



### Experiment-4

**Student Name:** Raj Kumar Singh  
**Branch:** CSE  
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**Subject Name:** ADBMS

**UID:** 23BCS11393  
**Section/Group:** KRG-3B  
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**To find the closure, candidate keys, prime attributes and highest normal form using the given relation and functional dependencies.**

#### **Question 1**

R(ABCD), FDs = {AB  $\rightarrow$  C, C  $\rightarrow$  D, D  $\rightarrow$  A}

#### ***Solution***

Closure:

AB<sup>+</sup> = {A, B, C, D}

BC<sup>+</sup> = {B, C, A, D}

BD<sup>+</sup> = {B, D, A, C}

Candidate Key: AB, BD, BC

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

Non-Prime Attributes: { }

Normal Form: It cannot be BCNF as C is a SK(C  $\rightarrow$  D). All determinants have prime attributes, so the relation is in 3NF.

#### **Question 2**

R(ABCDE), FDs = {A  $\rightarrow$  D, B  $\rightarrow$  A, BC  $\rightarrow$  D, AC  $\rightarrow$  BE}

#### ***Solution***

Closure:

A<sup>+</sup> = {A, D}

B<sup>+</sup> = {B, A, D}

C<sup>+</sup> = {C}

BC<sup>+</sup> = {B, C, A, D, E}

AC<sup>+</sup> = {A, B, C, D, E}

Candidate Key: AC, BC

Prime Attributes: {A, B, C}

Non-Prime Attributes: {D, E}

Normal Form: Partial dependency exists ( $A \rightarrow D$ ). Hence relation is in 1NF.

### Question 3

$R(ABCDE)$ , FDs = { $B \rightarrow A$ ,  $A \rightarrow C$ ,  $BC \rightarrow D$ ,  $AC \rightarrow BE$ }

#### *Solution*

Closure:

$B^+ = \{A, B, C, D, E\}$

$A^+ = \{A, C, B, D, E\}$

Candidate Key: A, B

Prime Attributes: {A, B}

Non-Prime Attributes: {C, D, E}

Normal Form: All determinants are either CK or SK. So this relation is in BCNF.

### Question 4

$R(ABCDEF)$ , FDs = { $A \rightarrow BCD$ ,  $BC \rightarrow DE$ ,  $B \rightarrow D$ ,  $D \rightarrow A$ }

#### *Solution*

Closure:

$A^+ = \{A, B, C, D, E\}$

$AF^+ = \{A, F, B, C, D, E\}$

$DF^+ = \{D, F, B, C, A, E\}$

$BF^+ = \{B, F, C, A, D, E\}$

Candidate Key: AF, DF, BF

Prime Attributes: {A, D, B, F}

Non-Prime Attributes: {C, E}

Normal Form: Partial dependency exists ( $A \rightarrow BCD$ ). Hence relation is in 1NF.

### Question 5

FDs = { $X \rightarrow Y$ ,  $WZ \rightarrow X$ ,  $WZ \rightarrow Y$ ,  $Y \rightarrow W$ ,  $Y \rightarrow X$ ,  $Y \rightarrow Z$ }

#### *Solution*

Closure:

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

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

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

Candidate Key: Y, X, WZ

Prime Attribute: {X, Y, W, Z}

Non-Prime Attributes: { }

Normal Form: All determinants are CK. Highest NF = BCNF.

## Question 6

R(ABCDEF), FDs = {A  $\rightarrow$  BC, A  $\rightarrow$  D, D  $\rightarrow$  E, BC  $\rightarrow$  D}

### *Solution*

Closure:

A<sup>+</sup> = {A, B, C, D, E}

AF<sup>+</sup> = {A, B, C, D, E, F}

Candidate Key: AF

Prime Attributes: {A, F}

Non-Prime Attributes: {B, C, D, E}

Normal Form: A  $\rightarrow$  BC introduces partial dependency (A is part of key AF and BC is non-prime).

Hence highest NF = 1NF.