Efficient Generation of Justifications for Collective Decision Making

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1 Literature review

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 [5]. 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.

However, just a couple of researches have been conducted on how to generate justifications of election outcomes given the preferences. Cailloux and Endriss [3] have used tools from AI to let people reason about the different voting rules. Moreover Cailloux and Endriss provided a model which generated a justification for an outcome if that outcome is the winner according to the Borda rule.

Instead of relying on a specific voting rule, Boixel and Endriss [2] 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.

Finally, in terms of methodology Belahcene et al. [1] and Geist and Peters [4] (chapter 13) employ the same tools as Boixel and Endriss [2], namely SAT solvers. These types solvers are capable of deciding whether a logic formula is satisfiable. Moreover, both papers use the minimal unsatisfiable set (MUS) to determine which set causes the formula to be unsatisfiable.

2 Research question

Producing the justification for why a target outcome would represent a reasonable compromise, however, is computationally hard. In this project, I will restrict my attention to axioms that only refer to at most two profiles. 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.

The research question is: How challenging is the task computationally of generating justifications for collective decision making when solely considering axioms that refer to at most two profiles?

3 Method and approach

The start of the project includes literature research to become more acquainted with the problem at hand and the used axioms. Moreover, the literature research is necessary for understanding and exploring possible approaches to design efficient search algorithms. Thereafter, based on the results from the literature research, efficient algorithms will be designed. Finally, the algorithms will be implemented and evaluated on their efficiency through a small experimental study. The implantation of the algorithm will be done in Python.

4 Evaluation

The efficiency and functionality of the implemented algorithms will be evaluated. This can be done by examining the time and space complexity of the algorithm. Moreover, the functionality can be tested by giving the algorithm different inputs and verifying the output. Lastly, the experiment in the paper of Boixel and Endriss [2] can be reproduced using the new algorithm and the results can be compared.

However, the most adequate way to evaluate the algorithm is yet to be determined.

5 Plan

In Figure 1 the current planning is presented. There are two main deadlines; on May 15th the midterm presentation and on June 26th the deadline for the final report. To ensure the latter is met on time, a first and second draft of the final report are included. The designing and implementation of the algorithm will overlap because refining the algorithm probably needs multiple tries. For the same reason the evaluation of the efficiency will overlap with the implementation. Finally, parts of the report are expected to be written during implementation to ensure the deadlines are complied.

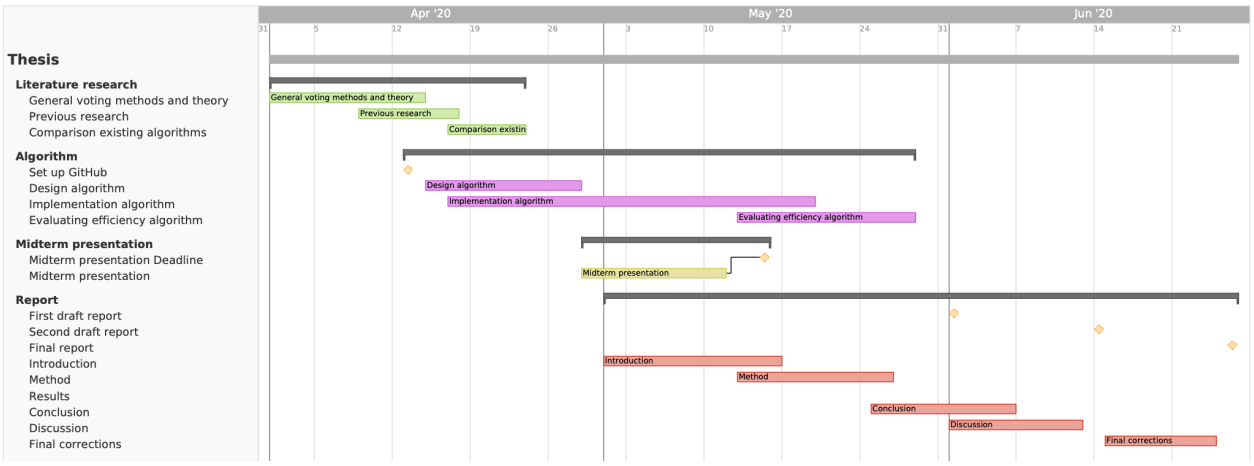

Figure 1: Planning

References

[1] K. Belahcene, Y. Chevaleyre, N. Maudet, C. Labreuche, V. Mousseau, and W. Ouerdane. Accountable approval sorting. 2018.

[2] A. Boixel and U. Endriss. Automated justification of collective decisions via constraint solving. In *Proceedings of the 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2020)*. IFAAMAS, May 2020.

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