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種別(和文)	論文要旨
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	知能システム科学	専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（ 工学 ）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis concerns about Multi-Agent Systems (MAS) and Learning Classifier Systems (LCS), new machine learning paradigms that are currently still under active research. MAS typically deals with distributing learning procedures across multiple intelligent agents. This allows agents to handle a very complicated problems by dividing it into sub-problems, and then each agent is responsible to handle the sub-problems assigned to them. Meanwhile LCS typically involves using Evolutionary Computation and Reinforcement Learning techniques to complex problems. It relies on an agent to evolve its knowledge by interacting with the environment which in turn, give rewards based on the impact made by the agent.

Most LCSs were designed with a single agent in mind. As such, building a successful LCS to solve a very complex problem requires tremendous efforts. We show in this thesis that, for complex problems that can be separated into sub-problems, it is possible to design a simple MAS, where each agent maintains its own LCS to solve those sub-problems. We believe, if the goals of Multi-Agent LCS were met, many of the goals from the area of machine learning would be accomplished.

We mainly concern about achieving precise and valuable computerized prediction. Simple goal, but challenging. The solution we propose is a distributed rule-based machine learning. By combining the power of MAS and LCS, we introduce a new learning paradigm to simplify the process to solve complex problems. We demonstrate possibilities of applying Learning Classifier Systems (LCS) technique in a multi-agent environment. We propose a few new parameters for LCS to make it works in a multi-agent environment. Those parameters also indicate mechanism for the agents to communicate and transfer knowledge from individual level to organizational level. We aim for a highly predictive machine learning technique. We show in this thesis that we can achieve it by designing an accuracy-oriented Learning Classifier System. Genetic Algorithms and Reinforcement Learning are used to evolve accurate rules and punish inaccurate ones.

To demonstrate the capabilities of our proposed method, we will show its application in recommender system RSs problems. RS is chosen because it is one of the most ubiquitous system on the various web services nowadays. It requires highly predictive capabilities so learn users' preference and it is very complex due to the large set of data. This makes it a very ideal test-bed for our proposed method.

We also show how to approach recommender systems (an example of predictive analytics problem) with LCS. By replacing ratings with classifier rules as the transaction connection between items and users, the system can learn not only the users' preference, but also able to deduce factors that make them prefer certain items under certain conditions.

Most recommender algorithms were designed with rating system in mind. This means that all previous ratings will affect future predictions regardless of user's change of taste. Furthermore, in this age of big data, ratings are not the only relevant inputs that can be gathered from users. More types of inputs are helpful to create user model that can predict user's behavior and preferences.

With our proposed method, the system does not only predict whether a user like an item, but also guess why he likes it. For example, a married businessman might prefer watching romance movies at home on TV, but prefer watching comedy shows on a smartphone while commuting on a train. Our proposed method is more flexible, in a sense that, it accepts any inputs, such as profile data, time, location, etc. It can by anything as long as it can be represented as real valued number. Since the population is dynamic, old rules that are irrelevant now (regardless of how good they were before) are either deleted or evolved by genetic algorithms. This means the system is able to recognize if there are changes to the users' preferences. The parameters of our method are also adjustable. The ideal value can be set depending on the available computing resource and how much accuracy is needed. Those adjustable parameters include, the trigger frequency of Organizational Learning algorithms the length of the classifiers, the size of population.

We tested our method in big number of agents, ranging from thousands to one million intelligent agent. Our simulation result shows that our proposed method successfully implement multi-agent approach to LCS and managed to generate accurate predictions in the domain of recommender system. Future development may include application in group recommendation system or other business intelligence domains.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).