Improving the Buurtbudget: Can Mathematics and Computer Science Help?

Science Park Open Dag 2021

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University of Amsterdam

Institute for Logic, Language and Computation

The Gemeenteraad

Decision Process for Budget Allocation

© Marianne de Heer Kloots

1000€

2000€

2500€

2500€

5000€

: 7000€

How would you decide which of the projects to fund?

The Buurtbudget

© Marianne de Heer Kloots

1000€

2000€

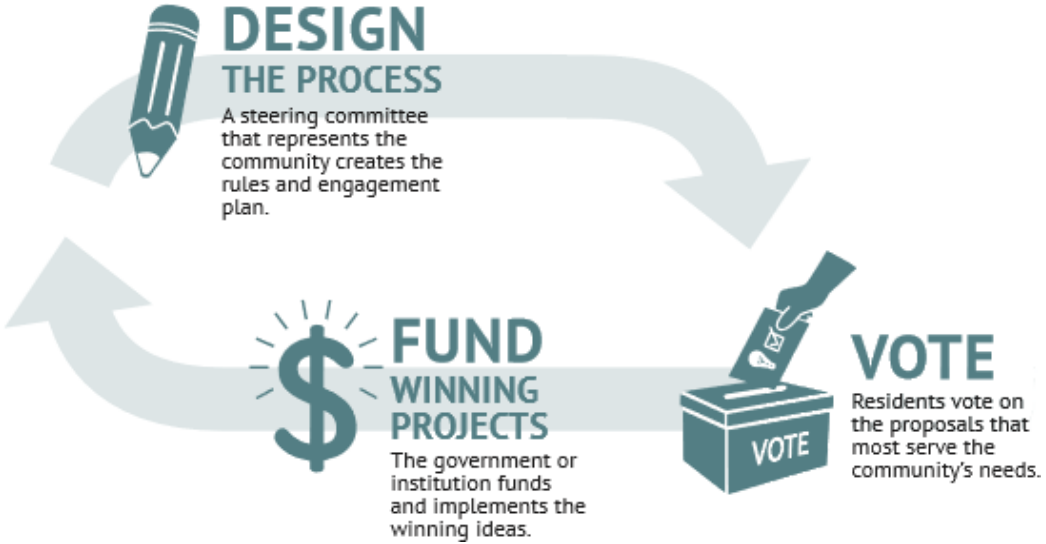
2500€

2500€

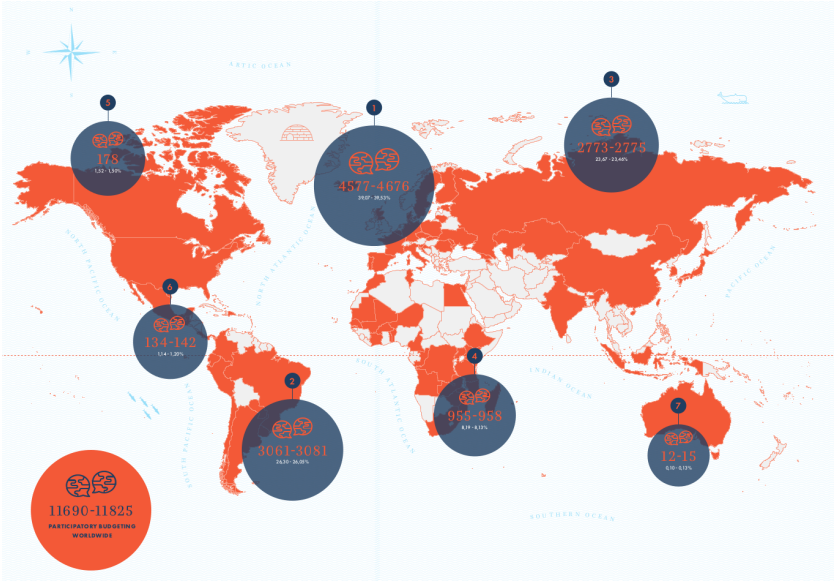
5000€

: 7000€

The Process



The Success Story



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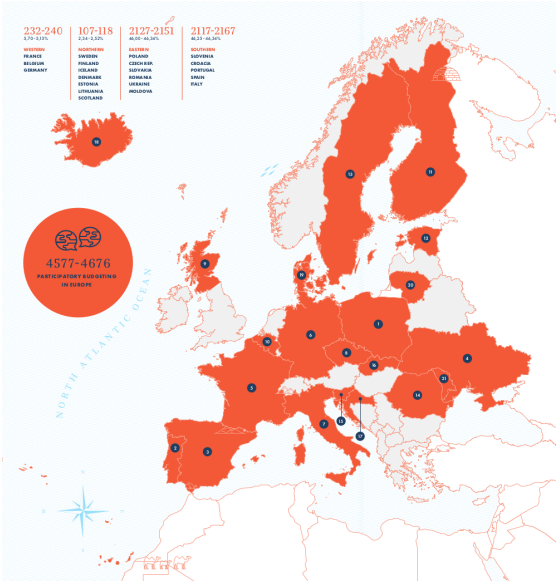
Participatory Budgeting in Europe



