SISTEMAS MULTIAGENTES

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CHAPTER 2: COORDINATION

Introduction

- Multiagent systems are composed of multiple agents that interact with each other to achieve a common goal. Coordination is the process of managing the interactions between agents to achieve the desired outcome.

Types of coordination

- There are several types of coordination in multiagent systems:
  - **Task allocation**: Assigning tasks to agents based on their capabilities and availability.
  - **Communication**: Sharing information between agents to improve decision-making.
  - **Negotiation**: Agents negotiate with each other to reach a mutually beneficial agreement.
  - **Cooperation**: Agents work together to achieve a common goal.

Challenges in coordination

- Coordination in multiagent systems can be challenging due to several factors:
  - **Communication**: Agents may have different communication protocols or languages.
  - **Uncertainty**: Agents may have incomplete or inaccurate information about the environment or other agents.
  - **Competition**: Agents may have conflicting goals or interests.
  - **Scalability**: As the number of agents increases, coordination becomes more complex.

Approaches to coordination

- There are several approaches to coordination in multiagent systems:
  - **Centralized**: A central authority manages the interactions between agents.
  - **Decentralized**: Agents interact with each other directly without a central authority.
  - **Distributed**: Agents interact with each other through a network without a central authority.

Conclusion

- Coordination is an essential aspect of multiagent systems. Effective coordination can lead to improved performance and better outcomes. However, coordination can also be challenging due to various factors. Different approaches to coordination can be used depending on the specific requirements of the system.

MEASURING THE PERFORMANCE

Introduction

- There are several ways to measure the performance of a multiagent system. One way is to use **performance indicators** that capture the system's behavior and characteristics. These indicators can be used to evaluate the system's efficiency, effectiveness, and quality.

Basic indicators

- Some common performance indicators for multiagent systems include:
  - **Throughput**: The number of tasks completed per unit time.
  - **Latency**: The time taken to complete a task.
  - **Scalability**: The ability of the system to handle an increasing number of agents.
  - **Robustness**: The ability of the system to function correctly in the presence of faults or errors.
  - **Fairness**: The degree to which the system distributes resources fairly among agents

Other factors

- In addition to performance indicators, there are several other factors that can affect the performance of a multiagent system, such as:
  - **Communication overhead**: The amount of communication required between agents.
  - **Task complexity**: The complexity of the tasks assigned to agents.
  - **Agent heterogeneity**: The degree to which agents differ in their capabilities and behavior.

Conclusion

- o measure the performance of a multiagent system, it is important to define appropriate metrics and evaluation criteria.
- Some common evaluation methods include simulation, experimentation, and mathematical analysis

APPLICATIONS

Multi-agent system for microgrids: design, optimization and performance

Multi-agent system for microgrids: design, optimization and performance

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Abstract

Smart grids are considered a promising alternative to the existing power grid, combining intelligent energy management with green power generation. Decomposed further into microgrids, these small-scaled power systems increase control and management efficiency. With scattered renewable energy resources and loads, multi-agent systems are a viable tool for controlling and improving the operation of microgrids. They are autonomous systems, where agents interact together to optimize decisions and reach system objectives. This paper presents an overview of multi-agent systems for microgrid control and management. It discusses design elements and performance issues, whereby various performance indicators and optimization algorithms are summarized and compared in terms of convergence time and performance in achieving system objectives. It is found that Particle Swarm Optimization has a good convergence time, so it is combined with other algorithms to address optimization issues in microgrids. Further, information diffusion and consensus algorithms are explored, and according to the literature, many variants of average-consensus algorithm are used to asynchronously reach an equilibrium. Finally, multi-agent system for multi-microgrid service restoration is discussed. Throughout the paper, challenges and research gaps are highlighted in each section as an opportunity for future work.

Performance Evaluation of Multiagent Systems: Communication Criterion

Performance Evaluation of Multiagent Systems: Communication Criterion

Faten Ben Hmida, Wided Lejouad Chaari & Moncef Tagina

Conference paper

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Abstract

Many MultiAgent Systems (MAS) have been developed in various application domains such as computer networks, Internet, industrial applications, automation, process control, air traffic, robotic, simulation, etc. In spite of the rapid growth of the international interest in MAS field and the importance of the number of developed MAS, there is still a lack related to their performance evaluation. In fact, there is no measurement tool that allows evaluating the performance of a MAS or comparing two MAS. The existing works on systems performance evaluation deal principally with classic computer systems. In this paper, we try to identify the MAS' special features and properties which have an impact on their performance and we propose a measurement model to evaluate one of these properties: communication. This model is based on the graph theory. An experimentation of the proposed evaluation model is carried out and tested on a diagnosis application.

Keywords

Multiagent Systems **Communication** **Performance Evaluation** **Measurement** **Methodology** **Graph Theory**

An Evaluation Method for Multi-Agent Systems

An Evaluation Method for Multi-Agent Systems

Pierpaolo Di Bitonto, Maria Laterza, Teresa Roselli & Veronica Rossano

Conference paper

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Abstract

The growing employment of Multi-Agent Systems (MASs) in several domains of everyday life has provided the impetus for much research into new tools and methodologies for their design and implementation. But up to now, few works have focused on evaluation of these MASs, and none of these considered characteristics such as the rationality, the autonomy, the reactivity and the environment adaptability of the agents in the MAS. We believe these characteristics affect the whole performance of these systems and are connected to the complexity of the environment where the agents act. In this paper we propose an evaluation method for static multi-agent systems. The method, based on the Goal-Question-Metric approach, allows evaluation of these same MAS characteristics and combines two analysis perspectives of these systems: intra-agent and inter-agent. We also report the use of the defined approach to evaluate the GeCo_Automotive system's MAS.

DESIGNING A MULTIAGENT SYSTEM

Designing a multiagent system

- Designing a multiagent system involves several steps. Here is a brief overview of the process:
  - **Identify the problem**: Determine the problem that the multiagent system will solve. This could involve identifying the tasks that need to be performed, the agents that will perform them, and the environment in which they will operate.
  - **Define the agents**: Define the agents that will participate in the system. This could involve specifying their capabilities, goals, and communication protocols.
  - **Specify the environment**: Specify the environment in which the agents will operate. This could involve defining the physical or virtual space in which they will interact, as well as any external factors that may affect their behavior.
  - **Design the interactions**: Design the interactions between agents. This could involve specifying how agents will communicate with each other, how they will share information, and how they will coordinate their actions.
  - **Implement and test**: Implement the multiagent system and test it to ensure that it behaves as expected. This could involve simulating the system under different conditions, as well as testing it in a real-world environment.
  - **Evaluate and refine**: Evaluate the performance of the multiagent system and refine it as necessary. This could involve measuring its efficiency, effectiveness, and quality, as well as identifying areas for improvement

Design methodology

- There are several design methodologies and tools available for designing multiagent systems.
- Some popular methodologies include **Agent-Oriented Software Engineering (AOSE)** and **Multi-Agent Systems Engineering (MaSE)**
- These methodologies provide a structured approach to designing multiagent systems and can help ensure that they are effective and efficient.