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Title	Epistemic Infinite-Regress Logics: the Surface to Deeper Layers and Latent Infinity
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Description	6th International Workshop On Philosophy and Logic of Social Reality. 28 February - 1 March, 2022, On-Line
Issue Date	2022
Doc URL	https://hdl.handle.net/2115/84817
Type	conference paper
File Information	Proceedings_of_SOCREAL2022_p2.pdf

Epistemic Infinite-Regress Logics:
the Surface to Deeper Layers and Latent Infinity
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Abstract

Common knowledge/belief is an important component in game theory, but its infinitary nature often hinders progress of game theory as a part of social science. The state of affairs behind a game situation may include such an infinite structure as latent. Formally, we consider an infinite-regress logic IR_β with two agents, which is a fixed-point logic. The subscript β is be a bound on the nested depths of beliefs and fixed-point (infinite-regress) operators; the limit case $\beta = \omega$ is unbounded. A proof system IR_β is constructed within the bound β, but the corresponding Kripke semantics already includes an infinite valuation, which is uniform over different bounds β up to ω. The smallest meaningful case is $\beta = 3$. The soundness-completeness theorem connecting IR_β with its semantics is provided; the proof theoretical part is interpreted as going from the surface to deeper layers as β becomes larger. In logic IR_β, each's basic beliefs may be different from the other's, in order to capture the feature that the individual beliefs are in the mind of each agent. Nevertheless, they have external interactions through their social world, after each's individual logical calculation, and after external interactions, each may revise his internal basic beliefs. Then, the situation starts again.