Efficient Generation of Justifications for Collective Decision Making

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1 Problem Definition

When a group decision needs to be made, there are various strategies to choose from. Classically, a *voting rule* is chosen to aggregate the individual *preferences* of the agents into a collective one [6]. Each voting rule satisfies different normative principles (so-called *axioms*) constraining the outcomes that can be selected under different situations (so-called *profiles of preferences*). The Pareto Principle, for example, states that if in a given profile all the agents prefer an alternative A over an alternative B, then the latter cannot possibly be part of the outcome. The axioms characterising a rule can then be seen as justifying the outcomes it gives.

Instead of relying on a specific voting rule, Boixel and Endriss [1] seek to generate a *justification* for why a target outcome would represent a *reasonable* compromise in a concrete situation directly in terms of appealing normative principles. The notion of justification they develop has both a normative and an explanatory component. The explanation shows how the selection of the target outcome follows from concrete *instances* of the normative principles considered.

Producing this kind of justification, however, is computationally hard. In this project, I will restrict my attention to axioms that only refer to at most two profiles at the time. Under such a restriction, I will try to understand how easier the problem of generating a justification becomes and design efficient algorithms to solve it. Furthermore, I will implement these algorithms and finally evaluate their efficiency through a small experimental study.

2 Key words

- Computational Social Choice
- Voting rules
- Explanation and Justification of Decisions
- Axiomatic Method
- Automated Reasoning
- Voting profiles

3 Literature

3.1 Stanford Encyclopedia of Philosophy - Voting Methods [5]

This site introduces and critically analyzes different voting methods using examples. It gives explanations of why certain voting rules are preferred over others. Moreover, various axiomatic characterizations are discussed, for example anonymity and neutrality.

3.2 Handbook of computational social choice [2]

In chapter two of this book, various social welfare functions (e.g. plurality and Borda) and voting rules (e.g. majority rule and Dodgson) are introduced. Moreover, it discusses different axioms in computational social choice. These axioms are precise definitions of the social welfare functions and voting rules: examples of these axioms include the Pareto principle and anonymity. Finally, this chapter concludes by discussing the strategyproofness of different social welfare functions and voting rules.

3.3 Automated justification of collective decisions via constraint solving [1]

This article proposes a model that generates a justification for why an outcome is a reasonable compromise in a concrete situation in terms of normative principles. The notion of justification they develop has both a normative and an explanatory component. The explanation shows how the selection of the target outcome follows from concrete instances of the normative principles considered.

3.4 Trends in Computational Social Choice [3]

In chapter 13 of Trends in Computational Social Choice, by Geist and Peters, a set of computer-aided tools for social choice theory are presented. These are used to outline the proof of the impossibility theorem.

They start of by encoding a resolute voting rule that satisfies both the majority criterion and strategyproofness into a conjunctive normal formula. This formula can then be passed on to a SAT solver; this solver is capable of deciding whether a formula is satisfiable. If the formula is unsatisfiable, which is the case with the impossibility theorem, the goal is to know why it is unsatisfiable. To do so, Geist and Peters use a tool which extracts the minimal unsatisfiable set; this set contains clauses that ascertain the formula is unsatisfiable. Based on these clauses a proof can be constructed. Finally, by induction, the proof is completed for arbitrary quantities. Furthermore, papers that have used these steps for proving different results are discussed.

3.5 The axiomatic characterization of majority voting and scoring rules [4]

This article explains how axiomatic characterizations are created from standard voting rules. The characterization of the majority rule by May as well as the axiomatization of the family of scoring rules by Young are highlighted.

References

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