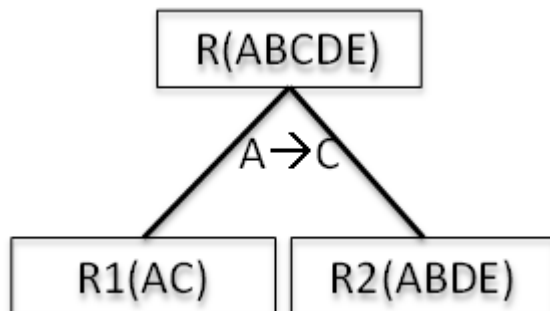


**Question 1 – You may get different solutions depending on the order you normalised the FDS**

**a)**

$AB^+ = ABCDE$  (AB is the candidate key)



Final answer:

$R1 [A, C]$

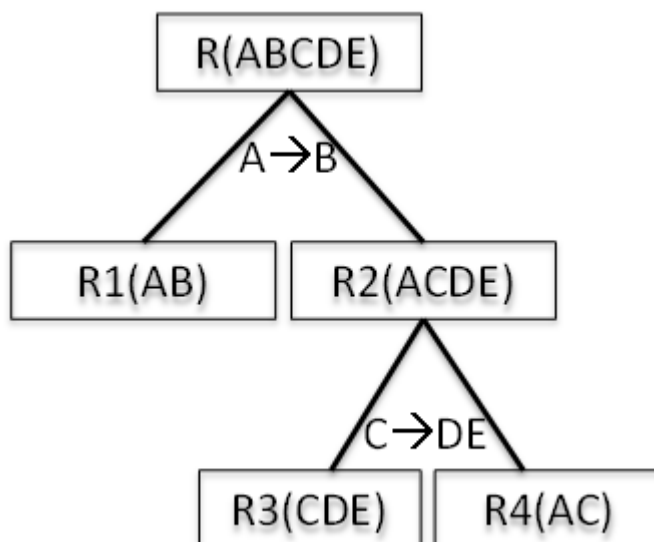
FD 1:  $A \rightarrow C$

$R2 [A, B, D, E]$

FD2:  $\{A, B\} \rightarrow \{D, E\}$

**b)**

$AC^+ = ABCDE$  (AC is the candidate key)



Final answer:

$R1[A, B]$

FD1:  $A \rightarrow B$

R3[C, D, E]

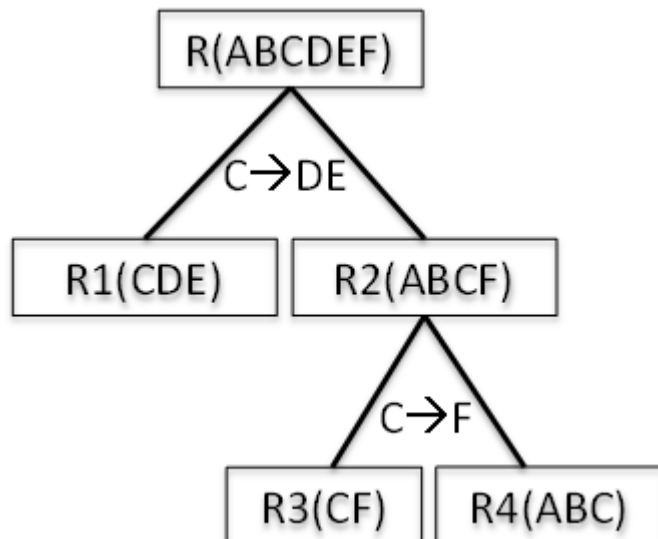
FD2:  $C \rightarrow \{D, E\}$

R4[A, C]

No non-trivial FD

c)

$A^+ = ABCDEF$  (A is the candidate key)



Functional dependency  $E \rightarrow F$  is lost

Final answer:

R1[C, D, E]

FD2:  $C \rightarrow \{D, E\}$

R3[C, F]

$C \rightarrow F$  [Implicit FD]

R4[A, B, C]

FD1:  $A \rightarrow \{B, C\}$

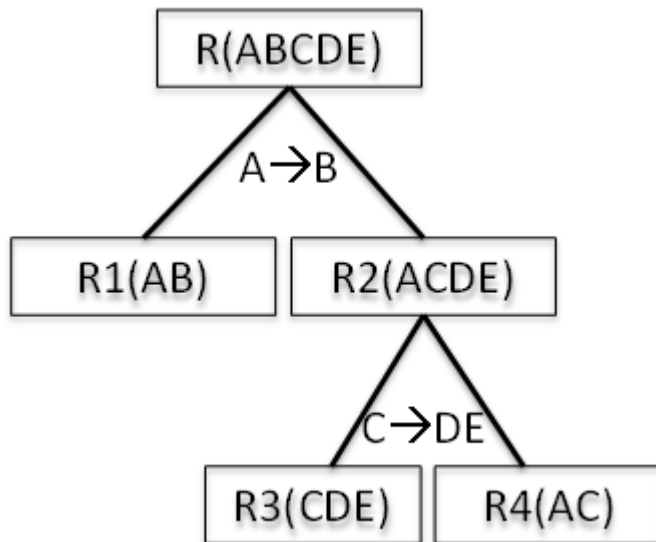
d)

