

GTU Department of Computer Engineering
CSE 411 – Spring 2023
Homework #2

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Question 1

A1	A2	A3	A4	A5
1	2	3	7	6
1	1	3	6	6
2	5	1	7	6

A2 A3 → A4 and A1 A3 → A5

a.) BCNF and 3NF Check

Check if it is in BCNF:

Firstly, neither of the functional dependencies are trivial.

Secondly, the determinant side of the functional dependency A1 A3 → A5 isn't a superkey.

Since these two requirements aren't satisfied, **it is not in BCNF**.

Check if it is in 3NF:

For the functional dependency A1 A3 → A5, the determinant side does not contain a candidate key.

Therefore, **it is not in 3NF** either.

b.) Decomposition

The following algorithm from the book is used for decomposing the relation to 3NF:

```
let  $F_c$  be a canonical cover for  $F$ ;  
 $i := 0$ ;  
for each functional dependency  $\alpha \rightarrow \beta$  in  $F_c$   
     $i := i + 1$ ;  
     $R_i := \alpha \beta$ ;  
if none of the schemas  $R_j, j = 1, 2, \dots, i$  contains a candidate key for  $R$   
    then  
         $i := i + 1$ ;  
         $R_i :=$  any candidate key for  $R$ ;  
/* Optionally, remove redundant relations */  
repeat  
    if any schema  $R_j$  is contained in another schema  $R_k$   
    then  
        /* Delete  $R_j$  */  
         $R_j := R_i$ ;  
         $i := i - 1$ ;  
until no more  $R_j$ s can be deleted  
return  $(R_1, R_2, \dots, R_i)$ 
```

Therefore, $R1 = \{A2, A3, A4\}$ and $R2 = \{A1, A3, A5\}$. The relations are as follows

$R1 = \{A2, A3, A4\}$

A2	A3	A4
2	3	7
1	3	6
5	1	7

$R2 = \{A1, A3, A5\}$.

A1	A3	A5
1	3	6
2	1	6

c.) Checking New Relations

Check if they are in BCNF:

For the relation R1, and functional dependency $A2 A3 \rightarrow A4$, determinant side is superkey, Therefore **it is in BCNF**.

For the relation R2, and functional dependency $A1 A3 \rightarrow A5$, determinant side is a superkey. Therefore, **it is in BCNF**.

d.) Functional Dependency Preservation

The functional dependencies are preserved in the new relations. The right hand side of each functional dependency doesn't get different values for the same value on the determinant side. In fact, the determinant side never get repeated values either.

Question 2

Firstly, I would describe the user requirements. Then, instead of using an ER diagram, I would create a schema for entities.

I would use Cassandra because it has a similar syntax to SQL and it would be easier to use the current ER model by shrinking it.

For example, for the Medical Record entity, I can remove the weak entities Medication and Examination result and include them in Medical Record table using <map> feature.

```
CREATE TABLE Medical_Record (  
    record_id varint PRIMARY KEY,  
    patient map<varint, text, text, date, text, text, text>,  
    doctor map<varint, text, text, varint, date, text, text>  
    date_of_treatment date,  
    diagnosis text,  
    treatment_desc text,  
    medication map<varint, text, varint>  
    examination_result map<varint, text>  
);
```

Here is how to insert a new record to the database:

```
INSERT INTO Medical_Record (record_id, patient, doctor, date_of_treatment, diagnosis,  
treatment_desc, medication, examination_result)  
VALUES (1, {1: 12345678901, 2: 'PatientName', 3: 'PatientSurname' 4: '12.06.1965', 5: 'Male',  
6: '123 Main Street, City', 7:'5353353535'}, {1: 12345, 2: 'DoctorName', 3: 'DoctorSurname',  
4:505, 5: '12.06.1965', 6: 'Female', 7: '5333333333'}, '12.06.2023', 'Tension', 'Rest and use  
medicine', {1: 123, 2: 'MedicineName', 3: 75}, {1: 12345, 2: '8-14 tension'});
```