



DECEMBER 9, 2024

ADVENTURES IN DEMOCRATIC
DECISION MAKING

INSTANT RUNOFF VOTING

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and encourages tactical voting.

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Adding a runoff helps, but does not
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fix these problems.

So how about adding *more* runoffs?...

This motivates another voting rule.

INSTANT RUNOFF VOTING (IRV)

Aka *Single Transferable Vote (STV)*, *Ranked-Choice Voting (RCV)*, or *Alternative Vote (AV)*

Voters submit full preference rankings.

Round <i>i</i>				
45	30	25	16	7
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
...	<i>d</i>
<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	...
...

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The candidate that gets the fewest first-place votes* is eliminated.

Round i				
45	30	25	16	7
a	b	c	d	e
...	d
e	e	e	e	...
...

Round $i + 1$				
45	30	25	16	7
a	b	c	d	e
...	d
e	e	e	e	...
...

*With tie-breaking (e.g., according to alphabetical order) if needed.

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45	30	25	16	7
a	b	c	d	e
...	d
e	e	e	e	...
...

Round $i + 1$				
45	30	25	16	7
a	b	c	d	e
...	d
e	e	e	e	...
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This process is repeated until only one candidate remains.

Round <i>i</i>				
45	30	25	16	7
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
...	<i>d</i>
<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	...
...

Round <i>i</i> + 1				
45	30	25	16	7
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
...	<i>d</i>
<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	...
...

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This candidate's votes are 'transferred' to the next candidate on the ballot.

This process is repeated until only one candidate remains.

Last standing candidate is the winner.

Round <i>i</i>				
45	30	25	16	7
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
...	<i>d</i>
<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	...
...

Round <i>i + 1</i>				
45	30	25	16	7
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
...	<i>d</i>
<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	...
...

*With tie-breaking (e.g., according to alphabetical order) if needed.

IRV ON AN EXAMPLE

Who gets the boot?

Round 1						
2	1	3	2	1	1	1
b	b	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>

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Who gets the boot?

In Round 1, *a* gets eliminated.

Round 1						
2	1	3	2	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>

IRV ON AN EXAMPLE

Who gets the boot?

In Round 1, *a* gets eliminated.

In Round 2, *d* gets eliminated.

Round 1							Round 2						
2	1	3	2	1	1	1	2	1	3	2	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>

IRV ON AN EXAMPLE

Who gets the boot?

In Round 1, *a* gets eliminated.

In Round 2, *d* gets eliminated.

In Round 3, *b* gets eliminated.

Round 1							Round 2							Round 3						
2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
Round 1							Round 2							Round 3						
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>

IRV ON AN EXAMPLE

Who gets the boot?

In Round 1, *a* gets eliminated.

In Round 2, *d* gets eliminated.

In Round 3, *b* gets eliminated.

Only *c* is left standing, hence *c* is the winner.

Round 1							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

Round 2							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

Round 3							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

Round 4							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

IRV REFINEMENTS

If ballot is incomplete, use as much of it as possible.

	Round 1						
2	1	3	2	1	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

IRV REFINEMENTS

If ballot is incomplete, use as much of it as possible.

Tie-breaking can be more sophisticated, e.g., eliminate candidate with fewer second-place votes.

	Round 1						
2	1	3	2	1	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

In a tie between *a* and *b*, *b* would be eliminated.



ISMAR VOLIĆ

IRV exploits voters' entire preference ranking, and allows candidates to gain an *eventual majority*.

Volić, I. (2024). *Making Democracy Count: How Mathematics Improves Voting, Electoral Maps, and Representation*. Princeton University Press.



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Plurality is like looking at the galaxy with the naked eye.

Runoff is like the Hubble telescope.

Instant runoff is like the Webb telescope.

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By transferring votes to next choices,
IRV tries to ensure that no vote is
wasted.



WILLIAM R. WARE (1832 – 1915)

I devised this rule around 1870, as a professor at MIT.

It is still in use there, to this day.



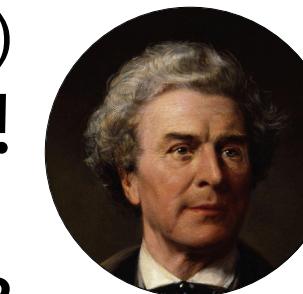
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SIR THOMAS HARE (1806 – 1891)

Humbug!



Instant-runoff is a special case of *Single Transferable Vote (STV)*, used to elect multiple representatives.

Which I came up in 1857, while being a lawyer and political reformer in Britain.

This idea of transferring votes can be extended to handle elections of *multiple* representatives, e.g., parliaments.

