



# SecurePoll

Joe Sutherland for the Wikimedia Foundation  
July 2023

# What is SecurePoll?

# Uses of SecurePoll

- Board elections
- Other global elections (e.g. MCDC elections)
- Referenda (e.g. UCoC ratification)
- Local elections (e.g. English Wikipedia)



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# History

- **2004:** [First Board election](#) run with the Boardvote extension (undocumented)
- **2008:** Board elections move to Software in the Public Interest servers for added security
- **2009:** [SecurePoll extension created](#)
- **2013:** SecurePoll moves to votewiki
- **2021:** "SecurePoll 2.0" launches



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# votewiki

- Used to host Wikimedia elections both global and local
- Users "jump" to the votewiki to cast their vote
- Lists of eligible voters are inserted into votewiki



Photo by [Jebulon](#), CC-0



- Tools
- [Upload file](#)
  - [Special pages](#)
  - [Printable version](#)

Special page

Search Wikimedi:

## SecurePoll: Create poll

[< SecurePoll](#)

Poll Title:

 \*

For wiki:

Primary Language:

Election Start Date:

Election End Date:

Return-to URL:

Poll type:

- Approval vote
- Schulze vote
- Plurality
- Range voting (plurality)
- Range voting (histogram range)
- Single transferable vote with Droop quota

Encryption:

- No encryption
- GPG
- Prevent voters from changing their votes
- Disable transparency features (e.g. voter list) to protect voter privacy

Admins:

- Request free text comments at the end of the ballot
- Shuffle questions on the voting page.
- Shuffle options on the voting page.

### Questions

Question

Question text:

Delete question

#### Options

Option text:

Delete option

Add another option

Add another question

# Histogram range (AKA "support/oppose")

- Voters select "support", "neutral", or "oppose" for each candidate
- Easy to understand for voters...
- ...but easy to game, since "oppose"s are more powerful than neutrals

**Candidates**

	Oppose	Neutral	Support
Bobcat	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aardvark	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Fox	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Cheetah	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Eagle	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Goldfish	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dingo	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Submit vote**

*Sample histogram range ballot*

# Histogram range (AKA "support/oppose")

*Sample histogram range results output. Note that this is usually refactored to be displayed as "Support / (Support + Oppose)".*

	Oppose	Neutral	Support	Average score
Eagle	1	1	3	0.4
Fox	1	1	3	0.4
Dingo	2	1	2	0
Goldfish	3	0	2	-0.2
Aardvark	3	1	1	-0.4
Cheetah	3	1	1	-0.4
Bobcat	5	0	0	-1



# Schulze

- Voters rank candidates from most preferred (1) to least preferred
- Voters can rank candidates at the same "level"
- Pairwise matrix determines the winners
- Can be difficult to parse the results

### Candidates

<input type="text" value="1"/>	Cheetah
<input type="text" value="3"/>	Goldfish
<input type="text" value="2"/>	Eagle
<input type="text"/>	Fox
<input type="text" value="2"/>	Bobcat
<input type="text"/>	Dingo
<input type="text" value="4"/>	Aardvark



# Single-transferable vote

- Voters rank candidates from most preferred to least preferred
- Voters cannot rank candidates at the same "level"
- Votes are transferred to lower preferences as candidates are elected or eliminated
- Can be difficult to understand the results

**Candidates**

Preference 1

Preference 2

Preference 3

Preference 4

Preference 5

Preference 6

Preference 7

**Submit vote**

# Single-transferable vote

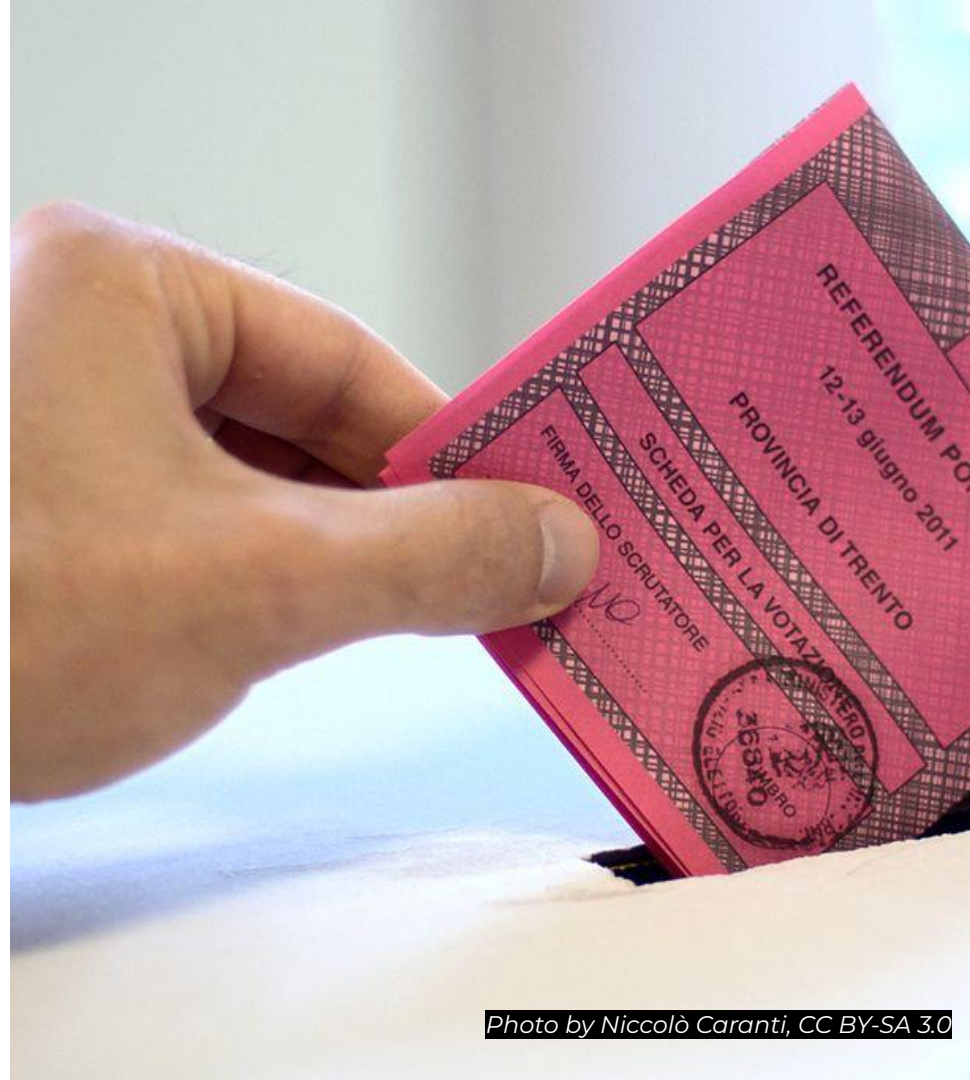
*Sample single-transferable vote results output*

