The Effectiveness of Surprisingly Popular Voting with Partial Preferences

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Motivation

Address the recovery of ground truth ranking of alternatives by voting.
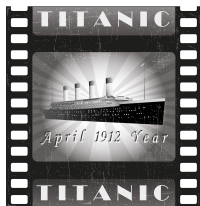
Address the recovery of ground truth ranking of alternatives by voting.

(a) The Avengers   (b) Batman Begins   (c) Titanic   (d) Deadpool

How would you rank the above movies in decreasing order of gross box office lifetime earnings?
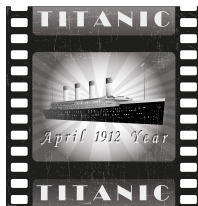
Common Solution

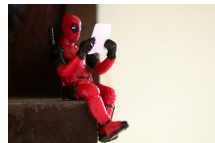(a) The Avengers (b) Batman Begins (c) Titanic (d) Deadpool

How would you rank the above movies in decreasing order of gross box office lifetime earnings?

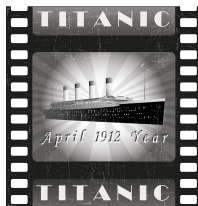**Solution** - Crowdsource votes and aggregate them using a voting rule.

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Wisdom of the crowd - Collective opinion better than the individual expert.
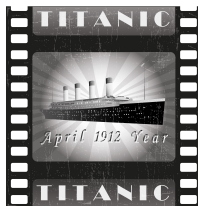
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What if the majority is wrong?

Solution - Surprisingly Popular Voting

Prelec et al. (2017) proposed the Surprisingly Popular algorithm that effectively recovers the ground truth, even when the **experts are in minority.**

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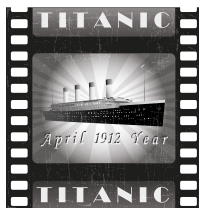
Prelec et al. (2017) proposed the Surprisingly Popular algorithm that effectively recovers the ground truth, even when the **experts are in minority.**
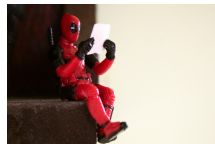

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How would you rank the above movies in decreasing order of gross box office lifetime earnings? Additionally, provide a ranking of these movies based on how they are likely to be ranked by everyone else.

Image Source - Adobe Stock

How to elicit information from voters?

- Elicitation formats are represented as **Vote** - **Prediction**.

- Both Vote and Prediction can be the following:
  - **Top** - Elicit most preferred alternative.
  - **Approval(t)** - Elicit t-most preferred alternatives in no specific order.
  - **Rank** - Elicit ranking on the set of alternatives.

Proposed Methodology

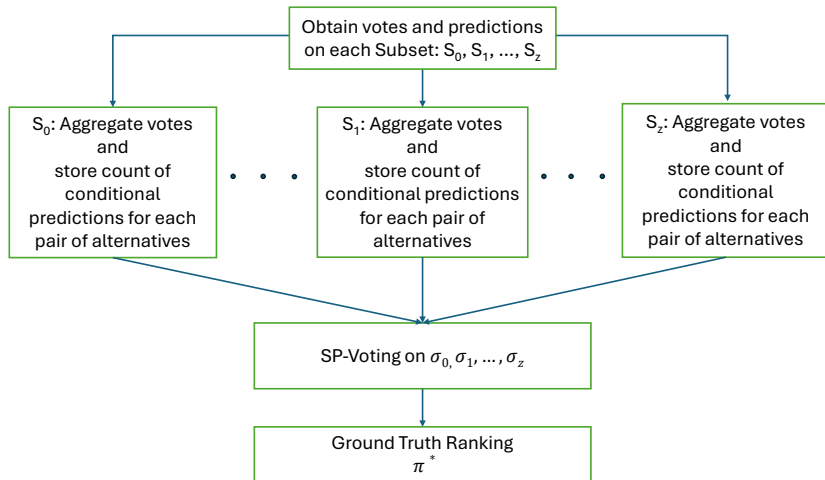- Split the m alternatives into subsets of size k as follows:

$$S_j = \{a_{1+j}, a_{1+j+s}, \ldots, a_{1+j+(k-1)s}\}, \quad j \geq 0, \quad j + (k-1)s < m.$$

Here, s is the distance between a pair of alternatives in $\pi^\star$ and $S_j \in S$, where S represents a set of all possible subsets.

- We propose two scalable variants of the SP algorithm adapted for partial rankings - **Partial-SP** and **Aggregated-SP**
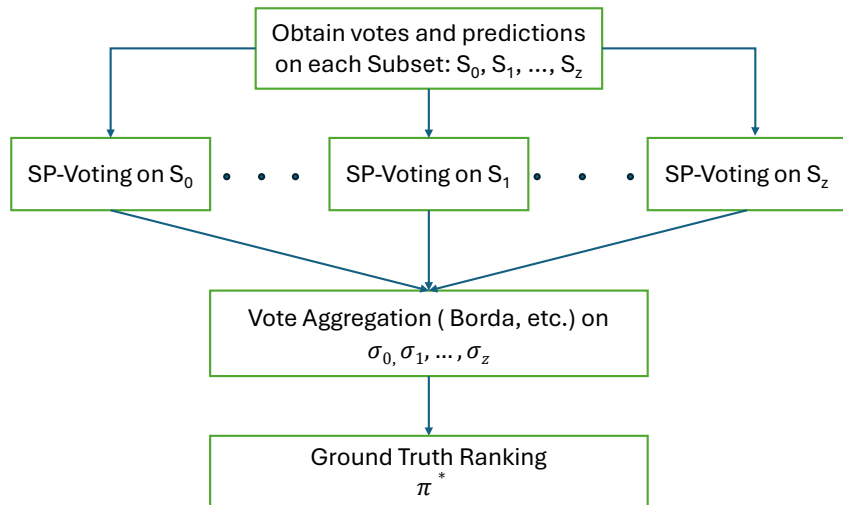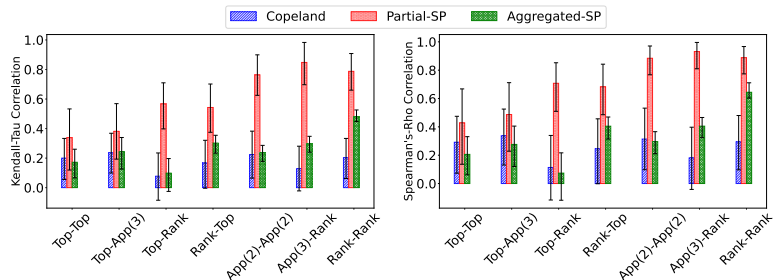
Partial-SP

Partial-SP

Aggregated-SP

Kendall-Tau and Spearman's Rho Correlation (higher is better)

- Increasing information improves ground-truth rank recovery.

- Approvals are as good as Rankings.

Results - Simulation and Theory

- Concentric Mixtures of Mallows can accurately simulate voting.

- Sample complexity increases as a factor of $k!$ for $k << m$.

Future Work

- Explore the setting of SP beyond the majority-minority dichotomy.

- Sample complexity can be explored with other probabilistic models.

Prelec, D., Seung, H. S., and McCoy, J. (2017). A solution to the single-question crowd wisdom problem. *Nature*, 541(7638):532–535.