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National University of Computer and Emerging Sciences, Lahore Campus



Course:	Database Systems	Course Code:	CS203
Program:	BS(Computer Science)	Semester:	Spring 2018
Duration:	3 Hours	Total Marks:	65
Paper Date:	Mon 21-May-2018	Weight	50%
Section:	ALL	Page(s):	11
Exam:	Final Exam		

**Instruction/Notes:** Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.

You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

**Q1. (5 points)** Consider the following two sets of FDs. Check whether or not they are equivalent. Provide proper reason.

$F1 = \{A \rightarrow B, B \rightarrow C, C \rightarrow A\}$  and  $F2 = \{A \rightarrow C, C \rightarrow B, B \rightarrow A\}$ .

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**Q2.** (5 points) Consider the relation schema  $R(A, B, C, D, E, F)$ , with FDs  $F = \{AB \rightarrow CD, B \rightarrow C, BC \rightarrow D, CD \rightarrow EF, E \rightarrow F\}$ . Compute the minimal cover for  $F$  (i.e.  $F_c$ ). Show your work!

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**Q3.** (5 points) Consider the relation  $R(A, B, C, D, E)$ , with FDs  $\{AB \rightarrow C, DE \rightarrow C, B \rightarrow D\}$ . Possible key of this relation is  $\{ABE\}$ . State which of the following decompositions of R relation are lossless decomposition. Justify your answer.

**a.**  $R1(\underline{A}, \underline{B}, C)$ ,  $R2(C, \underline{D}, \underline{E})$ , and  $R3(\underline{B}, D)$ .

**b.**  $R1(\underline{A}, \underline{B}, C)$ ,  $R2(\underline{A}, \underline{B}, \underline{E})$ , and  $R3(\underline{B}, D)$ .

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**Q4.** (5 points) Consider the relation schema  $R(A, B, C, D)$ , with FDs  $\{AB \rightarrow C, BC \rightarrow D, CD \rightarrow A\}$ . Identify the best normal form that  $R$  satisfies (*1NF*, *2NF*, *3NF*, or *BCNF*). Justify your answer. If  $R$  is not in *BCNF*, decompose it into a set of *BCNF* relations. Indicate which dependencies if any are not preserved by the decomposition.

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**Q5.** (5 points) Consider the following classes of schedules: conflict-serializable, view-serializable, strict, cascadeless, recoverable and non-recoverable. For a schedule  $S: r2(X); w3(X); w1(Y); r2(Y); r2(Z); r2(Y); c3; c2; r1(Z); c1$ , state which of the preceding classes it belongs to. Give proper reason. The actions are listed in the order they are scheduled. Also draw the serializability (precedence) graph for this schedule. If the schedule is conflict-serializable or view-serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

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**Q6. (10 points)** Consider the following database of the “BLOGs” website. The website keeps tracks of the different users and blog written by them on different topics. Each user is identified by a unique username. The website also keeps track of the various comments given by Users on the Blogs.

The field Bwriter in Blog table is a foreign Key from user table and it gives the unique username of the Blog-writer and similarly the field Cwriter in Comment Table is a foreign key and gives the username of the user who have given a comment on the Blog.

**USER**

<u>Uname</u>	Age	Gender
Sara	25	F
Zara	42	F
Ali	15	M
Ahmad	19	M
Aliya	27	F
Tania	29	F
Hamza	34	M

**TOPIC**

<u>TId</u>	Name	Subject
1	Deep Learning	Computer Science
2	Big Data	Computer Science
3	Databases	Computer Science
4	Algorithms	Computer Science
5	Human Interactions	Philosophy

**BLOG**

<u>BId</u>	Bname	Bwriter	TopicId
10	BigData Frameworks	Ahmad	2
20	Generation Gap	Sara	5
100	Map Reduce	Hamza	2
30	The world of CNN	Ali	1
50	Cassandra	Ali	3
70	Neural Nets	Tania	1
60	MongoDB	Tania	3
120	Emerging trends	Sara	2
80	Hbase	Ali	3

**COMMENT**

<u>CId</u>	<u>BlogId</u>	Cwriter
1	20	Hamza
2	100	Hamza
3	20	Zara
20	80	Hamza
7	30	Zara
9	50	Zara
5	80	Ali
12	50	Ahmad
15	50	Tania

Write both **SQL and Relation Algebra Queries** for the following tasks

- Find the name and age of the users who have never written any blog and have never given any comment.
- Find the name of the users who have given comment on all the blogs written in Computer Science area.

