Advanced Data Modeling

Summer Semester 2008
- Exercises V -

*To be handed in before **2008-06-01, 23:59** via e-mail to sschenk@uni-koblenz.de, subject line: [ADM] ...*

1) Explain the term „range restricted clause“ with respect to the completion.

   In a range restricted clause every variable in a clause occurs in at least one non negative body literal. That means, we have no existentials for veriables in negative literals. As a result, when searching for a model we can restrict the search space by starting from a definite subprogram by removing all negative literals. Taking into account these literals later leads to the actual model.

   Outlook: Depending on how we treat the negative literals we can come up with a sightly different semantics, the stable model semantics.

2) Prove that relational algebra has the same expressive power as non-recursive Datalog.

   We can show that every relational operator can be mapped to an equivalent datalog expression and vice versa.

3) Are the following clauses range restricted?

   1. p(x, a) :- q(x, y, a), not r(y, a). yes
   2. p(x, a) :- q(a, a, x), not r(x, y). no
   3. p(x, x) :- r(x, y). yes
   4. p(x,y) :- y=a, not r(x,y). yes
   5. p(x,y) :- y=a, not r(x,y), q(x,y,a). yes

4) Model the following scenario using Datalog and draw a dependency graph:

There are different types of events: lectures, tutorials and seminars. Every event takes place in a certain room and has a start, an end time and a title. An event may have other events as prerequisites. Professors, students and research assistants are persons. Every person has a name and an e-mail address. Additionally, every professor has a working group and every research assistant works in a working group. Events are given by professors or research assistants. Every tutorial belongs to a lecture. Students attend events.

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event(X) :- lecture(X).
event(X) :- tutorial(X).
event(X) :- seminar(X).
event(X) :- prerequisite(X, Y).
event(Y) :- prerequisite(X, Y).
person(X) :- professor(X).
person(X) :- student(X).
person(X) :- researchAssistant(X).
professor(X) :- hasWorkingGroup(X,Y).
workingGroup(Y) :- hasWorkingGroup(Y).
researchAssistant(X) :- worksIn(X,Y).
workingGroup(Y) :- worksIn(X,Y).
tutorial(X) :- belongsTo(X, Y).
lecture(Y) :- belongsTo(X, Y).
student(X) :- attends (X, Y).
event(Y) :- attends(X, Y).
inconsistent :- event(X), not eventDetail(X, _, _, _, _).
inconsistent :- person(X), not personDetails(X, _, _).
inconsistent :- professor(X), not hasWorkingGroup(X, _).
inconsistent :- researchAssistant(X), not worksIn(X,_).
inconsistent :- tutorial(X), not belongsTo(X, _).
consistent :- not inconsistent.
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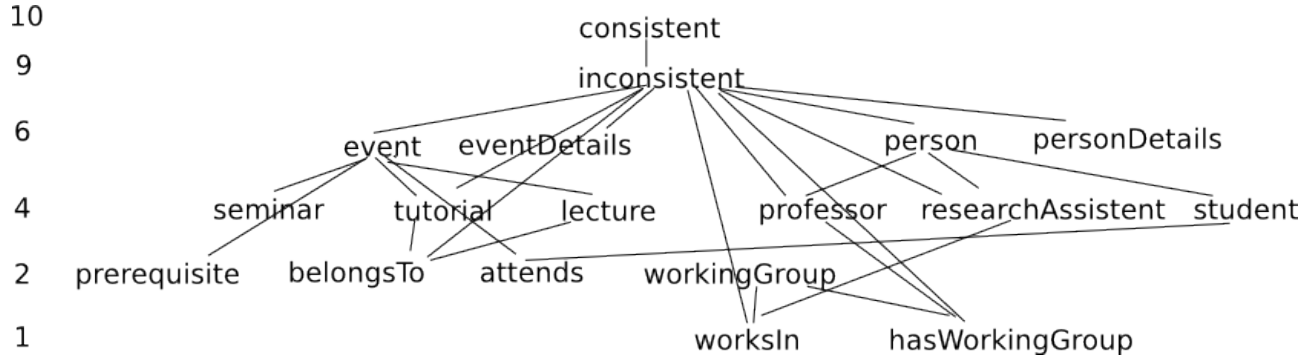

Is the resulting program in non-recursive Datalog?

Yes.

5) Compute the least Herbrand models of the following programs using the immediate consequence operator T_P.

1. p(a) :- p(x), q(x).
   p(f(x)) :- p(x).
   q(b).
   q(f(x)) :- q(x).

   $I_0 = \{\}$
   $I_1 = \{q(b)\}$
   $I_2 = \{q(b), q(f(b))\}$
   $I_3 = \{q(b), q(f(b)), q(f(f(b)))\}$
   $I_\omega = \{q(b), q(f(b)), ...,q(f^\omega(b))\}$

2. p(a).
   p(b).
   q(c).
   q(x) :- not r(x,b).
   r(x,x) :- p(x).

   Not definite, not stratifiable. For the maximal definite subprogram we have:

   $I_0 = \{\}$
   $I_1 = \{p(a), p(b), q(c)\}$
   $I_2 = \{p(a), p(b), q(c), r(a,a), r(b,b)\}$

3. $p_1(f(x))$:- $p_1(x)$.
   $p_2(a)$:- $p_1(x)$.
   $p_2(f(x))$:- $p_2(x)$.
   $p_3(a)$:- $p_2(x)$.
   $p_3(f(x))$:- $p_3(x)$.
   $p_4(a)$:- $p_3(x)$.
   $p_4(f(x))$:- $p_4(x)$.
   $p_5(a)$:- $p_4(x)$.

   $I_0 = \{\}$