

TIGHT BOUNDS ON THE DISTORTION OF RANDOMIZED AND DETERMINISTIC DISTRIBUTED VOTING

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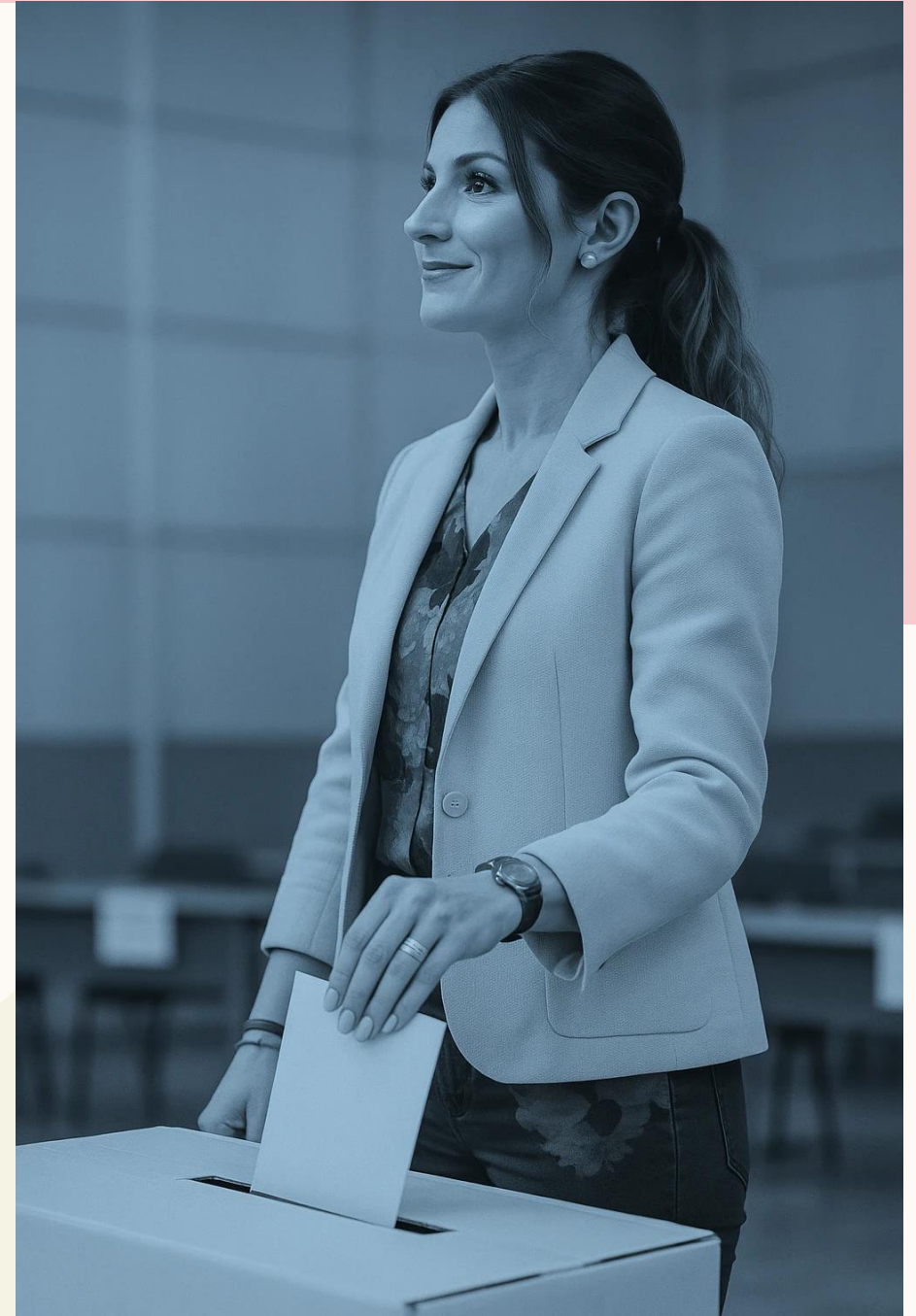
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NEURIPS 2025

