

Models of Bounded Reasoning in Individuals and Groups

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Formal models of individual and group reasoning have been developed and studied within, and across, a number of disciplines, including logic, probability and social choice, and more broadly, artificial intelligence. These models, for use by computational agents reasoning individually and interactively, and for normative guidance of human individual and group reasoning, are designed to be rational under the *impractical* and *unrealistic* assumption that agents enjoy unlimited computational/cognitive resources. The goal of this workshop was to therefore establish foundations for conceptual and technical frameworks for development of rational, *realistic* models of individual and collective reasoning.

To realize this goal, the workshop facilitated cross-fertilization amongst researchers in the above-mentioned disciplines as well as researchers in cognitive science, and economics. The workshop's activities were split into: 1) a series of tutorial style presentations and plenary talks that aimed at dissemination of key concepts to the workshop attendees; 2) identification of specific research topics that were adopted for discussion and investigation by smaller 'break out' groups who reported on these discussions at the close of day. A notable highlight was the extent to which the presentations and subsequent group discussions identified conceptual overlap between disciplines. For example, reasoning tasks shown to be cognitively demanding for humans by cognitive scientists (e.g., the Wason selection task) were noted to exhibit similar patterns of hypothetical reasoning – i.e., reasoning with virtual information – than those accounting for the complexity of reasoning in classical logic. Indeed, there was some discussion, and technical efforts directed at a more abstract (possible worlds) modeling of the use of virtual information. The aim being a unifying framework wherein each nested introduction of virtual information provides both an incrementing metric on the cognitive/computational resources available to an agent, and delineates a normative bound on the inferences available to a fully rational agent reasoning within the given bound. Another notable interdisciplinary insight was the effect that the framing of a reasoning task has on the cognitive difficulty experienced by humans in solving the task, and recent work in philosophical logic that accounts for the problem of logical omniscience. The latter enriches the ontology of propositions to effectively account for the context's (*qua* framing's) effect on an agent's capacity to infer that a proposition holds true.

The above observations testify to the benefit of the multidisciplinary nature and adopted format of the workshop, in that it not only included presentations, but also provided opportunities for exploring and consolidating connections and shared concepts. Indeed new research directions have been initiated. For example, the workshop seeded a collaboration between researchers working in dialogical models of joint (collective) reasoning and researchers working in logics for modeling how agents beliefs about other agents' beliefs (theory of mind) evolve. Clearly, each will inform the other, and a key characterizing feature of this two way relationship will be the finite resources available for modeling other agents' beliefs.

A tangible outcome of the workshop was the initiation of a shared working document in which key workshop participants within the fields of philosophy, cognitive science, formal logic, multi-agent systems and social choice, will, over the coming months, contribute 5-6 page sections describing the research challenges for addressing the problem of bounded rationality in their respective domains. Our aim is that this document evolves into a state of the art 'mission statement' for future research and collaboration. The document will be uploaded to ArXiv.

In summary, the workshop achieved its aims in terms of cross-fertilization of concepts and insights across multiple disciplines, and the seeding of a working document that will, we hope, blossom into an interdisciplinary research community addressing the pressing problem of bounded rationality in individuals and groups.

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