Select Uname, Age  
From User  
Except  
Select Uname, Age  
From User join Blog on Uname=Bwriter

### INTERSECT

Select Uname, Age  
From User  
Except  
Select Uname, Age  
From User join Comment on Uname=Cwriter

**Find the name of the users who have given comment on all the blogs written in Computer Science area.**

```
Select Uname
From User U
Where Not Exists
    (Select BId
     From Topic join Blog on TID = TopicId
     Where Subject = "Computer Science"
    EXCEPT
     Select BId
     From (Topic join Blog on TID = TopicId) join Comment on Bid = BlogId
     Where U.Uname = Cwriter
    )
```

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**Q7. (5 points)** For the above database, create a view that find and list the pair of users who have never written a blog on the same Topic. If this query is run on the above database, the result should be:

Blog Writer 1	Blog Writer 2
Ahmad	Tania
Hamza	Ali
Hamza	Tania

Create View **UserPairs** (BlogWriter 1, BlogWriter2) AS

Select U1.Uname, U2.Uname

From User U1 join User U2 on U1.Uname != U2.Uname

Where Not Exist (

(Select TId from BLOG where Bwriter=U1.Uname)

Intersect

(Select TId from BLOG where Bwriter=U2.UID)

)



**Q8. (10 points)** Write the result of the following queries for the Database State given above. Also show the intermediate tables. Explain in one sentence what these queries are doing.

a.  $STopics \leftarrow \Pi_{Subjects}(TOPIC)$

$BSubjects \leftarrow \Pi_{Bwriter, Subjects}(TOPIC \bowtie_{TId=TopicId} BLOG)$

$T \leftarrow \Pi_{Bwriter}(BSubjects) - (\Pi_{Bwriter}((\Pi_{Bwriter}(BSubjects) \times STopics) - BSubjects))$

b. **SELECT** BId

**FROM** blog B **JOIN** user U **ON** Bwriter=Uname

**WHERE** U.age < 30

**AND** B.Bid **IN** ( **SELECT** BlogId **FROM** comment **GROUP BY** BlogId **HAVING** COUNT (\*) >= 2 )

**AND** **NOT EXISTS** ( **SELECT** \* **FROM** comment **WHERE** B.Bwriter = Cwriter **AND** B.Bid = BlogId )

**STopics**

Subject
Computer Science (CS)
Philosophy (P)

**BSubjects**

Bwriter	Subject
Ahmad	CS
Sara	P
Hamza	CS
Ali	CS
Tania	Cs
Sara	CS

**T**

Bwriter
Sara

**This query gives the Blog writers who have written a blog on all the subjects**

**B part query**

This query finds the blogs such that the blog writer age is less than 30, and number of comments on the blog are two or more and none of the comment is from the blog writer

**T**

Bid
20
50

**Q9. (10 points)** Draw an ER/EER diagram for the following case study. Specify key attributes of each entity type and structural constraints on each relationship type. Note any unspecified requirements, and make appropriate assumptions to make the specification complete but clearly state your assumptions along the diagram.

A taxi company (like Uber) needs to model their activities. There are two types of employees in the company: drivers and operators. For drivers it is interesting to know the date of issue and type of the driving license, and the date of issue of the taxi driver's certificate. For all employees it is interesting to know their personal number, address and the available phone numbers. The company owns a number of cars. For each car there is a need to know its type, year of manufacturing, maximum number of passengers in the car and date of the last service. The company wants to have a record of

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car trips. A taxi may be picked on a street or ordered through an operator who assigns the order to a certain driver and a car. Departure and destination addresses together with times should also be recorded.

**Q10.** (5 points) Map following ER diagram into a relational model.

