HOMEWORK 6

1. Let T be Tripadvisor table with the following attributes. Each tuple represents one review of a restaurant by a user.

Restaurant – (A)

Address (of the restaurant) – (B)

Cuisine (what type of cuisine, offered, Italian, French etc) – (C)

Rating (overall average rating of restaurant, say 4.56) – (D)

Rank (what is the ranking of a given restaurant) – (E)

User_name – (F)

User_reviews (total reviews by user by the date) – (G)

Date – (H)

Stars (stars that the user have in review) – (I)

Number of user reviews is computed per user till a given date which is also the date when the user awarded stars (1-5) to given restaurant. Thus, the number of user reviews changes with date.

a) Identify all non-trivial functional dependencies for the scheme T

F = {A->B, A->C, A->D, A->E, E->A, E->B, E->C, E->D, FH->G, FHA->I, FHE->I}

b) Identify all keys of the table T

Candidate Keys – AFH, EFH

c) Pre-process all dependencies.

F = {A->BCDE, E->ABCD, FH->G, FHA->IBCDE, FHE->IABCD}

d) Is T in BCNF? If not, show BCNF decomposition using the BCNF decomposition algorithm from class.

A^+ = ABCDE

E^+ = ABCDE

FH^+ = FGH

FHA^+ = ABCDEFG

FHE^+ = ABCDEFG

T is not in BCNF since attributes A, E, and FH are not super keys.

A->BCDE violation of BCNF

R1 = ABCDE, F1 = {A->BCDE, E->ABCD} – in BCNF

R2 = AFGHI, F2 = {FH->G, FHA->I} – violation of BCNF Pick (FH->G)

Decompose R2

R1 = FHG, F1 = {FH->G} – in BCNF

R2 = AFHI, F2 = {FHA->I} – in BCNF

e) Using Chase algorithm show that the BCNF decomposition obtained in (d) is in fact lossless

R1 = {ABCDE}, R2 = {FGH}, R3 = {AFHI}

	A	B	C	D	E	F	G	H	I
R1(ABCDE)	A	B	C	D	E	F1	G1	H1	I1
R2(FGH)	A2	B2	C2	D2	E2	F	G	H	I2
R3(AFHI)	A	B4	C4	D4	E4	F	G4	H	I

Apply A->BCDE

	A	B	C	D	E	F	G	H	I
R1(ABCDE)	A	B	C	D	E	F1	G1	H1	I1
R2(FGH)	A2	B2	C2	D2	E2	F	G	H	I2
R3(AFHI)	A	~~B4~~ B	~~C4~~ C	~~D4~~ D	~~E4~~ E	F	G4	H	I

Apply E->ABCD

	A	B	C	D	E	F	G	H	I
R1(ABCDE)	A	B	C	D	E	F1	G1	H1	I1
R2(FGH)	A2	B2	C2	D2	E2	F	G	H	I2
R3(AFHI)	A	B	C	D	E	F	G4	H	I

Apply FH->G

	A	B	C	D	E	F	G	H	I
R1(ABCDE)	A	B	C	D	E	F1	G1	H1	I1
R2(FGH)	A2	B2	C2	D2	E2	F	G	H	I2
R3(AFHI)	A	B	C	D	E	F	~~G4~~ G	H	I

FHA->IBCDE, FHE->IABCD

	A	B	C	D	E	F	G	H	I
R1(ABCDE)	**A**	**B**	**C**	**D**	**E**	**F1**	**G1**	**H1**	**I1**
R2(FGH)	**A2**	**B2**	**C2**	**D2**	**E2**	**F**	**G**	**H**	**I2**
R3(AFHI)	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**

Therefore, the decompositions R1 = {ABCDE}, R2 = {FGH}, R3 = {AFHI} is a lossless join.

2. Projection of functional dependencies

Let R(ABCDE) be a database scheme with the following functional dependencies

F = {A->B, B->C, C->D, CD->E and D->A}

Project F onto ACD, by pre-processing F first and using the process described in class. Show the preprocessed dependencies and projected fds as well.

F = {A->BCDE, B->CDEA, C->DEAB, CD->EAB, D->ABCE}

Project(ACD) = {A->CD, C->DA, CD->A, D->AC}

Is ACD in BCNF? Justify your answer.

Yes ACD is in BCNF since all functional dependences in the Project(ACD) are super keys in the projection.

3. Assume that A is the key of the relational scheme R(ABCDE). How many superkeys will R(ABCDEF) have? Explain your answer

Since A is a minimal superkey therefore any superset of A are superkeys like AB, AC, ABC. There will be 32 possible superkeys (including A since A is a superkey).

