

**Foundations of Query Languages**  
**Summerterm 11**  
Discussion by 13.07.2011

### 3. Datalog

#### Exercise 1 (Datalog)

Consider a directed graph which is given by  $E(X, Y)$  (edges). Give a Datalog program which computes the following relations:

- a)  $Odd(X, Y)$ , which holds if there is a path with odd length from  $X$  to  $Y$ .
- b)  $Oddcycle(X)$ , there is a cycle with odd length through  $X$ .
- c)  $Evencycle(X)$ , there is cycle with even length through  $X$ .
- d)  $Bothcycles(X)$ , there are cycles with even length and cycles with odd length through  $X$ .

#### Exercise 2 (Datalog)

$parent(X, Y)$  is a family tree with root  $p$ . Please give a Datalog program, which computes the predicates  $same\_generation(X, Y)$ ,  $sibling(X, Y)$  and  $cousin(X, Y)$ . ( $same\_generation(X, Y)$  holds, if the distance between  $X$  and  $p$  is the same as the distance between  $Y$  and  $p$ ;  $sibling(X, Y)$  is true, if  $X$  and  $Y$  have the same parent;  $cousin(X, Y)$  holds, if  $X$  and  $Y$  belong to the same generation but are not siblings).

Hint: You may use negation in your programs.

#### Exercise 3 (Datalog)

Given are the following three Datalog programs to calculate the transitive closure of a graph:

right-recursive:

$$C(X, Y) \leftarrow E(X, Y). \quad C(X, Y) \leftarrow E(X, Z), C(Z, Y)$$

left-recursive:

$$C(X, Y) \leftarrow E(X, Y). \quad C(X, Y) \leftarrow C(X, Z), E(Z, Y)$$

double-recursive:

$$C(X, Y) \leftarrow E(X, Y). \quad C(X, Y) \leftarrow C(X, Z), C(Z, Y)$$

Use the naive algorithm to calculate the results of the given three programs with respect to the following database:

$$E(1, 2), E(2, 3), E(3, 4), E(4, 5), E(5, 6), E(6, 7)$$

#### Exercise 4 (Datalog)

Let the EDB relations  $visits(guest, bar)$ ,  $serves(bar, beer)$ , and  $likes(guest, beer)$  be given. The first relation indicates which guests visit which bar. The second relation contains information on which beers can be purchased in which bar. The third relation stores information on what guest likes what beer. You may assume that every guest visits at least one bar and likes at least one kind of beer. Define the following predicates in Datalog:

- $content(G)$  holds if a guest  $G$  visits a bar which serves a beer that he likes.
- $recommendation(G, B)$  holds if the guest  $G$  can purchase a beer that he likes in the bar  $B$ .
- $frustrated(G)$  holds if guest  $G$  does not visit a bar in which he can purchase a beer that he likes.

**Exercise 5 (Datalog)**

We are given two directed graphs  $G_{black}$  and  $G_{white}$  represented as binary relations over the same set of vertices  $V$ . Write a Datalog program that computes the set of pairs  $(a, b)$  of vertices such that there exists a path from  $a$  to  $b$  where black and white edges alternate, starting with a white edge.