$AC^+ = ABCDE$

$ADE^+ = ADECB$

$BC^+ = BCAD E$

AC, ADE, BC are all candidate keys



Functional dependencies  $\{A, D, E\} \rightarrow C$  and  $\{B, C\} \rightarrow A$  are lost

Final answer:

R1[A, B]	FD1: $A \rightarrow B$
R3[C, D, E]	FD2: $C \rightarrow \{D, E\}$
R4[A, C]	No non-trivial FD

Notice that this is the same solution as **b)**, think why this is the case despite **d)** having double the number of initial FDs. What is lost?

## Question 2

a)

### FDs in Standard Form

$$A \rightarrow D$$

$$A \rightarrow E$$

$$D \rightarrow A$$

$$B \rightarrow C$$

$$\{B, C\} \rightarrow A$$

$$\{B, C\} \rightarrow D$$

$$\{E, A\} \rightarrow D$$

### Minimize LHS

$$A \rightarrow D$$

$$A \rightarrow E$$

$$D \rightarrow A$$

$$B \rightarrow C$$

$$B \rightarrow A$$

$$B \rightarrow D$$

$$A \rightarrow D$$

### Delete Redundancy (Final Result)

$$A \rightarrow D$$

$$A \rightarrow E$$

$$D \rightarrow A$$

$$B \rightarrow C$$

$$B \rightarrow A$$

**b)**

FDs in Standard Form

$A \rightarrow B$

$A \rightarrow C$

$A \rightarrow D$

$A \rightarrow E$

$A \rightarrow F$

$\{B, C\} \rightarrow A$

$\{D, E\} \rightarrow B$

$C \rightarrow D$

Minimize LHS

No Changed Possible

Delete Redundancy

We can delete  $A \rightarrow D$  and  $A \rightarrow B$  as they are redundant

Final Result

$A \rightarrow C$

$A \rightarrow E$

$A \rightarrow F$

$\{B, C\} \rightarrow A$

$\{D, E\} \rightarrow B$

$C \rightarrow D$

**Question 3 – You may get different solutions depending on the order you normalised the FDs.**

**a)**

FDs after Minimal Cover is determined:

FD 1:  $\{A, B\} \rightarrow C$

FD 2:  $C \rightarrow D$

FD 3:  $C \rightarrow E$

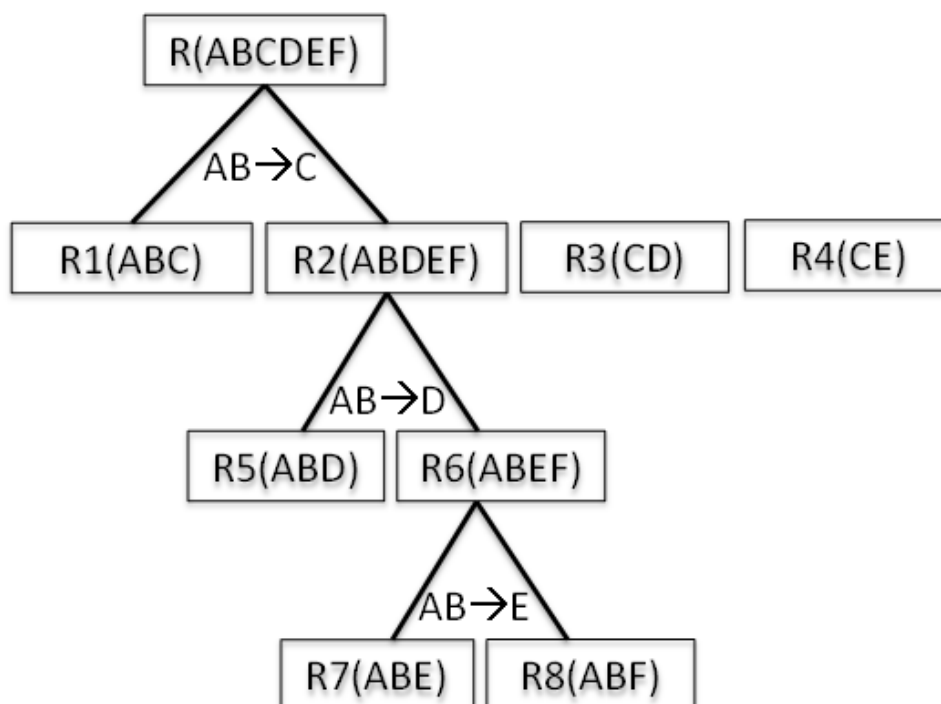
Through transitive rule we can derive 2 implicit FDs

