ELECTRONIC NEWSLETTER ON REASONING ABOUT ACTIONS AND CHANGE

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TODAY's EVENTS

ENRAC One-Year Anniversary

The News Journal for Reasoning about Actions and Change started exactly one year ago - the original monthly webpage appeared on July 31, 1997. As most of you know, we switched to the system with direct-mail Newsletters in September, and that's clearly the major reason why the interactions have been very lively since. The present one is the 97:th Newsletter, so another reason for celebration is coming up soon.

ETAI Volume 1 Completed

Just in time for this anniversary, we have now completed the official version of ETAI 1997. (Please remember that each annual volume contains those accepted articles that were *submitted* during that year, except of course those requiring major revision, so the delay of a number of months is quite normal). The completed volume is available, each paper in its own file(s), on the Linkoping E-Press server, and the ETAI webpages for the Journal have been modified accordingly. In particular, responding to a suggestion by Rob Miller in an earlier Newsletter, we now have an overview page for the annual volume that gives parallel access to the article itself and to the discussion about the article.

At this point, I feel that the basic idea with this electronic journal has become very clear in the webpage structure. While in the midst of Newsletter activities - reading and contributing to them - one may sometimes have the impression that this *is* the ETAI, or more precisely one of its sections. At the end of the year, however, we have the articles that have been discussed, revised, and refereed through the Newsletter-based interaction process, and for posterity ETAI will of course *be* the collection of those articles and their commentary. Please take a look at the ETAI journal page (accessible from the main ETAI page) to see things in this perspective.

All of this has of course been produced by you the subscribers/ peers/ participants/ colloquium members. One other key notion in the ENRAC, in particular, is that debate contributions ought to be produced with a look-and-feel that matches their quality and the work that got into them, or in brief, that everyone who contributed to the discussions shall be able to feel pride for it and be able to refer to it. This is one of the reasons why the News Journal (containing the accumulated contents of Newsletters, one News Journal issue per month) is produced not only in HTML form but also in postscript via latex. I feel that much of what is written in our debates has a lasting value, and that it is worth referring to. Please feel free, therefore, to cite ENRAC debates just like you would cite any other journal. It does have official status, and its contents can be characterized in the same way as for other journals, in terms of ISSN number, volume, page, and so on. In particular, in order to refer to the *discussion about* an article, the appropriate citation is to the News Journal issue where the comment was made. The News Journal is organized with separate segments for separate articles being discussed.

Today's debate contribution

Today's Newsletter contains a contribution to a 'panel' discussions: Jixin Ma's answer to the recent contribution by Erik Sandewall in the debate about the ontologies of time.

Debates

Ontologies for time

From: Jixin Ma

In Newsletter ENRAC 27.7 (98059), Erik wrote:

> *Jixin has observed that sometimes it is necessary to assume an intervening point between two intervals, for example, for being able to say that a ball that has been thrown vertically up into the air will be motionless (zero velocity) at a certain point in time. For some other actions or events it is desired not to have an intervening (time-)point, as is the case for two successive intervals, one where a switch was "on" and the next where the switch was "off". Sergio Brandano has already observed (ENRAC 23.4) that the timepoint domain will then be agent-specific. It will also be local to each scenario, so that if additional actions are added to the scenario description, one must change the timepoint domain accordingly. In fact, it even becomes necessary to revise the timepoint domain each time a* query *is asked for a scenario, which seems a bit odd.*

First of all, it is important to note that, by taking both intervals and points as primitive, the time domain is general enough for various scenarios, and hence does not need to be revised when a "query" is asked for a special scenario. In fact, although the time line consists of both intervals and points, it is not required that between any two intervals there must be a point standing there. Therefore, the time domain itself allows the case of two successive intervals over some parts of the time line, that is an interval meets another interval without any point standing between them (this is the case 1 as I classified in ENRAC 13.3). But this does not necessarily exclude the case where a point "Finishes" the first interval or "Starts" the second (Please bear in mind that an interval "Meets" a point is treated as different with the case the interval is "Finished-by" the point; similarly, a point "Meets" an interval is different with the case that the point "Starts" the interval. See below). Therefore, if needed, it can also cope the other two cases, i.e., case 2 and case 3, by imposing futher information that a point "Finishes" the first interval, or "Starts" the second, respectively). In addition, it supports the case that an interval meets a point which in turn meets another interval (this is the case 4 which is needed in modelling the motion of the a ball being thrown vertically up into the air thrown). All these four cases are allowed by the same time theory, without the need to revise the time domain at all. In fact, one can have some of these scenarios appear somewhere over the time line, meanwhile with other scenarios appear over somewhere else. Specially, as Pat pointed out, one may even have the case where over somewhere actions or events are modelled as discrete, while over somewhere else (of the same time line) actions or events are modelled as continuous.