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Back to the Gemeenteraad

The Modalities of the Vote

Budget Limit

7000€

The Modalities of the Vote

Budget Limit

 7000€

Available Projects


1000€


2000€


2500€


2500€


5000€

The Modalities of the Vote

Budget Limit

 7000€

Available Projects



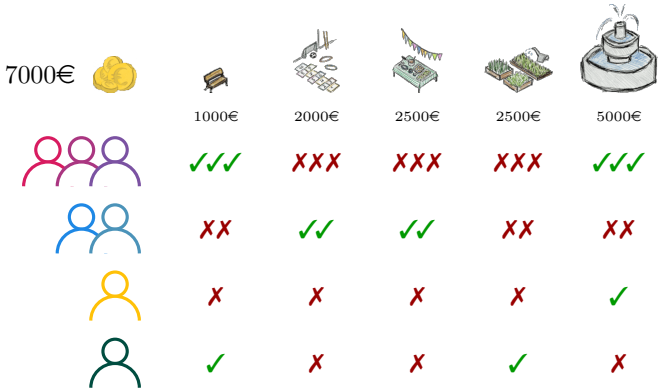


	1000€	2000€	2500€	2500€	5000€
	✓	✗	✗	✗	✓
Approval Ballots 	✗	✓	✓	✗	✗
	✗	✗	✗	✗	✓

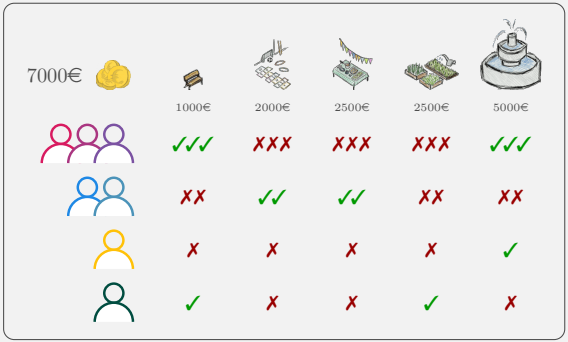
Selecting the Projects

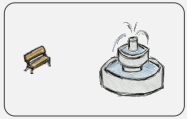
7000€	1000€	 2000€	 2500€	 2500€	 5000€
	✓✓✓	✗✗✗	✗✗✗	✗✗✗	✓✓✓
	✗✗	✓✓	✓✓	✗✗	✗✗
	✗	✗	✗	✗	✓
	✓	✗	✗	✓	✗

Selecting the Projects

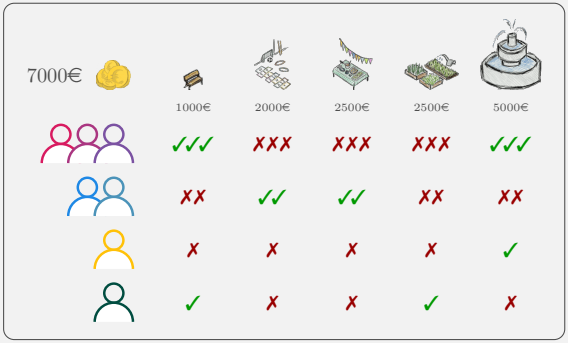


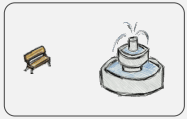
Voting Rule





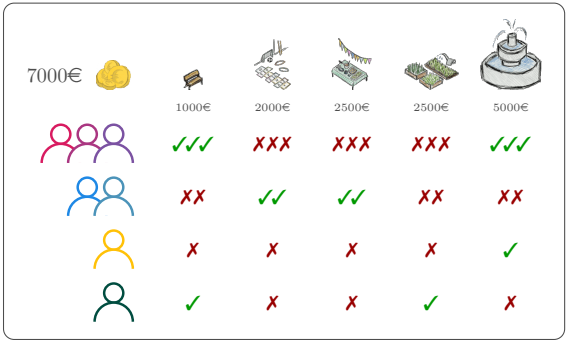
Voting Rule

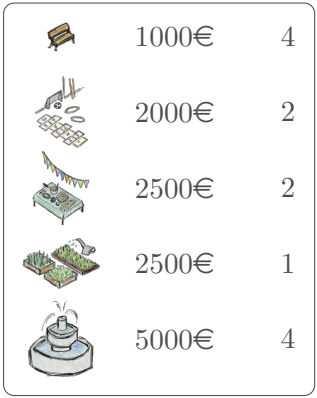




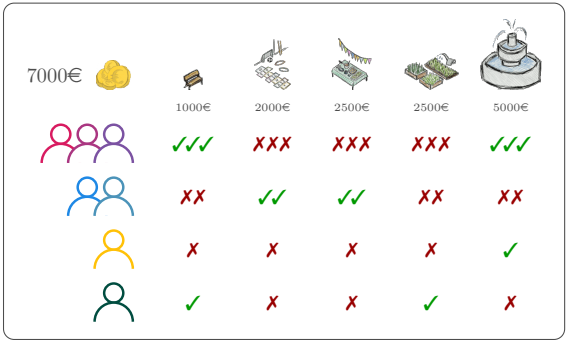
Computational Social Choice: studying, in a formal way, the properties of voting rules.

