Chapter 6
A Thorough Insight into Theoretical and Practical Developments in MultiAgent Systems

Dimple Juneja
Dronacharya Institute of Management and Technology, India

Aarti Singh
Maharishi Markandeshwar University, India

Rashmi Singh
Banasthali University, India

Saurabh Mukherjee
Banasthali University, India

ABSTRACT

Multiagent systems have been a fascination for research community and are often seen as an intelligent solution to many complex real world problems. Researchers have been active in the domain since last three decades and many developments pertaining to theoretical design and practical developments of multiagent systems are worth appreciating. The growth in MAS is multidirectional ranging from conceptual ideas to practical implementations and from the wide range of applications; it appears that multiagent systems are proving to be universal. The paper presents a concise survey of developments in MAS highlighting the important contributions in the field and also questions the universal applicability of agents.

INTRODUCTION

With the transformation from individual computing technologies to self-motivated distributed systems, a lot many research opportunities and threats have evolved. Dynamic and open environments (Shakshuki, Ghenniwa & Kamel, 2003) extent across business boundaries where in heterogeneous systems (Sycara, 1998) not only cooperates but also operate reactively and proactively. Such systems are capable of adapting to rapidly changing environments and are also able to respond to complex queries in real time. However, such systems demand high degree of autonomy (Barber & Martin, 1999; Lange & Oshima, 1999; Suzanne

Barber, Goel & Martin, 2000) which actually becomes a threat. For instance, web services (Alberti, Chesani, Daolio, Gavanelli, Lamma, Mello & Torroni, 2007) are the most sought after way of carrying out business activities as it offers service oriented architecture where in divergent and self-governing software components interact to offer automated solutions. Such automated systems are employing software entities more commonly known as software agents (Mařík & Lažanský, 2007; Pěchouček & Mařík, 2008) that offer powerful solutions to the emerging issues and are also able to manage the complexity of entire system. Since 1990, agent-based computing (Graesser, Jeon & Dufty, 2008; Nwana & Wooldridge, 1996; Nwana, 1996) is attracting community of researchers and lot many developments and changes can be seen in the technology. Simply speaking, a software agent is a software component capable of carrying out rational and self-directed actions in a typical multi-agent system (Panait & Luke, 2005; Hoek, Wiebe & Wooldridge, 2008). Agentsare finding applicability in a miscellaneous array of domains including intelligent manufacturing (Shen, Hao, Yoon & Norrie, 2006), traffic and transportation systems (Chen &Cheng2010), communications (Manvi & Venkataram, 2004), industrial process control (Mařík & Lažanský, 2007, Metzger & Polakow, 2011), Military applications (Cioppa, Lucas & Sanchez, 2004), geographical systems (Heppenstall, Crooks, See & Batty, 2011), optimization problems (Barbati, Giuseppe& Andrea, 2012), disaster management (Fiedrich & Burghardt, 2007)and many more.

AGENT BASED COMPUTING: IS IT SUPREME THAN ITS COUNTERPARTS?

The concept of software agents have evolved from Distributed Artificial Intelligence (DAI) (Ferber, 1999) research which was conducted about 3 decades ago.Carl Hewitt proposed an Actor system (Hewitt, Bishop & Steiger, 1973)and defined actors with clear internal definitions with the potential to communicate with peers in the system. The succeeding developments focused on making intelligent actors now known as software agents where the word agent has evolved from Greek word '*agein*', which implies to guide (Milojicic, 2000). The term is being explored by research fraternity continuously and many reports pertaining to the developments in agent oriented techniques that enable a more active role of the computers in knowledge acquisition have been contributed. In the domain of computer science, a software agent is a special software entity dedicated to perform an assigned task on behalf of a human or an object (Nwana, 1996).

Following definition has been adopted from (Smith, Cypher & Spohrer, 1994) and the agent is known as KidSim Agent, in particular.

…an agent is a persistent software entity dedicated to a specific purpose. 'Persistent' distinguishes agents from subroutines; agents have their own ideas about how to accomplish tasks, their own agendas. Special purpose' distinguishes them from entire multifunction applications; agents are typically much smaller. (Smith, Cypher & Spohrer, 1994)

Franklin and co-authors define an agent as

… special software entities carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some knowledge or representation of the user's goals or desires… (Franklin & Graesser, 1996)

Related Content

High Performance Computing of Possible Minds
Soenke Ziescheand Roman V. Yampolskiy (2020). *Natural Language Processing: Concepts, Methodologies, Tools, and Applications (pp. 1367-1378).*
www.irma-international.org/chapter/high-performance-computing-of-possible-minds/239995

Identifying Suggestions in Airline-User Tweets Using Natural Language Processing and Machine Learning
Rafael Jiménez, Vicente García, Karla Olmos-Sánchez, Alan Ponceand Jorge Rodas-Osollo (2021). *Handbook of Research on Natural Language Processing and Smart Service Systems (pp. 481-498).*
www.irma-international.org/chapter/identifying-suggestions-in-airline-user-tweets-using-natural-language-processing-and-machine-learning/263117

Information Retrieval in Business Industry Using Blockchain Technology and Artificial Intelligence
Sheela K.and Priya C. (2021). *Deep Natural Language Processing and AI Applications for Industry 5.0 (pp. 204-219).*
www.irma-international.org/chapter/information-retrieval-in-business-industry-using-blockchain-technology-and-artificial-intelligence/284210

LLMs for Quantum-Aware Threat Detection and Incident Response
Luay Albtosh (2025). *Leveraging Large Language Models for Quantum-Aware Cybersecurity (pp. 105-142).*
www.irma-international.org/chapter/llms-for-quantum-aware-threat-detection-and-incident-response/366977

Data Extraction to Identify and Analyze the Symptoms of Mental Illness
Thulasi Bikku, Arpit Jain, Ravindra Changala, K. Suresh Kumarand Bijesh Dhyani (2025). *Demystifying the Role of Natural Language Processing (NLP) in Mental Health (pp. 181-198).*
www.irma-international.org/chapter/data-extraction-to-identify-and-analyze-the-symptoms-of-mental-illness/372438