Database Systems

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Fall Semester, 2007

Assignment 3: SQL Queries

Questions

1. The following relations keep track of airline flight information:

> Flights(*flno:* **integer**, *from:* **string**, *to:* **string**, *distance:* **integer**, *departs:* **time**,
> *arrives:* **time**, *price:* **integer**)
> Aircraft(*aid:* **integer**, *aname:* **string**, *cruisingrange:* **integer**)
> Certified(eid: **integer**, aid: **integer**)
> Employees(*eid:* **integer**, *ename:* **string**, *salary:* **integer**)

Note that the Employees relation describes pilots and other kinds of employees aswell; every pilot is certified for some aircraft, and only pilots are certified to fly.Write each of the following queries in SQL.

a. Find the names of aircraft such that all pilots certified to operate them earn more than $80,000.
b. For each pilot who is certified for more than three aircraft, find the *eid* and the maximum *cruisingrange* of the aircraft for which she or he is certified.
c. Find the names of pilots whose *salary* is less than the price of the cheapest route from Los Angeles to Honolulu.
d. For all aircraft with *cruisingrange* over 1000 miles, find the name of the aircraft and the average salary of all pilots certified for this aircraft.
e. Find the names of pilots certified for some Boeing aircraft.
f. Find the *aids* of all aircraft that can be used on routes from Los Angeles to Chicago.
g. Identify the routes that can be piloted by every pilot who makes more than $100,000.
h. Print the *enames* of pilots who can operate planes with *cruisingrange* greater than 3000 miles but are not certified on any Boeing aircraft.
i. A customer wants to travel from Madison to New York with no more than two changes of flight. List the choice of departure times from Madison if the customer wants to arrive in New York by 6 p.m.
j. Compute the difference between the average salary of a pilot and the average salary of all employees (including pilots).
k. Print the name and salary of every nonpilot whose salary is more than the average salary for pilots.

l. Print the names of employees who are certified only on aircrafts with cruising range longer than 1000 miles.

m. Print the names of employees who are certified only on aircrafts with cruising range longer than 1000 miles, but on at least two such aircrafts.

n. Print the names of employees who are certified only on aircrafts with cruising range longer than 1000 miles and who are certified on some Boeing aircraft.

Ans:

a.
```
SELECT   DISTINCT   A.aname
FROM     Aircraft A
WHERE    A.Aid IN   (SELECT C.aid
                    FROM Certified C, Employees E
                    WHERE C.eid = E.eid AND
                    NOT EXISTS   ( SELECT *
                                 FROM Employees E1
                                 WHERE E1.eid = E.eid AND E1.salary < 80000 ))
```

b.
```
SELECT      C.eid, MAX (A.cruisingrange)
FROM        Certified C, Aircraft A
WHERE       C.aid = A.aid
GROUP BY    C.eid
HAVING      COUNT (*) > 3
```

c.
```
SELECT   DISTINCT   E.ename
FROM     Employees E
WHERE    E.salary <    ( SELECT MIN (F.price)
                       FROM Flights F
                       WHERE F.from = ‘Los Angeles’ AND F.to = ‘Honolulu’ )
```

d. Observe that aid is the key for Aircraft, but the question asks for aircraft names; we deal with this complication by using an intermediate relation Temp:

```
SELECT   Temp.name, Temp.AvgSalary
FROM     ( SELECT     A.aid, A.aname AS name, AVG (E.salary) AS AvgSalary
         FROM         Aircraft A, Certified C, Employees E
         WHERE        A.aid = C.aid AND C.eid = E.eid AND A.cruisingrange > 1000
         GROUP BY     A.aid, A.aname ) AS Temp
```

e.
```
SELECT   DISTINCT   E.ename
FROM     Employees E, Certified C, Aircraft A
WHERE    E.eid = C.eid AND C.aid = A.aid AND A.aname LIKE ‘Boeing%’
```