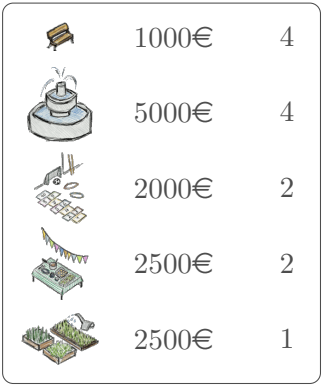
The Most Natural Voting Rule for Participatory Budgeting

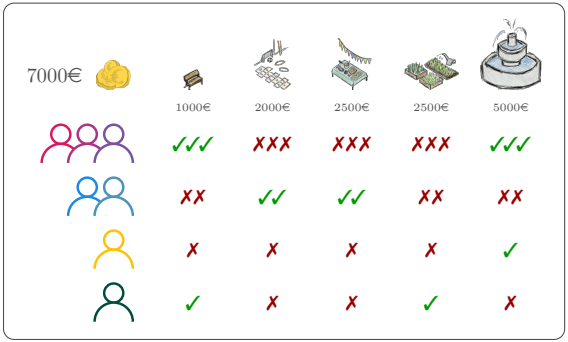




The Most Natural Voting Rule for Participatory Budgeting

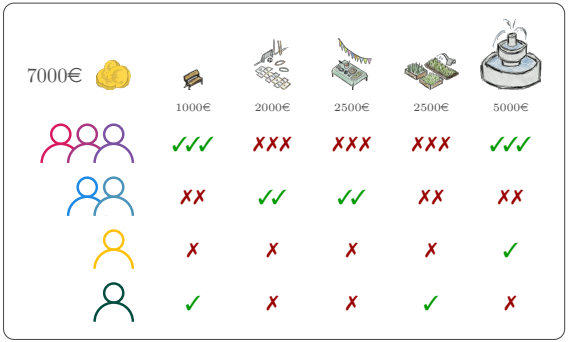


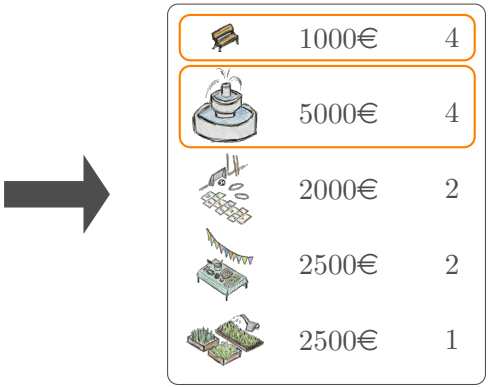



7000€
1000€
2000€
2500€
2500€
5000€
✓✓✓ ✗✗✗ ✗✗✗ ✗✗✗ ✓✓✓
✗✗ ✓✓ ✓✓ ✗✗ ✗✗
✗ ✗ ✗ ✗ ✓
✓ ✗ ✗ ✓ ✗


1000€ 4
5000€ 4
2000€ 2
2500€ 2
2500€ 1

The Most Natural Voting Rule for Participatory Budgeting





Limitations of the Previous Rule: Representation

7000€

1000€

2000€

5000€

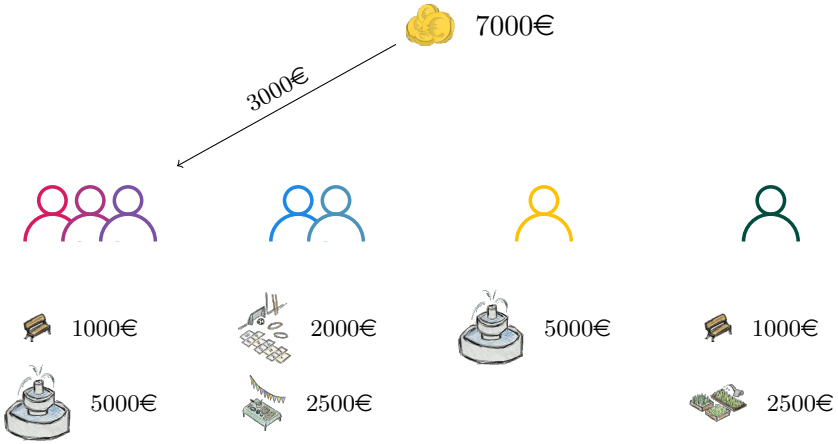
1000€

5000€

2500€

2500€

Limitations of the Previous Rule: Representation



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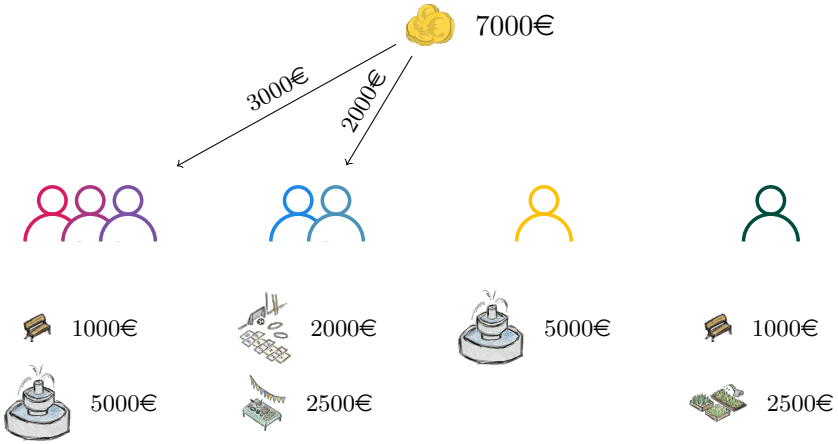

