

**CS 245, Database Management Systems**  
**Quiz 1, Winter 2022-2023**  
**Department of Computer Science and Engineering**  
**IIT Guwahati**  
**Time: 45 minutes**

Name: \_\_\_\_\_ Roll No.: \_\_\_\_\_

**Important**

1. A supplementary sheet is being provided for rough work. **Do not attach your rough work to the answer sheet.**
2. This quiz has 2 questions over 2 pages, with a total of 20 marks.
3. **No credit will be given for complicated answers, even if correct, when a simple answer exists.**

1. Suppose we have a relation  $Emp(ID, Name, Dept, Sal)$  for storing information about the ID, the name, department and salary of employees. For each of the following queries, write the query in **relational algebra**. You may use only the following operators of relational algebra: union  $\cup$ , intersection  $\cap$ , difference  $-$ , selection  $\sigma$ , projection  $\Pi$ , product  $\times$ , join  $\bowtie$  (both theta and natural) and renaming  $\rho$ .

(a) Find the departments with at least two employees of different names.

(5)

**Solution:**

$$\Pi_{S.Dept}(\sigma_{S.Dept=T.Dept \wedge S.Name \neq T.Name}(\rho_S(Emp) \times \rho_T(Emp)))$$

OR

$$\Pi_{S.Dept}((\rho_S(Emp) \bowtie_{S.Name \neq T.Name \wedge S.Dept = T.Dept} \rho_T(Emp)))$$

Note: Only one renaming is necessary. We have used renaming twice for symmetry. Also, the renaming can be done sequentially as two statements separate from the join followed by projection. So one can get multiple variations of the answers above.

- (b) Find the names of the employees who are in the same department and earn the same salary as the employee with ID 007.

(5)

**Solution:**

$$\Pi_{Name}(Emp \bowtie \Pi_{Dept, Sal}(\sigma_{ID=007}(Emp)))$$

OR

$$\Pi_{S.Name}(\rho_S(\sigma_{ID=007}(Emp))) \bowtie_{S.Sal=T.Sal \wedge S.Dept=T.Dept} \rho_T(Emp)$$

Note: Only one renaming is necessary. We have used renaming twice for symmetry. Instead of the join, a product followed by a selection can also be used as in Q1(a). By using renaming sequentially, or using two natural joins instead of one, one can get several variations of the answers above.

2. Consider the relation  $Emp(ID, Name, Dept, Sal)$  for storing information about the ID, the name, department and salary of employees from Question 1 above. Describe in English what each of the following SQL queries does. You can assume that there is only one employee with name Ravi.

(a) `select Dept  
from Emp  
where Sal > (select avg(Sal)  
              from Emp  
              where Dept = 'CS')`

(5)

**Solution:** Find all departments which have at least one employee with salary greater than the average salary in the CS department.

(b) `select Name  
from Emp natural join (select Sal  
                          from EMP  
                          where Name = 'Ravi');`

(5)

**Solution:** Find the names of all employees who have the same salary as Ravi.

Use the space below to answer any question you may have cancelled.