Round Number	Tally	Result
1	1. Mike Peel: 1,176 2. Michał Buczyński: 1,157 3. Shani Evenstein Sigalov: 1,032 4. Tobechukwu Precious Friday: 988 5. Kunal Mehta: 896 6. Farah Jack Mustaklem: 673	Quota: 1,974.000001
2	1. Mike Peel: 1,176 2. Michał Buczyński: 1,157 3. Shani Evenstein Sigalov: 1,032 4. Tobechukwu Precious Friday: 988 5. Kunal Mehta: 896 6. <del>Farah Jack Mustaklem: 673</del>	Quota: 1,974.000001 Eliminated: Farah Jack Mustaklem
3	1. Mike Peel: 1,176 + 137 = 1,313 2. Michał Buczyński: 1,157 + 102 = 1,259 3. Shani Evenstein Sigalov: 1,032 + 104 = 1,136 4. Tobechukwu Precious Friday: 988 + 144 = 1,132 5. <del>Kunal Mehta: 896 + 91 = 987</del>	Quota: 1,942.333334 Eliminated: Kunal Mehta Transferring votes
4	1. Mike Peel: 1,313 + 344 = 1,657 2. Michał Buczyński: 1,259 + 154 = 1,413 3. Shani Evenstein Sigalov: 1,136 + 167 = 1,303 4. <del>Tobechukwu Precious Friday: 1,132 + 150 = 1,282</del>	Quota: 1,885.000001 Eliminated: Tobechukwu Precious Friday Transferring votes
5	1. <b>Mike Peel</b> : 1,657 + 338 = 1,995 2. Shani Evenstein Sigalov: 1,303 + 479 = 1,782 3. Michał Buczyński: 1,413 + 238 = 1,651	Quota: 1,809.333334 Elected: Mike Peel Transferring votes
6	1. <b>Shani Evenstein Sigalov</b> : 1,782 + 53.047619 = 1,835.047619 2. <b>Mike Peel</b> : 1,995 - 185.666666 = 1,809.333334 (keep factor: 0.906934) 3. Michał Buczyński: 1,651 + 87.482038 = 1,738.482038	Quota: 1,794.287665 Elected: Shani Evenstein Sigalov Transferring votes

# What is Single Transferable Vote?

# Single Transferable Vote

- Allows voters to rank candidates in order of preference
- Aims for proportional representation
- Reduces "wasted" votes for candidates who are not elected
- Useful for multi-winner elections



# Mechanics

- Voters rank any number of candidates in order, starting with their number one choice
- The quota for election is set with a formula ([Droop quota](#))
- First-preference votes are counted; any candidate meeting the quota is elected
- Lowest-ranked candidate is eliminated and second-choice preferences are redistributed



Photo by PereslaviFoto, CC BY-SA 3.0

# Regular Single Transferable Vote example

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# Example

- Suppose seven candidates for three seats:

- Aardvark

- Bobcat

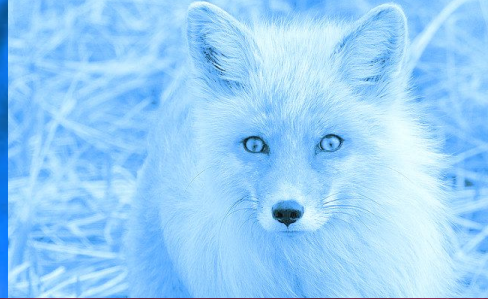
- Cheetah

- Dingo

- Eagle

- Fox

- Goldfish



*Image credits on last slide*



# Votes

- The votes are cast like this:

1st preference	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
2nd preference	Bobcat	Cheetah	Dingo	Eagle	Dingo		Fox
3rd preference		Dingo	Bobcat	Cheetah	Fox		
<b>Number of ballots</b>	<b>4</b>	<b>7</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>4</b>	<b>3</b>



