A voting system for California or anywhere

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This document outlines the voting system that I think is most desirable. I am not aware of any place or organization that uses it or advocates its use.

Contents

Guiding Principles

My goal is to design a voting system that reflects these principles as closely as possible. I would support any system in keeping with these principles, and I welcome any suggestions for modifications to this system that would better reflect these principles.

- People vote; people and their will are represented.
- Every voter should have a vote of equal weight and importance.
- No vote should be wasted; every vote cast should amplify the representation of the entity it is cast for.
    - The previous points taken together could be restated: Every vote cast should amplify the representation of the entity it is cast for *by an equal amount*; the fraction of votes cast for an entity should match the fraction of representation the entity receives.
- Voters should not be expected to devote much time or attention to studying their options. Candidates and officeholders should be expected to devote significant time and attention to studying policy and electoral matters.
- Tactical voting, i.e. casting a vote not in accordance with one's true preference, should be disincentivized.
- Cooperation, friendliness, and compromise should be incentivized.
- Polarization and demonization should be disincentivized.
- Officeholders should be incentivized to do what's best for the people as a whole.

Summary

Here is the crux of the system. The rest of this doc merely specifies details.

- There's a single-seat executive and a multi-seat legislature. All the seats in the legislature are at-large (i.e. not districted).
- The gist is that it's ranked choice voting, but instead of voters ranking candidates, the candidates for an office all rank each other before voting begins, and each voter just votes for one candidate (and that candidate's ranking list).
- *Excess votes* for a candidate—either the votes beyond the minimum required to win a seat, or all the votes for a candidate who didn't win a seat—cascade to the next viable candidate on that candidate's list.

Constitutional Setup

- Elected branches of government.
    - There is an executive and a legislature.
- The executive.
    - The executive comprises the governor and possibly more single-seat offices such as lieutenant governor.
- The legislature.

    - The legislature is unicameral because I don't see a point in having multiple chambers that do the same thing, though this system works for multiple chambers as well.
    - The legislature has about 50 members. For context, currently the California Assembly has 80 members and the California Senate has 40.
    - Members of the legislature don't represent districts; every member represents the people of the state as a whole.
    - The legislature doesn't elect any formal leader (such as speaker or majority leader).
- Passage of bills into law.
    - A bill passed by a simple majority vote of the legislature and signed by the governor becomes law.
    - A bill passed by some supermajority (¾ seems good) of the legislature becomes law regardless of whether the governor signs it.
    - Any bill presented to the legislature's clerk with the signatures of some significant minority (⅕ seems good) of the legislators must be scheduled for a prompt vote before the full legislature. If a bill is defeated, it is not eligible to be scheduled for a second vote unless it has either undergone substantive changes or received the signatures of a simple majority of the legislators.
    - Laws cannot be passed by voter initiative or ballot proposition.
- Elections.
    - All the seats in the legislature are up for election at the same time. This is necessary to facilitate proportional representation: The more seats there are, the more closely proportions of votes can match proportions of seats.
    - I don't feel strongly about whether legislative and executive elections should coincide or be staggered. One advantage of being held together is that voter turnout is generally higher. One advantage of staggering is that there is some continuity of government from one term to the next.
    - I don't feel strongly about term lengths. Terms of anywhere from two to five years seem fine. Executive terms don't necessarily have to be the same length as legislative terms.
    - Terms should probably begin as soon as vote counts are finalized.
    - There are no primary elections.
- Amendments to the constitution.
    - Amendments require the approval of both the governor and a supermajority (maybe ⅔ or ¾) of the legislature.
    - The constitution cannot be amended by voter initiative or ballot proposition.
- Elected officials' pay.
    - All elected officials and candidates for office should be paid a salary competitive with the highest paid professional positions in the private sector.
- Continuity with the previous constitution.
    - All provisions of the constitution that this replaces not in conflict with this constitution shall assume the status of statute, subject to the regular legislative procedures herein defined.

Elections Timeline

Here is a sample overview of the timeline of the election process.

Approximate dates	**Events**
January, February, and March	Prospective candidates collect and submit signatures to appear on the ballot.
April	Signatures are verified.
May, June, and July	Candidates who have successfully reached the ballot meet and discuss to familiarize themselves with the positions, character, experience, and demeanor of all the other candidates; negotiate deals; and submit a ranking of all the other candidates.
August and September	Campaigning. Voters receive booklets containing the name of each candidate, a statement from the candidate, and the candidate's complete rankings.
October and early November	Campaigning and voting.

Becoming a Candidate

The ideal number of candidates per race

In this section I conclude that there should be about 50 candidates for the governorship and about 300 candidates for the 50 seats in the legislature.

