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Answer to Question by Tom Costello

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Hello Michael,

Thanks for your comments about Definition 14 of initiation and termination points. You are of course right to say that the definition requires the least fixed point construction, so perhaps we should have made this explicit within the definition itself. We omitted this from the paper in an attempt not to overload the definition with too much formalism, but perhaps its omission is causing more rather than less confusion. (Hudson Turner emailed us a similar comment to your's a little while ago.)

So yes, the initiation and termination points are defined by a least fixed point construction (along the lines we say after the definition). Here's a version of the definition that makes this explicit:

Definition 14 [Initiation/termination points] Let H be an interpretation of $\mathcal{E} = \langle \Pi, \preceq, \Delta, \Phi \rangle$, and $D = \langle \gamma, \eta, \tau, \rho \rangle$ be a domain description. Let $\mathcal{W}$ be the set $2^{\Phi \times \Pi} \times 2^{\Phi \times \Pi}$ and let the operator $\mathcal{F} : \mathcal{W} \mapsto \mathcal{W}$ be defined as follows. For each, $\langle \mathcal{I}n, \mathcal{T}e \rangle \in \mathcal{W}$ denote $\mathcal{F}(\langle \mathcal{I}n, \mathcal{T}e \rangle)$ by $\langle \mathcal{I}n', \mathcal{T}e' \rangle$. Then for any $F \in \Phi$ and $T \in \Pi$, (F, T) is in $\mathcal{I}n'$ (respectively in $\mathcal{T}e'$) iff one of the following two conditions holds.

1. There is an $A \in \Delta$ such that (i) there is both an h-proposition in η of the form "A **happens-at** T" and a c-proposition in γ of the form "A **initiates** F **when** C" (respectively "A **terminates** F **when** C") and (ii) H satisfies C at T.

2. There is an r-proposition in ρ of the form "F **whenever** C" (respectively "$\neg F$ **whenever** C") and a partition $\{C_1, C_2\}$ of C such that (i) C_1 is non-empty, for each fluent constant $F' \in C_1$, $(F', T) \in \mathcal{I}n$, and for each fluent literal $\neg F' \in C_1$, $(F', T) \in \mathcal{T}e$, and (ii) there is some $T_2 \in \Pi$, $T \prec T_2$, such that for all T_1, $T \preceq T_1 \preceq T_2$, H satisfies C_2 at T_1.

Let $\langle \mathcal{I}n^f, \mathcal{T}e^f \rangle$ be the least fixed point of the operator $\mathcal{F}$ starting from the empty tuple $\langle \emptyset, \emptyset \rangle$. T is an *initiation-point* (respectively *termination-point*) *for* F *in* H *relative to* D iff $(F, T) \in \mathcal{I}n^f$ (respectively $(F, T) \in \mathcal{T}e^f$).

$\square$

So the operator corresponding to the least fixed point does indeed have an interpretation as argument. But there's no problem with this, because the interpretation is already fixed at the beginning of the definition. It's necessary include this argument in order to deal with preconditions of c-propositions. For example, consider the following domain (with time as the naturals):

$$\begin{array}{c} \mathit{Take}\ \textbf{initiates}\ \mathit{Picture}\ \textbf{when}\ \{\mathit{Loaded}\} \\ \mathit{Take}\ \textbf{happens-at}\ 2 \\ \neg \mathit{Picture}\ \textbf{holds-at}\ 1 \end{array}$$

We want 2 models, one in which *Loaded* is true at 1, and one in which *Loaded* is false at 1. In the former model, 2 should be an initiation-point for *Picture*, but in the latter it shouldn't.

Rob and Tony.