CS 550

Assignment 5

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Answer 1.

1	$AB \to C$	No
2	$A \to B$	Yes
3	$C \to A$	No
4	$BC \to A$	No
5	$ABC \to A$	No
6	$AB \to AC$	No

Answer 2. 1. Cover of F

$F = \{B \to A, A \to C\}$

Let G be cover of F

$\therefore$ G = { all of FD's logically implied }

(i) $B \to C$ - transitivity

(ii) $AB \to C$ - Transitivity & covered by (i)

Add (i) to G

$\therefore \quad G = \{B \to C\}$

2.2. Non-empty instance of R

A	B	C
1	1	2
1	2	2

2.3 Above table does not statisfy $A \to B$
but satisfies every FD in F

2.4. No. $AB \to C$ is logically implied by
the FD's in F
$\because A \to C$ and $B \to A$
which gives $AB \to C$ after union&
psuedo transitivity

Answer 3 $F = \{B \to CE, E \to D, E \to CD, B \to CE, B \to A\}$
$G = \{E \to CD, B \to AE\}$

Yes they are equivalent. Below is the explaination:

For FD's in F :

$B \to CE$ & $B \to A$

$\Rightarrow B \to ACE$

$\Rightarrow B \to AE$

~~$B \to CE$ & $E \to D$~~

$\Rightarrow$ ~~$B \to$~~ $E \to CD$ (directly given)

For FD's in G:

$E \to CD$

$\Rightarrow E \to C$ — (i)

$\Rightarrow E \to D$ — (ii)

$B \to AE$

$\Rightarrow B \to A$ — (iii)

$\Rightarrow B \to E$ — (iv)

$\Rightarrow B \to C$ (by (i) & iv) ——— (V)
$\Rightarrow B \to CE$ (by (V) & iv)

$E \to D$ (directly given
$E \to CD$ (directly given)

$B \to CE$ (proved
$B \to A$ (by (iii) decomposition)

Hence proved.

Answer 4 1. No, R is not in BCNF.
We know A is not super key since it does not appear LHS of any other FD other than $A \to DE$.
$A \to DE$ must be trivial for R to be in ~~BA~~ BCNF, but it is not.
And $A \to DE$ where A is not a ~~sp~~ super key and it does not determine anything but D and E.
Hence R is not in BCNF.

4.2. No, R is not in 3NF.
~~Pr~~ Proof:
It it were in 3NF, then all FD's in F are trivial, or LHS has to be superkey, or RHS must be part of ~~a~~ key.
~~As~~ As A → DE does not ~~st~~ satisfy any of the option above & DE is not part of a key since only IJ is the key.
Therefore R is not in 3NF.

Answer 5. 1. We see that E is a superkey and so C is also a superkey as C → E & D is also a superkey as D → BC we have D → C and A is a superkey as A → D.
Therefore B is a superkey as B → A.
LHS of every FD ~~is~~ is superkey. Therefore R is in ~~BN~~ BCNF.

5.2. S & T are lossless join decomposition of R if $CDE \cap BAD = D$ determines all attributes in S or T for every instance in R.

By $D \to BC$ and $C \to E$

we have $D \to CDE$

D is a superkey and shows that it is lossless decomposition.

5.3. $F^+_{CDE} = \{ C \to D,$ $(C \to E$ & $E \to D)$

$C \to E,$

$D \to C,$ $(D \to BC)$

$D \to E,$ $(D \to C$ & $C \to E)$

$E \to C,$ $(E \to D$ & $D \to C)$

$E \to D,$

$C \to CE,$

$D \to CD,$

$E \to CD,$

$CE \to D,$

$CD \to E,$

$DE \to C \}$

5.4. $F^+_{ABD} = \{ A \to B,$
$A \to D,$
$B \to A,$
$B \to D,$
$D \to A,$
$D \to B,$
$A \to BD,$
$B \to AD,$
$D \to AB,$
$AD \to B,$
$AD \to D,$
$BD \to A\}$

5.5. Yes. ~~We observe that~~ The decomposition of R into S and T is dependency-preserving if $(F_{CDE} \cup F_{ABD})^+ = F^+$.
We see that FD's in F imply that all attributes all attributes ~~of~~ i.e F^+ contains all possible FD's over ABCDE.
We already saw ~~De~~ all attributes determine D & vice versa.
Therefore all attributes determine all attributes

Answer 6. 1

A never appear on LHS, any key must have A. Similarly D never appear on LHS & determined by B. D will never be in candidate key

If we add B ~~to A~~ we have

$AB \to CEF$ & $B \to D$. Hence AB is candidate key

If we add C, we have $AC \to F$

we add E, we get $ACE \to B$ and by $B \to D$. Therefore we has ACE as candidate key.

If we add F, $AEF \to BC$ & thus all attributes are determined. AEF is also candidate

So we have candidate keys as

AB, ACE, AEF

6.2 No, The FD $B \to D$ holds for R, but is not trivial.
Also B is not superkey & D is not part of a key

6.3 No, same reason as for 6.2

6.4 $FE \to B$
$AC \to F$
$AC \to D$
$AB \to C$