Market-Oriented Programming (Abstract)

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Abstract

Market-oriented programming is the construction of computational economies, where agents interact through a price system. Markets can provide effective allocation of resources for a variety of distributed environments, and economic analysis a powerful design tool for interaction mechanisms. The spread of electronic commerce puts a premium on market-aware agents, and presents a case for market awareness on the part of agent developers and AI researchers as well.[1]

Overview

For the past several years, the *Decision Machines* research group at the University of Michigan has been exploring the idea of "market-oriented programming", solving multiagent decision problems by (1) casting them in terms of assigning resources to production and consumption activities of the constituent agents, and (2) running the agents within a computational market price system to determine an equilibrium allocation.

To date, we have tested this approach with applications to simple problems in transportation planning (Wellman 1993), distributed engineering design (Wellman 1995), and network information services (Mullen and Wellman 1995). Current work is developing more complex models in these domains, as well as investigating further applications in allocation of computational resources, and provision of distributed information services in a digital library (Mullen and Wellman 1996).

Examples from models we have developed illustrate fundamental concepts of the methodology, including: competitive versus strategic behavior (Hu and Wellman 1996), intertemporal allocation through futures markets (Yamaki et al. 1996), and representing uncertainty through contingent goods (Pennock and Wellman 1996).

Market Awareness

We argue that autonomous agents should be "market aware", not in the sense of following trends in the software business, but rather that they should be adept in interacting with and through market institutions. We can cite both computational and economic advantages to organizing agent interactions through markets. However, even if not persuaded by such arguments, one might still expect markets to be prevalent in multiagent worlds, simply because the real-world commerce system offers a "default interface" for artificial agents. Market rules tend to be generic and globally standard, providing a channel for agents who have not prearranged another approach.

The impetus for market awareness naturally extends from the agents to their designers, and also to designers of multiagent systems. Construction of engineerable multiagent worlds requires that we understand the implications of alternate configurations, alternate interaction mechanisms, and alternate agent behaviors. To the extent that the agents interact through markets, our task is essentially one of economic analysis and design.

References

Hu, J. and Wellman, M. P. 1996. Self-fulfilling bias in multiagent learning. In *Second International Conference on Multiagent Systems*, pages 118–125.

Mullen, T. and Wellman, M. P. 1995. A simple computational market for network information services. In *First International Conference on Multiagent Systems*, pages 283–289.

Mullen, T. and Wellman, M. P. 1996. Market-based negotiation for digital library services. In *Second USENIX Workshop on Electronic Commerce*, pages 259–269.

Pennock, D. M. and Wellman, M. P. 1996. Toward a market model for Bayesian inference. In *Proc. 12th Conference on Uncertainty in Artificial Intelligence*, pages 405–413.

Wellman, M. P. 1993. A market-oriented programming environment and its application to distributed multicommodity flow problems. *J. Artificial Intelligence Research*, 1:1–23.

Wellman, M. P. 1995. A computational market model for distributed configuration design. *AI EDAM*, 9:125–133, 1995.

Yamaki, H.; Wellman, M. P.; and Ishida, T. 1996. A market-based approach to allocating QoS for multimedia applications. In *2d International Conf. on Multiagent Systems*, pages 385–392.