Roll Number:

CS4.301: Data and Applications (Monsoon 2024)

Makeup Quiz

Maximum Marks: 15, Time: 40 minutes

- **Keep answers concise. State all assumptions.**
- **All questions are compulsory.**

Question 1

P			Q			R	
X	**Y**	**Z**	**X**	**Y**	**T**	**Y**	**V**
X1	Y1	Z1	X2	Y1	5	Y1	V1
X1	Y1	Z2	X1	Y2	3	Y3	V2
X2	Y2	Z2	X1	Y1	2	Y2	V3
X2	Y4	Z4	X3	Y3	8	Y2	V2

$$\pi_X(\sigma_{(P.Y = R.Y \wedge R.V = V2)}(P \times R)) - \pi_X(\sigma_{(Q.Y = R.Y \wedge Q.T < 8)}(Q \times R))$$

How many tuples will be returned? Show working.

(3 marks)

Question 2

Consider a relation *R(A, B, C, D, E)* **that satisfies the following functional dependencies:** *{ABC → D, E → B, AD → C}*. **Decompose the schema in BCNF.**

(2 marks)

Question 3

Let a prime attribute be one that appears in at least one candidate key. Let α and β be sets of attributes such that $\alpha \rightarrow \beta$ holds, but $\beta \rightarrow \alpha$ does not hold. Let A be an attribute that is not in α, is not in β, and for which $\beta \rightarrow A$ holds. We say that A is transitively dependent on α. We can restate our definition of 3NF as follows: *A relation schema R is in 3NF with respect to a set F of functional dependencies if there are no nonprime attributes A in R for which A is transitively dependent on a key for R.* **Show that this new definition is equivalent to the original one.**

(4 marks)

Question 4

SQL provides an *n*-ary operation called coalesce**, which is defined as follows:**
coalesce*($A_1, A_2, \ldots, A_n$)* **returns the first nonnull** A_i **in the list** $A_1, A_2, \ldots, A_n$**, and returns** *null* **if all of** $A_1, A_2, \ldots, A_n$ **are** *null*.

Let *a* **and** *b* **be relations with the schemas** *A(name, address, title)*, **and** *B(name, address, salary)*, **respectively. Show how to express** *a* natural full outer join *b* **using the** full outer-join **operation with an** on **condition and the** coalesce **operation. Make sure that the result relation does not contain two copies of the attributes** *name* **and** *address*, **and that the solution is correct even if some tuples in** *a* **and** *b* **have null values for attributes** *name* **or** *address*.

(4 marks)

Question 5

Rewrite the following query without using the with **construct.** The query must run; no partial marks will be awarded.

```
with dept_total (dept_name, value) as
        (select dept_name, sum(salary)
        from instructor
        group by dept_name),
dept_total_avg (value) as
        (select avg (value)
        from dept_total)
select dept_name
from dept_total, dept_total_avg
where dept_total.value >= dept_total_avg.value;
```

(2 marks)