FD4:  $\{A, B\} \rightarrow D$

FD5:  $\{A, B\} \rightarrow E$

$ABF^+ = ABFCDE$  (ABF is the candidate key)

Prime attributes: A, B, F



Final answer:

R1[A, B, C]

FD 1:  $\{A, B\} \rightarrow C$

R3[C, D]

FD 2:  $C \rightarrow D$

[To preserve the FD]

R4[C, E]

FD 2:  $C \rightarrow E$

[To preserve the FD]

R5[A, B, D]

FD 4:  $\{A, B\} \rightarrow D$

[Implicit FD]

R7[A, B, E]

FD 5:  $\{A, B\} \rightarrow E$

[Implicit FD]

R8[A, B, F]

No non-trivial FD

**b)**

FDs after Minimal Cover is determined:

FD 1:  $\{A, B\} \rightarrow C$

FD 2:  $\{C, D\} \rightarrow E$

FD 3:  $D \rightarrow F$

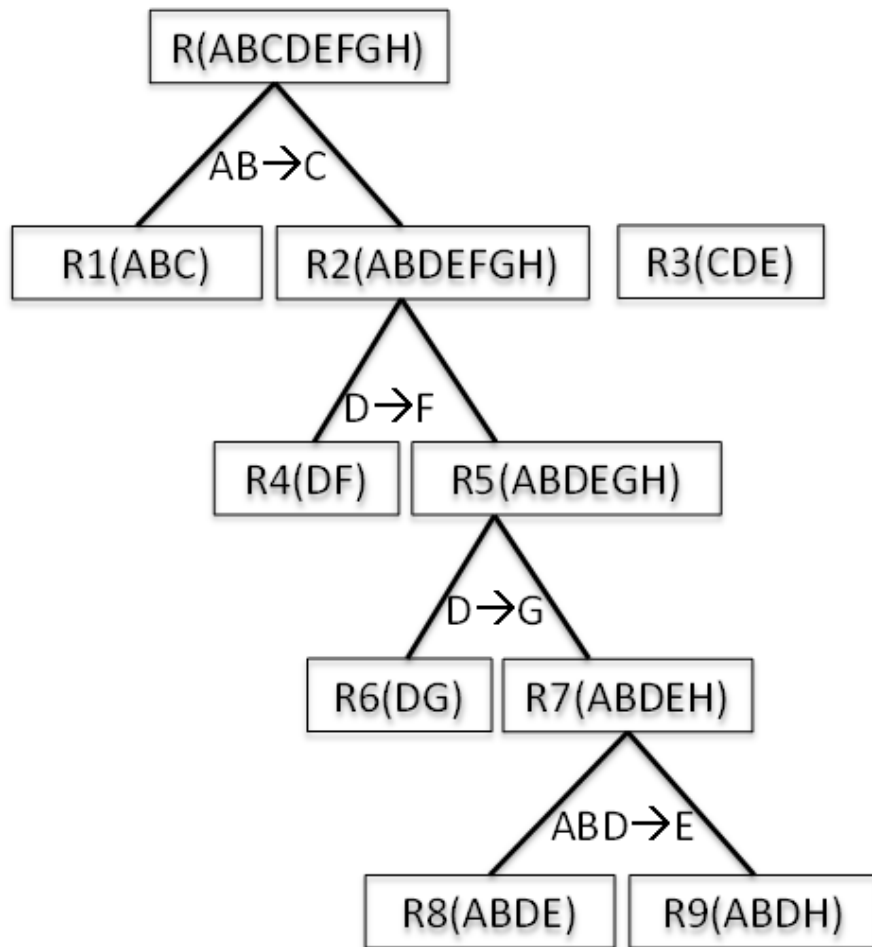
FD 4:  $D \rightarrow G$

Using the pseudotransitive rule we can derive one implicit FD

FD5:  $\{A, B, D\} \rightarrow E$

$ABDH^+ = ABDHCEFG$  (ABDH is the candidate key)

Prime attributes: A, B, D, H



Final answer:

R1[A, B, C]

R3[C, D, E]

R4[D, F]

R6[D, G]

R8[A, B, D, E]

R9[A, B, D, H]

FD 1:  $\{A, B\} \rightarrow C$

FD 2:  $\{C, D\} \rightarrow E$  [To preserve the FD]

FD 3:  $D \rightarrow F$

FD 4:  $D \rightarrow G$

FD 5:  $\{A, B, D\} \rightarrow E$  [Implicit FD]

No non-trivial FD