GAME THEORY IN MULTI-AGENT SYSTEMS

– Multi-Agent Systems Course

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OVERVIEW

Multi-Agent Systems domain is full of challenges, with enthusiasts still doing a lot of research uncovering many new theories. The Game Theory is rather an old theoretical work, which still proves itself worthy nowadays. In my report I present some insights on decision theory, to make the reader capable of fully understanding the game theory and furthermore there are few words on Evolutionary Game Theory, to make the image even greater. A specific application of game theory in Multi-Agent Systems is discussed in the last part of my report, with a cooperative approach being used.

The beauty of Game Theory comes from the early work of von Neumann and it's sharing multiple ideas with the decision theory. It is often interpreted from an economical point of view, modeling strategies performed interactively by intelligent agents, into games.

Evolutionary Game Theory is describing ways in which a rational individual takes decisions and how those affect the outcomes and the strategical interaction between the players, all these while providing the fundamentals of issuing rationally acceptable decisions in a tricky environment from the real – unsafe, doubtful – world.

So it is obvious to believe that the process of modeling such learning agents, beside being tricky sometimes, it's also requiring a shrewd mind to design strategies affecting the behaviors between existent agents in the system and toward the environment. Participants in a standard game are often used to theoretically model the agents involved from a Multi-Agent Systems perspective. There are three main characteristics that need addressing here::

- the hyper-rationality of the agents must be considered, as they must be capable of properly anticipating the other moves,
- agents are assuming 100 % environment related familiarity,
- the agents need to be aware of the fact that optimum strategy is being equivalent all the time, implying the existence of static Nash equilibrium.

APPLICATIONS

There are numerous applications in the field, but I choose to talk about a cooperative Multi-Agent Systems approach, in solving the **dynamic channel allocation in wireless networks** problem.

The problem of dynamically allocated channels problem is widely acquainted by scientists in their work for more than 20 years already. The availability of all kinds of strategies utilized to models the allocation of dynamic channels in multi-agent systems has begun in 1996.

Nowadays, we are aware that this problem is NP-difficult. Something of a great importance is the idea that the process of arriving calls asking for a channel is a stochastic one, this process being also characterized by a set of constraints that limit the use of alike frequencies, minimizing the interference among calls; these constraints are known as CRC, meaning Channel Reuse Constraints.

KEY WORDS

Multi-Agent Systems | Game Theory | Evolutionary Game Theory | Rational Agents | Strategies | Decision Theory | Decision Tree | Nash Equilibrium | Bayesian Network | Negotiations Agents | Distributed AI