ARTIFICIAL INTELLIGENCE AND MULTI AGENT TECHNOLOGY

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ABSTRACT

Artificial Intelligence: A Modern Approach introduces basic ideas in artificial intelligence from the perspective of building intelligent agents, which the authors define as "anything that can be viewed as perceiving its environment through sensors and acting upon the environment through effectors." This textbook is up-to-date and is organized using the latest principles of good textbook design. It includes historical notes at the end of every chapter, exercises, margin notes, a bibliography, and a competent index. Artificial Intelligence: A Modern Approach covers a wide array of material, including first-order logic, game playing, knowledge representation, planning, and reinforcement learning.

Artificial intelligence is a great breakthrough of modern technology. It deals with creation of systems that can feel the environment just like human. Through artificial intelligence, robots are created that can simulate human mind. Artificial intelligence has given a new dimension to the world oftechnology.

Expert system is an artificial intelligence program that has expert-level knowledge about a particular domain and knows how to use its knowledge to respond properly. Domain refers to the area within which the task is beingperformed.

INTRODUCTION

A **multi-agent system** (**MAS**) is a system composed of multiple interacting intelligent agents. Multi-agent systems can be used to solve problems that are difficult or impossible for an individual agent or a monolithic system to solve. Intelligence may include some methodic, functional, procedural or algorithmic search, find and processing approach.

Topics where multi-agent systems research may deliver an appropriate approach include online trading, disaster response, and modelling social structures.

The agents in a multi-agent system have several important characteristics:

- **Autonomy**: the agents are at least partiallyautonomous
- **Local views**: no agent has a full global view of the system, or the system is too complex for an agent to make practical use of suchknowledge
- **Decentralization**: there is no designated controlling agent (or the system is effectively reduced to a monolithicsystem)

Typically multi-agent systems research refers to software agents. However, the agents in a multi-agent system could equally well be robots, humans or human teams. A multi-agent system may contain combined human-agent teams.

Self organization and self steering

Multi-agent systems can manifest self-organization as well as self-steering and other control paradigms and related complex behaviors even when the individual strategies of all their agents are simple.

When agents can share knowledge using any agreed language, within the constraints of the system's communication protocol, the approach may lead to a common improvement. Example languages are Knowledge Query ManipulationLanguage (KQML) or FIPA's Agent Communication Language (ACL).

Multi-agent system basics

Multiple agent systems paradigms

Many MAS systems are implemented in computer simulations, stepping the system through discrete "time steps". The MAS components communicate typically using a weighted request matrix, e.g.

Speed-VERY_IMPORTANT: min=45 mph,

Path length-MEDIUM_IMPORTANCE: max=60 expectedMax=40,

Max-Weight-UNIMPORTANT

Contract Priority-REGULAR

and a weighted response matrix, e.g.

Speed-min:50 but only if weather sunny,

Path length:25 for sunny / 46 for rainy

Contract Priority-REGULAR

note - ambulance will override this priority and you'll have to wait

A challenge-response-contract scheme is common in MAS systems, where

First a **"Who can?"** question is distributed.

Only the relevant components respond: **"I can, at this price"**.

Finally, a contract is set up, usually in several more short communication steps between sides, also considering other components, evolving "contracts", and the restriction sets of the component algorithms.

Another paradigm commonly used with MAS systems is the pheromone, where components "leave" information for other components "next in line" or "in the vicinity". These "pheromones" may "evaporate" with time, that is their values may decrease (or increase) with time.

Properties

MAS systems, also referred to as "self-organized systems", tend to find the best solution for their problems "without intervention". There is high similarity here to physical phenomena, such as energy minimizing, where physical objects tend to reach the lowest energy possible, within the physical constrained world. For example: many of the cars entering a metropolis in the morning, will be available for leaving that same metropolis in the evening.

The main feature which is achieved when developing multi-agent systems, if they work, is flexibility, since a multi-agent system can be added to, modified and reconstructed, without the need for detailed rewriting of the application. These systems also tend to be rapidly self-recovering and failure proof, usually due to the heavy redundancy of components and the self managed features, referred to, above.

Multi-agent systems

The study of multi-agent systems is "concerned with the development and analysis of sophisticated AI problem-solving and control architectures for both single-agent and multiple-agent systems." Topics of research in MAS include:

- agent-orientedsoftwareengineering
- beliefs, desires, andintentions(BDI)
- cooperation andcoordination
- organization
- communication
- negotiation
- distributedproblemsolving
- multi-agentlearning
- scientificcommunities
- dependabilityandfault-tolerance
- robotics

- **Artificial intelligence** (**AI**) is the intelligence of machines and the branch of computer science that aims to create it. AI textbooks define the field as "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1956, defines it as "the science and engineering of making intelligentmachines."
- The field was founded on the claim that a central property of humans, intelligence—the sapience of *Homo sapiens*—can be so precisely described that it can be simulated by a machine. This raises philosophical issuesabout

the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of optimism, but has also suffered setbacks and, today, has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science.

- AI research is highly technical and specialized, and deeply divided into subfields that often fail to communicate with each other. Subfields have grown up around particular institutions, the work of individual researchers, the solution of specific problems, longstanding differences of opinion about how AI should be done and the application of widely differing tools. The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. General intelligence (or "strong AI") is still among the field's long termgoals.

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