Voters should have a significant amount of choice. Political space can be modeled along many independent axes, for example economic (socialist-capitalist), cultural (liberal-conservative), religious (secular-theocratic), personality of leadership (reserved-bombastic). Voters should be able to find a candidate who is close to them on a wide range of these dimensions. They will not need to fear that a vote for a candidate with no chance of winning is wasted; if a candidate is eliminated, votes for that candidate become votes for the next viable candidate on the eliminated candidate's list. Up to some reasonable limit, the more candidates a voter has to choose from, the better.

What is that limit? How many candidates can a voter be expected to research? In fact I do not expect voters to research any candidates. Rather, voters would just need to know where to look for endorsements. As they really already do, voters would turn to a trusted expert, community leader, interest group, or political organization for a recommendation of how to vote. By shifting

the burden of research away from the voter, we can actually provide the voter with much more choice.

Then what is the upper limit on the number of candidates? Since each candidate must rank all the other candidates, the limiting factor on the number of candidates that can run for any position is the attention and memory of the candidates themselves. What's the highest number of other candidates that a candidate can become familiar with and form an informed ranking of? Given that the candidates have a three-month period during which meeting the other candidates is their top priority, and given that even the candidates themselves will be relying on outside organizations to provide supplemental research, I think we can expect the candidates to become familiar with about 300 candidates per race. It's possible for some key single-seat races such as the governorship that extra scrutiny is warranted. For those races, the limit may be closer to 50 candidates.

For a 50-seat legislature, having 300 candidates means there would be six candidates per seat. This seems about right. It's conceivable that the electorate can be divided into about six different camps along the dimensions I mentioned above, and each camp would want to put a full slate of 50 candidates on the ballot, one per seat.

Getting on the ballot

State elections officials would determine the ballot qualifications with the target that about 300 candidates would qualify for the legislative race and about 50 candidates would qualify for the race for the governorship. Presumably the main hurdle for prospective candidates to overcome would be the collection of signatures. I leave it to the experts to tune the number of signatures required from election to election to ensure that the number of candidates comes approximately to the targets.

Parties and other interest groups would use their resources to assemble slates of candidates and gather signatures on their behalf to get them on the ballot. It would be possible but difficult for an individual to gather enough signatures on their own without the support of any outside groups.

Casting Votes

Voters vote for a single candidate per race. That is to say, one candidate for the legislature and one candidate for each single-seat race.

Parties, interest groups, community leaders, and prominent politicians would endorse candidates (surely taking into account the candidates' ranking lists). It's not expected that a voter would be familiar with all the candidates in a race. Rather, they'll probably only know the most prominent handful of candidates, plus maybe a few less prominent candidates who are vocal about niche issues that the voter cares about. A voter would just need to know where to

look for endorsements. Like with a parliamentary system, voters would essentially be picking the list they liked most.

Counting the Votes

The precise definition is that votes would be counted according to the weighted inclusive Gregory method, treating all the votes for a candidate as though they were ranked lists with the same rankings that the candidate themself submitted, and with the one modification that the eliminated candidates in each round are not those with the fewest first-choice (FFC) votes, but those with the most last-choice (MLC) votes.

This section explains what that means. It's easiest to explain the mechanics beginning with the single-seat case, though technically the single-seat case could be treated as a multi-seat case with just one seat.

Single-seat case

These two steps are repeated in a loop until there is a winner.

1. If any one candidate has a majority of the votes, stop. That candidate is the winner.
2. If no one candidate has a majority of the votes, then eliminate the candidate (or, in the event of a tie, candidates) with the most last-choice votes, and transfer any eliminated candidate's votes to the next not-yet-eliminated candidate on the lists that the votes originally came from.

For a detailed example, see Appendix A: Single-Seat Example.

Selecting candidates for elimination

Most typical ranked-choice voting systems eliminate the candidate with the fewest first-choice votes (FFC), but I have chosen to eliminate the candidate with the most last-choice votes (MLC) because I believe it leads to more suitable compromise outcomes.

By what mechanism does it produce better compromises? Consider a polarized electorate where there are more voters at the ideological extremes than at the ideological center. The best compromise candidate, one who might not be anybody's first choice but who is generally acceptable to most voters, is likely to be from the center. The voting system should yield outcomes where such compromise candidates are likely to prevail. If we use the typical FFC criterion, then these centrist candidates will be the first eliminated because very few voters consider them a first choice. By the later rounds, only extreme candidates will remain. In contrast, using the MLC criterion, the most disliked candidates will be eliminated first, and the centrist choices will survive to the final rounds.

For a detailed example, see Appendix B: Illustration of Elimination Criterion.

Multi-seat case

The single-seat case is similar to the multi-seat case, but with the additional mechanism that if a candidate receives more votes than is required to win a seat, their extra votes cascade down to the next candidates on their list. The Gregory method is a formalization of how exactly to calculate the surplus and of how exactly it cascades, and specifically I would use the weighted inclusive variant of it.

