Chapter 1.14
Software Agent Technology: An Overview

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ABSTRACT

This chapter provides an overview of the rapidly evolving area of software agents and presents the basic aspects of applying the agent technology to virtual enterprises (VE). As the field of software agents can appear chaotic, this chapter briefly introduces the key issues rather than present an in-depth analysis and critique of the field. In addition to, this chapter investigates the application of agent technology to virtual enterprises and presents current research activity that focuses on this field serving as an introductory step. Furthermore, this chapter makes a list of the most important themes concerning software agents and the application of agent technology to virtual enterprises apposing some order and consistency and serve as a reference point to a large body of literature.

INTRODUCTION

The aim of this chapter is to survey some key research issues in the software agents' area. It annotates several researchers' opinions on many areas concerning software agents trying to give a more documentary point of view of each argued subject. Its main goal is to provide an overview of the rapidly evolving area of software agents serving as a reference point to a large body of literature and outlining the key aspects of software agent technology. While this chapter does not act as an introduction to all the issues in the software agents' field, it intends to point the reader at the primary areas of interest. In addition to, this chapter investigates the application of agent technology to virtual enterprises. It presents basic aspects of applying agent technology to virtual enterprises serving as an introductory step.

First of all, this overview chapter attempts to answer the question of what a software agent is. Secondly, it analyzes the three technologies that distributed artificial intelligence (DAI) has evolved: (1) multi-agent system (MAS), (2) distributed problem solving (DPS), and (3) parallel AI (PAI). Thereinafter, it makes the distinction between single agent and multi-agent systems analyzing their dimensions. In addition to, it goes through the broad spectrum of agent properties.

Furthermore, it discusses the most acknowledged classification schemes or taxonomies (typologies) of software agents proposed in the agent research community. Moreover, it presents the most well known agent architecture classification schemes arguing about each distinct architecture. Besides, it explores the two most important agent communication approaches: (1) communication protocols, and (2) evolving languages. It also discusses about a number of languages for coordination and communication that have been proposed. It argues about possible implementations of agent transportation mechanisms as well. Further, it annotates prominent ontology specification languages and editors for ontology creation and maintenance. Then, it lists and argues standard languages and several prototype languages for implementing agent-based systems that have been proposed for constructing agent-based systems. Afterwards, it presents a number of tools and platforms that are available and support activities or phases of the process of agent-oriented software development. Next, it examines several agent oriented software engineering (AOSE) methodologies that have been proposed to assist engineers to create agent-based systems. At the end, it investigates the application of the agent technology to virtual enterprises, answering the question of why to use agents in virtual enterprises and presenting the current research activity that focuses on the agent technology applied to virtual enterprises.

BACKGROUND

As software agents comprise a prominent scientific area of research activity, a plethora of researchers have investigated them and stated their own point of view. Nwana and Ndumu (1996) mention that software agent technology is a rapidly developing area of research. According to Wooldridge and Jennings (1995), the concept of an agent has become important in both artificial intelligence (AI) and mainstream computer science. Oliveira, Fischer, and Stepankova (1999) observe that for some time now agent-based and multi-agent systems (MASs) have attracted the interest of researchers far beyond traditional computer science and artificial intelligence (AI).

Although software agent technology demonstrates expeditious advancement, there is a truly heterogeneous body of work being carried out under the "agents" banner (Nwana & Ndumu, 1996). Nwana and Ndumu (1996) introduce software agent technology by overviewing the various agent types currently under investigation by researchers. Nwana (1996) largely reviews software agents, and makes some strong statements that are not necessarily widely accepted by the agent community. Nwana (1996) presents a typology of agents, next places agents in context, defines them and overviews critically the rationales, hypotheses, goals, challenges, and state-of-the-art demonstrators of the various agent types of the proposed typology. Besides, Nwana (1996) attempts to make explicit much of what is usually implicit in the agents' literature and proceeds to overview some other general issues which pertain to all the types of agents in the typology.

Agent-based and multi-agent systems (MASs) have attracted the researchers' interest to great extents. Oliveira et al. (1999) try to identify focal points of interest for researchers working in the area of distributed AI (DAI) and MAS as well as application oriented researchers coming from related disciplines, for example, electrical and mechanical engineering. They do this by presenting key research topics in DAI and MAS research and by identifying application domains in which the DAI and MAS technologies are most suitable.

Sycara (1998) presents some of the critical notions in MASs and the research work that has addressed them and organizes these notions around the concept of problem-solving coherence. Sycara (1998) believes that problem-solving coherence is one of the most critical overall characteristics that an MAS should exhibit.