

Knowledge Processing

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Knowledge processing is a new approach to understanding open information systems—an approach which is informed by the social sciences (as opposed to artificial intelligence and cognitive science, which have been principally based on psychological and brain sciences). In this talk, I will outline some of the discoveries and methods in knowledge processing. I will highlight topics that are ripe material for intrepid souls in search of adventure, fun, challenge, and a thesis.

In order to work on large scale tasks—such as going to the moon, building the Golden Gate bridge, or designing earthquake-proof buildings—we need to build open-system, human/computer organizations that can conduct the information processing that is essential to effective performance. Just as organizations can accomplish tasks that individual humans cannot, we are interested in designing computer systems that can be scaled up to take on tasks of similar scope and magnitude.

This talk presents an approach for developing organizational information systems that can operate more effectively and intelligently with human organizations. In this regard, we will study *organizational information systems*—namely, all of the information processing done to coordinate all of an organization's work—with the exception of direct manipulation of physical objects. (Our vision of an *organization* includes humans, computers, and their interaction.)

Conflict is a fundamental aspect of all large-scale intelligent systems, and occurs whenever different forces are pulling in different directions. Conflict is the direct and natural result of differing perspectives and commitments.

Commitments have been discussed by Winograd and Flores in the context of Hermeneutics, and by Richard Fikes in the context of contract nets as developed by Reid Smith and Randy Davis. In this paper we are particularly concerned with organizational conflict, i.e., conflict between specialized components of an organization. Negotiation of conflict can strengthen organizational effectiveness. An organizational ideology that says "We are all in agreement here" denies the existence of internal conflicts. Since such conflicts are denied, they cannot be dealt with explicitly, and organizational performance suffers.

As we shall see, conflict is ubiquitous, inevitable, and must be dealt with in any complex organization. In general, conflicting parties must find ways of negotiating their differences in order to deal effectively with conflict. In the course of negotiations, one party often will deliberately contradict statements made by another party in order to sway organizational behavior.

Consider a meeting between a representative of Marketing and a representative of Development to negotiate whether the company should distribute another company's product or manufacture its own. Each party can present material on its view of the issue, the commitments that intersect the issue, and options for dealing with the issue. It is important to understand that these presentations are seldom ready-made. Instead, each party to the negotiation generates new material to fit the circumstances at hand. Contradictory statements are often generated as a natural way of bringing conflicting commitments to the attention of other parties.

Our goal is to construct a scientific and engineering discipline that supports the design, construction, and management of large-scale, open-system, human/computer organizations. Our challenge is to develop a knowledge processing architecture that supports robustness in open system environments.

The robustness of an organization's know-how is fundamental to its ability to accomplish a task in the face of "normal, everyday" contingencies. For example, the know-how of manufacturing integrated circuit chips means that in spite of various difficulties that arise during the operation of a plant—defective materials, delayed shipments, employee illness, and so on—the operators of the plant can continue production.

Since human organizations have evolved methods of dealing with indeterminacy and conflict—and have made them into strengths rather than weaknesses—adaptation of these methods can help create a foundation for robustness in a computer organization.

The development of a knowledge processing architecture for the design of concurrent computer information systems would have two important potential payoffs.

First, a knowledge processing architecture would have significant advantages in scalability and robustness. By creating a framework for dealing with conflict, knowledge processing makes human organizations both robust and scaleable. This is practical evidence for believing we can achieve the same results for computer organizations. Since conflict is ubiquitous to organizational life, our computer systems must be able to use conflict—and the contradictions that result—as a source of strength rather than weakness.

Second, a knowledge processing architecture will provide a better interface between the humans and the machines. If both organizations work by the same kinds of principles, then people will understand the computers more easily and intuitively—and the computers will also have a compatible model of how decisions are made in the human organization. Such compatibility holds the promise of better interaction between them. We are currently exploring the possibility of basing computer processes on human organizational principles.

Knowledge processing also shows that more formal modes of reasoning can be derived as a natural progression from the needs of organizations in dealing with conflict. As the parties to the conflict negotiate their differences, they generate justifications to support their position. When these justifications are generalized and decontextualized by the parties so that they can decide mechanically whether a given step is in accordance with a rule, then they have developed a microtheory. Since these microtheories are decontextualized, they can be carried from place to place and used to seek additional leverage in many different negotiations. Thus, microtheories and logical deduction can be seen as a natural kind of specialized development that often occurs in the negotiation of conflict.

Negotiation of conflict is a source of creativity and robustness. It allows an organization to consider and explore its alternatives in a way that takes other organizational commitments into account.