For a detailed example, see Appendix C: Multi-Seat Example.

How this system actualizes the guiding principles

The people and their will are accurately represented.

The will of the people

The weighted inclusive Gregory method produces a fairest mapping from a fractional share of the vote to a discrete number of seats. Put another way, if one candidate's list gets a certain percentage of the vote, it will have as close as possible to that percentage of seats in the legislature. For the single-seat case, thanks in part to the MLC elimination criterion, the ultimate winner will be a candidate at the people's ideological center of mass.

Niche interests

Among the people are many niche interests, and those interests should be reflected in the government. This system makes that possible. With 50 seats in the legislature, each seat represents two percent of the people. If two percent of the voters statewide are very passionate about some niche issue, they will have enough votes to elect a representative to the legislature. In contrast, those voters would never receive their fair representation under a first-past-the-post district-based system because they would not constitute a plurality of any one district. This is in fact an argument to increase the number of seats in the legislature so that ever smaller niche interests could be represented, but at some point the collegiality of the legislature becomes a more compelling interest.

Small-name candidates

I'm not necessarily trying to promote small-name candidates; I don't see why boosting them would be an inherent democratic virtue that we should be striving for. That said, if a small-name candidate is the best representation of the will of the people, then that candidate should win, and I do think this system would increase the likelihood that a not-well-known moderate emerges as a compromise winner after several rounds of elimination if they accumulate votes from eliminated candidates and avoid being targeted as a last choice.

Deviation from the party line

One benefit of this system over both the party-primary system and the party-list system is that there's less penalty for a candidate to deviate from the party line. (Think for example of an anti-abortion Democrat or a pro-same-sex-marriage Republican.) In a party-list system, if a backbencher votes against the party line, they'll likely not be put on the list again in the following election. In the party-primary system, a politician who votes against the party line risks a primary challenge with financial backing from the party establishment. In either case, their political career may effectively be over. In this system, as long as they can generate enough attention in their deviation to pull some voters with them, they'll still be reelected. The reality is that many people hold opinions that go against party orthodoxy, so improving their ability to be accurately represented in government is a good thing.

No vote is wasted.

A voter can always increase the representation that a candidate's list gets by casting a vote for that candidate.

Even in the case of a single-seat race, a vote cast for a candidate at one ideological extreme will tug the final result in that direction. While that candidate will probably not win the seat, the candidate who does win will be slightly closer to that extreme.

Cooperation is incentivized.

This system would encourage collaboration and cooperative discourse. Before rankings are finalized (or in anticipation of the following election cycle), each candidate would have an incentive to stay in the other candidates' good graces, hoping to be ranked highly by the other candidates. After rankings are finalized, candidates would know that they could stand to benefit from votes for candidates who ranked them highly, and would have incentive to campaign on each other's behalf, highlighting their similarities rather than their differences.

One common phenomenon is that parties not in power obstruct policies they sincerely support to prevent rivals from getting credit for their success. In presidential democracies, this is apparent when the executive and the legislature are controlled by different parties. In parliamentary democracies, one manifestation of this phenomenon is that one party may choose not to support an ideologically similar party in a coalition, calculating that it's more politically advantageous to play the role of the opposition than it is to play the role of the junior coalition member. I believe that this system is resilient to this phenomenon.

Partisan polarization is disincentivized.

Each candidate must rank every other candidate, even those from opposing extremes. It's therefore not possible to reject everyone from the other side because even a fierce partisan must publicly list out whom on the other side they think they have the most in common with.

It's possible that moderates on one side would even rank moderates from other sides before extremists on their own side. Whether they do or not, it would be informative to the voters either way. If they do, a centripetal spectrum would emerge rather than a multimodal polarization.

There is minimal opportunity for tactical voting.

The main opportunity I can think of for tactical voting is that a voter would vote for a candidate with more extreme positions than the voter's own in an effort to effect an ultimate compromise outcome that lands at the voter's true position. This effect could lead to an equilibrium where the only options are at the extremes, but I think the mechanisms outlined above that decrease polarization are enough to counteract this effect. I don't think this concern is remotely grave enough to outweigh the benefits of this system.

There is also an opportunity for tactical *ranking*, where a candidate would rank an ideologically close rival last in an effort to get them eliminated. Fortunately the rankings are public and voters would hopefully punish such behavior.

A discussion of district-based systems

In this section I offer some ideas about district-based systems.

Legislative districts are anti-democratic.

District-based systems are inherently anti-democratic. *The* core principle of democracy is that each *person* gets one vote, not weighted by money, land, or anything else. So the most democratic thing to do is to simply count the people. Land does not vote; land is not represented. Any subgrouping of people into districts is a deviation from this principle.