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IRV/STV IN PRACTICE

1918 House of Representatives in Australia

1937 Presidency of Ireland

1949 Presidency of India

Voted by an electoral college consisting of the elected members of both houses of parliament (MPs), the elected members of the State Legislative Assemblies (Vidhan Sabha) of all States, and the elected members of the legislative assemblies (MLAs) of union territories with legislatures, i.e., National Capital Territory (NCT) of Delhi, Jammu and Kashmir and Puducherry.

1997 - 2006 House of Representatives in Fiji

2003 Parliament elections in Papua New Guinea

Voters rank only three candidates

2024 Primary election in the 12th district of Budapest



Wikipedia contributors. (2024, November 11). [History and use of instant-runoff voting](#). Wikipedia.

STV ballot from the 2011 Irish general election

THE HUNGARIAN TWO-TAILED DOG PARTY

Funded in 2006, in Szeged. Officially registered as a party in 2014.

Platform promises eternal life, world peace, a one-day workweek, two sunsets a day (in assorted colors), lower gravity, free beer, and low taxes.

Main political activities consist of protesting, drawing graffiti, and making funny posters.

Got 1.73% of the total vote in the 2018 parliamentary election, but no seats.



Street art of the party in Budapest, illustrating the four color theorem

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Uses IRV in its elections.



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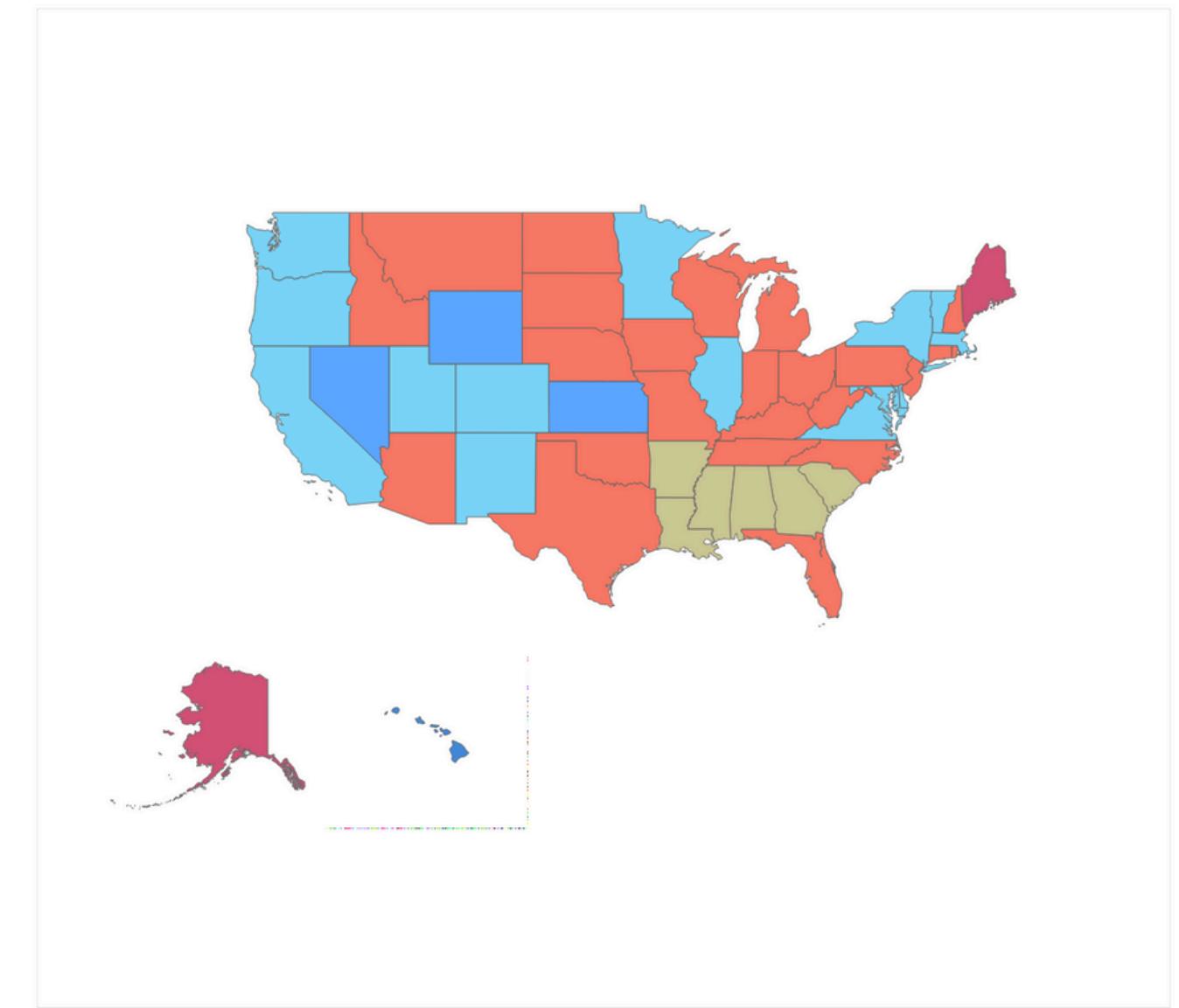
IRV IN THE US

1915 Ashtabula, Ohio
For city council members

1936 New York City
For school board and city council elections

currently statewide, in Alaska and Maine
two counties
58 cities

Instant Runoff Voting Usage in the U.S.



