

CS589 Principles of DB Systems

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Lecture 4f:

Semantics of a Datalog Program

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Reminder: Immediate Consequence Algorithm 3.4 (Meaning)

- This algorithm give the meaning for **unsafe**, **recursive** Datalog programs.
- The algorithm uses what is called “inflationary” semantics. This means that if you ever derive a fact in the answer, then it stays there.

Temp-21(x) :- Person(x, 21, y).

Temp-male (x) :- Person(x, z, “male”).

Answer(x) :- Temp-21(x), \neg Temp-male(x).

Algorithm 3.4 tells us that if we fire a rule (no matter what order), then the new tuples are added to Result. If the first rule fires and then the third, we’ll have some folks in Answer who are note male. (And this is not regarded as a problem.)

A program may have more than one fixed point.

Reminder: Immediate Consequence Algorithm 3.5 (New Meaning)

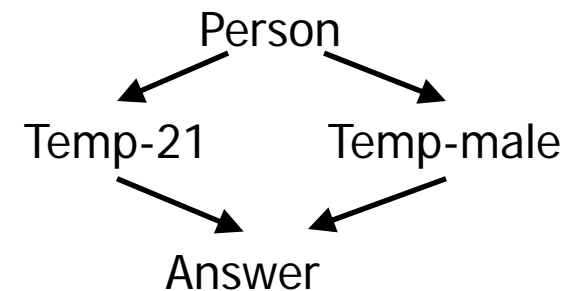
- This algorithm is for **safe, non-recursive** Datalog programs.
- Since the program is not recursive, we can use the dependency graph to induce an ordering on the relations. Basically, compute a relation before it's used in the body of other rules. Algorithm 3.5, computes the relations according to that order.

Temp-21(x) :- Person(x, 21, y).

Temp-male(x) :- Person(x, z, "male").

Answer(x) :- Temp-21(x), \neg Temp-male(x).

Order the relations: Either Temp-21 or Temp-male is first. Then the other one is second. Answer is computed third. This follows from the dependency graph.





Semantics of a Datalog Program

- The fixed point of the “immediate consequence” operator, applied to the Datalog program.
- The minimal model for the Datalog program.

Plus others, particularly for Datalog with negation.



Comments

- For Datalog with recursion, but NO negation, then:
 - The minimal model is unique.
 - The minimal model is always the intersection of all the models.
 - The minimal model is the same as the fixed point of the immediate consequence operator.
 - This language is monotonic (rules only add facts)
- For Datalog with recursion & negation:
 - There may not be a unique minimal model. And there may not be a unique fixed point.



Other comments

- For safe Datalog without recursion, with negation, if compute the relations one by one, according to the dependency graph, then there is a unique fixed point. And it is the same as the minimal model.
- Note that for this language, all rules only need to be fired once.