Future work in multi-agent systems research with probably approaches

A superficial tiny survey in Multi-Agent Systems

Mr. Liangyawei Kuang

https://www.deadsecond.com/

1. Game Theory for Multi-Agent Decision Making

In multi-agent systems, we are facing a lot of multi-agent decision-making problems, especially in environments with uncertain conditions. Game theory, which is originally designed to solve economic problems by modeling interactive behavior, is a good approach to this kind of problem by considering our agents as rational participants and reasoning strategically. Also, we may use strategic game frameworks to deal with the coordination game part in this topic as we need to run our systems with decentralized methods, considering the efficiency and robustness. And for coordination itself, we may also need the help of advanced algorithms focusing complexity for computing Nash equilibrium in practical problems.

2. Mechanism Design

With the development of multi-agent systems, we need to define the rules so that agents could act towards the goals in equilibrium. In this topic, we may focus on the stability of designed protocols and individual rationality for agents. As most multi-agent systems consider self-interested agents, we may concentrate more on agent interaction protocols. By studying the revelation principle and the Vickrey-Clarke-Groves mechanism, we may build more general and successful protocols under many cases.

3. Multi-agent Learning

Multi-agent learning, in particular, multi-agent reinforcement learning is much more complicated and difficult than single-agent missions due to the curse of dimensionality, multi-agent credit assignment problem, dynamic settings, overgeneralization, et al. Current works are mainly focused on the analysis of emergent behaviors, learning communication, learning cooperation, and agents modeling agents. Future work may focus on the open questions nowadays. The challenge of sparse and delayed rewards, the role of self-play, the combinatorial nature of MDRL. And we may solve them by extending single-agent solutions to multi-agent domains. For example, RUDDER has been created for delayed sparse reward single-agent setting problems. Transferring more single-agent techniques to multi-agent tasks maybe be a good way to the next steps.

Reference

[Vlassis, 2007] Nikos Vlassis. A concise introduction to multiagent systems and distributed artificial intelligence. Synthesis Lectures on Artificial Intelligence and Machine Learning, 1(1):1–71, 2007.