Social Choice

Branislav Bošanský

Czech Technical University in Prague

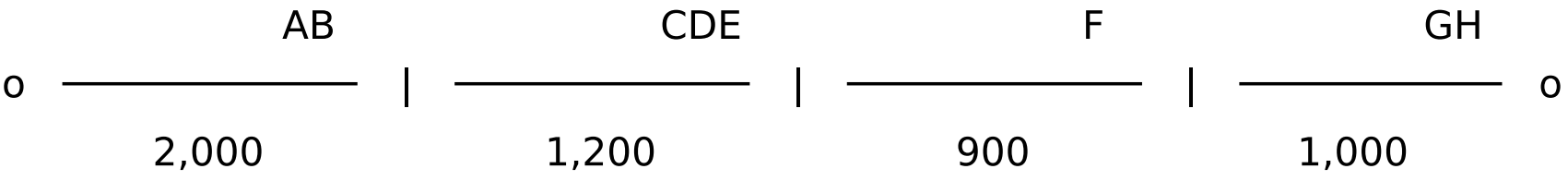
branislav.bosansky@agents.fel.cvut.cz

January 3, 2017

Previously ... on multi-agent systems.

Airport

The maintenance costs of airport runways are charged to the airlines landing planes. Light planes require shorter runways than heavy planes, and this raises the question of how to determine a fair allocation of maintenance costs among airlines with different types of planes. Define a cost game (N, c), where N is the set of all planes, labeled $A, B, \ldots, H$ that land at the airport on daily basis. Each plane requires the entire length of the runway up to (and including) the interval on which it is located in the figure. The weekly maintenance costs of each runway segment appear at the bottom of the figure.



Prove that if the Shapley value of this game is used to determine the allocation of costs, then the maintenance cost of each runway segment is borne equally by the planes using that segment.

And now ...

Simple Voting Example

Assume there are 7 agents with following preferences:

- 3 agents: $a > b > c$
- 2 agents: $b > c > a$
- 2 agents: $c > a > b$

Which of the candidates is selected if we use different voting protocols:

- plurality
- Borda
- pairwise elimination with ordering: a) (a, b, c), b) (b, c, a), c) (c, a, b)

Simple Voting Example

Assume there are 7 agents with following preferences:

- 3 agents: $a > b > c$
- 2 agents: $b > c > a$
- 2 agents: $c > a > b$

Assume that we want to include a fourth candidate d into the profiles. Is there a modification of the current preference profiles such that c can be the winner under Borda voting rule?

Condorcet Loser

Condorcet loser is a candidate that loses in pairwise comparison with every other candidate.

Assume we are using plurality voting rule. Can the winner under plurality be the Condorcet loser?

How the situation changes if we use Approval voting protocol?

How the situation changes if we use Borda voting protocol?

Games and Social Choice

Agents do not have to vote truthfully and can behave strategically. One of the classical problems in computational social choice: If one agent knows the full preferences of other agents, how hard it is to calculate an insincere vote that can improve agents preferences?

	unweighted votes, constructive manipulation		weighted votes, constructive				weighted votes, destructive		
# alternatives			2	3	4	≥5	2	3	≥4
# manipulators	1	≥ 2							
plurality	P	P	P	P	P	P	P	P	P
plurality with runoff	P	P	P	NP-c	NP-c	NP-c	P	NP-c	NP-c
veto	P	P	P	NP-c	NP-c	NP-c	P	P	P
cup	P	P	P	P	P	P	P	P	P
Copeland	P	P	P	P	NP-c	NP-c	P	P	P
Borda	P	NP-c	P	NP-c	NP-c	NP-c	P	P	P
Nanson	NP-c	NP-c	P	P	NP-c	NP-c	P	P	NP-c
Baldwin	NP-c	NP-c	P	NP-c	NP-c	NP-c	P	NP-c	NP-c
Black	P	NP-c	P	NP-c	NP-c	NP-c	P	P	P
STV	NP-c	NP-c	P	NP-c	NP-c	NP-c	P	NP-c	NP-c
maximin	P	NP-c	P	P	NP-c	NP-c	P	P	P
Bucklin	P	P	P	NP-c	NP-c	NP-c	P	P	P
fallback	P	P	P	P	P	P	P	P	P
ranked pairs	NP-c	NP-c	P	P	P	NP-c	P	P	?
Schulze	P	P	P	P	P	P	P	P	P

Table from Conitzer and Walsh, Barriers to Manipulation, Chapter 6 in Handbook of Computational Social Choice

Games and Social Choice

Design an algorithm for manipulating Borda rule.

Design an algorithm for manipulating STV.