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A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science

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Voting

Voting methods can be evaluated by measuring their accuracy under random simulated elections aiming to be faithful to the properties of elections in real life.

Voting is the process by which a group of people come together to make a collective decision, usually by choosing from a set of alternatives. Voting plays a central role in democratic decision-making, as it is a fundamental way of aggregating the preferences of individuals into a single collective decision. In this explanation, we'll delve into the different types of voting systems, the properties of voting rules, and the challenges faced in creating fair and efficient voting mechanisms.

1. Types of Voting Systems

There are several methods for conducting a vote, depending on how voters express their preferences and how the winner is determined. The most commonly used voting systems can be categorized into the following types:

1.1 Plurality Voting (First-Past-the-Post)

In this system, each voter selects one candidate, and the candidate with the most votes wins.

- **Example**: If there are three candidates A, B, and C, and voters cast their votes as:
    - 45% vote for A
    - 35% vote for B
    - 20% vote for C
    - Candidate A wins, even though 55% of voters did not vote for A.

Advantages:

- Simple and easy to implement.
- Works well in two-candidate elections.

Disadvantages:

- Susceptible to **vote splitting**, where similar candidates divide their supporters, allowing a less popular candidate to win.
- A winner may not have majority support, which can lead to dissatisfaction.

1.2 Ranked Choice Voting (Instant Runoff Voting, IRV)

In **Ranked Choice Voting (RCV)**, also known as **Instant Runoff Voting (IRV)**, voters rank candidates in order of preference. If no candidate receives more than 50% of first-preference votes, the candidate with the fewest first-preference votes is eliminated, and their votes are transferred to the voters' next choices. This process continues until one candidate has a majority.

Example:

- Three candidates: A, B, and C.

- Voters rank them: 1st, 2nd, 3rd.

- In each round, the candidate with the fewest votes is eliminated, and their votes are redistributed based on voters' preferences, until one candidate has a majority.

Advantages:

- Reduces the spoiler effect, as voters can rank third-party or less popular candidates without fear of wasting their vote.

- More reflective of voter preferences.

Disadvantages:

- More complex to administer and understand.

- Requires multiple rounds of counting.

1.3 Borda Count

In the **Borda Count** method, voters rank all candidates, and points are assigned based on the position in each voter's ranking. The candidate with the most points wins.

Example:

- If there are four candidates, each first-place vote is worth 4 points, second-place votes are worth 3 points, and so on. After all the votes are counted, the candidate with the highest total score wins.

Advantages:

- Encourages consensus, as candidates who are ranked consistently high, even if not first, can win.

Disadvantages:

- Vulnerable to strategic voting, where voters might rank less favored candidates lower to boost their preferred candidate.

- Can sometimes elect a candidate who is not the majority's top choice.

1.4 Condorcet Method

A **Condorcet winner** is a candidate who can beat every other candidate in a head-to-head comparison. A **Condorcet method** finds a ranking by comparing each pair of candidates and selecting the one who wins the most pairwise contests.

Example:

- If there are three candidates (A, B, and C), each pair of candidates is compared. If A beats B, and A beats C, then A is the Condorcet winner.

Advantages:

- Considers voters' preferences more comprehensively by looking at how candidates perform in head-to-head matchups.

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Disadvantages:

- A Condorcet winner does not always exist if there are cycles in preferences (Condorcet paradox).

- Complex to implement and compute.

1.5 Approval Voting

In **Approval Voting**, each voter can vote for (approve of) as many candidates as they wish. The candidate with the most votes wins.

Example:

- If there are four candidates, a voter might choose to approve candidates A and C. The winner is the candidate with the most approvals across all voters.

Advantages:

- Simple and allows voters to support multiple candidates.

- Reduces the risk of vote splitting.

Disadvantages:

- Does not account for the strength of voter preferences (a voter may like one candidate much more than the others, but that is not reflected in the vote).

1.6 Range Voting

In **Range Voting**, voters score each candidate on a scale (e.g., 0-10). The candidate with the highest average score wins.

Advantages:

- Gives a more nuanced representation of voter preferences.

- Allows voters to express varying degrees of support for different candidates.

Disadvantages:

- More complex than simple ranking or plurality systems.

- May be vulnerable to strategic voting, as voters might exaggerate their scores to boost or lower a candidate's chances.

2. Properties of Voting Rules

When designing or evaluating voting systems, several desirable properties should be considered:

2.1 Majority Criterion

- A voting system satisfies the **majority criterion** if it always selects the candidate preferred by a majority of voters (if one exists).

- Plurality voting and IRV satisfy this criterion, while Borda Count does not always guarantee a majority winner.

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2.2 Condorcet Criterion

- A system satisfies the **Condorcet criterion** if it always elects the Condorcet winner (if one exists).

- The Condorcet method satisfies this, but most other systems, like Plurality and IRV, do not.

2.3 Independence of Irrelevant Alternatives (IIA)

- A system satisfies the **IIA** property if the ranking between two candidates is unaffected by the presence or absence of a third candidate.

- Arrow's Impossibility Theorem shows that no voting system for three or more candidates can satisfy IIA and other fairness criteria simultaneously.

2.4 Monotonicity

- A voting system is **monotonic** if increasing support for a candidate (without changing the support for others) should not hurt that candidate's chances of winning.

2.5 Participation

- In a system that satisfies the **participation criterion**, voting should never harm a voter's preferred outcome. In other words, by voting, a voter should not cause an outcome worse than if they had abstained.

3. Challenges in Voting Systems

3.1 Arrow's Impossibility Theorem

Kenneth Arrow proved that no voting system can satisfy all of the following conditions simultaneously when there are three or more alternatives:

1. **Pareto Efficiency**: If every voter prefers one candidate over another, the final ranking should reflect this.

2. **Non-Dictatorship**: No single voter should have the power to determine the outcome regardless of others' preferences.

3. **Independence of Irrelevant Alternatives (IIA)**.

4. **Unrestricted Domain**: The system should be able to handle any set of individual preferences.

5. **Transitivity**: The collective preference should be consistent and logically ordered.

Arrow's Theorem demonstrates the inherent difficulties in designing a perfect voting system, meaning all systems must compromise on one or more desirable properties.

3.2 Strategic Voting

In many voting systems, voters may have an incentive to vote strategically rather than honestly. For example, in a plurality system, a voter might choose to vote for their second-favorite candidate to prevent their least favorite candidate from winning.

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3.3 Spoiler Effect

In systems like Plurality Voting, the presence of a third-party candidate can split votes among similar candidates, potentially leading to the election of a less-preferred candidate (the "spoiler effect"). For example, a candidate who is less popular overall might win because two other candidates split the majority vote.

4. Applications of Voting Systems

Voting systems are applied not only in political elections but also in a wide variety of contexts, including:

- **Corporate governance**: Shareholders vote on key decisions.

- **Online platforms**: Users vote on content, such as product reviews or articles.

- **Group decision-making**: Committees, boards, or juries often use voting to decide policies or actions.

- **Sports rankings**: Voting systems are sometimes used to determine rankings or awards in competitive sports.