

# Translation of SQL into relational algebra

## Exercises

Academic year 2017-2018

**Exercise 1.** The following are relations from a university database.

- Student(snum, sname, major, level, age)
- Class(name, meets\_at, room, fid)
- Enrolled(snum, cname)
- Faculty(fid, fname, deptid)

Translate the following SQL-queries into relational algebra. Make sure to also illustrate the intermediate steps.

1. 

```
SELECT S.sname
FROM Student S
WHERE S.snum NOT IN (SELECT E.snum
                     FROM Enrolled E)
```
2. 

```
SELECT C.name
FROM Class C
WHERE C.room = 'R128' OR C.name IN (SELECT E.cname
                                   FROM Enrolled E
                                   GROUP BY E.cname
                                   HAVING COUNT(*) >= 5)
```
3. 

```
SELECT F.fname
FROM Faculty F
WHERE 5 > (SELECT COUNT(E.snum)
          FROM Class C, Enrolled E
          WHERE C.name = E.cname
          AND C.fid = F.fid)
```

**Exercise 2.** Following are the relations concerning flights of an airline. The attributes of the primary key are underlined.

- Flights(flno:int, from: string, to: string, distance: int, departs: time, arrives: time)

- Aircraft(aid:int, aname:string, cruisingRange: int)
- Certified(eid:int, aid:int)
- Employees(eid: int, ename:string, salary: integer)

The Employees table contains pilots as well as other staff. Every pilot is certified for one or more aircrafts (otherwise he would not be allowed to fly), and only pilots can be certified. Write the following queries using SQL, and translate them into relational algebra.

1. Give the name of all pilots who can fly with a Boeing or an Airbus.
2. Find the *aids* of all aircrafts that can be flown on non-stop flight from Bonn to Chennai.
3. Identify all flights that can have a pilot in command earning more than 100,000 EUR. Such pilot must be certified for at least *one* aircraft with a sufficient cruising range for that flight.
4. Find all direct flights to Brussels or Ostend that arrive before 8AM and for which there is no other flight to the same destination arriving later.
5. Find the name of every pilot who can be at the control of an aircraft with a range larger than 3,000 km, but is not certified for a Boeing.
6. Find the name of aircrafts for which all certified pilots earn more than 80,000 EUR.
7. Give for each pilot who is certified for more than three aircrafts the *eid* as well as the maximum *cruisingRange*.
8. Give for each aircraft with a *cruisingRange* of more than 1,000 km the name of this aircraft and the average salary of every pilot certified for this aircraft.
9. A customer would like to travel from Madison to New York, with no more than two stopovers. Give all possible flight times from Madison such that the customer would arrive at the latest at 6PM in New York.