The evils of gerrymandering are well known. Gerrymandering is the drawing of legislative districts to maximize the number of an opponent's votes that are wasted. (Recall that the system described in this document *minimizes* the number of wasted votes.) The fact that how districts are drawn can result in hugely different electoral outcomes could be taken as proof that there is no such thing as the democratic will of the people, that it is purely an artifact of how it is measured. But this isn't the case. We quantify how severely a state is gerrymandered by how much the party makeup of its legislature differs from that of its electorate as a whole. We regard the makeup of the electorate as a whole as the baseline from which gerrymandering deviates because we know that it's the essence of the democratic will of the people. So why not have a system that just reflects it directly?

I want to specifically address objections to this system that take the form, "Without districts to ensure that rural areas are represented, rural interests will be dominated by urban interests!" This is essentially saying, "I want a system that arbitrarily amplifies the power of my favored

minority at the expense of the core democratic principle that all people should have an equal say." It's fine to object to the guiding principles I laid out at the beginning of this document; I have accepted them axiomatically. But anyone who wishes to depart from them should admit that their grievance is with democracy itself. If rural interests constitute some minority fraction of the population, then rural interests should occupy that same minority fraction of the seats in the legislature. That is their democratic share. Furthermore, if urban interests constitute a majority of the population, then urban interests *should* get their way as long as the rights of the minority are protected.

Why should geography be the factor by which people are divided and grouped?

More broadly, I object to the idea that people can be neatly divided into interest groups by geographically contiguous districts. If we're going to have dedicated representatives for segments of the population, why not have representatives for groupings by age? Or by income or wealth levels? Or alphabetically by last name? Or by job categories? Surely some of these groupings form more homogeneous interest groups than a geographic grouping would.

These other groupings also provide for interesting thought experiments. What if districts really were divided by income level? It would definitely reduce the number of rich people in the legislature and help make the legislature more responsive to the needs of the poor and middle class. What about by job category? What are the implications of always having plumbers represented in the legislature? From this lens, a district is a quota as a floor. But a district is also a quota as a ceiling. Is it fair that there can't ever be more than one plumber in the legislature at a time? Parallel question for geographic districts: Is it fair that there can't ever be more than one San Franciscan in the legislature at a time?

It's weird to me that geographical districts are so popular worldwide while the other groupings I proposed are not. Actually, when viewed as quotas, they are not uncommon. Many countries have quotas for the representation of ethnic minorities, disadvantaged castes, and women.

Token representation is not the same as political power.

As much as having guaranteed representation can provide protection, it can also reduce a minority's political power. For example, there are some districts in the U.S. that are drawn intentionally, in an act of benevolent gerrymandering, to be majority minority, to ensure that there will be a minority representative in the legislature. But the flip side of this coin is that the minority is now concentrated in that district, and has little power to sway outcomes in any other districts. And what protection can a minority realistically expect from a single representative who can easily be ignored?

District-based systems yield societally suboptimal outcomes.

A voting system should lead to the outcomes that are best for the entire society, and the way to do that is to align the incentives of the representatives with the welfare of the society as a whole. If a representative is only accountable to a segment of the population, then they are incentivized to only care about the interests of that segment at the expense of the population as a whole. For geographic districts, this yields nimbyism. For job-category districts, perhaps the equivalent would be excessive credentialing.

Appendices

Appendix A: Single-Seat Example

Initial vote			
Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	30%	1. Sanders (self) 2. Warren 3. Yang 4. Harris 5. Biden 6. Buttigieg 7. Klobuchar	15% 15% from Buttigieg
Warren	15%	1. Warren (self) 2. Sanders 3. Harris 4. Biden 5. Yang 6. Buttigieg 7. Klobuchar	5% 5% from Klobuchar
Biden	15%	1. Biden (self) 2. Harris 3. Klobuchar 4. Warren 5. Buttigieg 6. Sanders 7. Yang	0%
Buttigieg	15%	1. Buttigieg (self) 2. Klobuchar 3. Biden 4. Harris 5. Yang 6. Warren 7. Sanders	0%
Yang	10%	1. Yang (self) 2. Sanders 3. Warren 4. Buttigieg 5. Biden 6. Klobuchar 7. Harris	25% 15% from Biden 10% from Harris
Harris	10%	1. Harris (self) 2. Biden 3. Buttigieg 4. Klobuchar	10% 10% from Yang

		5. Warren 6. Sanders 7. Yang	
Klobuchar	5%	1. Klobuchar (self) 2. Biden 3. Buttigieg 4. Harris 5. Yang 6. Sanders 7. Warren	45% 30% from Sanders 15% from Warren

