ELECTRONIC NEWSLETTER ON
REASONING ABOUT ACTIONS AND CHANGE

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Today

Today, the ontologies discussion continues, with questions by Michael Gelfond and Luis Pereira.

Debates

Ontologies for actions and change

From: Michael Gelfond

I would like to better understand the following comment by Hector Geffner:

> *I believe they (models of actions in AI) are all* monotonic *in the set of observations. In other words, if they predict F at time i, nothing that they observe is going to affect that prediction.*

If I understood Hector correctly, the following may be a counter example. Consider the following domain description D0 in the language $\mathcal{L}$ from [j-jlp-31-201].

The language of D0 contains names for two actions, A and B, and two fluents, F and P. D0 consists of two causal laws and two statements describing the initial situation $S0$:

$$A \textsf{ causes } F \textsf{ if } P.$$
$$B \textsf{ causes } neg(P).$$
$$true\_at\ (P, S0).$$
$$true\_at\ (neg(F), S0).$$

The first statement says that F will be true after execution of A in any situation in which P is true. The third one means that P is true in the initial situation $S0$. $neg(P)$ stands for negation of P.

(Domain descriptions in $\mathcal{L}$ allow two other types of statements: $occurs(A, S)$ - action A occurred at situation S, and $S1 < S2$. We use them later)

Here we are interested in queries of the type

$$holds(F, [A1, ...An])$$

which can be read as "If sequence $A1...An$ were executed starting in the current situation then fluent F would be true afterwards". This seems to correspond to Hector's prediction of F at time i. We can also ask about occurrences of actions, truth of fluents in actual situations, etc).

The entailment relation on $\mathcal{L}$ between domain descriptions and queries formalizes the following informal assumptions:

- changes in the values of fluents can only be caused by execution of actions;

- there are no actions except those from the language of the domain description;
- there are no effects of actions except those specified by the causal laws of the domain;
- reasoner assumes that if there is no reason to believe that action A occured in situation S then it did not (In other words he normally observes all occurrences of actions).

As expected, we have that

$$D0 \text{ entails } holds(F, [A])$$

Now assume that the agent observed (or performed) B. This will be recorded in his description of the domain. New domain description D1 is D0 plus the statement

$$occurs(B, S0).$$

Now we have that D1 entails $neg(holds(F, [A]))$. It seems to me that the observation changed the prediction.

The second example shows how observations can change beliefs about the past. Consider a domain description D3

$$A \text{ causes } neg(F).$$
$$F \text{ at } S0.$$

This description entails $neg(occurs(A, S0))$. Now the reasoner observed that in some situation $S1$, F is false. This is recorded by adding to D3

$$S0 < S1$$
$$neg(F) \text{ at } S1.$$

The new description entails $occurs(A, S0)$. Again, observations changed the belief (this time about the past).

Hector, is this really a counter example or you meant something else?

Reference.

C. Baral, M. Gelfond, A. Provetti, "Representing Actions: Laws, Observations and Hypotheses", Journal of Logic Programming, vol. 31, Num. 1,2 and 3, pp. 201-245, 1997.

References:

[j-jlp-31-201] Chitta Baral, Michael Gelfond, and Alessandro Provetti. *Representing Action: Laws, Obervations and Hypotheses.* Journal of Logic Programming, vol. 31 (1997), pp. 201-244.

From: Luís Moniz Pereira

Dear Erik,

I noticed in the discussion that you said:

> *From the point of view of diagnostic reasoning these are familiar problems, but I can't think of any work in mainstream actions and change that has addressed nonmonotonicity with respect to observations in a serious way.*

I have tackled the issue of nonmonotonicty with respect to observations. Cf my home page, the AAAI-96, ECAI-96, AIMSA-96, LPKR97, JANCL97, AI&MATH98 papers. Using a LP approach I perform abuction to explain observations. The abductive explanations may be: non-inertiality of some fluent with respect to some action; occurrence of some erstwhile unsuspected foreign concurrent action along with some action of mine; or opting for a definite initial state of the world up till then given only by a disjunction of possibilities.

You're right, the techniques I and my co-author, Renwei Li, use were first developed by me and others in the context of diagnosis using LP! In fact we haven't yet used them all up yet in actions. For a view of LP and diagnosis, as well as representing actions in LP, see our book [mb-Alferes-96].

Best, Luís

References:

[mb-Alferes-96] José Júlio Alferes and Luís Moniz Pereira. *Reasoning with Logic Programs.* Springer Verlag, 1996.

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