Solutions for Exercise Sheet 1

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Our solutions for Exercise Sheet 1.

Exercise 1

Given the following queries:

- Find all students that have ever attended a lecture together with Schopenhauer, excluding Schopenhauer himself.

- Find all professors whose lectures were all attended by at least two students.

1. Express the queries in SQL and relational calculus (either tuple or domain calculus)

2. Manually translate the queries into execution plans (relational algebra)

Item 1

- ```sql
  SELECT DISTINCT s1.*
  FROM Studenten s1, Studenten s2, hoeren h1, hoeren h2
  WHERE s1.matrNr = h1.matrNr
  AND s1.matrNr != s2.matrNr
  AND s2.matrNr = h2.matrNr
  AND h1.vorlNr = h2.vorlNr
  AND s2.name = 'Schopenhauer'
  ```

  Relational calculus:

  $$\{s1 \mid s1 \in Studenten$$
  $$\land\ \exists h1 \in hoeren(s1.matrNr = h1.matrNr$$
  $$\land\ \exists h2 \in hoeren(h1.matrNr = h2.matrNr$$
  $$\land\ \exists s2 \in Studenten(s2.name = 'Schopenhauer' \land s2.matrNr \neq s1.matrNr)))$$
  $$\}$$

- ```sql
  SELECT p.* FROM (
    -- Number of modules with >=2 students that each professor has
    SELECT p.persnr, COUNT(*) AS numModulesGood FROM (
      SELECT vorlnr
      FROM hoeren
      GROUP BY vorlnr
      HAVING COUNT(*) >= 2
    ) h
    JOIN vorlesungen v ON h.vorlnr=v.vorlnr
    JOIN professoren p ON v.gelesenvon=p.persnr
  ```

```sql
    GROUP BY p.persnr
) a JOIN (
    -- Number of modules each professor has
    SELECT persnr, COUNT(*) AS numModules FROM
    vorlesungen JOIN professoren ON gelesenvon=persnr
    GROUP BY persnr
) b ON a.persnr=b.persnr
JOIN professoren p ON a.persnr=p.persnr
WHERE numModulesGood=numModules
```

Relational calculus:

$$\{p \,|\, p \in Professoren$$
$$\land\, \forall\, v \in vorlesungen(v.gelesenVon = p.persNr$$
$$\land\, \exists\, h1 \in hoeren(h1.vorlNr = v.vorlNr$$
$$\land\, \exists\, h2 \in hoeren(h2.matrNr \neq h1.matrNr \land h2.vorlNr = v.vorlNr)))$$
$$\}$$

Item 2

- Relational algebra:

$$\Pi_{s1.matrnr,\, s1.name,\, s1.semester}\big($$
$$\sigma_{s1.matrnr \neq s2.matrnr \land s2.name=\text{'Schopenhauer'}}\big($$
$$(\rho_{s1}(studenten \bowtie hoeren) \bowtie$$
$$(\rho_{s2}(studenten \bowtie hoeren)$$
$$)$$
$$)$$

- Relational algebra:

$$\Pi_{persnr,\, name,\, rang,\, raum}$$
$$\sigma_{numModules=numModulesGood}\big($$

(Number of modules with ≥ 2 students that each professor has)

$$\Gamma_{persnr,\, name,\, rang,\, raum;\, \text{COUNT}(*) \to numModulesGood}\big($$
$$\sigma_{numStudents \geq 2}(\Gamma_{vorlnr;\, \text{COUNT}(*) \to numStudents} hoeren)$$
$$\bowtie vorlesungen$$
$$\bowtie_{gelesenvon=persnr} professoren$$
$$)$$
$$\bowtie$$

(Number of modules each professor has)

$$\Gamma_{persnr;\, \text{COUNT}(*) \to numModules}(vorlesungen \bowtie_{gelesenvon=persnr} professoren)$$
$$)$$