Towards a Framework for Reasoning About Emotional BDI Agents

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Abstract

The BDI model of agency is a well studied concept in Formal Logic for Rational Agents, mainly through the $\mathsf{BDI}_{\mathrm{CTL}}$ [7] and **KARO** [7] logical frameworks. The former is based on the Branching Time Logic CTL [3], whereas the latter in based on Dynamic Logic [4]. Both have advantages and disadvantages, but the union of some properties of both frameworks provide, in our opinion, all the formal tools that we need to model the more recently introduced concept of Artificial Emotion within the BDI model [2].

In this work we propose an extension to the $\mathsf{BDI}_{\mathrm{CTL}}$ so its syntax and semantics to support reasoning about Artificial Emotions. We named this extension $\mathsf{BDI}_{\mathbf{E}}$–$\mathcal{L}_{\mathsf{A}}^{\mathsf{T}}$ logic. More particularly, we want to reason about the role of Artificial Emotions in BDI agents in a logical point of view, and for that we based the development of $\mathsf{BDI}_{\mathbf{E}} - \mathcal{L}_{\mathsf{A}}^{\mathsf{T}}$ in the ideas put forward in [2, 5]. Based on these ideas, we defined in $\mathsf{BDI}_{\mathbf{E}}$–$\mathcal{L}_{\mathsf{A}}^{\mathsf{T}}$ modal operators for modelling action-execution, capabilities (abstract plans of action) and resources (means to turn capabilities in executable actions). Moreover, we also defined modal operators for Artificial Emotions, in the same level of the BDI modal operators. With all these modal tools at hand, our main goal is to formally model two fundamental aspects of Artificial Emotions: their triggering and their influence in agents behaviour. Since the formal definition of Artificial Emotion and behavioural concepts are already present in the core of $\mathsf{BDI}_{\mathbf{E}} - \mathcal{L}_{\mathsf{A}}^{\mathsf{T}}$, we define the introduced aspects through establishing some interactions between the modal operators representing Artificial Emotions and the ones representing BDI, actions, capabilities and resources.

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