After one round			
Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	30%	1. Sanders (self) 2. Warren 3. Yang 4. Harris 5. Biden 6. Buttigieg ~~7. Klobuchar~~	15% 15% from Buttigieg
Warren	15%	1. Warren (self) 2. Sanders 3. Harris 4. Biden 5. Yang 6. Buttigieg ~~7. Klobuchar~~	5% 5% from Klobuchar
Biden	20% 15% from self 5% from Klobuchar	1. Biden (self) 2. Harris ~~3. Klobuchar~~ 4. Warren 5. Buttigieg 6. Sanders 7. Yang	0%
Buttigieg	15%	1. Buttigieg (self) ~~2. Klobuchar~~ 3. Biden 4. Harris 5. Yang 6. Warren 7. Sanders	45% 30% from Sanders 15% from Warren
Yang	10%	1. Yang (self) 2. Sanders 3. Warren 4. Buttigieg 5. Biden ~~6. Klobuchar~~ 7. Harris	25% 15% from Biden 10% from Harris
Harris	10%	1. Harris (self) 2. Biden 3. Buttigieg ~~4. Klobuchar~~ 5. Warren 6. Sanders 7. Yang	10% 10% from Yang
Klobuchar	0% originally 5%	1. ~~Klobuchar~~ (self) 2. Biden 3. Buttigieg 4. Harris 5. Yang 6. Sanders	

		7. Warren	

After two rounds			
Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	30%	1. Sanders (self) 2. Warren 3. Yang 4. Harris 5. Biden ~~6. Buttigieg~~ ~~7. Klobuchar~~	15% 15% from Buttigieg
Warren	15%	1. Warren (self) 2. Sanders 3. Harris 4. Biden 5. Yang ~~6. Buttigieg~~ ~~7. Klobuchar~~	5% 5% from Klobuchar
Biden	35% 15% from self 5% from Klobuchar 15% from Buttigieg	1. Biden (self) 2. Harris ~~3. Klobuchar~~ 4. Warren ~~5. Buttigieg~~ 6. Sanders 7. Yang	30% 30% from Sanders
Buttigieg	0% originally 15%	~~1. Buttigieg (self)~~ ~~2. Klobuchar~~ 3. Biden 4. Harris 5. Yang 6. Warren 7. Sanders	
Yang	10%	1. Yang (self) 2. Sanders 3. Warren ~~4. Buttigieg~~ 5. Biden ~~6. Klobuchar~~ 7. Harris	40% 15% from Biden 10% from Harris 15% from Warren
Harris	10%	1. Harris (self) 2. Biden ~~3. Buttigieg~~ ~~4. Klobuchar~~ 5. Warren 6. Sanders 7. Yang	10% 10% from Yang
Klobuchar	0% originally 5%	~~1. Klobuchar (self)~~ 2. Biden ~~3. Buttigieg~~ 4. Harris 5. Yang 6. Sanders 7. Warren	

After three rounds

Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	40% 30% from self 10% from Yang	1. Sanders (self) 2. Warren ~~3. Yang~~ 4. Harris 5. Biden ~~6. Buttigieg~~ ~~7. Klobuchar~~	40% 15% from Biden 15% from Buttigieg 10% from Harris
Warren	15%	1. Warren (self) 2. Sanders 3. Harris 4. Biden ~~5. Yang~~ ~~6. Buttigieg~~ ~~7. Klobuchar~~	5% 5% from Klobuchar
Biden	35% 15% from self 5% from Klobuchar 15% from Buttigieg	1. Biden (self) 2. Harris ~~3. Klobuchar~~ 4. Warren ~~5. Buttigieg~~ 6. Sanders ~~7. Yang~~	45% 30% from Sanders 15% from Warren
Buttigieg	0% originally 15%	~~1. Buttigieg (self)~~ ~~2. Klobuchar~~ 3. Biden 4. Harris ~~5. Yang~~ 6. Warren 7. Sanders	
Yang	0% originally 10%	~~1. Yang (self)~~ 2. Sanders 3. Warren ~~4. Buttigieg~~ 5. Biden ~~6. Klobuchar~~ 7. Harris	
Harris	10%	1. Harris (self) 2. Biden ~~3. Buttigieg~~ ~~4. Klobuchar~~ 5. Warren 6. Sanders ~~7. Yang~~	10% 10% from Yang
Klobuchar	0% originally 5%	~~1. Klobuchar (self)~~ 2. Biden ~~3. Buttigieg~~ 4. Harris ~~5. Yang~~ 6. Sanders 7. Warren	

After four rounds			
Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	40% 30% from self 10% from Yang	1. Sanders (self) 2. Warren ~~3. Yang~~ 4. Harris ~~5. Biden~~ ~~6. Buttigieg~~ ~~7. Klobuchar~~	40% 15% from Biden 15% from Buttigieg 10% from Harris

