Assignment 1: Relational Algebra Relational Calculus

(1) Consider the Movie Rental database schema with the following relations :

Customer (customer id : integer, name : string, city : string)

Movie (movie id : integer, title : string, genre : string , release_year : integer)

Rental (rental id : integer, customer_id : integer, movie_id : integer, rental_price : real)

(A)Write a relational algebraic expression to retrieve the customer_id and names of all customers who have rented at least one movie in every genre and belong to the city 'Boston'.

(B) Write a relational algebraic expression to find the average rental price for movies released before 2000 and rented more than 10 times.

(2) Consider the database schema given below.

Employee(Emp id, FName, LName, Address, Dept_id)

Department(Dept id, Dept_name, Emp_id)

Project(PName,Project id, PLocation, Dept_id)

Works_on(Emp id, Project id, Hours)

Dependent(Emp id, Dept_id)

(A) Write a Relational Calculus expression to find the first name of each employee who works on some projects under department ID 5.

(B) Write a Relational Calculus expression to list the FNames of managers who have at least one dependent.

Assignment 2: Views,Transactions, Roles and Authorizations

(1) Consider the following relation : Movie (id : integer, title : string, genre : string, release_year : integer). Suppose you have a view called "movies_2021" defined as follows :

CREATE VIEW movies_2021 AS

SELECT * FROM Movie

WHERE release_year = 2021;
Explain what happens when you try to execute the following insertion query on the "movies_2021" view :
INSERT INTO movies_2021 (id , title , genre , release_year) values (203, 'RRR', 'Drama' , 2022);

(2) Consider the following customers relation , initially with no records : customers (customer_id , customer_name, city)

Suppose the following SQL queries are executed in order :

1) INSERT INTO customers (customer_id, customer_name, city) VALUES (1, 'John Smith', 'Boston');

2) SAVEPOINT s;

3) UPDATE customers SET city = 'Los Angeles' WHERE customer_id = 1;

4)INSERT INTO customers (customer_id, customer_name, city) VALUES (2, 'Jane Doe', 'New York');

5) ROLLBACK TO s;

6)UPDATE customers SET city = 'San Francisco' WHERE customer_id = 1;

7)COMMIT;

If all the above SQL queries run in order, what will be the result of the below query ?

SELECT * FROM customers;

Give an explanation for your answer.

(3) Suppose a company has a database that contains information about its sales and customers. The sales manager in the UK needs access to the sales information for all customers based in the UK. However, the sales manager in the UK should not have access to the sales' information for the customers based in other countries. As a database administrator, how can you ensure data security by providing the appropriate level of access to the relevant information ?

(4) Suppose there is a database with the following relation :

employees(id : integer , name : string, salary : real , age : integer)

The following command is executed :

GRANT UPDATE (id, name, age) ON employees TO John;

if John executes the following command :

UPDATE employees SET name = 'Alice', id = 50 WHERE id = 101;

Will the update be successful or not ? Justify your answer.

Assignment 3: Functions, Procedures, Triggers

(1) Consider the 'Department' relation containing the attributes 'dept_name' and 'budget'. Show the details of the departments which have budgets more than the average budget across all departments by defining a function 'more_than_avg_budget' in SQL.

(2) Consider the 'Student' relation containing the attributes 'ID', 'Dept_name', 'Credits'. Create a procedure that deletes all students who are having 'Credits' less than 5.0 in the 'CS' department using SQL statements.

(3) How do DBMS automatically handle the condition mentioned in the previous question and meet the data consistency.

Assignment 4: Functional Dependencies Normal Forms

(1) Minimize the below set of functional dependencies.
{A -> B, C -> B, D -> ABC, AC -> D}

(2) Check whether the below given functional dependencies are equivalent or not.
F1 = {A -> B, AB -> C, D -> AC, D -> E}
F2 = {A ->BC, D -> AB, C -> B}

(3) Relation R(A B C D) and FD : {BC → D, C → A, D → B}. What is the highest normal form it is satisfying? Does it satisfy 3NF? If not, split the table and rewrite the functional dependencies of each table so that it satisfies 3NF.

(4) Relation R(X Y Z) and FD : {XY→ Z, Z → Y}. What is the highest normal form it is satisfying? Does it satisfy BCNF? If not, decompose the relation and rewrite the functional dependencies of each relation so that it satisfies BCNF. Justify whether the decomposition is lossless and dependency preserving?