Taking the context into account : New voting frameworks

Pôle 1 Meeting in Deauville

Théo Delemazure

Paris Dauphine University, PSL
Supervisors : Jérôme Lang and Dominik Peters

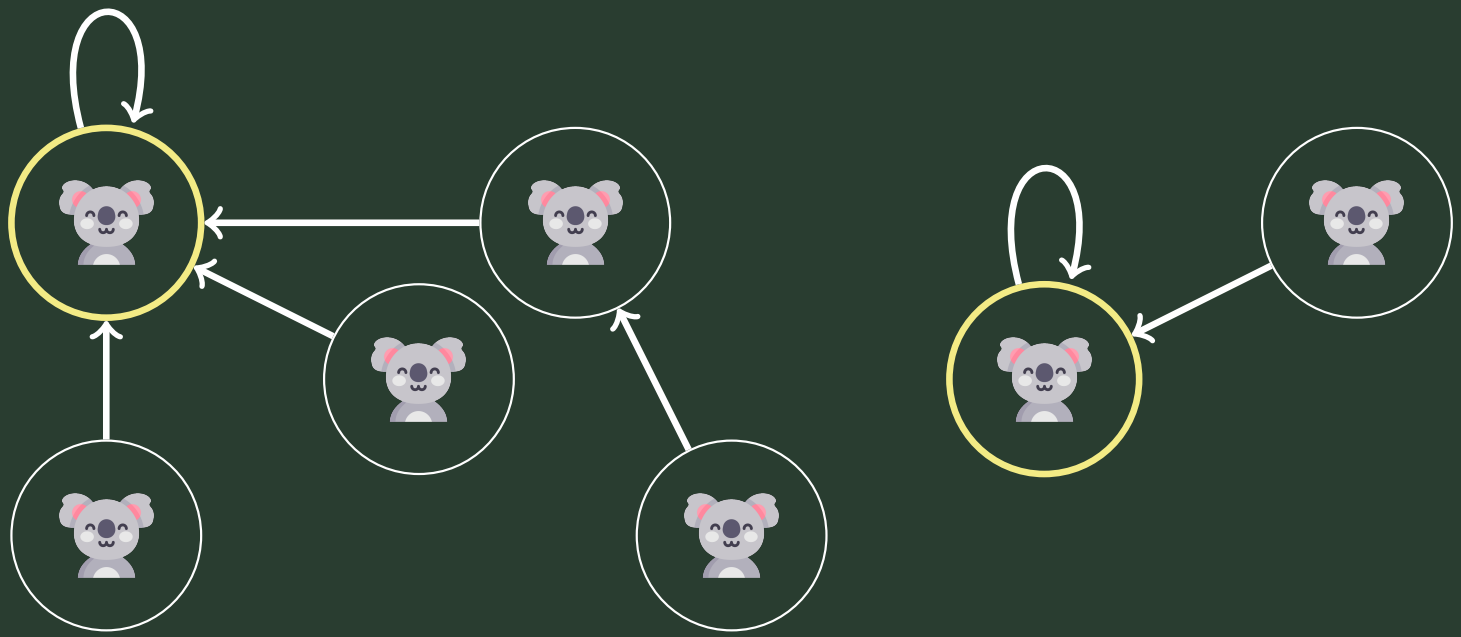
November 30th, 2021

Outline

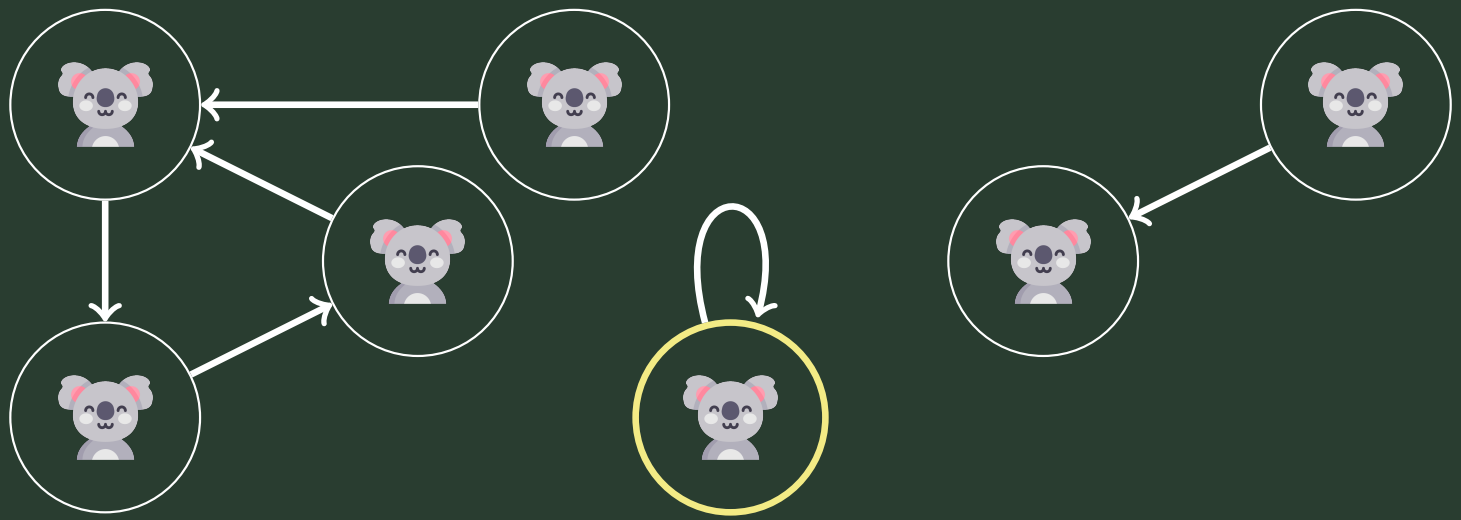
- Ranked Delegations for Liquid Democracy
  - With Ulrike Schmidt-Kraepelin, Markus Brill, Martin Lackner, Anne-Marie George
  - Submitted (Accepted ?) at AAAI 2022
- Approval With Runoff
  - With Jérôme Lang, Remzi Sanver, Jean-François Laslier

