CS3020 Database and Management Systems
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Exercise Sheet 2 : Hand out 17.02.23, Due 24.02.23 - 23 :59

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Assignment 1: Operations in Relational Algebra - 1 point

Consider the HR Management database schema with the following relations :

1. Employees (employee_id , name, joining_year , department_id)
2. Departments (department_id, department_name)
3. Salaries (salary_id , employee_id , salary_amount , from_date , to_date)
4. Managers : (manager_id , employee_id)

Note : manager_id is subset of employee_id.

(a) Write at least two relational algebraic expressions to find the employees details (employee_id , name) who work in either of the departments with id (department_id) 101 or 102. ?

(b) Write two relational algebraic expressions to find the names of employees who are working since 2018.

(c) Write at least two different relational algebraic expressions to find the name of employees who have worked in the 'Sales' department and earned a salary greater than $\$50,000$, but have not been a manager at any point in time.

Assignment 2: Joins in Relational Algebra - 1 point

(a) Write a relational algebraic expression to find the names of employees who have managers, along with the corresponding names of their managers.

(b) Consider the following two different relational algebraic expressions to find the names of employees who have worked in the department with department_id 10 .

- Expression 1 : $\Pi name(\sigma$ department_id=10 (Employees $\bowtie$ Departments))
- Expression 2 : $\Pi name$(Employees $\bowtie$ (σ department_id=10 Departments))

Additionally, consider that the total number of employees who have worked in the department with dept_id 10 is fewer than the total number of employees in the company. Which one of the above expressions is optimized(optimised means in terms of total number of tuples need to be accessed) ? Justify your answer.

(c) Consider two relations T1(A,B) and T2(B,C). Express T1 $\rtimes$ T2 . using natural join and other basic algebraic operations.

(d) Let the number of tuples in Employees and Salaries relations are 1000 and 2000 respectively. Then what would be the minimum and maximum number of tuples in the result of Employees $\bowtie$ Salaries ? Explain your answer

Assignment 3: Aggregation in Relational Algebra - 1 point

(a) Write an algebraic expression to find the average salary of the employees per each department.

(b) Write an algebraic expression which results in a table containing the information regarding 'Manager ID' and 'Number of employees working under each manager'.

(c) Write an algebraic expression to find the manger id and the number of employees working under that manager , who have the maximal number of employees.

Assignment 4: Relational Calculus - 1 point

(a) Write an expression to find all employees who worked under all managers using relational calculus.

(b) Consider the following expressions.

1) T | $\neg$ (T $\in$ Employees) V T.name='ABC'

2) employee_id | $\exists$ manager_id, $\neg$ (manager_id,employee_id) $\in Manager \wedge \exists$ joining_year,employee_id (employee_id,joining_year,department_id) $\in$ Employees

Which are safe and unsafe expressions ?Justify your answer

(c) Write the expression for the query 1.c) using 'Tuple Relational Calculus'.