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EXPERIMENT:4

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1. AIM:-

Solve the Problem related to Normalisation and give it closure ,candidate key along with prime attribute and non-prime attribute and in which type of normal exist

Problem 1

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.

Solution

Closures to find candidate keys

(AB)⁺

- Start: {A, B}
- From $AB \rightarrow C \Rightarrow \{A, B, C\}$
- From $C \rightarrow D \Rightarrow \{A, B, C, D\}$
- From $D \rightarrow A$ already there.

$AB^+ = \{A, B, C, D\} \Rightarrow AB$ is a candidate key.

(BC)⁺

- Start: {B, C}
- From $C \rightarrow D \Rightarrow \{B, C, D\}$
- From $D \rightarrow A \Rightarrow \{A, B, C, D\}$

$BC^+ = \{A, B, C, D\} \Rightarrow BC$ is a candidate key

(BD)+

- Start: {B, D}
- From $D \rightarrow A \Rightarrow \{A, B, D\}$
From $AB \rightarrow C \Rightarrow \{A, B, C, D\}$
 $BD^+ = \{A, B, C, D\} \Rightarrow BD$ is a candidate key
-

(CD)+

- Start: {C, D}
- From $C \rightarrow D \Rightarrow \{C, D\}$ (no change)
- From $D \rightarrow A \Rightarrow \{A, C, D\}$
- From $AB \rightarrow C$ (needs B, but not present) \rightarrow stop.
CD is **not** a key.

Candidate Keys = {AB, BC, BD}

Prime and Non-prime Attributes

- Prime attributes = appear in at least one candidate key.
 - Candidate keys: {AB}, {BC}, {BD} ◦ Prime attributes = {A, B, C, D} (since all appear across candidate keys).
- Non-prime attributes = none (all are prime).

Given Relation is in 3rd normal Form

Problem 2

Relation R(ABCDE) having functional dependencies as :

$A \rightarrow D$,

$B \rightarrow A$,

$BC \rightarrow D$,

$AC \rightarrow BE$

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

Solution

Step 1: closures to find candidate keys

(B, C)+

- Start: {B, C}
- From $B \rightarrow A \Rightarrow \{A, B, C\}$
- From $A \rightarrow D \Rightarrow \{A, B, C, D\}$
- From $AC \rightarrow BE$ (since A and C present) $\Rightarrow \{A, B, C, D, E\}$ BC is a candidate key.

(A, C)+

- Start: {A, C}
- From $A \rightarrow D \Rightarrow \{A, C, D\}$
- From $AC \rightarrow BE \Rightarrow \{A, B, C, D, E\}$
AC is a candidate key.

(B, E)+

- Start: {B, E}
- From $B \rightarrow A \Rightarrow \{A, B, E\}$
- From $A \rightarrow D \Rightarrow \{A, B, D, E\}$
- From $AC \rightarrow BE$ (need C)
- From $BC \rightarrow D$ (need C)
So {B, E, A, D} (missing C) not a key.

(B, C, E)+

- Start: {B, C, E}
- $B \rightarrow A \Rightarrow \{A, B, C, E\}$
- $A \rightarrow D \Rightarrow \{A, B, C, D, E\}$.
- But BC alone is already a key \rightarrow So BCE is superkey, not minimal.

So, Candidate Keys = {BC, AC}

- Prime attributes = those that appear in at least one candidate key.
 - Candidate keys = {BC, AC} ◦ Prime attributes = {A, B, C}.
- Non-prime attributes = the rest.
 - Non-prime = {D, E}.

Normal Form

Given Relation is in 1Normal Form

Problem 3. Consider a relation R having attributes as R(ABCDE), functional dependencies are given below:

**B \rightarrow A,
A \rightarrow C,
BC \rightarrow D,**

AC→BE

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

Solution

Compute Closures

(B, C)+

- Start: {B, C}
- From $B \rightarrow A \Rightarrow \{A, B, C\}$
- From $A \rightarrow C$ (C already present)
- From $AC \rightarrow BE \Rightarrow \{A, B, C, E\}$
- From $BC \rightarrow D \Rightarrow \{A, B, C, D, E\}$.

BC is a candidate key.

(A, C)+

- Start: {A, C}
- From $A \rightarrow C$ (no change)
- From $AC \rightarrow BE \Rightarrow \{A, B, C, E\}$
- From $B \rightarrow A$ (already have A)
- From $BC \rightarrow D \Rightarrow \{A, B, C, D, E\}$.

AC is a candidate key.

(B, A)+ (same as AB)

- Start: {A, B}
- From $B \rightarrow A$ (already there)
- From $A \rightarrow C \Rightarrow \{A, B, C\}$
- From $AC \rightarrow BE \Rightarrow \{A, B, C, E\}$ • From $BC \rightarrow D \Rightarrow \{A, B, C, D, E\}$ **AB is a candidate key.**

(B)+

- Start: {B}
- From $B \rightarrow A \Rightarrow \{A, B\}$
- From $A \rightarrow C \Rightarrow \{A, B, C\}$
- From $AC \rightarrow BE \Rightarrow \{A, B, C, E\}$
- From $BC \rightarrow D \Rightarrow \{A, B, C, D, E\}$ **B alone is a candidate key.**

(A)+

- Start: {A}
- From $A \rightarrow C \Rightarrow \{A, C\}$
- From $AC \rightarrow BE \Rightarrow \{A, B, C, E\}$
- From $B \rightarrow A$ (already have A)

- From $BC \rightarrow D \Rightarrow \{A, B, C, D, E\}$ **A alone is a candidate key.**