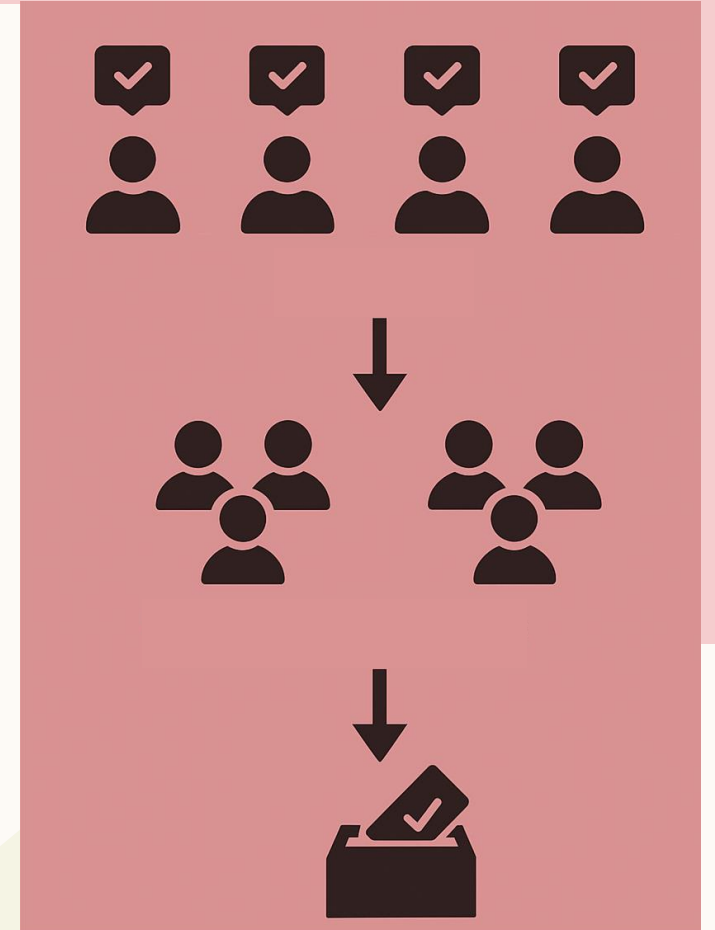
VOTING

- Aggregating individual preferences over a set of candidates into a collective decision.