Source: FairVote, 2023

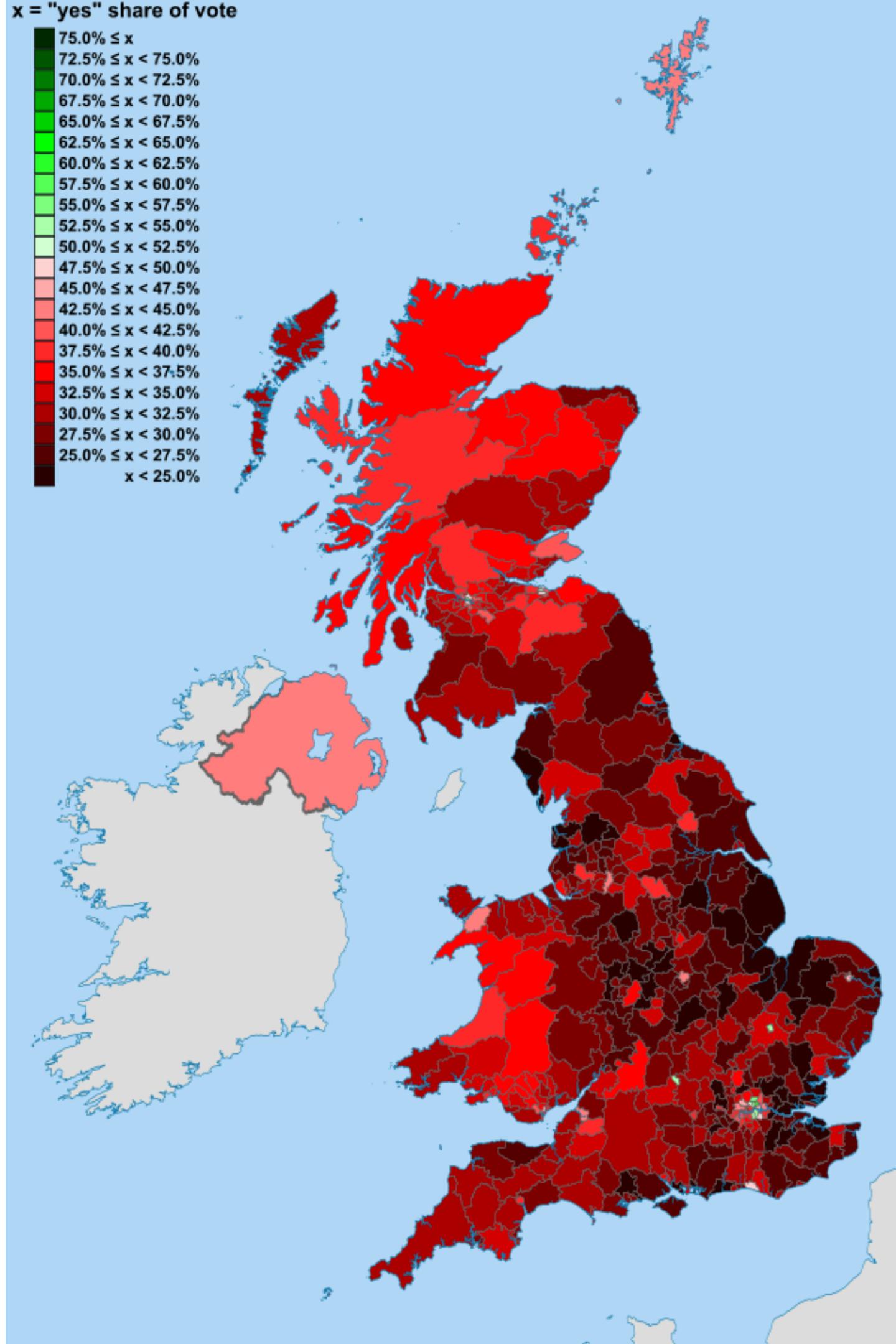
[Instant runoff voting](#). MIT Election Lab.

IN THE UK

In 2011, the UK held a referendum.

The question was whether to replace First-Past-the-Post (plurality) with Alternative Vote (IRV) when electing MPs.

The result was *no* (i.e., keep plurality), with 67.9% of the votes.



