

- VITALIY DOLGORUKOV, ELENA POPOVA, *Temporal Epistemic Logic for Agents with Delay in Awareness*.

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We present a multi-agent logic for reasoning about knowledge in time which involves delays in the agent's awareness. Awareness framework divides a common epistemic concept of knowledge into explicit and implicit ones. This division helps to avoid the problem of logical omniscience and proposes new instruments for analysis of resource-bounded agents reasoning.

Formulas of the language \mathcal{L}_T are given by the Backus-Naur form

$$\varphi ::= p \mid n_i \mid \neg\varphi \mid (\varphi \wedge \varphi) \mid K_i\varphi \mid A_i\varphi \mid X\varphi \mid Y\varphi$$

with $p \in Prop$, $i \in Ag$, $n \in \mathbb{N}$.

Formula " n_i " is read as "agent i 's delay in awareness is n steps".

A Temporal Epistemic Model for Agents with Delay in Awareness is a tuple

$$\mathcal{M} = (W, (\sim_i)_{i \in Ag}, \rightsquigarrow, A, V, T),$$

where $W \neq \emptyset$ is a set of possible worlds, $\sim_i \subseteq W \times W$ is an accessibility relation for an agent i , $\rightsquigarrow \subseteq W \times W$ is a temporal accessibility relation for the epistemic evolution of the possible worlds, $A_i : W \rightarrow \mathcal{P}(\mathcal{L}_T)$ for an agent i , $V : Prop \rightarrow \mathcal{P}(W)$ is an evaluation function for propositional variables, $T : Ag \times W \rightarrow \mathbb{N}$. Function T (type) returns a natural number, which measures delay in awareness for every possible combination of agent and possible world.

The truth of a modal formula φ in a pointed model (\mathcal{M}, w) is defined as follows:

- the truth of propositional variables and Boolean connectives are defined in a standard way;
- $M, w \models n_i \iff T(i, w) = n$
- $M, w \models K_i\varphi \iff \forall w' (w \sim_i w' \Rightarrow M, w' \models \varphi)$
- $M, w \models X\varphi \iff \forall w' (w \rightsquigarrow w' \Rightarrow M, w' \models \varphi)$
- $M, w \models Y\varphi \iff \forall w' (w' \rightsquigarrow w \Rightarrow M, w' \models \varphi)$
- $M, w \models A_i\varphi \iff \varphi \in A_i(w)$

To illustrate the formal instruments of the system, we will consider this problem with an example of a modified version of the "Muddy Children" puzzle. We introduce different types of agents: fast-reasoners and slow-reasoners, and model different interactions between them given their knowledge. This extension allows to enrich the puzzle's scenarios and bring to the problem of imperfect agency.

In the work, the axiomatization of temporal epistemic logic for agents with delay in awareness is constructed, and soundness and completeness theorem is proven.