution:

A	B	C
1	2	3
4	2	3
5	3	3
2	4	4
4	3	7

A -> B --- Invalid

AB -> C ---- Valid

B -> C ---- Invalid

C -> B ---- Invalid

Q6.

For a Relation R (A, B, C, D) and F = {A -> BC, AB -> D, B -> C} be the set of functional dependencies defined over R. Which of the following represents closure of attribute set (B)?

i. {ACD}
ii. {BC}
iii. {ABC}
iv. {B}

Solution:

(B)+ = {BC}

Q7.

Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.

F = {CH -> G, A -> BC, B -> CFH, E -> A, F -> EG} is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R.

How many candidate keys does the relation R have?

Solution:

Since D is not part of any functional dependency so it can be a candidate key or maybe part of a candidate key.

To find more candidate keys add A, B, C, D, E, G, and H to D & find its **closure**:

$(AD)^+ = \{ABCDEFGH\}$

$(BD)^+ = \{ABCDEFGH\}$

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

$(ED)^+ = \{ABCDEFGH\}$

$(FD)^+ = \{ABCDEFGH\}$

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

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

Since **AD, BD, ED and FD** gives all attributes, so they are candidate keys.

Q8.

Consider the relation scheme R = {E, F, G, H, I, J, K, L, M, N} and the set of functional dependencies

{{E, F} -> {G}, {F} -> {I, J}, {E, H} -> {K, L}, K -> {M}, L -> {N}} on R.

What is the key for R?

A. {E, F}

B. {E, F, H}

C. {E, F, H, K, L}

D. {E}

Solution:

Since EFH cannot be determined so it will part of candidate key or can be a candidate key.

(EFH)+ = {EFHGIJKLMN} (Candidate Key)

Q9.

Consider a relation R(XYZWV) with the given functional dependencies

F = {{X,Y} -> {Z,W}, {X,W,V} -> {Y,Z}}

Which of the following is the trivial functional dependency in F+?

{X,Z} -> {Z,W}

{X,V} -> {Y}

{X,W,V} -> {V,W}

{Y,W} -> {Y,X}

{X,W,V} -> {V,Y}

Solution:

{X,Z} -> {Z,W} (non-trivial)

{X,V} -> {Y} (non-trivial)

{X,W,V} -> {V,W} (trivial)

{Y,W} -> {Y,X} (non-trivial)

{X,W,V} -> {V,Y} (non-trivial)

Q10.

Consider a relation R(XYZWV) with the given functional dependencies

F = {{X,Y} -> {Z,W}, {X,W,V} -> {Y,Z}}

Final all the trivial functional dependencies from the given functional dependencies.

Solution:

XY -> XY

XY -> X

XY -> Y

XWV -> XWV

XWV -> XW

XWV -> VW

XWV -> VX

XWV -> X

XWV -> V

XWV -> W