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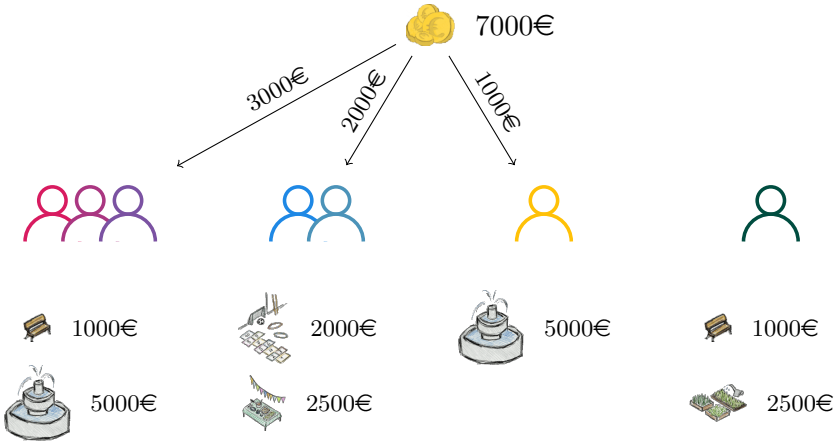
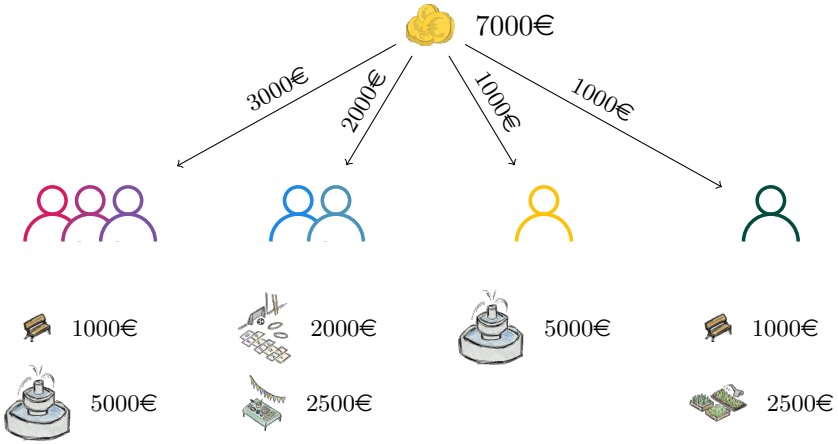


Limitations of the Previous Rule: Representation



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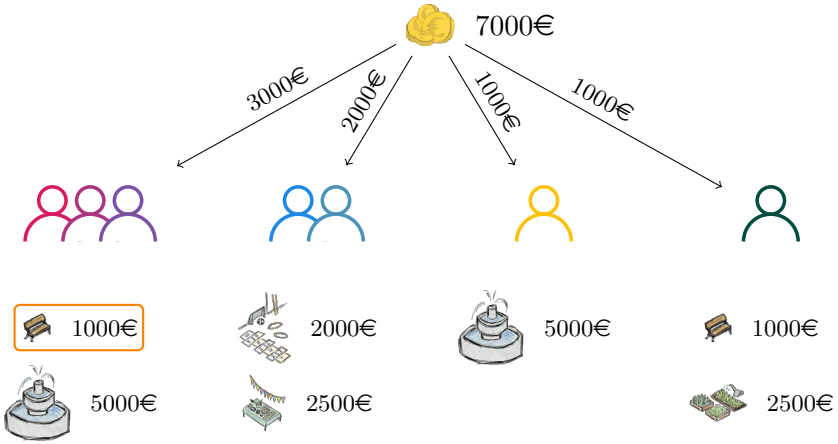

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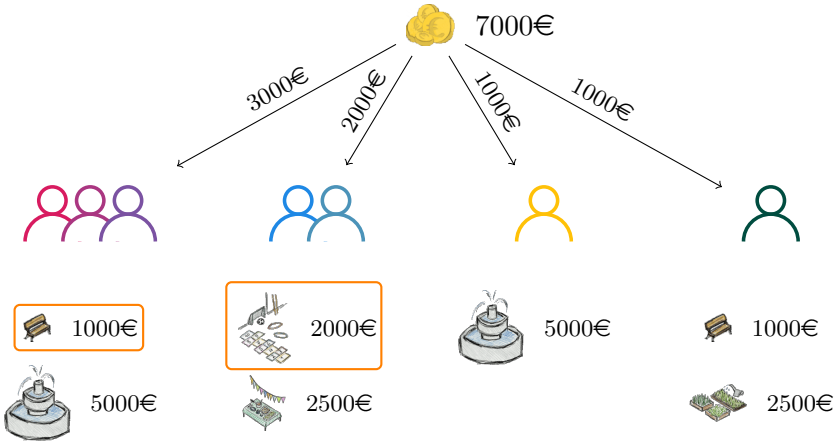

