B-4. 3NF (15 points)

Which of the following relations is in Third normal form (3NF)? Give sufficient reasoning if not in 3NF.

A relation schema R in 3DF(X→A), have two conditions:

1. X is a super key of R.

(ii)A is a prime attribute of R.

1. R1(ABCD) F = {ACD → B; AC → D; D → C; AC → B}

Find all the keys:AC, AD

Find prime attributes: A, C, D

ACD → B, ACD is a super key then satisfy(i).

AC→ D, AC is a key then super key then satisfy(i).

D → C, D is prime attributes then satisfy(i).

AC → B, AC is a key then super key then satisfy(i).

Then (i) or (ii) satisfied in an case so R1 is in 3NF.

1. R2(ABCD) F = {AB → C; BCD → A; D → A; B → C}

Find all the keys:BD

Find prime attributes: B, D

AB → C, AB is not a super key as well as not prime attribute.

BCD→ A, BCD is a key then super key then satisfy(i).

D → A, D is prime attributes then satisfy(ii).

B → C, B is prime attributes then satisfy(ii).

Then (i) or (ii) not satisfied in an case so R2 is not in 3NF.

(c) R3(ABCD) F = {AB → C; ABD → C; ABC → D; AC → D}

Find all the keys:AB

Find prime attributes:A, B

AB → C, AB is a super key then satisfy(i)

ABD → C, ABD is a super key then satisfy(ii)

ABC → D, ABC is a super key then satisfy(ii)

AC → D, AC is not a super key as well as not prime attribute

Then (i) or (ii) not satisfied in an case so R3 is not in 3NF.

(d) R4(ABCD) F = {C → B; A → B; CD → A; BCD → A}

Find all the keys:CD

Find prime attributes:C, D

C → B, C is a prime attribute then satisfy(ii).

A → B, A is not a super key as well as not prime attribute.

CD → A, CD is a key then super key then satisfy(i).

BCD → A, BCD is a super key then satisfy(i).

Then (i) or (ii) not satisfied in an case so R4 is not in 3NF.

(BCNF) 15 points)

Which of the following relations is in BCNF? Give sufficient reasoning if not in BCNF.

(a) R(ABCD) F = {BC → A; AD → C; CD → B; BD → C}

(b) R(ABCD) F = {BD → C; AB → D; AC → B; BD → A}

(c) R(ABCD) F = {A → C; B → A; A → D; AD → C

A relation is in BCNF normal form if in the given relation -

for any Functional dependency X -> Y exist, then X must be a superkey

Note; Super key are the set of attributes (which may not be minimal) but can determine all attributes of the relation

(a) closure of BC i.e (BC)+ = BCA

In above relation BC is unable to determine all attribute of relation i.e. BC can determine A,B,C but it cannot determine D. Hence BC is not a superKey, Hence R(ABCD) is not in BCNF

(b) (BD)+ = ABCD

(AB)+ = ABCD

(AC)+ = ABCD

(BD)+ = ABCD

Since in all FD every determiner is a super key. Hence given relation is in BCNF

(c) (A)+ = ACD

Since A is unable to determine all attribute of relation. Hence A is not a superKey. R is not in BCNF. No need to check other FD determiner