

A New Similarity Difference Measure in Multi Agent Systems

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Abstract

In this paper, we present a new measure for evaluating similarity changes in a multi agent system. The similarity measure of the agents changes during the learning process. The similarity differences are because of any composition or decomposition of some agent sets. The presented measure, defines the changes of homogeneity of agents by composition and decomposition. The utility of the metrics is demonstrated in the experimental evaluation of multi agent foraging. The results show that while the similarity difference gets a positive value, the performance grow rapidly.

1. Introduction

An important issue in multi agent research is the question of similarity between the agents on a team. Similarity has the same concept of Diversity but it shows the homogeneity rather than difference of the agents.

Diversity can be evaluated on a bipolar scale; systems are classified as either heterogeneous or homogeneous depending on whether any of the agents differ.

A homogeneous system consists of identical entities with the same capabilities and behaviors. A heterogeneous system may differentiate at different level: at the hardware level, at the controller level, at the function or behavior level and etc.

The essential idea behind the diversity measure is to cluster similar agents according to a problem-specific difference measure and look at the pattern they form in the feature space.

An intuitive and straightforward way is to use the

number of clusters the agents form in the feature space as the diversity measure. Each cluster is believed to be a group of similar agents, and essentially, the more clusters we have, the more diverse the system is.

Instead of just using the number of clusters, Balch introduced Shannon's information entropy to measure the diversity and named it the simple social entropy [1].

To evaluate the diversity of a multi agent system, the agents are first grouped according to their behaviors. Next, the overall system diversity is computed based on the number and size of the groups. Social entropy for a multi agent system composed of M groups is defined as[2]:

$$H(X) = -\sum_{i=1}^M P_i \log_2 p_i \quad (1)$$

In [1] hierarchic social entropy of a system has been presented as a measure of diversity.

In this paper, we present a measure of similarity difference in a multi agent system.

This measure enables us to measure the similarity difference in a multi agent system. This measure is based on changes of the agent's behavior to combine with the other agents or parted from the others.

We use this difference measure to show the similarity deviation of a system resulted by learning. The performance of the system is evaluated based on this measure.

Similar works have been presented for investigation of behavior diversity and performance on multi agent systems.

In [3] relationship between social differentiation and spatial structure in a multi-agent system was presented. It has been shown that by promoting diversity within the agent population it is possible to avoid deadlock conditions as an impact of diversity in [4].

It has been demonstrated in [5] that the system efficiency can be attained by introducing diversity. At low diversity, agent cooperation proceeds at the statistical level, resulting in the scaling relation of the variance with diversity [6].