Making Complex Beliefs Tractable

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The essence of classical approaches to common knowledge, originating from epistemology and modal logic, is consensus between group participants. When established, common knowledge is helpful in drawing common consequences from commonly known premises. This property is invaluable in creating models of others or in modelling conventions. However, in complex real-life applications, especially those involving cooperation or teamwork, the role of group knowledge has recently evolved.

1. Instead of "what every fool knows", group knowledge tends to express synthetic information extracted from the information delivered by individuals.
2. Consensus is not a requirement anymore, as group members do not necessarily adopt group conclusions. It suffices that during the group's lifetime they obey them.

Since agents joining a group do not have to revise their individual beliefs accordingly, inconsistencies may naturally appear. In order to prevent them from trivialising the reasoning, we choose to live with inconsistencies for the time being, though no longer than needed. Moreover, in contemporary applications we also need to cope with lack of information which usually leads to nonmonotonic reasoning.

How to formally model such complicated situations?

First of all, we propose a shift in perspective: from reasoning in multimodal systems of high complexity to querying (paraconsistent) knowledge bases.

This has led to a novel formalization of complex beliefs by Dunin-Kęplicz and Szałas. In order to bridge the gap between idealized logical approaches and their actual implementations, the original notion of epistemic profile serves as a tool for transforming preliminary beliefs into final ones. As epistemic profiles can be devised both on an individual and a group level in an analogical manner, a uniform treatment of individual and group beliefs has been achieved.

Various challenges naturally occurring in this context can be solved with the use of 4QL: a new four-valued rule-based query language designed by Małuszyński and Szałas. The role of 4QL is to provide firm foundations for paraconsistent knowledge bases used by applications external to this language. Importantly, using 4QL ensures tractability.