

# CS348-Homework 2

Fall 2017

Due: Friday, November 3, 2017 11:59 PM on Blackboard. (There will be a 10% penalty for each late calendar-day. After five calendar days, the homework will not be accepted.)

1) (10 pts) Consider the following relational schema:

worker(person-name, street, city )  
works(person-name, company-name, salary)  
company(company-name, city)  
manages(person-name, manager-name)

Write each of the following queries using Query-by-Example (QBE):

Assume that all workers work for at most one company.

- i. Find all workers who earn more than the average salary of all workers of their company.
- ii. Find the company that has the most workers.
- iii. Find the companies whose workers earn a higher salary, on average, than the average salary at "NY Corporation".

2) (15 pts) Consider the following relational schema:

worker(wid: integer, wname: string, age: integer, salary: real)  
works(wid: integer, cid: integer, time: integer)  
company(cid: integer, budget: real, managerid: integer)

- i. Using SQL, define a table constraint on worker that will ensure that every worker's salary is at least \$5000.
- ii. Define a table constraint on company that will ensure that all managers have age > 40.
- iii. Define an assertion on company that will ensure that all managers have age > 40.
- iv. Compare this assertion (iii) with the equivalent table constraint (ii). Explain which is better.

3) (10 pts) Given the following Relation  $R$  and the set of Functional Dependencies (FD)  $S$  that hold on  $R$ , find all the candidate keys for  $R$ . Show your work.

$R(A, B, C, D, E, F)$

$S$ :  
 $DF \rightarrow C$   
 $BC \rightarrow F$   
 $E \rightarrow A$   
 $ABC \rightarrow E$

4) (10 pts) Given the following Relation  $R$  and the set of Functional Dependencies (FD)  $S$  that hold on  $R$ , what is the highest possible normal form of  $R$  (1NF, 3NF, or BCNF) you can decompose  $R$  into with respect to  $S$ ? Show your work.

$R(A, B, C, D, E, F)$

$S$ :  
 $A \rightarrow D$   
 $B \rightarrow C$   
 $AB \rightarrow E$   
 $E \rightarrow F$

5) (15 pts) Suppose that Relation  $R$  of the previous question has been decomposed into the following relations  $R1, R2$  and  $R3$ . Now, identify the highest normal form (1NF, 3NF, or BCNF) for each of the relations in the decomposition. Show your work.

$R1(A, B, E, F)$   
 $R2(A, B, C)$   
 $R3(A, D)$

6) (10 pts) Given the following decomposition of Relation  $R$  and the set of functional dependencies  $S$ , is the decomposition dependency-preserving? Explain your answer.

$R(K, L, M, N, O, P, Q, R, S, T)$

$S$ :  
 $KL \rightarrow M$   
 $K \rightarrow NO$   
 $L \rightarrow P$   
 $P \rightarrow QR$   
 $N \rightarrow ST$

Decomposition:  
 $R1(K, L, M, N, O)$   
 $R2(L, P, Q, R)$   
 $R3(N, S, T)$

7) (15 pts) Given a relation  $R$  and the set of functional dependencies  $S$  on  $R$ , find out a decomposition of  $R$  into dependency-preserving lossless-join 3NF relations. Show your work.

$R(K, L, M, N, O, P, Q, R, S, T)$

$\underline{S}$ :

$KL \rightarrow M$

$LN \rightarrow OP$

$KN \rightarrow QR$

$K \rightarrow S$

$R \rightarrow T$

8) (15 pts) Given a relation  $R$  and the set of functional dependencies  $S$  that hold for  $R$ ,

(i) Identify the candidate key(s) for  $R$ .

(ii) Identify the best normal form that  $R$  satisfies ( $1NF$ ,  $3NF$ , or  $BCNF$ ).

(iii) If  $R$  is not in  $BCNF$ , decompose  $R$  into a set of  $BCNF$  relations that preserve the dependencies. Otherwise, explain why there is no  $BCNF$  decomposition for  $R$ .

$R(A, B, C, D)$

$\underline{S}$ :

$ABC \rightarrow D$

$D \rightarrow A$