Voting: Methods

(Based on Shoham and Leyton-Brown (2008). *Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations*, Cambridge.)
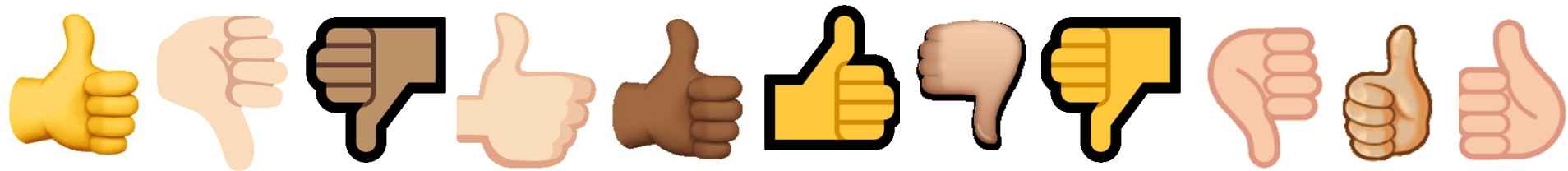
Leen-Kiat Soh

Introduction

- **Nonranking voting**
  - Top pick
  - **Plurality Voting, Cumulative Voting, Approval Voting**

- **Ranking voting**
  - Preference ordering
  - **Plurality with Elimination, Borda Voting, Pairwise Elimination**

👍👎👎👍👍👍👎👎👎👍👍

Nonranking Voting

- The most standard class of voting methods, in which ***each agent votes for one of the candidates***

- **Definition 9.3.1 Plurality Voting.** *Each voter casts a **single** vote. The candidate with the most votes is selected.*
  - In case of a tie, tie-breaking is needed; for example, a run-off election

- **Definition 9.3.2 Cumulative Voting.** *Each voter is given **k** votes, which can be cast arbitrarily (e.g., several votes could be cast for one candidate, with the remainder of the votes being distributed across other candidates). The candidate with the most votes is selected.*

Pseudo-ranking

- **Definition 9.3.3 Approval Voting.** *Each voter can cast a **single** vote for as **many of the candidates** as he or she wishes; the candidate with the most votes is selected.*

Two subsets: Candidates that are acceptable vs. candidates that are not acceptable to me

Ranking Voting

- *Allow voters to express their **full preference orderings***

- **Definition 9.3.4 (Plurality with elimination)** *Each voter casts a single vote for their most-preferred candidate. The candidate with the fewest votes is eliminated. Each voter who cast a vote for the eliminated candidate casts a **new** vote for the candidate he or she most prefers among the candidates that have not been eliminated. This process is repeated until only one candidate remains.*

  - Used for some political elections, e.g., instant runoffs if neither of the top 2 candidates garnered more than 45% of the votes each

	All 538 electoral votes of the Electoral College		
	270 electoral votes needed to win		
Turnout	55.2%[1] ▲ 5.0 pp		
Nominee	**Bill Clinton**	George H. W. Bush	Ross Perot
Party	Democratic	Republican	Independent
Home state	Arkansas	Texas	Texas
Running mate	**Al Gore**	Dan Quayle	James Stockdale
Electoral vote	370	168	0
States carried	**32 + D.C.**	18	0
Popular vote	44,909,806	39,104,550	19,743,821
Percentage	**43.01%**	37.45%	18.91%

Ranking Voting 2

- **Definition 9.3.5 Borda Voting.** *Each voter submits a **full** ordering on the candidates. This ordering contributes points to each candidate; if there are n candidates, it contributes $n-1$ points to the highest ranked candidate, $n-2$ points to the second highest, and so on; it contributes no points to the lowest ranked candidate. **The winners are those whose total sum of points from all the voters is maximal**.*

Potential problem with this?
- If there are many candidates, the "distance" between each successive pair of candidates might not be captured properly, creating inaccurate "points"
- Not every voter has a full ordering of all candidates, especially where there are many

Ranking Voting 4

- *Nanson's method* is a variant of Borda Voting that
  - **(1) eliminates the candidate with the lowest Borda score,**
  - **(2) recomputes the remaining candidates' scores, and**
  - **(3) repeats.**
- This method has the property that it **always chooses a member of the Condorcet set if it is nonempty**, and **otherwise chooses a member of the Smith set**

Ranking Voting 5

- **Definition 9.3.6 Pairwise Elimination.** *In advance, voters are given a schedule for the order in which pairs of candidates will be compared. Given two candidates (and based on each voter's preference ordering) determine the candidate that each voter prefers. **The candidate who is preferred by a minority of voters is eliminated**, and **the next pair of non-eliminated candidates in the schedule is considered**. Continue until only one candidate remains.*

  - Because a schedule is *revealing,* that could cause voters to change their votes for a current round in anticipation of the subsequent rounds

Might be still good for social choice, but not as good for social welfare. **Why?**

Connection to MAS?

When designing a MAS, think about what you want and the rationales behind that: social choice or social welfare?

Think about how much agents would want to reveal. What's the privacy concern? Top pick or full ordering?