

## Database 1 Test March 27th 2018

We have the following relations:

E := EMP (empno, ename, job, mgr, hiredate, sal, comm, deptno)  
D := DEPT (deptno, dname, loc)

The relations store information about employees and their departments. The mgr attribute stores the manager's employee number.

### Exercise 1 (4 points)

Express the following queries in (basic or extended) relational algebra:

- a) List the department names and locations where there is no employee whose job is ANALYST. (dname, loc)

$(\pi_{dname, loc} D) - \pi_{dname, loc} (\sigma_{job='Analyst'} (E \bowtie D));$

- b) List the names and jobs of employees who don't have a subordinate. (ename, job)

$\pi_{ename, job} (E \bowtie (\pi_{empno} E - \pi_{mgr} E));$

### Exercise 2 (6 points)

Express the following queries in extended relational algebra:

- a) List the employees who have maximal salary within their own department. Give the department number, employee name and salary for them. (deptno, ename, sal)

$T := \gamma_{deptno, Max(sal) \rightarrow ms}(E); \text{Result} := \sigma_{T.deptno=E.deptno \text{ AND } E.sal = ms}(T \times E)$

- b) Give the department name and average salary for those departments, where there are at least four employees. (dname, average)

$\pi_{dname, av} \sigma_{cn \geq 4} (\gamma_{dname, AVG(sal) \rightarrow av, COUNT(empno) \rightarrow cn} (E \bowtie D));$

### Exercise 3 (4 points)

We have R(A,B,C) and S(C,D) relations. Rewrite the following extended relational algebra expressions into SQL. **You can use only one SELECT keyword.**

- a)  $\tau_A \delta (\Pi_{B,D} (\sigma_{R.C=S.C} (R \times S)))$

**SELECT DISTINCT B, D FROM R, S WHERE R.C = S.C ORDER BY A;**

- b)  $\Pi_A (\sigma_{CN > 10} (\gamma_{A, COUNT(D) \rightarrow CN} \delta (\Pi_{A,D} (R \bowtie S)))$

**SELECT A FROM R NATURAL JOIN S  
GROUP BY A HAVING COUNT(DISTINCT D) > 10;**

### Exercise 4 (6 points)

We have the following relation (multiset meaning).

R(A,B,C): {(X,1,2), (Y,2,3), (Y,3,4), (X,1,5), (Y,3,5), (X,4,2), (X,4,4)}

Compute the result of the following expressions:

- a)  $\gamma_{A,B, SUM(C)}(R)$  {(X,1,7), (Y,2,3), (Y,3,9), (X,4,6)}  
b)  $\gamma_{A, SUM(B)} \delta (\Pi_{A,B} R)$  {(X,5), (Y,5)}  
c)  $\tau_{B,A} \Pi_{A,B} (\sigma_{C \geq 4} R)$  {(X,1), (Y,3), (Y,3), (X,4)}