Warren	15%	1. Warren (self) 2. Sanders 3. Harris ~~4. Biden~~ ~~5. Yang~~ ~~6. Buttigieg~~ ~~7. Klobuchar~~	5% 5% from Klobuchar
Biden	0% originally 15%	~~1. Biden (self)~~ 2. Harris ~~3. Klobuchar~~ 4. Warren ~~5. Buttigieg~~ 6. Sanders ~~7. Yang~~	
Buttigieg	0% originally 15%	~~1. Buttigieg (self)~~ ~~2. Klobuchar~~ ~~3. Biden~~ 4. Harris ~~5. Yang~~ 6. Warren 7. Sanders	
Yang	0% originally 10%	~~1. Yang (self)~~ 2. Sanders 3. Warren ~~4. Buttigieg~~ ~~5. Biden~~ ~~6. Klobuchar~~ 7. Harris	
Harris	45% 10% from self 15% from Biden 15% from Buttigieg 5% from Harris	1. Harris (self) ~~2. Biden~~ ~~3. Buttigieg~~ ~~4. Klobuchar~~ 5. Warren 6. Sanders ~~7. Yang~~	55% 30% from Sanders 15% from Warren 10% from Yang
Klobuchar	0% originally 5%	~~1. Klobuchar (self)~~ ~~2. Biden~~ ~~3. Buttigieg~~ 4. Harris ~~5. Yang~~ 6. Sanders 7. Warren	

After five rounds			
Candidate	Percent of vote	Ranking	Last-choice votes
Sanders	45% 30% from self 10% from Yang 5% from Klobuchar	1. Sanders (self) 2. Warren ~~3. Yang~~ ~~4. Harris~~ ~~5. Biden~~ ~~6. Buttigieg~~ ~~7. Klobuchar~~	55% 15% from Biden 10% from Harris 15% from Warren 15% from Buttigieg
Warren	55% 15% from self 15% from Biden 15% from Buttigieg 10% from Harris	1. Warren (self) 2. Sanders ~~3. Harris~~ ~~4. Biden~~ ~~5. Yang~~ ~~6. Buttigieg~~ ~~7. Klobuchar~~	45% 5% from Klobuchar 30% from Sanders 10% from Yang
Biden	0%	~~1. Biden (self)~~ ~~2. Harris~~	

	originally 15%	~~3. Klobuchar~~ 4. Warren ~~5. Buttigieg~~ 6. Sanders ~~7. Yang~~	
Buttigieg	0% originally 15%	~~1. Buttigieg (self)~~ ~~2. Klobuchar~~ ~~3. Biden~~ ~~4. Harris~~ ~~5. Yang~~ 6. Sanders 7. Warren	
Yang	0% originally 10%	~~1. Yang (self)~~ 2. Sanders 3. Warren ~~4. Buttigieg~~ ~~5. Biden~~ ~~6. Klobuchar~~ ~~7. Harris~~	
Harris	0% originally 10%	~~1. Harris (self)~~ ~~2. Biden~~ ~~3. Buttigieg~~ ~~4. Klobuchar~~ 5. Warren 6. Sanders ~~7. Yang~~	
Klobuchar	0% originally 5%	~~1. Klobuchar (self)~~ ~~2. Biden~~ ~~3. Buttigieg~~ ~~4. Harris~~ ~~5. Yang~~ 6. Sanders 7. Warren	

Appendix B: Illustration of Elimination Criterion

Consider this example. Here, four candidates are running in a quite polarized electorate, and each ranks the others sensibly in order of ideological proximity to themself. (Whether the moderates rank towards the center before ranking to their extreme is immaterial; the outcome in this example is the same either way.)

Candidate	Percent of vote	Ranking
Bernie Sanders (extreme left)	41%	1. Sanders (self) 2. Biden 3. Romney 4. Cruz
Joe Biden (moderate left)	11%	1. Biden (self) 2. Sanders or Romney 3. Romney or Sanders 4. Cruz
Mitt Romney (moderate right)	9%	1. Romney (self) 2. Biden or Cruz 3. Cruz or Biden 4. Sanders
Ted Cruz (extreme right)	39%	1. Cruz (self)

		2. Romney 3. Biden 4. Sanders

Clearly a majority of votes went to leftist candidates, so one of the two leftist candidates should be the winner. In the spirit of compromise, we should want the moderate leftist to win because a significant portion of votes were for rightist candidates.

If our elimination criterion is who received the fewest first-choice votes, then the two moderate candidates will be the first to be eliminated, leaving only the extremist candidates standing to win the seat in the final rounds. Alternatively, if our elimination criterion is who received the most last-choice votes, the extremist candidates will be eliminated first, leaving the moderates to win in the end. In keeping with the principle that compromise should be incentivized, I prefer this approach.

