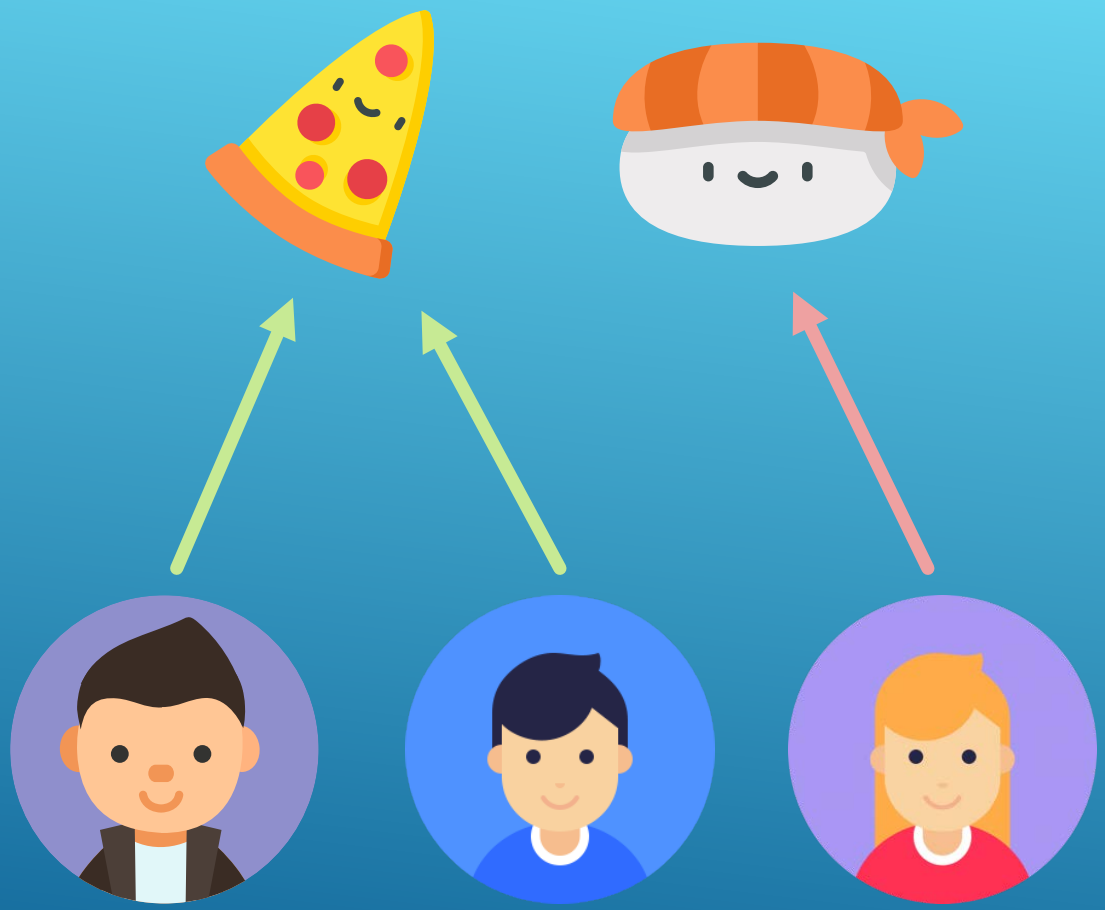
THEORY OF VOTING*

CMSC828M – Spring 2018

*social choice functions



MAJORITY RULES

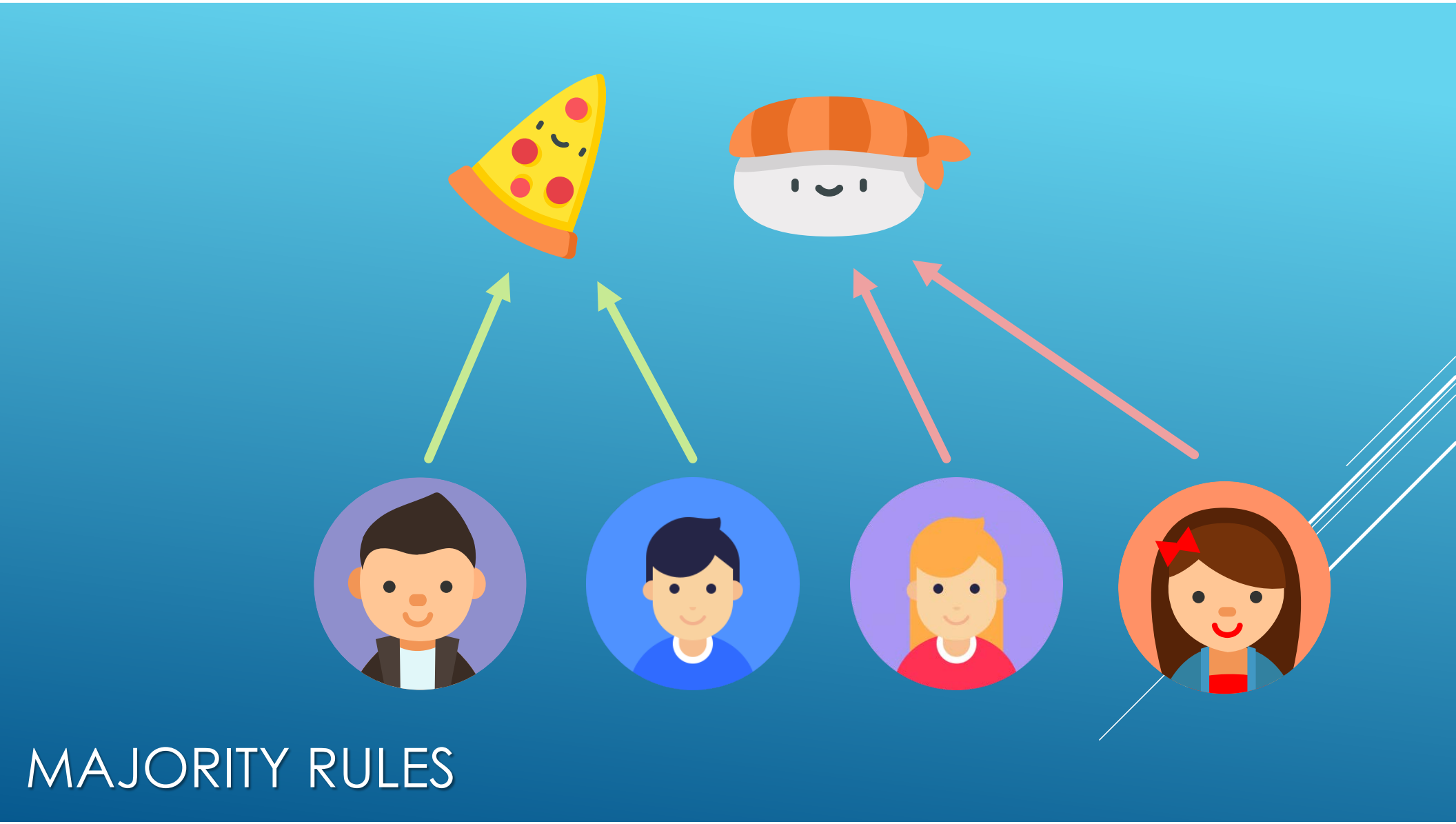
POTENTIAL WISHLIST

- **Resolute:** single winner
- **Neutral**: "Treats all candidates fairly"
- **Anonymous**: roles of voters should be interchangeable
- **Pareto:** if everyone favors x to y, y cannot win
- **Monotonic:** adding votes to the winner shouldn't change winner
- **Responsive**: if tied, and a voter switches, should be unique winner

DO WE HAVE TO SATISFY THEM ALL?

Not really…

- **Should constitutional amendment require a simple majority?**
- **What about electing committees? Pick progressively lower vote counts?**


MAJORITY RULES

HANDLING TIES

- **Fixed Ordering of Alternatives:** breaks neutrality
- **Designated Voter?**: breaks anonymity
- **Randomized**: indeterminate voting rules
- **Directly deal with Sets:** prioritize individuals?
- **La-la-la-la:** fine for narrow proofs, not elections

LET'S MAKE SOME ASSUMPTIONS

- Every voter plays an equal role
- Every alternative is treated equally
- There are only 2 alternatives *we'll relax this

