CS 353 HW 5

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Q1

a) No. A does not functionally determine B since for $A = a_2$, the tuples $t_3(a_2, b_3, c_1, d_3)$ and $t_4(a_2, b_3, c_2, d_3)$ have two different values for C namely c_1, c_2.

b) Yes. B functionally determines D. $t_3(a_2, b_3, c_1, d_3)$, $t_4(a_2, b_3, c_2, d_3)$, and $t_5(a_3, b_3, c_2, d_3)$ have the same values for B for the same values for D.

c) No. BCD does not functionally determine A since $t_4(a_2, b_3, c_2, d_3)$ and $t_5(a_3, b_3, c_2, d_3)$ have all the same BCD values namely b_3, c_2, d_3, but they have different A values namely a_2, a_3.

d) $(A)^+ = \{A, D\}$
$(B)^+ = \{B, D\}$

e) No. AB is neither a condidate key nor a super key of this relation. Since:

$(AB)^+ = \{A, B, D\}$

so AB cannot uniquely identify C.

Q2

a)

$A^+ = \{ADE\}$

b)

$CF^+ = \{ABCDEF\}$

c)

$AB \to C$

$A \to D$

$F \to A$

$D \to F$

$BE \to F$

$AC \to B$

$DB^+ \to DBE$

so $DB \to C$ holds on R

Q3

a) A is the candidate key of the relation because all the attributes can be reached according to relation F.

$A \rightarrow A$ $A \rightarrow D$ $A \rightarrow BD$ $B \rightarrow C$

$A^+ \rightarrow ABCD$

b) No. it does not satisfy BCNF. since except one of the left hand side, B, D is a super key

$A^+ \rightarrow ABCD$
$B^+ \rightarrow BC$
$D^+ \rightarrow BCD$

c) No it does not satisfy 3NF since three functional dependencies violate 3NF which are:

$A^+ \rightarrow ABCD$

$B^+ \rightarrow BC$

$D^+ \rightarrow BCD$

Except one of the left hand side, attribute sets B, D is a super key.

Only one of the r.h.s. attribute sets ABCD is a part of the candidate key A.

Q4

a) Primary key of the relation is (AF) since (AF) = {A, D, F, B, C, E}

A → D is a partial functional dependency on it is violating 2NF.

So the relation is not in BCNF. Morover it is in 1NF.

b) Removing partial functional dependency, we convert it into 2NF.

2NF decomposition is :

(A, D)

(A, B, C, F, E)

removing transitive functional dep. BC → E we get

3NF. decomposition:

(A, D)

(B, C, E)

(A, B, C, F)

this is the BCNF we are asked.

c) All the dependencies are covered by som relation

For example relation (A, D) covers A → D,

relation (B, C, E) covers BC → E, and (A, B, C, F) covers AF → BC. So yes, the BCNF dependency is preserving.

Q4 continue

d) The decomposition is lossy since the attribute D is in common in both R1 and R2 and D is not a key of R1 nor R2.

e) R1(A,B,C,D): A → D

R2(D,E,F): no dependency

BC → E is not covered in any decomposed relation

So relation R1 and R1 is not dependency preserving.

Scanned with CamScanner

Q5

a) we need to check if $B \to C$ since $B \to C$ must preserve for D to be extraneous in $BD \to C$

$B^+ = \{B, E, A, D, C\}$

$B \to E$

$E \to AD$

$A \to BC$

so $B \to C$

and D is extroneous in $BD \to C$

b)

$A \to B$

$B \to E$

$E \to AD$

$AD \to CE$

so. $A^+ = \{A, B, E, D, C\}$

so E is extraneous in $A \to BC$.

c) Minimal Cover

$F = \{ A \to B,\ A \to C,\ B \to E,\ BD \to C,\ AD \to C,\ AD \to E,\ E \to A,\ E \to D \}$

check if $A \to B$ reducible

$A^+ = \{C\}$

so it is not reducible

Check if $A \to C$ reducible

$A^+ = \{B, E, A, D, C\}$

so it is reducible

Check if $B \to E$ reducible

$B^+ \to \{B\}$

so it is not reducible

check if $BD \to C$ reducible

$B^+ = \{B E A D C\}$

yes it is reducible

Q5

C continue

check if $AD \to C$ reducible

$AD^+ = \{A\ B\ C\ E\ D\}$

So it is reducible

check if $AD \to E$ reduc.

$A^+ = \{ABCDE\}$

Result

$F = \{A \to B,\ B \to E,\ A \to C,\ E \to A,\ E \to D\}$