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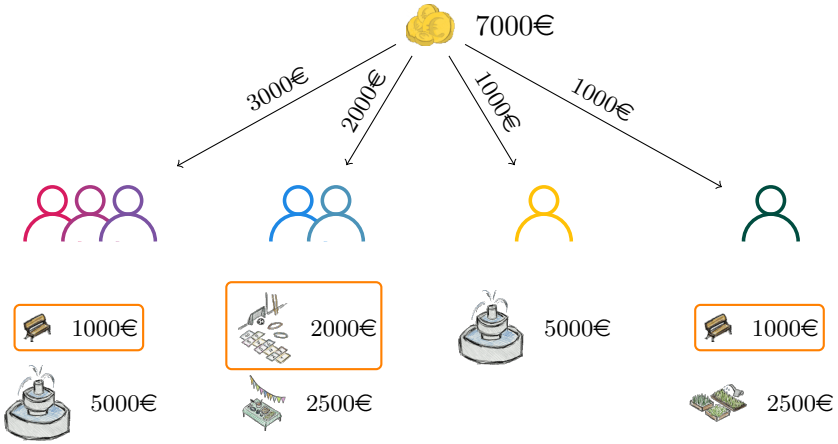

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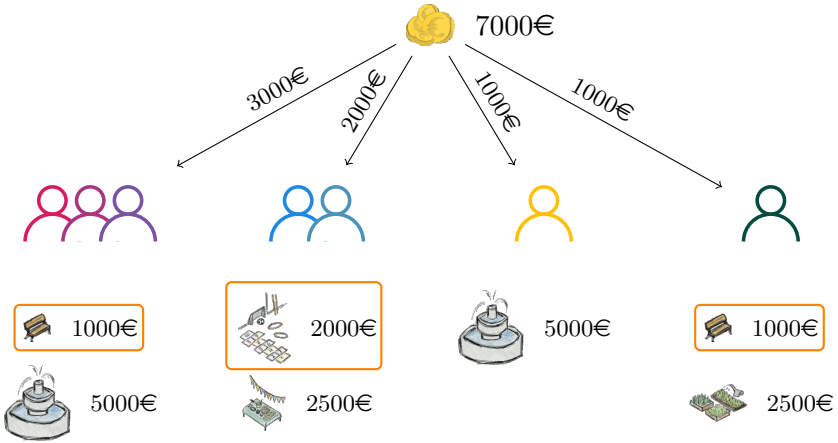


↪ The previous rule is not representative.

Another Voting Rule, Proven to be Representative

Another Voting Rule, Proven to be Representative

1000€

1000€

1000€

1000€

Each pay: 50€

1000€ 200€

5000€ 200€

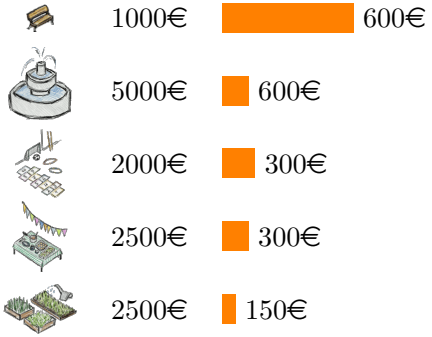
2000€ 100€

2500€ 100€

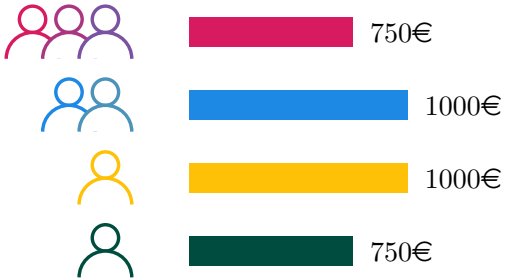
2500€ 50€

Another Voting Rule, Proven to be Representative

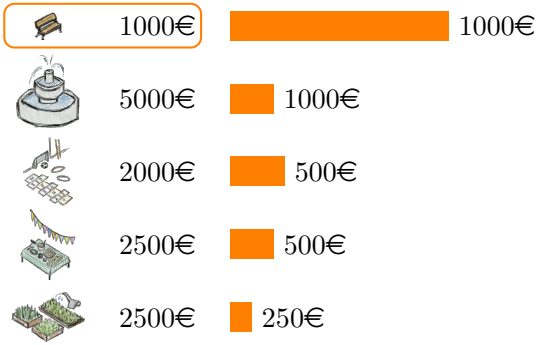
Each pay: 150€



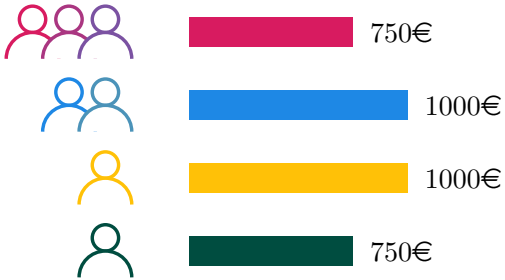
Another Voting Rule, Proven to be Representative



