

Voting Mechanisms in Reinforcement 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

- 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.

I. INTRODUCTION

In a democratic society choices are not made by a dictator but by taking the preferences of the whole society into account. Each member of the society is entitled to cast a vote which represents its preferences. This concept of considering multiple individuals’ preferences by using a voting mechanism to make choices can be transferred to multi-agent reinforcement learning systems.

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 [1] for example states that no rank-order voting mechanisms can 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 of social choice theory. 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

A. Arrow’s Impossibility Theorem

Arrow’s Impossibility Theorem is of great importance for the design of a voting mechanisms. It states that there cannot be a completely fair rank-order voting system. Meaning that every voting system that has the properties of unanimity and independence of irrelevant alternatives also contains a dictator which vote decides the preference of the society as a whole.

- 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.

III. RELATED WORK

REFERENCES

- [1] K. J. Arrow, *Social choice and individual values*. Yale university press, 2012, vol. 12.