Database Management Systems (COP 5725)

(Fall 2019)

Instructor: Dr. Markus Schneider

TA: Kyuseo Park

Homework 5

Name:	
UFID:	
Email Address:	

Pledge (Must be signed according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

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Signature

For scoring use only:

	Maximum	Received
Exercise 1	20	
Exercise 2	25	
Exercise 3	25	
Exercise 4	15	
Exercise 5	15	
Total	100	

Exercise 1 - Normalization [20 points]

Consider the following table which is used to store students and courses records.

UFID	Course_ID	Grade	Student_Name	Department	Tuition Fee	Instructor
4114123	COP01, COP02, COP03	A, A, B	John Smith	CISE	250	James, Andrew, Peter
3124234	BU01, BU02	B, B	Roger Hicks	Business	300	Alan, Alan

Please note that *Tuition Fee* depends on the department.

1. Normalize the table to the 1st Normal Form and explain your answer. [5 points]
2. Explain the criteria for 2nd Normal Form and normalize the table you obtained from the previous part to meet them. Then explain which anomalies can occur with your answer. [5 points]
3. Explain the criteria for 3rd Normal Form and normalize the table you obtained for the previous question to meet them. [5 points]
4. Explain if the tables you obtained for the previous question is in BCNF and, if not, normalize it to BCNF. [5 points]

Exercise 2 – Normal Forms [25 points]

Consider the relation schema R = (A, B, C, D, E) for the following questions.

1. Assume we have the following functional dependencies:
   - $AB \rightarrow C$
   - $C \rightarrow D$
   - $B \rightarrow E$

   Briefly explain if the relation R is in 2NF. If not, what modifications can be made to normalize it into 2NF? [5 points]

2. Is R in 2NF with the following functional dependencies? If not, normalize it. [5 points]
   - $A \rightarrow BC$
   - $AD \rightarrow E$
   - $B \rightarrow C$

3. Are the relations from the answer of question 2 in 3NF? If not, normalize it. [5 points]

4. Briefly explain if the relation R is in 2NF. [2 points].
   - $A \rightarrow BCDE$
   - $BC \rightarrow ADE$
   - $D \rightarrow E$

   Further, is R in 3NF? If not, what modifications can be made to normalize it into 3NF? [3 points]

5. Assume we have the following functional dependencies:
   - $AB \rightarrow D$
   - $C \rightarrow E$
   - $E \rightarrow C$
   - $C \rightarrow A$
   - $A \rightarrow C$

   We decompose R into schemas R1(ABC) and R2(ABDE). Show whether it is dependency preserving by using one of the algorithms that covered in the lecture. [5 points]

Exercise 3 – Lossless Join Decomposition [25 points]

1. For the relation schema R = (ABCDEF) and functional dependencies F = $\{AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow F\}$, determine whether the following decomposition is lossless. Also, determine if it is dependency preserving.

   P = {R1(AB), R2(BC), R3(ABDE), R4(EF)} [10 points]

2. Consider the relation schema R = (ABCDE).
   a. For the functional dependencies F = $\{AB \rightarrow C, C \rightarrow E, B \rightarrow D, E \rightarrow A\}$, is P = {R1 (BCD), R2 (ACE)} a lossless decomposition? Show all the steps. [5 points]
   b. For the functional dependencies F = $\{A \rightarrow CD, B \rightarrow CE, E \rightarrow B\}$, give a lossless-join decomposition of R into BCNF. [5 points]
   c. For the functional dependencies F = $\{A \rightarrow CD, B \rightarrow CE, E \rightarrow B\}$, give a lossless-join decomposition of R into 3NF preserving functional dependencies. [5 points]

Exercise 4 - Normalization [15 points]

Suppose we have a relation schema R(A, B, C, D, E, F, G) and a set of functional dependencies F = {BCD $\rightarrow$ A, BC $\rightarrow$ E, A $\rightarrow$ F, F $\rightarrow$ G, C $\rightarrow$ D, A $\rightarrow$ G, A $\rightarrow$ B}. Decompose R into 3NF by using the 3NF synthesis algorithm. Show all steps and argue precisely. Is this decomposition also in BCNF? If so, why? If not, why not? [15 points]

Exercise 5 – Integrity Constraints [15 points]

Consider the following tables:

```
CREATE TABLE PRODUCT
(MAKER VARCHAR2(50),
MODEL VARCHAR2(50),
TYPE VARCHAR2(30));

CREATE TABLE DESKTOP
(MODEL VARCHAR2(50) NOT NULL,
SPEED NUMBER(8),
RAM VARCHAR2(30),
HD VARCHAR2(30),
PRICE NUMBER(8));

CREATE TABLE LAPTOP
(MODEL VARCHAR2(50) NOT NULL,
SPEED NUMBER(8),
RAM VARCHAR2(30),
HD VARCHAR2(30),
SCREEN VARCHAR2(30),
PRICE NUMBER(8));

CREATE PRINTER
(MODEL VARCHAR2(50) NOT NULL,
COLOR VARCHAR2(30),
TYPE VARCHAR2(30),
PRICE NUMBER(8));
```

1. Write a check condition to ensure that no manufacturer of desktops also makes laptops. [3 points]
2. Write a check condition to ensure that a manufacturer of a desktop also makes a laptop with at least the same processor speed. [4 points]
3. Create a trigger that checks that there is no lower priced desktop with the same speed when the price of a desktop is updated. [4 points]
4. Create a trigger that checks if the model number exists in the *Product* table when a new printer is inserted. [4 points]