Does IRV prevent spoilers?

IRV AND THE SPOILER EFFECT

In the 2000 US Presidential election, the final decision came down to the (very close) result in Florida.

Actual Florida vote count		
Bush	Gore	Nader
2,912,790	2,912,253	97,488

Bush won by a very narrow margin.

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Possible Florida preferences		
Bush	Gore	Nader
Gore	Nader	Gore
Nader	Bush	Bush

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Possible Florida preferences		
Bush	Gore	Nader
Gore	Nader	Gore
Nader	Bush	Bush

In this case, IRV would have elected Gore.

NO SPOILERS (WITH IRV)

In 2022, Alaska voted for its one seat in the House of Representatives.

Candidates were Mary Peltola ([Democrat](#)), Sarah Palin ([Republican](#)) and Nick Begich ([Republican](#)).

Alaska had switched to IRV in 2020.

Round 1									
27,053	15,467	11,290	34,049	3,652	21,272	47,407	4,645	23,747	
Begich	Begich	Begich	Palin	Palin	Palin	Peltola	Peltola	Peltola	
Palin	Peltola		Begich	Peltola		Begich	Palin		
Peltola	Palin		Peltola	Begich		Palin	Begich		

NO SPOILERS (WITH IRV)

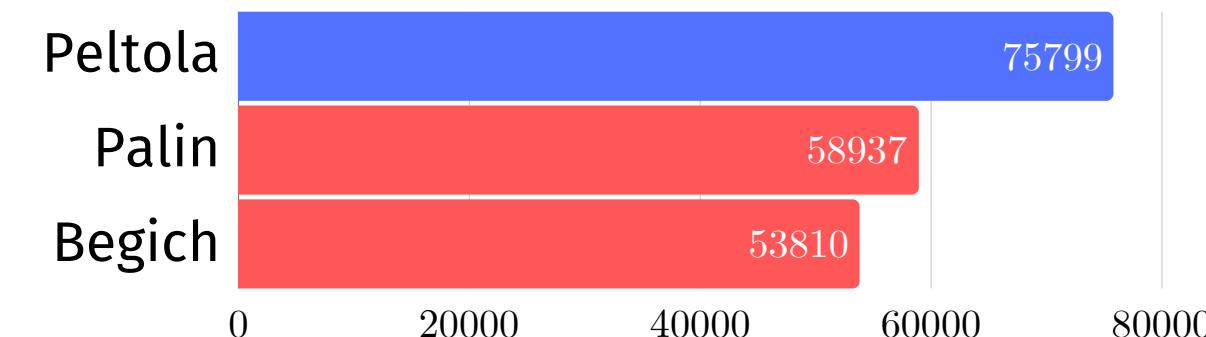
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Alaska had switched to IRV in 2020.

Round 1									
27,053	15,467	11,290	34,049	3,652	21,272	47,407	4,645	23,747	
Begich	Begich	Begich	Palin	Palin	Palin	Peltola	Peltola	Peltola	
Palin	Peltola		Begich	Peltola		Begich	Palin		
Peltola	Palin		Peltola	Begich		Palin	Begich		

Begich got eliminated in the first round.



NO SPOILERS (WITH IRV)

In 2022, Alaska voted for its one seat in the House of Representatives.

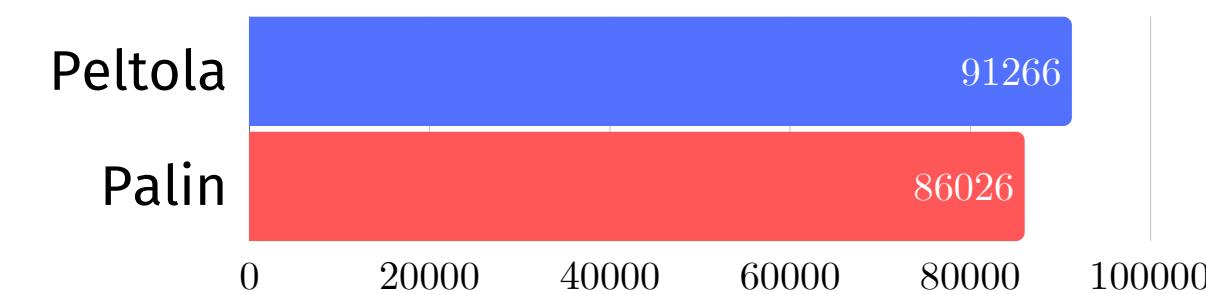
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But (surprisingly?) Peltola won in the second.