# Tallying: Regular STV

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
Setting the quota	<p><b>The quota is 6:</b>            total votes / (options to choose + 1) + 1, rounded down            = 23 / (3 + 1) + 1, rounded down            = 6.75, rounded down            = 6</p>						
Step 1	4	7 ELECTED (1 surplus vote)	1	3	1	4	3



# Tallying: Regular STV

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
Step 2	4	ELECTED	1	3	1	4	3
Step 3	4	ELECTED	2	$3 + 1 = 4$	<i>eliminated</i>	4	3
Step 4	4	ELECTED	<i>eliminated</i>	$4 + 2 = 6$ ELECTED (0 surplus votes)	<i>eliminated</i>	4	3
Step 5	4	ELECTED	<i>eliminated</i>	ELECTED	<i>eliminated</i>	$4 + 2 = 6$ ELECTED (0 surplus votes)	<i>eliminated</i>



# Meek (or "Scottish") STV example

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# Meek (or "Scottish") STV

- Meek STV introduces a "keep factor" and fractional transfers of surplus votes from elected candidates
- This is performed algorithmically



# Votes

The votes are cast like this:

1st preference	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
2nd preference	Bobcat	Aardvark	Dingo	Eagle	Dingo	Goldfish	Fox
3rd preference		Dingo	Bobcat	Cheetah	Fox	Bobcat	
<b>Number of ballots</b>	<b>201</b>	<b>198</b>	<b>171</b>	<b>189</b>	<b>182</b>	<b>176</b>	<b>149</b>



# Tallying: Meek STV

**The quota is 317:**

$$\begin{aligned} & \text{total votes} / (\text{options to choose} + 1) + 1, \text{ rounded down} \\ & = 1,266 / (3 + 1) + 1, \text{ rounded down} \\ & = 317.25, \text{ rounded down} \\ & = 317 \end{aligned}$$





# Tallying: Meek STV

Nobody meets the quota, so we must first eliminate a candidate as normal.

**Fox** meets the quota and is elected.

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
<b>Step 1</b> Quota: 317	201	198	171	189	182	176	149
<b>Step 2</b> Quota: 317	201	198	171	189	182	176 + 149 = <b>325</b> <b>ELECTED</b>	<i>eliminated</i> (149)



# Votes after Step 2

The ballots currently look like this:

1st preference	Aardvark	Bobcat	Cheetah	Dingo	Eagle	<del>Fox</del>	<del>Goldfish</del>
2nd preference	Bobcat	Aardvark	Dingo	Eagle	Dingo	<del>Goldfish</del>	<del>Fox</del>
3rd preference		Dingo	Bobcat	Cheetah	<del>Fox</del>	Bobcat	
<b>Number of ballots</b>	<b>201</b>	<b>198</b>	<b>171</b>	<b>189</b>	<b>182</b>	<b>176</b>	<b>149</b> (exhausted)

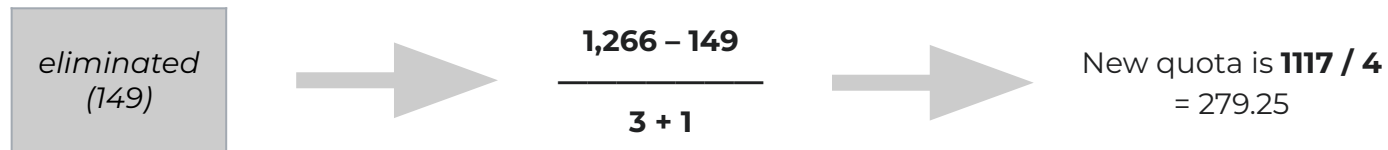


# Quota change

When ballots become **exhausted**, the quota changes according to the formula:

$$\frac{\text{Total votes} - \text{Excess votes}}{\text{Seats} + 1}$$

In our example, **Goldfish** was eliminated, leaving **149 exhausted ballots**:



Therefore, the new quota is 279.25. This is calculated after every step.



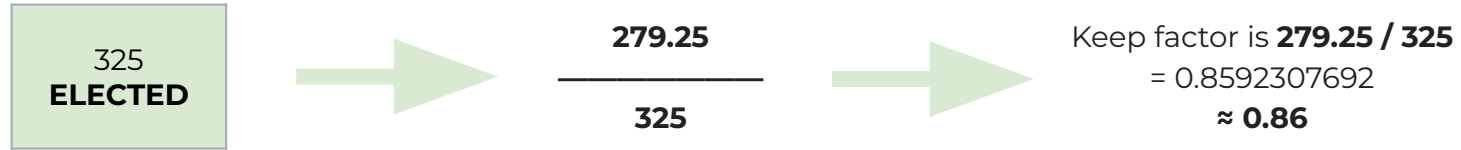
# Surplus votes

When a candidate is **elected**, surplus votes are transferred using a formula:

$$\frac{\text{Winning quota}}{\text{Votes for that candidate}}$$

This number is **different for every elected candidate**. It is known as the "keep factor".

In our example, **Fox** was elected with **325 votes**:



Therefore, **Fox** can "keep"  $\approx$  **0.86 of their votes** and still be at the winning quota.



# Tallying: Meek STV

So, let's transfer **Fox**'s surplus votes to the next choices on their first-preference ballots.

These are transferred using the formula **(1 - keep factor) \* total votes**.

This can in theory include transfers to other elected candidates, but in this case it does not.