Each pay: 250€



Another Voting Rule, Proven to be Representative



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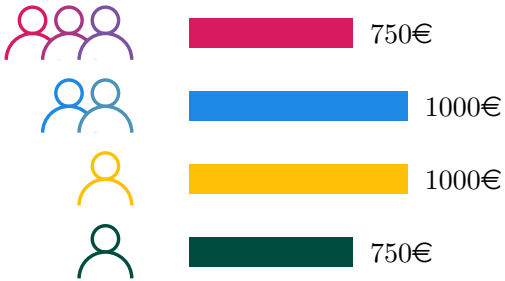
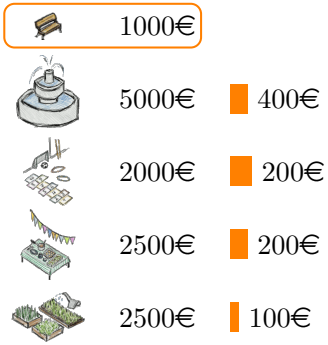
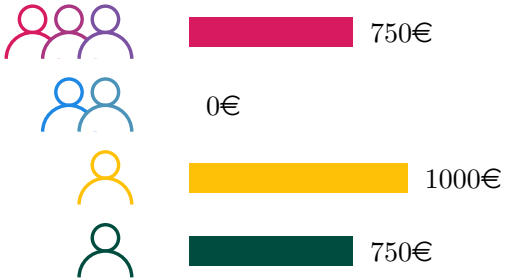


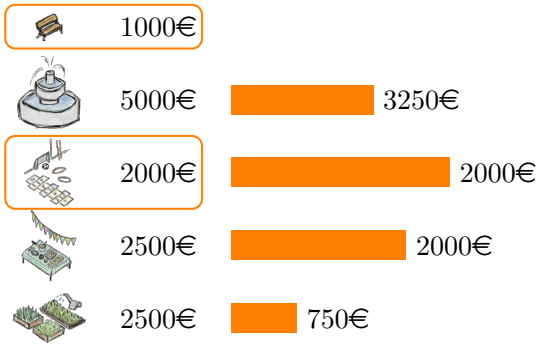
Each pay: 100€



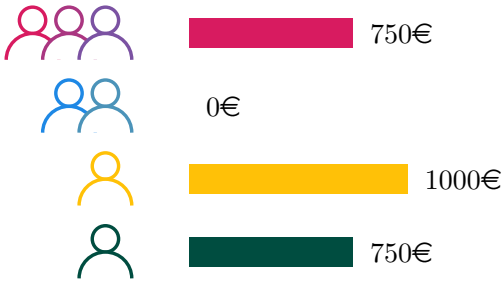
Another Voting Rule, Proven to be Representative



Each pay at most: 1000€



Another Voting Rule, Proven to be Representative



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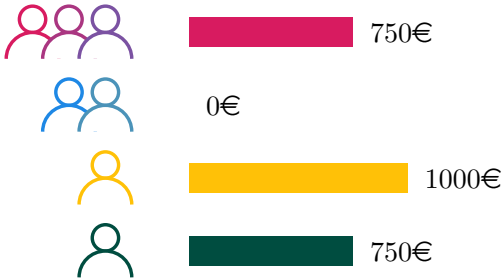
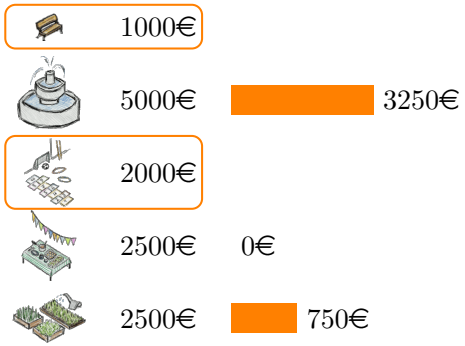
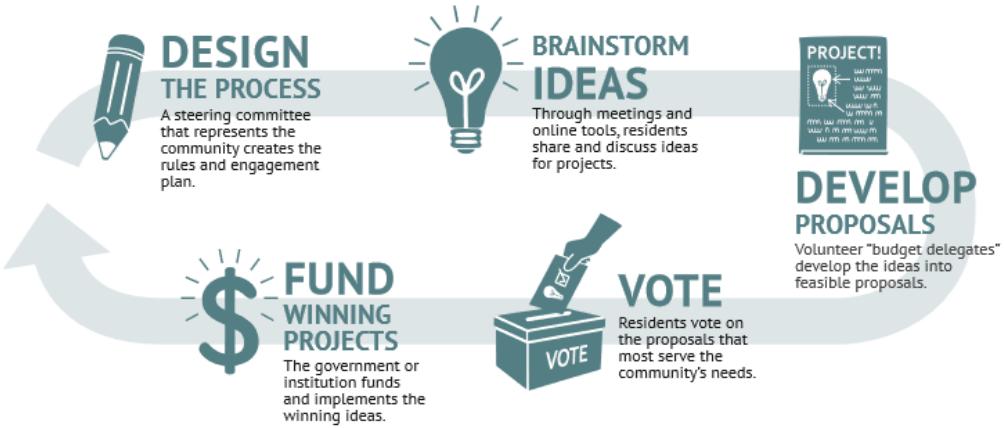