f.
```
SELECT   A.aid
FROM     Aircraft A
WHERE    A.cruisingrange > ( SELECT   MIN (F.distance)
                           FROM     Flights F
                           WHERE    F.from = ‘Los Angeles’ AND F.to = ‘Chicago’ )
```

```
g.  SELECT    DISTINCT    F.from, F.to
    FROM      Flights F
    WHERE NOT EXISTS      ( SELECT   *
                          FROM       Employees E
                          WHERE      E.salary > 100000
                          AND
                          NOT EXISTS    (SELECT     *
                                        FROM        Aircraft A, Certified C
                                        WHERE       A.cruisingrange > F.distance AND
                                                    E.eid = C.eid AND A.aid = C.aid) )

h.  SELECT    DISTINCT    E.ename
    FROM      Employees E
    WHERE     E.eid IN    ( ( SELECT C.eid
                          FROM Certified C
                          WHERE EXISTS     ( SELECT A.aid
                                           FROM Aircraft A
                                           WHERE A.aid = C.aid
                                           AND A.cruisingrange > 3000 )
                                           AND
                                           NOT EXISTS ( SELECT A1.aid
                                                        FROM Aircraft A1
                                                        WHERE A1.aid = C.aid
                                                        AND A1.aname LIKE  'Boeing%'  ))

i.  SELECT    F.departs
    FROM      Flights F
    WHERE     F.flno IN ( ( SELECT   F0.flno
                          FROM       Flights F0
                          WHERE      F0.from =  'Madison'  AND F0.to =  'New York'
                                     AND F0.arrives <  '18:00'  )
                          UNION
                          ( SELECT   F0.flno
                          FROM       Flights F0, Flights F1
                          WHERE      F0.from =  'Madison'  AND F0.to <>  'New York'
                                     AND F0.to = F1.from AND F1.to =  'New York'
                                     AND F1.departs > F0.arrives
                                     AND F1.arrives <  '18:00'  )
                          UNION
                          ( SELECT   F0.flno
                          FROM       Flights F0, Flights F1, Flights F2
                          WHERE      F0.from =  'Madison'
                                     AND F0.to = F1.from
                                     AND F1.to = F2.from
                                     AND F2.to =  'New York'
                                     AND F0.to <>  'New York'
                                     AND F1.to <>  'New York'
                                     AND F1.departs > F0.arrives
                                     AND F2.departs > F1.arrives
                                     AND F2.arrives <  '18:00'  ))
```

```
j.  SELECT    Temp1.avg - Temp2.avg
    FROM      (SELECT    AVG (E.salary) AS avg
               FROM      Employees E
               WHERE     E.eid IN (SELECT   DISTINCT C.eid
                                   FROM     Certified C )) AS Temp1,
              (SELECT    AVG (E1.salary) AS avg
               FROM      Employees E1 ) AS Temp2

k.  SELECT    E.ename, E.salary
    FROM      Employees E
    WHERE     E.eid NOT IN ( SELECT   DISTINCT  C.eid
                             FROM     Certified C )
    AND E.salary > ( SELECT AVG (E1.salary)
                     FROM     Employees E1
                     WHERE    E1.eid IN
                              ( SELECT  DISTINCT  C1.eid
                              FROM      Certified C1 ) )

l.  SELECT      E.ename
    FROM        Employees E, Certified C, Aircraft A
    WHERE       C.aid = A.aid AND E.eid = C.eid
    GROUP BY    E.eid, E.ename
    HAVING      EVERY (A.cruisingrange > 1000)

m.  SELECT      E.ename
    FROM        Employees E, Certified C, Aircraft A
    WHERE       C.aid = A.aid AND E.eid = C.eid
    GROUP BY    E.eid, E.ename
    HAVING      EVERY (A.cruisingrange > 1000) AND COUNT (*) > 1

n.  SELECT      E.ename
    FROM        Employees E, Certified C, Aircraft A
    WHERE       C.aid = A.aid AND E.eid = C.eid
    GROUP BY    E.eid, E.ename
    HAVING      EVERY (A.cruisingrange > 1000) AND ANY (A.aname = ’ Boeing’ )
```

2. Consider the following relational schema. An employee can work in more than one department; the *pct_time* filed of the Works relation shows the percentage of time that a given employee works in a given department.

   Emp(*eid:* **integer**, *ename:* **string**, *age:* **integer**, *salary:* **real**)
   Works(*eid:* **integer**, *did:* **integer**, *pct_time:* **integer**)
   Dept(*did:* **integer**, dname: **string**, *budget:* **real**, *managerid:* **integer**)

   Write the following queries in SQL:

   a. Print the names and ages of each employee who works in both the Hardware department and the Software department.
   b. For each department with more than 20 full-time-equivalent employees (i.e., where the part-time and full-time employees add up to at least that many full-time employees), print the *did* together with the number of employees that work in that department.
   c. Print the name of each employee whose salary exceeds the budget of all of the departments that he or she works in.
   d. Find the *managerids* of managers who manage only departments with budgets greater than $1 million.
   e. Find the *enames* of managers who manage the departments with the largest budgets.
   f. If a manager manages more than one department, he or she *controls* the sum of all the budgets for those departments. Find the *managerids* of managers who control more than $5 million.
   g. Find the *managerids* of managers who control the largest amounts.
   h. Find the *enames* of managers who manage only departments with budgets larger than $1 million, but at least one department with budget less than $5 million.

Ans:

a.
```
SELECT    E.ename, E.age
FROM      Emp E, Works W1, Works W2, Dept D1, Dept D2
WHERE     E.eid = W1.eid AND W1.did = D1.did AND D1.dname =  'Hardware'  AND
          E.eid = W2.eid AND W2.did = D2.did AND D2.dname =  'Software'
```

b.
```
SELECT    W.did, COUNT (W.eid)
FROM      Works W
GROUP BY  W.did
HAVING    2000 < ( SELECT   SUM (W1.pct time)
                   FROM     Works W1
                   WHERE    W1.did = W.did )
```

```
c.  SELECT    E.ename
    FROM      Emp E
    WHERE     E.salary > ALL (SELECT    D.budget
                              FROM      Dept D, Works W
                              WHERE     E.eid = W.eid AND D.did = W.did)

d.  SELECT    DISTINCT  D.managerid
    FROM      Dept D
    WHERE     1000000 < ALL (SELECT D2.budget
                             FROM Dept D2
                             WHERE D2.managerid = D.managerid )

e.  SELECT    E.ename
    FROM       Emp E
    WHERE     E.eid IN (SELECT   D.managerid
                        FROM     Dept D
                        WHERE    D.budget = (SELECT  MAX (D2.budget)
                                             FROM    Dept D2))

f.  SELECT    D.managerid
    FROM      Dept D
    WHERE     5000000 <  (SELECT SUM (D2.budget)
                          FROM Dept D2
                          WHERE D2.managerid = D.managerid )

g.  SELECT    DISTINCT   tempD.managerid
    FROM      (SELECT    DISTINCT    D.managerid, SUM (D.budget) AS tempBudget
              FROM       Dept D
              GROUP BY D.managerid ) AS tempD
              WHERE      tempD.tempBudget = (SELECT MAX (tempD.tempBudget)
                                             FROM     tempD)

h.  SELECT    E.ename
    FROM      Emp E, Dept D
    WHERE     E.eid = D.managerid GROUP BY E.Eid, E.ename
    HAVING    EVERY (D.budget > 1000000) AND ANY (D.budget < 5000000)
```