	Odd	Even
Resolute	✓	
Anonymous	✓	✓
Neutral	✓	✓
Monotonic	✓	
Responsive		✓

May's Theorem (1952): only reasonable approach is **majority rule**

6

5

4

MORE SUBTLE PROBLEMS

6

40%

5

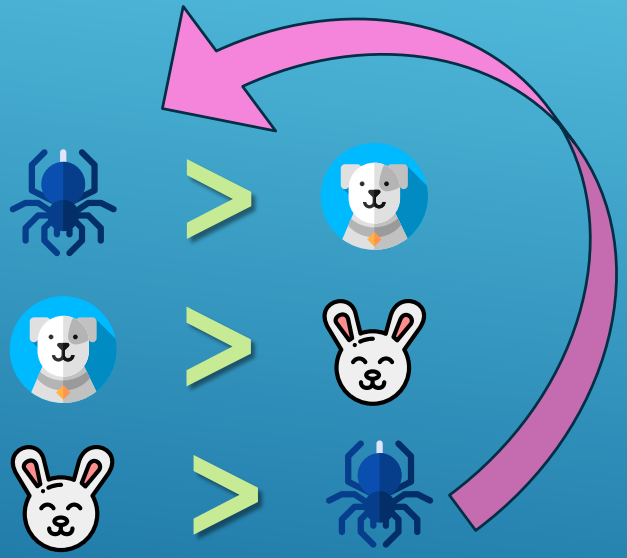
4

9

60%

MORE SUBTLE PROBLEMS

Plurality != Majority



MORE SUBTLE PROBLEMS

Majority Preference
is not Transitive Condorcet (1785)

CONDORCET WINNER

Not guaranteed

- **Winner must win majority of the vote in all head-to-head matches against other candidates**

Arrow's Impossibility Theorem (1951)

Given 3 alternatives. There is no rule that is simultaneously:

- **Pareto efficient** (if all voters prefer X to Y, the rule prefers X to Y)
- **Non-dictatorial** (there is no single voter whose rankings are always followed)
- **Independent of Irrelevant Alternatives**
  - Assume X > Y
  - Change votes, but not relative ordering of X and Y
  - X > Y must still be true

IT GETS WORSE

Last place gets one point, 2nd to last 2 points, …

Most points wins.

Pros:

All candidates you support get credit.

Every vote matters

Cons:

Tends to elect "acceptable" candidates rather than majority-approved

Encourages insincere voting… you can still harm your first choice

Rarely used

BORDA COUNT (1435)

COPELAND'S METHOD (1299)

Order candidates by pairwise **victories** minus **defeats**

Best score wins.

Pros:

