Beyond Plurality: Truth-Bias in Binary Scoring Rules

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Why truth-bias?

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Nash Equilibrium

	Pinocchio 	Jiminy Cricket 	Gideon the cat 
1st preference	Puppet show	Do what the blue fairy says 	Pleasure island
2nd preference	Pleasure island	Puppet show 	Puppet show 
3rd preference	Do what the blue fairy says 	Pleasure island	Do what the blue fairy says 

What's truth-bias?

Each voter gets an ε extra utility from being truthful. The ε is small enough so that a voter would rather change the winner to someone more to its liking than to be truthful.

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What's the *k*-approval voting rule?

Each voter gives a point to *k* candidates and the rest do not receive any point from the voter.

The candidate with the most points, wins.

When *k*=1, this is **plurality.**
When *k*=number of candidates-1, this is **veto.**

Veto

What about the equilibria?

They don't necessarily exist…

a > c > b

c > a > b

c > a > b

c > a > b

c > b > a

Lexicographic tie-breaking rule

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They don't necessarily exist…

a > c > b
c > a > b
c > a > b
c > a > b
c > b > a

a > b > c
c > a > b
c > a > b
c > a > b
c > b > a

Lexicographic tie-breaking rule

What about the equilibria?

They don't necessarily exist…

a > c > b	a > b > c	**a > b > c**
c > a > b	c > a > b	c > a > b
c > a > b	c > a > b	c > a > b
c > a > b	**c > a > b**	c > b > a
c > b > a	c > b > a	c > b > a

Lexicographic tie-breaking rule

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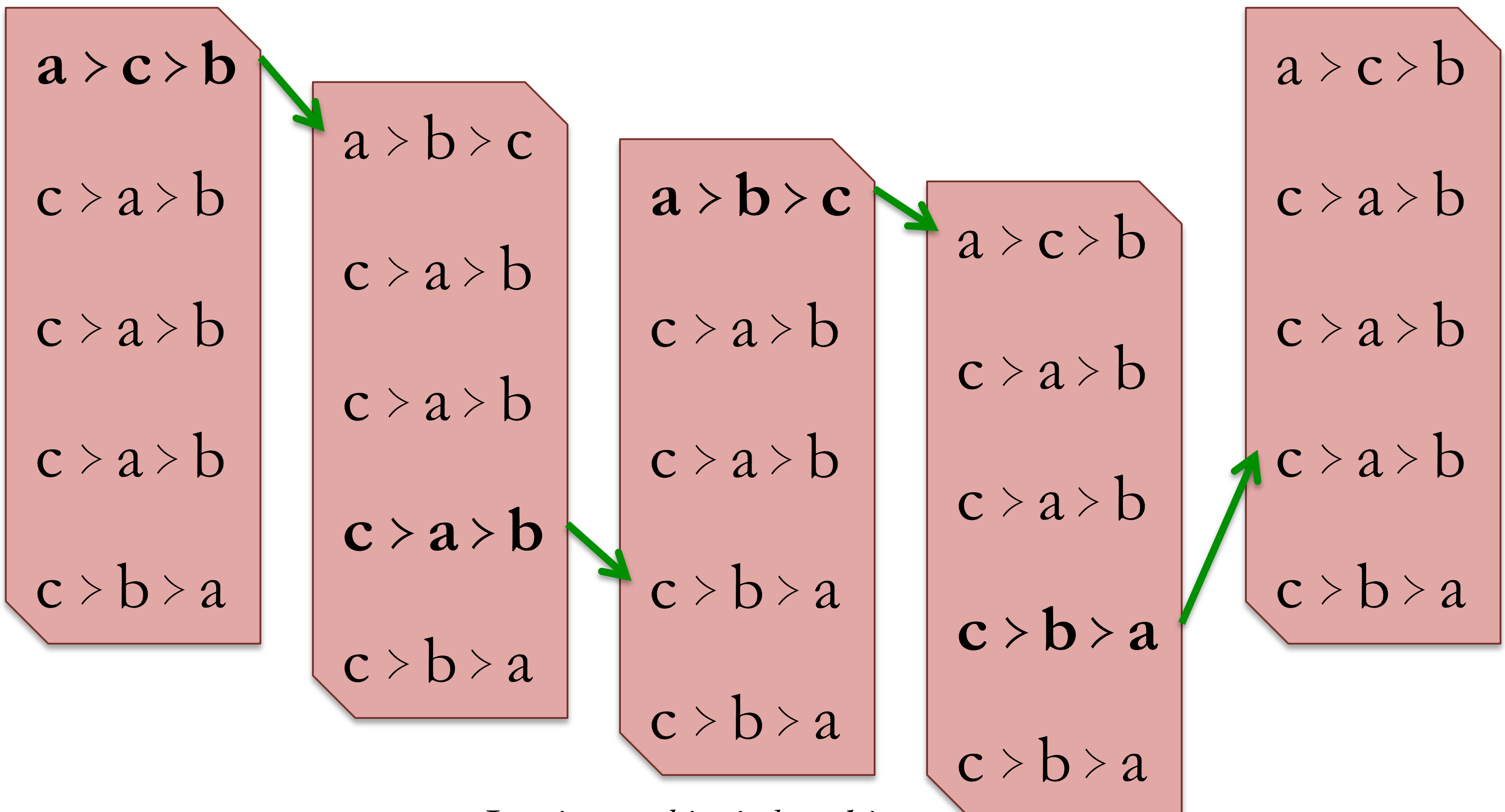
They don’t necessarily exist…