Summary

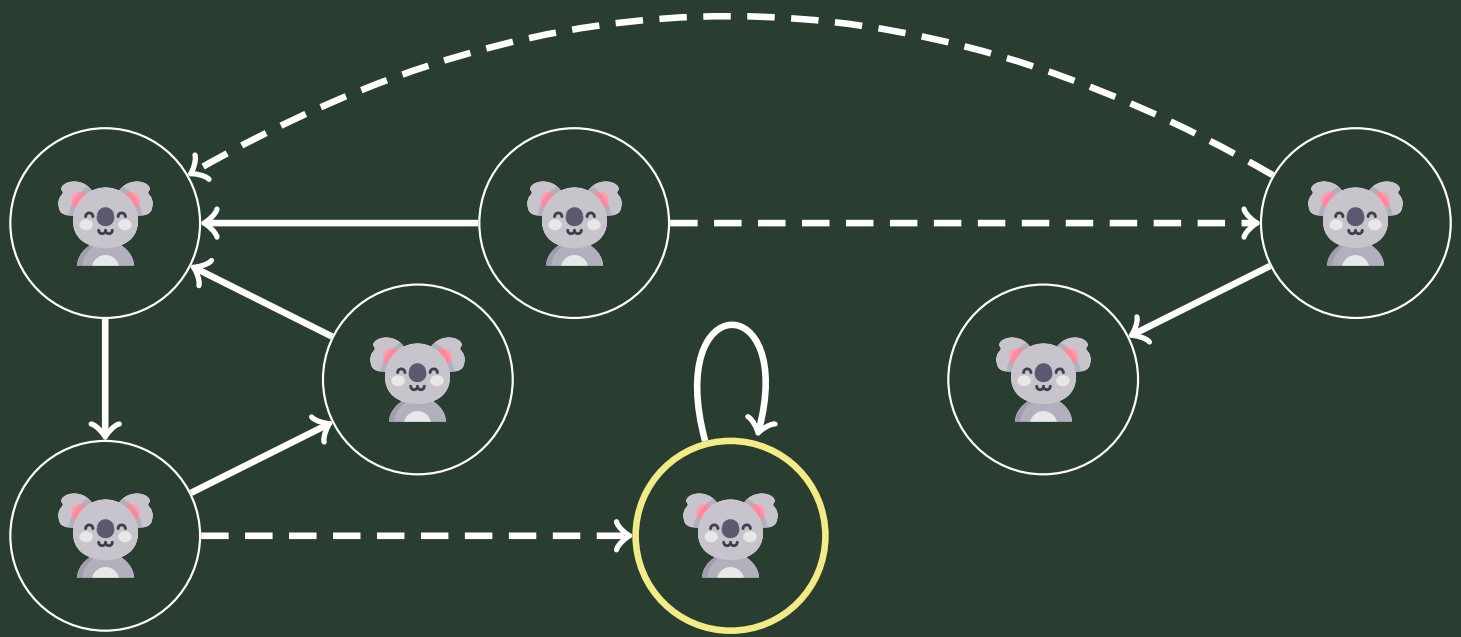
Liquid Democracy Framework



The issue with Liquid Democracy



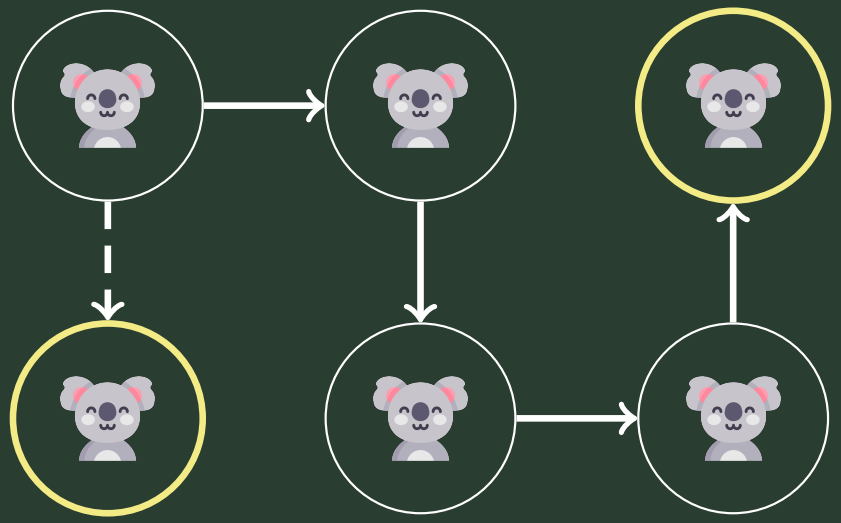
The solution : ranked delegations



1 ⟶

2 - - - →

How to assign representatives ?



1 ⟶

2 - - - →

Which delegation sequence to choose between (2) and $(1,1,1,1)$?

The delegation rules

Which delegation sequence to choose between $s_1 = (2)$ and $s_2 = (1, 1, 1, 1)$?

Here are some examples of such delegation rules :

- Breadth-First-Delegation : Select the shortest sequence (lexicographic tie-breaking)
- Depth-First-Delegation : Select the best sequence according to the lexicographic order
- Min-Sum : Select the sequence of minimal sum (lexicographic tie-breaking)
- Diffusion : Algorithmic rule
- LexiRank : s_1 is preferred to s_2 if $\sigma(s_1)$ is better than $\sigma(s_2)$ according to lexicographic order, where σ sort the sequence in decreasing order

Our results

- Axiomatic analysis of the voting rules with nice characterizations and several impossibility theorems.
- Experimental analysis of the voting rules which highlight a trade-off between power concentration and voter satisfaction

Summary

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

⇒

v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

⇒

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

$\Rightarrow$

		
v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

$\Rightarrow$

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

$\Rightarrow$

		
v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

$\Rightarrow$

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

$\Rightarrow$

		
v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

$\Rightarrow$ 

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

$\Rightarrow$

		
v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

$\Rightarrow$ 

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

Plurality with Runoff : French presidential election, 2017

					
v_1	✓	✓	✓		
v_2		✓	✓	✓	
v_3				✓	
v_4	✓				
v_5	✓	✓		✓	✓
...	...	...	...	...	...

$\Rightarrow$

		
v_1	✓	
v_2	✓	
v_3		✓
v_5		✓
...	...	...

$\Rightarrow$ 

People are not ready for a radical change

First round : let's replace plurality votes by approval ballots

How to select the two finalists ?

A first possibility :

Definition (Approval Voting)

The two finalists are the two candidates with the highest approvals

50	a'a
25	a'ab
40	bcd
20	c
5	a'abc

$\Rightarrow$

a'a	80
b	70
c	65
d	40

$\Rightarrow \{a, a'b\}$

$\Rightarrow$ What is the point of doing a runoff if we use the same criterion for both finalists ?

How to select the two finalists ?

