Exercises from lecture 9 (Voting) TEK5010 Multiagent systems 2021

Question 1

3 robots are faced with the problem of deciding the sequence of doing a set of 4 independent tasks. The tasks can only be completed by cooperation among the robots. However, the robots are of different manufacturer and owners, consequently they might have different desires and may value the outcome of doing the tasks differently. So, in order to solve the problem, the robots decide that a voting procedure is a way of agreeing upon the sequence of doing the different tasks:

Given the voters (i.e. robots) $Ag = \{1, 2, 3\}$ and their available outcomes (i.e. tasks) $\Omega = \{\omega_1, \omega_2, \omega_3, \omega_4\}$. The preference ordering of the different voters are as follows:

$$\varpi_1 = (\omega_1, \omega_2, \omega_3, \omega_4)$$

$$\varpi_2 = (\omega_2, \omega_3, \omega_4, \omega_1)$$

$$\varpi_3 = (\omega_3, \omega_4, \omega_1, \omega_2)$$

a) What outcome is winner if voting procedure is plurality?

b) Do we have a Condorcet's paradox here?

c) What is tactical voting? Is it possible for the voters to manipulate this election? How can we safeguard against strategic manipulation?

d) What is the Borda count of each outcome? Apply the Borda rule. Is this outcome Pareto efficient (as defined in the criterion of Arrow's theorem)? Explain.

e) We are now going to look at this voting in terms of sequential majority voting. What types of sequential majority voting is there? Sketch the different types.

f) Write up all winners in pairwise elections and draw a majority graph representing the results. What is the preferred social ordering based on this graph?

g) What edges in the majority graph must be flipped in order to have a social ordering with a Condorcet's winner (assuming minimal number of edges to flip)? What is the best outcome in terms of the slater rule? Why is the slater rule problematic to use in the general case?

h) In terms of the analysis above, which task should the robots do first?