Lexicographic tie-breaking rule

Can we say anything about it?

If an equilibrium is non-truthful:

The winner's score is the same as in the truthful setting.

There is a *threshold candidate*, that would win if the winner lost a point.

All non-truthful voters veto a "runner-up", i.e., candidates one point away from winning.

Can we say if candidate *w* has an equilibrium where it wins?

No.

Finding if there is an equilibrium in which candidate *w* is the winner in a veto election with truth-biased voters is NP-complete.

Furthermore,

Finding if there is an equilibrium a veto election with truth-biased voters is NP-complete.

But do not falter!

The candidate following *w* in the tie breaking rule – *t* – has a truthful score at least as high as *w*.

All voters that do not veto *w* prefer it to the candidate following *w* in the tie breaking rule ($w \succ_i t$).

The truth(-bias) is out there!

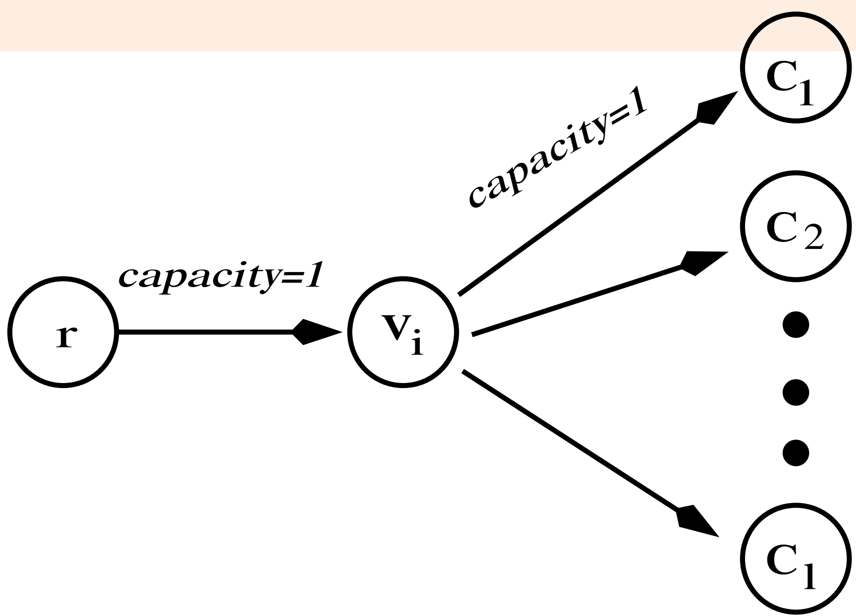
In veto elections with truth-biased voters, if the 2 conditions hold for a candidate *w*, determining if there is an equilibrium in which it wins can be done in polynomial time.

Not true for each condition separately!

Creating a graph: potential deviations

Nodes are *source*, *sink*, C (candidates), V (voters)

For a voter v truthfully vetoing r we add an edge (r,v).
And for each c such that $w >_v c >_v r$ we add an edge (v,c).