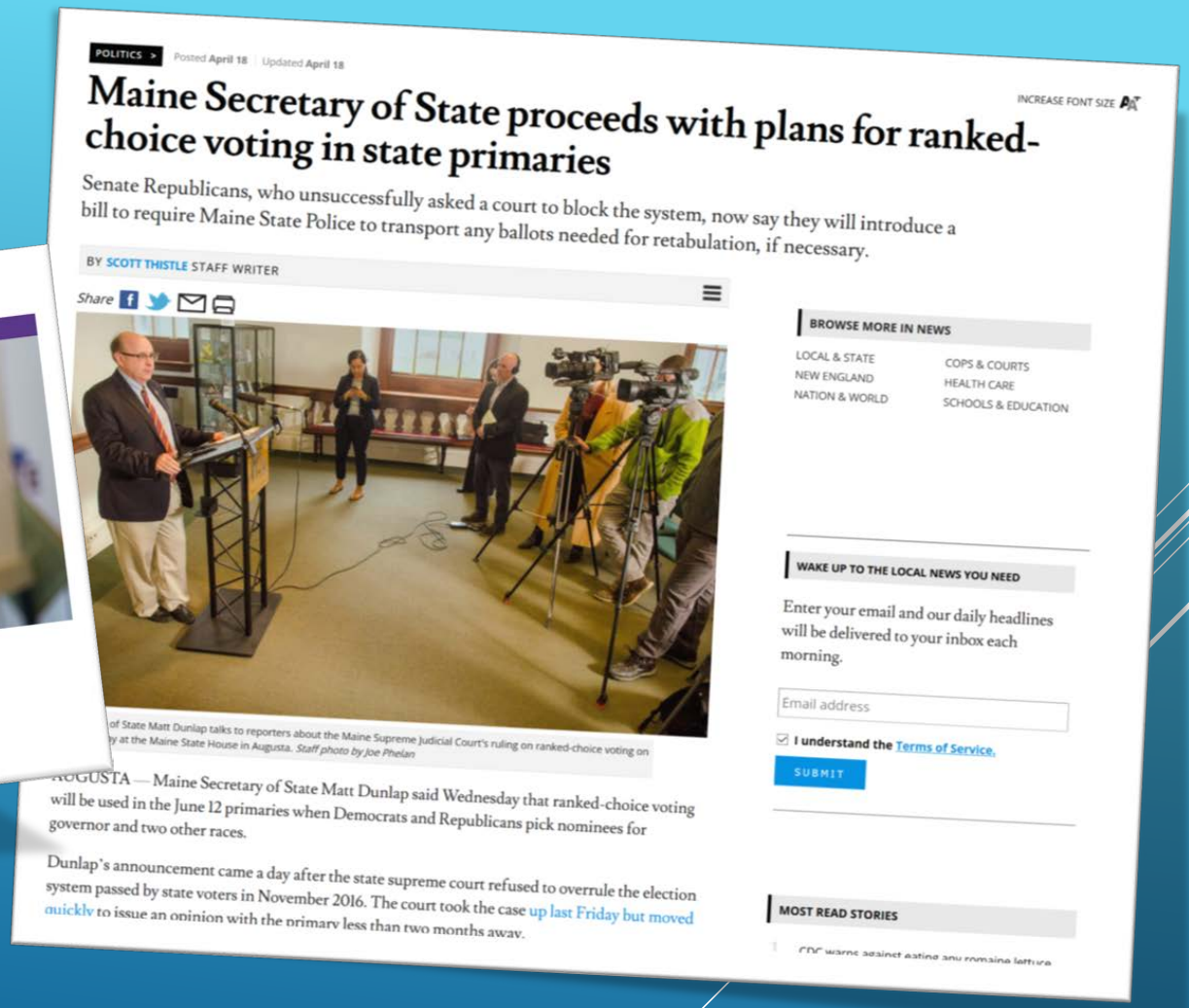
Easy to calculate

Familiar to populous
(round robin tournaments)

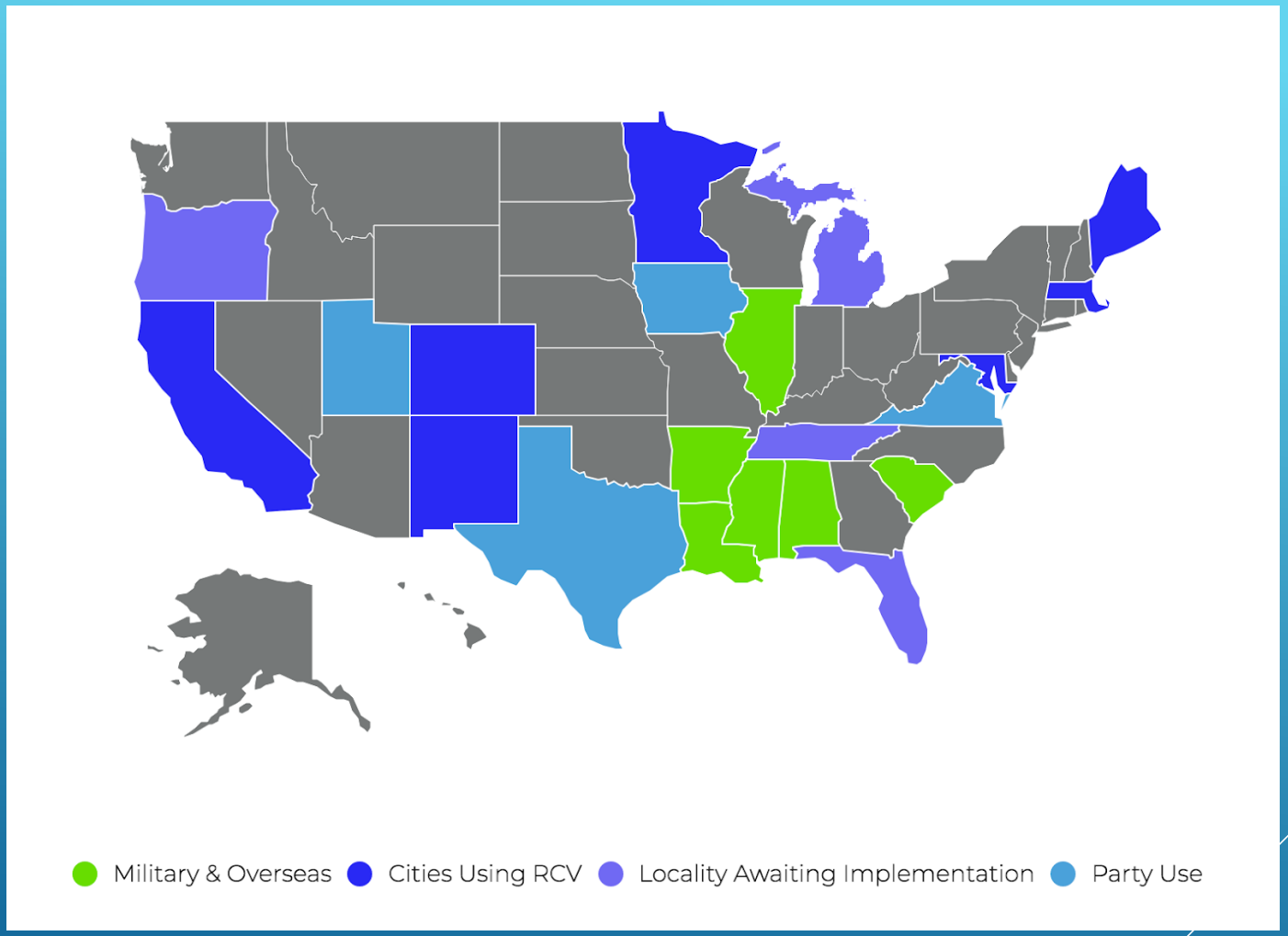
Cons:

Often leads to ties

Doesn't account for **magnitude** of victory or defeat, only **number**



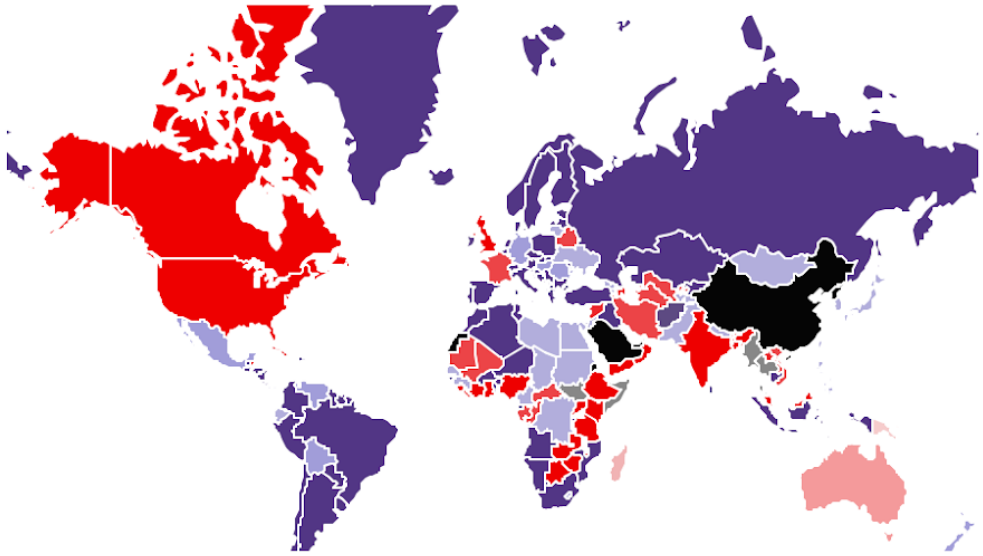
RANKED CHOICE VOTING



RANKED CHOICE VOTING

http://www.fairvote.org/research_electoralsystems_world

Electoral Systems of the World



List Proportional Representation
Multi-winner Ranked Choice Voting
Other Proportional System
Mixed Member Proportional
Mixed PR and winner-take-all
Plurality
Block Voting
Two Round System
Single-winner RCV
Other Winner-take-all
Other (Limited RCV)
Other (Modified Borda Count)
In transition
Not applicable

http://www.fairvote.org/research_electoralsystems_world

RANKED CHOICE VOTING - BENEFITS

- **Promotes majority support** - undermines Gerrymandering since candidates have to get at least 50% of the vote or are progressively eliminated
- **Discourages negative campaigning** - based on poll of user sentiment
- **Provides more voter choice** - more can compete without fear of splitting the vote
- **Minimize strategic voting** - don't have to bank on "lesser of two evils"
- **Lower costs all around** - no need for primaries, increases viability of grass-roots campaigning
- **Reflective representation** - 2.7x turnout in some municipalities

RANKED CHOICE VOTING - ISSUES

- **Computational Complexity –** NP-Hard (applied to hundreds of millions of votes?)
- **Spatial Complexity –** What if topics are interrelated, not independent? Exponentially growing space
- **Human Factors –** Do you have to rank all? What is the difference between 4^{th} and 5^{th} place?
- **Model Applicability –** How would this apply to abstract votes?

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Brandt, F., Conitzer, V., Endriss, U., Lang, J., & Procaccia, A. D. (Eds.). (2016). Handbook of computational social choice. Cambridge University Press.

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