<b>Bobcat</b> 's initial vote total	+	1 - <b>Fox</b> 's keep factor	*	<b>Fox</b> 's total votes	=	<b>Bobcat's new total</b>
198	+	(1 - 0.86)	*	325	=	<b>243.5</b>



# Tallying: Meek STV

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
Keep factor	1	1	1	1	1	<b>0.86</b>	—
<b>Step 3</b> Quota: 279.25	201	$198 + (1 - 0.86) * 325$ = <b>243.5</b>	171	189	182	$= 325 * 0.86$ = <b>279.5</b>	<i>eliminated</i>



# Tallying: Meek STV

Nobody meets quota, so we eliminate the candidate with the least votes (**Cheetah**) and distribute to their next-preferences.

**Dingo** meets the quota and is elected.

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
Keep factor	1	1	1	1	1	<b>0.86</b>	—
Step 4 Quota: 279.25	201	243.5	<i>eliminated</i> (171)	= 189 + 171 = 360 <b>ELECTED</b>	182	279.5	<i>eliminated</i>

Note that the quota remains the same, since these actions do not exhaust any ballots.



# Votes after Step 4

The ballots currently look like this:

1st preference	Aardvark	Bobcat	<del>Cheetah</del>	<del>Dingo</del>	Eagle	<del>Fox</del>	Goldfish
2nd preference	Bobcat	Aardvark	<del>Dingo</del>	Eagle	<del>Dingo</del>	<del>Goldfish</del>	<del>Fox</del>
3rd preference		<del>Dingo</del>	Bobcat	<del>Cheetah</del>	<del>Fox</del>	Bobcat	
<b>Number of ballots</b>	<b>201</b>	<b>198</b>	<b>171</b>	<b>189</b>	<b>182</b>	<b>176</b>	<b>149</b> (exhausted)





# Tallying: Meek STV

We work out a new keep factor for **Dingo** and transfer their votes.

In the next round, we eliminate **Aardvark** and transfer their votes as normal.

**Bobcat** now meets the quota and is elected.

Step	Votes for each option						
	Aardvark	Bobcat	Cheetah	Dingo	Eagle	Fox	Goldfish
<b>Keep factor</b>	1	1	1	<b>0.78</b>	1	<b>0.86</b>	—
<b>Step 5</b> Quota: 279.25	201	243.5	<i>eliminated</i>	= $360 * 0.78$ = <b>280.8</b>	= $182 + (1 - 0.78) * 360$ = <b>261.2</b>	279.5	<i>eliminated</i>
<b>Step 6</b> Quota: 279.25	<i>eliminated</i> (201)	= $243.5 + 201$ = <b>444.5</b> <b>ELECTED</b>	<i>eliminated</i>	280.8	261.2	279.5	<i>eliminated</i>

