

# Query languages

## Assignment sheet 1

### 1 Query evaluation (1)

Consider the following instances:

$$R(a, b) = \{(0, 1), (2, 3), (0, 1), (2, 4), (3, 4)\}$$
$$S(a, b) = \{(0, 1), (2, 4), (0, 2), (2, 5), (3, 4), (3, 4)\}$$

What is the result of each of the following queries on these instances?

1.  $R \cup_S S$
2.  $R \cup_B S$
3.  $R \cap_S S$
4.  $R \cap_B S$
5.  $R \setminus_S S$
6.  $R \setminus_B S$
7.  $S \setminus_S R$
8.  $S \setminus_B R$
9.  $\pi_{a+b \rightarrow c, a^2 \rightarrow a, b^2 \rightarrow b}(R)$
10.  $\pi_{a+1 \rightarrow a, b-1 \rightarrow b}(S)$
11.  $\sigma_{a < b \wedge (a+b > a \times b \vee a+b \geq 6)}(R)$
12.  $\sigma_{a < b \wedge (a+b > a \times b \vee a+b \geq 6)}(S)$
13.  $\sigma_{a > 1 \vee b > 4 \vee b = 2}(R)$
14.  $\sigma_{a > 1 \vee b > 4 \vee b = 2}(S)$

## 2 Query evaluation (2)

Consider the following instances:

$$\begin{aligned}R(a, b) &= \{(0, 1), (2, 3), (0, 1), (2, 4), (3, 4)\} \\S(b, c) &= \{(1, 2), (1, 2), (2, 5), (3, 5), (4, 5)\} \\T(c, d) &= \{(2, 3), (3, 4), (5, 5), (5, 6)\}\end{aligned}$$

What is the result of each of the following queries on these instances?

1.  $R \bowtie S$
2.  $S \bowtie T$
3.  $R \bowtie T$
4.  $R \bowtie_{R.b < S.b} S$
5.  $R \bowtie_{a+d=5} T$
6.  $R \bowtie_{b=c} T$
7.  $\gamma_{a, SUM(b)}(R)$
8.  $\gamma_{c, MIN(b)}(S)$
9.  $\delta(R)$
10.  $\tau_{b,a}(R)$

## 3 Query expressions (1)

Consider the following database schema:

```
movie[title, director, actor]
seen[movieGoer, title]
likes[movieGoer, title]
```

Express the following queries in the extended relational algebra for bags and in SQL. Draw the expression tree.

1. Who are the actors of the movies directed by “Lucas”?
2. Who are those movie goers who like a movie they have never seen?
3. Who are those movie goers who have seen all movies?
4. Who are those movie goers who like all the movies they have seen?
5. How many movie goers like no movie?
6. What is the average number of movies seen per movie goers?

## 4 Query expressions (2)

Express in the relational algebra the semi-join and full outer join. Recall that:

1. The semi-join between  $R$  and  $S$  are the tuples  $r$  of  $R$  such that there exists at least one tuple  $s$  of  $S$  for which the value for the attribute common to  $R$  and  $S$  are the same for both tuples.
2. The full outer join of  $R$  and  $S$  includes in the result, in addition to the join, the tuples of  $R$  (resp.  $S$ ) that do not join with  $S$  (resp.  $R$ ), using the  $NULL$  special constant for the attributes whose values is not known.

## 5 Query evaluation and expressions

Consider the following instance:

$$\text{grade}(\text{student\#}, \text{CS}, \text{humanities}) = \{(1, 45, \text{NULL}), (2, \text{NULL}, 90), (3, 100, 80)\}$$

Express in the extended relational algebra and in SQL, and then evaluate, the following queries on this instance:

1. Give those students whose grade in CS is greater than their grade in Humanities, and at the same time their grade in Humanities is greater than 75 and their grade in CS is greater than 45, or whose grade in CS is lesser than 50.
2. Is the average grade in Humanities greater than the average grade in computer science?

## 6 Algebraic operator properties

An algebraic operator  $f$  is called idempotent is, whatever the relation  $R$ ,  $R$ ,  $f(f(R)) = f(R)$ . Which operators, among  $\delta, \pi, \sigma, \gamma, \tau$ , are idempotent?