University Institute of Engineering

Department of Computer Science & Engineering

EXPERIMENT: 4

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BRANCH: BE-CSE **SECTION / GROUP: KRG_2A**

SEMESTER: 5TH **SUBJECT CODE: 23CSP-339**

SUBJECT NAME: ADBMS

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.
   Ans:
   R (A, B, C, D)
   Closure:
   A+ → A
   B+ → B
   C+ → C, D, A
   AB+ → A, B, C, D
   AC+ → A, C, D
   AD+ → A, D,
   BC+ → B, C, D, A
   BD+ → B, D, A, C
   CD+ → C, D, A

   Candidate Keys: AB, BC, BD
   Prime Attributes: A, B, C, D
   Non-prime Attributes:
   Normal Form: 3NF

Explanation: We compute closures of attribute sets. AB+ covers all attributes {A,B,C,D}, hence AB is a candidate key. Similarly, BC+ and BD+ also cover all attributes. Since all attributes appear in candidate keys, all are prime. Non-prime attributes = None. As every FD has a prime attribute on the left-hand side, relation is in 3NF.

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.
   Ans:
   R (A, B, C, D, E)
   Closure:
   A+ → A, D
   B+ → B, A, D
   C+ → C
   AB+ → A, B, D
   AC+ → A, C, D, B, E
   AD+ → A, D
   BC+ → B, C, A, D, E
   Candidate Keys: AC, BC
   Prime Attributes: A, B, C
   Non-prime Attributes: D, E
   Normal Form: 1NF

Explanation: Closures show AC+ and BC+ determine all attributes, making them candidate keys. A, B, C are part of candidate keys, so they are prime. D, E never appear in any candidate key, so they are non-prime. The relation is only in 1NF as some FDs violate 2NF (partial dependencies).

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.
   Ans:
   R (A, B, C, D, E)
   Closure:
   A+ → A, C, B, E, D
   B+ → B, A, C, D, E
   C+ → C
   D+ → D
   E+ → E
   Candiate Keys: A, B

Prime Attributes: A, B
Non-prime Attributes: C, D, E Normal Form: BCNF

Explanation:

- Compute closures:
  - A+ = {A, C, B, E, D} → all attributes, so A is a candidate key.
  - B+ = {B, A, C, D, E} → all attributes, so B is also a candidate key.
- Hence, {A, B} are candidate keys.
- Prime attributes = {A, B}.
- Non-prime attributes = {C, D, E}.
- Since all FDs have a candidate key on the left-hand side, the relation satisfies **BCNF**.

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.
   Ans:
   R (A, B, C, D, E, F)
   Closure:
   A+ → A, B, C, D, E
   B+ → B, D, A, C, E
   C+ → C
   D+ → D, A, B, C, E
   E+ → E
   F+ → E
   AF+ → A, B, C, D, E, F
   BF+ → B, F, D, A, C, E
   CF+ → C, F
   DF+ → D, F, A, B, C, E
   Candiate Keys: AF, BF, DF
   Prime Attributes: A, B, D, F
   Non-prime Attributes: C, E
   Normal Form: 1NF

Explanation:

- Compute closures:
  - AF+ = {A, B, C, D, E, F} → all attributes, so AF is a candidate key.
  - BF+ = {B, D, A, C, E, F} → all attributes, so BF is also a candidate key.
  - DF+ = {D, A, B, C, E, F} → all attributes, so DF is also a candidate key.
- Candidate Keys = {AF, BF, DF}.
- Prime attributes = {A, B, D, F}.
- Non-prime attributes = {C, E}.
- Because of transitive and partial dependencies, the relation only satisfies **1NF**.

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.
Ans:
R (W, X, Y, Z)
Closure:
    X+ → X, Y, W, Z
    Y+ → Y, X, W, Z
    WZ+ → W, Z, X, Y
Candiate Keys: X, Y, WZ
Prime Attributes: X, Y, W, Z
Non-prime Attributes:
Normal Form: BCNF
Explanation:

- Compute closures:
  - X+ = {X, Y, W, Z} → all attributes, so X is a candidate key.
  - Y+ = {Y, X, W, Z} → all attributes, so Y is also a candidate key.
  - WZ+ = {W, Z, X, Y} → all attributes, so WZ is also a candidate key.
- Candidate Keys = {X, Y, WZ}.
- Since all attributes are part of some candidate key, all are **prime**.
- No non-prime attributes exist.
- Each FD has a candidate key on the left-hand side → relation is in **BCNF**.

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.
Ans:
    R (A, B, C, D, E, F)

Closure:

A+ → A, B, C, D, E

B+ → B

C+ → C

D+ → D, E

AF+ → A, B, C, D, E, F

Candiate Keys: AF

Prime Attributes: A, F

Non-prime Attributes: B, C, D, E Normal Form: 1NF

Explanation:

- A+ = {A, B, C, D, E}. Missing F → not a key.
- AF+ = {A, B, C, D, E, F} → covers all attributes → Candidate Key.
- No smaller set works, so **Candidate Key = {AF}**.
- Prime attributes = {A, F}. Non-prime attributes = {B, C, D, E}.
- The relation is only in **1NF**, since A → BC and A → D create partial dependencies (violating 2NF).