A logic programming framework for the abduction of events in a dialogue system

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January 25, 2000

In order to support incomplete knowledge, dialogue systems need the capability to handle non-monotonic reasoning. In the proposed framework this characteristic is supported through the abductive inference of the events that explain the recognized speech acts.

Abduction is modeled by a logic programming framework extended with explicit negation. The semantics of the framework is given by the well founded semantics of logic programs extended with explicit negation (WFSX).

In this work the agent/computational system is modeled by an extended logic programming that represents its mental state. The mental state is composed by:

- Attitudes

  Attitudes are the agent beliefs, intentions, and objectives at each time point.

- Reasoning rules

  These rules define what are the relations between attitudes.

- Behavior rules

  These rules describe the agent behavior, namely, its level of sincerity cooperativeness, credulity, and activity. Different behaviors can be supported through the change of these rules.

- Temporal axioms

  Temporal axioms define what properties are valid at each time point. As basic temporal axioms we have used a variation of the Event Calculus.

- Action rules

  These rules describe the actions that may be executed by the agent. Namely, they define speech acts and domain specific actions in terms of effects and pre-conditions.

- World knowledge

  These rules describe other world knowledge: events, concepts taxonomies, and entities.

After each sentence in a dialogue, the agent's model is updated with the facts that represent the new event.

The new agent's model is the well founded model of this new extended logic program.

One of the main features of this work is that, as we have integrity constraints specifying that properties must be caused by actions, it is necessary to support the observed properties with some unknown actions. This process is done through the abduction of the events that may explain the observed properties.

However, the model may still be contradictory. In fact, it is possible that the new event initiates some properties that are contradictory with the old mental state and there is no possible sequence of (abduced) actions that support the new state. When this happens, it is necessary to apply a contradiction removal process (CRSX - Contradiction Removal Semantics of logic programs with explicit negation) that terminates some properties (changing their truth value) and eliminates the contradiction.

The next step is to plan the system actions. Again, this step is done through the abduction of the actions that allow the satisfaction of the system objectives.

It is possible that there is no well founded model that supports the system objectives. In this situation, there is no plan (sequence of actions) that leads to the satisfaction of the objectives. If there is a plan (sequence of abduced actions) then it is possible for the system to generate the actions and to participate in the dialogue.