> *I suppose one could get used to this mode of thinking, and to accept that time is in the mind of the beholder. However, here are two examples where the punctuated time approach leads to absurd conclusions.*
>
> *A. Jim fires a model rocket and observes its flight. At the moment when it reaches the top of its trajectory, he turns a switch. If the flight of the rocket is modelled like Jixin proposes to model the throwing of a ball, then it requires that there exist a point for the clocktime when it is at its apex, but at the same time the fact that Jim turned the switch implies that there must not be any such point. Therefore, if the scenario description includes the statement that Jim turned the switch at the same (clock-)time as the rocket reached the apex, then it is semantically inconsistent.*

I think this example is similar to the following one as raised by Galton:

Suppose two lights, Green light and Red light, are both switched at the same time point P. By commonsense, we have that

(C) "GreenOff Meets GreenOn" and "RedOff Meets RedOn".

In addition, assume that by some reason we impose that the Green light is, for instance, On, at the switching point P, how are we going to express the situation for the Red light? In other words, is the Red light "Off" or "On" at the switching point P? Galton was afraid that this would lead to the Deviding Instant Problem again.

Let me sort out this problem first and then show that Erik's example can be dealt with similarly.

Since we have no information about the the state of the Red light at the switch point P, we may just use two successive intervals, I1 and J1, to express the scenario as:

$$Holds(RedOff, I1), \quad Holds(RedOn, J1), \quad Meets(I1, J1) \qquad \text{(R)}$$

However, we do have the addition information that the Green light is on the switching point P, therefore, the expression for the situation of Green light could be:

$$Holds(GreenOff, I2), \quad Holds(GreenOn, P), \quad Holds(GreenOn, J2), \quad Meets(I2, P), \quad Meets(P, J2) \qquad \text{(G)}$$

And hence, we can express the assumed whole scenario as:

$$\begin{array}{ll} Holds(GreenOff, I2), & \text{(GR)} \\ Holds(GreenOn, P), & \\ Holds(GreenOn, J2), & \\ Holds(RedOff, I1), & \\ Holds(RedOn, J1), & \\ Meets(I2, P), & \\ Meets(P, J2), & \\ Meets(I1, J1). & \end{array}$$

where $I1 + J1 = I2 + P + J2$

Since (GR) allows us to express $P + J2$, i.e, the ordered union of P and $J2$, as a single interval $J2'$, such that $Holds(GreenOn, J2')$, it therefore provides a satisfactory expression consistent with (C).

However, if we in addition specially impose that, for instance, the Red light is Off at the swiching point P, we can still express the whole scenario as:

$$\begin{array}{ll} Holds(GreenOff, I2), & \text{(GR*)} \\ Holds(GreenOn, P), & \\ Holds(GreenOn, J2), & \\ Holds(RedOff, I2), & \\ Holds(RedOff, P), & \\ Holds(GreenOn, J2), & \\ Meets(I2, P), & \\ Meets(P, J2). & \end{array}$$

Again, since (GR*) allows us to express $P + J2$ as interval $J2'$, such that $Holds(GreenOn, J2')$, and also to express $I2 + P$ as interval $I2'$, such that $Holds(RedOff, I2')$, again, we reach a satisfactory expression consistent with (C) for the specified scenario.

