Databases and Information Systems
CS303

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Assignment
Deadline $15 - 09 - 2023$

1. An online board game service uses a database to store game information, manage player profiles, and allow them to organize their games. Players register by providing a unique nickname, email address and password, and the database also records the date of their registration. The games information includes title of the game, minimum and maximum number of players per game session and a text about the rules of the game. Each game can have several variants and when one game is a variant of another, this information is also provided.

   Each player is interested in playing some of the games among the available games. A player can start a game session for one of the game which (s)he is interested (in which case that player is the organizer of that game session) or join a game session to play the game. For each game session, the database maintains the following information: which game is being played, organizing player of the game session, participants, date, status of the game: 'to be played' (if the game session is scheduled but not yet happened) or 'in progress' (if it is currently in progress) or 'finished'. If the status is 'finished' then the database also records the ranking of all the participants (assume that there are no ties) for that game session.

   (a) Design an ER diagram to capture the specifications of this online board game service. Specify the entities, the primary keys, the relationships, and for each relationship, indicate the cardinalites.

   (b) Translate the designed ER diagram into a relational schema. Specify the primary keys and the referential constraints (foreign keys).

Design the ER diagram and the schema on the website that we used in the lab. Submit the screenshot along with your roll number in the label.

2. Consider the following schema:

> Activity (<u>a_id</u>, a_name, category)
> Student (<u>s_id</u>, s_name, level)
> Instructor (<u>i_id</u>, i_name)
> student_activity (<u>a_id, s_id</u>)
> Instructor_activity (<u>a_id, i_id</u>)

The primary keys are underlined and the foreign keys are references with the same attribute names.

Write expressions in relational algebra; formula in tuple relational calculus and formula in domain relational calculus to retrieve the following. Also, in each case write the output result for the database described in Figure 1 :

(a) The id and name of instructors who are not supervising any activity.

(b) The names of the instructors who supervise at least one activity in the category "Boxing" and at least one activity in the "Combat" category.

(c) The names of the activities in which no students of level "L2" participate.

(d) The names of the instructors who supervise at least one activity that is taken by all "L2" level students.

(e) The categories of activities that are taken by at least one "L1" level student and one "L2" level student.

Activity		
a_id	a_name	category
1	Judo	Combat
2	Karate	Combat
3	Martial Arts	Combat
4	Taekwondo	Combat
5	English Boxing	Boxing
6	French Boxing	Boxing
7	Cardio Boxing	Boxing
8	Diving	Aquatic sport
9	Swimming	Aquatic sport
10	Snorkeling	Aquatic sport

Instructor	
i_id	i_name
1	Macron
2	Trudeau
3	Merkel
4	Jacinda
5	Theresea

student_activity	
a_id	s_id
1	2
1	1
1	6
1	8
2	1
2	2
3	3
3	5
4	12
4	11
4	4
5	4
5	5
5	6
6	4
7	7
7	12
8	9
8	11
9	6
10	5
10	4
10	6

Student		
s_id	s_name	Level
1	Stan	L3
2	Eminem	L3
3	Marshall	L3
4	Marie	L2
5	Malala	L2
6	Diana	L2
7	Alex	L1
8	Peter	L1
9	Stewie	L1
10	Brayant	L1
11	Rick	L1
12	Morty	L1

Instructor_activity	
a_id	i_id
1	2
2	3
3	4
4	3
5	5
6	4
9	2
10	3

Figure 1: Database instance for Question 2.

3. Consider the following table:

R		
A_1	A_2	A_3
a	p	1
b	p	2
a	q	1
c	p	4
d	r	1

Can following functional dependencies exist? If not, why?

(a) $\{A_3\} \rightarrow \{A_1\}$

(b) $\{A_1\} \rightarrow \{A_3\}$

(c) $\{A_2\} \rightarrow \{A_3\}$

(d) $\{A_1, A_2\} \rightarrow \{A_1, A_2\}$

(e) $\{A_1, A_2\} \rightarrow \{A3\}$

4. Consider the following schema:

S $(\underline{B_1, B_2, B_3}, B_4, B_5, B_6)$

Here the S is the table name and $B_1, \ldots B_6$ are the attributes. Attributes (B_1, B_2, B_3) form the primary key. There are no other candidate keys and there are no multi-valued attributes. The functional dependencies are given as follows:

FD_1: $B_1, B_2 \rightarrow B_4$

FD_2: $B_2, B_3 \rightarrow B_5$

FD_3: $B_5 \rightarrow B_6$

Is it in BCNF? If not, explain why and construct a new schema with the same information where the tables are in BCNF.

Is it in 3NF? If not, explain why and construct a new schema with the same information where the tables are in 3NF.