

Database Theory
Winter Term 2013/14
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4. Unit: Datalog

Discussion by 15./22.1.2014

Exercise 1 (Äquivalenz von Algebra und Datalog) Show that for every expression of the relational algebra there is an equivalent stratified Datalog program.

Exercise 2 (Datalog to Algebra)

Consider the translation of Datalog programs with a distinguished answer predicate to the relational algebra.

- Given a rule $B \leftarrow C_1 \wedge \dots \wedge C_n \wedge D_{n+1} \wedge D_{n+k}$ where the C_i are positive literals and the D_i are negative literals, give an algebra expression that returns the relation defined by it.
- Which additional construct must also be translated?
- Consider the following program (arbitrary arity of predicates, each rule assumed to be safe):
$$\begin{aligned} \text{res}(\dots) &:- p(\dots), q(\dots), \neg r(\dots). \\ \text{res}(\dots) &:- p(\dots), s(\dots), \neg t(\dots). \\ p(\dots) &:- u(\dots), v(\dots). \\ p(\dots) &:- w(\dots). \\ t(\dots) &:- x(\dots), y(\dots). \end{aligned}$$

where q, r, s, u, v, w, x, y are EDB relations.

Give the algebra expression that corresponds to the res predicate.

Exercise 3 (Stratified Datalog)

Give an example for the nonmonotonicity of the stratified semantics,

show that for a stratifiable program P there can be multiple minimal models.

Exercise 4 (Datalog-Anfragen an Mondial: Schweizer Sprachen) Give Datalog programs for the following queries against the Mondial database. Compare with the same queries in the algebra and in the relational calculus.

- a) All codes of countries in which some language is spoken that is also spoken in Switzerland.
- b) All codes of countries in which only languages are spoken that are not spoken in Switzerland.
- c) All codes of countries in which only languages are spoken that are also spoken in Switzerland.
- d) All codes of countries in which all languages are spoken that are spoken in Switzerland.

Exercise 5 (Datalog-Anfragen an Mondial: Landlocked)

- Give a Datalog program that returns the names of all countries that have no coast.
- Give a Datalog program that returns the names of all countries that have no coast and that have no neighbor country that has any coast.

- Give the dependency graph of your program.

Asking `?- hasnonlandlockedneighbor(C)` yields many countries several times, e.g., MK (Macedonia) three times since `C2` can be bound by three ways to coastal neighbors: AL, GR, BG.

This can be avoided by a Prolog cut in the “subquery” that searches for possible `C2` bindings:

Exercise 6 (Aggregation in Datalog/XSB) Define the aggregation operators in XSB in a module `aggs.P`.

The syntax of the comparison predicates and of the arithmetic operators is given in Sections 3.10.5 (Inline Predicates) and 4.3 (Operators) of the XSB Manual Part I.

Then use `aggs.P` for answering the following queries in Datalog:

- a) Give for each country the name and the number of neighbors.
- b) Give the name of the country that has the highest number of neighbors (and how many).
- c) Give the average area of all continents (to test `avg`).
- d) Give the average latitude and longitude of all cities.