Model Sharing in Multiagent Systems

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Abstract

Agent modelling is made complex by the number of models that the agents need to track. This paper discusses the use of intra-agent and inter-agent model sharing as an approach to reducing the number of models to be tracked by an agent. The paper also describes the GossipWorld simulation environment we have created for studying agent modelling and model sharing issues. Finally, the paper discusses ways of coping with the spread of delusion (with experimental results) that can occur as a result of inter-agent model sharing.

1. Introduction

Agent modelling/tracking [4] is a very important capability for agents in a multiagent system (MAS) that involves monitoring the actions of the other agents and inferring any other necessary information that is needed (such as goals, intentions, etc). This paper focuses on the problems faced by agents that model other agents. In particular, we consider model sharing between agents as a way to manage and solve some of the problems that the agents face while doing agent modelling. Our investigation of model sharing within multiagent systems is based on an ongoing effort to build an intelligent help system [2] in which students are represented by personal agents that model the students and other agents within the system.

2. The problems of agent modelling

The number of models that an agent must track increases with the size of the MAS, as the possibility of the number of agents it must interact with also increases. The number of models is further increased when recursive models are allowed [1]. This first problem is particularly severe in situations where the action selection is required in real-time (such as in RoboCup), where the agent must make the action selection in time for the selected action to be useful. The second major problem faced by agents that model other agents is that of the accuracy of the models. This problem is even more severe since it determines the difference between a seemingly intelligent agent and a dumb one. When errors occur in agent models we say that the agent storing the model is *deluded* [3]. The attempt to get rid of errors in agent models is the problem of *overcoming delusion*. In previous work [3] we focused on how an agent can overcome delusions in its models.

Intra-agent model sharing has been previously suggested as an approach to reducing the number of models to be tracked [4]. In this study, we extend the idea to inter-agent model sharing When inter-agent model sharing is considered, it makes the overcoming of delusion even more important, since an agent can pass on its delusions to other agents while sharing models with them (and vice versa).

3. The GossipWorld simulator

To experiment with some possible approaches for limiting or coping with the spread of delusion while allowing model sharing, we created the GossipWorld simulator that is made up of a 10X10 grid of rooms as shown in Figure 1. Each cell in the grid represents a room that can contain a maximum of 3 agents at any time. Each room also contains a stationary agent that either has a certain (property shown by the '*') or not. Agent **A**'s goal is to find out whether the stationary agents in each of the 100 rooms have the property '*'. **A** can achieve this by visiting every room one after the other and noting the property of the stationary agent in the room. It is clear that

at the end of the visits, agent **A** can be sure to have correct models of the stationary agents in each of the rooms in the grid (assuming that its sensors are not defective and the stationary agents do not change after being visited).
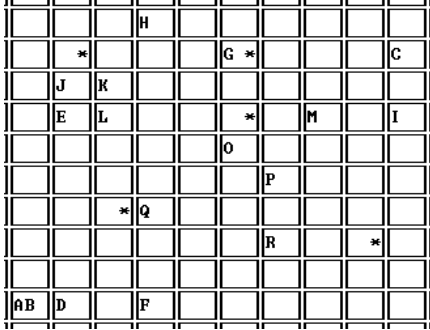

Figure 1: GossipWorld - Agent A must visit every room to find out if the light is on or off

Now assume we have many more agents (**B-R**) sharing the same goal as agent A, and they are allowed to share models via gossip with each other. Each agent can reduce the number of rooms it needs to visit by sharing models with each other when they meet in a room.

3.1. Experiments in the GossipWorld

The GossipWorld simulator allows us to compare the effect of various strategies for reducing the spread of delusion when agents share models via gossiping. To introduce delusion into the system we assume that agent **R**'s sensors are faulty and would always sense the wrong property for the stationary agent. Our metric of measurement is the total delusions held across all the agents in the GossipWorld at the end of the explorations. In this initial study we compared two strategies. The first strategy, called free model sharing (FMSH), assumes that an agent always believes what it is told. The second strategy, called reserved model sharing (RMSH), assumes that an agent will only believe what it is told in the absence of anything that suggests that the information cannot be trusted. We observed a statistically significant difference between these 2 strategies as shown in Figure 2 as the number of times agent R gossips increases. The disadvantage of strictly adopting RMSH is that agents tend to believe agents that believe in the same things as themselves. This leads to deluded agents believing only other deluded agents.
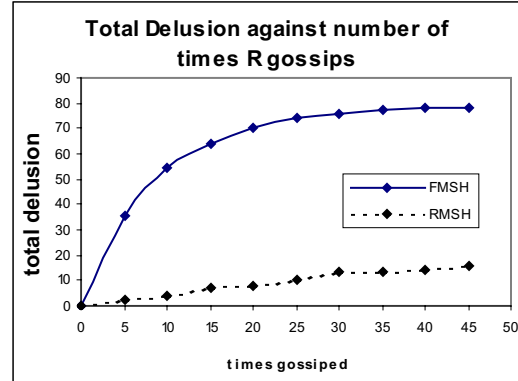

Figure 2: Total delusion against number of times R gossips with reserved model sharing.

4. Conclusions

Our conclusion in this study is that model sharing via gossip can help reduce the number of models an agent needs to track, but it also introduces the problem of the spread of delusion. Thus, any agent that shares models with other agents must also possess a strategy (or strategies) for limiting the spread of delusion. Our results showed a significant difference between FMSH and RMSH. In future studies we plan on exploring a third type of strategy that lies between FMSH and RMSH, which should also avoid the stated problem with RMSH. Building MAS with modelling agents will become more feasible in the future as strategies for avoiding the delusion problem are developed.

References

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