Now, let's come back to Erik's example A:

First of all, I don't think the time theory criticized is semantically inconsistent. Yeah, for the modelling of the throwing of a ball, it requires that there exists a point referring to the apex. However, the fact that Jim turned the switch does not necessary imply that there must not be any such point, especially if one insists that "at the moment (point?) when it (the ball) reaches the top of its trajectory, he (Jim) turns a switch". I guess what Erik actually means here is that we don't have any information about the state of the object (a light?) being switched at the switching point. What we do know is just that the "On" state is immediately after the "Off" state. Therefore, similar to the treatment to the above "Two Lights Problem", we can express Erik's scenario as:

$$\begin{array}{l} Holds(BallGoingUp, I1), \\ Holds(BallStationary, P), \\ Holds(BallGoingDown, J1), \\ Holds(LightOff, I2), \\ Holds(LightOn, J2), \\ Meets(I1, P), \\ Meets(P, J1), \\ Meets(I2, J2). \end{array}$$

possibly with the constraint: $I2 + J2 = I1 + P + J1$

B. Tom and Bob compete for eating icecream cones. They start with four cones each, and have to eat them as fast as possible, starting at the same time. The referee rings a bell when one of them has finished

> *eating all his cones. If one of the contestants tries to cheat by dropping icecream on the ground, he also rings the bell in order to call off the contest. The bell sounds at time t. What conclusions can be drawn from this?*
>
> *Consider the following ontology for this domain which is plausible if one uses punctuated time in order to deal with the DIP: 1. The ringing of the bell is momentary, that is, it occurs at a particular point in time. 2. The cone is supposed to still exist while it is being eaten, it does not exist after it has been consumed, and the clocktime at the end of the eating period does not have a corresponding point. This convention is made in order to avoid the dividing instant problem with respect to the existence of the icecream cone that has just been eaten. With these assumptions, it follows that one of the contestants cheated at time t, because in the case of an honest game, a point both exists and does not exist at the clocktime when the winner finishes his last cone and the bells rings.*
>
> *It is easy to generate additional examples of the same kind. I don't see how one can get around them as long as punctuated time is allowed. The only reasonable approaches seem to be either (a) the* transitory value approach*, where one uses an additional fluent value for "undefined or "transitory" for e.g. the state of a switch in the moment it is being thrown, or (b) the* multiple models approach *that I mentioned above. Both of these approaches are sufficiently expressive for dividing instant situations even when complete (unpunctuated) time is used. How else would you deal with these examples?*

First of all, I don't agree with the claim that "a point both exists and does not exist at the clocktime when the winner finishes his last cone and the bells rings". Again, I think this claim was reached by means of confusing the two cases, that is, the case that an interval "Meets" a point, and the case that an interval was "Finished-by" a point. This is in fact the approach taken by many researchers such as Vilain (1982) and Parthasarathy (1990, 1994), and which actually leads to the problem. However, as I shown in ENRAC 1.4, these two cases should be taken as different since they play the critical roles in characterising the closed and open nature of intervals, and treating the corresponding problems.

Now, let me try to model this interesting example:

For Tom, we have:

$Holds(f1, I1)$,
$Holds(f2, I2)$,
$Holds(f3, I3)$,
$Holds(f4, I4)$,
$Meets(I1, I2)$,
$Meets(I2, I3)$,
$Meets(I3, I4)$

where $f1$ denotes that all the four cones have not been finished by Tom, and $f2$ denotes that just one cone has been finished by Tom, and so on.

Similarly, for Bob, we have:

$Holds(g1, j1)$,
$Holds(g2, j2)$,
$Holds(g3, J3)$,
$Holds(g4, J4)$,
$Meets(J1, J2)$,
$Meets(J2, J3)$,
$Meets(J3, J4)$

To express that Tom and Bob start at the same time, we have:
$Meets(I, I1)$,
$Meets(I, J1)$

Also, we have:
$Holds(RingingBell, t)$

If Tom finishes his last cone before Bob, that is:
$Duration(I1 + I2 + I3 + I4) < Duration(J1 + J2 + J3 + J4)$

then we have: $Meets(I4, t)$

Similarly, if Bob finishes his last cone before Tom, i.e.,
$Duration(J1 + J2 + J3 + J4) < Duration(I1 + I2 + I3 + I4)$

then $Meets(J4, t)$

As for the cheating:

If
$Holds(TomDroppingIcecream, K) \wedge During(K, I1 + I2 + I3 + I4)$

then $Meets(K, t)$

Similarly, if
$Holds(BobDroppingIcecream, L) \wedge During(L, J1 + J2 + J3 + J4)$

then $Meets(L, t)$

I feel that's it, though I wonder if I missed some of the specifications of the example.

Jixin

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