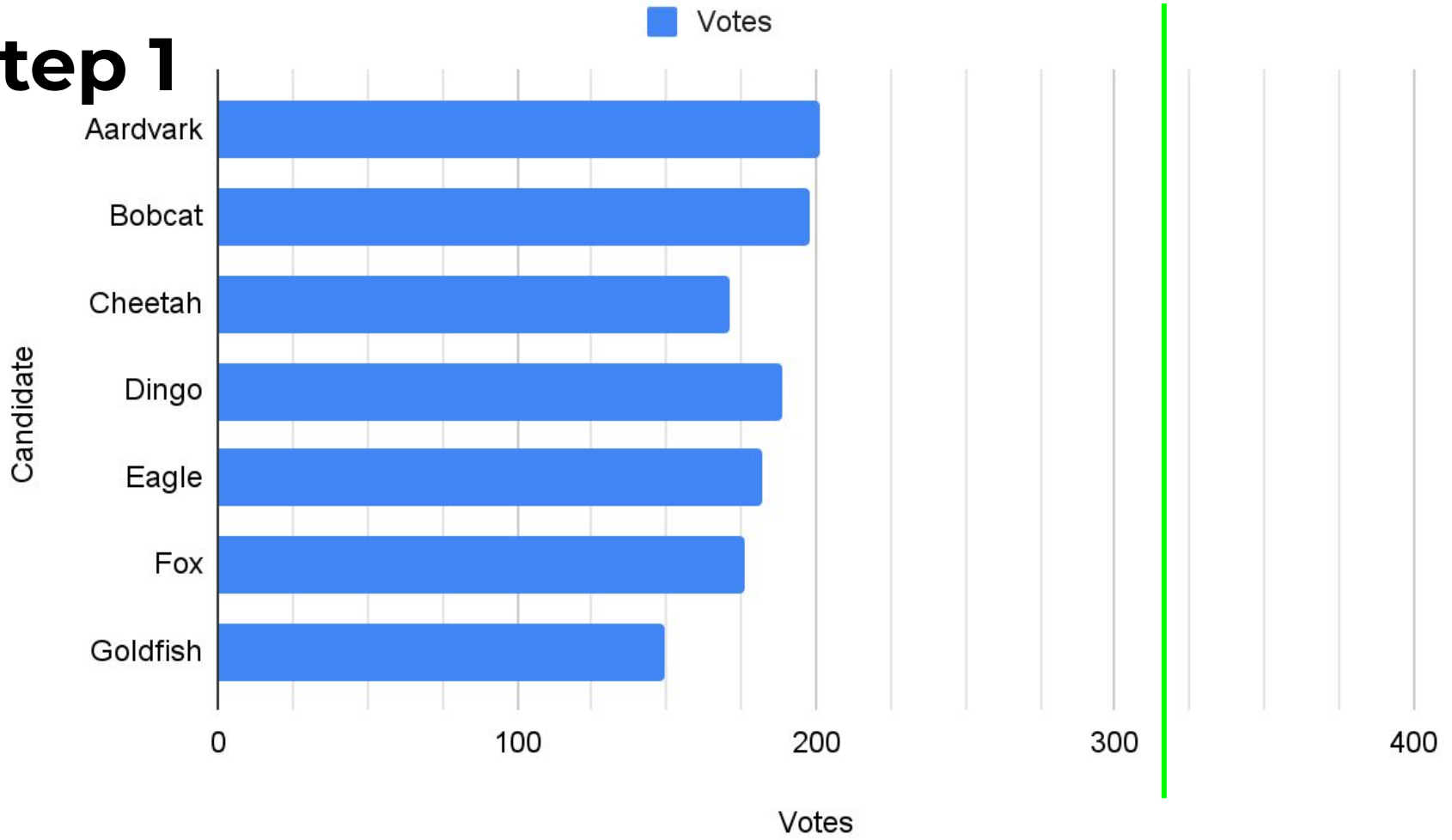


# Results as charts

The following slides depict the same information as charts, showing visually where the surplus votes were transferred.

