

Substructural Negation in Epistemic Logic

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Abstract. The modal logic of equivalence graphs S5 is a knowledge representation formalism with notable applications in computer science, philosophy, and elsewhere. Public announcements, represented by subgraph constructions, are a simple formal representation of information update. Together they provide an elegant model of knowledge and its dynamics. Yet, the model has at least two drawbacks. Firstly, knowledge as represented by S5 is closed under logical consequence. The most problematic special cases of this problem, also known as the problem of logical omniscience, pertain to closure under valid multiple-assumption rules, such as Modus Ponens and Conjunction Introduction. Secondly, information update as represented by public announcements is monotonic with respect to non-modal formulas. If A does not contain modal operators, then it is known only if it remains known after every possible update. Both of these features are problematic from the viewpoint of knowledge representation, but formalisms that avoid both of them are not easy to find in the epistemic logic literature. This talk argues that a formalism avoiding both multiple-assumption omniscience and non-modal monotonicity can be obtained in a relatively simple manner. We add to S5 with public announcements a weak substructural negation, represented as a negative modal operator. The informal interpretation of our framework is loosely based on the Relevant Alternatives Theory of knowledge, and our framework avoids a problem encountered by a recent formalisation of the theory. The main technical contribution is a completeness result for S5 with public announcements and substructural negation.