Experiment 4

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Q1. Consider a relation R having attributes as R(ABCD), functional dependencies are given below:

AB->C, C->D, D->A

Identify the set of candidate keys possible in relation R. List all the set of prime and non prime attributes.

Given: R(A,B,C,D) with FDs

- $AB \rightarrow C$
- $C \rightarrow D$
- $D \rightarrow A$

$(AB)+ = ABCD$

$(BC)+ = ABCD$

$(BD)+ = ABCD$

So the Candidate Keys are : **{ AB, BC, BD }**

Prime attributes: { A, B, C, D }

Non-prime attributes: none $\rightarrow \emptyset$

Normal form :

BCNF: No

- Condition: For every FD $X \rightarrow Y$,X must be a superkey.
- $C \rightarrow D$: C is not a superkey $\rightarrow$ violates.
- $D \rightarrow A$: D is not a superkey $\rightarrow$ violates.

3NF: Yes

- Condition: For every FD $X \rightarrow Y$, either X is a superkey **or** every attribute in Y is prime.
- $AB \rightarrow C$: AB is a key $\rightarrow$ OK.

- C→D: C not a superkey, but D is prime → OK.
- D→A not a superkey, but A is prime → OK.

Normal Form : 3NF

Q2. Relation R(ABCDE) having functional dependencies as :
A->D, B->A, BC->D, AC->BE
Identify the set of candidate keys possible in relation R. List all the set of prime and non prime attributes.

Given: R(A,B,C,D,E) with FDs

- $A \rightarrow D$
- $B \rightarrow A$
- $BC \rightarrow D$
- $AC \rightarrow BE$

Closures:

- (BC)+ = {A,B,C,D,E}
- (AC)+ = {A,B,C,D,E}

So the Candidate Keys are: { BC, AC }
Prime attributes: { A, B, C }
Non-prime attributes: { D,E }
Normal form:

BCNF: **No**

- Condition: For every FD X→Y, X must be a superkey.
- A→D: A not a superkey → violates.
- B→A: B not a superkey → violates.
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3NF: No

- Condition: For every FD X→Y, either X is a superkey or every attribute in Y is prime.
- A→D: A not a superkey, D is non-prime → violates → not in 3NF.
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2NF: No
Normal Form: 1NF

Q3. Consider a relation R having attributes as R(ABCDE), functional dependencies are given below:

B->A, A->C, BC->D, AC->BE
Identify the set of candidate keys possible in relation R. List all the set of prime and non prime attributes.

Given: R(A,B,C,D,E) with FDs

- B → A
- A → C
- BC → D
- AC → BE

Closures:

☐ (A)+ = {A, C, B, E, D} = {A,B,C,D,E}

☐ (B)+ = {B, A, C, E, D} = {A,B,C,D,E}

☐ (C)+ = {C}

☐ (D)+ = {D}

☐ (E)+ = {E}

Candidate Keys: { A, B }

Prime attributes: { A, B }
Non-prime attributes: { C, D, E }

BCNF: Yes

- B→A: B is a superkey → Ok
- A→C: A is a superkey → Ok

   So on.. all LHS are superkeys

Normal Form: BCNF

Q4.Consider a relation R having attributes as R(ABCDEF), functional dependencies are given below:

A->BCD, BC->DE, B->D, D->A

Identify the set of candidate keys possible in relation R. List all the set of prime and non prime attributes.

Given: R(A,B,C,D,E,F) with FDs

- $A \rightarrow B\ C\ D$
- $BC \rightarrow D\ E$
- $B \rightarrow D$
- $D \rightarrow A$

Closures:

- $(A)+ = \{A, B, C, D, E\}$
- $(B)+ = \{A, B, C, D, E\}$
- $(D)+ = \{A, B, C, D, E\}$
- $(F)+ = \{F\}$
- $(AF)+ = \{A,B,C,D,E,F\} \rightarrow$ key
- $(BF)+ = \{A,B,C,D,E,F\} \rightarrow$ key
- $(DF)+ = \{A,B,C,D,E,F\} \rightarrow$ key

Candidate Keys: { AF, BF, DF }

Prime attributes: { A, B, D, F }
Non-prime attributes: { C, E }

BCNF: No

- A→BCD: A is not a superkey → violates.

3NF: No

- A→C (part of A→BCD): A not a superkey and C is non-prime → violates.

2NF: No

- AF is a key, but A→C (C non-prime) is a partial dependency on part of key AF → violates.

1NF: Yes — attributes assumed atomic.

Normal Form: 1NF

Q5. Designing a student database involves certain dependencies which are listed below:

X ->Y

WZ ->X

WZ ->Y

Y ->W

Y ->X

Y ->Z

Given: attributes {W, X, Y, Z} with FDs

- $X \to Y$

- $WZ \to X$

- $WZ \to Y$

- $Y \to W$

- $Y \to X$

- $Y \to Z$

Closures:

- $(Y)+ = \{Y, W, X, Z\}$ = all attributes → Y is a key.

- $(X)+ = \{X, Y, W, Z\}$ = all attributes → X is a key.

- $(WZ)+ = \{W, Z, X, Y\}$ = all attributes → WZ is a key.

Candidate Keys: { X, Y, WZ }
Prime attributes: { W, X, Y, Z }
Non-prime attributes: ∅

BCNF: Yes

- Every FD has LHS that is a superkey (X, Y, WZ) → satisfies BCNF.

Normal Form: BCNF

Q6. Debix Pvt Ltd needs to maintain database having dependent attributes ABCDEF. These attributes are functionally dependent on each other for which functionally dependency set F given as:

{A -> BC, D -> E, BC -> D, A -> D} Consider a universal relation R1(A, B, C, D, E, F) with functional dependency set F, also all attributes are simple and take atomic values only. Find the highest normal form along with the candidate keys with prime and non-prime attribute.

Given: R(A,B,C,D,E,F) with FDs

- $A \rightarrow B\ C$

- $D \rightarrow E$

- $BC \rightarrow D$

- $A \rightarrow D$

Closures:

- $(A)+ = \{A, B, C, D, E\}$

- $(AF)+ = \{A, B, C, D, E, F\} \rightarrow$ key

- $(BC)+ = \{B, C, D, E\}$

- $(D)+ = \{D, E\}$

- $(F)+ = \{F\}$

Candidate Keys: { AF }
Prime attributes: { A, F }
Non-prime attributes: { B, C, D, E }

BCNF: No

- $A \rightarrow BC$ / $A \rightarrow D$: A not a superkey $\rightarrow$ violates.

3NF: No

- $A \rightarrow BC$: A not a superkey and B,C are non-prime $\rightarrow$ violates.

2NF: No

- AF is a key, $A \rightarrow BC$ (BC non-prime) is a partial dependency on part of the key $\rightarrow$ violates.

1NF: Yes — attributes atomic.

Normal Form: 1NF