MAS Assignment 1: Strategic Voting

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Introduction

In **honest voting** the outcome follows from the true voting preferences expressed by all voters.

Strategic voting means that at least one of the involved voters supports an alternative (possible outcome, candidate) other than her/his sincere (true) preference in order to achieve a voting outcome that is more desirable (in terms of voter happiness level) for this voter than the outcome that would result from non-strategic (honest) voting.

Strategic Voting: Types

Strategic voting results in the change (increase or decrease) of the overall score of at least one alternative.

- *Compromising* – ranking an alternative insincerely higher than another
- *Burying* – ranking an alternative insincerely lower than another
- *Push-over* (only in round-based voting) – ranking an "easy to beat" alternative insincerely higher than another in the first round(s) in order to increase the chance to win of the true preference in the final round
- *Bullet voting* – voting for just one alternative, despite having the option to vote for several

Voting Schemes

- Plurality voting (voting for one)

$$\{1,0,\dots,0\}$$

- Voting for two

$$\{1,1,0,\dots,0\}$$

- Anti-plurality voting

$$\{1,1,\dots,0\}$$

- Borda voting

$$\{m-1,m-2,\dots,1,0\}$$

Example

Voting situation: Consider preference matrix below (5 voters, and 4 alternatives A, B, C and D), and assume Borda voting is used.

	1st Voter	2nd Voter	3rd Voter	4th Voter	5th Voter
1st Preference	C	B	C	B	B
2nd Preference	A	D	D	D	C
3rd Preference	D	C	A	C	D
4th Preference	B	A	B	A	A

Question: Are there possibilities for strategic voting?

Example (cont.)

First, check how the „true“ voting outcome looks like:

	1st Voter	2nd Voter	3rd Voter	4th Voter	5th Voter	Outcome
1st Preference	C	B	C	B	B	C:10
2nd Preference	A	D	D	D	C	B:9
3rd Preference	D	C	A	C	D	D:8
4th Preference	B	A	B	A	A	A:3

Next, check whether any voter (**V**) is unhappy about this outcome → **V2, V4, V5**

Let‘s first focus on **V5.** What can it do to be „happier“?

Example (cont.)

If **V5** would *compromise* **C** in favor of **A**:

	1st Voter	2nd Voter	3rd Voter	4th Voter	5th Voter	Outcome
1st Preference	C	B	C	B	B	B:9
2nd Preference	A	D	D	D	A	C:8
3rd Preference	D	C	A	C	D	D:8
4th Preference	B	A	B	A	C	A:5

Note: V2 and **V4** together could have achieved the same result (by making **C** their least preferred alternative).

Voter collusion makes things even more complex (and even more interesting).

Example (cont.)

Carefully considering the resulting voting situation:

	1st Voter	2nd Voter	3rd Voter	4th Voter	5th Voter	Outcome
1st Preference	C	B	C	B	B	B:9
2nd Preference	A	D	D	D	A	C:8
3rd Preference	D	C	A	C	D	D:8
4th Preference	B	A	B	A	C	A:5

„Strategic voting in response to strategic voting“?

- Now **V1** and **V3** are „unhappy“ (as they prefer winner **B** the least)
- **V1** (or **V1** and **V3**) can make **D** win (with 10 (or 11) points)
- In response to this, **V2** and/or **V4** may think about *burying* **D** …

Conclusions

- Strategic voting highly depends on what the agents know!

In the above example, what does each of the voters need to know in order to be able to decide (rationally) whether she has an incentive to vote strategically?

- Limiting possibilities of strategic voting is done by design of voting mechanisms

Borda said: „My scheme is only intended for honest men!"

Important theoretical result: *Gibbard theorem (1978)* shows that, if there are more than two voting alternatives, the only system which eliminates strategic voting is dictatorship.

Goal

Design and implement a software agent, which analyzes risk of strategic voting in a given voting situation (preference matrix + voting scheme).

Agent Outputs

The agent should analyze the voting situation and output:

- Non-strategic voting outcome
- Overall voter happiness level
- Set of strategic voting options
- Overall risk of strategic voting

For details see Assignment Description.

Example (cont.): Voter Happiness

- Order of alternatives in a voting outcome is compared to a true preference list.

j – is a position of alternative in a true preference list (indexed from bottom, starting from 1).

Weight of an alternative is defined by its position in the true preference list ($w_j = j$).

k – is a position of alternative in a voting outcome (indexed as j).

	5th Voter	Outcome
1st Preference	B	C
2nd Preference	C	B
3rd Preference	D	D
4th Preference	A	A

Individual distances: $d_j = k - j$

$d_1 = 1 - 1 = 0$; $d_2 = 2 - 2 = 0$; $d_3 = 4 - 3 = 1$; $d_4 = 3 - 4 = -1$

Total distance: $d = \sum_{j=1}^{m} w_j d_j = 1 * 0 + 2 * 0 + 3 * 1 + 4 * (-1) = -1$

Thus, happiness level of **V5** is: $H_5 = \frac{1}{1+|d|} = 0.5$

Remarks

Simplifications:

1. Agent only analyses single-voter manipulations (no voter collusion)
2. Agent does not deal with the issue of counter-strategic voting
3. Agent has perfect information about the true preferences of voters

- Ties are always broken in lexicographical order (e.g. **C** is preferred to **D**).

Report

In your report do not forget to include analysis of possible extensions of the agent to cover:

1. Voter collusions
2. Counter-strategic voting
3. Both voter collusion and counter-strategic voting
4. Imperfect information

How to start?

- Understand the problem.
- Apply strategic voting in basic voting situations.
- More information on the suggested timeline is in the Assignment Description.

- You need to form groups of 4. Please self-enroll through Canvas **before the end of the class**!
- In case of problems with the self-enroll, please send **one** e-mail per group with your names to: amir.ahangi@maastrichtuniveristy.nl.

Questions?