Each pay at most: 1000€



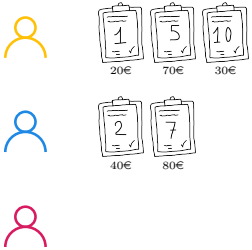
One Year Later, at the Gemeenteraad

The Full Buurtbudget Process



A Formal Representation of the Full Process

Agents think about their proposals



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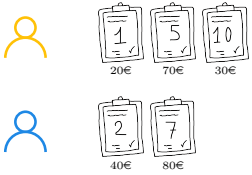
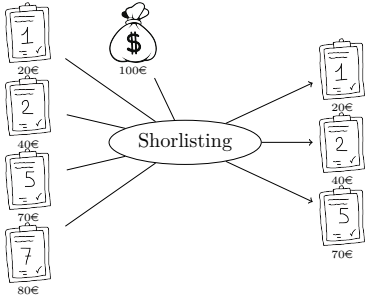


They submit some of their proposals, that are *shortlisted*



A Formal Representation of the Full Process

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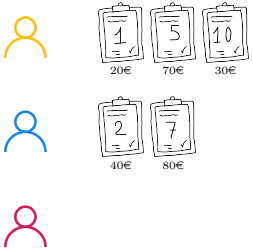

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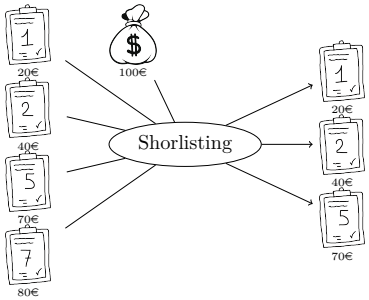
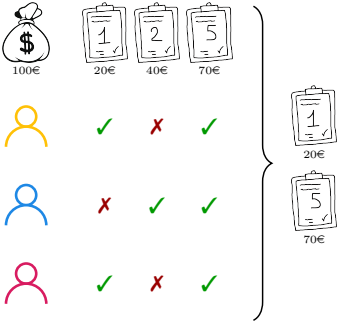
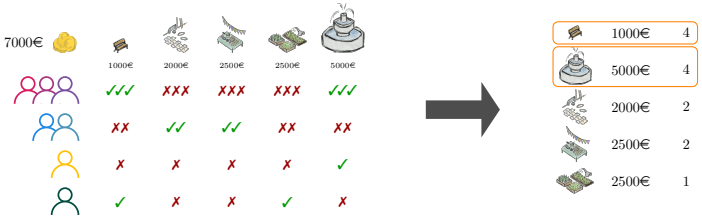


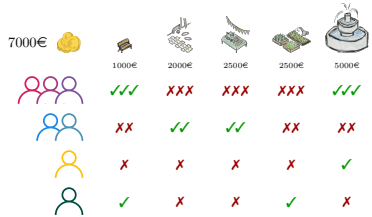
Agents vote on the shortlist to determine the *budget allocation*