Round 2									
27,053	15,467	11,290	34,049	3,652	21,272	47,407	4,645	23,747	
Begich	Begich	Begich	Palin	Palin	Palin	Peltola	Peltola	Peltola	
Palin	Peltola		Begich	Peltola		Begich	Palin		
Peltola	Palin		Peltola	Begich		Palin	Begich		



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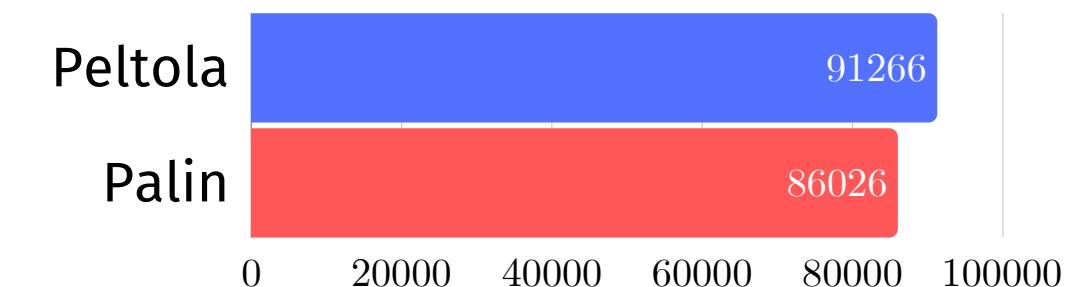
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Begich got eliminated in the first round.

But (surprisingly?) Peltola won in the second.

Suggests that the Republican vote was not split among the two candidates (?).

Round 2									
27,053	15,467	11,290	34,049	3,652	21,272	47,407	4,645	23,747	
Begich	Begich	Begich	Palin	Palin	Palin	Peltola	Peltola	Peltola	
Palin	Peltola		Begich	Peltola		Begich	Palin		
Peltola	Palin		Peltola	Begich		Palin	Begich		





SARAH PALIN

Ranked-choice voting [i.e., IRV] is corrupt: 60% of Alaskans voted Republican, yet a Democrat won.



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Ranked-choice voting [i.e., IRV] is corrupt: 60% of Alaskans voted Republican, yet a Democrat won.



MARK Z. BARABAK

That's a feature, not a bug.

[The purpose of IRV] was to weed out extremists by making it harder for candidates to be elected simply by appealing to the hard-liners of their party's base.

Barabak, M. Z. (2023, July 2). [Column: Think our politics stink? Look north — to Alaska.](#) *Los Angeles Times*.

One of the main selling points of IRV
is that it encourages more civil
discourse. Why?

One of the main selling points of IRV is that it encourages more civil discourse. Why? Because candidates now have to appeal to a broader segment.

OAKLAND 2010 MAYORAL ELECTIONS

In 2010, city councilwoman Jean Quan ran for mayor in Oakland, California.

The favorite was Don Perata, a conservative Democrat with a lot of money to spend.



Elinson, Z., & Shih, G. (2010, November 12). [The Winning Strategy in Oakland: Concentrate on Being 2nd or 3rd Choice](#). *The New York Times*.

