Detecting, Repairing, and Preventing Human-Machine Miscommunication

Susan McRoy

■ This article summarizes a workshop entitled "Detecting, Repairing, and Preventing Human-Machine Miscommunication," held on 4 August 1996 in Portland, Oregon. The author presents the significant issues raised during the four specific workshop sessions.

Any system that communicates must be able to cope with the possibility of miscommunication—including misunderstanding, nonunderstanding, and misinterpretation. Research related to achieving robust interaction is an important subarea in AI. Early work concerned the correction of spelling or grammatical errors in a user's utterance so that the system could more easily match them against a fixed linguistic model; work has also been done in the area of speech recognition, attempting to find the best fit of a sound signal to legal sequences of linguistic objects. All these approaches have assumed that the system's model is always correct. More recently, researchers have been looking at detecting and correcting errors in the system's model of an interaction. This work includes research on speech repairs; miscommunication; misunderstanding; nonunderstanding; and related work in planning, such as plan misrecognition and plan repair.

The Workshop on Detecting, Repairing, and Preventing Human-Machine Miscommunication brought together researchers interested in developing theoretical models of robust interaction or designing robust systems. We were particularly interested in results drawn from experiments and applications that use speech as their primary modality of interaction. Some experiments involving multiple modalities were also discussed.

The workshop was organized into four sessions: (1) "Empirical Data Regarding the Occurrence of Miscommunication," (2) "Strategies for Identifying Potential Causes of Break-downs," (3) "Knowledge Representation and Reasoning about Miscommunication," and (4) "Repair in Spoken Language Systems." These sessions represent a progression from work that clarifies the problem of miscommunication to work that describes the strategies used to repair miscommunication. I review the most significant issues raised by the participants at these sessions.

In the session on empirical issues, the participants discussed various approaches to empirically evaluating hypotheses about human-machine miscommunication. The approaches differed in two dimensions: First, experimenters specified different environments of the interaction by selecting different modalities of interaction or distributions of initiative (control) for the interaction. Second, experimenters selected a method for eliciting data; they used the computer to mediate between two humans, participate in the collaborative performance of some task with the user, or simulate an error-prone user interface to an implication. The results included data on the types of error that occur in the different environments, the sources of error (for example, the misrecognition of some word or the violation of a cooperative principle), and the strategies that people use to pre-vent or resolve miscommunication. The results suggest a new hypothesis: Repairs are tailored to families of tasks so that dialog differs significantly from conversation, and dialog systems do not make up a uniform class.

The next portion of the workshop was devoted to different approaches to preventing and repairing miscommunication. The participants discussed the importance of representing principles of cooperative communication and representing both the content and the structure of the discourse context. They also argued for the need for metareasoning and metacommunication capabilities. The most important strategies brought up at the sessions include the management of initiative (control) of the discourse, the management of the size and modality of turns, the public reviewing of the discourse by the participants to verify shared understanding, and the private monitoring of the discourse by individuals to identify inconsistencies and incoherence between different parts of their discourse model or between the discourse model and the domain model.

The last session was the presentation of work involving deployed systems using speech as a mode of interaction. Currently, faulty speech understanding provides the most common source of human-machine miscommunication. In the systems that were discussed, mechanisms for handling the problem of miscommunication were constrained by their impact on overall system performance as well as system usability. Participants considered the kinds of repair that arise in the specific task domain. They also considered the interaction between speech recognition and other components, in particular, how the presence of an error influences the structure and modality of communication used by the speaker.

Susan McRoy is an assistant professor of computer science at the University of Wisconsin at Milwaukee. Her research interests include AI, computational linguistics, and information retrieval. She is the associate director of the Decision Systems and Artificial Intelligence Laboratory and an adjunct professor of the University of Wisconsin Medical School.