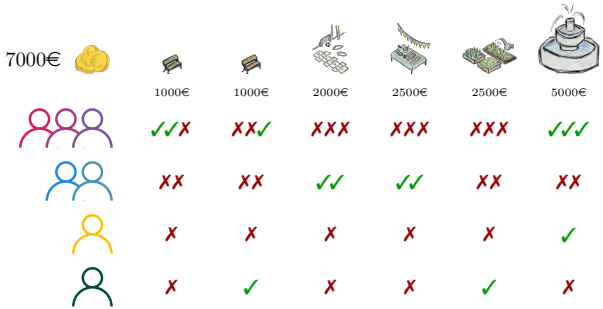


Interactions Between the Two Stages



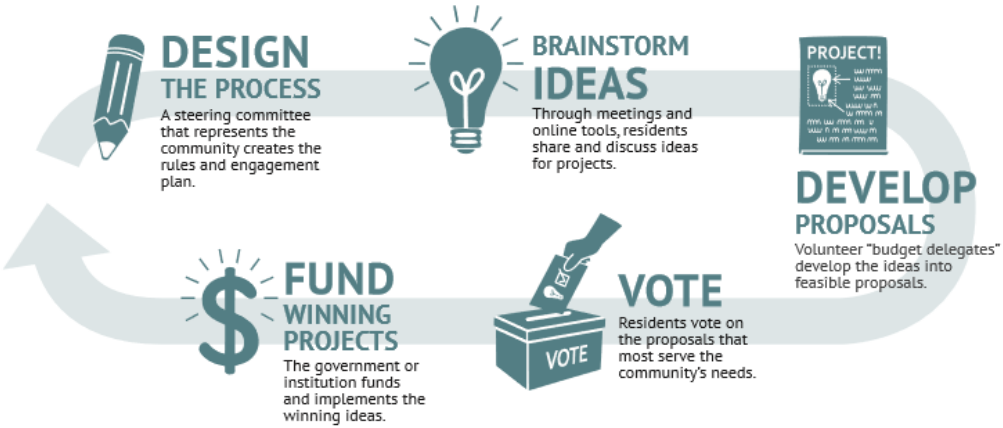
Interactions Between the Two Stages





Two Years Later, at the Gemeenteraad

Processes Spanning Several Years



A Formal Representation of Repetitive Participatory Budgeting

		Year 1 ($ = 10				Year 2 ($ = 10				Year 3 ($ = 10			
		1	2	3	4	5	6	7	8	9	10	11	12
Cost		6	2	2	4	5	5	3	2	7	7	$4/3$	$29/3$
Robots		✓			✓		✓	✓	✓	✓		✓	
		✓		✓			✓		✓	✓		✓	
		✓			✓		✓	✓	✓	✓		✓	
Animals			✓		✓	✓		✓	✓		✓	✓	✓
				✓	✓	✓		✓			✓		✓

A Formal Representation of Repetitive Participatory Budgeting

		Year 1			$= 10	Year 2			$= 10	Year 3			$= 10
		1	2	3	4	5	6	7	8	9	10	11	12
	Cost	6	2	2	4	5	5	3	2	7	7	4/3	29/3
Robots		✓			✓		✓	✓	✓	✓		✓	
		✓		✓			✓		✓	✓		✓	
		✓			✓		✓	✓	✓	✓		✓	
Animals			✓		✓	✓		✓	✓		✓	✓	✓
				✓	✓	✓		✓			✓		✓

Can we satisfy properties such as representation over time and not just for one-shot instances?

The Gemeenteraad Now Focuses on Other Issues

Computational Social Choice

Devising suitable rules for making collective decisions

Devising suitable rules for making collective decisions

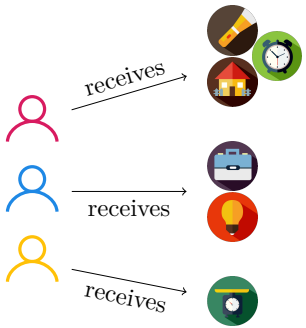
Voting Scenarios

Single-winner elections

Multi-winner elections

Devising suitable rules for making collective decisions

Fair Division



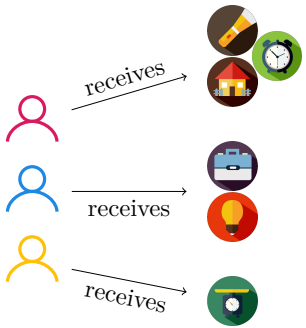
Voting Scenarios

Single-winner elections

Multi-winner elections

Devising suitable rules for making collective decisions

Fair Division



Voting Scenarios

Single-winner elections

Multi-winner elections

Other Topics

Matching

Opinion Diffusion

Liquid Democracy

The Group at the UvA

Arthur Boixel
Automatically justifying election outcomes

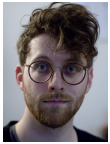
Sirin Botan
Understanding when voters can benefit from lying

Julian Chingoma
Studying voting scenarios involving complex preferences

Ulle Endriss
Using computer science to make better decisions

Ronald de Haan
Developing fast algorithms for hard problems in AI

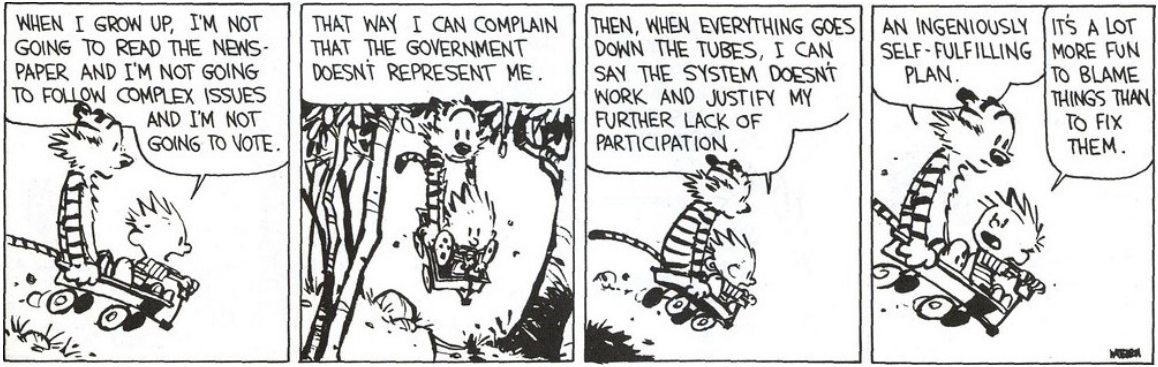
Adrian Haret
Finding conditions under which crowds can be wise



Jan Maly
Devising voting rules for selecting several winners

Oliviero Nardi
Automatically justifying election outcomes

Thanks for the Attending the Presentation



...and if you live in Zuid, don't forget to vote for the buurtbudget (in January)!