An application of quantitative techniques to conflict resolution in a multi-agent system

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Abstract

The distributed artificial intelligence (DAI) can create multiple interacting systems and deal with the description. It looks alike that a group of experts' cooperating together to solve a global problem, which is difficult and decomposed. Each expert can be implemented as an individual agent, which is a self-contained, independent, and active object that can communicate with other agents either indirectly or directly.

For achieving a solution to a certain global problem, each agent has its own local goal to be fulfilled. As each agent is given control over its own actions, its own local goals, and its own utility functions, it will naturally pursue its own interests. When working on a shared goal each agent would like its priorities to be given the most consideration. Unfortunately, many agents' priorities (arising from their own personal goals) will not be coherent with their fellow agents', thus leading to the conflict phenomenon. Thus, before a satisfactory solution to the whole problem can be presented, this situation of conflict must be resolved.

In this paper, we will develop a mathematical model of which tries to resolve the conflict in a multi-agent system by providing a possible solution to the problem. We concentrate on the linear programming model to develop its conflict resolution algorithm and implement it on AGENT-0. Finally, the linear programming algorithm was implemented on the Unix workstations within the AGENT-0 environment that is set under the common Lisp environment. Besides, we evaluated the whole system and proposed some suggestions for future work.
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Keywords: Distributed artificial intelligence (DAI); Multi-agent system; Linear programming model

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1. Introduction

The multi-agent system is the subject of a stream of research within distributed artificial intelligence (DAI). This section will introduce some general ideas about AI and DAI, and then begin our paper field. The AI is a scientific discipline, which resembles physics in the sense that it is interested in behavior and tries to extract models able to reproduce that behavior and explain it. In AI [Gas87], the objects of study are intelligent entities rather than physical objects. The main part of any artificial intelligence application is knowledge, a knowledge which it acquires from human experts and which has many components such as relationships, procedures, facts, theories and concepts. This knowledge is contained within a knowledge base that typically focuses on a specific subject area or domain. The DAI is a sub-area of AI dealing with the description and creation of multiple interacting systems. It is concerned with a set of loosely coupled intelligent agents who will spend more time on computation than on communication between each other, cooperating to solve a global problem. A DAI system is that of a group of experts cooperating together to solve the problems, which are difficult and decomposed [24]. Therefore DAI applies both AI techniques and multiple problem solvers to solve these problems. Each expert is implemented as an agent, which is a self-contained, independent, active object, which can communicate with other agents either directly or indirectly. Thus, DAI is actually interested in the cooperative solution of problems by a decentralized group of agents.

This followings presents a brief outline of how this paper has been structured. Section 1 introduces the definitions of both AI and DAI. Section 2 describes the basic ideas of DAI and justify for DAI. Section 3 discusses types of conflict and their associated conflict resolution strategies. It also presents the importance of conflict resolution and previous work carried out in this area. Section 4 describes a certain mathematical formula and techniques to be used. Section 5 gives a brief assessment of this method mentioned in Section 4 and then concentrates on this method to develop its algorithm. Section 6 introduces the idea of 'AGENT-0' and describes the design of the programming. Section 7 sees the implementation of the formulae and technique into the algorithm I have developed. Section 8 evaluates the system and describes the future work. Section 9 presents my conclusions of the paper.

2. Distributed artificial intelligence

Currently, DAI [3,34,35,42,44,50,56,57] is viewed as providing a strategy for problem solving, where the problem is naturally distributed. The literature identifies two sub-strategies that are emerging in the world of DAI—distributed problem solving and multi-agent coordination [2,24], and suggests that different architectures are more suited to specific application needs such as in distributed planning or distributed control. Research is also being undertaken in a third area known as parallel AI (PAI) [2]. In general, PAI involves the application of parallel computing resources to a problem without a restructuring of that problem. The purpose of PAI is to achieve a linear speed-up in response to applying multiple processors to a given problem.

The blackboard model is the most commonly used architecture in DAI. A taxonomy of blackboard applications [40] identifies three classes of system. The distributed vehicle monitoring test-bed (DVMT) [12] is one of the hybrid systems representing a further extension to the