



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment-4

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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⁺ = {A, B, C, D}

BC⁺ = {B, C, A, D}

BD⁺ = {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⁺ = {A, D}

B⁺ = {B, A, D}

C⁺ = {C}

BC⁺ = {B, C, A, D, E}

AC⁺ = {A, B, C, D, E}

Candidate Key: AC, BC

Prime Attributes: {A, B, C}



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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:

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

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

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



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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⁺ = {A, B, C, D, E}

AF⁺ = {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.