Voting Mechanisms in Reinfocement Learning

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Abstract—This paper aims to deliver an overview over voting mechanisms used in reinforcement learning. Voting mechanisms are first introduced to the reader and then explained in more detail by describing usage examples and experiments from current research.

Index Terms—voting, reinforcement learning, multi-agent systems

I. Introduction

In multi-agent settings there are a number of mechanisms that allow for interaction between several agents. One of these mechanisms is voting which enables a distributed decision process where multiple agents decide on which actions to take. However designing a voting mechanism is non-trivial since the voting system has to consider different aspects like security, fairness and robustness. Arrow's Impossibility Theorem even states that voting mechanisms cannot be designed to be completely fair. Ongoing research constantly tries to improve the security, robustness and fairness of voting mechanisms.

To give an overview over voting mechanisms in reinforcement learning Section II introduces basic principles and constraints of voting systems. Section III describes related work to highlight use cases of voting mechanisms in reinforcement learning as well as ongoing research trying to improve such mechanisms.

II. Basic Principles

- Robert's Rules of Order (Newly Revised) (RONR)
  - Set of rules for voting procedure
- Arrow's Impossibility Theorem
  - states that no rank-order electoral system can be designed to be perfectly fair matching these criterias:
  - If every voter prefers alternative X over alternative Y, then the group prefers X over Y.
  - If every voter's preference between X and Y remains unchanged, then the group's preference between X and Y also remains unchanged.
  - There is no "dictator": no single voter possesses the power to always determine the group's preference.

III. Related Work