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EPISTEMIC LOGIC, LOGICAL OMNISCIENCE
AND ARTIFICIAL INTELLIGENCE

Abstract

According to traditional epistemic logics, based on Kripke-style possible world semantics, the objects of knowledge and belief are assumed to be intensions of sentences, i.e. sets of possible worlds. This kind of formalization suffers from the well-known problem of logical omniscience: the epistemic agents are assumed to know (or believe) all the logically valid formulas, and to know (or believe) all the logical consequences of their basic beliefs (section 2). This idealisation is problematic both from the philosophical viewpoint, and from the point of view of many applicative domains of epistemic logics. For example, the aim of artificial intelligence (AI) is to model the inferential abilities of computationally limited rational agents. From this point of view, the idealisations implicit in the logical omniscience assumption cannot be accepted. In this work we review some of the formalisms adopted in the logicist tradition of AI to face this problem. Many of these proposals present analogies with the solutions proposed in the logico-philosophical tradition, and could offer interesting hints to philosophers. The logic of minimal models (section 3) is a generalisation of possible world semantics, according to which the objects of knowledge and belief are still assumed to be sets of possible worlds. Minimal models impose weaker inferential abilities for epistemic agents, but cannot solve definitively the problem: in minimal model semantics, logically equivalent formulas are still indistinguishable from the semantical point of view. In order to face this problem, more fine-grained semantical distinctions must be introduced. In this direction, an “extremist” position is the syntactic approach proposed by K. Konolige (section 4). According to Konolige, the objects of epistemic attitudes are assumed to be sentences, i.e. entities of a syntactical nature. Section 5. describes a more moderate position due to H. Levesque. It is based on the introduction of situations, i.e. non classical semantic structures allowing for incoherent or incomplete states of affairs. Section 6. deals with the work of R. Fagin and J.Y. Halpern. According to Fagin and Halpern, the lack of logical omniscience in actual epistemic agents is a complex phenomenon, due to the interaction of different causes. They generalise the approaches described in the previous sections by proposing three logics, each of them facing a different aspect of the problem of logical omniscience.