CS631002 - Data Mgt Systems Design

Assignment - 5

Consider a relation R(ABCDEFGHIJ) with the following set of functional dependencies G = { F—>AB, CD—>E, C—>FG, H—> IJ, D—> H }

1. Is CDE a superkey of R (w.r.t. G)?

   CDE+ = CDEFGHIJAB = R

   Hence, CDE is superkey of R

2. Is CDE a key of R (w.r.t. G)?

   CDE is a super key.

   Removing ‘E’

   CD+ = CDEFGHABIJ = R

   CDE’ is a super key but not a minimal super key

   CDE is NOT a key of R

3. Apply the appropriate algorithm to determine a key for R (w.r.t. G).

   K=ABCDEFGHIJ Order = J,I,H,G,F,E,D,C,B,A

   Removing J

   ABCSDEFGHI+ = ABCDEFGHIJ = R

   Removing I

   ABCDEFGH+ = ABCDEFGHIJ = R

   Removing H

   ABCDEFG+ = ABCDEFGHIJ = R

   Removing G

   ABCDEF+ = ABCDEFGHIJ = R

   Removing F

   ABCDE+ = ABCDEFGHIJ = R

   Removing E

   ABCD+ = ABCDEFGHIJ = R

   Removing B

   ACD+ = ABCDEFGHIJ = R

Removing A

CD+ = ABCDEFGHIJ = R

C,D cannot be removed because they did not appear in RHS on any FD

Therefore The Key of R (w.r.t. G) is “CD”

4. Apply the appropriate algorithm to determine all the keys for R (w.r.t. G).

   Consider all the attributes that do not appear on RHS , CD

   CD+ = ABCDEFGHIJ = R

   Therefore CD is the key of R

5. Determine the prime attributes of R.

   Prime attributes are the part of some key of R

   Therefore C,D are the prime attributes of R

6. Is R in BCNF (w.r.t. G)?

   To check if R is in BCNF:

   R is in BCNF iff LHS of every FD is a superkey of R

   Consider f —> AB violates BCNF

   Therefore R is not in BCNF (w.r.t. G)

7. Is R in 3NF (w.r.t. G)?

   For R to be in 3NF:

   Either LHS should be a superkey in every FD or

   RHS of every FD should be a prime attribute

   CD is the Key of R

   Therefore Prime attributes are C,D

   F —> AB

   F+ = FAB != R

   Therefore F —> AB violates 3NF as it is not the superkey or

   A,B are not the prime attributes

   F —> AB violates 3NF

   R is not in 3NF

8. Determine whether the decomposition D = { CDE, CFG, DH, HIJ, FAB } has (i) the dependency preservation property and (ii) the lossless join property, with respect to G. Also determine which normal form each relation in the decomposition is in.

G={F —> AB, CD —> E , C —> FG , H —> IJ , D —> H}

(i)
F —> AB is in PiFAB(G)
CD —> E is in PiCDE(G)
C —> FG is in PiCFG(G)
H —> IJ is in PiHIJ(G)
D —> H is in PiDH(G)

Therefore The decomposition D has dependency preservation property

(ii)
D = { CDE , CFG , DH , HIJ , FAB }
Let R1 = CDE, R2 = CFG ; R12 = CDEFG
Checking if R1 and R2 are in loss-less join of R12
A decomposition D = {R1,R2} of R is lossless w.r.t. a set of FD's on R iff either
F != (R1 AND R2) —> (R1 - R2) or
F != (R1 AND R2) —> (R2 - R1)
Let R1 = CDE, R2 = CFG

R1 and R2 = C
R1 - R2 = DE
R2 - R1 = FG
G != C —> DE or G != C —> FG
C+ = CFAAB
R2- R1 is a part of (R1 and R2)+
(R1 or R2) is a lossless join
Continue with (R1 or R2)

R12 = CDEFG , let R3 = DH , R123 = CDEFGH
Check if R12 and R3 are are lossless join
R12 and R3 =. D
R12 - R3 = CEFG
R3 - R12 = H

G != D —> CEFG. Or D —>H

D+ = H

R3 - R12 is a part of (R12 and R3)+

Therefore D+ = H is a subset of H

R12 and R3 are a lossless join

Continue with R123

R123 =. CDEFGH and let R4 = HIJ => R1234 = CDEFGHIJ

Check R123 and R4 is a lossless join

R123 and R4 = H

R123 - R4 = CDEFG

R4 - R123 = IJ

G !=H —> CDEFG or H—> IJ

H+ = IJ

H+ = IJ is a subset of IJ

R123or R4 is a loss less join

Continue with R1234

R1234 = CDEFGHIJ let R5 = FAB => R1234 = CDEFGHIJ

R1234 and R5 = F

R1234 - R5 = CDEGHIJ

R5 - R1234 = AB

G != F —> CDEGHIJ   or F —> AB

F+ = AB is a subset AB

R1234 or R5 is a loss less join

D = R1 or R2 or R3 or R4 or R5

D has a lossless join property with respect to G