EXPERIMENT- 04

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Q1. 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.

Sol- Since attribute **B** never appears on the RHS of any dependency, it must be part of every candidate key.

Closures:
- (AB)+ = ABCD
- (CB)+ = CBDA
- (DB)+ = DBAC

Keys:
- Candidate Keys = {AB, CB, DB}
- PA = {A, B, C}
- NPA = {D, E}

Normalization check:
- In **BCNF**, the dependencies C->D and D->A is a problem because C and D are not a superkeys. Hence BCNF is violated.
- In **3NF**, all attributes are prime, so it is satisfied.
- In **2NF**, there are no partial dependencies (since there is no non-prime attribute), so it satisfies.
- In **1NF**, the relation is already in 1NF as there are no multivalued dependencies.

Q2. 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.

Sol- Since attribute **C** never appears on the RHS of any dependency, it must be part of every candidate key.

Closures:
- (AC)+ = ACBED
- (BC)+ = ACDBE

Keys:

- Candidate Keys = {AC, BC}
- PA = {A, B, C}
- NPA = {D, E}

Normalization check:

- In BCNF, dependencies like A->D and B->A are problems because A and B are not superkeys. Hence BCNF is violated.
- In 3NF, dependency B->A also violates the condition since B is not a superkey.
- In 2NF, A->D creates a partial dependency (A is part of AC), so it is violated.
- In 1NF, the relation is already in 1NF as there are no multivalued dependencies.

Q3. 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.

Sol- All attributes appear on RHS, so we determine candidate keys using closure.

Closures:

- (A)+ =ACBED
- (B)+ = BACDE

Keys:

- Candidate Keys = {A, B}
- PA = {A, B}
- NPA = {C, D, E}

Normalization check:

- In BCNF, all LHS of dependencies are superkeys. Hence BCNF is satisfied.
- In 3NF, since BCNF is satisfied, 3NF is also satisfied.
- In 2NF, no partial dependencies exist, so 2NF is satisfied.
- In 1NF, the relation is already in 1NF as there are no multivalued dependencies.

Q4. 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.

Sol- Since attribute **F** never appears on the RHS of any dependency, it must be part of every candidate key.

Closures:
- (AF)+ = ABCDEF
- (BF)+ = BFEDAC
- (DF)+ = DFABCE

Keys:
- Candidate Keys = {AF, BF, DF}
- PA = {A, B, D, F}
- NPA = {C, E}

Normalization check:

- In BCNF, dependencies like A -> BCD, B -> D, and D -> A are a problem because A, B, D are not superkeys. Hence BCNF is violated.
- In 3NF, A -> BCD violates 3NF because RHS has non-prime attributes.
- In 2NF, there are no partial dependencies, so 2NF is satisfied.
- In 1NF, the relation is already in 1NF as there are no multivalued dependencies.

Q5: 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.

Sol- Firstly, we will check each FD to see if it can be derived from others.

- X -> Y is redundant because Y -> X exists.
- WZ -> Y is redundant because WZ -> X and X -> Y together give WZ -> Y.
- Y -> W, Y -> X, Y -> Z are essential.

Reduced FD:
• WZ -> X
• Y -> W

- Y -> X
- Y -> Z

Closures:
- (WZ)+ = WXZY
- (Y)+ = YWXZ

Keys:
- Candidate Keys = {WZ, Y}
- PA = {W, X, Y, Z}
- NPA = Ø

Normalization check:
- **BCNF:** All functional dependencies have a candidate key in the RHS, so BCNF is satisfied.
- **3NF:** All functional dependencies either have a candidate key in the RHS or their dependent attributes are prime, so 3NF is satisfied.
- **2NF:** There are no partial dependencies, so 2NF is satisfied.
- **1NF:** All attributes are atomic or don't have multi-values, so the relation satisfies 1NF.

Q6: 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.

Sol- Since attribute **F** never appears on the RHS of any dependency, it must be part of every candidate key.

Closure:
- (AF)+ = ABCDEF

Keys:
- Candidate Keys = {AF}
- PA = {A, B, C, D, E, F}
- NPA = Ø

Normalization check:
- **BCNF:** Some functional dependencies have determinants that are not candidate keys (A -> BC, D -> E, BC -> D, A -> D), so BCNF is violated.
- **3NF:** Some functional dependencies have non-prime attributes on RHS (BC -> D, D -> E), so 3NF is

violated.

- **2NF:** Partial dependency exists (A -> BC is a partial dependency on candidate key AF), so 2NF is violated.
- **1NF:** All attributes are atomic or don’t have multi-values, so 1NF is satisfied.