A first possibility :

Definition (Approval Voting)

The two finalists are the two candidates with the highest approvals

50	a'a
25	a'ab
40	bcd
20	c
5	a'abc

$\Rightarrow$

a'a	80
b	70
c	65
d	40

$\Rightarrow \{a, a'b\}$

$\Rightarrow$ What is the point of doing a runoff if we use the same criterion for both finalists ?

How to select the two finalists ?

A first possibility :

Definition (Approval Voting)

The two finalists are the two candidates with the highest approvals

50	a'a
25	a'ab
40	bcd
20	c
5	a'abc

$\Rightarrow$

a'a	80
b	70
c	65
d	40

$\Rightarrow \{a, a'b\}$

$\Rightarrow$ What is the point of doing a runoff if we use the same criterion for both finalists ?

A spectrum of rules

The first finalist is the one with highest approvals and...

Definition (Approval Voting)

...the second finalist is the one with the second highest approvals

10	a
20	abc
30	ab
20	cd
5	d

$\Rightarrow$

a	60
b	50
c	40
d	25

$\Rightarrow \{a, b\}$

A spectrum of rules

The first finalist is the one with highest approvals and...

Definition (Proportional Approval Voting)

...the second finalist is the one with highest approval if the weight of voter already satisfied is $1/2$

10	a	$10 \times 1/2 = 5$
20	abc	$20 \times 1/2 = 10$
30	ab	$30 \times 1/2 = 15$
20	cd	$20 \times 1 = 20$
5	d	$5 \times 1 = 5$

$\Rightarrow$

a	60	
b	50	25
c	40	30
d	25	25

$\Rightarrow \{a, c\}$

A spectrum of rules

The first finalist is the one with highest approvals and...

Definition (Chamberlain-Courant Approval Voting)

...the second finalist is the one with highest approval if the weight of voter already satisfied is 0

10	a	$10 \times 0 = 0$
20	abc	$20 \times 0 = 0$
30	ab	$30 \times 0 = 0$
20	cd	$20 \times 1 = 20$
5	d	$5 \times 1 = 5$

$\Rightarrow$

a	60	
b	50	0
c	40	20
d	25	25

$\Rightarrow \{a, d\}$

Axiomatic analysis

	AV^R	$sPAV^R$	$sCCAV^R$	$TRIV^R$
Pareto-efficient	✓	✓	$\sim$	
Monotonic	✓			✓
W/S Strategy-proof				✓
Weakly Clone-proof			✓	

- Characterization of AV
- Several impossibilities :
  - Efficient + Strategy-proof
  - Symmetry + (Weakly) Clone-proof + Monotonic
  - (Strongly) Clone-proof + Efficient

Axiomatic analysis

	AV^R	$sPAV^R$	$sCCAV^R$	$TRIV^R$
Pareto-efficient	✓	✓	$\sim$	
Monotonic	✓			✓
W/S Strategy-proof				✓
Weakly Clone-proof			✓	

- Characterization of AV
- Several impossibilities :
  - Efficient + Strategy-proof
  - Symmetry + (Weakly) Clone-proof + Monotonic
  - (Strongly) Clone-proof + Efficient

Experiments on real data

City	Respondents
Strasbourg	1055
HSC	701
Grenoble	1048
Crolles-1	1291
Crolles-2	1269

Table – Datasets with approval ballots

Experiments on real data

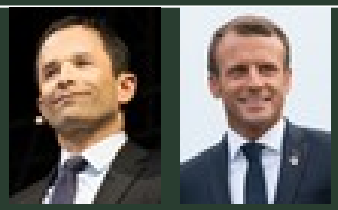
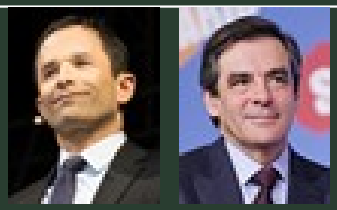
AV	PAV	CCAV
		
Left - Liberal	Far left - Liberal	Left - Right

Table – Selected finalists with different approval with runoff rules (Grenoble dataset)

Other projects

- Proportional rankings and bidimensional apportionment : The case of French regional elections (with Jérôme)
- The tradeoff between proportionality and strategyproofness in Multi-winner approval voting (with Jonas Israel, Patrick Lederer and Tom Demeulemeester)
- What metric distorsion has to say about irrelevant alternatives
- Algorithms aggregation using the Nash product (with François Durand and Fabien Mathieu)

Thanks

Thanks for listening !