ELECTRONIC NEWSLETTER ON
REASONING ABOUT ACTIONS AND CHANGE

Issue 98027 Editor: Erik Sandewall 13.3.1998

Today

In yesterday's Newsletter, Pat Hayes brought up the question of how to represent the instant where something changes, and how this relates to the ontology of intervals. Although this came up in response to a message by Vladimir Lifschitz, it also connected to the discussion about Jixin Ma's article also at the Commonsense workshop. Today we have an answer from Jixin in this debate.

In the ENRAC web pages these contributions go into the panel on

Debates

Ontologies for actions and change

From: Jixin Ma

Dear Erik,

Since, as you mentioned in the Newsletter ENRAC 12.3 (98026), Pat Hayes' opinion about instantaneous changes has a close relation to our previous work (In fact, Pat did raise the similar question at the Commonsense workshop), I would like to make the following claims/arguments:

(1) For general treatment, both intervals and points are needed.

(2) To overcome the so-called Dividing Instant Problem, that is the problem in specifying whether intervals is "open" or "closed" at their ending-points, both intervals and points should be treated as primitive on the same footing. Neither intervals are constructed out of points, nor points are defined as the "meeting place" of intervals. Points have zero duration and are non-decomposable, while interval have positive duration and are either decomposable or non-decomposable (moments). Intervals Meets/Met-by points or other intervals. Therefore, although conceptually there is no definition of the ending-points for intervals, one may still say if an interval is open or closed at a point when the corresponding knowledge is available. E.g., if we know interval I Meets point P1, we may say I is (right) open at P1; if we know that interval I1 Meets Interval I2 and point P2 Meets I2, then we may say I1 is (right) closed at P2. In fact, this interpretation is consistent with the conventional definition about the closed and open nature of intervals that are constructed out of points such as reals or rationals. (For full details of the axiomatization of such a time structure based on both intervals and points as primitive, see The computer Journal 37(2), 1994, pp.114-123).

(3) Now consider the classical example of switching on a light. The arguments really depend on what knowledge is given/available for such a case. First of all, one can image there is an interval I immediately before the switching point P, and another interval J which is immediately after P. That is: $Meets(I,P) \wedge Meets(P,J)$, where $HOLDS(\neg(LightOn), I) \wedge HOLDS(LightOn, J)$. Now, what about the switching point P?

By Commonsense, at any time, the light is either on or off, and cannot be both on and off. In other words, one should be able to express the example in terms of two adjacent intervals, I1 and I2, where over I1 the light is off and over I2 the light is on, that is $Meets(I1, I2) \wedge HOLDS(\neg(LightOn), I1) \wedge HOLDS(LightOn, I2)$. This is in fact the intention of Allen's approach, which, by excluding the concept of points, overcomes the Dividing Instant Problem, successfully. However, with Allen's logic, one cannot talk about anything about the switching point P, which is intuitively there anyway.

The question now is that, by taking both intervals and points as primitive temporal objects, on the one hand, we can talk about time points such as the switching point P. However, on the other hand, can we still successfully express the Commonsense knowledge for the above example, without bearing the DIP? The answer is YES, since it really depends on what knowledge is given/available. In fact, there are three possible cases:

Case a) We have no knowledge about the state of the Light at the switching point P, though we may insist that there is a switching point, but we don't know if the LightOff interval I1, or the LightOn interval I2 is open or closed at the switching point P. What we know is just that the light changes from state "Off" to state "On". Hence, such a case can be simply expressed as: () $Meets(I1, I2) \wedge HOLDS(\neg(LightOn), I1) \wedge HOLDS(LightOn, I2)$.

Case b) We do know, or we impose (by some reason for the specified application) that the Light is on at the switching point P, that is, $HOLDS(LightOn, P)$. In this case, we still can express it as (), but with the additional knowledge that $I1 = I$, $I2 = P + J$. Therefore, we may say that the LightOff interval I1 is right-open at the switching point P, and the LightOn interval I2 is left-closed at P.

Case c) As an alternative to b), we may know, or we may impose that the Light is still off at the switching point P, that is, $HOLDS(\neg(LightOn), P)$. In this case, the additional knowledge becomes $I1 = I + P$, $I2 = J$. Therefore, we may say that the LightOff interval I1 is right-closed at the switching point P, and the LightOn interval I2 is left-open at P.

Jixin

This newsletter is issued whenever there is new news, and is sent by automatic E-mail and without charge to a list of subscribers, in plaintext format. The present postscript issue is a bona fide rendering of the same information in alternative typography. Instruction for contributors and other additional information is found at the following URL:

`http://www.ida.liu.se/ext/etai/actions/njl/`