4. Prove that each step of BCNF decomposition, when a scheme R is decomposed into XY and R-Y (where X->Y violated BCNF) has lossless join property. Use Chase algorithm.

R1 = {XY} , R2 = {X}

	X	Y
R1(XY)	**X**	**Y**
R2(X)	**X**	**Y1**

Apply X->Y

	X	Y
R1(XY)	**X**	**Y**
R2(X)	**X**	~~**Y1**~~ **Y**

Therefore, the decompositions R1 = {XY}, R2 = {X} is a lossless join.

5. In relation Sells(Bar, Beer, Price), lets assume that Beer is foreign key with the parent table being the table Beers. Assume that DELETE CASCADE option has been selected for this foreign key. What will be the consequences of deleting a beer from the table Beers? What are consequences of deleting a tuple from Sells? What are possible scenarios following insertion of a tuple into Sells?

Consequences of deleting beer from table Beers

The consequence of deleting a beer from the Beers table (other than deleting a tuple in the Beers table) is that it will Delete all tuples in the Sells table that references that beer's name.

Consequences of deleting tuple from table Sells

There are no consequences of deleting tuples in the Sells table (of course except the consequence of deleting the tuples) since Beer is the foreign key that references the Name attribute in the table Beers thus it will not affect other tables or tuples.

Possible Scenarios following insertion of tuples into Sells

1. **The insertion is success**
    a. **The Beer's name is in the Beers table**
2. **The insertion failed**
    a. **The Beer's name is not in the Beers table**

6. For each of the following schedules, state whether it is conflict-serializable. Draw Precedence Graph. If it is serializable, provide all equivalent serial schedules. If no, state why it is not conflict-serializable. ($r_i(X)$ denotes a read on object X for transaction T_i. $w_j(Y)$ denotes a write on object Y for transaction T_j.)
    a. r1(X), r3(Y), r2(Y), w3(Y), r3(X), r2(Z), w1(X), w2(Z), r1(Z), w1(Z)
    b. r1(X), r2(Y), r3(Y), w3(Y), r2(Z), w1(X), r3(X), r1(Z), w2(Z), w1(Z)
    c. r1(X), w1(X), r3(Y), r1(Z), w3(Y), r2(Y), r2(Z), r3(X), w1(Z), w2(Z)
    d. w1(X), r3(Y)), r1(Z), w3(Y), r2(Y), r2(Z), r3(X), w2(Z), w2(Y), w1(Z)

Question 6 is on the next page

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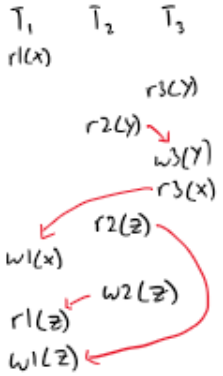
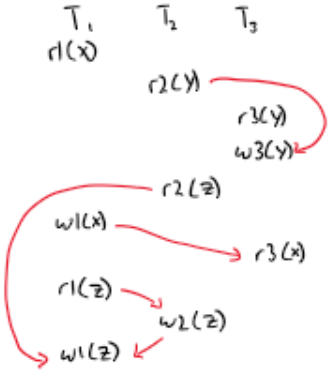
6a)

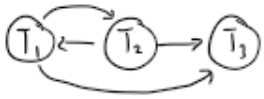


The schedule is conflict serializable since the precedence graph is acyclic.

$T_2 \rightarrow T_3 \rightarrow T_1$
$T_2 \rightarrow T_1 \rightarrow T_3$

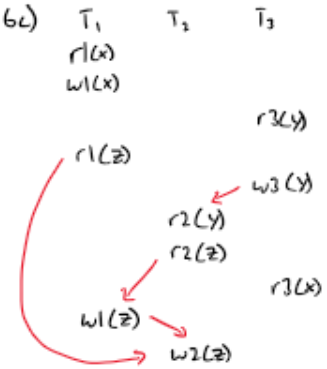
6b)

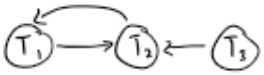




The schedule is not conflict serializable since the precedence graph has a cycle.

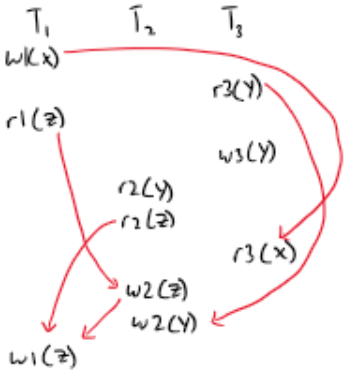
6c)





The schedule is not conflict serializable since the precedence graph has a cycle.

6d)



The schedule is not conflict serializable since the precedence graph has a cycle.