# Simultaneous Elicitation of Committee and Voters' Preferences

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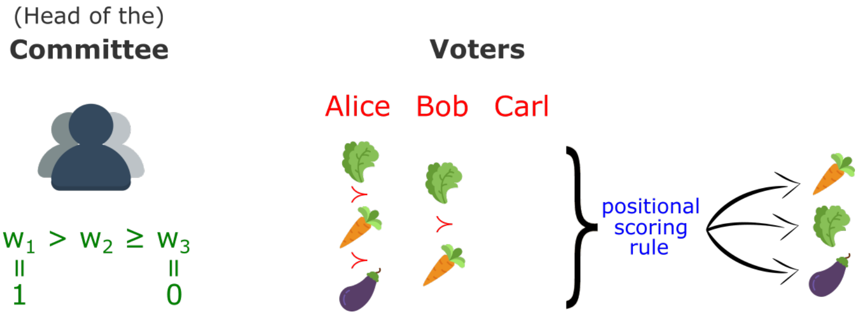
# Scenario

**Setting**: Incompletely specified profile and positional scoring rule




**Goal**: Development of an incremental elicitation protocol based on minimax regret

# Motivation and approach

**Who?**

- Imagine to be an *external observer* helping with the voting procedure

**Why?**

- Voters: difficult or costly to order *all* alternatives
- Committee: difficult to *specify* a voting rule precisely and abstractly

**How?**

- *Minimax regret*: given the current knowledge, the alternatives with the lowest worst-case regret are selected as tied winners

# Related Works

**Incomplete profile**

- and known weights: Minimax regret to produce a robust winner approximation (*Lu and Boutilier 2011*, [2]; *Boutilier et al. 2006*, [1])

**Uncertain weights**

- and complete profile: dominance relations derived to eliminate alternatives always less preferred than others (*Stein et al. 1994*, [3])
- in positional scoring rules (*Viappiani 2018*, [4])

# Framework

$|N| = n, |A| = m$ voters, alternatives

$\succ_j^{p}$ partial preference order of the voter $j \in N$

$\mathcal{C}_W$ set of linear constraints given by the committee about $\boldsymbol{w}$

Given complete voters preferences $\boldsymbol{v}$, a specific positional scoring rule, defined by a scoring vector $\boldsymbol{w}$, attributes a score $s^{\boldsymbol{v},\boldsymbol{w}}$ to each alternative

# Framework

## Assumptions

- Voters and committee have true preferences in mind
- The voting rule is a Positional Scoring Rule where the scoring vector $\boldsymbol{w} = (w_1, \ldots, w_m)$ is a convex sequence of weights and $w_1 = 1$, $w_m = 0$

# Minimax Regret

$\mathrm{PMR}^{\mathbf{p},\mathbf{W}}(\mathbf{x},\mathbf{y})$ is the maximum difference of score between $x$ and $y$ under all possible realizations of the full profile *and* weights

$\mathrm{MR}^{\mathbf{p},\mathbf{W}}(\mathbf{x})$ represents the worst case loss: the *maximal regret* between a chosen alternative x and best real alternative y

**We select the alternative which minimizes the maximal regret**

# Pairwise Max Regret Computation

The computation of $\mathrm{PMR}^{\boldsymbol{p},W}(x,y)$ can be seen as a game in which an adversary can both

- **complete the partial profile**


- **choose a feasible weight vector**

$$\mathbf{(1, 0, 0)}$$

in order to maximize the difference of scores

# Question Types

**Questions to the voters**

Comparison queries that ask a particular voter to compare two alternatives

$$x \succ_j y \quad ?$$

**Questions to the committee**

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

- **Random**: equiprobably draws a question among the set of the possible ones;
- **Extreme completions**: choses the question that reduces the most the uncertainty;
- **Pessimistic**: selects the question that leads to minimal regret in the worst case;
- **Two phase**: it asks a predefined sequence of questions to the committee and then it only asks questions about the voters.

Thank You!

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