Creating a graph: deviations

If a candidate *c* needs more points to beat *w*, there is an edge (*source,c*) with capacity of the score it needs to add to become a runner-up.

If a candidate *c* beats *w*, there is an edge (*c,sink*) with capacity of the score it needs to lose to become a runner-up.

Maxflow

If maxflow<incoming to *sink* – not enough points changed to make *w* the winner.

If maxflow=incoming to *sink* – some tweaks to flow manifestation will show the flow means voters moving veto from some candidates to others.

But what about the conditions? (1)

The candidate following *w* in the tie breaking rule – *t* – has a truthful score at least as high as *w*.

Condition ensured *t* was the threshold candidate

But what about the conditions? (2)

All voters that do not veto *w* prefer it to the candidate following *w* in the tie breaking rule ($w >_i t$).

Condition ensured no one would veto *w*, making *t*, the threshold candidate, the winner.

Plurality

Plurality truth-bias

Equilibrium not ensured.

Knowing if equilibrium exists is NP-complete.

Winner increases score (if not-truthful)

Runner-up score does not change

Obraztsova et al. (SAGT 2013)

k-approval

k-approval truth-bias

Winner score can stay the same or rise.

Runner-up score can increase or decrease

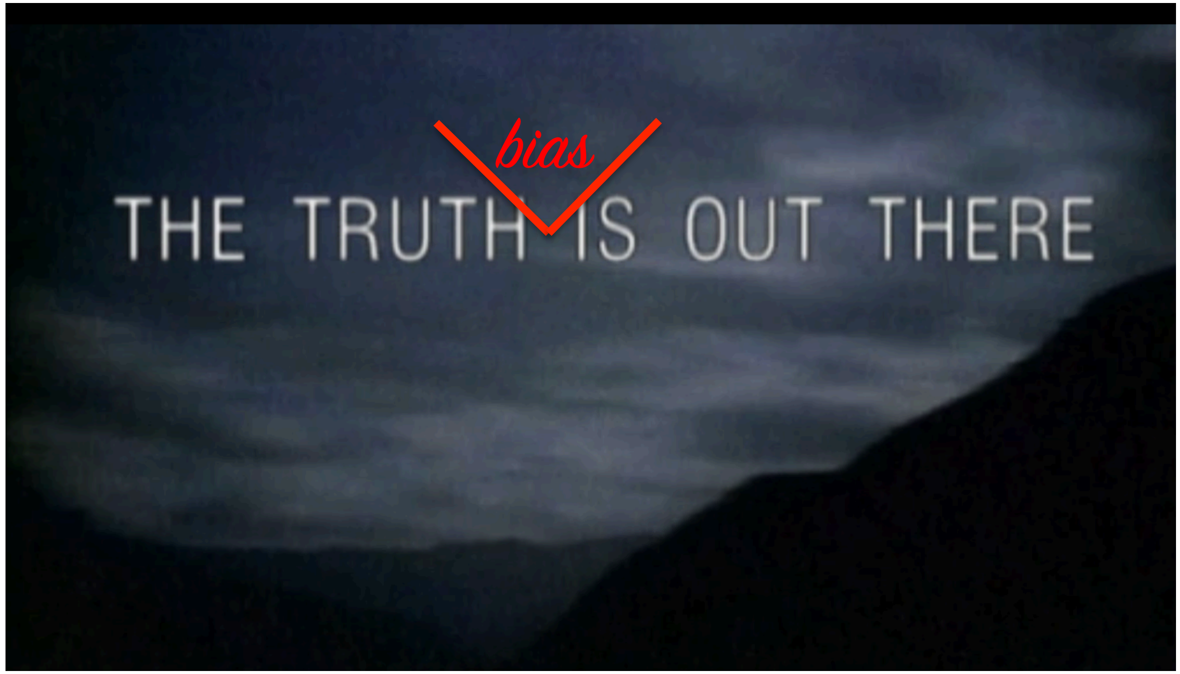
Future directions

Other voting rules!
(we're not even sure what's going on in non-binary scoring rules…)

Simulation / analysis: how good are the winners?

More useful conditions to make problems poly-solvable.

Classes of truth-biased equilibria?



Thanks for listening!