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Protocol of the discussion during March, 1998 on

Causality in Reasoning about Actions

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From: Eugenia Ternovskaia on 2.3.1998

Erik Sandewall wrote:

> *maybe the section on "related work" in research papers ought not to be our only mechanism for assembling topic-specific surveys and bibliographies, and possibly the present debate forum could serve as a complement. Additional contributions are invited to this account of recent history, therefore.*

A few notes about earlier work on the solution to the frame and ramification problems based on the notion of causation.

In connection with the frame problem, an important step forward was the idea

1. to characterize the conditions making fluent F true and the conditions making it false separately, and, at the same time,
2. to say that actions produce no other effects using a minimization policy.

I think it was proposed in Lifschitz's 1987 paper [s-Brown-87-35], but it needs a check. Vladimir, could you remind us?

Reiter, basing his solution on the previous work by Pednault, Haas and Schubert, appeals to the same two principles [s-Lifschitz-91-359]. He specifies the conditions making a fluent to hold and not to hold by FO formulas γ^+ and γ^-. Instead of explicit minimization, he uses the Causal Completion Assumption.

The main lesson we can derive from this work is that no special non-logical symbol (predicate) is necessary to capture causal information in classical logic.

With respect to the ramification problem, Elkan [c-cscsi-92-221] considers a "stuffed room" domain, a variant of the "suitcase example". He argues that the ambiguity problem can be resolved using an explicit notion of causation. He uses two predicates, $causes(a, s, f)$ to be read "executing action a in state s causes fluent f to become true", and $cancels(a, s, f)$ saying "executing action a in state s causes fluent f to become false". In order to specify that actions produce no other effects, he uses "bidirectional implication as a minimization operator", i.e., he completely characterises predicates "causes" and "cancels".

References:

[c-cscsi-92-221] Charles Elkan. *Reasoning about Action in First-Order Logic.* Proc. Conference of the Canadian Society for Computational Studies of Intelligence, 1992, pp. 221-227.

[s-Brown-87-35] Vladimir Lifschitz. *Formal Theories of Action.* In: Brown (ed): The Frame Problem in Artificial Intelligence, pages 35-58. Morgan Kaufmann Publishers, Inc., 1987.

[s-Lifschitz-91-359] Ray Reiter. *The frame problem in the situation calculus: a simple solution (sometimes) and a completeness result for goal regression.* In: Vladimir Lifschitz (ed): Artificial Intelligence and the Mathematical Theory of Computation: Papers in Honor of J. McCarthy. Academic Press, 1991.