Simultaneous Elicitation of Committee and Voters Preferences

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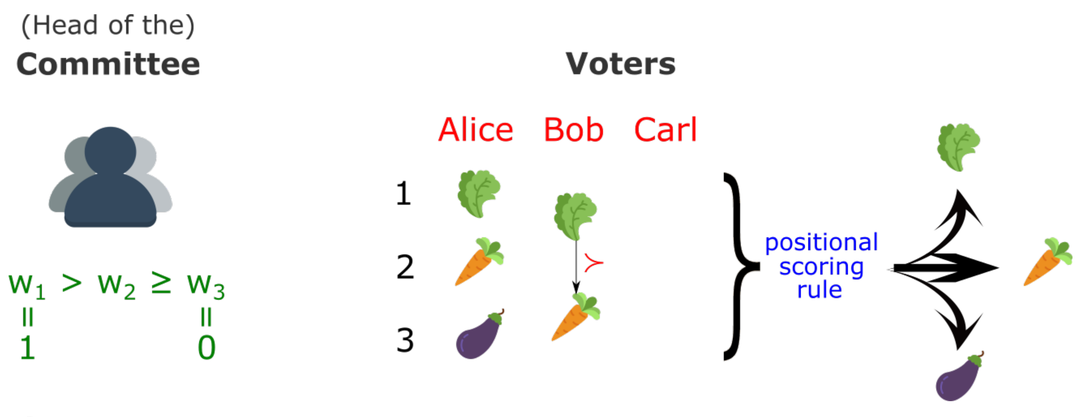
Setting

Incomplete profile and uncertain positional scoring rule



Goals

- Development of query strategies interleaving questions to the chair and to the voters in order to simultaneously elicit preferences and voting rule
- Robust winner determination

Motivation and approach

- **Who?**
  - Imagine to be an *external observer* helping with the voting procedure
- **Why?**
  - Requiring voters to express *full preference* orderings can be prohibitively *costly*, especially for decisions with lots of alternatives
  - *Difficult* for non-expert users *to formalize* a voting rule on the basis of some generic preferences over a desired aggregation method
- **How?**
  - *Minimax regret*: given the current knowledge, the alternatives with the lowest worst-case regret are selected as tied winners
- **Assumptions:**
  - Voters and committee have true preferences in mind
  - The voting rule is a Positional Scoring Rule where the scoring vector $(w_1, \ldots, w_m)$ is a convex sequence of weights and $w_1 = 1$, $w_m = 0$

Minimax Regret

$$\begin{aligned}
\text{Regret}^{\boldsymbol{v},\boldsymbol{w}}(x) &= \max_{y \in A} s^{\boldsymbol{v},\boldsymbol{w}}(y) - s^{\boldsymbol{v},\boldsymbol{w}}(x) \\
\text{PMR}^{\boldsymbol{p},W}(x,y) &= \max_{\boldsymbol{w} \in W} \max_{\boldsymbol{v} \in C(\boldsymbol{p})} s^{\boldsymbol{v},\boldsymbol{w}}(y) - s^{\boldsymbol{v},\boldsymbol{w}}(x) \\
\text{MR}^{\boldsymbol{p},W}(x) &= \max_{y \in A} \text{PMR}^{\boldsymbol{p},W}(x,y) \\
\text{MMR}(\boldsymbol{p},W) &= \min_{x \in A} \text{MR}^{\boldsymbol{p},W}(x) \\
x^*_{\boldsymbol{p},W} \in A^*_{\boldsymbol{p},W} &= \arg\min_{x \in A} \text{MR}^{\boldsymbol{p},W}(x)
\end{aligned}$$

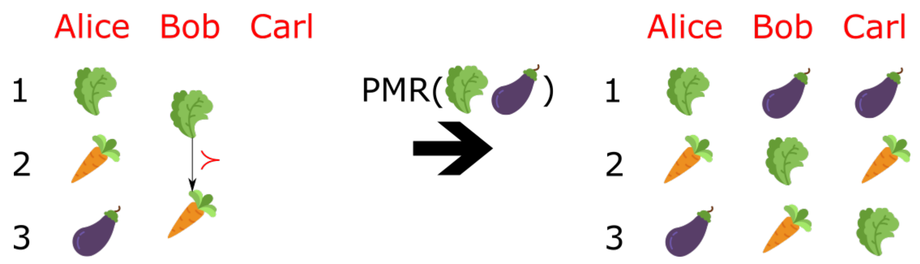
Pairwise Max Regret Computation

The computation of $\text{PMR}^{\boldsymbol{p},W}(x,y)$ can be seen as a game in which an adversary can both extend the partial profile into a complete one and instantiate the weights choosing among any feasible weight vector

- **Profile Completion**
  For any other alternative a

$$\begin{aligned}
a \succ_j x &\Leftrightarrow \neg(x \succeq^{\text{p}}_j a) \\
y \succ_j a &\Leftrightarrow \neg(a \succeq^{\text{p}}_j y) \wedge \neg((x \succeq^{\text{p}}_j y) \wedge \neg(x \succeq^{\text{p}}_j a)).
\end{aligned}$$

  Considering the example



- **Weights Choice**
  The vector that satisfies the constraints specified by the chair so far and maximize the PMR is chosen.
  In the previous example the vector $(1, 0, 0)$ is chosen.

Question Types

- **Questions to the voters**
  - Comparison queries that ask a particular agent to compare two alternatives

$$a \succ_j b \quad ?$$

- **Questions to the chair**
  - Queries relating the difference between the importance of consecutive ranks r and $r+1$

$$w_r - w_{r+1} \geq \lambda(w_{r+1} - w_{r+2}) \quad ?$$

Elicitation strategies

A function that, given our partial knowledge so far, returns a question that should be asked.

- **Random**: it decides, with a probability of 1/2, whether to ask a question to the voters or to the chair, then it equiprobably draws a question among the set of the possible ones;
- **Extreme completions**: it asks a question to the chair or to the agents depending on which uncertainty contributes the most to the regret;
- **Pessimistic**: it selects the question that leads to minimal regret in the worst case considering, and aggregating, both possible answers to each question;
- **Two phase**: it asks a predefined, non adaptive sequence of $m-2$ questions to the chair and then it only asks questions about the agents.

References

References

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