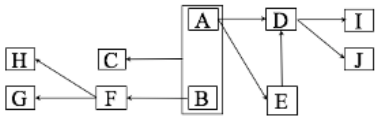
Dependencies Assignment

1. Considering the following relation, which of the following functional dependencies may hold? If the functional dependency cannot hold, explain what tuples cause the violation.

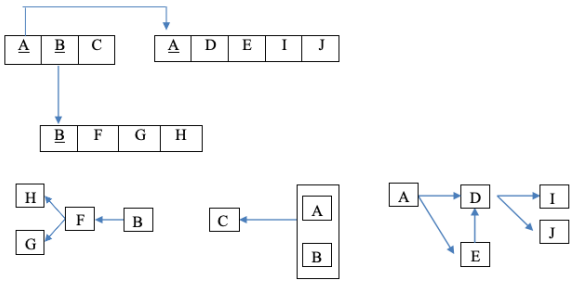
A	B	C
10	b1	c1
10	b2	c2
11	b4	c1
12	b3	c4
13	b1	c1

   a. A → B
      No, <10, b1>, <10, b2> violates the functional dependency.
   b. B → C
      Yes the functional dependency holds for all tuples.
   c. C → B
      No, <c1, b1>, <c1, b4> violates the functional dependency.
   d. B → A
      No, <b1, 10>, <b1, 13> violates the functional dependency.
   e. C → A
      No, <c1, 10>, <c1, 11>, <c1, 13> violates the functional dependency.

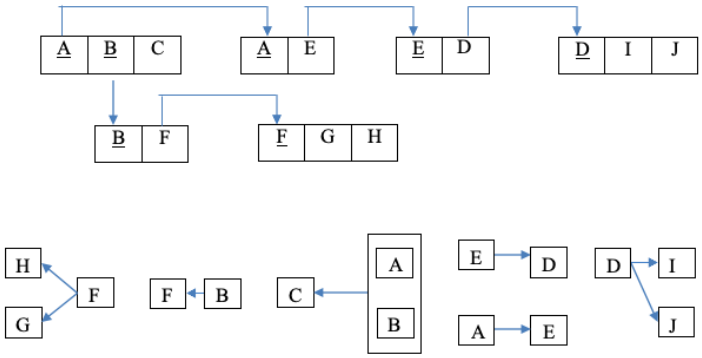
2. Given a 1NF relation FIRST with attributes {A, B, C, D, E, F, G, H, I, J} and the functional dependencies as well as the dependency diagram as follows:
   Functional Dependencies: {AB → C, A → DE, B → F, E → D, F → GH, D → IJ}
   Dependency Diagram:



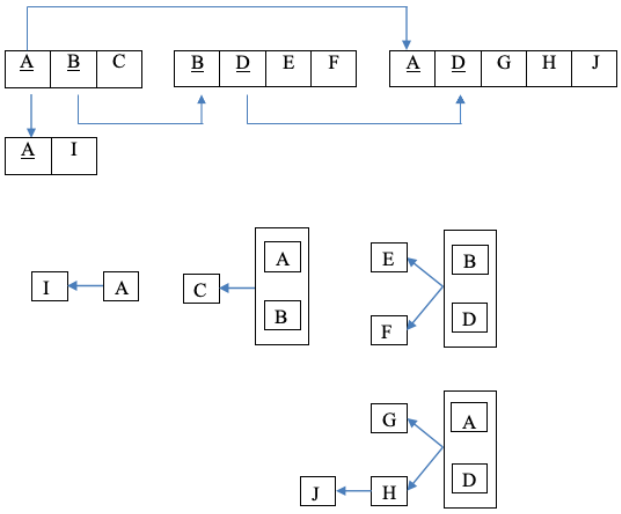
   a. What is the key for FIRST?
      AB
   b. Normalize FIRST into 2NF



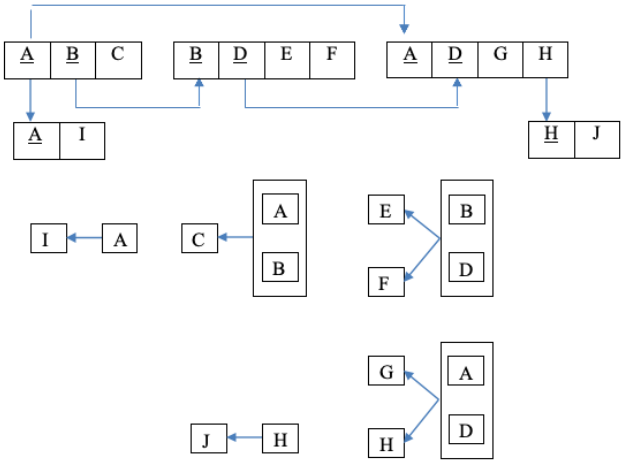
c. Normalize 2NF result form Part b) into 3NF