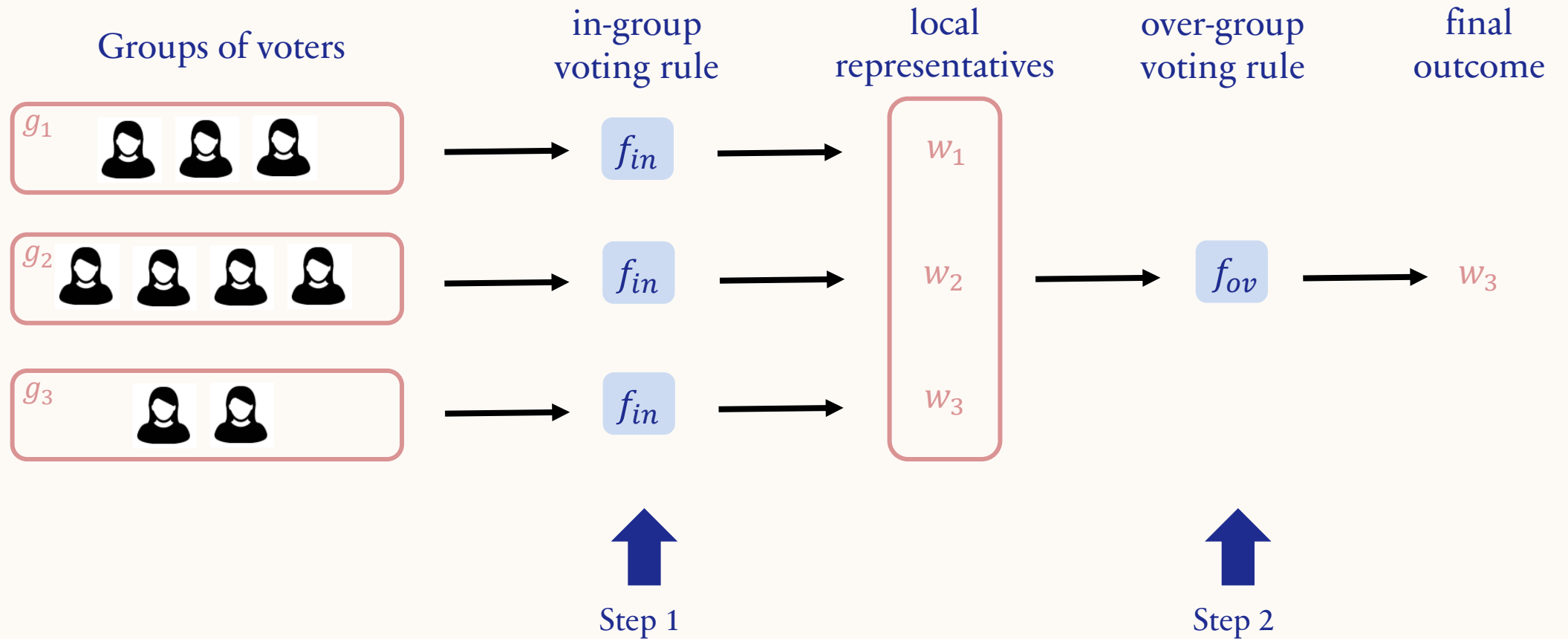


DISTRIBUTED VOTING

- Voters are partitioned into k disjoint groups, each selecting a local representative, and a final winner is chosen from them.
- Real-world application: the U.S. presidential elections.



AN ILLUSTRATION OF DISTRIBUTED VOTING



PROBLEM FORMULATION IN METRIC SPACE

A distributed voting mechanism $\mathcal{M} = (f_{in}, f_{ov})$

- f_{in} : in-group voting rule
- f_{ov} : over-group voting rule

Cost objectives:

- Average of averages (avg_avg)
- Average of maxima (avg_max)
- Maximum of averages (max_avg)
- Maximum of maxima (max_max)

DISTORTION

- A well-established benchmark to quantify outcome of the mechanism \mathcal{M} .
- The ratio of the winner's cost to the optimal candidate's cost in the worst case.
- w : final winner of \mathcal{M}
- For any candidate c , we define

$$\text{distortion}(\mathcal{M}) = \max \frac{\text{cost}(w)}{\min \text{cost}(c)}$$

PREVIOUS RESULTS (DETERMINISTIC)

Cost	Metric Distortion
avg_avg	$[7, 11]$
avg_max	$[2 + \sqrt{5}, 11]$
max_avg	$[2 + \sqrt{5}, 5]$
max_max	$[3, 5]$

Anshelevich, E., Filos-Ratsikas, A., and Voudouris, A. A. (2022). The distortion of distributed metric social choice. Artificial Intelligence.

OUR RESULTS (DETERMINISTIC)

det – *det* mechanism $\mathcal{M} = (f_{in}, f_{ov})$

- f_{in}, f_{ov} : deterministic

Cost	Metric Distortion
avg_max	$[2 + \sqrt{5}, 7]$
max_avg	5
max_max	3

OUR RESULTS (RANDOMIZED)

rand – *det* mechanism $\mathcal{M} = (f_{in}, f_{ov})$

- f_{in} : deterministic
- f_{ov} : randomized
- k : # of groups

Cost	Metric Distortion
avg_avg	$5 - \frac{2}{k}$
avg_max	3
max_avg	5
max_max	3

OUR RESULTS (RANDOMIZED)

rand – *rand* mechanism $\mathcal{M} = (f_{in}, f_{ov})$

- f_{in}, f_{ov} : randomized
- n^* : the largest group size

Cost	Metric Distortion
avg_avg^*	$[3 - \frac{2}{n}, 3 - \frac{2}{kn^*}]$
avg_max	$[3 - \frac{2}{n}, 3]$
max_avg	3
max_max	3

*In the symmetric case, the bound is tight.

THANK YOU

