Data Mgt Systems Design – RP946-RAMNIKHIL

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

1. 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

1. 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”

1. 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

1. 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

1. 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)

1. 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

1. 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