



University Institute of Engineering
Department of Computer Science & Engineering

EXPERIMENT:4

NAME : Aditya Chandra

UID : 23BCS12981

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SUBJECT NAME : ADBMS

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 \rightarrow 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→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}
- $A \rightarrow BCD \Rightarrow \{A, B, C, D\}$
- 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

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

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

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

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 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