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EXPERIMENT:4

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1. AIM:-

Solve the Problem related to Normalistion 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→C ⇒ {A, B, C}
- From C→D ⇒ {A, B, C, D}
- From D→A already there.

AB+ = {A, B, C, D} ⇒ AB is a candidate key.

(BC)+

- Start: {B, C}
- From C→D ⇒ {B, C, D}
- From D→A ⇒ {A, B, C, D}

BC+ = {A, B, C, D} ⇒ BC is a candidate key

(BD)+

- Start: {B, D}
- From D→A ⇒ {A, B, D}
  From AB→C ⇒ {A, B, C, D}
  BD+ = {A, B, C, D} ⇒ BD is a candidate key
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(CD)+

- Start: {C, D}
- From C→D ⇒ {C, D} (no change)
- From D→A ⇒ {A, C, D}
- From AB→C (needs B, but not present) → 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->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.

Solution

Step 1: closures to find candidate keys

(B, C)+

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

(A, C)+

- Start: {A, C}
- From A→D ⇒ {A, C, D}
- From AC→BE ⇒ {A, B, C, D, E}
  AC is a candidate key.

(B, E)+

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

(B, C, E)+

- Start: {B, C, E}
- B→A ⇒ {A, B, C, E}
- A→D ⇒ {A, B, C, D, E} .
- But BC alone is already a key → 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->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.

Solution

Compute Closures

(B, C)+

- Start: {B, C}
- From B → A ⇒ {A, B, C}
- From A → C (C already present)
- From AC → BE ⇒ {A, B, C, E}
- From BC → D ⇒ {A, B, C, D, E}.

BC is a candidate key.

(A, C)+

- Start: {A, C}
- From A → C (no change)
- From AC → BE ⇒ {A, B, C, E}
- From B → A (already have A)
- From BC → D ⇒ {A, B, C, D, E}.

AC is a candidate key.

(B, A)+ (same as AB)

- Start: {A, B}
- From B → A (already there)
- From A → C ⇒ {A, B, C}
- From AC → BE ⇒ {A, B, C, E}
- From BC → D ⇒ {A, B, C, D, E}

AB is a candidate key.

(B)+

- Start: {B}
- From B → A ⇒ {A, B}
- From A → C ⇒ {A, B, C}
- From AC → BE ⇒ {A, B, C, E}
- From BC → D ⇒ {A, B, C, D, E}

B alone is a candidate key.

(A)+

- Start: {A}
- From A → C ⇒ {A, C}
- From AC → BE ⇒ {A, B, C, E}
- From B → A (already have A)
- From BC → D ⇒ {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->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.

Solution

To check Attribute Closures

(A)+

- Start: {A}
- A → BCD ⇒ {A, B, C, D}
- From B → D (already have D)
- From D → A (already have A)
- From BC → DE (BC ⊆ {A,B,C,D}) ⇒ add E
  → {A, B, C, D, E}
  Missing F. Not a key.

(B)+

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

(C)+

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

(D)+

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

(E)+

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

(F)+

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

(A,F)+

- Start: {A, F}
- From A → BCD ⇒ {A, B, C, D, F}
- From BC → DE ⇒ add E
  ⇒ {A, B, C, D, E, F} .
  {A, F} is a key.

(B,F)+

- Start: {B, F}
- From B → D ⇒ {B, D, F}
- From D → A ⇒ {A, B, D, F}
- From A → BCD ⇒ {A, B, C, D, F}
- From BC → DE ⇒ {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 → A ⇒ {A, D, F}
- From A → BCD ⇒ {A, B, C, D, F}
- From BC → DE ⇒ add E

⇒ {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 ->Y
WZ ->X
WZ ->Y
Y ->W
Y ->X
Y ->Z

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

Solution

Closure are

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

Solution

Find Candidate Keys

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

A^+ = {A, B, C, D, E} ≠ R1 **(F missing).**
F^+ = {F} ≠ R1 **(F missing).**
FD^+={F,D,E} ≠ R1 **(F missing).**
FBC^+={F,B,C,D} ≠ 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