CSCE 475/875 Multiagent Systems
Handout 14: Voting Methods
February 20, 2020
(Based on Shoham and Leyton-Brown 2011)

Nonranking Voting

The most standard class of voting methods is called ***nonranking*** *voting*, 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.*

(***Note***: 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.*

> **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.*

Ranking Voting

Although it is more expressive than plurality, approval voting still *fails to allow voters to express their **full** preference orderings.*

Voting methods that do so are called ***ranking voting*** methods.

Among them, one of the best known is *plurality with elimination*; for example, this method is used for some political elections. (***Note***: When preference orderings are elicited from agents before any elimination has occurred, the method is also known as *instant runoff*.)

> **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.*

Another method which has been widely studied is *Borda voting*.

> **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.*

Nanson's method is a variant of Borda 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.

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 noneliminated candidates in the schedule is considered. Continue until only one candidate remains.*

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