Minimal candidate keys = $\{A, B\}$

Prime vs Non-prime Attributes

- Prime attributes = attributes in any candidate key.
 - Candidate keys = $\{A, B\}$ ◦ Prime attributes = $\{A, B\}$
- Non-prime attributes = others.
 - Non-prime = $\{C, D, E\}$

Normal Form

Given Relation is in BCNF

Problem 4 Consider a relation R having attributes as R(ABCDEF), functional dependencies are given below:

$A \rightarrow BCD$,

$BC \rightarrow DE$,

$B \rightarrow D$,

$D \rightarrow A$

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

Solution

To check Attribute Closures

(A)+

- Start: $\{A\}$
- $A \rightarrow BCD \Rightarrow \{A, B, C, D\}$
- From $B \rightarrow D$ (already have D)
- From $D \rightarrow A$ (already have A)
- From $BC \rightarrow DE$ ($BC \subseteq \{A, B, C, D\}$) \Rightarrow add E
 $\rightarrow \{A, B, C, D, E\}$ **Missing**
F. Not a key.

(B)+

- Start: $\{B\}$
- From $B \rightarrow D \Rightarrow \{B, D\}$
- From $D \rightarrow A \Rightarrow \{A, B, D\}$
- From $A \rightarrow BCD \Rightarrow \{A, B, C, D\}$
- From $BC \rightarrow DE$ (need C, now present) $\Rightarrow \{A, B, C, D, E\}$ Still missing F. Not a key.

(C)+

- Start: {C}
- No FD fires. \Rightarrow {C} Not a key.

(D)+

- Start: {D}
- From $D \rightarrow A \Rightarrow \{A, D\}$
- From $A \rightarrow BCD \Rightarrow \{A, B, C, D\}$
- From $BC \rightarrow DE$ (have B,C) \Rightarrow add E
 $\Rightarrow \{A, B, C, D, E\}$
Missing F. Not a key.

(E)+

- Start: {E}
- No FD fires. \Rightarrow {E} Not a key.

(F)+

- Start: {F}, no FDs apply. Not a key.

(A,F)+

- Start: {A, F}
- From $A \rightarrow BCD \Rightarrow \{A, B, C, D, F\}$
- From $BC \rightarrow DE \Rightarrow$ add E
 $\Rightarrow \{A, B, C, D, E, F\}$.
{A, F} is a key.

(B,F)+

- Start: {B, F}
- From $B \rightarrow D \Rightarrow \{B, D, F\}$
- From $D \rightarrow A \Rightarrow \{A, B, D, F\}$
- From $A \rightarrow BCD \Rightarrow \{A, B, C, D, F\}$ • From $BC \rightarrow DE \Rightarrow \{A, B, C, D, E, F\}$.
{B, F} is a key.

(C,F)+

- Start: {C, F}
- No FDs fire (need A, B, D). **Not a key.**

(D,F)+

- Start: {D, F}
- From $D \rightarrow A \Rightarrow \{A, D, F\}$
- From $A \rightarrow BCD \Rightarrow \{A, B, C, D, F\}$
- From $BC \rightarrow DE \Rightarrow$ add E

$\Rightarrow \{A, B, C, D, E, F\}$.
 $\{D, F\}$ is a key.

$(E, F)^+$

- Start: $\{E, F\}$, no FDs apply. **Not a key.**

Check minimality

- $\{A, F\}$ **minimal**
- $\{B, F\}$ **minimal**
- $\{D, F\}$ **minimal**

Candidate Keys

$\{AF, BF, DF\}$

Prime vs Non-prime Attributes

- Prime attributes = those that appear in at least one candidate key.
 - Candidate keys = $\{A, F\}$, $\{B, F\}$, $\{D, F\}$ ◦ Prime attributes = $\{A, B, D, F\}$
- Non-prime attributes = the rest.
 - Non-prime = $\{E, C\}$

Normal Form

Given relation is 1st Normal Form

Problem 5.

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

$X \rightarrow Y$

$WZ \rightarrow X$

$WZ \rightarrow Y$

$Y \rightarrow W$

$Y \rightarrow X$

$Y \rightarrow Z$

The task here is to remove all the redundant FDs for efficient working of the student database management system.

Solution

Closure are

$X^+ \{X, Y, W, Z\}$

$Y^+ \{X, Y, W, Z\}$

$WZ^+ \{X, Y, W, Z\}$

Candidate Keys Are

$\{X, Y, WZ\}$

Prime vs Non-prime Attributes

- Prime attributes = those that appear in at least one candidate key.
 - Candidate keys = $\{X\}, \{Y\}, \{WZ\}$
 - Prime attributes = $\{X, Y, W, Z\}$
- Non-prime attributes = null;

Normal Form

Given relation is in BCNF

Problem 6

Debix Pvt Ltd needs to maintain database having dependent attributes ABCDEF. These attributes are functionally dependent on each other for which functional dependency set F given as: $A \rightarrow BC$,

$D \rightarrow E$,

$BC \rightarrow D$,

$A \rightarrow D$

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.

Solution

Find Candidate Keys

- AF^+ :
 - Start with $\{A, F\}$.
 - From $A \rightarrow B, C, D, E$, we get $\{A, B, C, D, E, F\}$ So **AF is a candidate key.**

$A^+ = \{A, B, C, D, E\} \neq R1$ (F missing).

$F^+ = \{F\} \neq R1$ (F missing).

$FD^+ = \{F, D, E\} \neq R1$ (F missing).

$FBC^+ = \{F, B, C, D\} \neq R1$ (F missing).

Thus, the only candidate key = $\{A, F\}$.

Prime vs Non-prime Attributes

- Prime attributes = those that appear in at least one candidate key.

- Candidate keys = {AF} ○ Prime attributes = {A,F }
- Non-prime attributes = {B,C,D,E} **Normal Form**
Given relation is in 1st normal form