



**Database Theory**

Summer Semester 2016

**Exercise Sheet 10 – Datalog Evaluation**

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**Exercise 10.1** Consider the following program  $P$ :

$$T(x) \leftarrow e(x)$$

$$T(x) \leftarrow a(x, y) \wedge T(y) \wedge b(x, z) \wedge T(z)$$

- (a) Describe, in your own words, the kind of structures that the query  $\langle T, P \rangle$  recognises.
- (b) Give the rules for semi-naive evaluation of  $P$ .
- (c) Compute the semi-naive evaluation of  $P$  for the database that contains the following facts:

e(1) e(2) e(6) a(3,1) a(4,3) a(5,3) a(7,5) b(3,2) b(5,3) b(7,6)

Specify for each newly derived fact which of the rule(s) of (b) will produce it at the given point in the derivation.

**Exercise 10.2** Consider the “Same generation” Datalog program given in the lecture (predicates: S for “same generation”, p for “parent”, h for “human”):

$$S(x, x) \leftarrow h(x)$$

$$S(x, y) \leftarrow p(x, w) \wedge S(v, w) \wedge p(y, v)$$

and the adorned version for query  $S(1, x)$ :

$$\text{(Rule } a) \quad \text{Query}^f(x) \leftarrow S^{bf}(1, x)$$

$$\text{(Rule } b) \quad S^{bf}(x, x) \leftarrow h(x)$$

$$\text{(Rule } c) \quad S^{bf}(x, y) \leftarrow p(x, w) \wedge S^{fb}(v, w) \wedge p(y, v)$$

$$\text{(Rule } d) \quad S^{fb}(x, x) \leftarrow h(x)$$

$$\text{(Rule } e) \quad S^{fb}(x, y) \leftarrow p(x, w) \wedge S^{fb}(v, w) \wedge p(y, v)$$

together with the database that contains the following facts for predicate p:

h(1) h(2) h(3) h(4) h(5) h(6) h(7)

p(1,2) p(2,3) p(4,3) p(5,4) p(6,1) p(7,1).

Sketch the database as a tree. What are the expected answers to the query? Apply the QSQR algorithm to compute the answer to the query.

**Exercise 10.3** Consider the following modified version of the same generation program:

$$S(x, x) \leftarrow h(x)$$

$$S(x, y) \leftarrow p(x, w) \wedge p(y, v) \wedge S(v, w)$$

What is the adorned version of this program for query  $S(1, x)$ ? Use this program to show that it is possible that some tuples in an input-relation are not copied to the  $\text{sup}_0$  relation of a rule during the execution of the QSQR algorithm.

**Exercise 10.4 (Abiteboul, Hull and Vianu; Exercise 13.14)** Consider the following program:

$$Sv(x, y) \leftarrow \text{flat}(x, y)$$

$$Sv(x, y) \leftarrow \text{up}(x, z_1) \wedge Sv(z_1, z_2) \wedge \text{flat}(z_2, z_3) \wedge Sv(z_3, z_4) \wedge \text{down}(z_4, y)$$

Give the magic set transformation for this program and query  $Sv(a, y)$ , where  $a$  is a constant.