After one round				
Eliminating fewest first-choice votes			Eliminating most last-choice votes	
Candidate	Percent of vote		Candidate	Percent of vote
Bernie Sanders (extreme left)	41%		Bernie Sanders (extreme left)	41%
Joe Biden (moderate left)	11% or 20%		Joe Biden (moderate left)	11%
			Mitt Romney (moderate right)	48%
Ted Cruz (extreme right)	48% or 39%			

After two rounds				
Eliminating fewest first-choice votes			Eliminating most last-choice votes	
Candidate	Percent of vote		Candidate	Percent of vote
Bernie Sanders (extreme left)	52%			
			Joe Biden (moderate left)	52%
			Mitt Romney (moderate right)	48%
Ted Cruz (extreme right)	48%			

Appendix C: Multi-Seat Example

In this example, there are twelve candidates for four seats. Let's say the candidates have organized themselves into four camps: Democratic Socialists (DS), Moderate Democrats (MD),

and Republicans (R). Each camp has four candidates on the ballot. Most voters are familiar with the camp leaders, but fewer voters know the smaller-name candidates.

The candidates might have the following rankings:

Candidate	Ranking		Candidate	Ranking		Candidate	Ranking
DS1	DS1 DS2 DS3 DS4 MD2 MD3 MD1 MD4 R4 R3 R2 R1		MD1	MD1 MD2 MD3 MD4 DS2 DS1 R4 DS3 DS4 R3 R2 R1		R1	R1 R2 R3 R4 MD4 MD1 MD3 DS3 MD2 DS4 DS2 DS1
DS2	DS2 DS1 DS3 DS4 MD2 MD3 MD1 MD4 R4 R3 R2 R1		MD2	MD2 MD1 MD3 MD4 DS2 DS1 R4 DS3 DS4 R3 R2 R1		R2	R2 R1 R3 R4 MD4 MD1 MD3 DS3 MD2 DS4 DS2 DS1
DS3	DS3 DS1 DS2 DS4 MD2 MD3 MD1 R4 MD4 R3 R2 R1		MD3	MD3 MD1 MD2 MD4 DS2 DS1 R4 DS3 DS4 R3 R2 R1		R3	R3 R1 R2 R4 MD4 MD1 MD3 DS3 MD2 DS4 DS2 DS1
DS4	DS4 DS1 DS2 DS3 MD2 MD3 MD1 MD4 R4 R3 R2 R1		MD4	MD4 MD1 MD2 MD3 DS2 DS1 R4 DS3 DS4 R3 R2 R1		R4	R4 R1 R2 R3 MD4 MD1 MD3 DS3 MD2 DS4 DS2 DS1

Say they win the following vote shares:
DS1: 18%
DS2: 4%
DS3: 2%

DS4: 1%
MD1: 31%
MD2: 8%
MD3: 4%
MD4: 2%
R1: 23%
R2: 4%
R3: 2%
R4: 1%

The first step is to calculate what fraction of the vote is enough to win a seat. Call this the quota. For an N-seat body, the quota is the fraction of the vote that N candidates could win but N+1 candidates could not. For a four-seat body, the quota is 20% + 1 votes. Four candidates can receive 20% + 1 votes, but five candidates cannot. (If five candidates each won 20% + 1 votes, there would be 100% + 5 votes, which isn't possible.)

Until all the seats are filled:

a. Award a seat to any candidate who has met the quota.
b. Reallocate surplus votes (any votes beyond the quota) from the candidates who met the quota in step (a).
c. If no candidate reached the quota this round, remove the candidate with the most last-choice votes who hasn't already reached the quota.
d. Reallocate the votes from the candidate removed in step (c).

The ultimate result is that DS1, MD1, MD2, and R1 win the seats. Below is a walkthrough of every step.

Round 1a:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	
MD1	31%	
MD2	8%	
MD3	4%	
MD4	2%	
R1	23%	70% (18% from DS1, 4% from DS2, 2% from DS3, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
R2	4%	

R3	2%	
R4	1%	

Round 1b:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	
R1	20%	
R2	7%, 4% + 3% from R1	70% (18% from DS1, 4% from DS2, 2% from DS3, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
R3	2%	
R4	1%	

Round 1c: Would only occur if no candidate reached the quota this round.

Round 1d: Would only occur if no candidate reached the quota this round.

Round 2a: No candidate reached the quota this round.

Round 2b: No candidate reached the quota this round.

Round 2c:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	
MD1	20%	

MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	
R1	20%	
R2	7%, 4% + 3% from R1	70% (18% from DS1, 4% from DS2, 2% from DS3, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
R3	2%	
R4	1%	

Round 2d:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	
R1	20%	
R2	0%	
R3	9%, 2% + 3% from R1 + 4% from R2	70% (18% from DS1, 4% from DS2, 2% from DS3, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
R4	1%	

Round 3a: No candidate reached the quota this round.

Round 3b: No candidate reached the quota this round.