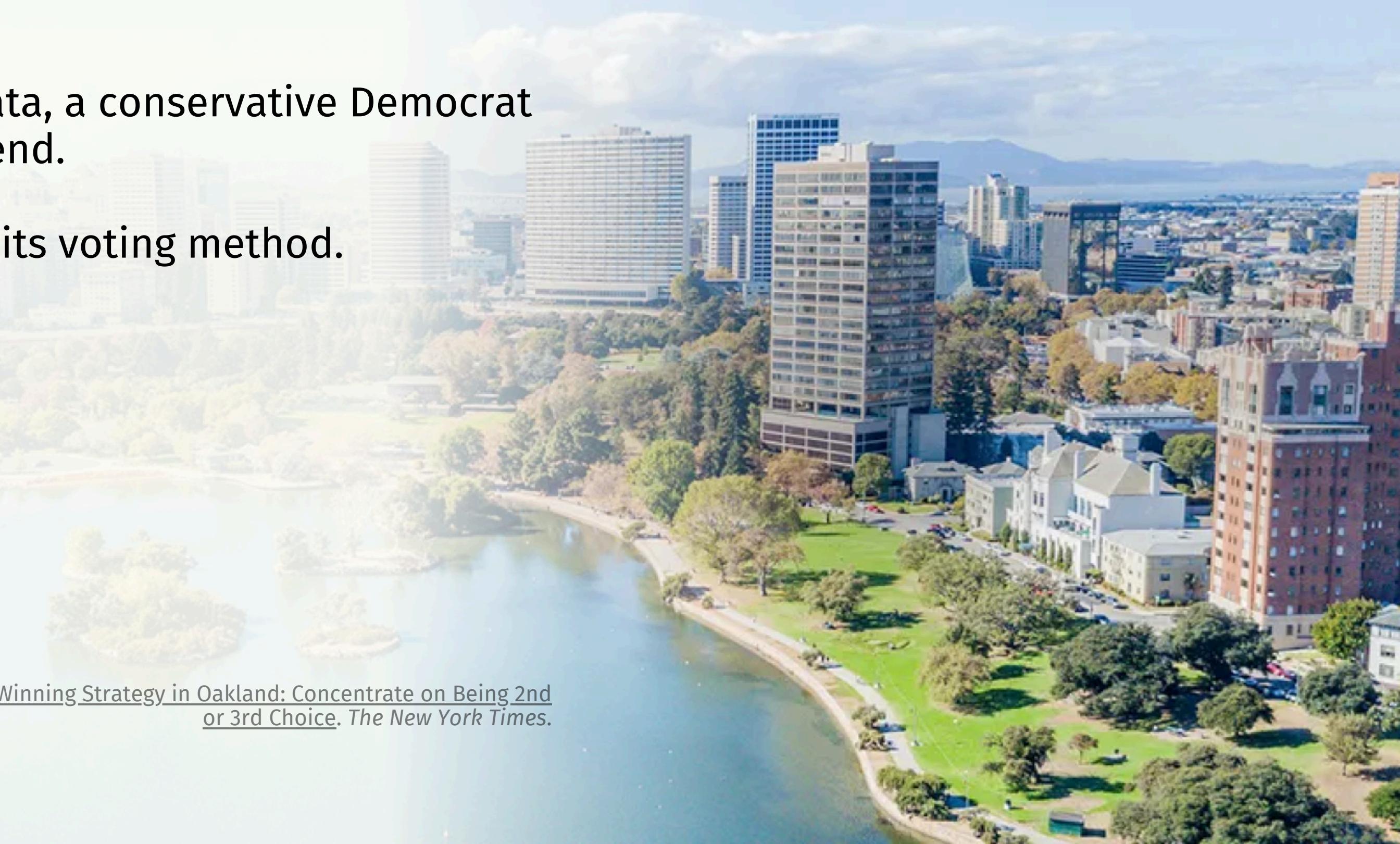
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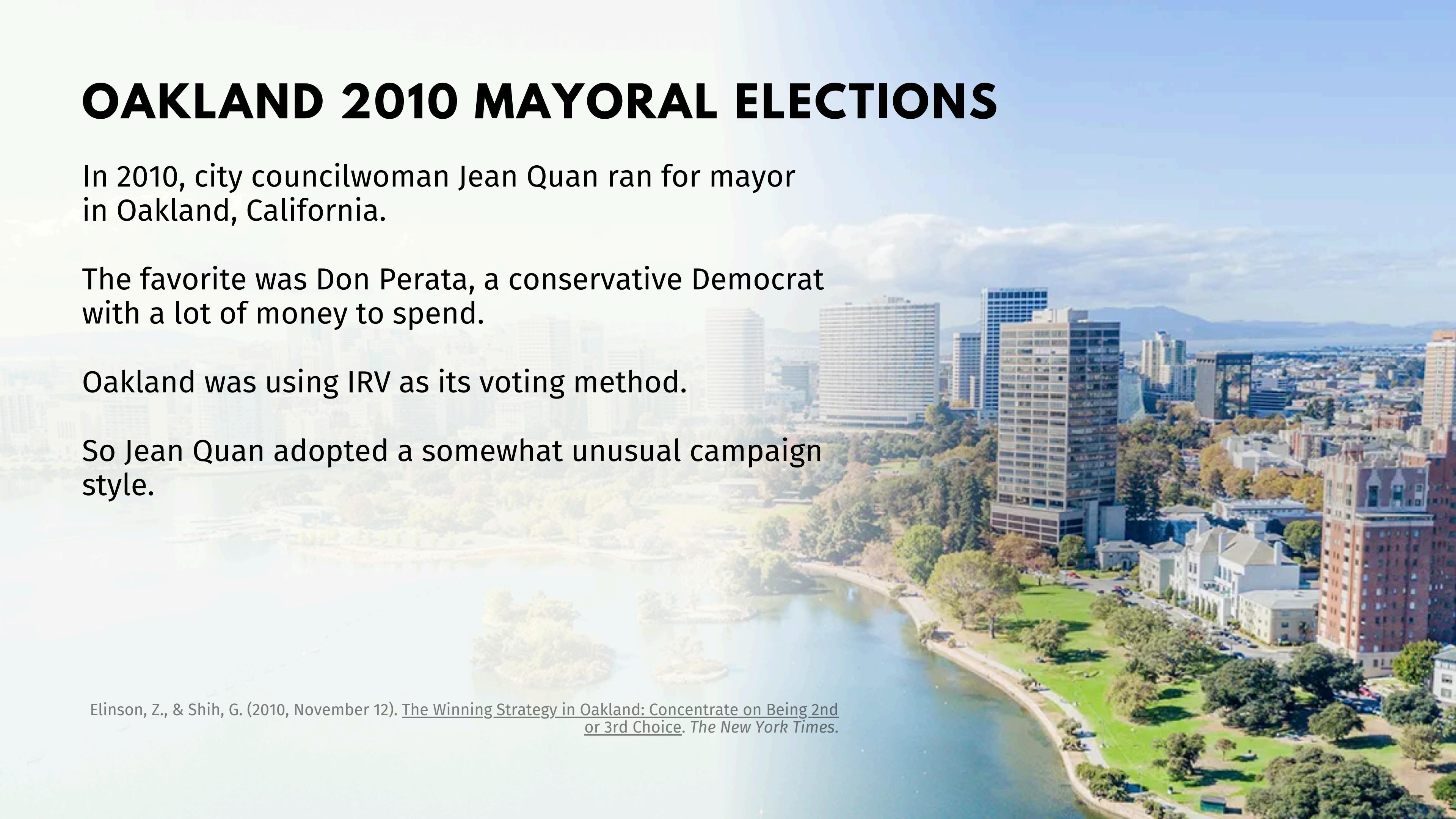
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JEAN QUAN

