



**University Institute of Engineering**  
**Department of Computer Science & Engineering**

**EXPERIMENT:4**

**NAME : Harshit Dwivedi**

**UID : 23BCS13854**

**BRANCH : BE-CSE**

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**SEMESTER : 5<sup>TH</sup>**

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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 3<sup>rd</sup> 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 1<sup>st</sup> 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 1<sup>st</sup> normal form