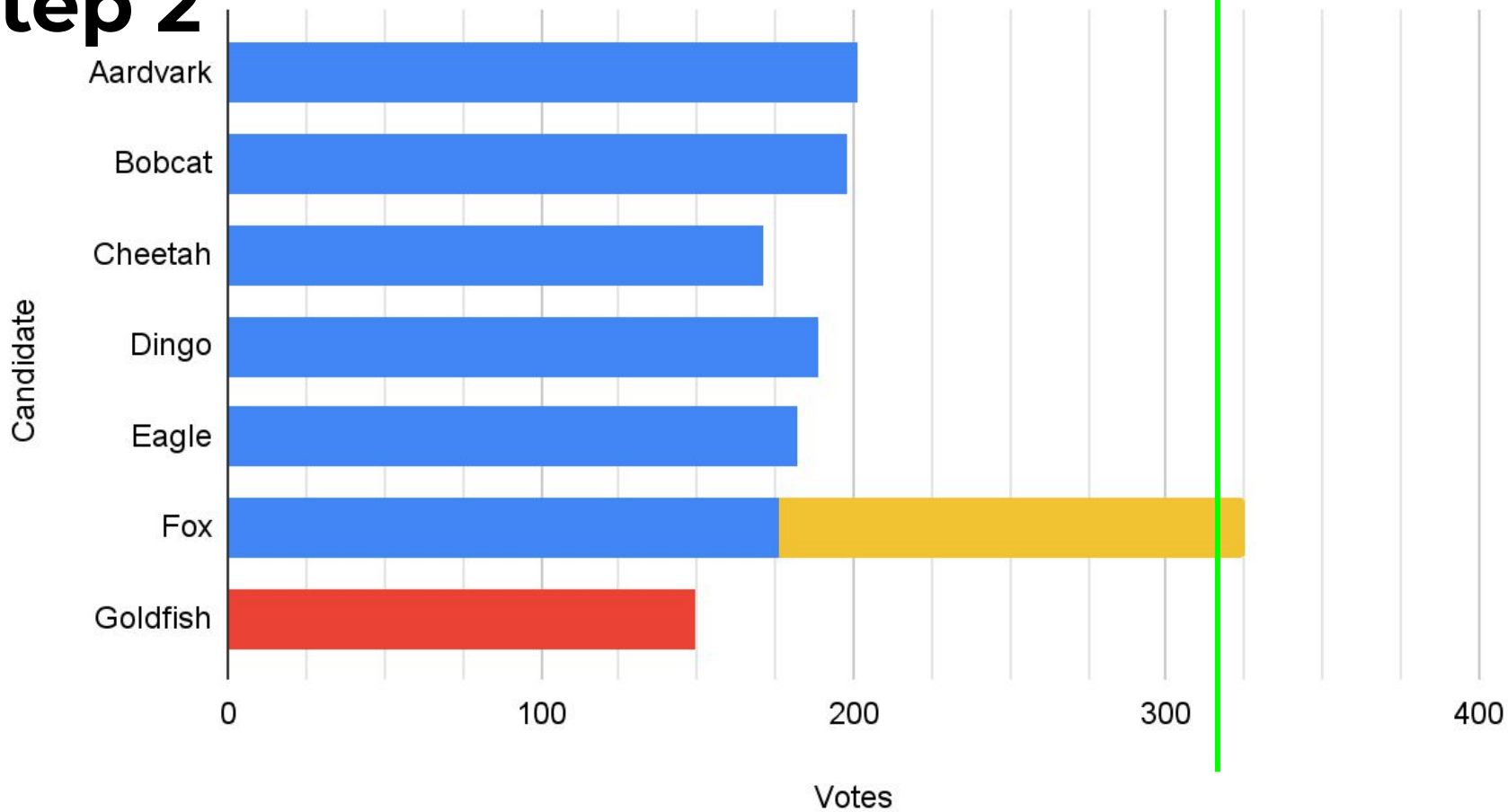


# Step 1

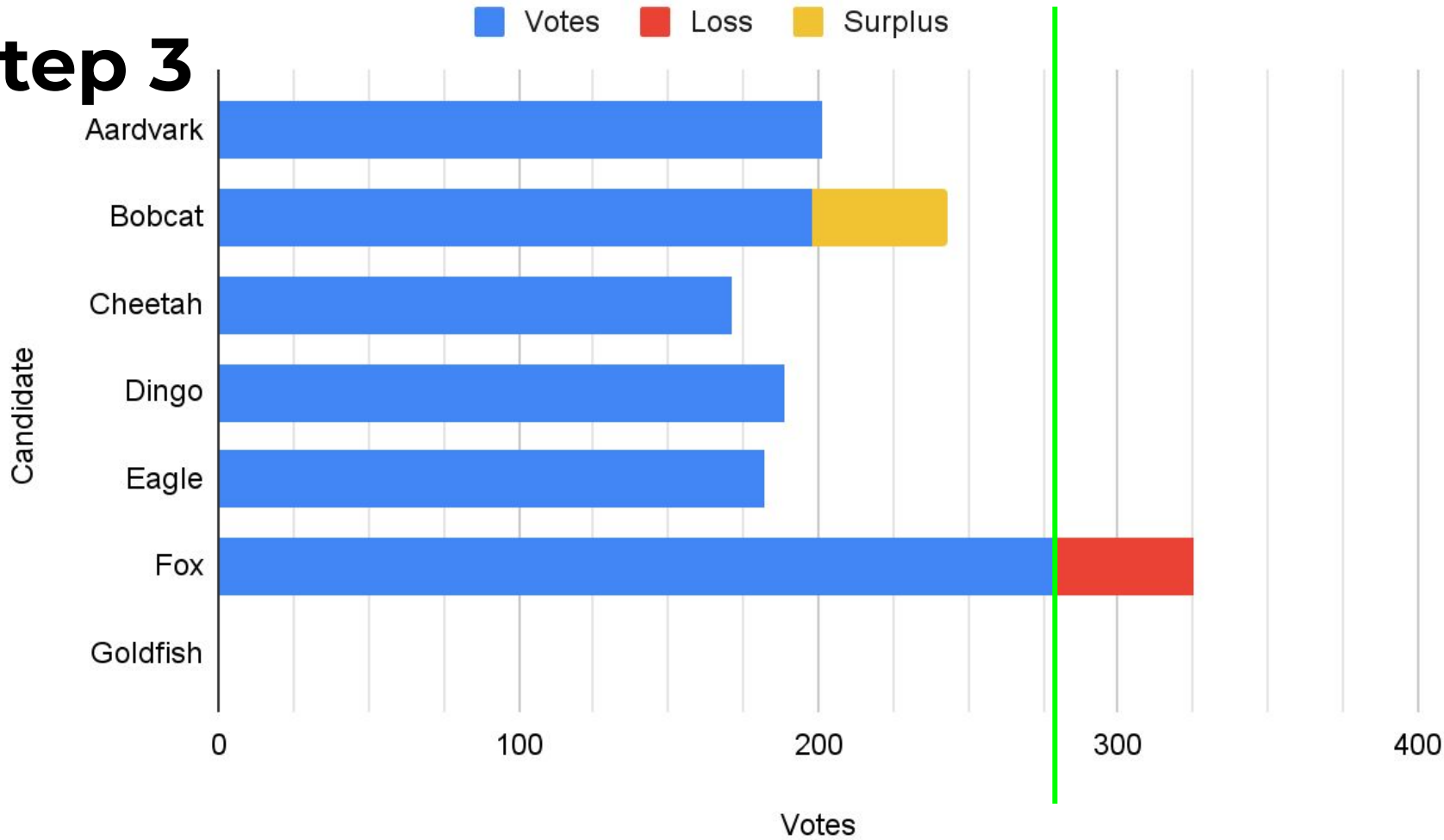


# Step 2

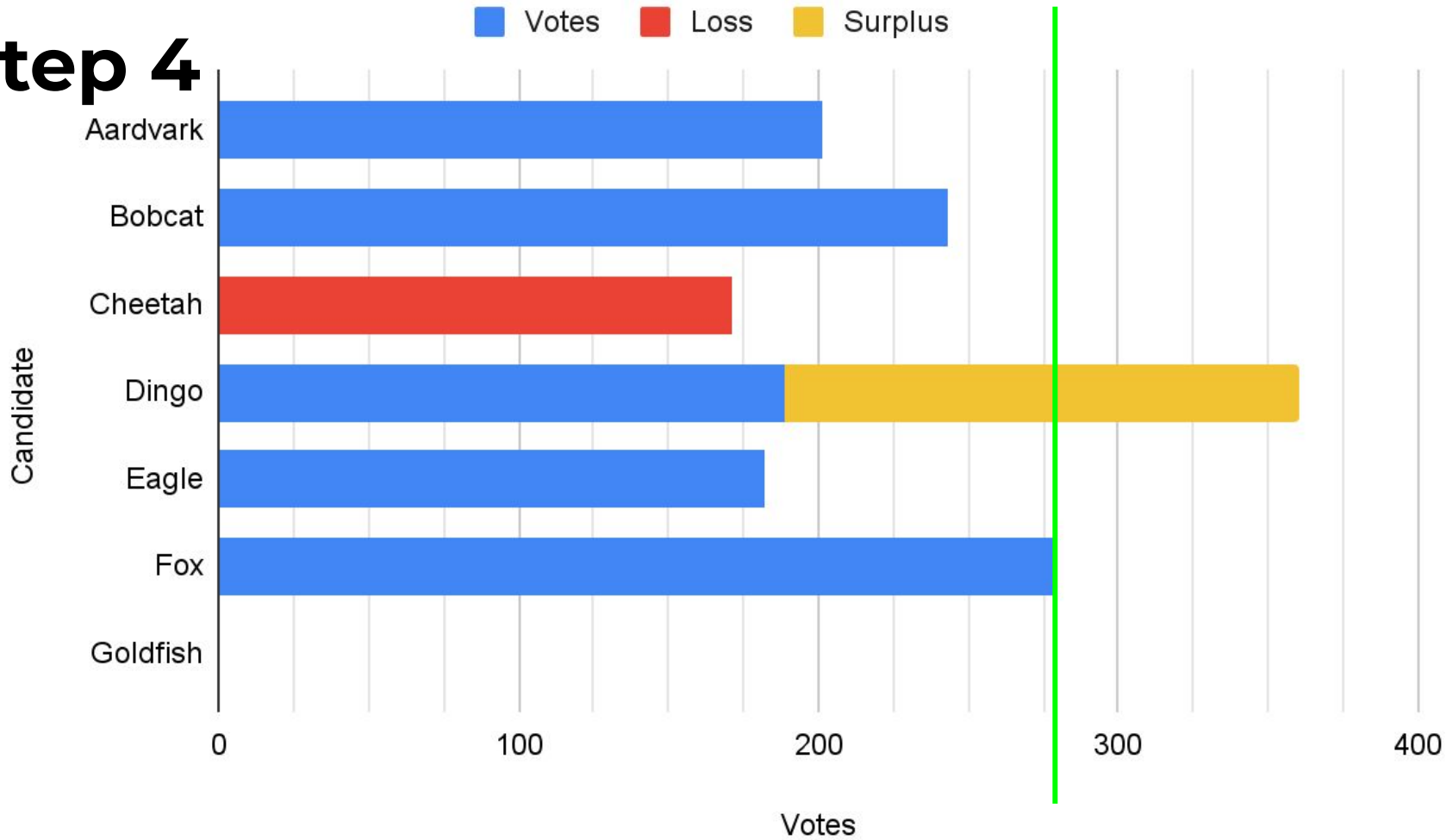
■ Votes ■ Loss ■ Surplus



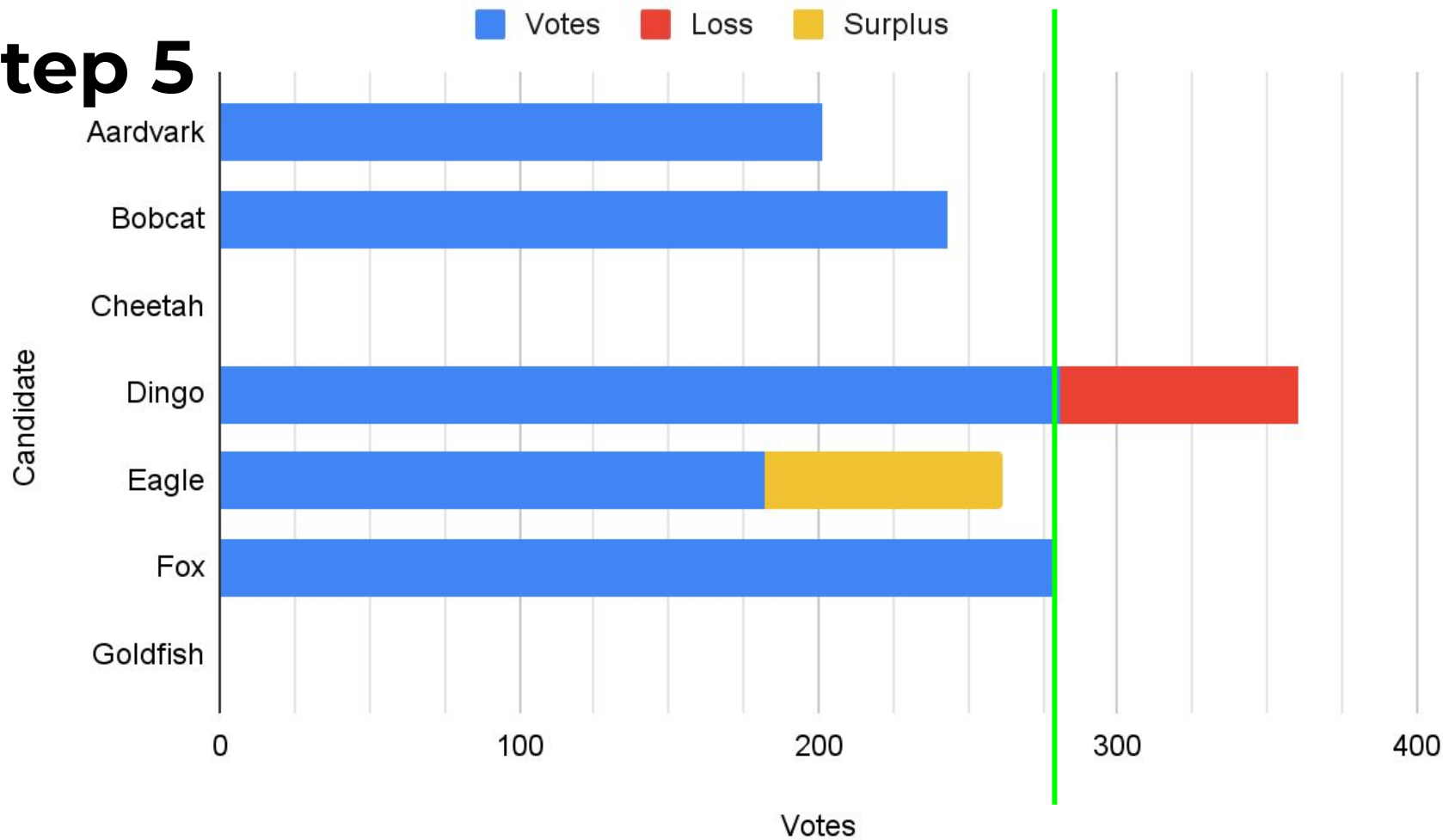
# Step 3



# Step 4

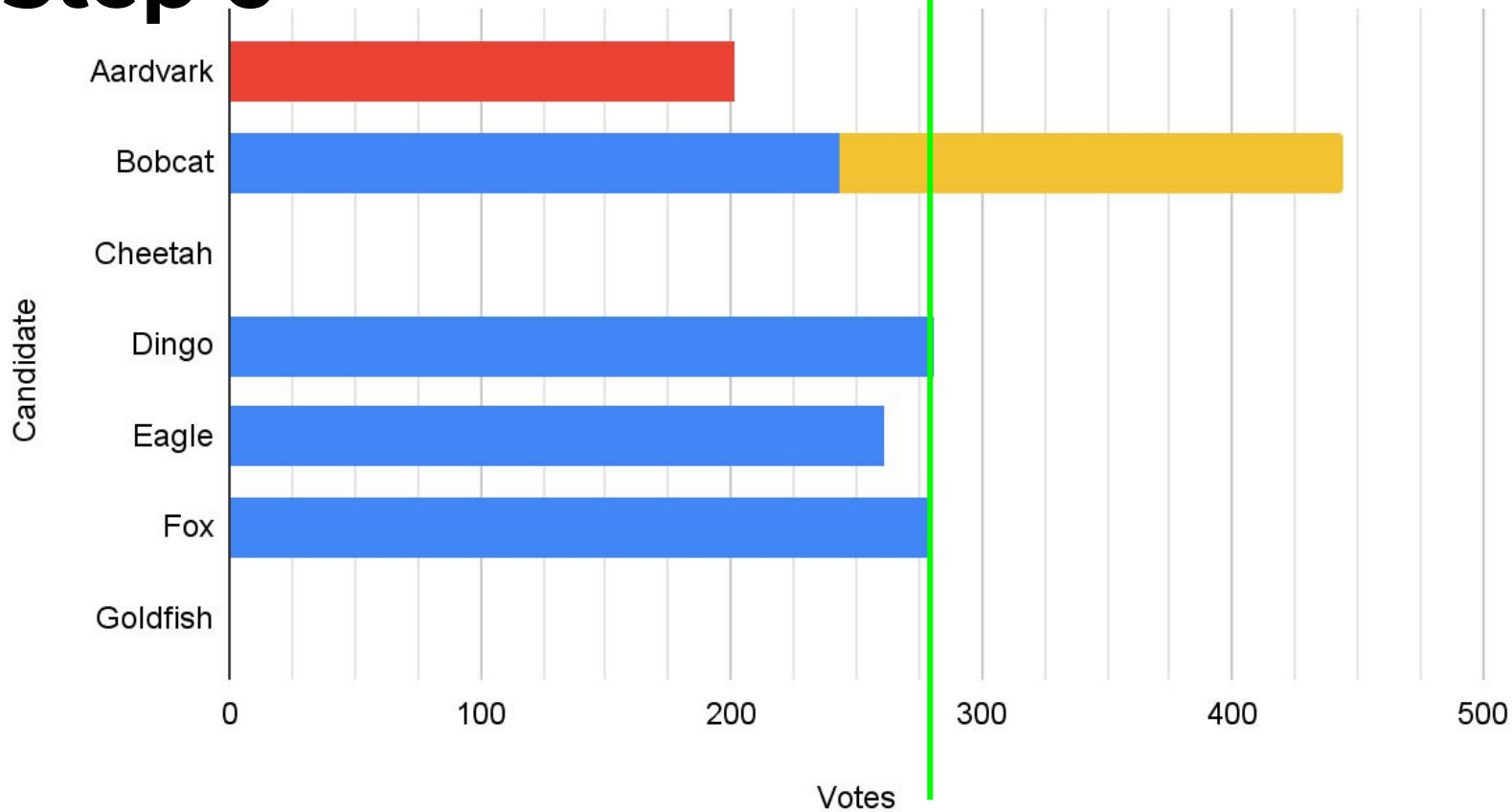


# Step 5



# Step 6

Votes Loss Surplus





# Image credits

- [File:Aardvark \(Orycteropus afer\).jpg](#) by Theo Kruse, CC BY-SA 4.0
- [File:Bobcat \(Lynx rufus\) California.jpg](#) by Marlin Harms, CC BY 2.0
- [File:Gepard \(Acinonyx jubatus\) Tiergarten Schönbrunn.jpg](#) by Alexander Leisser, CC BY-SA 4.0
- [File:Female Dingo from close distance.jpg](#) by Majkalala, CC BY-SA 4.0
- [File:Kaiseradler Aquila heliaca 2 amk.jpg](#) by AngMoKio, CC BY-SA 2.5
- [File:Alaska Red Fox \(Vulpes vulpes\).jpg](#) by Gregory "Slobirdr" Smith, CC BY-SA 2.0
- [File:Fantail Goldfish Carrot.jpg](#) by Ry362, CC BY-SA 3.0

