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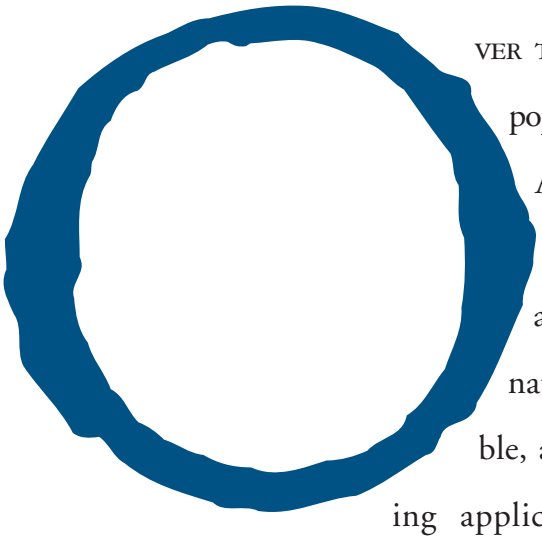
Multiagent Systems ON THE NET



OVER THE LAST FEW YEARS, THE TERM "AGENTS" HAS BECOME popular, and consequently, much used and abused. Although several agent-based systems now exist on the network, most are essentially centralized on a single agent. However, the distributed, large-scale, dynamic nature of the Internet speaks to the need for open, flexible, and scalable solutions. This is especially so in emerging applications such as e-commerce, virtual enterprises, scientific computing, intelligent manufacturing, home automation, component-based software construction, and power distribution management.

Fortunately, there has been a recent accretion of approaches for building multiagent systems for Internet applications. Such systems, which let disparate agents with differing capabilities interact to solve some problem, allow for scalability, permit software reuse, handle software evolution, and promote *open* systems. Multiagent systems and theories to specify and analyze them are gathering increasing interest. These theories provide a basis for understanding and designing the interactions and communications among agents in a multiagent system. As agent technology moves to the marketplace, there is an increasing interest in techniques for modeling multiagent systems and methodologies for constructing them.

We hope this special section presents a cohesive,

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broad picture of the work in industry and academia regarding techniques and methodologies for building multiagent systems, as well as descriptions and experience reports on systems-building efforts. Here, we present in-depth articles and brief reports about projects in the U.S., Europe, and Asia that represent some of the leading-edge efforts in the field.

Gustavsson describes a Swedish university-industry project called "Information, Society, Energy, and Systems," or ISES. The ISES project employs multiagent systems over an electric power grid creating networked smart homes. ISES demonstrates how a multiagent system of smart appliances can work in conjunction with utility agents to balance load, save energy, and provide safety. Interestingly, ISES appliances not only obtain power from the electric grid, but also use it as an integrated Internet connection.

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Rice et al. detail a multiagent system called "SciAgents" that supports networked scientific computing—a vision promoted for a number of years, but that has only recently become reality through the application of agent technology. Networked scientific computing systems will enable scientists to view networked hardware and software resources as a single virtual *metacomputer*. Collaborating intelligent agents locate, combine and invoke the resources needed to solve the given problem. The authors demonstrate SciAgents in the domain of aircraft gas turbine engines.

Multiagent communities are presented by Hattori et al. from NTT in Japan. They define *software* as infrastructure that will support virtual communities (neighborhoods, offices, organizations, and so on) that exist in cyberspace. Their prototype system is based on multiagent systems enabling a number of autonomous software and human agents to interact in a shared virtual space.

Jain et al. explore how agents may be used to make business and manufacturing processes *coherent*. Coherence has to do with how different activities in a distributed system consisting of heterogeneous and autonomous parts relate to each other. Thus, coherence is the next step beyond mere interoperating because it considers the global structure of different activities, not just the basic exchange of data among them.

For multiagent systems to succeed, interagent collaboration is clearly required. However, this presupposes that the internal cognitive structure of agents is conducive to collaboration, especially when human-like tasks such as learning and planning are desired. Sloman and Logan address this issue in the context of agents that interact believably with humans. Baxter and Hepplewhite build upon the same ideas to carry out tank battle simulations for training troops.

The potential of multiagent technology seen by DARPA is described by Dyer, and Greene and Pant illustrate the internal multiagent architecture of the well-known Lycos system that represents an important commercial application of agents. And Chaturvedi and Mehta describe an interesting application where populations of interacting agents are used to mimic real-life markets.

We hope this collection of articles will acquaint *Communications* readers with the potential of this emerging technology in utilizing the promise of (inter)networked computers and information resources. C

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