INFSCI 2710 Database Management, Fall 2022

Homework 3: ER, Schema Refinement, Storage and Indexing (100 pts)

100 pts

Due Date: 11/17, at the beginning of the class. Please submit a pdf to the Canvas assignment.

Q1 [10 pt] Draw an ER diagram for an online conference peer review system on the following description: The database must store information about people involved such as author who submits the paper, reviewer who reviews the paper and organizer who host the conference, also information about the conferences that papers are submitted to.

- Authors, reviewers, and organizers share some common attributes such as email (you can assume email as the unique identifier), and name, authors and organizer will have specific attributes: phone number, website, while reviewers will give a decision when review a paper. (You should use the ISA structure to describe the hierarchical structure)
- Each paper is described by id, title, authors, reviewers, conference, submitted time, key words and download link, one paper may be written by more than one author and reviewed by more than one reviewer, but each paper can only be published at one conference.
- Each conference should have information about its id, name, submission page, and organizers.
- You can draw ER diagram by hand, but make sure it's readable

Q2[10 pts] Translate the ER diagram from Q1 into SQL DDL statements

Q3 [15 pts] Consider a relation R in table (a). Complete the table (b) for given functional dependencies (FD). Please just answer yes, no or unknown

A	B	C	D
A_1	B_1	C_1	D_1
A_2	B_1	C_2	D_2
A_1	B_2	C_1	D_1
A_3	B_1	C_2	D_2
A_4	B_3	C_3	D_3
A_4	B_1	C_1	D_1
A_5	B_4	C_3	D_1
A_5	B_3	C_2	D_3
A_3	B_4	C_3	D_1

Table (a)

FD	**Satisfied by R (yes/ no/unknown)**	**Hold on R (yes/no/unknown)**	**Trivial (yes/no)**
A→ B			
B→ A			
AC→ D			
ABD→ B			
AC→B			
AD→ B			
C→ ABC			
BC→ D			
BD→ D			
BD→ A			

Table (b)

Q4 [10 pts] Consider a relation R1(A,B,C,D,E,F,G) and a set of functional dependencies FD = {AC → E, B → DE, F→ C, CD → GF} which hold on R1. Using Armstrong's axioms verify if the following functional dependencies hold on R1

FD	Yes/No	Proof if yes
ABC → G		
AC→ F		
BF→G		
BCD→ F		
ABC→DEF		

Q5 [10 pts] Consider a relation R(A,B,C,D,E,F) and a set of functional dependencies, which hold on R : { AB→E, C→BF, D→A } Are decompositions in the table lossless and why?

Decomposition	Lossless? (Yes) /(No)	Why
R1(ABF) and R2(CDE)		
R1(ABCEF) and R2(CDE)		
R1(ABDE) and R2(ACDF)		
R1(ACDF) and R2(BCDE)		
R1(ABEF) and R2(BCDF)		

Q6 [10 pts] Consider the following relations with the associated functional dependencies. Decide, whether those relations are in (a) BCNF, (b)3NF, (c) neither in BCNF nor 3NF normal form.

Relation, FD	Answer (a, b, or c)	Solution
R1(A,B,C,D) {AB→ C, C→ D}		
R2(A,B,C,D), {AC→ BD}		
R3(A,B,C,D) {AB→ CD, D→A}		
R4(A,B,C,D,E), {AC→D, D→B}		
R5(A,B,C,D,E) {A→ CE, D→ CE}		

NOTE: For the next questions, Q7 – Q10, you are running a DBMS on a computer that has 5 kByte disk block size. Reminder: 1kByte=1024bytes, 1 MByte = 1024 kBytes.

Q7 [5 pts] Table T in your database D has size 3 kBytes. How much space does Table T take on the drive? Show your calculations.

Q8 [5 pts] Table T in your database D has size 300 MBytes. You execute a query: "select * from T". How much data will be read from the drive? Assume that n*size_of_tuple = block_size, where n is a natural number. Show your calculations.

Q9 [5 pts] Assume that table T is defined in the same way as in question 8. You execute a query "select * from T where num=500". How many blocks and how many bytes will be read from the disk? Show your calculations (There is no index built on this column).

Q10 [10pts] How your answer will be different from question 9, if clustered index for column num is used for table T. Assume that size of the required index structure is 8 kBytes and there are m records with num = 500, which may be stored in n different blocks.

Q11 [10pts] Draw a valid B+ tree below for the search keys (1, 2, 3, 4, …, 10). Assume the keys are inserted in their natural order. The order of the tree is 3