We talked to everybody, and if you had a sign for [other candidates] Joe Tuman or Rebecca Kaplan or Don Perata, we wanted their No. 2.

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So Jean Quan adopted a somewhat unusual campaign style.

She spoke ill of no one, and actively sought the second- or third-place vote.

And won.

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JEAN QUAN

We talked to everybody, and if you had a sign for [other candidates] Joe Tuman or Rebecca Kaplan or Don Perata, we wanted their No. 2.



DON PERATA

If this were a normal election, I would've won in a landslide.

Elinson, Z., & Shih, G. (2010, November 12). [The Winning Strategy in Oakland: Concentrate on Being 2nd or 3rd Choice.](#) *The New York Times*.

Any downsides to IRV?

One common complaint is that IRV is confusing, and/or too complicated.

IRV IN MAINE

In a 1998 survey among resident of Maine, IRV produced low levels of voter confidence, voter satisfaction, and ease of use.

Voters thought the process favored their least favorite party.

And it took them longer to fill in their ballot.

Though it did increase ‘sincere voting’ (here, voting for minor candidates).

Style no. [redacted]

**State of maine sample ballot
republican primary election, June 12, 2018
for**

Instructions to voters	Governor	Style no. [redacted]				
		1st choice	2nd choice	3rd choice	4th choice	5th choice
To vote, fill in the oval like this ●	Fredette, Kenneth Wade Newport	0	0	0	0	0
To rank your candidate choices, fill in the oval:	Mason, Garrett Paul Lisbon	0	0	0	0	0
• In the 1st column for your 1st choice candidate.	Mayhew, Mary C. China	0	0	0	0	0
• In the 2nd column for your 2nd choice candidate, and so on.	Moody, Shawn H. Gorham	0	0	0	0	0
Continue until you have ranked as many or as few candidates as you like.	Write-in	0	0	0	0	0
Fill in no more than one oval for each candidate or column.						
To rank a write-in candidate, write the person's name in the write-in space and fill in the oval for the ranking of your choice.						

Turn over for additional contests

61

Maine Republican primary ranked ballot, 2018

Sometimes, IRV is described as unfair.

Sometimes, IRV is described as unfair. But the reasoning can be unclear.



DAVID CAMERON

There's an inherent unfairness under AV [i.e., IRV].

Supporters of unpopular parties end up having their votes counted a number of times... potentially deciding the outcome of an election... while people who back more popular parties only get one vote.

Wintour, P. (2011, February 18). AV reform is “inherently unfair”, says David Cameron. *The Guardian*.



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Wintour, P. (2011, February 18). [AV reform is “inherently unfair”, says David Cameron](#). *The Guardian*.



TIMOTHY GOWERS

This is a misrepresentation of how AV works.

Gowers, T. (2011, April 20). [Is AV better than FPTP?](#) Gowers's Weblog.

More serious is the fact that a plurality winner can lose.

BURLINGTON 2010 MAYORAL ELECTIONS

In 2010 there were elections for mayor in Burlington, Vermont.

Kurt Wright (Republican) lost the election to Bob Kiss (Progressive) under IRV.

Wright lost even though he was the plurality winner.

As part of the backlash, Burlington repealed IRV.

Nonetheless, IRV *can* produce odd results.

IRV WINNER CAN LOSE HEAD-TO-HEAD CONTESTS

In our original example, *c* is the IRV winner.

Round 1							Round 2							Round 3							Round 4													
2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		

IRV WINNER CAN LOSE HEAD-TO-HEAD CONTESTS

In our original example, *c* is the IRV winner.

