

Database Management Systems

(COP 5725)

Fall 2021

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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.

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 customers' information.

CustomerID	EventNumber	Winning	customerGrade	DiscountRate
C01	E001, E005, E010	Y, N, Y	Gold	10%
C02	E002, E005	N, Y	Vip	20%
C03	E003, E007	Y, Y	Gold	10%
C04	E004	N	Silver	5%

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

- $AB \rightarrow C$
- $D \rightarrow A$
- $C \rightarrow E$

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]

- $AB \rightarrow D$
- $C \rightarrow E$
- $E \rightarrow C$
- $C \rightarrow A$
- $A \rightarrow C$

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

4. Are the relations from **the answer to question 3** in BCNF? If not, identify FDs that violate BCNF and normalize them. [5 points].

5. Assume we have the following functional dependencies in F :

- $A \rightarrow B$
- $B \rightarrow C$
- $A \rightarrow C$
- $C \rightarrow A$

We decompose $R(A,B,C)$ into schemas $R_1(AB)$ and $R_2(AC)$. 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 $R = (ABCDEFG)$ and functional dependencies $F = \{AB \rightarrow C, C \rightarrow A, BC \rightarrow D, ACD \rightarrow B, D \rightarrow EG, BE \rightarrow C, CG \rightarrow BD, CE \rightarrow G\}$, determine whether the following decomposition is lossless. Also, determine if it is dependency preserving.

$P = \{R_1(AB), R_2(BC), R_3(ABE), R_4(DEF)\}$ [10 points]

2. Consider the relation schema $R = (ABCDE)$.
 - a. For functional dependencies $F = \{AB \rightarrow C, BC \rightarrow D, AD \rightarrow E\}$, is $P = \{R_1(ABC), R_2(BCD), R_3(ADE)\}$ a lossless decomposition? Show all the steps. [5 points]
 - b. For 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 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 $F = \{B \rightarrow D, DG \rightarrow C, BD \rightarrow E, AG \rightarrow B, ADG \rightarrow B, ADG \rightarrow C\}$. 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 STUDENT
(STNO NUMBER(8) NOT NULL,
NAME VARCHAR2(50),
EMAIL VARCHAR2(30));
```

```
CREATE TABLE COURSE
(CRNO NUMBER(8) NOT NULL,
TITLE VARCHAR(20),
CREDIT NUMBER(2));
```

```
CREATE TABLE TAKES
(STUDENT_NO NUMBER(8),
COURSE_NO NUMBER(8),
GRADE NUMBER);
```

```
CREATE TABLE STUDENT_LOG
(ID BIGINT,
STUDENT_NO NUMBER(8),
COURSE_NO NUMBER(8),
TIME TIMESTAMP);
```

1. Add constraints to the table TAKES that checks STUDENT_NO and COURSE_NO refer to columns STUDENT.STNO and COURSE.CRNO, respectively. The constraint should guarantee that once a student or course are deleted from STUDENT or COURSE tables, the corresponding records in TAKES table are also deleted. [3 points]
2. Create primary constraints for STNO and CRNO on the STUDENT and COURSE tables. Create a constraint that checks STUDENT.EMAIL is unique. Create constraints that check TAKES.GRADE is not greater than 4 and COURSE.CREDIT is less than 9. [4 points]
3. Create a trigger that displays the average grades of students for course (identified by COURSE_NO), before inserting a record in TAKES table with the same COURSE_NO. [4 points]
4. Create a trigger that inserts STUDENT_NO, COURSE_NO and the current timestamp in the STUDENT_LOG table after inserting or updating a record in the table TAKES. The ID for the new record in the STUDENT_LOG table should be the current highest ID + 1. [4 points]