

## COMP 421 Database Assignment 4

Q1.

a)  $F_{\text{claims}} = \{ \text{claim\_id} \rightarrow \text{date}, \text{totalCost}, \text{co-payCost}, \text{InsurancePayCost}, \text{ProcedureCode}, \text{plan\_ID}, \text{provider\_ID}, \text{member\_ID} \}$

$\text{member\_id} \rightarrow \text{plan\_ID}$

$\text{co-payCost}, \text{InsurancePayCost} \rightarrow \text{totalCost} \}$

$F_{\text{provider}} = \{ \text{Provider\_ID} \rightarrow \text{all other attributes} \}$

$F_{\text{DentalOffices}} = \{ \text{location\_ID} \rightarrow \text{all other attributes} \}$

$F_{\text{MedicalHistory}} = \{ \text{member\_ID}, \text{date} \rightarrow \text{all other attributes} \}$

$F_{\text{Demographics}} = \{ \text{State} \rightarrow \text{all other attributes} \}$

$F_{\text{plan}} = \{ \text{plan\_ID} \rightarrow \text{all other attributes} \}$

$F_{\text{members}} = \{ \text{member\_id} \rightarrow \text{all other attributes} \}$

b) It is not in 3NF

$F_{\text{claims}}$  does not satisfy the condition

c) It is not in BCNF

$F_{\text{claims}}$  does not satisfy the condition

d) For our project, we first came up with our project idea — to make a database for dental insurance claims. We thought of all the entities, relations, and their attributes, and made an ER diagram and relational schema. Using this, we implemented our database in DB2, along with some sample queries and other functions. Finally, we created a Java interface so that other people can interact with and modify our database.

Through all of this, we learned how to create a database from scratch until the consumer ready version. We especially learned how important it is to keep everything as simple as possible and avoid redundancies. In our schema, we had multiple entities that referred to each other, and relations that duplicated what we already expressed in our entities. If we could re-do the project, we would definitely prune these out of our entities, as well as decompose our claims entity to make the whole thing in BCNF.

Q2.  $R = \{B, N, S, T, A, R, C\}$

- a) N, S, A, and R don't show up on the right of any FD, so they must be part of a key to include all of relation R.

$$(NSAR)^+ = B \text{ (from A)}, N, S, T \text{ (from AB)}, A, R, \text{ and } C \text{ (from R)}$$

Therefore NSAR is a key and the only key because any other "candidate" key would be a superkey containing NSAR.

b)  $G = \{AB \rightarrow T, A \rightarrow B, R \rightarrow C, NS \rightarrow BT\}$

$$G = \{AB \rightarrow T, A \rightarrow B, R \rightarrow C, NS \rightarrow B, NS \rightarrow T\}$$

$$AB \rightarrow T : A^+ = ABT, B \text{ redundant} \\ \hookrightarrow A \rightarrow T$$

$$NS \rightarrow B : N^+ = N, S^+ = S$$

$$NS \rightarrow T : N^+ = N, S^+ = S$$

$$G = \{A \rightarrow T, A \rightarrow B, R \rightarrow C, NS \rightarrow B, NS \rightarrow T\}$$

$$\text{remove: } A \rightarrow T : A^+ = AB \quad \text{no } T$$

$$A \rightarrow B : A^+ = AT \quad \text{no } B$$

$$R \rightarrow C : R^+ = R \quad \text{no } C$$

$$NS \rightarrow B : (NS)^+ = NST \quad \text{no } B$$

$$NS \rightarrow T : (NS)^+ = NSB \quad \text{no } T$$

$$G = \{A \rightarrow T, A \rightarrow B, R \rightarrow C, NS \rightarrow B, NS \rightarrow T\}$$



c)  $A \rightarrow T$  :  $A$  not key,  $T$  not part of key,  
 $T \notin A$  : violates 3NF

$$A^+ = ABT$$

$$R = \{ABT\}, \{NSARC\}$$

$$A \rightarrow B, A \rightarrow T$$

$R \rightarrow C$  :  $R$  not key,  $C$  not part of key  
 $C \notin R$  : violates 3NF

$$R^+ = RC$$

$$R = \{ABT\}, \{RC\}, \{NSAR\}$$

$$A \rightarrow B, A \rightarrow T, R \rightarrow C$$

$NS \rightarrow T$  :  $NS$  not key,  $T$  not part of key  
 $T \notin NS$  : violates 3NF  $NS^+ = NSBT$

$$R = \{ABT\}, \{RC\}, \{NSBT\}, \{NSAR\}$$

$$A \rightarrow B, A \rightarrow T, R \rightarrow C, NS \rightarrow B, NS \rightarrow T$$

The union of all projections includes everything in  $F^+$ , so this decomposition is dependency preserving.

Joining all sub-relations together gives the original, so it's loss-less.

d) The resulting set of relations is in BCNF as well because no functional dependency is in the form  $X \rightarrow A$  where  $A$  is part of a key.

### Exercise 3

a. not serializable  
recoverable  
avoid cascading aborts  
not strict

b. serializable  
recoverable  
avoid cascading aborts  
not strict

c. serializable  
recoverable  
avoid cascading aborts  
strict

d. not serializable  
recoverable  
avoid cascading aborts  
strict

e. not serializable  
recoverable  
not avoid cascading aborts  
not strict