Round 3c:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	

DS3	2%	
DS4	1%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	
R1	20%	
R2	0%	
R3	9%, 2% + 3% from R1 + 4% from R2	70% (18% from DS1, 4% from DS2, 2% from DS3, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
R4	1%	

Round 3d:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	45% (31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	23% (18% from DS1, 4% from DS2, 1% from DS4)

Round 4a: No candidate reached the quota this round.

Round 4b: No candidate reached the quota this round.

Round 4c:

Candidate	Votes for	Last-choice votes
DS1	18%	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	
DS4	1%	45% (31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	23% (18% from DS1, 4% from DS2, 1% from DS4)

Round 4d:

Candidate	Votes for	Last-choice votes
DS1	19%, 18% + 1% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	45% (31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	23% (18% from DS1, 4% from DS2, 1% from DS4)

Round 5a: No candidate reached the quota this round.

Round 5b: No candidate reached the quota this round.

Round 5c:

Candidate	Votes for	Last-choice votes
DS1	19%, 18% + 1% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	2%	45% (31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	23% (18% from DS1, 4% from DS2, 1% from DS4)

Round 5d:

Candidate	Votes for	Last-choice votes
DS1	21%, 18% + 2% from DS3 + 1% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	

R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	68% (18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)

Round 6a:

Candidate	Votes for	Last-choice votes
DS1	21%, 18% + 2% from DS3 + 1% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS2	4%	
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	68% (18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)

Round 6b:

Candidate	Votes for	Last-choice votes
DS1	20%	
DS2	5%, 4% + (18/21)% from DS1 + (2/21)% from DS3 + (1/21)% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)

R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	68% (18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)

Round 6c: Would only occur if no candidate reached the quota this round.

Round 6d: Would only occur if no candidate reached the quota this round.

Round 7a: No candidate reached the quota this round.

Round 7b: No candidate reached the quota this round.

Round 7c:

Candidate	Votes for	Last-choice votes
DS1	20%	
DS2	5%, 4% + (18/21)% from DS1 + (2/21)% from DS3 + (1/21)% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	2%	2% (2% from DS3)
R1	20%	
R2	0%	
R3	0%	
R4	10%, 1% + 2% from R3 + 3% from R1 + 4% from R2	68% (18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)

Round 7d:

Candidate	Votes for	Last-choice votes
DS1	20%	

DS2	5%, 4% + (18/21)% from DS1 + (2/21)% from DS3 + (1/21)% from DS4	75% (23% from R1, 4% from R2, 2% from R3, 1% from R4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	12%, 2% + 1% from R4 + 2% from R3 + 3% from R1 + 4% from R2	25% (2% from DS3, 18% from DS1, 4% from DS2, 1% from DS4)
R1	20%	
R2	0%	
R3	0%	
R4	0%	

Round 8a: No candidate reached the quota this round.

Round 8b: No candidate reached the quota this round.

Round 8c:

Candidate	Votes for	Last-choice votes
DS1	20%	
DS2	5%, 4% + (18/21)% from DS1 + (2/21)% from DS3 + (1/21)% from DS4	75% (23% from R1, 4% from R2, 2% from R3, 1% from R4, 31% from MD1, 8% from MD2, 4% from MD3, 2% from MD4)
DS3	0%	
DS4	0%	
MD1	20%	
MD2	19%, 8% + 11% from MD1	
MD3	4%	
MD4	12%, 2% + 1% from R4 + 2% from R3 + 3% from R1 + 4% from R2	25% (2% from DS3, 18% from DS1, 4% from DS2, 1% from DS4)
R1	20%	

R2	0%	
R3	0%	
R4	0%	

Round 8d:

Candidate	Votes for	Last-choice votes
DS1	20%	
DS2	0%	
DS3	0%	
DS4	0%	
MD1	20%	
MD2	24%, 8% + 11% from MD1 + 4% from DS2 + (18/21)% from DS1 + (2/21)% from DS3 + (1/21)% from DS4	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)
MD3	4%	2% (2% from MD4)
MD4	12%, 2% + 1% from R4 + 2% from R3 + 3% from R1 + 4% from R2	68% (2% from DS3, 18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3)
R1	20%	
R2	0%	
R3	0%	
R4	0%	

Round 9a:

Candidate	Votes for	Last-choice votes
DS1	20%	
DS2	0%	
DS3	0%	
DS4	0%	
MD1	20%	
MD2	24%, 8% + 11% from MD1 + 4% from DS2 + (18/21)% from DS1 +	30% (23% from R1, 4% from R2, 2% from R3, 1% from R4)

	(2/21)% from DS3 + (1/21)% from DS4	
MD3	4%	2% (2% from MD4)
MD4	12%, 2% + 1% from R4 + 2% from R3 + 3% from R1 + 4% from R2	68% (2% from DS3, 18% from DS1, 4% from DS2, 1% from DS4, 31% from MD1, 8% from MD2, 4% from MD3)
R1	20%	
R2	0%	
R3	0%	
R4	0%	