The logic of coalitional games

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Formal logics of cooperation, in particular about how autonomous agents may form coalitions and the powers these coalitions have, is needed to represent and reason about the strategic structure of multi-agent systems. There is a long tradition of formally modeling cooperation and coalitions in mathematical game theory. Models of game theory can broadly be divided into non-cooperative games, taking possible actions of individual players as primitives, and coalitional (or cooperative) games, taking possible actions of coalitions as primitives. Both types of games can be used to reason about different aspects of cooperation. However, existing logics of cooperation, such as Coalition Logic and Alternating-time Temporal Logic, are logics of (certain types of) non-cooperative games and cannot be interpreted directly in coalitional games. Furthermore, these logics tend to ignore the essential issue of the players' preferences over outcomes.

In the talk I will, after discussing formal models of cooperation, present a new logic of coalitional games. The logic has operators for expressing preferences directly. I will discuss meta results, such as expressiveness, completeness and computational complexity. The logical language is interpreted directly by coalitional games, and the logic gives a complete axiomatisation of such games. I will show how important properties of coalitional games can be formally expressed in the logic, in particular solution concepts such as the core, the stable sets of Von Neumann and Morgenstern, and the bargaining set.

The talk is based on joint work with Wiebe van der Hoek and Michael Wooldridge.