

Problem 1

1. The given relation instance doesn't satisfy the functional dependency $AB \rightarrow C$. Because there are two rows in A and B are the same but with difference value of C: $A = B = 1$ but $C = 2$ and $C = 3$.
2. All the functional dependencies (involving the attribute A, B, C) that are satisfied by the relation instance:

X	X ⁺	ABC	AB	AC	BC	A	B	C
ABC	ABC	->	->	->	->	->	->	->
AB	ABC	->	->	->	->	->	->	->
AC	AC			->		->		->
BC	ABC	->	->	->	->	->	->	->
A	A					->		
B	ABC	->	->	->	->	->	->	->
C	AC			->		->		->

$ABC \rightarrow ABC$, $ABC \rightarrow AB$, $ABC \rightarrow AC$, $ABC \rightarrow BC$, $ABC \rightarrow A$, $ABC \rightarrow B$, $ABC \rightarrow C$
 $AB \rightarrow ABC$, $AB \rightarrow AB$, $AB \rightarrow AC$, $AB \rightarrow BC$, $AB \rightarrow A$, $AB \rightarrow B$, $AB \rightarrow C$
 $AC \rightarrow AC$, $AC \rightarrow A$, $AC \rightarrow C$
 $BC \rightarrow ABC$, $BC \rightarrow AB$, $BC \rightarrow AC$, $BC \rightarrow BC$, $BC \rightarrow A$, $BC \rightarrow B$, $BC \rightarrow C$
 $A \rightarrow A$
 $B \rightarrow ABC$, $B \rightarrow AB$, $B \rightarrow AC$, $B \rightarrow BC$, $B \rightarrow A$, $B \rightarrow B$, $B \rightarrow C$
 $C \rightarrow AC$, $C \rightarrow A$, $C \rightarrow C$

Problem 2:

$R = (A, B, C)$ prove that the functional dependency $AB \rightarrow C$

Prove:

Let's take t_1, t_2

Such that $t_1[AB] = t_2[AB]$

It follows that $t_1[A] = t_2[A]$

And $t_1[B] = t_2[B]$

Because $A \rightarrow B$ it follows $t_1[B] = t_2[B]$

$B \rightarrow C$ $t_1[C] = t_2[C]$

All together $t_1[BC] = t_2[BC]$

We proved that $AB \rightarrow C$

Problem 3:

1. The set of all functional dependencies that are implied by F and there are 29 functional dependencies

The 19 functional dependencies that are trivial:

$ABC \rightarrow ABC$, $ABC \rightarrow AB$, $ABC \rightarrow AC$, $ABC \rightarrow BC$, $ABC \rightarrow A$, $ABC \rightarrow B$, $ABC \rightarrow C$
 $AB \rightarrow AB$, $AB \rightarrow A$, $AB \rightarrow B$
 $BC \rightarrow BC$, $BC \rightarrow B$, $BC \rightarrow C$
 $AC \rightarrow AC$, $AC \rightarrow A$, $AC \rightarrow C$
 $A \rightarrow A$
 $B \rightarrow B$
 $C \rightarrow C$

The 10 functional dependencies that are not trivial

$AC \rightarrow ABC$, $AC \rightarrow AB$, $AC \rightarrow BC$, $AC \rightarrow B$
 $BC \rightarrow ABC$, $BC \rightarrow AB$, $BC \rightarrow AC$, $BC \rightarrow A$
 $A \rightarrow AB$, $A \rightarrow B$

2. The superkey: ABC, AC, BC
Key: AC, BC

Problem 4:

1. A key of V: (Date, Pno)
2. V is not BCNF because

Pno is not a superkey of V because $Pno^+ = (Pno, Pname)$

Dno is not a superkey of V because $Dno^+ = (Dno, Dname)$

Diagnosis is not a superkey of V because $Diagnosis^+ = (Diagnosis, Cost)$

(Date, Pno) is a key of V because $(Date, Pno)^+ = (Date, Pno, Pname, Dno, Dname, Diagnosis, Cost)$

Therefore, V is not BCNF (3 violations)

3. $V1 = (Date, Pno, Dname)$ is not BCNF because the functional dependency $Pno \rightarrow Pname$ whose left hand side is not a superkey $Pno^+ = (Pno, Pname)$.
4. $V2 = (Date, Pno, Dname, Diagnosis, Cost)$ is not BCNF because $Dno \rightarrow Dname$ and $Diagnosis \rightarrow Cost$ whose left handside are not a superkey.
5. $V1$ and $V2$ is not a lossess-join decomposition because the common attribute (Date) is not a superkeys of either the component relations $V1$ and $V2$
6. A losses_join decomposition of V into BCNF relation schema is $(Pno, Pname)$, $(Dno, Dname)$, $(Diagnosis, Cost)$, $(Date, Pno, Dname, Diagnosis)$

Problem 5:

1. The functional dependencies that denote the information given:

$Pno \rightarrow Pname$

$Sno \rightarrow Sname$

$(Sno, Date) \rightarrow Loc$

$(Date, Loc) \rightarrow Sno$

$(Pno, Date, Time) \rightarrow Loc$

$(Loc, Date, Time) \rightarrow Pno$

$(Sno, Date, Time) \rightarrow Pno$

$(Pno, Date, Time) \rightarrow Sno$

2. The negative aspects of the initial relation:

There are 4 functional dependencies are repeating and are unnecessary. If we update the information, we also have to update the Pno, Sno.

$(Pno, Date, Time) \rightarrow Loc$

$(Pno, Date, Time) \rightarrow Sno$

$(Sno, Date) \rightarrow Loc$

$(Sno, Date, Time) \rightarrow Pno$

3. A losses join decomposition of R into BCNF relation schema:

$(Pno, Pname), (Sno, Sname), (Sno, Date, Loc), (Pno, Sno, Date, Time)$