Experiment 4

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1. **Aim:**
   Q1: Relation R(A,B,C,D)
   FDs:
   AB → C
   C → D
   D → A
   Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

   ANS:
   Closures:
   A+ = {A}
   B+ = {B}
   FDs have either a superkeyC,D}
   BC+ = {B,C,D,A}
   BD+ = {B,D,A,C}

   Candidate Keys: AB, BC, BD
   Prime Attributes: A, B, C, D
   Non-prime Attributes: None
   Normal Form: 3NF
   Explanation: All FDs have either a superkey on LHS or RHS is prime, satisfying 3NF.

   Q2: Relation R(A,B,C,D,E)
   FDs:
   A → D
   B → A
   BC → D
   AC → B E
   Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

   ANS:
   Closures:
   A+ = {A, D}
   B+ = {B, A, D}

C+ = {C}
AC+ = {A, C, D, B, E}
BC+ = {B, C, A, D, E}

Candidate Keys: AC, BC
Prime Attributes: A, B, C
Non-prime Attributes: D, E
Normal Form: 1NF
Explanation: Partial dependency exists (A→D is a part of key AC determining non-prime attribute D), violates 2NF.

Q3: Relation R(A,B,C,D,E)
FDs:
B → A
A → C
BC → D
AC → B E
Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

ANS:
Closures:
A+ = {A,B,C,D,E}
B+ = {B,A,C,D,E}
C+ = {C}
D+ = {D}
E+ = {E}

Candidate Keys: A, B
Prime Attributes: A, B
Non-prime Attributes: C, D, E
Normal Form: BCNF
Explanation: All FDs have LHS as a superkey → satisfies BCNF.

Q4: Relation R(A,B,C,D,E,F)
FDs:
A → B C D
BC → D E
B → D
D → A
Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

ANS:
Closures:
A+ = {A,B,C,D,E}

B+ = {B,D,A,C,E}
D+ = {D,A,B,C,E}
AF+ = {A,B,C,D,E,F}
BF+ = {B,F,D,A,C,E}
DF+ = {D,F,A,B,C,E}

Candidate Keys: AF, BF, DF
Prime Attributes: A, B, D, F
Non-prime Attributes: C, E
Normal Form: 1NF
Explanation: Partial and transitive dependencies exist; violates 2NF.

Q5: Relation R(W,X,Y,Z) — Student DB example
FDs (given):
X → Y
WZ → X
WZ → Y
Y → W
Y → X
Y → Z
Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

ANS:
Closures:
X+ = {X,Y,W,Z}
Y+ = {Y,X,W,Z}
WZ+ = {W,Z,X,Y}

Candidate Keys: X, Y, WZ
Prime Attributes: X, Y, W, Z
Non-prime Attributes: None
Normal Form: BCNF
Explanation: Every FD has LHS as a candidate key → satisfies BCNF.

Q6: Relation R(A,B,C,D,E,F) (Debix Pvt. Ltd)
FDs:
A → B C
D → E
BC → D
A → D (note A→D is implied by A→BC and BC→D, but it was given explicitly)
Goal: find candidate keys, prime/non-prime attributes, and highest normal form.

ANS:
Closures:

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

Candidate Keys: AF
Prime Attributes: A, F
Non-prime Attributes: B, C, D, E
Normal Form: 1NF
Explanation: Partial dependency exists (A→B,C,D), violates 2NF. Transitive dependencies also present.