But in a direct vote between *a* and *c*, *a* wins.

Round 1							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	
Round 2							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	
Round 3							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	
Round 4							
2	1	3	2	1	1	1	
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	

IRV WINNER CAN LOSE HEAD-TO-HEAD CONTESTS

In our original example, *c* is the IRV winner.

But in a direct vote between *a* and *c*, *a* wins.

In fact *a*, the first candidate to get eliminated, wins in a head-to-head contest against *everyone*.

Round 1							Round 2							Round 3							Round 4												
2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1	1	2	1	3	2	1	1
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>			
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>d</i>	<i>c</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>b</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		
<i>c</i>	<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>d</i>	<i>c</i>	<i>c</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>a</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>d</i>	<i>c</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>c</i>	<i>b</i>		



CONDORCET
Hmmm...

CENTER SQUEEZE

With IRV, Center gets eliminated first, leaving Left as the winner.

Round 1			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 2			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 3			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

CENTER SQUEEZE

With IRV, Center gets eliminated first, leaving Left as the winner.

Even though Center is preferred to both Left and Right by a majority of voters.

Round 1			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 2			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 3			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

CENTER SQUEEZE

With IRV, Center gets eliminated first, leaving Left as the winner.

Even though Center is preferred to both Left and Right by a majority of voters.

Centrist candidates get squeezed out by more extreme candidates.

Round 1			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 2			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

Round 3			
36	34	16	14
Left	Right	Center	Center
Center	Center	Left	Right
Right	Left	Right	Left

And then, something even stranger.

INCREASING SUPPORT

With IRV, c gets eliminated in the first round and a ends up winning.

Round 1					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

Round 2					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

Round 3					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

INCREASING SUPPORT

With IRV, c gets eliminated in the first round and *a* ends up winning.

Suppose, however, that three of the $b > a > c$ voters change to $a > b > c$.

Round 1						Round 1
6	6	6	4	3	2	6 + 3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>

Round 2						
6	6	6	4	3	2	
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	

Round 3						
6	6	6	4	3	2	
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	

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With IRV, c gets eliminated in the first round and a ends up winning.

Suppose, however, that three of the $b > a > c$ voters change to $a > b > c$.

And the two $c > b > a$ voters change to $c > a > b$.

Round 1						Round 1				
6	6	6	4	3	2	9	6 + 2		1	
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>		<i>b</i>	
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>		<i>a</i>	
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>		<i>c</i>	

Round 2					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

Round 3					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

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Suppose, however, that three of the $b > a > c$ voters change to $a > b > c$.

And the two $c > b > a$ voters change to $c > a > b$.

In essence, a wins more support.

Round 1						Round 1				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 2					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 3					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

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Round 1						Round 1				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 2						Round 2				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 3					
6	6	6	4	3	2
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>

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And the two $c > b > a$ voters change to $c > a > b$.

In essence, a wins more support.

But now c comes out as winner.

Round 1						Round 1				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 2						Round 2				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 3						Round 3				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

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Suppose, however, that three of the $b > a > c$ voters change to $a > b > c$.

And the two $c > b > a$ voters change to $c > a > b$.

In essence, a wins more support.

But now c comes out as winner.

The increased support for a knocks it out of the race!

Round 1						Round 1				
6	6	6	4	3	2	9	8	6	1	3
a	c	b	b	a	c	a	c	b	b	a
b	a	c	a	c	b	b	a	c	a	c
c	b	a	c	b	a	c	b	a	c	b

Round 2						Round 2				
6	6	6	4	3	2	9	8	6	1	3
a	c	b	b	a	c	a	c	b	b	a
b	a	c	a	c	b	b	a	c	a	c
c	b	a	c	b	a	c	b	a	c	b

Round 3						Round 3				
6	6	6	4	3	2	9	8	6	1	3
a	c	b	b	a	c	a	c	b	b	a
b	a	c	a	c	b	b	a	c	a	c
c	b	a	c	b	a	c	b	a	c	b

This is a failure of *monotonicity*.

This is a failure of *monotonicity*.
When increased support for an
alternative ends up hurting it in the
outcome.

MANIPULATING IRV

The failure of monotonicity also shows that IRV can be manipulated.

Supporters of *c* can insure *c* wins by placing *a* above *b*.

Round 1						Round 1				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 2						Round 2				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

Round 3						Round 3				
6	6	6	4	3	2	9	8	6	1	3
<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>
<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>b</i>

BURLINGTON 2010 MAYORAL ELECTIONS

The 2010 elections also exhibited a failure of monotonicity.

Wikipedia contributors. (2024, November 5). [2009 Burlington mayoral election](#). Wikipedia.