

Part 2

Answer 1.

Relation R with attributes ABCDEFGH

FD's given:

$A \rightarrow C, A \rightarrow D, C \rightarrow F, G \rightarrow B, G \rightarrow H, G \rightarrow D, CD \rightarrow G, BF \rightarrow G, BCG \rightarrow F, BCG \rightarrow H, DF \rightarrow E, DEF \rightarrow B, DEF \rightarrow C, DEF \rightarrow D, AD \rightarrow G, E \rightarrow A, E \rightarrow C, E \rightarrow D$

(a) Minimal Basis:

1. **$A \rightarrow C$** ✓

2. **$A \rightarrow D$** ✓

3. **$C \rightarrow F$** ✓

4. **$G \rightarrow B$** ✓

5. **$G \rightarrow H$** ✓

6. **$G \rightarrow D$** ✓

7. **$CD \rightarrow G$** ✓

8. $BF \rightarrow G$ ✗ : This can be achieved using 5, $G \rightarrow H$

9. $BCG \rightarrow F$ ✗ : This can be achieved using 3, $C \rightarrow F$

10. $BCG \rightarrow H$ ✗ : This can be achieved using 5, $G \rightarrow H$

11. **$DF \rightarrow E$** ✓

12. $DEF \rightarrow B$ ✗ : This can be achieved using 1,2,7,4,16, $[E^+] = EAD\overline{C}GB$

13. $DEF \rightarrow C$ ✗ : This can be achieved using 1,16, $[E^+] = EAC$

14. $DEF \rightarrow D$ ✗ : This can be achieved using 2,16, $[E^+] = EAD$

15. $AD \rightarrow G$ ✗ : This can be achieved using 1,2,7, $[A^+] = ACD\overline{G}$

16. **$E \rightarrow A$** ✓

17. $E \rightarrow C$ ✗ : This can be achieved using 1,16, $[E^+] = EAC$

18. $E \rightarrow D$ x : This can be achieved using 2,16, $[E^+]=EAD$

Therefore,

1. $A \rightarrow C, A \rightarrow D, C \rightarrow F, E \rightarrow A, G \rightarrow B, G \rightarrow H, G \rightarrow D, CD \rightarrow G, DF \rightarrow E$

(b) 3NF decomposition of R

Step1. Finding FD that violates R

- **$A \rightarrow C$** , $[A^+]=ABCDEFGH$ ✓ : As A is a key
- **$A \rightarrow D$** , $[A^+]=ABCDEFGH$ ✓ : As A is a key
- **$C \rightarrow F$** , $[C^+]=CF$ xviolates: As neither C is a key nor F is a prime
- **$E \rightarrow A$** , $[E^+]=ABCDEFGH$ ✓ : As E is a key
- **$G \rightarrow B$** , $[G^+]=BDGH$ xviolates: As neither G is a key nor B is a prime
- **$G \rightarrow H$** , $[G^+]=BDGH$ xviolates: As neither G is a key nor H is a prime
- **$G \rightarrow D$** , $[G^+]=BDGH$ ✓: As D is a prime
- **$CD \rightarrow G$** , $[CD^+]=ABCDEFGH$ ✓: As CD is a key
- **$DF \rightarrow E$** , $[DF^+]=ABCDEFGH$ ✓: As DF is a key

Step2. Decomposing using FD, **$G \rightarrow H$**

$[G^+]=BDGH$

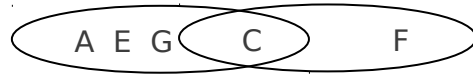


Therefore, the 2 decomposition are :

R1:ACEFG & R2:GBDH

FD, **$C \rightarrow F$** violates R1

$[C^+]=CF$



Decomposing R1 further into

R3: AEGC & R4:CF

The following are the 3NF decomposition:

R2: GBDH , key(s) : G ($[G^+] = BDGH$)

R3: AEGC , key(s) : A and E (keys for relation R)

R4: CF, key(s): C ($[C^+] = CF$)

Answer 2.

Relation R with attributes HIJK

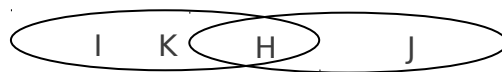
FDs given:

$JK \rightarrow H$, $JK \rightarrow I$, $H \rightarrow J$, $I \rightarrow K$

Step1. Finding FD that violates BCNF

$H \rightarrow J$ violates as $[H^+] = HJ$

Decomposing:



R1: IKH & R2: HJ

$I \rightarrow K$ violates R1 as $[I^+] = IK$

Decomposing R1:



R3: HI & R4: IK

So these decomposed relations are:

R2: HJ , FD : $H \rightarrow J$

R3: HI (key) as $[HI] = HIJK$, FDs: $H \rightarrow J, I \rightarrow K$

R4: IK , FD : $I \rightarrow K$