3. Repeat Question 2 for the following different set of functional dependencies.
   Functional Dependencies: {AB → C, BD → EF, AD → GH, A → I, H → J}
   a. What is the key of the relation?
      ABD
   b. Normalize the relation into 2NF

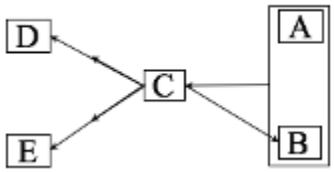


   c. Normalize the 2NF from Part b) into 3NF

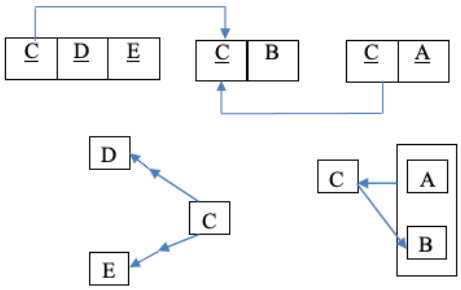


4. Given a 1NF relation SECOND with attributes {A, B, C, D, E} and the functional and multivalued dependencies as well as the dependency diagram as follows:
   Functional Dependencies: {AB → C, C → B}
   Multivalued Dependencies: {C →→ D, C →→ E}

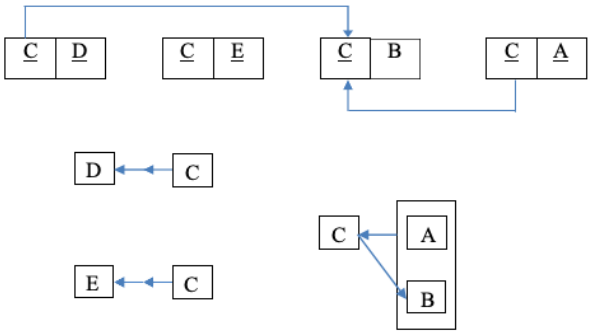
   Dependency Diagram:



   a. What is the key for SECOND?
      ACDE or ABDE
   b. What is the highest normal form this relation is in?
      3NF
   c. Normalize the relation into BCNF



   d. Normalize the result from Part c) into 4NF



5. Prove or disprove the following inference rules for functional/multivalued dependencies using the following interference rules:
   (R0) X → XX
   (R1) if Y ⊆ X, then X → Y
   (R2) X → Y = XZ → YZ
   (R3) X → Y, Y → Z = X → Z

   a. X → Y and Z ⊆ Y and W ⊆ Z = X → W
      Y → Z (R1)

$X \rightarrow Z$ (R3)
$Z \rightarrow W$ (R1)
$X \rightarrow W$ (R3)

b. $X \rightarrow Y, Z \rightarrow Y = X \rightarrow Z$
Disproof:

X	**Y**	**Z**
x1	y1	z1
x1	y1	z2

Relation satisfies $X \rightarrow Y$, but not $X \rightarrow Z$ because of <x1, z1> and <x1, z2>.

c. $X \rightarrow Y, XY \rightarrow Z = X \rightarrow Z$
$XX \rightarrow XY$ (R2)
$XY \rightarrow Z$
$XX \rightarrow Z$ (R3)
$X \rightarrow XX$ (R0)
$X \rightarrow Z$ (R3)

d. $X \rightarrow\rightarrow Y = X \rightarrow Y$
Disproof:

X	**Y**
x1	y1
x2	y2

Relation satisfies $X \rightarrow\rightarrow Y$, but not $X \rightarrow Y$ because of <x1, y1> and <x1, y2>.

e. $X \rightarrow Y, Z \rightarrow W = XZ \rightarrow YW$
$XZ \rightarrow YZ$ (R2)
$ZY \rightarrow WY$ (R2)
$ZX \rightarrow WY$ (R3)
$XZ \rightarrow YW$