CS34800: Homework 2

Spring 2018

Due: Thursday April 12, 2018 11:59PM on Blackboard (There will be a 10% penalty for each late calendar-day. After five calendar days, the homework will not be accepted.)

1) (15 pts) Consider the following relational schema:
worker(<u>wid: integer</u>, wname: string, age: integer, salary: real)
works(<u>wid: integer, cid: integer</u>, time: integer)
company(<u>cid: integer</u>, budget: real, managerid: integer)
    Here, every manager is also a worker. Now, answer the following questions:

i. Define a table constraint on worker that will ensure that every worker's salary is at least $4000.

ii. Define a table constraint on company that will ensure that all managers have age > 50.

iii. If you replace the above table constraint in (ii) with an equivalent assertion, explain which will be better in this particular scenario.

2) (15 pts) Given the following Relation R and the set of Functional Dependencies (FD) FD that hold on R, find a minimum cover of FD. Show your work.

a) $R(K, L, M, N, O, P, Q, R)$
<u>FD</u>:
$K \rightarrow L$
$KLMN \rightarrow O$
$OP \rightarrow Q$
$OP \rightarrow R$
$KMNP \rightarrow O$
$KMNP \rightarrow R$

b) $R(P, Q, R, S, T, U, V, W)$
<u>FD</u>:
$Q \rightarrow U$
$U \rightarrow V$
$PQ \rightarrow WST$
$SU \rightarrow TR$
$VT \rightarrow RW$

$R \rightarrow W$

3) (20 pts) Given the following Relation R and the set of Functional Dependencies (FD) FD that hold on R, Find the following:
a) Identify the candidate key(s) for R.
b) what is the highest normal form of $R(1NF, 3NF, or BCNF)$.
   Show your work for all the above.
   $R(K, L, M, N)$

$\underline{FD}$:
$KL \rightarrow M$
$KL \rightarrow N$
$M \rightarrow K$
$N \rightarrow L$

4) (10 pts) Given the following decomposition of the relation R and the set of functional dependencies FD, is the decomposition dependency-preserving? Justify your answer (with explanation).
   $R(K, L, M, N, O, P, Q, R, S, T)$

$\underline{FD}$:
$KL \rightarrow M$
$K \rightarrow NO$
$L \rightarrow P$
$P \rightarrow QR$
$N \rightarrow ST$

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

5) (20 pts) Given a relation R and the set of functional dependencies FD on R, find out a decomposition of R into dependency-preserving lossless-join $3NF$ relations. Show your work.
   $R(K, L, M, N, O, P, Q, R, S, T)$

$\underline{FD}$:
$KL \rightarrow M$
$LN \rightarrow OP$
$KN \rightarrow QR$
$K \rightarrow S$
$R \rightarrow T$

6) (20 pts) Given a relation R and the set of functional dependencies FD that hold for R,

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

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

Show your work for all the above.

$R(K, L, M, N)$

$\underline{FD}$:

$KLM \rightarrow N$

$N \rightarrow K$